

Hardware and Engineering

ZE motor-protective relay Overload monitoring of EEx e motors

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Warning! **Dangerous electrical voltage!**

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure relosing interlock that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Connect to earth and short-circuit.
- Cover or fence off neighbouring live parts.
- Follow the installation instructions (AWA) included with the device.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The rated value of the mains voltage may not fluctuate or deviate by more than the tolerance specified, otherwise malfunction and hazardous states are to be expected.
- Panel-mount devices may only be operated when properly installed in the cubicle or control cabinet.

Contents

<hr/>	
About this manual	3
Target group	3
Abbreviations and symbols	3
<hr/>	
1 Motor protection relay ZE	5
Preface	5
Overview of the devices	6
Device description	6
– Overload protection relays with bimetallic release	6
– Current ranges for ZE relays	7
– Temperature compensation	8
– Phase loss	8
– Reset	9
– Test function	10
<hr/>	
2 Configuration	11
Monitoring overload of motors in the EEx e area	11
Adjusting the overload current protection	11
Short-circuit protection of the motor protection relay	12
Approvals	13
<hr/>	
3 Installation	15
Notes on installation	15
Mounting the devices	17
<hr/>	
4 Operating the devices	19
Settings	19
– Reset	19
– Test	19

Appendix	21
ZE nameplates	21
ZE tripping characteristics	23
– ZE-0,16	23
– ZE-0,24	24
– ZE-0,4	25
– ZE-0,6	26
– ZE-1,0	27
– ZE-1,6	28
– ZE-2,4	29
– ZE-4	30
– ZE-6	31
– ZE-9	32
– ZE-12	33

About this manual

This manual covers the ZE motor protection relay.

It describes the overload monitoring system for the protection of EEx e motors operating in areas with a potentially explosive atmosphere.

Target group

This manual addresses qualified personnel who install, commission and service the motor overload protection relay.

Abbreviations and symbols

The abbreviations and symbols used in this manual have the following meaning:

EEx e	"Increased safety" type of protection
PTB	Physikalisch Technische Bundesanstalt. German Federal Testing Laboratory: Accredited certification authority for devices operated in EEx areas.
NM	Lowest possible setup current
HM	Highest possible setup current

► indicates actions to be taken



Draws your attention towards interesting tips and additional information



Note!

Warns of a hazardous situation that could result in damage to the product or components.



Warning!

Warns of the risk of heavy material damage and of serious or lethal injury.

The chapter title in the header on the left side and the title of the current topic on the right side provide you with a good overview of this documentation. Exceptions are the starting pages of the chapters and empty pages at the end of a chapter.

1 Motor protection relay ZE

Preface

In addition to the type of protection specified in the standards EN 60079-14 and VDE 0165 Part 1, further provisions have been made to ensure safety from ignition for motors operated in potentially explosive atmospheres. EN 50019 demands additional measures for operating motors with "increased safety" type of protection "e". These measures provide a higher degree of safety and prevent impermissible high temperature and development of sparking and arcing on the motors, which usually does not occur under normal operating conditions. The motor protection equipment used for this is operated at a location separate from the EEx e area and must be certified by an accredited certification authority.

The guidelines on the application of Directive 94/9/EC (ATEX 100a) on the harmonization of the laws of the Member States concerning equipment and protection systems intended for use in potentially explosive atmospheres became mandatory from 30 June 2003.

The ZE motor protection system is approved by the PTB in accordance with the Directive 94/9/EC (ATEX 100a).



The EC Type Examination Certificate Number is:
PTB 01 ATEX 3331

Overview of the devices

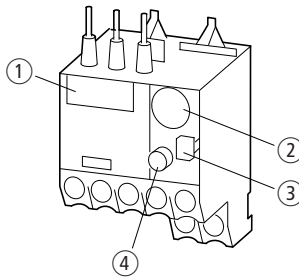


Figure 1: Motor protection relay ZE

- ① Device nameplate
- ② Wheel for setting motor current
- ③ OFF button, test
- ④ Reset knob, reset lock-out

Device description

Overload protection relays with bimetallic release

The ZE motor protection relays are 3-pole electromechanical motor circuit breakers using bimetallic elements. They are suitable for monitoring both DC and AC currents. Type ZE motor protection relays have been designed to be fitted directly on to DILEEM and DILEM contactors,

In the event of overload tripping, the auxiliary contacts 95-96 and 97-98 change over and disconnect the control voltage circuit from the corresponding contactor relay, and thus indirectly switch off the current to the motor being monitored. (→ following Fig. 2)

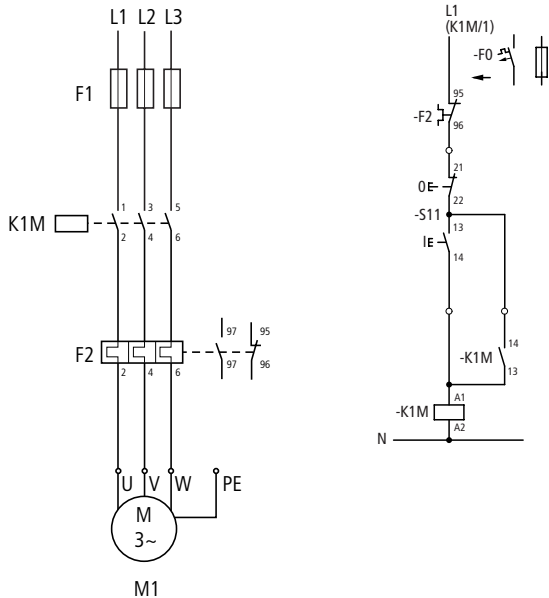


Figure 2: Circuit diagram of a motor connection with a ZE motor protection relay

- F1 Fuse
- F2 Motor protection relay
- K1M Motor contactor
- M1 Motor

Current ranges for ZE relays

The ZE relays are adjusted by means of a setting wheel (→ fig. 1 on Page 6) to suit the motor current rating.

11 different types enable the monitoring of motors with current ratings from 0.1 to 12 A (→ following Table 1).

Table 1: Current ranges for ZE relays

Type	Current range I_e A
ZE-0,16	0.10 to 0.16
ZE-0,24	0.16 to 0.24
ZE-0,4	0.24 to 0.4
ZE-0,6	0.4 to 0.6
ZE-1,0	0.6 to 1.0
ZE-1,6	1.0 to 1.6
ZE-2,4	1.6 to 2.4
ZE-4	2.4 to 4
ZE-6	4 to 6
ZE-9	6 to 9
ZE-12	9 to 12

Temperature compensation

Two parameters influence the deflection of the bimetallic releases. Firstly, the heat which is generated in proportion to the current flow, and secondly, the influence of the ambient temperature. The influence of the ambient temperature is automatically compensated within a temperature range from -5 to $+50$ °C by means of an additional current-free bimetallic release that continuously corrects the tripping range.

Phase loss

ZE motor protection relays are phase-failure sensitive. The deflecting action of all three bimetallic releases is directed towards a tripping bridge that switches over a quick-break switch when the limit value is reached. At the same time, all three bimetallic releases shift the differential bridge. If the path of action of one of the bimetallic releases is reduced

due to a phase loss, the differential bridge is retarded and the distance is converted into an additional tripping distance, which leads to an early tripping.

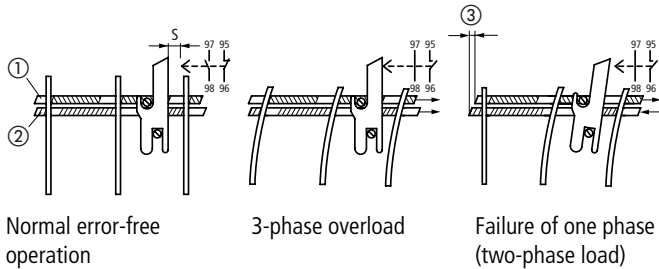


Figure 3: Function of the phase sensitivity by means of tripping and differential bridge

- ① Tripping bridge
 - ② Differential bridge
 - ③ Differential distance
- s = Tripping distance



If the ZE relay is to be used for monitoring an AC or DC motor, the current must flow through all three current paths in order to avoid early tripping.



Figure 4: Wiring of the motor protection relay for the protection of AC or DC motors (bimetallic releases wired in series)

(→ chapter “ZE tripping characteristics” on Page 23)

Reset

After tripping, the bimetallic releases must first cool down before the motor protection relay can be reset. Manual and

automatic reset can be selected by means of a selector switch (→ section "Reset" on Page 19).

In auto mode, the contacts automatically fall back after the bimetallic releases have cooled down, whereas in manual mode the tripping must be acknowledged locally on the ZE motor protection relay.

**Warning!**

For **Ex** (explosion protection) operation, it is only permissible to reset/switch on the motor protection relay manually, after the bimetallic release has cooled down, or automatically via a control interlock circuit for the motor or electrical machinery.

A manual reset may be carried out by trained personnel locally or in the control room.

Test function

The function of the auxiliary contacts can be verified by means of an additional Test button that has a dual function:

- Pressing the Test button opens the break contact 95-96. When the button is released, the break contact closes again. This function can also be used to switch off the motor manually.
- Pulling the Test button will trip the motor protection relay. The break contact 95-96 opens and the make contact 97-98 closes. After the Test button is released, the motor protection relay must be reset in the same way as after normal tripping (→ section "Reset" on Page 9).

2 Configuration

Monitoring overload of motors in the EEx e area

Special design features are implemented so that motors can achieve the ignition protection rating EEx e. The motors are assigned to temperature classes on the basis of the highest permissible surface temperature. The temperature rise time t_E and the ratio between startup current and rated current I_A/I_N are calculated also and specified on the rating plate of the motor.

The temperature rise time t_E represents the time required for the temperature of the motor winding to rise from its final rated operational temperature up to the limit temperature, at a startup current of I_A .

However, since EEx e motors are not intrinsically safe, explosion safety is only achieved by taking special measures during installation and by selecting appropriate operating conditions (PTB testing regulations), e.g. by a combination of the circuit with a correctly rated and set overload current protection.

Adjusting the overload current protection



Warning!

The selected current overload protection system must not only ensure proper motor current monitoring, but also that a blocked motor is switched off within the temperature rise time t_E . This means, the protective device must be rated in such a way to ensure that the tripping time t_A for the ratio I_A/I_N of the EEx e motor is not higher than its temperature rise time t_E according to its characteristic curve, in order safely to switch off the motor within that period (→ following example).

Example: $I_A/I_N = 6$, $t_E = 10$ s

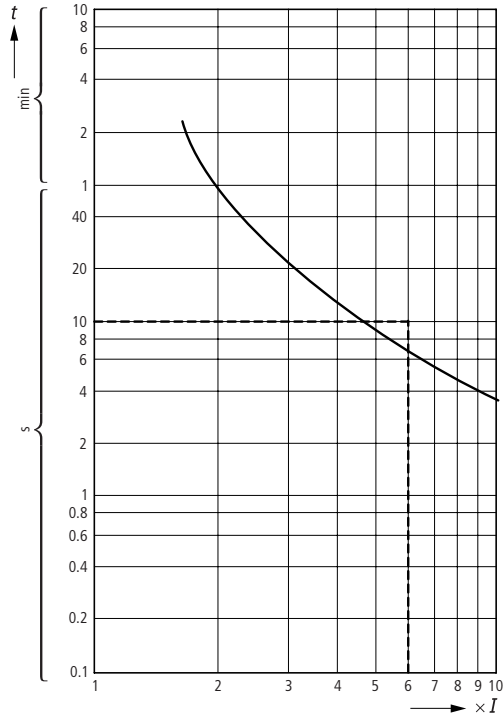


Figure 5: Tripping characteristics of the motor protection relay

The motor is reliably protected.

Short-circuit protection of the motor protection relay

The short-circuit protection of the ZE motor protection relay can be partially implemented either with or without a fuse. The classification type is related to the type of DILEM or DILEEM contactor that is used (→ following Table 2).

Table 2: Overview of short-circuit protection with ZE relays

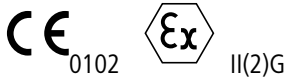
Type	Short-circuit current rating I_q kA	With fusing Classification type	
		"1"1)	"2"1)
		A gG/gL	A gG/gL
ZE-0,16	100	20	0.5
ZE-0,24	100	20	1
ZE-0,4	100	20	2
ZE-0,6	100	20	2
ZE-1,0	100	20	4
ZE-1,6	100	20	6
ZE-2,4	100	20	6
ZE-4	100	20	10
ZE-6	100	20	10
ZE-9	50	20	10
ZE-9	100	20	10
ZE-12 ²⁾	–	25	25

1) to IEC/EN 60947

2) for ZE-12, the data apply without a DIL(E)EM contactor

Approvals

The ZE motor protection relay is built to the IEC EN 60947 standard for low-voltage switchgear, and conforms to the requirements of the Directive 94/9/EC (ATEX 100a) for the protection of motors in **EEx e** areas.



PTB 01 ATEX 3331

The system is approved by UL and CSA for the USA and Canada.



Further approvals exist for

- Romania **ML PAT**

- Russia



- China



- Slovak Republic



3 Installation

Notes on installation



For the mechanical and electrical installation, the Installation Instructions AWA23-883 on the inside of the packaging must be observed.



Warning!

For Ex (explosion protection) operation, it is only permissible to reset/switch on the motor protection relay manually, after the bimetallic release has cooled down, or automatically via a control interlock circuit for the motor or electrical machinery.

A manual reset may be carried out by trained personnel locally or in the control room.



Warning!

Particularly in EEx e applications, an automatic restart must be prevented after an interruption and restoration of the control voltage. This is prevented safely by means of the latching function of the power relay.

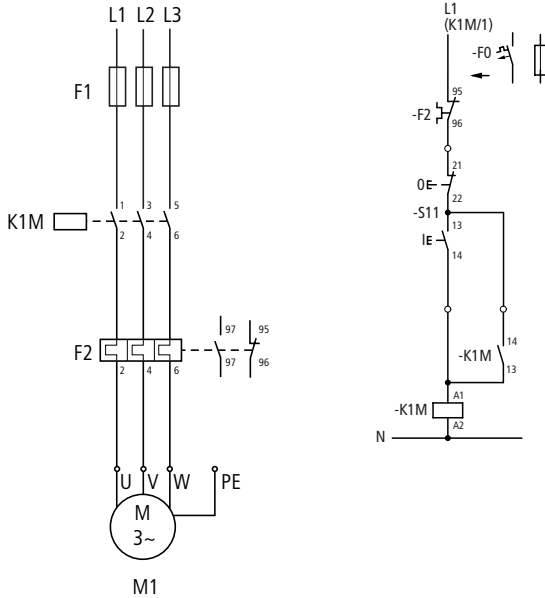


Figure 6: The circuit prevents an automatic restart.

- F1 Fuse
- F2 Motor protection relay
- K1M Contactor relay
- M1 Motor

The latching function of the K1M contactor relay prevents an automatic restart.

Mounting the devices

- Mount the ZE motor protection relay on the DIL(E)EM contactor.

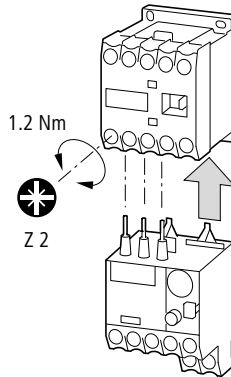
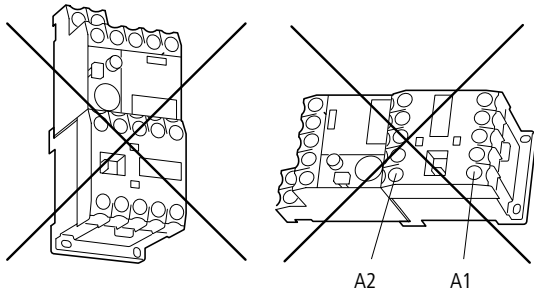


Figure 7: Assembly of DIL(E)EM and ZE

- Both can be mounted in any position, apart from as shown in Fig. 8.

Figure 8: Impermissible mounting positions for DIL(E)EM and ZE
A1, A2 coil connections

► Wire up the motor cables.

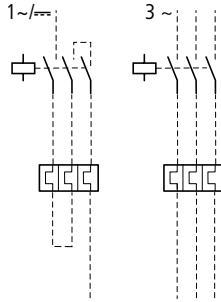


Figure 9: Mains wiring

The following maximum conductor cross-sections can be used.

Table 3: Maximum conductor cross-sections for the motor leads

ZE-...	T1, T2, T3 95-96, 97-98 mm ²		T1, T2, T3 95-96, 97-98 AWG	
	min.	max.	min.	max.
	0.75	2.5	18	14
	0.5	1.5	–	–
	0.75	2.5	18	14
	0.5	1.5	–	–

4 Operating the devices

Settings

Before commissioning the ZE relay, the rated current of the motor must be set, using the setting wheel on the ZE relay (→ table 1 on Page 8).

Reset

The ZE relay also offers the option of using the reset selector knob to choose between an automatic restart "A" and a manual reset "H".



Figure 10: Switching options of the reset selector knob

The ZE relay is factory-set to position "H", which prevents an automatic restart. In position "H", the relay must be reset manually after it has tripped, by pressing the selector knob.

Test

The ZE relay is provided with a Test button that contains a double function.

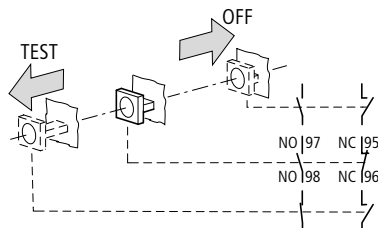


Figure 11: Switching options of the test button

Pressing the button opens the auxiliary contact 95-96, and this can be used to switch off the contactor. → fig. 11 on Page 19



Warning!

Faulty devices may not be opened for repairs and must be replaced only by skilled persons.

Appendix

ZE nameplates


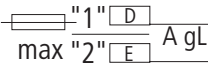
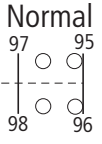
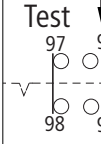
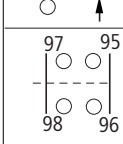
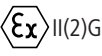

MOELLER 	
A	F
U_{imp} 6000 V U_e 690 V ~	
	
Normal 	Test ↓ 
	
AC-15 U_e 220/240 380/415 500V~ 95-96: I_e 1,5 0,7 0,5 A 97-98: I_e 1,5 0,5 0,3 A U_{imp} 6000 V I_{th} 6 A	
IEC/EN 60947 VDE 0660	
	
	

Figure 12: Example: nameplate ZE-...

The assignment of the values to the individual types can be found in the following Table 4.

Table 4: Values for individual types

A	D	E	F
ZE-0,16	20	0.5	0.1 to 0.16 A
ZE-0,24	20	1	0.16 to 0.24 A
ZE-0,4	20	2	0.24 to 0.4 A
ZE-0,6	20	2	0.4 to 0.6 A
ZE-1,0	20	4	0.6 to 1.0 A
ZE-1,6	20	6	1.0 to 1.6 A
ZE-2,4	20	6	1.6 to 2.4 A
ZE-4	20	10	2.4 to 4 A
ZE-6	20	10	4 to 6 A
ZE-9	20	10	6 to 9 A
ZE-12	–	–	9 to 12 A

ZE tripping characteristics ZE-0,16

Range	0.10 to 0.16 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	10.09.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	21	16	20	13
$7.2 \times I$	5.5	4.6	5.2	4

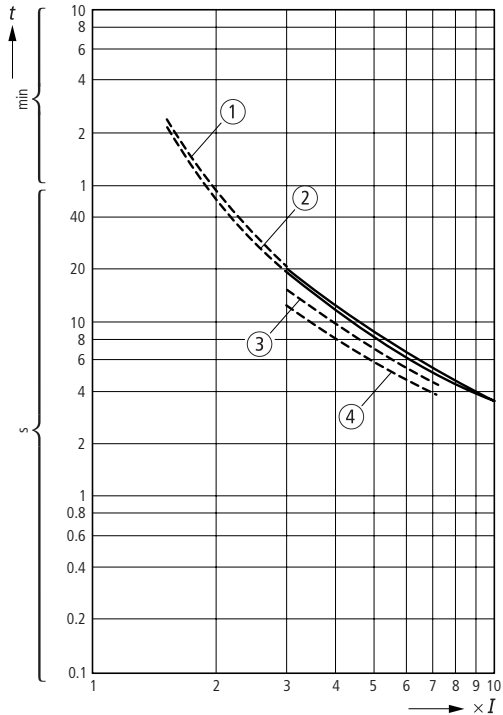


Figure 13: ZE-0,16

ZE-0,24

Range	0.16 to 0.24 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	02.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	24	15.6	20	12.2
$7.2 \times I$	5.7	4.5	5.3	3.8

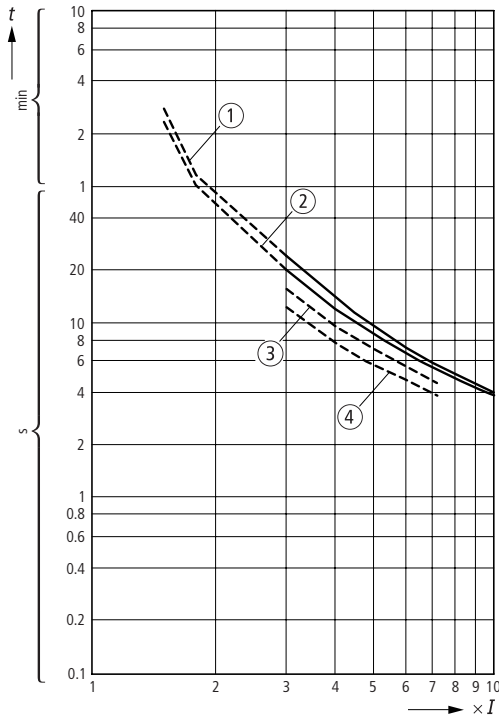


Figure 14: ZE-0,24

ZE-0,4

Range	0.24 to 0.4 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	23	17	19	11.8
$7.2 \times I$	5.5	4.8	4.9	3.8

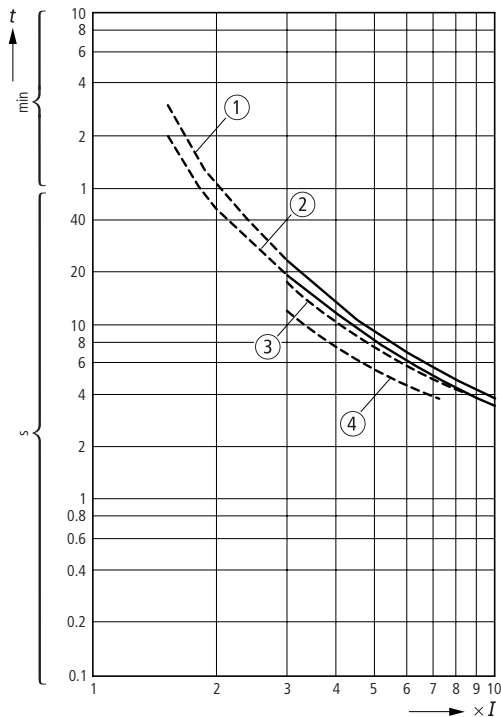


Figure 15: ZE-0,4

ZE-0,6

Range	0.4 to 0.6 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	27	19.5	25	15.5
$7.2 \times I$	6.5	5.4	6.1	4.55

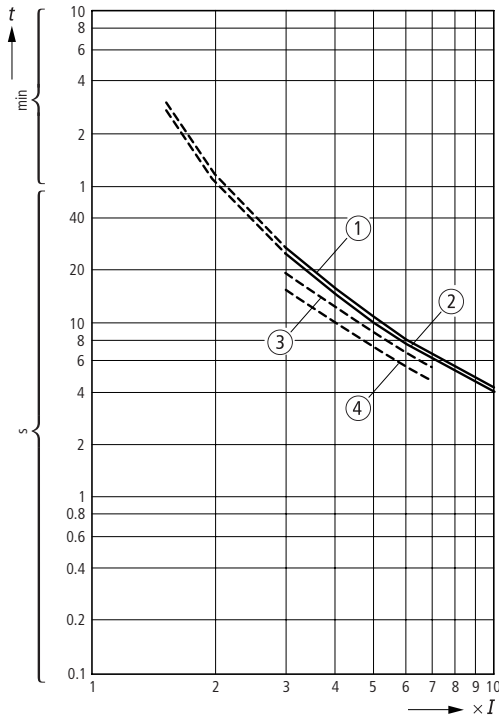


Figure 16: ZE-0,6

ZE-1,0

Range	0.6 to 1.0 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	25.5	18.5	22.5	13.9
$7.2 \times I$	6.1	5.2	5.5	4.4

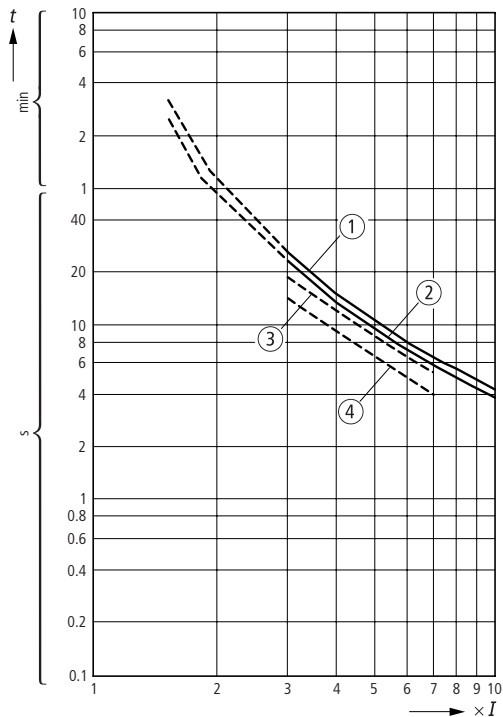


Figure 17: ZE-1,0

ZE-1,6

Range	1.0 to 1.6 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	24	17	21	13
$7.2 \times I$	5.6	4.4	4.9	3.6

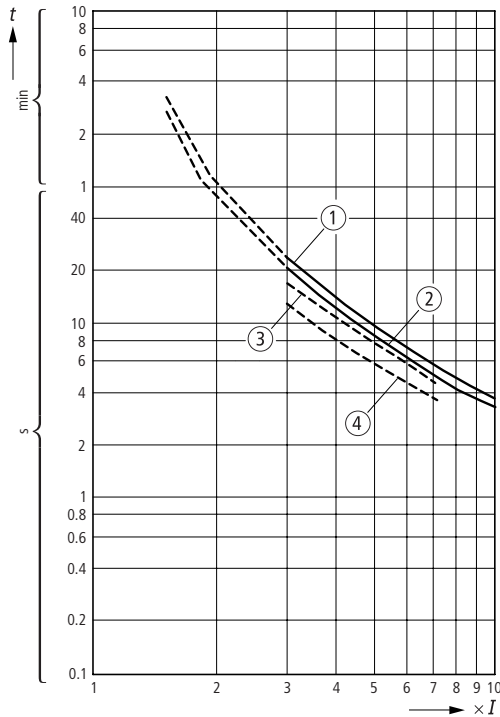


Figure 18: ZE-1,6

ZE-2,4

Range	1.6 to 2.4 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	24.7	18.1	21.7	13.7
$7.2 \times I$	6	5	5.5	4.3

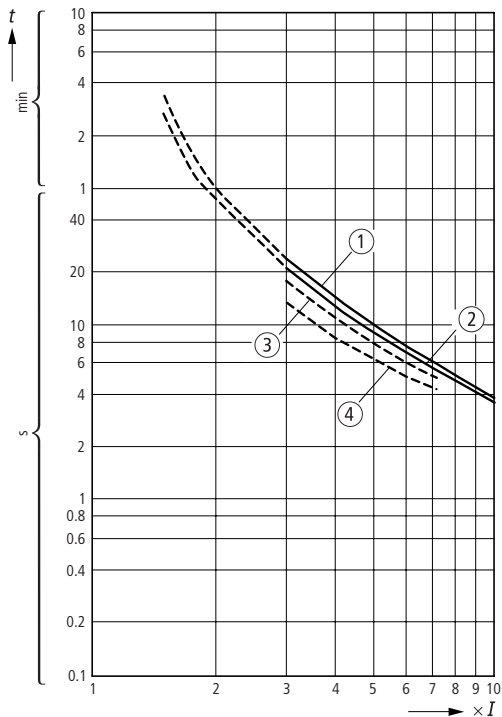


Figure 19: ZE-2,4

ZE-4

Range	2.4 to 4 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	29.06.01

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	30.0	20.0	25.5	15.5
$7.2 \times I$	6.8	5.2	6.1	4.4

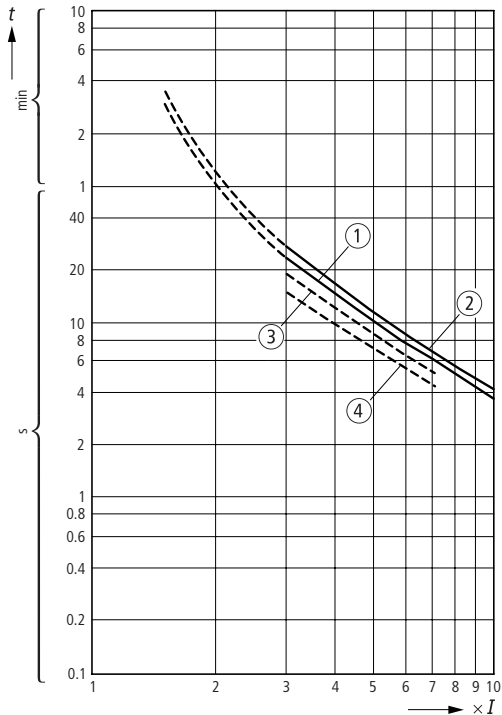


Figure 20: ZE-4

ZE-6

Range	4 to 6 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	06.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	26	18.1	24	15
$7.2 \times I$	6.1	4.8	5.6	4

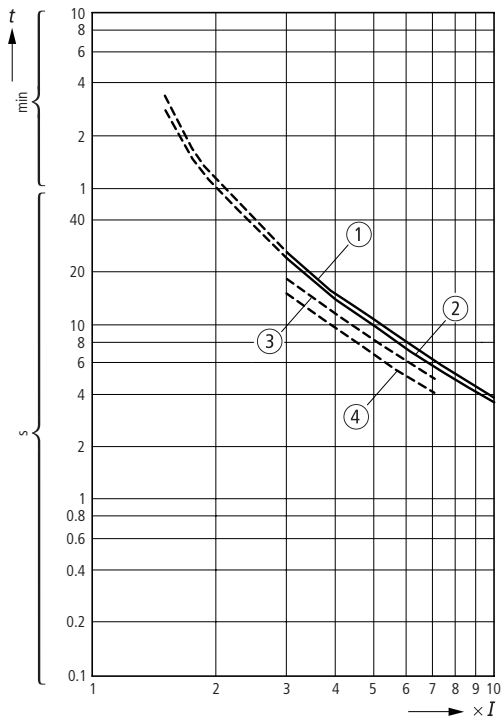


Figure 21: ZE-6

ZE-9

Range	6 to 9 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	08.10.97

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	28.8	20.6	24.8	15.5
$7.2 \times I$	5.7	4.5	4.9	3.6

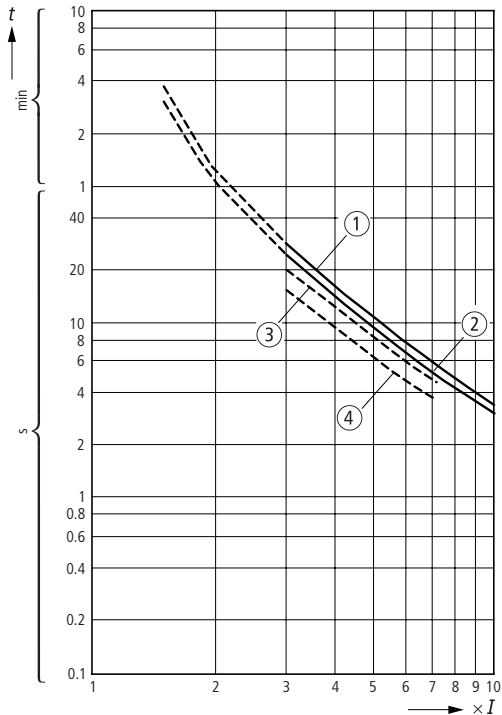


Figure 22: ZE-9

ZE-12

Range	9 to 12 A (NM to HM)
Ambient temperature	20 °C
Tripping class	10 A
Tolerance range	± 20 %
Date	05.01.98

Setting	Tripping time t [s]			
	NM		HM	
	3-phase ①	2-phase ③	3-phase ②	2-phase ④
$3 \times I$	29	18	28	17
$7.2 \times I$	4.9	3.3	4.7	2.9

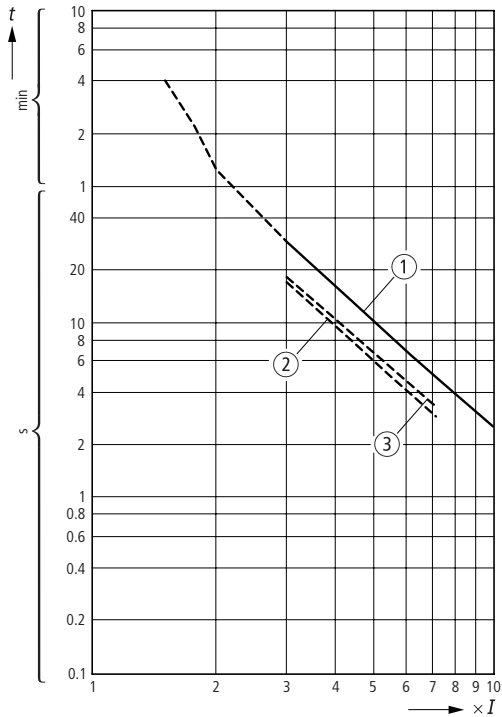


Figure 23: ZE-12

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