Doepke

The safe way to use electricity: residual current circuit breakers from Doepke

——— our residual current circuit breakers
——— standards and regulations
——— guide to selecting the right circuit breaker

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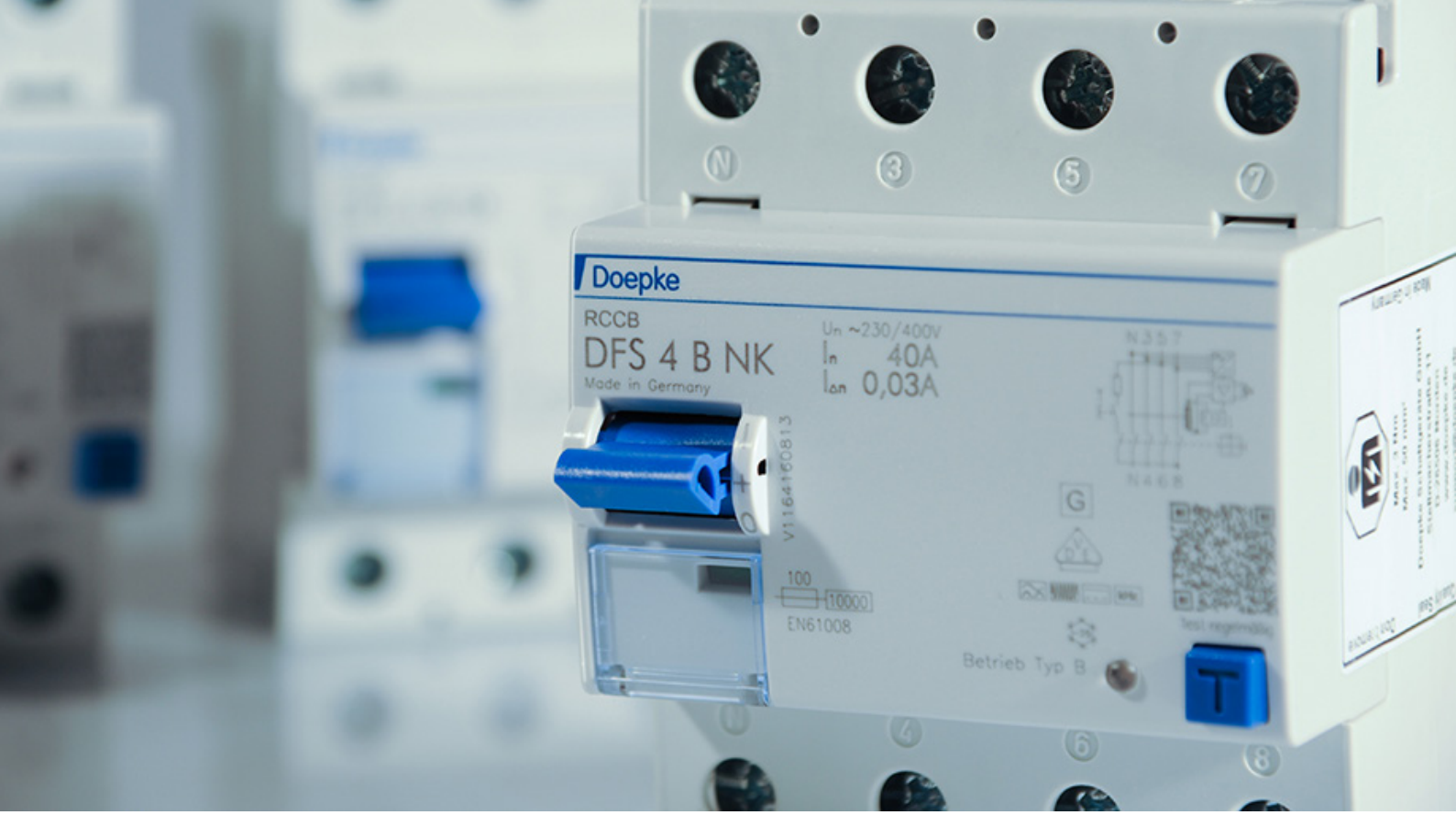


Residual current circuit breakers (RCCBs) are used in all applications where it is necessary to implement the „Automatic switch-off of power supply" protective measure as per the requirements of VDE 0100 part 410 or corresponding international installation regulations. At Doepke Schaltgeräte, electricians can find the right residual current circuit breaker for all their needs and for any project:

Series DFS 2 residual current circuit breakers are compact two-pole residual current circuit breakers for single-phase networks. In the standard design, they only take up two module-width units of space. The standard design of the compact two-pole or four-pole DFS 4 residual current circuit breakers is only four module-width units wide. Despite their compact size, Doepke residual current circuit breakers cover a wide range of different residual currents, rated currents (up to 125 A depending on the design) and rated residual currents. DSF 4 are designed for three-phase networks but can also be used in single-phase networks when set up with the neutral conductor to the right.

The DSF 2 and DSF 4 are simple to install since they have large double-level terminals to accommodate conductors with large cross sections and a practical multi-functional switch toggle, as well as being equipped with a label window. With their extremely low internal energy consumption and low dissipation power per pole, these two residual current circuit breakers are exceptionally energy efficient.

Pulsating current, AC and mixed frequency sensitive

AC sensitive residual current circuit breakers, Type AC

Doepke also caters for the international market with its Type AC residual current circuit breakers. Since these detect only AC residual currents and not pulsating DC residual currents, they are not approved as residual current devices in Germany and are thus only for export.

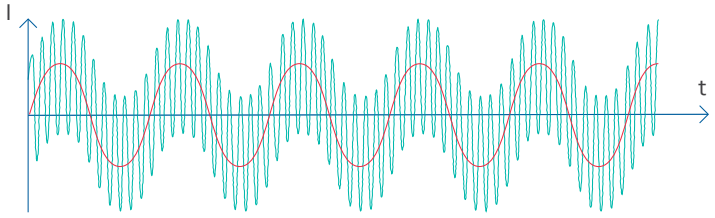
Pulsating current and AC sensitive residual current circuit breakers, Type A

Type A residual current circuit breakers are independent of the mains voltage and enable the detection of sinusoidal AC and pulsating DC residual currents. In their standard design, they are intended for monitoring circuits with a rated voltage of 230 V or 400 V and a rated frequency of 50 Hz.

Mixed frequency sensitive residual current circuit breakers, Type F
For installations with single-phase frequency converters (for example)

Washing machines, compactors, hammer drills, heating and thermal pumps, ballast in lighting systems and welding devices: Some of these devices are very much everyday items.
For continuous speed control, many of these electrical consumers operate using single-phase frequency converters; this means that residual currents with mixed frequencies other than 50 Hz can occur if there is a fault. Type A residual current circuit breakers cannot adequately detect these frequencies.

The short-time delay built into a Type F residual current circuit breaker also reduces false trips caused by high inrush currents or surge currents in the event of thunderstorms.



50 Hz sine wave
mixed signal

AC/DC sensitive residual current circuit breakers, Type B/Type B+

Typ B / Typ B+

Many standards, regulations and directives require the provision of Type B/Type B+ AC-DC sensitive residual current circuit breakers. They are the ideal solution for protecting installations that use electronic consumers with operating frequencies extending into the kilohertz range. In three-phase networks, these include frequency converters, while examples in single-phase networks include photovoltaic systems or heat pumps, which are being installed more and more frequently in both new builds and renovations. Alongside conventional AC residual currents, smooth DC residual currents and residual currents with frequencies other than 50 Hz can also occur in all these electronic consumers. Doepke has three different tripping characteristics to offer you in AC-DC sensitive residual current circuit breakers. Take a look at our range and find the right breaker for your needs.

Ideal for facilities at risk of fire: Type B NK

AC-DC sensitive residual current circuit breakers with the "NK" tripping characteristic curve ensure conventional fire protection for 300 mA at frequencies up to 150 kHz, thereby significantly exceeding the requirements under the standard covering Type B+ residual current circuit breakers. This makes this circuit breaker the ideal protection for facilities at risk of fire that are subject to stringent fire-protection requirements. DFS 2/4 NK AC-DC sensitive residual current circuit breakers comply with standards DIN VDE 0664-10, DIN VDE 0664-40 and DIN VDE 0664-400.

Fire protection up to max. 20 kHz: Type B+

Type B+ residual current circuit breakers meet the requirements of standard DIN VDE 0664-400. Unlike residual current circuit breakers with the NK tripping characteristic curve, these breakers trip in the event of residual currents subject to an upper tripping threshold of 420 mA and offer fire protection up to 20 kHz.

High system availability sought: Type B SK

In many electrical installations, fire protection plays a secondary role. Defined up to 150 kHz, the SK tripping characteristic curve is the ideal choice for systems such as those in which operational leakage currents may occur, but which need to remain operational at all times as far as possible. Due to the lower response sensitivity at higher frequencies, downtimes are prevented, which is vital for production facilities, for example. Doepke's DFS 2/4 B SK AC-DC sensitive residual current circuit breakers comply with the DIN VDE 0664-10 and DIN VDE 0664-40 standards.

Standards and regulations containing important information about the use of Type B residual current circuit breakers:

DIN VDE 0100-410:
automatic disconnection of supply

VDE 0100-530:
erection of low voltage installations: selection and erection of electrical equipment – Switchgear and controlgear

VDE 0100-420:
protection against thermal effects

VDE 0100-704:
requirements for special installations or locations – Construction and demolition site installations

VDE 0100-712:
Requirements for special installations or locations – Photovoltaic (PV) systems (new)

VDE 0100-722:
requirements for special installations or locations – supplies for electric vehicles

DE 0100-723:
requirements for special installations or locations – classrooms with experimental equipment

DGUV information 203-006 (BGI 608):
Selection and operation of electrical installations and operating equipment on building sites

DGUV information 209-067 (BGI 5017):
charging equipment for vehicle batteries

GDV publication (VdS 3501):
Insulation protection in electrical installations with electronic equipment – RCDs and frequency converters

VdS 3145:
photovoltaic installations – technical guidelines

The current version of DIN VDE 0100-704 on the construction of low-voltage installations on building sites stipulates that three-phase sockets up to 63 A must always be protected using Type B AC-DC sensitive residual current devices. From a technical perspective, AC-DC sensitive residual current devices are, however, largely already required for building-site distribution boards as only Type B residual current devices provide the highest possible level of protection where electronically controlled machinery and equipment is in use on building sites. Furthermore, should any problems arise, the constructor of the installation is then safeguarded if they can document that they have taken all necessary steps to correctly and safely plan and implement the power supply on the building site.

Choosing the right residual current circuit-breaker

Basic circuit for electronic operating equipment in accordance with HD 60364-5-53:
- three-phase full bridge circuit
- three-phase star circuit
- full bridge circuit between external conductors
- single-phase detection with smoothing

Systems with frequency converters:
- pumping, air conditioning and ventilation systems
- escalators and elevator systems
- medical devices
- solar power plants
- welding plants
- UPS systems

YES

Will the RCCB be used in a charging device for electric vehicles?

NO

YES

Does the vehicle manufacturer stipulate an AC/DC-sensitive RCCB?

YES

NO

NO

use of single-phase frequency inverters

examples:
- washing machines
- vibrators
- hammer drills
- heat pumps

NO

YES

A

DFS 2/4 A

use conventional RCCBs (Type A).

F

DFS 2/4 F

use mixed frequency sensitive RCCBs (Type F).

A EV

DFS 4 A EV

with active additional device for tripping at residual DC currents greater than 6 mA.

B SK

DFS 4 B SK

with a tripping threshold of 2 A at frequencies above 2 kHz, this RCCB protects against high leakage currents.

Note:
The rated residual current is not subject to this illustration – it has to be chosen according to the protection purpose.

Will the RCCB be used for a plant where fire is a potential hazard?

examples:
- agricultural facilities
- biogas plants
- paint shops
- joineries
- refuelling systems
- warehouses

YES

Is a fire protection threshold of 420 mA too high or are frequencies greater than 20 kHz?

NO

YES

NO

Will the RCCB be used in a circuit with unknown upstream protective measures?

NO

YES

Will the RCCB be used in a circuit with unknown upstream protective measures?

NO

YES

B SK MI

DFS 4 B SK MI

with a reduced tripping threshold of ≤ 6 mA in order to ensure the correct tripping of upstream protective devices.

B+

DFS 4 B+

meets required fire protection levels of 420 mA at frequencies of only 20 kHz or lower.

Result: limited system protection

B+ MI

DFS 4 B+ MI

with a reduced tripping threshold of ≤ 6 mA in order to ensure the correct tripping of upstream protective devices.

B NK

DFS 4 B NK

meets conventional required fire protection levels of 300 mA at frequencies up to 100 kHz.

Result: optimal system protection

The right design for all your needs

Almost all Doepke residual current circuit breakers are available in different designs. Whatever type of protection you need for your project, Doepke has the solution for you!

DFS 4 N-right design

Series DFS 4 residual current circuit breakers are also available with the neutral conductor connection positioned on the right. Doepke's standard design is to have the connection on the left. The right-hand option applies to residual current circuit breakers of Type A and F (16 A to 125 A) and Type B/B+ (16 A to 80 A).

For harsh environments:
HD (heavy-duty) desig

All our residual current circuit breakers can also be made with the HD (heavy-duty) design. HD breakers are produced using special non-corroding alloys and particularly high-end components, such as robust stainless steel latches. This makes our HD designs particularly well suited for use in harsh environments or outdoors, for example on building sites or in swimming pools, tunnelling works or charging columns. They are considerably less sensitive to corrosive gases than standard designs and can also be used at temperatures of up to 60°C.

HD at a glance

- special alloys
- stainless steel latch
- wider temperature range
- highly resistant to corrosive gases
- particularly suitable for use in harsh environments (e.g. in agriculture, swimming pools, paint shops and underground transport tunnels)

Simply put "HD" after the item number when you place your order!

for maximum listening enjoyment

For maximum listening enjoyment: Audio design

Doepke's DFS F Audio mixed frequency sensitive residual current circuit breaker offers reliable protection for people and electrical installations against dangerous residual currents in audio ranges, without any loss of sound. This residual current circuit breaker has been specifically developed for circuits containing high-quality audio components such as high-end record players, CD players, network streamers, amplifiers and active speakers.

The new DFS Audio is also the ideal choice for use in the professional sector, for example for sound systems in theatres and concert halls, as well as cinemas. Its special construction ensures a low-impedance design for maximum listening enjoyment.

Together we face the change
– with pioneering spirit and 60 years
of experience in residual
current protection technology.

We make electricity safe.

Selective:
S design

Selective switch-off is required in some installations with stacked distribution boards. This means that when RCCBs are connected in series, only the one immediately upstream of the installation section containing the fault (e.g. an earth fault) should trip. In this way, the devices are able to increase system availability. In our selective residual current circuit breakers, the residual current is allowed to flow for longer before tripping than in instantaneous breakers. Likewise, the value of the rated residual current is selected to be at least 3 times that of the downstream RCCB. The lowest rated residual current of a selective residual current is 100 mA.

Our selective residual current circuit breakers are available in Types A, B SK and B NK. They are not suitable for providing additional protection (i.e. for protecting people).

Short-time delayed:
KV design

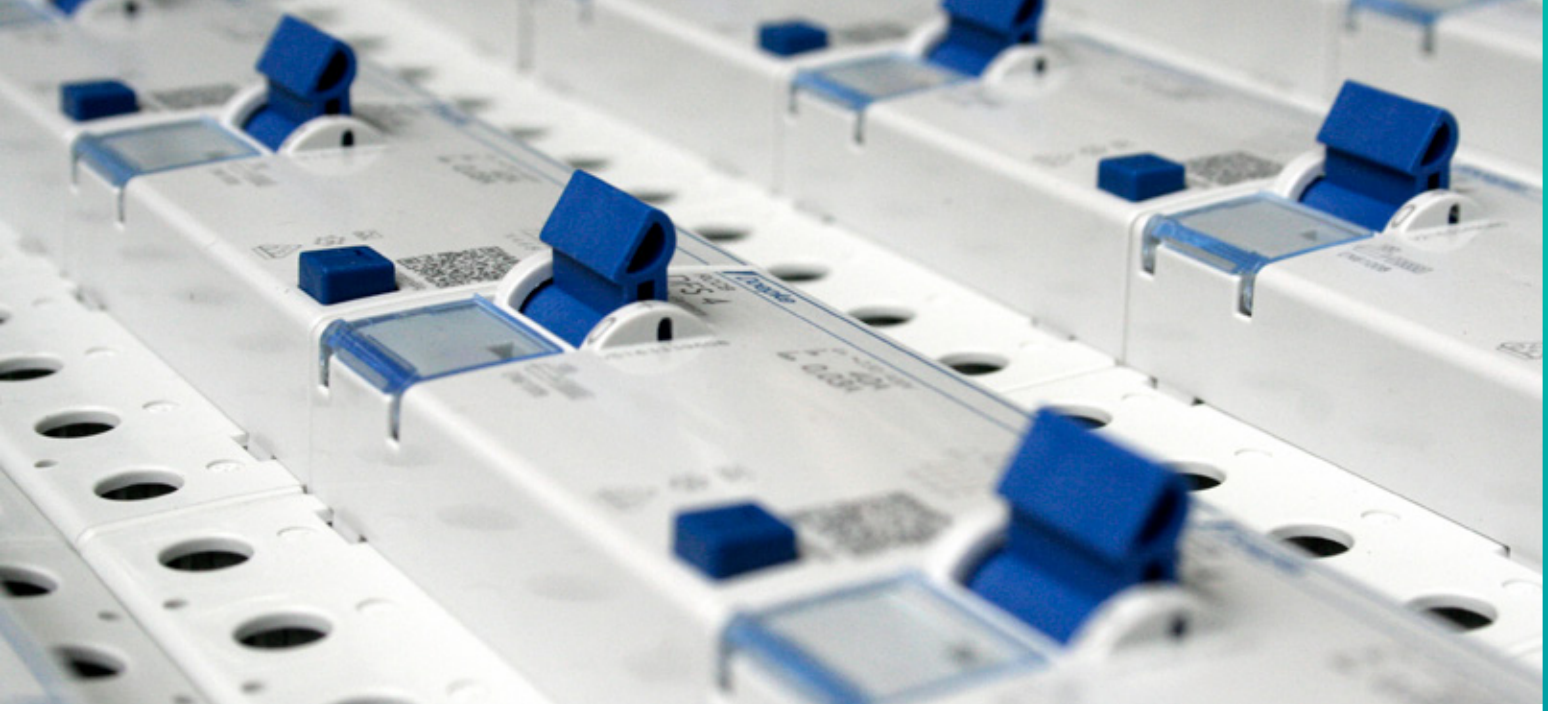
Because they feature a response delay, residual current circuit breakers in the KV design only respond to residual currents that last longer than a half-period of the power frequency. Unlike instantaneous breakers, the KV type is much less sensitive to brief pulsating residual currents. Fault-free operation is still ensured even if switching or lightning overvoltages within the installation cause surge residual currents or insulation flashovers with a secondary current.

Our KV residual current circuit breakers adhere to the tripping times set out in national and international design regulations for instantaneous RCCBs. In principle, therefore, they may be used instead of a standard breaker.

The short-time delay built into a Type F residual current circuit breaker reduces false trips caused by high inrush currents or surge currents in the event of thunderstorms. The DFS 2 and DFS 4 residual current circuit breakers of Types B NK, B SK, B+ and F are already equipped with a short-time delay, as well as being lightning-resistant in accordance with Austrian standard ÖVE E 8601.

For point heaters:
W design

The special "W" design has been specifically developed for the requirements of track installations with a rated frequency of 16 2/3 Hz. The mains-voltage-independent residual current circuit breakers are designed for voltages of up to 500 V. This special design is also available for Type AC residual current circuit breakers.



For frequencies ≠ 50 Hz:
Hz design

Residual current circuit breakers in the Hz design are intended for rated mains frequencies other than 50 Hz. Common frequencies are 60 or 400 Hz; devices for other frequencies can be manufactured upon request. Devices in this design are intended for monitoring circuits with a rated voltage of 230 V or 400 V.

For special voltages:
V design

Doepke Type V residual current circuit breakers are the perfect choice for protecting against special voltages. This design of residual current circuit breaker is intended for monitoring circuits with a rated voltage other than 230/400 V and a rated frequency of 50 Hz.

No interruption to the power supply:
Twin design

Under VDE standards, residual current circuit breakers in some applications must be tested regularly by pressing the test button, yet this always causes the power supply to the downstream installation to be briefly interrupted. In private households, this does not normally pose a problem because a refrigerator or freezer can ride out this power supply interruption. In other applications, however, interruption of supply is rather more critical: Computers and sensitive medical devices cannot necessarily tolerate a loss of power supply, nor can laboratories, where long-term tests must run without any disruptions. Doepke has the solution to this problem – its "Twin" residual current circuit breaker.

The DFS Twin is a specially developed combination of two residual current circuit breakers that protect the downstream installation independently of one another. This means that the proper functioning of one residual current circuit breaker can be tested while the other continues to monitor the current without causing any loss of power. Full protection against residual currents is thus assured at all times. Each protective device has its own switch toggle and test button. The DFS Twin is connected in exactly the same way as a conventional residual current circuit breaker. Other design variants are available with selective or short-time delayed options.

We can provide the right product for every occasion including,

For electromobility:
EV design

Reliable residual current protection for charging plug sockets on charging columns and wall boxes is ensured by the DFS 4 EV residual current circuit breaker. Type A EV reliably trips in the event of pulsating and AC residual currents while Type F EV trips when mixed frequencies occur. Both types are capable of detecting EV DC residual currents of more than 6 mA, as can typically occur when charging electric vehicles. This integrated extra function prevents blinding of upstream residual current circuit breakers and ensures that they continue to protect the existing electrical installation. The extra function is powered via the mains voltage. As a result, there is no need for any additional devices to prevent DC residual currents > 6 mA.

With emergency stop function:
NA design

For classrooms or laboratories with experiment equipment, the requirements on electrical safety are particularly stringent in accordance with DIN VDE 0100-723. The standard stipulates that, in addition to a 30 mA AC-DC sensitive residual current device, there must also be an emergency shut-off device. This emergency stop device must be an isolating device as per DIN VDE 0100-537.

Doepke's DFS residual current circuit breaker with emergency stop function ("NA" variation) meets all these requirements: This breaker is available as Type B (AC-DC sensitive) and Type A (pulsating current/AC sensitive) and allows suitable operating elements to be connected (e.g. buttons for switching off the residual current circuit breaker in emergency situations). The DFS NA thus combines two important safety functions in one device – delivering reliable residual current protection and monitoring the external emergency stop circuit at the same time. It does so through an integrated active additional device, which can also be used to operate multiple DFS 4 NA devices concurrently.

The LED built into the RCCB not only signals tripping by a control element but also a wire breakage in the emergency stop circuit. In this state, the residual current circuit breaker is prevented from reclosing. An auxiliary contact also signals that the residual current circuit breaker is switched off.

by request, an individually manufactured micro-series.

With remote trip function:
FT design

The FT design of our residual current circuit breaker is the ideal choice if you want to remotely check the breaker's protective function. In this design, the connections of the internal test button are led to two terminals so that the test device can be activated externally. An auxiliary contact also reliably signals when the residual current circuit breaker is switched off.

Automated function tests:
ST design

The "Selftest" residual current circuit breaker series performs monthly automated self diagnoses to test the proper functioning of the breaker. While the self-test is being performed, bypass contacts supply the installation with power to prevent the system stopping. The test can be logged via a programmable, potential-free contact. The protective function of the breaker can also be checked manually as desired by pressing the test button. The ST design is available as a Type A residual current circuit breaker (pulsating current/AC sensitive) with short-time delay.

Automatic reclosing:
STR design

The "Selftest Restart" complements the "Selftest" function by adding an automatic restart in the event of false trips. The STR design is often used in server rooms or office facilities where surge currents that would cause standard residual current circuit breakers would trip occur repeatedly due to consumers with power supplies being switched on at the same time.

When the Selftest Restart function is triggered, a simplified insulation resistance test is performed. To avoid creating a critical installation situation at any point and protect people or property, the insulation resistance test is carried out using a safety extra-low voltage of 24 V and the installation is kept switched off throughout. The installation is only switched on once it has been confirmed that it is fault-free. The insulation test takes approximately 10 seconds. If a fault is detected, repeat tests are performed every two minutes. The STR design is available as a Type A residual current circuit breaker (pulsating current/AC sensitive) with short-time delay.

For mobile installations

MI design

The DFS 4 MI protects existing installations where the upstream protective measure is unknown or consists of a Type A residual current circuit breaker. Mobile installations are special in that existing protective measures and electrical consumers may not be adapted to one another. To be ready to deal with all eventualities, electric equipment that may generate smooth DC residual currents in the event of a fault must be protected by an AC-DC sensitive residual current circuit breaker. Smooth DC residual currents greater than 6 mA can saturate the summation current transformer of a Type A device, in the worst case scenario causing the transformer to be blinded and preventing it from tripping. This destroys the protective function, something which usually goes unnoticed.

According to the installation rules, however, Type B residual current circuit breakers (AC-DC sensitive) may not be used downstream of a Type A breaker. Yet depending on how the existing installation is installed, this may be the set-up on buildings sites or in mobile systems. The DFS 4 MI AC-DC sensitive residual current circuit breaker provides the answer to this problem: The DFS 4 MI can be safely connected downstream of a Type A residual current circuit breaker since it reliably disconnects the electric equipment being protected from the mains as soon as a DC residual current of 6 mA is reached. As a result, dangerous pre-magnetisation of the upstream Type A RCD is averted.

The MI design is available with various tripping characteristics: With its residual current detection range of up to 20 kHz, the DFS 4 B+ MI residual current circuit breaker meets Type B+ requirements. Its low tripping threshold in the upper frequency range thus makes

We make the use of electricity safe and provide exciting innovations and developments.

the B+ MI best suited for use in facilities at risk of fire.

If you would like the residual current circuit breaker to be less sensitive to high leakage currents in order to ensure maximum system availability, the SK MI design of the DFS 4 B is the ideal choice for you: With its residual current detection range of up to 150 kHz, it considerably exceeds its product standards. The high tripping threshold in the upper frequency range makes it more resistant to false trips.

Mobile distribution board

Protection Box

The Doepke Protection Box is the perfect choice for ensuring proper residual current protection on building sites or in other mobile applications. The equipment used in these applications is often controlled by a frequency converter and may generate smooth DC residual currents in the event of a fault. The equipment must be protected using an AC-DC sensitive residual current circuit breaker. As stipulated by VDE 0160 / EN 50178, these breakers must not be operated downstream of a Type A or F residual current device. Since our Protection Box is fitted with a DFS 4 B SK MI that trips as soon as a residual current of 6 mA is reached, it reliably protects upstream Type A or F residual current circuit breakers from being blinded. In the "HD" design, the DFS 4 B SK MI is particularly insensitive to external influences, while also being suitable for a wider range of temperatures.

The Protection Box is a protection class II portable solid rubber distribution unit. The black case is unbreakable, non-ageing, acid-resistant and alkali-proof: built to last. Depending on the design, the box has one or two CEE sockets with a rating of 16 or 32 A. The variant that features both connections has a change-over switch so that you can select the active outlet.

DFA remote actuator

Automatic reclosing devices (ARDs) or remote actuators ensure increased system availability. Devices in the DFA series are only intended for operation on Doepke DFS 2 or DFS 4 residual current circuit breakers and are flange-mounted on the left of the breakers. Using the DFA, the residual current circuit breakers can be switched on or off remotely. Depending on the design, the DFA can also automatically reclose the residual current circuit breaker after a trip.

The DFA displays its status via relays or a semiconductor output. The installation width of the DFA 2 is 4 module-width units, while that of the DFA 3 is just 1 module-width unit. Depending on the design, they can also be operated using different supply voltages.

DHi

The auxiliary devices in the DHi 2 and DHi 11 series consist of auxiliary or fault signal switches that are intended for use with residual current circuit breakers from the DFS 2 and DFS 4 series. These devices indicate the operating status of a residual current circuit breaker using additional display devices (e.g. buzzers or light signals). The function is set via a control element on the DHi. They signal the closing and opening of the RCCB in „auxiliary switch" operating mode; only tripping is signalled in „fault signal switch" operating mode. Both DHis take up just half a module-width unit.

WES reclosing lockout

WES reclosing lockouts for DFS residual current circuit breakers prevent the associated switching device from closing. They can be used to implement protective measure „Secure against restart" during maintenance and repair work. The lockouts can be sealed or secured using a conventional padlock (shackle diameter up to 3.5 mm).

KA terminal cover

With our terminal covers, protecting people is simple. They prevent users accidentally touching live terminals, and the KA-DFS covers are suitable for both the two and four-pole DFS residual current circuit breakers.

We are partner

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