CLIPSAL

CLIPSAL spark·e·mate

Multi-function Electrical Installation Safety Tester

Cat. № 493

OPERATING HANDBOOK

FEB, 2021, EDITION 2.1

PATENTS PENDING

DESIGNED AND MANUFACTURED IN AUSTRALIA

Clipsal Australia Pty Ltd
A member of Schneider Electric
33-37 Port Wakefield Road,
Gepps Cross, SA 5094

MADE IN AUSTRALIA

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Document Control

Document ID	G/08175 © 2021
Document Name	*Spark-e-mate* Electrical Installation Safety Tester 493 Handbook
Security	Public Domain
Circulation	Clipsal Australia Pty Ltd, Design 2000 Pty Ltd, Electrical Wholesalers, Electrical Contractors
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Version Control

Edition	Date	Notes
1	03/09/2009	None
1.1	08/09/2009	Type A RCD Symbol
1.2	14/09/2009	AMDT N0. 1 JUL 2009, Table 8.2
1.3	12/11/2009	Selectable Insulation Resistance conductors. Missing Neutral detection.
1.4	24/05/2011	Advanced RCD Test Mode Optional Bluetooth Logging
1.5	08/08/2011	PSC
1.6	04/04/2012	Bluetooth update
1.7	08/11/2013	Updated specifications
1.8	20/10/2014	Updated specifications
1.9	09/04/2015	Removed Bluetooth Logging and created F2469/02
2.0	01/02/2021	Standard RCD Test Advanced RCD Test AS/NZS 3760 RCD Test AS/NZS 3003 RCD Test
2.1	09/02/2021	Formatting

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Contents

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1.0 OVERVIEW

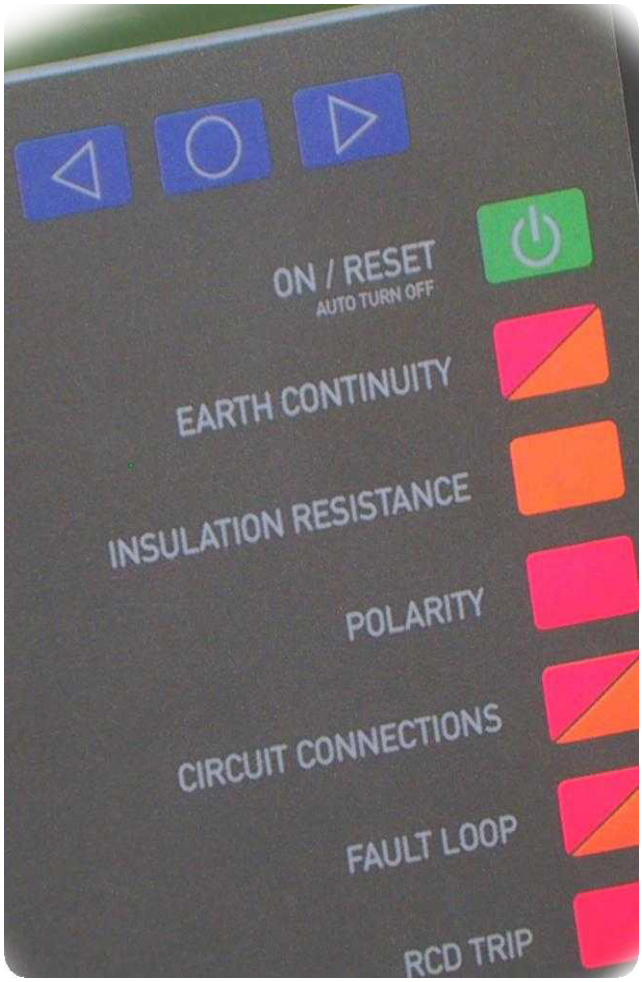
Spark-e-mate CAT. Nº 493

MULTI-FUNCTION ELECTRICAL INSTALLATION SAFETY TESTER

FEATURES

This unit performs comprehensive electrical wiring tests implicit in AS/NZS 3000 from socket outlets, with no need for a separate earth reference, no need to bridge out RCDs*1, and no need for multiple test instruments.

- ❑ **EARTH CONTINUITY**
  AS/NZS 3000 Clause 8.3.5
- ❑ **INSULATION RESISTANCE**
  AS/NZS 3000 Clause 8.3.6
- ❑ **POLARITY**
  AS/NZS 3000 Clause 8.3.7
- ❑ **CORRECT CIRCUIT CONNECTIONS**
  AS/NZS 3000 Clause 8.3.8
- ❑ **EARTH FAULT LOOP (A TO E) IMPEDANCE**
  (Without tripping RCDs *1)
  AS/NZS 3000 Clause 8.3.9
- ❑ **OPERATION OF RCDs**
  AS/NZS 3000 Clause 8.3.10
- ❑ **IDLE SUPPLY VOLTAGE & FREQUENCY**
  Check for voltage to AS 60038
  ie. 230V +10%, -6% @ 50Hz
- ❑ **EXTENSION LEAD TESTING**
- ❑ **LIGHTING CIRCUIT TESTING**
  Using the optional 493L Test lead set



- ❑ **BLUETOOTH LOGGING 493BTLi (Optional)**
  Spark-e-mate 493BTLi units can log test results on a Bluetooth enabled Smartphone. Free logging Apps for iPhone and Android are available from the App Store and Google Play. Test reports for each installation can be printed and stored as a Verification Record (AS/NZS 3000 Clause 8.4).

*1 *As long as there is no other residual leakage current.*

Congratulations and thank you for purchasing this Australian engineered and manufactured innovative product. You are guaranteed to have years of dependable and trouble free service from this new compact multi-function Installation Tester. We trust that it will make the testing of electrical outlets a straightforward process.

2.0 NOTES

- The *Spark-e-mate 493* is designed to be plugged directly into a three pin power point (General Purpose Outlet (GPO) or Socket Outlet. It can also be used to test lighting circuits using the optional 493L clip/probe test lead set to connect to bare wires or bayonet and Edison screw outlets.

- Clearly an entire electrical installation cannot be tested from a single socket outlet.

- Apart from over-voltage (>300 V a.c.), there are no wiring transpositions or key presses that can damage *Spark-e-mate*.

- Only use the supplied power cable. If it is worn or damaged, replace only with K3755ORA IEC C13 R/A or manufacturer's equivalent.

- If the 493 indicates a wiring fault, a qualified electrician must correct it before testing can be continued. Please note that if *Spark-e-mate* is placed in close proximity to switched mode power supplies, high voltage lines, or high strength a.c. magnetic fields, the internal non-contact voltage sensor may inadvertently indicate DANGER - VOLTAGE ON EARTH or HAZARD - NO EARTH. Simply move *Spark-e-mate* away.

- The tester may be used to test the wiring of extension leads, power boards and double adaptors.

- The 493 is a professional piece of electrical test equipment. It is not considered to be a consumer electronics appliance.

- Although the 493 is splash proof, do not subject or submerge the unit into any liquid.

- The 493 may be configured and supplied with special leads for testing power points with different mains voltages & plug styles of other countries as an option.

- The 493 has no user serviceable parts apart from the batteries. To prevent electric shock, never remove the rear cover without first disconnecting from the mains. Repair and calibration is to be performed by qualified personnel only.

- Routine calibration (annual) is recommended.

- Regular cleaning of the 493L Test Lead plugs and sockets using a commercially available Contact Cleaner in a spray can with long nozzle is essential. This keeps Contact resistance in check. Otherwise incorrect higher readings may be obtained.

- The internal 6 x AA alkaline battery state is indicated by the battery symbol on the LCD display. If the batteries need to be replaced, it is absolutely mandatory that the unit is disconnected from the mains supply before opening the back cover – refer to Section 9 of this handbook.

3.0 COMPLIANCE

- The *Spark-e-mate* 493 performs both mandatory and optional tests as outlined in AS/NZS 3000 Section 8, and complies with the relevant clauses of AS/NZS 3017 (prevention of a fire and preventing a person from receiving an electric shock), AS/NZS 3260 (now superseded by AS/NZS 60950), AS/NZS 3100 (guidelines covering design and testing of electrical equipment to ensure safety and protection against electric shock) and AS/NZS 61010.1 (general safety requirements for electrical test, measuring, control and laboratory equipment) for Electrical Safety.

- The 493 meets Category IV, 600V – high energy circuits Industrial use as per AS 61010.1 “Safety of Electrical Equipment for Measurement, Control and Laboratory Use”.

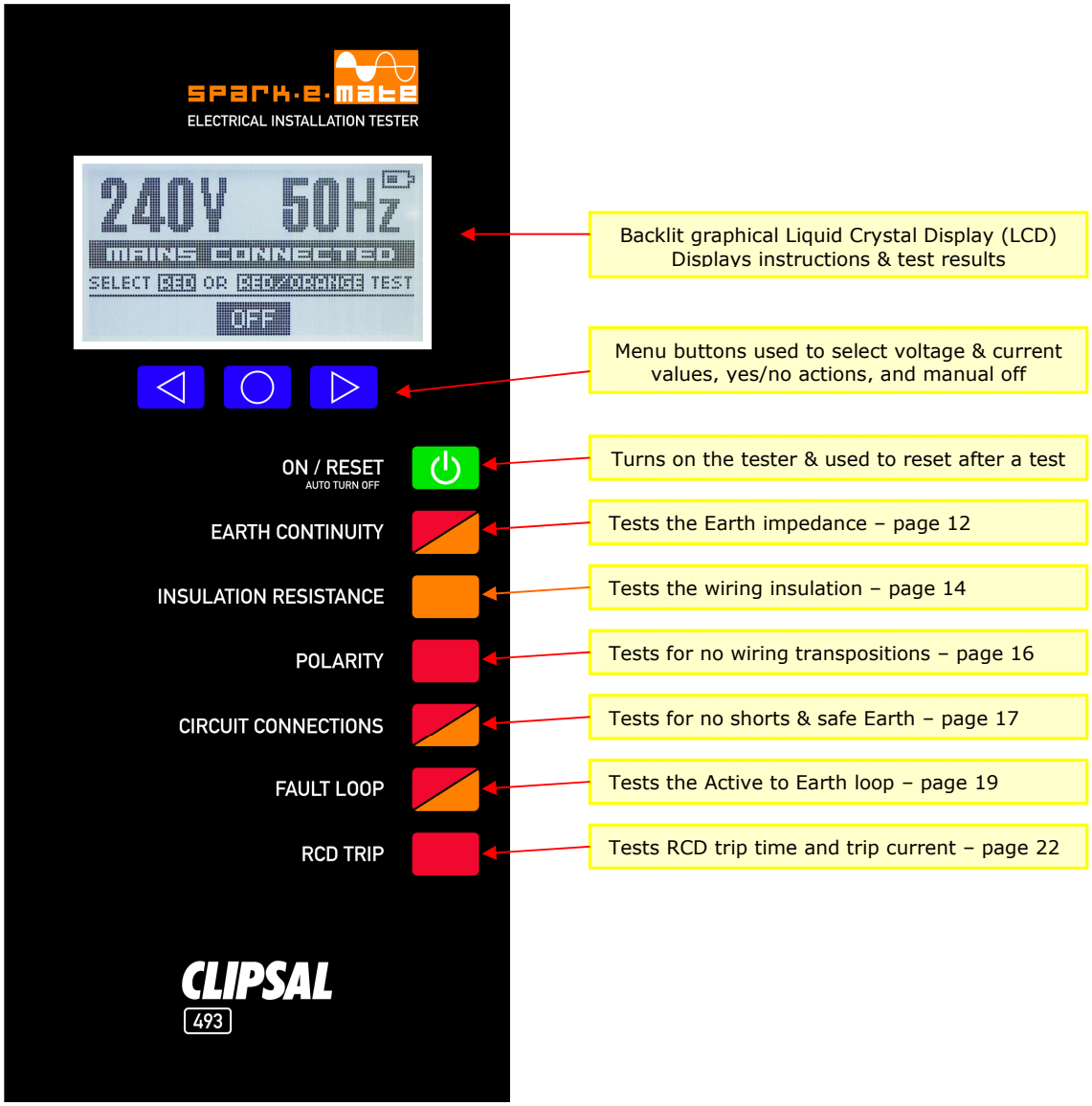
4.0 DISCLAIMER

- The manufacturer or authorized distributor cannot accept responsibility for any unlikely damages or personal injury deemed to be as result of using the *Spark-e-mate* 493 tester.

- Clipsal Australia Pty Ltd reserves the right to change specifications or designs described in this handbook without notification.

5.0 GENERAL DESCRIPTION

The *Spark-e-mate* Multi-function Electrical Installation Safety Tester, Cat. № 493, is designed to measure and test the integrity of household, commercial building and construction site mains electrical circuits in all respects as detailed in AS/NZS 3000. It is a portable instrument typically used by electricians involved in the installation and maintenance of the electrical wiring and outlets.



Testing is easily performed from the power point (socket outlet) under test simply by plugging the unit in, pressing the ON/RESET button and selecting a test. The LCD (Liquid Crystal Display) then provides a test result.

Spark-e-mate performs both unpowered d.c. tests (mains supply off, with internal battery power feed) and powered a.c. tests (mains supply on).

- ❖ Red/Orange test buttons perform both powered a.c. and unpowered d.c. tests.
- ❖ Red test buttons perform only powered a.c. tests.
- ❖ Orange test buttons perform only unpowered d.c. tests.

Spark-e-mate features automatic protection of unpowered tests if mains power is applied. Although the *Spark-e-mate* fascia suggests a test order as per AS/NZS 3000 Clause 8.3.4 Sequence of Tests, the tests can be performed in any order. Apart from over-voltage (>300 V a.c.), there are no wiring transpositions or key presses that can damage *Spark-e-mate*.

Certain faults will automatically halt testing by necessity and must be fixed before testing can continue.

Spark-e-mate is designed for very straightforward and failsafe operation:

- The LCD provides actual impedance or resistance readings in Ohms (Ω), thousands of Ohms (KΩ) or millions of Ohms (MΩ). When it comes to **continuity** and **loop resistance**, you want a very **low** Ω reading. When it comes to **insulation resistance**, you want a very **high** MΩ reading.

This is generally all the testing officer needs to know, however the following descriptions and instructions go into more detail, with the assumption of a good understanding of Wiring Rules AS/NZS 3000.

Spark-e-mate is ideal for testing new electrical installations prior to hand-over of compliance certificates. It is used on construction sites to satisfy tagging and OH & S requirements. It is also the perfect test instrument for testing the wiring to power points in existing and older homes. Always of concern, old household and building wiring (whether it is visible or concealed) can be tested in seconds.

5.1 USAGE & BENEFITS

Spark-e-mate will test:

- ✓ **Earth Continuity** – is the Earth bonded to the Neutral properly and is the Earthing conductor resistance low enough to permit the passage of current necessary to operate the over current protective device?

- ✓ **Insulation Resistance** – is the resistance between all live conductors and Earth as high as it should be? (Tested using 250V d.c. or 500V d.c. selectable).

- ✓ **Polarity** – is the Active and Neutral wired correctly and are there no other transpositions?

- ✓ **Correct Circuit Connections** - is the earth connected and at a safe potential?

- ✓ **Earth Fault Loop Impedance** (***without tripping RCDs***[*1]) – is the total loop resistance of the Active and Earth wires as low as it should be so that protective devices will operate?

- ✓ **Residual Current Device (Earth leakage detector or Safety switch) operation** – does it really work and trip in time at the correct residual current at the power outlet?

- ✓ **Extension Leads** – test these, power boards, double adaptors etc.

- ✓ **Supply Voltage** – is the mains supply within –6% and + 10% of the specified 230V a.c.? (Other voltages to order).

- ✓ **Mains Frequency** – is it alternating at 50Hz?

[*1] *As long as there is no other residual leakage current*

People are afraid of electricity because it can't be seen but it can certainly bite! The main benefit of *Spark-e-mate* is that it provides a straightforward **visual** indication of the condition of power outlets. It also offers cost savings by being quick and easy to use. Needless to say that the ultimate aim is to reduce the incidence of electrocution or fire and maximize the operating life of appliances.

6.0 TESTS

The following test instructions assume that you have plugged the 493 into the power point under test, pressed the ON/RESET button and that you see either NO MAINS CONNECTED (for "ORANGE" or "RED/ORANGE" button unpowered d.c. tests) or MAINS CONNECTED (for "RED" or "RED/ORANGE" button powered a.c. tests).

Spark-e-mate **running on internal battery power – ready for ORANGE or RED/ORANGE (d.c.) tests**

Spark-e-mate **running on mains power – ready for RED or RED/ORANGE (a.c.) tests**

Although the *Spark-e-mate* fascia suggests a test order as per AS/NZS 3000 Clause 8.3.4 Sequence of Tests, the tests can be performed in any order without the risk of damaging the unit. Apart from over-voltage (>300 V a.c.), there are no wiring transpositions or key presses that can damage Spark-e-mate.

- Red/Orange test buttons perform both powered a.c. and unpowered d.c. tests.
- Red test buttons perform only powered a.c. tests.
- Orange test buttons perform only unpowered d.c. tests.

All test results are displayed for up to 60 seconds. You can repeat or move on to the next test before this time expires. After testing, *Spark-e-mate* will turn itself off after 60 seconds or you may press the ◯ button to manually turn it off.

6.1 EARTH CONTINUITY (AS/NZS 3000 Clause 8.3.5)

It is suggested that this test be performed with mains supply available (but can also be performed even more accurately without mains). It negates the need to run a separate test lead from the main Earth to the socket outlet under test.

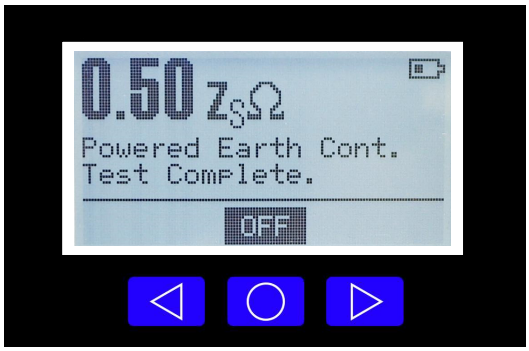
Therefore this test should be performed with the individual circuit breaker turned ON, the RCD turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected.

Press the EARTH CONTINUITY test button:

Spark-e-mate automatically measures the A to E, N to E and A to N impedances and computes the formula

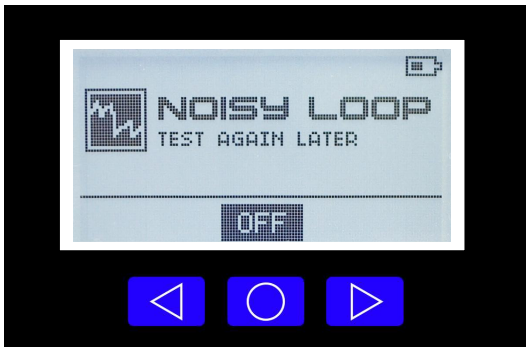
$$[(A \rightarrow E + N \rightarrow E) - A \rightarrow N]/2 = Z_s \Omega_e$$

The Earth impedance from the socket under test to the MEN connection is displayed on the LCD display in impedance Ohms (Z_s Ω). A reading of about 0.80 Z_s Ω or less is a good result but should be checked against table 8.2.



Notes:

- If the RCD trips during powered tests, the 493 has a desensitization routine at the beginning of the Earth and Fault Loop tests. This stops the new Clipsal 4RC series RCDs from tripping during Earth and Fault Loop tests. Ironically the desensitization is most likely what is causing some types of RCDs to trip. You can by-pass the desensitization pulses on the Earth and Fault Loop tests by pressing and holding the test button. You'll get a message saying "DESENSE OFF" and then the test will continue. On the next test the desensitization pulses will return if you don't press and hold the test button.
- You can also put Spark-e-mate into SAFE MODE by pressing the ON button and the FAULT LOOP button simultaneously. This mode will stay until you press ON button and the FAULT LOOP button simultaneously again. It will cycle through TURBO MODE, NORMAL MODE, SAFE MODE and SUPER SAFE MODE. Brief to extremely brief 1A loads are used to calculate the impedance of just the Earth wire.
- You will normally NOT need to bridge out the RCD. If the RCD does trip during this test then it has some leakage current (although the wiring rules state that this test has already passed if this occurs). To verify the MEN connection and upstream neutral conductors you will then need to find and remove the source of the resistance (possibly a 'leaky' appliance) or bridge out the RCD from supply side to load side (RCD turned off while bridged) to perform the Earth Continuity test.
- Inductive loads such as heaters, induction cook tops, motors, transformers, ballasts, and power line communication devices should be disconnected from circuits under test as these can interfere with the phase angle and affect the Earth impedance reading. Unsteady supply, superimposed noise and switch mode loads on the Supply side can also affect Earth readings. If this occurs, test results may vary in which case an average of several readings will need to be recorded, or preferably perform an unpowered Earth test. Sometimes NOISY will appear with the reading indicating misshapen waveforms and in extreme cases *Spark-e-mate* will report Noisy loop, try again later
- Erratic or high readings can indicate a high impedance or missing MEN connection.
- In very large installations where the Neutral is carrying hefty currents resulting in significant voltage drop along the Neutral wire, erratic readings could be obtained.



The Earth Continuity test can also be performed more accurately without mains supply however Active, Neutral and Earth must be bridged out at the switchboard otherwise >20Ω will be displayed. An easy way is to connect the Active under test to the MEN.

The resistance is displayed on the LCD display in Ohms (Ω). Further measurements to the Earth stake are recommended but not imperative as dangerous fault currents will return via the protective Earth wire and an over-current protective device will operate if the Earth is properly bonded to the Neutral via the MEN link. This is proven in this test and the FAULT LOOP test.

Tutorial Note:

RCDs trip on an Active – Neutral current imbalance. Although an RCD will still work without an Earth connection, the protective Earthing system is employed so that an RCD will trip before a person touches a faulty 'live' appliance.

The protective Earth wire provides a fault loop (an alternative Neutral path) if a resistance (leakage) or short circuit develops between the Active and the grounded chassis of a non-double insulated appliance. In an installation where there is no RCD or the RCD fails to operate, fault current flows via the Earth wire (which must have significantly less resistance than a person) and the over-current protective device (circuit breaker) will operate when its current rating is exceeded.

6.2 INSULATION RESISTANCE TEST (AS/NZS 3000 Clause 8.3.6)

This test should be performed with the individual circuit breaker turned OFF, the RCD turned ON, and the socket outlet switch turned ON. This is an un-powered test ie. mains supply disconnected.

Notes:

- This tester fully complies with AS/NZS 3000 Clause 8.3.6. The test calls for 500V d.c. or 250V d.c. when measuring insulation resistance. The test voltage applied can be 250V d.c. where installed equipment or protective devices are likely to be damaged by 500V d.c..

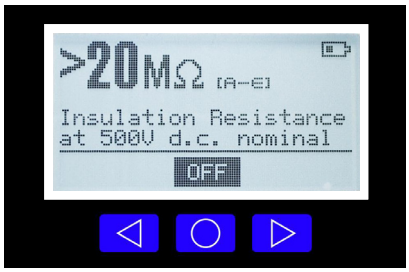
- This test should be performed with all other appliances on the circuit either unplugged or turned OFF at their socket outlets, and the socket outlet switch under test turned ON.

Press the INSULATION RESISTANCE test button:

Spark-e-mate asks you to select the required conductors using the ◁ and ▷ buttons and then the ○ button to confirm your selection of either Active to Earth, Active to Neutral or Neutral to Earth.

Spark-e-mate asks you to select the required test voltage using the ◁ and ▷ buttons and then the ○ button to confirm your selection of either 250V d.c. or 500V d.c..

250V d.c. or 500V d.c. nominal is then applied between the selected conductors, in this case Active and Earth. The leakage resistance between Active and Earth is then automatically calculated. This is displayed on the LCD display in KiloOhms (KΩ) or MegOhms (MΩ). A reading of about 1 MΩ or more is a good result.



Notes:

It is possible to obtain less favorable results if:

- ❑ There is an RCD with MOV element between Active and Earth
- ❑ There is an RCD FE type with electronic elements connected between Neutral and Earth.
- ❑ There are electrical loads with leakage current to Earth (eg. heating appliances, cook-tops, washing machines, water pumps etc…)

It is suggested that the RCD's and electrical loads be disconnected should they be affecting the resistance readings.

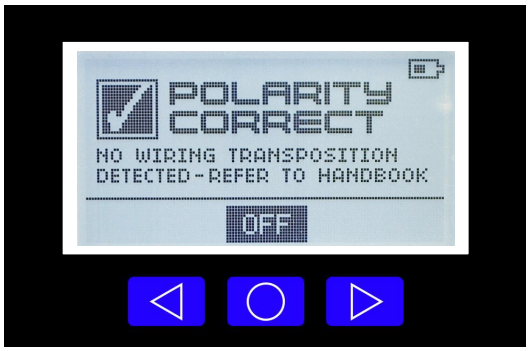
WARNING:
RCD's, electronic accessories and electrical appliances may be damaged by the 500V d.c. generated by *Spark-e-mate*. If in doubt, use the 250V d.c. test voltage.

6.3 **POLARITY** (AS/NZS 3000 Clause 8.3.7)

This test should be performed with the individual circuit breaker turned ON, the RCD turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected.

Press the POLARITY test button:

Spark-e-mate analyses the wiring and will ideally display the following:



Notes:

- ❑ If Active and Neutral are reversed `A & N REVERSED` is displayed.
- ❑ If Neutral is missing `HAZARD - NO NEUTRAL` is displayed.
- ❑ If there is no Earth connection, `HAZARD - NO EARTH` is displayed.
- ❑ If Active and Earth are transposed, `DANGER – VOLTAGE ON EARTH` is displayed

Important Notes:

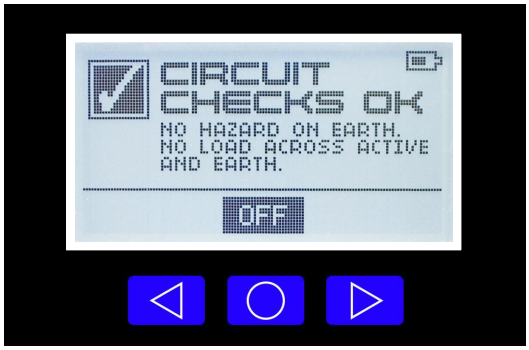
- ❑ To test if the Active is being switched, you must operate the socket outlet switch and check that *Spark-e-mate* displays `NO MAINS CONNECTED` with the switch in the off position. If the Neutral is being switched by mistake, *Spark-e-mate* displays `HAZARD - NO NEUTRAL` with the switch in the off position.
- ❑ If Neutral and Earth are transposed, the RCD will trip automatically on connection, even without pressing the POLARITY test button. To make absolutely sure that Neutral and Earth are not transposed, you will need to disconnect the Neutral at the MEN bar and check that *Spark-e-mate* displays `HAZARD - NO Neutral`. If Neutral and Earth are transposed then *Spark-e-mate* will display `HAZARD - NO EARTH` with the Neutral disconnected at the MEN.
- ❑ Some other wiring transpositions can produce an indeterminable test result.

6.4 CORRECT CIRCUIT CONNECTIONS (AS/NZS 3000 Clause 8.3.8)

This test should be performed with the individual circuit breaker turned ON, the RCD turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected. Note that even with the socket outlet switch in the off position, *Spark-e-mate* in the unpowered state will detect a voltage on Earth.

Press the CIRCUIT CONNECTIONS test button:

Spark-e-mate analyses the wiring and will ideally display the following:



An Earthing conductor that carries current will cause an Active-Neutral current flow imbalance and this should trip the RCD. The load between Active and Earth causing the imbalance must be identified and removed.

If *Spark-e-mate* shows `DANGER – VOLTAGE ON EARTH` then either the Active & Earth conductors are transposed or a stray voltage is present on the Earth wire. This must be rectified immediately.

A missing Earth connection indicated by `HAZARD - NO EARTH` must also be rectified immediately to provide a path of least resistance and allow over-current protective devices to operate should a short circuit develop between the Active and the grounded chassis of a non-double insulated appliance.

A missing Neutral connection indicated by `HAZARD - NO NEUTRAL` must also be rectified immediately to prevent the possibility of current returning via Earth.

Interconnection of conductors between different circuits can be checked by turning off the associated circuit breaker for the circuit under test & checking the *Spark-e-mate* display for `NO MAINS CONNECTED`

Notes:

- ❑ If a load or short exists between Active and Earth, either the RCD will trip or DANGER – VOLTAGE ON EARTH is displayed.
- ❑ If Neutral and Earth are transposed, the RCD will trip automatically on connection, even without pressing the POLARITY test button. To make absolutely sure that Neutral and Earth are not transposed, you will need to disconnect the Neutral at the MEN bar and check that *Spark-e-mate* displays HAZARD - NO NEUTRAL. If Neutral and Earth are transposed then *Spark-e-mate* will display HAZARD - NO EARTH with the Neutral disconnected at the MEN.
- ❑ If Active and Earth are transposed, DANGER – VOLTAGE ON EARTH is displayed
- ❑ If there is no Earth connection, *Spark-e-mate* displays HAZARD - NO EARTH.
- ❑ If there is only an Active connection (no Earth & no Neutral) to any one of the socket outlet receptacles, *Spark-e-mate* displays DANGER - VOLTAGE ON E OR N, OR ONLY ACTIVE PRESENT ON A, N or E. This is potentially a very dangerous wiring condition.
- ❑ Interconnection of conductors between different circuits can be checked by turning off the associated circuit breaker for the circuit under test & checking the *Spark-e-mate* display for NO MAINS CONNECTED.
- ❑ Some other wiring transpositions can produce an indeterminable test result.

6.5 EARTH FAULT LOOP (Active to Earth) IMPEDANCE (AS/NZS 3000 Clause 8.3.9)

It is suggested that this test be performed with mains supply available (but can also be performed more accurately without mains). It verifies the integrity of the MEN connection, the upstream neutral (PEN) conductors and measures the value of impedance ($Z_s\Omega$) for the complete circuit.

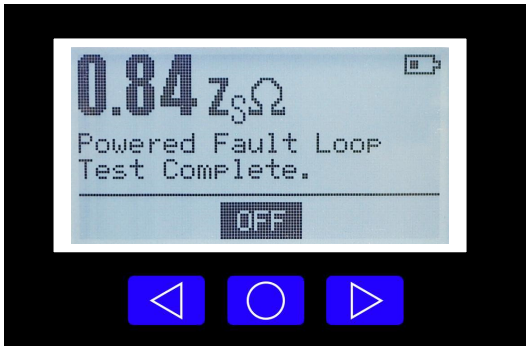
Therefore this test should be performed with the individual circuit breaker turned ON, the RCD turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected.

Notes:

- If the RCD trips during powered tests, the 493 has a desensitization routine at the beginning of the Earth and Fault Loop tests. This stops the new Clipsal 4RC series RCDs from tripping during Earth and Fault Loop tests. Ironically the desensitization is most likely what is causing some types of RCDs to trip. You can by-pass the desensitization pulses on the Earth and Fault Loop tests by pressing and holding the test button. You'll get a message saying "DESENSE OFF" and then the test will continue. On the next test the desensitization pulses will return if you don't press and hold the test button.
- You can also put Spark-e-mate into SAFE MODE by pressing the ON button and the FAULT LOOP button simultaneously. This mode will stay until you press ON button and the FAULT LOOP button simultaneously again. It will cycle through TURBO MODE, NORMAL MODE, SAFE MODE and SUPER SAFE MODE. Brief to extremely brief 1A loads across A and E are used to calculate the fault Loop. Fault Loop = unloaded Voltage minus loaded Voltage, divided by load current.
- You can also put Spark-e-mate into SAFE MODE by pressing the ON button and the FAULT LOOP button simultaneously. This mode will stay until you press ON button and the FAULT LOOP button simultaneously again. It will cycle through TURBO MODE, NORMAL MODE, SAFE MODE and SUPER SAFE MODE.
- The difference between modes is the amount of time that the load is applied.
- You will normally NOT need to bridge out the RCD. If the RCD does trip during this test then it has some leakage current or it is very sensitive such as 10mA types (although the wiring rules state that this test has already passed if this occurs). To verify the MEN connection and upstream neutral conductors you will then need to find and remove the source of the resistance (possibly a ‘leaky’ appliance) or bridge out the RCD from supply side to load side (RCD turned off while bridged) to perform the Fault Loop test.
- Inductive loads such as heaters, induction cook tops, motors, transformers, ballasts, and power line communication devices should be disconnected from circuits under test as these can interfere with the phase angle and affect the fault loop impedance reading. Unsteady Supply, superimposed noise and switch mode loads on the Supply side can also affect fault loop readings. If this occurs, test results may vary in which case an average of several readings will need to be recorded, or preferably perform an unpowered Fault Loop test. Sometimes `NOISY` will appear with the reading indicating misshapen waveforms and in extreme cases *Spark-e-mate* will report `NOISY LOOP, TRY AGAIN LATER`

Press the FAULT LOOP test button:

Spark-e-mate directly measures the Active to Earth impedance (without tripping the RCD [*1] or circuit breaker) by drawing current very briefly at a specific points in the a.c. cycle. The resulting impedance is then indicated on the LCD display in impedance Ohms (Z_s Ω).



The total fault loop (A to E) impedance reading is then related to the type and rating of the protective devices used to protect the circuit under test, as per AS/NZS 3000 Table 8.1 tested in accordance with Clause 8.3.9.3 (b).

Table 8.1 is shown here:

Protective Device Rating (Amps)	Circuit Breakers			Fuses	
	Type B	Type C	Type D		
	Disconnection Times (*Spark-e-mate* should not cause disconnection [*1])				
	0.4 s			0.4 s	5 s
	Maximum Earth Fault-Loop Impedance ($Z_s\Omega$)				
6	9.58	5.11	3.07	11.50	15.33
10	5.75	3.07	1.84	6.39	9.20
16	3.59	1.92	1.15	3.07	5.00
20	2.88	1.53	0.92	2.09	3.59
25	2.30	1.23	0.74	1.64	2.71
32	1.80	0.96	0.58	1.28	2.19
40	1.44	0.77	0.46	0.96	1.64
50	1.15	0.61	0.37	0.72	1.28
63	0.91	0.49	0.29	0.55	0.94
80	0.72	0.38	0.23	0.38	0.68
100	0.58	0.31	0.18	0.27	0.48
125	0.46	0.25	0.15	0.21	0.43
160	0.36	0.19	0.12	0.16	0.30
200	0.29	0.15	0.09	0.13	0.23

The Earth and Fault Loop tests can also be performed more accurately without mains supply however Active, Neutral and Earth must be bridged out at the switchboard otherwise >20Ω will be displayed. An easy way is to connect the Active under test to the MEN.

Where mains supply is not available or disconnected, use *Spark-e-mate*'s Earth Continuity and Fault Loop resistance tests to measure the resistances of the Earth and Active & Earth conductors in accordance with clause 8.3.9.3 (a) and check readings against the maximum limits shown in Table 8.2 in AS/NZS 3000.

Table 8.2 (with AMDT No. 1 JUL 2009) is shown here:

Conductor Size		**Protective Device Rating**	**Circuit Breakers**									**Fuses**		
Active mm^2	Earth mm^2	A	Type B			Type C			Type D					
			Maximum d.c. Resistances Ω											
			R_{phe}	R_{ph}	R_e	R_{phe}	R_{ph}	R_e	R_{phe}	R_{ph}	R_e	R_{phe}	R_{ph}	R_e
1	1	6	6.14	3.07	3.07	3.28	1.64	1.64	1.96	0.98	0.98	7.36	3.68	3.68
1	1	10	3.68	1.84	1.84	1.96	0.98	0.98	1.18	0.59	0.59	4.10	2.05	2.05
1.5	1.5	10	3.68	1.84	1.84	1.96	0.98	0.98	1.18	0.59	0.59	4.10	2.05	2.05
1.5	1.5	16	2.30	1.15	1.15	1.22	0.61	0.61	0.74	0.37	0.37	1.96	0.98	0.98
2.5	2.5	16	2.30	1.15	1.15	1.22	0.61	0.61	0.74	0.37	0.37	1.96	0.98	0.98
2.5	2.5	20	1.84	0.92	0.92	0.98	0.49	0.49	0.58	0.29	0.29	1.34	0.67	0.67
4	2.5	25	1.48	0.57	0.91	0.78	0.30	0.48	0.47	0.18	0.29	1.05	0.40	0.65
4	2.5	32	1.15	0.44	0.71	0.62	0.24	0.38	0.37	0.14	0.23	0.82	0.32	0.50
6	2.5	40	0.92	0.27	0.65	0.49	0.14	0.35	0.30	0.09	0.21	0.61	0.18	0.43
10	4	50	0.74	0.21	0.53	0.39	0.11	0.28	0.24	0.07	0.17	0.46	0.13	0.33
16	6	63	0.59	0.16	0.43	0.32	0.09	0.23	0.19	0.05	0.14	0.36	0.10	0.26

Tests:

R_{phe} is the resistance of the Active and Earth loop. Press the FAULT LOOP test button to measure this resistance.

R_e is the resistance of the Earth wire. Press the EARTH CONTINUITY test button to measure the resistance.

6.6.0 RCD TESTING

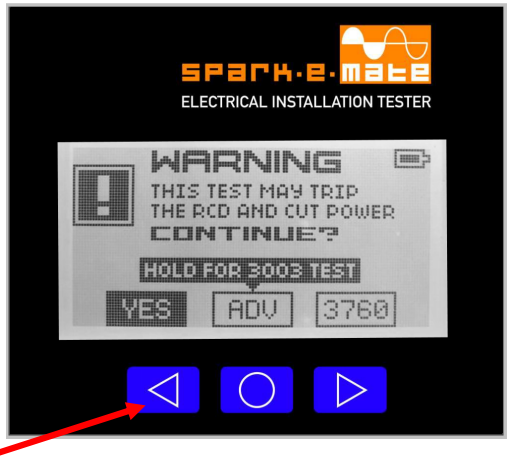
Residual Current Device (RCD), also called a safety Switch

6.6.1 STANDARD RCD TEST (AS/NZS 3000 Clause 8.3.10)

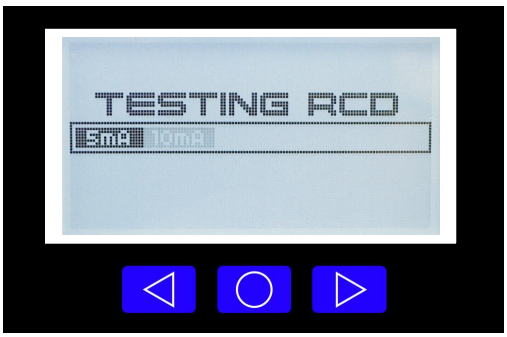
This test must be performed with the individual circuit breaker turned ON, the Residual Current Device (RCD or Safety Switch) turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected.

Press the RCD TRIP button:

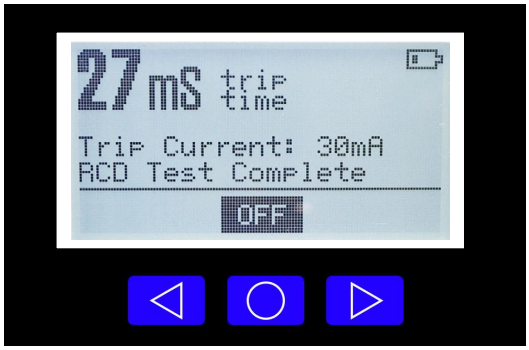
Spark-e-mate asks you if you are sure that you want to “cut the power”:



If you select YES, slowly rising residual test currents of 5, 10, 15, 30, 50, 100 and 150 mA (@ 90 degrees) are applied from Active to Earth.



The time taken for the Active (and Neutral) to be disconnected by the RCD is measured and displayed on the LCD display in milliseconds (ms). A trip time of 300 ms or less is a good result. The trip current is also displayed and this reading is then related to the type and rating of the protective device used to protect the circuit under test. 10 mA trip current RCDs are used in certain places like hospitals, child and aged care facilities, where most household or commercial RCDs have a trip current of 30 mA. Either type should not trip at less than 50% of their rated trip current unless there is some other residual leakage current from an appliance or low insulation resistance.



If the RCD fails to trip or the circuit is not protected by an RCD, the LCD will read **RCD TRIP FAILURE,** `RCD did not trip.`

Operation of the Integral Test Device

Pressing the integral test button on the RCD Safety Switch itself doesn't provide the ultimate guarantee that the RCD works at any given power point. The *Spark-e-mate* RCD Test does. This said, the AS/NZS wiring rules require that each final sub-circuit protected by an RCD be tested by pressing the integral test button and ensuring that the *Spark-e-mate* shows **NO MAINS CONNECTED** at a socket outlet in the circuit under test.

Notes:

- The 493 provides half-way and elevated residual test currents. Slowly rising trip currents of 5, 10, 15, 30, 50, 100 and 150 mA are automatically applied until the RCD trips or fails to trip.
- The 493 can be programmed to provide a residual pulsating d.c. test current for Type A and Type B RCDs, however AS/NZS 3000 does not require you to perform a d.c. test if the RCD has Type A identification. In Australia & New Zealand, these carry
- the  symbol. They trip on both a.c. and pulsating d.c. currents.

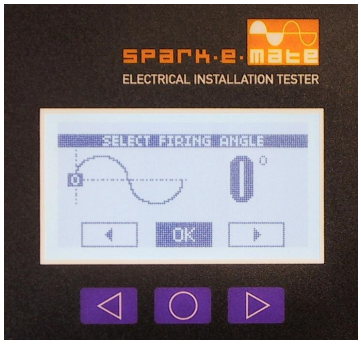
6.6.2 ADVANCED (ADV) RCD TEST

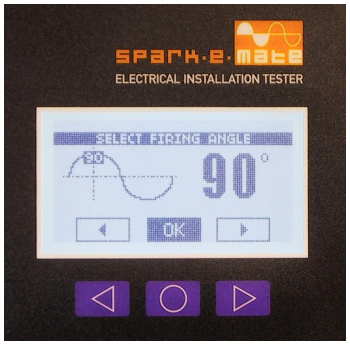
Press the “RCD TRIP” button:

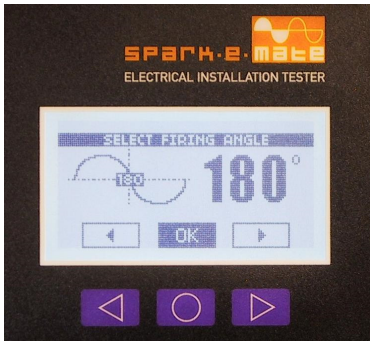
This test allows you to manually select the firing angle and trip current. Momentarily press the ADV button to bring up this screen:

Firing Angle

Press the ► button to choose a firing angle of 0°, 90° or 180°.







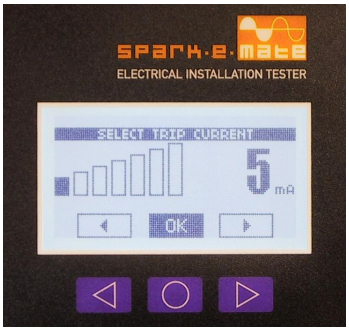
This is the point in the a.c. waveform that the trip current is applied:

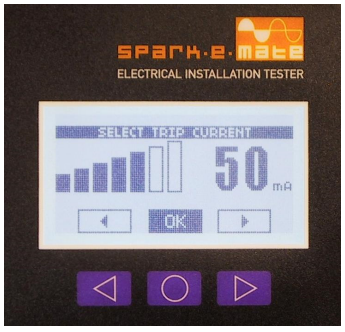
- Some RCDs will alternate between their fastest and slowest tripping times regardless of the firing angle
- 0° should give you the RCD's fastest or slowest trip time (RCD type and installation dependant)
- 180° should give you the slowest or fastest trip time (RCD type and installation dependant)
- 90° should give you the typical trip time (RCD type and installation dependant)

Press OK to move to the next step.

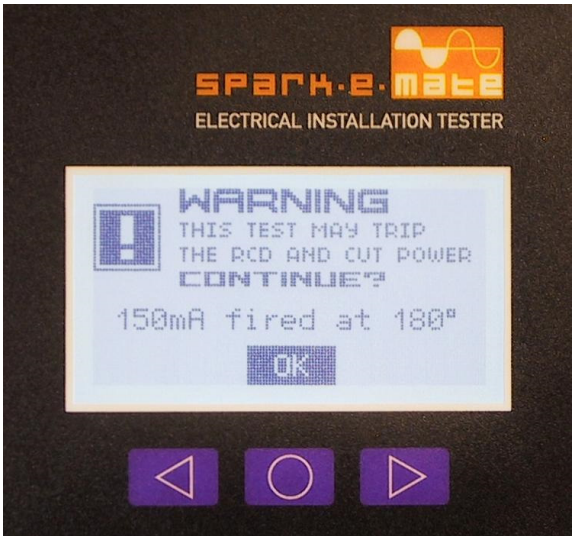
Trip Current

Press the ► button to choose 0, 5, 10, 15, 30, 50, 100 or 150mA trip current.





After pressing the OK button shown above, you will receive the final warning that the RCD could trip at the selected firing angle and trip current:



Tripping the RCD

After pressing the OK button shown above, Spark-e-mate applies the selected trip load at the selected point in the waveform and trips the RCD:

The RCD under test should:

- not trip at half its rated trip current
- trip within 300ms at its rated current (30mA and 100 mA RCDs)
- trip within 40ms at its rated current (10mA RCDs)
- trip within 40 ms at five times its rated trip current

After testing, *Spark-e-mate* will turn itself off after 60 seconds or you may press the  button to manually turn it off.

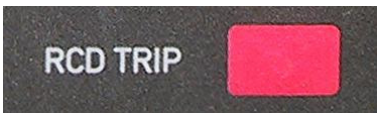
6.6.3 IN-SERVICE RCD TEST (AS/NZS 3760)

This is an advanced test that tests RCDs in accordance with AS/NZS 3760. This test is not a mandatory test in AS/NZS 3000.

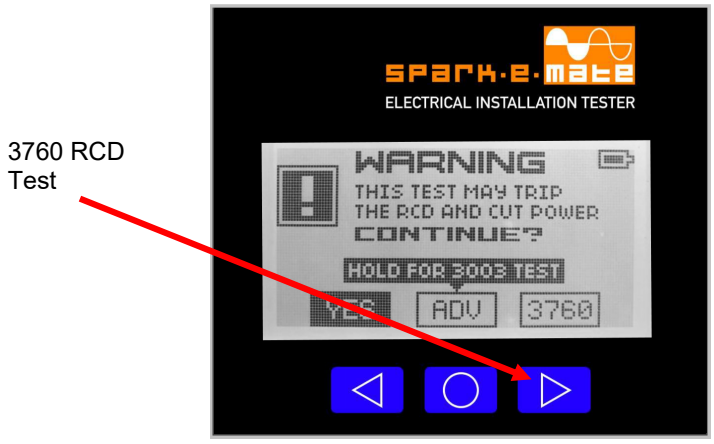
AS/NZS 3760 advises that RCDs should have their integral test button pressed every six months, and their operating times tested every 12 months or 2 years depending on the type of environment.

The test must be performed with the individual circuit breaker turned ON, the Residual Current Device (RCD or Safety Switch) turned ON, and the socket outlet switch turned ON. This is a powered test ie. mains supply connected.

Press the RCD TRIP button:

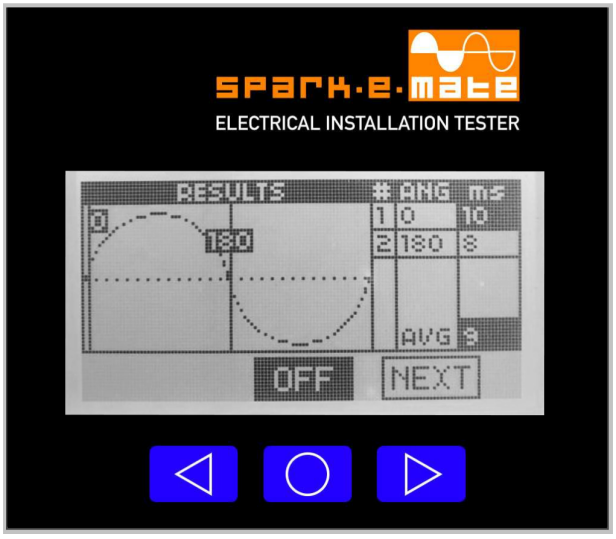


Select the 3760 mode:



Spark-e-mate displays “CONTINUE?”.

If you press YES, tests at 0 degrees and 180 degrees will be performed. You'll then see the results:



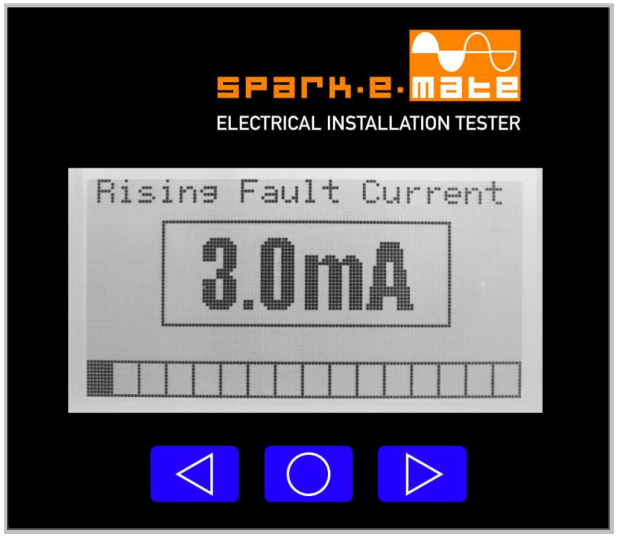
6.6.4 3003 RCD TEST MODE

This RCD Test Mode allows you to test 10mA RCDs in Body Protected and Cardiac Protected areas in Hospitals, Aged Care Homes and Child Minding Centres. Schneider Electric supplies the Medilec series of Combination RCD/MCBs.

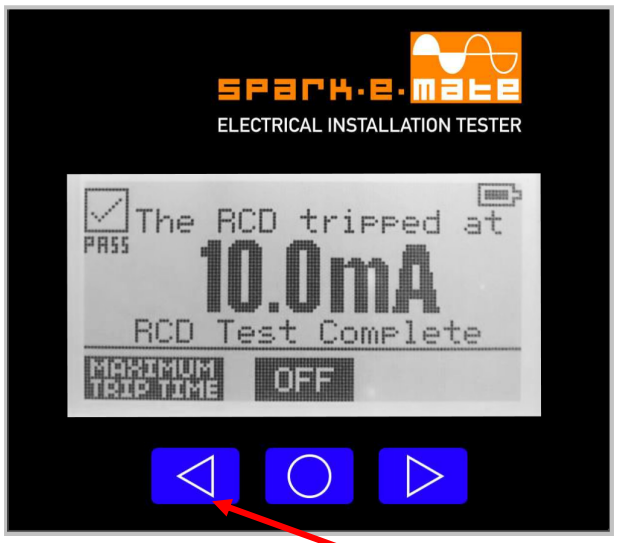
Press the “RCD TRIP” button:

For the AS/NZ 3003 RCD test, press and hold ADV button and you’ll briefly see:

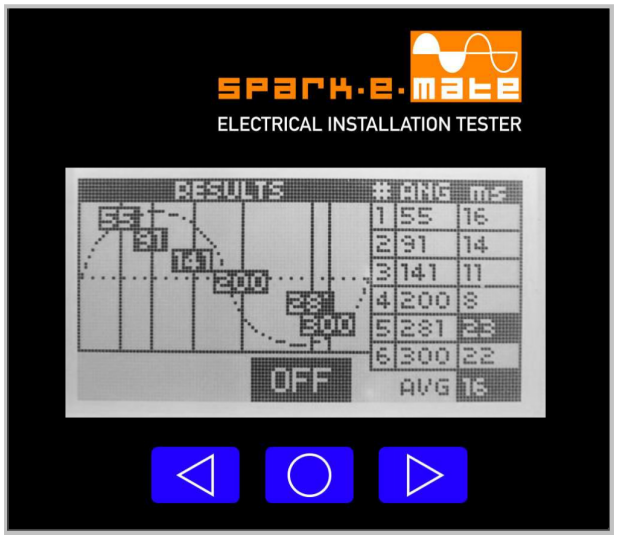
Spark-e-mate applies a slowly rising fault current from 3 -10.5mA until the RCD trips



The RCD under test tripped at 10mA of fault Current:



Once the rising fault current test is complete, select maximum trip time ◁ to perform 6 tests at 10.5mA at random firing angles. After the six 3003 tripping tests are complete, the results are displayed:



6.7 BLUETOOTH LOGGING OPTION 493BTLi (AS/NZS 3000 Clause 8.4)

Spark-e-mate 493BTLi units can log test results on a Bluetooth enabled Smartphones (Apps for Android and iOS are available free of charge). Test reports for each installation can be printed and stored as a Verification Record. Existing 493 units can be retrofitted with the 493BTi module at a nominal charge.

Only units that carry this optional symbol are Bluetooth enabled.

Refer to Document F2469/02 for Logging details.

7.0 Energisation of an Installation (AS/NZS 3000 Clause 8.4)

Date of energisation and original verification details are to be recorded and available on site in an accessible record. This also facilitates the process of re-verification at a later date. Here is a Test Report that can be filled out manually:

ELECTRICAL INSTALLATION ENERGISATION & VERIFICATION RECORD	**INSTALLATION:**
DATE OF ENERGISATION: / /	
Testing Organization and Department	

Test Equipment	**Model Number**	**Serial Number**	**Manufacturer**	**Date Last Calibrated**
Electrical Installation Tester	Clipsal Cat. № 493		Design 2000 Pty Ltd	

Describe Electrical Installation(s) Tested	**Tests**			**Reading / Remedial Action**	**Date**
1.	**Passed**	**Yes**	**No**		
	Earth Continuity				
	Insulation Resistance				
	Polarity				
	Correct Circuit Connections				
	Fault Loop				
	RCD Test				
2.	**Passed**	**Yes**	**No**		
	Earth Continuity				
	Insulation Resistance				
	Polarity				
	Correct Circuit Connections				
	Fault Loop				
	RCD Test				
Other Comments					

Tested by	**Signature**	**Dated**

Contact your supplier for copies of this form

8.0 MISCELLANEOUS TESTS

8.1 EXTENSION LEAD TESTING

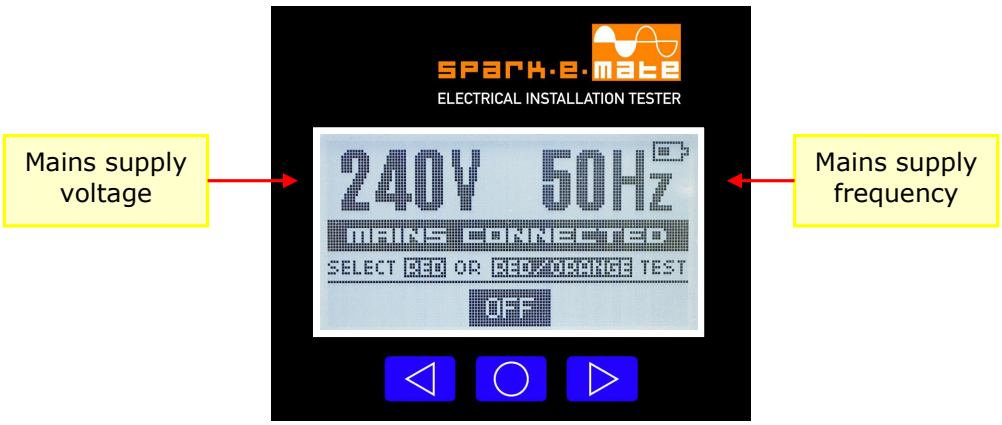
These can easily be tested in conjunction with a Socket Outlet with known characteristics. First fully test the socket outlet carefully noting the readings. Before plugging the extension lead into the socket, plug the *Spark-e-mate* test lead into the socket of the extension lead. Check the plug is not in contact with anything conductive & perform the Insulation Resistance test (described above), if OK plug the extension lead into the socket outlet and switch on the outlet. Note the polarity indication and check the display for dangerous voltages on earth. Also perform the Earth Fault Loop test. The results of the socket outlet tests are simply subtracted from these results. This gives an accurate indication of the lead's condition. Power boards and double adaptors can also be tested as described above.

8.2 IDLE SUPPLY VOLTAGE (Check for voltage to AS 60038 ie. 230V +10% -6%)

When *Spark-e-mate* is plugged into a live socket outlet, the supply voltage is displayed when the ON/RESET button is pressed. The unloaded Active to Neutral potential is shown on the LCD display in Volts (V). Ideally it should read 230V – 6% / + 10%.

8.3 MAINS SUPPLY FREQUENCY

When *Spark-e-mate* is plugged into a live socket outlet, the supply frequency is displayed when the ON/RESET button is pressed. The frequency of the mains supply alternating current is shown on the LCD display in Hertz (Hz). Ideally it should read 50 Hz in Australia, New Zealand and the United Kingdom.



8.4 PROSPECTIVE SHORT CIRCUIT CURRENT

You can calculate the prospective short circuit current (PSC) of a live to ground fault by dividing the mains voltage by the fault loop impedance:

PSC = Voltage / fault Loop Impedance

PSC example: 240 Volts / 0.5 Ohms = 480 Amps (then compare this figure to the protective device's short circuit interrupting capacity)

8.5 TESTING THREE PHASE OUTLETS AND 415V RCDs

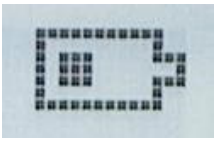
You can use *Spark-e-mate* to test 10A, 20A, 32A & 50A three phase socket outlets with or without a Neutral connection. You can use the optional 493L test lead probes or better still, the optional 493AD three phase adaptor. Please refer to the 493AD Instructions, **Document F2402/2a**

8.6 TESTING FOR DANGEROUS VOLTAGES ON METAL WATER OR GAS PIPES

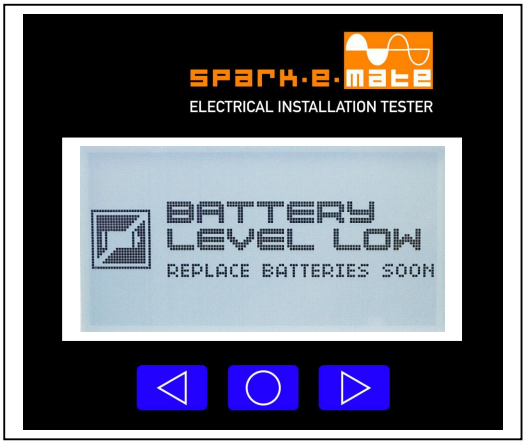
Using the optional 493L Test Lead Earth clip or probe make firm contact with the metal pipe. Leave the Active and Neutral leads disconnected and turn on *Spark-e-mate.* If the pipe is live
"DANGER – VOLTAGE ON E…" will be displayed.

9.0 BATTERY AND MAINTENANCE CHECK

To display the *Spark-e-mate* internal battery status, simply press the ON/RESET button. The battery status is indicated by the number of vertical bars within the battery symbol on the LCD display.



If the battery level is critically low you will see this screen when you press the ON/RESET button:



The internal batteries are 6 x AA alkaline. Please note that alkaline or non-rechargeable lithium batteries must be used. Rechargeable batteries cannot be used.

NOTE:

- ❑ *If the Spark-e-mate fails to start up, the internal batteries may be fully discharged (flat) and will need to be replaced.*
- ❑ *Only a licensed Electrician should change the batteries.*
- ❑ *The internal battery holders are accessed by removing the power lead, sliding off the rubber holster and removing the four screws that fasten the back cover.*
- ❑ *It is absolutely mandatory that the unit is disconnected from the mains supply before opening the back cover !!!*

10.0 QUICK USER GUIDE

- Press the ON/RESET button to turn on *Spark-e-mate*.
- If any of the following tests fail (shown by a warning message or bad reading), stop and rectify the problem before performing the next test. Certain faults will halt testing and must be fixed before testing can continue.
- It is only suggested that the tests are performed in the following order. They can be performed in any order without the risk of damaging *Spark-e-mate*.

1. Earth Continuity

Energise circuit, plug in *Spark-e-mate*, turn on the socket outlet and press the Earth Continuity button. If the RCD trips the test passes. If a reading is obtained, check for 0.50 Ω or less. The reading may be higher in low current circuits or lower in high current circuits. Check Table 8.2.

2. Insulation Resistance

De-energise circuit at circuit breaker, press Insulation Resistance button, select 250V or 500V test voltage and check for 1 MΩ or more.

3. Polarity

Re-energize circuit at circuit breaker, press Polarity button and check for `POLARITY CORRECT`. Turn off socket outlet switch and check for `NO MAINS CONNECTED`. Turn socket outlet switch back on and check for `MAINS CONNECTED`.

4. Correct Circuit Connections

Leave circuit energized, press Circuit Connections button and check for `NO HAZARD ON EARTH`. Also check for `NO LOAD ACROSS ACTIVE & EARTH`.

5. Fault Loop

Leave circuit energized, press Fault Loop button. If the RCD trips the test passes. If a reading is obtained, check reading against maximum limits in Table 8.1. Please note that noisy mains supply can cause results to vary in which case an average of several readings will need to be recorded. Generally, a reading of less than 1.53Ω is good for a 20A MCB but may be higher in low current circuits or lower in high current circuits.

6. RCD Test

Leave circuit energized, press the RCD Trip button, select YES and press OK. Check for a trip time of 300 milliseconds or less and a trip current applicable to the RCD under test.

- Reset the RCD Safety Switch at the switchboard/meter box. Press the RCD integral test button and ensure that the RCD trips then reset the RCD.
- Check that the *Spark-e-mate* shows that the Mains supply voltage is 230V +10%, -6% @ 50Hz, and then unplug *Spark-e-mate*. *Spark-e-mate* will turn itself off after 60 seconds or you may press the  button to manually turn it off.

****** Spark-e-mate has verified that the Socket outlet is OK to use ******

- Fill out the attached **ELECTRICAL INSTALLATION ENERGISATION & VERIFICATION RECORD** and affix in the meter box or switchboard for future reference.

11.0 Specifications

Catalogue Number	493
Enclosure	Hammond 1599HBK, ABS fire retardant rating UL94HB, IP54 rated
Dimensions	220mm x 110mm x 45mm (H x W x D)
Fascia Label	EBG180 Autoflex hard coated polyester, automotive grade
Holster	Santoprene thermoplastic vulcanizate rubber, PANTONE 115 U (Yellow)
Operating Temperature Range	-10 → 50 ° C ambient
Storage Temperature Range	-20 → 70 ° C ambient
Humidity, Storage and Operating	To 98% non condensing
Mean Time Between Failure	> 20 years
Control Logic	PIC 18LF8722, 128K bytes internal program flash memory, 4K bytes RAM, 1K bytes EEPROM
Indicators	Graphical Liquid Crystal Display – 122 (H) x 64 (V) pixels
Connector	IEC 60320 C14 mains socket
Power lead	K3755ORA IEC C13 R/A medical power cord. Three pin Mains plug to IEC 60320 C13. Other plugs to order
Testing Criteria	AS/NZS 3000: Section 8 – Verification
Earth Continuity Test	Calculated by loaded voltage drop along the Earth conductor divided by the load current. Loaded Earth voltage drop measured using the neutral as an unloaded connection point. Load applied across active and Earth from mains when available or internal batteries when unpowered. (RCD will not trip*1). Range 0 → 10Ω, Resolution 0.01Ω, Accuracy ±0.1Ω ±2%
Insulation Resistance Test	Active to Earth and Active to Neutral insulation resistance measured during internally generated 250V d.c. or 500V d.c. within -10%/+20% applied across a 1MΩ load. 250V Range 0.03MΩ → 10MΩ, Resolution 0.01MΩ, Accuracy ±2% at 1MΩ decreasing to ±6% at extremes of range 500V Range 0.25MΩ → 20MΩ, Resolution 0.01MΩ, Accuracy ±2% at 1MΩ decreasing to ±6% at extremes of range
Polarity	Polarity Correct, A&N reversed, A&E reversed, no Neutral, no Earth, RCD forced to trip when N&E are reversed
Correct Circuit Connections	Circuit Checks OK, Earth hazard – load or short between Earth & live conductor, detect threshold of 70V a.c. potential on Earth, non-contact detection method
Earth Fault Loop Test	Calculated by unloaded voltage less loaded voltage divided by load current. Load applied across active and Earth from mains when available or internal batteries when unpowered. (RCD will not trip*1). Range 0 → 10Ω, Resolution 0.01Ω, Accuracy ±0.1Ω ±2% (±0.2Ω ±2% with noisy mains)
RCD Test	5, 10, 15, 30, 50, 100 & 150 mA nominal between active and earth. Range 2 → 300 ms trip time, Resolution 1ms, Accuracy ± 2ms (2 – 40ms), ± 4ms (41 – 120ms), ± 8ms (121 – 300ms) Default Firing Angle 90° (0° or 180° selectable)
Mains Supply Indicator	True RMS. Range 150 → 300V~, Resolution 1V, Accuracy ± 2 digits ± 2% (150 – 264V), ± 5 digits ± 2% (265 – 300V)
Mains Supply Frequency Indicator	Range 38 → 62Hz, Resolution 1Hz, Accuracy ± 1Hz
Battery Condition Indicator	Battery Symbol on the LCD, vertical bars indicate state
Field Calibration	Hidden menu. Authorised Partners only
Factory Programming	Via Host Computer (USB or Bluetooth optional)
Nominal Power Requirement	230V a.c. -6/+10%, 50Hz ± 12Hz (other voltages to order)
Abs. Minimum Power input	150V a.c.
Abs. Maximum Power input	300V a.c..
Power Consumption	0mA off, 30mA nominal, up to 150mA depending on test
Internal Batteries	6 x AA alkaline
Battery Life	1.95 years with one complete set of tests everyday using the supplied batteries
Auto turn-off	Backlight after 30 seconds, shutdown after 60 seconds (programmable)
Unpacked Weight	610 gms
Warranty	Two years
Quality Assurance Certification	ISO9001
RoHS	2002/95/EC Compliant
REACh	2006/121/EC Compliant
Electrical Safety Compliance	AS/NZS 3100, AS/NZS 61010.1 Category IV 600V
ACMA Supplier Code	N468 (C-Tick)
ERAC Responsible Supplier Number	E1287 (RCM)
Human Rights Australia	Privacy Commissioner assent 89/328
Optional Test Leads	493L
Optional Three Phase Adaptor	493AD1050 (with 10/20A plug and 32/50A plug)
Spark-e-mate with inbuilt Bluetooth Logging for Android & IOS	493BTLi
Optional Bluetooth Modules that can be fitted to existing 493 units	493BTi

Spark-e-mate kit includes 493 and 493L in hard carry case (not currently available in NZ)	493K
Spark-e-mate with inbuilt *Bluetooth* Logging for Apple iOS and Android	493BTLi
Spark-e-mate kit includes 493BTLi and 493L in hard carry case (not currently available in NZ)	493BTLKi

[1] As long as there is no other residual leakage current

12.0 Spark-e-mate Video Links

Clipsal Spark-e-mate Electrical Installation Tester

https://www.youtube.com/watch?v=fZNeCr3O6Fw

Clipsal Spark-e-mate RCD Testing Video Part 1: RCD Sensitivity

https://www.youtube.com/watch?v=M7Xd1XXg9oc

Clipsal Spark-e-mate RCD Testing Video Part 2: Maximum Tripping Time

https://www.youtube.com/watch?v=_hGCOC3VU0g

13.0 Service Information

If problems are experienced with the operation of the *Spark-e-mate* 493, talk to your supplier first for advice. In most cases, problems can be diagnosed and rectified on-site or over the phone, avoiding unnecessary transportation and service costs.

Warranty

The equipment has a warranty against defects in material and workmanship for a period of **two years** from date of purchase. Within this period repairs, if necessary, are without charge for parts and labor.

See 'SERVICE INFORMATION' above. In the explicit event of a malfunction, please send the unit, (along with an accurate fault report, contact name and number, and a return address) for repair to the **place of purchase**.

Warranty Information for Wholesalers & Resellers only

Transport costs to the factory will be to the customer's account, and Clipsal Australia Pty Ltd will cover the return transport costs for warranty repairs. If units are sent to the factory and discovered to be 'No Fault Found', a service charge may apply and the return transport costs may be to the customer's account.

NATIONAL CUSTOMER SERVICE ENQUIRIES:

1300 2025 25

spark·e·mate

Cat. Nº 493

CLIPSAL

LIVING ELECTRICAL

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FEB 2021 Edition 2.1

DESIGNED AND MADE IN AUSTRALIA

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F2215/04b