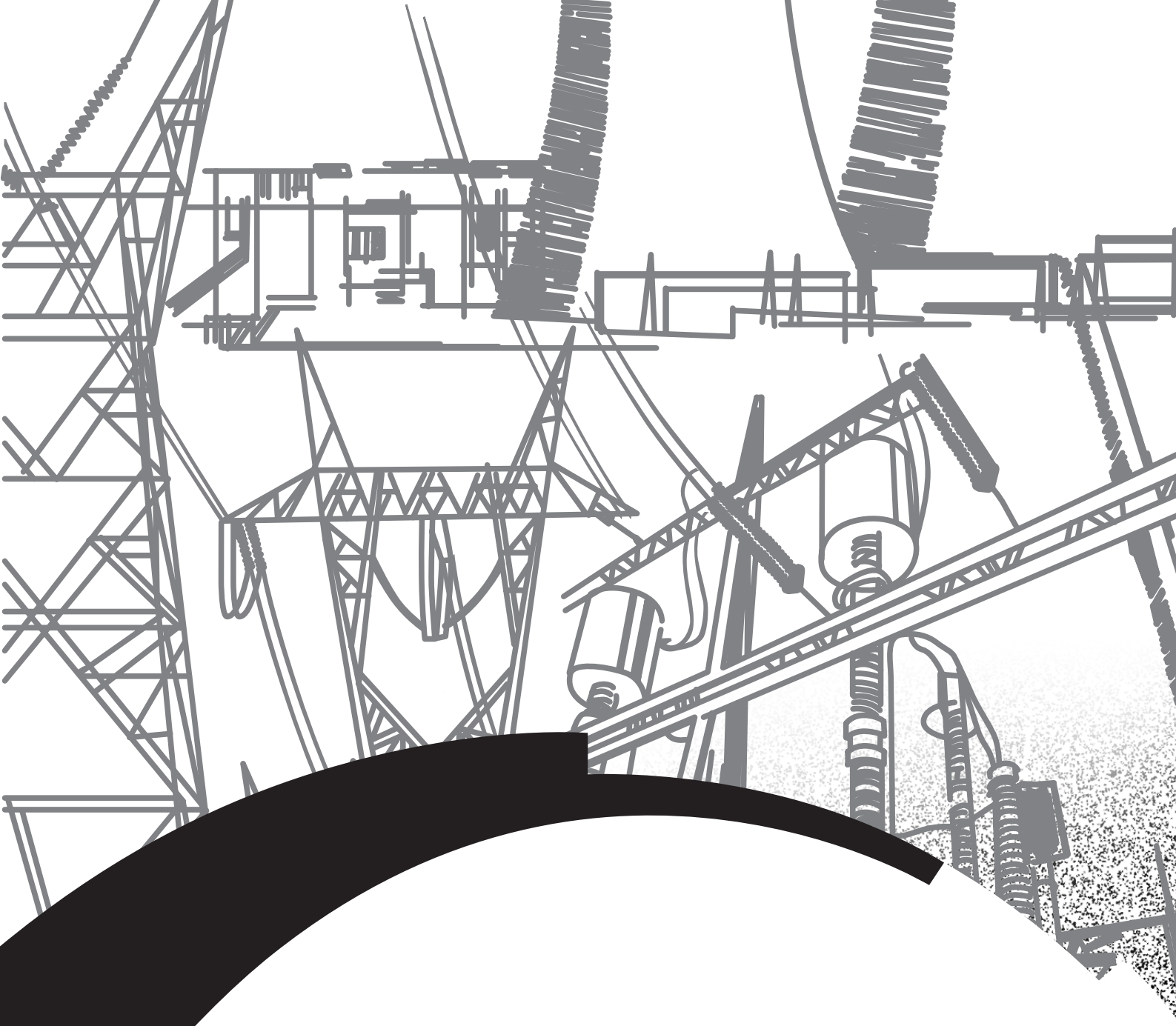


Service Manual

Type MWTU 11
Forward and Reverse Power Relay

ALSTOM

Service Manual

Type MWTU 11
Forward and Reverse Power Relay

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

CONTENTS

SAFETY SECTION

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

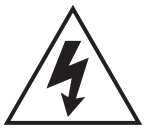
Health and safety

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

The MWTU 11 is a single phase relay measuring Icosϕ, where I is the current flowing into the relay and ϕ is the phase angle between the current and voltage vectors. MWTU 11 relays are suitable for power measurement on systems where the system voltage is considered to be constant. With a balanced load, the single phase MWTU 11 may be used to measure the three phase power of the system. This is achieved by using a phase to neutral or phase to phase connection as indicated in Figures 1 and 2 respectively. For measuring VARs in a system the MWTU 11 may be used with a quadrature connection as shown in Figure 3.

The Icosϕ detector provides an instantaneous output, the operation time of this measuring unit varies with the relay setting and is given in Figure 4. The timer incorporated within the relay may be set to start timing from either pick up or drop off of the instantaneous element, this allows the MWTU 11 to be used for detecting either overpower or underpower conditions.

A switch mode power supply is used to power the relay which is available in three different voltage ranges, 24/54V, 48/125V and 110/250V dc. Setting of the relay is achieved by a set of DIL switches on the front of the relay. These are calibrated to give a setting range of 1% to 32.5% P_n in steps of 0.5% P_n, where P_n is equal to I_n cosϕ and a timer setting range of 0.25 to 32 seconds in steps of 0.25 seconds.

Section 2. INSTALLATION

2.1 General

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.

2.2 Relay mounting

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

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 ALSTOM T&D Protection & Control Ltd should be promptly notified. Relays which are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

2.3 Unpacking

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

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 construction work.

2.4 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 ambient 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.

The storage temperature range is –25°C to +70°C.

2.5 Site

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 relays these dimensions will also be found in publication R6127.

Publication R7012, Parts Catalogue and Assembly Instructions, will be useful when individual relays are to be assembled as a composite rack or panel mounted assembly.

Publication R6001 is a leaflet on the modular integrated drawout system of protective relay.

Publication R6014 is a list of recommended suppliers for the pre-insulated connectors.

Section 3. COMMISSIONING

3.1 Commissioning preliminaries

Check that ratings of relay agree with the supplies to which the relay is to be connected.

3.1.1 Electrostatic discharge (ESD)

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

3.2 Wiring

Check all wiring connections to the relay, including the case earthing connection above the terminal block. The relay diagram number appears inside the case.

3.3 Inspection

Before leaving the factory all relays are accurately adjusted, tested and carefully packed. Hence there should be no need for any re-adjustment on commissioning.

3.3.1 Removal of cover and case

To gain access to the relay, first loosen the captive cover screws. Then carefully remove the cover from the case.

The module can then be removed from the case by grasping the handles at the top and bottom of the front plate and pulling forwards.

Care must be taken to ensure that mechanical settings of the element are not disturbed.

3.3.2 Connections

Examine wiring connections and major components and ensure that there is no obvious mechanical damage. Do not adjust trimpots on the PCB.

3.3.3 Replace the module in the case and refit the cover. Make sure that the reset mechanism in the cover is correctly located and that the LED indicator or flag can be reset.

3.4 Insulation

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 1000V. Accessible terminals of the same circuit should first be strapped together. Deliberate circuit earthing links, removed for the tests, subsequently must be replaced.

3.5 Earthing

Ensure that the case earthing stud is used to connect the relay to a local earth bar.

3.6 Main current transformers

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

3.7 Commissioning equipment required

Phase shifting transformer

Variable current source

Wattmeter

Ammeter 0 – 10A ac

Voltmeter 0 – 150V ac

Phase angle meter (optional)

Timer 0 – 100 seconds

Note: Accurate testing of the relay near the boundaries (±90° from RCA) may not be satisfactory using the calibrated marks on the phase shifting transformer. We therefore recommend that a wattmeter or phase angle meter is used to test the relay near the boundary. It is also essential that stable low harmonic content current and voltage sources are used.

Connections to the relay are shown in Figures 5 and 6 (for phase to phase and phase to neutral respectively).

3.8 Commissioning tests

Set switch $\%P_n$ to 1%.

Set timer control to 0.25 seconds.

Set DPU/DDO switch to DPU.

Connect the relay as shown in Figures 5 and 6 (phase to neutral or phase to phase connection) as appropriate.

Apply rated V_n and I_n.

Apply rated V_x.

Where the relay range covers more than one voltage apply the lowest voltage.

The values of V_n, I_n and V_x are marked on the front of the relay.

Check the green POWER LED illuminates when the auxiliary voltage (V_x) is applied to the relay.

3.8.1 Calibrating phase shifter

The following is only necessary if a phase meter is not used.

Adjust the phase shifter to give maximum reading on the wattmeter.

Set the phase shifter pointer to indicate 0°.

Adjust the phase shifter to give minimum reading on the wattmeter and readjust the pointer if necessary to indicate 90°.

Set the phase shifter to zero degrees, the voltage and current inputs are now in phase and the system set to unity power factor (UPF). This coincides with the relay characteristic angle (RCA) of 0°.

3.8.2 Power settings ($\%P_n$)

Current settings at UPF in mA.

Apply rated V_n.

Apply rated V_x.

Where the relay range covers more than one voltage apply the lowest voltage.

The operate current is measured for each switch setting given in the table below by first injecting the minimum current and checking that the instantaneous element does not pick up after 60 seconds, then injecting the maximum current and checking the output element operates within 60 seconds.

3.8.2.1 Commissioning procedure

$\%P_n$	Current = 1 Operating current in mA			Current = 5 Operating current in mA		
	nominal	minimum	maximum	nominal	minimum	maximum
1	10	8.00	12.00	50	40.00	60.00
1.5	15	13.00	17.00	75	65.00	85.00
2	20	18.00	22.00	100	90.00	110.00
3	30	28.00	32.00	150	140.00	160.00
5	50	48.00	52.00	250	240.00	260.00
9	90	87.30	92.70	450	436.50	463.50
17	170	164.90	175.10	850	824.50	875.50
32.5	325	315.25	334.75	1625	1576.25	1673.75

Setting limits are ±3% of the nominal values, or ±2mA for I_n = 1A and ±10mA for I_n = 5A, whichever is the greater.

The relay should reset at a current level greater than 97% of pick-up.

3.8.3 Relay boundary

Apply rated V_n and I_n

Apply rated V_x.

Where the relay range covers more than one voltage apply the lowest voltage.

With the power setting as given in the following table, the phase angle between the current and voltage vectors is varied to give the lead and lag phase angle boundaries for the instantaneous unit to operate with rated current applied.

Note: Adjust phase shifter SLOWLY into the operating zone until the relay operates.

Power setting %Pn	Nominal boundary from RCA	Tolerance
3	±88.3°	±1.5° or ±15% of the nominal Icosϕ value whichever is the greater.
30	±72.5°	

3.8.4 Instantaneous operating time

Set power setting $\%P_s$ to 16%.

Check the relay is connected as indicated in Figures 5 and 6 for phase to phase or phase to neutral connections as applicable.

Apply rated V_n and I_n.

Apply rated V_x.

Where the relay range covers more than one voltage apply the lowest voltage.

Set I to the following at UPF:

480mA for I_n = 1A

1500mA for I_n = 5A

Set the timer to measure the time from the switch closing to the normally open instantaneous contact between terminals 2 and 4 closing.

The measured operating time delay should be between 10ms and 40ms.

Check the contact between terminals 4 and 6 open and the contact between terminals 1 and 5 closes when the instantaneous element operates.

Open the switch at the end of the test and set all supplies to zero.

3.8.5 Reverse operation check

Reverse the connections to terminals 27 and 28 on the relay to give a 180° phase reversal.

Apply rated V_n and I_n.

Apply rated V_x.

Where the relay range covers more than one voltage, apply the lowest voltage.

Set I to the following at UPF:

480mA for I_n = 1A

1500mA for I_n = 5A

Close the switch. Check that the relay does not operate.

Open the switch at the end of the test and set all supplies to zero.

Reverse the connections to terminals 27 and 28 on the relay.

3.8.6 Time delayed operating time

Set the timer to measure the time between the normally open instantaneous contacts between terminals 2 and 4 closing and the normally open time delayed contacts between terminals 17 and 19 closing.

Using the same test conditions as given in Section 3.8.4, operate the relay by closing the switch. After a time delay the red TRIP LED should be illuminated. The TRIP LED is reset by pressing the reset push button.

Check the normally closed contact between terminals 19 and 20 opens and the normally open contact between terminals 15 and 16 closes after the time delay.

Check the time delay for the following settings:

Set time delay	Operating time (seconds)	
	Minimum	Maximum
0.25	0.20	0.30
0.5	0.45	0.55
1.0	0.95	1.05
1.5	1.425	1.575
2.5	2.375	2.625
4.5	4.275	4.725
8.5	8.075	8.925
16.5	15.675	17.375

The operating time delay tolerance is ±5% or 50ms whichever the greater.

Open the switch at the end of the test and set all supplies to zero.

3.8.7 DDO operation

Set the DPU/DDO switch to DDO.

Set the operating time to 4.5 seconds.

Set power setting $\%P_n$ to 16%.

Check the relay is connected as indicated in Figures 5 and 6 for phase to phase or phase to neutral connections as applicable.

Apply rated V_n and I_n.

Apply rated V_x.

Where the relay range covers more than one voltage apply the lowest voltage.

Set I to the following at UPF:

480mA for I_n = 1A

1500mA for I_n = 5A

Set the timer to measure the time between the normally open instantaneous contacts between terminals 2 and 4 opening and the normally open time delayed contacts between terminals 17 and 19 closing.

With the switch open, the timer should time out and the normally open time delayed contact between terminals 17 and 19 should be closed.

Close the switch to reset the MWTU 11 timer delay circuit. The time delayed contact between terminals 17 and 19 should open.

Open the switch, check the measured time delay is between 4.275 and 4.725 seconds.

Open the switch at the end of the test and set all supplies to zero.

3.8.8 Connecting relay to system

Connect the relay to the system as shown in the application diagrams (10 MWTU11 01 sheets 1, 2 and 3).

Apply the required power setting $\%P_n$ and time delay setting, including setting the time delay to DPU or DDO as required.

Check the instantaneous contacts close when power flows in the direction indicated on the application diagram.

Check the time delayed output contacts close and the TRIP indicator illuminates when the time delay circuit operates as set by DPU/DDO switch.

3.8.9 Replace any links, wiring fuses and remove any CT short circuits used during commissioning.

Section 4. MAINTENANCE

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

Routine testing of the relay can be performed by the secondary injection method, as detailed in the commissioning instructions.

As a minimum test, the relay should be routinely checked to ensure the green POWER LED is illuminated. This LED indicates the auxiliary supply is present on the relay terminals and the internal power supply is operational.

Section 5. PROBLEM ANALYSIS

5.1 General

These instructions enable a fault to be located to sub-assembly level, fault finding to component level is not recommended.

The major reasons for this are as follows:

– Fault finding on printed circuit boards (PCBs) requires specialised knowledge and equipment.

– Components used in manufacture are subjected to strict quality control procedures and in certain cases selected for a particular characteristic. Metal oxide semiconductors (MOS) components used require very careful handling.

– Damage can be caused to printed circuit board track unless extreme care is used in replacement of components.

– Replacement of certain components will require recalibration of the relay.

In the event of a faulty sub-assembly being found, it is recommended that the relay is returned to ALSTOM T&D Protection & Control Ltd or sent to a competent service centre for the work to be carried out. However, replacement sub-assemblies can be made available from ALSTOM T&D Protection & Control Ltd on request, provided the relay model number and serial number are quoted.

When investigating any faults on the relay full ESD precautions, including wearing an earthed wrist strap must be observed. Refer to the instructions inside the front cover of this manual.

When a PCB is removed from the module it should be immediately placed in an anti-static bag. Under no circumstances should the PCBs be placed in plastic bags or on a plastic surface.

If the measuring PCB is replaced it will be necessary to recalibrate the complete relay.

5.2 Visual examination of wiring

Ensure that all the push-on blades to the rear terminal block are in position.

Ensure that all the connectors to the PCB are in position and pushed fully hoe.

Note: The large wirewound resistors at the top of the PCB ZJ0250 are not fitted to the VAR versions of the MWTU 11.

Check all the PCB interconnecting plugs and sockets are making correctly.

5.3 Gaining access to the relay internal circuits

Where required the following method is used to gain access to the internal circuits of the module.

The method for removing the front plate is to remove the four pozidrive screws from the black front plate which will then release the front plate from the relay module.

To remove the measuring PCB, first disconnect all the connectors plugged into the side of the measuring PCB, the PCB may then be gently eased forward taking care not to stress the rear PCB to PCB connectors. When the measuring PCB is replaced, care should be taken to ensure the rear mounted connectors align before fully pushing the measuring PCB home.

The measuring PCB may now be pulled forward.

5.4 Power supply PCB test

This section is to check the power supply consisting of the backplane PCB ZJ0300 and the backplane daughter PCB ZJ0228 operate correctly.

With the measuring PCB still in the module, apply rated dc auxiliary voltage to terminal 13(+) and 14(–). Use a high impedance dc voltmeter to check the voltages measure on PL2 of the backplane power supply PCB are as follows:

Measure voltage between terminals on PCB ZJ0300 - PL2	Approximate voltage (V)
PL2-6 to PL2-8	+15V
PL2-5 to PL2-8	+5V
PL2-10 to PL2-8	–15V

Note: Care should be taken to ensure that no short circuits to other connector terminals are made inadvertently when connecting the voltmeter to the required terminals, as this could result in damage to the relay.

Pin 1 of PL2 is to the top of the PCB.

The measuring PCB should always be in position when power is applied to the relay.

If any of the voltages are not present or are very low, a fault is present on the power supply back plane or daughter PCB. In this instance both the backplane PCB ZJ0300 and daughter PCB ZJ0228 should be replaced.

5.5 CT test

A suitable connector will be required for this test to allow connections to be made to PL8.

Check all supplies are off.

Unplug PL8 from the PCB, this is the connection from the torroidal current transformer.

Connect an ammeter between the yellow and blue wires to PL8.

Apply rated current (I_n) to terminals 27 and 28.

Do not apply auxiliary voltage (V_x) or measured voltage (V_n) to the relay.

The reading obtained on the ammeter should be 2.5mA.

Switch off the ac current supply to the relay.

Change the ammeter connections to measure the current between the yellow and green wires.

Apply rated current (I_n) to terminals 27 and 28.

Do not apply auxiliary voltage (V_x) or measured voltage (V_n) to the relay.

The reading obtained on the ammeter should be 5mA.

Switch off the ac current supply to the relay.

5.6 VT test

A suitable connector will be required for this test to allow connections to be made to PL7.

Check all supplies are off.

Unplug PL7 from the measuring PCB ZJ0250. This is the connection to the voltage transformer.

Connect a voltmeter between the red and black wires.

Apply rated voltage (V_n) to terminals 21 and 22.

Do not apply auxiliary voltage (V_x) or current (I_n) to the relay.

The reading obtained on the voltmeter should be approximately 38V.

Switch off the voltage supply to the relay.

5.7 Measuring PCB (ZJ0250)

Use a phase to phase connection as shown in Figure 5.

Apply the phase to neutral voltage V_n to terminals 21 and 22.

Measuring the voltage across the 12W wirewound resistors, this should be approximately V_n.

Section 6. SPARES

When ordering spares, quote the full relay model number and any component reference numbers.

PCB numbers are marked on the component side of the PCB and consist of the PCB number printed on the silk screen followed by the PCB part number written after the pcb number.

Transformer numbers can be found on the side of torroidal transformers or on the laminations of shell transformers.

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. A copy of any commissioning test results should also be sent with the equipment.

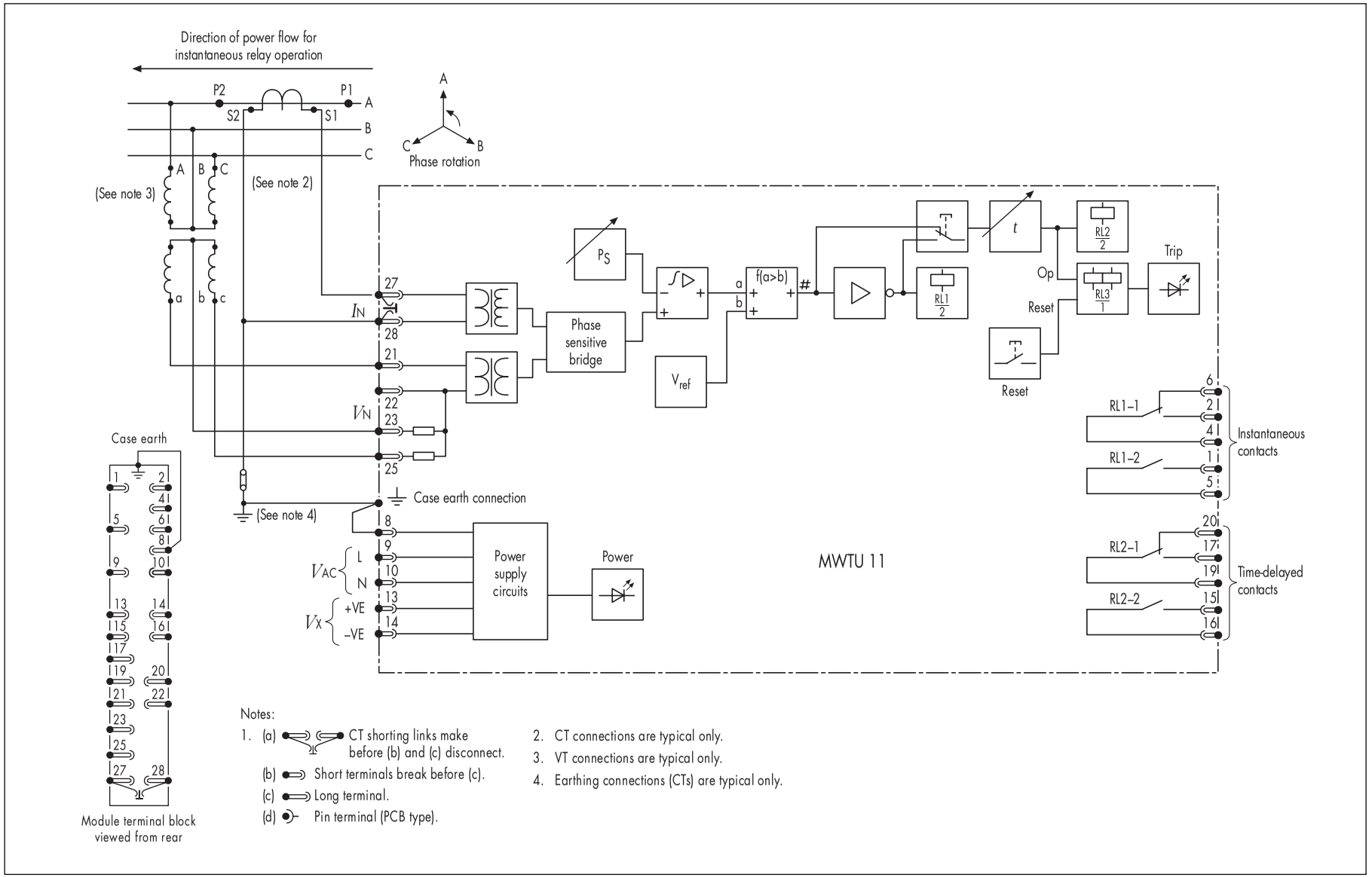


Figure 1. Application diagram for phase to phase reverse power connection

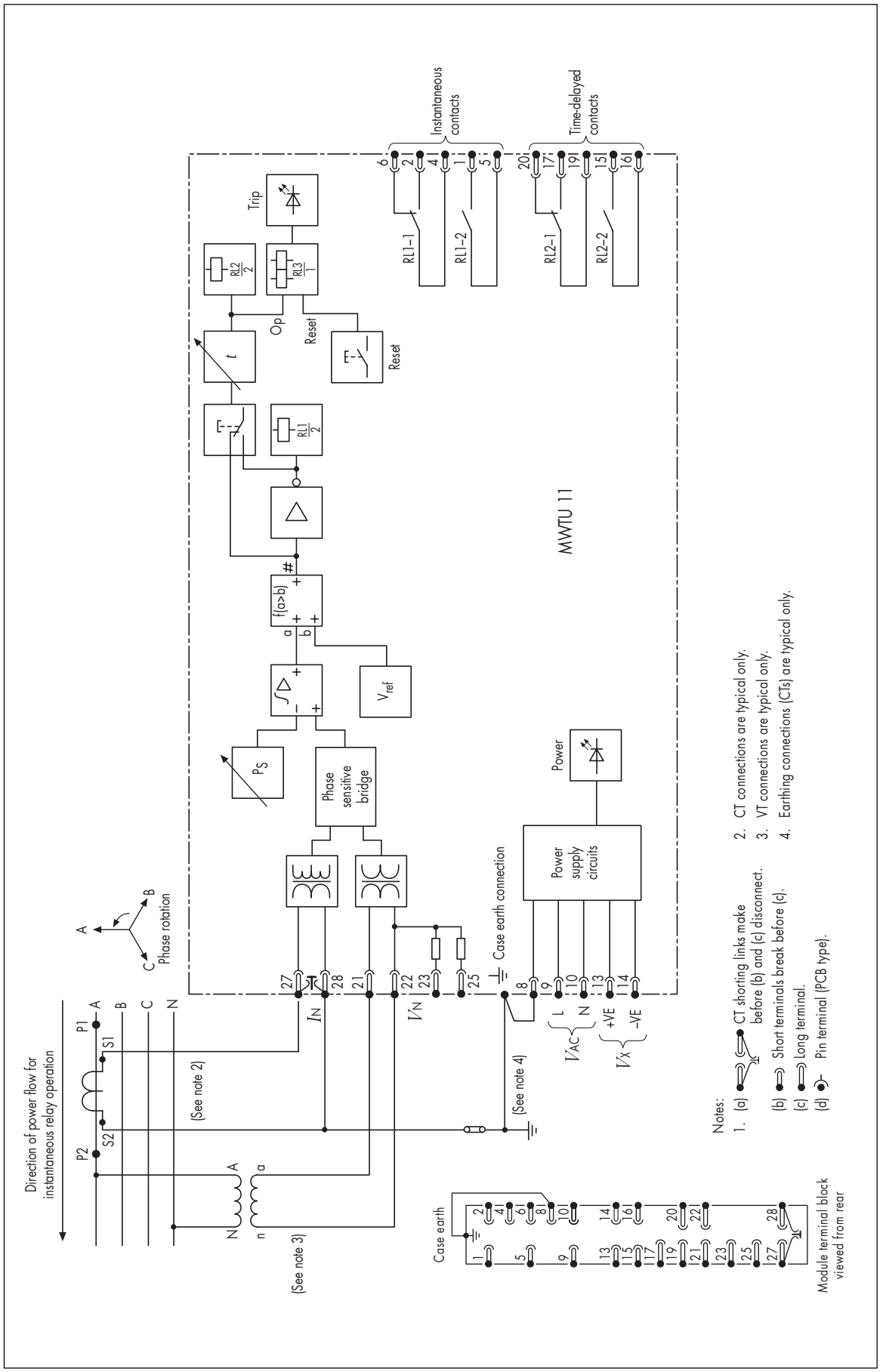


Figure 2. Application diagram for phase to neutral reverse power connection

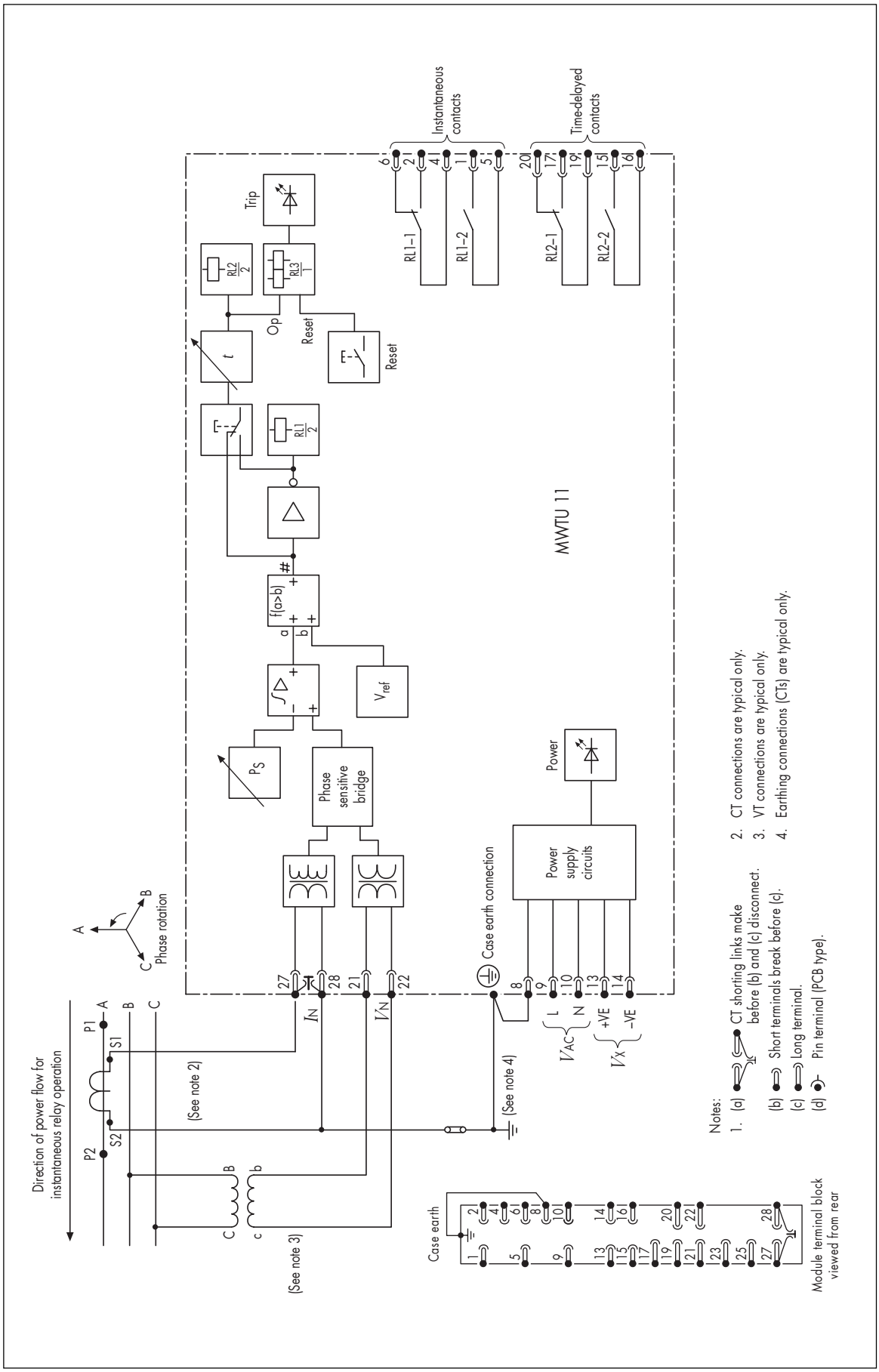


Figure 3. Application diagram for phase to phase reverse VAR connection

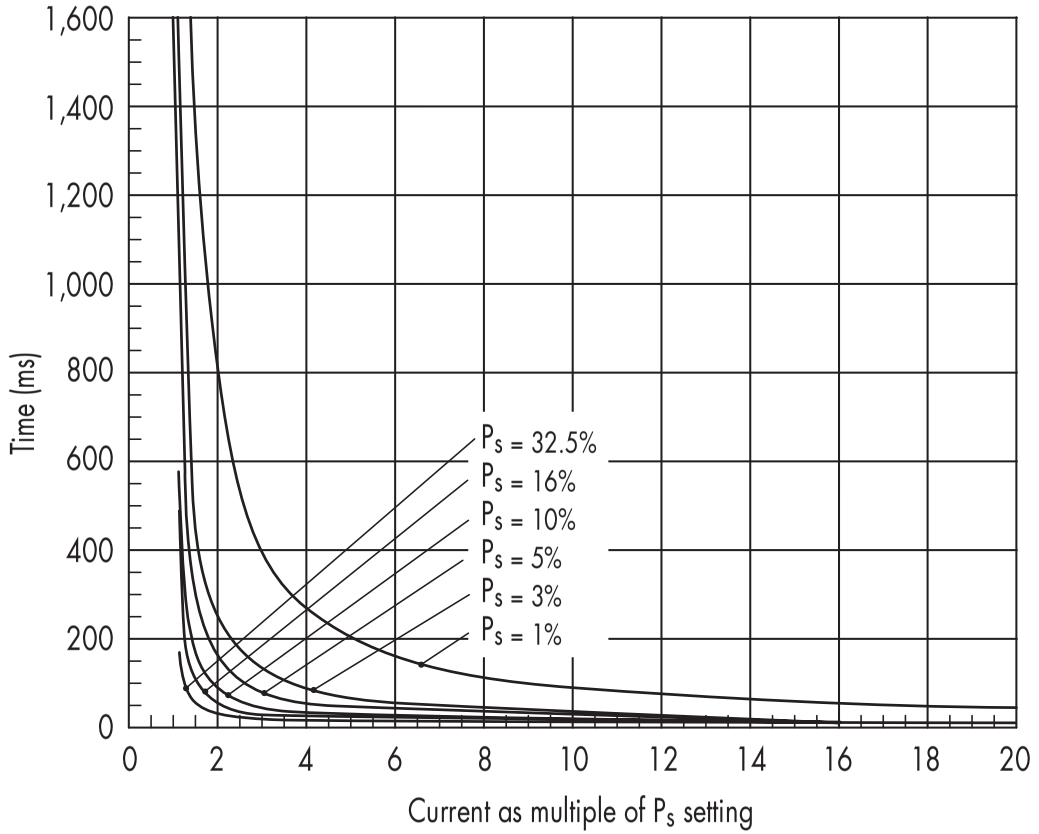


Figure 4. Instantaneous operating times

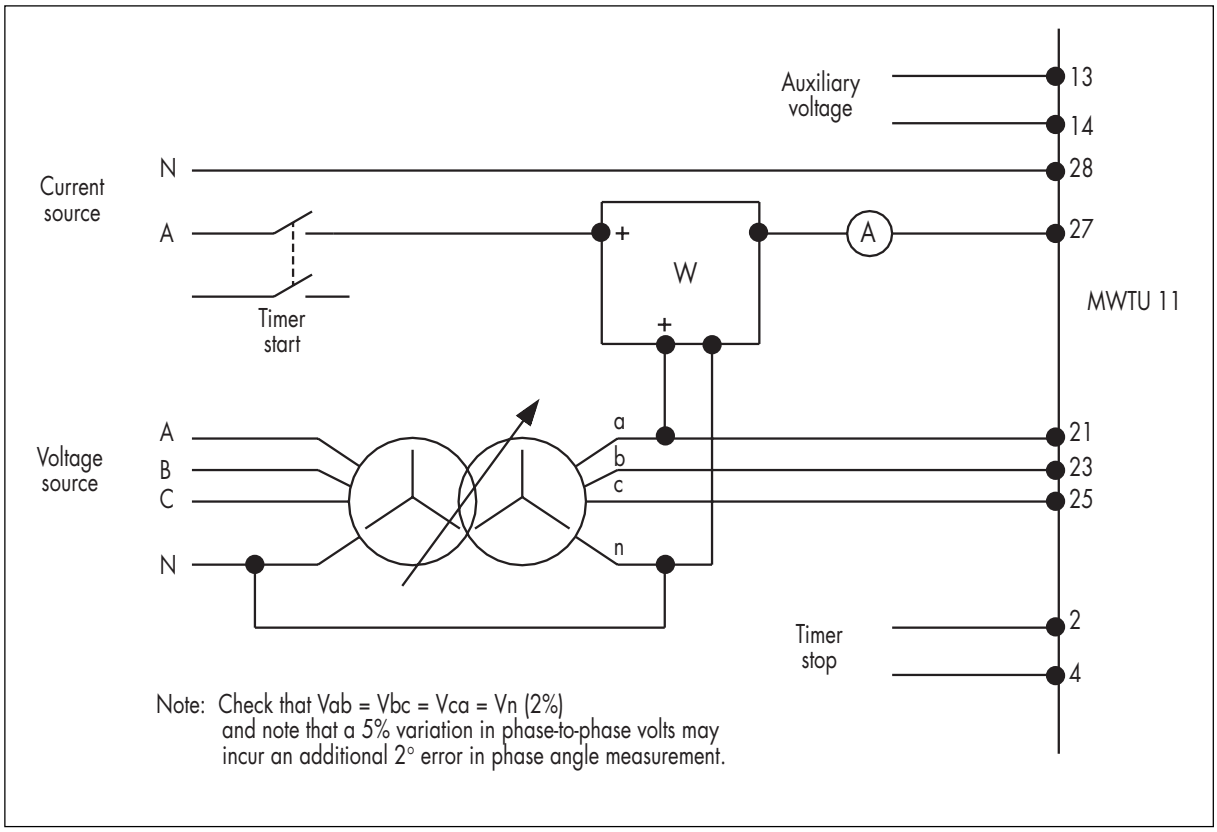


Figure 5. Commissioning phase to phase connections

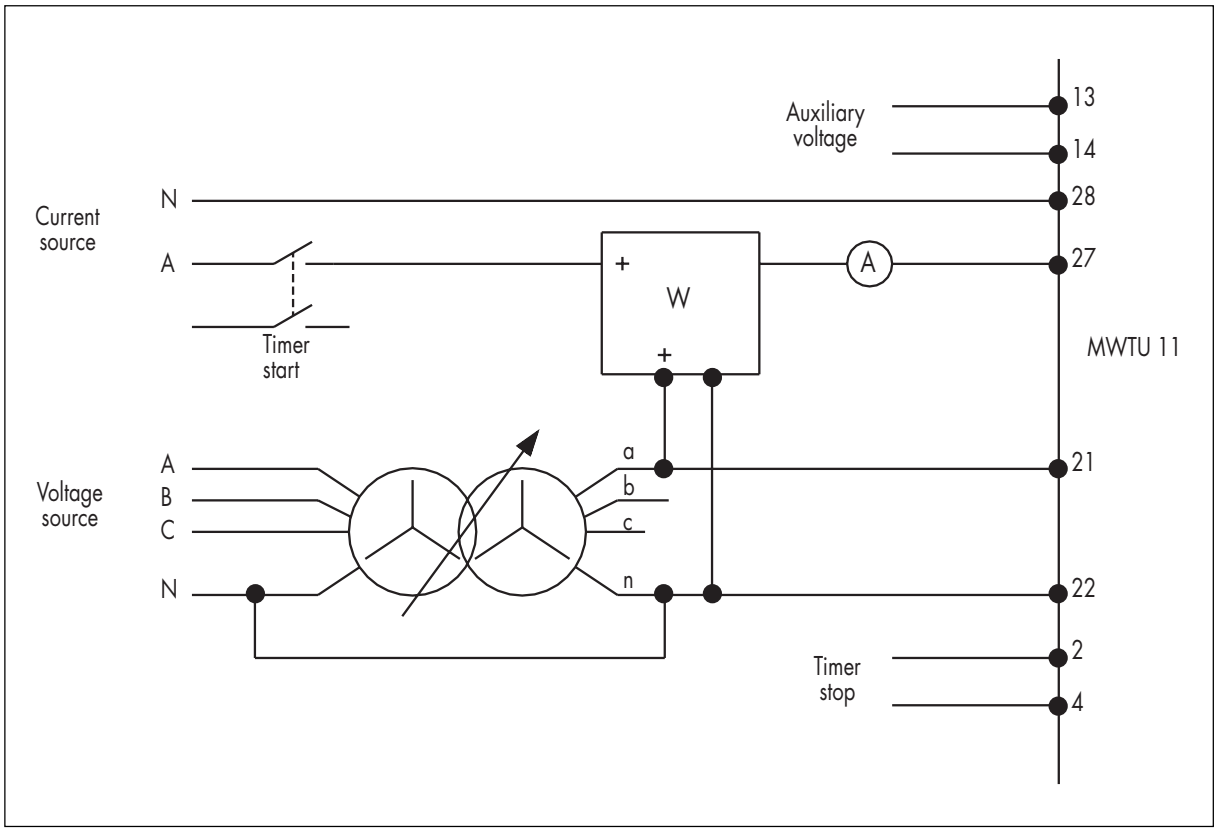


Figure 5. Commissioning phase to neutral connections

Section 7. COMMISSIONG INSTRUCTIONS

Date _____

Station _____ Circuit _____

Relay Model No. _____ Serial No. _____

Vn _____ V Vx _____ V Time delay _____

In _____ A Setting _____ %Pn Frequency _____ Hz

DPU or DDO _____

TESTS

3.4 Insulation

3.8 Power indicator

3.8.2 Current sensitivity at RCA

%Pn	mA
1	_____
1.5	_____
2	_____
3	_____
5	_____
9	_____
17	_____
32.5	_____

3.8.3 Boundary

Setting	Degrees lead	Degrees lag
3%	_____	_____
30%	_____	_____

3.8.4 Instantaneous operating time _____

Instantaneous contacts _____

3.8.5 Reverse operation check _____

3.8.6 Time delayed operating time

Time setting	Operate time
0.25	_____
0.50	_____
1	_____
1.5	_____
2.5	_____
4.5	_____
8.5	_____
16.5	_____
Time delayed contacts	_____

3.8.7 DDO operating time _____

2.8.6 System connections _____

2.8.7 Relay settings _____

%Pn _____

time delay _____

DPU/DDO _____

_____	_____
Commissioning Engineer	Customer Witness
_____	_____
Company	Company
_____	_____
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: _____

ALSTOM 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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