

# Definite Time Frequency Relay with ROCOF

## Features

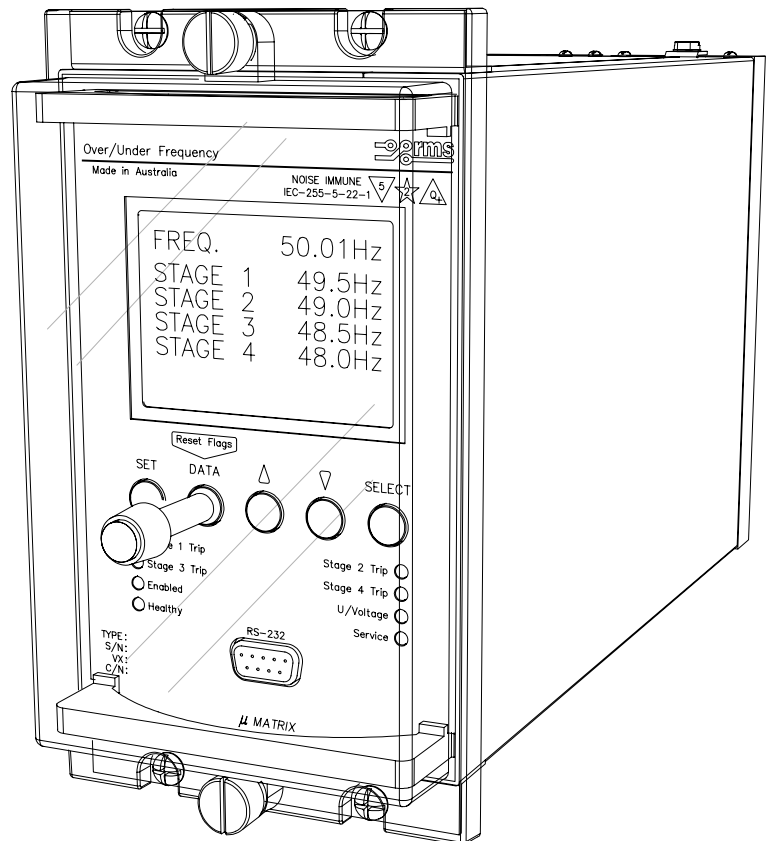
- Large back lit display panel
- High resolution frequency & voltage display readout
- Four independent frequency stages
- Independent time delay per frequency stage
- 41 to 59Hz PU setting range
- 63.5/110V AC nominal inputs
- Four independent rate of change dF/dt detection stages
- Independent definite time delay per dF/dt stage
- Adjustable dF/dt sample measurement time to optimize accuracy & response time
- Timing & trip indication LED's
- Separate overvoltage & undervoltage alarm stages with independent output relays
- Undervoltage blocking function
- Relay enable input
- CPU watchdog
- Wide auxiliary supply range with fail alarm contact

### COMMUNICATION

- RS232 PC programming port
- Non platform specific PC programming software
- Optically isolated communication ports
- MODBUS RTU compatible protocol on RS485 or RS232 network port
- Size 4 draw out case

## Application

Reduction in system frequency is an early indicator of impending system voltage collapse. This can lead to plant & equipment damage if not taken off line or the frequency / voltage level restored. The 2H34 relay can be used to provide four stages of load shedding as the frequency progressively falls through the four independent setting stages. A rate of frequency change ROCOF element (dF/dt), can also be established for each stage for the detection of very fast frequency loss due to disconnection from the mains grid.



2H34 in size 4 rack mount case

## Operation

Made in Australia

The 2H34 Series relay is a frequency monitoring relay with four stages of adjustable frequency pick up & drop out points. Each frequency set point can be set for under or over frequency operation & has an independent time delay driving an output relay. An undervoltage lockout is used to disable the four frequency sensing stages when the voltage falls below a preset level.

A single status input is used to enable the four frequency sensing stages.  
A second status input is used to reset the front panel latched LED trip indicators.

Each of the four setting stages has a rate of change of frequency (ROCOF) element with an independent time delay. The dF/dt element is available to operate as an AND or an OR logic function with the frequency element driving a common output contact per stage.

A separate Under Voltage & Over Voltage stage are provided for alarm functions.

The 2H34 relay is built on the Micro MATRIX digital platform. The standard Micro MATRIX human machine interface (HMI) is combined with fully solid state voltage sensing & measuring circuitry to provide high accuracy, simple set up & flexible operation. Self-monitoring is carried out by hardware & software watchdogs. A CPU software watchdog records abnormal events & performs automatic periodic checks. High speed, high contact rating output relays are used.

The input transformer, output relays & opto isolated status input form the essential barriers against high voltage line transients while a switchmode auxiliary supply provides a wide operating range.

An RS232 programming port is provided for ease of establishing relay settings using a PC &  $\mu$ MATRIXwin which is available free of charge.

### FREQUENCY STEP SET POINTS

Inputs: Single pole 63.5/110V AC nominal  
 Setting stages: 4 independent stages  
 Operating range: 40 to 60 Hz  
 Setting range: 41 to 59Hz in 0.05Hz steps  
 Measurement resolution: 0.01Hz at 50Hz  
 Accuracy: +/-0.03Hz (70 to 121V) at 50Hz  
 Hysteresis: 0.05 to 0.5Hz in 0.05Hz steps  
 Frequency measuring time: 20ms (Add to time delay setting)  
 Over frequency function: PU at set point  
 DO at set point – hysteresis +/-0.03Hz  
 Under frequency function: PU at set point  
 DO at set point + hysteresis +/-0.03Hz

### FREQUENCY STEP TIME DELAY SETTING

The 2H34 allows for a separate time range for each of the four frequency stage set points.  
 Setting range: 0.1 to 100s in 0.05s steps.  
 Minimum operate time: 0.1s typical  
 Timing error: <20ms + 0.1% of time delay setting

### RESET TIME DELAY

Electronic reset time: 0.0 to 5s in 0.1s steps  
 Accuracy: <60ms + 0.1% of setting  
 When the frequency pick up & drop out points are set very close together it is advisable to set a longer reset delay to avoid timer resetting due to transient frequency fluctuations.

### UNDER VOLTAGE LOCKOUT

An Under Voltage lockout feature is used to block all output stages in the event of voltage loss caused by a failed VT or fuse.  
 Setting range: 20 to 100V in 0.1V steps  
 Accuracy: +/-250mV or +/-0.5% of setting  
 Fixed time delay: 370ms approx.  
 Hysteresis: 0.2 to 5V in 0.1V steps

### UNDER VOLTAGE PROTECTION

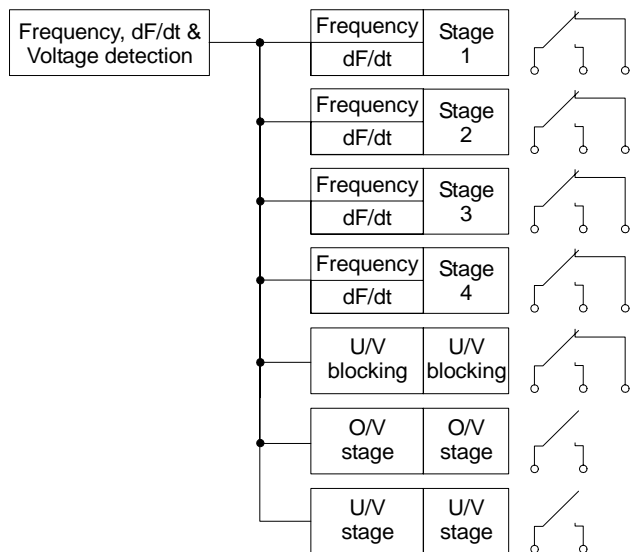
An Under Voltage protection stage is available to monitor & trip if the pre set voltage level is reached.  
 Setting range: 20 to 110V in 0.1V steps  
 Accuracy: +/-250mV or +/-0.5% of setting  
 Fixed time delay: 370ms approx.  
 Hysteresis: 0.2 to 5V in 0.1V steps

### OVER VOLTAGE PROTECTION

An Under Voltage protection stage is available to monitor & trip if the pre set voltage level is reached.  
 Setting range: 110 to 140V in 0.1V steps  
 Accuracy: +/-0.5% of setting  
 Fixed time delay: 370ms approx.  
 Hysteresis: 0.2 to 5V in 0.1V steps

### OUTPUT STAGES

All contacts are self reset.



### AUXILIARY SUPPLY

20-70V DC switchmode supply or  
 40-275V AC / 40-300V DC switchmode supply

#### Inputs:

A high efficiency switchmode power supply is incorporated which provides a low burden to the auxiliary supply.

### BURDENS

Auxiliary supply: At 110V DC nominal supply  
 During timing: < 7 watts  
 With output relays energized: < 10 watts  
 Sensing circuits: < 1VA per phase all setting

### RELAY FAIL ALARM

A C/O alarm contact is maintained in the energized state when all of the following conditions are met:

- The auxiliary supply is applied
- The internal 24V DC rail is within acceptable limits
- The CPU hardware watchdog maintains a pulsing output

A CPU software watchdog records "suspect" events to an assert register and if necessary performs a soft restart.

### RELAY ENABLE STATUS INPUT

The status input on the 2H34 is used to enable the four frequency monitoring stages of the relay. The relay must be "enabled" in order for the time delay stages to operate. A front panel LED is illuminated red when the relay is disabled.

### STATUS INPUT FUNCTION

The status input function is factory set to enable on the application of a control voltage. It is also possible for the status input to operate on the removal of a control voltage by simply changing a software flag in the PC setup program.

### OUTPUT CONTACT RATINGS

#### Make & carry

30A AC or DC (Limits L/R=40ms & 300V max.) for 0.2s  
 20A AC or DC (Limits L/R=40ms & 300V max.) for 0.5s  
 5A AC or DC continuously

#### Break (Limits 5A & 300V max.)

1,250VA AC resistive  
 250VA at 0.4PF AC inductive  
 75W DC resistive  
 30W DC inductive L/R = 40ms  
 50W DC inductive L/R = 10ms

#### Minimum recommended load

0.5W, 10mA or 5V minimum.

### AMBIENT OPERATING TEMPERATURE RANGE

-5 to 55 degrees C.

### INSULATION WITHSTAND

IEC60255-5 2KV RMS & 1.2/50 5KV impulse between:

- ♦ all input terminals & frame
- ♦ all output terminals & frame
- ♦ all input & output terminals
- ♦ each input group
- ♦ each output group

### HIGH FREQUENCY DISTURBANCE

IEC60255-22-1 2.5KV 1MHz common mode  
 1.0KV 1MHz differential mode

### ELECTROSTATIC DISCHARGE

EN61000-4-2:1995 8KV Level 3

### FAST TRANSIENT DISTURBANCE

EN61000-4-4:1995 4KV Level 4

### CASE

Size 4 draw out  
 56 M4 screw terminals  
 Flush panel mount or 4U high 1/4 width 19 inch rack mount  
 IP51 rating

### 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

### dF/dt FUNCTION

Rate of change of frequency known as ROCOF or dF/dt is a useful parameter for the fast detection of events such as disconnection of a generator from the grid.

Under such conditions it is unlikely that an under frequency element will operate fast enough to protect the power system before the frequency & voltage has dropped below acceptable limits.

### dF/dt SAMPLING ENGINES

Performance of the dF/dt elements is dependant on the sampling time used to calculate & average the dF/dt reading.

dF/dt measurements are based on the difference between successive frequency readings recorded on each cycle of the AC signal being monitored.

dF/dt measurements based on 2 samples is required for fast response but is not suitable for detecting low dF/dt rates.

dF/dt measurements based on 5 samples is required to detect very slow dF/dt rates but is consequently slower to respond & is not suitable for detecting high dF/dt rates.

To allow dF/dt setting flexibility while remaining within the constraints described in Table 1, two dF/dt sampling engines (A & B) are provided:

- dF/dt activation: Set to ON or OFF
- Sample time A: 2 to 5 cycles in 1 cycle steps
- dF/dt rejection A: 0.2 to 18Hz/s in 0.1Hz/s steps
- Sample time B: 2 to 5 cycles in 1 cycle steps
- dF/dt rejection B: 0.2 to 18Hz/s in 0.1Hz/s steps

### dF/dt REJECTION FUNCTION

A dF/dt rejection setting is provided to reject dF/dt readings above a user defined setting. This feature is used to reject spurious readings due to noise & transients to ensure stability & improve security particularly when using short delay times. When selecting a dF/dt rejection setting, consideration should be given to the maximum dF/dt rate expected on the system plus 1Hz/s. As a separate dF/dt rejection setting is available for each dF/dt engine, these may be set to approximately twice the maximum dF/dt P/U setting used for that engine.

### dF/dt SET POINTS

Four independent dF/dt elements are provided. When this function is activated the dF/dt pick up is used to initiate an independent dF/dt timer.

- Setting stages: 4 independent stages
- Setting range: 0.13 to 9.0Hz/s in 0.1Hz/s steps
- dF/dt function: PU at set point  
DO at set point – hysteresis
- dF/dt engine: Select dF/dt sampling engine A or B

### dF/dt SETTING CRITERIA

Sample time (Cycles)	2	3	4	5
Maximum setting (Hz/s)	9	7	6	5
Minimum setting (Hz/s)	0.70	0.50	0.20	0.13
Minimum time delay setting	40ms	60ms	80ms	100ms
dF/dt Measurement time	70ms	100ms	150ms	200ms
Hysteresis (Hz/s)	0.24	0.12	0.07	0.05
Accuracy at 50Hz (Hz/s)	+/-0.2	+/-0.1	+/-0.07	+/-0.05
Timing accuracy	+/-30ms	+/-40ms	+/-50ms	+/-60ms

Table 1

## dF/dt Function (ROCOF)

### dF/dt MINIMUM & MAXIMUM SETTING

The dF/dt setting range is dependant on the sample time setting as shown in Table 1. Outside the specified setting range the stated accuracy is not met.

### dF/dt TIME DELAY SETTING

The 2H34 allows for a separate time range for each of the four dF/dt stage set points.

- Setting range: 0.00 to 100s in 0.02s steps.
- Timing accuracy: Refer table 1.

The dF/dt element operate time is dependant on the sample time setting which determines the dF/dt measurement time shown in Table 1.

The actual operate time for each stage is the sum of the dF/dt measurement time + the dF/dt stage time delay setting +/- timing error.

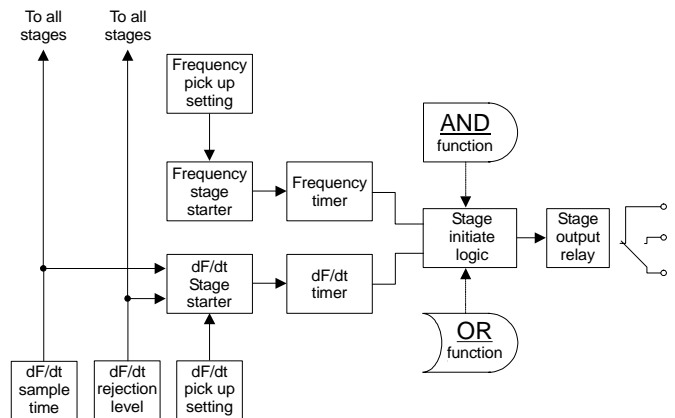
A minimum dF/dt time delay setting equal to the sample time setting is recommended as per Table 1.

### dF/dt FUNCTION LOGIC OPTIONS

Two global logic options are available:

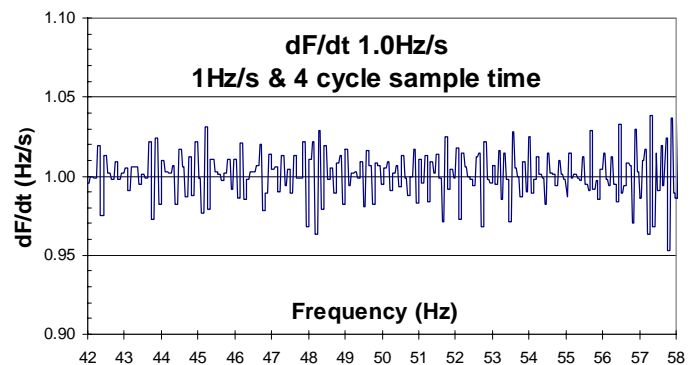
The OR logic function requires either the frequency step element OR the dF/dt element to time out for the stage output relay to operate.

The AND logic function requires both the frequency step element AND the dF/dt element to time out for the stage output relay to operate.



### dF/dt ACCURACY

A typical dF/dt measurement sweep is depicted below using a sample time of 4 cycles which provides high measurement accuracy but & moderate response time.

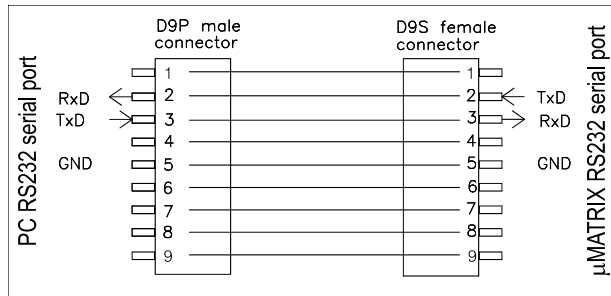


While random noise hits may cause spikes beyond the maximum error quoted these will not be of sufficient duration to cause a trip event due to the time delay setting & dF/dt rejection function.

Where very fast operate times are required for dF/dt rates above 0.70Hz/s, shorter sample times must be used at the expense of measurement accuracy. The dF/dt measurement accuracy for each sample time setting is shown in Table 1.

### PC TO $\mu$ MATRIX SERIAL CABLE

One cable supplied with each order.  
P/N 997-000-042



# Communications

## COMMUNICATION PORTS

Two (2) communications ports are available.

### Programming port

The programming port is accessible from the front panel of the relay via an RS232 physical link & PC configuration program supplied with the relay. The  $\mu$ MATRIXwin configuration program is designed to operate with all relays from the  $\mu$ MATRIX range & all firmware versions.

### Network port

The network port is intended for applications where permanent connection to a master control system is required. An optically isolated RS232 or RS485 physical layer is provided for this function.

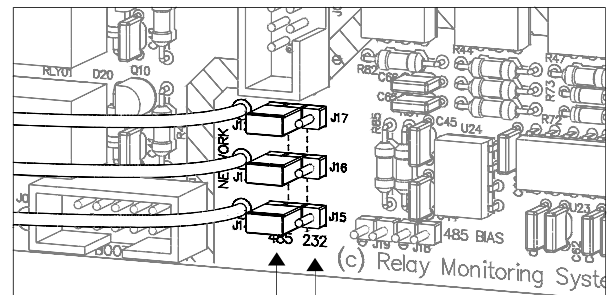
The RS485 connection is intended for applications where multiple  $\mu$ MATRIX relays are to be connected on a common communications bus.

The RS232 connection is intended for interface to an RS232 to optic fiber converter in environments subject to extreme electrical interference.

The network port may be used for a permanent link to a modem, remote PC, data concentrator or SCADA system. The standard communications protocol is MODBUS RTU.

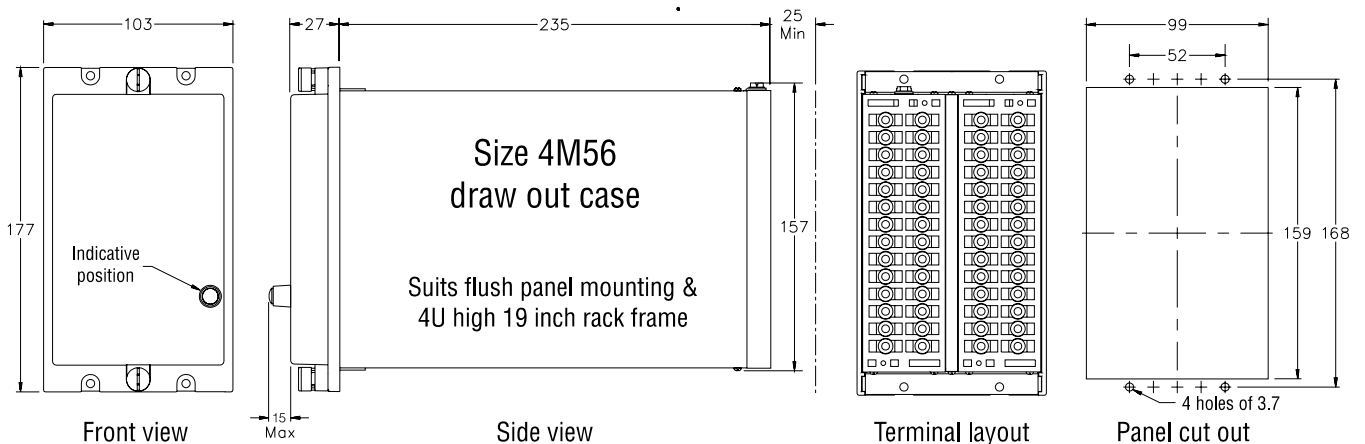
### Changing the Network port from RS485 to RS232

$\mu$ MATRIX relays are shipped with the rear network port terminals configured as RS485. This configuration may be changed in the field to RS232 if required by withdrawing the relay module from the case & changing the three configuration links as depicted.



RS485 Port Header Position

RS232 Port Header Position



# Ordering Information

Generate the required ordering code as follows: e.g. 2H34 BBB

2H34 1 2 3

## 1 AUXILIARY SUPPLY RANGE

- A 20-70V DC
- B 40-275V AC / 300V DC

## 2 RELAY INITIATE INPUT

Opto-isolated input

- A 24-80V AC/DC
- B 75-150V AC/DC
- C 150-300V AC/DC

## 3 REMOTE FLAG RESET INPUT

Opto-isolated input

- A 24-80V AC/DC
- B 75-150V AC/DC
- C 150-300V AC/DC



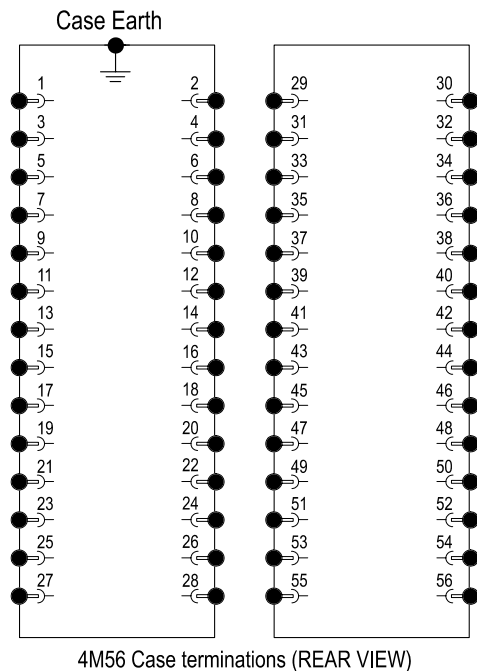
## REQUEST DEFAULT APPLICATION SOFTWARE

- A UMX2H34-A Frequency OR dF/dt output logic function
- B UMX2H34-B Frequency AND dF/dt output logic function

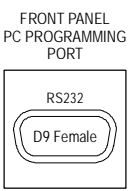
All current UMX software applications may be downloaded from:

[www.rmspl.com.au/umatrix](http://www.rmspl.com.au/umatrix)

These may then be loaded into the relay using uMATRIXwin.

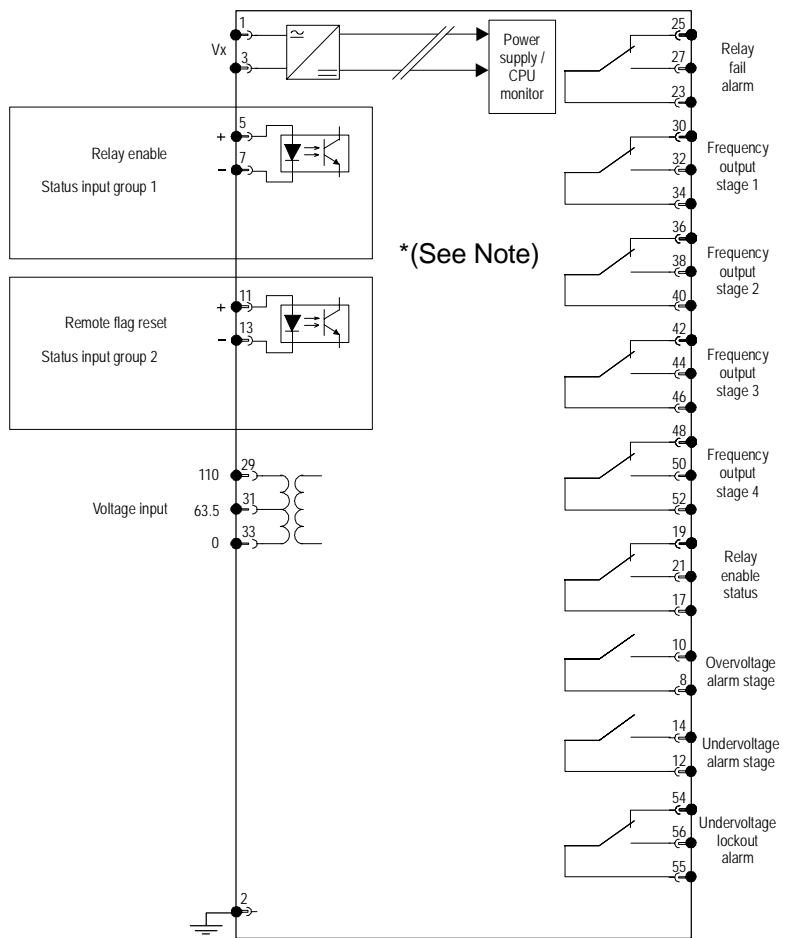
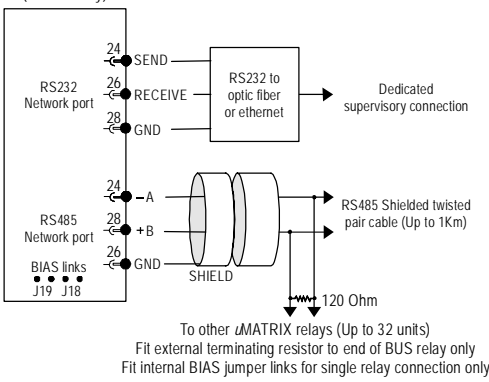


\*Note: The status inputs & some relay outputs are assigned by the software (UMX) loaded on the relay.  
Shown here are the standard terminal assignments of the A UMX. Other UMX versions may differ. Consult the UMX manuals for specific I/O assignments.



One DE09 straight through male to female 2 metre connection cable supplied with each order of relays (P/N 997-000-042B)

SCADA COMMUNICATIONS PORT (Use one only)



2H34 wiring diagram - Relay shown in de-energised condition

## **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.



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