2V164-S User Guide

Voltage Regulating & Control Relay

relay monitoring systems pty ltd

Advanced Protection Devices

User Guide

Test Manual

Relay Software

µMATRIXwin

2V164-S User Guide

About This Manual

This User Guide covers all 2V164-S relays manufactured from April 2009. Earlier relays do not necessarily incorporate all the features described. Our policy of continuous may means that extra features & functionality may have been added.

The 2V164-S User Guide is designed as a generic document to describe the common operating parameters for all relays built on this platform. Some relay applications are described but for specific model information the individual “K” number Product / Test manuals should be consulted.

While the information and guidance given in this document is believed to be correct, no liability shall be accepted for any loss or damage caused by any error or omission, whether such error or omission is the result of negligence or any other cause. Any and all such liability is disclaimed.

Contact Us

6 Anzed Court • Mulgrave 3170 • AUSTRALIA
Phone 61 3 9561 0266 • Fax 61 3 9561 0277
Email rms@rmspl.com.au • Web www.rmspl.com.au

To download a PDF version of this guide:
http://www.rmspl.com.au/userguide/2v164-s_user_guide.pdf

To download the model specific Test Manual:
http://www.rmspl.com.au/search.asp

How this guide is organised

This guide is divided into five parts:

Part 1 Overview

About this Manual

Contents

Test Manual

Mechanical Configuration

Description of Operation

Line Drop Compensation

Part 2 Technical Bulletin

Part 3 Software Function

Compatible Software

Factory Default Software

Determining Software UMX

Determining UMX Functionality

User Interface

Field Calibration

Part 4 Installation

Handling of Electronic Equipment

Safety

Unpacking

Accessories

Storage & Handling

Recommended Mounting Position

Relay Dimensions & Other Mounting Accessories

Equipment Connections

Part 5 Maintenance

Mechanical Inspection

Test Intervals

Defect Report Form

Part

1

Test Manual

This User Guide covers all 2V164-S relay versions & describes the generic features & attributes common across all versions.

Different relay versions are required to cater for varying customer requirements such as auxiliary voltage range, I/O configuration, case style, relay functionality etc.

The product ordering code described in the Technical Bulletin is used to generate a unique version of the relay specification & is called a type number. The type number takes the form 2V164-SKxx where the Kxx is the “K” or version number.

Refer to: www.rmspl.com.au/handbook/parta3.pdf
for a complete description of the RMS “K” number system.

Each 2V164-S version has a specific Test Manual which provides details on the unique attributes of the relay. Each Test Manual includes the following information:

- Test Certificate
- Specific technical variations from the standard model if applicable
- Test & calibration record

A Test Manual is provided with each relay shipped.
A CD & serial comms. cable is supplied with each relay order.

If you require a copy of the Test Manual for an RMS product the following options are available:

- Check the RMS web site at: www.rmspl.com.au/search.asp
- RMS CD catalogue select: List all Product/Test Manuals under Technical Library
- Contact RMS or a representative & request a hard copy or PDF by email.

Mechanical Configuration

Great care has been taken to design a rugged, cost effective & flexible mechanical solution for the *MATRIX* range of RMS protection relays. The *MATRIX* range provides a compact draw out case solution with M4 screw terminals:

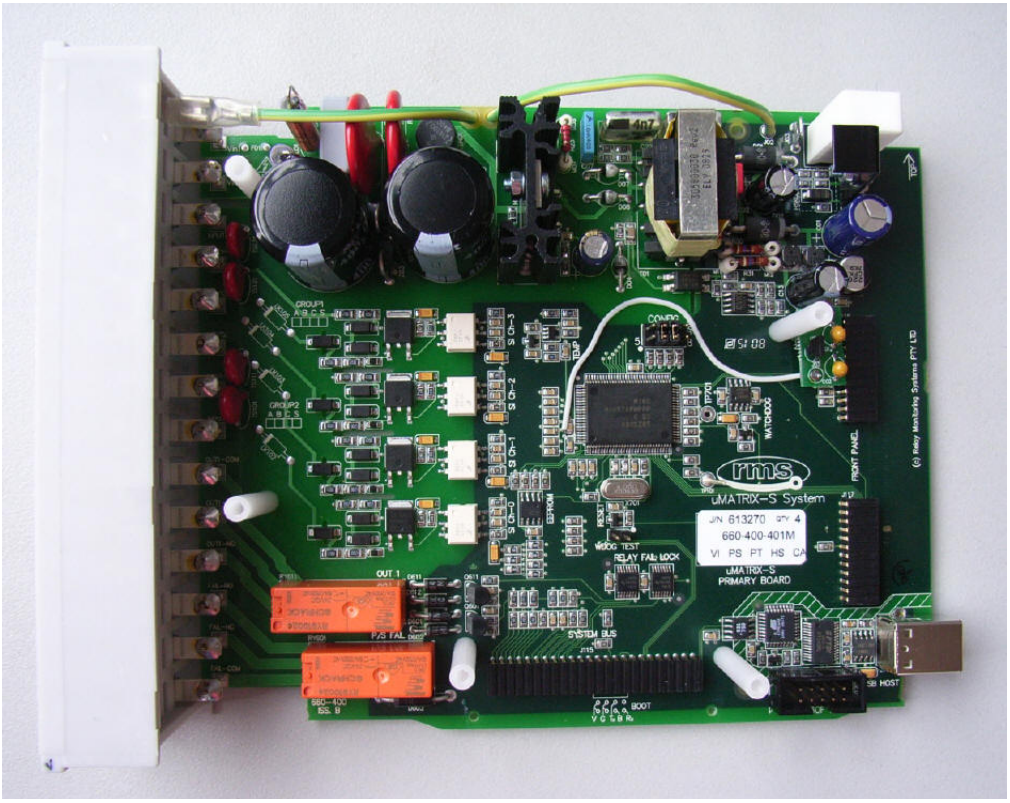
- 2M28 Size 2 with 28 terminals
- 4M28 Size 4 with 28 terminals
- 4M56 Size 4 with 56 terminals

Complete details & attributes for the M (MATRIX) cases & accessories may be found at:

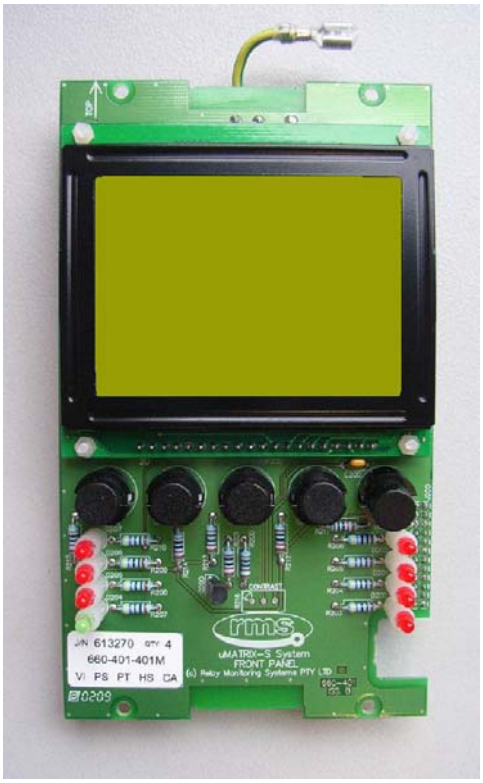
http://www.rmspl.com.au/mseries.htm

The 2V164-S is configured in a 4M56-S case & the following photographs depict the general mechanical configuration. It should be noted that re-usable JIS plastic threading (PT type) screws are used to bind the draw out relay module.

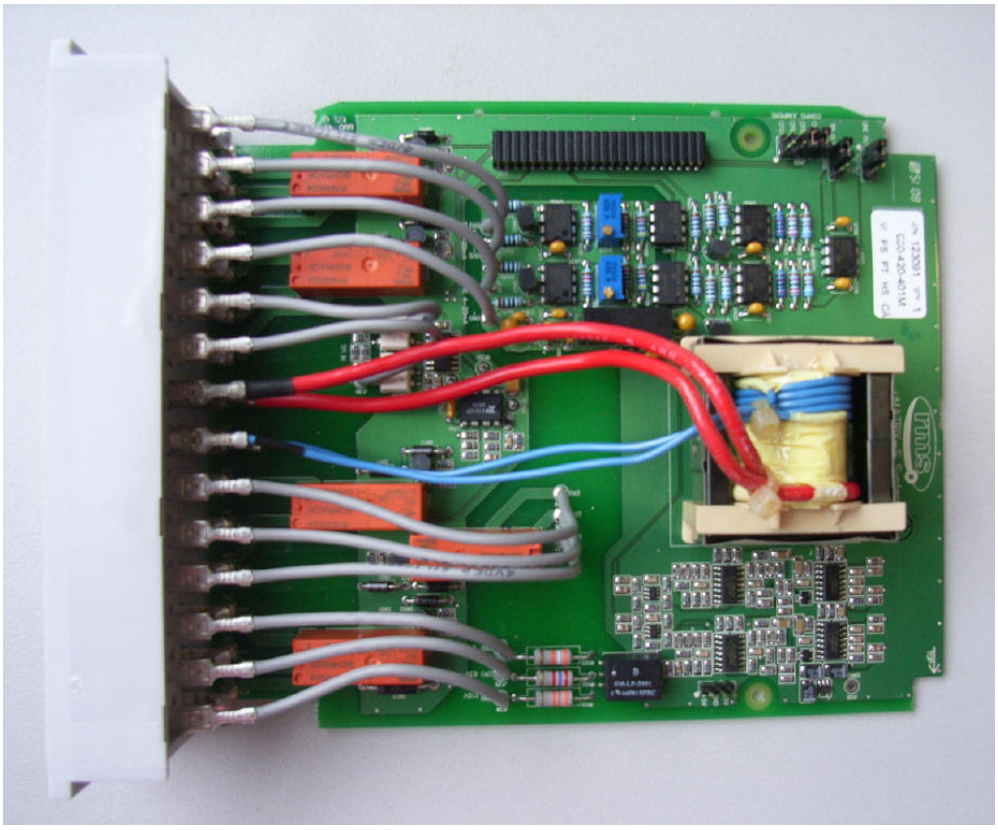
Image of generic inner relay module after removal from the outer case.



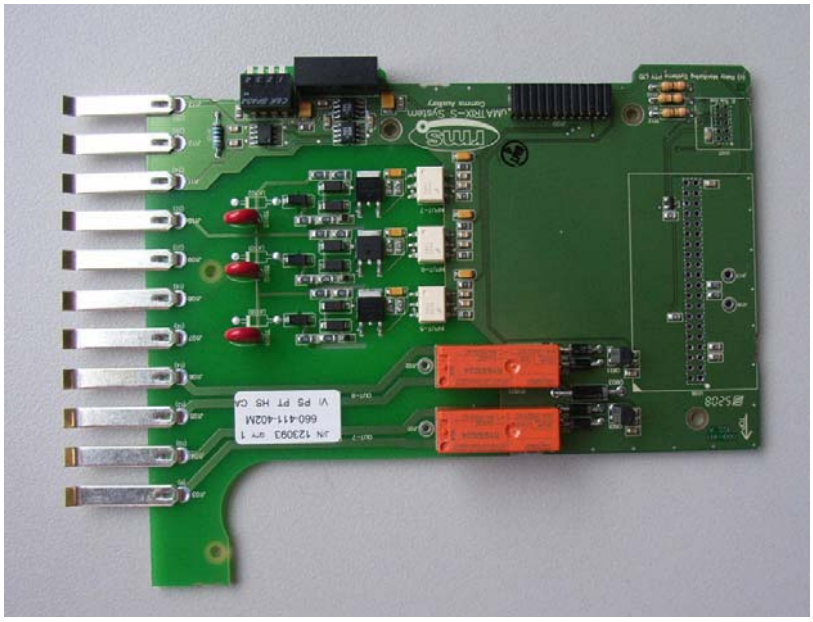
Primary circuit board showing the wide range power supply at the top.



Front panel circuit board showing graphic LCD panel and push buttons.



Secondary circuit board showing analogue voltage and current channels.



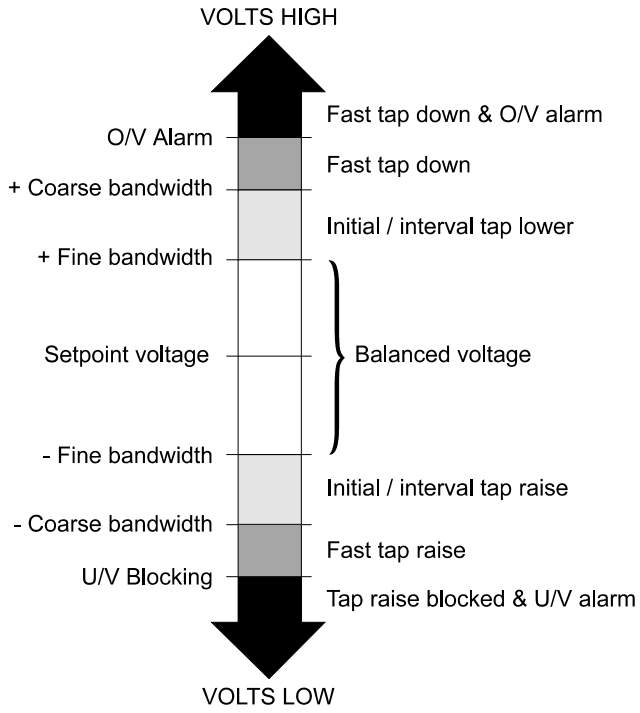
Optional network communications circuit board with additional I/O.

Description of Operation

The 2V16x Series relays are designed for the control of motor driven on-load power transformer tap changers.

The 2V164-S Voltage Regulator Relay continuously monitors the transformer output voltage & current & provides "RAISE" & "LOWER" control commands to the on-load tap changer such that the load centre is automatically maintained within acceptable limits. Small variations in supply frequency will not affect the system performance.

When designing the 2V164-S, considerable emphasis was placed on producing a relay, which would be very simple to install, set up & operate in the field. The result is a simple yet effective & very dependable voltage regulator relay available at a competitive price. 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.



Line Drop Compensation

The line drop compensation, i.e. the inclusion of the voltage drop of a line connected to the transformer in the regulating process, can be accomplished in two different ways. Two modes are available:

Z-Compensation

Z-compensation is easier to set than the vectorial compensation method and is suitable where only small shifts in the phase angle cosΦ are experienced.

Vectorial compensation (Four setting modes: ±PHASE and ±QUAD)

Vectorial compensation is more difficult to set as exact line data must be known but is more accurate when set correctly.

Setting the LDC Mode of Operation

Six settings are selected in the 2V164-S from the LDC menu as follows:

LDC mode:	**OFF**	LDC inactive
	+ PHASE	Use when relay wired in phase configuration
	- PHASE	Use when relay wired in phase configuration
	+ QUAD	Use when relay wired in quadrature configuration
	- QUAD	Use when relay wired in quadrature configuration
	Z-COMP	Use when relay wired in phase configuration

Z Mode LCD Compensation Setting

Z-Compensation may be employed with the relay wired in phase or in quadrature configuration where only small shifts in the phase angle cosΦ are experienced.

The calculated percentage of the voltage rise, referred to the voltage level, set at the 2V164-S LDC menu Z-Comp value in % as per the following formula:

$$\text{Voltage rise \%} = 100 \cdot \frac{U_{Tr} - U_{Load}}{U_{Load}} \cdot \frac{I_N \cdot R_{CT}}{I}$$

Where:

Voltage rise	=	setting of Z-compensation in %
U_{Tr}	=	transformer voltage at current I
U_{Load}	=	line end voltage at current I and with the same service position of the tap changer
I	=	load current in amps
I_N	=	rated current in amps of the selected current transformer connection to the voltage regulator, i.e. 1A or 5A
R_{CT}	=	current transformer ratio e.g. 200A/5A

Check the Z-compensation operation using the following steps:

1. Set Z-compensation voltage rise to 0%;
2. Apply a voltage to achieve balanced state;
3. Set Z-compensation voltage rise to 15%;
4. A voltage raise LED must light up when a load current of 10% of the rated current input is applied;
5. Now carry out the required setting of the Z-compensation as per the above formula.

Vectorial Compensation (Phase and quadrature mode) LDC setting

Refer to the wiring diagram to choose the appropriate mode setting. The negative modes simply reverse the sense of the compensation voltage which is more convenient than changing the wiring polarity.

For the correct setting in these modes it is necessary to calculate the resistive and inductive line voltage drop, referred to the secondary side of the voltage transformer in V and the correct setting of the existing measuring transformer configuration according to the following formula:

$$U_r = I_N \cdot \frac{R_{CT}}{R_{VT}} \cdot r \cdot L \text{ Volts}$$

$$U_x = I_N \cdot \frac{R_{CT}}{R_{VT}} \cdot x \cdot L \text{ Volts}$$

Where:

U_r	=	LDC setting for resistive line voltage drop in Volts
U_x	=	LDC setting for inductive line voltage drop in Volts
I_N	=	rated current in A of the selected current transformer connection to the voltage regulator, i.e. 1A or 5A
R_{CT}	=	current transformer ratio, e.g. 200A/5 Amps
R_{VT}	=	voltage transformer ratio: e.g. $\frac{33{,}000V / \sqrt{3}}{110V}$ IN PHASE connection wiring
		e.g. $\frac{33{,}000V}{110V}$ IN QUAD connection wiring
r	=	ohmic resistance of the line in ohm/km per phase
x	=	inductive reactance of the line in ohm/km per phase
L	=	length of the line in km

The resistive and reactive line drop compensation settings are entered into the 2V164-S at the LDC page in volts.

Check the vectorial compensation operation using the following steps:

1. Set the Resistive and Reactive voltage settings to 0V;
2. Set the LDC mode to +PHASE or +QUAD based on the wiring configuration used;
3. Apply a voltage to achieve balanced state;
4. Set the Reactive voltage ($\mathbf{U_x}$) setting to 15V;
5. A voltage raise LED must light up when the rated current input is applied at 90 degree lag relative to the line voltage;
6. Set the LDC mode to -PHASE or -QUAD based on the wiring configuration used;
7. A voltage lower LED must light up when the rated current input is applied at 90 degree lag relative to the line voltage;
8. Now carry out the required setting of the LDC Resistive ($\mathbf{U_r}$) and Reactance ($\mathbf{U_x}$) compensation as per the above formula.

Provided the resistive and inductive line voltage drops $\mathbf{U_r}$ and $\mathbf{U_x}$ are correctly set the voltage at the load end will remain constant, independent of the load current.

Part

2

Technical Bulletin

The detailed technical attributes, functional description & performance specifications for the 2V164-S are described in the attached Technical Bulletin. For the most up to date version go to:

www.rmspl.com.au/handbook/2v164-s.htm

For any specific attributes of a particular version refer to the Test Manual for that type (K) number.

The order of precedence for technical information is as follows:

- Test Manual
- Technical Bulletin
- User Guide

Technical Bulletin

2V164-S

Voltage Regulating & Tap Change Control Relay

Features

SYSTEM FEATURES

- Large back lit display panel
- System status LED indicators
- Simple menu setting procedure
- Wide auxiliary supply range with fail alarm contact
- Self diagnosis and fail alarm
- Size 4M56-S draw out case
- Made in Australia

VOLTAGE CONTROL

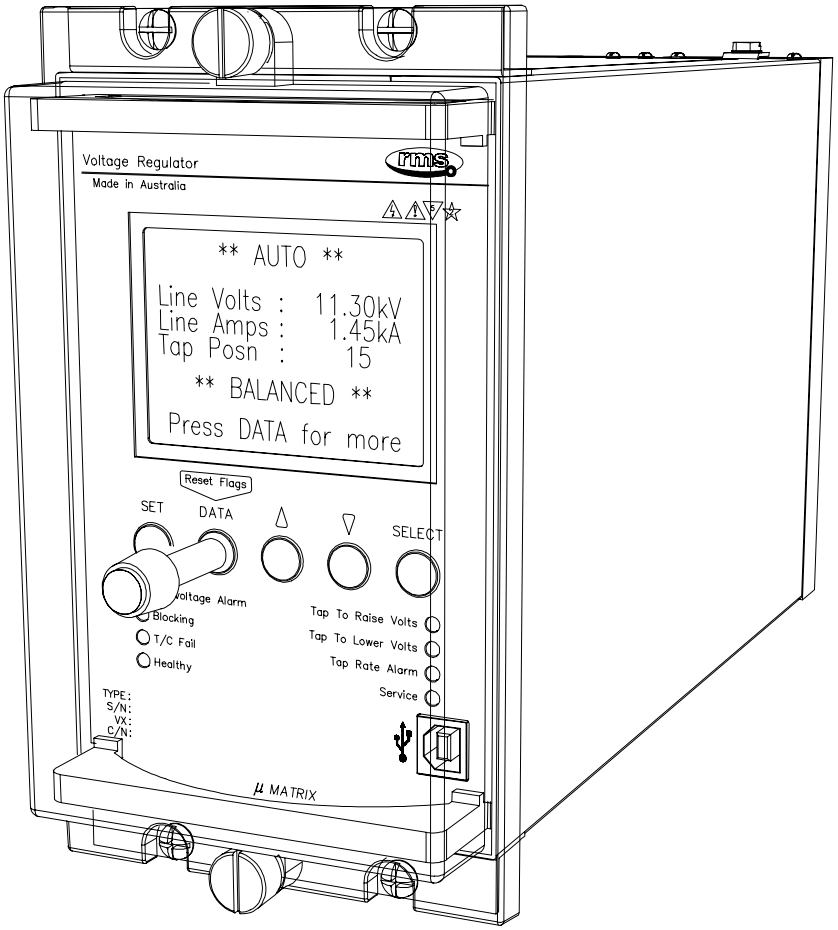
- Line drop compensation with 1A and 5A CT inputs
- Z Compensation
- 63.5 and 110V AC VT inputs
- Definite time and inverse time delays
- Independent fine and coarse voltage bandwidth windows
- Over and under voltage alarms
- Under voltage blocking function
- Tap change fail alarm
- Two digital input load step stages
- Overcurrent blocking

METERING AND EVENT RECORDING

- Line voltage display
- Line current display
- Tap position indicator
- Tap rate of change alarm
- Tap change event counter
- Tap position mA output
- Line voltage mA output

COMMUNICATION

- USB front programming port
- Non platform specific PC programming software: μMATRIXwin
- Optically isolated RS485 network communication port
- MODBUS RTU compatible network protocol



2V164-S depicted in a size 4M56-S draw out case

Application

Made in Australia

The 2V164 Series relays are designed for the control of motor driven on-load power transformer tap changers.

The 2V164 Voltage Regulator Relay continuously monitors the transformer output voltage and current and provides "RAISE" and "LOWER" control commands to the on-load tap changer such that the load centre is automatically maintained within acceptable limits. Small variations in supply frequency will not affect the system performance.

When designing the 2V164, considerable emphasis was placed on producing a relay, which would be very simple to install, set up and operate in the field. The result is a simple yet effective and very dependable voltage regulator relay available at a competitive price. The standard Micro MATRIX human machine interface (HMI) is combined with fully solid state voltage sensing and measuring circuitry to provide high accuracy, simple set up and flexible operation.

PARALLEL CONTROL SCHEMES

Parallel control schemes are available to meet a range of transformer control configurations based on the master / follower principal. These systems are supplied fully wired in 19" sub rack frames ready for integration into customer panels. Up to 4 transformers operating in parallel on one or two groups are possible.

For further details refer to the RMS 1M122A, 1M122D and 2V165 technical bulletins which provide details on our range of transformer parallel control systems.

Voltage Control Functions

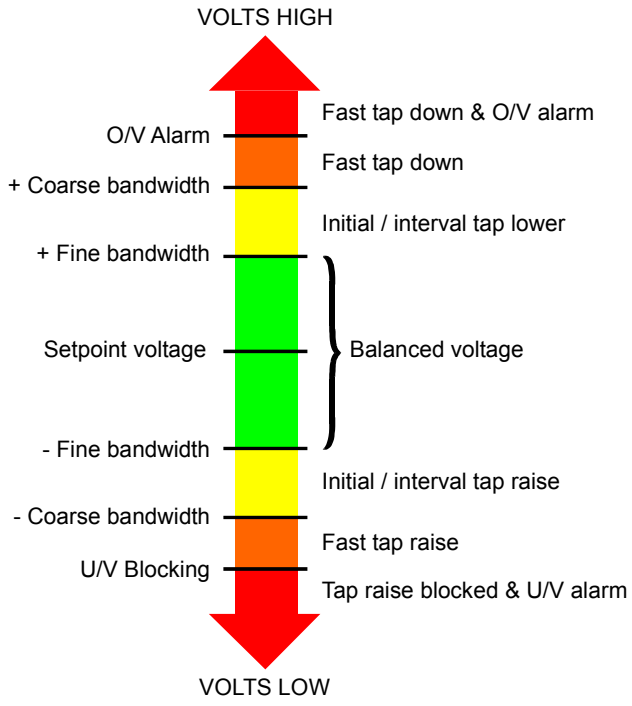


Figure 1: User defined voltage set points

SETPOINT VOLTAGE RANGE
90V to 130V in 0.1V steps.
110V and 63.5V nominal inputs.

"FINE" VOLTAGE BANDWIDTH SETTING (SENSITIVITY)
0.3 V to 5.0V in 0.1V steps.
The bandwidth setting should be made in accordance with the relative step voltage of the tap changer. A narrow bandwidth may result in the tap changer *hunting* between adjacent taps.

INITIAL RAISE / LOWER TIMER
10s to 300s in 10s steps.
The initial time delay between the detection of an error in the monitored voltage and the resultant tap change output, is switch selectable as either a definite time or true inverse time response.

The initial time delay starts when the voltage deviation exceeds the upper or lower limit. The respective instantaneous HIGH / LOWER LED illuminates.

If the deviation falls back to within bandwidth limits before the pre set time delay is completed, the timer is reset.

At the completion of the pre set time delay the respective RAISE / LOWER tap output contact will close.

INTERVAL TIME DELAY
1s to 100s in 1s steps.
The interval time delay only becomes active when the initial delay has caused a tap change but without affecting a balanced condition, ie. if more that one tap change operation is necessary to bring the voltage within set limits.

INVERSE TIME DELAY CHARACTERISTIC
In the inverse time mode, the initial time delay is inversely proportional to the ratio of deviation to bandwidth down to a minimum of a one-second delay. For example:

- When the detected error is equal to the selected bandwidth the time delay is equal to the delay setting.
- For a detected error of N times the selected bandwidth, the time delay is 1/N times the delay setting.

"COARSE" VOLTAGE BANDWIDTH SETTING
1V to 20V in 1V steps.
1s to 60s in 1s steps.
A second independent voltage control window can be set with a definite time delay. This can be used for a fast tap change function for large voltage deviations, which are outside the fine bandwidth window.

UNDER VOLTAGE BLOCKING FUNCTION
60V to 90V in 1V steps.
0s to 60s in 1s steps.
An undervoltage blocking function is combined with a definite time delay output.
Undervoltage blocking suppresses tap change operations during a system breakdown to avoid the tap changer mechanism from being driven to the top tap. The self reset Blocking alarm relay is activated when this element has timed out and a message reported on the HMI.

OVER VOLTAGE ALARM
110V to 140V in 1V steps.
0s to 60s in 1s steps.
An overvoltage alarm is combined with a definite time delay output. The self reset overvoltage alarm relay contact is activated when this element has timed out and a message reported on the HMI.

OVER CURRENT BLOCKING
50 to 150% in 5% steps – Can also be set to OFF
0s to 60s in 1s steps
Reset: >0.97Iset
When timed out all tap commands are inhibited / cancelled.
The self reset Blocking alarm relay is activated when this element has timed out and a message reported on the HMI.

LINE DROP COMPENSATION
Resistance and reactance compensation: 0V to 20V in 0.1V steps
Settings are provided to cater for *in phase* and *in quad* connections, with either positive or negative reactance compensation.

Correct setting of the LDC requires the calculation of the resistive and reactive line-drops as a voltage with reference to the secondary side of the VT and the setting of the instrument transformer for IN PHASE or IN QUAD connection. Z compensation is also available: 0 to +15% setting range.

The LDC function does not effect the under or over voltage alarm set points. These operate from the direct voltage measurements.

VOLTAGE LOAD STEP INPUTS
-10% to +10% of the set point voltage in 0.5% steps
Two independent load step stages are provided. The voltage reduction or boost level for each stage can be independently set while a separate digital input is provided to initiate each stage. If both stages are initiated then the stage 2 level is operative.

OPERATIONAL INDICATORS
Red LED's on the front panel indicate the following conditions:

- Over voltage — Bus voltage above alarm setting
- Blocking — BUS voltage / current outside block settings
- Tap change fail — Tap change time out alarm
- Raise volts — Flash when timing / On for Raise tap initiate
- Lower volts — Flash when timing / On for Lower tap initiate
- Tap rate — Tap rate alarm level exceeded

TAP CHANGE FAIL ALARM
10s to 300s in 10s steps.
The tap change fail alarm timer is initiated when an out of bandwidth voltage error is detected. Time out will result in the alarm contact closing. The alarm timer and contact is reset when the sensed voltage has moved back to a balanced condition.

AUTO / MANUAL MODE CONTROL INPUT
A digital input is provided to change the relay from AUTO to MANUAL mode.

In AUTO mode the 2V164 will monitor the voltage and current inputs and output tap raise / lower commands to maintain the load center in accordance with the relay settings.

In MANUAL mode tap raise and lower commands are inhibited.
The Blocking and Overvoltage alarm outputs remain active.
The relay fail alarm remains active.

TAP POSITION INDICATOR
A tap position indicator input is provided to enable the transformer tap to be displayed on the HMI. The output from the RMS type 2V200 Tap Position Transducer is required for this function to operate. Refer to the 2V200 Technical Bulletin for details.

TAP POSITION INDICATOR INPUT
For this function to operate an RMS type 2V200 transducer / sender unit is required at the tap changer. Refer to the 2V200 Technical Bulletin for application details.

The 2V200 is designed to interface to tap changes and convert one of the following parameters:

- an analogue voltage signal proportional to the tap position
- a binary coded decimal signal
- a BCD signal

The 2V200 converts any of these inputs to a frequency signal proportional to the tap position.

The 2V164 VRR is then simply programmed with the number of tap positions within the range 10 to 30. Scaling is carried out automatically so that the correct tap position is indicated on the 2V164 display.

A 4-20mA analogue output proportional to tap position is also provided by the 2V164 for local panel indication or interface to SCADA.

VOLTAGE DISPLAY
The HMI displays the line voltage. The VT ratio may be entered so that the HMI display reads in primary voltage. A 4-20mA analogue output is also provided.

Display range (Secondary):	10-145V
VT setting range:	0.11KV to 132.00KV

CURRENT DISPLAY
The HMI displays the line current from the LDC input. The CT ratio may be entered so that the HMI display reads in primary current.

Display range (Secondary):	0.1-1.35Is
CT setting range:	1A to 6.00KA

TAP CHANGE EVENT COUNTER
A record is maintained and displayed of the number of tap operations since this function was last reset. The tap rate indicator takes account of all tap changes initiated by the 2V164 tap raise / lower contacts. Manual taps initiated by external control contacts are not included.

RANGE OF TAP OPERATION
A record is maintained and displayed of the minimum and maximum tap position reached since this function was last reset.

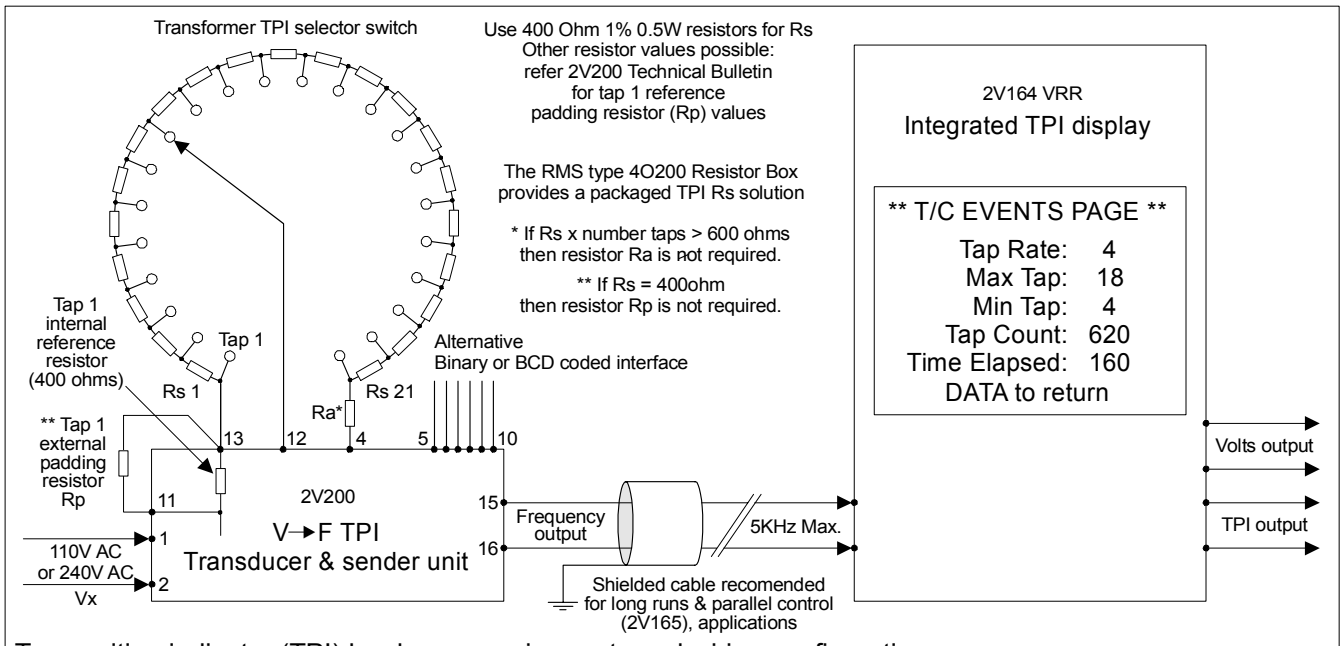
TIME ELAPSED SINCE TAP COUNT RESET
A record is maintained and displayed of the time in hours since the tap count was last reset.

TAP RATE ALARM
The 2V164 records and displays the rate at which tap raise/lower commands have been output over the preceding 15-minute period. If the set point rate is exceeded (taps per hour), an alarm contact is picked up. This alarm contact is automatically reset when a tap rate lower than the alarm set point is updated to the display or when the tap count is manually reset. The tap rate indicator takes account of all tap changes initiated by the 2V164 tap raise / lower contacts. Manual taps initiated by external control contacts are not included.

TAP POSITION INDICATOR ANALOGUE OUTPUT
A single tap position indicator analogue output signal is provided for interface to an RTU. The analogue output is linked to the tap position as follows:

Output:	4 to 20mA
Compliance voltage:	5V
Maximum burden:	250 Ohms
Accuracy:	+/-3%
Analogue output:	
▪ Tap 1	4mA
▪ Tap N	20mA

Where N = maximum selected tap setting



Tap position indicator (TPI) hardware requirements and wiring configuration.

Figure 2

RELAY CONFIGURATION USING μMATRIXwin

The purpose of the μMATRIXwin application is to provide display, configuration and diagnostic facilities required to support the entire family of μMATRIX digital relays. The prime functions of the application are:

Create a setting file off line
To create and view relay setting files at your PC without the need for a relay;

Relay setting
To down load a setting file (UMP) into a relay connected to a PC;

To display and change settings in a connected relay;

Relay status
To display the Status of nominated inputs and outputs of a connected relay;

Relay Control
Manual raise / lower commands and resetting functions can be performed;

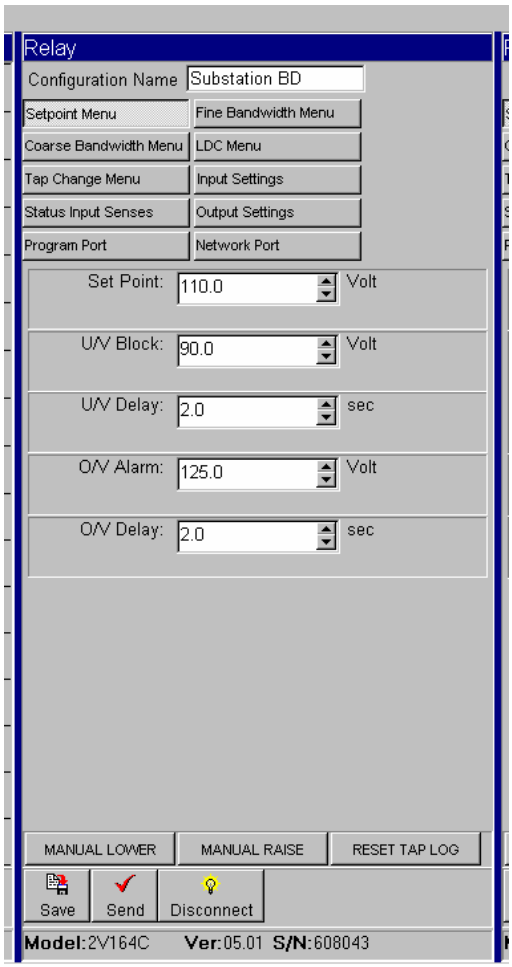
Commissioning
To export reports of setting parameters and status screen to confirm correct functionality during commissioning;

Upgrade relay software
To configure a μMATRIX relay for a specific customer application;

To upgrade the operational software (UMX) of a μMATRIX relay;

All current UMX software applications may be downloaded from:
www.rmspl.com.au/umatrix

Maintenance
To provide utility and diagnostic facilities at a technical level.



COMMUNICATION PORTS

Two (2) communications ports are available. The front USB programming port is provided as standard while the rear RS485 network port is available as an option.

Programming port
The programming port is accessible from the front panel of the relay via a USB physical link and PC configuration program supplied with the relay. The μMATRIXwin configuration program is designed to operate with all relays from the μMATRIX range and with all installed firmware version.

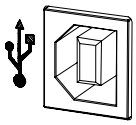
Network port
The network port is intended for applications where permanent connection to a master control system is required. An optically isolated RS485 physical layer is provided for this function.

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

Network Port Terminating Resistor
Where multiple relays are connected in a multi-drop configuration the RS485 comms. bus must have a 120 ohm terminating resistor fitted at each end. If the μMATRX-S relay is at one end of the transmission line a terminating resistor can be added by placing SW100-3 and SW100-4 in the ON position as depicted in the wiring diagram.

Network Port BIAS Resistors
Where a single relay is connected to the network, or where the relay is a long distance from other devices on the comms. bus, BIAS resistors may need to be fitted to ensure reliable operation. To simplify this configuration, BIAS resistors are fitted to each μMATRIX-S relay and may be selected IN by setting switches SW100-1 and SW100-2 to the ON position as depicted in the wiring diagram. This bank of four switches can be accessed by withdrawing the relay module from it's case, turning upside down and looking at the centre PCB near the rear terminal blocks.

PC TO μMATRIX USB CONNECTION



2V164-S front panel USB programming port

USB DRIVERS

The uMATRIX-S USB port is configured as a Virtual Communications Port (VCP) and is operated through a PC COM port. USB drivers must be installed on the PC to enable correct communication. A ZIP file containing the driver files needed for this process may be downloaded from:
www.rmspl.com.au/umatrix

VOLTAGE SENSING CIRCUITRY

Nominal monitoring voltage

IN QUAD connection:	110V 50HZ
IN PHASE connection:	63.5V 50Hz
Sensing supply burden:	Less than 0.2VA
Thermal rating:	300V continuous
Nominal sensing frequency:	40 to 60Hz

Voltage measurement secondary accuracy (110V tap):

Precision of voltage setting:	0.1V steps
Voltage pick up repeatability:	+/-0.1V from 90 to 120V
Voltage measurement resolution:	45mV
Resolution of voltage display:	0.1V
Accuracy of displayed voltage:	+/-0.1V from 90 to 120V

ACCURACY OF TIMERS

All timers +/-0.1s

LINE DROP COMPENSATION (LDC) INPUT

Nominal sensing current:	CT taps for 1A and 5A inputs
LDC input burden:	<0.5VA
Thermal rating:	3x nominal continuous 3.5x nominal for 10 minutes 6x nominal for 2 minutes 100A for 1s on 1A input 350A for 1s on 5A input 700A for 1 cycle on 1A input 2,500A for 1 cycle on 5A input
Note:	M Series case terminals and CT shorting switches are limited to 400A for 1s.
LDC accuracy:	+/- 0.3V error at nominal 110V setting and 10 to 120% CT input

SET POINT HYSTERESIS

All voltage set points have a hysteresis equal to 50% of the bandwidth voltage setting. Other values available on application.

TAP CHANGE FEEDBACK FUNCTION

When a tap change command is output to the OLTC, the tap change fail timer is started. If a single tap change restores the sensed voltage to a balanced condition the relay is reset. If the sensed voltage remains in error the interval time delay will start based on one of the three methods described below: The required operating mode is selected using the UMX order code.

VOLTAGE MONITORING (Automatic mode) UMX2V164**A**

In this mode the 2V164 provides a 1s output pulse to initiate a tap change. This output pulse is then repeated at a rate set by the Interval Timer setting until the sensed voltage has moved back to a balanced condition. This is the simplest connection method as it does not require a hard-wired contact between the OLTC and the VRR.

The output pulse may be selected as continuous for application with linear voltage regulators. The continuous output contact and interval timer delay is reset once the sensed voltage moves back to the balanced condition.

OLTC AUXILIARY CONTACT METHOD UMX2V164**B**

In this mode an auxiliary contact on the OLTC is employed to signal completion of a tap change sequence. This signal is used by the 2V164 to pause the interval time delay until the previous tap change sequence has been completed.

The default 2V164 T/C feedback status input is set for a control voltage to be removed when the tap change starts (OLTC auxiliary contact opens) and re-applied when the tap change sequence is completed (OLTC auxiliary contact closes). The interval time delay is paused until the completion of the tap change sequence has been signaled.

The output pulse may be selected as continuous or to provide a 1s pulse output.

The continuous output contact and interval time delay is reset once the sensed voltage moves back to a balanced condition.

TPI FEEDBACK METHOD UMX2V164**C**

In this mode the 2V200 TPI transducer must be connected as per figure 2. The control sequence is as follows:

1. A voltage deviation starts the initial time delay.
2. The time delay expires and a tap change command is output.
3. The tap change contact will remain closed until a signal is received from the TPI transducer confirming that a tap change event has occurred.
4. The interval time delay is initiated.
5. Sequence 2 to 4 will repeat at the rate determined by the Interval timer setting until the sensed voltage has moved back to a balanced condition.

TAP POSITION TRANSDUCER FAIL (UMX2V164C only)

In the event that a 2V200 TPI transducer loses connection to the 2V164 or fails, any pending tap commands are blocked.

For TPI transducer (2V200) failure conditions, a 'TPI Fail' message is displayed on the MMI and the tap position displays as 'TPI Offline'. The TPI fail output contact is also set.

Normal tap change feedback and voltage regulation control function is automatically restored once the TPI transducer signal is recovered.

It should be noted that the 'TPI fail alarm' and the 'Tap change fail alarm' share a common output contact.

LINE VOLTAGE ANALOGUE OUTPUT

Output:	4 to 20mA
Compliance voltage:	5V
Maximum burden:	250 Ohms
Accuracy:	+/-3%
Analogue output:	Lower (4mA) set point range: 0V - 146V Upper (20mA) set point range: 50V - 146V

STATUS INPUT MINIMUM OPERATING CURRENT
10 mA P/U for 1 ms then reducing to1.5 mA after 4 ms.

STATUS INPUT OPERATING TIME

Initiate input	Parameter	Delay
DC	P/U	<4 ms
	D/O	<16 ms
AC	P/U	<23 ms
	D/O	<33 ms

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

Burden: Less than 10 watts with all output relays energized using 110V DC nominal supply.

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

Input Transients:
Withstands multiple high-energy transients and ring waves in accordance with IEEE28 - ANSI C26.1 Cat. II, accordingly:

- 0.5uS 100kHz 6kV O/C, 500A S/C, 4J
- 1.2/50uS 6kV O/C
- 8/20uS 3kA S/C, 80J clamped at 1,000V

Mains conducted EMI within limits specified by AS 3548 Class B.

Isolation:
The inputs are isolated from the outputs in accordance with AS3260 Class II Limited Current Circuitry, accordingly:

- Withstand voltage of 2.5kV RMS 50Hz for one minute
- Creepage and clearance distance greater than 4mm
- Output leakage current less than 0.25A to earth

Output Protection:
Outputs will withstand continuous short circuit. Output regulators and switching control regulator are thermally protected.

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.

A front panel green LED is illuminated when the relay is healthy. A separate flashing red LED indicates a software problem has been encountered which caused causing the CPU to perform a warm boot.

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

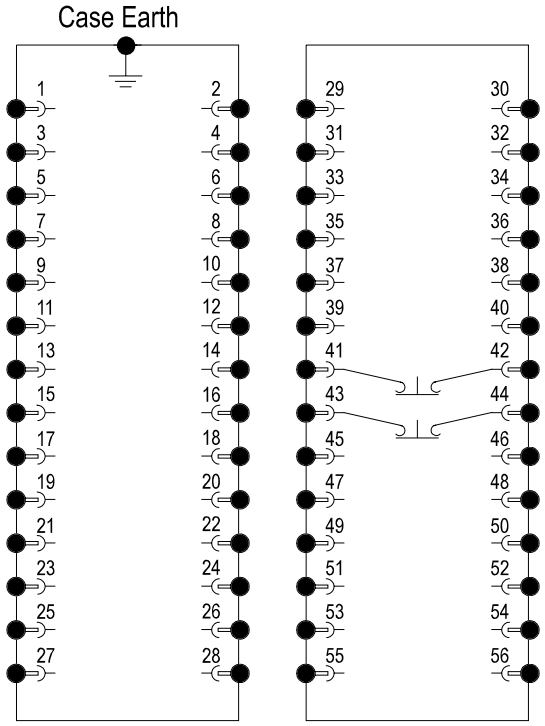
SHIPPING DETAILS
Each relay is supplied individually packed in pre formed cardboard cartons with internal moulded polystyrene former.

Weight: 3.5Kg
Size: 370(L) x 240(W) x 145(D)mm - Size 4 case

For large shipment individual cartons are packed in sturdy cardboard pallet boxes and surrounded by loose fill to absorb vibration and shock during transit.

ACCESSORIES SUPPLIED
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
1 x μMATRIX User Guide per order
1 x USB cable per order
1 x CD - μMATRIXwin software, setting files and applications per order

Technical Data



4M56 Case terminations (REAR VIEW)

OUTPUT CONTACT RATINGS **IEC60255-0-2**

Carry continuously	5A AC or DC	
Make and carry	0.5 s 20 A AC or DC	
L/R ≤ 40ms & V ≤ 300V	0.2 s 30 A AC or DC	
Break capacity I ≤ 5A and V ≤ 300V	AC resistive	1,250 VA
	AC inductive	250 VA @ PF ≤ 0.4
	DC resistive	75 W
	DC inductive	30 W @ L/R ≤ 40 ms 50 W @ L/R ≤ 10 ms
Minimum number of operations		10^6 at maximum load
Minimum recommended load		0.5W limit 10mA / 5 V

TRANSIENT OVERVOLTAGE **IEC60255-5 CLASS III**

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

INSULATION COORDINATION **IEC60255-5 CLASS III**

Between all terminals and earth	2.0 kV rms for 1 min.
Between independent circuits	2.0 kV rms for 1 min.
Across normally open contacts	1.0 kV rms for 1 min.

AUXILIARY SUPPLY **IEC60255-11**

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

HIGH FREQUENCY DISTURBANCE **IEC60255-22-1 CLASS III**

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

ELECTROSTATIC DISCHARGE **IEC60255-22-2 CLASS III**

6 kV contact discharge	≤ 5% variation

FAST TRANSIENT **IEC60255-22-4**

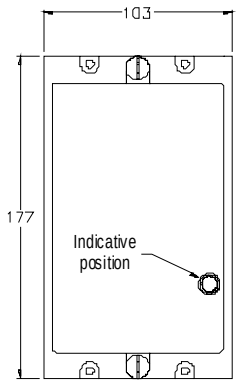
4 kV, 5/50 ns, 100 KHz repetitive	≤ 3% variation

TEMPERATURE RANGE **IEC68-2-1/2**

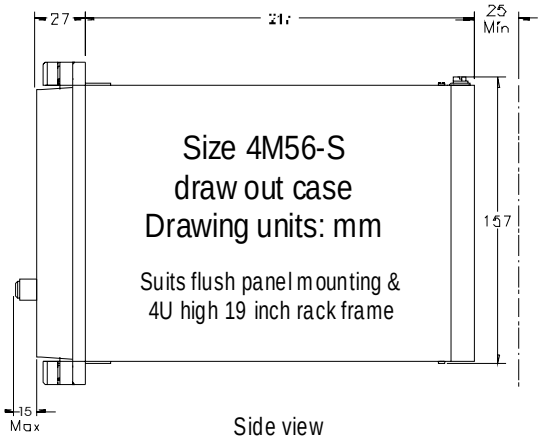
Operating:	-5 to +55°C
Storage:	-25 to +75°C

HUMIDITY **IEC68-2-78**

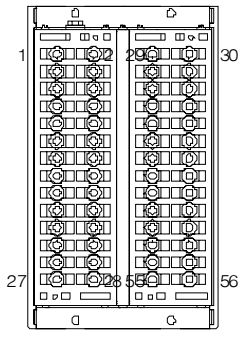
40 °C and 95% RH non condensing



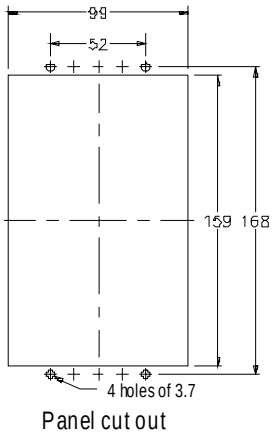
Front view



Side view



Terminal layout

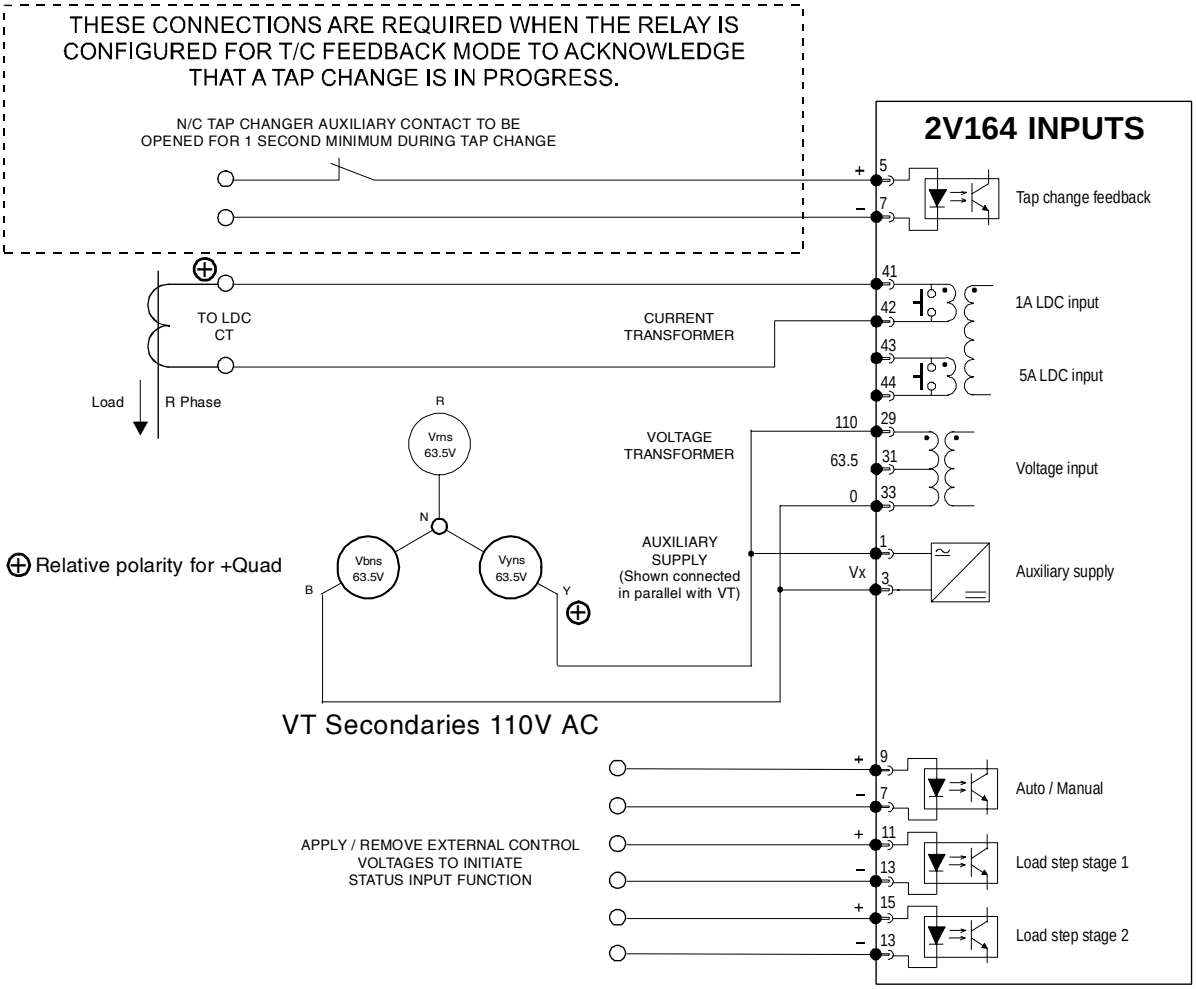


Panel cut out

Application Diagram

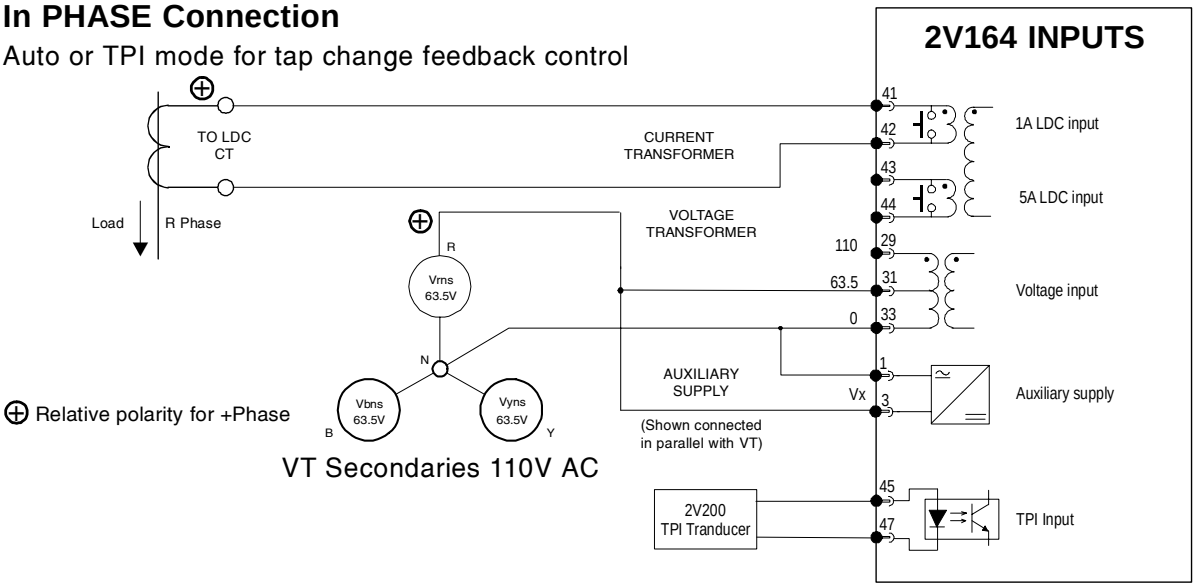
In QUAD Connection

Tap change feedback control mode depicted



In PHASE Connection

Auto or TPI mode for tap change feedback control



2V164 application diagram

All relay contacts are shown with a healthy supply applied, the 2V164 in a balanced condition, auxiliary supply connected in parallel with the 110V sensed voltage & 1 Amp CT tap LDC input wired.

Ordering Information

Generate the required ordering code as follows: e.g. 2V164-S-BDDAA

General Type		Order Code				
		1	2	3	4	5
2V164-S	-					

1 AUXILIARY SUPPLY RANGE

A	20-70V DC	B	40-275V AC (300V DC)

2 DIGITAL INPUT OPERATING VOLTAGE – GROUP 1

A	24-80V AC/DC	B	80-150V AC/DC
C	150-275V AC (300V DC)	D	18-275V AC (300V DC)

3 DIGITAL INPUT OPERATING VOLTAGE – GROUP 2

A	24-80V AC/DC	B	80-150V AC/DC
C	150-275V AC (300V DC)	D	18-275V AC (300V DC)

4 ANALOGUE OUTPUTS

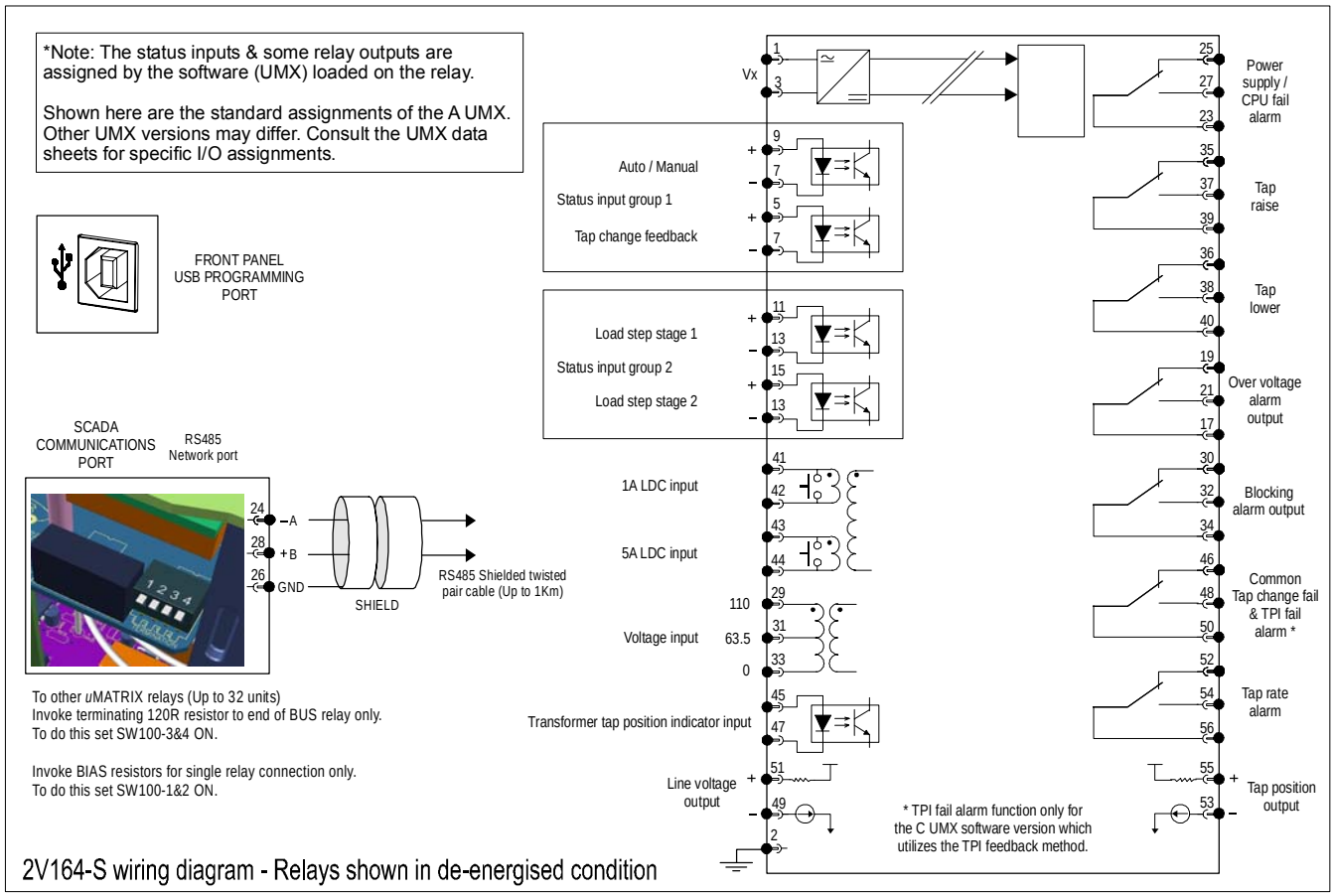
A	Not required
B	Required 4 to 20mA

5 REAR COMMUNICATIONS PORT

A	Not required
B	Required – Modbus protocol

SELECT DEFAULT APPLICATION SOFTWARE

A	UMX2V164A	Voltage monitoring feedback – Auto mode
B	UMX2V164B	OLTC auxiliary contact method
C	UMX2V164C	TPI feedback method



2V164-S wiring diagram - Relays shown in de-energised condition

Part

3

Software Function

Compatible Software UMX

The 2V164-S relay has a number of software programs called UMX available, which can be installed by the user. Each UMX provides a different functional configuration to suit specific applications. They must be however, compatible with the relay hardware. 0500 version UMX and later are compatible with 2V164-S relays.

Download the UMX compatibility list from the RMS website:

A copy of the UMX Hardware / Software Compatibility Register is attached.

Download the most up to date UMX Hardware / Software Compatibility Register from the RMS website:

http://www.rmspl.com.au/digital/compatibility.pdf

Factory Default Software

The 2V164-S relay is ordered with a customer specified default UMX so that it is ready for operation when received. To achieve this, an ordering code may be sought at time of quotation and specified on your order.

Determining Software UMX

Determining which UMX is loaded onto a MATRIX relay may be done in three ways:

1. New relays received from the factory have a label located on the side of the draw out module. This label is printed with information specific to the relay and includes the UMX type that was loaded during production.

2. Press the DATA and SET page buttons on the relay simultaneously to bring up the DIAGNOSTICS page.

   Now press SELECT to view the versions page and you will see:

   ** VERSION PAGE **

BIOS Version:	Vxx.xx	The version of the low level BIOS code loaded by the factory.
S/W Version:	Vxx.xx	The version of the software UMX.
CBD:	RMS Default	The .ump parameters file saved to the relay from μMATRIXwin.
Model:	xxxxxU	The xxxxx is the relay hardware code. The "U" is the UMX code.
S/N:	xxxxxx.xx	The production tracking serial number also found on the front label.
H/W Config:	xx	This number is related to the PCB loading and is auto detected.
Volt Adj:		Select to enter a voltage calibration offset.

3. Connect to the relay through the front panel USB configuration port using μMATRIXwin and a PC. The UMX code & version is displayed at the bottom of the centre panel.

Determining UMX Functionality

Now that you have determined the UMX loaded in the relay you need to obtain the Software Functional Description Document which relates to it. It may be obtained from our web site as follows:

Document name is: UMX2V164U.pdf using the "U" code from the version page above.

The location is: www.rmspl.com.au/ptmanual/umx2v164u.pdf

User Interface

Refer to the μMATRIX Users Guide for detailed instructions on the operation of the user interface.

To download a PDF version of the guide:

www.rmspl.com.au/digital/umatrixinfo.pdf

To download further μMATRIX software & documentation:

Twww.rmspl.com.au/umatrix.htm

Field Calibration

Small errors in voltage reading and miss match to other voltage measuring devices is a common observation during commissioning and routine testing. Adjustment of the voltage calibration is possible in the field by accessing the diagnostic menu as follows:

1. Press the DATA and SET page buttons on the relay simultaneously to bring up the DIAGNOSTICS page as described above.

2. Now arrow down to the Volt Adj line and press SELECT to enter a voltage adjustment value.

A calibration adjustment in 0.1V increments can be entered for the voltage measurement system. This adjustment changes the voltage measured by the relay and is reflected in the voltmeter display on the Data Page.

This adjustment setting is stored in EEPROM memory and will not be overwritten when new setting (UMP) or application (UMX) files are up loaded to the relay. Changes can only be made at the relay using the Volt Adj line in the diagnostics menu.

3. Press the DATA page button to return to the DATA Page.

Part

4

Installation

Handling of Electronic Equipment

A person's normal movements can easily generate electrostatic potentials of several thousand volts. Discharge of these voltages into semiconductor devices when handling electronic circuits can cause serious damage, which often may not be immediately apparent but the reliability of the circuit will have been reduced.

The electronic circuits of Relay Monitoring Systems Pty Ltd products are immune to the relevant levels of electrostatic discharge when housed in the case. Do not expose them to the risk of damage by withdrawing modules unnecessarily.

Each module incorporates the highest practicable protection for its semiconductor devices. However, if it becomes necessary to withdraw a module, the following precautions should be taken to preserve the high reliability and long life for which the equipment has been designed and manufactured.

1. Before removing a module, ensure that you are at the same electrostatic potential as the equipment by touching the case.
2. Handle the module by its front-plate, frame, or edges of the printed circuit board.
3. Avoid touching the electronic components, printed circuit track or connectors.
4. Do not pass the module to any person without first ensuring that you are both at the same electrostatic potential. Shaking hands achieves equipotential.
5. Place the module on an antistatic surface, or on a conducting surface which is at the same potential as yourself.
6. Store or transport the module in a conductive bag.

If you are making measurements on the internal electronic circuitry of an equipment in service, it is preferable that you are earthed to the case with a conductive wrist strap.

Wrist straps should have a resistance to ground between 500k – 10M ohms. If a wrist strap is not available, you should maintain regular contact with the case to prevent the build up of static.

Instrumentation which may be used for making measurements should be earthed to the case whenever possible.

Safety Section

This Safety Section should be read before commencing any work on the equipment.

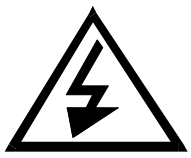
The information in the Safety Section of the product documentation is intended to ensure that products are properly installed and handled in order to maintain them in a safe condition. It is assumed that everyone who will be associated with the equipment will be familiar with the contents of the Safety Section.

Explanation of Symbols & Labels

The meaning of symbols and labels which may be used on the equipment or in the product documentation, is given below.

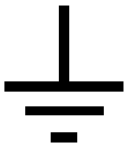
Caution: refer to product information

Caution: risk of electric shock



Functional earth terminal

Note: this symbol may also be used for a protective/safety earth terminal if that terminal is part of a terminal block or sub-assembly eg. power supply.



Unpacking

Upon receipt inspect the outer shipping carton or pallet for obvious damage.

Remove the individually packaged relays and inspect the cartons for obvious damage.

To prevent the possible ingress of dirt the carton should not be opened until the relay is to be used. Refer to the following images for unpacking the relay:

Outer packing carton showing shipping documentation pouch.
Address label on top of carton.

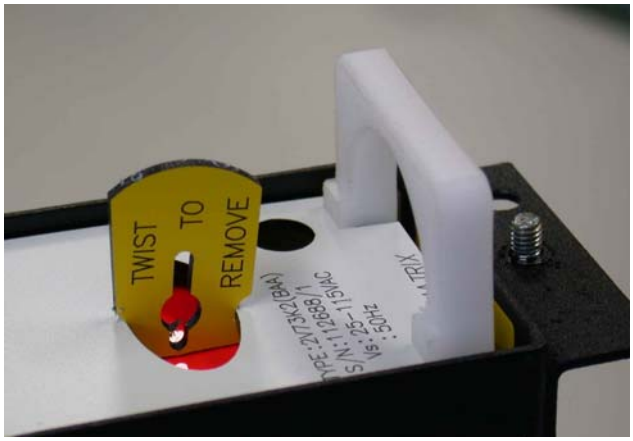
Inner packing carton showing front label detailing the customer name, order number, relay part number & description, the relay job number & packing date.
(Size 2 inner packing carton depicted)

Unpacking (Continued)

Inner packing carton with lid open showing protective foam insert.

CD depicted supplied with digital relay models or upon request at time of order.

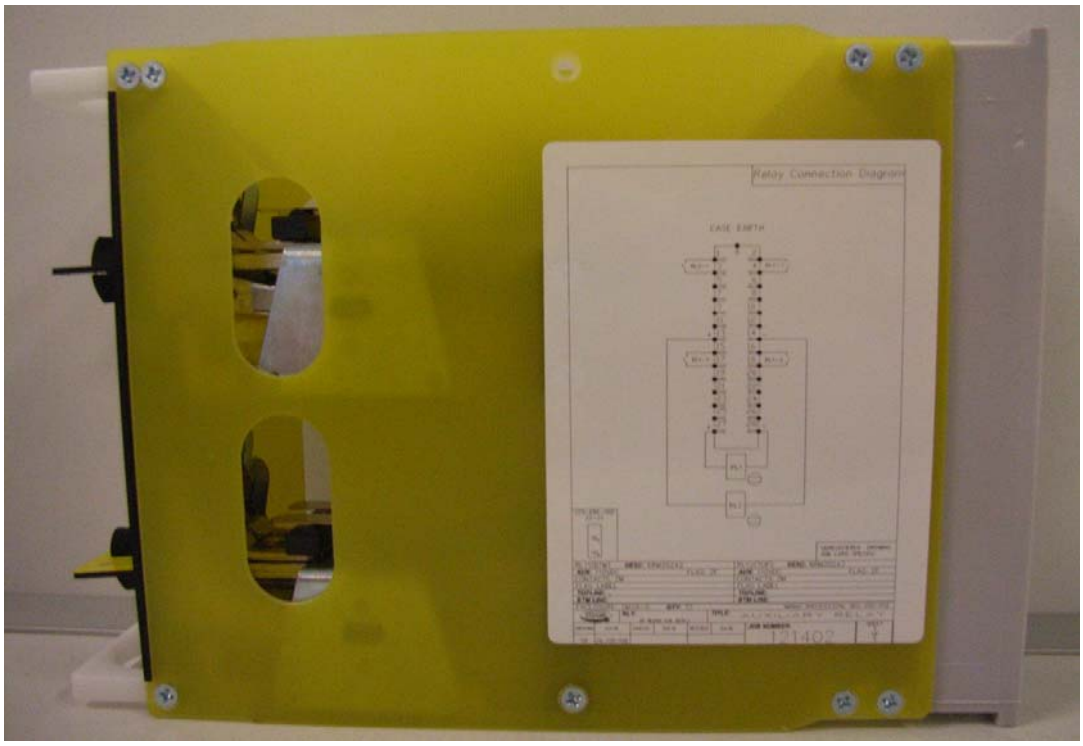
Inner packing carton with protective foam insert removed showing relay location.



Where mechanical flags are fitted the yellow transit wedge must be removed before operation using a gentle twisting action. The wedge should be stored with the original packaging material.

Relay Module Side Label Depicting Product Details

Relay Module Side Label Depicting Wiring Diagram (6R MATRIX relays only)



Accessories Supplied With Each Relay

Self threading M4 mounting screws

M4 terminal screws with captured lock washers

Storage & Handling

If damage has been sustained a claim should immediately be made against the carrier, also inform Relay Monitoring Systems Pty Ltd and the nearest RMS agent

When not required for immediate use, the relay should be returned to its original carton and stored in a clean, dry place.

Relays which have been removed from their cases should not be left in situations where they are exposed to dust or damp. This particularly applies to installations which are being carried out at the same time as constructional work.

If relays are not installed immediately upon receipt they should be stored in a place free from dust and moisture in their original cartons.

Dust which collects on a carton may, on subsequent unpacking, find its ay into the relay; in damp conditions the carton and packing may become impregnated with moisture and the de-humidifying agent will lose is efficiency.

Equipment Operating Conditions

The equipment should be operated within the specified electrical and environmental limits.

Protective relays, although generally of robust construction, require careful treatment prior to installation and a wise selection of site. By observing a few simple rules the possibility of premature failure is eliminated and a high degree of performance can be expected.

Care must be taken when unpacking and installing the relays so that none of the parts are damaged or their settings altered and must al all times be handled by skilled persons only.

Relays should be examined for any wedges, clamps, or rubber bands necessary to secure moving parts to prevent damage during transit and these should be removed after installation and before commissioning.

The relay should be mounted on the circuit breaker or panel to allow the operator the best access to the relay functions.

Relay Dimensions & Other Mounting Accessories

Refer drawing in Technical Bulletin. Relevant Auto Cad files & details on other accessories such as 19 inch sub rack frames, semi projection mount kits & stud terminal kits may be down loaded from:

http://www.rmspl.com.au/mseries.htm

Equipment Connections

Personnel undertaking installation, commissioning or servicing work on this equipment should be aware of the correct working procedures to ensure safety. The product documentation should be consulted before installing, commissioning or servicing the equipment.

Terminals exposed during installation, commissioning and maintenance may present hazardous voltage unless the equipment is electrically isolated.

If there is unlocked access to the rear of the equipment, care should be taken by all personnel to avoid electric shock or energy hazards.

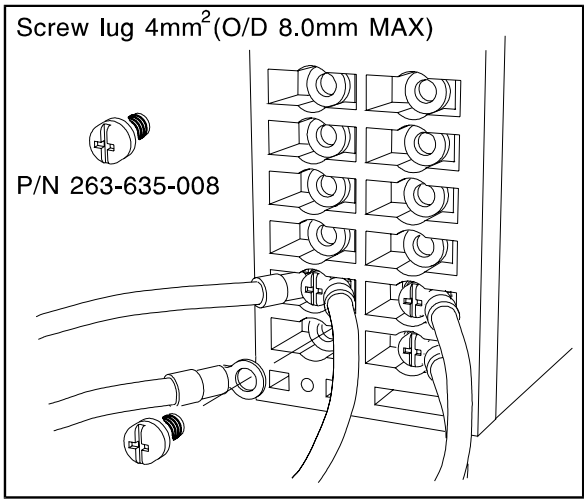
Voltage and current connections should be made using insulated crimp terminations to ensure that terminal block insulation requirements are maintained for safety. To ensure that wires are correctly terminated, the correct crimp terminal and tool for the wire size should be used.

Before energising the equipment it must be earthed using the protective earth terminal, or the appropriate termination of the supply plug in the case of plug connected equipment. Omitting or disconnecting the equipment earth may cause a safety hazard.

The recommended minimum earth wire size is 2.5mm^2, unless otherwise stated in the technical data section of the product documentation.

Before energising the equipment, the following should be checked:

1. Voltage rating and polarity;
2. CT circuit rating and integrity of connections;
3. Protective fuse rating;
4. Integrity of earth connection (where applicable)



Current Transformer Circuits

Do not open the secondary circuit of a live CT since the high voltage produced may be lethal to personnel and could damage insulation.

External Resistors

Where external resistors are fitted to relays, these may present a risk of electric shock or burns, if touched.

Insulation & Dielectric Strength Testing

Insulation testing may leave capacitors charged up to a hazardous voltage. At the end of each part of the test, the voltage should be gradually reduced to zero, to discharge capacitors, before the test leads are disconnected.

Insertion of Modules

These must not be inserted into or withdrawn from equipment whilst it is energised, since this may result in damage.

Electrical Adjustments

Pieces of equipment which require direct physical adjustments to their operating mechanism to change current or voltage settings, should have the electrical power removed before making the change, to avoid any risk of electric shock.

Mechanical Adjustments

The electrical power to the relay contacts should be removed before checking any mechanical settings, to avoid any risk of electric shock.

Draw Out Case Relays

Removal of the cover on equipment incorporating electromechanical operating elements, may expose hazardous live parts such as relay contacts.

Insertion & Withdrawal of Heavy Current Test Plugs

When using a heavy current test plug, CT shorting links must be in place before insertion or removal, to avoid potentially lethal voltages.

Commissioning Preliminaries

Carefully examine the module and case to ser that no damage has occurred during transit. Check that the relay serial number on the module, case and cover are identical, and that the model number and rating information are correct.

Carefully remove any elastic bands/packing fitting for transportation purposes.

Check that the external wiring is correct to the relevant relay diagram or scheme diagram. The relay diagram number appears inside the case.

Particular attention should be paid to the correct wiring and value of any external resistors indicated on the wiring diagram/relay rating information.

Note that shorting switches shown on the relay diagram are fitted internally across the relevant case terminals and close when the module is withdrawn. It is essential that such switches are fitted across all CT circuits.

If a test block system is to be employed, the connections should be checked to the scheme diagram, particularly that the supply connections are to the 'live' side of the test block.

Earthing

Ensure that the case earthing connection above the rear terminal block, is used to connect the relay to a local earth bar.

Insulation

The relay, and its associated wiring, may be insulation tested between:

- all electrically isolated circuits
- all circuits and earth

An electronic or brushless insulation tester should be used, having a dc voltage not exceeding 1000V. Accessible terminals of the same circuit should first be strapped together. Deliberate circuit earthing links, removed for the tests, subsequently must be replaced.

Commissioning Tests

If the relay is wired through a test block it is recommended that all secondary injection tests should be carried out using this block.

Ensure that the main system current transformers are shorted before isolating the relay from the current transformers in preparation for secondary injection tests.

DANGER

DO NOT OPEN CIRCUIT THE SECONDAY CIRCUIT OF A CURRENT TRANSFORMER SINCE THE HIGH VOLTAGE PRODUCED MAY BE LETHAL AND COULD DAMAGE INSULATION.

It is assumed that the initial preliminary checks have been carried out.

Relay CT shorting switches

With the relay removed from its case, check electrically that the CT shorting switch is closed.

Primary injection testings

It is essential that primary injection testing is carried out to prove the correct polarity of current transformers.

Before commencing any primary injection testing it is essential to ensure that the circuit is dead, isolated from the remainder of the system and that only those earth connections associated with the primary test equipment are in position.

Decommissioning & Disposal

Decommissioning: The auxiliary supply circuit in the relay may include capacitors across the supply or to earth. To avoid electric shock or energy hazards, after completely isolating the supplies to the relay (both poles of any dc supply), the capacitors should be safely discharged via the external terminals prior to decommissioning.

Disposal: It is recommended that incineration and disposal to water courses is avoided. The product should be disposed of in a safe manner.

Part

5

Maintenance

Mechanical Inspection

Relay Assembly

Inspect the relay for obvious signs of damage or ingress of moisture or other contamination.

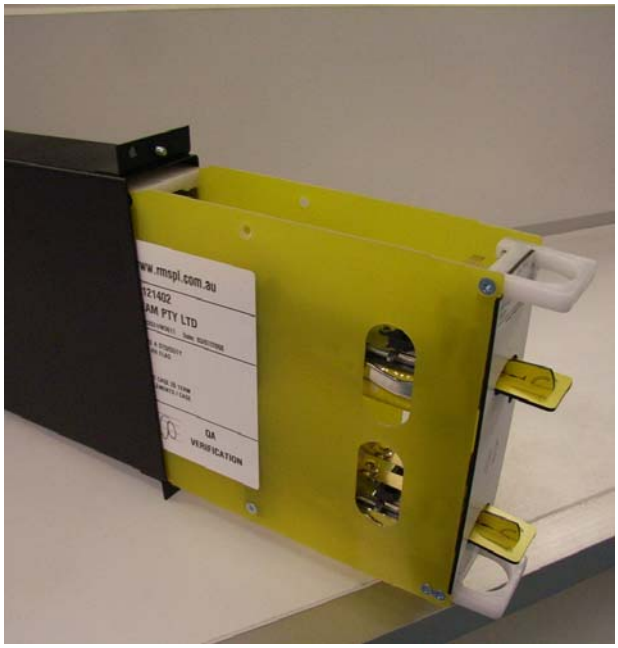
Relay Module

Isolate the relay, remove the front cover & carefully withdraw the relay module from the case.

Care must be taken to avoid subjecting the relay element to static discharge which may damage or degrade sensitive electronic components.

Inspect the relay module for signs of any overheating or burn marks which may have been caused by overvoltage surge or transient conditions on the power supply or digital status inputs.

Inspect the VT & CT stages for degradation of insulation on the terminal wiring & transformer windings.



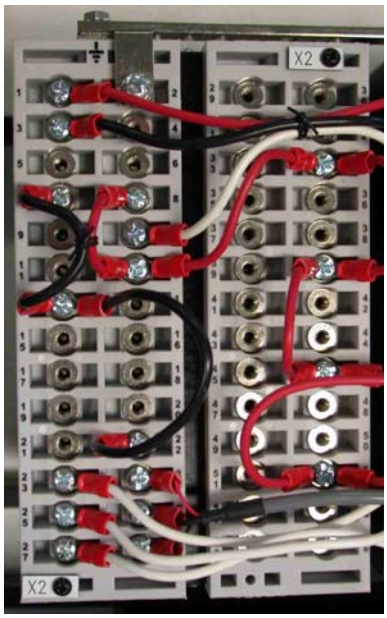
Remove cover by unscrewing black thumb screws & withdraw the relay module from the case.

Relay Case

Inspect the outer terminals checking insulation integrity & tightness.

Inspect inside the case and use a blower to remove dust.

Inspect the inner terminals for worn, distorted or tarnished contacts and if necessary clean the contacts using a brush dipped in a suitable substance.



Case outer terminals

Case inner terminals

Module plug in terminals

Test Intervals

The maintenance tests required will largely depend upon experience and site conditions, but as a general rule it is recommended that the following inspection and tests are performed every twelve months.

- Mechanical Inspection
- Check of Connections
- Insulation Resistance Test
- Fault Setting Tests by Secondary Injection
- Tests using Load Current
- Check the continuity of the neutral CT loop with a bell test set or an ohmmeter

Defect Report Form

Please copy this sheet and use it to report any defect which may occur.

Customers Name & Address:	Contact Name:
	Telephone No:
	Fax No:
Supplied by:	Date when installed:
Site:	Circuit:

When Defect Found

Date:	Commissioning?	Maintenance?	Systems Fault?	Other, Please State:
Product Part No:				Serial Number:
Copy any message displayed by the relay:				
Describe Defect:				
Describe any other action taken:				
Signature:		Please Print Name:		Date:

For RMS use only

Date Received:	Contact Name:	Reference No:	Date Acknowledged:	Date of Reply:	Date Cleared:

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 80%. 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 8544 1200 Fax: +61 3 8544 1201 Email: rms@rmspl.com.au Web: www.rmspl.com.au