Reyrolle
Protection
Devices

7XG3120 – ReyArc20

Arc Fault Monitor Relay

Energy Management

SIEMENS

7XG3120 - RA20

Arc Fault Monitor Relay

Features

- Compact economic design
- Simple panel mounting for retrofit applications
- Two or three arc sensor inputs
- Two high-speed, tripping duty output contacts
- Push-button reset
- Continuous arc sensor supervision
- Integrated self supervision
- Fail alarm contact
- AC or DC operation
- 3 options for auxiliary supply range, suitable for 24 to 250V supplies

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 effectively clear arcing short circuits before significant damage is caused.

Arcing faults can occur as a result of insulation breakdown due to equipment age and/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.

ARC Fault Protection

Arc fault protection is a 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 10 ms using arc detection only or within 20 ms 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 problem of arc faults is most prevalent in older metal clad switchgear which already has operational protection systems. The RA20 (Reyarc20) 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 RA20 Arc Fault Monitors as depicted in the single line application diagrams (Figures 1, 2 & 3).

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 RA20 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.

An Arc Fault Monitor relay RA20 is installed on the switchgear panel adjacent to the protection relay. The RA20 is specifically designed for simple retrofit to existing panels & requires only a single 31mm mounting hole to be drilled. The RA20 fits through this hole, the designation label supplied with the unit positioned & the retention shroud fitted. Refer Figure 14 & 16.

RA30 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 RA20 does not need to be mounted on the front panel as the alarm indications are available on the feeder relay. Remote reset of the RA20 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.

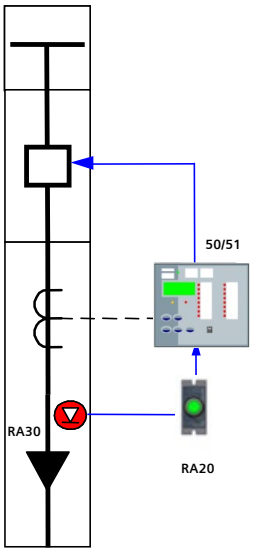


Figure 1: Single arc sensor - Cable box only
(Optional overcurrent check stage depicted)

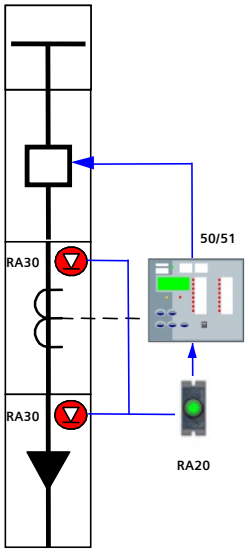


Figure 2: Two arc sensors - Cable box & CT chamber
(Optional overcurrent check stage depicted)

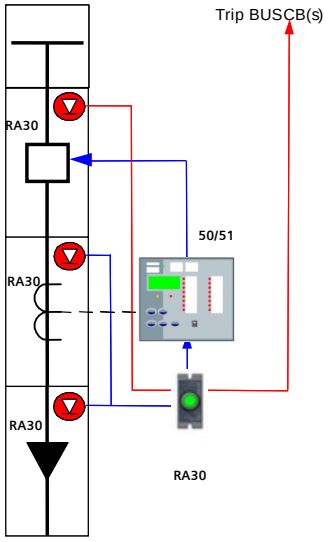


Figure 3: Two arc sensors - Cable box & CT chamber
Independent trip to CB
(Optional overcurrent check stage depicted)
One arc sensor - CB chamber
Independent trip to BUS breaker
(BUS overcurrent check stage not shown)

Busbar Applications

Combined BUS bar & switchgear Arc Protection

Figure 4 shows an application where a single RA20 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.

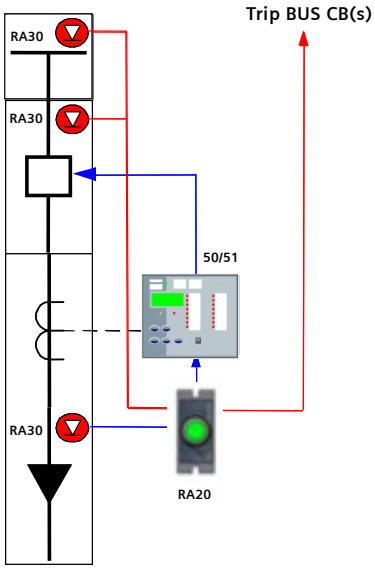


Figure 4: One arc sensor - Cable box / CT chamber
Independent trip to CB
Two arc sensors - CB chamber & BUS chamber
Independent trip to BUS breaker
(BUS overcurrent check stage not shown)

BUS bar ARC Protection

Figure 5 depicts how the RA30 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.

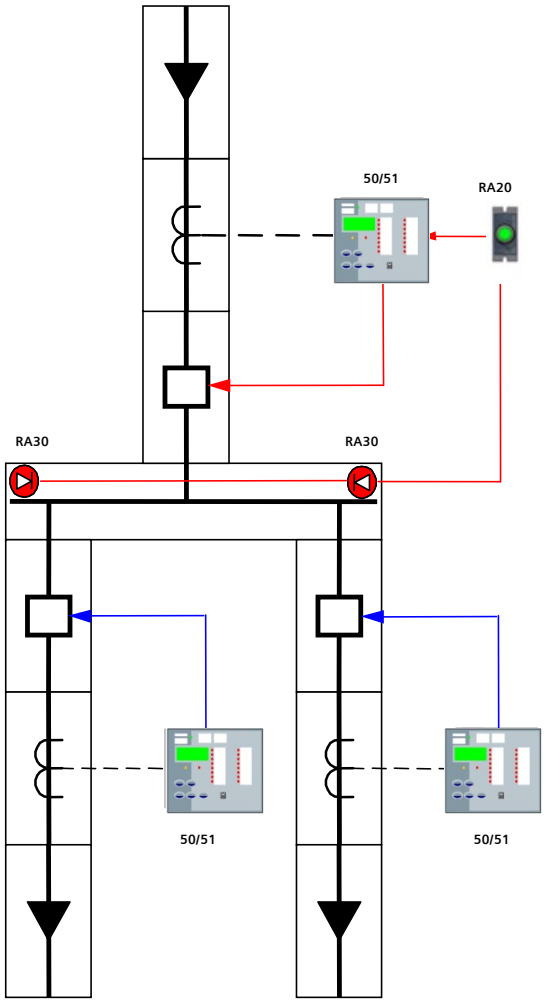
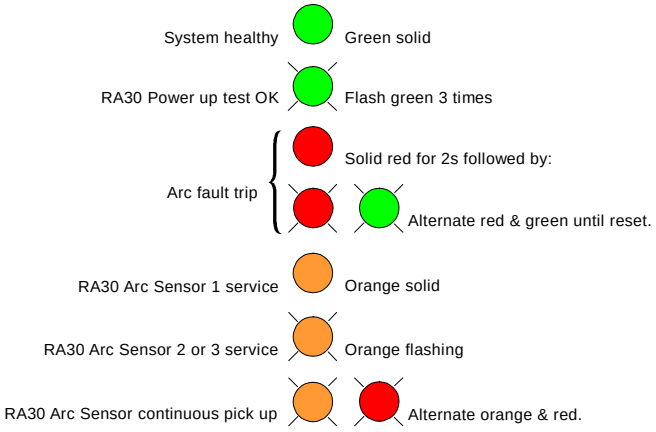


Figure 5: One, two or three arc sensors located in the BUS chamber

Operation

Operation Indicator

A single tri-colour LED is integrated into the front panel reset push button to provide the following status indications:



Arc sensor circuit supervision

The RA30 Arc Sensor is the heart of the system & supervision of circuit continuity is critical for correct operation. To monitor the integrity of the wiring between the RA30 arc sensor & RA20 Arc Monitor, a continuous 2mA supervision current flows between the units. The RA20 alarm contact will drop out after a 1s time delay if it fails to detect this current.

Where a fault is detected on the Arc Sensor 1 circuit the front panel LED will give a solid orange indication.

Where a fault is detected on Arc Sensor 2 or 3 circuits the front panel LED will give a flashing orange indication.

Where a fault is detected on Arc Sensor 1 & 2 or 1& 3 circuits the front panel LED will give a solid orange indication.

Arc Sensor Function

The RA30 is an optical sensor that responds to the flash of light emitted during the incidence of an arcing fault. Onset of the light flash & detection by the RA30 occurs in a few milliseconds.

When an arc is detected, the resistance presented by the RA30 drops to a level where the current flow increases to approximately 20mA. This increased current flow is instantaneously detected by the RA20 and its trip output contacts close. Refer to the RA30 Technical catalogue sheet for further details.

Arc fault tripping using current check

Fast operation of a tripping scheme usually results in reduced system security. The arc detection method can however, combine the RA20 optical detection technique with a traditional overcurrent method to maximize system security particularly for BUS bar protection schemes. Both conditions must coexist for the trip condition to be met as depicted in figure 6.

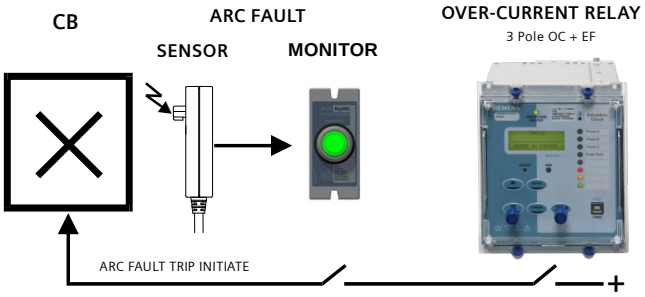


Figure 6: Key components required to implement an Arc Fault Protection scheme with an overcurrent check stage to enhance system security

The application examples in figures 1 to 5 utilize this concept for enhanced system security in that both the RA20 AND the OC 50 starter contact must be picked up for a CB trip signal to be initiated. As the arc fault trip contact closes considerably faster than the overcurrent relay starter element picks up, the CB trip time will be dictated by the overcurrent relay performance.

Low current arcing faults

Arcing faults can occur at low current levels & it is possible for the over-current starter element to be set above this level. To avoid this problem & obtain very fast clearance (<10ms), of an arc fault, the RA20 arc fault trip contact may be wired directly to the breaker operate coil. It should be noted that this method may lead to reduced system security.

ARC detection reset time (effect of multiple arc trips)

A delay of 2s is required to reset the RA20 after an initial arc sensor trip. Subsequent arc detection will cause the trip output contacts to re-operate & reset the time delays described under *Configuration Switch Settings*.

Independent trip output contacts

The RA20 may be set using configuration switch 3 for both trip output contacts to pick up when an arc is detected by any sensor input. Alternatively arc sensor 1 can be linked to trip contact 1 & arc sensor 2 (& 3 if fitted), to trip contact 2. This function may be applied where an arc fault detected in the cable box is directed to trip the feeder circuit breaker while an arc fault in the BUS chamber is to be directed to trip the BUS.

ARC sensor continuously picked up

High ambient light levels may cause a RA30 to be continuously picked up. This condition could occur for example if the CB cable box cover was left open in very high ambient light level conditions. A non arc fault over-current pick up would then result in an arc fault trip operation.

To avoid possible mal-operation due to this condition, the RA20 is designed to automatically disable the arc fault tripping function if the RA30 sensor is picked up for >10s. The RA20 alarm contact will be set & the front LED flash alternate orange & red until the ambient light level problem is corrected. The RA20 will then perform an arc sensor test function & automatically reset.

Configuration

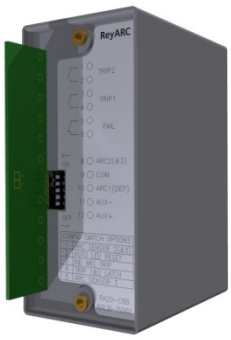


Figure 7: RA20 rear view showing configuration switches

Configuration switch

The configuration switches are accessible to the user by first unplugging the electronic module from the terminal base as shown in Figure 7.

1: ARC SENSOR 2	ON		OFF
2: LATCHING TRIP LED	ON		OFF
3: INDEPENDENT ARC TRIP	ON		OFF
4: LATCHING TRIP CONTACTS	ON		OFF
5: ARC SENSOR 3	ON		OFF

Configuration switch settings

The internal wiring label identifies the position of the following switch functions:

Switch 1: Arc sensor 2
- ON - Arc Sensor 2 fitted
- OFF - Arc Sensor 2 not fitted

Switch 2: Arc fault trip indication LED reset
- ON - Latching until manually reset
- OFF - Automatic self reset (Extinguish) after 4 hours will also reset contacts set for latching function

Switch 3: Independent arc trip output contacts
- ON - Arc Sensor 1 activates trip output contact 1 & Arc sensor 2 or 3 activates trip output contact 2
- OFF - Arc Sensor 1, 2 or 3 activate both trip outputs

Switch 4: Arc fault trip output contact reset
- ON - Latching – Reset with trip LED
- OFF - Self reset after 2s

Switch 5: Arc sensor 3
- ON - Arc Sensor 3 fitted
- OFF - Arc Sensor 3 not fitted

Wiring Diagram

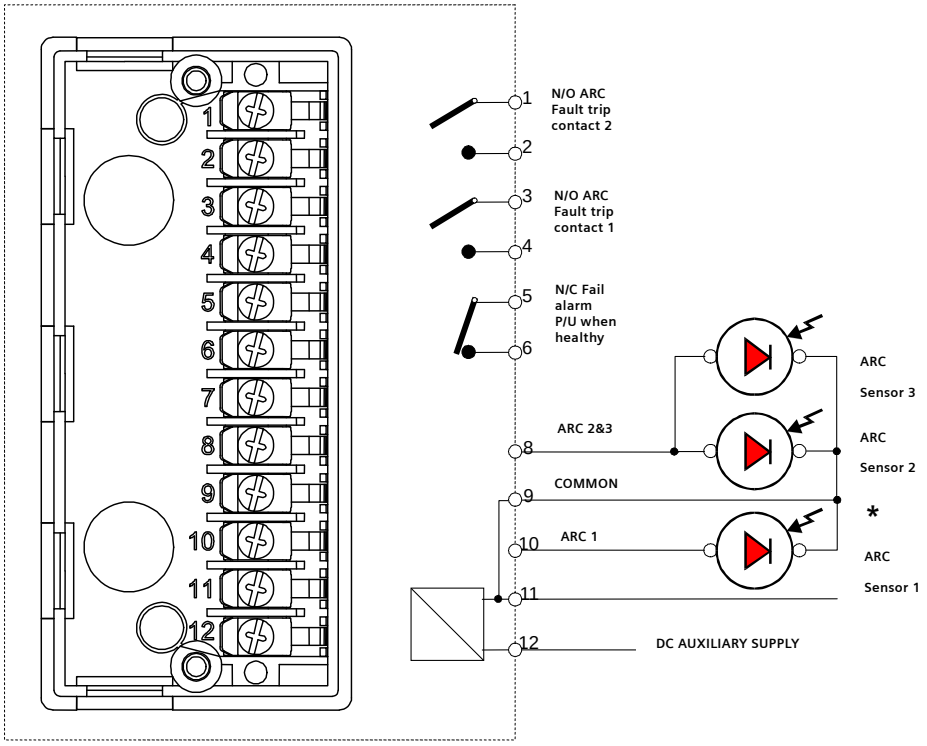
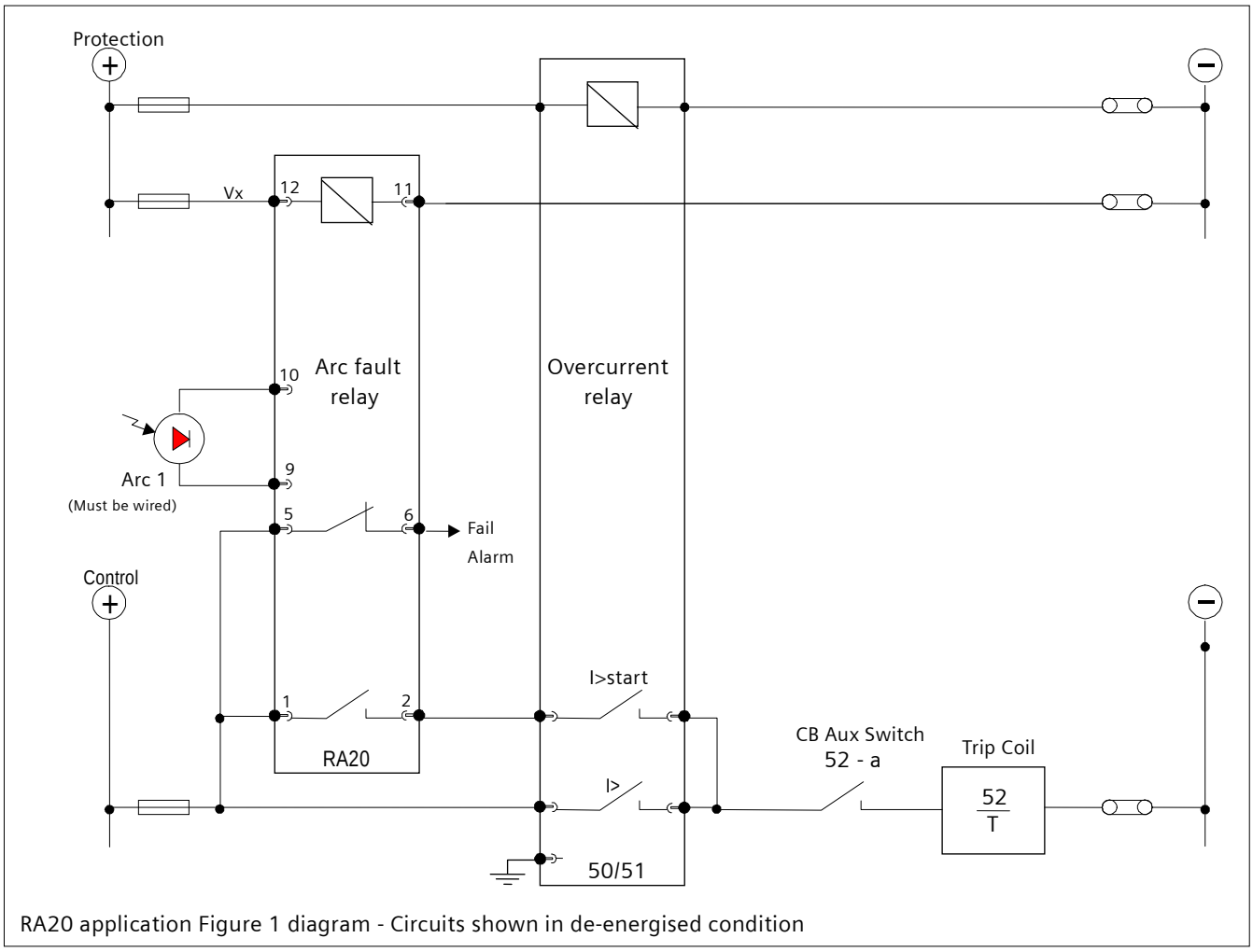


Figure 8: RA20 Socket Terminal Layout viewed from the front when un-plugged from the main housing
Note: * Always wire Arc Sensor 1. Arc Sensors 2 & 3 are optional.



RA20 application Figure 1 diagram - Circuits shown in de-energised condition

Figure 9: RA20 Wiring application diagram (Refers to Figure 1 Line Diagram)

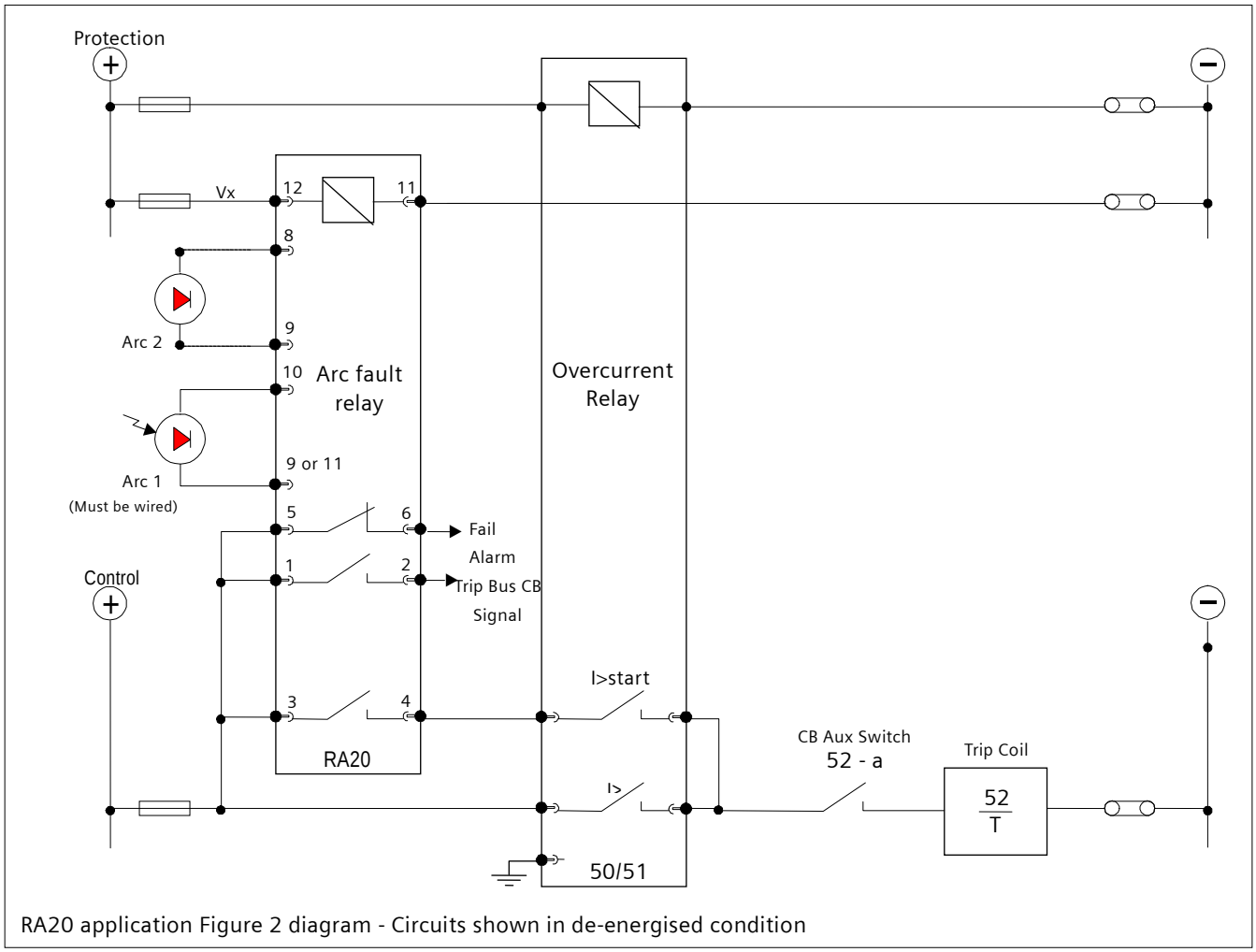


Figure 10: RA20 Wiring application diagram (Refers to Figure 2 Line Diagram)

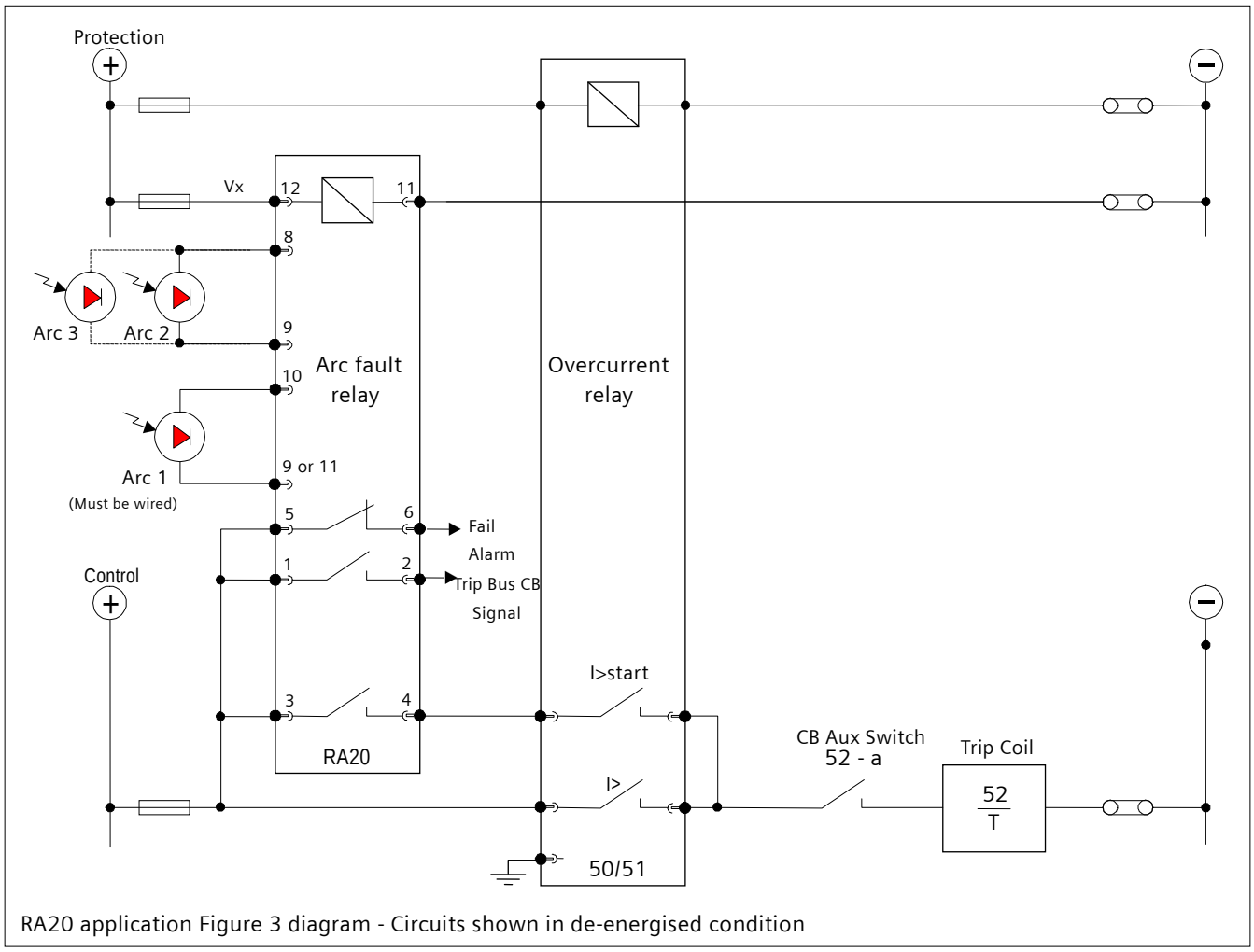


Figure 11 : RA20 Wiring application diagram (Refers to Figure 3 Line Diagram)

Mounting Options

The RA20 is available in two versions:

1. A surface mount version which has a separate reset button & LED indicator on the front panel. The advantage of this version is the lower cost & where front panel space in limited.

2. A panel mount version which has a combined reset button & LED indication. The advantage of this version is that it can be either panel or surface mounted.

Surface mount version

This version is suitable for location in the rear of a cubicle. It may be surface mounted as shown in figures 12 & 19. It may also be DIN rail mounting when the optional DIN Rail Mounting Kit is fitted. Refer figures 13, 18 & 21.

Figure 12: RA20 surface mount version front panel

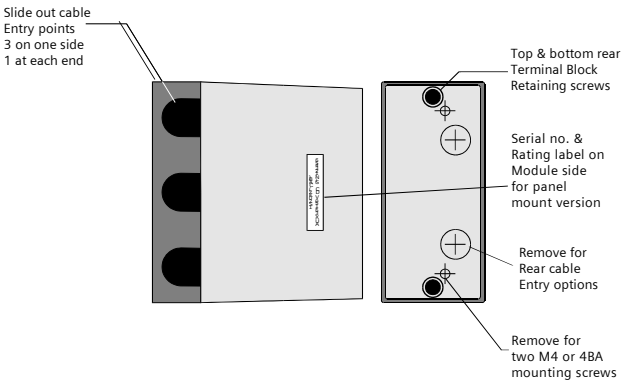


Figure 13: Surface mount version side view

Panel mount version

This version is suitable for mounting on the front panel of a cubicle or door. This is achieved using a 31mm diameter hole in the panel adjacent to the protection relay as depicted in figures 14, 15 & 16.

This version may also be surface mounted by reversing the terminal block retaining screws. It may also be DIN rail mounting when the optional DIN Rail Mounting Kit is fitted. Refer figures 17, 18 & 21.

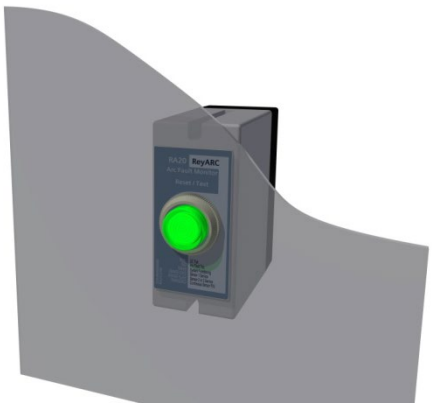


Figure 14: RA20 through-hole panel mount version

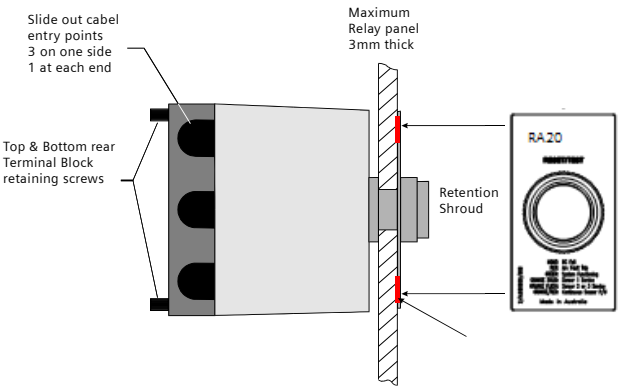
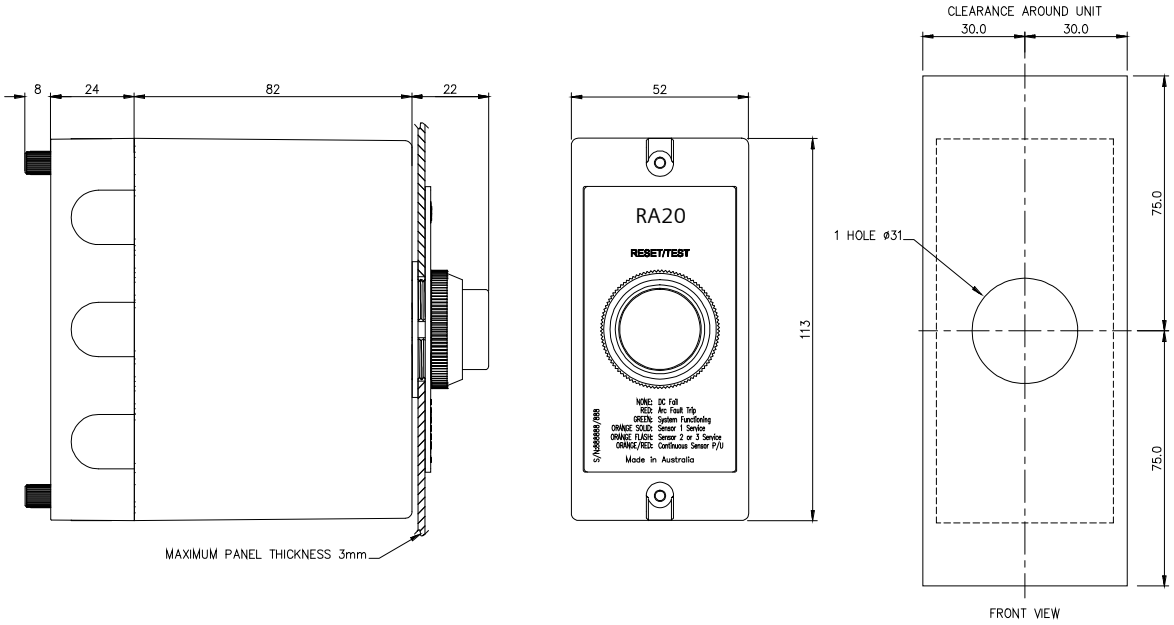


Figure 15: Panel mount version side view

Panel Mount Version



igure 16: Panel mounting cut out detail

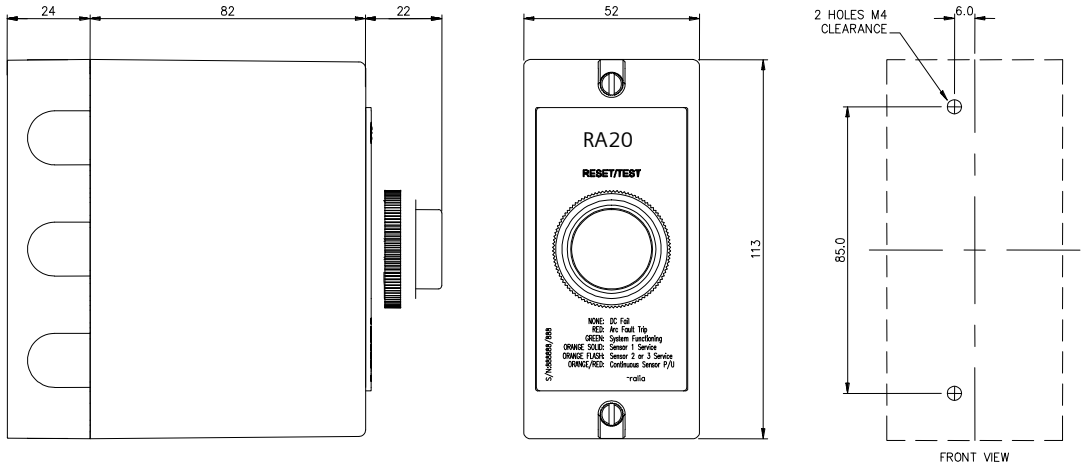


Figure 17: Surface mounting detail

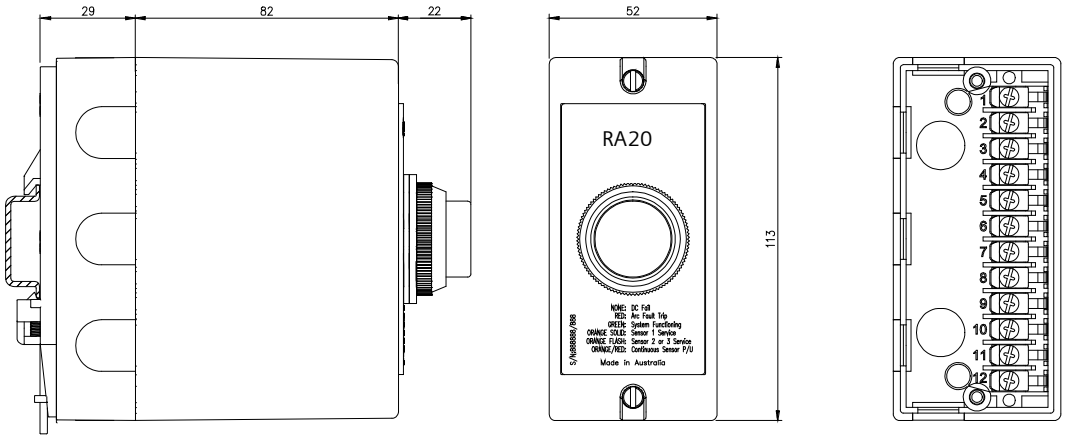


Figure 18: DIN rail mounting detail

Surface Mount Version

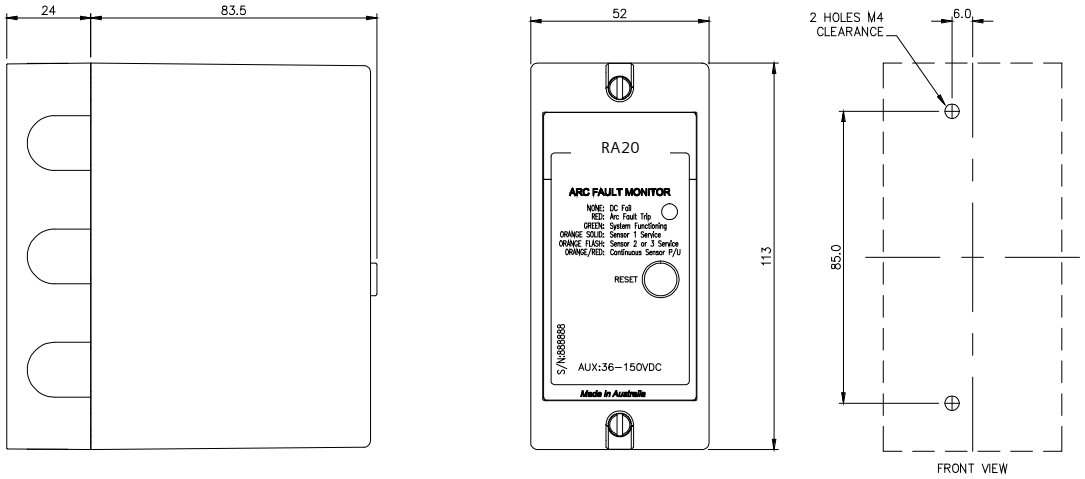


Figure 19: Surface mounting detail

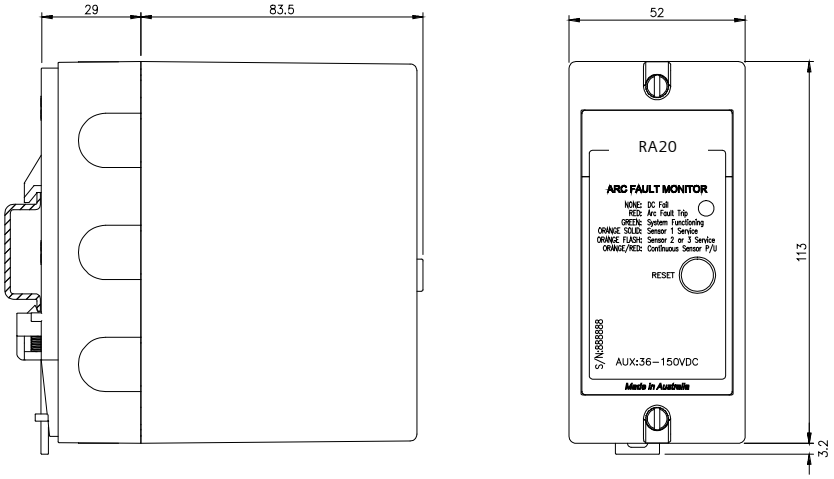


Figure 20: DIN rail mounting detail

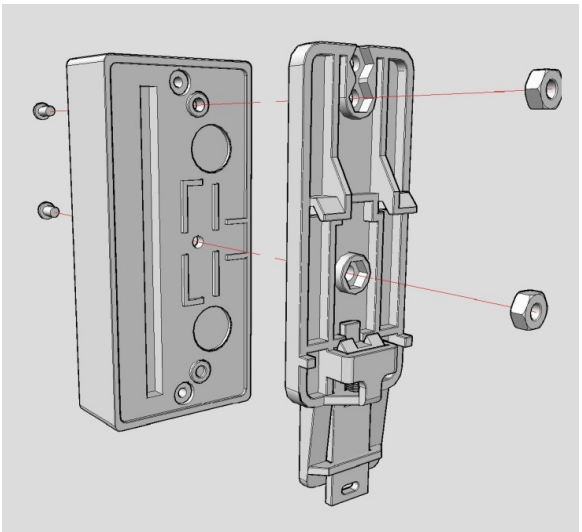


Figure 21: DIN rail clip fitting detail

Technical Data

Auxiliary Supply burden (at 110V DC)

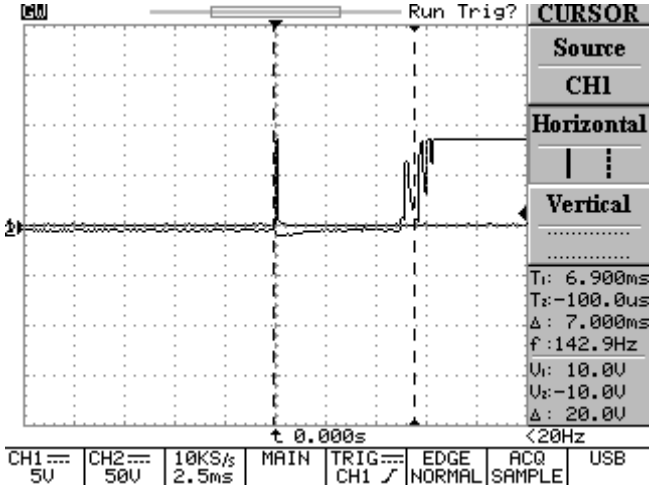
Monitoring mode:	Less than 4W
Arc fault detected:	Less than 10W for 2s

Auxiliary Supply

3 options are available for the auxiliary supply:
24/32/48V AC or DC nominal
110/125V AC or DC nominal
220/240/250V AC or DC nominal

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 overcurrent relay operate time is ~25ms.

7SR21/22: 50 Instantaneous Overcurrent Element – Operate Time

Operate and Reset Time

	Attribute	Value
t_{basic}	Element basic operate time	0 to 2 x*Is*: 30 ms, ± 10ms
		0 to 5 x*Is*: 20 ms, ± 10ms

ARC sensor inputs

Two or three independent arc sensor inputs for type RA30 arc sensors.

Figure 22: RA30 Arc Fault Sensor (Refer RA30 Technical Bulletin)

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 will reset in 2 seconds as per the configuration switch 4 setting.

Manual reset

Press front reset button or interrupt power supply to reset the unit.

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 L/R ≤ 40ms & V ≤ 300V	0.5s 20A AC or DC	
	0.2s 30A AC or DC	
Break capacity I ≤ 5A & V ≤ 300V	AC resistive	1,250VA
	AC inductive	250VA @ PF ≤ 0.4
	DC resistive	75W
	DC inductive	30W @ L/R ≤ 40ms 50W @ L/R ≤ 10ms
Minimum number of operations		10^6 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 Collapse to zero from nominal voltage	≤ 20ms

High frequency disturbance - IEC60255-22-1 Class III

2.5kV 1MHz common mode 1.0kV 1MHz differential mode	No mal operation

Electrostatic discharge - IEC60255-22-2 Class III

6kV contact discharge	No mal operation

Technical Data (Contd.)

Radio frequency interference IEC60255-22-3 Class III

10V/m, 80 TO 1,000MHz	No mal operation

Fast transient IEC60255-22-4 Class III

4kV, 5/50ns, 100KHz repetitive	No mal operation

Conducted RFI IEC60255-22-6 Class III

10V, 0.15 to 80MHz	No mal operation

Temperature range IEC68-2-1/2

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

Humidity IEC68-2-78

40 °C & 93% RH non-condensing

Case

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

Ordering Information

Product description	Variants	Order No.
		7 X G 3 1 2 0 - □ □ □ 0 0 - 0 A A 0
Arc Fault Protection Components	Category	
	Arc Protection	3 1
	Device	
	RA20 Arc Fault Monitor Relay	2 0
	Sensor Inputs	
	Two sensor inputs	2
	Three sensor inputs	3
	Operating Voltage	
	24/32/48V AC or DC Nominal	F
	110/125V AC or DC Nominal	G
	220/240/250V AC or DC Nominal	H
	Mounting	
	Panel or Surface Mount, No DIN Rail kit.	A
	Panel or Surface Mount, With DIN Rail kit.	B
	Surface Mount only, No DIN Rail kit.	C
	Surface Mount, With DIN Rail kit.	D

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P.O. Box 8
North Farm Road
Hebburn
Tyne & Wear
NE31 1TZ
United Kingdom
Phone: +44 (0)191 401 7901
Fax: +44 (0)191 401 5575
E-mail: marketing.spdl.gb@siemens.com

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For enquires please contact our Customer Support Center
Phone: +49 180/524 8437 (24hrs)
Fax: +49 180/524 24 71
E-mail: support.ic@siemens.com
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