

*RAILWAY
PROTECTION
RELAY*

Functions provided by measuring relays in railway equipment

1-Current relays

-Minimum current relays (During normal operation, if the current is present these relays are in operating position and switch to rest state if current consumption becomes too low.)

- Operate with direct current (DC) or alternating current (AC).
- Close if the current drops below the rated operating value.
- Open if the current value is greater than 0.
- Used to check that current is present in a circuit, in other words to check that the power supply is operating.
- Examples of application:
 - Checking the presence of the power supply current for a DC motor,
 - Checking the presence of the power supply current for a traction line.
 - Checking the current direction in a traction line (braking or traction).

-Maximum current relays (During normal operation, if the current is present these relays are in rest position and switch to operating position if current consumption becomes too great.)

- Operate with direct current (DC) or alternating current (AC).
- Reset if the current value exceeds the normal operating value.
- Used to protect a circuit against an overload harmful to operation.
- Examples of application:
 - Protects the primary or secondary side of a power transformer. The relay coil is energised by a measuring core. In the event of overload, it transmits a signal acting directly on the tripping circuit.
 - Monitoring traction or braking overload.
 - Monitoring auxiliary circuit overload.

Note: exists as an option in polarised version, with time-delay, and adjustable pick-up and drop-out values.

-Current balance relays

- Operate with direct current.
- These relays have two coils used to compare two currents which should normally be balanced. They close. if the difference between the two currents measured reaches an abnormal level.
- Examples of application:
 - Checking the input and output currents of a motor or traction line or current imbalance resulting from an isolation fault.
 - Checking current imbalance in the circuit of two traction motors mounted in series.

-Relay for thyristor filter short-circuiter: this relay protects the precharge resistor of the filter.

2-Voltage relays

-Minimum voltage relays

- Operate with direct current (DC) or alternating current (AC).
- Close for a voltage value less than the rated operating value.
- Check the presence of voltage at the terminals of a circuit to confirm that the power supply is operating.
- Examples of application:
 - Checking absence of line voltage (sensing function) for single-phase alternating current or direct current; pick-up and drop-out can be delayed to offset pantograph bounce.
 - Monitor the presence of voltage at the auxiliary circuit terminals.

-Maximum voltage relays

- Operate with direct current (DC) or alternating current (AC).
- Close for a voltage value greater than the rated operating value.
- Used to protect a circuit against overvoltage harmful to operation.

-Interval relays

- Operate with direct current (DC) or alternating current (AC).
- In make position when the voltage is between two set values and in break position if the voltage is less than the minimum setpoint or greater than the maximum setpoint.
- Examples of application:
 - Monitoring a network or power supply.

-Voltage balance relays

- Based on the same principle as current balance relays (see above).

-Battery voltage test relay (charge or discharge).

3-Other functions

-Time-delay relays with pick-up or drop-out time-delay. This function can be installed with most of the functions described in the other paragraphs.

-Grounding detection relays used to detect accidental grounding of circuits by current measurement.


-Relays monitoring current return to the rail used to protect persons and equipment against a fault in the circuit returning the traction current to the rail.


-Wheel slip monitoring relay, for two traction motors connected in series.

DIRECT CURRENT MEASURING RELAY

Application: This relay monitors the presence of current in the **traction circuit** of electric railway equipment such as:


- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle.

 The traction or braking current passes through the relay which **is energised at a threshold set in the factory.**

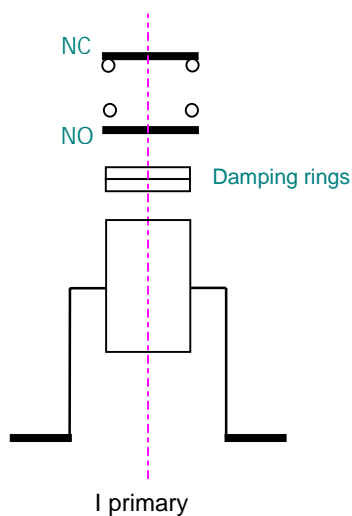
 Maximum **dielectric isolation** between the power rail and the contacts is **20KV 50HZ 1mn.**

 **The pick-up threshold current** of the relay is 100A.

 **The drop-out threshold current** of the relay is 50A.

 **The rated primary current** varies from **600A to 2000A** depending on the power of the traction system.


 These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms.**





CURRENT OVERLOAD TEST RELAY

Application: This relay monitors the overload current in the **traction circuit** of electric railway equipment such as:

- Subway systems
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle

 The traction and braking current passes through the relay which **is energised at a pre-set overload current.**

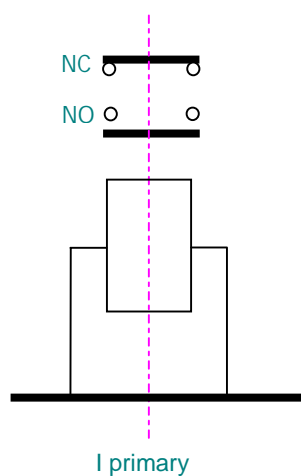
 Maximum **dielectric isolation** between the power rail and the contacts can be **20KV 50HZ 1mn.**

 **The pick-up threshold value** of the relay depends on the specifications.

 The **drop-out threshold value** of the relay is immaterial.

 **The rated primary current** is determined according to the traction line power.


 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms.**




POLARISED CURRENT MEASURING RELAYS


Application: This relay differentiates the traction current from the braking current in the **traction circuit** of electric railway equipment such as:

- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle.

 The traction current or braking current passes through the relay which, because it is fitted with a magnetic diode, can only be **energised in one direction of the current** (direct).

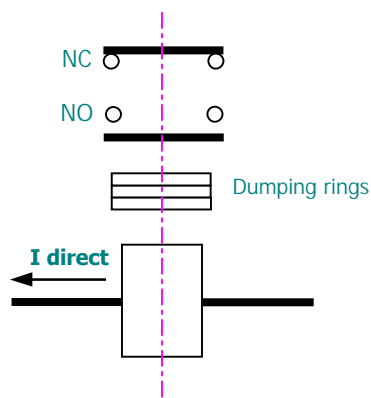
 Maximum **dielectric isolation** between the power rail and the contacts can be **20KV 50HZ 1mn.**

 **The pick-up threshold current** of the relay for the traction current direction is **100A.**

 **The non-pick up threshold current** of the relay for the braking current direction is **2000A.**

 **The rated primary current** varies from **600A to 2000A** depending on the traction equipment.


 These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms.**



CURRENT MEASURING INVERSE TIME RELAY

Application: This relay protects the filter precharge resistor of a **traction circuit** chopper on railway equipment such as:


- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle

 **The filter precharge resistor** is sized to take the power required by the capacitor load but **cannot permanently withstand the maximum load current**. It is therefore short-circuited by a thyristor or capacitor and the relay triggers the opening of the precharge circuit, by measuring the current passing through the resistor using a higher response curve than the theoretical precharge curve of the capacitor.

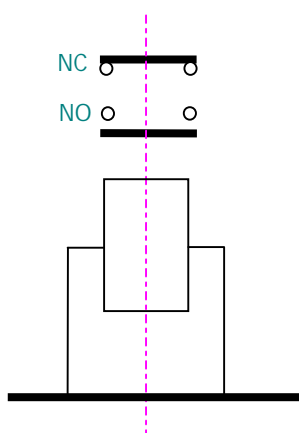
 **Dielectric isolation** between the power rail and the contacts is **10KV 50HZ 1mn**.

 **The pick-up threshold** depends on the filter precharge curve.

 **The response time** is inversely proportional to the current passing through the relay.

 **The rated primary current** varies from **600A to 2000A** depending on the power of the traction system.


 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms**.





DIFFERENTIAL CURRENT MEASURING RELAY

Application: This relay monitors **isolation faults** in the **traction circuit** of electrical railway equipment such as:

- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle.


 The traction current crosses the relay, with the positive **in opposition** to the negative. If there is an isolation fault, the **differential** of the two currents **is no longer zero** and the relay switches to **make position**.

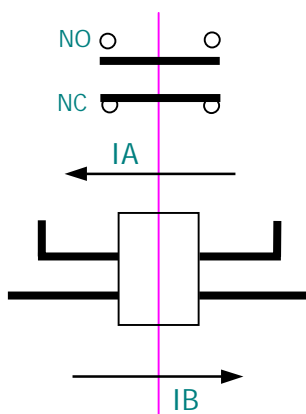
 **The dielectric isolation** between the two power rails may be **20KV 50HZ 1mn**.

 **The pick-up threshold current** of the relay in **ΔI** varies from **80A to 200A** depending on the power rating of the traction system.

 **The rated primary power** varies from **600A to 2000A** depending on the rated power of the traction system.

 These relays are fitted with a **NO contact** and a **NC contact** with breaking capacity of **0.3A 90VDC L/R 20ms**.

 The relay has a **very fast response time**. In addition, it is inversely **proportional** to the **level of the fault current** (inverse time).




SHORT-CIRCUIT CURRENT MEASURING RELAY FOR THE TRANSFORMER PRIMARY

Application: This relay triggers the opening of the main circuit breaker of a 50Hz or 16Hz2/3 traction line if the power transformer primary is short-circuited, for electric railway equipment such as:

- Electric railcars
- Electric locomotives
- Any other electric traction vehicle with pantograph power supply.

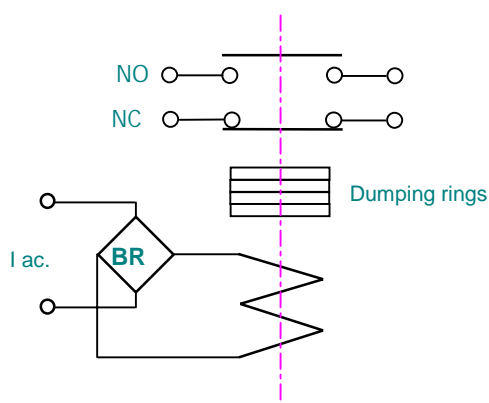
 The relay is **energised by a measuring core with a ratio of 100** connected to the 25KV 50 Hz or 18KV 16Hz2/3 power transformer primary.

 The relay **closes if the current is greater than the magnetising current of the transformer.**

 **Dielectric isolation** between the coil circuit terminals (measuring core secondary) and the contact terminals is **1.5KV 50HZ 1mm**, high voltage isolation being provided by the measuring core.


 **The operating thresholds** vary according to specifications. They are adapted to the **catenary power supply networks and the transformer power.**


 These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms.**



SINGLE-PHASE CURRENT TEST RELAY

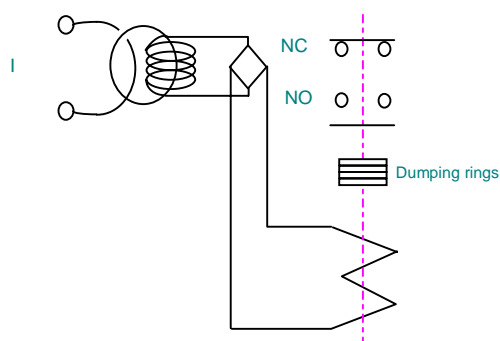
Application: This relay is used to check a 50HZ or 60HZ or 16HZ 2/3 single-phase current. For all railway applications, rolling stock or fixed installations.

 **The operating characteristics** range from a few amperes to several hundred amperes. The current is measured by a cable crossing the core.

 **Dielectric isolation** between the coil circuit terminals (measuring core secondary) and the contact terminals is **1.5KV 50HZ 1mn**, with isolation of the 10KV high voltage provided by the measuring core and the insulating sheath of the cable crossing it.

 **Pick-up and drop-out values** vary according to specifications.

 These relays are fitted with a **NO contact** and **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms**.





TEST RELAY FOR CURRENT RETURN TO RAIL

Application: This relay **monitors the traction current return** via the **ground shunt braids of the axle boxes** of electric railway equipment such as:

- Electric railcars
- Electric locomotives

 Under normal operation, the relay is **short-circuited by the current return circuit** in the axles.

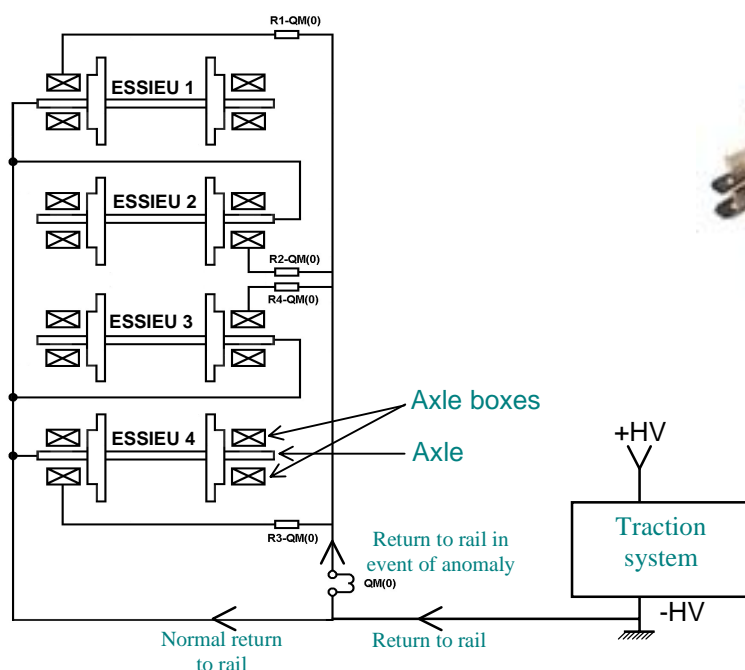
 If the normal return circuit **is broken**, the current return passes through **the axle boxes** via resistors and causes the **relay to close**.

 These relays provide **protection of personnel** by preventing the line voltage from passing through the body of the motor unit and **protects the bearings** of the axle boxes.

 **Dielectric isolation** is **2KV 50HZ 1mn**.








 The **pick-up threshold current** of the relay is **6A 50HZ** or **16HZ 2/3** or **7Acc**.

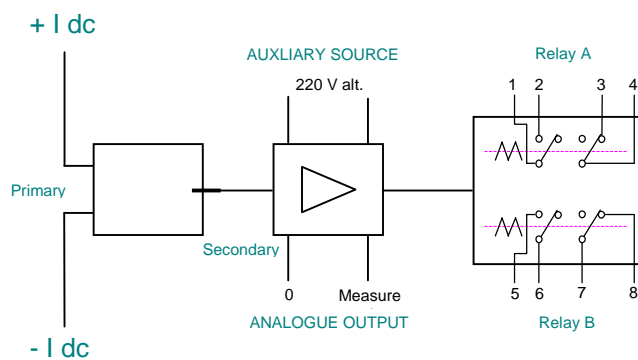
 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms**.



HEAT TRACING CABLE PROTECTION SYSTEM

Application: This product is a Hall-effect system that monitors the current in the **heat tracing cable circuit of the traction rails** for aerial subways.

-  The heat tracing cables are powered directly by the traction 750 VDC power supply. They are connected in series along the tyre running strips of the rails in order to thaw them during cold weather before operating the rolling stock.
-  The system comprises two relays, one **measuring the minimum current** to indicate a break in the heat tracing cable circuit and the other **measuring the maximum current** to indicate that a section of the heat tracing cable circuit is in short circuit with the rail.
-  **Dielectric isolation** between the current measurement and the relay contacts is **10KV 50HZ 1mn.**
-  **Pick-up and drop-out thresholds** depend on the length of the heat tracing cable circuit.
-  This monitoring system requires a permanent auxiliary source.
-  **The rated primary current** varies from **10A to 50A** depending on the network configuration.
-  The relays are fitted with a **NO contact** and **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms.**



CURRENT SENSOR WITH SIGNAL PROCESSING

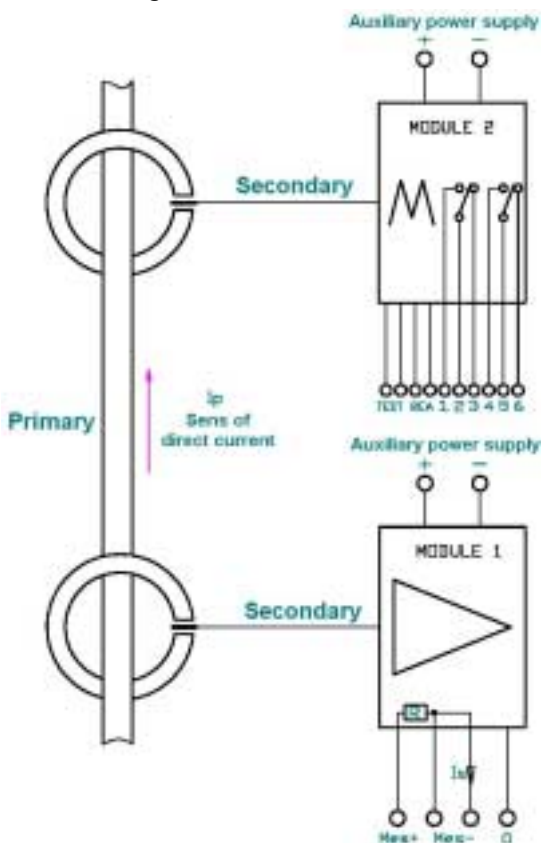
Application: This sensor measures the **current level** delivered by electric railway equipment substations operating under 750VDC, 1500VDC or 3000VDC.

The sensor is directly connected to the output of the substation rectifier bridge. The first module delivers a **secondary current proportional to the direct current delivered by the substation**: e.g. 0/20mADC or secondary 4/20mADC for primary 0/2000ADC, and the second module delivers a **logic signal for an inverse current threshold** indicating the failure of a branch of the substation rectifier bridge.

Dielectric isolation between the primary circuit bar and the secondary circuit terminals can be **20KV 50HZ**.

This sensor is used primarily to **guarantee galvanic isolation** between the substation output voltage and the distribution board device indicating the voltage level, and to **protect the rectifier bridge** on the substation power circuit.

This equipment requires an **auxiliary power supply** rated according to specifications: e.g. 0/+24VDC or 220V.



BATTERY VOLTAGE MONITORING RELAY

Application: This relay monitors the voltage level of the LV auxiliary network batteries for electric railway equipment such as:

- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives
- Diesel locomotives
- Any other electric traction vehicle.

The battery voltage energises the coil of the relay which **closes at a threshold set in the factory. It opens when the voltage becomes too low** in order to reduce battery drain by load shedding on the auxiliary circuits. The relay can have a slight **drop-out delay** to offset transient voltage drops.

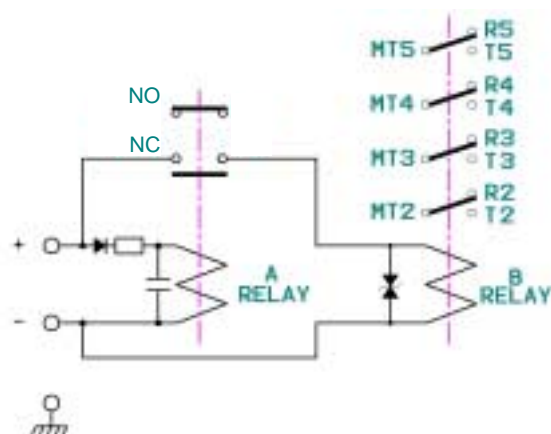
Dielectric isolation between the measuring coil and the contacts is **2KV 50HZ 1mn.**

The pick-up threshold voltage of the relay is lower than the rated voltage of the battery.

The drop-out threshold voltage of the relay is greater than the minimum contractual level of the battery.

The rated coil voltage varies from **24VDC to 110VDC** depending on the equipment specifications.


These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms.**





SINGLE-PHASE LINE VOLTAGE SENSING RELAY


Application: This relay monitors the **voltage level** of a pantograph power supply line for **rolling stock** of electric railway equipment such as:

- Electric railcars
- Electric locomotives
- Any other electric traction vehicle with catenary power supply

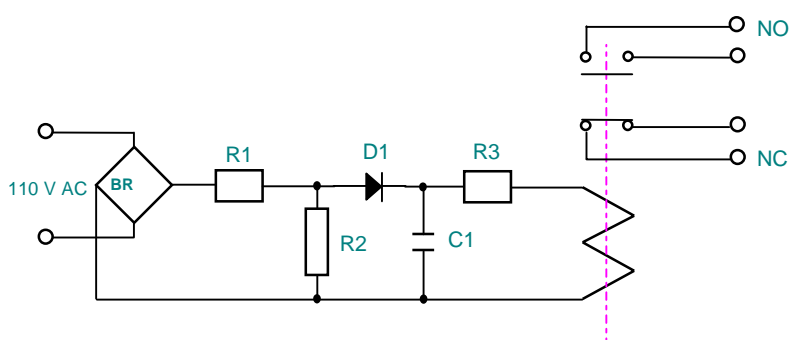
 The relay is powered by a secondary winding of the 25KV 50 Hz or 18KV 16 2/3 Hz power transformer. It is **energised continuously**, while the line voltage is at least equal to the minimum authorised voltage.

 The relay **opens** when the line voltage drops below the **minimum authorised level**. It has a time delay of a few milliseconds to **allow for pantograph bounce**.

 **Dielectric isolation** between the coil circuit terminals and the contact terminals is **2.5KV 50HZ 1mn**, high voltage isolation being guaranteed by the power supply transformer secondary.

 **The operating thresholds** vary according to the type of load. They are adapted to **catenary power supply networks**.

 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms**.



HV GROUND FAULT DETECTION RELAY

Application: This relay detects an isolation fault in the HV cables on electric railway equipment powered via a power transformer, such as:

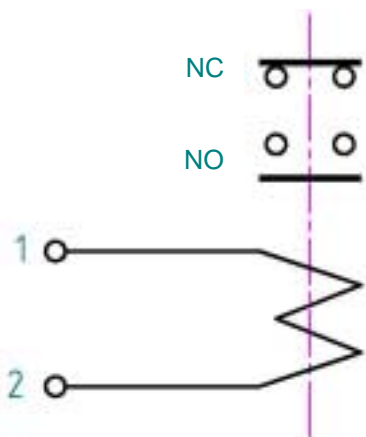
- Electric railcars
- Electric locomotives

The relay coil is connected between the - HV wiring and the + battery, with the - HV cable not connected to the general ground of the vehicle and the - battery connected directly to the general ground of the vehicle. If there is an **isolation fault between the HV wiring and the general ground**, the relay coil is directly energised by the battery and closes. If there is no isolation fault, the relay coil is never energised.

The **relay pick-up threshold voltage is lower than the minimum level of the battery voltage**, and there is no drop-out threshold voltage since the relay opens when the power supply is cut.

Dielectric isolation between the coil circuit terminals and the contact terminals is **10KV 50HZ**.

This relay is fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms**.




750VDC DETECTION RELAY

Application: This relay monitors **the presence of voltage** in fixed railway installations of **750VDC networks** such as:

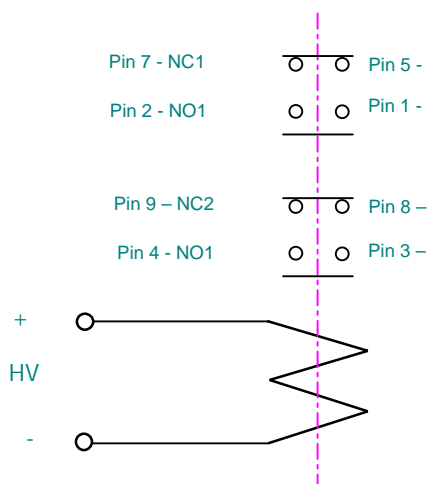
- Subway systems
- Tramways
- Trolley buses etc.

 The relay is powered by the 750VDC network of the substation and is **continuously energised** while the voltage is between **500VDC and 900VDC**. It can withstand **high voltage surges**.

 The relay **drops out** when the **750VDC** voltage disappears or drops below **250VDC**.

 **Dielectric isolation** between the coil circuit terminals and the contact terminals is **10KV 50HZ 1mn**.


 These relays are fitted with **two NO contacts** and **two NC contacts** with a breaking capacity of **2A 220V 50Hz**.




1500VDC VOLTAGE MEASURING RELAY


Application: This relay monitors the **voltage level** of a catenary power line for **rolling stock** used with electric railway equipment such as:

- Electric railcars
- Electric locomotives
- Any other electric traction vehicle with pantograph power supply.

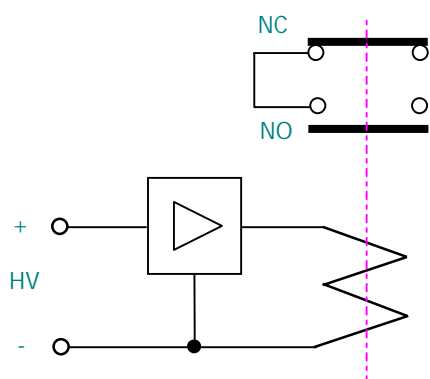
 The relay is powered by the 1500 VDC pantograph voltage and its **continuously energised** while the line voltage is at least equal to the minimum authorised voltage.

 The relay **opens** when the line voltage drops below the **authorised minimum**. It has a time delay of a few milliseconds to **offset pantograph bounce**.

 **Dielectric isolation** between the terminals of the coil circuit and the contact terminals is **10KV 50HZ**.


 **The operating thresholds** vary according to specifications. They are adapted to the catenary power supply networks. **Hysteresis between the closing threshold and the opening threshold is very slight (< 5%)**.


 These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms**



VOLTAGE SENSOR

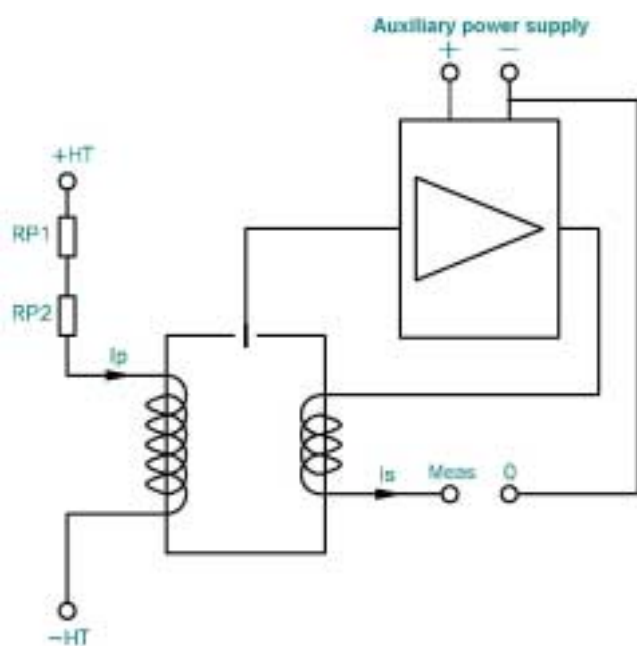
Application: This sensor measures the **voltage level** delivered by all the substations of electric railway equipment operating under 750VDC, 1500VDC or 3000VDC.

 The sensor is directly connected to the output of the substation rectifier bridge. It delivers a **secondary current proportional to the input voltage**: e.g. secondary 0/20mADC or 4/20mADC for primary 0/2000VDC.

 **Dielectric isolation** between the primary circuit terminals and the secondary circuit terminals can be **20KV 50HZ**.

 This sensor is used primarily to **guarantee galvanic isolation** between the substation output voltage and the distribution board device indicating the voltage level.


 This equipment requires an **auxiliary power supply** rated according to specifications: e.g. 0/+24VDC or 220V





TEST RELAY FOR POWER SUPPLY NETWORK VOLTAGE RANGE


Application: This relay monitors the line **voltage level** of a catenary power supply for **rolling stock** of electrical railway equipment such as:

- Electric railcars
- Electric locomotives
- Any other electric traction vehicle with catenary power supply.

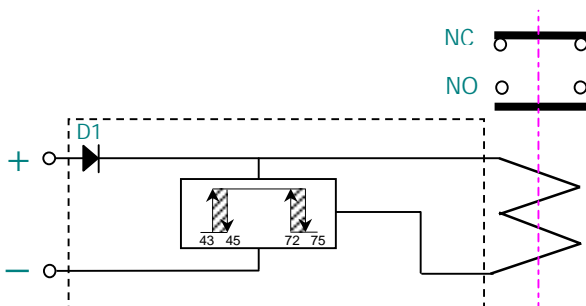
 The relay is powered by the 1500 VDC catenary voltage. It is **permanently energised** while the line voltage remains within the authorised voltage range.

 The relay **drops out** when the line voltage drops below the **authorised minimum or exceeds the authorised maximum**. It has a time-delay of a few milliseconds to **offset pantograph bounce**.

 **Dielectric isolation** between the coil circuit terminals and the contact terminals is **10KV 50HZ**.


 **The pick-up and drop-out values** vary according to specifications. They are adapted to the catenary power supply network. **Hysteresis between the pick-up values and drop-out values is very slight (< 5%)**.


 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 0.3A 90VDC L/R 20ms**.




PHASE SEQUENCE MONITORING RELAY

Application: All industrial and railway three-phase networks

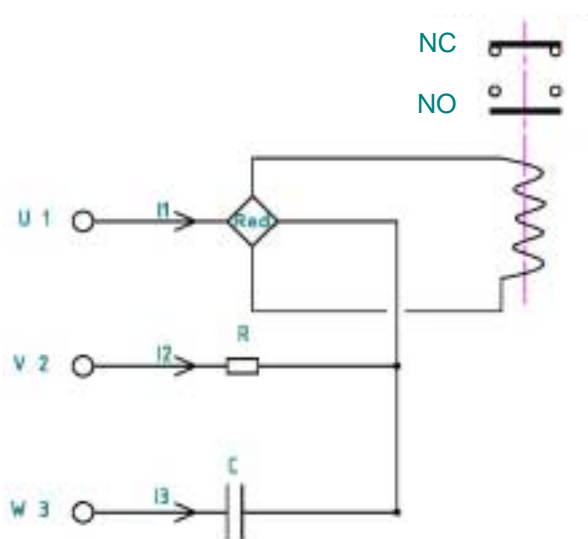
 The relay **picks up when the three phases are connected in the direct** rotation direction (clockwise) and **drops out when a phase is cut**. It cannot reset for inverted rotation of the phases even for a voltage 20% greater than the rated voltage.

 **Dielectric isolation** between the three-phase terminals and the contacts is **2.5KV 50HZ 1mn**.

 **The pick-up threshold voltage** of the relay depends on the voltage of three-phase network. It is less than the minimum value of the voltage.

 **The drop-out voltage threshold** is 15% less than the pick-up voltage.

 These relays are fitted with a **NO contact** and a **NC contact** with **breaking capacity of 2A 220V 50HZ**.



MOTOR ALTERNATOR PROTECTION SYSTEM

Application: This system provides **protection of the drive motor** of a motor alternator supplying power to the rolling stock of electric railway equipment such as:

- Subway trains
- Electric railcars

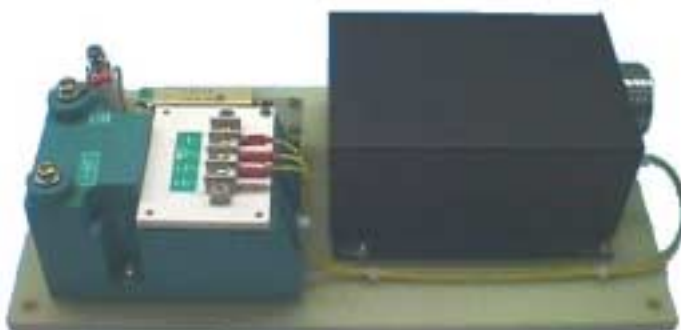
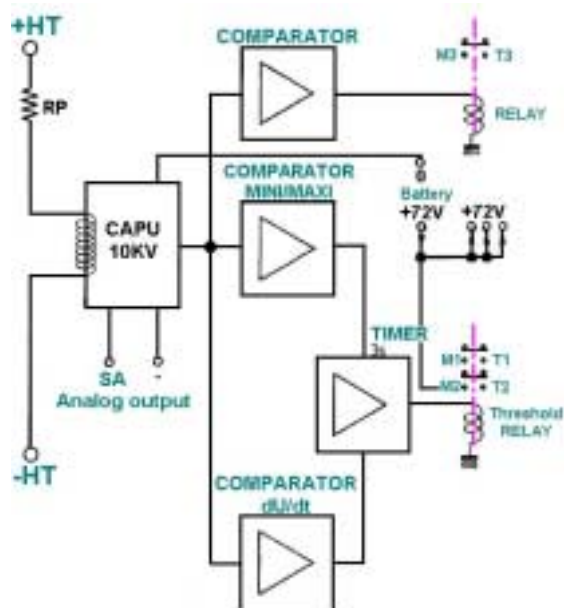
This system comprises a **Hall-effect sensor** measuring the power supply voltage of the unit motor (750VDC or 1500VDC) and a **signal processing card** providing the following functions:

- **Detection of the motor power supply low voltage** to provide a load shedding function by suppressing loads at the alternator output.
- **Detection of line voltage minimum and maximum values** to enable closure of the motor power supply contactor.
- **Detection of the line voltage dU/dT** to distinguish between a non-bridgeable interruption of line power and an in-line load demand in order to avoid current surge in the motor caused by additional power supply without a start-up cycle.

This system requires a **permanent auxiliary source** (72VDC for example).

Dielectric isolation between the HV input and LV outputs is **10KV 50Hz 1mn.**

The outputs are fitted with **NO and NC contacts** with breaking capacity of **0.3A 90VDC L/R 20ms.**



ALTERNATOR MONITORING SYSTEM


Application: This system **monitors the three-phase outputs of a motor alternator** supplying the auxiliary power to on-board railway equipment such as:

- Subway trains
- Electric railcars

 This system comprises **4 electronic circuits** providing the following functions:

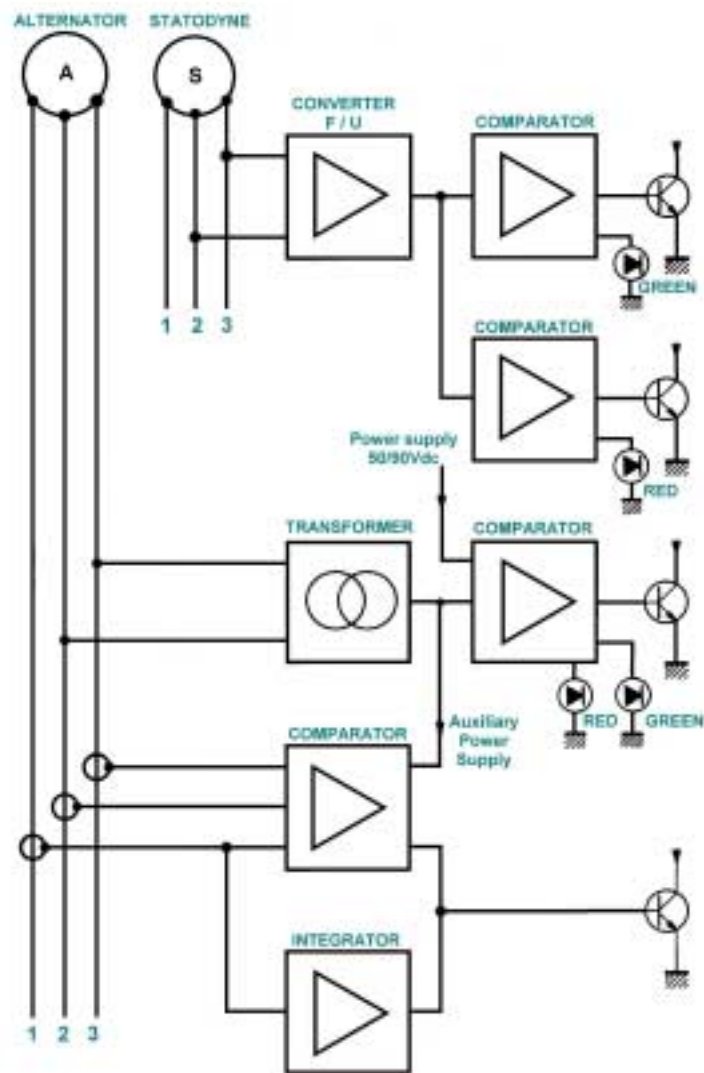
- **Detection of under-frequency and over-frequency** with a time delay to offset transient faults.
- **Detection of under-voltage and over-voltage** with a time delay to offset transient faults.
- **Detection of current unbalance between phases** with a time delay to offset transient faults.
- **Detection of over-current** with an inverse-time time delay to offset short over-current.

 This system requires a **permanent auxiliary source** connected directly to the three-phase output of the alternator.

 **Dielectric isolation** between the alternator three-phase output and the unit outputs is **2.5KV 50HZ 1mn.**

 The outputs are fitted with **NO and NC** contacts with a breaking capacity of **0.3A 90VDC L/R 20ms.**







ISOLATION FAULT DETECTION SYSTEM FOR THREE-PHASE NETWORK

Application: This system detects an isolation fault or loss of phase on the **three-phase auxiliary circuit** for electrical railway equipment such as:

- Subway trains
- Tramways
- Trolleybuses
- Electric railcars
- Electric locomotives

 The system comprises three relays and is **powered by the three phases of a three-phase inverter and an artificial neutral point** connected to the ground. In the event of an **ground fault or interrupt of one of the three phases**, one of the three relays is energised causing the general circuit of the three-phase network to open. This system has been developed for safety applications **preventing the re-injection of a 50Hz component** on the current return rail to avoid disturbing train network signalling.

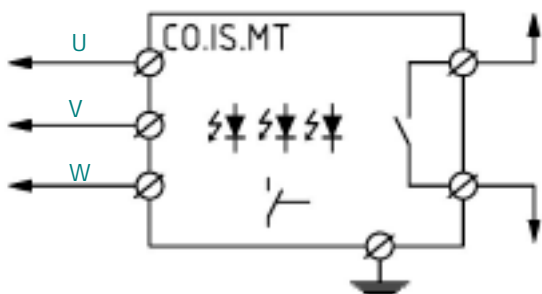
 **Dielectric isolation** between the terminals and the ground is **2.5KV 50HZ 1mn.**

 **The relays close** for a phase interrupt or isolation fault $\leq 1500\Omega$ in a voltage range of $\pm 10\%$ of the rated voltage.

 **The response time** is inversely proportional to the resistance value of the fault.

 **The rated primary voltage** varies from **200V to 400V 50HZ or 60HZ** depending on requirements.

 These relays are fitted with a **NO contact** and a **NC contact** with a **breaking capacity of 0.3A 90VDC L/R 20ms.**



Australian Distributor



Relay Monitoring Systems Pty Ltd
6 Anzed Court
Mulgrave, Victoria, 3170, Australia

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