



GE VERNOVA

MVAJ

05, 10, 20

Technical Manual
Tripping & Control Relays

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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 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 GE Vernova 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 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 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 buildup of static. Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

GE Vernova strongly recommends that detailed investigations on the electronic circuitry, or modification work, should be carried out in a Special Handling Area as described in BS5783 or IEC 60147-0F.

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1. SAFETY SECTION

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

1.1 Health and safety

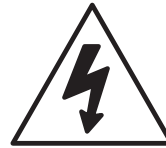
The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

1.2 Explanation of symbols and labels

The meaning of symbols and labels 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 e.g. power supply.

*** NOTE:** THE TERM EARTH USED THROUGHOUT THE PRODUCT DOCUMENTATION IS THE DIRECT EQUIVALENT OF THE NORTH AMERICAN TERM GROUND.

2. 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 electrical 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 2.5mm² 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)
- Remove front plate plastic film protection
- Remove insulating strip from battery compartment

3. EQUIPMENT OPERATING CONDITIONS

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

3.1 Current transformer circuits



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

3.2 External resistors



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

3.3 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.

3.4 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.

3.5 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.

3.6 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.

4. 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 electrical 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.

5. 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.

6. 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 601010-1: 1990/A2: 2001 Class I EN 61010-1: 2001 Class I	This equipment requires a protective (safety) earth connection to ensure user safety.
Insulation Category (Overvoltage):	IEC 601010-1: 1990/A2: 1995 Category III EN 61010-1: 2001 Category III	Distribution level, fixed insulation. Equipment in this category is qualification tested at 5kV peak, 1.2/50µs, 500Ω, 0.5J, between all supply circuits and earth and between independent circuits.
Environment:	IEC 601010-1: 1990/A2: 1995 Pollution degree 2 EN 61010-1: 2001 Pollution degree 2	Compliance is demonstrated by reference to generic safety standards.
Product Safety:	72/23/EEC	Compliance with the European Commission Low Voltage Directive.
	EN 61010-1: 2001 EN 60950-1: 2002	Compliance is demonstrated by reference to generic safety standards.

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 possibility of premature failure is eliminated, and a high degree of performance can be expected.

The safety section should be read before any work takes place and should be referred to throughout. Special care should be taken to adhere to suitable electro-static discharge precautions.

1.2 Receipt

The relays are either dispatched 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 GE Vernova should be promptly notified. Relays which are supplied unmounted and not intended for immediate installation should be returned to their protective polythene bags.

1.3 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 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.

1.4 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 -40°C to $+70^{\circ}\text{C}$.

1.5 Installation

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 the GEV-MVAJ51020-Brochure.

2. COMMISSIONING

2.1 Commissioning preliminaries

2.1.1 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.

2.1.2 Inspection

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 and cover are identical and also check that the rating information is correct for the system.

2.1.3 Wiring



WARNING:

EXPOSED TERMINALS MAY PRESENT A HAZARDOUS VOLTAGE UNLESS EQUIPMENT IS ELECTRICALLY ISOLATED.

Check that the external wiring is correct to the relevant relay diagram and/or scheme diagram. It is especially important that DC supplies are wired with the correct polarity. The relay external connection diagram number is given on the rating label inside the case.

2.1.4 External links

There are two external links as detailed in tables 1 and 2.

All trip relays are supplied as high burden. With the exception of MVAJ102, 202, they may be converted to low burden by removing the link between case terminals 22 and 24.

Relay Type	Feature	Link In	Link Out
MVAJ 051, 053, 054, 055	Burden Cut-off	High Instantaneo	Low Instantaneous
MVAJ 101, 103, 104, 105 201, 203, 204, 205	Burden Cut-off	High 40-60ms time delayed	Low Instantaneous
MVAJ102, 202	Link not necessary - configured as high burden models		

NOTE: At the point at which the relay cut-off occurs the current drawn by the relay is either reduced to an economised level or is removed entirely (i.e. zero watt cut-off state).

Table 1: Configuration of high/low burden link (terminals 22 to 24)

A second link is supplied fitted to selected 10 and 20 contact relays as detailed in Table 2. This link, connected between case terminals 21 and 23 enables a reset inhibitor feature to be introduced into the circuit of 10 and 20 contact electrical reset relays, ensuring that the reset circuit is disabled when the operate circuit is energised. On relay types 104, 105, 204 and 205 this link may be removed if this feature is not required.

NOTE: This link must remain fitted to MVAJ101 and 201 relays to enable the economising circuit.

Relay Type	Feature	Link In	Link Out
MVAJ 051, 053, 054, 055, 101, 102	Link of available		
MVAJ 101, 201	Link fitted (relay cut-off to economised state)		
MVAJ103, 203	Link not available (relay cut-off to zero watts)		
MVAJ104, 105, 204, 205	Cut-off state reset inhibitor	Economised active	Zero watts disabled

Table 2: Configuration of economising/reset inhibit link (terminals 21 to 23)

2.2 Preliminary checks

Before leaving the factory, all relays are accurately adjusted, tested and carefully packed. 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.

- 2.2.1 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.

- 2.2.2 Carefully remove the rubber band securing the flag mechanism.

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

- 2.2.4 Check that all push-on connections to the PCB are secure.

Check that all the push-on connections to the back of the contacts are secure.

Check that all the push-on connections to terminal block are secure.

- 2.2.5 Carefully actuate the armature of each unit in turn with a small screwdriver/probe.

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

- 2.2.6 Check that the serial number in the cover and the relay case match that of the module. 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.

Check that the armature(s) are in the reset position by pressing the appropriate reset buttons.

2.3 Insulation tests

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.

2.4 Operate/reset operation

WARNING:



EXPOSED TERMINALS MAY PRESENT A HAZARDOUS VOLTAGE UNLESS EQUIPMENT IS ELECTRICALLY ISOLATED.

2.4.1 Self, hand, electrical and hand/electrical reset

1. The operate circuit is terminated to case terminals 27(+), 28(-).
2. The electrical reset circuit is terminated to case terminals 25(+), 26(-).
3. Disconnect external wiring from these terminals to allow application of the test supply.
4. Check operation of operate circuit by energising the relay with 60% of the lower nominal supply voltage. Please note that the supply voltage applied across the relay case terminals should be directly at 60% of the lower nominal supply voltage (for example LNV= 110 V, so you have to inject 66 V) and this voltage should not be applied gradually to reach 60% of the lower nominal supply voltage. The relays should switch cleanly with one movement.
5. With the relay set check the continuity of the closed contacts, Contact continuity test should be done by applying 5A current & measuring the voltage across the output contact terminals after that you can check the impedance of the relay.
6. Check the operating time of the relay at 100% lower nominal supply voltage and check the continuity of the closed contacts.

2.4.2 Self-reset 2.5s delayed reset

1. The operate circuit is terminated to case terminals 25(+), 27(+), 28(-).
2. Disconnect external wiring from these terminals to allow application of the test supply.
3. Check operation of operate circuit by energising the relay with 60% of the lower nominal supply voltage. Please note that the supply voltage applied across the relay case terminals should be directly at 60% of the lower nominal supply voltage (for example LNV= 110 V, so you must inject 66 V) and this voltage should not be applied gradually to reach 60% of the lower nominal supply voltage. The relays should switch cleanly with one movement.
4. With the relay set check the continuity of the closed contacts, Contact continuity test should be done by applying 5A current & measuring the voltage across the output contact terminals.
5. Check the operating time of the relay at 100% lower nominal supply voltage and check the continuity of the closed contacts.
6. Check the delayed reset time by energising the relay with full rated supply volts to case terminations 25(+), 27(+), 28(-), then remove energisation from the case termination 27(+). Time the closure of a normally closed contact from this point in time. The reset time shall be between 2 - 2.8s.

2.5 Restoration of wiring

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

2.6 Problem analysis

Repeat Section 2.2 with particular attention to the connection of external links.

If the relay is found to be faulty it should be returned to GE Vernova for repair and recalibration. There are no user serviceable parts inside.

3. MAINTENANCE



Periodic maintenance is not necessary, however routine testing should be carried out to meet the customer requirements.

Check the relay for operation at 60% lower nominal supply voltage and for contact wear. If required, the mechanical settings may be checked against those shown in Section 4.

4. MECHANICAL SETTINGS

4.1 General

Contacts are set at the factory and should not require adjustment.

If contacts show signs of contamination during maintenance, it may be necessary to clean contacts and check settings.



CONTACTS MUST BE CHECKED BY QUALIFIED PERSONNEL ONLY TO ENSURE THAT SETTINGS ARE NOT DISTURBED.

The safety section should be read before attempting any adjustments.

4.2 Cleaning contacts

Contacts should be cleaned with the burnishing tool, supplied in relay tool kits. On no account should cleaning fluids, knives, files or abrasive materials be used.

4.3 Contact settings

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. Follow through should be measured at the centre of the armature. 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 reset position unless otherwise specified on the appropriate circuit diagram.

Symbols used on diagrams

Contact type	Normal duty
Make (normally open) Break (normally closed)	M B

4.4 Settings

Settings should be within those specified in the following tables.

4.4.1 Relay types MVAJ05

	Standard armature gap	1.5 to 1.25	mm
Make	Follow through		
	– just closed	0.5	mm
	– just open	0.6	mm
	Force to make	25 to 30	grammes
Break	Contact gaps	1.25 to 1.5	Mm
	Force to break	25 to 30	grammes
Break	Cut off contact (top left-hand viewed from front)		
	Force to break	25 to 30	grammes
	Contact gap (measured at armature)	0.2 to 0.5	mm

4.4.2 Relay types MVAJ10, MVAJ20

		Standard flag	Following flag	Units
	Standard armature gap	1.5 to 1.4	1.5 to 1.25	mm
Make	Follow through			
	– just closed	0.5	0.5	mm
	– just open	0.6	0.6	mm
	Force to make	26 to 29	20 to 25	grammes
	Force to make (when less than 4 make)	30 to 35	25 to 30	grammes
Break	Contact gaps	1.25 to 1.5	1.25 to 1.5	Mm
	Force to break	26 to 29	20 to 25	grammes
Break	Cut off contact (bottom right-hand viewed from front)			
	Force to break	25 to 30	20 to 25	Grammes
	Contact gap measured at the armature centre	0.4 to 0.6	0.4 to 0.6	mm

5. SPARES

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

5.1 Repairs

Should the need arise for the equipment to be returned to GE Vernova 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. CONNECTION DIAGRAMS

5 contact versions

01 MVAJ051 01	self reset
01 MVAJ053 01	hand reset
01 MVAJ054 01	electrical reset
01 MVAJ055 01	hand and electrical reset

10 contact versions

01 MVAJ101 01	self reset
01 MVAJ102 01	self reset (2s delayed reset)
01 MVAJ103 01	hand reset
01 MVAJ104 01	electrical reset
01 MVAJ105 01	hand and electrical reset

20 contact versions

01 MVAJ203 01	hand reset
01 MVAJ204 01	electrical reset
1 MVAJ205 01	hand and electrical reset

Where required, any specific diagram may be supplied on request. If the actual diagram number is not known, please provide the full model number and serial number. Typical diagrams follow.

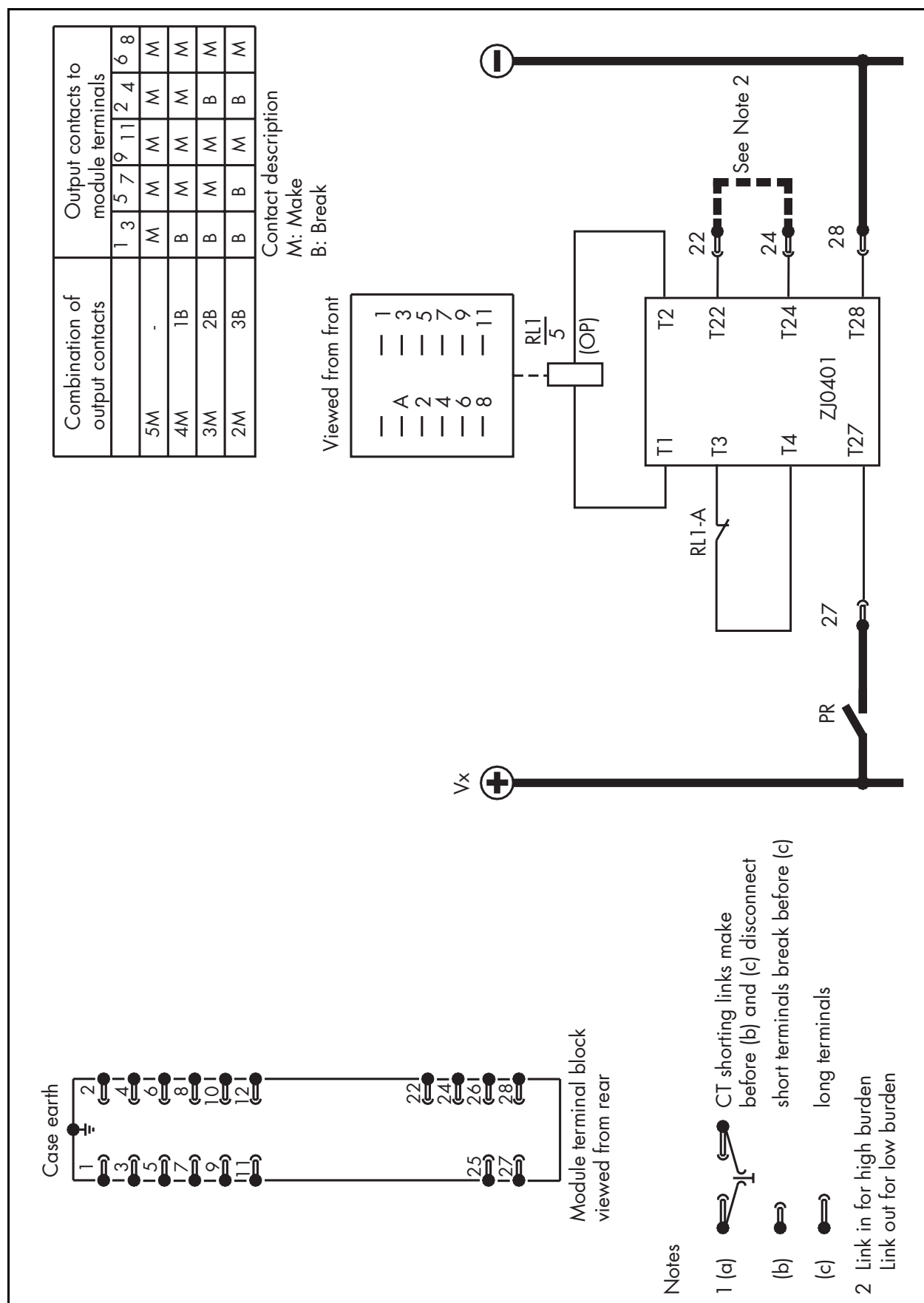


FIGURE 1: TYPICAL APPLICATION DIAGRAM MVAJ 051

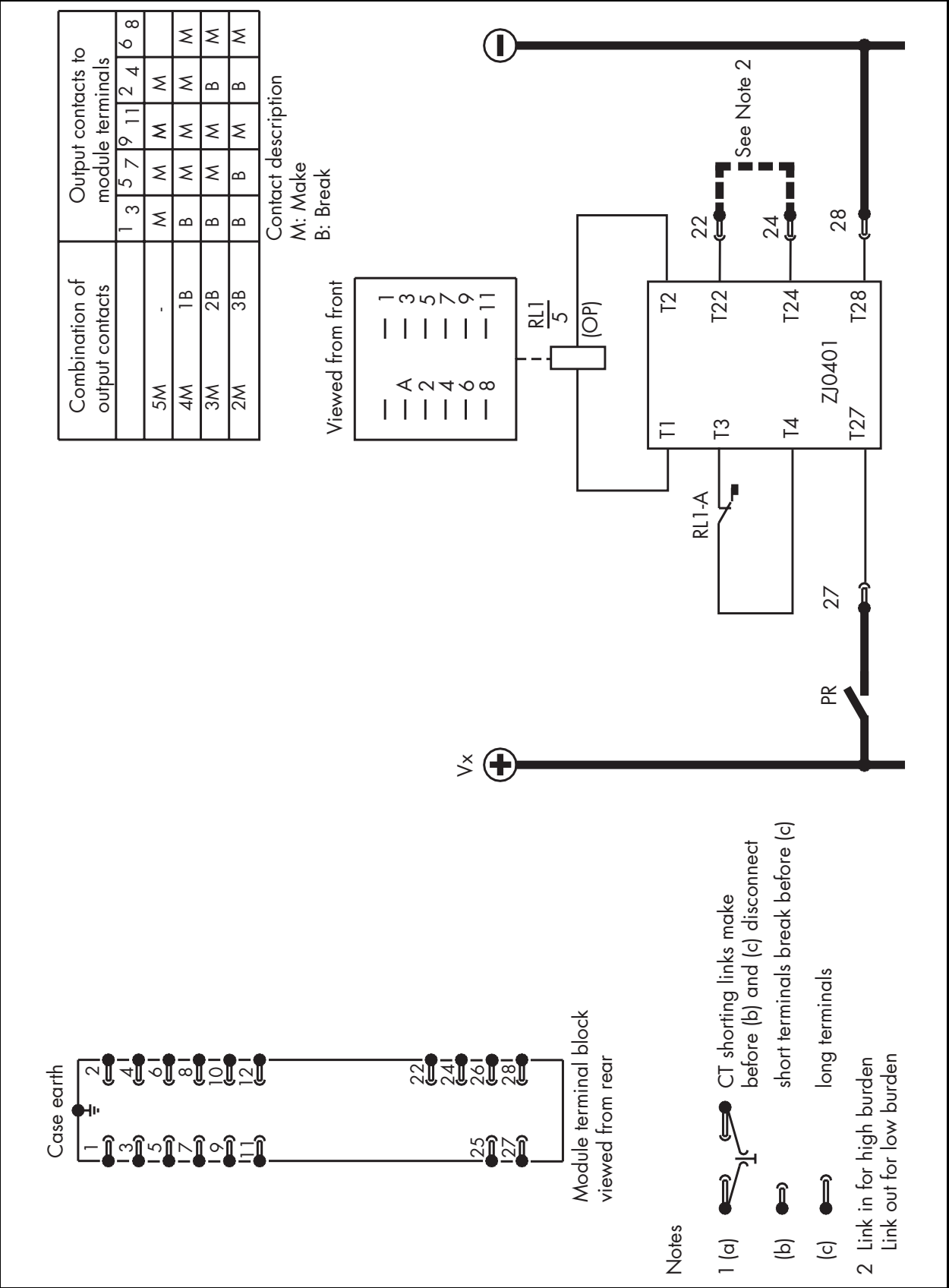


FIGURE 2: TYPICAL APPLICATION DIAGRAM MVAJ 053

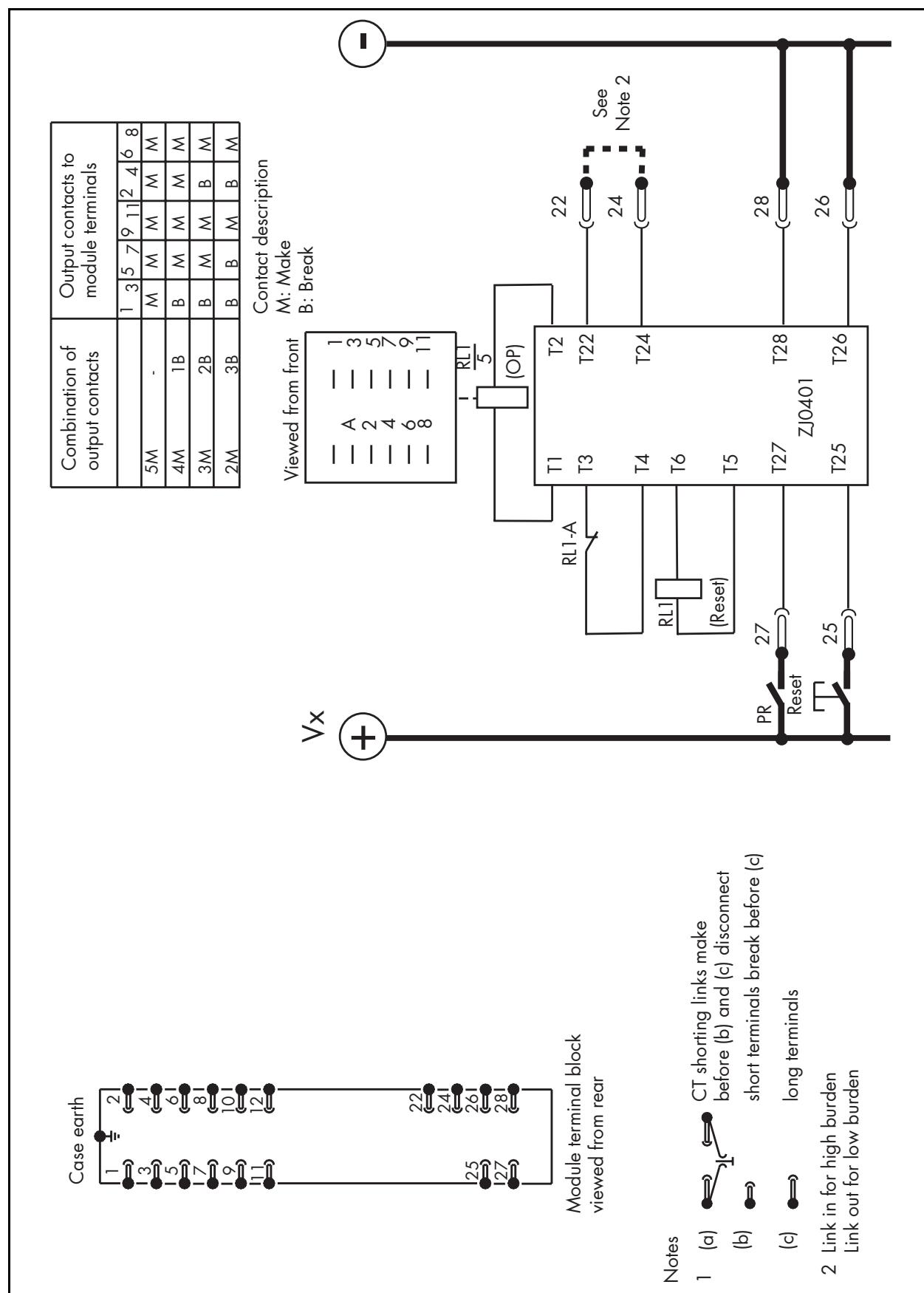


FIGURE 3: TYPICAL APPLICATION DIAGRAM MVAJ 054

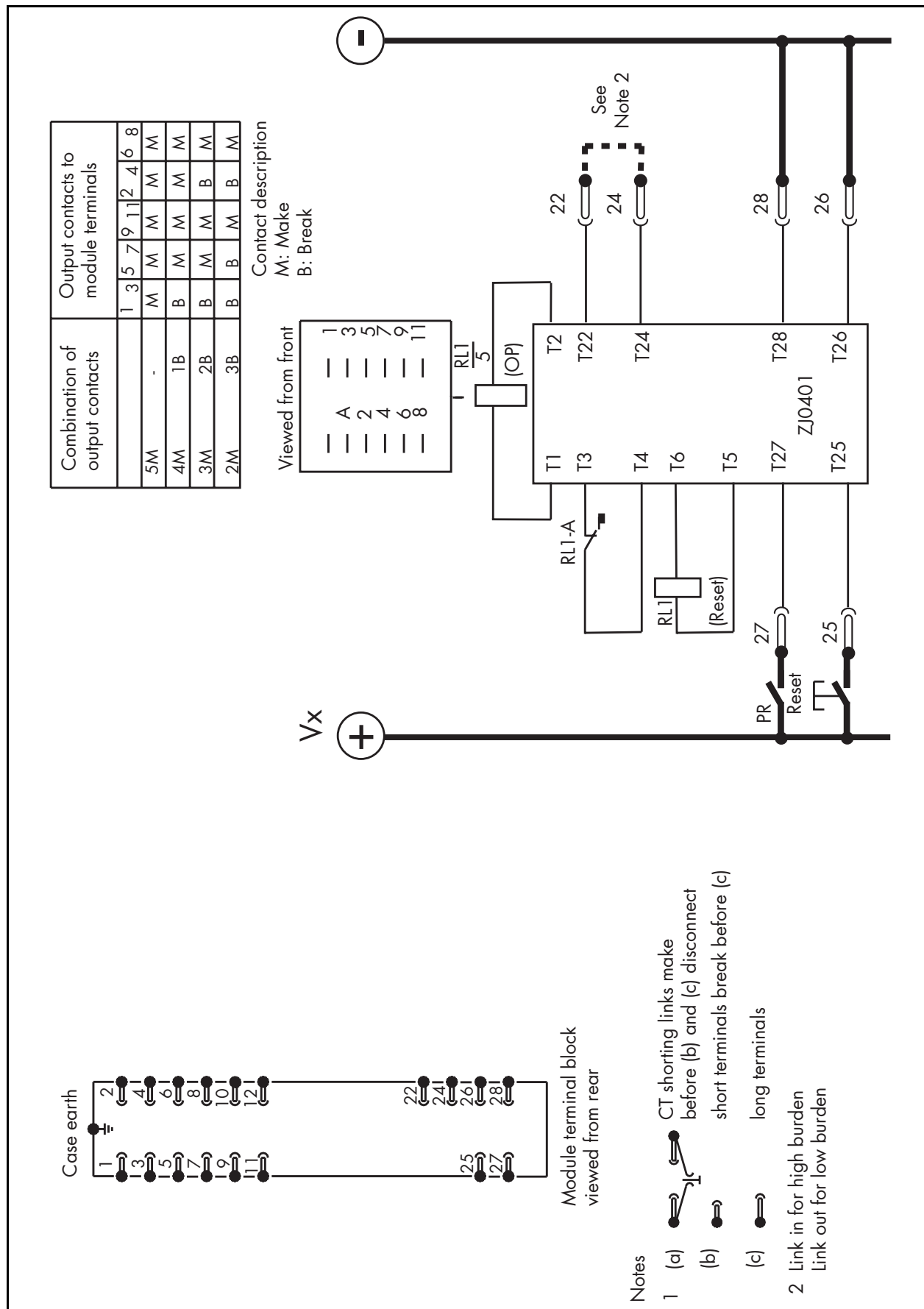


FIGURE 4: TYPICAL APPLICATION DIAGRAM MVAJ 055

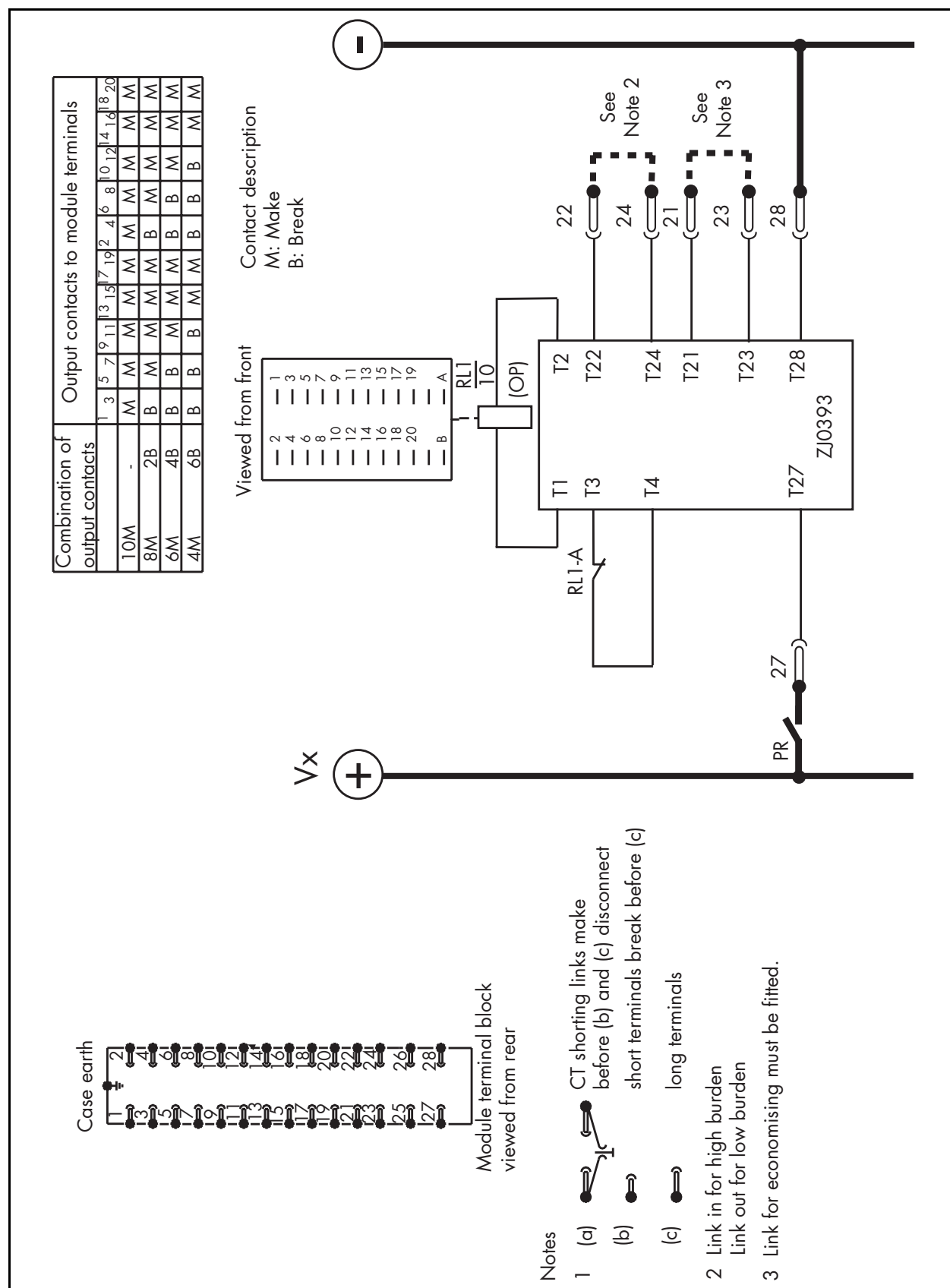


FIGURE 5: TYPICAL APPLICATION DIAGRAM MVAJ 101

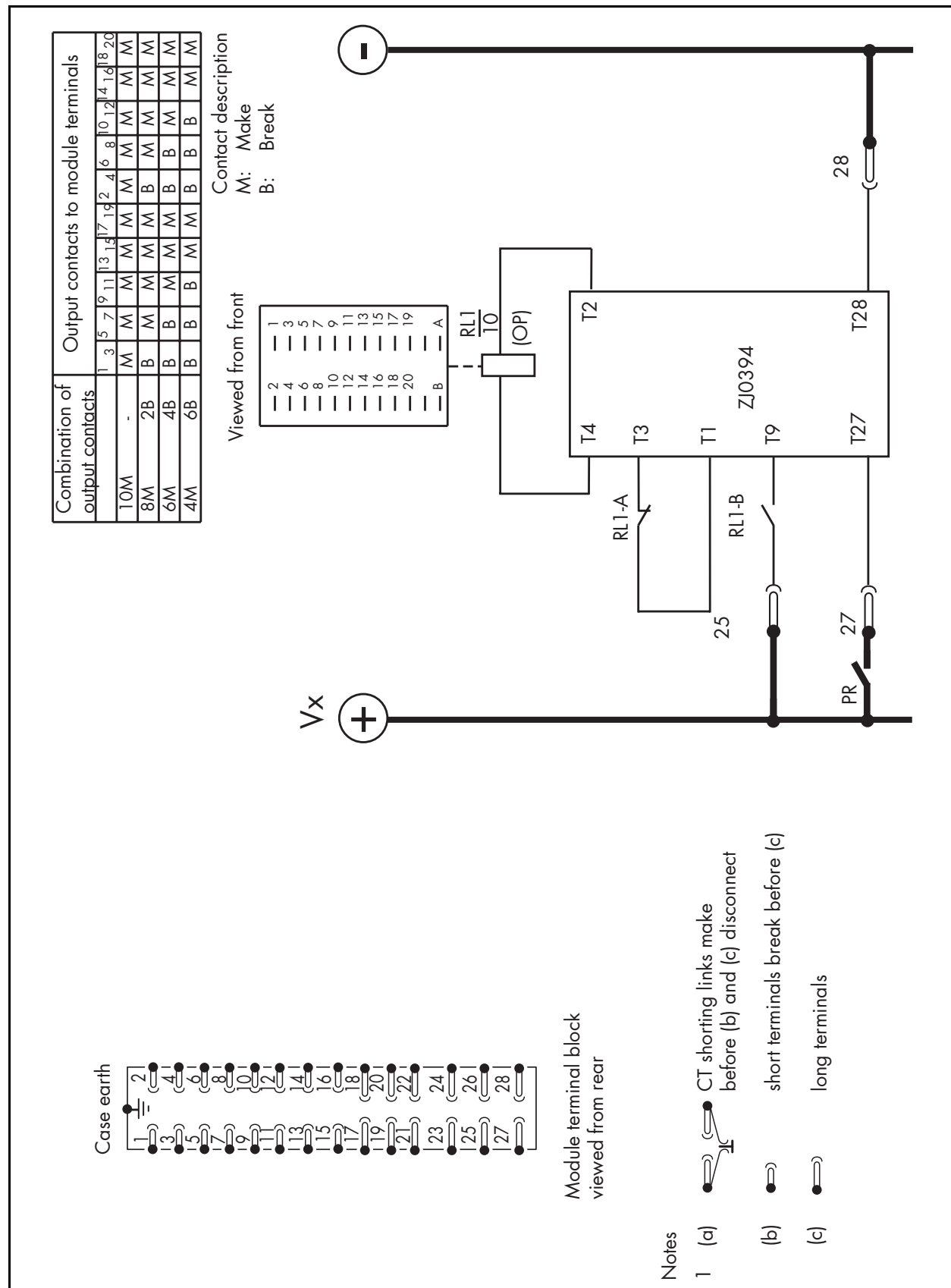
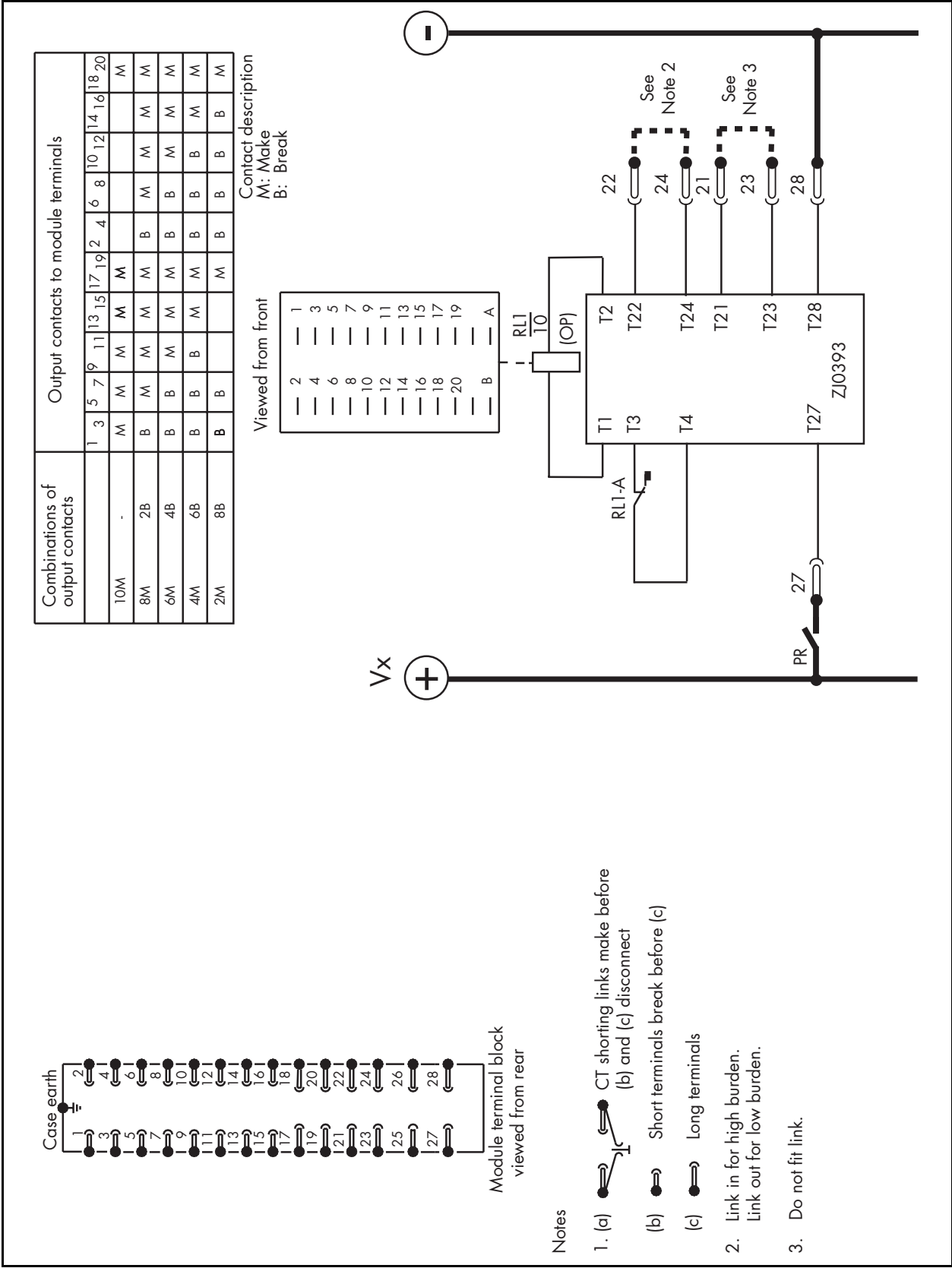


FIGURE 6: TYPICAL APPLICATION DIAGRAM MVAJ 102



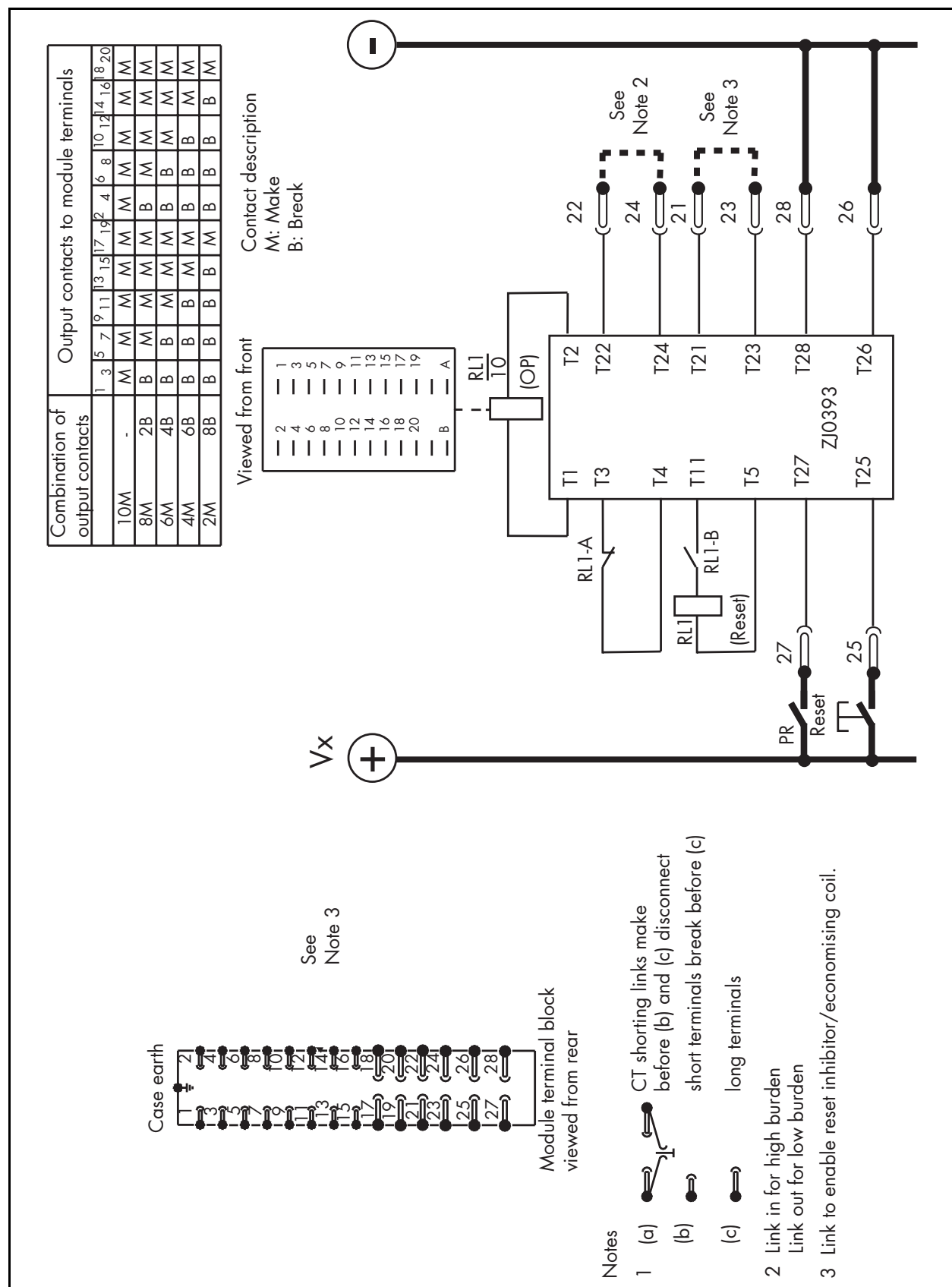


FIGURE 8: TYPICAL APPLICATION DIAGRAM MVAJ 104

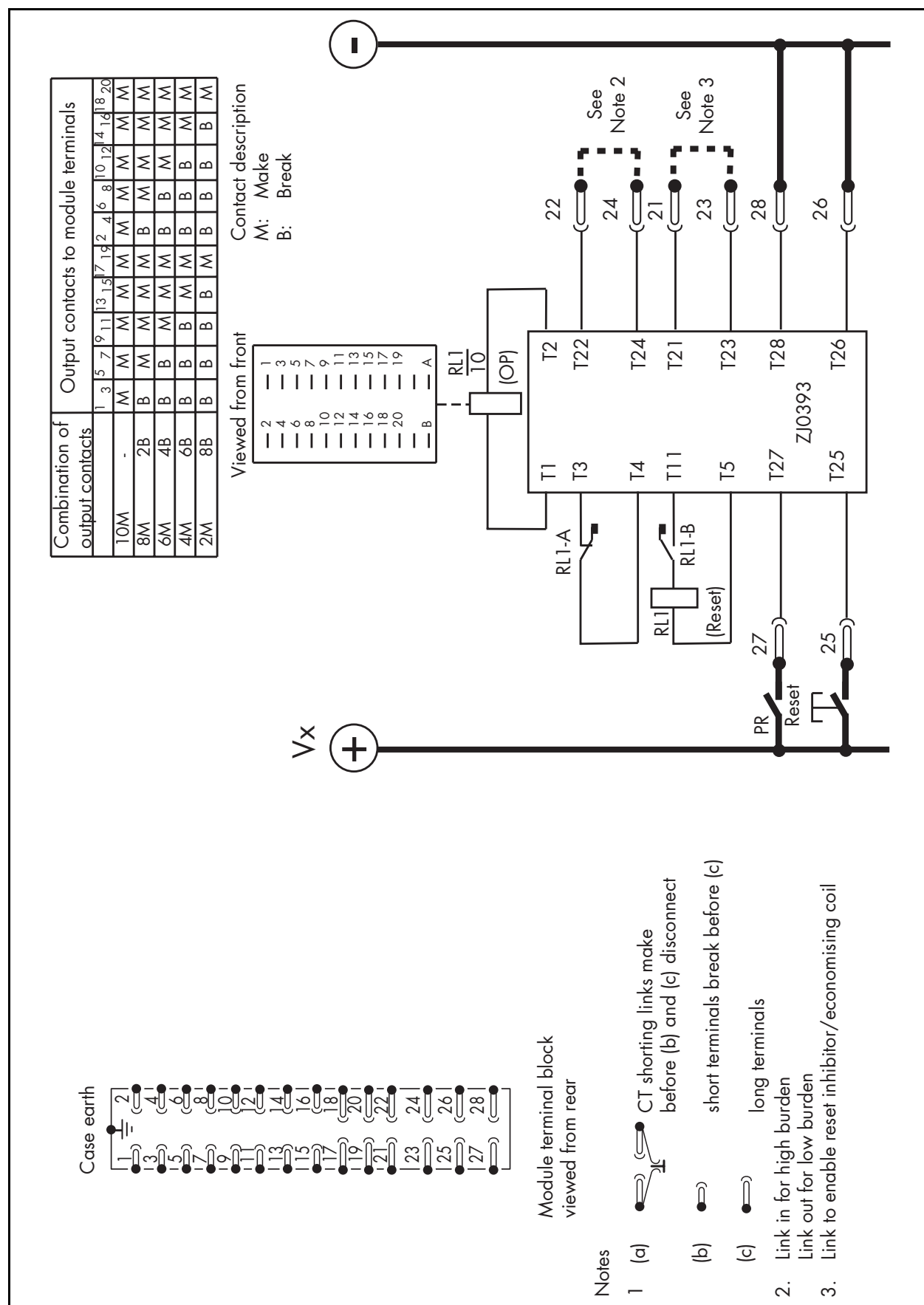


FIGURE 9: TYPICAL APPLICATION DIAGRAM MVAJ 105

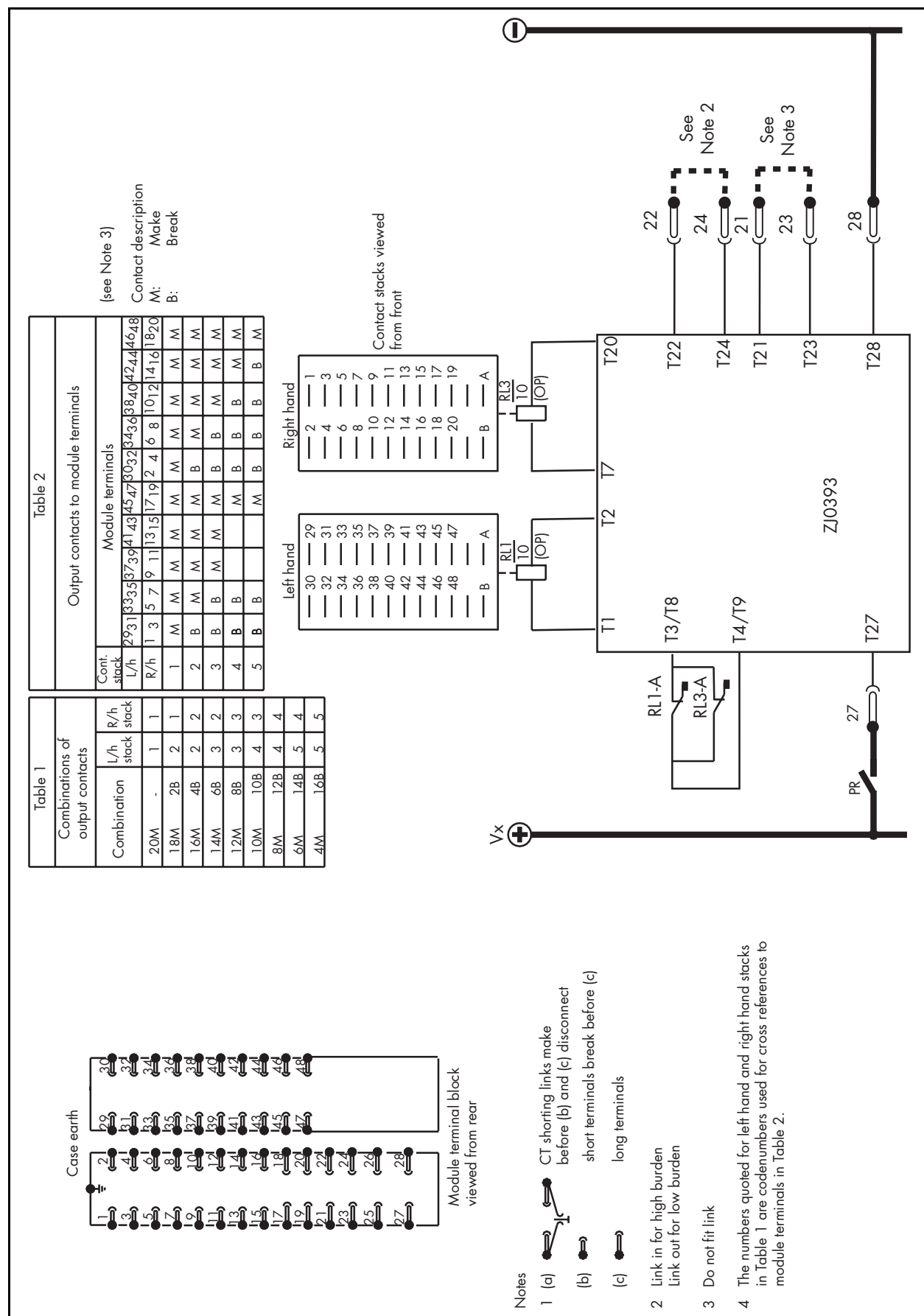


FIGURE 10: TYPICAL APPLICATION DIAGRAM MVAJ 203

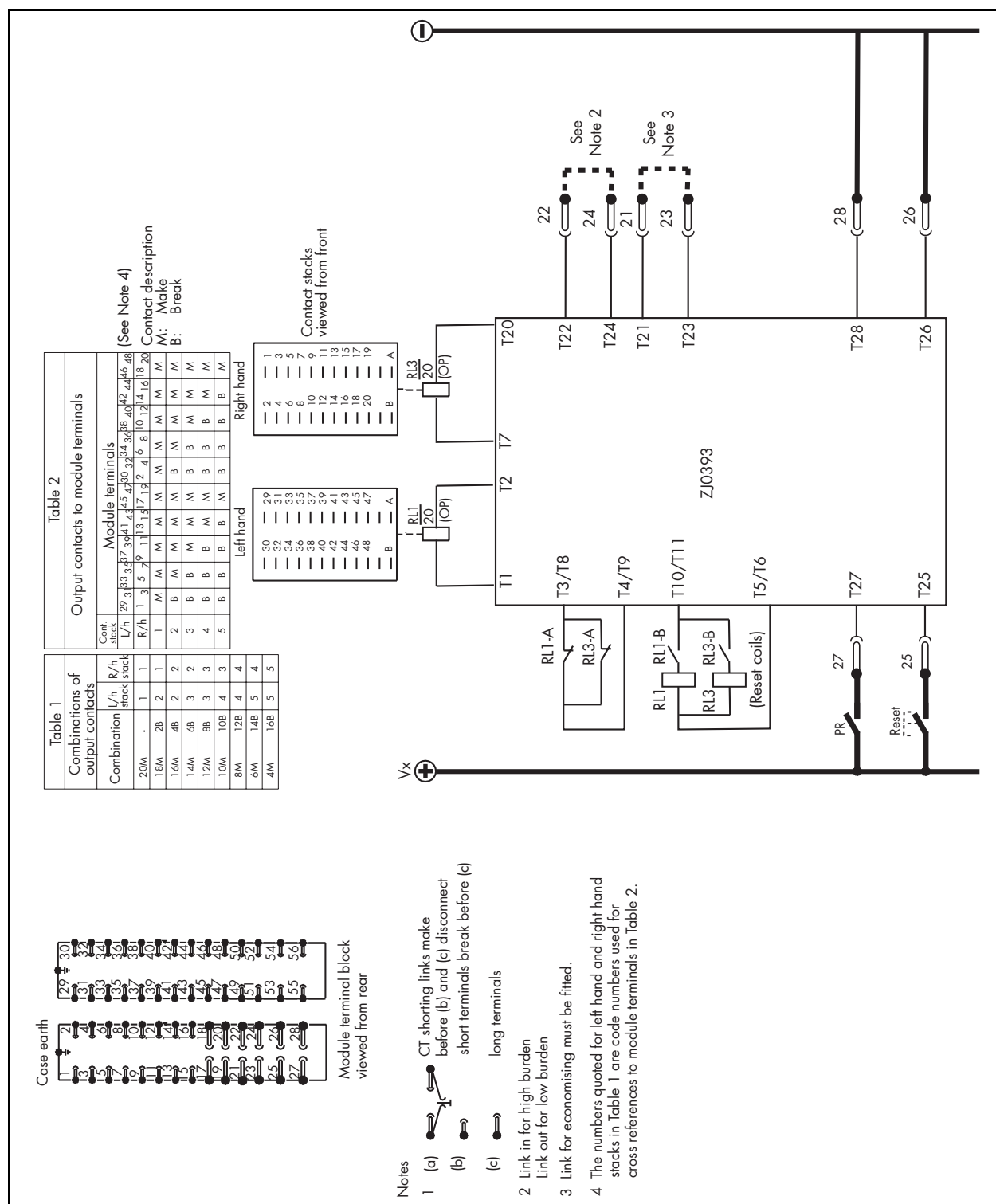


FIGURE 11: TYPICAL APPLICATION DIAGRAM MVAJ 204

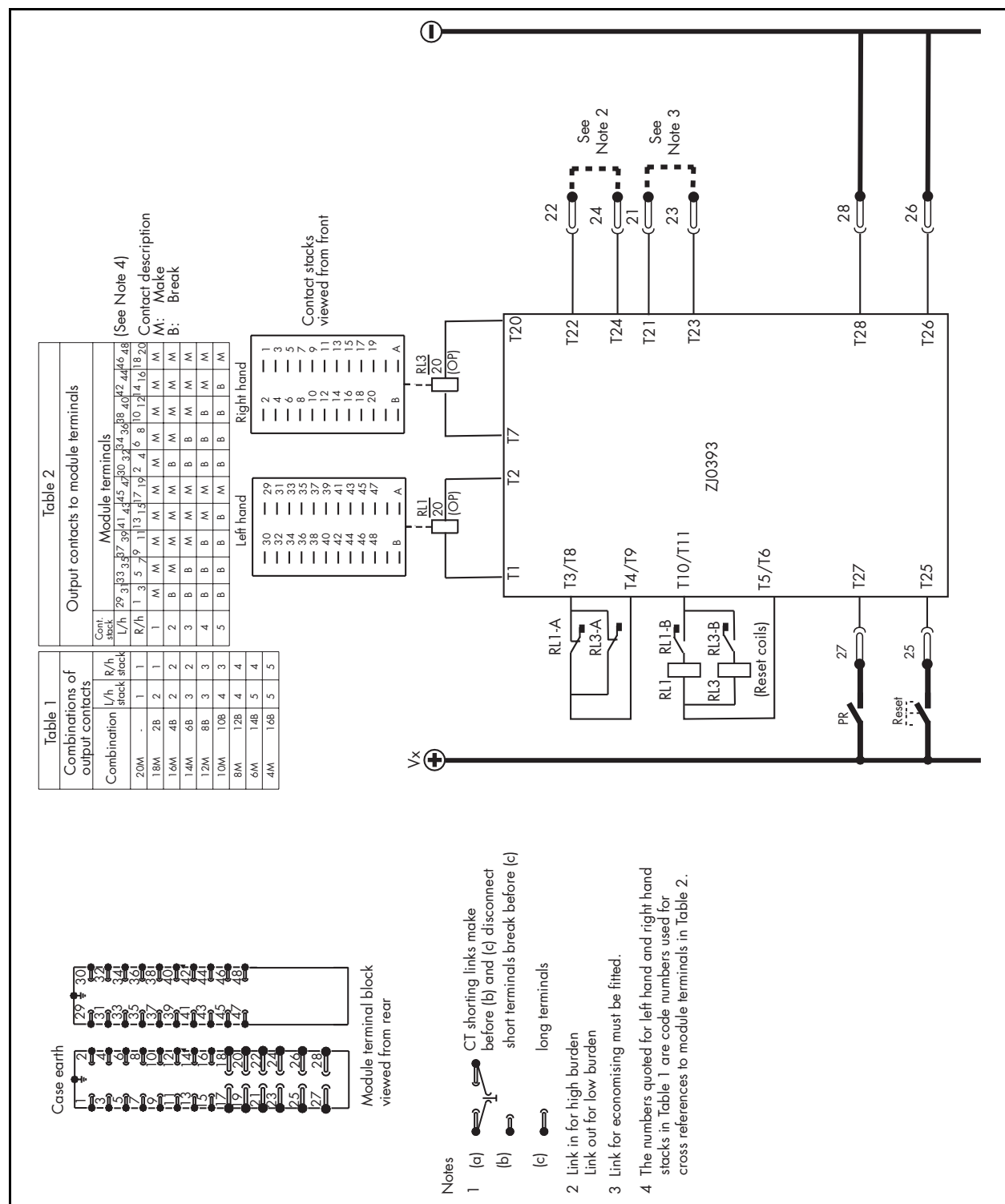


FIGURE 12: TYPICAL APPLICATION DIAGRAM MVAJ 205

7. COMMISSIONING TEST RECORD

Date	_____	Site	_____
Station	_____	Circuit	_____
Relay Model No.	_____	Serial No.	_____

**Relay Rated Lower Nominal Voltage:
LNV** _____

Visual inspection

Operational tests

Operating coil

Check operation at 60% LNV

Check operating time at 100% LNV

ms

Check contact continuity*

Resetting coil

Check electrical reset at 60% LNV

Check reset time at 100% LNV (MVAJ102 only)

ms

Check unit resets correctly

Check flags/cover

All Voltage tests to be applied as step changes from zero Volts

*Contact continuity test should be done by applying 5A current & measuring the voltage across the output contact terminals.

Remarks:

Tested by		Company	
Witness		Company	
Date			



5. Return Packaging Standards (ALL PRODUCTS)

1. Please ensure the device is clean, no sharp edges are exposed, and the device is in a suitable condition to be handled.
2. Relays returned without cases should be placed into Anti-Static Bags and sealed to protect hyper-sensitive components.



3. A suitable size box should be used, with packing material at the bottom, the device placed into the box with sufficient gaps to fill with packing material around each side and on the top, extra packaging material placed around the relay.



4. Please include a copy of the completed RMA form then close the lid and seal with packaging tape.
5. The relay should then be secondary packed if being exported, the primary packed box should be placed into an oversized box with packaging material surrounding the primary packed box and then sealed.



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