

Service Manual R8061
Type MFVU 21
Under/Over Frequency Protection Relay

ALSTOM

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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.

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SAFETY SECTION

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

Health and safety

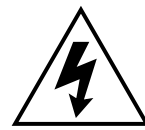
The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety 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 mm², 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, 500µs, 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:	73/23/EEC	Compliance with the European Commission Low Voltage Directive.
CE	EN 61010-1: 1993/A2: 1995 EN 60950: 1992/A11:	Compliance is demonstrated 1997 by reference to generic safety standards.

Section 1 DESCRIPTION

1.1 Applications

The relay is suitable for any application where definite time under or over frequency protection is required. Also, several relays may be used in load shedding and reconnection applications.

1.2 Brief description

The relay has two independent frequency monitoring circuits which can be set to give outputs for either under ($f <$) and over ($f >$) frequency. The frequency settings are controlled by thumbwheel switches which set the time period for one cycle of the frequency for the required setting. The usable setting range is from 0.00200s to 0.09999s which correspond to frequencies of 500Hz and 10.001Hz respectively.

Three terminals (26, 27, 28) are provided for the voltage input to the frequency monitoring circuits. The voltage input connections must be either phase-to-phase or phase-to-neutral. Two of the three terminals are selected depending on the maximum voltage which can appear at the terminals. Figure 3 details the maximum permissible input voltage for each pair of terminals.

The period of the input voltage is compared with the set period to determine whether the frequency is higher or lower and an output given according to the operating mode. This output then starts a time delay circuit with a minimum fixed setting of 0.1s which is added to, giving a maximum of 21.15s in steps of 0.05s. If the timing circuit input does not reset, a hinged armature relay with two change over contacts will operate when the set time has elapsed.

When the PU:DO = 1:1 mode is selected, both circuits operate independently as described. When the PU:DO = $f_2:f_1$ mode is selected an under frequency latching operation is obtained by selecting $<f_1$ and $<f_2$, an over frequency latching mode is obtained by selecting $>f_1$ and f_2 . The output relay RL2 will have its pickup controlled by the f_2 (t_2) setting and the drop off by the f_1 (t_1) setting. If the time delays are used, t_1 must be less than t_2 .

The output relay RL1 is controlled by the setting of f_1 and t_1 .

Whatever mode is selected there are two other switches which enable the f_1 and/or f_2 circuitry to be made inoperative. This would only normally be done if changing settings with the relay live on the system, otherwise they should be set to f_1 on and f_2 on.

The light emitting diode operation indicators are lit when the corresponding output relays pick up and are latched until the input is back to normal and the reset button pressed. (In the PU:DO = $f_2:f_1$ mode the f_2 led can be reset before RL2 resets). The test button causes an output to be given from the appropriate relay and indication when under frequency operation is selected.

It should be noted that the auxiliary supply which may be either ac or dc is brought in on case terminals 17 and 18 and for supplies greater than 125V (nominal) an external regulating device is required.

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.

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 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.

2.2 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 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 construction work.

2.3 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.

2.4 Relay Mounting

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 R6061.

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

3.1.1 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.

3.1.2 Inspection

Carefully examine the module and case to see that no damage has occurred since installation and visually check that any current transformer shorting switches are wired into the correct circuit and are closed with the module withdrawn. Check that the relay rating information is correct for the system.

3.1.3 Wiring

Check that the external wiring is correct to the relevant relay diagram or scheme diagram. Ensure that the voltage input connections are either phase-to-phase or phase-to-neutral. The relay diagram number appears inside the case.

3.1.4 Earthing

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

3.1.5 Insulation tests

These tests may be done by the main plant contractor at an earlier date.

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 giving 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 must subsequently be replaced.

3.1.6 Test block type MMLG

If test block type 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) and with terminals allocated with odd numbers (1, 3, 5, 7 etc.) and also that the dc connection is routed via test block terminals 13 and 15.

3.2 Commissioning tests

3.2.1 Equipment required

- 1 double pole switch
- 1 electronic time interval meter
- 1 accurate frequency meter suitable for supply voltage or frequency meter and oscillator capable of giving at least 20V rms at around the supply frequency to be monitored or calibrated variable frequency source giving at least 20V rms
- 1 multimeter
- 1 test plug type MMLB01 if test block type MMLG is fitted.

3.2.2 Auxiliary supply

The auxiliary supply may be either ac or dc. Check with the module removed, that the appropriate auxiliary supply is available on case terminals 17(+ if dc) and 18.

If a test block type MMLG is fitted, auxiliary dc supplies should be routed through it and removal of the cover isolated the dc positive terminal. If the test plug type MMLB01 is to be used, it is necessary to link across the appropriate terminals to restore the auxiliary supply to the relay. The voltage should be checked before connection to the relay.

If the auxiliary supply is greater than a nominal 125V ac or dc, then an external auxiliary supply unit is necessary and the relay will always be a dc type.

3.2.3 Commissioning procedure when only the supply frequency is available

3.2.3.1 Check using self-test facility

Set the option switches to:

<f1, <f2, f1 on, f2 on, PU:DO 1:1, t1 and t2 to minimum time

Connect auxiliary supply to the relay, press the test button and check that both the f1 and f2 LEDS light and that all output contacts operate. (See Figure 1). Release the test button and check that pressing the reset button causes the LEDS to go off.

3.2.3.2 Checks using the supply to be monitored

With independent elements, ie. PU:DO set 1:1, connect the accurate frequency meter to monitor the supply and a double pole switch to connect one pole of the supply to the relay and the other pole of the switch to start the time interval meter.

Measure the supply frequency to the nearest 0.1Hz then calculate the period t for a frequency 0.1Hz below and above the supply frequency. (At frequencies greater than 100Hz use a difference greater than 0.1Hz, say 0.5Hz at 400Hz).

Set t1 and t2 to give a frequency 0.1Hz below the supply frequency, set <f1 and <f2 on the option switches and check that no operation is obtained when the supply frequency is switched to the relay. Check that with >f1 and >f2 set operation is obtained.

Set t1 and t2 to give a frequency 0.1Hz above the supply frequency. Check that with >f1 and >f2 set on the option switches that no operation is obtained when the supply is switched to the relay. Check that with <f1 and <f2 set operation is obtained on switching on the supply.

Set the option switches to their required operating positions. Also set the required times for t1 and t2. Timing checks can now be done using the necessary t1 and

settings to give operation when the supply is switched to the relay. Use one pole of the double pole switch to start the electronic timer in the appropriate mode and stop it with the required relay contact.

It may be thought desirable to check the minimum and maximum time settings available before doing the check at the actual required setting. Take the average of five timing shots. Times should be within $\pm 3\%$ or 50ms whichever is the greater.

Put the required settings on t1 and t2 and make sure the result sheets and setting chart are completed.

3.2.4 Commissioning procedure if an accurate variable frequency source is available

3.2.4.1 Check using the relay self test facility. This can be done as described in Section 2.3.3.1.

3.2.4.2 Put the required setting on t1 and t2. Set the options required and initially set t1 and t2 to their minimum.

3.2.4.3 If PU:DO is set to 1:1 and <f is set on a particular element

The variable frequency supply should be connected to the appropriate relay terminals via one pole of the two pole switch. The voltage is not critical except at low frequencies when the input transformer will saturate at a much lower value. If the supply is only a low voltage, it may be necessary to connect to the more sensitive input if it is not already connected. The figure giving the maximum input voltage for given input terminals at all frequencies should also be referred to. (See Figure 3).

Set the supply frequency just above the set frequency, switch it on to the relay and slowly lower the frequency until operation is obtained. Note that with no time delay set, output relay contact chatter may be heard at the operation boundary.

The measured frequency should show very close agreement with the set frequency taking into account the allowable error in the frequency meter or calibrated source.

The required times should now be set on t1 and/or t2 and the supply frequency set to say 1 Hz below the relay set frequency. The other pole of the double pole switch should be connected to start the time interval meter and the appropriate relay contact to stop it. If it is thought necessary, a check on the minimum and maximum time settings could be done first.

Take the average of five timing shots. The time obtained should be within $\pm 3\%$ or 50ms whichever is the greater.

3.2.4.4 If PU:DO is set to 1:1 and >f is set on a particular element

Proceed as in Section 3.2.4.3 but initially set the supply frequency below the setting and increase it to determine the setting.

For timing tests set the frequency above the setting.

3.2.4.5 If PU:DO is set to f2:f1 and <f1 and <f2 are set

The element controlled by f1 and t1 can be checked as in Section 3.2.4.3.

The element controlled by t2 and t2 can also be checked as in Section 3.2.4.3 except in addition it must be checked that the contact drop-off occurs at the frequency set for f1. (The f2 LED can be reset at about the f2 frequency).

3.2.4.6 If PU:DO is set to f2:f1 and >f1 and >f2 are set

The element controlled by f1 and t1 can be checked as in Section 3.2.4.4.

The element controlled by f2 and t2 can also be checked as in Section 3.2.4.4 except in addition it must be checked that the contact drop off occurs at the frequency set for f1. (The f2 LED can be reset at about the f2 frequency).

3.2.4.7 Make sure all necessary result are recorded and the in-service setting chart completed on the sheets provided.

Section 4 MAINTENANCE

Periodic maintenance is not necessary. However, periodic inspection and test is recommended. This should be carried out every 12 months or more often if the relay is operated frequently or is mounted in poor environmental conditions.

4.1 Repeat commissioning tests to prove correct operation or for more limited testing operate the test pushbutton having previously isolated the tripping circuits from the relay output.

Section 5 PROBLEM ANALYSIS

Should any problems be experienced with the relay, the commissioning tests should be repeated. If the relay is found to be faulty it should be returned to ALSTOM T&D Protection & Control Ltd for repair and recalibration since there are no user serviceable parts inside.

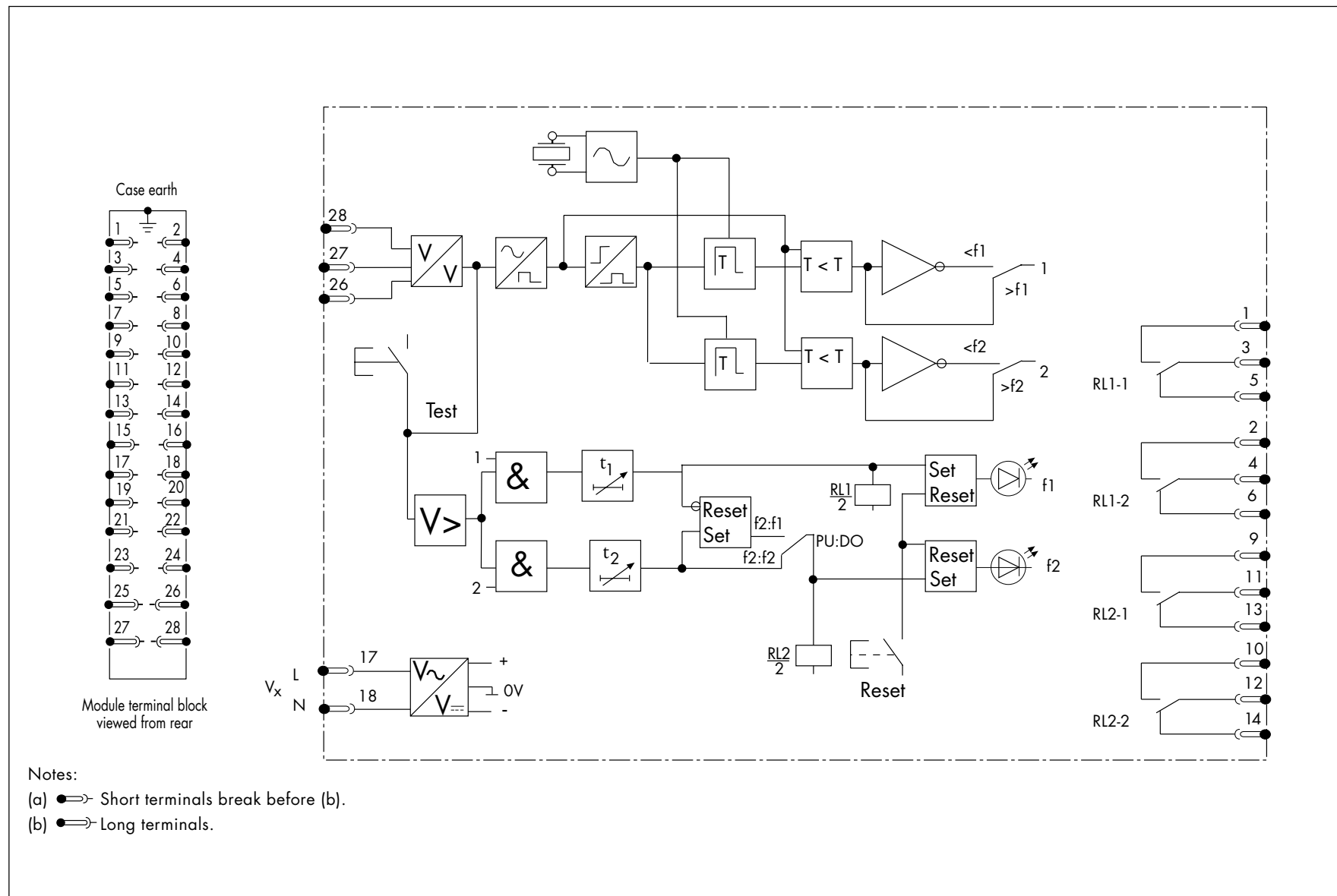


Figure 1. Typical block diagram - AC relay - (diagram no. 10 MFVU21 501)

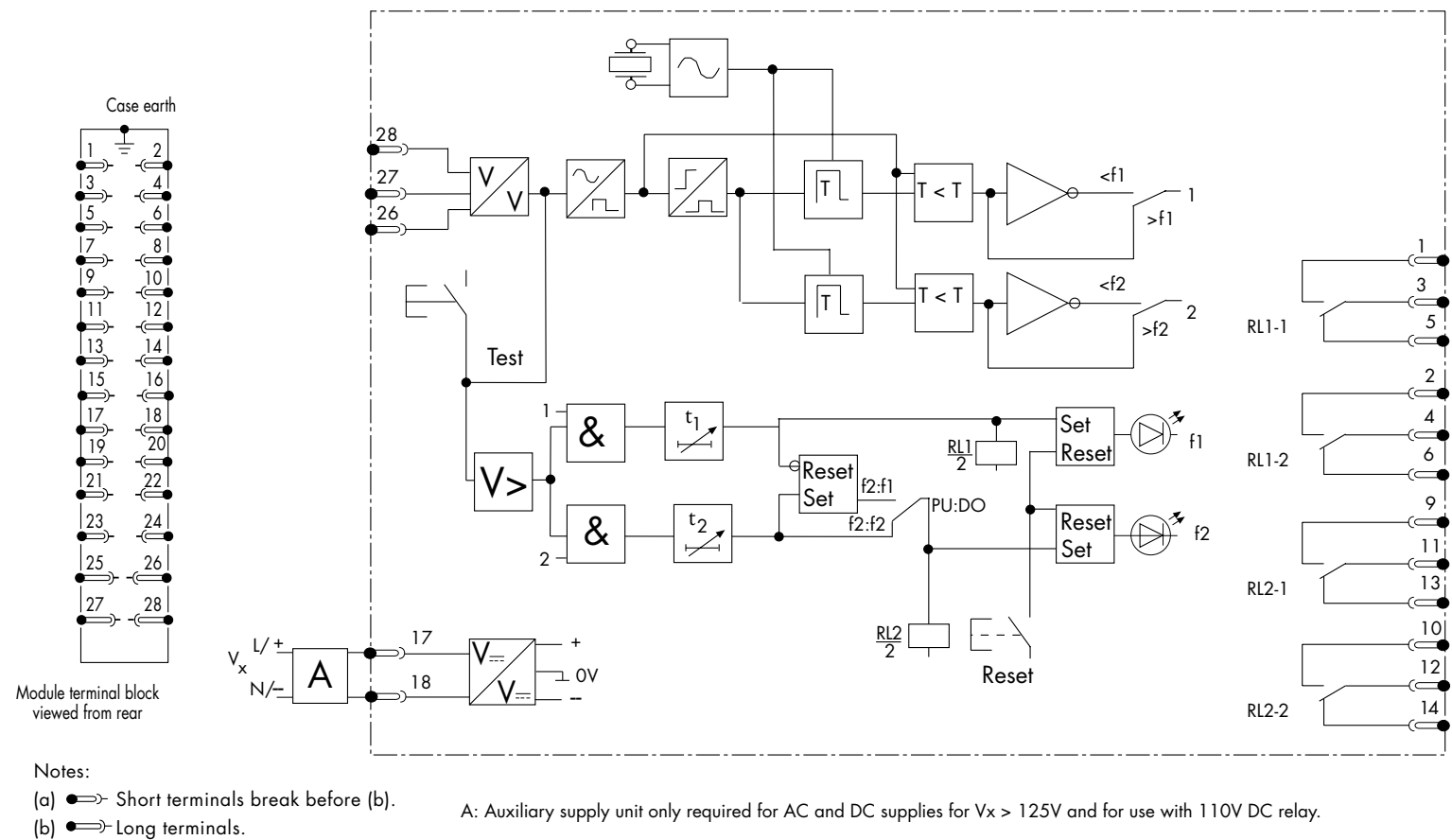


Figure 2. Typical block diagram - DC relay - (diagram no. 10 MFVU21 502)

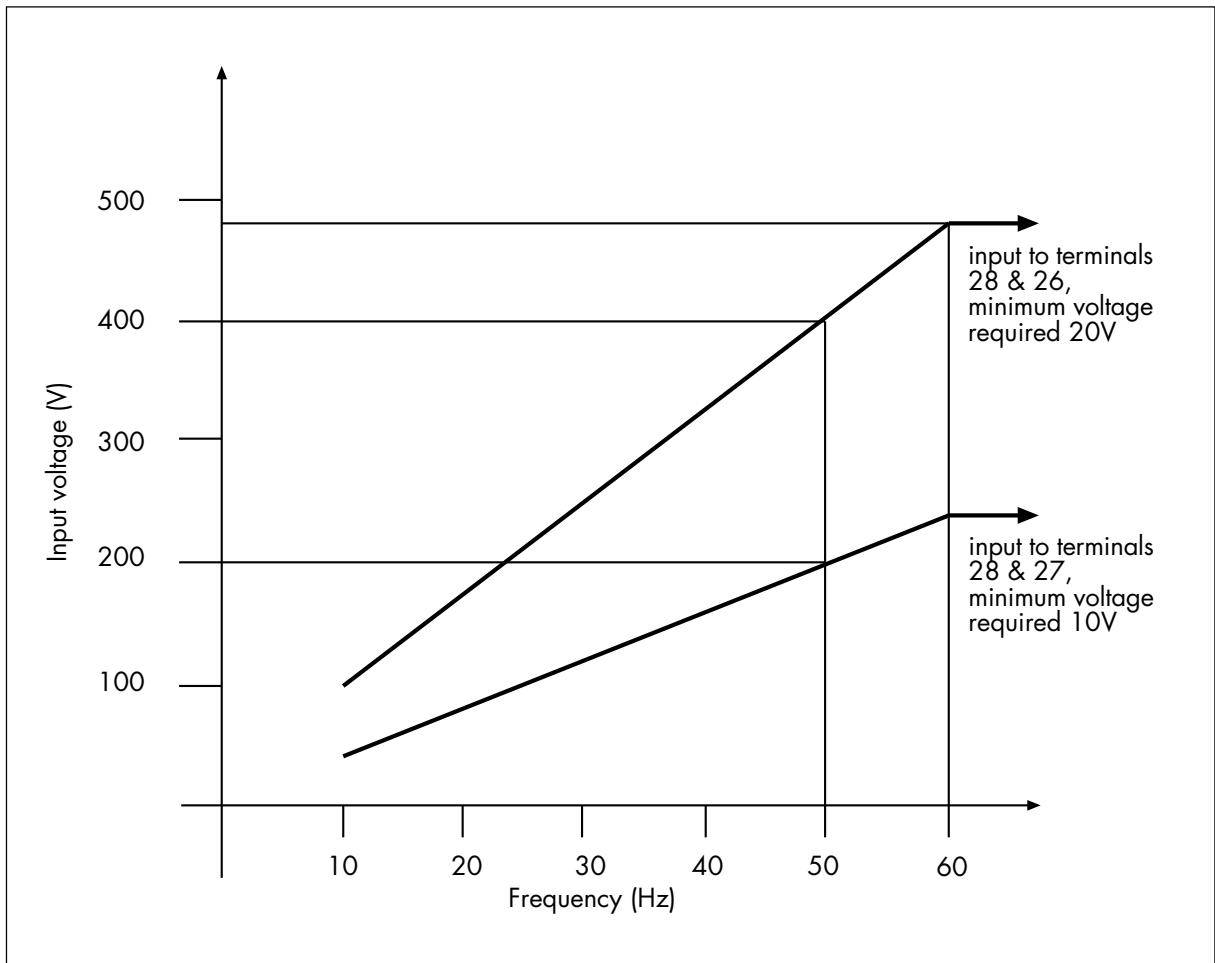


Figure 3. Maximum permissible variation of input voltage with frequency

Σ = The sum of numbers by switches to the left

Indicate switches set to the left by

X	
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Figure 4. Chart of in service settings

Section 6. COMMISSIONING TEST RECORD

Under/Over frequency relay type MFVU 21

Station _____ Circuit _____

Model no. _____ Serial no. _____

Auxiliary supply Vx _____ V _____ AC _____ DC _____

Visual inspection _____

Insulation tests _____

Auxiliary supply at terminals 17 and 18 _____

Self test facility checks _____

3.2.3 Checks using supply frequency only

Measured supply frequency _____ Hz

Setting for t1 and t2 below supply frequency _____ s

Setting for t1 and t2 above supply frequency _____ s

Correct operation for t1 and t2 giving a frequency below supply frequency ☐

Correct operation for t1 and t2 giving a frequency above supply frequency ☐

Timing tests

t1 set to 0.1s average time = _____ s

t1 set to 21.15s average time = _____ s

t1 set to _____ s average time = _____ s

t2 set to 0.1s average time = _____ s

t2 set to 21.15s average time = _____ s

t2 set to _____ s average time = _____ s

t1 setting = _____ s

t2 setting = _____ s

Chart of in service settings completed

☐

3.2.4 Checks using an accurate variable frequency source

Required f1 = _____ Hz

Set t1 = _____ s

Measured f1 = _____ Hz

Required f2 = _____ Hz

Set t1 = _____ s

Measured f2 = _____ Hz

Timing tests

t1 set to 0.1s

average time = _____ s

t1 set to 21.15s

average time = _____ s

t1 set to _____ s

average time = _____ s

t2 set to 0.1 s

average time = _____ s

t2 set to 21.15s

average time = _____ s

t2 set to _____ s

average time = _____ s

If PU:DO is set to f2:f1

Frequency at which RL2 resets = _____ Hz

Chart of in service settings completed

11

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: _____

GECA 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
Tel: 44 (0) 1785 223251 Fax: 44 (0) 1785 212232 Email: pcs.enquiries@tde.alstom.com Internet: www.alstom.com

©1999 ALSTOM T&D Protection & Control Ltd

Our policy is one of continuous product development and the right is reserved to supply equipment which may vary from that described.