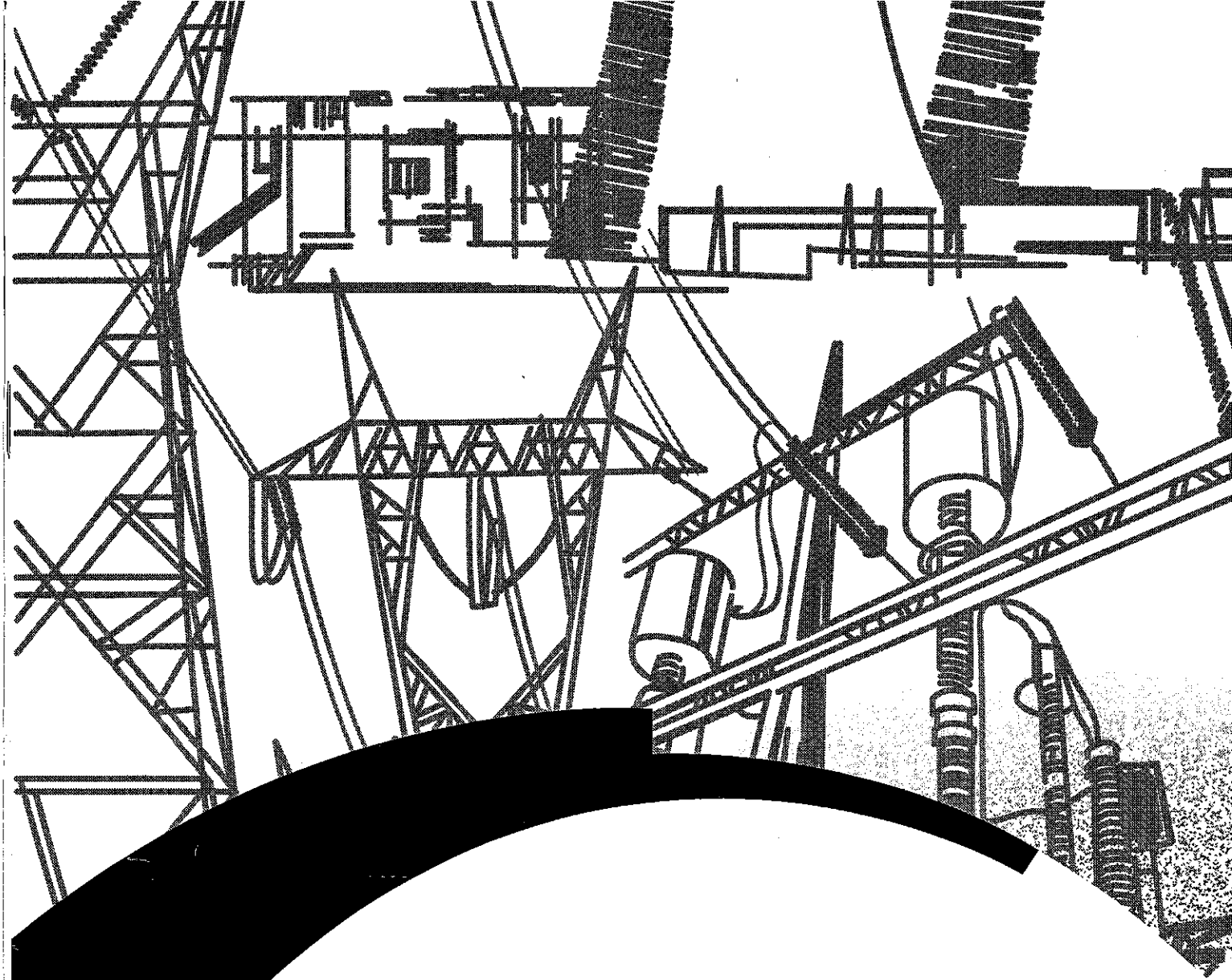

Service Manual
Type MVAJ
Tripping and Control Relays

ALSTOM

Service Manual
Type MVAJ
Tripping and Control 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 completely safe from electrostatic discharge when housed in the case. 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

LOW BURDEN

Types:	MVAJ 11	MVAJ 41
	MVAJ 13	MVAJ 43
	MVAJ 14	MVAJ 44
	MVAJ 15	MVAJ 45
	MVAJ 17	

HIGH BURDEN

Types:	MVAJ 21	MVAJ 51
	MVAJ 23	MVAJ 53
	MVAJ 24	MVAJ 54
	MVAJ 25	MVAJ 55
	MVAJ 26	MVAJ 57
	MVAJ 27	MVAJ 58
	MVAJ 28	MVAJ 59
	MVAJ 29	

CONTROL

Type: MVAJ 34

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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. INSTALLATION

1.1 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 possiblity 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 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.

1.2 Unpacking

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

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.

1.3 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.

1.4 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 R6015.

Publication R7012 is a Parts Catalogue and Assembly Instructions. This document 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 MIDOS modular integrated drawout system of protective relays.

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

Section 2. COMMISSIONING

2.1 Inspection

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

2.2 Wiring

Check all wiring connections to the relay, including the case earthing connection above the terminal block. It is especially important that dc supplies and magnetic blowout contacts are wired with the correct polarity. The relay diagram number appears inside the case.

2.3 Preliminary checks

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.

Moving parts are held in position during transit by rubber bands and packing. These should be removed carefully.

2.3.1 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.

2.3.2 Carefully remove the rubber band securing the flag mechanism.

2.3.3 Check that the bottom end of the contact operating card has not been dislodged from the slot in the armature extension.

2.3.4 Carefully actuate the armature of each unit in turn with a small screwdriver/probe. Note: immediately after the point where any make contacts just close there is a further small movement of the armature. This ensures that contact follow through and wiping action is present. Repeat similarly with break contacts on armature release.

On units fitted with hand reset flag indicators, check that the flag is free to fall before, or just as, any make contacts close.

2.3.5 Replace the module in the case and refit the cover. Make sure that the reset mechanism in the cover is correctly located with respect to the relay element, and that the flag (or mechanism) can be reset.

2.4 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.

2.5 Operate/reset operation

Check operation of operate or electrical reset by energising the relay with 60% of the rated supply voltage, except MVAJ 34 which should be checked at 80% of the rated supply voltage. The appropriate terminals should be identified from the internal wiring diagram normally supplied.

Disconnect external wiring from these terminals to allow application of the test supply.

The relays should switch cleanly with one movement.

The rated voltages are marked on either the lower handle strip or front plate.

2.6 Restoration of wiring

Restore any external wiring connections that may have been disturbed during the above tests.

Section 3. 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.

Repeat check 2.3 with emphasis on contact wear and condition. Mechanical settings may be checked against those shown in section 4.

Tests 2.4 and 2.5 should be carried out to prove operation.

Section 4. MECHANICAL SETTINGS

4.1 General

Armature gap measurements should be made with the top of the feeler gauge level with the centre line of the core.

Contact pressures are measured with a gramme gauge at the contact tips.

In general contact gaps and follow through are defined by quoting an armature gap at which the tips should be just closed or just open. Some mechanically operated contact gaps must be measured directly with feeler gauges at the contact tips.

The relay contact state is always defined with the relay in the unenergised position unless otherwise specified on the appropriate circuit diagram.

	Symbol used on diagrams	
Contact Type	Normal Duty	Heavy Duty
Make (normally open)	M	Z
Break (normally closed)	B	Y
Break before make (changeover)	BBM	

4.1.1 With the armature closed the clearance between the back of the armature and the back stop should be 0.005"/0.008".

4.1.2 Nominal armature gap open 0.050"/0.060" for all types.

4.2 Contact settings

4.2.1 MVAJ 11, 17, 21, 26, 41 and 51 (main element with output contacts)

Normal/heavy duty make and break contacts.

With the armature closed on to a 0.012" feeler gauge the make contacts should be closed, but should be open using a 0.015" feeler gauge.

With the relay in the operated position the break contacts should have a contact gap of 0.060"/0.070".

Force to just close the make contacts:	27/30 grams.
MVAJ 41, 45 only:	20/25 grams.
Force to just open the break contacts:	27/30 grams.
MVAJ 41, 45 only:	20/25 grams.

4.2.2 MVAJ 13, 14, 15, 23, 24, 25, 26, 27, 28, 29, 43, 44, 45, 53, 54, 55, 57, 58 and 59 (main element with output contacts).

Normal/heavy duty make and break contacts:.

With the armature closed on to a 0.018" feeler gauge the make contact should be closed, but should be open using a 0.022" feeler gauge.

With the relay in the operated position the break contacts should have a contact gap of 0.060"/0.070".

Force to just close the make contacts:

MVAJ 43, 44:	20/25 grams.
MVAJ 53, 54, 55, 57, 58 and 59:	27/30 grams.

Force to just open the break contacts:

MVAJ 43, 44	20/25 grams.
MVAJ 53, 54, 55, 57, 58 and 59:	27/30 grams.

4.2.3 MVAJ 13, 14, 15, 23, 24, 25, 27, 28, 29, 43, 44, 53, 54, 55, 57, 58 and 59

Cut off contact – lower left hand contact.

First set the lower lug on the armature extension so that the top of the roller is level with the top of the plastic catch when the relay is in the operated position.

Remove the operating wire from the plastic block on the moving contact.

Set the contact gap to 0.045"/0.055".

Force to just close the make contact: 12/15 grams.

Reposition the operating wire which should locate freely in the hole in the plastic block on the moving contact blade. If necessary bend the wire to suit.

4.2.4 MVAJ 34

Normal/heavy duty make and break contacts.

With the armature closed on to a 0.017" feeler gauge the make contacts should be closed, but should be open using a 0.020" feeler gauge.

With the relay in the operated position the break contacts should have a contact gap of 0.060"/0.070".

Force to just close the make contacts: 20/23 grams.
Force to just open the break contacts: 18/23 grams.

4.2.5 Auxiliary units in MVAJ 11, 17, 21, 26, 27, 28, 29, 41, 51, 57, 58 and 59

Normal/heavy duty make and break contacts.

With the armature closed on to a 0.011" feeler gauge the make contacts should be closed, but should be open using a 0.013" feeler gauge.

With the armature closed on to a 0.027" feeler gauge the break contact should be open, but should be closed using a 0.029" feeler gauge.

Force to just close the make contacts: 20/25 grams.
Force to just open the break contacts: 18/23 grams.

4.3 Mechanical settings related to the latch

For MVAJ 13, 14, 15, 23, 24, 25, 27, 28, 29, 34, 43, 44, 45, 53, 54, 55, 57, 58 and 59

The upper limiting lug should be clear of the cross roller and armature backstop in all positions.

Care should be taken to ensure that the upper lug still prevents the cross roller from riding up and over the armature extension.

With the armature closed the force to lift the cross roller above the latch should be 40/50 grams.

With the armature closed on to a 0.003" feeler gauge the cross roller should pass clear of the plastic catch, but with a 0.006" feeler gauge the roller should not clear the catch. To achieve this the armature extension should be bent. The upper face of the plastic catch should remain tangential to a circle centred on the armature hinge. The armature should return freely to the fully open position when partly closed and released and the reset arm should fall freely to the fully operated position when partly reset and released.

4.4 Electrical mechanism

For MVAJ 14, 15, 24, 25, 28, 29, 34, 44, 45, 54, 58 and 59

With the unit de-energised the lever arm should rest on the frame with the control spring just touching.

When the reset armature is closed on to a 0.005" feeler gauge it should reset the main element, but not reset with a 0.010" feeler gauge. Set spring on the reset so that a force of 45-55 grams, measured at the bottom of the lower armature, is required to reset it.

If the reset mechanism has been moved or changed, it may be necessary to adjust the position of the reset electromagnet by means of the mounting screws which are located in slotted holes.

4.5 Mechanical flag settings

4.5.1 Self reset units MVAJ 11, 17, 21, 26, 41 and 51

With the armature closed on to a 0.015" feeler gauge the flag should be free to fall, but should not fall using a 0.020" feeler gauge. Adjustment is made to the catch spring on the flag.

4.5.2 Hand reset and electrically reset units
MVAJ 13, 14, 15, 23, 24, 25, 27, 28, 29, 43, 44, 53, 54, 55, 57, 58 and 59

With the armature closed on to a 0.022" feeler gauge the flag should be free to fall, but should remain unoperated with a 0.027" feeler gauge. Adjustment is made to the flag catch spring on the flag.

4.5.3 Self reset flag MVAJ 34

Adjust the flag operating lever such that the flag side arm is parallel to the frame, when viewed from the side and the flag covers the flag label.

4.6 Settings for reset levers on hand reset and hand/electrically reset units MVAJ 13, 15, 23, 25, 27, 29, 43, 45, 53, 55, 57 and 59

The distance between the reset lever and the top of the reset arm should be 0.250". This is measured above the roller pivot and is adjusted by bending the reset lever.

Section 5. PROBLEM ANALYSIS

5.1 Failure to operate/reset

Check diagram for correct input connections.

Check rated voltage, this is marked on the front of the module.

Ensure the power supply is capable of supplying the necessary power.

With MVAJ 13, 14, 15, 23, 24, 25, 27, 28, 29, 34, 53, 54, 55, 57, 58 and 59, check that the relays are not latched in the operated position.

Some relays may be fitted with cut-off contacts – refer to diagram.

Flag spring may have been distorted and is holding the armature open or closed.

Check internal wiring.

Check continuity – result open circuit:

- coil open circuit.
- cut-off contact in series with coil open circuit.
- internal wiring damaged.
- diode bridge damaged: MVAJ 11, 13, 14, 15, 21, 41 and 51.
- series resistor open circuit.
- parallel resistor (when fitted) short circuit.

Check continuity – result short circuit:

- parallel resistor (when fitted) short circuit.
- diode bridge damaged – relay takes excessive current.

5.2 Excessive current taken by relay:

- diode bridge damaged.
- incorrect voltage applied.
- internal resistors short circuit.

5.3 Output contacts not changing state:

- operating card not in position.
- check output terminals with reference to diagram.
- internal wiring damaged.
- contamination of contacts.

Note: contacts should be cleaned with the burnishing tool, supplied in relay tool kits. On no account should knives, files or abrasive materials be used.

- Check mechanical settings as per section 4.

5.4 Relays fail to economise: (MVAJ 11, 17, 21, 26, 41 and 51)

- check economy relay, contact settings and wiring.

5.5 Relays fail to cut off: (MVAJ 13, 14, 15, 23, 24, 25, 27, 28, 29, 43, 44, 53, 54, 55, 57 and 59):

- check mechanical operation of wire operated contact (lower left hand contact viewed from front) by manually operating the relay.
- check mechanical settings.

5.6 Operating times too long:

- check power supply is capable of supplying current and does not current limit during operation.

Note: the operating time is measured to the first closure of the contacts and the timer must not add any subsequent contact bounce.

Section 6. SPARES

When ordering spares, quote the full relay model number and any component references numbers, or briefly describe the parts required.

Repairs

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.

Section 7. COMMISSIONING TEST RECORD

Date _____ Site _____

Station _____ Circuit _____

Relay Model No. _____ Serial No. _____

Rating

Operating _____ Volts dc Resetting _____ Volts dc

Diagram No. _____

Check Operation

	Minimum volts	Minimum amps
Operating coil	_____	_____
Reset coil	_____	_____

Cut off contacts Operation _____

Operating time at 100% V _____ ms

Contacts/flag indicators

Check for correct operation/reset _____

Remarks:

_____ _____

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

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

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