

# xEffect

## RCDs for machines and equipment with electrical drives



# EATON

*Powering Business Worldwide*

## Enhanced reliability in drive applications



### Challenges for machine builder

The use of an RCD is an effective instrument for protection against electrical shock and fire prevention. Innovative electrical drive systems offer specific application solutions and improving the energy efficiency. In modern electrical equipment's and machineries both components are used together in more and more cases.

Thereby it is mandatory to consider the compliance with all standards and regulations.

Especial attention must be paid here on the usual technical compatibility problems between RCDs and electrical drive systems.

Unwanted trips of the RCDs can happen during the normal operation because of

high system cause earth leakage currents which are generated in applications with frequency controlled drives. Increasing the level of the personal and equipment protection means very often a reduced system up time.

### Optimized interaction of Eaton Drives and RCDs

Eaton takes up this problem and offers a complete solution from one hand. The interaction between Eaton drives and RCDs are harmonized. Unwanted trips because of system caused earth leakage currents will be avoided and a safe power disconnection in case of dangerous fault currents is guaranteed.

It is clearly recommended and in many cases already mandatory to use RCDs Type F and Bf<sub>q</sub> are for such application.

They gives the possibility to offer a safe and reliable operation of the machine with a high system uptime.

To learn how a harmonized RCDs and drives solution can provide increased energy efficiency with maximum productivity and machine uptime download the whitepaper here [www.eaton.eu/en/cp/rcd](http://www.eaton.eu/en/cp/rcd)



# Residual Current Devices Type F



## Benefits:

- Reliable protection for machines with 1-phase frequency converters
- Increased protection due to
  - detection of mixed frequencies
  - higher load rating with DC residual currents up to 10mA
- Reduction of nuisance tripping thanks to
  - time delayed tripping
  - high current withstand capability

## Definition

The Type F RCD is defined according IEC/ EN 62423. It provides safe and reliable protection against sinusoidal residual currents and pulsating DC fault currents (like Type A devices). It is also capable of handling residual currents with mixed frequencies of up to 1 kHz (10, 50, 1000 Hz) in accordance with the IEC 62423 standard.

Type F RCDs can accept smooth DC residual currents of up to 10 mA without affecting their standard functionality, have a time delayed tripping and distinguish themselves from other devices thanks to their high resistance to power surges: this ensures minimal false tripping and a high degree of safety.

They are available in 2-pole or 4-pole versions for nominal currents of 16 to 100 A. With three versions for different residual currents (30 mA, 100 mA and 300 mA), Type F RCDs are voltage independent and can be used for fault and additional protection. As a result, the recommendations for installations including variable frequency drives have been modified.

## Field of Application

Type F residual-current circuit breaker are designed specifically for use in applications with single phase frequency converters, such as pumps, welding units, vibrators or hammer drills. In this type of application, residual currents with mixed frequencies can arise which residual-current circuit breakers Type AC and A

are unable to cope with. The detection of mixed frequencies and the higher load rating with DC residual currents up to 10 mA the RCD Type F provides excellent protection for humans and the system in all applications which contains appliances and motors with single phase frequency converters.

The time delayed tripping and the high current withstands capability supports in addition to avoid nuisance tripping. Overall the RCD Type F enables machine builders and plant manufacturers to develop equipment that is extremely reliable while ensuring high safety levels for the operator and maintenance staff.



## Residual Current Devices Type B, Bfq and B+



### Benefits:

- Reliable protection for machines with 3phase frequency converters
- Safe power disconnection at smooth DC and AC residual Currents
- Detection of high frequency residual currents
- Highest system availability by digital technology and pre-warnings

## Definition

The RCCB Type B detects (acc. to IEC 62423) beside AC and pulsating DC residual currents also smooth DC residual currents. With the extended sensitivity of the RCCB Type B electrical installers and machinery builders can increase the safety considerably in power distribution and machineries.

The special adapted tripping curve (non-sensitive against system caused earth leakage currents at high frequencies) of the RCCB Typ Bfq complies to the specifications of the RCCB Type B and avoid in addition unwanted tripping in industrial applications which contains frequency converter controls.

The RCCB Typ B+ is sensitive to all residual currents and is additionally equipped with a tripping curve that limits the tripping current to max. 420 mA for frequencies up to 20 kHz. This complies additionally to the specifications for superior fire protection according to the German standard VDE 066-440 (formerly VVDEV 0664-110).

## Field of Application

Smooth DC residual currents can occur in industrial, commercial and residential applications which contain photovoltaic systems, frequency converters or electronic consumers. In this kind of applications only RCCBs Type B, Bfq or B+ can guarantee a safe protection for persons and equipment.

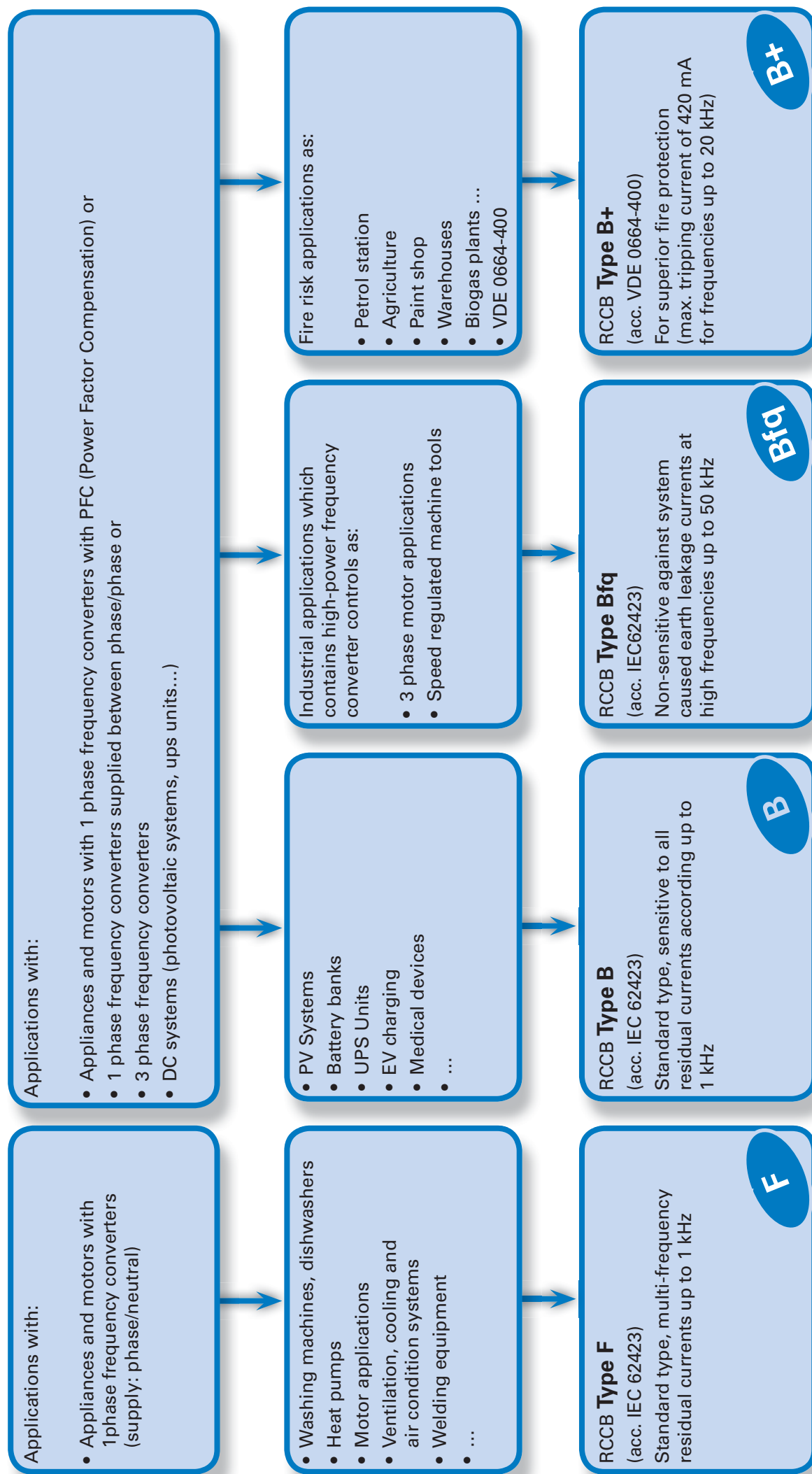
They are also equipped with a time delayed tripping and a high current withstand capability to offer high reliability for the system.

RCCBs Type Bfq with their special adapted tripping curve are the perfect choice for industrial applications with 3phase frequency converters.

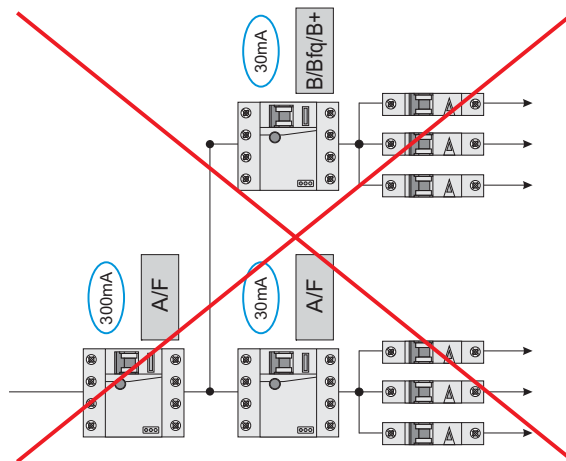
RCCBs Type B+ are perfectly suitable for installers and machinery builders to increase the safety in fire risk applications as petrol station, agriculture, paint shops, depots, warehouses and many more.



## Selection help RCDs Type F / Type B






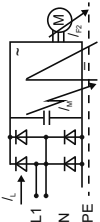
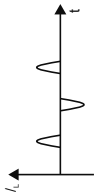
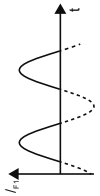
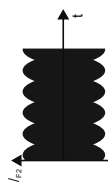






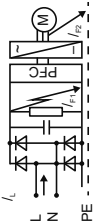
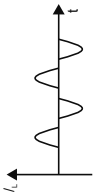
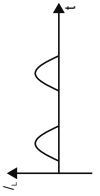







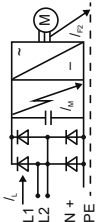
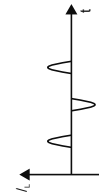
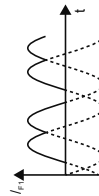







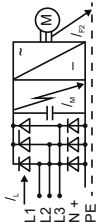
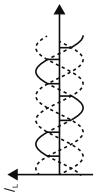
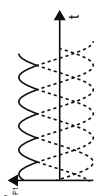



## Possible residual current waveforms of applications with frequency converters and suitable RDCs



RCDs Type F are not suitable for appliances that can generate smooth DC residual currents e.g. 1 phase FC with PFC or 1 phase FC supplied between phase/phase.

Electrical loads that can generate smooth DC residual currents in the event of a fault must be assigned to their own circuit with a universal current-sensitive residual current protective device (type B, type Bfg or type B+).

Suitable RCCB Type	Circuit	Load Current	Residual Current
B    F  			 
1			
B+    kHz   			 
2			
Bf    kHz   			 
3			
Bf    kHz   			 
4			

## Possible residual current waveforms and suitable RCDs

Suitable RCCB – Type	Circuit	Load Current	Residual Current
<div> <div>B</div> <div>F</div> <div>A</div> <div>AC</div> </div> <div> <div>B+</div> <div>BfHz</div> <div>Bfq</div> </div>	1		
	2		
	3		
	4		
	5		
	6		
	7		
	8		
	9		
	10		
	11		
	12		
	13		
	14		

The table shows the possible residual current wave forms and the suitable RCDs.

In general RCDs Type F are designed for applications with 1 phase frequency converters. But there are also 1 phase FC (frequency converters) designs which require RCD Type B protection.

RCDs Type F are not suitable for applications that can generate smooth DC residu-

al currents e.g. 1 phase FC with PFC or 1 phase FC supplied between phase/phase (see Table, Possible residual current waveforms and suitable RCDs, circuits 8 to 13).


They are not suitable for installation in networks with frequencies that deviate from the rated frequency 50/60 Hz (not at the outgoing terminal of a frequency converter).


Electrical loads that can generate smooth DC residual currents in the event of a fault must be assigned to their own circuit with a universal current-sensitive residual current protective device (type B, type Bfq or type B+).

For more details see Eaton Whitepaper „RCDs&Drives“.

## Residual Current Devices FRCmM Type G/F


Surge current-proof 3 kA, sensitive to residual pulsating DC, Type G/F (ÖVE E 8601)  


	$I_n/I_{\Delta n}$ (A)	Type Designation	Article No.	Units per package
	<b>2-pole</b>			
	16/0.03	FRCmM-16/2/003-G/F	187365	1/60
	16/0.1	FRCmM-16/2/01-G/F	187371	1/60
	16/0.3	FRCmM-16/2/03-G/F	187377	1/60
	25/0.03	FRCmM-25/2/003-G/F	187366	1/60
	25/0.1	FRCmM-25/2/01-G/F	187372	1/60
	25/0.3	FRCmM-25/2/03-G/F	187378	1/60
	40/0.03	FRCmM-40/2/003-G/F	187367	1/60
	40/0.1	FRCmM-40/2/01-G/F	187373	1/60
	40/0.3	FRCmM-40/2/03-G/F	187379	1/60
	63/0.03	FRCmM-63/2/003-G/F	187368	1/60
	63/0.1	FRCmM-63/2/01-G/F	187374	1/60
	63/0.3	FRCmM-63/2/03-G/F	187380	1/60
	80/0.03	FRCmM-80/2/003-G/F	187369	1/60
	80/0.1	FRCmM-80/2/01-G/F	187375	1/60
	80/0.3	FRCmM-80/2/03-G/F	187381	1/60
	100/0.03	FRCmM-100/2/003-G/F	187370	1/60
	100/0.1	FRCmM-100/2/01-G/F	187376	1/60
	100/0.3	FRCmM-100/2/03-G/F	187382	1/60

	<b>4-pole</b>			
	16/0.03	FRCmM-16/4/003-G/F	187407	1/30
	16/0.1	FRCmM-16/4/01-G/F	187413	1/30
	16/0.3	FRCmM-16/4/03-G/F	187419	1/30
	25/0.03	FRCmM-25/4/003-G/F	187408	1/30
	25/0.1	FRCmM-25/4/01-G/F	187414	1/30
	25/0.3	FRCmM-25/4/03-G/F	187420	1/30
	40/0.03	FRCmM-40/4/003-G/F	187409	1/30
	40/0.1	FRCmM-40/4/01-G/F	187415	1/30
	40/0.3	FRCmM-40/4/03-G/F	187421	1/30
	63/0.03	FRCmM-63/4/003-G/F	187410	1/30
	63/0.1	FRCmM-63/4/01-G/F	187416	1/30
	63/0.3	FRCmM-63/4/03-G/F	187422	1/30

## Residual Current Devices FRCmM Type S/F

Surge current-proof 5 kA, sensitive to residual pulsating DC, Type S/F (ÖVE E 8601)  



	$I_n/I_{\Delta n}$ (A)	Type Designation	Article No.	Units per package
	<b>2-pole</b>			
	16/0.1	FRCmM-16/2/01-S/F	187389	1/60
	16/0.3	FRCmM-16/2/03-S/F	187395	1/60
	25/0.1	FRCmM-25/2/01-S/F	187390	1/60
	25/0.3	FRCmM-25/2/03-S/F	187396	1/60
	40/0.1	FRCmM-40/2/01-S/F	187391	1/60
	40/0.3	FRCmM-40/2/03-S/F	187397	1/60
	63/0.1	FRCmM-63/2/01-S/F	187392	1/60
	63/0.3	FRCmM-63/2/03-S/F	187398	1/60
	80/0.1	FRCmM-80/2/01-S/F	187393	1/60
	80/0.3	FRCmM-80/2/03-S/F	187399	1/60
	100/0.1	FRCmM-100/2/01-S/F	187394	1/60
	100/0.3	FRCmM-100/2/03-S/F	187400	1/60

	<b>4-pole</b>			
	16/0.1	FRCmM-16/4/01-S/F	187431	1/30
	16/0.3	FRCmM-16/4/03-S/F	187437	1/30
	25/0.1	FRCmM-25/4/01-S/F	187432	1/30
	25/0.3	FRCmM-25/4/03-S/F	187438	1/30
	40/0.1	FRCmM-40/4/01-S/F	187433	1/30
	40/0.3	FRCmM-40/4/03-S/F	187439	1/30
	63/0.1	FRCmM-63/4/01-S/F	187434	1/30
	63/0.3	FRCmM-63/4/03-S/F	187440	1/30

## Residual Current Devices FRCdM Type G/B

**Surge current-proof 3 kA, AC-DC sensitive, Type G/B (ÖVE E 8601)**





	$I_{r}/I_{\Delta n}$ (A)	Type Designation	Article No.	Units per package
 	<b>4-pole</b>			
	25/0.03	FRCdM-25/4/003-G/B	167892	1/30
	25/0.3	FRCdM-25/4/03-G/B	167896	1/30
	40/0.03	FRCdM-40/4/003-G/B	187893	1/30
	40/0.3	FRCdM-40/4/03-G/B	167897	1/30
	63/0.03	FRCdM-63/4/003-G/B	167894	1/30
	63/0.3	FRCdM-63/4/03-G/B	167898	1/30

## Residual Current Devices FRCdM Type S/B

**Selective + surge current-proof 5 kA, Type S/B**





 	<b>4-pole</b>			
	25/0.3	FRCdM-25/4/03-S/B	167900	1/30
	40/0.3	FRCdM-40/4/03-S/B	167901	1/30
	63/0.3	FRCdM-40/4/03-S/B	167902	1/30

## Residual Current Devices FRCdM Type G/Bfq

**Surge current-proof 3 kA, AC-DC sensitive, Type G/Bfq (ÖVE E 8601)**





 	<b>4-pole</b>			
	25/0.03	FRCdM-25/4/003-G/Bfq	179530	1/30
	25/0.3	FRCdM-25/4/03-G/Bfq	167904	1/30
	40/0.03	FRCdM-40/4/003-G/Bfq	179531	1/30
	40/0.3	FRCdM-40/4/03-G/Bfq	167905	1/30
	63/0.03	FRCdM-63/4/003-G/Bfq	179532	1/30
	63/0.3	FRCdM-63/4/03-G/Bfq	167906	1/30

## Residual Current Devices FRCdM Type S/Bfq

**Selective + surge current-proof 5 kA, Type S/Bfq**





 	<b>4-pole</b>			
	25/0.3	FRCdM-25/4/03-S/Bfq	167908	1/30
	40/0.3	FRCdM-40/4/03-S/Bfq	167909	1/30
	63/0.3	FRCdM-63/4/03-S/Bfq	167910	1/30

## Residual Current Devices FRCdM Type G/B+

**Surge current-proof 3 kA, Type G/B+ (ÖVE E 8601)**





 	<b>4-pole</b>			
	25/0.03	FRCdM-25/4/003-G/B+	167880	1/30
	25/0.3	FRCdM-25/4/03-G/B+	167884	1/30
	40/0.03	FRCdM-40/4/003-G/B+	167881	1/30
	40/0.3	FRCdM-40/4/03-G/B+	167885	1/30
	63/0.03	FRCdM-63/4/003-G/B+	167882	1/30
	63/0.3	FRCdM-63/4/03-G/B+	167886	1/30

## Residual Current Devices FRCdM Type S/B+

**Selective + surge current-proof 5 kA, Type S/B+**



 	<b>4-pole</b>			
	25/0.3	FRCdM-25/4/03-S/B+	167888	1/30
	40/0.3	FRCdM-40/4/03-S/B+	167889	1/30
	63/0.3	FRCdM-63/4/03-S/B+	167890	1/30

## Technical Data

FRCmM, Type F	
<b>Electrical</b>	
Design according to	IEC/EN 61008 Type G acc. to ÖVE E 8601
Current test marks as printed onto the device	
Tripping	instantaneous
Type G	10 ms delay
Type S	40 ms delay - with selective disconnecting function
Rated voltage	$U_n$ 240/415V AC, 50/60Hz
Limits operation voltage test circuit	
2-pole	196 - 264 V~
4-pole 30 mA	196 - 264 V~
4-pole 100, 300 mA	196 - 456 V~
Rated tripping current	$I_{\Delta n}$ 30, 100, 300 mA
Sensitivity	AC and pulsating DC
Rated insulation voltage	$U_i$ 440 V
Rated impulse withstand voltage	$U_{imp}$ 4 kV (1.2/50µs)
Rated short circuit capacity	$I_{cn}$ 10 kA with back-up fuse
Peak withstand current	
Type G/F	3 kA (8/20 µs) surge current proof, 10 ms delayed
Type S/F	5 kA (8/20 µs) surge current proof, 40 ms delayed
Rated breaking capacity or rated fault breaking capacity	
$I_n = 16-40$ A	500 A
$I_n = 63$ A	630 A
Endurance	
electrical components	≥ 4,000 operating cycles
mechanical components	≥ 20,000 operating cycles
<b>Mechanical</b>	
Frame size	45 mm
Device height	80 mm
Device width	35 mm (2MU), 70 mm (4MU)
Mounting	quick fastening with 2 lock-in positions on DIN rail IEC/EN 60715
Degree of protection, built-in	IP40
Degree of protection in moisture-proof enclosure	IP54
Upper and lower terminals	open mouthed/lift terminals
Terminal protection	finger and hand touch safe, BGV A3, ÖVE-EN 6
Terminal capacity	1.5 - 35 mm <sup>2</sup> single wire
	2 x 16 mm <sup>2</sup> multi wire
Terminal screw	M5 (with slotted screw acc. to EN ISO 4757-Z2, Pozidriv PZ2)
Terminal torque	2 - 2.4 Nm
Busbar thickness	0.8 - 2 mm
Operation temperature	-25°C to +40°C
Storage- and transport temperature	-35°C to +60°C
Resistance to climatic conditions	acc. to IEC/EN 61008
Contact position indicator	red / green
Tripping indicator	white / blue

## Technical Data

FRCdM Type B, Bfq and B+	
<b>Electrical</b>	
Design according to	Types B and Bfq acc. to IEC/EN 61008, IEC/EN 62423 Types B+ acc. to VDE 0664-400, formerly known as VDE V 0664-110 Type G/B, G/Bfq and G/B+ additional acc. to ÖVE E 8601
Current test marks as printed onto the device	
Tripping	
Type G	10 ms delay - with selective disconnecting function
Type S	40 ms delay - with selective disconnecting function
Rated voltage	$U_n$ 240/415 V AC, 50 Hz (Special types for 60 Hz Networks available)
Limits operation voltage electronic	50 – 456V AC
Limits operation voltage test circuit	
30 mA	196 - 264 V~
300 mA	196 - 456 V~
Rated tripping current	$I_{\Delta n}$ 30, 300 mA
Sensitivity	All types of current
Rated insulation voltage	$U_i$ 440 V
Rated impulse withstand voltage	$U_{imp}$ 4 kV (1.2/50µs)
Rated short circuit capacity	$I_{cn}$ 10 kA with back-up fuse
Peak withstand current	
Type G/B, G/B+ and G/Bfq	3 kA (8/20 µs) surge current proof
Type S/B, S/B+ and S/Bfq	typ. 5 kA (8/20 µs) selective + surge current proof
Rated breaking capacity	
or rated fault breaking capacity	
$I_n = 25-40$ A	500 A
$I_n = 63$ A	630 A
Endurance	
electrical components	≥ 4,000 operating cycles
mechanical components	≥ 20,000 operating cycles
<b>Mechanical</b>	
Frame size	45 mm
Device height	80 mm
Device width	70 mm (4MU)
Mounting	quick fastening with 2 lock-in positions on DIN rail IEC/EN 60715
Degree of protection, built-in	IP40
Degree of protection in moisture-proof enclosure	IP54
Upper and lower terminals	open mouthed/lift terminals
Terminal protection	finger and hand touch safe, BGV A3, ÖVE-EN 6
Terminal capacity	1.5 - 35 mm <sup>2</sup> single wire 2 x 16 mm <sup>2</sup> multi wire
Terminal screw	M5 (with slotted screw acc. to EN ISO 4757-Z2, Pozidriv PZ2)
Terminal capacity warning contact	0.25-1.5 mm <sup>2</sup> (plug in terminals)
Terminal torque	2 - 2.4 Nm
Busbar thickness	0.8 - 2 mm
Operation temperature	
25-40 A	-25°C to +55°C
63 A	-25°C to +45°C
Storage- and transport temperature	-35°C to +60°C
Resistance to climatic conditions	acc. to IEC/EN 61008
Contact position indicator	red / green
Tripping indicator	white / blue
<b>Alarm contact</b>	
Nominal switching capacity @ 30 V DC (resistive load)	2 A
Nominal switching capacity @ 240 V AC (resistive load)	0.25 A
Maximum switching power (resistive load)	60 W
Maximum switching voltage DC	220 V
Maximum switching voltage AC	240 V
Maximum switching current	2 A
Minimum switching capacity (Reference value)	10 µA, 10 mV DC
Number of electrical operations	
Electrical (at 20 cpm) 2 A 30 V DC resistive	>10 <sup>5</sup>
Electrical (at 20 cpm) 1 A 30 V DC resistive	>5 x 10 <sup>5</sup>
Terminals	0.25 – 1.5 mm <sup>2</sup>

Eaton is a power management company with 2016 sales of \$19.7 billion. We provide energy-efficient solutions that help our customers effectively manage electrical, hydraulic and mechanical power more efficiently, safely and sustainably. Eaton is dedicated to improving the quality of life and the environment through the use of power management technologies and services. Eaton has approximately 95,000 employees and sells products to customers in more than 175 countries.

For more information, visit [Eaton.com](http://Eaton.com).



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