Eaton.com

xEffect - Industrial Switchgear Range Combined RCD/MCB Devices FRBm4

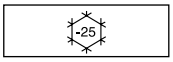
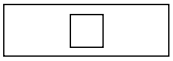
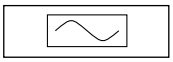
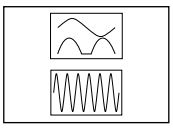
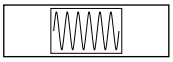
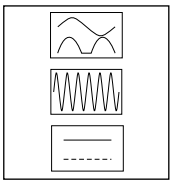
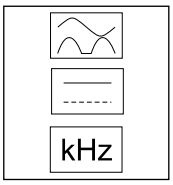
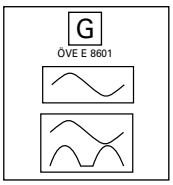
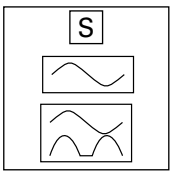
Catalog

EATON

Powering Business Worldwide

Residual Current Devices - General Data

Short description of the most important RCD types

Symbol	Description
	Eaton standard. Suitable for outdoor installation (distribution boxes for outdoor installation and building sites) up to -25° C.
	Conditionally surge-current proof (>250 A, 8/20 µs) for general application.
	Type AC: AC current sensitive RCCB
	Type A: AC and pulsating DC current sensitive RCCB, not affected by smooth DC fault currents up to 6 mA
	Type F: AC and pulsating DC current sensitive RCCB, trips also at frequency mixtures (10 Hz, 50 Hz, 1000 Hz), min. 10 ms time-delayed, min. 3 kA surge current proof, higher load capacity with smooth DC fault currents up to 10 mA
	Frequency range up to 20 kHz
	Trips also at frequency mixtures (10 Hz, 50 Hz, 1000 Hz)
	Type B: All-current sensitive RCD switchgear for applications where DC fault currents may occur. Non-selective, non-delayed. Protection against all kinds of fault currents.
	Type B+: All-current sensitive RCD switchgear for applications where DC fault currents may occur. Non-selective, non-delayed. Protection against all kinds of fault currents. Provides enhanced fire safety.
	RCD of type G (min 10 ms time delay) surge current-proof up to 3 kA. For system components where protection against unwanted tripping is needed to avoid personal injury and damage to property. Also for systems involving long lines with high capacitive reactance. Some versions are sensitive to pulsating DC. Some versions are available in all-current sensitive design.
	RCD of type S (selective, min 40 ms time delay) surge current-proof up to 5 kA. Mainly used as main switch, as well as in combination with surge arresters.This is the only RCD suitable for series connection with other types if the rated tripping current of the downstream RCD does not exceed one third of the rated tripping current of the device of type S. Some versions are sensitive to pulsating DC. Some versions are available in all-current sensitive design.

Kind of residual current and correct use of RCD Types

Kind of current	Current profile	Correct use / application field of RCCB types AC	A	F	B / B+	Tripping current
Sinusoidal AC residual current		✔	✔	✔	✔	0.5 to 1.0 $I_{\Delta n}$
Pulsating DC residual current (positive or negative half-wave)		–	✔	✔	✔	0.35 to 1.4 $I_{\Delta n}$
Cut half-wave current		–	✔	✔	✔	Lead angle 90°: 0.25 to 1.4 $I_{\Delta n}$
Lead angle 90° el Lead angle 135° el			✔	✔	✔	Lead angle 135°: 0.11 to 1.4 $I_{\Delta n}$
Half-wave with smooth DC current of 6 mA		–	✔	✔	✔	max. 1.4 $I_{\Delta n}$ + 6 mA
Half-wave with smooth DC current of 10 mA		–	–	✔	✔	max. 1.4 $I_{\Delta n}$ + 10 mA
Smooth DC current		–	–	–	✔	0.5 to 2.0 $I_{\Delta n}$

Tripping time

Break time and non-actuating time for alternating residual currents (r.m.s. values) for type AC and A RCCB

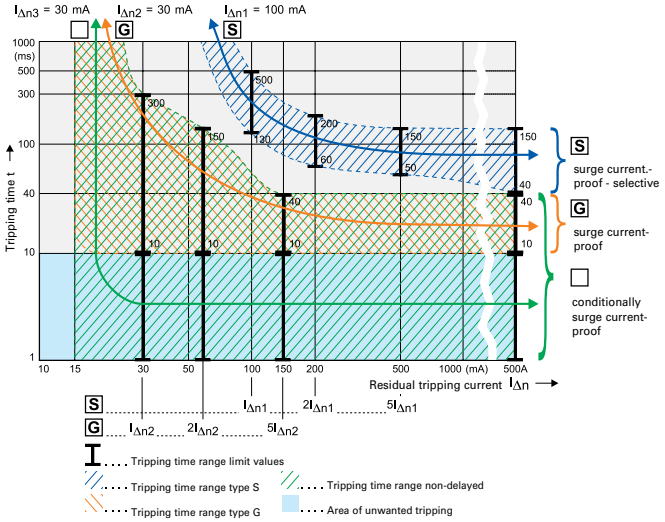
Classification	$I_{\Delta n}$ mA		$I_{\Delta n}$	$2xI_{\Delta n}$	$5xI_{\Delta n}$	5 x $I_{\Delta n}$ or 0.25A	500A
Standard RCD Conditionally surge current-proof 250 A	≤30	Max. tripping time (s)	0.3	0.15		0.04	0.04
Standard RCD Conditionally surge current-proof 250 A	>30	Max. tripping time (s)	0.3	0.15	0.04		0.04
RCCB Type G (Short-time-delay) Surge current-proof 3 kA	30	Min. non actuating time(s) Max. tripping time (s)	0.01 0.3	0.01 0.15		0.01 0.04	0.01 0.04
RCCB Type G (Short-time-delay) Surge current-proof 3 kA	>30	Min. non actuating time(s) Max. tripping time (s)	0.01 0.3	0.01 0.15	0.01 0.04		0.01 0.04
RCCB Type S (Selective) Surge current-proof 5 kA	>30	Min. non actuating time(s) Max. tripping time (s)	0.13 0.5	0.06 0.2	0.05 0.15		0.04 0.15

Break time for half-wave pulsating residual currents (r.m.s. values) for type A RCCB

Classification	$I_{\Delta n}$ mA		$1.4xI_{\Delta n}$	$2xI_{\Delta n}$	$2.8xI_{\Delta n}$	$4xI_{\Delta n}$	7 x $I_{\Delta n}$	0.35 A	0.5 A	350A
Standard RCD Conditionally surge current-proof 250 A	<30	Max. tripping time (s)		0.3		0.15			0.04	0.04
Standard RCD Conditionally surge current-proof 250 A	30	Max. tripping time (s)	0.3		0.15			0.04		0.04
Standard RCD Conditionally surge current-proof 250 A	>30	Max. tripping time (s)	0.3		0.15		0.04			0.04
RCCB Type G (Short-time-delay) Surge current-proof 3 kA	30	Max. tripping time (s)	0.3		0.15			0.04		0.04
RCCB Type G (Short-time-delay) Surge current-proof 3 kA	>30	Max. tripping time (s)	0.3		0.15		0.04			0.04
RCCB Type S (Selective) Surge current-proof 5 kA	>30	Max. tripping time (s)	0.5		0,2		0.15			0.15

Tripping Characteristics (IEC/EN 61008)

Tripping characteristics, tripping time range and selectivity of instantaneous, surge current-proof „G“ and surge current-proof - selective „S“ residual current devices.



IEC 60364-4-41 deals with additional protection: The use of RCDs with a rated residual operating current not exceeding 30 mA, is recognized in a.c. systems as additional protection in the event of failure of the provision for basic protection and/or the provision for fault protection or carelessness by users.

This means when using RCDs for fault current/residual current protection two RCDs must be connected in series.

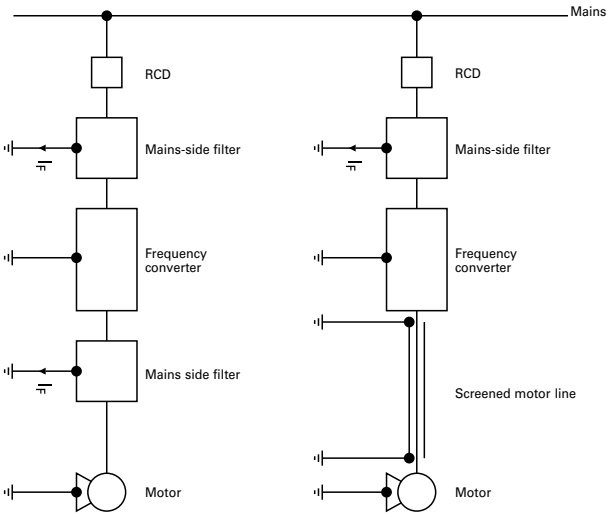
Testing:

RCDs with tripping time delay (Types -G and -S) may be function tested with conventional testing equipment which must be set according to the instructions for operation of the testing device. Due to reasons inherent in the measuring process, the tripping time determined in this way may be longer than expected in accordance with the specifications of the manufacturer of the measuring instrument.

However, the device is ok if the result of measurement is within the time range specified by the manufacturer of the measuring instrument.

Applications with frequency converters:

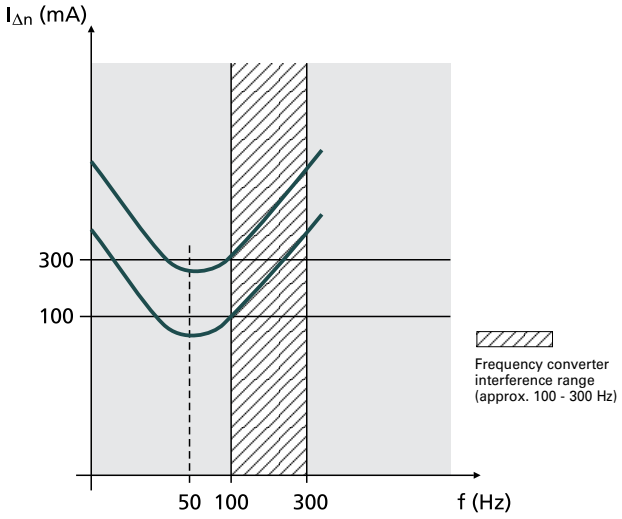
Due to the currents flowing off through the filters (designated IF), the sum of currents through the RCD is not exactly zero, which causes unwanted tripping.



Frequency converters are used in a wide variety of systems and equipment requiring variable speed, such as lifts, escalators, conveyor belts, and large washing machines. Using them for such purposes in circuits with conventional residual current devices causes frequent problems with unwanted tripping.

The technical root cause of this phenomenon is the following: Fast switching operations involving high voltages cause high interference levels which propagate through the lines on the one hand, and in the form of interfering radiation on the other. In order to eliminate this problem, a mains-side filter (also referred to as input filter or EMC-filter) is connected between the RCD and frequency converter. The anti-interference capacitors in the filters produce discharge currents against earth which may cause unwanted tripping of the RCD due to the apparent residual currents. Connecting a filter on the output side between frequency converter and 3-phase AC motor results in the same behaviour.

Tripping characteristic



This sample tripping characteristic of a 100 mA RCD and a 300 mA RCD shows the following: In the frequency range around 50 Hz, the RCDs trip as required (50 - 100 % of the indicated $I_{\Delta n}$).
In the range shown hatched in the diagram, i. e. from approx. 100 to 300 Hz, unwanted tripping occurs frequently due to the use of frequency converters. Type F RCCBs are designed to reliably sense higher frequency residual currents ,which leads to an enormous increase in the reliability and availability of electrical systems.

Therefore, we recommend to use RCDs designed for applications with frequency converter!
These special residual current devices can be recognised by an extension of the type designation („**-F**"). They meet the requirements of compatibility between RCDs and frequency converters with respect to unwanted tripping.
Eaton stands for highest availability of your system also in applications where frequency drives are used. Therefore a full suite of Type F RCCBs (mechanical and digital assisted) are available in all feasible ratings to assist you in your application needs.

Our RCDs of type „-F" are characterized by:
- Improved capabilities of reliably sensing residual currents up to 1 kHz
- Improved capabilities of withstanding 10 mA DC offset
- 10 ms short time delay minimum (G/F)
- Surge current proofness of 3 kA (G/F) and 5kA (S/F)

SG02213

Description

- High-quality residual current device / miniature circuit breaker combination, line voltage-independent
- Contact position indicator red - green
- Fault current tripping indicator white - blue
- Guide for secure terminal connection
- 3-position DIN rail clip, permits removal from existing busbar system
- Comprehensive range of accessories suitable for subsequent installation
- Wide variety of rated tripping currents
- Rated currents up to 32 A
- Tripping characteristics B, C, D
- Rated breaking capacitiy 4.5 kA acc. to IEC/EN 61009 & IEC/EN 60947
- Classified for the use in rail rolling stock

SG02213

SG02213

$I_n/I_{\Delta n}$ (A)	Type Designation	Article No.	Units per package
Type A			
4.5 kA, 3+N-poles			
Conditionally surge current-proof 250 A, sensitive to residual pulsating DC, Type A			
Characteristic C			
20/0.03	FRBm4-C20/3N/003-A	171000	1/30
25/0.03	FRBm4-C25/3N/003-A	171001	1/30
32/0.03	FRBm4-C32/3N/003-A	171002	1/30
20/0.1	FRBm4-C20/3N/01-A	170930	1/30
25/0.1	FRBm4-C25/3N/01-A	170931	1/30
32/0.1	FRBm4-C32/3N/01-A	170932	1/30
20/0.3	FRBm4-C20/3N/03-A	170958	1/30
25/0.3	FRBm4-C25/3N/03-A	170959	1/30
32/0.3	FRBm4-C32/3N/03-A	170960	1/30
Characteristic D			
20/0.03	FRBm4-D20/3N/003-A	170895	1/30
20/0.1	FRBm4-D20/3N/01-A	170942	1/30
20/0.3	FRBm4-D20/3N/03-A	170970	1/30

$I_n/I_{\Delta n}$ (A)	Type Designation	Article No.	Units per package

Type AC

4.5 kA, 3+N-poles

Conditionally surge current-proof 250 A, Type AC

SG02213

Characteristic C

20/0.03	FRBm4-C20/3N/003	170993	1/30
25/0.03	FRBm4-C25/3N/003	170994	1/30
32/0.03	FRBm4-C32/3N/003	170995	1/30
20/0.1	FRBm4-C20/3N/01	170923	1/30
25/0.1	FRBm4-C25/3N/01	170924	1/30
32/0.1	FRBm4-C32/3N/01	170925	1/30
20/0.3	FRBm4-C20/3N/03	170951	1/30
25/0.3	FRBm4-C25/3N/03	170952	1/30
32/0.3	FRBm4-C32/3N/03	170953	1/30

SG02213

Characteristic D

20/0.03	FRBm4-D20/3N/003	171007	1/30
20/0.1	FRBm4-D20/3N/01	170937	1/30
20/0.3	FRBm4-D20/3N/03	170965	1/30

Specifications | Combined RCD/MCB Devices FRBm6, FRBm4, 3+N-poles

Description

- Combined RCD/MCB device
- Line voltage-independent tripping
- Compatible with standard busbar
- Twin-purpose terminal (lift/open-mouthed) above and below
- Busbar positioning optionally above or below
- Free terminal space despite installed busbar
- Guide for secure terminal connection
- Contact position indicator red - green
- Fault current tripping indicator white - blue
- Comprehensive range of accessories suitable for subsequent installation
- The test key "T" must be pressed every 6 months. The system operator must be informed of this obligation and his responsibility in a way that can be proven. Under special conditions (e.g. damply and/or dusty environments, environments with polluting and/or corroding conditions, environments with large temperature fluctuations, installations with a risk of overvoltages due to switching of equipment and/or atmospheric discharges, portable equipment ...), it's recommended to test in monthly intervals.
- Pressing the test key "T" serves the only purpose of function testing the residual current device (RCD). This test does not make earthing resistance measurement (R_E), or proper checking of the earth conductor condition redundant, which must be performed separately.
- **Type -A**: Protects against special forms of residual pulsating DC which have not been smoothed.

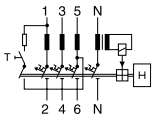
Accessories:		
Auxiliary switch for subsequent installation	ZP-IHK	286052
	ZP-WHK	286053
Tripping signal switch for subsequent installation	ZP-NHK	248437
Shunt trip release	ZP-ASA/..	248438, 248439
Terminal cover 4-poles	Z-TC/SD-4P	178101

Technical Data

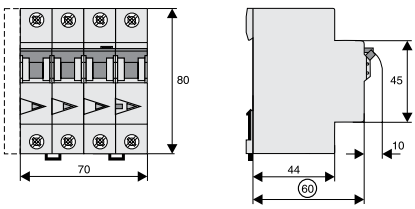
			FRBm4, 3+N-poles
Electrical			
Design according to			IEC/EN 61009, IEC/EN 60947
Classified according to			IEC 61373, EN 45545-2
Current test marks as printed onto the device			
Tripping line voltage-independent			instantaneous 250A (8/20µs), surge current-proof, N protected
Rated voltage		U_n	240/415V AC, 50Hz
Rated tripping current		$I_{\Delta n}$	30, 100, 300 mA
Rated non-tripping current		$I_{\Delta no}$	0.5 $I_{\Delta n}$
Sensitivity			AC and pulsating DC
Selectivity class			3
Rated short circuit capacity			
FRBm4	acc. to IEC/EN61009: 6A…32A	I_{cn}	4.5 kA
	acc. to IEC/EN60947-2: 6A…32A	I_{cu}	4.5 kA
		I_{cs}	3 kA
Rated current			6 - 32 A
Rated impulse withstand voltage		U_{imp}	4 kV (1.2/50µs)
Characteristic			B, C, D
Maximum back-up fuse (short circuit protection)			100 A gL (>10 kA)
Endurance			
	electrical components		≥ 4,000 operating cycles
	mechanical components		≥ 10,000 operating cycles
Mechanical			
Frame size			45 mm
Device height			80 mm
Device width			70 mm (4MU)
Mounting			3-position DIN rail clip, permits removal from existing busbar system
Degree of protection switch			IP20
Degree of protection, built-in			IP40
Upper and lower terminals			open mouthed/lift terminals
Terminal protection			finger and hand touch safe, DGUV VS3, EN 50274
Terminal capacity			1 - 25 mm^2
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 +70°C
Resistance to climatic conditions			acc. to IEC 68-2 (25..55°C / 90..95% RH)

Connection diagram

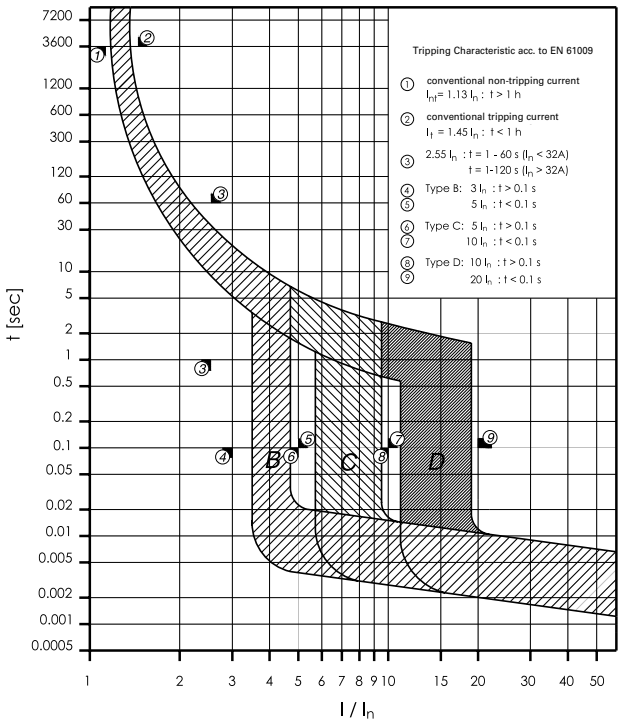
3+N-poles



Dimensions (mm)



Tripping Characteristic FRBm. 3+N-poles, Characteristics B, C and D



Internal Resistance FRBm. 3+N-poles

	Type B			Type C			Type D		
At room temperature (single pole)									
	L1. L2	L3	N	L1. L2	L3	N	L1. L2	L3	N
I_n [A]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]	R* [mΩ]
6	-	-	-	34.3	28.2	28.8	34.3	28.0	29.7
10	-	-	-	19.3	15.3	18.1	19.7	15.3	15.3
13	11.8	12.6	12.2	11.9	12.7	9.1	9.9	10.4	8.9
16	9.8	9.3	7.8	9.5	8.8	6.6	9.8	9.2	6.8
20	-	-	-	6.5	5.9	5.5	6.6	6.1	5.5
25	-	-	-	4.3	3.7	3.5	-	-	-
* 50Hz									

Power Loss at I_n FRBm. 3+N-poles

	Type B	Type C	Type D
(entire unit)			
I_n [A]	P* [W]	P* [W]	P* [W]
6	-	4.8	4.8
10	-	8.2	7.8
13	10.2	9.4	7.7
16	11.6	10.9	11.2
20	-	11.8	12.0
25	-	11.6	-
32	-	15.6	-
* 50Hz and ambient temperature			

	Ambient Temperature T [°C]										
I_n [A]	**-25**	**-15**	**-5**	**10**	**30**	**40**	**45**	**55**	**60**	**65**	**70**
6	7.7	7.4	7.1	6.6	6	5.7	5.6	5.2	5.1	4.9	4.8
10	12.6	12.1	11.6	10.9	10	9.5	9.3	8.8	8.6	8.3	8.1
13	16.8	16.1	15.4	14.4	13	12.4	12.1	11.4	11.0	10.7	10.3
16	19.8	19.1	18.4	17.4	16	15.3	14.9	14.2	13.9	13.5	13.2
20	24.8	23.9	23.1	21.7	20	19.1	18.6	17.8	17.3	16.9	16.4
25	32.9	31.4	30.1	27.8	25	23.5	22.7	21.3	20.6	19.8	19.1
32	40.2	38.7	37.2	35.0	32	30.5	29.7	28.2	27.5	26.7	26.0

Back-up Protection FRBm4/

The up-stream protective devices will protect the down-stream FRBm4 up to the short-circuit current specified.

FRBm and NZM1

Short circuit currents in kA.

FRBm4/ FRBm6	NZMB1(C1)(N1)(H1)-A… U_e = 415 V		
	Type B	**Type C**	**Type D**
6	-	20	20
10	-	20	20
13	20	20	20
16	20	20	20
20	-	20	20
25	-	20	-

U_e = 415V: I_{cn} (FRBm4) = 4.5 kA (acc. to IEC/EN 61009)
U_e = 415V: I_{cu} (FRBm6) = 6 kA (acc. to IEC/EN 61009)
U_e = 400/415V: I_{cn} (NZMB1) = 25 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMC1) = 36 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMN1) = 50 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMH1) = 100 kA (acc. to IEC/EN 60947-2)

FRBm and NZM2

Short circuit currents in kA.

FRBm4/ FRBm6	NZMB2(C2)(N2)(H2)-A… U_e = 415 V		
	Type B	**Type C**	**Type D**
6	-	20	20
10	-	20	20
13	20	20	20
16	20	20	20
20	-	20	20
25	-	20	-

U_e = 415V: I_{cn} (FRBm4) = 4.5 kA (acc. to IEC/EN 61009)
U_e = 415V: I_{cu} (FRBm6) = 6 kA (acc. to IEC/EN 61009)
U_e = 400/415V: I_{cn} (NZMB2) = 25 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMC2) = 36 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMN2) = 50 kA (acc. to IEC/EN 60947-2)
U_e = 400/415V: I_{cn} (NZMH2) = 150 kA (acc. to IEC/EN 60947-2)

FRBm4: Influence of ambient temperature on load carrying capacity

	Ambient temperature / °C											
I_n [A]	**-25**	**-30**	**-5**	**10**	**30**	**40**	**45**	**50**	**55**	**60**	**65**	**70**
6	7.7	7.4	7.1	6.6	6	5.7	5.6	5.4	5.2	5.1	4.9	4.8
10	12.6	12.1	11.6	10.9	10	9.5	9.3	9.1	8.8	8.6	8.3	8.1
13	16.8	16.1	15.4	14.4	13	12.4	12.0	11.7	11.4	11.0	10.7	10.3
16	19.8	19.1	18.4	17.4	16	15.3	14.9	14.6	14.2	13.9	13.5	13.2
20	24.8	23.9	23.0	21.7	20	19.1	18.6	18.2	17.8	17.3	16.9	16.4
25	32.9	31.4	30.0	27.8	25	23.5	22.7	22.0	21.3	20.6	19.8	19.1
32	40.2	38.7	37.2	35.0	32	30.5	29.7	29.0	28.2	27.5	26.7	26.0

Eaton's electrical business is a global leader with deep regional application expertise in power distribution and circuit protection; power quality, backup power and energy storage; control and automation; life safety and security; structural solutions; and harsh and hazardous environment solutions. Through end-to-end services, channel and an integrated digital platform & insights Eaton is powering what matters across industries and around the world, helping customers solve their most critical electrical power management challenges.

For more information, visit **Eaton.com.**

To contact us please visit **https://www.eaton.com/us/en-us/support/international-support-contacts.html**
For technical questions please contact your local Eaton team.

Eaton Industries (Austria) GmbH
Scheydgasse 42
1210 Vienna
Austria

9010238151802

Eaton
EMEA Headquarters
Route de la Longeraie 7
1110 Morges, Switzerland

Publication No. CA003016EN
Article number 301999-MK
May 2022

Follow us on social media to get the latest product and support information.

Powering Business Worldwide