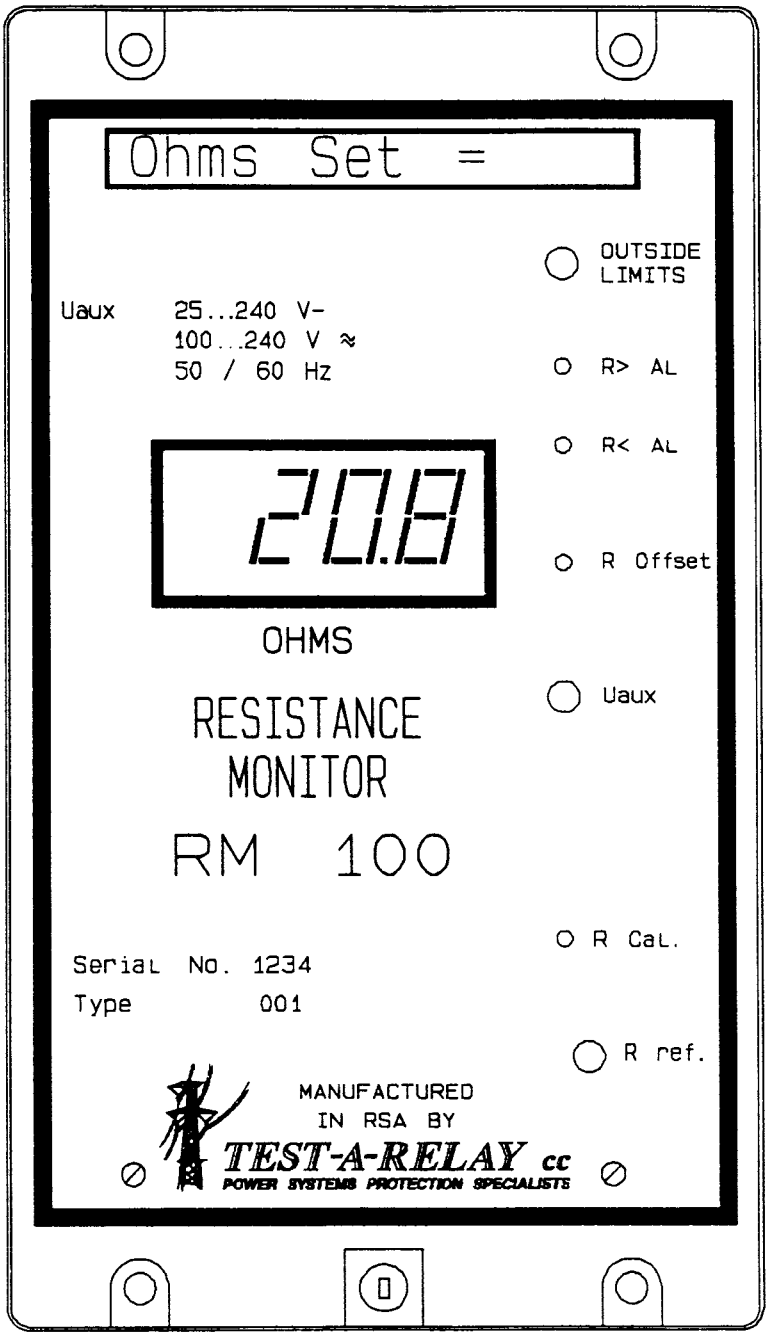
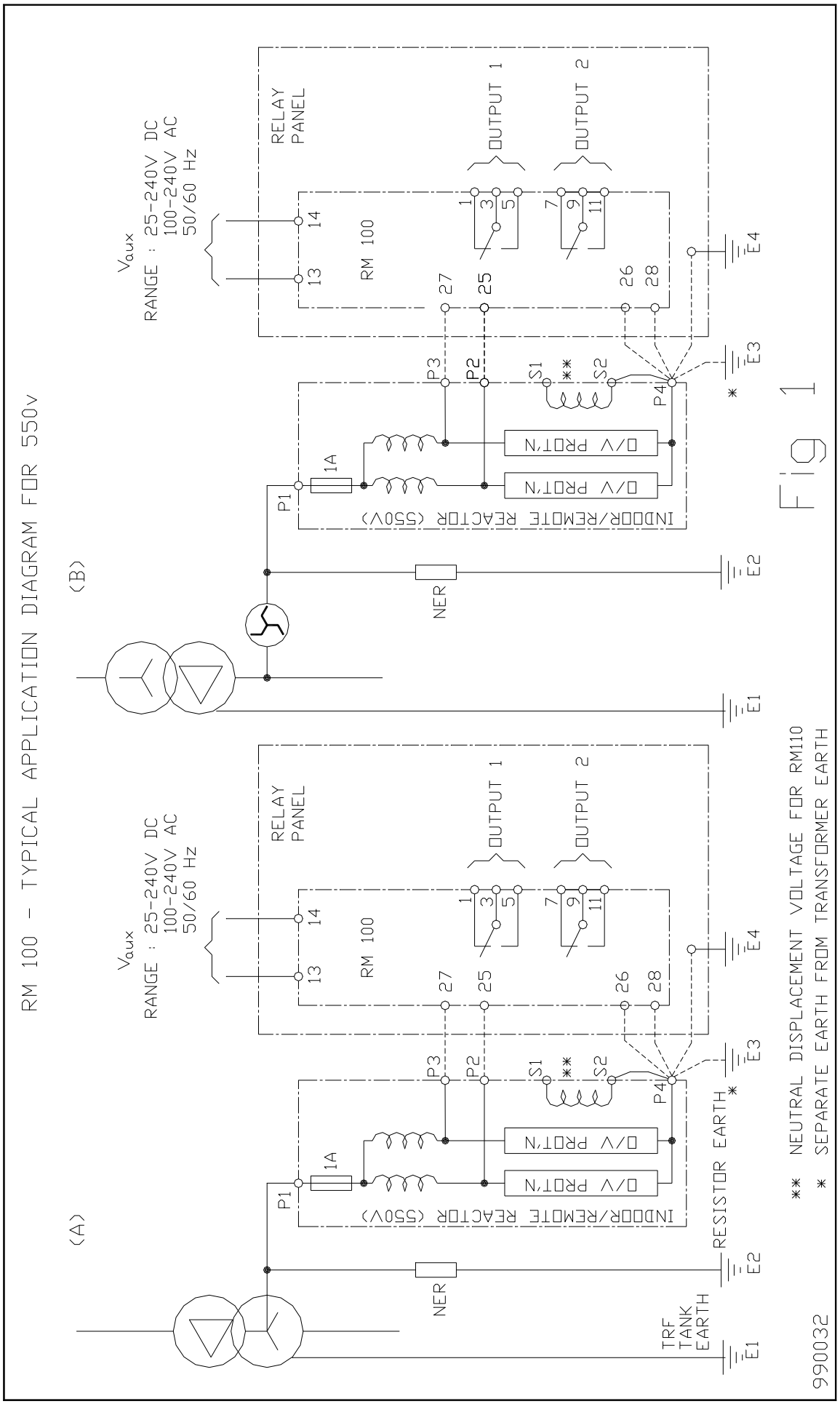
EARTHING RESISTOR MONITOR
TYPE RM 100

Fully designed and manufactured in the Republic of South Africa.



Continuous readout of resistor value. (Range 10 to 150 ohms)
Adjustable alarm limits
Draw-out case design
Optional – Built in back-up protection for open circuit resistor condition


RM 100 - TYPICAL APPLICATION DIAGRAM FOR 550v
(A)
(B)
Vaux
RANGE : 25-240V DC
100-240V AC
50/60 Hz
RELAY
PANEL
RM 100
OUTPUT 1
OUTPUT 2
INDOOR/REMOTE REACTOR (550V)
D/V PROT'N
1A
NER
RESISTOR EARTH
TRF
TANK
EARTH
E1
E2
E3
E4
P1
P2
P3
P4
S1
S2
** NEUTRAL DISPLACEMENT VOLTAGE FOR RM110
* SEPARATE EARTH FROM TRANSFORMER EARTH
990032
Fig 1

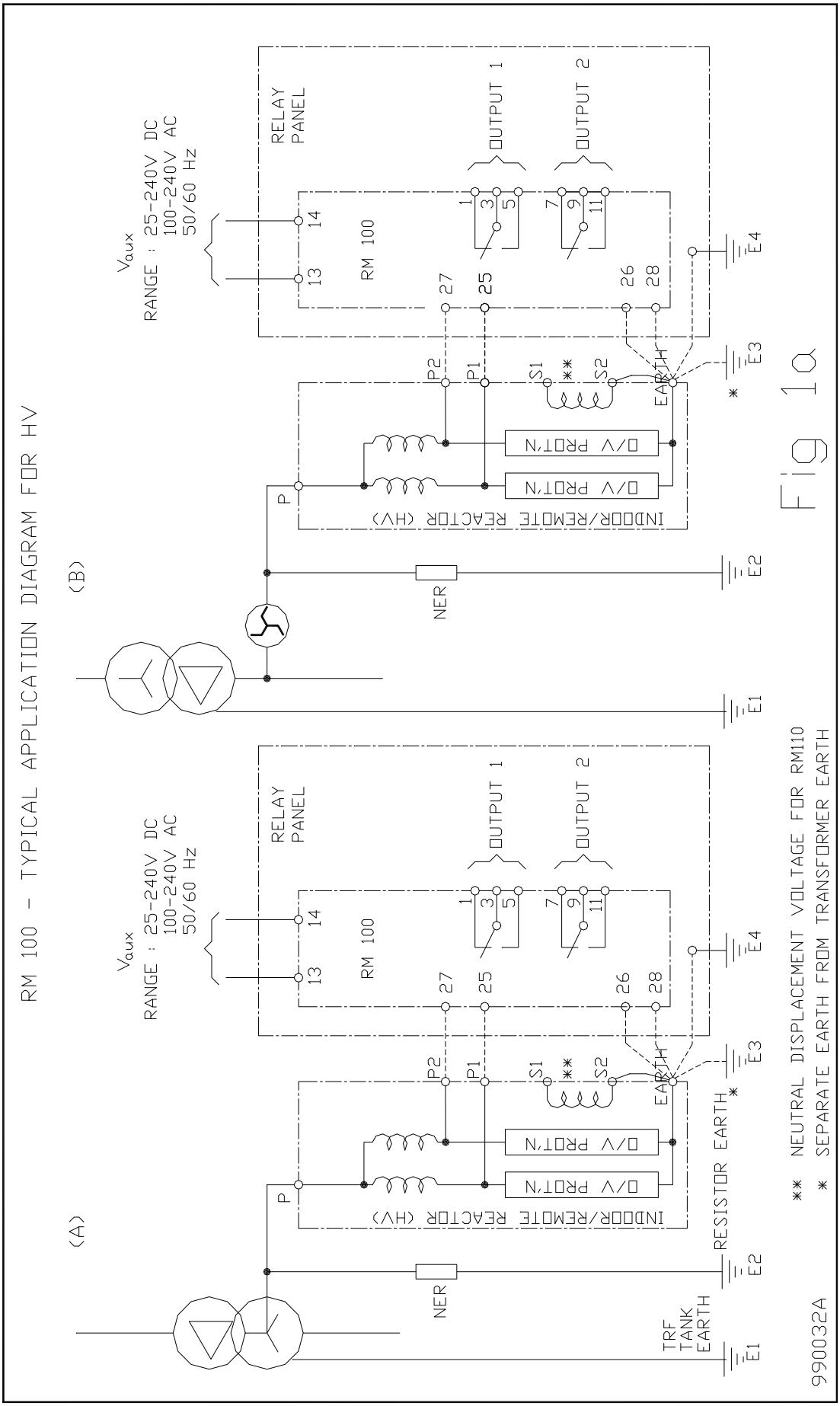

RM 100 - TYPICAL APPLICATION DIAGRAM FOR HV
(A)
(B)
Vaux
RANGE : 25-240V DC
100-240V AC
50/60 Hz
RELAY
PANEL
RM 100
OUTPUT 1
OUTPUT 2
INDOOR/REMOTE REACTOR (HV)
D/V PROT'N
NER
RESISTOR EARTH
TRF
TANK
EARTH
E1
E2
E3
E4
P
P1
P2
S1
S2
EARTH
** NEUTRAL DISPLACEMENT VOLTAGE FOR RM110
* SEPARATE EARTH FROM TRANSFORMER EARTH
990032A

Fig 10

NOTES:-

a) Terminal 28 and terminal 26 MUST NOT BE EARTHED DIRECTLY TO THE PANEL EARTH point E4. TERMINAL 28 MUST ONLY BE EARTHED AT THE REACTOR END to earth point E3 via the cable lead between terminal 28 and P4 and a similar lead must be used for terminal 26, as shown in the drawing. This creates a FOUR wire measurement system!

b) P4 must be connected to the panel earth via a separate cable lead as shown

c) The connection of P4 to the system earth must be as far removed as possible from the resistor (NER) earth E3, to minimise the chance of the earth being broken or stolen when the copper for the NERs earth is removed for any reason!

d) Fig 1a shows the connections for an HV reactor.

Technical Specifications : RM 100

Measuring Element	**No of Inputs** **Type of Input**	**1 (four wire)** **Resistance through Coupling Reactor**
Auxiliary Power Supply	**Operating Range (dc)** **Operating Range (ac)** **Burden (VA)**	**25 – 240 V DC** **100 – 240 V AC** **< 3 VA with relay energised**
Output Relays	**Quantity** **Contact forms** **Making current** **Continuous current** **Breaking capacity** **Max breaking current** **Max breaking voltage** **Fail safe operation**	**1** **2 x C/O** **10A** **5A** **1250VA/35 – 250W** **5A AC / 0,4A (110 V DC)** **300 V DC / 250 V AC** **Switchable : Fail safe / Normal**
Display	**Type** **Screen size** **Character height**	**Liquid crystal** **27 x 12mm** **11mm (Max. display 199.9 ohms) (sensitive version 19.99 ohms)**
Indicators	**Quantity** **Type** **Function**	**2** **Light emitting diodes** **Green : Power on** **Red : Outside limits**
Pushbuttons	**Quantity** **Function**	**1** **Resistance reference calibration**
Measurement Setting Range	**Resistance value**	**10 - 120 ohms**
Alarm Setting Range	**Resistance value**	**10 - 120 ohms**
Accuracy	**Basic accuracy**	**+/- 5% of reading**
Insulation resistance	**2.0 kV for 1 minute**	**IEC 255-4**
Temperature Range	**-10 to + 55 deg C**	**IEC 68-2-2**
Enclosure	**Type** **Degree of Protection**	**'MIDOS' type case** **IP50 to IEC 529**

TEST-A-RELAY cc

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Description

The introduction of earthfault current limiting resistors has become standard practice for medium and low voltage electrical systems. These resistors are either dry type with air insulation or wet type, usually oil immersed. Liquid resistors are also used.

There has been a recent increase in the failure rate of these earthing resistors, which could result in catastrophic consequences, especially in the mining industry. Also, the increase in copper theft has often resulted in the removal of the earthing connection from the NER. The system becomes effectively "unearthed".

In this condition, provided that no earth fault exists, the electrical system can operate without a deliberate earth connection. The system has capacitance to earth, which allows the system to "float" approximately at the same potentials as if the NER was still connected.

However, for any subsequent earth fault, two types of fault to ground can occur.

1) A solid connection to earth will result in the system voltages shifting compared to earth such that the faulted phase is at earth potential and the other phases are at phase-to-phase potential with respect to earth. Usually no tripping occurs and the earth fault remains undetected. When a second fault occurs anywhere on one of the healthy phases, the result is a two phase to earth fault (often called "cross country" faults i.e. faults at different locations) generally with high fault current.

2) Should the fault be arcing in nature, the system capacitance in combination with the system inductance can cause an increase in voltage to earth of up to fives times system peak voltage. These overvoltages are likely to damage the insulation of other equipment on the same system. They can therefore be very dangerous to the system.

The RM 100 has been developed to monitor continuously the resistance value of both low voltage and medium voltage earthing resistors and provide an alarm if the resistor value goes outside these upper and lower limits. The designed range is from 10 to 150 ohms. **There is now an optional model for 0.5 to 15 ohms.** The upper and lower alarm limits are fully adjustable and the output relay contacts are delayed by at least 5 seconds to ensure that no false alarms occur for possible transient conditions, e.g. a system earth fault of say 2 seconds.

THE "LIVE" SIDE CONNECTION OF THE NER MUST BE AVAILABLE, for connection of the reactor through which the measurement is made by the RM100 relay! When transformers and their NERs are operated in parallel, all NERs need to have monitors as there is an interreaction which will cause some additional errror of reading. If only one monitor was used on two NERs, the reading would be 50% that on one NER.

The RM 110 is an extended version of the monitor, which has an additional feature to provide back-up Neutral Displacement DTL earthfault protection for system faults that could occur whilst the earthing resistor is open circuited or if downstream earth fault protection fails. No CT is necessary for backup detection of such an earth fault, besides which no appreciable earth fault current flows when the NER is disconnected from earth so detection by a CT fed relay is not possible.

Both units are fully developed and manufactured in the Republic of South Africa with full back up service country wide.

Application

The RM100 is connected as shown in Fig 1 above. The RM100 can be used for both low and high voltage systems. Different applications require different reactors! The voltage on which the RM 100 is to be used must be specified with the order. For the higher voltage systems, the reactor must be placed next to the NER, mounted on earthed steelwork, to prevent any high voltages from being produced in the panel where the meter/relay is mounted. The method of earthing defined above for Fig 1 is necessary to minimise the chance of high voltages being transmitted to the panel, as multiple earthing connections need to be broken before the reactor would become unearthed.

For low voltage systems, below 660v, the reactor can be placed in the same cabinet as the relay. This could result in voltages equal to phase to neutral values appearing IF the NER is unearthed or damaged (open circuit) AND an earth fault exists on the system.

The main requirements for installation are that the reactor must be earthed independently `from the NER's earthing connection as described in the NOTES to fig 1. The reactor must be earthed at it's location and again to the panel by means of a lead in the seven core cable as shown in fig 1 above. This method of earthing will minimise the probability of high voltages appearing at the relay panel.

RESISTANCE MONITOR CALIBRATION

a) GENERAL

The resistance monitor is used for measuring a Neutral Earthing Resistor's (NER) resistive ohmic value and will gives an alarm should the value change beyond preset high and low values. For an open circuit, the RM 100 will read **"1 "** i.e. 1 with three blanks digits (overrange).

b) CALIBRATION

There are four screw driver operated calibration points, namely:-

i) Calibration to measure resistance value (bottom potentiometer named R cal.)

ii) Offset adjustment {when required in earlier models to compensate for the Reactor's and leads' resistance to allow the meter to indicate the NER's value only} (second from bottom marked R OFFSET)

iii) The "Preset alarm value" for the minimum resistance acceptable (third from bottom marked R< ADJ)

iv) The "Preset alarm value" for the maximum resistance acceptable (top marked R> ADJ)

The unit is calibrated for all adjustments using the display. However, in addition, the actual resistance value of the NER should first be checked against the nameplate value by measuring, when the NER is isolated from the system and the RM100/RM110, using a separate ohmmeter.

(NB!! The unit is adjusted during test and manufacture to read the ***correct ohmic value.*** However, this calibration can be checked on site with the built in 100 ohm resistor. The calibration is done by first ensuring that the "R OFFSET" adjustment is turned fully clockwise, at least 22 turns or until a faint clicking noise is heard. The actual ohmic reading is then calibrated by adjusting "R cal." while pressing in the pushbutton "R ref".. This pushbutton switches in a 100 ohm resistor. "R cal." is

adjustment is varied until "**100.0"** is read on the display (99.5 to 100.5 for a 0.5% allowable error). This completes "ohms" adjustment. However, when the preset alarms are adjusted, the "R ADJUST" calibration is first be used during the adjustment of the highset "R> Al". and lowset "R<Al" to , after which the unit must be recalibrated to 100 ohms.

Note that the response of the display is deliberately designed to be **SLOW** (2 to 3 seconds) to eliminate any noise or 50 Hz signal in the measuring circuit affecting the reading!!!
The "R cal." is also used to assist with the calibration of the alarm limits of the unit.

First adjust "R< ADJ" fully clockwise and "R> ADJ" fully anti-clockwise by at least 22 turns or until a faint clicking is heard The red LED will now be off.

Recommended values for the limits are +25% and -25% i.e. for a 20 ohm NER use 25 ohms and 15 ohms as the final limits. These limits cover a NER which has been designed for a maximum of 5% variation of resistance for fault current flowing for the maximum rated time. A typical rating is 300 amps for 10 seconds. This long time operation could be made up from a typical 4 times multishot auto reclose cycle with 2 seconds for each fault clearance. (Eskom often sets the DTL earth fault protection at 6.0 seconds, which is less than the rating of the NER)

Closer limits of +15% and –10% can be used, but should be monitored initially to ensure that unnecessary alarms are not caused by the reduced values used!

Now adjust "R cal." until the display reads the desired upper limit (25 ohms in the example). Then adjust "R> ADJ" slowly clockwise until the red LED turns on.. Re-adjust "R cal."untiol the display reads the lower desired limit (15 ohms in the example). The red LED will go off. Now adjust "R< ADJ" anti-clockwise slowly until the red LED turns on again.

Finally adjust "R cal.", while pressing in the pushbutton"R ref.". until the value of "**100.0"** is read on the display (99.5 to 100.5 for a 0.5% allowable error).

On releasing the pushbutton, the ohmic value of the NER will be displayed.

This completes the calibration of the display and the alarm set points.

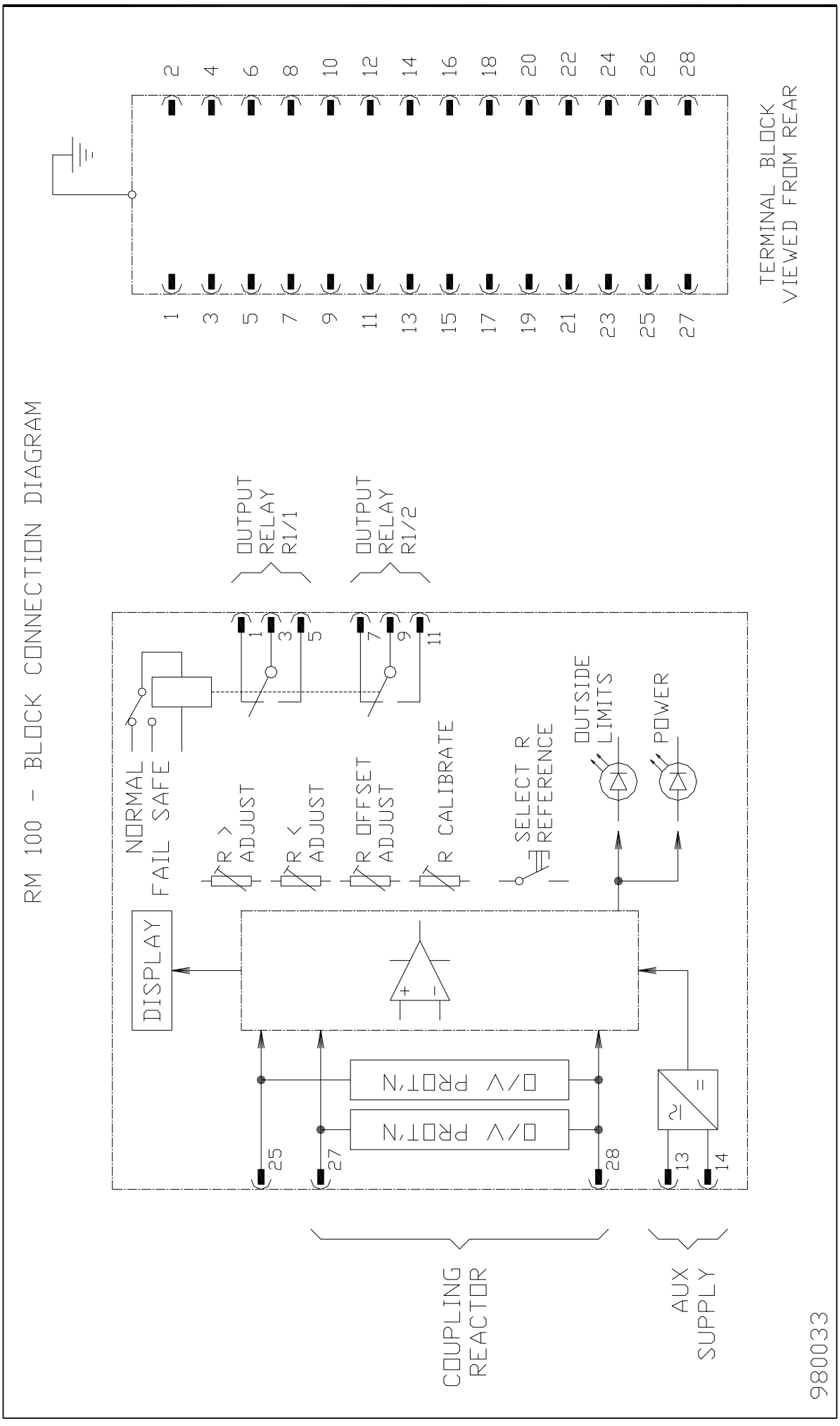
c) FAILSAFE ALARM OPERATION

The relay can be used in either a failsafe "rest to alarm" mode or standard/normal "operate to alarm" mode. The selection is made with the relay outside it's case. To use in a failsafe mode, the switch on the upper back position of the printed circuit board, just above the output relay, must be switched downwards.. A normally closed contact on the relay will then open when

- power is available,
- the calibration is correct
- and the NER has the right value.

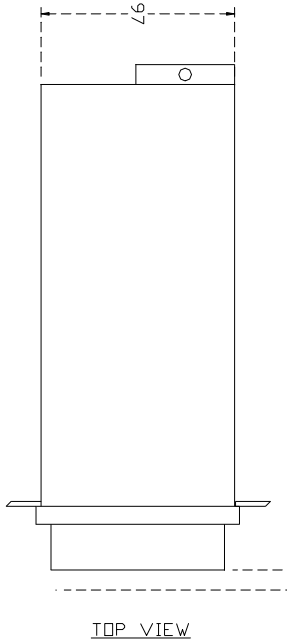
(2 off change over contacts are available, on terminals 1-3-5 and 7-9-11 as shown in fig 1).

For standard/normal operation i.e. relay picks up when the NER is out of range, the switch must be up (away from the output relay). In this mode the relay will pick and change over it's contacts only when the NER resistance is outside the alarm limits.


RM 100 - BLOCK CONNECTION DIAGRAM
TERMINAL BLOCK
VIEWED FROM REAR
2 4 6 8 10 12 14 16 18 20 22 24 26 28
1 3 5 7 9 11 13 15 17 19 21 23 25 27
OUTPUT RELAY R1/1
OUTPUT RELAY R1/2
1 3 5 7 9 11
NORMAL
FAIL SAFE
R > ADJUST
R < ADJUST
R OFFSET ADJUST
R CALIBRATE
SELECT R REFERENCE
OUTSIDE LIMITS
POWER
DISPLAY
+
-
D/V PROT'N
D/V PROT'N
25
27
28
13
14
COUPLING REACTOR
AUX SUPPLY
980033

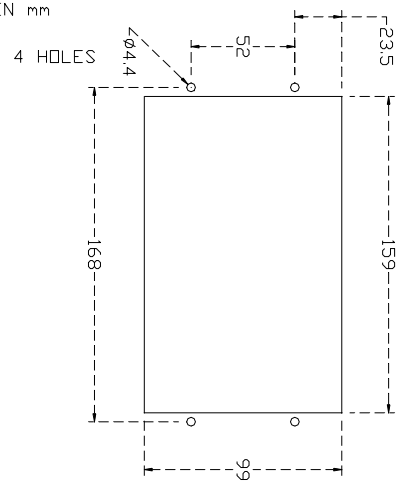
RM100.doc

* ALL DIMENSIONS IN mm

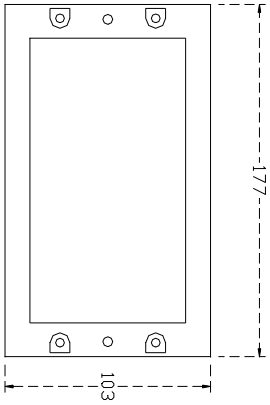


TOP VIEW

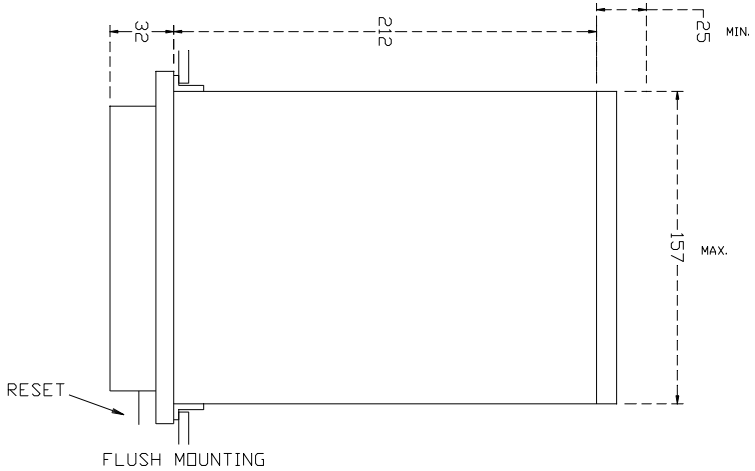
PUSH BUTTON
PROJECTION 10 MAX.



PANEL CUT-OUT
FLUSH MOUNTING FIXING DETAILS



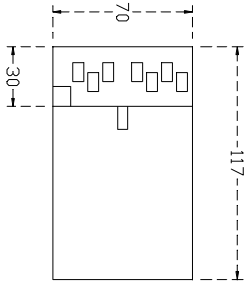
FRONT VIEW



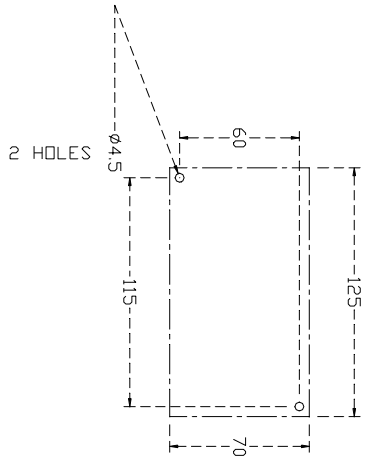
SIDE VIEW

RM100/110 CASE

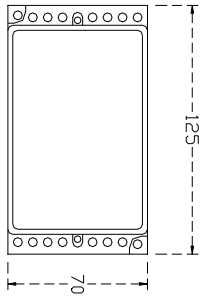
* ALL DIMENSIONS IN mm



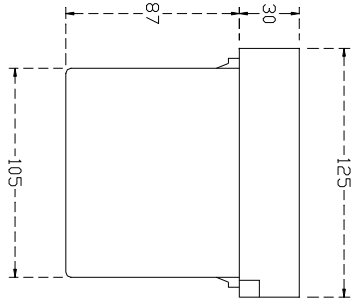
TOP VIEW



2 HOLES FOR
PANEL MOUNTING



FRONT VIEW



SIDE VIEW

REACTOR CASE (LOW VOLTAGE)
SURFACE MOUNTED (<<660v)

				RM100/RM110 & LV REACTOR DIMENSIONS & CUT-OUT DETAILS	Design Checked by M NEALE	TEST-A-RELAY	DRAWING No TAR 99-018	sheet 1
					Drawing Checked by	*TEST-A-RELAY*		cont -
0			99 29		Drawn by LD DUNCAN		CAD REF. 990280	
Rev Ind		Appd	Year Week					