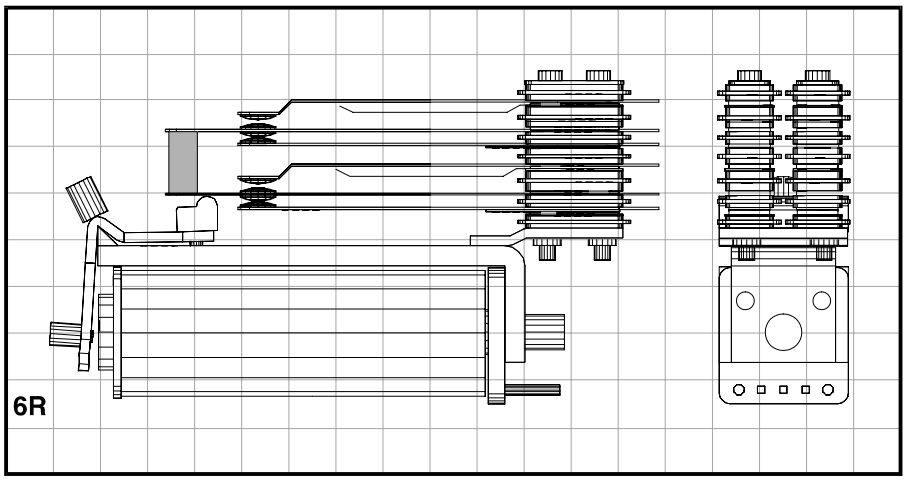
Technical Bulletin

6R Relay Series
Technical Data Supplement

Features

- Ratings tested over 24,48,125 & 250 Volt AC & DC
- Contacts are of fine silver, to ensure low resistance & high reliability
- Contact configuration utilises overtravel to provide self cleaning action
- Optional magnetic blowouts to increase DC switching capacity
- Anti-bounce buffers for high speed relay specifications
- Economy resistor & cut throat contacts to protect coil
- Made in Australia



Application

The information contained in this publication has been established by extensive testing at RMS & independent testing laboratories. This information should be read in conjunction with the specific product data sheet describing the total relay assembly.

It should also be noted that for DC switching loads the contact rating performance is greatly enhanced by the addition of magnetic blowout assemblies.

Due to their high contact rating & design flexibility the 6R relay elements are ideal for a multitude of direct CB tripping, auxiliary & trip circuit supervision applications.

Withstands

INSULATION WITHSTAND
General:
In accordance with IEC 255-5:
Across open contacts: 1KV RMS
Between contacts & coil: 2KV RMS
5KV 1.2/50 5KV impulse

NOISE IMMUNITY
Withstands the high frequency interference test detailed in IEC 255-22-1.

Refer also to the following RMS data sheets for detailed information on product applications & technical specifications:

6R MATRIX Relay Series
M Series MATRIX Case System
6RM QUAD 4 Element Flag Relays
3A20 Pilot Wire Send/Receive Relays
6R MATRIX Pre Defined Relays

Introduction

Made in Australia

While solid state & digital protection systems have replaced electro-mechanical relays in some applications & types of service, there are still many areas where the traditional relay reins supreme - & is likely to do so for many years to come. This data supplement discusses the enduring application of electromechanical relays for electrical protection & control schemes.

Electro Mechanical Relay Benefits

Despite the maturity of the technology, electro-mechanical relays provide an array of useful characteristics including:

- High levels of electrical isolation between input & output circuits
- A huge range of resistance between switch-on/switch-off
- Many independent isolated outputs may be associated with one input
- Physical ruggedness. Most relays can withstand massive short term overloads across both actuating & switching components.
- Relays are largely immune to electrical, radio frequency & other forms of radiation
- Actuating voltages & currents are relatively uncritical
- The operation of the relay is largely self evident making fault finding simpler
- Innumerable switching configurations are possible

This data sheet is intended to provide additional technical information for the RMS relays which utilize the 6R contact element. Also discussed are the enduring attributes of electromechanical relays & the key issues involved in effectively combining them with modern digital relays.

Magnetic Blowouts

Magnetic blowouts are available as an option on the 6R Relay elements. Their fitment provides greatly enhanced switching capabilities for DC loads by extinguishing the electrical arcs initiated when the load is broken.

Magnetic blowouts function as a result of the Lorentz force law which describes how a force (F) is applied to the arc in a direction perpendicular to both the magnetic field (B) & the current flow (I) as shown in figure 1. By using this effect to displace the arc from its direct current path, the path length is increased & the arc extinguished at a higher current / voltage rating than would be possible without the magnetic field present.

The permanent magnets used to create the magnetic field about the contacts are fitted in various configurations as required by the contact stack design but always such that the magnetic flux lines are perpendicular to the current flow.

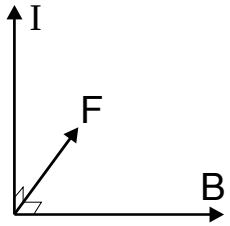


Figure 1.

As the magnetic flux lines flow in a radial pattern from the north pole to the south pole of the magnet, the electric arc will be displaced as depicted in figure 2. ie. In direction Fa for current flowing out of the page & Fb for current flowing into the page.

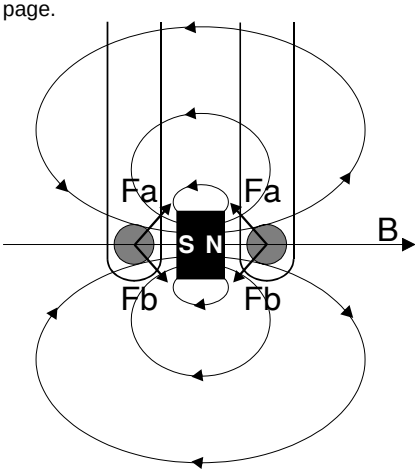


Figure 2. Dual contact stack viewed from above with a centrally mounted permanent magnet

The magnetic blowouts fitted to the 6R Relays work effectively for current flowing in either direction which means that both contacts on a change over stack work equally efficiently & that there is no need to polarise electrical terminations when wiring to the relay.

Contact Rating Chart

6R RELAY CONTACT RATINGS

Make & Carry Continuously
3,000 VA AC resistive with maximums of 660V & 12A
3,000 W DC resistive with maximums of 660V & 12A

Make & Carry for 3 Seconds
7,500 VA AC resistive with maximums of 660V & 30A
7,500 W DC resistive with maximums of 660V & 30A

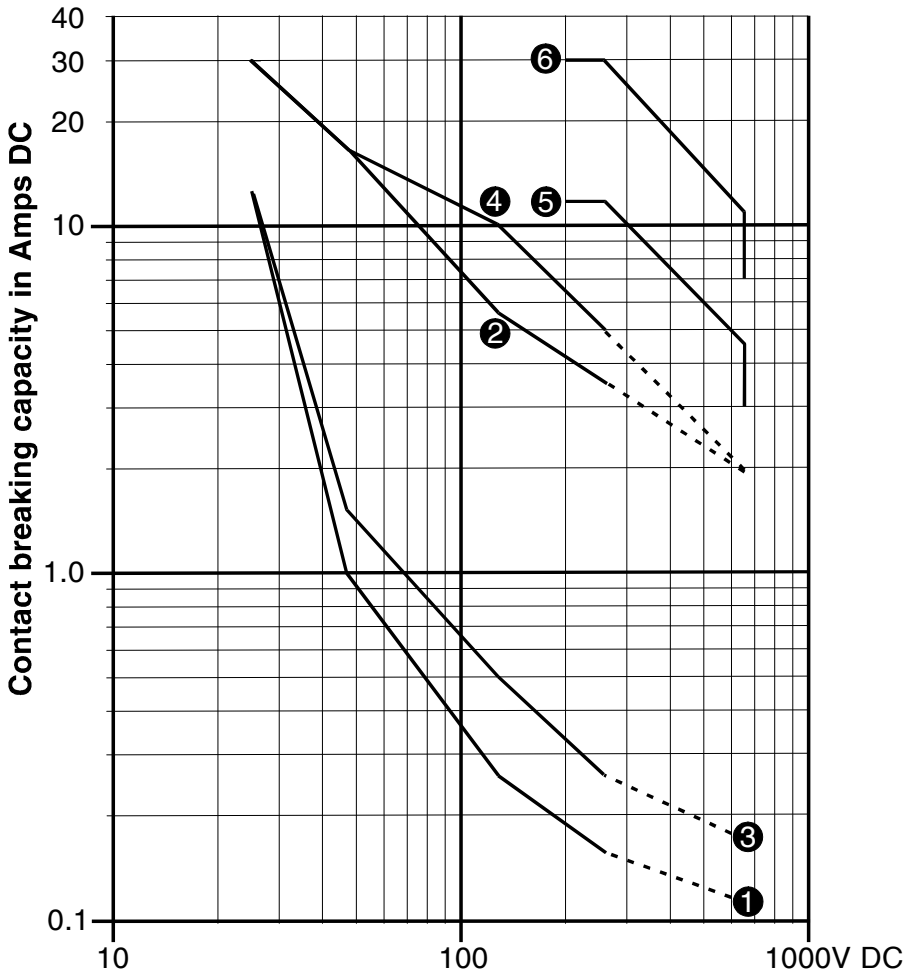
AC Break Capacity
3,000 VA AC resistive with maximums of 660V & 12A

DC Break Capacity (Amps)

Voltage			24V	48V	125V	250V
Resistive rating		1 2	12 12	12 2	10 0.5	5 0.25
L/R=40ms	Maximum break	1 2	30 12	15 1	5.5 0.25	3.5 0.15
	1K operations (N3 Rating)	1	12	12	5	2.5

1 = With magnetic blowouts **2 = Without magnetic blowouts**

6R Relay Contact DC Break Ratings



Inductive Load L/R 40ms
1. Without magnetic blowouts
2. With magnetic blowouts

Resistive load
3. Without magnetic blowouts
4. With magnetic blowouts
5. Make & carry continuous rating
6. Make & carry for 3 seconds

Factors Effecting Operating Speed

Relay operating speed is an important factor when designing a protection or control system. In broad terms the faster the operating speed the higher the relay cost and coil power required. The use of high speed trip relays are therefore usually limited to applications where system fault clearance times are critical.

COIL TIME CONSTANT
The primary factor which determines the relay operate time is the time constant of the relay coil to build up the magnetic field. The time constant is determined by the inductance which in turn is governed by the square of the number of windings divided by the resistance. To achieve a small time constant a short relay coil is often employed which has far fewer turns of wire & hence a much lower inductance. A resistor placed in series with the coil can also be used to reduce the time constant while a capacitor fitted in parallel with the resistor provides a path for the inrush current to drive the coil at maximum power.

MECHANICAL FORCE
The second factor is the mechanical force required to move the armature. Given the standard travel provided this is largely determined by the contact stack weight. ie the number of makes & break contacts fitted to the relay. As extra contacts are added to the relay stack more coil power is required to produce sufficient magnetic field strength & hence attractive force on the armature. Additional coil power can be used to improve operate speed provided a mechanism to thermally protect the coil is added. The power required to achieve adequate switching speed often exceeds the continuous power rating of the coil. To overcome this a normally closed contact is used in two ways depending on the relay type:

- For latching relays the contact is used to cut power to the coil once the relay has picked up & latched. In this instance the coil burden is cut to zero.
- For self reset relays the contact is used to add a series resistance with the coil whenever the relay is picked up.

High Speed Trip Relays

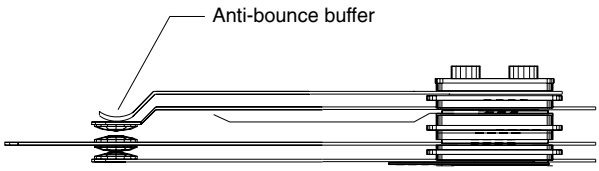
High speed operation is defined as contact closure having occurred within **10ms** at the nominal rated operating voltage. Relay operation is guaranteed over the specified operating range.

To achieve these characteristics requires very careful design of the coil & contact stack. The high efficiency of protection class auxiliary relay designs should allow both of the above criteria to be met for a wide range of coil voltages & contact stack combinations.

Contact Bounce

Contact bounce occurs due to the speed at which the contacts meet. If too much coil power is used then the contacts will come together with too much force causing excessive bounce. It is therefore important to only fit relay coils with adequate power to provide the force required to switch the relay at the minimum operate voltage 65% of nominal.

In addition contact bounce can be greatly reduced through the addition of anti-bounce buffers. These components are added to each contact to provide a damping wiping motion when the contacts meet thus dissipating the force which would otherwise produce bounce.



Standard Speed Auxiliary Relays

Many types of flag, interposing & repeat relays have a less stringent requirement in regards to speed of operation. In these instances there is little point in specifying more expensive and sometimes power hungry high speed relays. The following chart provides a guide to the operating characteristics for standard speed auxiliary relays with nominal 1W or 2W coil operating power.

Contact Stack	Pick up* 1W coil	Pick up* 2W coil	Drop out* 1W coil	Drop out* 2W coil
1 N/O	25	22	34	35
2 N/O	32	25	24	25
3 N/O	35	25	18	19
4 N/O	40	30	14	15
6 N/O	50	35	12	13
9 N/O	65	45	10	11
1 N/C	25	22	38	38
2 N/C	40	25	25	26
3 N/C	52	35	20	21
4 N/C	62	40	18	19
6 N/C	70	52	13	14
1 C/O	35	22	26	27
2 C/O	45	25	20	21
3 C/O	60	40	13	14
4 C/O	75	45	12	13
6 C/O	90	50	10	11
7 C/O	110	55	9	10

1.* Tolerance on stated operate times: +/-10%.
2.* Operate times are in ms & refer to armature operated contacts.
3.* For flag operated contacts (Latching) add 20% (Approx).
4.* Faster operating speeds are possible through the addition of electronic speed up components. Consult factory if required.

Contact Cleaning

The design of the relay should be such that the contact surface is kept clean to avoid high resistance contacts. In the most common form of armature attracted relays the contact surface is spherical such that when the contacts are driven to an overtravel position they actually wipe. The wiping action serves to clean the contacts a & also provides a damping action to assist in reducing bounce.

Contact Configuration

Contact stacks are available in mixtures of normally open, normally closed & changeover on the one relay. Up to 16 contacts on a single relay is possible. The contacts can be specified to latch or be a mixture of latching & non latching.

Target Flags

Flags may be specified to operate on coil energisation or de-energisation with latching or non-latching operation.

Resets

Resetting of flags & contacts may be either manual at the relay panel or electrical via a remote signal or both. The provision to separately reset the flag & contact is also possible.

Electrical Isolation

Electrical isolation between the coil & contacts is very important & figures up to 15KV may be required for pilot wire tripping schemes. The isolation between open contacts & adjacent contacts may also be required to achieve isolation between circuits switched by the same relay coil. As isolation is basically achieved by air spacing the physical size of the relay is the primary factor.

OPERATING VOLTAGE
Guaranteed operation between 65% & 120% of nominal rated DC operating voltage. 2HSM relays are “All or Nothing” devices & continuous application of AC or DC voltages below the pick up level is not recommended.

AC VOLTAGES
Standard 2HSM relays are not intended for operation with AC voltages. Application of continuous AC voltage below the pick up level will cause excessive power dissipation in the capacitor discharge resistor & likely result in thermal damage to the device.

MINIMUM OPERATING CURRENT
Low burden relays: 50mA
High burden relays: 100mA

ELECTRICAL RESET
Operate voltage: As per specified operate voltage.
Reset cut off: Instantaneous with main relay reset.

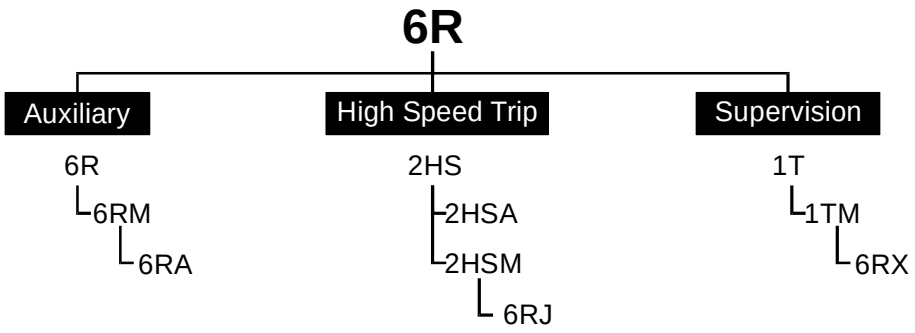
Continuous application of both the high speed pick up coil & the reset coil will defeat the cut throat contact & result in overheating & thermal damage to both coils & associated circuit.

CAPACITOR DISCHARGE TEST
High burden tripping relays are designed to withstand the 10uF capacitor discharge test such that the relay will not operate when a 10uF capacitor charged to the maximum specified operating voltage is applied across the coil of the relay.

6R Relay Family Tree

The various contact configurations used on all RMS electro-mechanical relays are based on the 6R heavy duty relay element.

This covers the following family of 6R based relay products:



The 6RM, 2HSM and 1TM relay series are part of the 6R MATRIX range of products.

The 2HSA relay series are special high speed configuration with a high number of contacts.

The 6RA, 6RJ and 6RX series are a sub set of the 6R MATRIX series with limited pre-defined ordering options.

Application Examples

The effect of a fault on a power system is dependent on the speed with which the fault can be detected & isolated. Modern protection schemes incorporate ever increasing functionality through the application of digital techniques to protection relay technology. While this technology has already replaced many old designs such as induction disc overcurrent & voltage relays, the requirement for highly reliable tripping, lockout, flag & control relays largely remains. This is particularly evident where compatibility to high voltage switchgear for system upgrades is required.

Electromechanical multi trip relays remain the preferred option for a wide range of functions such as:

- Interfacing signals from protection relays where the required number of contacts exceeds the number of protective relay contacts or where the circuit breaker trip coil power requirements exceed the protective relay capacity.
- Where secure system lockout is required.
- Auxiliary trips to start disturbance recorders, signal classical SCADA systems, start backup protection timers.
- Provide target flags for fault diagnosis, alarms for loss of battery supplies.
- Flagged follower relays for transformer winding temperature, buchholz alarm & trip.
- Monitor trip supply voltage, the trip circuit & coil integrity through continuous energisation of the relay coil ensuring failure is detected & alarmed.
- Intertripping of switchgear via pilot wires which may have an induced AC voltage. The pilot receive relay can be designed to discriminate between the induced AC voltage yet still provide a high speed trip from the DC trip signal.

Summary

There remains a strong argument for the retention of electromechanical relays to provide auxiliary, tripping & supervision functions in modern protection relay schemes. The key benefits offered by mixing technologies within the one system include:

- Lower total system cost achieved through the selecting of the appropriate relay technology for a particular task
- Increased system security by reducing the likelihood of multiple device failure due to a common fault mechanism
- Compatibility with existing equipment for system refurbishment & upgrades
- A “smart” digital system can retain local flags, targets, secure lockouts & reset mechanisms in order to provide familiarity to technicians
- Compact high performance electromechanical relays can directly trip HV circuit breakers with high trip coil ratings
- Electromechanical relays still provide a low risk fast track option for design engineers

Far from being simple devices which can be easily replaced by the increased functionality offered by digital relays, they need to be recognised for the critical nature of the functions they perform. Careful consideration is required as part of the complete protection design to ensure system integrity & reliability is achieved for new installations & maintained for system upgrade projects.

6R MATRIX

The 6R MATRIX range has been developed to provide design engineers with a compact & modular system to meet a wide variety of system configurations. Based on the well proven 6R heavy duty control relay the 6R MATRIX system offers numerous benefits:

- Modular configuration to simplify panel layout & circuit design
- High density to reduce required panel space
- Standardised component design to reduce delivery lead time
- Rack or flush mount cases to suit required panel construction
- Draw out & non draw out case styles to match budget

Refer to the following RMS data sheets for detailed information:

6R MATRIX, M Series Case System.

Australian Content

Unless otherwise stated the product(s) quoted are manufactured by RMS at our production facility in Melbourne Australia. Approximately 60% of our sales volume is derived from equipment manufactured in house with a local content close to 90%. Imported components such as semi-conductors are sourced from local suppliers & preference is given for reasonable stock holding to support our build requirements.

Quality Assurance

RMS holds NCSI (NATA Certification Services International), registration number 6869 for the certification of a quality assurance system to AS/NZS ISO9001-2008. Quality plans for all products involve 100% inspection and testing carried out before despatch. Further details on specific test plans, quality policy & procedures may be found in section A4 of the RMS product catalogue.

Product Packaging

Protection relays are supplied in secure individual packing cardboard boxes with moulded styrene inserts suitable for recycling. Each product & packing box is labeled with the product part number, customer name & order details.

Design References

The products & components produced by RMS are based on many years of field experience since Relays Pty Ltd was formed in 1955. A large population of equipment is in service throughout Australia, New Zealand, South Africa & South East Asia attesting to this fact. Specific product & customer reference sites may be provided on application.

Product Warranty

All utility grade protection & auxiliary relay products, unless otherwise stated, are warranted for a period of 24 months from shipment for materials & labour on a return to factory basis. Repair of products damaged through poor application or circumstances outside the product ratings will be carried out at the customer's expense.

Standard Conditions of Sale

Unless otherwise agreed RMS Standard Terms & Conditions (QF 907) shall apply to all sales. These are available on request or from our web site.

Relay Monitoring Systems Pty Ltd

6 Anzed Court, Mulgrave, Victoria 3170, AUSTRALIA

Tel: 61 3 9561 0266 Fax: 61 3 9561 0277 Email: rms@rmspl.com.au Web: www.rmspl.com.au