

## Features

- Configure for SEND or RECEIVE function
- Suitable for operation with 'metallic' pilot wire differential relays
- Detects open circuited, short circuited & crossed pilot wires
- Simple to set up & commission
- Inherent 5KV or 15KV isolation  
No external components required
- Wide range DC auxiliary with integrated supply supervision
- Simple & robust design
- Flush, rack or projection mounting
- Made in Australia

## Application

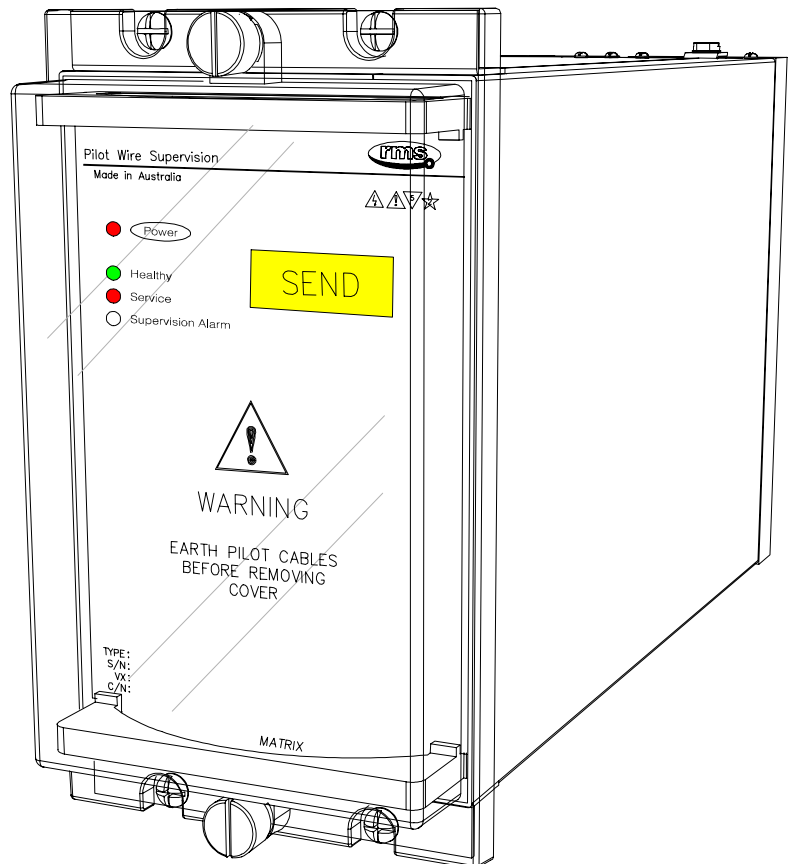
Differential protection schemes employing copper pilots remain widely used despite the increased availability of optical fibre infrastructure & numeric protection relays:

- ◆ Differential protection schemes which employ circulating current techniques & static relays are simple, reliable & low cost;
- ◆ Existing copper pilots have many years of useful life while dedicated optic fibre links are not always available, can be expensive to lease & may be subject to variable line delays due to telecoms exchange switching;
- ◆ Expansion of existing schemes requires compatible static relays & schemes.

Due to the above reasons, many utilities are reluctant to replace existing pilot wire & static protection relay schemes. Adding new 'T' feeders necessitates new matching relays to be installed which means we can expect to see traditional pilot wire protection schemes to be used for many years to come.

While very reliable, traditional DC pilot wire supervision systems providing 5KV & 15KV isolation are bulky & expensive.

The 3A320 has been designed to provide an improved supervision scheme for copper pilots employed for communicating between pilot wire protection relays.



3A320 DC Supervision Station Front Panel  
5KV isolation level size 4 case version depicted

## Description

Made in Australia

Differential feeder protection systems offer unit protection, which ensure discrimination without reference to the rest of the power system & provide high-speed operation.

To ensure maximum security of this protection system the pilot wires should be supervised so that faults such as short circuits, open circuits & crossed wiring are quickly detected.

### Pilot Wire Supervision

Pilot wire supervision is based on a DC signal that is injected at one end of the pilot by the SEND relay & monitored at the opposite end of the pilot by the RECEIVE relay. A pilot fail alarm is initiated by the RECEIVE relay if the DC signal is lost.

### AC Immunity

AC filtering is employed to provide immunity to AC voltages which may be induced on the pilot & otherwise cause mal operation of the pilot supervision system.

### Pilot Wire Isolation

5KV or 15KV power supply isolation is provided using a compact encapsulated isolating transformer utilizing triple insulated Teflon winding wire. The intertrip & pilot wire supervision receive channel is isolated using a fibre optic link.

### Auxiliary Supply Supervision

For additional security, a built in auxiliary supply supervision function is provided in the 3A320 with an alarm contacts.

### Mounting

The efficient & compact design of the 3A320 makes it suitable for 4U 19 inch rack or panel mounting & allows the use of standard sub station batteries.

# Supervision Scheme

### SYSTEM OPERATION

The 3A320 employs a DC/DC converter to generate a regulated DC supervision voltage. This voltage is maintained on the isolated side of the circuit & is switched onto the pilot lines when the 3A320 is configured as the SEND relay.

The DC supervision voltage is monitored at the remote end of the pilot by a 3A320 configured as the RECEIVE relay.

Loss of detection of the DC supervision signal at the RECEIVE end will result in the normally picked up supervision alarm contacts at the RECEIVE end dropping out after a short delay to signal an abnormal condition.

Loss of the DC supervision signal at the SEND end will result in the normally picked up supervision alarm contacts at the SEND end dropping out after a short delay to signal an abnormal condition.

Refer to the application diagram shown in figure 1 & the functional block diagram depicted in figure 2.

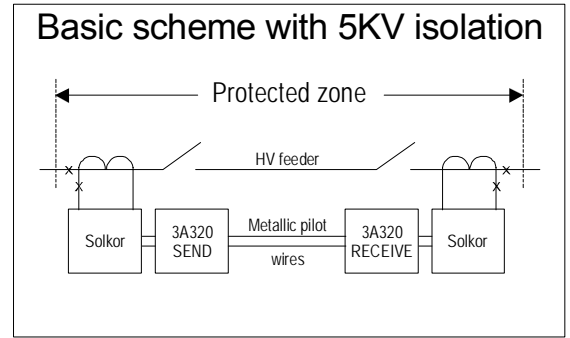


Figure 1

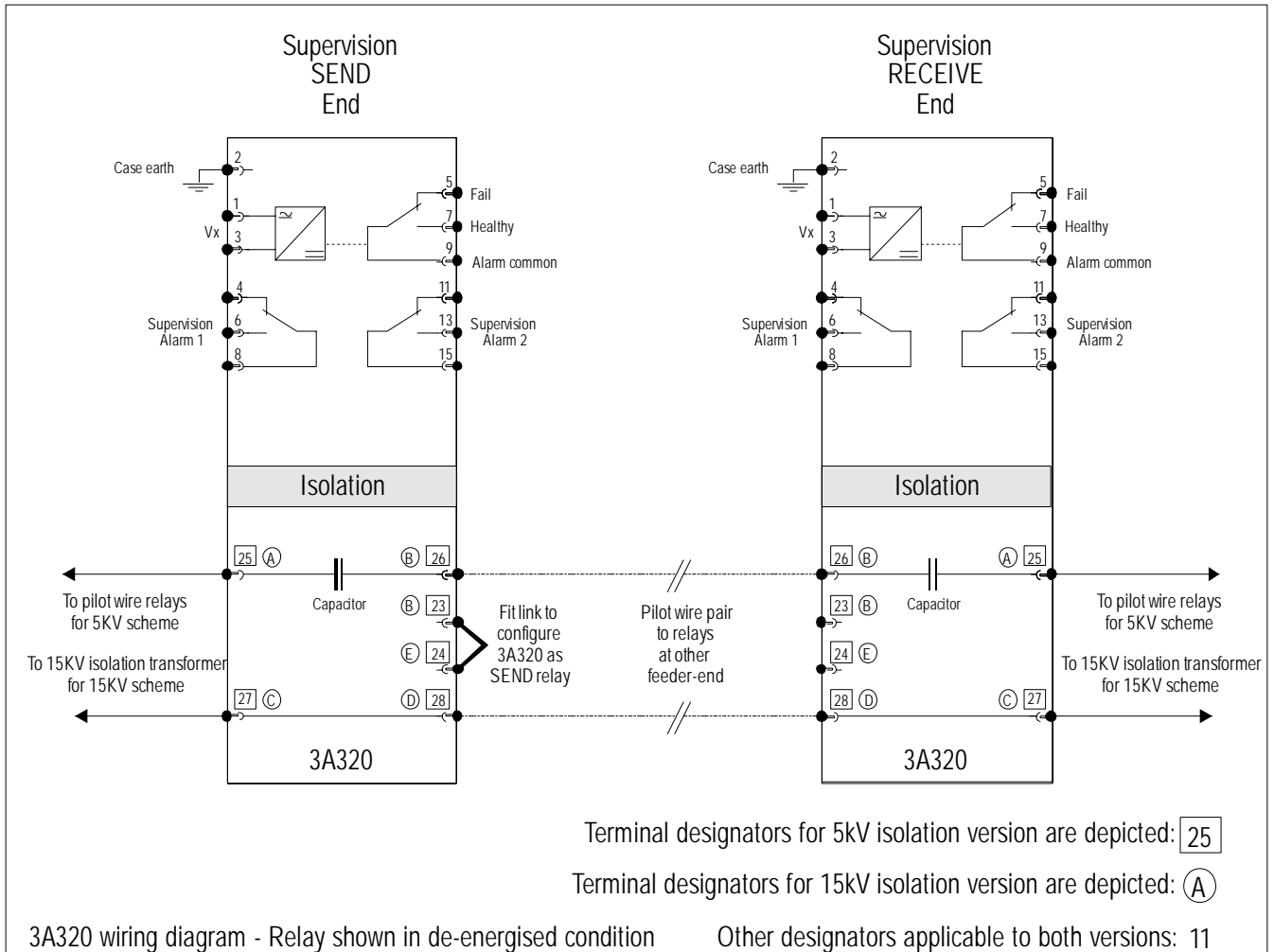


Figure 2

**Note 1:** If the 3A320 is mounted in a metal cubicle or rack the EMC ground must be connected to the chassis ground.

## SUPERVISION CONFIGURATION

The 3A320 is designed for application as either the supervision SEND or the supervision RECEIVE relay. This configuration is achieved by fitting a single link between two terminals of the SEND relay only as per table 1:

|                     | Isolation Version             |                             |
|---------------------|-------------------------------|-----------------------------|
|                     | 5kV                           | 15kV                        |
| Supervision SEND    | Fit between terminals 23 & 24 | Fit between terminals B & E |
| Supervision RECEIVE | Do not fit configuration link |                             |

Table 1 – Configuration label

To identify the supervision configuration fit the appropriate label supplied with the relay to the 3A320 front panel.

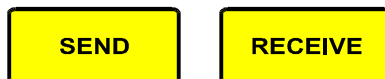


Figure 3 – Configuration labels supplied with each relay

## CONTINUOUS MODE PILOT WIRE SUPERVISION

The SEND relay outputs a continuous 30V DC unloaded supervision signal. The RECEIVE relay monitors this signal & outputs an alarm if the signal is lost after a short time delay.

The advantage of this mode is simplicity.

Under normal conditions both the SEND & RECEIVE relays will have the red Power LED & green Healthy LED energised. Failure of the SEND or RECEIVE relays to detect the supervision signal cause the red Supervision Alarm LED to flash after a short time delay.

All LED's are self reset.

## PILOT OPEN CIRCUIT FAULT DETECTION

An open circuit pilot will cause a loss of the supervision voltage at the RECEIVE relay end & cause the RECEIVE relay to signal a pilot fail alarm.

## PILOT SHORT CIRCUIT FAULT DETECTION

A loss of insulation resistance across the pilot cores will lead to a reduction in the supervision voltage level applied to the pilots. A low resistance or short circuit will cause the supervision signal to be eventually lost & the associated pilot fail alarms being signaled.

## CROSSED PILOT DETECTION

The supervision SEND & RECEIVE relays are polarized such that crossing the pilot wires will cause a loss of the supervision voltage at the RECEIVE relay end & cause the RECEIVE relay to signal a pilot fail alarm.

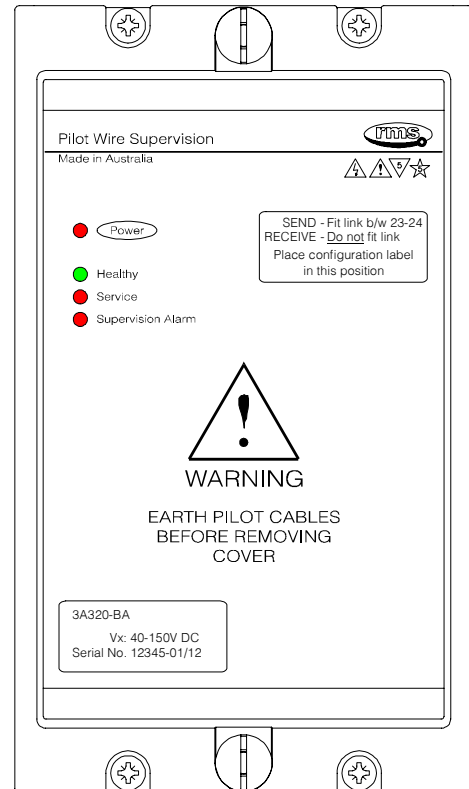


Figure 4 – Front panel layout (Left section only of 15kV version)

## SYSTEM RELIABILITY

System reliability is primarily achieved through the application of proven technology for the DC supervision SEND & RECEIVE circuit elements.

The DC/DC converter power supply is of robust design & incorporates considerable protection against pilot line transients & short circuit pilots. Continuous supervision of the DC pilot supervision voltage level is incorporated.

## SELF TEST SEQUENCE

When the 3A320 is powered up a complete system self test routine is performed including a LED test. The system monitoring described in this section then commences.

## SELF SUPERVISION ALARM CONTACT

Extensive self supervision features have been incorporated to monitor complete system integrity & output an alarm in the event of failure. A CPU watchdog is employed to monitor the system for correct function. The CPU performs memory & program checks & if no fault is detected a check pulse is output to reset an independent alarm timer. Failure of the CPU to provide the periodic check pulse will cause the alarm timer to expire, the Self Supervision Healthy LED to be extinguished, the CPU Alarm LED to be energised & the Self Supervision fail alarm contact to drop out. This method is employed to ensure the self supervision system is fail safe in the event of its own failure.

## POWER SUPPLY

Failure of the power supply will cause all LED's to be extinguished & the Self Supervision fail alarm contact to drop

# Mounting Details

**CASE**

5kV isolation version

Case: 4M28-S draw out case  
 Termination: M4 screw terminals suitable for ring lugs

15kV isolation version

Case: Size 8 non draw out rack or flush mount case fabricated from high insulation acetal & fiberglass material with a separate pilot wire termination cover.

Pilot Cables: M5 studs  
 Configuration link: M5 studs  
 Secondary wiring: M4 screw terminals suitable for ring lugs

**ACCESSORIES SUPPLIED WITH EACH RELAY**

1 x M4 self threading mounting screw kit P/N 290-406-151  
 2 x M4 terminal screw kit (28 per kit) P/N 290-407-153

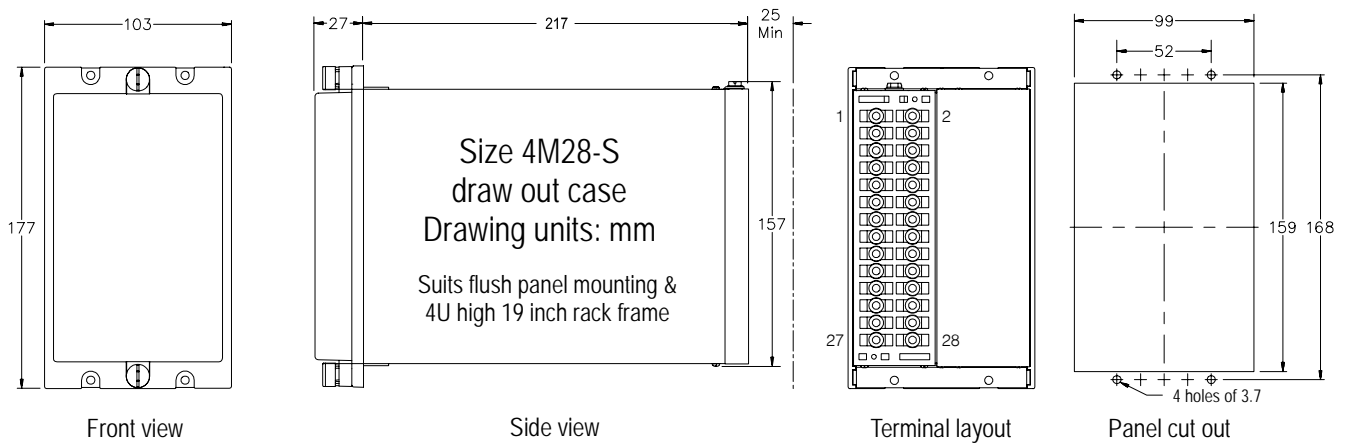


Figure 5 – 4M28-S case for 5kV isolation version

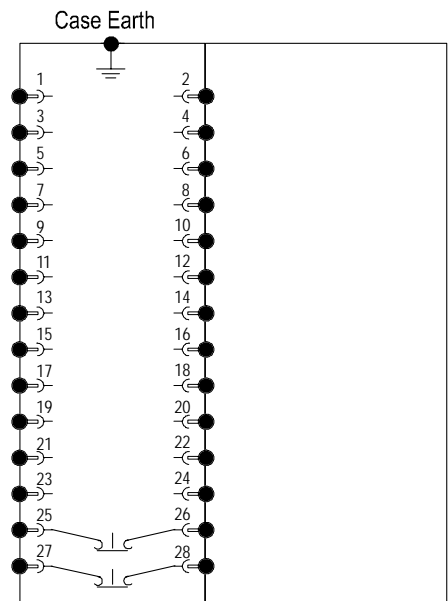
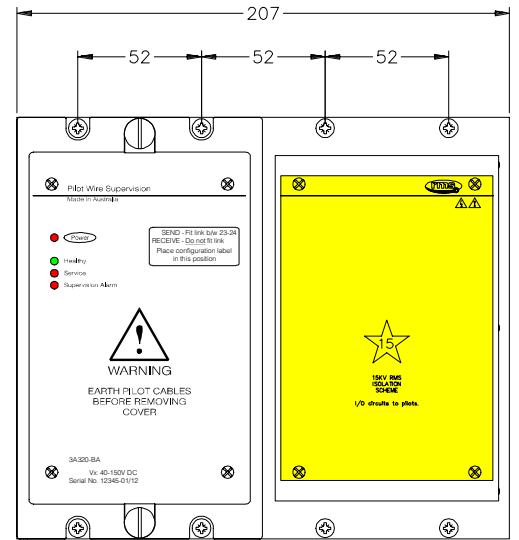
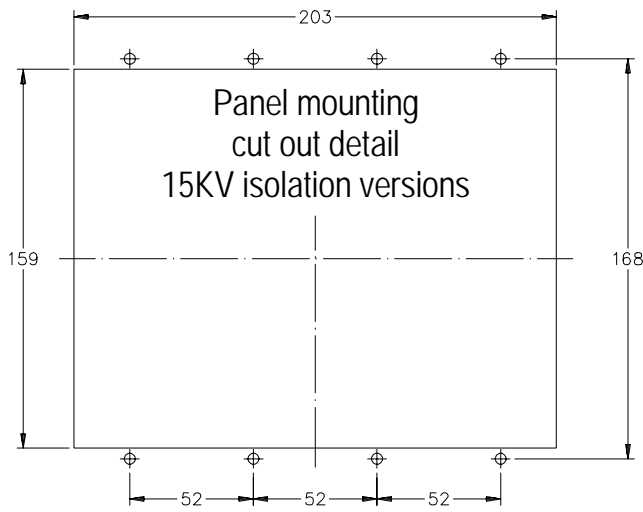
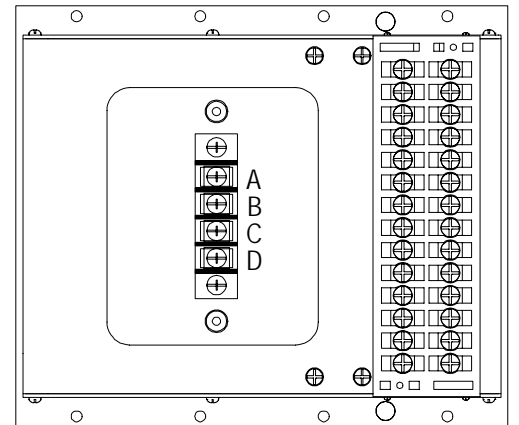
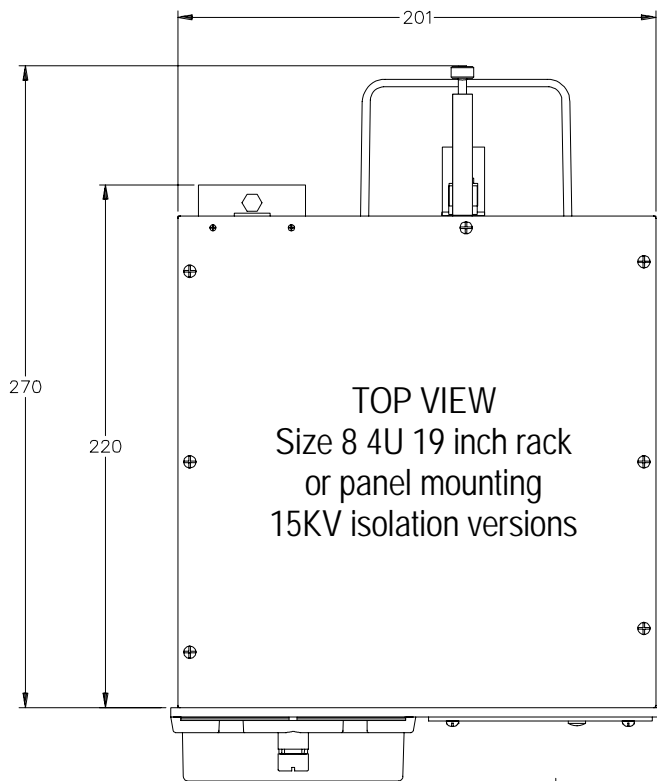


Figure 6 – 4M28-S case rear terminals

# Mounting Details



Size 8  
15KV Isolation Version



Pilot wire terminal cover provided with 15KV isolation versions only

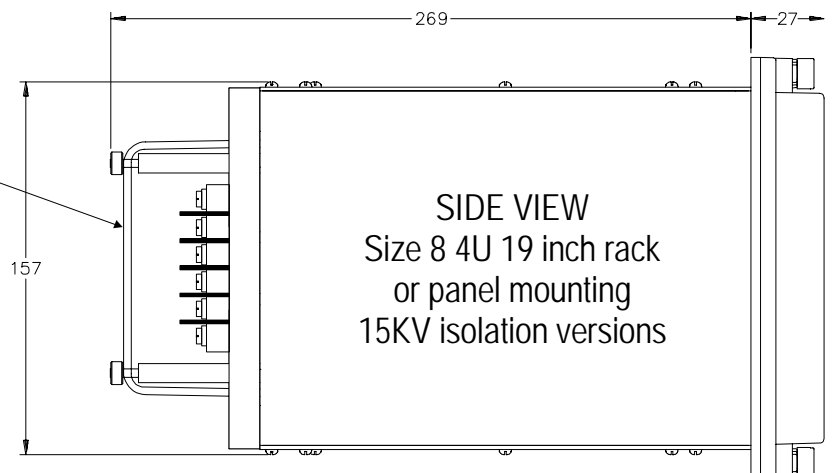


Figure 7 – Size 8 non draw out case details for 15kV isolation version

#### AUXILIARY SUPPLY

Vx: 40-150V DC

#### AUXILIARY SUPPLY BURDEN (At 110V DC)

Configured as SEND: <8W in continuous supervision mode

Configured as RECEIVE: <6W in continuous supervision mode

#### PILOT WIRE OUTPUT VOLTAGE (Unloaded)

Supervision voltage: 30V DC +/-5%

#### PILOT SUPERVISION RECEIVE

Pilot supervision pick up: >9.1V DC

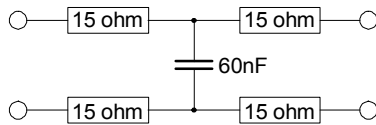
Pilot supervision drop off: <9.0V DC

#### PILOT WIRE SUPERVISION ALARM DELAY

Continuous mode: 2s fixed time delay

#### PILOT WIRE RESISTANCE & CAPACITANCE

The 3A320 system will operate with a maximum 'balanced' pilot line load of 2K ohm resistance & 2uF capacitance. As a guide a pilot wire pair will typically present a 60 ohm resistance & 60nF capacitance per kilometer. This load is depicted in the following figure:



Using this pilot wire characteristic a maximum end to end pilot wire length of 30km is possible.

#### FRONT PANEL INDICATORS

Power LED colour: Red energized solid  
 Healthy LED colour: Green energized solid  
 Service LED colour: Red energized flashing  
 Pilot wire supervision alarm: Red flashing

## Technical Data

#### AC IMMUNITY OF INTERTRIP RECEIVE ELEMENT

50Hz version: Up to 400V RMS at 50Hz for 3s

60Hz version: Up to 400V RMS at 60Hz for 3s

#### PILOT WIRE INPUT THERMAL RATING

500V DC & 350V AC continuous

565V DC & 400V AC for 3s

#### IMPEDANCE PRESENTED TO PILOTS

22.5K ohm & 10nF

#### OUTPUT CONTACTS

Pilot wire supervision alarm: 2 C/O self reset contacts

System fail alarm: 1 C/O self contact

#### 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

AC resistive 1,250VA

Break capacity AC inductive 250VA @ PF ≤ 0.4

I ≤ 5A & V ≤ 300V DC resistive 75W

DC inductive 30W @ L/R ≤ 40ms

50W @ L/R ≤ 10ms

Minimum number of operations 10<sup>6</sup> at maximum load

Minimum recommended load 0.5W limit 10mA / 5V

#### TRANSIENT OVERVOLTAGE

IEC60255-5 CLASS III

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 CLASS III

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

Between all input terminals & pilot wire terminals 5KV RMS or

15KV RMS for 1 minute

Between all output terminals & pilot wire terminals 5KV RMS or

15KV 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 No mal operation

1.0kV 1MHz differential mode

#### ELECTROSTATIC DISCHARGE

IEC60255-22-2 CLASS III

6kV contact discharge No mal operation

#### RADIO FREQUENCY INTERFERENCE

IEC60255-22-3

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

#### FAST TRANSIENT

IEC60255-22-4

4kV, 5/50ns, 2.5KHz repetitive No mal operation

#### CONDUCTED RFI

IEC60255-22-6

10V, 0.15 to 80MHz No mal operation

#### TEMPERATURE RANGE

Operating: -5 to +55°C

Storage: -25 to +75°C

#### HUMIDITY

IEC68-2-1/2

40°C & 95% RH non condensing

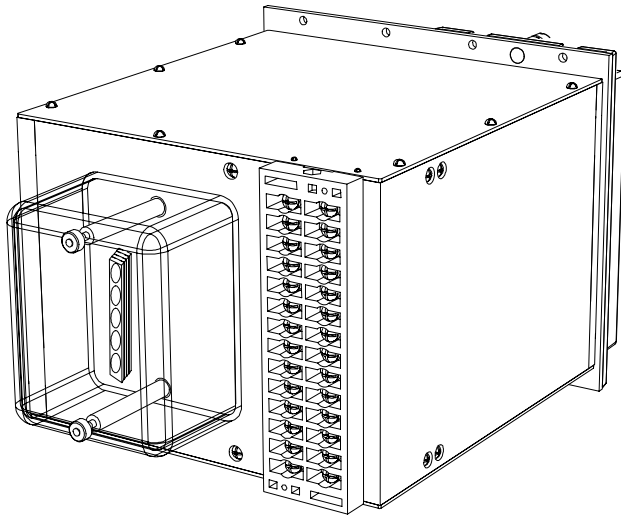


Figure 8 - Rear view of 15kV isolation version showing pilot wire & secondary terminations

## Ordering Information

### ORDER CODE

The order code determines the production build in the factory & cannot be changed in the field.

Generate the required order code as follows: e.g. 3A320-BA

|              |            |   |
|--------------|------------|---|
| General Type | Order Code |   |
|              | 1          | 2 |
| 3A320        | -          |   |

#### 1 AUXILIARY SUPPLY RANGE

- B 40-150V DC with 50Hz AC rejection filter
- D 40-150V DC with 60Hz AC rejection filter

#### 2 PILOT WIRE ISOLATION LEVEL

- A 5KV RMS
- B 15KV RMS

### **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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