

Features

- Compact, economic design
- Simple panel mounting for retrofit applications
- Two or three arc sensor inputs
- Two high speed tripping duty arc sense output contacts
- Push button reset
- Integrated self supervision
- Fail alarm contact
- 20-60 & 36-150V DC auxiliary versions

Introduction

Medium voltage switchgear is a key element in the power supply chain. Existing protection systems operate effectively under most circumstances, but they are too slow to handle arcing short circuits.

Arcing faults can occur as a result of insulation breakdown due to equipment age & / or poor maintenance.

The degree of damage caused by arcing depends principally on the duration of the arc. If an arc lasts only 100ms, the switchgear needs to be checked & the insulation resistance measured before power can be re-established. With a 200ms arc, the power supply will be interrupted; the switchgear must be checked; power is re-established only after minor repairs. In the event of a 500ms arc the supply is interrupted, metal parts of the switchgear are destroyed & poisonous gases are emitted. A 1s arc destroys most of the switchgear & may cause a fire, injury to personnel & damage to property.

The over-current caused by an arc is, due to its resistance, lower than the over-current caused by a "metallic" short circuit. The over-current caused by the arc may also be lower than the protection start current when energising circuits or starting large motors. The consequence of these conditions is that a protection system based solely on over-current detection cannot effectively discriminate between normal system currents & an arc fault condition:

- For moderate arc fault currents the trip time of the over-current IDMT stage will be too slow;
- For very low arc fault currents the instantaneous trip stage of a standard over-current relay cannot be set low enough.



1S20 depicted in a ZA12 panel mount case configuration

ARC Fault Protection

Made in Australia

Arc fault protection is a relatively new technique employed for the fast clearance of arcing faults on BUS bars & within metal clad switchgear & associated cable boxes. The arc is detected using an optical sensor & the signal input to a protection device which also monitors the load current on the system. A trip signal can be achieved in less than 10ms using arc detection only or within 15ms when using overcurrent check. This is considerably faster than a traditional IDMT overcurrent relay & provides additional protection from the onset of arcing faults with relatively low fault currents.

Arguably the greatest risk of arc fault damage exists at the CB cable termination & in the CB chamber itself due to the slow clearance times of the IDMT feeder protection. The CB cable termination is particularly at risk to ingress of moisture & rodent damage.

The problem of arc faults is most prevalent in older metal clad switchgear which already has operational protection systems. The 1S20 Arc Fault Monitor has therefore been designed for the following applications:

EXISTING SWITCHGEAR

Where a requirement exists to retrofit arc fault protection to metal clad switchgear utilizing the existing overcurrent protection relay;

NEW SWITCHGEAR

Where a requirement exists to install arc fault protection to new switchgear for integration with the customer preferred overcurrent feeder protection relay.

Switchgear Applications

SWITCHGEAR ARC PROTECTION

Risk of arc fault damage exists at the CB cable termination & in the CB chamber itself. The CB cable termination is particularly at risk to ingress of moisture & rodent damage.

One, two or three arc sensors may be connected to the 1S20 Arc Fault Monitors as depicted in the single line application diagrams at right.

Figures 1 & 2 show the trip signals being used to trip the feeder circuit breaker in the event of an arc fault occurring at any sensor provided the overcurrent relay starter contact is picked up. In these applications the overcurrent check stage is optional as the consequence of a single feeder outage is less than the loss of an entire BUS.

Figure 3 shows an application where a single 1S20 is applied for the protection of the Cable box, CT chamber & CB chamber using three sensors. In this configuration one arc trip output is used to trip the feeder circuit breaker in the event of an arc fault in the cable box / CT chamber. The second trip output is set for independent operation to trip the BUS breaker (BUS overcurrent check not shown), in the event of an arc fault in the CB chamber.

EXISTING SWITCHGEAR APPLICATIONS

The existing overcurrent relay protecting the feeder will normally provide an independent output contact associated with the start current setting of the relay. That is an output contact that will close when a phase or earth fault current is detected above the threshold which starts the internal relay timers. This starter element should be set for instantaneous operation so that it will pick up in the order of 15ms.

An Arc Fault Monitor relay 1S20 is installed on the switchgear panel adjacent to the protection relay. The 1S20 is specifically designed for simple retrofit to existing panels & requires only a single 30mm mounting hole to be drilled. The 1S20 fits through this hole, the designation label supplied with the unit positioned & the retention shroud fitted. Refer Figure 7.

1S30 optical arc sensors are fitted in the cable termination box & CT chamber as depicted in figure 2.

The overcurrent relay starter contact may optionally be wired in series with the arc fault detection trip output contact as depicted in figure 6. The resulting "AND" function trip output is wired to trip the breaker in ~15ms in the event that an arc fault is detected while the overcurrent start element is picked up.

The second arc trip & fail alarm contacts may be employed for interface to a SCADA system for fault reporting.

NEW SWITCHGEAR APPLICATIONS

For new switchgear installations a modern numeric feeder protection relay is likely to be employed which will have numerous programming & configuration options.

The basic concept is the same as for the existing switchgear application described above except that the additional features & flexibility of modern feeder protection relay allows improved system integration.

This may be achieved by using the second arc trip output contact to interface to a programmable status input on the feeder protection relay. Depending on the model of protection relay being used this input may be programmed to provide an alarm message on the HMI, time stamped event record available via its communications link.

Where this level of system integration is employed the 1S20 does not need to be mounted on the front panel as the alarm indications are available on the feeder relay. Remote reset of the 1S20 LED is achieved by momentary interruption of the power supply using a SCADA controlled series contact. The DIN rail mounting option is a convenient alternative in this situation.

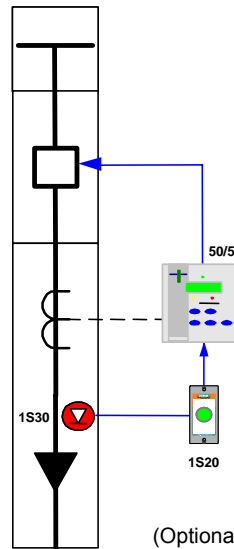


Figure 1:
Single arc sensor - Cable box only
(Optional overcurrent check stage depicted)

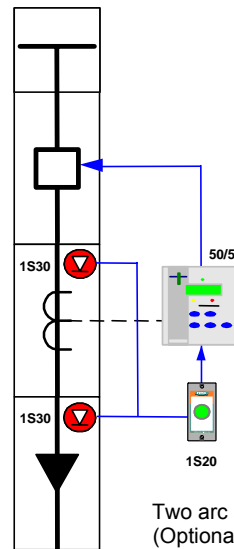


Figure 2:
Two arc sensors - Cable box & CT chamber
(Optional overcurrent check stage depicted)

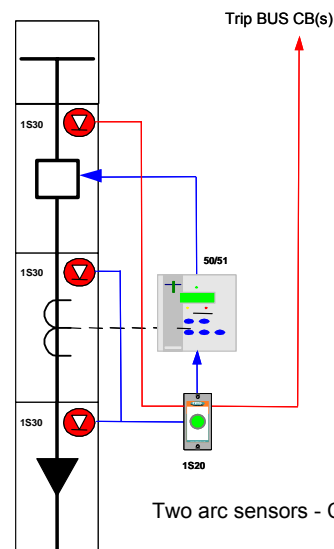


Figure 3:
Two arc sensors - Cable box & CT chamber
Independent trip to CB
(Optional overcurrent check stage depicted)

One arc sensor - CB chamber
Independent trip to BUS breaker
(BUS overcurrent check stage not shown)

BUS Bar Applications

COMBINED BUS BAR & SWITCHGEAR ARC PROTECTION

Figure 4 shows an application where a single 1S20 is applied for the protection of the Cable box & CT chamber plus the CB chamber & BUS chamber using three sensors.

In this configuration one arc trip output is used to trip the feeder circuit breaker in the event of an arc fault in the cable box / CT chamber. The second trip output is set for independent operation to trip the BUS breaker (BUS overcurrent check stage not shown), in the event of an arc fault in the CB chamber or BUS chamber.

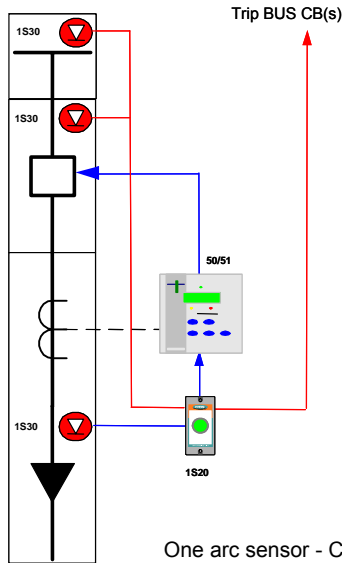


Figure 4:
 One arc sensor - Cable box / CT chamber
 Independent trip to CB
 Two arc sensors - CB chamber & BUS chamber
 Independent trip to BUS breaker
 (BUS overcurrent check stage not shown)

BUS BAR ARC PROTECTION

Figure 5 depicts how the 1S20 may also be applied for the protection of bus bars. The number of sensors in the bus chamber is dictated by the switchgear design and the length of switchboard.

In most indoor metal clad switchgear the bus bar chamber is a continuous chamber between panels only broken into segregated sections at a bus section breaker & as such the strategic placement of one or two arc sensors in each bus bar chamber run is normally adequate.

Some indoor metal clad switchgear may segregate the bus chamber of each panel from the next via insulated bus chamber side barriers per panel, if this is the case then each bus chamber per panel would need to be monitored by at least one arc sensor.

In large enclosures the arc sensors should be placed at approximately 5m intervals.

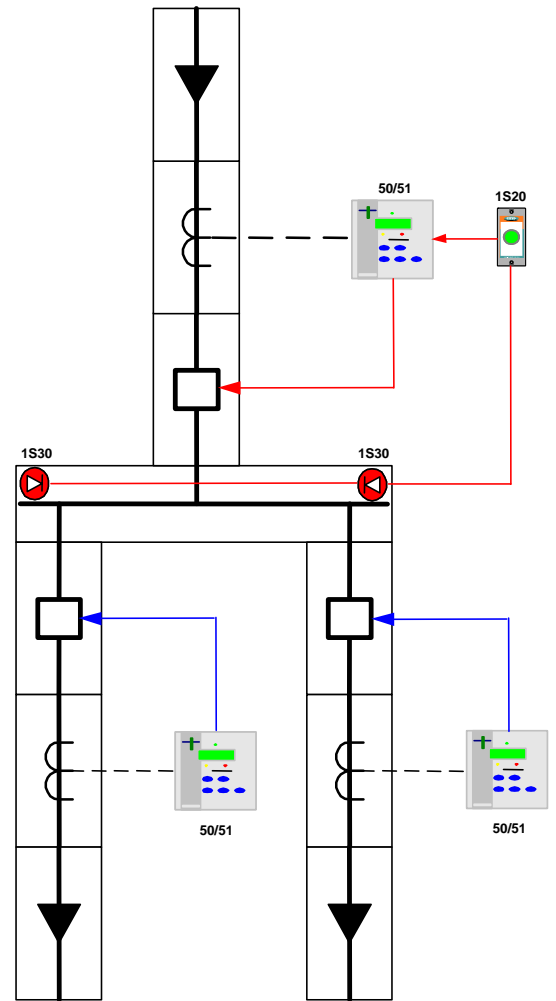


Figure 5:
 One, two or three arc sensors located in the BUS chamber

Mounting

Panel mounting is achieved using a 30mm diameter hole in the panel adjacent to the protection relay.

Rear of cubicle surface or DIN rail mounting is also possible by fitting the optional H01180001B DIN rail clip.

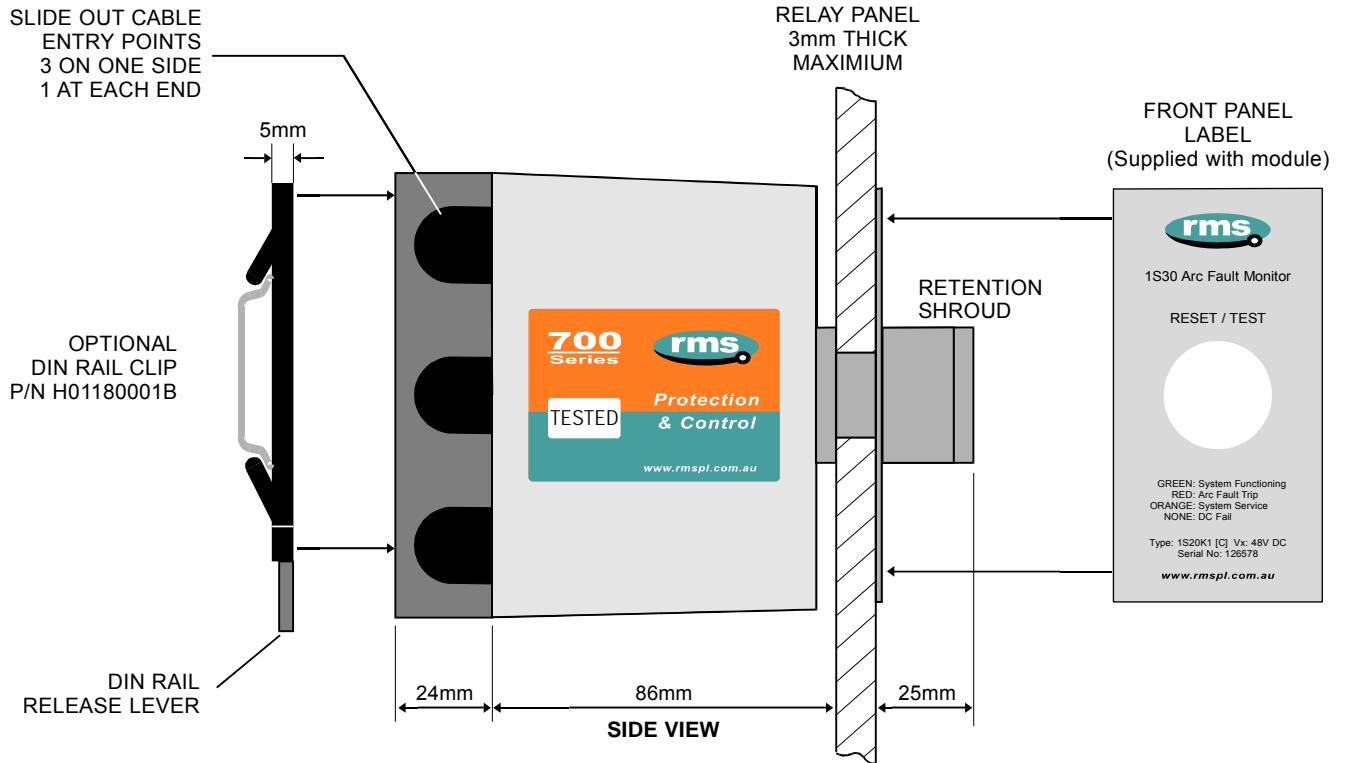


Figure 7: 1S20 Panel mounting arrangement depicted – Optional DIN rail mounting available

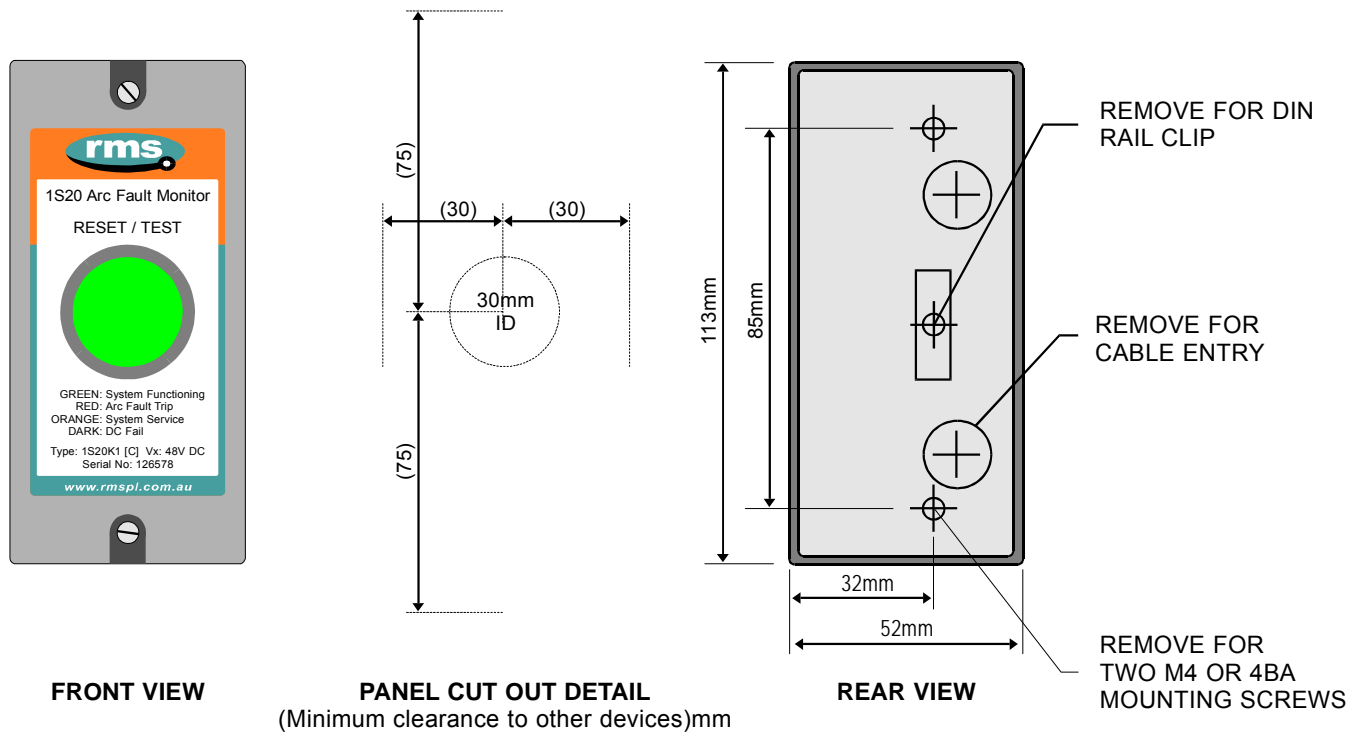


Figure 8: 1S20 Front view, panel cut out & rear view

AUXILIARY SUPPLY BURDEN (At 110V DC)

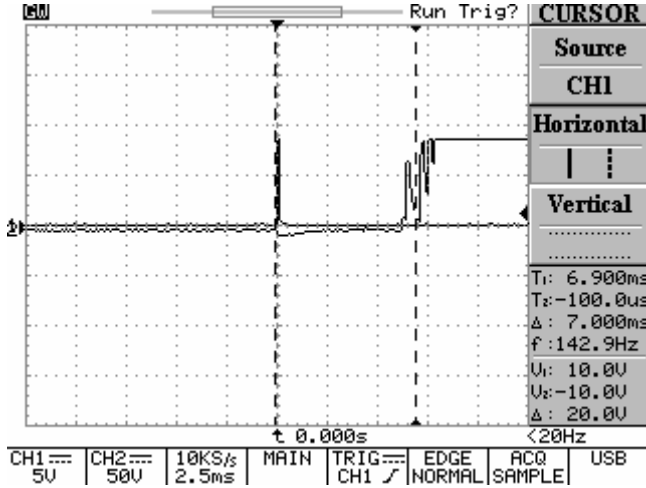
Monitoring mode: Less than 4W
 Arc fault detected: Less than 10W for 2s

AUXILIARY SUPPLY

20 - 60V DC
 36 - 150V DC

OPERATE TIME

Arc fault trip contacts guaranteed to pick up in less than 10ms including bounce. Typical operate time is 7ms.



CRO trace showing nominal operation time of the trip contacts at 7ms. First contact touch at 6.25ms and fully closed by 7.25ms. Operation in <10ms is considered acceptable as current check relay operate time is ~15ms.

ARC SENSOR INPUTS

Two or three independent arc sensor inputs type 1S30 or similar.

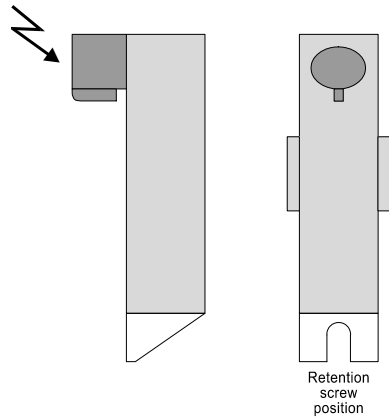


Figure 9: 1S30 Arc Fault Sensor

MINIMUM ARC DURATION

The minimum arc "flash" duration required to guarantee operation of the output contacts is 1.25ms.

TRIP CONTACT RESET TIME

Once operated the trip output contacts reset as follows:
 Trip contact 1: Self reset in 2s.
 Trip contact 2: Reset as per configuration switch 4.

MANUAL RESET

Press front button or interrupt power supply to reset LED's.

OUTPUT CONTACTS

Arc fault trip contacts: 2 N/O
 Fail alarm: 1 N/C for the power supply / CPU fail
 Normally picked up & drops out to signal an alarm condition.

OUTPUT CONTACT RATINGS

IEC60255-0-2

Carry continuously: 5A AC or DC
 Make & carry: 0.5s 20A AC or DC
 L/R ≤ 40ms & V ≤ 300V: 0.2s 30A AC or DC
 Break capacity: AC resistive 1,250VA
 I ≤ 5A & V ≤ 300V: AC inductive 250VA @ PF ≤ 0.4
 DC resistive 75W
 DC inductive 30W @ L/R ≤ 40ms
 50W @ L/R ≤ 10ms
 Minimum number of operations: 10⁶ at maximum load
 Minimum recommended load: 0.5W limit 10mA / 5V

TRANSIENT OVERVOLTAGE

IEC60255-5

Between all terminals & earth: 5kV 1.2/50us 0.5J
 Between independent circuits without damage or flashover: 5kV 1.2/50us 0.5J

INSULATION COORDINATION

IEC60255-5

Between all terminals & earth: 2.0kV RMS for 1 minute
 Between independent circuits: 2.0kV RMS for 1 minute
 Across normally open contacts: 1.0kV RMS for 1 minute

AUXILIARY SUPPLY

IEC60255-11

Allowable breaks / dips in supply: ≤ 20ms
 Collapse to zero from nominal voltage

HIGH FREQUENCY DISTURBANCE

IEC60255-22-1 CLASS III

2.5kV 1MHz common mode: ≤ 3% variation
 1.0kV 1MHz differential mode

ELECTROSTATIC DISCHARGE

IEC60255-22-2 CLASS III

6kV contact discharge: ≤ 5% variation

RADIO FREQUENCY INTERFERENCE

IEC60255-22-3

10V/m, 80 TO 1,000MHz: ≤ 5% variation

FAST TRANSIENT

IEC60255-22-4

4kV, 5/50ns, 2.5KHz repetitive: ≤ 3% variation

CONDUCTED RFI

IEC60255-22-6

10V, 0.15 to 80MHz: ≤ 5% variation

TEMPERATURE RANGE

Operating: -5 to +55°C
 Storage: -25 to +75°C

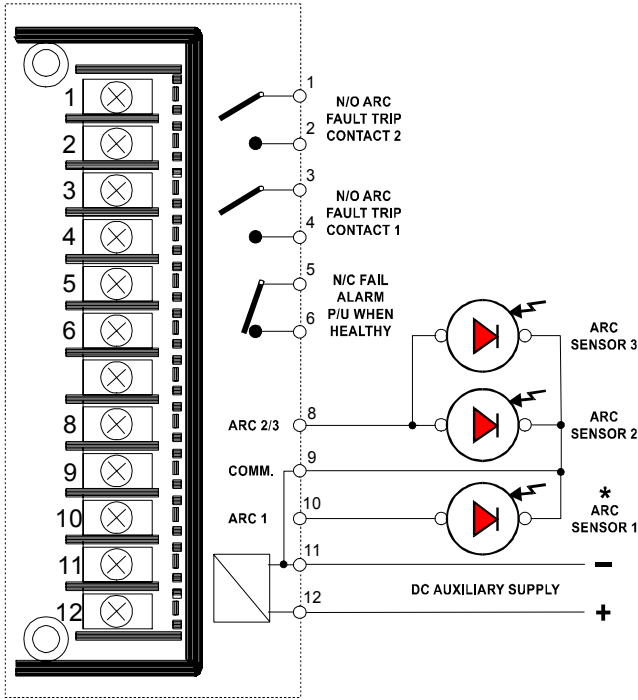
HUMIDITY

IEC68-2-1/2

40°C & 95% RH non condensing

CASE

ZA12 flush or DIN rail mount type
 12 M4 screw terminals
 Plug in module to facilitate easy wiring & fast changeover



1S20 SOCKET TERMINAL LAYOUT

Viewed the from front when un-plugged from the main housing
(Note: * Always wire Arc Sensor 1. Arc sensor 2 & 3 optional)

Ordering Information

Generate the required ordering code as follows: e.g. 1S20 CAA

1S20 1 2 3 Arc Fault Monitor Relay

1 AUXILIARY SUPPLY RANGE

- A 20 - 60V DC
- C 36 - 150V DC

2 MOUNTING

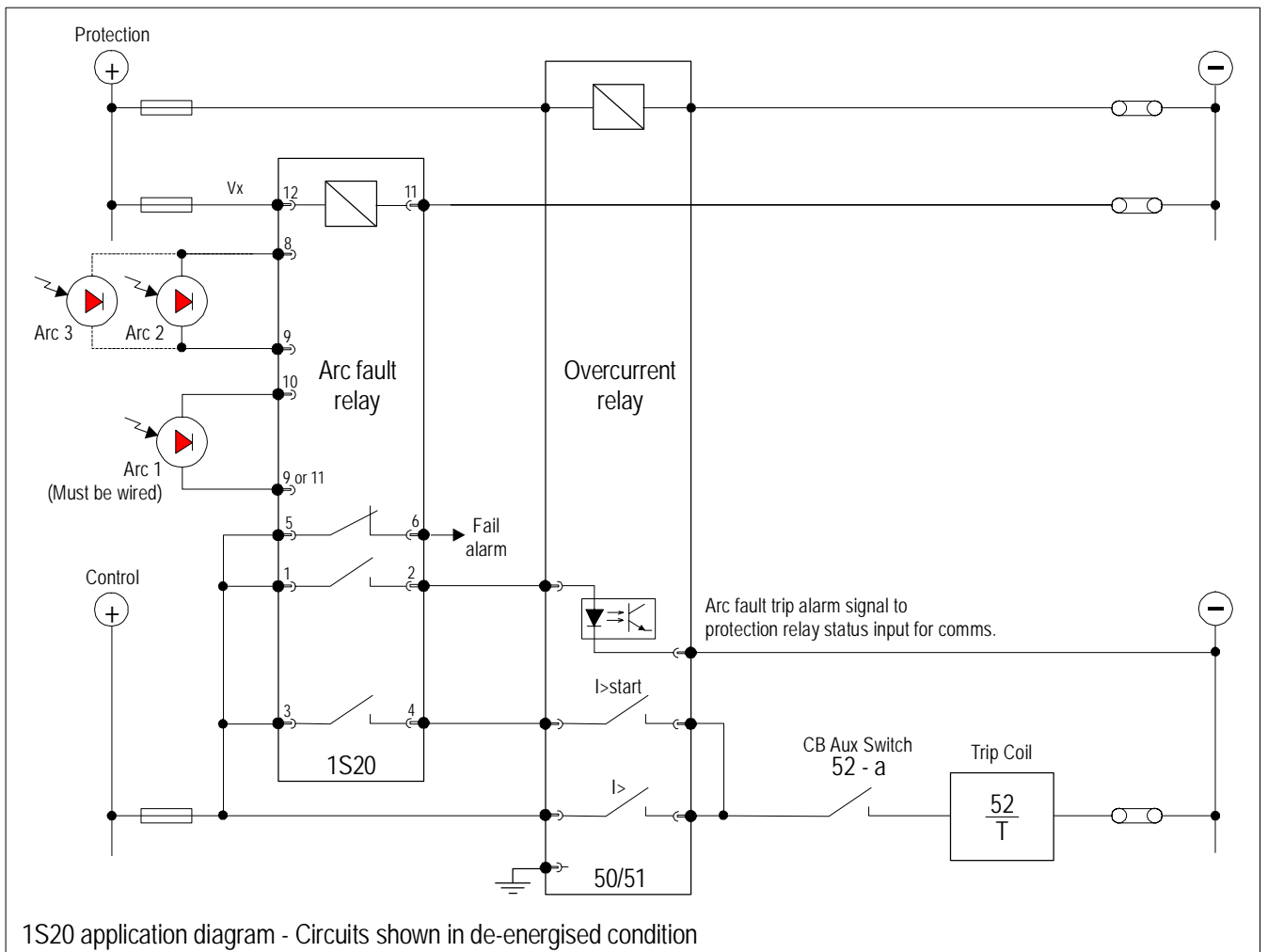
- A Panel mount
- B DIN rail mount

3 SENSORS

- A Two arc sensor inputs (Default)
- B Three arc sensor inputs

No options are required when specifying the 1S30 Arc Fault Sensor.
Standard cable length is 6m.

1S30 Arc Fault Sensor



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 ISO9001-2000. 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.



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