# Section 10

Residual current relays, current transformers and toroids  
Technical data and selection guide

## Residual current relays (RCDs)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth leakage protection – Why?</td>
<td>10 - 2</td>
</tr>
<tr>
<td>Selecting a device that is right for your application</td>
<td>10 - 2 to 10 - 3</td>
</tr>
<tr>
<td>Specifier’s checklist – RCDs</td>
<td>10 - 4</td>
</tr>
<tr>
<td>Installation recommendations</td>
<td>10 - 5</td>
</tr>
<tr>
<td>How does the earth leakage relay function?</td>
<td>10 - 6</td>
</tr>
<tr>
<td>Holmgreen connection</td>
<td>10 - 7</td>
</tr>
<tr>
<td>RD setup instructions</td>
<td>10 - 8 to 10 - 9</td>
</tr>
<tr>
<td>RD relays - selection table</td>
<td>10 - 10</td>
</tr>
</tbody>
</table>

## Technical Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZS residual current relays and current transformers</td>
<td>10 - 11 to 10 - 13</td>
</tr>
<tr>
<td>RD2AO</td>
<td>10 - 14 to 10 - 15</td>
</tr>
<tr>
<td>RD3AF</td>
<td>10 - 16 to 10 - 17</td>
</tr>
<tr>
<td>RD1B</td>
<td>10 - 18 to 10 - 19</td>
</tr>
<tr>
<td>RD1DF</td>
<td>10 - 20 to 10 - 21</td>
</tr>
<tr>
<td>RD1EP</td>
<td>10 - 22 to 10 - 23</td>
</tr>
<tr>
<td>RD3E21 Delta</td>
<td>10 - 24 to 10 - 25</td>
</tr>
<tr>
<td>RD1G2</td>
<td>10 - 26 to 10 - 27</td>
</tr>
<tr>
<td>DSRM72 and DSR48TD mining relay</td>
<td>10 - 28 to 10 - 29</td>
</tr>
<tr>
<td>TD and DSR – ring current transformers</td>
<td>10 - 30 to 10 - 31</td>
</tr>
</tbody>
</table>
Earth leakage protection - Why?

The opportunity
Devices for providing protection against earth leakage faults appeared in the 1930s. Since that time, substantial developments have taken place.

Wiring regulations and practices demand good bonding to earth of all accessible conductive parts within an electrical installation. It could then be assumed that if a fault between the supply and earth developed, the resulting current flow would be of sufficient magnitude to trip the short circuit protection device (SCPD), clearing the fault. This principle works reliably where the supply is shorted directly to earth, but this is not always the case. Earth faults may develop where the resistance to current flow is sufficient to limit the fault current to a level that will not trip the SCPD.

An example of this is in the case of human electrocution where the human body inadvertently becomes connected between the supply and earth, due to the resistance of the human body the resultant fault current (earth leakage) flowing through the body is insufficient to trip the SCPD and interrupt the supply, but sufficient to cause fatal injuries.

This situation can also occur within electrical installations and equipment where the age and/or normal wear and tear or accumulation of dirt, dust or moisture around terminals causes a partial breakdown in insulation between supply and earth.

Once again, the resultant fault (earth leakage) current may not be of sufficient magnitude to trip the SCPD but could lead to significant damage to property and equipment or even fires.

The answer
To increase the safety of the user, the core balance residual current device has emerged as a means of detecting very small residual (earth leakage) currents. As a result, a high level of protection can now be offered while ensuring the principle of operation remains simple and reliable.

Residual current devices monitor the current flowing in the active and neutral supply conductors which, under normal conditions, should be balanced. The function of the device is to detect any imbalance (earth leakage) in the supply conductors. When the imbalance exceeds the preset value of the residual current device the “tripping process” initiates to trip the controlling switch or sends a signal to do so, resulting in the disconnection of the supply to the downstream circuit.

Selecting a device that is right for your application.
As per AS 3190 and AS/NZS 61008 and AS/NZS 61009 RCDs and relay can be classified as different types.

<table>
<thead>
<tr>
<th>RCD CLASSIFICATION</th>
<th>DESCRIPTION</th>
<th>AS3190</th>
<th>AS/NZS61008</th>
<th>AS/NZS61009</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERSONAL PROTECTION</td>
<td>RCDs and relays with $I_{\Delta n}$ not exceeding 10 mA.</td>
<td>I</td>
<td>TYPE 1</td>
<td>TYPE 1</td>
</tr>
<tr>
<td>PERSONAL PROTECTION</td>
<td>RCDs and relays with $I_{\Delta n}$ in excess of 10 mA but not exceeding 30 mA.</td>
<td>II</td>
<td>GENERAL</td>
<td>GENERAL</td>
</tr>
<tr>
<td>PROPERTY/EQUIPMENT PROTECTION</td>
<td>RCDs and relays with $I_{\Delta n}$ in excess 30 mA but not exceeding 300 mA without selectivity tripping time delay characteristics.</td>
<td>III</td>
<td>GENERAL</td>
<td>GENERAL</td>
</tr>
<tr>
<td>PROPERTY/EQUIPMENT PROTECTION</td>
<td>RCDs and relays with $I_{\Delta n}$ in excess of 30 mA but not exceeding 300 mA with selectivity tripping time delay characteristics.</td>
<td>IV</td>
<td>TYPE S</td>
<td>TYPE S</td>
</tr>
</tbody>
</table>

Due to the wide range of sophisticated adjustable earth leakage relays and circuit breaker RCBO or RCCB devices in the market place today there is sometimes confusion on their correct application. It is necessary therefore to define the correct use of earth leakage devices covering the areas of general industrial equipment protection, personnel protection and their use in applications, such as mining. See the following page covering these different applications.
Earth leakage relay and circuit breaker based RCD device applications

1. Equipment property protection

Terasaki Earth Leakage relays are suitable for earth fault protection of equipment and the limitation of touch voltages where automatic disconnection of supply is required. Typically this is achieved by shunt tripping another protective device such as an upstream circuit breaker. Earth leakage relays are used in particular where ground (earth) fault detection is required or the Fault Loop Impedance is of such a level that the over-current device (circuit breaker) does not achieve automatic disconnection within the times prescribed in the Wiring Rules.

2. Personnel protection

Earth leakage relays are NOT suitable for personnel protection against direct contact as specified in the Wiring Rules, e.g. for socket outlets and lighting circuits. For these applications an RCD (10 mA or 30 mA) must comply with the relevant standards (AS 3190, AS/NZS 61008 or AS/NZS 61009) and be approved by the relevant authorities. Earth leakage relays are not designed to meet the requirements of this approval. For personnel protection Safe-T and Din-T devices such as the ELR relay, SRCB, DSRCD, DSRCB, DSRCM, DSRCBS & DSRCBH are all suitable. These are approved devices and meet the relevant standards.

3. Mining protection

The DSRM72 earth leakage relay when used with test device DSR48TD are suitable for mining applications, as governed by AS 2081.3:2002 - Electrical Equipment for coal and shale mines, Part 3: ‘Earth Leakage protection for use on earth-fault current limited systems (IT systems).’ Other earth leakage relays may be used on mining applications but not specifically in coal or shale mines as they are not designed to comply with certain technical requirements of the above mining standard.

Other earth leakage devices that can be used coal and shale mines and other mines are the MCCB add-on blocks ELB125, ELB250, and ELB250AH. Circuit breaker based 10 mA and 30 mA RCD devices do not need to comply with AS 2081.3:2002 as this standard accepts devices that meet the personnel protection standards: AS 3190, AS/NZS 61008 or AS/NZS 61009. As such, the following Safe-T and Din-T devices are suitable: ELR relay, SRCB, DSRCD, DSRCB, DSRCM, DSRCBS and DSRCBH.
Specifier’s checklist

It is almost impossible to ascribe ideal parameters by which a system and or equipment must be chosen for different applications since these must be set on a case by case basis. It is unwise to even generalise. However, there are some key parameters which must be considered.

Current ratings
Equipment to be protected may have a load current from 1 amp up to 2000 amps.

Residual current sensitivity
This could range from 30 mA to 30 amps depending on the application whether it be personnel, property or equipment protection.

Numbers of phases to be protected
One to three phases with or without neutral can be protected depending on the system requirements.

Overcurrent and short circuit protection
Protection could be provided to individual sub-circuits by using a combined MCB/RCD from NHP’s Din-Safe or Safe-T range of products. Or the earth leakage relay can be backed up by one of NHP’s extensive range of circuit breakers or a fuse from the NHP Compact fuse range.

Speed of operation
Standards are set for the maximum tripping times as per the table below based on Australian Standards AS 3190, AS/NZS 61008.

- Settings chosen will be in accordance with system requirements.

<table>
<thead>
<tr>
<th>RCD type</th>
<th>I - TYPE 1</th>
<th>II - GENERAL</th>
<th>III - GENERAL</th>
<th>IV - TYPE S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity/n</td>
<td>≤ 10 mA</td>
<td>&gt; 10, ≤ 30 mA</td>
<td>&gt;30, ≤ 300 mA</td>
<td>&gt;30, ≤ 300 mA</td>
</tr>
<tr>
<td>Test current</td>
<td>100 % 1Δn + 3 -0 %</td>
<td>200 % 1Δn ± 5 %</td>
<td>500 % 1Δn ± 5 %</td>
<td>300</td>
</tr>
<tr>
<td>RCD</td>
<td>40 ms</td>
<td>300</td>
<td>300</td>
<td>130</td>
</tr>
<tr>
<td>Relay</td>
<td>40 ms</td>
<td>250</td>
<td>250</td>
<td>60</td>
</tr>
<tr>
<td>RCD</td>
<td>40 ms</td>
<td>150</td>
<td>150</td>
<td>50</td>
</tr>
<tr>
<td>Relay</td>
<td>40 ms</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Domestic
Domestic premises have a wide variety of circuits to consider, these include lights, power points, stove, hot water systems and out buildings. Power points being of prime importance as all portable and fixed domestic appliances are generally fed from a GPO and therefore pose the greatest risk of electrocution. In this application, the ideal installation should be as follows: Fed directly from main switch, stove and out buildings. A minimum of two safety switches, 2 pole (40 A) 30 mA is used to protect lighting and power circuits. These safety switches are used for protection of personnel. Alternatively each power circuit in the installation can be protected by a residual current circuit breaker Din-Safe MCB. These devices combine the function of a ‘short’ circuit protective device with an earth leakage device. If required, a 2 pole 80 amp 100/300 mA safety switch could be used as a main switch in conjunction with the above individual circuit protection to provide protection against fire and equipment damage to the entire installation. However, it should be noted, an earth fault on a single protected circuit may still result in power interruption to the entire installation (no discrimination). If discrimination is required, a type S (selective) safety switch could be used as a main switch.

Note: Residual current devices for use in domestic applications for the purpose of personal protection as per AS/NZS 3000 are required to be an approved device complying to AS 3190, AS/NZS 61008.1 or AS/NZS 61009.1 (Din-Safety switches, Din-Safe MCB), for more information on these please refer NHP Price list catalogue CPB section 1 and other NHP earth leakage catalogues.

Commercial
Commercial applications in general utilise the residual current circuit breaker Din-Safe MCB giving 30 mA, providing protection to every circuit individually if desired. To offer added protection against fire and property damage a main switch could consist of either a Din-Safety Switch with a protective threshold 100-300 mA or an earth leakage relay with a 100-300 mA protective threshold, connected to a main circuit breaker via a shunt trip.

Note: Residual current devices, Din-Safe MCBs and Din-Safety Switches for use in commercial applications can be found in the NHP Price list catalogue CPB section 1 and NHP earth leakage catalogues.
Specifier’s checklist (cont’d)

Industrial
The industrial area is where the earth leakage relay provides the ultimate solution. The relay combined with the toroid capable of monitoring the supply conductors can be separately mounted within the confines of the switchboard. The residual current threshold and tripping delay is generally adjustable thus allowing an earth protection cascade system to be utilised. Earth leakage relays have other features such as test and reset, alarm settings and continuous digital indication for the residual current value which are more suitable to industrial applications. Each earth leakage relay must be used in conjunction with a circuit breaker of appropriate size and rating. Toroids are also available in different sizes to allow system current ratings up to 2000 amps. Residual currents and tripping times are normally adjustable between 30 mA and 30 amps and 0 and 5 seconds.

Mining
The mining sector has very stringent regulations (AS/NZS 2081.3:2002) on earth leakage protection due to the harsh and dangerous environments that exist. To meet these stringent standards a separate relay (DSRM72) and test device (DSR48TD) is required. An important feature of the mining relay is that they use a latching mechanism that doesn’t rely on supply voltage. The relay, test device combined with the toroid capable of monitoring the supply conductors can all be separately mounted within the confines of the switchboard. Each earth leakage relay must be used in conjunction with a circuit breaker of appropriate size and rating. Toroids are also available in different sizes to allow system current ratings up to 1800 amps. Residual currents and tripping times are adjustable between 30 mA and 500 mA and 0.05 and 0.5 seconds.

Voltage rating and frequency
Depending on the system, single phase 24, 110, 240 volt or three phase 415 volts/50 Hz or 60 Hz or 24-150 V DC.

Mounting
Generally earth leakage relays are only available in panel mounting types but NHP’s range of earth leakage relays offer the choice between surface mount, DIN rail mount and panel mounting types. Panel mounting types are available in 48 x 48 mm, 72 x 72 mm and 96 x 96 mm.

Accessories
Accessories such as the shunt trip, under voltage trip, auxiliary switch and alarm switch that may be required must be considered. Generally, only MCB’s, MCB’s and safety switches can have a combination of these accessories added. Relays do not have these facilities available. In all, NHP has the solution for personnel, property and equipment protection in all areas - domestic, commercial and industrial. Together with technical back-up and stock locations in every state, NHP is ready to provide your earth leakage solution.

Installation recommendations
Installation recommendations to maintain accuracy:

A) Preferably the connection should be made with shielded cable; this is very important when high-sensitivity residual current relays (\( I_{\Delta n} \leq 0.1 \) A) are used. In case a shielded cable cannot be used, use twisted pair conductors to connect the current transformer to the residual current relay.

B) Attention must be paid to the distance between the ring transformer and residual current relay so it is as short as possible, the maximum distance allowed between relay and toroid is five (5) meters.

C) Ensure maximum segregation from power conductors or other devices that may induce noise on the system. Do not mount the toroid near equipment that produces magnetic fields (contactor coils, transformers and large cables) as it may interfere with the toroid.

D) Select the smallest internal diameter current transformer that will allow the cable to fit. If using a large toroid try to keep the cable as close to the centre of the toroid as possible.

E) Only use approved toroid’s recommended by the supplier otherwise nuisance tripping may occur or even worse equipment failure.

F) It is recommended not to bring cable back past the toroid within one diameter of the toroid.

G) The system will operate more accurately if a single set of cables are used rather than running several in parallel.
How does earth leakage relay function?

The earth leakage relay consists of two distinct components; a ring current transformer (toroid) and an amplifier relay. The TD ring current transformer is equipped with a single galvanically-insulated measurement winding. The active line conductors cross through the ring transformer, generating a magnetic field proportional to its current. In a normal situation the vector sum of the currents (and relevant magnetic fluxes) is zero, even with unbalanced 3 phase loads.

A leakage current ($I_{\Delta n}$) towards earth on one or more conductors downstream from the ring current transformer causes an imbalance in the vector sum proportional to the leakage current. The imbalance is detected by the measurement winding and sent to the amplifier relay. The amplifier relay receives the signal from the ring current transformer and compares it with the preset threshold value; the relay output is turned ON in the case where the detected value is higher than the preset threshold and lasts for a longer time than the preset tripping time value. The output remains in the ON state until the relay is reset, either manually or electrically.

**Test**

The earth leakage relay is equipped with a test circuit (TEST) to check the operation of earth leakage relays and ring current transformers, giving a full guarantee against connection errors and allowing the diagnosis of possible faults. Manual test: Pressing the test button injects a test current into the sensing circuit of the relay that excites the output relay, thereby checking the correct function of the relay.

**Selectivity**

In complex and articulated plants, the installation of only one earth leakage relay at the point of distribution is not advisable as a fault on one circuit interrupts the power to the whole installation. The use of only one earth leakage relay on a wide network could cause tripping due to the sum of all the leakage currents always present in a plant. To prevent this problem it is necessary to create vertical selectivity. Mounting an earth leakage relay on each distribution line that, appropriately calibrated, (that is with an intervention threshold and time delay lower than the next highest) allows the plant to be divided into zones and guarantees that the earth leakage relay placed downstream intervenes before those placed upstream.
Residual current relays  
Holmgreen connection system

Application
In specific applications where the dimensions of supply cables or busbar configurations for the system to be protected, do not allow the use of a single ring current transformer, it is possible to use multiple current transformers (specially selected CTs with homogeneous errors) one per phase, connected with a special summation transformer TDSSDxx, using the Holmgreen connection system. This system can be used on 3 and 4 wire supply systems.

Ring current transformer – selection
TDSSDxx: Special summation ring current transformer. When selecting this item, the CT ratio of the individual CTs (TA) must be specified.

TA: Measuring CTs specially selected and matched with homogeneous errors, class 0.5 or 1. Busbar window size suitable for application must be specified. (Refer catalogue Part B section 9)

Residual current relay – selection
RD: Standard RD relays can be used with measuring CTs (TA) having ratios not higher than 400/5 A or 80/1 A.
RD (S): In applications where the measuring CTs (TA) have a higher ratio than 400/5 A or 80/1 A, a special 10 x IΔn RD relay will be required where the residual current settings will be multiplied by 10. These relays will have an additional inscription on the front face “x 10 IΔn”

Ordering information
The Holmgreen connection system is available by special order on an indent only basis. Refer NHP for assistance when specifying.

E.g. 1. 250 A incoming supply to distribution board requiring 500 mA earth leakage protection, cable used is 4 x 120 mm² single core PVC insulated cable
TA (CT) = 4 x TA1200 250/5A class 0.5)
Summation transformer = TDSSD250 ratio 250/5 A ()
Relay = RD3AF14

E.g. 2. 1600 A main switchboard feeder busbars comprising 2 x solid copper bars 80 x 6.3 mm per phase and neutral with a ground fault specified at 80 A.
TA (CT) = TAS80 1600/5S class 0.5 )
Summation transformer = TDSSD1600 ratio 1600/5 A )
Relay = RD3AF145 (x10 IΔn)

Note: ) Non-standard components available on indent only.
**RD SETUP INSTRUCTIONS**

**Current set point:**
The current set point \((I\Delta n)\) is set by adjusting the 7 position potentiometer and the 2 dip switches to give a range from 30 mA to 30 A. The 7 position potentiometer can be set at 0.03, 0.05, 0.075, 0.1, 0.15, 0.2 and 0.3. The 2 dip switches add a multiplication factor of X1, X10 or X100.

**Time delay:**
The time delay is set by adjusting the 7 position potentiometer to give a range from 0 to 5 seconds. The 7 position potentiometer can be set at 0, 0.15, 0.25, 0.5, 1.0, 2.5 and 5 seconds.

**Signalling:**
A green LED indicates the power is on.
A red LED indicates that the relay has tripped.
On certain models there are yellow LED's that indicate the percentage earth leakage current in regards to the current set point \((I\Delta n)\).

**Manual reset setting:**
**Manual reset:** Requires manually pressing the reset button on the front face of the relay to reset the output relay. On some models this can be done remotely by pressing a push button closing terminals 4 and 6.

**Automatic reset setting:**
**Automatic reset:** Will automatically try to reset the relay 3 times, once every 60 seconds. In this setting the relay can also be reset as per the manual setting.

**Manual test:**
**Manual test:** The relay can be manual tested by pressing the test button on the front face of the relay. On some models this can be done remotely by pressing a push button closing terminals 1 and 3. The remote test function doesn’t work on DC aux. supply models.

**Selectable pre-trip alarm/ trip contact:**
On certain relay models a second set of contacts can be selected to act as either a pre trip alarm or a second set of trip contacts.
Failsafe setting - Positive security (Ne):
The output relay is normally in the energised state and de-energises in the case of an earth leakage current exceeding the preset threshold (In). The normally energised relay will also de-energise in the case where the protection features are disabled, i.e. the auxiliary power supply is removed or the connection between the relay and ring current transformer is broken.

Non-Failsafe setting - Negative security (Nd):
The output relay is normally in the de-energised state and energises in the case of an earth leakage current exceeding the preset threshold (In).

Positive / negative field selectable:
The relay is factory supplied in the negative security mode and can be simply changed to positive security by switching a dip switch on the front of the unit.

Integral test (2 wires):
**Manual test:** Pressing the test button injects a test current into the sensing circuit of the relay that excites the output relay, thereby checking the correct function of the relay.

**Continuous automatic test:** A small signal is continuously injected on the measurement winding. In the case of a faulty connection between ring current transformer and the relay the output relay is excited, thereby continuously monitoring the status of the connection between the ring current transformer and the relay. The test winding is redundant in this system.

Integral test (4 wires):
**Manual test:** Pressing the test button injects a test current into the test winding. A corresponding current flows in the measurement winding that excites the output relay.

**Continuous automatic test:** A small signal is continuously injected on the test winding and the corresponding signal sensed by the measurement winding is continuously monitored. In case of a faulty connection between ring current transformer and the relay, the output relay is excited.
Residual current relays type RD, DSR, TZS and Earth leakage toroids selection guide

Residual current relays

<table>
<thead>
<tr>
<th>Cat. No.</th>
<th>Voltage</th>
<th>Harmonic filter</th>
<th>Auto Reset option</th>
<th>% LED indication of IΔn</th>
<th>Setting range (A)</th>
<th>Time delay range</th>
<th>Positive/ negative security</th>
<th>Power fail</th>
<th>selecteable pre-trip alarm or extra aux. contact</th>
<th>Remote reset/ test</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD2AO</td>
<td>240 V AC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0.03/0.3</td>
<td>0/0.1 s</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>RD3AFL</td>
<td>110 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD3AF14</td>
<td>240 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD3AF15</td>
<td>415 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD3AF1N</td>
<td>24 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD3AF1H</td>
<td>24-150 V DC</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>DIN Mount-4 module (2 sets change over contacts SPDT)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>RD1B212</td>
<td>110 V AC</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD1B214</td>
<td>240 V AC</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD1B215</td>
<td>415 V AC</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD1B21H</td>
<td>24-150 V DC</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Panel Mount-48 mm (1 set change over contacts SPDT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RD1DF12</td>
<td>110 V AC</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>RD1DF14</td>
<td>240 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>RD1DF15</td>
<td>415 V AC</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Panel Mount-48 mm (1 set change over contacts SPDT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>RD1EP212</td>
<td>110 V AC</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD1EP214</td>
<td>240 V AC</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
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<tr>
<td>RD1EP215</td>
<td>415 V AC</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/Yes</td>
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<tr>
<td>RD1EP21H</td>
<td>24-150 V DC</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>1 C/O</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Panel Mount-72 mm (2 sets change over contacts SDPT)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>RD3E21B</td>
<td>110 V AC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>No</td>
<td>1 N/O</td>
<td>No</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD3E217B</td>
<td>240 V AC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
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<td>1 N/O</td>
<td>No</td>
<td>Yes/Yes</td>
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<tr>
<td>RD3E218B</td>
<td>415 V AC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>No</td>
<td>1 N/O</td>
<td>No</td>
<td>Yes/Yes</td>
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<tr>
<td>RD3E21HB</td>
<td>24-150 V DC</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>No</td>
<td>1 N/O</td>
<td>No</td>
<td>Yes/No</td>
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<tr>
<td>Panel Mount-96 mm (1 set change over contacts &amp; pre-trip alarm 1 set change over contacts SPDT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>RD1G212</td>
<td>110 V AC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>RD1G214</td>
<td>240 V AC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes/Yes</td>
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<tr>
<td>RD1G215</td>
<td>20-60 V DC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0.03 to 30</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>Panel Mount-96 mm (1 set change over contacts SPDT)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RD1G217</td>
<td>110 V AC</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0.4 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>RD1G218</td>
<td>240 V AC</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0.4 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>RD1G219</td>
<td>20-60 V DC</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>0.03 to 30</td>
<td>0.4 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Mining Relay-Panel Mount 72 mm &amp; 48 mm (1 set change over contacts SPDT)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DSRM72111</td>
<td>110 V AC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0.03/0.5</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>DSR460T110</td>
<td>110 V AC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.03/0.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>DSRM72240</td>
<td>240 V AC</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>0.03/0.5</td>
<td>0 - 5 s</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes/Yes</td>
</tr>
<tr>
<td>DSR460T240</td>
<td>240 V AC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.03/0.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Surface mount Relay (1 Set change over contacts SPDT)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T25AD120240</td>
<td>120/240</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>0.03/1.0</td>
<td>0.2 - 2 s</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>T25AD415440</td>
<td>415/440</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>0.03/1.0</td>
<td>0.2 - 2 s</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Earth leakage toroids

<table>
<thead>
<tr>
<th>1Δn minimum</th>
<th>1Δn maximum</th>
<th>Diameter</th>
<th>RD Relay Toroid Cat. No.</th>
<th>Mining Relay Toroid Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 mA</td>
<td>49</td>
<td>15 mm</td>
<td>TDS82</td>
<td>DSR130DEL</td>
</tr>
<tr>
<td>30 mA</td>
<td>115</td>
<td>24 mm</td>
<td>TDS110</td>
<td>TDS140DEL</td>
</tr>
<tr>
<td>30 mA</td>
<td>257</td>
<td>40 mm</td>
<td>TDS210</td>
<td>TDS240EL</td>
</tr>
<tr>
<td>30 mA</td>
<td>556</td>
<td>68 mm</td>
<td>TDS310</td>
<td>TDS360EL</td>
</tr>
<tr>
<td>30 mA</td>
<td>990</td>
<td>100 mm</td>
<td>TDS410</td>
<td>TDS410EL</td>
</tr>
</tbody>
</table>

Note: 1) DSRM72 mining relay requires a 4 wire Toroid.
Residual current relays
TZS residual current relays

Features
- Adjustable sensitivity and current
- Rugged construction for arduous environments
- Immune to false tripping via harmonics
- High vibration withstand
- Output C/O contact
- Indication – LED
- Reset function – electrical
- Designed and manufactured with “state-of-the-art” technology
- Surface mounting

Ordering details

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Adjustable sensitivity</th>
<th>Adjustable time range</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>120/240 AC</td>
<td>30 mA-1 amp ¹)</td>
<td>0.3-2 sec.</td>
<td>TZSAD120/240</td>
</tr>
<tr>
<td>415/440 AC</td>
<td>30 mA-1 amp ¹)</td>
<td>0.3-2 sec.</td>
<td>TZSAD415/440</td>
</tr>
<tr>
<td>Flush mounting (collar only)</td>
<td></td>
<td></td>
<td>TPDOSZ FLUSH COLLAR</td>
</tr>
</tbody>
</table>

Tripping times

<table>
<thead>
<tr>
<th>Rated operating time (sec)</th>
<th>Operating time range (sec)</th>
<th>Non-operating time range (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3</td>
<td>0.2 - 0.36</td>
<td>0.15</td>
</tr>
<tr>
<td>0.5</td>
<td>0.4 - 0.6</td>
<td>0.38</td>
</tr>
<tr>
<td>1</td>
<td>0.8 - 1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>2</td>
<td>1.3 - 2</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Surface mount

- Dimensions (mm) W/H/D: 60/70/100
- Weight (kg) (relay only): 0.22

Standard features
- Earth leakage detection solid state current operated type
  - Internally mounted contact: 1 C/O
  - Earth leakage indication: LED
  - Reset function (electrical): Standard
  - Test button: Standard
  - Remote reset (power source): 1 VA

Toroidal current transformers (ZCT)

<table>
<thead>
<tr>
<th>Diam. (mm)</th>
<th>Max. wire size (mm²)</th>
<th>Current rating (4 wire) (A)</th>
<th>Cat. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>5.5</td>
<td>49</td>
<td>TZS-15</td>
</tr>
<tr>
<td>24</td>
<td>22</td>
<td>115</td>
<td>TZS-24</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
<td>257</td>
<td>TZS-40</td>
</tr>
<tr>
<td>68</td>
<td>250</td>
<td>556</td>
<td>TZS-68</td>
</tr>
<tr>
<td>100</td>
<td>600</td>
<td>990</td>
<td>TZS-100</td>
</tr>
</tbody>
</table>

Note: ¹) Tripping time is fixed (below 40 ms) when current is set at 30 mA.
Residual current relays
TZS residual current relays (cont’d)

Outline dimensions
Earth leakage relay
Surface mount type

Drilling plan

Flush mount type

Toroidal current transformers (ZCT)

Connection diagram
Earth leakage relay

TZS-AD
ZCT wire length
30 mA: less than 3 m, 100, 300 mA: less than 5 m, 500, 1000 mA: less than 10 m

Note: The output contacts are held in until the reset button is pressed. Loss of control power resets the contacts automatically.

Terminal screw tightening torque: 0.45 - 0.73 Nm (4.6 - 7.4 kgf.cm)

<table>
<thead>
<tr>
<th>(ZCT)</th>
<th>Type</th>
<th>od</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>TZS-15</td>
<td>I</td>
<td>15</td>
<td>–</td>
<td>55</td>
<td>60</td>
<td>32</td>
<td>28</td>
<td>–</td>
<td>25</td>
<td>46</td>
</tr>
<tr>
<td>TZS-24</td>
<td>I</td>
<td>24</td>
<td>–</td>
<td>67</td>
<td>72</td>
<td>40</td>
<td>32</td>
<td>–</td>
<td>34</td>
<td>58</td>
</tr>
<tr>
<td>TZS-40</td>
<td>II</td>
<td>40</td>
<td>30</td>
<td>71</td>
<td>113</td>
<td>51</td>
<td>62</td>
<td>57</td>
<td>110</td>
<td>130</td>
</tr>
<tr>
<td>TZS-68</td>
<td>II</td>
<td>68</td>
<td>42</td>
<td>85</td>
<td>141</td>
<td>65</td>
<td>76</td>
<td>70</td>
<td>134</td>
<td>150</td>
</tr>
<tr>
<td>TZS-100</td>
<td>II</td>
<td>100</td>
<td>45</td>
<td>105</td>
<td>181</td>
<td>85</td>
<td>96</td>
<td>90</td>
<td>150</td>
<td>170</td>
</tr>
</tbody>
</table>

All dimensions in mm
Residual current relays
TZS residual current relays (cont’d)

Earth leakage trip characteristic
Residual current relays
RD2AO

- Adjustable IΔn 30 mA or 300 mA
- Adjustable trip time instantaneous or 100 ms
- 2 wire current transformer connection, automatic permanent test
- Standard IEC 60755

**Input**
- **Connection:** low voltage lines, with series TDG current transformer
- **Waveform IΔn:** sinusoidal, pulsating, chopped pulsating, pulsating + DC 6 mA (type A)
- **Rated frequency (fn):** 50 Hz
- **Working frequency:** 47…63 Hz

**Set up**
- **Current set point IΔn:** selectable by 2 position DIP-switch
- **Ranges IΔn:** 30 or 300 mA
- **Other ranges on request**
- **Non-operating residual current:** 0,5 IΔn
- **Intervention time t:** selectable by 2 position DIP-switch
- **Adjustable range t:** 0 or 100 ms
- **Instantaneous intervention:** <40 ms (@ 5 IΔn)
- **Maximum break time:** 1,5 t (@ 2 IΔn)

**Signalling**
- **POWER ON:** Green LED “ON”
- **Trip status:** red LED “TRIP” and relay switching “TRIP”

**Control**
- **Manual test:** verifies the state of the relay
- **Automatic continuous test:** verifies the integrity of the connection between relay and ring core

**Trip function**
- **TRIP state:** red LED “TRIP” and relay self-retention
- **Reset:** manual, by front pushbutton
- **Reset value:** < 50 % IΔn
- **Reset inhibited with persistent residual current flow of >50 % IΔn**

**Output**
- **Trip relay:** 1 SPDT contact
- **Contact rating:** 5 A 250 V AC cos ϕ 1, 3 A 250 V AC cos ϕ 0.4, 5 A 30 V DC
- **Negative security:** (normally de-energised relay)

**Auxiliary supply**
- **Rated voltage:** (Uaux) 240
- **Tolerance:** 204…264 V (Uaux 240 V)
- **Rated frequency:** 50 Hz
- **Tolerance:** 47…63 Hz
- **Rated burden:** ≤ 2.5 V A
- **Immunity to short interruption of supply voltage up to 300 ms**

**Voltage and insulation tests**
- **Insulation voltage rating:** 450 V
- **AC Test voltage:** 2.5 kV 50 Hz/1 minute
- **Considered circuits:** input, output, auxiliary supply
- **AC Test voltage:** 4 kV RMS, 50 Hz/1 minute
- **Considered circuits:** all circuits and earth
- **Impulse test voltage:** 5 kV standardised impulse 1.2/5 μs 0.5 J
- **Considered circuits:** input, output, supply
Residual current relays
RD2A0 (cont’d)

Environmental conditions
Nominal temperature range: -5…50 °C
Limit temperature range: -10…55 °C
Limit temperature range for storage: -40…70 °C
Relative humidity: 50 % (highest value at 40 °C)
Option: tropicalisation for saline-humid-heat ambient
Max power dissipation: ≤ 2 W
(for switchboard thermal calculation)

Housing
Dimensions: 2 module DIN
Connections: screw terminals for cable up to 4 mm²
Mounting: rail 35 mm
Front frame: sealable to avoid improper opening
Housing material: self-extinguishing makrolon
Protection degree: IP 40 front frame, IP 20 terminal
Weight: 200 grams

Wiring diagram

Dimensions (mm)
Residual current relays RD3AF

- Adjustable IΔn up to 30 amps
- Adjustable trip time up to 5 seconds
- Instantaneous display as percentage of IΔn
- Field-selectable negative or positive security
- Automatic permanent test
- 2 wire current transformer connection
- Filter for harmonics
- Standard IEC 60755, AS60947-2 (ANNEX B and M)

**Input**
Connection: low-voltage lines, with series TDG current transformer
Waveform IΔn: sinusoidal, pulsating, chopped pulsating, pulsating + 6 mA DC (type A)
Rated frequency (fn): 50 Hz
Working frequency: 47…63 Hz

**Set up**
Current set point IΔn: selectable by 7-position potentiometer, 3 ranges x 1, x 10, x 100
Ranges IΔn: see table below
Non-operating residual current: 0.5 IΔn
Intervention time t: selectable by 7-position potentiometer
Adjustable range t: 0, 0.15, 0.25, 0.5, 1, 2.5, 5 sec
Maximum break time: See table below.

**Signalling**
POWER ON: Green LED “ON” and relay switching “power fail”
Residual current indication: 3 LEDs indicating 20 - 40 - 60 % of set IΔn value
Trip status: red LED “TRIP” and relay switching “TRIP”
Ring current transformer-relay connection failure: Red LED “Trip” blinking and relay switching.

**Control**
Manual test: verifies the state of the relay
Automatic continuous test: verifies the continuity and safe operation of the relay, current transformer and connections

**IΔn Range Selector**

<table>
<thead>
<tr>
<th>IΔn (A)</th>
<th>0.03</th>
<th>0.05</th>
<th>0.075</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch</td>
<td>x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1.5 A</td>
<td>2 A</td>
<td>3 A</td>
</tr>
<tr>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7.5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

**Maximum break time**

<table>
<thead>
<tr>
<th>Set point (IΔn)</th>
<th>0.03 A</th>
<th>0.05...30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay t(s)</td>
<td>0 s</td>
<td>0.15 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2IΔn</td>
<td>0.15 s</td>
<td>0.25 s</td>
</tr>
<tr>
<td>Max. delay @ 5IΔn</td>
<td>0.03 s</td>
<td>0.24 s</td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).
Residual current relays
RD3AF (cont’d)

Voltage and insulation tests (IEC 60947 - 1)
Insulation voltage rating: 450 V
AC Test voltage: 2 kV RMS 50 Hz/1 minute
Considered circuits: input, relay “TRIP” auxiliary supply
AC Test voltage: 4 kV RMS 50 Hz/1 minute
Considered circuits: all circuits and earth
Impulse Test voltage: 5 kV standardised impulse 1.2/50 µs 0.5 J
Considered circuits: input, relay “TRIP”, auxiliary supply

Electromagnetic compatibility (EMC) (IEC 60947 - 2)
Emission tests according to EN 50081-1, EN 55011 immunity tests according to EN 50082-2

Environmental conditions
Nominal temperature range: -5…50 °C
Limit temperature range: -10…55 °C
Limit temperature range for storage: -40…70 °C
Relative humidity: 50 % (highest value at 40 °C)
Option: tropicalisation for saline-humid-heat ambient
Max power dissipation: ≤ 2 W
(for switchboard thermal calculation)

Housing
Dimensions: 2 module DIN
Connections: screw terminals for cable up to 4 mm²
Mounting: rail 35 mm
Front frame: sealable to avoid improper opening
Housing material: self-extinguishing makrolon
Protection degree : IP 50 front frame, IP 20 terminals
Weight: 200 grams

Wiring diagram

Dimensions (mm)
Residual current relays
RD1B

- Adjustable $I\Delta n$ up to 30 amps
- Adjustable trip time up to 5 seconds
- Instantaneous display as percentage of $I\Delta n$
- Field-selectable negative or positive security
- Automatic permanent test
- 2 wire current transformer connection
- Filter for harmonics
- Selectable pre trip alarm or second trip contact
- Standard IEC 60755, AS60947-2 (ANNEX B and M)

Input
Connection: low-voltage lines, with series TDG current transformer
Waveform $I\Delta n$: sinusoidal, pulsating, chopped pulsating, pulsating + 6 mA DC (type A)
Rated frequency (fn): 50 Hz
Working frequency: 47…63 Hz

Set up
Current set point $I\Delta n$: selectable by 7-position potentiometer, 3 ranges x 1, x 10, x 100
Ranges $I\Delta n$: see table below
Non-operating residual current: 0.5 $I\Delta n$
Intervention time $t$: selectable by 7-position potentiometer
Adjustable range $t$: 0, 0.15, 0.25, 0.5, 1, 2.5, 5 sec
Maximum break time: See table below.

Signalling
POWER ON: Green LED “ON” and relay switching “power fail”
Residual current indication: 4 LEDs indicating 20 - 30 - 40 - 50 % of set $I\Delta n$ value
Trip status: red LED “TRIP” and relay switching “TRIP”
Ring current transformer-relay connection failure: Red LED “Trip” blinking and relay switching.
Pre alarm: 50 % $I\Delta n$ relay switching.

Control
Manual test: verifies the state of the relay
Automatic continuous test: verifies the continuity and safe operation of the relay, current transformer and connections

$I\Delta n$ Range Selector

<table>
<thead>
<tr>
<th>$I\Delta n$ (A)</th>
<th>0.03</th>
<th>0.05</th>
<th>0.075</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
<td>300 mA</td>
</tr>
<tr>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1.5 A</td>
<td>2 A</td>
<td>3 A</td>
</tr>
<tr>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7.5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

Maximum break time

<table>
<thead>
<tr>
<th>Set point ($I\Delta n$)</th>
<th>0.03 A</th>
<th>0.05…30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay (s)</td>
<td>0 s</td>
<td>0.15 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2$I\Delta n$</td>
<td>0.15 s</td>
<td>0.25 s</td>
</tr>
<tr>
<td>Max. delay @ 5$I\Delta n$</td>
<td>0.03 s</td>
<td>0.24 s</td>
</tr>
<tr>
<td></td>
<td>0.35 s</td>
<td>0.63 s</td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).
Residual current relays
RD1B (cont’d)

Voltage and insulation tests (IEC 60947 - 1)
Insulation voltage rating: 450 V
AC Test voltage: 2.5 kV RMS 50 Hz/1 minute
Considered circuits: input, relay “TRIP” auxiliary supply
AC Test voltage: 4 kV RMS 50 Hz/1 minute
Considered circuits: all circuits and earth
Impulse Test voltage: 5 kV standardised impulse 1.2/50 µs 0.5 J
Considered circuits: input, relay “TRIP”, auxiliary supply

Electromagnetic compatibility (IEC 60947 - 2)
Emission tests according to EN 50081-1, EN 55011 immunity
tests according to EN 50082-2

Environmental conditions
Nominal temperature range: -5...50 °C
Limit temperature range: -10...55 °C
Limit temperature range for storage: -40...70 °C
Relative humidity: 50 % (highest value at 40 °C)
Option: tropicalisation for saline-humid-heat ambient
Max power dissipation: ≤ 2.0 W
(for switchboard thermal calculation)

Housing
Dimensions: 4 module DIN
Connections: screw terminals for cable up to 4 mm²
Mounting: rail 35 mm
Housing material: self-extinguishing makrolon
Protection degree: IP 40 front frame, IP 20 terminals
Weight: 280 grams

Wiring diagram

Dimensions (mm)
Residual current relays
RD1DF

- Adjustable IΔn 30 amps
- Adjustable trip time up to 5 seconds
- Field-selectable negative or positive security
- Automatic permanent test
- 2 wire current transformer connection
- Filter for harmonics
- Standard IEC 60755, AS 60947-2 (ANNEX B and M)

**Input**
Connection: low-voltage lines, with series TDG current transformer
Waveform IΔn: sinusoidal, pulsating, chopped pulsating, pulsating + 6 mA DC (type A)
Rated frequency (fn): 50 Hz
Working frequency: 47…63 Hz

**Set up**
Current set point IΔn: selectable by 7-position potentiometer, 3 ranges x 1, x 10, x 100
Ranges IΔn: see table below
Non-operating residual current: 0.5 IΔn
Intervention time t: selectable by 7-position potentiometer
Adjustable range t: 0, 0.15, 0.25, 0.5, 1, 2, 5 sec
Maximum break time: See table on next page.

**Signalling**
POWER ON: Green LED “ON”
Trip status: red LED “TRIP” and relay switching “TRIP”

**Control**
Manual test: verifies the state of the relay
Automatic continuous test: verifies the continuity and safe operation of the relay, current transformer and connections

**Trip function**
TRIP state: red LED “TRIP” and “TRIP” relay self-retention, excluded with auto reset
Reset: manual, by front pushbutton
Reset value: < 50 % IΔn
Reset inhibited with persistent residual current flow of >50 % IΔn
Automatic reset: 3 restart attempts (1 each 60 seconds)
Remote: By external contact closing (available only with AC supply)

**Output**
Trip relay: 1 SPDT contact
Contact rating: 5 A 250 V AC cos ϕ 1, 3 A 250 V AC cos ϕ 0.4, 5 A 30 V DC
Negative security (normally de-energised relay) or positive security (normally energised relay) field-selectable

**Auxiliary supply**
Rated voltage: (Uaux) 110 V or 240 V or 415 V (~)
Tolerance: 97…127 V (Uaux 110 V)
204…264 V (Uaux 240 V)
340…440 V (Uaux 415 V)
Rated frequency: 50 Hz
Tolerance: 47…63 Hz
Rated burden: ≤ 2.5 W
Immunity to short interruption of supply voltage up to 300 ms

**Voltage and insulation tests (IEC 60947 - 1)**
Insulation voltage rating: 450 V
AC Test voltage: 2.5 kV RMS 50 Hz/1 minute
Considered circuits: input, output, auxiliary supply
AC Test voltage: 4 kV RMS 50 Hz/1 minute
Considered circuits: all circuits and earth
Impulse Test voltage: 5 kV standardised impulse 1.2/5 μs 0.5 J
Considered circuits: input, output, auxiliary supply

**Electromagnetic compatibility (EMC) (IEC 60947 - 2)**
Emission tests according to EN 50081-1, EN 55011 immunity tests according to EN 50082-2
Residual current relays  
RD1DF (cont’d)

### IΔn Range Selector

<table>
<thead>
<tr>
<th>IΔn (A)</th>
<th>0.03</th>
<th>0.05</th>
<th>0.075</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
<td>300 mA</td>
</tr>
<tr>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1.5 A</td>
<td>2 A</td>
<td>3 A</td>
</tr>
<tr>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7.5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

### Maximum break time

<table>
<thead>
<tr>
<th>Set point (IΔn)</th>
<th>0.03 A</th>
<th>0.05...30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay t(s)</td>
<td>0 s</td>
<td>0.15 s 0.25 s 0.5 s 1 s 2.5 s 5 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2IΔn</td>
<td>0.15 s 0.25 s 0.5 s 1 s 2.5 s 5 s</td>
<td></td>
</tr>
<tr>
<td>Max. delay @ 5IΔn</td>
<td>0.03 s 0.24 s 0.35 s 0.63 s 1.20 s 2.80 s 5.50 s</td>
<td></td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).

### Environmental conditions

- **Nominal temperature range:** -5...50 °C
- **Limit temperature range:** -10...55 °C
- **Limit temperature range for storage:** -40...70 °C
- **Relative humidity:** 50 % (highest value at 40 °C)
- **Option:** tropicalisation for saline-humid-heat ambient
- **Max power dissipation:** ≤ 2 W (for switchboard calculation)

### Housing

- **Mounting:** flush mounting (panel cut-out 45 x 45 mm)
- **Front frame:** 48 x 48 mm (76 x 76 mm with IP 54 cover)
- **Depth:** 102 mm
- **Connections:** female spade connector 6.3 x 0.8 mm
- **Housing material:** self-extinguishing makrolon
- **Protection degree:** IP 40 front frame, IP 20 terminals (insulated female spade connector 6.3 x 0.8 mm)
- **Weight:** 200 grams

### Wiring diagram

[Image of wiring diagram]

### Dimensions (mm)

[Image of dimensions diagram]
Residual current relays
RD1EP

- Adjustable IΔn up to 30 amps
- Adjustable trip time up to 5 seconds
- Instantaneous display as percentage of IΔn
- Field-selectable negative or positive security
- Automatic permanent test
- 2 wire current transformer connection
- Filter for harmonics
- Pre trip alarm
- Standard IEC 60755, AS 60947-2 (ANNEX B and M)

**Input**
- **Connection:** low-voltage lines, with series TDG current transformer
- **Waveform IΔn:** sinusoidal, pulsating, chopped pulsating, pulsating + 6 mA DC (type A)
- **Rated frequency (fn):** 50 Hz
- **Working frequency:** 47...63 Hz

**Set up**
- **Current set point IΔn:** selectable by 7-position potentiometer, 3 ranges x 1, x 10, x 100
- **Ranges IΔn:** see table below
- **Non-operating residual current:** 0,5 IΔn
- **Intervention time t:** selectable by 7-position potentiometer
- **Adjustable range t:** 0, 0.15, 0.25, 0.5, 1, 2.5, 5 sec
- **Maximum break time:** See table on next page.

**Signalling**
- **POWER ON:** Green LED “ON”
- **Residual current indication:** 4 yellow LEDs indication, 20 - 30 - 40 - 50 % of set IΔn value
- **Trip status:** red LED “TRIP” and relay switching “TRIP”
- **Pre alarm:** 50% IΔn relay switching
- **Ring current transformer - relay connection failure:** Red LED “TRIP” Blinking + “TRIP” relay switching

**Control**
- **Manual test:** verifies the state of the relay
- **Automatic continuous test:** verifies the continuity and safe operation of the relay, current transformer and connections

**Trip function**
- **TRIP state:** red LED “TRIP” and “TRIP” relay self-retention, excluded with auto reset
- **Reset:** manual, by front pushbutton
- **Reset value:** < 50 % IΔn
- **Reset inhibited with persistent residual current flow of ≥ 50 % IΔn**
- **Automatic reset:** 3 restart attempts (1 each 60 seconds)
- **Remote:** By external contact closing (available only with AC supply)

**Output**
- **Trip 50 % IΔn relay:** 1 SPDT contact (negative security)
- **TRIP relay:** 1 SPDT contact
- **Contact rating:** 5 A 250 V AC cosφ 1, 3 A 250 V AC cosφ 0.4, 5 A 30 V DC
- **Negative security (normally de-energised relay) or positive security (normally energised relay):** field-selectable

**Auxiliary supply**
- **Rated voltage:** (Uaux) 110 or 240 V or 415 V (~)
- **Tolerance:** 97...127 V (Uaux 110 V)
- **Pre alarm:** 50% IΔn relay switching
- **Rated frequency:** 50 Hz
- **Tolerance:** 47...63 Hz
- **Rated burden:** ≤ 2.5 V A
- **Immunity to short interruption of supply voltage up to 150 ms**

**Voltage and insulation tests (IEC 60947 - 1)**
- **Insulation voltage rating:** 450 V
- **AC Test voltage:** 2.5 kV RMS 50 Hz/1 minute
- **Considered circuits:** input, output, auxiliary supply
- **AC Test voltage:** 4 kV RMS 50 Hz/1 minute
- **Considered circuits:** all circuits and earth
- **Impulse Test voltage:** 5 kV 1.2/5 µs 0.5 J
- **Considered circuits:** Input, output, auxiliary supply

**Electromagnetic compatibility (EMC) (IEC 60947 - 2)**
- **Emission tests according to EN 50081-1, EN 55011**
- **Immunity tests according to EN 50082-2**
Residual current relays
RD1EP (cont’d)

IΔn Range Selector

<table>
<thead>
<tr>
<th>IΔn (A)</th>
<th>0,03</th>
<th>0,05</th>
<th>0,075</th>
<th>0,1</th>
<th>0,15</th>
<th>0,2</th>
<th>0,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch</td>
<td>x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1,5 A</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7,5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
</tr>
</tbody>
</table>

Maximum break time

<table>
<thead>
<tr>
<th>Set point (IΔn)</th>
<th>0.03 A</th>
<th>0.05...30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay t(s)</td>
<td>0 s</td>
<td>0.15 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2IΔn</td>
<td>0.15 s</td>
<td>0.25 s</td>
</tr>
<tr>
<td>Max. delay @ 5IΔn</td>
<td>0.03 s</td>
<td>0.24 s</td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).

Environmental conditions

Nominal temperature range: -5...50 °C
Limit temperature range: -10...55 °C
Limit temperature range for storage: -40...70 °C
Relative humidity: 50 % (highest value at 40 °C)
Option: tropicalisation for saline-humid-heat ambient
Max power dissipation: ≤ 2 W (for switchboard calculation)

Housing

Mounting: flush mounting (panel cut-out 68 x 68 mm)
Front frame: 72 x 72 mm (75 x 75 mm with IP 54 cover)
Depth: 75 mm
Connections: female spade connector 6.3 x 0.8 mm
Housing material: self-extinguishing makrolon
Protection degree: IP 40 front frame, IP 20 terminals (insulated female spade connector 6.3 x 0.8 mm)
Weight: 250 grams

Wiring diagram

Dimensions (mm)
Earth leakage relay
RD3E21 relay

- Adjustable IΔn up to 30 amps
- Adjustable trip time up to 5 seconds
- 2 changeover contacts
- Instantaneous digital display
- Field-selectable negative or positive security
- Automatic permanent test
- 2 wire current transformer connection
- Filter for harmonics
- Standard IEC 60755, AS 60947-2 (ANNEX B and M)

Input
Connection: low voltage lines, with series TDG transformer
Waveform IΔn: sinusoidal, (type AC) or chopped pulsating with superimposed DC (type A)
Rated frequency fn: 50 Hz
Working frequency: 47…63 Hz

Set up
Current set point IΔn: selectable by 7 position potentiometer, 3 ranges x 1, x 10, x 100
Ranges IΔn: see table below
With range set on 0.03, the range selector (x1/x10/x100) is automatically excluded.
Non-operating residual current: 0.5 IΔn
Intervention time t: selectable by 7 position potentiometer
Adjustable range t: 0, 0.15, 0.25, 0.5, 1, 2, 5 sec
Alarm + 50 % IΔn pre-alarm or alarm with 2 contacts, selectable.
alarm with 1 SPDT contact + 1 SPST contact
50 %: alarm with 1 SPDT contact + pre-alarm 1 SPST contact
Maximum break times: See table below.

Signalling
Power ON: display turned on
Alarm intervention: “AL” message blinking + “FAULT” relay switching

Ring current transformer-relay connection failure: “CT” message blinking + “FAULT” relay switching
Pre alarm: “ALARM” relay switching
Manual test: “AL” message fixed + “FAULT” relay switching
Instantaneous value IΔn: 1000 points display (3 digit)
Display type: red LED, 7 segments
Digit height: 10 mm
Accuracy: ± 5 % + 1 digit (referred to measuring full scale)
ELR FUNCTION: (earth leakage relay protection on)
Measuring range: 10…100 % selected IΔn 3 mA - 50 A
MONITOR FUNCTION: (earth leakage relay protection off)

Control
Manual test: verifies the residual current relay is working
Local: front key
Remote: by external closing contact
Automatic continuous test: verifies the integrity of the connection between relay and ring core

TRIP function
Trip state memorisation: “AL” message blinking + “FAULT” relay self-retaining
Reset: manual, local or remote
Local: front key
Remote: external contact closing (available only AC supply)
Inhibited reset with persistent residual current: > 60 % IΔn

IΔn Range Selector

<table>
<thead>
<tr>
<th>IΔn (A)</th>
<th>0.03</th>
<th>0.05</th>
<th>0.075</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch</td>
<td>x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td></td>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1.5 A</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7.5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
</tr>
</tbody>
</table>

Maximum break time

<table>
<thead>
<tr>
<th>Set point (IΔn)</th>
<th>0.03 A</th>
<th>0.05…30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay t(s)</td>
<td>0 s</td>
<td>0.15 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2IΔn</td>
<td>0.15 s</td>
<td>0.25 s</td>
</tr>
<tr>
<td>Max. delay @ 5IΔn</td>
<td>0.03 s</td>
<td>0.24 s</td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).
Earth leakage relay
RD3E21 relay

Output
Alarm relay (FAULT) + pre-alarm (ALARM):
FAULT relay: 1 SPDT contact
ALARM relay: 1 SPST contact
Alarm relay with 2 contacts: 1 SPDT contact + 1 SPST contact
Contact range: 5 A 250 V AC cosq 1, 3 A 250 V AC cosq 0.4, 5 A 30 V DC
Negative security (normally de-energised relay) or positive security fail safe (normally energised relay): selectable by dip switch

Auxiliary supply
Rated voltage: (Uaux) 110 V or 240 V or 415 V
Rated frequency: 50 Hz
Tolerance: 47…63 Hz
Rated value Tolerance
48 V 48 ... 60 V
110 V 77 ... 143 V
240 V 154 ... 264 V
415 V 266 ... 456 V
Rated burden: 4 VA
Rated value Uaux: 20…150 V DC
Protect against incorrect polarity: 4 W
Immunity to short interruption of supply voltage up to 150 ms (Rated Uaux)

Insulation properties: (IEC 60947-1)
Insulation category: III
Pollution degree: 2
Insulation reference voltage: 450 V
Impulse Test voltage: 5 kV 1.2/50 0.5J
Considered circuits: input, relay output, auxiliary supply
AC Test voltage: 2.5 kV RMS 50 Hz/1 min
Considered circuits: input, relay output, auxiliary supply
AC Test voltage: 4 kV RMS 50 Hz/1 min
Considered circuits: all circuits and earth

Electromagnetic compatibility (EMC) (IEC 60947-2)
Emission tests according to EN 61000 - 6 - 3
Emission tests according to EN 61000 - 6 - 2

Environmental conditions
Nominal temperature range: -25…+55 °C
Limit temperature range for storage: -40…+85 °C
Relative humidity: 50 % (highest value at 40 °C)
Suitable for tropical climates
Max. power dissipation: 2.5 W. For switchboard thermal calculation

Housing
Housing: flush mounting (panel cut-out 68 x 68 mm)
Front frame: 72 x 72 mm
Depth: 81.8 mm
Connections: extractable terminals, screw terminal for cable up to 4 mm²
Housing material: self-extinguishing polycarbonate
Protection degree: IP 40 (front frame), IP 20 (terminals)
Weight: 280 grams

Wiring diagram

Dimensions (mm)

Rear view RD3E21
Residual current relays
RD1G2

- Adjustable trip current \( I \Delta n \) up to 30 A
- Adjustable time delay up to 5 seconds
- Rotary selector switches
- Positive and negative security field selectable
- Automatic permanent test
- 2 wire current transformer connection
- Harmonic filter
- Pre-trip alarm
- Standard IEC 60755, AS60947-2 (ANNEX B and M)

Input
- Connection: low voltage lines, with series TD transformer
- Waveform \( I \Delta n \): sinusoidal (type AC) or chopped pulsating with superimposed d.c. (type A)
- Rated frequency \( f_n \): 50 Hz
- Working frequency: 47…63 Hz

Set up
- Current set point \( I \Delta n \): selectable by 7-position potentiometer, 3 ranges \( x1 - x10 - x100 \)
- Range \( I \Delta n \): See table on next page.
- Non-operating residual current: 0.5 \( I \Delta n \)
- Intervention time \( t \): selectable by 7-position potentiometer
- Adjustable range \( t \): 0, 0.15, 0.25, 0.5, 1, 2.5, 5 seconds
- Switch AL2 - AL50%: alarm relay with double exchange
- AL50%: alarm relay + pre-alarm 50 % \( I \Delta n \)
- Relay marked 60 - 61 - 62 is a pre-alarm state with fixed intervention threshold, equal 50 % of selected \( I \Delta n \) value
- Maximum break times: See table on next page.

Signalling
- POWER ON: Green LED “ON”
- Instantaneous value \( I \Delta n \): 4 yellow LED’s, 20 - 30 - 40 - 50 % of set \( I \Delta n \) value
- Alarm intervention: Red LED “TRIP” + “TRIP” relay switching
- Ring current transformer-relay connection failure: Red LED “TRIP” blinking and “TRIP” relay switching
- Pre-alarm: 50 % \( I \Delta n \) relay switching

Control
- Manual test: it verifies the residual current relay perfect working.
- Local: front key
- TRIP state: red LED “TRIP” and relay self-retention “TRIP”
- Reset: manual, by front pushbutton or remote
- Reset: inhibited with persistent residual current ≥ 50 % \( I \Delta n \)

Alarm
- TRIP state: red LED “TRIP” and relay self-retention “TRIP”
- Reset: manual, by front pushbutton or remote
- Reset: inhibited with persistent residual current ≥ 50 % \( I \Delta n \)

Output
- Relay “TRIP”: 2 x SPDT contact
- Pre alarm: (50 %) - TRIP 1 SPDT, 50% 1 SPDT
- Contact rating: 5 A 250 V AC cos\( \phi \) 0.1
- 3 A 250 V AC cos\( \phi \) 0.4
- 5 A 30 V DC
- Negative security fail safe: (normally de-energised)
- Positive security fail safe: (normally energised)

Auxiliary supply
- Rated voltage: 110 V AC or 240 V AC or 20-150 V DC
- Tolerance: 95…127 V (110 V AC)
- 192…253 V (240 V AC)
- Rated frequency: 50 Hz
- Tolerance: 47…63 Hz
- Rated burden: \( ≤ 2.5 \) W (DC) or \( ≤ 2.5 \) VA (AC)
- Immunity to short interruption of supply voltage: 150 ms

Insulation properties (IEC 60947 - 1)
- Insulation voltage rating: 450 V
- Impulse Test voltage: 5 kV 1.2/50 \( \mu \)s 0.5 J
- Considered circuits: input, “TRIP” relay, auxiliary supply
- AC Test voltage: 2 kV RMS 50 Hz/1min
- Considered circuits: input, “TRIP” relay, auxiliary supply
- AC Test voltage: 4 kV RMS 50 Hz/1 minute
- Considered circuits: all circuits and earth

Electromagnetic compatibility (IEC 60947 - 2)
- Emission tests according to EN 50081-1, EN 55011
- Immunity tests according to EN 50082-8
- High frequency disturbance test, 1 MHz damped oscillatory wave (EN 61000 - 4 - 4)
- Test voltage: 2.5 kV common, 1 kV series mode
Residual current relays
RD1GP (cont’d)

IΔn Range Selector

<table>
<thead>
<tr>
<th>IΔn (A)</th>
<th>0.03</th>
<th>0.05</th>
<th>0.075</th>
<th>0.1</th>
<th>0.15</th>
<th>0.2</th>
<th>0.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIP switch</td>
<td>x1</td>
<td>30 mA</td>
<td>50 mA</td>
<td>75 mA</td>
<td>100 mA</td>
<td>150 mA</td>
<td>200 mA</td>
</tr>
<tr>
<td>x10</td>
<td>300 mA</td>
<td>500 mA</td>
<td>750 mA</td>
<td>1 A</td>
<td>1.5 A</td>
<td>2 A</td>
<td>3 A</td>
</tr>
<tr>
<td>x100</td>
<td>3 A</td>
<td>5 A</td>
<td>7.5 A</td>
<td>10 A</td>
<td>15 A</td>
<td>20 A</td>
<td>30 A</td>
</tr>
</tbody>
</table>

Maximum break time

<table>
<thead>
<tr>
<th>Set point (IΔn)</th>
<th>0.03 A</th>
<th>0.05...30 A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selected delay t(s)</td>
<td>0 s</td>
<td>0 s</td>
</tr>
<tr>
<td>Non-operating time at @ 2IΔn</td>
<td>0.15 s</td>
<td>0.25 s</td>
</tr>
<tr>
<td>Max. delay @ 5IΔn</td>
<td>0.03 s</td>
<td>0.24 s</td>
</tr>
</tbody>
</table>

Selecting the intervention threshold on position 0.03 the intervention delay is automatically excluded, independently of position of range selector (x1/10/100).

Environmental conditions

Nominal temperature range (IEC 60755): -5…50 °C
Limit temperature range: -10…55 °C
Limit temperature range for storage: -40…70 °C
Relative humidity (IEC 60755): 50 % (highest value at 40 °C)
Max. power dissipation: ≤ 2 W

Wiring diagram

![Wiring diagram](image)

Dimensions (mm)

![Dimensions diagram](image)

Housing

**Housing**: flush mounting (panel cutout 72 x 72 mm)
**Front frame**: 96 x 96 mm
**Depth**: 80 mm
**Connections**: female spade connectors 6.3 x 0.8 mm
**Housing material**: self-extinguishing makrolon
**Protection degree**: IP 40 front frame IP 20 terminals
**Weight**: 280 grams
Earth leakage relay DSRM72 with DSR48TD (mining relay) separate test device ¹) ²)

- Adjustable trip current \( I_{\Delta n} \) up to 500 mA
- Adjustable trip time up to 0.5 seconds
- 1 changeover contact
- Field-selectable negative or positive security
- Automatic permanent test
- 4 wire current transformer connection
- Filter for harmonics
- Separate test unit for circuit integrity test ¹) ²)
- Standard AS/NZS 2081.3 : 2002

## Input

**Connection:** low voltage lines, with TD series, 4 wire

**Waveform \( I_{\Delta n} \):** sinusoidal, pulsating \( @ = 0^\circ \), chopped pulsating \( @ = 90^\circ \), pulsating \( @ = 0^\circ + 6 \text{ mA DC} \)

**Rated frequency \( f_{\text{in}} \):** 50 Hz

**Working frequency:** 47…63 Hz

## Set up

For correct working according to AS/NZS 2081.3:2002 the device shall be set as positive security \( Ne \)

**Current set point \( I_{\Delta n} \):** selectable by 7-position potentiometer

**Ranges:** 0.03, 0.06, 0.1, 0.2, 0.3, 0.4, 0.5 A

**Intervention accuracy according to AS/NZS 2081.3:2002:** 0.5 \( I_{\Delta n} \)

**Intervention time:** selectable by 7 position potentiometer

**Instantaneous intervention:** 50 ms

**Adjustable range \( t \):** 0.05, 0.1, 0.15, 0.2, 0.3, 0.4, 0.5 s

## Signalling

**Power on:** green LED “ON”

**Instantaneous value \( I_{\Delta n} \):** 4 yellow LEDs, 20 - 30 - 40 - 50 % of set \( I_{\Delta n} \) value

**Transformer connection failure:** red LED “Trip” and relay “Trip” switching

**Ring current transformer-relay connection failure:** red LED “TRIP” blinking + “TRIP” relay switching

## Control

**Manual test:** verifies the residual current relay is working

**Automatic continuous test:** verifies the integrity of the relay - transformer connection

**DSRM72 + DSR48TD**

**Manual test:** verifies continuity and correct working of relay - transformer - connections

**Selectable ranges \( I_{\Delta n} \):** 0.03, 0.06, 0.1, 0.2, 0.3, 0.4, 0.5 A

**Automatic continuous test:** verifies the integrity of the relay - transformer connection

## Alarm

**TRIP state memorisation:** red LED “TRIP” + relay latching

**Reset:** manual

**Local manual:** front key

**Inhibited reset with persistent residual current:** 70 % \( I_{\Delta n} \)

## Output

**AI.2 “TRIP” relay:** 2 SPDT contacts:

**AI.aux “TRIP” relay:** 1 SPDT contact:

**“POWER FAIL” relay:** 1 SPDT contact (negative security)

**Contact range:** 5 A 250 V AC \( \cos \phi \) 1, 3 A 250 V AC \( \cos \phi \) 0.4, 5 A 30 V DC

**Negative security (normally de-energised relay) or positive security fail safe (normally energised relay):** selectable by dip switch

## Auxiliary Supply

**Rated value \( U_{\text{aux}} \):** 115 V - 240 V

**Tolerance:** 0.85…1.1 \( U_{\text{aux}} \)

**Rated frequency:** 50 Hz

**Tolerance:** 47…63 Hz

**Rated burden:** \( \leq 2.5 \text{ VA} \)

**Immunity to short interruption of supply voltage up to 150 ms (Rated \( U_{\text{aux}} \)):**

## Notes:

¹) Separate test unit for circuit integrity test.

²) Units are supplied with separate test device, i.e. 1 x relay and 1 x test unit. Refer NHP if only one device is required.
Earth leakage relay DSRM72 with DSR48TD (mining relay) separate test device

Insulation properties
Insulation category: III
Pollution degree: 2
Insulation reference voltage: 450 V
Impulse Test voltage: 5 kV 1.2/50s 0.5 J
Considered circuits: input, relay output, auxiliary supply
AC Test voltage: 2.5 kV RMS 50 Hz/1 min
Considered circuits: input, relay output, auxiliary supply
AC Test voltage: 4 kV RMS 50 Hz/1 min
Considered circuits: all circuits and earth

Electromagnetic Compatibility
Emission tests according to EN 50081-1, EN 55011
Immunity tests according to EN 50082-2
High frequency disturbance test, 1 MHz damped oscillatory wave (IEC 255-4)
Test voltage: 2.5 kV common mode, 1 kV series mode

Environmental conditions
Nominal temperature: -5...+60 °C
Limit temperature range: -10...+60 °C
Limit temperature range for storage: -40...+70 °C
Relative humidity (IEC 60755): 50 % (highest value at 40 °C)
Suitable for tropical climates
Max. power dissipation: ≤ 3.5 W. For switchboard thermal calculation

NHP DSRM Earth Leakage Mining Relay Functional Diagram

Dimensions (mm)
DSRM72 (RD1E4)
DSR48TD (AR0D)
Earth leakage relay
TD and DSR Delta ring current transformers

- Closed-core ring current transformers
- Suits RD & DSR range of earth leakage relays
- Wide range to select from
- Open-core ring current transformers
- Suits RD & DSR range of earth leakage relays
- Suitable for retrofitting on existing installations

Models

<table>
<thead>
<tr>
<th>Dimensions (mm)</th>
<th>Imin (A)</th>
<th>Imax (A)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED CORE TOROIDS</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>2 wire toroids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDGB2</td>
<td>35</td>
<td>75</td>
<td>85</td>
</tr>
<tr>
<td>TDGH2</td>
<td>60</td>
<td>88</td>
<td>112</td>
</tr>
<tr>
<td>TDGC2</td>
<td>80</td>
<td>108</td>
<td>132</td>
</tr>
<tr>
<td>TDGD2</td>
<td>110</td>
<td>148</td>
<td>170</td>
</tr>
<tr>
<td>TDGE2</td>
<td>140</td>
<td>177</td>
<td>206</td>
</tr>
<tr>
<td>TDGF2</td>
<td>210</td>
<td>270</td>
<td>295</td>
</tr>
<tr>
<td>OPEN CORE TOROIDS</td>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>2 wire toroids</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDAA2</td>
<td>110</td>
<td>185</td>
<td>121</td>
</tr>
<tr>
<td>TDAB2</td>
<td>150</td>
<td>225</td>
<td>259</td>
</tr>
<tr>
<td>TDAC2</td>
<td>310</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>4 wire toroids</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>DSR110ADEL</td>
<td>110</td>
<td>185</td>
<td>219</td>
</tr>
<tr>
<td>DSR150ADEL</td>
<td>150</td>
<td>225</td>
<td>259</td>
</tr>
</tbody>
</table>

Application
When connected with residual current relays it allows detection of leakage currents towards earth caused by insulation breakdown on electrical equipment.

Working principle
Supply conductors cross the toroid creating a magnetic field proportional to load current flow. The vector sum of the currents (and relevant magnetic fluxes) is zero, even when an imbalanced 3 phase load is experienced. A leakage towards earth on one or more conductors after the toroid causes an imbalance in the vector sum, with a value proportional to the leakage current. This imbalance is detected by the toroid and sent to the residual current relay.

Choice of transformer
A suitable toroid shall be selected according to lowest value of residual current to be detected and the hole diameter through which shall pass all the active conductors and neutral (where applicable) of the system to be protected.

Notes: See following page for dimensional drawings

1) DSR 4 wire toroids only to be used with DSRM relays.
Earth leakage relay
TD and DSR Delta ring current transformers

Insulation properties (IEC 185)
Insulation voltage rating: 0.72 kV
AC test voltage: 3 kV RMS 50 Hz/1 minute
Pollution degree: measuring winding and test winding
AC test voltage: 0.8 kV RMS 50 Hz/1 minute
Considered circuits: measuring and test windings

Working conditions
Reference temperature: 20 °C ± 5 °C
Nominal temperature range (IEC 60755-1008, DIN-VDE 0664, CEI 23-18): -5...+40 °C
Limit temperature range: -10...+55 °C
Limit temperature range for storage: -40...+70 °C
Connections: screw terminals with protection terminal cover (sealable)
Housing material: self-extinguishing ABS

Wiring diagrams and dimensions

TDG & DSR (closed-core 2 wire & 4 wire)

TDA & DSR (open-core 2 wire & 4 wire)

TDAC2 (open-core 2 wire)

Note: 1) No test wiring on 2 wire toroids.