

Circuit-breaker overview

- Residual current protection from Doepke
- The key to a modern house distribution system
- All-round protection in the lab and in experimentation rooms
- Compact dual protection: residual current operated circuit-breakers with integral overcurrent protection
- Safety boosted to the power of three: fire protection switch
- Expert line protection
- Personal protection switch module



Doepke Academy



Webinars



- 20–45 minute interactive webinars
- Topics covered: recognising potential hazards, preventative protection technology, up-to-date information on safety guidelines and requirements
- The Doepke talk series: experts respond to your questions live and discuss the latest issues.

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Sendung

Dates and recordings available at: akademie.doepke.de

Residual current protection from Doepke

Type F:
mixed
frequency
sensitive

Type of residual current	A	F	B+	B
For sinusoidal AC residual currents = AC sensitive	■	■	■	■
For pulsating DC residual currents = pulsating current sensitive and AC sensitive	■	■	■	■
For residual currents with mixed frequencies = mixed frequency sensitive		■	■	■
For smooth DC residual currents = AC/DC sensitive			■	■
Short-time delayed = less faulty tripping, e.g. in response to inrush currents or surge currents during thunderstorms		■	■	■
Residual current detection up to 20 kHz			■	■
Residual current detection up to 150 kHz				■

DFS Type A — Standard protection for circuits with a frequency of 50 Hz. Suitable for scenarios where there is no risk of residual currents with a mixed frequency component, or of smooth DC residual currents (> 6 mA).

DFS Type F — Single-phase frequency converters generate mixed frequencies and are found in many everyday appliances in homes, workshops and offices (e.g. in washing machines, concrete vibrating tools, hammer drills and heating or thermal pumps). Consequently, Type F RCCBs provide future-proof protection for homes, offices and industry.

The right circuit-breaker for any requirements

AC/DC sensitive RCCBs

In the event of a fault, smooth DC residual currents can be generated by multi-phase operated or frequency-controlled electronic equipment such as cranes, pumps, fans, compactors or concrete vibrating tools. AC/DC sensitive RCCBs are also the optimum form of protection when using consumers with operating frequencies that extend into the kilohertz range. They are stipulated by many standards (see also page 8) and make a particularly important contribution to electrical safety on construction sites (see pages 2 and 3).

Type B NK

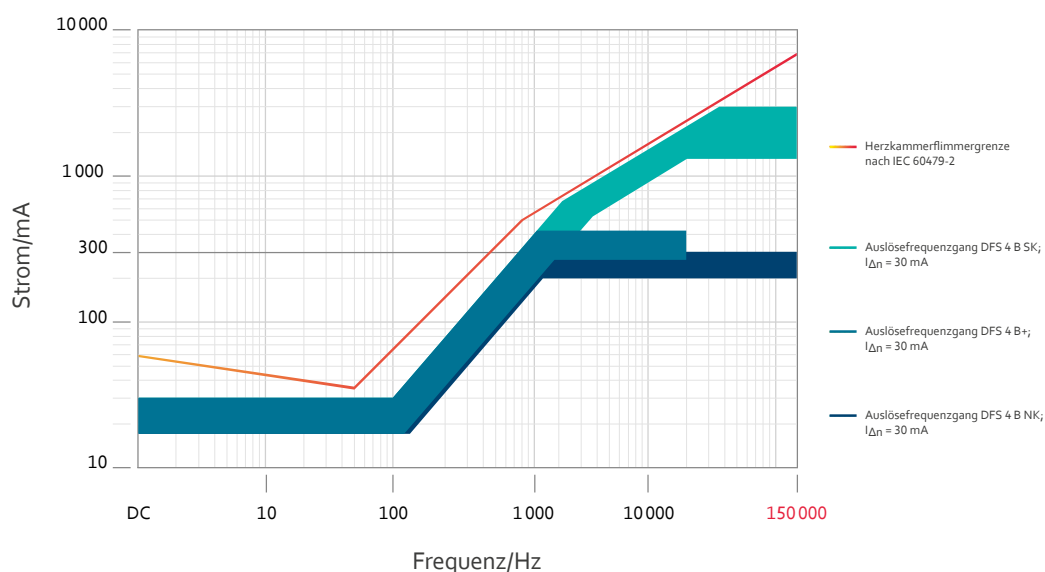
- For facilities at risk of fire
- Preventive fire protection up to max. 150 kHz
- Upper tripping limit of max. 300 mA
- Satisfies the standards DIN VDE 0664-10 and DIN VDE 0664-40
- Exceeds the requirements of standard DIN VDE 0664-400 (Type B+)

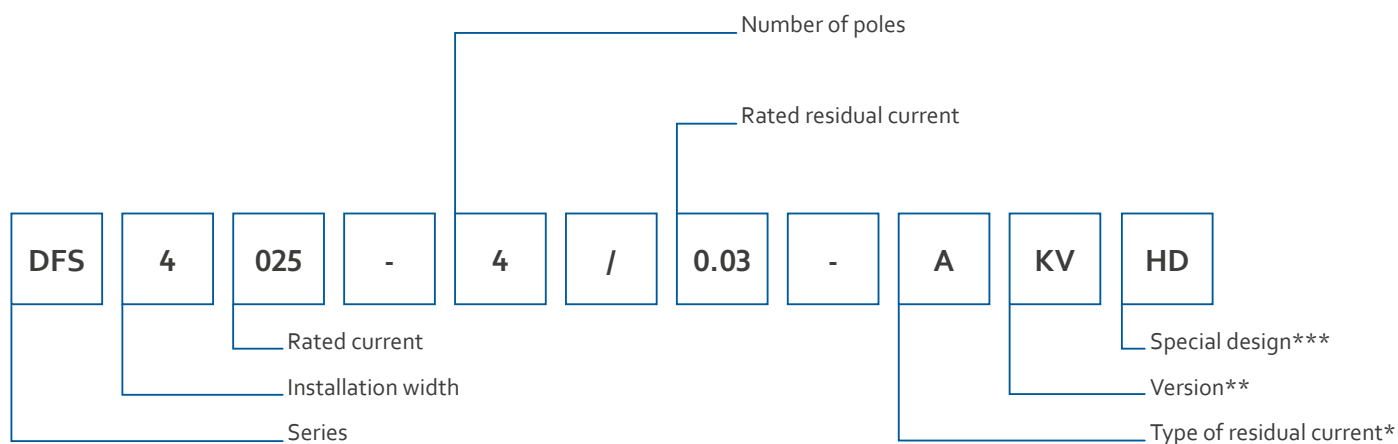
Type B+

- For facilities at risk of fire
- Fire protection up to max. 20 kHz
- Satisfies standard DIN VDE 0664-400
- Upper tripping limit of 420 mA

Type B SK

- High installation availability
- Tripping characteristic curve optimised for installations with high operational leakage currents
- Satisfies the standards DIN VDE 0664-10 and DIN VDE 0664-40
- With the ability to detect residual currents up to 150 kHz, it exceeds the requirements of the relevant device standard





*Type of residual current

- AC — Type AC (AC sensitive)
- A — Type A (pulsating current sensitive and AC sensitive)
- F — Type F (mixed frequency sensitive)
- B — Type B (AC/DC sensitive)
- B+ — Type B+ (AC/DC sensitive)

**Possible versions

- KV — Increased surge current strength: considerably less sensitive to short-term pulsed residual currents
- S — Selective: when RCCBs are connected in series
- FT — With remote tripping: enables functional testing from a distance
- V — Rated voltage \neq 230/400 V
- Hz — For frequencies \neq 50 Hz
- W — Point heater circuit-breaker, voltages up to 500 V
- SK — Tripping threshold of 3 A for frequencies greater than 1 kHz
- NK — Meets the conventional fire protection requirement of 300 mA up to a frequency of 150 kHz
- EV — For electromobility
- NA — Emergency stop function according to DIN VDE 0100-723
- MI — For mobile installations
- IS Ω HD — Insulation testing without the need for disconnection
- R — Neutral conductor on the right
- Twin — Two RCCBs in one device

***Special designs

- HD — Heavy-duty design for harsh environmental conditions

Our recommendations for a modern house distribution system

Type A

Residual current circuit-breaker DFS A

- For pulsating and alternating residual currents
- Application areas: socket circuits, conventional lighting

Type A KV

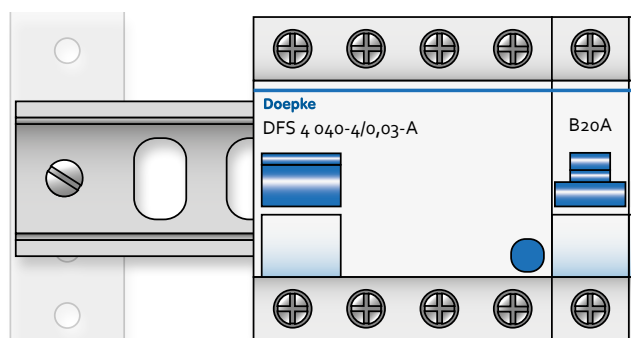
Residual current circuit-breaker DFS A KV

- For pulsating and alternating residual currents
- KV = short-time delayed, surge current proof
- Significantly less faulty tripping due to inrush currents from consumers such as: LED and fluorescent lamps or switched-mode power supplies
- Recommended in DIN VDE 0100-530

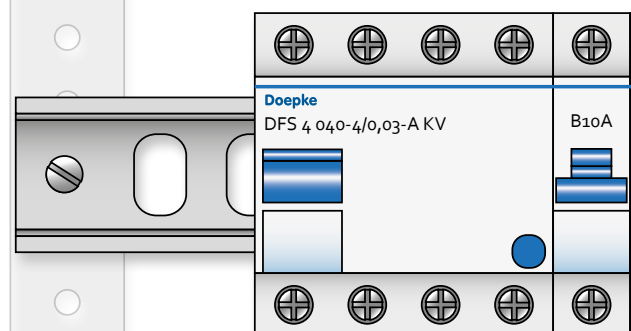
Type F

Residual current circuit-breaker DFS F

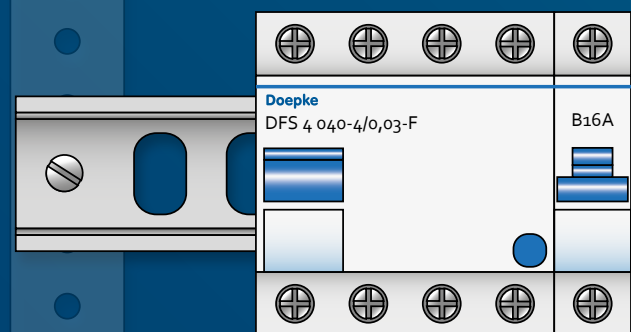
- For pulsating and alternating residual currents + residual currents with mixed frequencies
- Short-time delayed and lightning-resistant
- New addition to DIN VDE 0100-530
- Consumers with single-phase frequency converters: washing machines, heating or heat pumps, air conditioners



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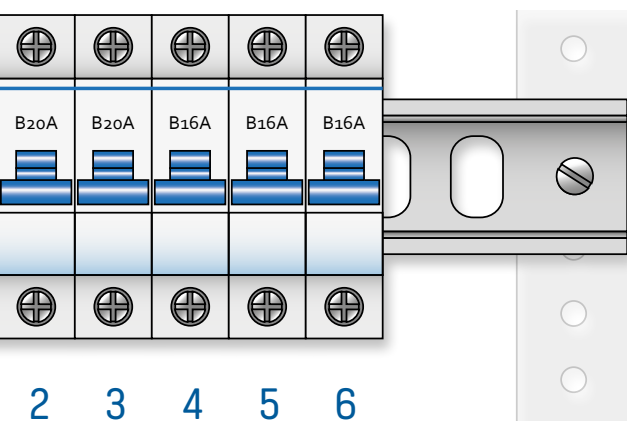
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Note: Type A and F in EV design:

Buyers are increasingly opting for electric vehicles in the private sector: Doepke also has residual current circuit-breakers in an EV (electric vehicle) design specifically for protecting against the DC residual currents that can occur when charging electric vehicles.

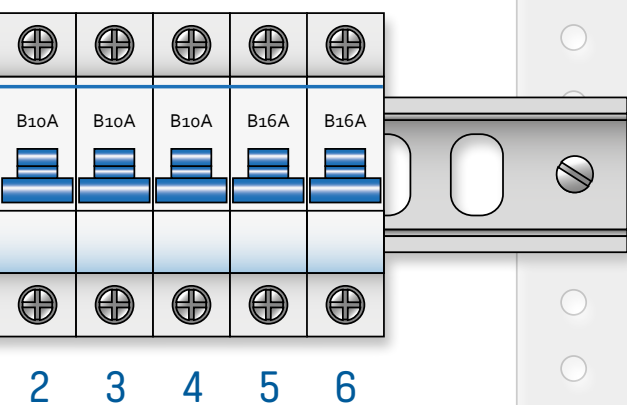


Miniature circuit-breaker

DLS 6

— Example assignment B 16 A/B 20 A:

- 1 –
- 2 –
- 3 –
- 4 – Sockets
- 5 – Freezer
- 6 – Refrigerator

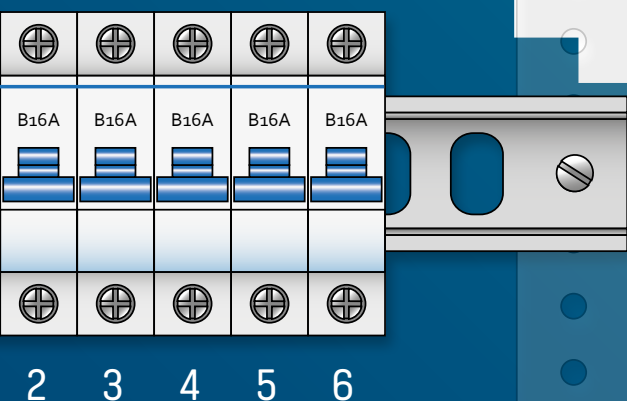


Miniature circuit-breaker

DLS 6

— Example assignment B 10 A/B 16 A:

- 1 – LED lighting
- 2 – LED lighting
- 3 – Sockets
- 4 – Fluorescent lamps
- 5 – ICT/switched-mode power supplies
- 6 – Solar power systems



Miniature circuit-breaker

DLS 6

— Example assignment B 16 A:

- 1 – Washing machine
- 2 – Heating pump
- 3 – Heat pump
- 4 – Air conditioners
- 5 – Vacuum cleaner systems
- 6 – Other devices with 1-phase FCs

*The general installation and manufacturer's instructions must also be observed



The safe way to charge electric vehicles

EV

— For electromobility

Doepke developed the EV (electric vehicles) design of its DFS RCCB specifically for charging electric vehicles. These circuit-breakers are VDE-certified to IEC 62955, detect smooth DC residual currents and trip at 6 mA DC. By using this product, you can prevent the summation current transformer's core from becoming pre-magnetised (a phenomenon known as "blinding").

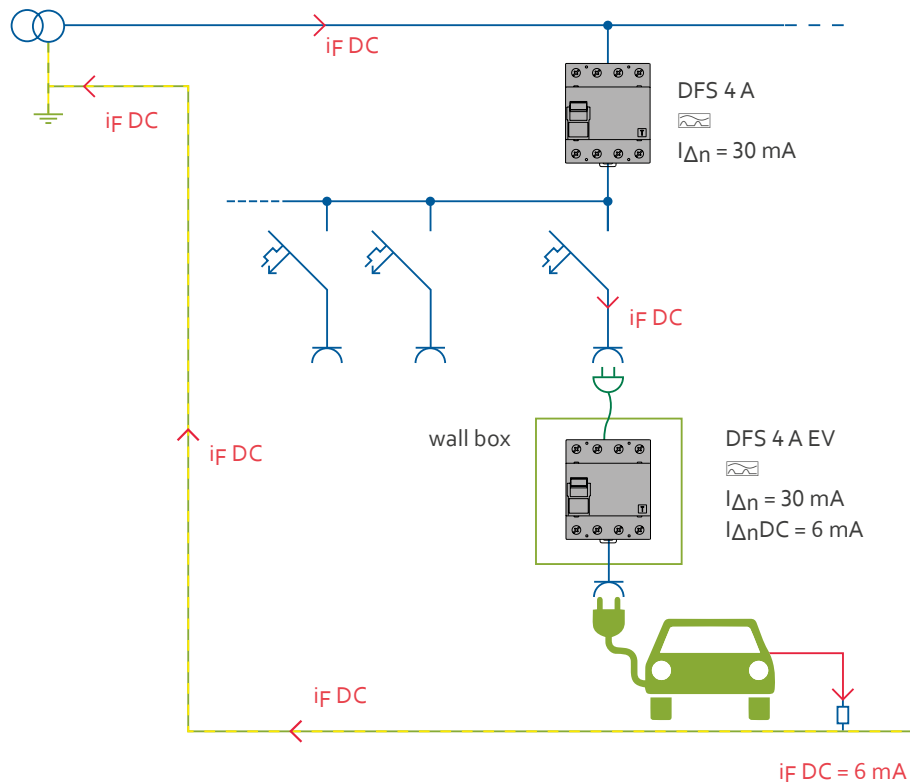
Not only does this protect the RCDs being used at this point, but also any upstream Type A and Type F RCDs.

The DFS 4 A EV NA was likewise developed specifically for use in electric vehicle charging equipment.

In addition to detecting 6 mA direct currents, it also offers an emergency switching-off function. In the event of danger, one or even several charging points can be switched off centrally at the push of a button. This ensures additional safety in public areas, for example.

- Ensures that existing RCDs continue to function safely
- Trips at max. 6 mA DC
- Type A certified to IEC 62955
- No additional components required for residual current protection
- Available in Type A and Type F
- Optical display of DC detection via LEDs

Residual current protection for charging – schematic diagram



Remote switching and signalling

DFA

Remote operators

After an RCCB has tripped, reclosing is not normally a problem, provided that the device is readily accessible. To prevent prolonged downtimes when installations are located some distance away, Doepke offers the DFA remote operator. This additional device can be used to monitor the RCCB and, depending on the series, reclose it remotely after it trips. Depending on the design, the circuit-breaker is reclosed automatically three times.

- For monitoring the connected RCCB and – depending on the series – reclosing it automatically
- Simple click-on connection
- Status signalled via relay or semiconductor output
- DFA 2: four module widths
- DFA 3: one module width
- Compatible with RCCBs from the DFS 2 and DFS 4 series



All-round protection in the lab and in experimentation rooms

NA

— Emergency switching-off —

Whenever locations contain circuitry for experiments and tests, it is advisable and sometimes even mandatory (as stipulated by DIN VDE 0100-723) to incorporate an emergency switching-off function into the circuits.

In addition to an AC/DC sensitive RCD, there must be a remote-controlled emergency stop circuit.

The technical requirements stipulate the use of a device that will disconnect all active conductors, including the neutral conductor. Our DFS 4 B NA products accommodate all these requirements in one compact device.

- Continuous monitoring of the external emergency switching-off circuit
- Allows the connection of emergency stop equipment, e.g. a button
- Prevents reclosing of the RCCB while the emergency stop button is activated
- LED signals status of the emergency stop circuit
- Auxiliary contact signals that the RCCB has tripped
- Available as Type A and Type B
- Suitable for use in accordance with the requirements of DIN VDE 0100-723



Versions: DFS 4 A EV NA and DHS FANA

The DFS 4 A EV NA has been developed specifically for use in electric vehicle charging equipment. It offers detection of 6 mA direct currents and an emergency switching-off function in one unit.

Reliable switching off

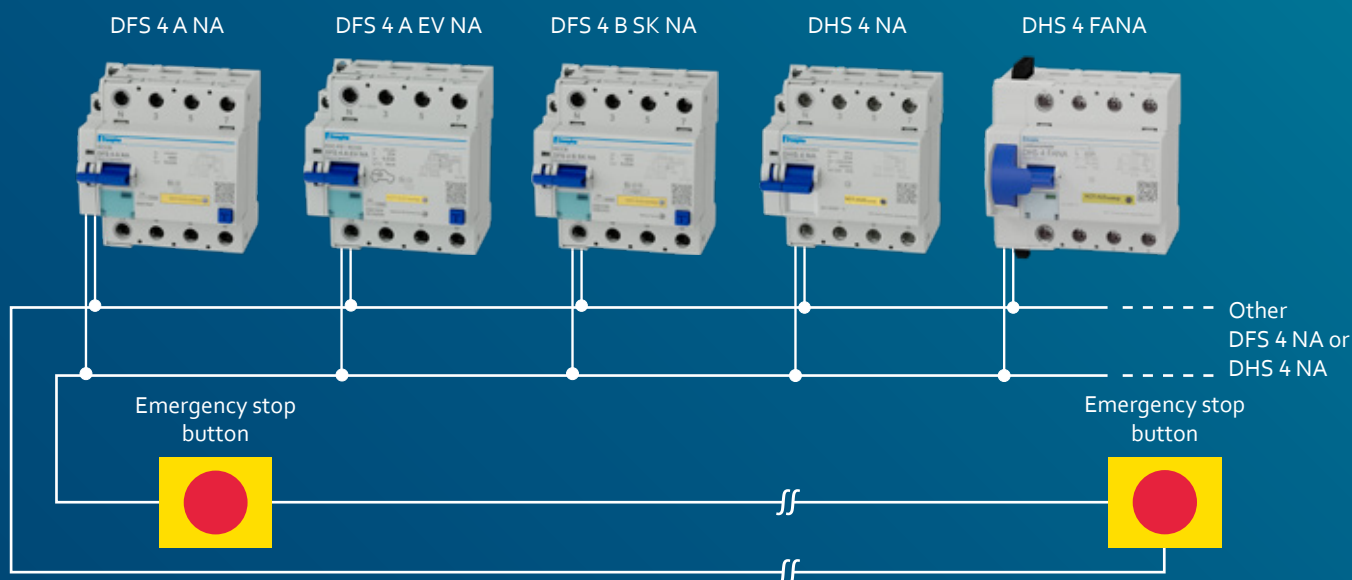
coupled with convenient switching on - The DHS FANA combines a switch-disconnector, an emergency switching-off function and remote operator all in one compact device. As soon as a connected emergency stop button is pressed, the DHS FANA fully disconnects all poles of the electrical supply from the connected system components and consumers. The remote operator makes reclosing the device really straightforward without the need for trips back and forth to the distribution board.

Remains closed in the event of a voltage drop

Supports the connection of multiple emergency stop buttons

Meets the requirements of DIN VDE 0100-723 when combined with a Type B residual current circuit-breaker

Safe and reliable disconnection with the emergency switching-off function.



Retrofitting AC/DC sensitive building-site distribution boards

Construction sites are frequently home to items of electric equipment that could potentially generate smooth DC residual currents in the event of a fault. Examples include cranes, pumps, fans, sand sifters, compactors and masonry saws, to name but a few. According to device standards, Type A residual current circuit-breakers must not be subjected to smooth DC residual currents higher than 6 mA. The reason for this is that even low smooth DC residual currents can have a detrimental effect on any Type A or Type F circuit-breakers, with the result that they are no longer able to provide reliable protection.

Excessive DC residual currents lead to pre-magnetisation of the summation current transformer. In turn, this can change the tripping thresholds and tripping times or cause a complete failure (a phenomenon known as 'blinding' because the device cannot see the fault current). In a worst-case scenario, a malfunction may go completely unnoticed.

According to DIN VDE 0100-704 (Requirements for special installations or locations – Construction and demolition site installations), a Type B residual current circuit-breaker has been a mandatory form of protection for all building-site distribution boards since May 2021: This means that three-phase sockets with a rated current up to and including 32 A must be protected by an RCCB for a rated residual current of max. 30 mA, while circuits with sockets exceeding 32 A must be protected by RCCBs for a rated residual current of max. 500 mA. This is the responsibility of the constructor.

ISΩ HD

– Test-proof and safe

ISΩ HD RCCBs are test-proof. When carrying out periodic testing on electric installations in accordance with DIN VDE 0100-600, this means that the insulation can be measured without having to disconnect the circuit-breakers first. Type B Doepke residual current circuit-breakers in the ISΩ HD design can handle nominal currents of up to 63 A and rated residual currents of up to 500 mA.



MI

– for mobile installations

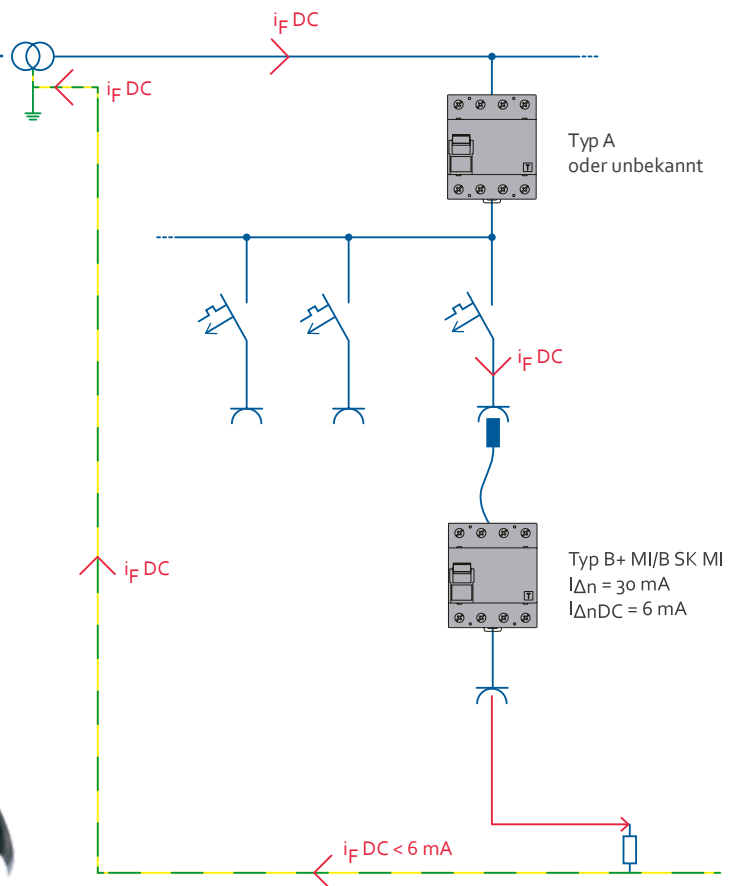
Multi-phase frequency converters are used in mobile installations on construction sites, at festivals, fairs or at similar locations/events. These applications require Type B RCDs. However, these must not be connected downstream of a Type A RCCB or a device of an unknown type. Operators are often unaware of which type of RCCB is installed in the upstream fixed installation.

The DFS B MI is the only Type B RCD that can be installed downstream of a Type A RCCB or one whose type is unknown. This means that it is always compatible, even if the type of RCCB in the upstream fixed installation is not known.

- Trips from a DC residual current of 6 mA
- Prevents pre-magnetisation of upstream Type A RCCBs or those of an unknown type and safeguards their protective function
- The only Type B RCD that can be connected downstream of a Type A RCCB
- Ideal for electrical consumers that can cause DC residual currents and are used in different locations
- DFS 4 B+ MI for use in facilities at risk of fire
- DFS 4 B SK MI for high installation availability: perfect for construction sites



Series connection of different types



Standards that refer to the use of AC/DC sensitive RCCBs

- DIN VDE 0100-530** ————— Low-voltage electrical installations; Selection and erection of electrical equipment – Switchgear and controlgear
- DIN VDE 0100-704** ————— Requirements for special installations or locations – Construction and demolition site installations
- DIN VDE 0100-712** ————— Requirements for special installations or locations – Solar photovoltaic (PV) power supply systems
- DIN VDE 0100-722** ————— Requirements for special installations or locations – Supplies for electric vehicles
- DIN VDE 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 equipment on construction sites
- DGUV Information 203-032** ————— Selection and operation of power generators on construction and installation sites
- DGUV Information 209-067 (BGI 5017)** ————— Charging equipment for vehicle batteries
- GDV Publications (VdS 3501)** ————— Insulation protection in electrical installations with electronic equipment – RCD and frequency converters
- VdS guideline 3145** ————— Guidelines from insurance providers for selecting, planning, erecting and operating grid-connected photovoltaic systems





Special environmental conditions require special protective measures

HD

– Heavy duty

- The specialist for harsh environments
- Virtually all DFS 2/4 devices are available in the HD special design
- Ideal for construction sites, farms, swimming pools, paint shops, electrical vehicle charging stations
- Less susceptible to corrosive gases, temperature fluctuations, corrosion
- Non-stop protection, including in the de-energised state
- Reason: Uses special alloys and has a stainless steel latch
- Ready for action 24/7/365



Frost



Heat



Dust



Moisture



Corrosive gases



Residual current and line protection: residual current operated circuit-breakers with integral overcurrent protection

Residual current operated circuit-breakers with integral overcurrent protection (RCBOs) are devices that offer combined residual current and line protection.

They are the number one choice for reliable protection against residual currents, short-circuits and overloads when it comes to circuits in residential and purpose-built buildings. RCBOs can be used to divide up electrical installations so that only the affected circuit is switched off in the event of a fault.

DRCBO 3 A and DRCBO 4 A

- _____ Mains voltage independent protection against AC residual currents and pulsating DC residual currents at the mains frequency
- _____ Conventional residual current protection in residential and purpose-built buildings
- _____ Ideal for socket outlet circuits and conventional lighting
- _____ Available with tripping characteristics B and C
- _____ Optionally available in a short-time delayed and lightning-resistant version (KV)
- _____ Rated residual currents of 10 mA, 30 mA, 100 mA and 300 mA
- _____ Rated currents up to 40 A
- _____ Rated short-circuit current of 6 kA, 10 kAr



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

Gerold Roofs, Head of Research and Development

DRCBO 4 B

— Compact double protection —

Doepke now offers its residual current operated circuit-breaker with integral overcurrent protection in an even more compact form: The DRCBO 4 B has a module width of just 2.5 units in the two-pole variant, and 4.5 units in the four-pole design. In the event of an overload, short-circuit or residual current, only the faulty circuit is switched off.

In addition to the tripping characteristics already available, B SK and B NK, the residual current operated circuit-breaker with integral overcurrent protection is now also available in a B+ version.

- Significant space savings
- Rated currents up to 32 A
- Rated residual currents of 30, 100 and 300 mA
- VDE-certified

Now available in an even more compact design



Module width of
2.5 instead of 4



Module width of
4.5 instead of 6



Safety³ = DAFDD

Doepke's DAFDD fire protection switch (AFDD = arc-fault detection device) provides triple safety, combining residual current protection and line protection with protection against dangerous arc faults in a size of just three module widths. If the additional module detects series or parallel arc faults, it switches off the circuit affected, thereby providing reliable protection.

- DAFDD**
- Three functions in a single device: RCCB + MCB + AFD
 - Measures just three module widths
 - Simple troubleshooting: signal indicates cause of tripping (LED flashing code, indicator triggered by fault current, indicator shows contact position)
 - Last AFD fault code is saved, can be read out again
 - integrated overvoltage protection (> 270 V)
 - Self-monitoring of AFD unit – no manual function test required
 - Residual current type A (pulsating current sensitive and AC current sensitive) and A KV (short-time delayed)
 - Line protection: tripping characteristics B and C available

DIN VDE 0100-420 recommends using arc-fault detection devices in:

- Premises with sleeping accommodation
- Rooms or places where there is a particular risk of fire
- Rooms or places made from flammable building materials
- Rooms or places where irreplaceable goods may be at risk

The planner and/or constructor must carry out a risk assessment as early as the planning phase in order to determine whether the use of AFDDs needs to be considered.





More than just fire protection: one device, three functions

Electric arcs and arc faults in series and parallel

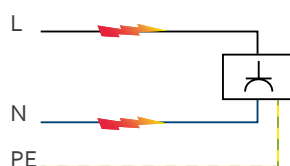
Electric arcs can occur for operational reasons when opening or closing mechanical contacts. They do not present any hazard.

Arc faults can be caused even by minor damage or insulation defects on conducting lines. If these go unnoticed, they can become a fire risk in the electrical installation. Parallel arc faults are detected by MCBs and RCCBs, but series arc faults can go unnoticed if no AFD unit is present.

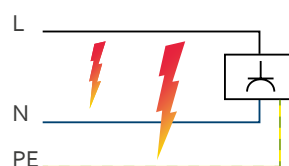
If these dangerous arc faults keep occurring for days, months or even years, they exert thermal stresses on the surrounding material, causing it to undergo changes and, in the worst-case scenario, leading to devastating fires.

Types of arc fault

Series fault:



Parallel fault:



Fault code display (repeated three times)

Continuously lit green:	normal operation
1 × yellow:	series fault
2 × yellow:	dimmer fault
3 × yellow:	parallel fault
4 × yellow:	overvoltage (>270 V)
5 × yellow:	temperature (> 115°C)
6 × yellow+ continuous yellow/red:	internal error

Expert line protection to keep you safe at all times

Miniature circuit-breakers (MCBs) protect cables, lines and installation devices against overloads and short circuits and – in turn – from damage and premature ageing.

DLS 6 The DLS 6 series provides a large selection of different types for use in residential and purpose-built buildings as well as the industrial sector. Its compact design leaves ample room for wiring. The DLS 6 miniature circuit-breakers (MCBs) are easy to install thanks to their large clamping area and are suitable for universal use thanks to the wide range of available accessories.

Protection elements The structure of the MCB consists of two protection elements.

Electromagnetic tripping

If the overcurrent increases to the point that it enters the short-circuit range (higher than or equal to the magnetic threshold), the magnet system instantly reacts.

Thermal tripping

The circuit is interrupted if the rated current is exceeded for a prolonged period but is below the magnetic tripping threshold. The miniature circuit-breaker will not react in the event of brief, minor exceedances.



At a glance Our “red” MCBs
According to DIN VDE 0100-560 (Equipment for safety purposes)
switchgear and control gear must be clearly labelled.
This applies to final circuits such as
Safety lighting
Fire alarms
Smoke and heat ventilation systems





Product range

— The fact that the system components are designed for different functions and levels of performance means that the range offers the ideal solution for a wide variety of applications:

DLS 6h — The DLS 6h design for skilled trade applications and conventional residential buildings features a rated switching capacity of 6 kA, making it ideal for distributor and final circuits.

DLS 6h — The DLS 6hsl screwless design for industrial/commercial applications features a rated switching capacity of 6 kA, making it ideal for distributor and final circuits. It is particularly easy to handle thanks to the screwless plug-in terminals at the top.

DLS 6hdc — The DLS 6hdc design features a rated switching capacity of 6 kA, making it ideal for applications in DC networks of up to 250 V DC.

DLS 6i — The DLS 6i design features a high rated switching capacity of 10 kA, making it perfect for industrial and mechanical engineering applications.

DPRCD-M – For safe use of heavy current

If a socket within an existing installation is going to be used for commercial/industrial purposes but you do not know what upstream protective measures are in place, you must implement suitable safety precautions first. That is why we offer the PRCD for 230 V sockets. However, according to BG Bau (the employers' mutual insurance association for the construction industry in Germany), a PRCD is also required for 400 V sockets.

To accommodate this, Doepke has developed the DPRCD-M. This module combines an AC/DC sensitive residual current protection device with mains conductor and protective earthing conductor monitoring. The key feature of a mobile PRCD is that it is connected between the heavy current socket and the consumer. The DPRCD-M provides 30 mA residual current protection (for personal protection) and trips in response to DC residual currents of 6 mA or higher. This prevents pre-magnetisation of any upstream residual current circuit-breakers, thereby safeguarding their protective function.

If a voltage is present on the protective earthing conductor or if the conductor is interrupted, the DPRCD-M cannot be closed.

Mobile
personal
protection



If the fault on the protective earthing conductor occurs during operation, the DPRCD-M opens immediately. If external voltage is applied to the protective earthing conductor – e.g. as a result of drilling into a line – all mains conductors are disconnected but the protective earthing conductor remains connected. If the feeding voltage is interrupted, the DPRCD-M opens – but when the voltage is restored, it does not close again automatically for safety reasons.

- Protective earthing conductor monitoring
- Undervoltage release
- Mains conductor monitoring
- External residual current detection
- Optional anti-clockwise rotating field lock
- All-pole disconnection, including protective earthing conductor
- Single toggle operation
- Funding through BG Bau





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