



## OPERATING AND MAINTENANCE MANUAL

Product: ***Primary Current Injection Test Set***  
Type: ***750ADM mk4***



*DESIGNED AND MANUFACTURED BY:*

**T & R Test Equipment Limited**

15-16 Woodbridge Meadows, Guildford, Surrey, GU1 1BJ, United Kingdom

Telephone: 01483 207428

e-mail: [sales@trtest.com](mailto:sales@trtest.com)

Web: [www.trtest.com](http://www.trtest.com)



## GENERAL SAFETY STATEMENT



### WARNING

The following safety precautions should be reviewed to avoid injury to the user and damage to the product (and other products connected to it). To avoid potential hazards only use this product as specified.

- **Only suitably qualified personnel should use this equipment. Servicing of this product should only be carried out by suitably qualified service personnel.**

### To Avoid Fire Hazards and Personal Injury

- Use the correct power supply lead. Only use a suitably rated and approved power supply lead for the country of use.
- Ensure that systems that the unit is to be connected to are dead.
- Do not connect and disconnect leads whilst outputs are switched on. Breaking the output circuit with current flowing may cause arcing.
- Ensure that the product is grounded. To avoid electric shock, it is essential that the grounding conductor is connected to the earth ground. An additional earth terminal is unit that must be connected to a local earth. Ensure that the unit is properly grounded before making any connections to inputs or outputs.
- Terminal ratings must be observed to prevent fire hazards and risk of injury to the operator. Consult the product manual for ratings information before making connections to any terminal.
- It is ESSENTIAL to consult the product manual for rating information before making any connection to a terminal or terminal group marked with a warning triangle.
- Only use fuses of a type and rating specified for this product.
- Do not operate the unit out of its case or with any covers or panels removed.
- Do not touch exposed connections and components when power is present.
- Do not operate the product if any damage is suspected. Refer the unit to qualified service personnel to be checked.
- Do not operate the unit in wet or damp conditions
- Do not operate the unit in an explosive atmosphere
- The 750ADM series have a high output current (up to 750A), and therefore generate a large magnetic field around the output leads. Care must be taken in siting units next to items sensitive to magnetic fields (such as computer monitors and other sensitive equipment).
- Warnings from cardiac pacemaker manufacturers state that strong magnetic fields may affect operation. Any high current unit should therefore not be operated by, or in the vicinity of persons fitted with cardiac pacemakers or any other electronic or electrical medical implants.

If any further queries occur regarding the usage and maintenance of the equipment detailed in this manual, please refer these to the supplier of the

equipment in the first case or to the manufacturer, T & R Test Equipment Limited.

## SAFETY TERMS AND SYMBOLS

The following safety symbols appear on the equipment:



CAUTION/WARNING – Refer to manual



CAUTION/WARNING - hot



Mains off



Mains on

The following safety symbols appear in this manual:



CAUTION

This action or procedure may be dangerous if not carried out correctly and may cause damage to the equipment or connected equipment.



WARNING

This action or procedure may be cause injury or death to the operator or other personnel if not carried out correctly using applicable safety procedures.



WARNING - Hot

Parts of the equipment, output leads and connections may become hot with use at high currents

# CONTENTS

<b>1.</b>	<b>DESCRIPTION OF EQUIPMENT</b>	<b>9</b>
<b>1.1</b>	<b>Front Panel Layout</b>	<b>10</b>
<b>1.2</b>	<b>Electrical Specification</b>	<b>11</b>
1.2.1	Supply Requirements	11
1.2.2	Main Current Output	11
1.2.3	Current Metering	13
1.2.4	Timing System Specification	13
1.2.5	Contact Inputs	14
1.2.6	Vdc Contact Input	14
1.2.7	Storage of results	15
1.3.1	Displayed Values	19
1.3.2	Warning Messages	19
<b>1.4</b>	<b>Overload Protection</b>	<b>20</b>
<b>1.5</b>	<b>Installation</b>	<b>20</b>
<b>2.</b>	<b>OPERATION</b>	<b>21</b>
<b>2.1</b>	<b>Main Output</b>	<b>21</b>
2.1.1	Connecting the output leads	21
2.1.2	Current Injection Procedure (No Timing)	22
2.1.3	Maximising the Output Current	23
<b>2.2</b>	<b>Timing System</b>	<b>24</b>
2.2.1	General Procedure for Timing Tests	24
2.2.2	Timer Mode: Off	25
2.2.3	Timer Mode: Internal Start	25
2.2.4	Timer Mode: Single Contact	25
2.2.5	Timer Mode: Dual Contact	25
2.2.6	Timer Mode: Current Operated	25
2.2.7	Timer Mode: Pulse	25
<b>3</b>	<b>APPLICATION NOTES – TESTING SPECIFIC DEVICES</b>	<b>26</b>

<b>3.1</b>	<b>Primary Injection of Over Current Relays</b>	<b>26</b>
<b>3.2</b>	<b>Secondary Injection of Over Current Relays</b>	<b>27</b>
3.2.1	Connections	27
3.2.2	Test Procedure	27
<b>3.3</b>	<b>Timing of Auto-Reset/Reclosing Devices</b>	<b>29</b>
3.3.1	Connections	29
3.3.2	Test Procedure	30
<b>3.4</b>	<b>Timing Circuit Breakers with No Auxiliary Contacts)</b>	<b>31</b>
3.4.1	Connections	31
3.4.2	Test Procedure	32
3.4.3	Devices with Short Trip Times	32
<b>3.5</b>	<b>Using the 750ADM as a Stand-Alone Timer (Single Contact)</b>	<b>33</b>
3.5.1	Timer Mode	33
3.5.2	Connections	33
3.5.3	Test Procedure	33
<b>3.6</b>	<b>Using the 750ADM as a Stand-Alone Timer (Dual Contact)</b>	<b>34</b>
3.6.1	Timer Mode	34
3.6.2	Connections	34
3.6.3	Test Procedure	34
<b>4.</b>	<b>MAINTENANCE</b>	<b>35</b>
<b>4.1</b>	<b>Variable Transformer Brush</b>	<b>35</b>
<b>4.2</b>	<b>Removal of the 750ADM from Case</b>	<b>35</b>
<b>5.</b>	<b>STANDARD ACCESSORIES</b>	<b>36</b>
<b>5.1</b>	<b>Standard Accessories Supplied</b>	<b>36</b>
<b>6.</b>	<b>OVERALL PERFORMANCE SPECIFICATION</b>	<b>37</b>
<b>6.1.</b>	<b>Insulation Resistance at 1000V DC</b>	<b>37</b>
<b>6.2.</b>	<b>Applied Voltage Test</b>	<b>37</b>
<b>6.3.</b>	<b>Accuracy of Instrumentation and associated circuit components</b>	<b>37</b>
6.3.1	Main Output Ammeter	37

6.3.2	Timing System	37
<b>7.</b>	<b>REVISION</b>	<b>39</b>





## **1. DESCRIPTION OF EQUIPMENT**

The 750ADM mk4 is a flexible current injection system capable of supplying currents of up to 750A ac into a variety of loads. The unit is designed for testing devices used for power system protection but can also be used wherever a high current AC source is required. The outputs may also be used in voltage mode to supply voltages of up to 16Vac. Accurate metering facilities and a very flexible timing system are also provided.

The 750ADM mk4 is designed to be used on 'dead' systems (i.e. no externally supplied voltages are present on the test object. Under no conditions connect the 750ADM mk4 to a live system. Always check that the power to the device under test is off and the circuit is isolated before making any connections.

Note: All references to 750ADM in this manual refer to the 750ADM mk4.

## 1.1 Front Panel Layout

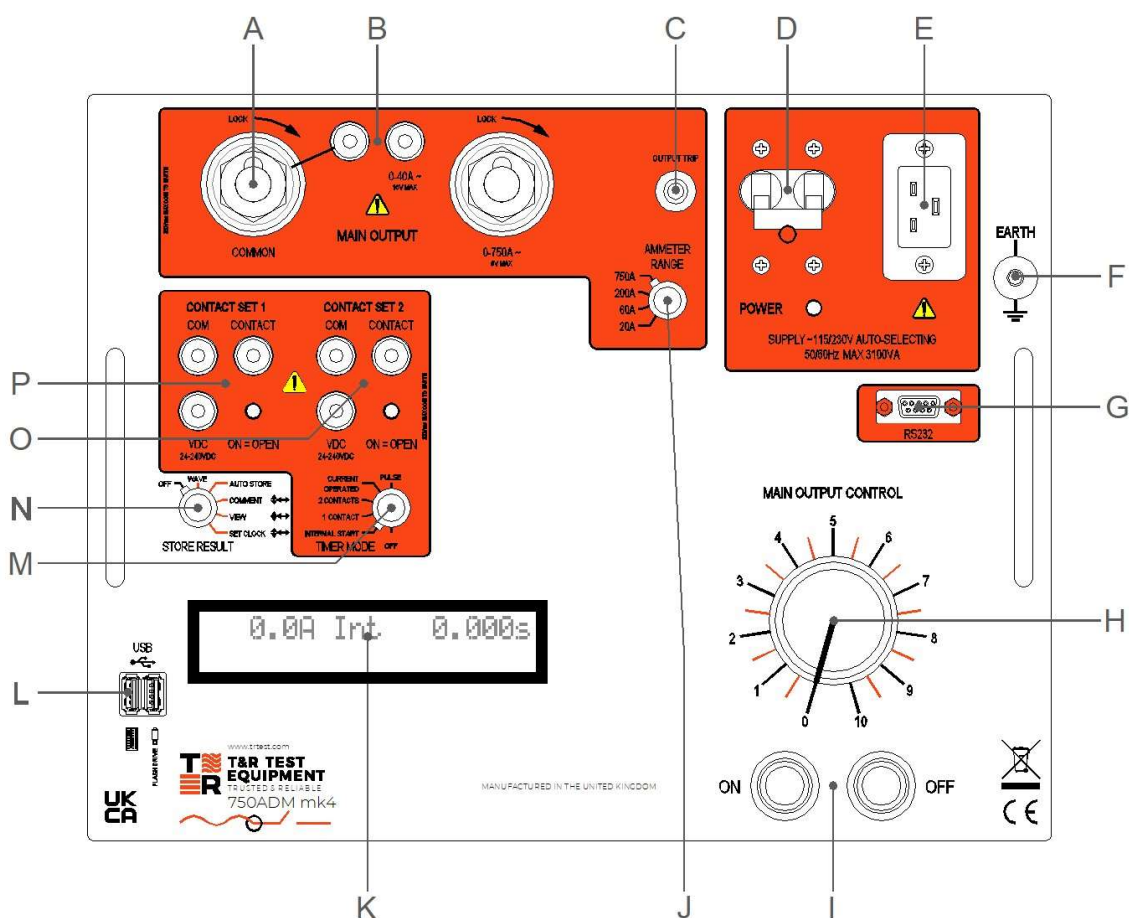


Figure 1.1. Front panel layout

Ref	Item	Description
A	Main output terminals	Main ac outputs for ac tests up to 750A
B	40A output terminals	16V 40A Output terminals
C	Output circuit breaker	Miniature circuit breaker protecting outputs
D	Mains on/off circuit breaker	Mains supply switch and circuit breaker
E	Mains input connector	16A IEC Mains inlet connector
F	Earth terminal	Connect 750ADM to local ground
G	RS232 connector	For connection to a printer or PC
H	Main output control	Controls voltage/current of main output
I	Main output on/off controls	Switches the main output on & off
J	Metering range switch	Selects output metering range
K	Display	Shows current and time
L	USB connector	For USB storage and external keyboard
M	Timer mode select	Selects timer mode
N	Store Result select	Select storage mode, view results and edit comments
O	Timer contact set 2	Timer input
P	Timer contact set 1	Timer input

## 1.2 Electrical Specification

### 1.2.1 Supply Requirements

The 750ADM requires a single phase 50/60Hz supply of  $115V \pm 10\%$  or  $230V \pm 10\%$ . The correct range is automatically selected by the unit without any user intervention.

The maximum power requirements of the unit are shown in the table below.

Unit	Supply voltage	Power requirements
750ADM	115V	1900VA
	230V	3900VA

### 1.2.2 Main Current Output

The main current output of the unit has two taps, allowing currents of up to 40A or 750A to be selected. The ratings of each tap are shown in the table below.

		750ADM	
		115V	230V
750A Output	Open circuit voltage	3.5V	5.0V
	Voltage at 500A	2.8V	4.0V
	Continuous current	125A	125A
	5 min on/ 15 min off	250A	250A
	1 min on/ 15 min off	440A	500A
	Maximum current	500A	750A
	Max current "on" time	10s	20s

		750ADM	
		115V	230V
40A Output*	Open circuit voltage	10V	16V
	Voltage at 40A	7.5V	10V
	Continuous current	10A	10A
	5 min on/ 15 min off	40A	40A

\*When using the 40A output, ensure that the metering range switch is set to 20A or 50A to protect the output.

Each output is rated for a continuous current and for higher intermittent currents. The maximum 'on' time for intermittent currents is enforced by the unit, and the output will be switched off if the rating is exceeded. The display will then show the following message until 15 minutes have passed to clear the trip condition:

Duty Cycle Trip Wait 15 Minutes
------------------------------------

The complete curve for intermittent current ratings is shown in figure 1.2. The figure is for the 5V output on the 750A range using a supply voltage of 230V.

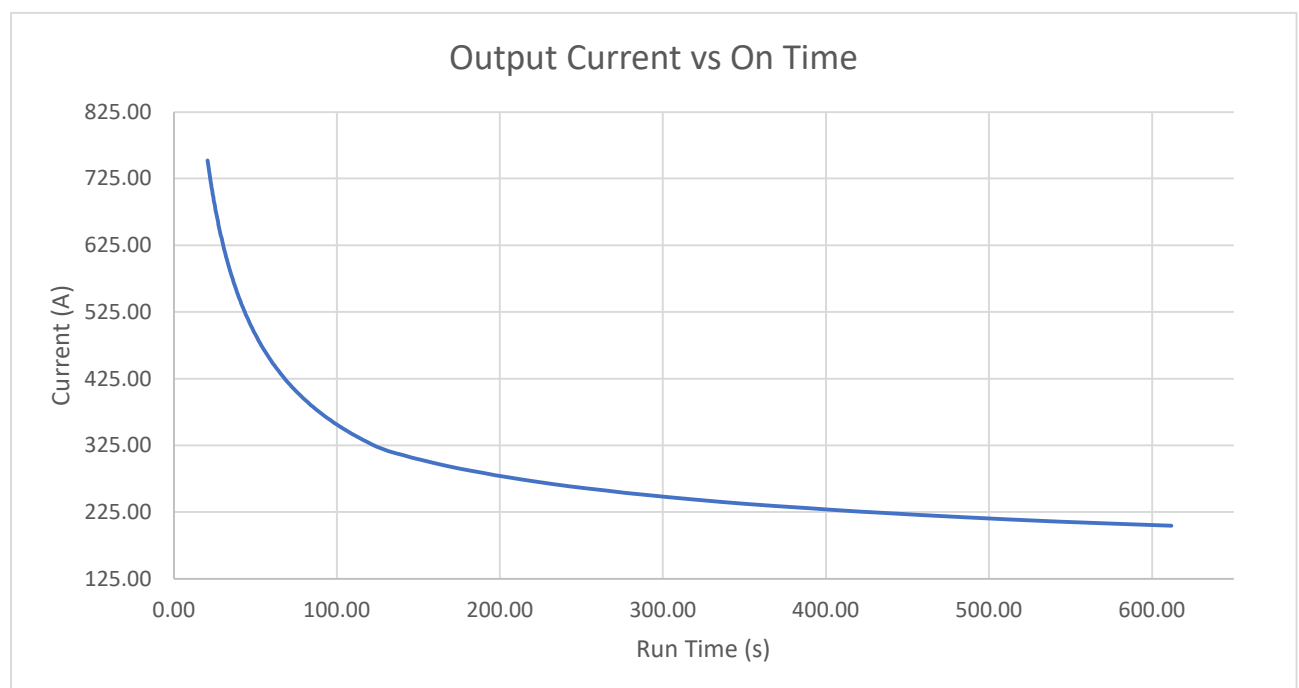


Figure 1.2 750ADM maximum 'on' times

### 1.2.3 Current Metering

The main output current is metered by a true RMS reading digital memory ammeter with single cycle capture. The following ranges are available:

Range	Resolution	Accuracy	Trip current
20.00A	0.01A	$\pm 0.5\%$ rdg $\pm 5d$	21A
50.00A	0.01A	$\pm 0.5\%$ rdg $\pm 5d$	53A
200.0A	0.1A	$\pm 0.5\%$ rdg $\pm 5d$	210A
750A	1A	$\pm 0.5\%$ rdg $\pm 2d$	788A

The ammeter range is independent of the current output selected and is therefore possible to meter low currents accurately.

The unit has an electronic trip circuit that monitors the output current and switches the output off if the trip value exceeds 105% of full scale of the metering range selected.



CAUTION

When using the 40A output, select only the 20A or 50A range to ensure that the output is adequately protected.

### 1.2.4 Timing System Specification

The 750ADM is fitted with an integrated timing system which is linked to the main output and two sets of contact inputs. The system is highly flexible and allows for the timing of all common protection devices and trips.

Full details of operating the timer are given in section 2.

#### Timer information

<b>Timer range</b>	0-999.999s/9999.99s/99999.9s auto-ranging
<b>Resolution</b>	1ms/10ms/100ms
<b>Accuracy</b>	$\pm 0.01\%$ rdg $\pm 2d$ All modes except current operated $\pm 0.01\%$ rdg $\pm 4d$ Current operated mode
<b>Contact o/c voltage</b>	24V
<b>Contact s/c current</b>	20mA
<b>Contact indication</b>	LED on – contact open LED off – contact closed

## Timer Modes

Timer Mode	Timer Start Condition	Timer Stop Condition	Automatic output off	Example application
Off	-	-	-	Set current
Internal Start	Main output on	C1 change	When timer stops	IDMT relay
1 Contact using Contact 1	C1 1 <sup>st</sup> change	C1 2 <sup>nd</sup> change	C1 1 <sup>st</sup> change (timer start)	Auto-recloser
1 Contact using Contact 2	C2 1 <sup>st</sup> change	C2 2 <sup>nd</sup> change	C2 2 <sup>nd</sup> change (timer stop)	Drop-off timing
2 Contacts 1st change C1	C1 change	C2 change	C2 change (timer stop)	
2 Contacts 1st change C2	C2 change	C1 change	C2 change (timer start)	Auto-reclose relay
Current Operated*	Current >20% of range	Current <20% of range	Current <20% Timer stop	Miniature circuit breakers
Pulse	Main output on	200ms	200ms	Set current for thermal devices

\* results obtained with test currents below 20% of range will give a lower accuracy than specified.

### 1.2.5 Contact Inputs

The 750ADM has two contact inputs which are used to start and stop the timer depending on the mode selected. Each input has a connection for volt-free contacts and for triggering by a DC voltage. In each case, the input auto-selects for normally open or normally closed contacts. The contact state is shown by an LED, which is off when the contact is closed, and on when the contact is open.

The maximum open circuit voltage across the contact input is 24V, and the short circuit current through the contacts is limited to 20mA.

### 1.2.6 Vdc Contact Input

The Vdc contact input is triggered by a change of state of an external DC voltage. It is triggered by voltages in the range 24-240Vdc. Either a change from zero to 24-240V or a change from 24-240V to zero will trigger the timer. The negative of the signal is connected to the blue "Com" socket and the positive is connected to the red "Vdc socket".



WARNING

When making connections ensure that the circuit under test is dead and earthed (i.e. no voltages are present). Ensure that the 240Vdc maximum for the input is not exceeded.

### 1.2.7 Storage of results

The 750ADM can store all displayed values to a CSV spreadsheet file whenever the timer stops or the output is switched off. This is useful for recording all results, plotting relay curves and plotting transformer magnetisation curves.

Files are stored on the USB key in the folder \TRTEST. A folder is then created in this using the day's date, and results files are named with the time of the test.

A comment can be entered to be stored with the results using a USB keyboard.

The following values are stored:

- Time
- Date
- Main output current
- Timer result
- Comment

#### 1.2.7.1 USB key

A standard USB flash memory key is used to store the results files. The unit has been tested with keys up to 16Gb in size.

Insert the USB key into the upper USB socket on the unit before starting to test. Most USB memory devices have an LED that indicates when the device is accessed. This will flash when a result is written.



Do not unplug the USB key whilst data is being written – data loss will result.

#### 1.2.7.2 Setting the clock

The output of the unit must be switched off to set the clock. Use an external USB keyboard to set the clock.

- Set the STORE RESULT switch to SET CLOCK.

hh:mm:ss	dd-mm-yy
10:13:24	15-12-08

- Use the ← and → keys to select which digit to change.
- Use the ↑ and ↓ arrows to change the selected digit.
- Use the ENTER button to save the changes to the clock.
- Use the green OFF button to cancel setting the clock.
- Set the STORE RESULT switch to OFF.

#### 1.2.7.3 Entering a comment

Each result is tagged with a comment when it is stored. The comment is entered by setting the store result control to “comment” and typing the comment using the optional USB keyboard.

The same comment is tagged to each result until the comment is updated, and the comment is erased when the unit is switched off.

Any USB keyboard can be used with the 750ADM.

The comment can be typed on the USB keyboard using the letters a-z, numbers 0-9 and punctuation marks. A maximum of 39 characters may be entered for the comment.

The following keys are also used:

Shift + a-z	Enter capital letter.
←→	Move cursor left/right.
Ins	Switch between overwrite and insert mode. By default the unit will overwrite the character to the right of the cursor when a new character is typed. Switching to insert mode will shift characters of the right of the cursor right when a new character is typed.
Enter	Accept the current comment.
Esc	Lose the changes made to the comment since entering comment mode and revert to the last comment entered.
⇐ (backspace)	Delete the character to the left of the cursor.
Del	Delete the character under the cursor.
→ (cursor right)	Move cursor one character to the right.
← (cursor left)	Move cursor one character to the left.
Shift+→	Move cursor to end of comment .
Shift+←	Move cursor to start of comment.
End	Move cursor to end of comment .
Home	Move cursor to start of comment.

The following keys have no effect: caps lock, shift lock, alt, Windows key, tab, ↑, ↓, page up/down, F1-F12.

#### 1.2.7.4 Auto-store

Set the STORE RESULTS switch to AUTO-STORE.

Set TIMER MODE to internal start, 1 contact, 2 contacts or current operated.

A result record is added to the current result file whenever the timer stops (this includes when the output is switched off in internal start mode).

If results are to be stored not dependant on the timer, set the timer mode to internal start, and press the OFF button for the main output when a result is to be stored.

Results are not stored when the timer is set to OFF. This allows the output current to be set without storing any results to the output file.

Pressing the ON while the output is already ON, will cause a snapshot to be written to the .csv file. An 'S01' will appear on the LCD screen and will increment each time the ON button is subsequently pushed until 'S99' or the OFF button is pushed.



The example below shows data stored when testing a relay.

```
750ADM,V1.3.12,C00,P1,A1,  
Time,Date,Main_A,Timer,Phase,Freq Hz,Aux Range,Comment  
02:09:58,27/02/24,0.340,3.276,0.000,0.000,100A,Comment - up to 39 characters,
```

#### 1.2.7.5 *Waveform storage*

Waveform storage mode allows the main output current and auxiliary input waveform to the USB memory key as a CSV file.

Set the STORE RESULTS switch to WAVEFORM.

Set TIMER MODE to internal start, 1 contact, 2 contacts or current operated.

The waveform is stored to the memory key whenever the timer stops or the output is switched off. It takes a number of seconds to write the waveform data to the memory key. Please be patient while the unit finishes writing the data.

A spreadsheet program (e.g Microsoft Excel or OpenOffice Calc) can be used to show the waveform graphically.

#### 1.2.7.6 *File formats*

##### **Results file format**

The results file is in CSV (comma separated value) format. The first line of the file details unit type, software version and configuration information. The second line specifies column headings for the data, and the third line onwards is data.

```
750ADM,V1.3.12,C00,P1,A1,  
Time,Date,Main_A,Timer,Phase,Freq Hz,Aux Range,Comment  
02:09:58,27/02/24,0.340,3.276,0.000,0.000,100A,Comment - up to 39 characters,
```

Double-clicking on a results file in MS Windows on a PC with a spreadsheet installed will open the file.

##### **Waveform file format**

The waveform file is in CSV (comma separated value) format.

The first line lists the time, date, and time between samples in ms (0.15=150us). The second line specifies column headings, and subsequent lines list one sample value for main output current in A. 1024 samples are stored.

```
02:14:41,27/02/24,Comment - up to 39 characters,Sample Time (ms),0.1562,  
Main,  
0.844,  
0.230,  
0.165,  
0.509,
```

-0.114,

0.165,

Double-clicking on a results file in MS Windows on a PC with a spreadsheet installed will open the file.

#### 1.2.7.7 *Viewing results*

The VIEW RESULTS setting allows the results from the current day to be displayed.

Ensure the main output is off. Set the STORE RESULTS switch to VIEW. The files to view can be scrolled through using AUX AC ADJ and the file to view opened using ➔. The results in the file can then be stepped through using AUX AC ADJ.

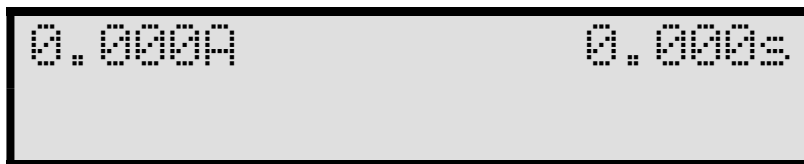
Press OFF to delete the current result. Changes are not saved after deleting a result until the ➔ key is pressed.

Navigate folders with the ↑, ↓, ← and ➔ arrows on the external USB keyboard. ESC will exit the current folder/file.

## 1.3 Displayed Values and Messages

### 1.3.1 Displayed Values

The 750ADM display simultaneously shows the injected test current, the timer mode and the timer result on a liquid crystal display. It also displays warning and error messages, detailed in section 1.3.2.



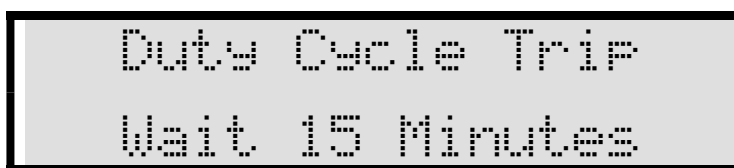
*Figure 1.3 Normal values displayed on screen*

### 1.3.2 Warning Messages

In addition to the normal display screens, the 750ADM can show a range of warning messages if the unit trips on over-current or duty cycle or is too hot internally. If an over current or duty cycle trip occurs, the user must wait 15 minutes to clear the trip condition. If the unit trips on over temperature, the unit will automatically reset when the temperature falls to an acceptable level. If the unit is over temperature, switching the unit off and back on will not clear the message – the unit must be allowed to cool.



*Figure 1.4 Over-current trip warning message*



*Figure 1.5 Duty cycle trip warning message*



*Figure 1.6 Unit over temperature warning message*

## 1.4 Overload Protection

The 750ADM is fitted with a range of over protection devices, listed in the table below.

Location	Protection
Mains supply	Circuit breaker
Contact circuits	Auto-resetting semiconductor fuses
Main output	Electronic over-current trip Electronic duty cycle trip Thermal protection Circuit breaker

## 1.5 Installation

The 750ADM is designed for use in an indoor industrial and electrical substation environment.

Maximum altitude: 2000m

Temperature: 0°C to 45°C operating  
-20°C to 60°C storage

Relative humidity: 90% non-condensing

Protection rating: IP40 lid closed  
IP20 in use

Before installation, a suitable mains connector must be connected to the 3-core mains input cable provided. The connector and supply must be rated for 16A. It is also essential to ensure that the unit is adequately earthed.



### WARNING

In substation environments the earth terminal on the front panel of the unit should be connected to a low impedance local earth.



### WARNING

Ensure that the unit is connected to an appropriate supply by a suitably rated connector.

## 2. OPERATION

This chapter describes how to use the different outputs and timing modes on the 750ADM. Details of testing specific relay types are given in the application notes section of this manual.

### 2.1 Main Output

The main output on the 750ADM is used to inject current or supply voltage to a test object to determine operating levels and trip times. The outputs are switched on and off using the “output on” and “output off” pushbuttons, and the voltage (and hence current) is set using the “main output control” knob.

Two outputs are provided to allow a wide range of currents to be injected into a range of load impedances.

For details of the ratings of the outputs see section 1.2.2.

A true RMS ammeter with 20, 50, 200 and 750A ranges meters the output current. The meter range is totally independent of the output selected, allowing any metering range to be used with either of the outputs. The ammeter has a fast capture time of 20ms and will accurately measure the rms of a single cycle. The metering range also sets an over-current trip to full scale +5% (e.g. 21A on the 20A metering range).

#### 2.1.1 Connecting the output leads



Before making any connections to the object under test, ensure that the system is dead and earthed.

WARNING

Ensure that the 750ADM is switched off at the mains before making any connections.



WARNING

Under no circumstances make or break the output circuit when the output is switched on or current is flowing. Arcs may be created if this is attempted.

The high current (750A) output uses twist-to-lock high current welding connectors. To connect the cable to the output terminal, insert the plug into the socket, ensuring that the key on the plug lines up with the slot on the socket. When the plug has been fully inserted, twist the plug clockwise to lock it in place and make a secure connection.



CAUTION

Ensure that the connector is firmly twisted before injecting any current. If the plug is loose in the socket, overheating may occur.



CAUTION

The output clamps that provide connection to the load may become hot when high currents are injected. Avoid touching the contact areas and contact end of the clamps after tests until the clamps have cooled.

To disconnect the plug from the socket, first twist the plug anti-clockwise and then withdraw it from the socket.

The low current output uses 4mm sockets. The 4mm common terminal is connected internally to the high current common terminal.

### 2.1.2 Current Injection Procedure (No Timing)

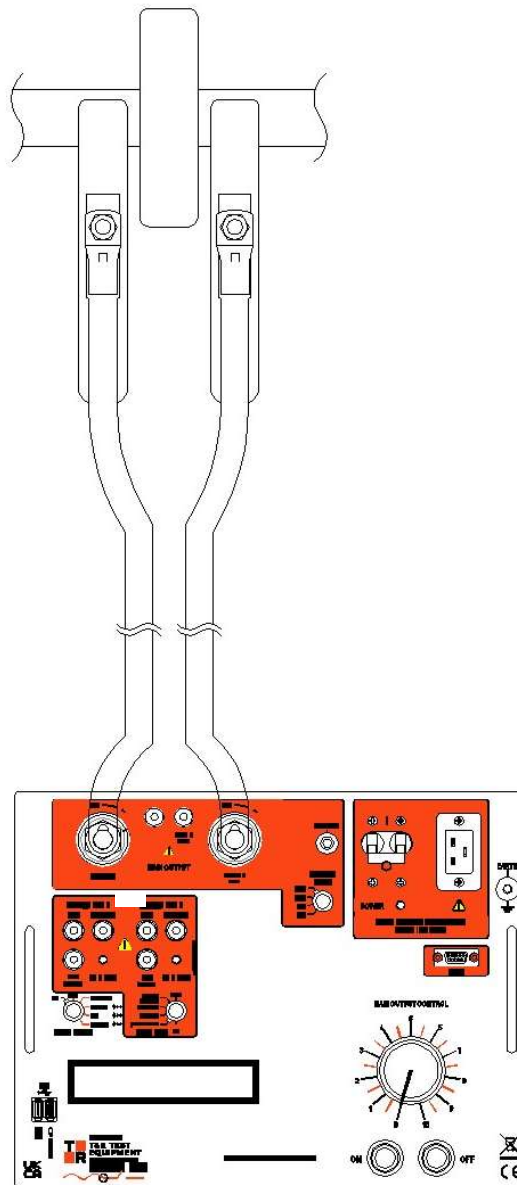
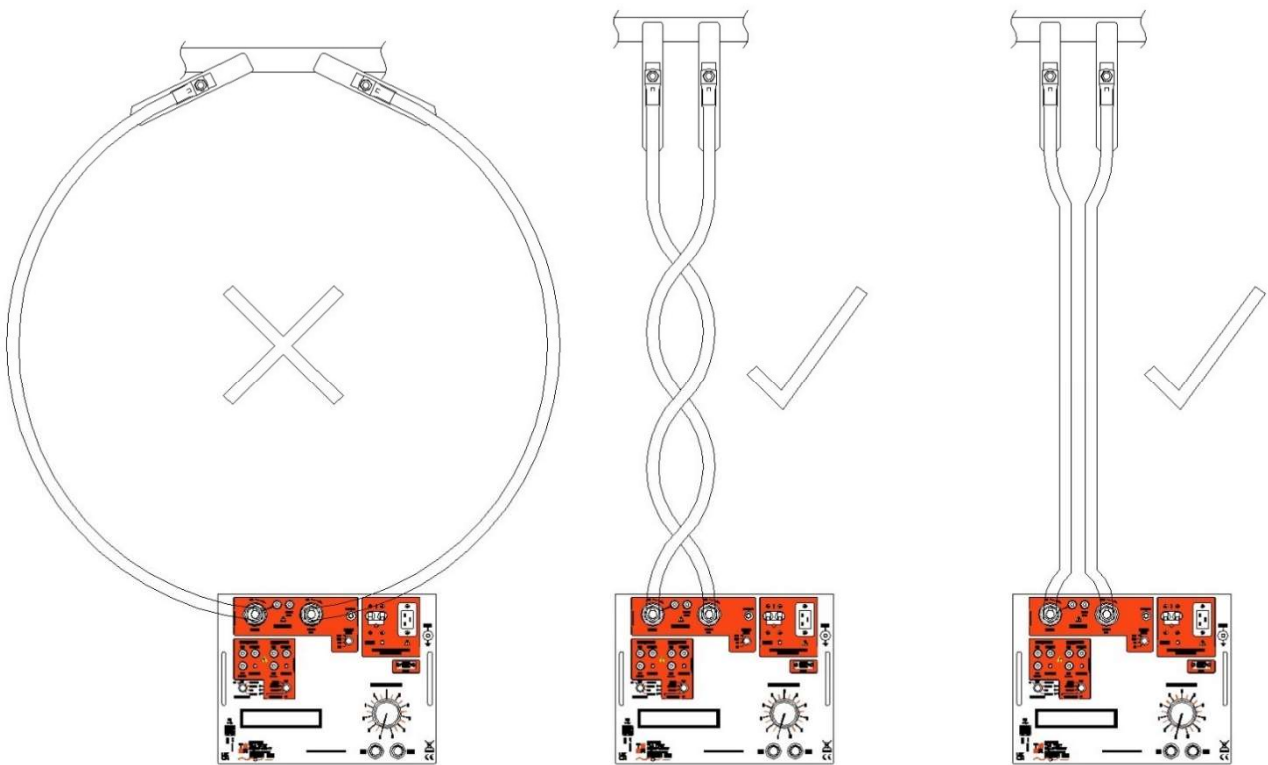


Figure 2.1 750ADM showing high current output connected to load

- Connect the test object to the desired output. An example connection is shown in figure 2.1 using the high current output.
- Set the “AMMETER RANGE” switch to a suitable setting.
- Set the output control to zero, and the timer mode switch to “Off”.
- Switch the output on using the “OUTPUT ON” pushbutton and increase the test current to the desired level.
- Switch the output off using the “OUTPUT OFF” pushbutton.

## 2.1.3 Maximising the Output Current

### 2.1.3.1 Output Lead Arrangement



*Figure 2.2 Maximising output current*

The output current of the 750ADM is limited by the impedance of the output lead set and load. Whilst it is not possible to alter the impedance of the load and the resistance of the leads, the inductance of the output circuit (and hence the ac impedance) may be kept to a minimum by keeping the high current leads as close together as possible as shown in figure 2.2. The best possible results are obtained by twisting the output leads together.

#### 2.1.3.1 1.5m Output Leads

When operating from a 115V supply or when the maximum possible current is required 1.5m output leads are recommended.

## 2.2 Timing System

The 750ADM timer is closely integrated with the main output. A summary of the start and stop events for the timer is shown in the table below.

Timer Mode	Timer Start Condition	Timer Stop Condition
Off	-	-
Internal Start	Main output on	Contact set 1 change
Single Contact	Contact set 1 change	Contact set 1 change
Dual Contact C1 1 <sup>st</sup> *	Contact set 1 change	Contact set 2 change
Dual Contact C2 1 <sup>st</sup> *	Contact set 2 change	Contact set 1 change
Current Operated	Current >20% of range	Current <10% of range
Pulse	Main output on	200ms

\*See section 2.2.5

The timer is automatically reset in every mode when the output is switched on. In each mode that the timer is active, the output of the unit must be switched on to arm the timer.

Each contact channel has a contact input for volt-free contacts and a Vdc input for dc voltages. The Vdc input may be used to trigger the timer from a dc voltage and will trigger from either the voltage switching from zero to 24-240Vdc or 24-240Vdc to zero. The voltage must be connected with positive to the red "Vdc" terminal and negative to the blue "com" terminal.

### 2.2.1 General Procedure for Timing Tests

To time the operation of any device a basic procedure needs to be followed to set the desired test current and to carry out the timing test.

- Connect the device under test to the output of the unit and to the contact inputs as required. For details of connection configurations, see the applications notes section.
- Set the timer to 'off' mode and the output control to zero. Switch on the output of the unit and increase the current or voltage to the desired level.
- Switch off the output of the unit and select the desired timer mode.
- Switch on the output of the unit. The timer will reset and start when the start condition is met.
- The timer will stop when the stop condition is met.



### **2.2.2    *Timer Mode: Off***

In the 'off' mode, the timer has no effect on the operation of the set, and the timer does not run. This mode is used to set the required current through the test object before a timing test.

### **2.2.3    *Timer Mode: Internal Start***

The internal start mode starts the timer when the main output is switched on and stops the timer on the first change of contact set 1. When the timer is stopped, the output of the unit is automatically switched off.

### **2.2.4    *Timer Mode: Single Contact***

In single contact mode, the timer starts on the first change of state of contact set 1 after the output is switched on and stops on the second change on contact set 1. The output is automatically switched off when the timer is started. The timer is reset when the output is switched on. This timer mode is ideally suited to timing auto-reclose relays.

If a single contact mode is required where the output remains on until the second change of contact, this may be achieved by using single contact mode with contact set 2.

### **2.2.5    *Timer Mode: Dual Contact***

Dual contact mode uses both contact set 1 and contact set 2. The time between C1 and C2 changing is always measured whether C1 or C2 changes first. If C1 changes first, the output switches off when the timer stops. If C2 changes first, the output switches off when the timer starts. In dual contact mode the timer will initially start when the output is switched on but will restart on the first contact change.

### **2.2.6    *Timer Mode: Current Operated***

Current operated mode is used to time devices that have contacts in series with the current sense element. This includes miniature circuit breakers and MCBs.

The timer is started when the output current exceeds 20% of full scale of the selected metering range and stops when the current falls below 10%. The timer is reset once the ON button is pushed. If the OFF button is pushed before current reaches the 20% threshold, the timer will display the previous time.

### **2.2.7    *Timer Mode: Pulse***

The pulse mode is used to set the current in devices that are sensitive to heating due to the test current. In this mode current is injected for 200ms when the ON switch is pressed. The current is captured and displayed.

### 3 APPLICATION NOTES – TESTING SPECIFIC DEVICES

This chapter gives details of how to test many common types of protection device using the 750ADM.



WARNING

Before making any connections to a relay, panel, or any other device under test ensure that the panel is isolated from the supply and earthed.

#### 3.1 Primary Injection of Over Current Relays

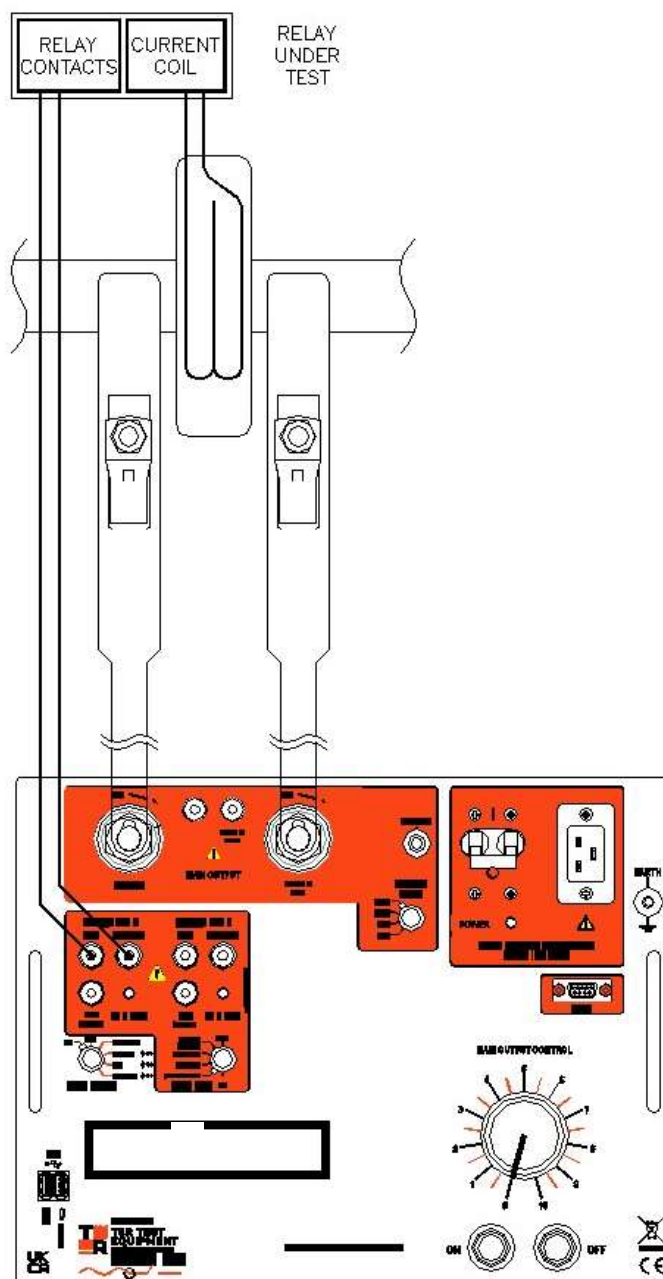


Figure 3.1 Primary injection of overcurrent relay

## 3.2 Secondary Injection of Over Current Relays

The configuration shown in figure 3.1 is suitable for testing over-current relays and will measure the time delay between the time when the “on” pushbutton is pressed and the time the relay trips.

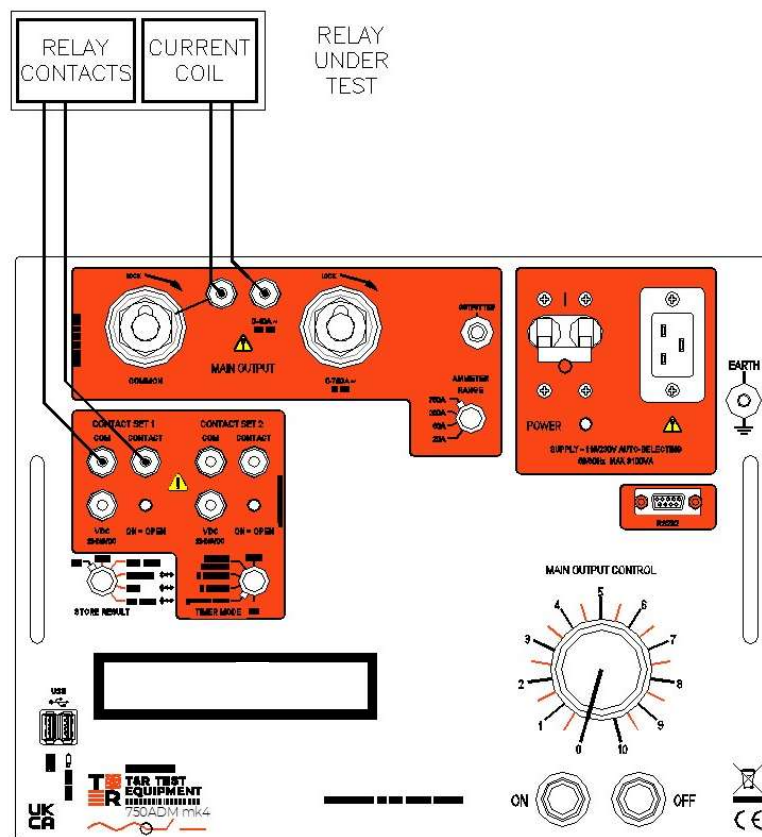


Figure 3.2 Connections for testing over-current relays



Do not use the 200A or 750A metering range when using the 40A output – only the 20A and 50A range afford the unit protection by setting a valid trip level for the output.

### 3.2.1 Connections

Ensure that the output is switched off and that the relay is isolated before making any connections.

Connect the relay contacts to contact set 1.

If the relay requires an auxiliary supply, identify the auxiliary supply connections on the relay and the voltage required. Set the correct voltage and connect the auxiliary DC supply to the relay.

Connect the relay coil to the 40A output and select either the 20A or 50A metering range.

### 3.2.2 Test Procedure

Set the output control to zero (anti-clockwise) and the timer mode to “off”.

Select the desired ammeter range.

Switch the auxiliary DC supply on.

Press the “output on” pushbutton and increase the current using the output control until the desired test current is reached.

Switch the output off using the “output off” pushbutton.

Select “internal start” timer mode and switch the output on. The unit now resets and starts the timer and starts injecting current into the relay. When the relay’s contacts change state, the timer will stop, and the output will be switched off automatically.

### 3.3 Timing of Auto-Reset/Reclosing Devices

Auto-reclosing devices require that the timer is started when power is removed from the device, and the timer stops when the contacts change state. This may be achieved using the single contact timer mode.

Figure 3.3 shows the relay connected for primary injection, but this test may also be carried out using the 40A secondary injection output.

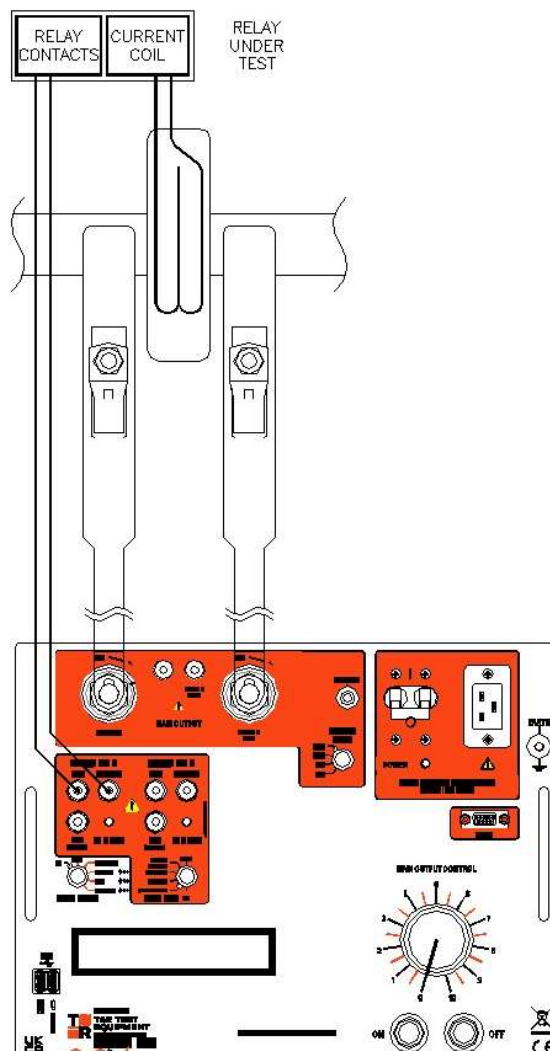


Figure 3.3 Connections for testing auto-reclose devices

#### 3.3.1 Connections

Ensure that the outputs are switched off and that the relay is isolated before making any connections.

Connect the relay contacts to contact set 1.

If the relay requires an auxiliary supply, identify the auxiliary supply connections on the relay and the voltage required. Set the correct voltage and connect the auxiliary DC supply to the relay.

Connect the main output as shown in figure 3.3, selecting the most appropriate output tap for the relay under test.

### **3.3.2 Test Procedure**

Set the main output control to zero (anti-clockwise) and the timer mode to “off”.

Switch on the main output and increase the output to the desired level.

Switch off the main output.

Switch the timer to “single contact” mode and reset the relay.

Switch the main output on. The output will be switched off and the timer will start when the relay trips. The timer will stop when the relay auto-resets.

### 3.4 Timing Circuit Breakers with No Auxiliary Contacts)

Testing CBEs, MCBs, MCCBs and other devices with no auxiliary contacts is possible using the current operated timer mode on the 750ADM. This mode starts the timer when the output current exceeds 20% of the selected current range and stops the timer when the current falls below 20% of range.

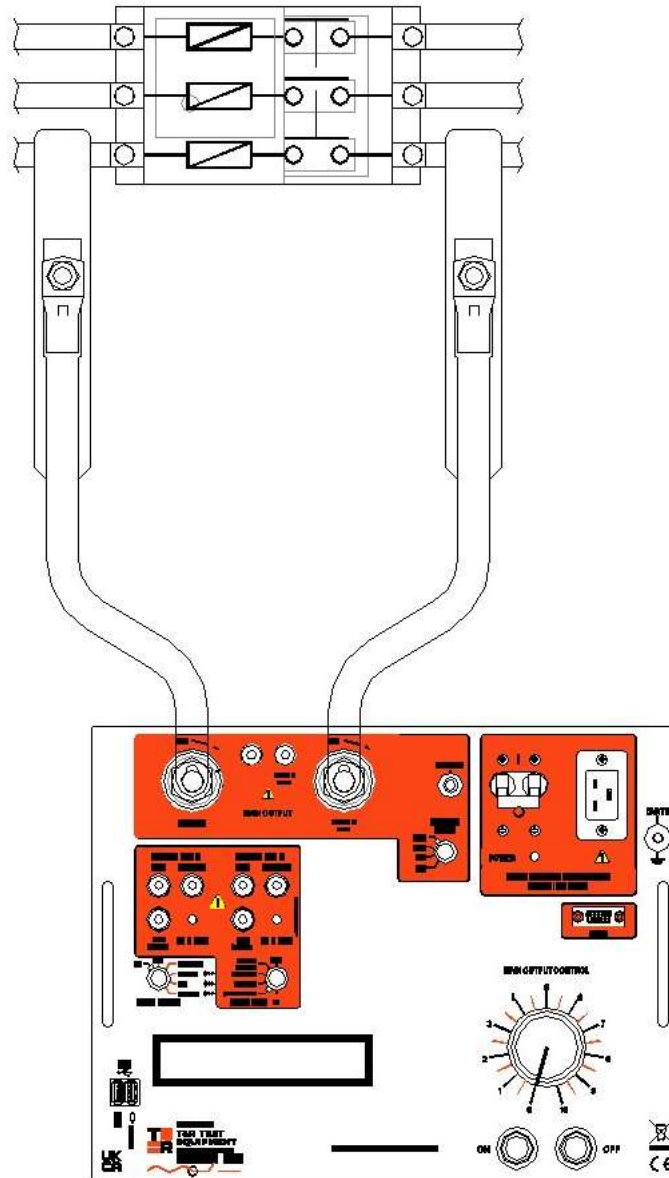


Figure 3.4 Connections for testing circuit breakers

#### 3.4.1 Connections

Ensure that the outputs are switched off and that the device under test is isolated and earthed before making any connections.

Connect the main output as shown in figure 3.4. The 750ADM is shown connected to one phase of a three-phase circuit breaker in figure 3.4.

Set the ammeter switch to the most suitable range.

### **3.4.2    *Test Procedure***

Set the main output control to zero (anti-clockwise) and the timer mode to “off”.

Switch on the main output and increase the output to the desired level. It may be desirable to use pulse mode to set the current to reduce heating in the device under test.

Switch off the main output.

Switch the timer to “current operated” mode and reset the breaker if it has tripped.

Switch the main output on. The timer will start when current starts flowing in the device under test and will stop when the device trips.

### **3.4.3    *Devices with Short Trip Times***

When testing devices with short trip times (such as thermal circuit breakers at high over-current factors), setting the current may cause the breaker to trip. In such circumstances, set the current using pulse mode. In this mode, current will be injected for 200ms and the current logged every time the “output on” button is pressed.

When the correct current has been set, the unit can then be switched to current operated mode to time the operation of the device.



### 3.5 Using the 750ADM as a Stand-Alone Timer (Single Contact)

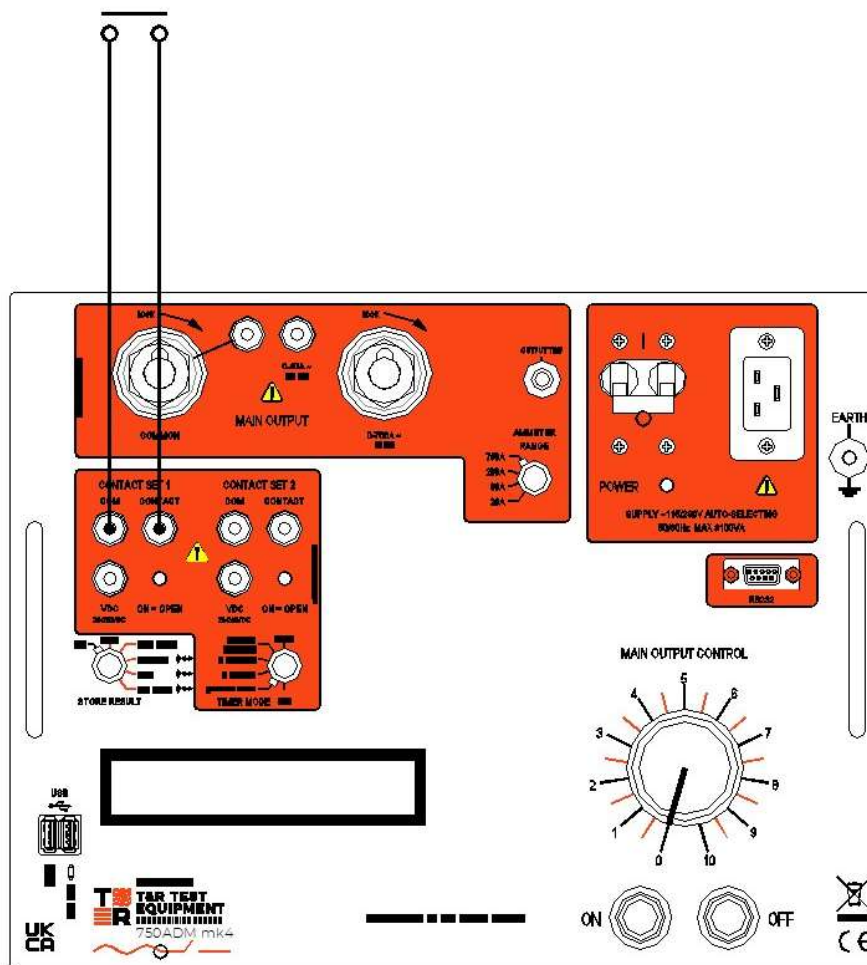


Figure 3.5 Single contact timer

#### 3.5.1 Timer Mode

Single contact

#### 3.5.2 Connections

Connect contact to be timed to contact set 1.

#### 3.5.3 Test Procedure

Switch on the main supply switch.

Set timer mode switch to the single contact position.

Ensure that the output regulator is in the zero position and reset the timer.

Press output on push-button. The timer system is now armed and will start when contact set 1 changes state (i.e. open to closed or vice-versa).

The timer will stop when the contacts return to their original state.

### 3.6 Using the 750ADM as a Stand-Alone Timer (Dual Contact)

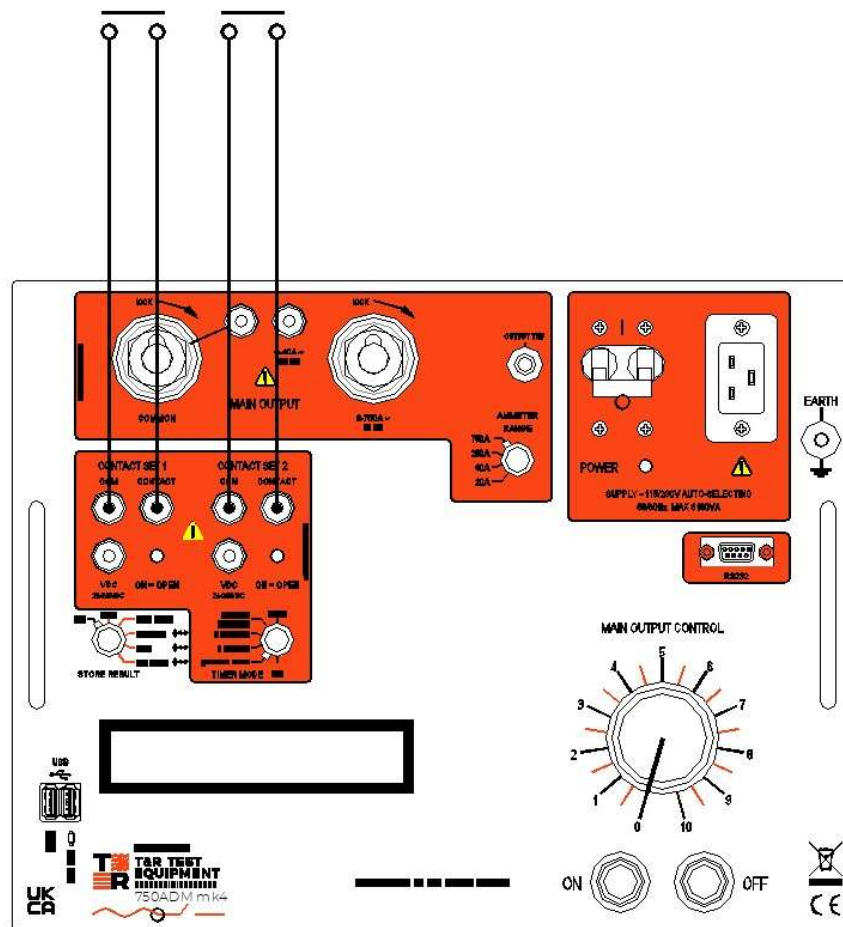


Figure 3.6 Dual contact timer

#### 3.6.1 Timer Mode

Dual contact

#### 3.6.2 Connections

Connect contact to start timer to contact set 1.

Connect contact to stop timer to contact set 2.

#### 3.6.3 Test Procedure

Switch on the main supply switch.

Set timer mode switch to the dual contact position.

Ensure that the output regulator is in the zero position and reset the timer.

Press output on push-button. The timer system is now armed and will start when contact set 1 changes state (i.e. open to closed or vice-versa).

The timer will stop when contact set 2 changes state.

## **4. MAINTENANCE**

**Before removing the unit from its case, ensure that the unit is disconnected from the mains. Under no circumstances connect the unit to the mains whilst it is removed from its case.**

### **4.1 Variable Transformer Brush**

The variable transformer brush should be examined and replaced if necessary. The interval between inspection and renewal of the brushes will depend upon the amount of usage. However, it should be remembered that damage to the variable transformer can result if the brush is allowed to wear away to such an extent that a loss of brush pressure occurs.

### **4.2 Removal of the 750ADM from Case**

To remove the instrument from its case, the following procedure should be used: -

- a. Remove the lid from the case and place the unit on its face such that it is resting on the handles on the front panel.
- b. Remove the four fixing screws from the base of the unit.
- c. Lift the case from the unit.
- d. Disconnect the earth lead from the case.

To re-assemble the unit, reverse the process.

## **5. STANDARD ACCESSORIES**

### **5.1 Standard Accessories Supplied**

- a. Mains input lead.
- b. Operating & Maintenance Manual

## 6. OVERALL PERFORMANCE SPECIFICATION

### 6.1. Insulation Resistance at 1000V DC

The insulation resistance will not be less than 10 megohms between mains input to frame and all isolated outputs, and all combinations of isolated output to isolated output.

### 6.2. Applied Voltage Test

Mains input to frame: 2.0kV RMS for 1 minute.

All combinations of isolated output to isolated output and isolated output to frame:  
1.0kV for 1 minute

### 6.3. Accuracy of Instrumentation and associated circuit components

#### 6.3.1 Main Output Ammeter

	Range	Resolution	Accuracy
True rms ac current	20.00A	0.01A	$\pm 0.5\%$ rdg $\pm 5d$
True rms ac current	60.00A	0.01A	$\pm 0.5\%$ rdg $\pm 5d$
True rms ac current	200.0A	0.1A	$\pm 0.5\%$ rdg $\pm 5d$
True rms ac current	750A	1A	$\pm 0.5\%$ rdg $\pm 2d$

#### 6.3.2 Timing System

Timer mode	Range	Resolution	Accuracy
Internal start	0-999.999s/ 9999.99s/ 99999.9s	1ms/ 10ms/ 100ms	$\pm 0.01\%$ rdg $\pm 2d$
Single contact	0-999.999s/ 9999.99s/ 99999.9s	1ms/ 10ms/ 100ms	$\pm 0.01\%$ rdg $\pm 2d$
Dual contact	0-999.999s/ 9999.99s/ 99999.9s	1ms/ 10ms/ 100ms	$\pm 0.01\%$ rdg $\pm 2d$
Current operated	0-999.999s/ 9999.99s/ 99999.9s	1ms/ 10ms/ 100ms	$\pm 0.01\%$ rdg $\pm 4d$
Pulse mode	200ms	1ms	$\pm 2ms$



## 7. REVISION

Product / Type: Secondary Current Injection Test Set / 750ADM mk4

File: OM0043

Author: M. Clancy

Issue / Date: 1 / 05.03.2024

Modified By: M. Clancy

Checked By: G Biggs	Date: 06/03/24
---------------------	----------------

Drawings Required

A3/002269 latest issue