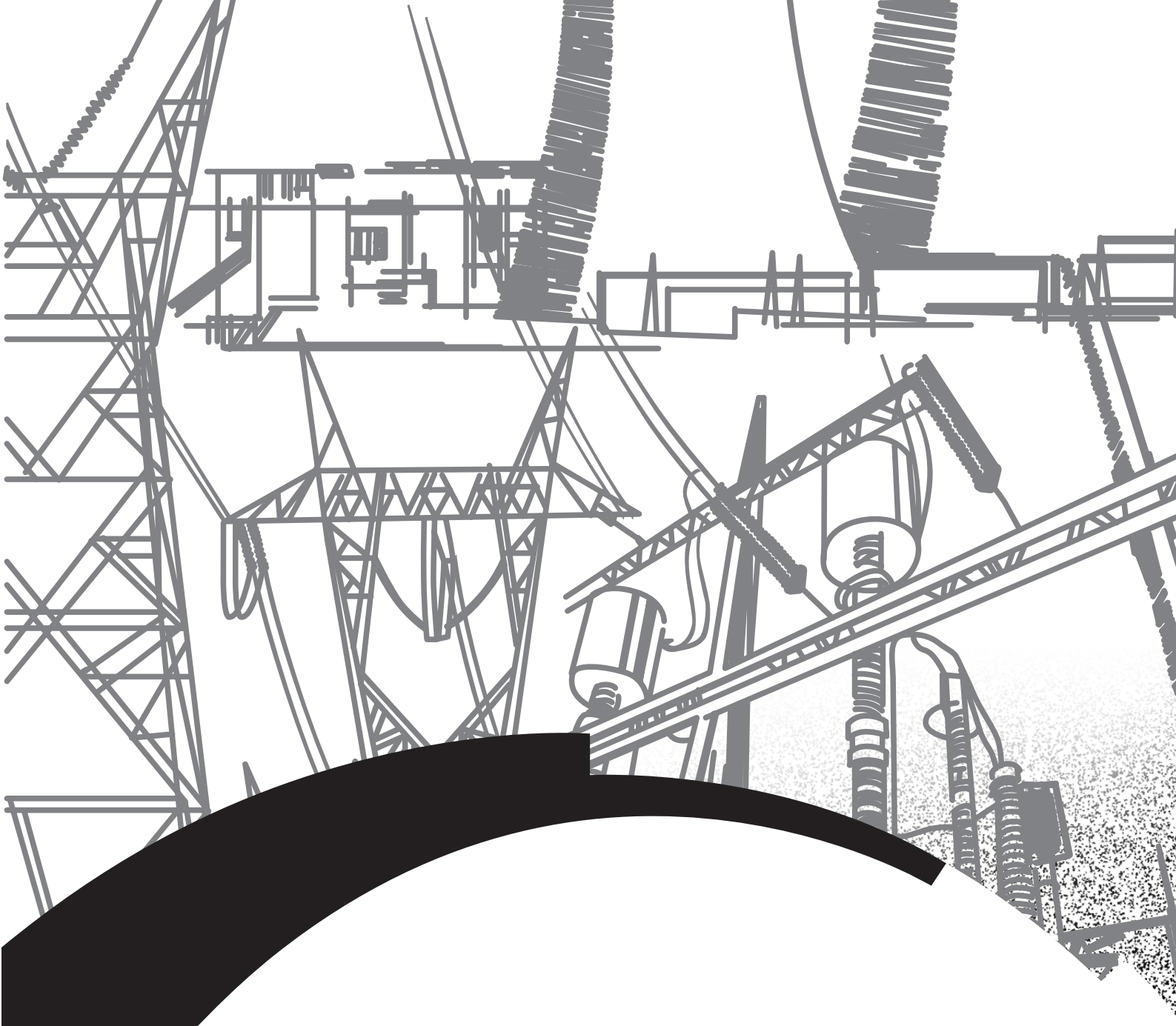

Service Manual

Type MVTU

Definite Time Delayed Relays

ALSTOM

Service Manual
Type MVTU
Definite Time Delayed Relays

HANDLING OF ELECTRONIC EQUIPMENT

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of ALSTOM T&D Protection & Control Ltd products are immune to the relevant levels of electrostatic discharge when housed in their cases. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board. Avoid touching the electronic components, printed circuit track or connectors.
3. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.
4. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
5. Store or transport the module in a conductive bag.

More information on safe working procedures for all electronic equipment can be found in BS5783 and IEC 60147-0F.

If you are making measurements on the internal electronic circuitry of an equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap.
Wrist straps should have a resistance to ground between 500k – 10M ohms. If a wrist strap is not available, you should maintain regular contact with the case to prevent the build up of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

ALSTOM T&D Protection & Control Ltd strongly recommends that detailed investigations on the electronic circuitry, or modification work, should be carried out in a Special Handling Area such as described in BS5783 or IEC 60147-0F.

ALSTOM

TYPES: MVTU 11
Definite Time Delayed Undervoltage Relay

MVTU 12
Definite Time Delayed Overvoltage Relay

MVTU 13
Definite Time Delayed Neutral Displacement Relay

MVTU 18
Definite Time Delayed Neutral Displacement Relay with Additional Timer

CONTENTS

This Safety Section should be read before commencing any work on the equipment.

Health and safety

The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

Explanation of symbols and labels

The meaning of symbols and labels which may be used on the equipment or in the product documentation, is given below.

Caution: refer to product documentation

Caution: risk of electric shock

Protective/safety *earth terminal

Functional *earth terminal.
Note: this symbol may also be used for a protective/ safety earth terminal if that terminal is part of a terminal block or sub-assembly eg. power supply.

*Note: The term earth used throughout the product documentation is the direct equivalent of the North American term ground.

Installing, Commissioning and Servicing

Equipment connections

Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present a hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is 2.5 mm^2, unless otherwise stated in the technical data section of the product documentation.

Before energising the equipment, the following should be checked:

Voltage rating and polarity;

CT circuit rating and integrity of connections;

Protective fuse rating;

Integrity of earth connection (*where applicable*)

Equipment operating conditions

The equipment should be operated within the specified electrical and environmental limits.

Current transformer circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.

External resistors

Where external resistors are fitted to relays, these may present a risk of electric shock or burns, if touched.

Battery replacement

Where internal batteries are fitted they should be replaced with the recommended type and be installed with the correct polarity, to avoid possible damage to the equipment.

Insulation and dielectric strength testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Insertion of modules and pcb cards

These must not be inserted into or withdrawn from equipment whilst it is energised, since this may result in damage.

Fibre optic communication

Where fibre optic communication devices are fitted, these should not be viewed directly. Optical power meters should be used to determine the operation or signal level of the device.

Older Products

Electrical adjustments

Equipments which require direct physical adjustments to their operating mechanism to change current or voltage settings, should have the electrical power removed before making the change, to avoid any risk of electric shock.

Mechanical adjustments

The electrical power to the relay contacts should be removed before checking any mechanical settings, to avoid any risk of electric shock.

Draw out case relays

Removal of the cover on equipment incorporating electromechanical operating elements, may expose hazardous live parts such as relay contacts.

Insertion and withdrawal of extender cards

When using an extender card, this should not be inserted or withdrawn from the equipment whilst it is energised. This is to avoid possible shock or damage hazards. Hazardous live voltages may be accessible on the extender card.

Insertion and withdrawal of heavy current test plugs

When using a heavy current test plug, CT shorting links must be in place before insertion or removal, to avoid potentially lethal voltages.

Decommissioning and Disposal

Decommissioning: The auxiliary supply circuit in the relay may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the relay (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal: It is recommended that incineration and disposal to water courses is avoided. The product should be disposed of in a safe manner. Any products containing batteries should have them removed before disposal, taking precautions to avoid short circuits. Particular regulations within the country of operation, may apply to the disposal of lithium batteries.

Technical Specifications

Protective fuse rating

The recommended maximum rating of the external protective fuse for this equipment is 16A, Red Spot type or equivalent, unless otherwise stated in the technical data section of the product documentation.

Insulation class:	IEC 61010-1: 1990/A2: 1995 Class I EN 61010-1: 1993/A2: 1995 Class I	This equipment requires a protective (safety) earth connection to ensure user safety.
Installation Category (Overvoltage):	IEC 61010-1: 1990/A2: 1995 Category III EN 61010-1: 1993/A2: 1995 Category III	Distribution level, fixed installation. Equipment in this category is qualification tested at 5kV peak, 1.2/50µs, 500Ω, 0.5J, between all supply circuits and earth and also between independent circuits.
Environment:	IEC 61010-1: 1990/A2: 1995 Pollution degree 2 EN 61010-1: 1993/A2: 1995 Pollution degree 2	Compliance is demonstrated by reference to generic safety standards.
Product safety: CE	73/23/EEC	Compliance with the European Commission Low Voltage Directive.
	EN 61010-1: 1993/A2: 1995 EN 60950: 1992/A11: 1997	Compliance is demonstrated by reference to generic safety standards.

Section 1. DESCRIPTION OF SETTINGS

1.1 Voltage settings

The setting voltage is determined by the positions of the six dual-in-line switches. The sum of all the voltages shown by each respective switch position and the constant value gives the required setting voltage. For example, an MVTU 11 with the switches set to the position shown corresponds to a setting of 32 + 26 = 58V ac.

	1	—>	0	
Voltage	2	—>	0	Vs = (32 +Σ)
setting	2	<—	0	= 32 + 2 + 8 + 16
switches	2	—>	0	= 58V
	8	<—	0	
	16	<—	0	

For other versions the setting method is identical. Refer to the nameplate on each individual relay.

1.2 Time settings

The time setting is selected between 0.1 and 9.9 seconds by means of the thumbwheel switches.

1.3 Trip indication

Earlier relays were fitted with hand reset mechanical flag indicators, later relays being fitted with non-volatile hand reset LED trip indicators.

Section 2. AUXILIARY EQUIPMENT

2.1 External series resistors

The following dropper resistors pre-mounted on an external assembly, marked with the relay serial number, are supplied with each relay when required. The part numbers of the assemblies are listed below together with the resistor values.

The 66kΩ external resistor, Rext 2, required only on the 380/440V versions, is made up of two 15kΩ and two 18kΩ wirewound resistors, all connected in series. The 380/440V versions are initially calibrated with this external resistor assembly and if the assembly or any of the resistors on it are changed, the relay must be recalibrated.

2.2 MVTU 11 Undervoltage and MVTU 12 overvoltage

Relay ac rating (V) 50/60Hz	Relay dc rating (V)	Resistor assembly part number	Dropper resistor values fitted:	
			dc series resistor (ohm) Rext 1	ac series resistors (ohm) Rext 2
57/70 100/120	30/34	None required	—	—
220/250 380/440	30/34	ZE0103 020	—	66k
57/70 100/120	48/54	FJ0340 007	220R	—
220/250 380/440	48/54	ZE0103 021	220R	66k
57/70 100/120	110/125	FJ0340 001	1k0	—
220/250 380/440	110/125	ZE0103 022	1k0	66k
57/70 100/120	220/250	ZE0103 018	2 x 4k7 (in parallel)	—
220/250 380/440	220/250	ZE0103 023	2 x 4k7 (in parallel)	66k

2.3 MVTU 13 Neutral displacement

Relay ac rating (V) 50/60Hz	Relay dc rating (V)	Resistor assembly part number	Dropper resistor fitted:	
			dc series resistor (ohm) Rext 1	ac series resistors (ohm) Rext 2
57/120	30/34	None required	—	—
57/120	48/54	FJ0340 007	220R	—
57/120	110/125	FJ0340 001	1k0	—
57/120	220/250	ZE0103 018	2 x 4k7 (in parallel)	—

2.4 MVTU 18 Neutral displacement

The MVTU 18 does not require external dropper resistors.

Section 3. INSTALLATION

3.1 Precautions

Protective relays, although generally of robust construction, require careful treatment prior to installation and a wise selection of site. By observing a few simple rules the possibility of premature failure is eliminated and a high degree of performance can be expected.

3.2 Packing

The relays are either despatched individually or as part of a panel/rack mounted assembly, in cartons specifically designed to protect them from damage.

3.3 Inspection

Relays should be examined immediately they are received to ensure that no damage has been sustained in transit. If damage due to rough handling is evident, a claim should be made to the transport company concerned immediately, and the nearest ALSTOM T&D Protection & Control representative should be promptly notified. Relays which are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

3.4 Unpacking

Care must be taken when unpacking and installing the relays so that none of the parts is damaged or their settings altered; they should only be handled by skilled persons.

Relays should be examined for any wedges, clamps or rubber bands necessary to secure moving parts to prevent damage during transit and these should be removed after installation and before commissioning.

Relays which have been removed from their cases should not be left in situations where they are exposed to dust or damp. This particularly applies to installations which are being carried out at the same time as constructional work.

3.5 Storage

If relays are not installed immediately upon receipt they should be stored in a place free from dust and moisture in their original cartons and where de-humidifier bags have been included in the packing they should be retained. The action of the de-humidifier crystals will be impaired if the bag has been exposed to humid conditions and may be restored by gently heating the bag for about an hour, prior to replacing it in the carton.

Dust which collects on a carton may, on subsequent unpacking, find its way into the relay; in damp conditions the carton and packing may become impregnated with moisture and the de-humidifying agent will lose its efficiency.

Storage temperature –25 to +70°C.

3.6 Siting

The installation should be clean, dry and reasonably free from dust and excessive vibration. The site should preferably be well illuminated to facilitate inspection.

An outline diagram is normally supplied showing panel cut-outs and hole centres. For individually mounted MVTU relays these dimensions will also be found in Publication R6041.

Note: Earlier relays were fitted with hand reset mechanical flag indicators, later relays being fitted with a non-volatile hand reset LED trip indicator.

CAUTION:

If a flag indicator is fitted, damage is likely to be incurred if the flag indicator/ armature assembly of a miniature relay is actuated manually with a screwdriver/ probe. Flags should always be reset with the cover in position by the mechanism provided.

4.1 Inspection and wiring check

Carefully examine the module and case to see that no damage has occurred during transit. Check that the relay serial number on the module, case, cover and resistor assembly (when an assembly is required) are identical and that the model number and rating information are correct.

Check that the external wiring is correct to the relevant relay diagram or scheme diagram. The relay diagram number appears inside the case. Particular attention should be paid to the wiring of the external resistors Rext 1 and Rext 2 to the relay (if required on scheme).

4.1.1 Electrostatic discharges (ESD)

The relay uses components which are sensitive to electrostatic discharges. When handling the module, care should be taken to avoid contact with components and electrical connections. When removed from the case for storage, the module should be placed in an electrically conducting anti-static bag. See full recommendations inside the front cover of this manual.

4.2 Connection of the MMLG test block

If a test block MMLG is provided, the connections should be checked to the scheme diagram, particularly that the supply connections are to the live side of the test block (coloured orange) – the odd numbered terminals. The auxiliary supply voltage to the scheme should be routed via the test block terminals 13 and 15. To facilitate ease of wiring the MMLG should be located at the right hand side of the assembly.

4.3 Earthing

Ensure that the case earthing connection above the rear terminal block is used to connect the relay to the local earth bar.

4.4 Insulation check

The relay and its associated wiring, may be insulation tested between:

– all electrically isolated circuits.

– all circuits and earth.

An electronic or brushless insulation tester should be used, having a dc voltage not exceeding 1kV. Accessible terminals of the same circuit should first be strapped together. Deliberate circuit earthing links, removed for the tests must subsequently be replaced.

4.5 Functional testing

Equipment required (all versions):

Variac transformer

DC voltmeter to check nominal dc volts

AC voltmeter to cover setting range

Resistance meter

AC ammeter 0-10mA

One double pole switch

One electronic timer

MVTU 11 and MVTU 12 380/440V versions only:

Step-up transformer to cover setting range of 380/440V relay

MVTU 13 and MVTU 18:

One 6W 50kΩ wirewound resistor

Note: Measuring accuracy depends on the accuracy of the instruments used.

4.5.1 DC auxiliary supply check

Ensure that the correct series dropping resistor(s) are fitted if required. Remove the relay from its case and check that the incoming dc supply at the relay case terminal 13(+ve) and 14(–ve) is within the range specified below:

Rated dc voltage (V)	DC operative range (V)
30/34	24 – 37.5
48/54	37.5 – 66
110/125	87.5 – 150
220/250	175 – 300

4.5.2 Test block type MMLG

If a test block is included in the scheme, it may also be associated with protection CT circuits. It is important that the sockets in the type MMLB01 test plug, which correspond to the current transformer secondary windings, are LINKED BEFORE THE TEST PLUG IS INSERTED INTO THE TEST BLOCK

DANGER: DO NOT OPEN CIRCUIT THE SECONDARY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATION.

The test plug isolates terminals 13 & 14, removing the dc positive, making it necessary to add a link between these terminals on the test plug to restore the auxiliary supply to the relay.

4.5.3 Isolation of VT circuit

Before any secondary injection tests are carried out, the voltage transformer supply to the relay should be isolated by means of the panel links or connecting blocks.

4.5.4 Voltage setting check

The pick-up and drop-off voltages of the relay should be measured with the timer set to 0.1s and with the voltage setting switches set to each of the positions shown in the table below.

1 = switch closed (left hand position)

0 = switch open (right hand position)

Table 1

Switch position		Pick-up voltage (VRMS)								
Switch	1 2 3 4 5 6	MVTU 11 57/70V	MVTU 11 100/120V	MVTU 11 220/250	MVTU 11 380/440V	MVTU 12 57/70V	MVTU 12 100/120V	MVTU 12 220/250	MVTU 12 380/440V	MVTU 13/18 57/120V
Test 1	0 0 0 0 0 0	32	62	135	210	60	105	230	400	5
Test 2	1 0 0 0 0 0	33	63.5	138	216	61.5	107.5	235	410	6
Test 3	0 1 0 0 0 0	34	65	141	222	63	110	240	420	7
Test 4	0 0 1 0 0 0	34	65	141	222	63	110	240	420	7
Test 5	0 0 0 1 0 0	34	65	141	222	63	110	240	420	7
Test 6	0 0 0 0 1 0	40	74	159	258	72	125	270	480	13
Text 7	1 1 1 1 1 1	63	108.5	228	396	106.5	182.5	385	710	36

When the switches have been set for each test, the cover should be replaced to ensure that the trip indicator is always reset with the cover reset mechanism (where applicable).

The relays should be connected as shown in the circuit diagrams, Figures 1, 2 and 3.

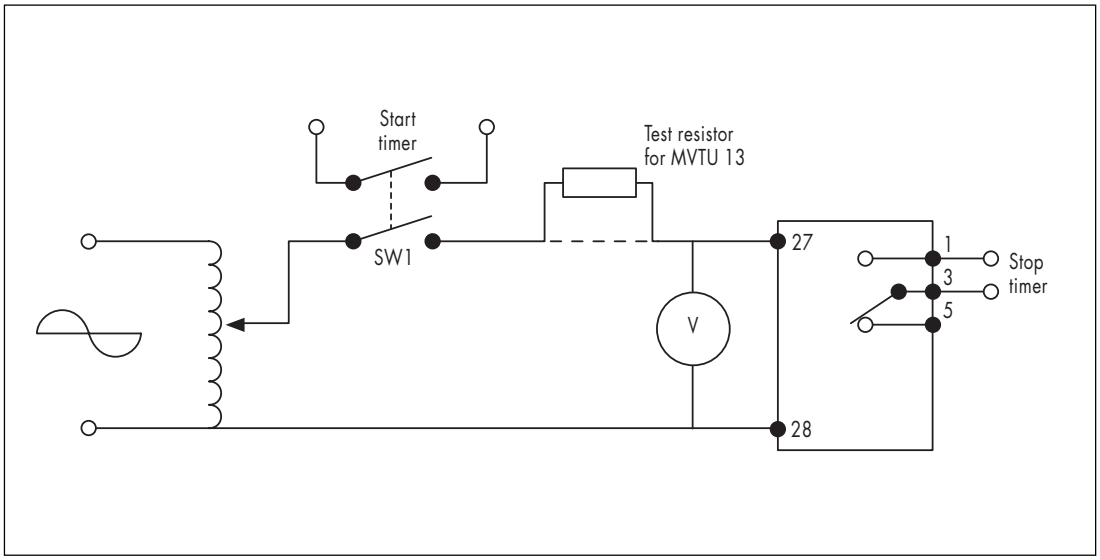

Figure 1 Test circuit for MVTU 13, 18 and for 57/70V, 110/120V versions of MVTU 11 and MVTU 12

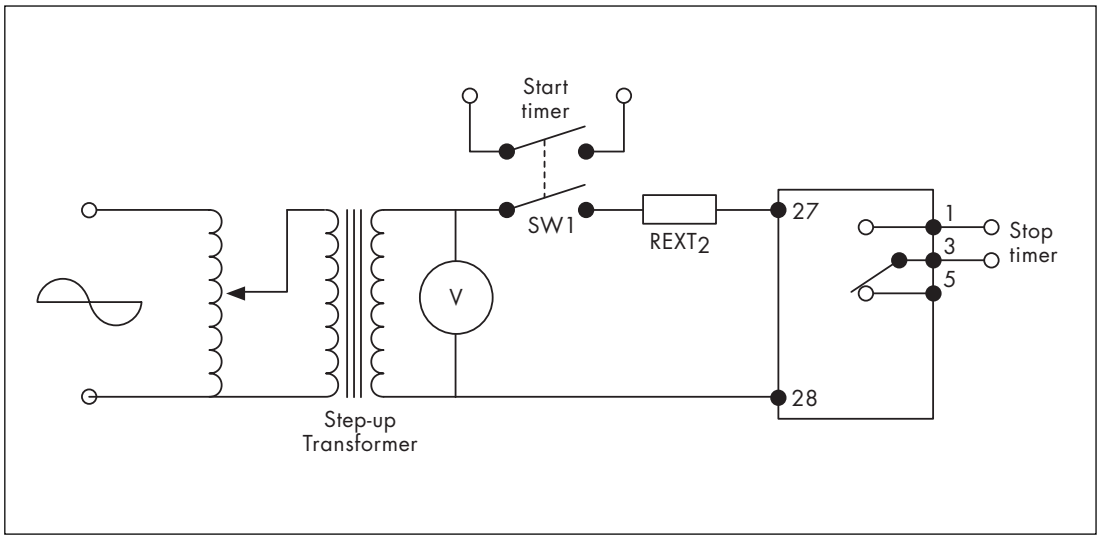

Figure 2 Test circuit for the 220/250V and the 380/440V versions of MVTU 11 and MVTU 12

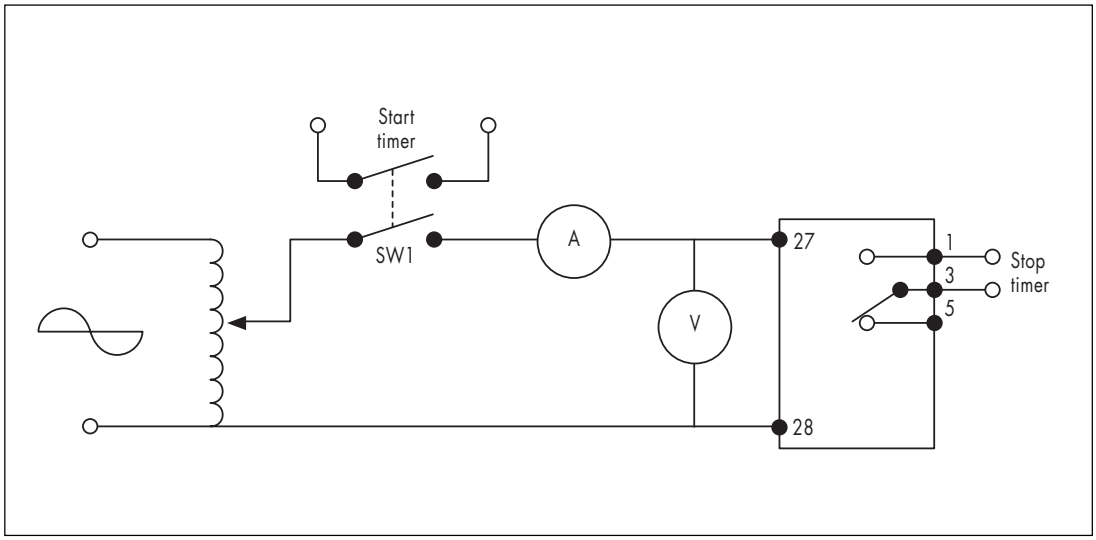

Figure 3 Test circuit for 380/440V version of MVTU 11 and MVTU 12 when no step-up transformer is available

MVTU 11 undervoltage relay

See Figure 1 for the test circuits for the 57/70V and 100/120V versions and Figure 2 for the 220/250V and the 380/440V versions.

If the 380/440V version is being commissioned a step-up transformer is needed to allow the calibration of the settings to be checked.

The ac input voltage should be increased to a value above the setting value and the trip indicator reset. Slowly decrease the input voltage until the relay picks up (when the trip indicator operates). Record the pick-up value.

Slowly increase the voltage, checking to see when the trip indicator can be reset. This is the drop-off value and should be recorded.

Alternatively, the pick-up and drop-off values can be determined using an ohmmeter connected across the contacts.

Repeat the test for each of the settings shown in Table 1.

The allowable errors on the voltage settings are ±2% on the lowest setting and ±4% on all other settings (no allowance has been made for instrument errors).
The drop-off value should be within 5% of the pick-up value.

MVTU 12 overvoltage relay

See Figure 1 for the test circuits for the 57/70V and 100/120V versions and Figure 2 for the 220/250V and the 380/440V versions.

If the 380/440V version is being commissioned, a step-up transformer is needed to allow the calibration of the settings to be checked.

Check that the trip indicator is reset and slowly increase the ac voltage until the trip indicator operates. Record the pick-up value. Slowly lower the voltage to see when the trip indicator can be reset. This is the drop-off value and should be recorded.

The allowable errors on the voltage settings are ±2% on the lowest setting and ±4% on all other settings (no allowance has been made for instrument errors).

The drop-off value should be within 5% of the pick-up value.

Alternative test method for 380/440V versions of MVTU 11 and MVTU 12

This method should be used only when no step-up transformer is available.

See Figure 3 for the test circuit.

Firstly, accurately measure the resistance of the dropper resistor assembly (Rext 2).

With the relay on the lowest setting and the dropper resistor (Rext 2) removed from the circuit, measure the pick-up voltage directly at the relay terminals 27 and 28 and the ac current into the relay at the pick-up voltage. Use the following formula to calculate the effective pick-up voltage:

$$V_{eff} = VM + I_M R_M$$

where V_{eff} = effective pick-up voltage
V_M = measured pick-up voltage with Rext 2 out of circuit
I_M = the measured pick-up current with Rext 2 out of circuit
R_M = measured resistance of Rext 2

The drop-off voltage can be found in the same way.

The pick-up voltage should be within ±2% of the lowest setting voltage.
No allowance has been made for instrument errors.

This test has checked the calibration point of the relay. The other relay settings need only be checked to see that they are functioning. Refer to Tests 2 – 7 in Table 1 for the appropriate switch positions.

With the dropper resistors (Rext 2) still out of circuit, monitor the voltage at the relay terminals 27 and 28 for the MVTU 12. Slowly increase the voltage until the relay picks up and record the pick-up value. Slowly lower the voltage until the relay drops off and record the drop-off value. For the MVTU 11, slowly decrease the voltage to record the pick-up value and then increase the voltage to record the drop off value.

On the MVTU 12, if the pick-up voltage at the 400V setting is Z, the measured pick-up voltages at the other settings should be higher than the 400V setting by the amounts shown. A similar method is adopted for the MVTU 11.

Test number	Setting voltage (V)		Pick-up voltage at relay input terminals (27 & 28) (V)	
	MVTU 11	MVTU 12	MVTU 11	MVTU 12
1	210	400	Z	Z
2	216	410	Z + 1 ± 1	Z + 2 ± 1
3, 4, 5	222	420	Z + 2 ± 1	Z + 4 ± 1
6	258	480	Z + 10 ± 2	Z + 17 ± 2
7	396	710	Z + 39 ± 3	Z + 66 ± 4

The drop-off voltages should be within 5% of the pick-up values.

MVTU 13 and MVTU 18 neutral displacement relays

A series dropper resistor of approximately 50kΩ should be inserted in series with the input terminals 27 and 28 to allow sufficient sensitivity in the setting range when using a 0 – 240V variac supply, see Figure 1 for the test circuit.

Check that the trip indicator is reset and slowly increase the ac input voltage until the trip indicator operates. Record the pick-up value.

Slowly lower the voltage, checking to see when the trip indicator can be reset. This is the drop-off value and should be recorded.

Alternatively, the pick-up and drop-off states can be determined by connecting an ohmmeter across the contacts.

Repeat the test for each of the settings shown in Table 1.

The allowable errors on the voltage settings are ±2% on the lowest setting and ±4% on all other settings.

(No allowance has been made for instrument errors.)

The drop-off value should be within 5% of the pick-up value.

4.5.5 Timer setting check

It is recommended that all MVTU relays are tested on the following timer settings: 1.1, 2.2, 3.3, 4.4, 5.5, 6.6, 7.7, 8.8, 9.9 seconds. The circuit diagrams for these tests are shown in Figures 1, 2 and 3.

The applied voltage levels should be greater than 10% above and 10% below any convenient voltage setting.

MVTU 11 – undervoltage

Remove the ac supply from 10% above the voltage setting to zero volts, simultaneously starting the timer. The timer stop contacts should be connected to the relay output contacts. The allowable errors in the timer settings are ±3% or 70ms whichever is the greater.

MVTU 12 – overvoltage and MVTU 13 – neutral displacement

Apply the ac supply from zero to 10% above the voltage setting, simultaneously starting the timer. The timer stop contacts should be connected to the relay output contacts. The allowable errors in the timer settings are ± 3% or 70ms whichever is the greater.

MVTU 18 – neutral displacement

Time delay t_1 is checked as for MVTU 13

Time delay t_2 is checked by connecting the timer as shown in Figure 4 and repeating the tests as for time delay t_1.

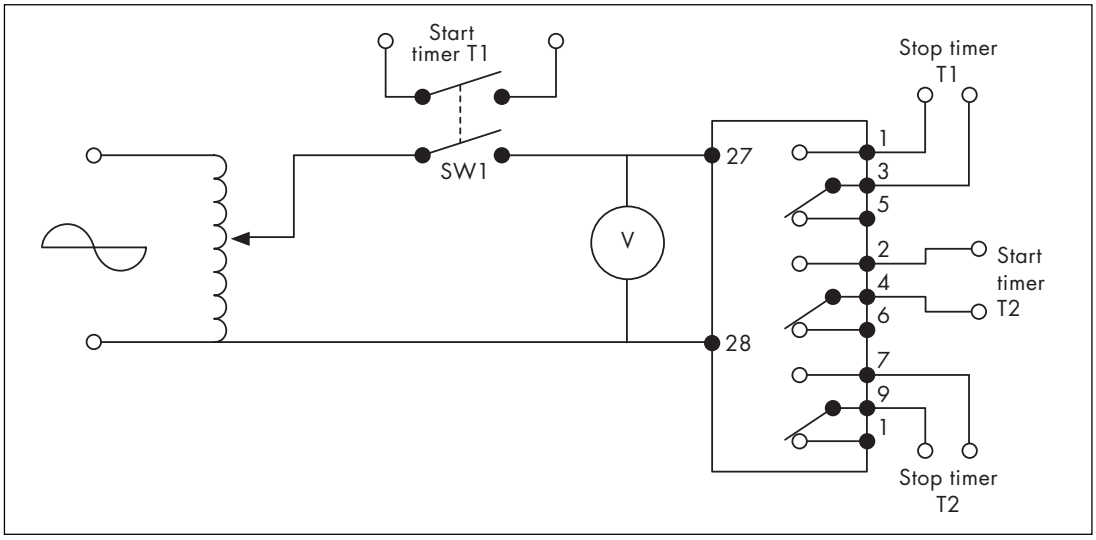

Figure 4 Test circuit for MVTU 18 relay

4.5.6 Final setting checks

Adjust the voltage setting to its functional setting and measure the pick-up and drop-off values as already mentioned. Check that they are within the stated tolerance.

With the final voltage setting and the functional timer setting selected, measure the operating times when a voltage ≥1.1x the setting voltage is applied (≤0.9x for MVTU 11). Check that this is within the stated tolerance.

4.5.7 Trip indicator and contact check

Check that the trip indicator and reset facility operate. Also check that the contacts operate by carrying out continuity checks.

4.5.8 Final checks

Operate the relay with the trip and alarm links restored to ensure that the trip and alarm circuits are energised according to the relevant schematic diagram.

Remove all test leads, test switches, temporary shorting leads etc.

Replace any links that have been removed to facilitate testing.

If a test plug (MMLB) and test block (MMLG) have been used, remove the test plug.

CAUTION:

Replace the test block cover to put the protection in service.

Section 5. MAINTENANCE

Periodic maintenance is not necessary. However, periodic inspection and test is recommended.

5.1 Visual inspection

Isolate all supplies and withdraw the module from the case using the two black handles on the relay. Inspect the printed circuit board for any sign of loose components or connections.

Note that, where fitted, flag mechanisms should not be disturbed unless found to be operating incorrectly during the routine function tests.

Your attention is drawn to the fact that the relay can be damaged by electrostatic discharges. The pcb should not be touched unless precautions have been taken.

5.2 Functional checks

Periodic function tests should be carried out using the test procedures shown in the commissioning section.

The operation of the trip indicator and the reset facility should be checked during these functional tests.

Section 6. PROBLEM ANALYSIS

These instructions enable a fault to be localised to sub-assembly level. Fault finding to component level is not recommended. The main reasons for this are as follows:

- Fault finding on printed circuit boards requires the use of specialised knowledge and equipment.
- Components used in manufacture are subject to strict quality control and in certain cases selected for particular characteristics. Complementary metal oxide silicon (CMOS) components are used, which require extremely careful handling.
- Damage can be caused to the printed circuit track unless extreme care is used in the replacement of components.
- Replacement of some components will necessitate recalibration of the relay.
- The printed circuit boards are covered with a protective coating of polycoat which makes access to tracks and components very difficult.

6.1 Test equipment required for fault finding

Equipment required for fault finding is minimal and consists of the following:

- Digital multimeter with ranges of 0 – 1000V ac/dc and 0 – 1A ac/dc
- DC voltage supply 30V 0.5A
- AC voltage source 0 – 500V 50Hz at 10mA
- Oscilloscope (optional)
- Relay tool kit

6.2 General procedure and precautions

Care must be taken when making test connections to printed circuit boards to avoid short circuiting or damaging the copper tracks. Before connecting or disconnecting any test equipment the relay must be isolated from the supply.

Relevant schematic diagrams

MVTU 11	–	Undervoltage	–	F10 MVTU 11 501	Figure 5
MVTU 12	–	Overvoltage	–	F10 MVTU 12 501	Figure 6
MVTU 13	–	Neutral displacement	–	F10 MVTU 13 501	Figure 7
MVTU 18	–	Neutral displacement	–	F10 MVTU 18 501	Figure 8

6.3 Inspection – removal of module from case

Unscrew the two front cover screws and remove the clear plastic front cover. Ensure that the dc supply is isolated and then withdraw the module assembly by the two black handles. A quick inspection of the relay may result in the detection of obvious faults. i.e. loose components or connections. Otherwise proceed to the next section.

6.4 Connections for MVTU 11, MVTU 12 and MVTU 13

There are two classes of relay connection. Firstly, the external connections to the relay; these are the connections between the relay terminals and the rest of the system.

Secondly, the printed circuit board connections; these are the connections between the relay terminal block and the printed circuit board soldered connections.

Terminal connections: Terminals 13 and 14 are connected to the positive and negative dc supply. Terminals 1 to 6 are the tripping outputs of the relay. Terminals 27 and 28 are the ac input.

PCB connections: There are six loop and bead connectors mounted on the pcb. They are connected as follows:

Connection 1 to terminal 13 – positive dc supply

Connection 2 to terminal 14 – negative dc supply and to pcb ZG7001

Connection 3 to pcb ZG7001

Connection 4 pcb ZG7001

Connection 5 to terminal 27 – ac input

Connection 6 to terminal 28 – ac input

Connections for MVTU 18

Terminal connections: Terminals 13 and 14 are connected to the positive and negative dc supply. Terminals 1 to 6 are the tripping outputs from timer t_1. Terminals 7 to 12 are the tripping outputs from timer t_2. Terminals 27 and 28 are the ac input.

PCB connections: The MVTU 18 has 2 printed circuit boards. ZJ0065 contains the measuring circuit and the circuit for timer t_1. ZJ0160 contains the circuit for timer t_2 and the output relays for t_1 and t_2.

PCB ZJ0065:	Connection 1 to terminal 13 positive dc supply
	Connection 2 to terminal 14 negative dc supply
	Connections 3, 4, 9 and 10 to pcb. ZJ0160
	Connection 5 to terminal 27 – ac input
	Connection 6 to terminal 28 – ac input
	Connection 7 to pcb screen
PCB ZJ0160:	Connections 1, 2, 3 and 4 to ZJ0065
	Connections 5 to 10: to t_1 output contacts
	Connections 11 to 16: to t_2 output contacts

6.5 Checking voltage supplies to module

The dc voltage ratings available are 30/34V, 48/54V, 110/125V and 220/250V. Where voltage sources which are higher than 30V are used, external dropper resistors are connected in series with the positive supply rail.

Note that MVTU 18 relays do not require external dropper resistors.

Check that the dc supply voltage is present and that the polarity is correct between terminals 13 and 14 on the relay case terminal block when the module is removed from the case. Note that when the module is in the case and the supply is connected, the voltage across the terminals may be less due to the voltage drop across the external dropper resister Rext 1 (if fitted).

Check that the ac is present between terminals 27 and 28. Check for the 220/250V and the 380/440V ac versions of the MVTU 11 and MVTU 12, that the series resistors are fitted in series with the ac supply terminals.

6.6 Printed circuit board tests

If all the connections are intact and the supplies are of the correct voltage and polarity, it is likely that the fault will lie somewhere on the pcb. Proceed to the next two sections to try to confirm this.

6.6.1 Monitoring of the voltage across relay coil

Set the thumbwheel switches to 0.1 seconds. Connect an electronic voltmeter across pcb ZJ0062 connection 3 and 4 to monitor the output signal. Adjust the ac input to an amplitude lower and then higher than the relay setting voltage. The output voltage should change from zero to approximately 24V for the overvoltage (MVTU 12) and the neutral displacement (MVTU 13) version, and from approximately 24V to zero for the undervoltage (MVTU 11) version.

6.6.2 Measurement of the dc operating currents of the modules

By monitoring the dc operating current of a module, a good indication is provided that the module is connected correctly and that the dc power supply section is operating correctly if the current measured lies within about ±10% of the specified value. Allowances must be made for supply voltages deviating from the lower rated voltage as this has a significant effect on the dc burden.

These dc burden tests should be carried out in the operated and non-operated state – that is with the ac input both above and below the voltage setting level.

An ammeter should be connected in the positive supply line to measure these burdens. Typical values for the dc burdens are shown in the following tables for the MVTU 11, 12, 13 and 18.

Burdens for MVTU 11 definite time delayed undervoltage relay

Nominal voltage range (V)		30/34	48/54	110/125	220/250
Series dropper resistor Rext 1 (ohm)		None	220	1k	2 x 4k7 in parallel
DC voltage supplied for test (V)		30	48	110	220
Current drain for relays fitted with mechanical flag (mA)	Relay on standby Vin > V setting	31	41	71	76
	Relay output energised Vin < V setting	69	70	72	76
Current drain for relays fitted with LED trip indicator (mA)	Relay on standby Vin > V setting	31	41	71	76
	Relay output and LED trip indicator operated	82	83	85	89
	LED trip indicator operated only	75	76	78	82

Burdens for MVTU 12 definite time delayed overvoltage relay

Nominal voltage range (V)		30/34	48/54	110/125	220/250
Series dropper resistor Rext 1 (ohm)		None	220	1k	2 x 4k7 in parallel
DC voltage supplied for test (V)		30	48	110	220
Current drain for relays fitted with mechanical flag (mA)	Relay on standby Vin < V setting	28	38	70	76
	Relay output energised Vin > V setting	67	69	71	76
Current drain for relays fitted with LED trip indicator (mA)	Relay on standby Vin < V setting	28	38	70	76
	Relay output and LED trip indicator operated	80	82	84	89
	LED trip indicator operated only	73	75	77	82

Burdens for MVTU 13 definite time delayed neutral displacement voltage relay

Nominal voltage range (V)		30/34	48/54	110/125	220/250
Series dropper resistor Rext 1 (ohm)		None	220	1k	2 x 4k7 in parallel
DC voltage supplied for test (V)		30	48	110	220
Current drain for relays fitted with mechanical flag (mA)	Relay on standby Vin < V setting	30	41	71	76
	Relay output energised Vin > V setting	68	69	75	78
Current drain for relays fitted with LED trip indicator (mA)	Relay on standby Vin < V setting	30	41	71	76
	Relay output and LED trip indicator operated	81	82	88	91
	LED trip indicator operated only	74	75	81	84

Burdens for MVTU 18 definite time delayed neutral displacement voltage relay with additional timer

Nominal voltage range (V)		30/34	48/54	110/125
DC voltage supplied for test (V)		30	48	110
Current drain (mA)	Relay on standby Vin < V setting	41	38	36.5
	Output relay RL1 and t_1 led operated	237	133	80
	t_1 LED only operated	40.5	37.5	36.0
	Output relays RL1 and RL2 and t_1 and t_2 LEDs operated	240	140	87
	t_1 and t_2 LEDs only operated	40	36.6	35.5

6.6.3 Measurement of the ac operating currents of the modules

Monitor the ac input current by connecting an ammeter in series with one input terminal and the source. This test should be done at the following input voltages:

63.5V	on	57/70V	version of MVTU 11 & MVTU 12
110V	on	100/120V	version of MVTU 11 & MVTU 12
250V	on	220/250V	version of MVTU 11 & MVTU 12
415V	on	380/440V	version of MVTU 11 & MVTU 12
63.5V	on	57/120V	version of MVTU 13 & MVTU 18

The current through the transformer primary should be approximately 6mA.

If the measured current is zero, suspect an open circuit primary winding, series resistor or connection.

If the measured current exceeds 8mA, check that the external dropper resistors are correctly fitted on the 220/250V and the 380/440V versions. If they are correctly fitted, then the primary windings may be shorted together – return the module for repair.

6.7 Calibration information

All relays are supplied precalibrated. The 220/250V and the 380/440V ac versions of the MVTU 11 and 12 are calibrated with the external dropper resistors, Rext 2, fitted on the resistor assembly supplied with the module. If any external ac series resistor or the printed circuit board assembly itself is exchanged, the relay will require recalibration. The dc series dropper resistor Rext 1 may be exchanged without affecting the relay calibration.

6.8 Repair and replacements

The instructions given enable the detection of faults to sub-assembly level. It is recommended that any fault on the pcb should be rectified by replacement of the complete board. However, if any component is replaced, then the relay must be recalibrated.

It is recommeded that the module is returned to ALSTOM T&D Protection and Control Ltd for recalibration.

Should the need arise for the equipment to be returned to ALSTOM T&D Protection & Control Ltd for repair, then the form at the back of this manual should be completed and sent with the equipment together with a copy of any commissioning test results.

6.9 Repair of trip indicator on MVTU 11, MVTU 12 and MVTU 13 relays

If the trip indication fails then it may be necessary to replace the mechanical flag unit or LED indicator pcb depending on which is fitted,

On the MVTU 18 only, the LED trip indication and the output relays are fitted to pcb ZJ1060 which should be replaced complete in the event of trip indication failure.

6.10 Repair and replacement of miniature pcb mounted relay and flag mechanism (where fitted)

The miniature relay cannot be repaired. If it is proved to be operating incorrectly, it must be replaced. The flag assembly can be reset, or damaged parts replaced as required. If any part of the flag/relay assembly is disturbed, the settings of the assembly must be checked and adjustments made where necessary.

To gain access to the flag assembly, to replace parts or check the settings, it is necessary to dismantle the module. Once access to the flag assembly, mounted on the front plate of the relay, has been gained, adopt the following procedure:

(i) Remove the screw holding the side plate to the top plate and remove the side plate. This will reveal the miniature relay and the flat spring. Access is possible through the side of the assembly unless impeded by other components.

(ii) Remove the 3 screws (2 at the top, 1 at the bottom) holding the printed circuit board to the top and bottom plates. The circuit board, with the miniature relay can now be withdrawn from the flag assembly.

(iii) Remove the 2 screws holding the flag spring and clamp plate to the bottom plate. The flag spring can now be extracted from the assembly.

Note that the top and bottom plates cannot be removed from the relay front plate without damaging the adhesive name plate, which covers the heads of the countersunk screws holding the top and bottom plates to the front plate.

Assembly is in the reverse order of dismantling.

6.10.1 Setting up procedure for the flag assembly.

Flag spring units are supplied pre-bent and should need no further adjustment before assembly.

With the flag spring and printed circuit board carrying the miniature relay assembled to the top and bottom plates check the settings:

(i) Lift the flag spring to the latched position so that the tab on the flag spring rests on the catch on the relay,

(ii) With a gap of 0.4mm between the inside face of the armature and the core, the flag should remain latched.

With a gap of 0.15mm the flag should drop. If necessary carefully bend the tab to fulfil these conditions.

These tests should be performed by positioning an appropriate feeler gauge between the armature and coil and then energising the coil with the appropriate voltage to pick up the relay.

(iii) With the flag in the latched position the spring should exert a force of 10 – 12 grams on the catch. This is checked using a gram gauge, just lifting the flag off the catch.

(iv) With the flag in the latched position the white stripes on the flag should show evenly through the slots in the nameplate. Adjustment is made by slackening the pcb fixing screws and moving the pcb assembly up or down as necessary, then re-tightening the screws. After adjustment of the pcb the catch engagement must be rechecked as in (ii).

(v) Allow the flag to drop (by energising the relay coil). The red stripes should show evenly through the slots in the nameplate. Adjustment is made by bending the tabs, one on each side of the bottom plate.

6.10.2 Flag replacement parts

Spring	GT7001 001
Flag	GT9009 001
Clamp plate	GT2007 001
Printed circuit board	ZG0859

Armature clip

Several different makes of relay are used, which require different designs of armature clip. When ordering a replacement relay, state that it is for use in a flag assembly and it will be supplied with the correct armature clip.

The armature clip is marked by a number in the moulding to indicate which make of relay it fits:

Make of relay	Number on clip	Reference number
PASI	1	GT 6008 001
HALLER	2	GT 6007 001

6.11 Replacements parts – ordering information

When ordering any spares, please quote the relay model number and serial number as well as the printed circuit board part number.

Should the need arise for the equipment to be returned to ALSTHOM T&D Protection & Control Ltd for repair, then the form at the back of this manual should be completed and sent with the equipment together with a copy of any commissioning test results.

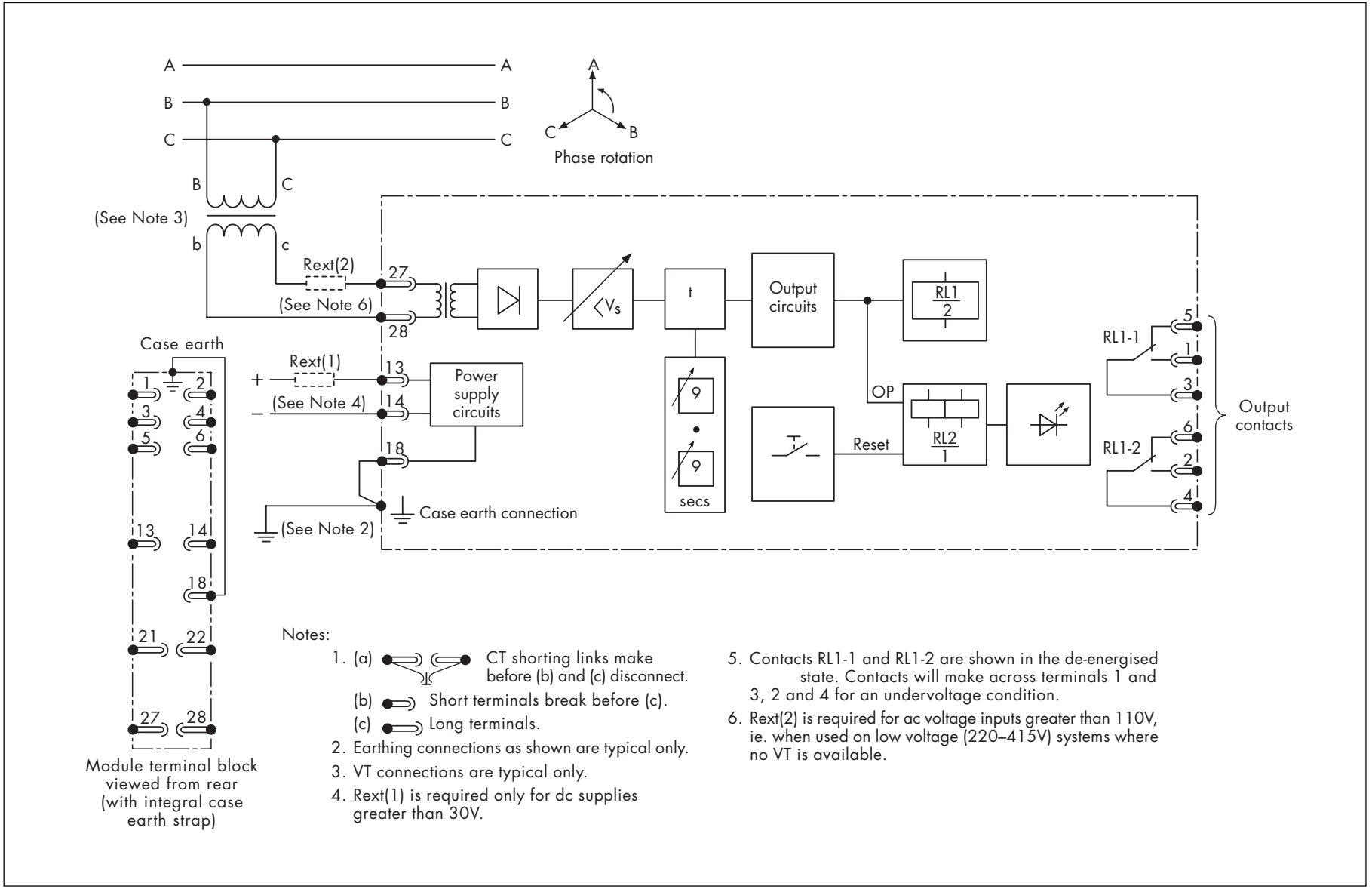

Figure 5 Application Diagram: Static modular definite time delayed undervoltage relay – Type MVTU 11

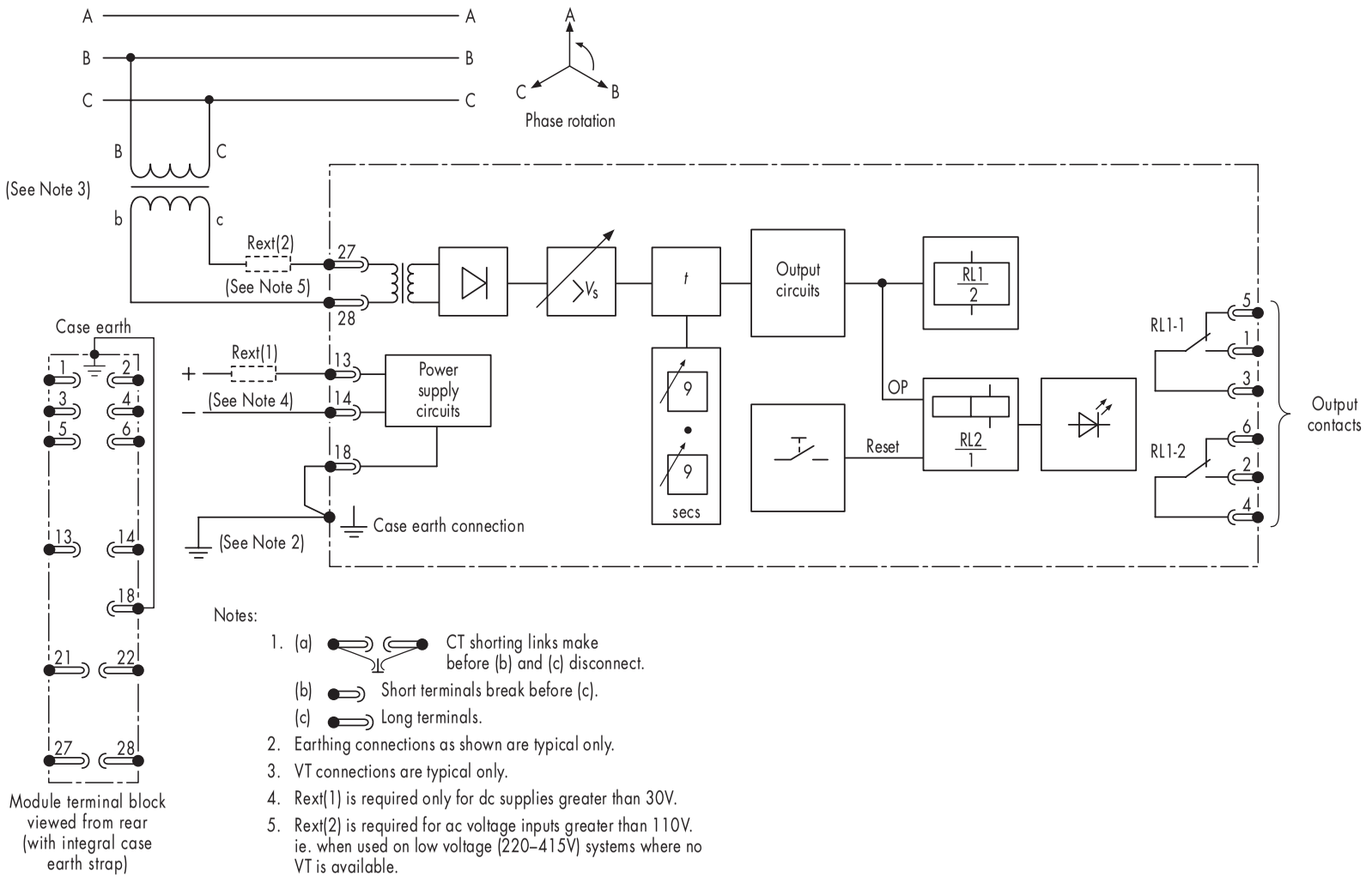

Figure 6 Application diagram: Static modular definite time delayed overvoltage relay – Type MVTU 12

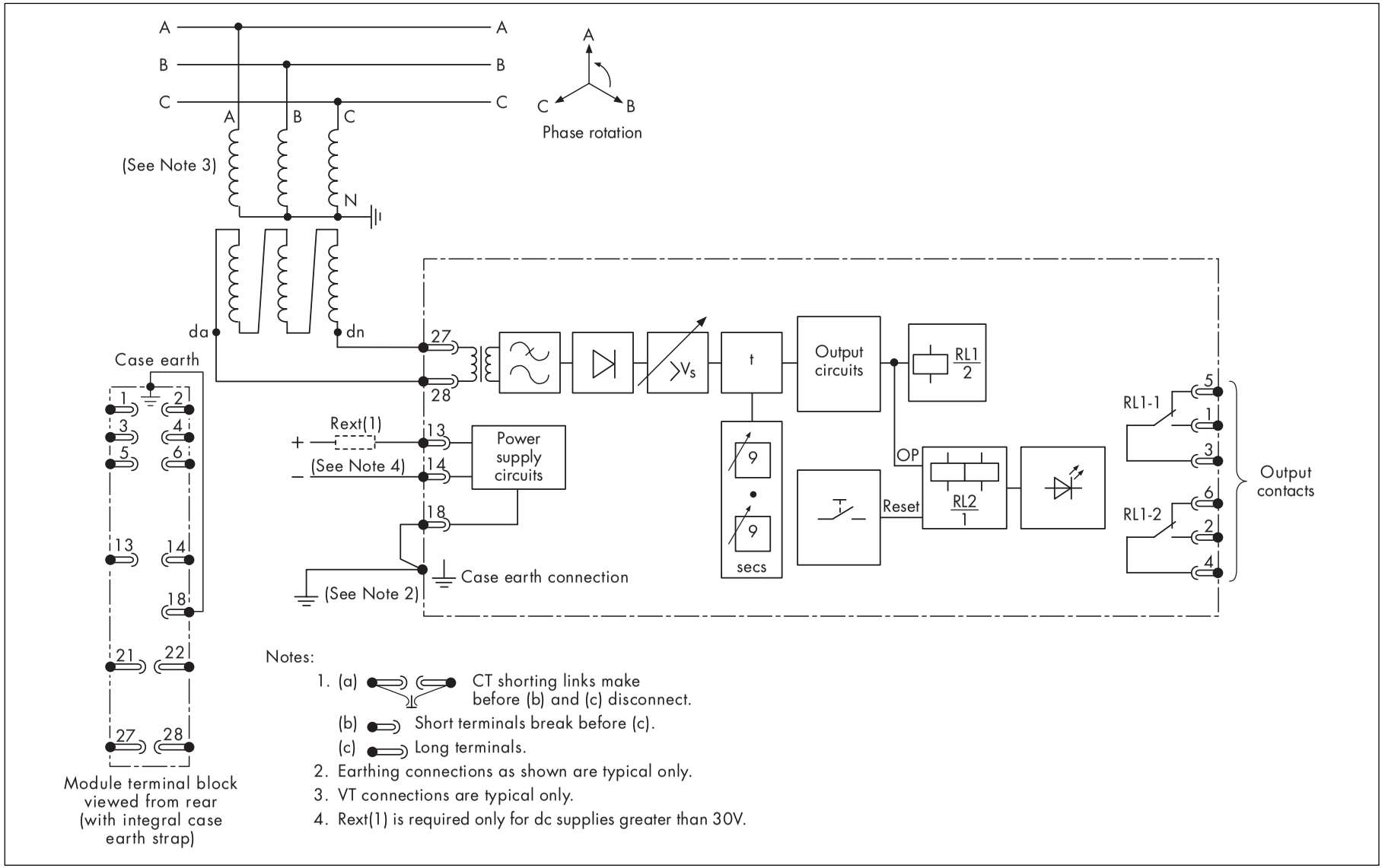

Figure 7 Application Diagram: Static modular definite time delayed neutral displacement voltage relay – Type MVTU 12. Suitable for use with unearthed, solidly earthed or impedance earthed systems).

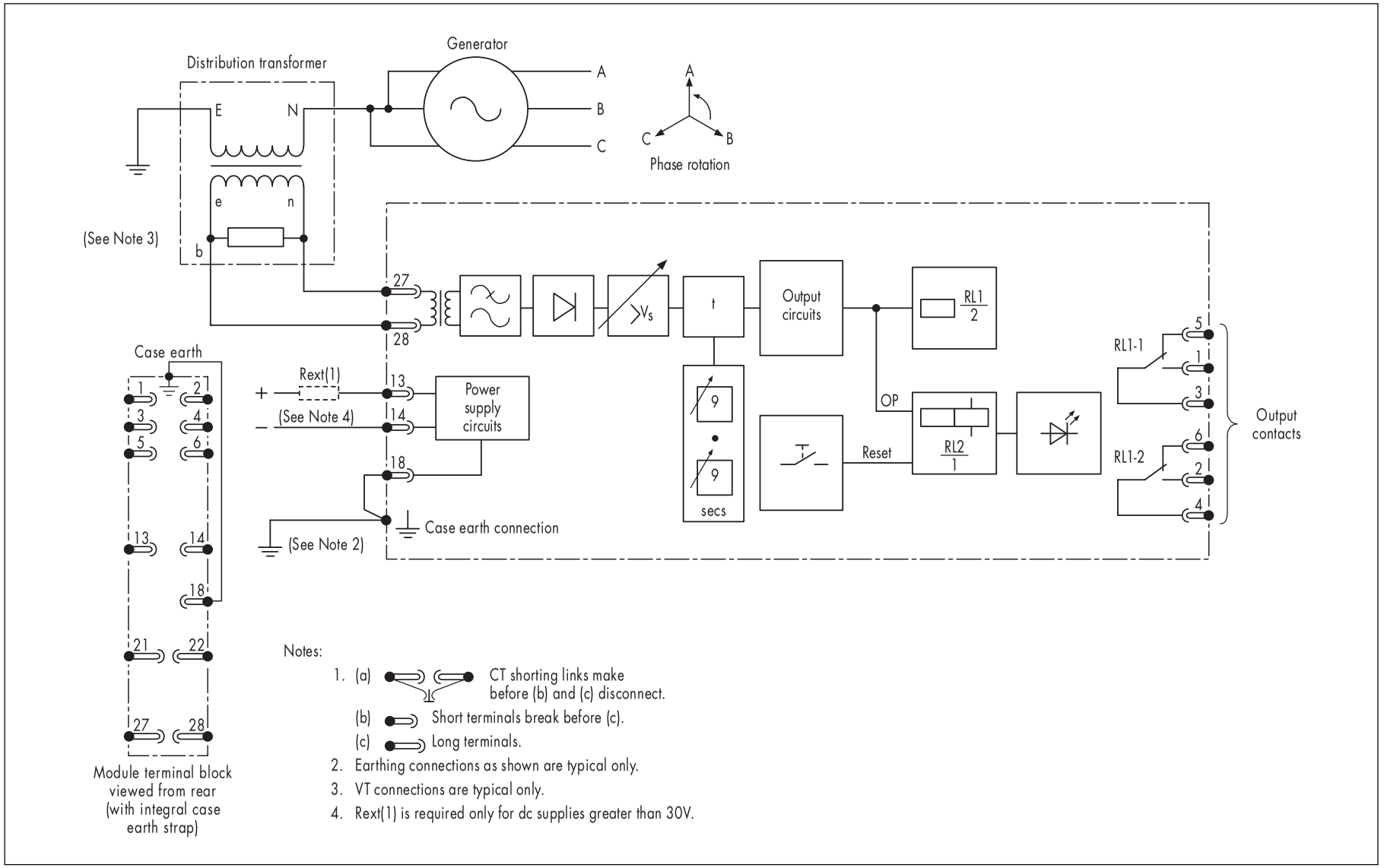

Figure 8 Application diagram: Static modular definite time delayed neutral displacement voltage relay, type MVTU 13. Suitable for use with distribution earthed generators for stator earth faults).

Section 7 COMMISSIONING TEST RECORD

Definite Time Voltage Relays Type MVTU

Date _____

Station _____ Circuit _____

Relay Model No. MVTU _____ Serial No. _____

Rated AC Voltage Vn _____ Rext 2 (if required) _____

DC Auxiliary Voltage Vx _____ Rext 1 (if required) _____

DC Supply Check VX _____ Volts

Voltage Setting Check Timer Setting = 0.1 s

	Voltage Setting	Pick Up Value	Drop Off Value
Test 1			
Test 2			
Test 3			
Test 4			
Test 5			
Test 6			
Test 7			
Final Setting			

Timer Setting t_1 Check Voltage setting Vs _____

1.1	_____	2.2	_____	3.3	_____
4.4	_____	5.5	_____	6.6	_____
7.7	_____	8.8	_____	9.9	_____

Final Setting Ts _____ Time _____ s

Timer Setting t_2 Check MVTU 18 only

Voltage Setting Vs _____

1.1	_____	2.2	_____	3.3	_____
4.4	_____	5.5	_____	6.6	_____
7.7	_____	8.8	_____	9.9	_____

Final Setting Ts _____ Time _____ s

Contact Check

(All Relays)		MVTU 18 only		Trip Indicator Check	
1-3	_____	7-9	_____	Operate	_____
3-5	_____	9-11	_____		
2-4	_____	8-10	_____	Reset	_____
4-6	_____	10-12	_____		

_____ _____

Commissioning Engineer Customer Witness

_____ _____

Date Date

REPAIR FORM

Please complete this form and return it to ALSTOM T&D Protection & Control Ltd with the equipment to be repaired. This form may also be used in the case of application queries.

ALSTOM T&D Protection & Control Ltd
St. Leonards Works
Stafford
ST17 4LX, England

For: After Sales Service Department

Customer Ref: _____ Model No: _____

Contract Ref: _____ Serial No: _____

Date: _____

1. What parameters were in use at the time the fault occurred?

   AC volts _____ Main VT/Test set

   DC volts _____ Battery/Power supply

   AC current _____ Main CT/Test set

   Frequency _____

2. Which type of test was being used? _____

3. Were all the external components fitted where required? Yes/No
   (Delete as appropriate.)

4. List the relay settings being used

   _____

   _____

   _____

5. What did you expect to happen?

   _____

   _____

   _____

   _____

continued overleaf

6. What did happen?

_____

_____

_____

_____

7. When did the fault occur?

Instant Yes/No Intermittent Yes/No

Time delayed Yes/No (Delete as appropriate).

By how long? _____

8. What indications if any did the relay show?

_____

_____

_____

9. Was there any visual damage?

_____

_____

_____

10. Any other remarks which may be useful:

_____

_____

_____

_____ _____

Signature Title

_____ _____

Name (in capitals) Company name

ALSTOM T&D Protection & Control Ltd St Leonards Works, Stafford, ST17 4LX England
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