

OPERATING AND MAINTENANCE MANUAL

Product: ***Primary Current Injection***
Type: *PCU1/E MK3 CONTROL UNIT*
LU500 LOADING UNIT
LU1000 LOADING UNIT
LU2000 LOADING UNIT
LU3000 LP LOADING UNIT

DESIGNED AND MANUFACTURED BY:

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GENERAL SAFETY STATEMENT

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.

Hazardous voltages and currents are present on the outputs of this unit.

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.

Ensure that the product is grounded. To avoid electric shock it is essential that the grounding conductor is connected to the earth ground. If an additional earth terminal is provided on the equipment that may be connected to a local earth. Ensure that the product 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

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:

T & R Test Equipment Limited

CONTENTS

1. Description of Equipment
2. Operation of Equipment
3. Maintenance Instructions
4. Standard Accessories
5. Overall Performance Specification
6. Calibration Results
7. Test Certificate
8. Revision

1. DESCRIPTION OF EQUIPMENT

- 1.1 Electrical Specification
- 1.2 Variable Voltage Supply
- 1.3 Variable Secondary Current Supply
- 1.4 Variable Primary Current Supply
- 1.5 Timer Control
- 1.6 Output Controls
- 1.7 Construction

1.1 Electrical Specification

1.1.1 The supply voltage for the equipment is 240 volts, single phase, 50/60Hz. The input will tolerate the following voltage variation:

240V +10% and -6%

1.1.2 The maximum power supply requirements will be 7.2kVA.

1.1.3 The current outputs which are obtainable from the PCU1/E control unit are as follows:

Voltage	Current 1	Current 2
0-10V	25A	50A
0-5V	50A	100A
0-240V	15A	30A

Output current duty cycles:

Current 1 Continuously rated

Current 2 5 minutes ON load followed by 15 minutes OFF load

1.1.4 The output currents which are obtainable from the loading units are as follows:

LOADING UNIT TYPE	VOLTAGE	CURRENT 1	CURRENT 2
LU500 (parallel connection)	4V	250A	500A
LU500 (series connection)	8V	125A	250A
LU1000 (parallel connection)	4V	500A	1000A
LU1000 (series connection)	8V	250A	500A
LU2000 (parallel connection)	3.3V	1000A	2000A
LU2000 (series connection)	6.6V	500A	1000A
LU3000LP (parallel connection)	2.1V	1500A	3000A
LU3000LP (series connection)	4.2V	750A	1500A

Current 1 Continuously rated

Current 2 5 minutes ON load followed by 15 minutes OFF load

1.1.5 The maximum voltage appearing on the relay contact test sockets (C1 and C2) is 24V DC. The maximum current flowing in the test circuit when the relay contacts are connected will be 0.13A DC. The contact test circuits are fully isolated.

Note: The contacts may be (when open) reversed biased to a maximum of 220V DC. The polarity of the DC bias must be positive to red terminal, negative to blue terminal. This DC voltage, if present, has no effect on the circuit operation.

1.1.6 Contact set C1 has a DC voltage level operation option, using terminal marked V DC positive to red terminal (Vdc), negative to blue terminal.

Note: This circuit connection responds only to the voltage level change. See section 2.3.10. Figure 3i for additional information.

1.2 Variable Voltage Supply

- 1.2.1 The variable output voltage mode of operation from the PCU1/E control unit is selected by means of an output selector switch which is located on the right-hand side of the control panel. (See **Section 2 Figure 1**)
- 1.2.2 The variable voltage supply is controlled from zero by means of a variable ratio auto transformer located in the PCU1/E control unit. The output voltage is increased by moving the regulator control knob in a clockwise direction.
- 1.2.3 The output terminals for the variable voltage supply are coloured brown and blue, and are located on the right-hand side at the top of the control panel. (See **Section 2 Figure 1**)
- 1.2.4 The output voltage is metered by a single scale voltmeter which is located on the front panel of the instrument.
- 1.2.5 The current drawn from the variable voltage output is monitored by a dual scaled ammeter. The maximum current that can be drawn is 30A. The ammeter scale factors are as follows:

Range	Scale factor
100A	x 0.25

1.3 Variable Secondary Current Supply

1.3.1 The variable secondary current output, which is obtained from the PCU1/E control unit, is selected by the output selector switch located on the front panel. The output is also fully isolated from the supply.

1.3.2 The output terminals, which are coloured black, are located on the front panel of the PCU1/E control unit. The terminals are marked as follows:

COMMON 100A 50A

The **common** terminal is used always and the operator has the choice of either a **50A** or a **100A** output.

1.3.3 The output current from each range is monitored by the PCU1/E control unit's ammeter. The correct ammeter range is automatically selected depending on which output, i.e 50A or 100A, is selected by the operator.

1.3.4 The following table summarises the secondary current output supply from the PCU1/E control unit:

Output Range:	50A	100A
Output Terminals:	COMMON - 50A	COMMON - 100A
Maximum Current:	50A	100A
Output Voltage:	10V	5V
Ammeter Scale Factors:	x 0.5	x 1 (100A scale)

1.4 Variable Primary Current Supplies

1.4.1 There are 4 sizes of standard output primary loading unit. These units are summarised in the following table:

TYPE:	LU500	LU1000	LU2000	LU3000LP
RANGE 1 CURRENT:	500A	1000A	2000A	3000A
RANGE 1 VOLTAGE:	4V	4V	3.3V	2.1V
RANGE 2 CURRENT:	250A	500A	1000A	1500A
RANGE 2 VOLTAGE:	8V	8V	6.6V	4.2V

NOTE 1: The duty cycle for the output currents stated above is as follows:
5 minutes ON load followed by 15 minutes OFF load.

NOTE 2: The continuous current rating of each unit and on each current range is 50% of the current ratings stated above.

1.4.2 The output current of each loading unit is monitored by the ammeter in the PCU1/E control unit. The ammeter scale factors are as follows:

TYPE:	LU500	LU1000	LU2000	LU3000
RANGE 1 scale factor:	x 5	x 10	x 20	x 30
RANGE 2 scale factor	x 2.5	x 5	x 10	x 15

The above scale factors refer to the 100A scale on the PCU1/E's ammeter. The 30A scale can be used for the LU3000LP loading unit giving scale factor of x100 and x50 for range 1 and 2 respectively.

1.4.3 The heavy current output terminals are located on the top panel of the loading unit together with the RANGE 1 and RANGE 2 connection links. Each terminal is clearly marked. (See **Section 2** regarding link changes for RANGE1 and RANGE 2)

1.4.4 When the output selector switch is moved to the **external** position the ammeter in the PCU1/E control unit will monitor the output current from the external loading unit.

NOTE: If the metering cable is not connected between the PCU1/E control unit and the external loading unit, the ammeter will not function and the output contactor in the control unit will fail to energise when the output **ON** push-button is pressed. The metering cable between the control and external loading unit acts as an interlock circuit.

1.5 Timer Control

1.5.1 The PCU1/E is fitted with a multifunction quartz locked timer system which is linked to the main output control. The timing system has 4 main functions. These functions are selected by a 6 position timer mode switch. For all timing/contact configurations see **Section 2**.

1.5.2 The timer control system will automatically de-energise the main output once the device under test has operated in all modes of operation.

1.5.3 The timer system has the following specification:

Range: 0-999.999 seconds

Resolution: 0.001 seconds

Accuracy: Contact mode ± 2 ms

Current mode ± 3 ms for test currents 20-40% on each range

Current mode +3ms or -1ms for test currents 40-100% on each range

NOTE: Timing results obtained with test currents below 20% of the selected ammeter range or measured times of 19ms and below are of doubtful accuracy and should be ignored.

1.5.4 The PCU1/E has 2 contact control circuits which are designated **C1** and **C2**. each circuit have the following characteristics:

- a. Red and blue 4mm sockets for external contact connection.
- b. LED contact status indication which will give:
LED ON for normally open contact
LED OFF for normally closed contact.
- c. Each contact circuit will automatically select for normally open or normally closed contacts.
- d. The external contacts may be voltage free or may have a DC voltage applied (220V DC maximum).

NOTE: When connecting live relay contacts to the PCU1/E due care and attention must be strictly observed. It is advisable to connect the PCU1/E first followed by the contacts.

1.6 Output Control

- 1.6.1 The desired output from the equipment is selected by means of an output selector switch which is located on the front panel of the PCU1/E control unit. (See **Figure 1**)
- 1.6.2 Once the desired output is selected it is controlled by the illuminated **ON** and **OFF** push-buttons which are located on the front panel of the PCU1/E control unit. (See **Figure 2**)
- 1.6.3 The selected output is automatically switched off by one of the following actions:
- a. Depressing the output OFF push-button.
 - b. By the change of state of the external contacts, when in contact mode of timer operation.
 - c. By the change of state of the external Vdc, when in voltage mode of timer operation.
 - d. Collapse of output current, when in current operated mode of timer operation.
 - e. By depressing the timer master reset control, In contact mode only, In this case the timer will also be reset to zero.

1.7 Construction

- 1.7.1 The PCU1/E control unit is housed in a robust steel case. The unit is also mounted on rubber feet for maximum protection. The front panel is protected by a steel cover which is fixed and hinged to the main case. The unit is also fitted with stainless steel handles at each end of the main chassis.
- 1.7.2. The external loading units (Types LU500, LU1000, LU2000 and LU3000LP) are housed in steel cases which are similar in construction to the PCU1/E control unit. However, these external loading units are not fitted with a protective cover.

2. OPERATION

2.1. Front Panel Control Functions

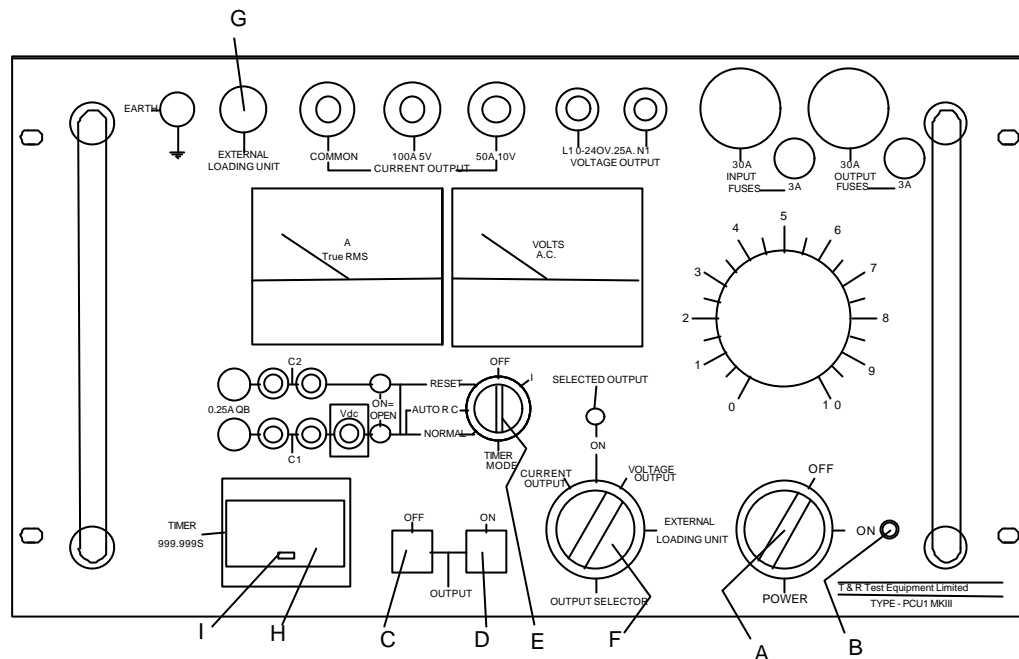
2.2. Connections

2.3. Method of Operation

2.2 Front Panel Control Functions

2.2.1	ITEM	FUNCTION
	Supply ON/OFF switch	To isolate both supply leads from the mains supply.
	Supply ON lamp (RED)	To indicate supply is connected, the ON/OFF switch is closed, and that the supply fuse is healthy.
	Output OFF illuminated push-button (GREEN)	Indicates output is OFF. Switches OFF output when pressed.
	Output ON illuminated push-button (RED)	Indicates output is ON. Switches ON output when pressed.
	Timer mode switch	This 5 position switch selects the method of timer/output control.
	Timer master reset push-button	When depressed this push-button will reset the timer display to zero. When the timer mode switch is set to any of the contact modes, i.e. normal, auto re-close and reset, the push-button will also switch off the main output.
	Output selector switch	Selects the desired output from the PCU1/E.

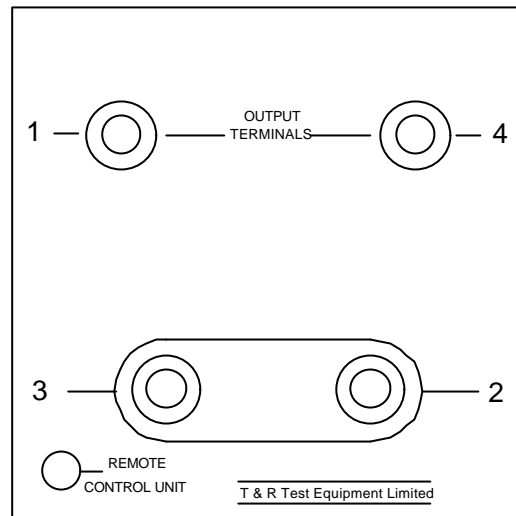
Figure 1 Front Panel Layout - PCU1/E control unit



- A. Supply ON/OFF switch
- B. Supply ON lamp
- C. Output OFF push-button
- D. Output ON push-button
- E. Timer mode switch
- F. Output selector switch
- G. External metering input socket
- H. Electronic timer
- I. Timer reset push-button

Figure 2A Front Panel Layout - External loading unit

Output shown connected in series



Link connections as follows:

Terminal 3 is linked to Terminal 2

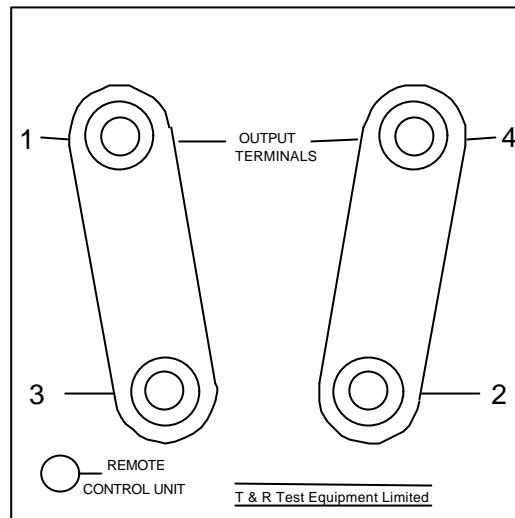
Output connections as follows:

Terminal 4

Terminal 1

Figure 2B Front Panel Layout - External loading unit

Output shown connected in parallel



Link connections as follows:

Terminal **2** is linked to Terminal **4**

Terminal **3** is linked to Terminal **1**

Output connections as follows:

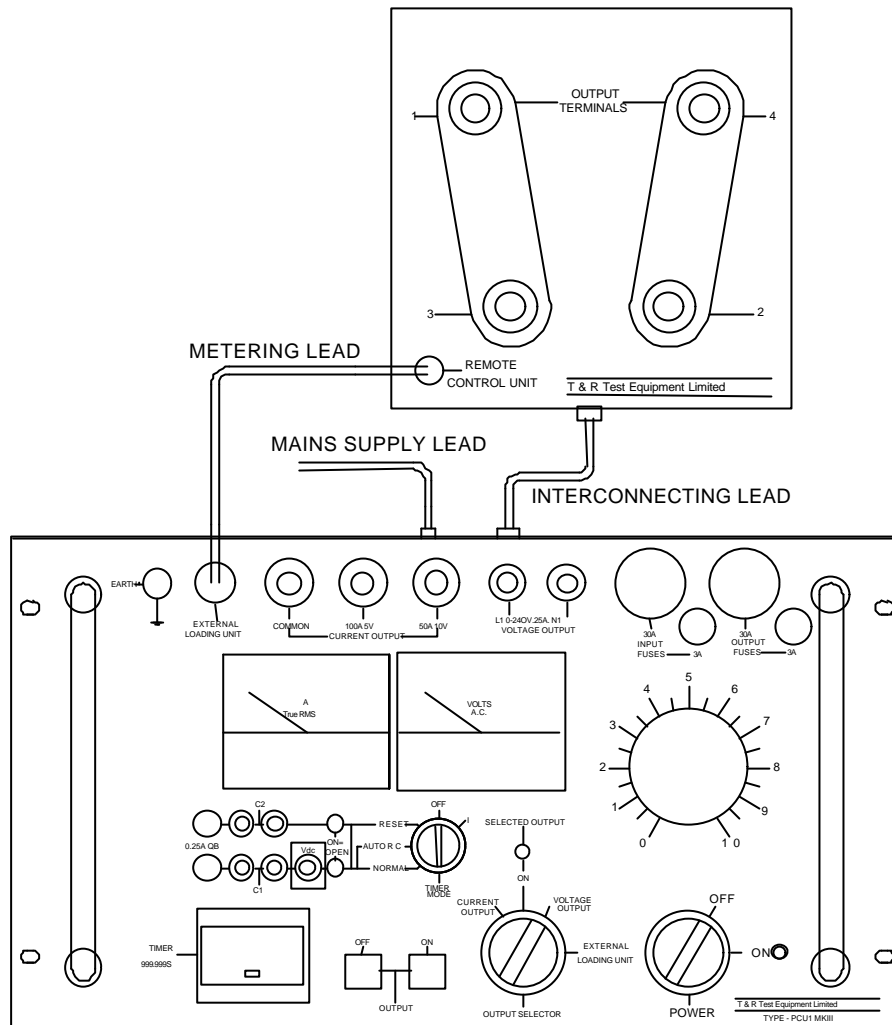
Terminal **1**

Terminal **4**

2.3 Connections and Timing Functions

- 2.3.1 **Figure 3a** gives the complete connection layout when using the external loading unit.
- 2.3.2 The following figures give the connections and associated timing functions for various relay types.
- 2.3.3 **Figure 3b** Over current and over voltage relays
- 2.3.4 **Figure 3c** Under current and under voltage relays
- 2.3.5 **Figure 3d** Reset timing inductive disc relays
- 2.3.6 **Figure 3e** Timing of auto-reset/reclosing devices
- 2.3.7 **Figure 3f** Timing devices with no auxiliary contacts
- 2.3.8 **Figure 3g** Connection method when using the PCU1/E as a digital timer only (Single contact operation)
- 2.3.9 **Figure 3h** Connection method when using the PCU1/E as a digital timer only (Dual contact operation)
- 2.3.10 **Figure 3i** Connections and function of Vdc socket on C1 contact set

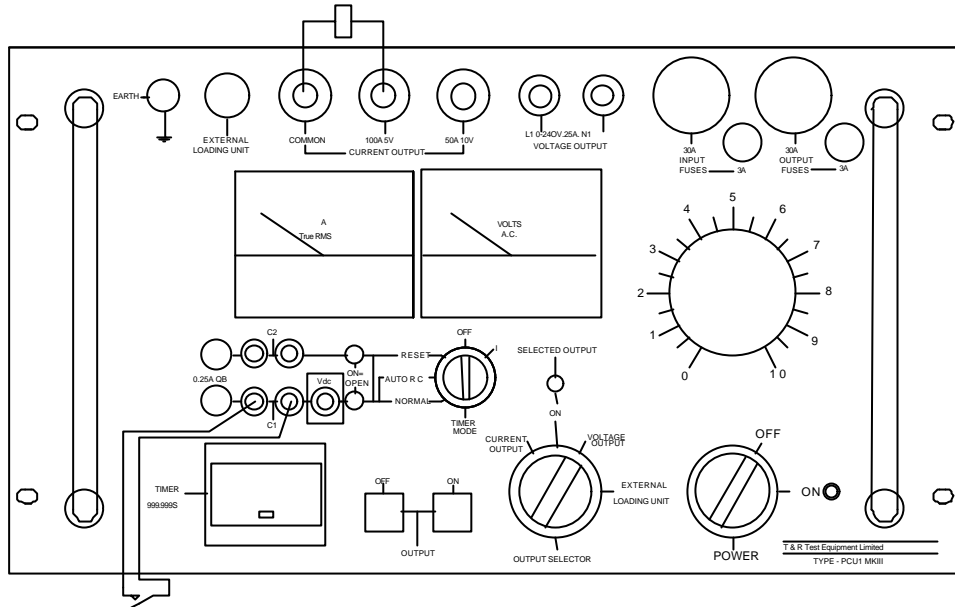
Figure 3a Overall connection scheme



IMPORTANT NOTE:

Should the supply ground/earth be of doubtful integrity it is advisable to connect a separate ground lead to the earth terminal on the PCU1/E which in turn should be connected to a good local earth/ground of low impedance.

Figure 3b Over current and over voltage relays



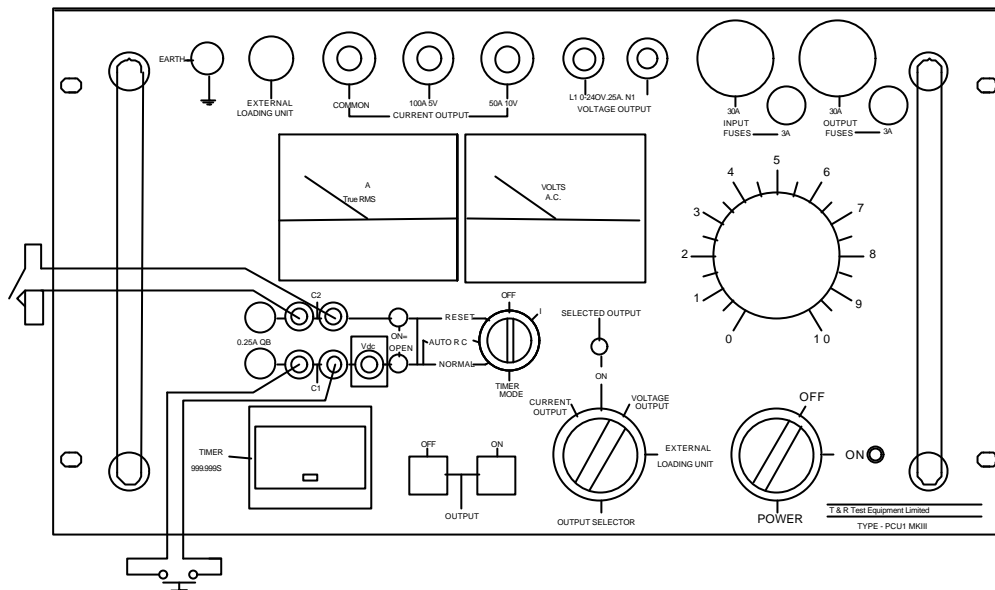
CONNECTIONS

1. Timer mode switch setting to **NORMAL**.
2. Relay contacts to **C1**.
3. Relay coil to the desired output.

TEST PROCEDURES

1. Switch on the main supply switch.
2. Select timer mode switch to the **OFF** position.
3. Ensure that the output regulator is in the zero position.
4. Select the desired ammeter range.
5. Check that connections are made as above.
6. Press output ON push-button and adjust output regulator until the desired output level is indicated.
7. Press output OFF push-button.
8. Select **NORMAL** position on the timer mode switch and ensure timer is reading zero.
9. Press output ON push-button.
10. Relay will trip after a set time, which will be displayed on the timer, and the output will be switched off automatically.

Figure 3c Under current and under voltage relays



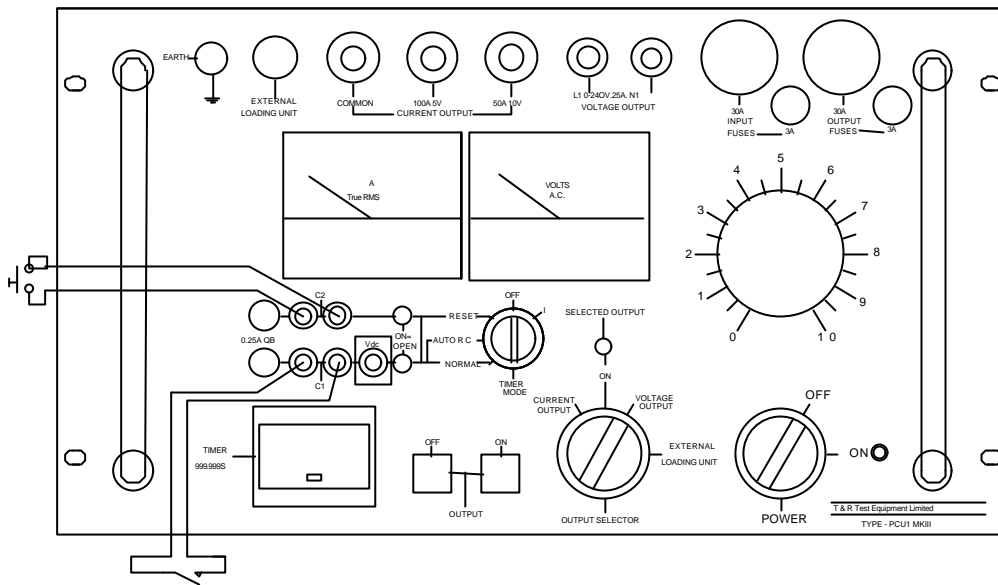
CONNECTIONS

1. Timer mode switch setting to **RESET**.
2. Relay contacts to **C2**.
3. Remote start button to **C1**.
4. Relay to the desired output.

TEST PROCEDURES

1. Switch on the main supply switch.
2. Select timer mode switch to the **OFF** position.
3. Ensure that the output regulator is in the zero position.
4. Select the desired ammeter range.
5. Check that connections are made as above.
6. Press output ON push-button and adjust output level until the relay picks up.
7. Press output OFF push-button.
8. Select **RESET** position on the timer mode switch and ensure the timer is reading zero.
9. Press output ON push-button and relay will pick up.
10. Depress remote start push-button.
11. Relay will trip and the time will be displayed on the timer when the relay under test reaches the alarm position.

Figure 3d Reset timing inductive disc relays



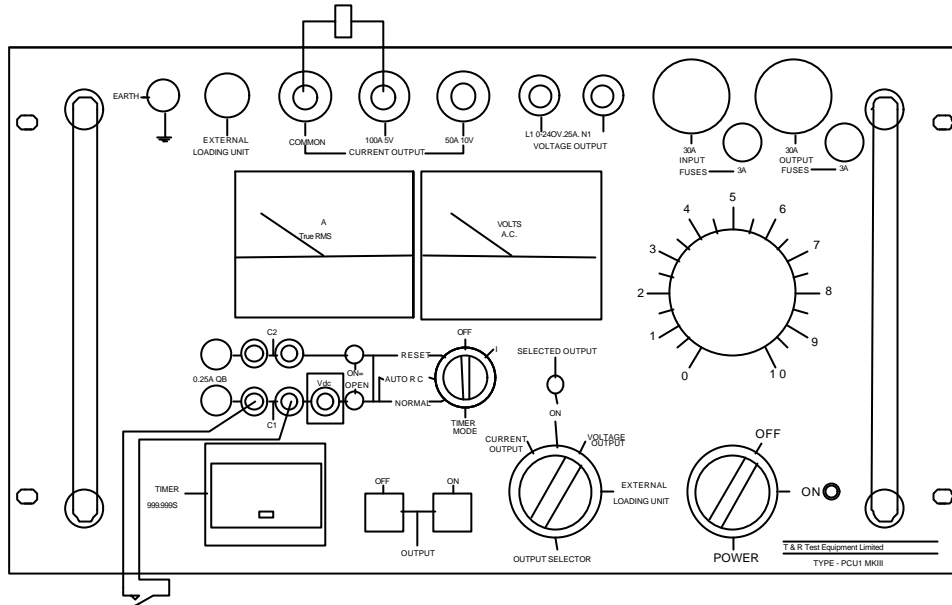
CONNECTIONS

1. Timer mode switch setting to **RESET**.
2. Relay contacts to **C1**.
3. Remote start button to **C2**.
4. Relay coil to the desired output.

TEST PROCEDURES

1. Switch on main supply switch.
2. Select timer mode switch to the **OFF** position.
3. Ensure the output regulator is in the zero position.
4. Select the desired ammeter range.
5. Check that connections are made as above.
6. Press output ON push-button and adjust output to the desired level.
7. Press output OFF push-button.
8. Select **RESET** position on the time mode switch and ensure the timer is reading zero.
9. Press output ON push-button.
10. The relay will energise and on reaching the trip position will start the timer and switch off the output.
11. When the disc returns to the rest position press the remote push-button. This will stop the timer and the reset time of the relay will be displayed.

Figure 3e Timing of auto-reset/reclosing devices



CONNECTIONS

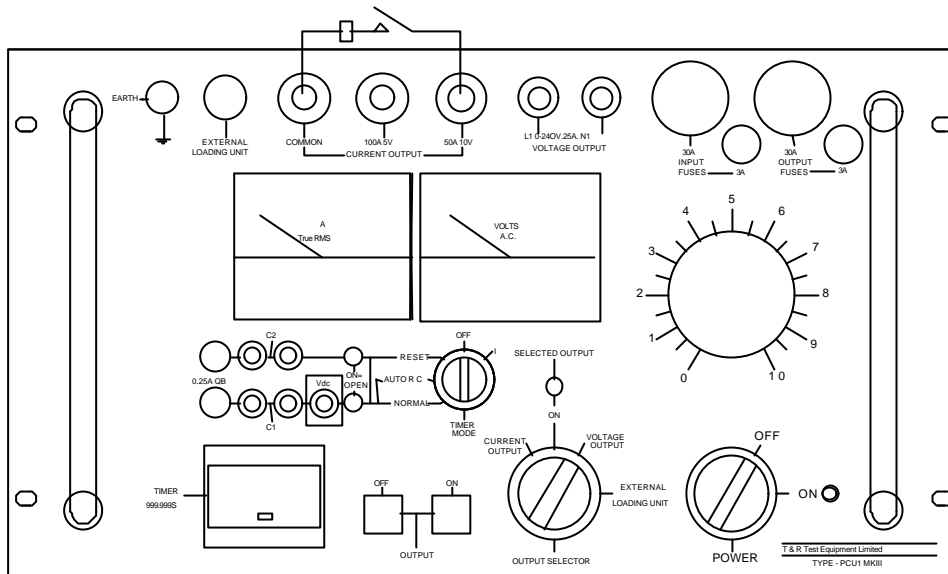
1. Timer mode switch setting to **AUTO R.C**
2. Relay contacts to **C1**.
3. Relay coil to desired output.

TEST PROCEDURES

1. Switch on main supply switch.
2. Select timer mode switch to the **OFF** position.
3. Ensure the output regulator is in the zero position.
4. Select the desired ammeter range.
5. Check that connections are made as above.
6. Press output ON push-button and adjust output to the desired level.
7. Press output OFF push-button.
8. Select **AUTO R.C** position on the timer mode switch and ensure the timer is reading zero.
9. Press output ON push-button.
10. Relay will energise and, on reaching the trip position, will start the timer and switch off the output.
11. Once the relay auto-resets the timer will stop thus displaying the dwell time.

NOTE: Timings of less than 19ms are of doubtful accuracy and should be ignored.

Figure 3f Timing devices with no auxiliary contacts



CONNECTIONS

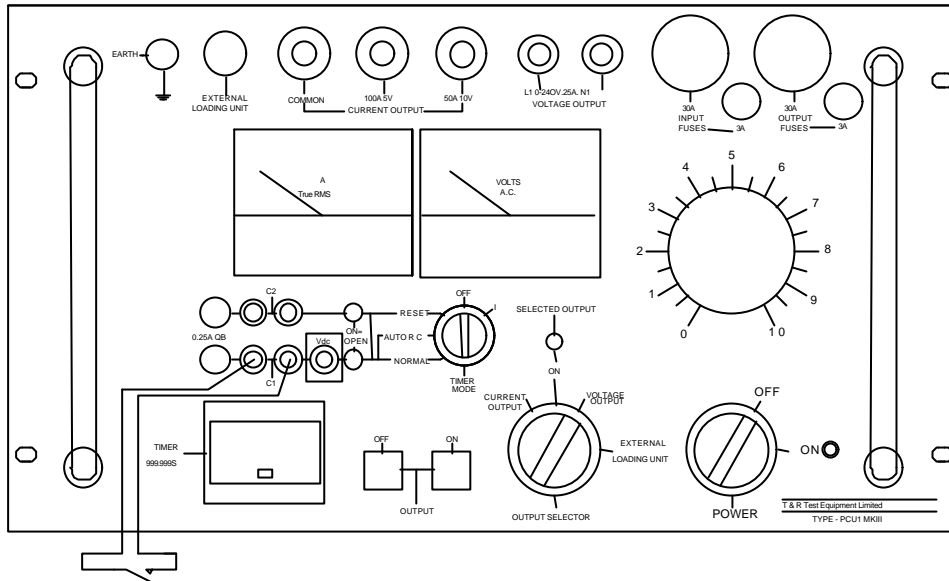
1. Timer mode switch setting to **I**.
2. Connect the device to the desired output.

TEST PROCEDURES

1. Switch on the main supply switch.
2. Select timer mode to the **OFF** position.
3. Ensure that the output regulator is in the zero position.
4. Select the desired ammeter range.
5. Check that the connections are made as above and that the device is closed.
6. Press output ON push-button and adjust to the desired output level.
7. Press output OFF push-button.
8. Select **I** position on the timer mode switch and ensure the timer is reading zero.
9. Press the output ON push button.
10. Current will now flow through the device.
11. Once the device has tripped the timer will stop and the output will be switched off.

NOTE: Timing results obtained with test currents below 20% on each ammeter range, and on measured times of 19ms and below, are of doubtful accuracy and should be ignored.

Figure 3g Connection Method When Using PCU1/E as a Separate Timer (Single contact operation)



CONNECTIONS

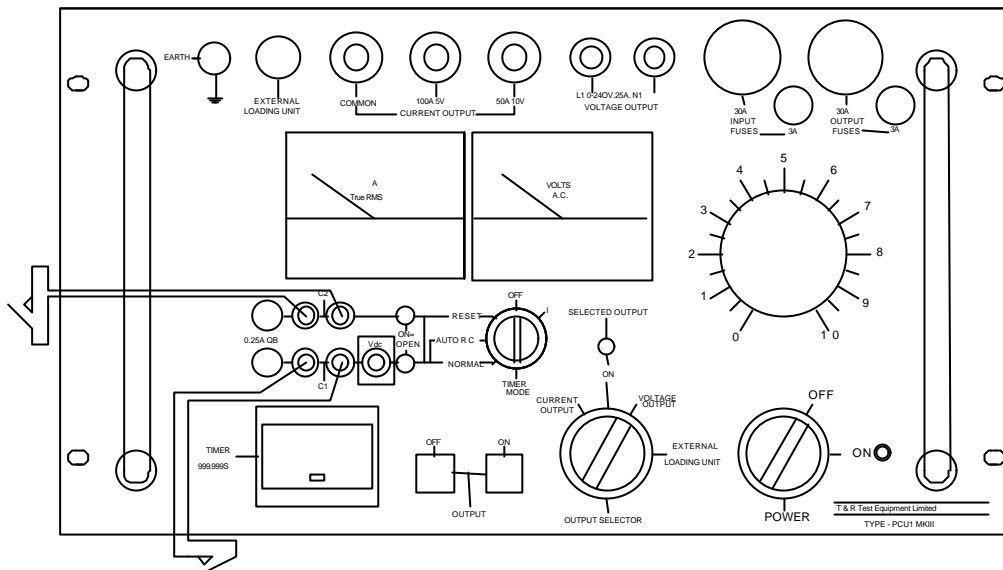
1. Connect contact to be timed to **C1**.

TEST PROCEDURES

1. Switch ON main supply.
2. Select timer mode to **AUTO R.C** position.
3. Ensure regulator is at zero.
4. Make connections as above.
5. Press output ON push-button.
6. The timer system is now armed and ready to receive change of state signal from test contacts.
7. The timer will start on the change of state, ie from N/C to N/O or vice versa.
8. The timer will stop when the contacts revert to their original state.

NOTE: Timings of less than 19ms are of doubtful accuracy and should be ignored.

Figure 3h Connection Method When Using PCU1/E as a Separate Timer (Dual contact operation)



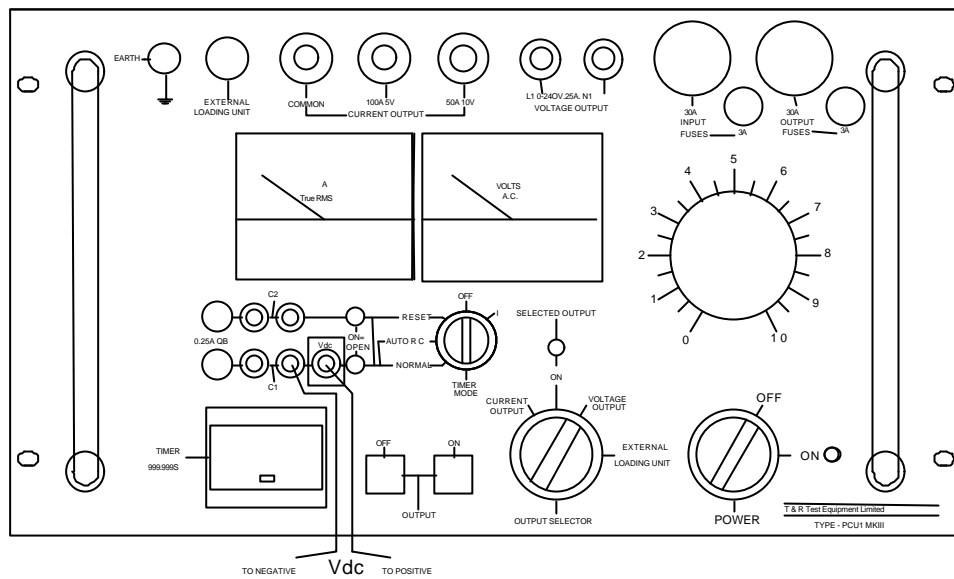
CONNECTIONS

1. Connect contacts to be timed to the following.
Start contact to **C1**.
Stop contact to **C2**.

TEST PROCEDURES

1. Switch ON main supply.
2. Select mode to **RESET** position.
3. Ensure regulator is at zero.
4. Make connections as above.
5. Press output ON push-button.
6. The timer system is now armed and ready to receive a change of state signal from the start contacts.
7. The timer will start on the change of state of the C1 contact.
8. The timer will stop on the change of state of the C2 contact.

Figure 3i Connections and Function of the Vdc Sockets



NOTE: This connection method is DC voltage level operated, regardless of source resistance.

CONNECTIONS

1. Connect a DC voltage signal to the terminals on **C1** contact set as shown above
2. The **positive** must be connected to the **Vdc** socket and the **negative** to the **blue** socket.

FUNCTION

1. When using this method to stop or start the timer the test procedures will be the same as described in the previous sections.
2. Minimum voltage signal for correct function is 24Vdc and the circuit will auto - select for the following signal transitions:

0V	Ⓜ	+Vdc
+Vdc	Ⓜ	0V
3. The maximum voltage for this method of operation is 240Vdc.
4. The input resistance to the signal source is 30 kilohms.
5. If the above resistance is too low for voltages over 24V dc an external resistance of 500 ohms per volt for each volt over 24V dc can be added in series with the signal source if required.
6. This circuit is not fused but is internally protected up to a maximum voltage of 240V dc of either polarity.

2.4 Method of Operation

- 2.4.1. Connect a suitable connector to the 3-core cable provided. See **Figure 3a** regarding earth/ground security.
- 2.4.2 Connect the output leads to the desired output terminals which are located on the top panel. The methods of connection are described in **Section 2.3**. Select the desired output.
- 2.4.3 It is advisable to make a preliminary test on the test object, starting at zero voltage, in order to test the load impedance, before performing the test with regulator set at higher values. Therefore, ensure the regulator knob is fully anti-clockwise before switching on.
- 2.4.4 Connect the supply lead to the mains and move the supply switch to the ON position. The supply ON lamp should now be illuminated.
- 2.4.5 Ensure the timer mode switch is in the OFF position. Select the desired ammeter range.
- 2.4.6 Depress the ON push-button.
- 2.4.7 Increase the current by rotating the regulator knob in a clockwise direction until the desired current is indicated on the ammeter. Depress the output OFF push-button.
- 2.4.8 Connect the test object contacts to the relay contact terminals on the test set, select timer mode switch NORMAL, reset timer if necessary.
- 2.4.9 Depress the ON push-button and the following occurs:-
 - a. Timer will start, current will flow through the test object
 - b. Once the test object's contacts have changed state the timer will stop and the test current will be automatically switched off
 - c. 2-3 seconds must now elapse before the timer function is active and ready for a repeat test.
- 2.4.10 On completion of the test, return regulator to zero and switch off the supply. Before disconnecting the test object ensure the mains supply switch is in the OFF position.
- 2.4.11 it is usual to repeat the above test method several times checking that the times are consistent. However, it is advisable to allow the relay to cool between tests, particularly, if large overcurrents are being passed through the relay.
- 2.4.12 When testing thermal devices or circuit breakers with no auxiliary contacts, the test method is the same except that the timer control switch is in the "I" position.

3. MAINTENANCE

- 3.1 The switches and contactors should be occasionally examined for signs of wear and contact erosion. Badly eroded contacts should be replaced immediately.
- 3.2 The voltage regulator should be regularly examined, particularly in respect of the brushes, in order that the latter can be replaced before excessive wear has taken place.
- 3.3 The intervals between inspection and renewal of the brushes will depend upon the amount of usage. However, it should be remembered that extensive damage to the regulator can result if the brushes are allowed to wear away to such an extent that a loss of brush pressure occurs, thus causing arcing.
- 3.4 The occasional wiping of the regulator track with an alcohol moistened rag is recommended. If, however, the track is badly corroded, it should be cleaned with very fine flour paper, ensuring a flat surface is restored. Remove particles with a fine brush, and finally cleanse with an alcohol moistened brush.

4. STANDARD ACCESSORIES

4.1 Types of fuses supplied:-

- a. 2 off 30 amp, Bussmann Ref. 059-0151
- b. 2 off **F250mA** 20mm
- c. 2 off **T3.15A** 1¼inch

4.2 The following items are provided with the equipment:

- a. 2.5 metre long supply cable terminated at one end to suit the input into the PCU1/E control unit
- b. 5 metre long interconnecting lead terminated at both ends to suit the PCU1/E control unit and the external loading unit.
- c. 5 metre long metering lead terminated at both ends to suit the PCU1/E control unit and the external loading.
- d. 5 metre long non-latching lead.
- e. Cable wallet to hold above leads.
- f. Operating & Maintenance Manual.

5. OVERALL PERFORMANCE SPECIFICATION

5.1. 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.

5.2. Applied Voltage Test

Mains input to frame and all isolated outputs 2kV RMS for 1 minute.

All combinations of isolated output to isolated output.

Isolated output to frame.

1.5kV RMS for 1 minute.

5.3 Accuracy of Instruments

Dependent on instrument type fitted:-

DC moving coil Voltmeter (rectified ac) $\pm 1.5\%$ F.S.D

DC moving coil Ammeter (RMS AC) $\pm 1.5\%$ F.S.D

AC moving iron voltmeter & ammeter $\pm 2\%$ F.S.D

5.4. Polarity

Zero phase shift occurs on the following:

Mains input - voltage output.

Mains input - secondary current output (Common = Neutral).

Mains input external loading unit (Terminal 1 = Neutral)

6. CALIBRATION RESULTS

6.1 PCU1/E MK3 control unit serial number

6.2 Metering Circuits

Voltmeter

Set	Std
50	
100	
150	
200	
250	

Ammeter 100A Range

Set	Std
20	
40	
60	
80	
100	

Ammeter 50A Range

Set	Std
50	

External loading unit

Loading unit type..... serial number

LU500		LU1000		LU2000		LU3000LP		Non Standard	
Set	Std	Set	Std	Set	Std	Set	Std	Set	Std
500		1000		2000		3000			
400		800		1600		2500			
300		600		1200		2000			
200		400		800		1500			
100		200		400		1000			
50		100		200		500			

7. TEST CERTIFICATE

PRODUCT TYPE: *Primary Current Injection Test Set*

PCU1/E MK3 control unit serial number

Loading unit type serial number

TEST PROCEDURE: As routine test sheet : PCU1 MK3 rts.doc

TESTED BY:

PASSED BY:

DATE:

8. REVISION

Product / Type: Primary Curren Injection / PCU1/E MK3 Control Unit & Loading Units
File: PCU1-E MK3 old manual v6.doc
Author: D. Buckle

Issue / Date: 6 / 19.06.2001
Modified By: D. Buckle

Checked By: I.D.W. Lake	Date: 19.06.2001
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Drawings Required

A2/000503 latest issue