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NHP

TemBreak PRO

ZS Model Circuit Breaker with Integrated Residual Current Protection (CBR)

Thermal Magnetic and Residual Current Trip Unit from 125A up to 250A

USER MANUAL

Version
1.0.1

Using this manual

Safety Precautions

Authorised Personnel Only
The product or system described in this documentation must be installed, operated and maintained by qualified personnel only. NHP or Terasaki accept no responsibility for the consequences of the use of this equipment by unqualified personnel.
A qualified person is one with the necessary skills and knowledge of the construction and operation of the installation of electrical equipment and has been trained to identify and avoid risks.

Appropriate use of NHP / Terasaki products
NHP / Terasaki products are intended to be used only for the applications described in the catalogue and technical documentation, which is dedicated to them. If products and components from other manufacturers are used, they must be recommended or approved by NHP or Terasaki.
Appropriate use of NHP / Terasaki products during transport, storage, installation, assembly, commissioning, operation and maintenance is necessary to ensure safe operation and without any problems.
The permissible ambient conditions must be met. The information contained in the technical documentation must be observed.

Publication of responsibility
The contents of this document have been reviewed to ensure that the reliability of the information is correct at time of publication.
NHP or Terasaki are not responsible for printing or damage resulting from errors. NHP or Terasaki reserve the right to make corrections and changes needed in subsequent edition.

Warnings and notes
This documentation contains safety instructions that you must follow for your personal safety and to prevent damage to property.
Safety instructions, referring to your personal safety are reported in the literature by a safety alert symbol.

Safety warning symbols and the words below are classified according to the degree of risk.

WARNING: Indicates an imminently hazardous situation which, if it cannot be avoided, will result in death or serious injury.

WARNING: Indicates a potentially hazardous situation which, if it cannot be avoided, can result serious injury or death.

WARNING: Indicates a potentially hazardous situation which, if it cannot be avoided, may cause minor or moderate injury.

Notice: Indicates a warning of property damage and can also indicate important operating and especially useful information on the product, that it should pay particular attention to efficient and safe operation.

Summary of Changes

This section highlights the details of changes made since the previous issue of this document.

The versioning convention used to track changes in this document follows the structure V**x.y.z** where:

x: Major revision, where extensive changes are made which is generally incompatible with the previous version. Such changes may include new products and/or features, or removal of information which is no longer relevant or applicable to the previous version.

y: Minor revision, where changes made do not change the overall scope of the previous version but may include additional information which complements or corrects the previous version or provides additional clarity on an existing topic.

z: Patch version, where small changes are made to correct minor errors or adjust existing text, charts, figures and/or images, and which do not add or remove information from the previous version. Example changes may include spelling corrections, image re-sizing and adjustments, updated images, etc.

Version	Publication date	Changes	By
V 1.0.0	17-12-2024	Initial release	B. PARK
V 1.0.1	18-12-2024	Correction to internal accessory part numbers and website URLs	B. PARK

Table of Contents

Introduction

This user manual describes the TemBreak *PRO* Thermal Magnetic MCCB (**ZS_TF**) features and instructions for use and provides information for commissioning and configuring. ZS_TF model MCCBs were previously described as Earth Leakage Circuit Breakers, or ELCBs, however ZS_TF model MCCBs are defined as per AS/NZS 60947.2 Annex B as a circuit breaker with integrated residual current protection, denoted as CBR in this document hereinafter.

Some additional features may require the use of additional products and accessories to achieve full utilization of that feature. Refer the respective User Manual in the TemBreak *PRO* series for additional information on the respective product.

Notice: Not all MCCBs in the TemBreak *PRO* series are identical. This document specifically covers the ZS_TF series CBR only. Refer to the respective TemBreak *PRO* User Manual (e.g. B_SE, P_SE, etc.) for information and instructions on other models in the TemBreak *PRO* range.

Who Should Use This Manual?

This manual aims to provide users, electricians, panel builders and maintenance personnel, with the technical information required for commissioning and operation of the NHP / Terasaki TemBreak *PRO* ZS_TF CBR.

Users of this document must have at minimum a basic understanding of electrical circuit protection topics including (but not limited to):

- Power distribution and reticulation
- Circuit protection devices
- Fault currents
- Arc faults
- Temperature rise and thermal derating of switchgear.
- Earth leakage and earth faults

Additional resources

The following resources contain additional information which should be read in conjunction with this document.

Resource	Description
NHP/Terasaki TemBreak *PRO* ZS_TF Installation Instructions TBP-ZS125-ZS250-Installation-Manual	Information on installing, mounting, and wiring the TemBreak *PRO* Thermal Magnetic Residual Current CBR.
NHP/Terasaki Trip Control Unit (TCU) Installation Instructions *TBA*	Information on installing, mounting, and wiring the TemBreak *PRO* ZS_TF Trip Control Unit (TCU).
Technical Catalogue NHP-Moulded-Case-Circuit-Breaker-Technical-Catalogue	TemBreak PRO Catalogue, containing part numbers, product data, dimensions, and more to assist with product selection.
Technical Data – Temperature and Watts Loss TemBreak-PRO-Moulded-Case-Circuit-Breaker-Temperature-and-Watts-Loss-Technical-Catalogue	Temperature and Watts Loss tables for TemBreak *PRO* Moulded Case Circuit Breakers.
Technical Data – Cascading and Selectivity TemBreak-PRO-Moulded-Case-Circuit-Breaker-Cascading-and-Selectivity-Technical-Catalogue	Cascading and Selectivity tables for TemBreak *PRO* Moulded Case Circuit Breakers with Din-T, Din-Safe, & MOD6 MCBs/RCBOs
Technical Data – Coordination TemBreak-PRO-Moulded-Case-Circuit-Breaker-and-Socomec-Component-Ordering-Technical-Catalogue	Socomec Backup Tables with TemBreak *PRO* Moulded Case Circuit Breakers
Technical Data – Type 2 Coordination Type-2-Coordination-for-TemBreak-Pro-Technical-Catalogue	Type 2 Coordination for Premium Efficiency Motor Starters with TemBreak *PRO* Moulded Case Circuit Breakers
NHP/Terasaki External Mount Handle Installation Instructions TemBreak-PRO-HP-External-Handle-For-B160-B250-ZS125-ZS250-Installation-Manual	Information on installing and mounting the HP external mount handles.
NHP/Terasaki HB Direct Mount Handle Installation Instructions TemBreak-PRO-HB-External-Handle-For-B160-B250-ZS125-ZS250-Installation-Manual	Information on installing and mounting the HB direct mount handles.
NHP Terasaki Rear Connection Tags Installation Instructions TemBreak-PRO-Rear-Tags-ZS125-ZS250-A250-P250-B160-B250-Installation-Manual	Information on installing and terminating to rear connection tags.

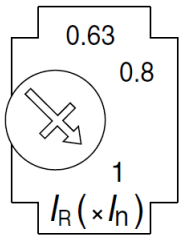
Introduction

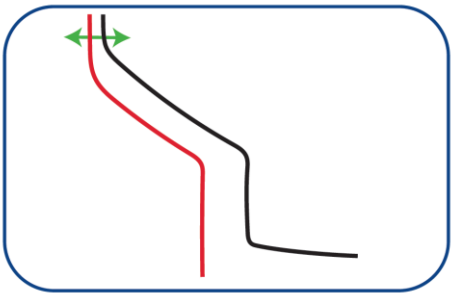
Terminology and Abbreviations

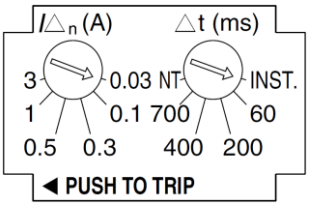
Abbreviation	Description	Abbreviation	Description
ACP	Auxiliary Communications port: Plug for Smart auxiliary / alarm contact block	**MIP**	Maintenance Interface Port: Plug for temporary connection to OCR testing, servicing, and maintenance tools
AL	Alarm: An auxiliary contact indicating trip status	**N**	Neutral
ASCII	American Standard Code for Information Interchange	**NP**	Neutral Protection
AX or AUX	Auxiliary: Auxiliary contact indicating open / closed	**OAC**	Optional Alarm Contact: Connection connector optional alarm output contact
BE	Basic Electronic Trip Unit (dial type, **LSI** and **LSIG**)	**OCR**	Over Current Relay
CBR	Circuit breaker with residual current protection, previously known as Earth Leakage Circuit Breakers, or ELCBs	**P or PTA**	Pre-trip Alarm
CCW	Connected Components Workbench software	**PCB**	Printed Circuit Board
CIP [1] [2]	[1] Communication Interface Port: Plug for control power and data for use with the TPED remote display and TPCM communication module [2] Common Industrial Protocol	**PDU**	Protocol Data Unit
CRC	Cyclic Redundancy Check – error-detecting code used at the end of each Modbus message	**PELV**	Protected Extra Low Voltage (earthed system)
dec	Decimal (base-10) numbering system	**PTA**	Pre-Trip Alarm: is a programmable output contact to advise when a trip may be imminent.
DINT	Signed Double Integer datatype (4 bytes or 32 bits in length)	**RT**	Remote Trip
EIPM	TemBreak *PRO* Ethernet/IP Module	**RTU**	Remote Terminal Unit
E/L	Earth Leakage	**S or STD**	Short Time Delay Protection
ELCB	Earth Leakage Circuit Breaker	**SE**	Smart Energy Trip Unit
FF	Fixed Thermal and Fixed Magnetic	**SELV**	Separated Extra Low Voltage
FM	Fixed Thermal and Adjustable Magnetic	**SN**	Solid Neutral
G or GF	Ground Fault Protection	**SSID**	Service Set Identifier (name of the Wi-Fi wireless network)
hex	Hexadecimal (base-16) numbering system	**STR**	String datatype
I or INST	Instantaneous Protection	**TCP**	Transmission Control Protocol
IEC	International Electrotechnical Commission	**TCU**	Trip Control Unit
IEEE	Institute of Electrical and Electronics Engineers	**TF**	Adjustable Thermal and Fixed Magnetic
I_g	Ground Fault Protection Current	**THD**	Total Harmonic Distortion
I_i	Instantaneous Protection Current	**TM**	Adjustable Thermal Magnetic
I_n	Rated Current	**TPCM**	TemCom *PRO* Communication Module
$I\Delta_n$	Residual Operating Current	**TPED**	TemView *PRO* External Display
I_N	Neutral Protection Current	**Δt**	Residual Current Non-Actuating Time delay
INT	Signed Integer datatype (2 bytes or 16 bits in length)	t_r	LTD Time delay
IP	International Protection (Ingress Protection)	t_{sd}	STD Time delay
I_r	LTD Protection Current	t_{tsp}	Thermal Self-Protection Time delay
I_{sd}	STD Protection Current	**UDINT**	Unsigned Integer (2 bytes or 16-bits in length)
I_{tsp}	Thermal Self-Protection Current	**UINT**	Unsigned Integer (2 bytes or 16 bits in length)
L or LTD	Long Time Delay Protection	**ULINT**	Unsigned Long Integer datatype (8 bytes or 64 bits in length)
LCD	Liquid Crystal Display (LCD)	**URLs**	Uniform Resource Locator (address of an Internet website)
LED	Light Emitting Diode	**WORD**	2 bytes or 16-bits of data
LINT	Signed Long Integer datatype (8 bytes or 64 bits in length)	**ZCT**	Zero Phase Current Transformer
LSI	Long Time, Short Time and Instantaneous Protection	**ZSI**	Zone Selective Interlocking (zone selectivity)
LSIG	Long Time, Short Time, Instantaneous and Ground Fault Protection	**θ**	Thermal imaging value
MCCB	Moulded Case Circuit Breaker	θ_C	Cold start mode thermal imaging value
MHT	Magnetic Hold Trigger	θ_H	Hot start mode thermal imaging value
microSD	Micro Secure Digital	θ_{trip}	Thermal imaging value tripping threshold

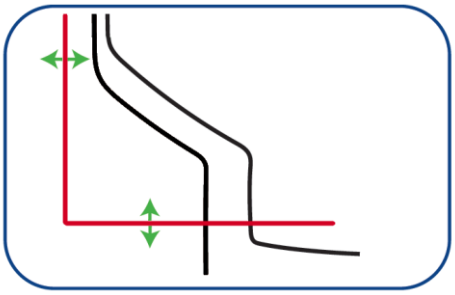
Product Information

The TemBreak *PRO* ZS model circuit breakers with integrated residual current protection (CBRs) with trip unit type TF offer protection against overloads and short circuits, with additional functionality for the detection and tripping of earth leakage and earth fault currents. The TF type trip unit features adjustable protection settings via preset rotary switches. It provides adjustable thermal and fixed magnetic tripping curves, as well as adjustable residual current protection.









Features (TF – adjustable – fixed)

- Adjustable thermal trip curves
- Non-adjustable (fixed) magnetic trip protection
- Adjustable residual current protection
- 3-pole and 4-pole versions available
- 4-pole versions available with either Switched Neutral pole or Unswitched Neutral (solid) pole
- Switched Neutral (4P only) with early make/late break design which reduces the risk of abnormal line to neutral voltages that may damage sensitive electronic equipment
- Remote Trip function

Frame Sizes

- ZS125
- ZS250

Protection Functions

- Thermal – Long Time Delay
- Magnetic – Instantaneous
- Residual Current – Residual operating current and non-actuating time delay

Product Information

Part Number Break Down

P	160	F	2	4	160	BE	G
a)	b)	c)	d)	e)	f)	g)	h)

a) Model Type

A	Basic applications (160…250 A)
P	Mid to advanced applications (160…630 A)
B	High current, high kA applications (160…1600 A)
ZS	Earth Leakage applications (125…250 A)
XS	Highest current applications (2000…3200 A)

b) Ampere Frame

125	A
160	A
250	A
400	A
630	A
800	A
1000	A
1250	A
1600	A
2000	A
2500	A
3200	A

c) Short Circuit Break Capacity I_{cu} (kA)

R	200 kA
L	150 kA
P	125 kA
S	110 kA
G	100 kA
HL	85 kA
H	70 kA
M	65 kA
N	50 kA
F	36 kA
E	25 kA
D	Switch

d) Pole Pitch Size (mm) 1)

1	25
2	30
3	35

e) No. of Poles

1	7)
2	8)
3	
4	

f) Trip Unit Rating (I_n)

I_n	x A

g) Trip Unit Type

TF	Adj Thermal Fix Magnetic 4)
FF	Fix Thermal Fix Magnetic
TM	Adj Thermal Adj Magnetic
SX	Smart Ammeter 5) 6)
BE	Basic Electronic 6)
SE	Smart Energy 6)
NN	Non-Auto Switch

h) Trip Unit Option

G	Ground Fault 2)
N	Neutral 2)
P	Pre-Trip Alarm 3)
SN	Solid Neutral 9)

Notice: Not all combinations are possible. Confirm part number combination with NHP for availability.

1. 160AF only
2. For P_SE versions these features are standard and therefore are not added to the end of the part number.
3. PTA is standard with P electronic models and therefore P is not added to the end of the part number.
4. Only available in A & ZS models
5. Only available in B models
6. Not available in A and ZS models
7. Only available in A and B models (FF Only Trip Unit)
8. Not available in A and B models (FF Only Trip Unit)
9. ZS Models

Product Information

Available MCCBs in the TemBreak *PRO* range

Rating Short Circuit Break Capacity (kA)		Frame Size										
		160	250	400	630	800	1000	1250	1600	2000	2500	3200
E	*25*	A160E – TF A160E – FF B160E – FF	A250E – TM	P400E-TM	P630E – TM							
F	*36*	A160F – TF P160F – FF P160F – TM P160F – BE P160F – BEG P160F – SE	A250F – TM P250F – TM P250F – BE P250F – BEG P250F – SE	P400F – TM P400F – BE P400F – BEG P400F – SE	P630F – TM P630F – BE P630F – BEG P630F – SE	B800F – TM						
N	*50*	P160N – TM P160N – BE P160N – BEG P160N – SE	P250N – TM P250N – BE P250N – BEG P250N – SE	P400N – TM P400N – BE P400N – BEG P400N – SE	P630N – TM P630N – BE P630N – BEG P630N – SE	B800N – TM B800N – BE B800N – SX B800N – SE	B1000N – BE B1000N – BEG B1000N – SX B1000N – SE	B1250N – BE B1250N – BEG	B1600N – BE B1600N – BEG			
H	*70*	P160H – TM P160H – BE P160H – BEG P160H – SE	P250H – TM P250H – BE P250H – BEG P250H – SE	P400H – TM P400H – BE P400H – BEG P400H – SE	P630H – TM P630H – BE P630H – BEG P630H – SE	B800H – TM B800H – BE B800H – BEG B800H – SX B800H – SE	B1000H – BE B1000H – BEG B1000H – SX B1000H – SE	B1250H – BE B1250H – BEG				
HL	*85*							B1250HL – BE B1250HL – BEG	B1600HL – BE B1600HL – BEG	XS2000HL – BE XS2000HL – BEG	XS2500HL – BE XS2500HL – BEG	XS3200HL – BE
G	*100*					B800G – TM B800G – BE B800G – BEG B800G – SX B800G – SE						
S	*110*			P400S – TM P400S – BE P400S – BEG P400S – SE	P630S – TM P630S – BE P630S – BEG P630S – SE							
P	*125*	B160P – TM	B250P – TM B250P – BE B250P – SE	B400P – BE B400P – BEG		B800P – BE B800P – BEG B800P – SX B800P – SE						
R	*200*	B160R – TM	B250R – TM	B400P – BE B400P – BEG		B800R – BE B800R – BEG B800R – SX B800R – SE						
D	*Switch*	A160D – NN P160D – NN	A250D – NN P250D – NN	P400D – NN	P630D – NN	B800D – NN	B1000D – NN	B1250D – NN	B1600D – NN	XS2000D – NN	XS2500D – NN	

Product Information

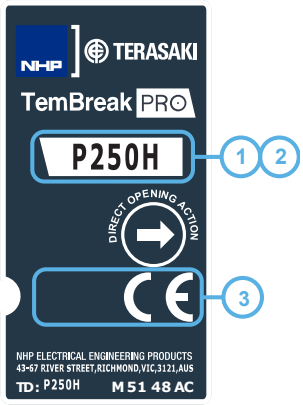
Available CBRs in the TemBreak *PRO* range

Rating Short Circuit Break Capacity (kA)		Frame Size											
		125	160	250	400	630	800	1000	1250	1600	2000	2500	3200
M	*65*	ZS125M – TF		ZS250M – TF									

Product Information

Label Identification

The label on the MCCB features information to aid in product identification.



	Description	Notes
1	Circuit Break Identifier	Identifies the model type, ampere frame, and I_{cu} rating.
2	Trip unit type	The trip unit type is indicated by the colour of the label.
3	Certifications	Identifies the additional localised certifications of the product, in addition to the international product standard, IEC 60947-2 / AS/NZS IEC 60947-2. For additional certifications please contact NHP.

White label – Thermal-magnetic type trip unit

Trip Units	FF, TF, FM, TM
Models	A, P, B, ZS
Ampere Frame	125 – 800

Grey label – electronic or non-auto type trip unit. To distinguish between the two, electronic trip units will have the "I_{cu}" letter and non-auto will use the letter "D," Switch.

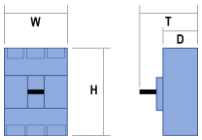
Trip Units	BE, BEG, BEGN , NN
Models	A, P, B, XS
Ampere Frame	160 – 3200

Blue Label – SMART electronic type trip unit

Trip Units	SX, SE
Models	P, B
Ampere Frame	160 – 1000

Product Information

ZS_TF Information

Frame / Model	Attribute	Unit	Condition	ZS125_TF	ZS250_TF
Number of Poles				3, 4	3, 4
Nominal current ratings Trip unit ratings	I_{CT}	(A)	50°C Calibration	20, 32, 50, 63, 100, 125	160 250
Residual current ampere settings	$I_{\Delta n}$	(A)		0.03, 0.1, 0.3, 0.5, 1, 3	0.03, 0.1, 0.3, 0.5, 1, 3
Electrical characteristics					
Rated maximum operational voltage	U_e	(V)	AC 50/60 Hz	525	525
		(V)	DC	—	—
Rated insulation voltage	U_i	(V)		525	525
Rated impulse withstand voltage	U_{imp}	(kV)		8	8
Selectivity category				A	A
Rated short time withstand current	I_{cw}	(kA)	0.4 sec	—	—
Residual current unit minimum voltage		(V)	AC 50/60 Hz	200	200
Ultimate breaking capacity	I_{cu}	(kA)	525 Vac	25	25
			440 Vac	50	50
(IEC, JIS, AS/NZS)			415 Vac	65	65
			400 Vac	65	65
			240 Vac	85	85
DC Voltage			250 Vdc	—	—
Service breaking capacity	I_{cs}	(kA)	525 Vac	22	25
			440 Vac	25	25
(IEC, JIS, AS/NZS)			415 Vac	33	36
			400 Vac	36	36
			240 Vac	85	85
DC Voltage			250 Vdc	—	—
Residual short-circuit making and breaking capacity	$I_{\Delta m}$	(kA)		25% of I_{cu}	25% of I_{cu}
Protection - Over Current Release types	Std Standard Opt Optional — Not Available				
Adjustable thermal, fixed magnetic				Std	Std
Residual current protection, Type A	M Req Module Required			Std	Std
Installation (Std / Opt / —)					
Front connection (FC)				Std	Std
Extension bar (FB)				Opt	Opt
Cable tunnel clamp (FW)	Std Standard Opt Optional — Not Available			Opt	Opt
Rear Connection (RC)				Opt	Opt
DIN rail adaptor				Opt	—
Withdrawable mechanism				—	—
Plug-in				—	—
Reverse supply connection possible to 440V				Yes	Yes
Dimensions 	H	(mm)		155	165
	W	(mm)	1 pole	—	—
			2 pole	—	—
			3 pole	90	105
			4 pole	120	140
	D	(mm)		68	68
	T	(mm)		92	92
Weight	W	(kg)	1 pole	—	—
			2 pole	—	—
			3 pole	1.1	1.5
			4 pole	1.4	1.9
Operation options (Std / Opt / —)	Std Standard Opt Optional — Not Available				
Toggle operation				Std	Std
Extension handle TP-HS/HP or Direct mount T2HB				Opt	Opt
Motor operation TP-MC				Opt	Opt
Endurance	Electrical	Cycles	415 Vac	10000	10000
	Mechanical	Cycles		30000	30000

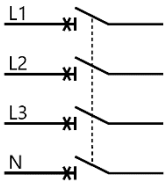
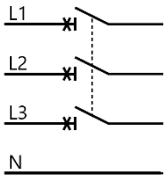
Neutral Switching Options for 4-pole ZS_TF CBRs

The 4-pole ZS_TF CBRs are available with Switched Neutral as standard, however Solid (Unswitched) Neutral versions can be selected depending on the electrical requirements of the application.

Selecting Switched or Solid Neutral versions of 4-pole ZS_TF CBRs is achieved by modifying the part number when ordering:

- Switched Neutral versions are standard, and no further action is required when ordering (e.g. ZS125M4125TF).
- Solid Neutral versions have the suffix “SN” appended to the part number (e.g. ZS125M4125TFSN).

When a 4-pole ZS_TF CBR has a Solid (Unswitched) Neutral, the CBR will have a sticker affixed to the lower portion of the Neutral pole which states “SN TYPE, UNSWITCHED NEUTRAL”, as indicated below.

Switched Neutral version	Solid Neutral (SN) version
	
	

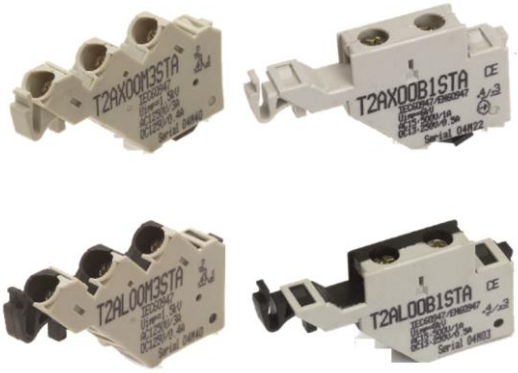
Notice: The Neutral switching type of an existing ZS_TF CBR cannot be modified. Switched or Solid Neutral options are only able to be selected when ordering the CBR.

Internal Accessories

Internal accessories include Auxiliary and Alarm contacts, which may be installed under the front cover of the MCCB in various combinations to provide additional functionality and connection with external control circuits.

For information regarding installation of the internal accessories, see Internal Accessory Mounting Locations

Auxiliary & Alarm Switches



Auxiliary Contacts

An auxiliary contact can be installed to indicate whether an MCCB is Open (both OFF and Tripped positions) or Closed (ON). Auxiliary contacts come in either general purpose, heavy duty, or micro-switch type, with some combinations pre-wired or with terminals. General purpose auxiliary switches are provided as a single change-over switching arrangement (1x C/O).

Part Number	Description	Contact Type	Connection Type	Conductor			
				Minimum	Maximum	Size	Length
T2AX00M3SWA	Auxiliary	General purpose	Pre-wired	N/A		0.5mm²	700mm
T2AX00M3STA	Auxiliary	General purpose	Terminal	0.5mm²	1.25mm²	N/A	
T2AX00M3RTA	Auxiliary	Micro-switch	Terminal	0.5mm²	1.25mm²	N/A	

Alarm Contacts

An alarm contact can be installed to indicate whether an MCCB is in the Tripped or Not Tripped position (ON, OFF). Alarm contacts come in either general purpose, heavy duty, or micro-switch type, with some combinations pre-wired or with terminals. General purpose alarm switches are provided as a single change-over switching arrangement (1x C/O).

Part Number	Description	Contact Type	Connection Type	Conductor			
				Minimum	Maximum	Size	Length
T2AL00M3SWA	Alarm; left side only	General purpose	Pre-wired	N/A		0.5mm²	700mm
T2AL00M3STA	Alarm; left side only	General purpose	Terminal	0.5mm²	1.25mm²	N/A	
T2AL00M3RTA	Alarm; left side only	Micro-switch	Terminal	0.5mm²	1.25mm²	N/A	

Heavy Duty Style Auxiliary and Alarm Switches

Part Number	Description	Contact Type	Connection Type	Conductor				Switching Arrangement
				Minimum	Maximum	Size	Length	
T2AX00B1STA	Auxiliary	Heavy Duty	Terminal	1.25mm²	2.5mm²	N/A		1 N/O
T2AX00B2STA	Auxiliary	Heavy Duty	Terminal	1.25mm²	2.5mm²	N/A		1 N/C
T2AL00B1STA	Alarm	Heavy Duty	Terminal	1.25mm²	2.5mm²	N/A		1 N/O
T2AL00B2STA	Alarm	Heavy Duty	Terminal	1.25mm²	2.5mm²	N/A		1 N/C

For information regarding wiring and terminal designations, see Annex H

Internal Accessories

Auxiliary and Alarm Data

General purpose contact						
AC (V)			DC (V)			Minimum Load
Volts (V)	Amperes (A)		Volts (V)	Amperes (A)		
	Resistive Load	Inductive Load		Resistive Load	Inductive Load	
480	—	—	250	—	—	100 mA @ 15 Vdc
250	3	2	125	0.4	0.05	
125	3	2	30	3	2	

Heavy duty contact						
AC (V)			DC (V)			Minimum Load
Volts (V)	Amperes (A)		Volts (V)	Amperes (A)		
	Resistive Load	Inductive Load		Resistive Load	Inductive Load	
500	1	1	—	—	—	—
440	3	3	250	0.5	0.5	
240	4	4	125	1	1	
110	5	5	48	3	2.5	
48	6	6	24	6	2.5	

Micro-switch contact			
DC (V)			Minimum Load
Volts (V)	Amperes (A)		
	Resistive Load	Inductive Load	
30	0.1	—	1 mA @ 5 Vdc

Number of internal accessories

The ZS_TF CBRs can accept the following number of Auxiliary and Alarm contact accessories. The Auxiliary contacts used for each ZS_TF CBR must be selected as General Purpose or Heavy Duty type, individual ZS_TF CBRs cannot accept a combination of General Purpose and Heavy Duty type Auxiliary contacts. Alarm contact accessories can be General Purpose or Heavy Duty type, regardless of the type and number of Auxiliary contacts installed.

Frame Size	Auxiliary General Purpose		Auxiliary Heavy Duty		Alarm Contact (General Purpose or Heavy Duty)
ZS125	2	Or	1	And	1
ZS250	2		2		1

Internal Accessories

Shunt Trip or Under Voltage Trip

The ZS_TF CBRs can accept auxiliary and alarm contact accessories as fitted in the left-hand side accessory chamber, however the ZS_TF CBRs cannot accept Shunt Trip nor Under Voltage Trip accessories as the right-hand side area of the CBR is occupied by the integrated residual current unit.

ZS125	ZS250
	

While Shunt Trip and Under Voltage Trip accessories cannot be installed in ZS_TF CBRs, the ZS_TF CBRs come standard with a Remote Trip (RT) function if remote tripping functionality is required. See the Remote Trip Operation section for additional information.

Notice: The integrated residual current unit of the ZS_TF CBR is not a removable or replaceable component.

ZS_TF CBR Only Accessories

Notice: The following list of accessories are unique to the ZS_TF model CBRs. For other accessories in the TemBreak PRO series, refer to the TemBreak PRO technical catalogues, respective user manuals, and installation instructions.

Trip Control Unit (TCU)

The Trip Control Unit (TCU) is an optional accessory that mounts on the right-hand side of a ZS_TF CBR, part number T2M1166CBA.

Features:

- Cause Of Trip contact to indicate if the CBR has tripped due to residual current protection, which also acts as a Pre-Trip Alarm.
- Pre-Trip Alarm contact which can be configured to activate at 50% or 70% of the residual operating current setting.
- Alarm LED to indicate if an earth leakage or earth fault has been detected by the CBR.
- Remote Trip facility.
- Down-Voltage Trip function.
- Can be retrofitted to ZS_TF CBRs on-site by qualified personnel.

For more information on the features, installation and usage instructions, please refer to the Trip Control Unit User Manual.

Notice: When the add-on TCU is used, the standard integrated Remote Trip (RT) feature of the ZS_TF CBR should not be used as it can cause incorrect operation of the TCU.

Tamper Proof Seal

The ZS_TF CBR can be fitted with optional tamper-proof seal to help prevent unauthorized adjustment of the residual operating current and time delay settings, part number T2SF25NTA.

Installation

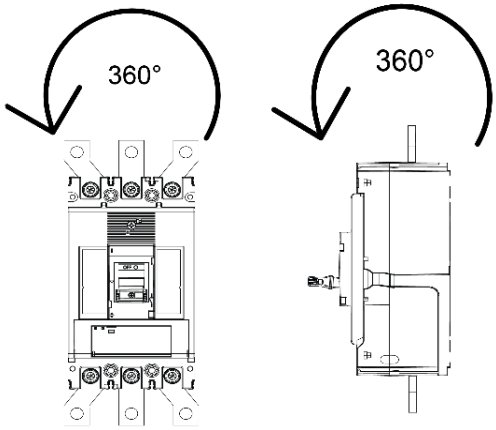
Precautions

WARNING: To prevent electrical shock and damage to equipment, disconnect and isolate power source upstream of the MCCB before installing or servicing the MCCB including its connected accessories.

Notice: To ensure correct performance, and integrity of equipment, the installation instructions and recommendations provided herein shall be respected. Refer to the respective user manual and installation instructions provided with the MCCB and associated accessories.

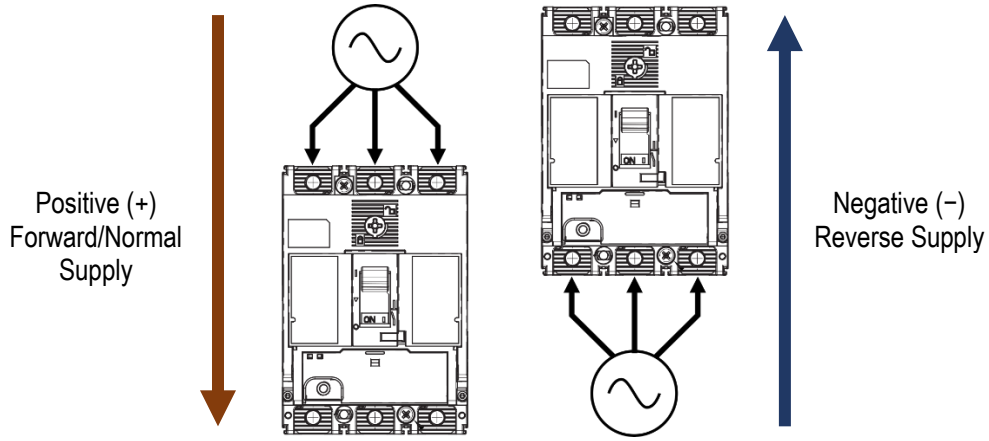
Mounting Angles

TemBreak *PRO* MCCBs may be mounted at any angle without affecting performance.



Direction of Power Supply

Power supply may be fed in either direction with respect to the MCCB without affecting electrical performance.



Installation

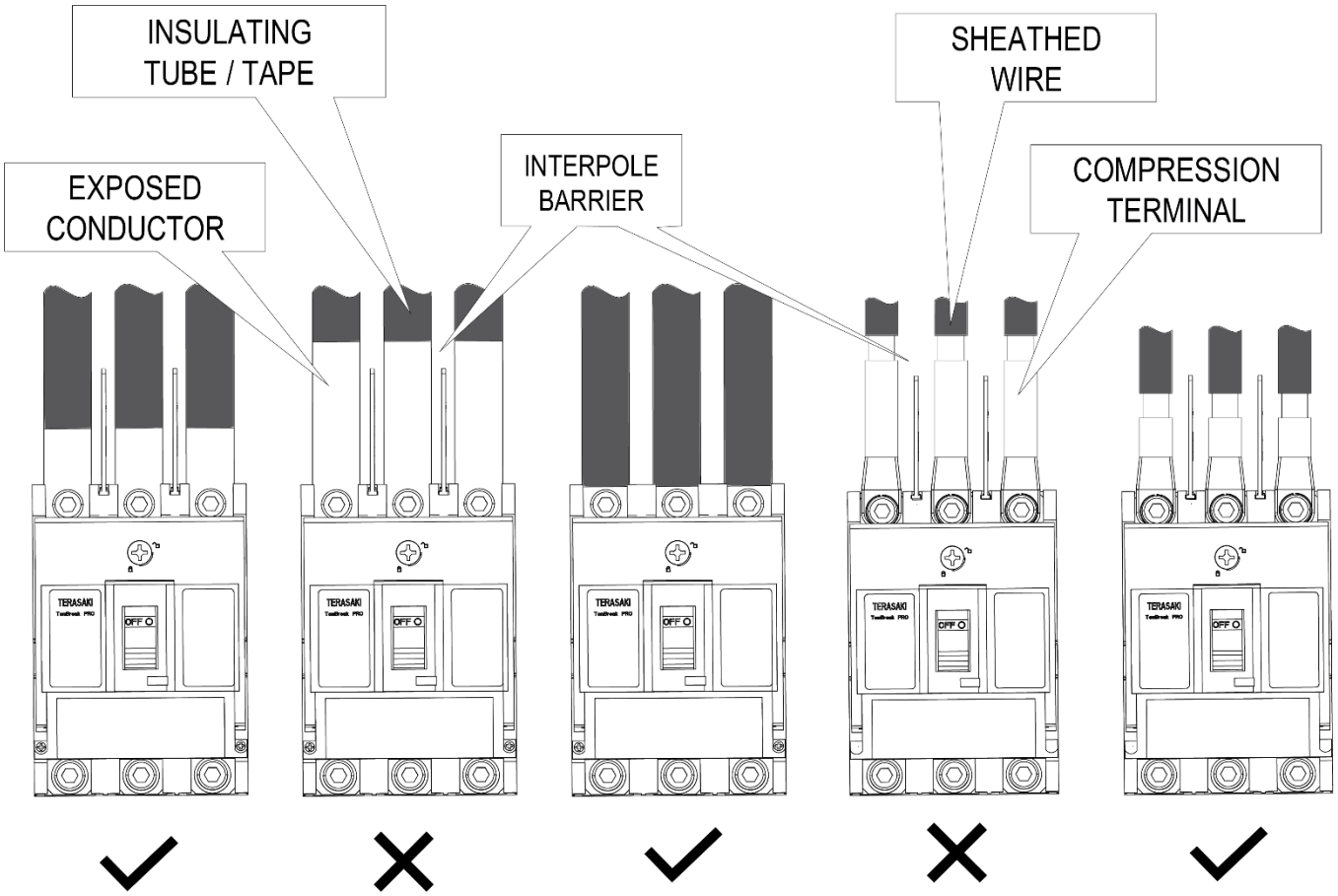
Clearances

WARNING: Exposed conductors including terminals at attached busbars must be insulated to avoid possible short-circuit or earth faults due any foreign matter coming into contact with the conductors.

Phase to Phase and Earth

Interruption of large currents during fault or normal switching operation produces ionised gases and arcing materials which expelled from the vents at the top of the MCCB for both ZS125 and ZS250. These ionised gases are highly conductive, concentrated, and at an elevated temperature when it exits the MCCB via the arc vents. Care must be taken to avoid an arcing fault from occurring due to the presence of concentrated ionised gases creating a conductive path between exposed conductors. Incoming conductors must therefore be insulated the full length up to the terminal opening of the MCCB, ensuring bare conductors are not exposed directly to concentrated ionised gases. This also applies to the attached busbars supplied as part of the MCCB.

Interpole barriers or terminal covers may be used to achieve creepage and clearance requirements. Conductors must not impede the flow of ionised gas and allow it to clear and disperse safety. Interpole barriers are supplied as standard with Terasaki MCCBs for the line side only. 2 barriers with 3P MCCBs and 3 with 4P MCCBs. In cases where two different MCCB types are installed one above the other, the insulation distance between the two models should be as for the lower model.



Installation

Insulating Distance

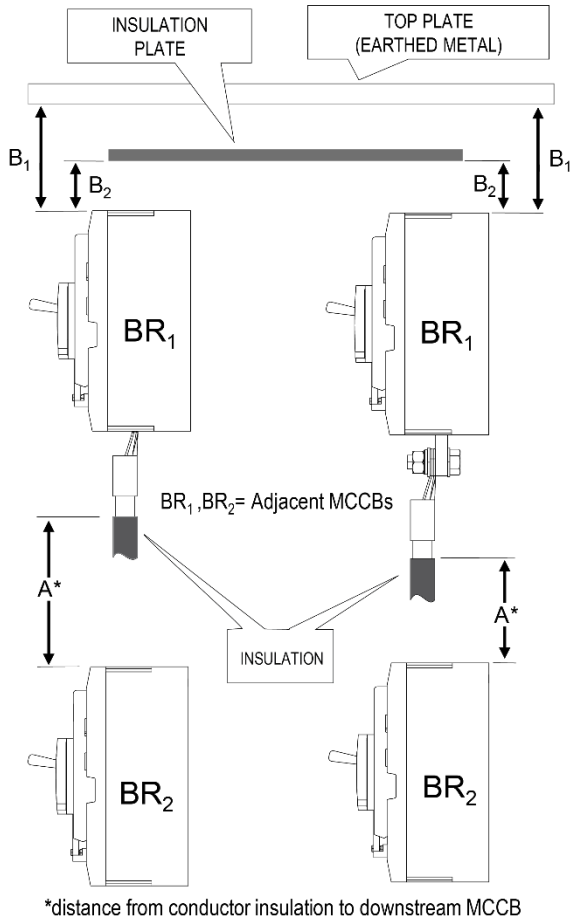
When earth metal is installed within proximity of the breakers, the correct insulating distance must be maintained, refer to Minimum Clearance for further details.
This distance is necessary to allow the exhausted arc gases to disperse. This could include the mounting plate or side panel within a switchboard.

Minimum Clearance

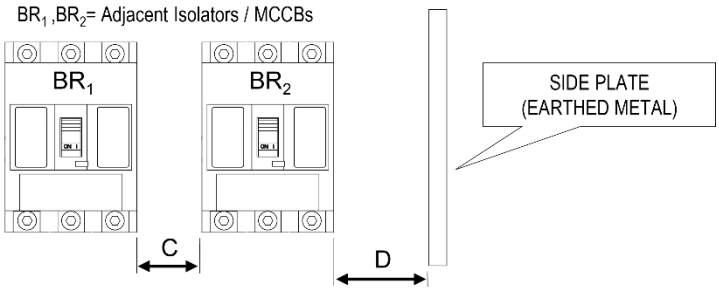
Below illustrates the minimum clearance that must be maintained. Ensure that the exposed conductor is insulated until it overlaps the moulded case breaker at the terminal, or the terminal cover.

Dim.	Description
A	Distance from lower breaker to open charging part of terminal on upper breaker (front connection) or the distance from lower breaker to upper breaker end (rear connection and plug-in type)
B_1	Distance from breaker end to ceiling (earthed metal)
B_2	Distance from breaker end to insulator
C	Clearance between breakers
D	Distance from breaker side to side plate (earthed metal)

MCCB Cat. No.	Distances (mm)				
	A	B_1	B_2	C	D
ZS125	75	45	25	0	25
ZS250	100	80	30	0	25



*distance from conductor insulation to downstream MCCB



Installation

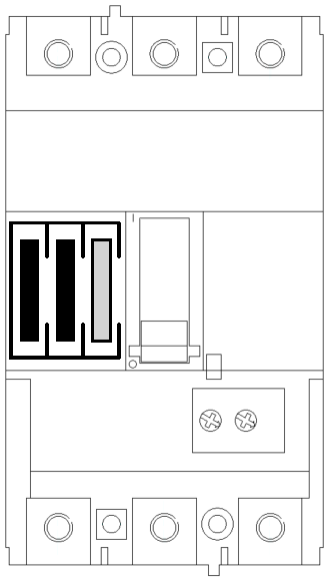
Internal Accessory Mounting Locations

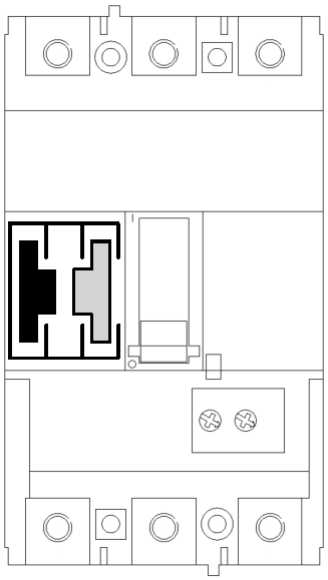
ZS125 and ZS250 frame sizes have different internal mounting locations for auxiliary contacts and alarm contacts.

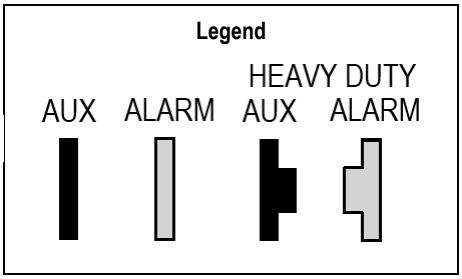
Auxiliary contacts and alarm contacts may be mounted in the left-hand side internal accessory chamber only as the right-hand side is occupied by the integrated residual current unit.

Refer to the following illustrations for each frame size listing the various possible internal accessories combinations.

ZS125 internal accessories combination

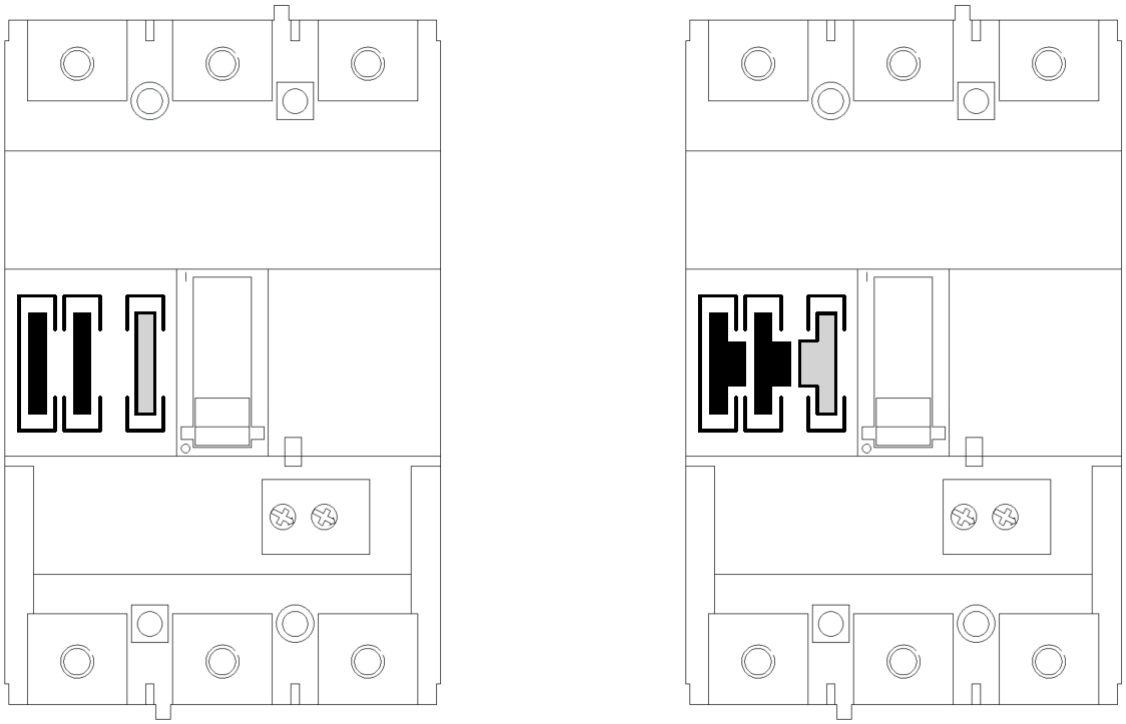


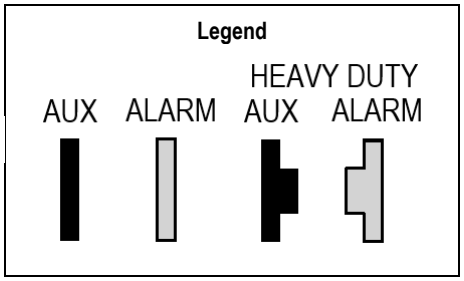




Installation

ZS250 internal accessories combination



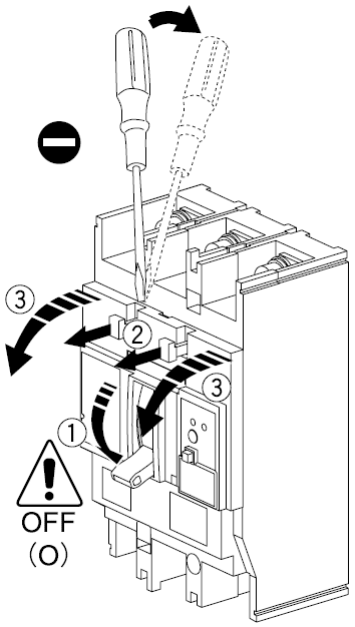
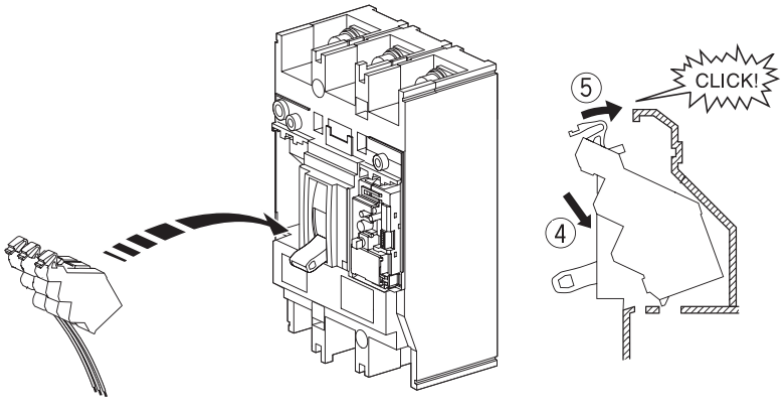
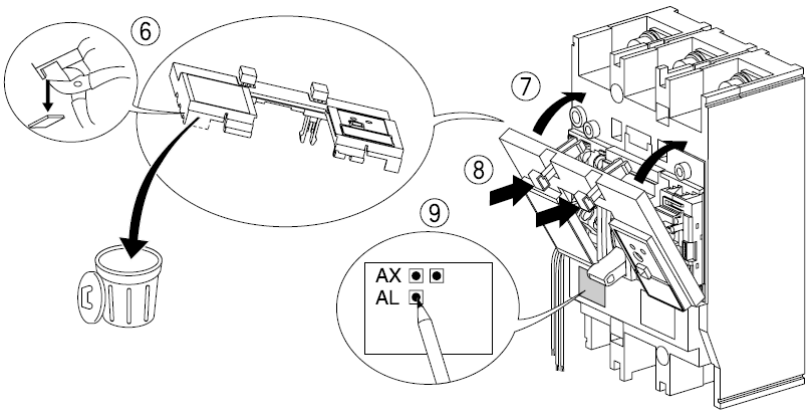


Installation

Alarm Switch Installation

The alarm switch has a trip bar that needs to interact with the MCCBs trip mechanism. As such they must be installed in a specific way. Refer to the supplied Installation Instructions for the respective accessories for further detail.

Standard Alarm & Auxiliary installation

	Action	Note
1	Switch the MCCB to the OFF position.	
2	Using a flat-head screwdriver, gently lever the MCCB face plate securing tabs outward	
3	Lower the MCCB face plate	
4	Insert the bottom of the auxiliary or alarm contact towards the bottom rear of the left-hand chamber	
5	The alarm will need to be rolled into place, follow the images to the right	
6	Remove the bottom corner of the face plate to allow the wiring to run out the left-hand side of the MCCB	
7	Close the faceplate	
8	Push the faceplate securing tabs back in	
9	Update the accessory legend sticker	

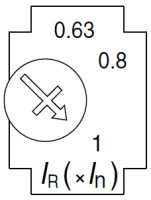
Protection Settings

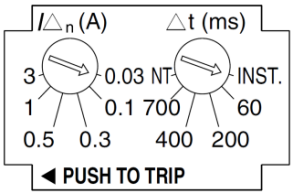
Trip Curve

The TemBreak *PRO* ZS_TF thermal magnetic trip unit protects against overcurrent and short circuit faults for many types of electrical distribution systems. The ZS_TF OCR has protective characteristics according to the requirements of the standard AS/NZS IEC 60947-2.

The ZS_TF residual current trip unit protects against earth leakage and earth faults in electrical systems, the protective characteristics of which are according to the requirements of AS/NZS IEC 60947-2 Annex B.

The ZS_TF OCR consists of a single large dial type (blue coloured dial) for thermal adjustment, and two smaller dials (grey coloured dials) for residual current threshold and time delay adjustment.

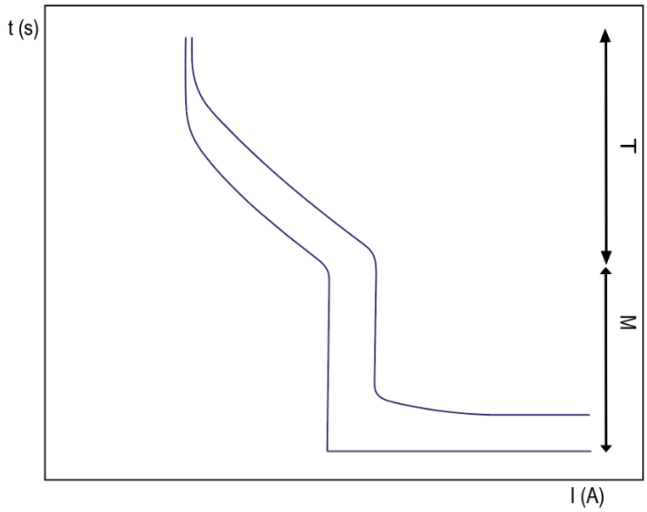


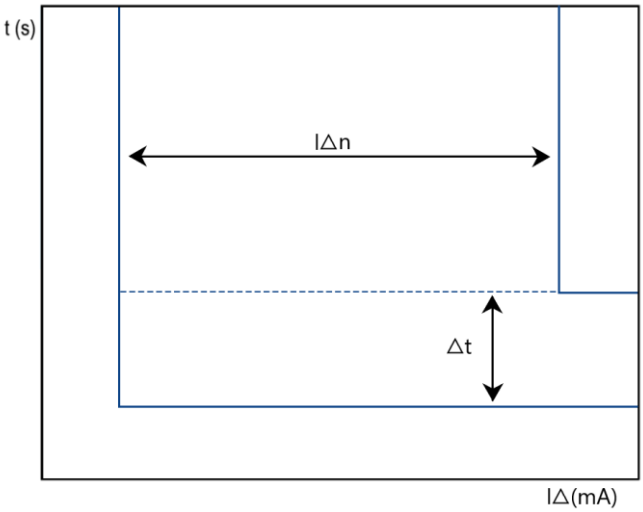


List of Protection Functions

Abbreviation	Description	Protection against	Symbol	Definition
T	Thermal	Low level overload current	I_r	Threshold thermal protection
F	Magnetic	High level short-circuit current	I_i	Fixed magnetic protection
R	Residual Current	Earth leakage and earth fault current	$I\Delta_n$	Residual current protection

Time-current curve

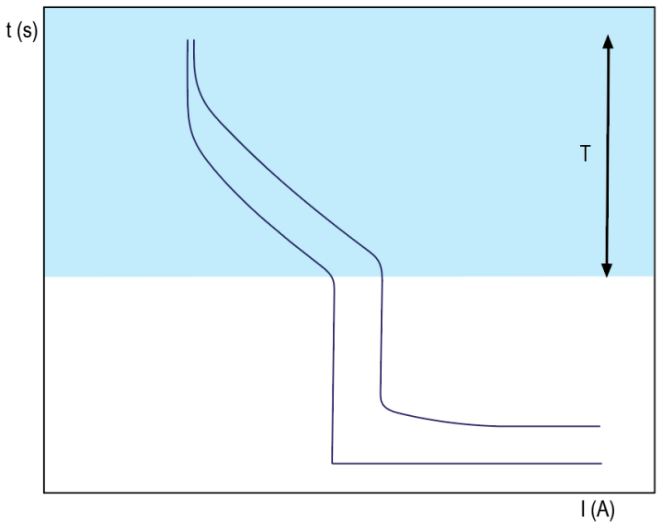




Protection Settings

Thermal protection

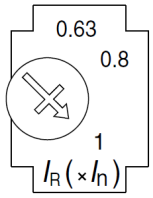
The thermal protection is designed to protect against current overloads or surges in power distribution or motor control applications.
Thermal protection is an inverse-time protection, labelled as I_r.



TF – Adjusting I_r (Current)

The thermal protection trip range is: 0.63 – 1.0 x I_n according to standard AS / NZS / IEC 60947-2.

The I_r trip threshold is adjusted using the I_r dial on the front of the ZS_TF CBR: It is continuously adjustable between 0.63 x I_n to 1.0 x I_n, with reference labels of 0.63, 0.8 and 1.0 on the I_r dial.



Thermal Protection Settings (I_r)		
Rating (I_n)	Dial Range (x I_n)	Adjustable Current Range (A)
20 A	0.63 ... 1.0	12.5 ... 20
32 A	0.63 ... 1.0	20 ... 32
50 A	0.63 ... 1.0	32 ... 50
63 A	0.80 ... 1.0	50 ... 63
100 A	0.63 ... 1.0	63 ...100
125 A	0.63 ... 1.0	80 ... 125
160 A	0.63 ... 1.0	100 ... 160
250 A	0.63 ... 1.0	160 ... 250

Labelling of Calibrated Points

I_r dial of the ZS_TF CBR has been calibrated for points 0.63, 0.8 & 1 x I_n.

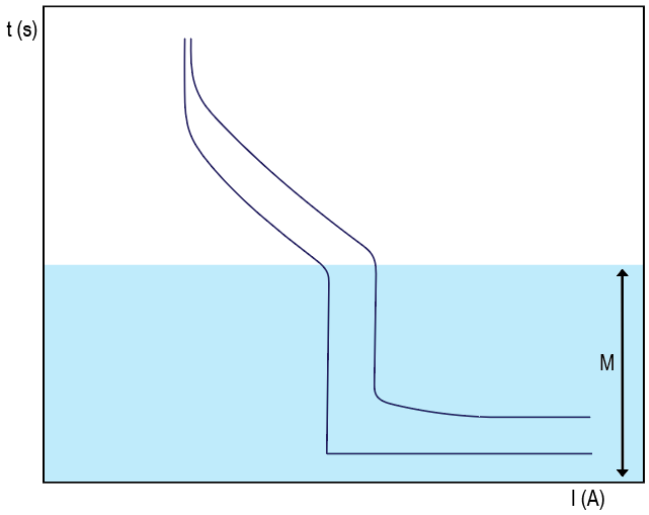
I_r calibration points are marked as follows:
Red: 1.0 x I_n
Blue: 0.8 x I_n
Black: 0.63 x I_n

WARNING: Setting I_r dial outside of the calibrated zone (0.63 - 1) may cause unpredictable behaviour of the CBR.

Protection Settings

Magnetic Protection

The magnetic protection is designed to protect against fast high current faults such as short circuits, labelled as I_i.



TF – Fixed I_i (Current)

The magnetic protection of the TF type Trip Unit is at a fixed value based on a multiple of the nominal current rating of the CBR (I_n).
The multiple of the rated current I_n, and the magnetic trip threshold currents for the respective ZS_TF CBR rated currents are as follows:

Magnetic Protection Settings		
Rated Current (I_n)	Multiple of I_n	Magnetic trip threshold (I_i)
20 A	12 x I_n (+/- 20 %)	240 A
32 A	12 x I_n (+/- 20 %)	384 A
50 A	12 x I_n (+/- 20 %)	600 A
63 A	12 x I_n (+/- 20 %)	756 A
100 A	12 x I_n (+/- 20 %)	1200 A
125 A	10 x I_n (+/- 20 %)	1250 A
160 A	13 x I_n (+/- 20 %)	2080 A
250 A	10 x I_n (+/- 20 %)	2500 A

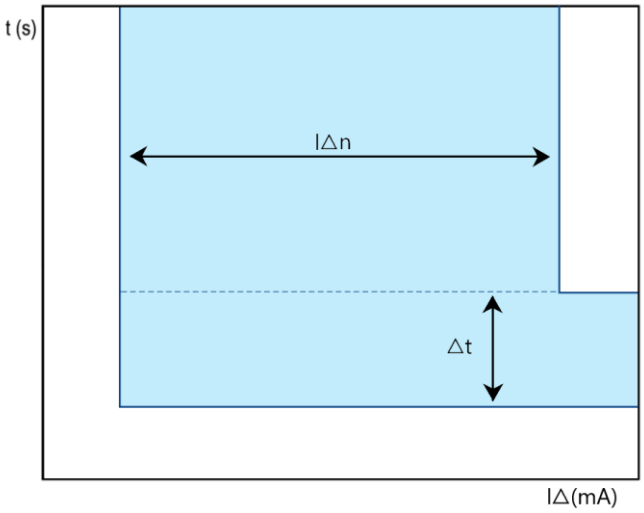
Protection Settings

Residual Current Protection

The residual current protection is designed to provide protection against abnormal current flow to the earth, either due to an insulation fault (Earth Fault) or in the absence of an insulation fault (Earth Leakage).

The ZS_TF CBR allows for adjustment of both the residual operating current and non-actuating time delay. Settings can be adjusted to provide specific residual current protection for electrical systems and equipment, or to allow for residual current selectivity in electrical systems where residual current protection devices are connected in series. Introducing a time delay in the upstream residual current protection device such as a ZS_TF CBR allows for the downstream residual current protection device nearest to the earth fault to operate first, improving the reliability of supply of the electrical system.

The residual current protection threshold is labelled as $I\Delta_n$ (A), and the non-actuating time delay is labelled as Δt (ms).



Residual Current Protection Type

The ZS_TF CBR offers Type A residual current protection.
Tripping is ensured for residual sinusoidal AC in the presence of residual pulsating DC.

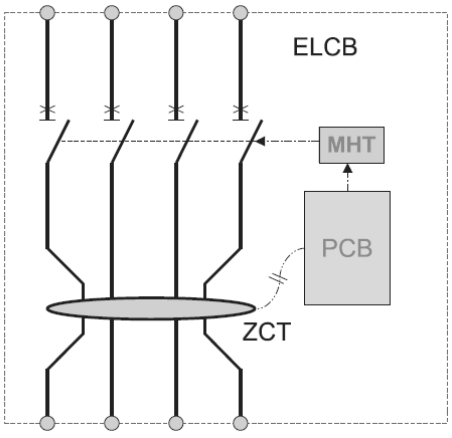
Zero Phase Current Transformer (ZCT)

The ZS_TF CBR uses an internal Zero Phase Current Transformer (ZCT) for the detection of earth leakage and earth fault currents.

The single cores of the electrical system pass through the inner diameter of the ZCT within the CBR. While the system is fault free the outgoing and return current vectors are balanced, so no current will flow in the secondary output of the ZCT.

When an earth leakage or earth fault is present in the system, the residual current (zero phase sequence current) of the system flows through the secondary of the ZCT, and this secondary current is detected by the residual current detection circuit (PCB).

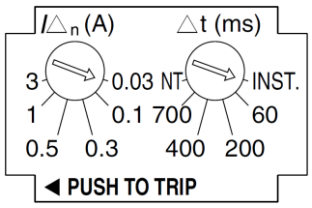
If the detected residual current exceeds the selected residual operating current setting ($I\Delta_n$), the non-actuating time delay (Δt) is initiated, after which the Magnetic Hold Trigger (MHT) will operate and cause the main poles of the CBR to open automatically.



4-pole ZS_TF CBR shown

Protection Settings

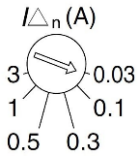
The residual operating current and non-actuating time delay can be selected from multiple values using the adjustment dials on the ZS_TF CBR.



R – Adjusting IΔn (Residual Operating Current)

The residual operating current setting can be set to values between 30 mA and 3.0 A according to standard AS / NZS / IEC 60947-2 Annex B.

The residual operating current setting is adjusted using the 'IΔn (A)' dial on the front of the ZS_TF CBR: It is not continuously adjustable and must be selected from the available discrete settings labelled on the ZS_TF CBR, as listed below.

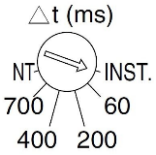


Residual Operating Current Threshold IΔn (A)					
0.03	0.1	0.3	0.5	1.0	3.0

R – Adjusting Δt (Time Delay)

The limiting non-actuating time, or time delay, can be set to values between 60ms and 700ms, and can also be set to Instantaneous (INST – no additional delay) or No Trip (NT – "infinite" delay).

The time delay is adjusted using the 'Δt (ms)' dial on the front of the ZS_TF CBR: It is not continuously adjustable and must be selected from the available discrete settings labelled on the ZS_TF CBR, as listed below.



Time delay Δt Setting (ms)	Maximum break time (s)			
	1x IΔn	2x IΔn	5x IΔn	10x IΔn
INST (Instantaneous)	0.3	0.15	0.04	0.04
60	0.19	0.16	0.15	0.15
200	0.36	0.35	0.34	0.34
400	0.62	0.61	0.60	0.60
700	0.95	0.94	0.93	0.93
NT (No Trip)	n/a	n/a	n/a	n/a

The non-actuating time delay setting determines when the trip will be initiated, however the actual breaking time is not a definite value due to various mechanical and electrical factors which may affect the time to open the circuit. The maximum breaking time for each time delay setting at various residual fault current magnitudes is shown in the table above.

Notice: Setting the residual operating current IΔn adjustment dial to 30 mA will override the time delay setting Δt and will default to INST (no additional delay), regardless of the Δt time delay dial setting.

WARNING: The residual operating current threshold (IΔn) and non-actuating time delay (Δt) can be set to levels which are not suitable for personnel protection against earth leakage or earth fault currents.

Protection Settings

Temperature Ratings

The ZS_TF CBRs are fitted with a thermomagnetic trip unit which has its thermal element set for a specific calibration temperature.

The ZS_TF CBRs have been calibrated for operation at 50˚C for all frame sizes.

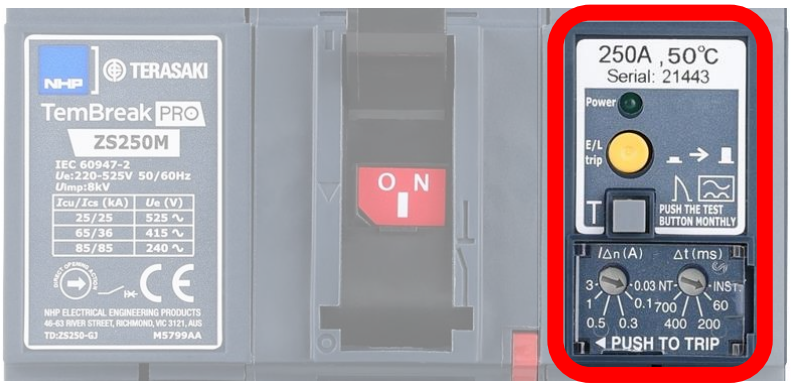
Notice: Due to the nature of thermal protection, it is not possible to set I_r to an exact value. Ambient temperatures and conductor temperatures will have an effect. The ZS_TF CBRs have been calibrated for operation at 50°C.

For ambient temperatures other than 50˚C, with the maximum setting, the variation of thermal current threshold is given in the tables as follows:

Refer to Annex F – Temperature Calibration Tables for details on temperature deratings.

Integrated Residual Current Unit

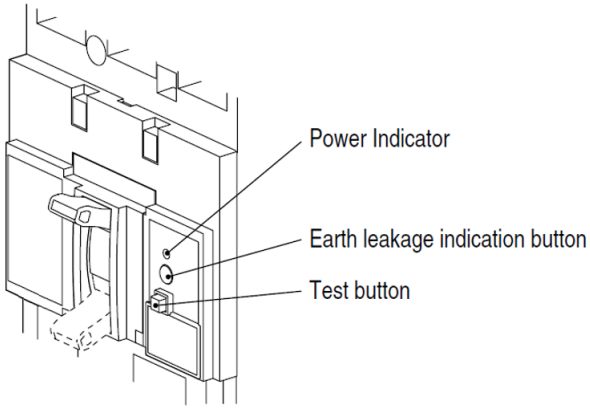
The ZS_TF CBR uses an integrated residual current unit which provides the residual current protection functionality. The residual current unit features a power indication LED, residual current Trip indicator, Test button, and Remote Trip functionality as standard.



Notice: The integrated residual current unit of the ZS_TF CBR is not a repairable or replaceable component. In the event of failure of the residual current unit, the ZS_TF CBR must be replaced in its entirety.

Residual Current Unit Indication and Function Button Locations

The Power indicator, residual current (Earth leakage) trip indicator and Test button are positioned on front of the residual current unit of the ZS_TF CBR as indicated below.



Residual Current Unit Power Indication

The "Power" indicator is a green LED which will illuminate when the residual current unit of the ZS_TF CBR is energized. The residual current unit is self-powered via connection to the bottom of the 3 main power poles of the CBR. The Power indicator should illuminate when the CBR is turned ON and should not be illuminated when the CBR is in the TRIPPED or OFF position.

Notice: When a ZS_TF CBR is reverse connected, the Power indicator LED will be illuminated before and after any overcurrent or residual current trip event.

Notice: The brightness of the Power indication LED may vary during normal operation. The LED may appear brighter when CBR is initially turned ON, and when Test button is operated.

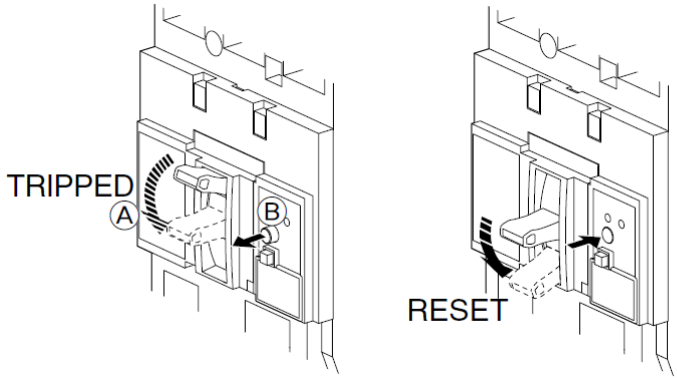
Integrated Residual Current Unit

Residual Current Trip Indication

The yellow pushbutton labelled “E/L trip” indicates that the ZS_TF CBR has tripped due to operation of the residual current protection.

The E/L trip button remains in the depressed (“pushed in”) position during normal operation and no residual current trip event has occurred. When a residual current trip event occurs, the CBR main power toggle will switch to the TRIPPED position and the E/L trip indicator will extend outwards (“popped out”).

When the CBR main power toggle is reset to the OFF position after being tripped, the E/L trip button will automatically reset and retract to the depressed position.



Notice: After a residual current trip, the yellow E/L indicator will pop out and the black toggle of the breaker will move to the TRIPPED position. During an overload trip, only the black toggle on the breaker will move to the TRIPPED position.

Residual Current Unit Test Button

The ZS_TF CBR residual current unit features a grey square test button labelled “T” which is used to confirm the operation of the residual current protection facility.

The test button performs a complete residual current test of the full current path within the CBR by injecting a current of magnitude $I\Delta_n$ as set by the adjustment dial into the internal test coil of the CBR. This injected current is detected by the ZCT which will operate the residual current detection circuit and trip the CBR.

This test should be performed monthly at a minimum, with additional testing performed as stipulated by site specific requirements.

Notice: If pressing the residual current unit test button for 2 to 3 seconds does not cause the ZS_TF CBR to trip open, the CBR may be faulty and require replacement.

Notice: Do not perform OFF operation by pressing the Test button of the CBR. Putting the CBR into the TRIP position rather than OFF for the purpose of power isolation will reduce the lifespan of the breaker prematurely.

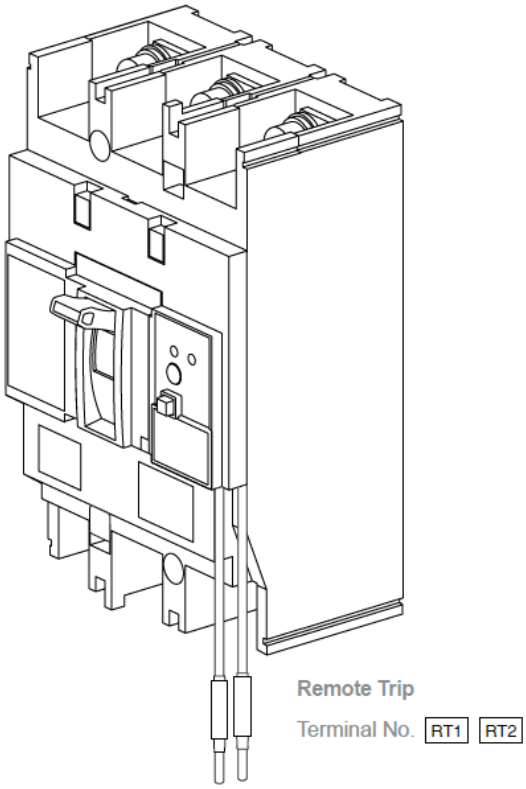
Integrated Residual Current Unit

Remote Trip Operation

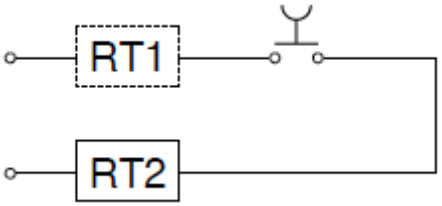
Remote Trip (RT) functionality is provided as a standard feature for ZS_TF model CBRs.

The residual current unit of the ZS_TF CBRs has two Remote Trip wires, labelled RT1 and RT2, which come out of the front right-hand side of the CBR through a small opening in the front cover. When the Remote Trip wires form a closed circuit, the trip function of the CBR's residual current unit will be activated.

The speed at which the ZS_TF CBR is tripped by Remote Trip is determined by the setting of the non-actuating time delay dial (Δt).



The Remote Trip wires can be closed via dry contact closure by using an external pushbutton, relay, or other similar closing mechanism. No external power source is required for Remote Trip operation.



Upon activation, the RT1 and RT2 leads will have a potential voltage of 45V DC and draw 5mA. Select a switching device that is adequately suitable for controlling Remote Test activation, considering the operating voltage and current of the RT circuit.

The Remote Test switch must not be shared with other equipment or used to control the RT feature of more than one ZS_TF CBR.

The RT leads are 1.0m in length as standard and can be extended up to 3.0m in length.

Integrated Residual Current Unit

Remote Trip Operation

If Remote Trip functionality is not required, the “REMOTE TRIP” wires RT1 and RT2 can be stored or removed in such a manner that there is no continuity between the RT conductors.

When storing the Remote Trip wires for future use, the RT1 and RT2 conductors can either be coiled up safely or wired to terminal blocks that are not connected to any other equipment.

If the Remote Trip wires are to be removed, open the CBR front cover and cut the RT1 and RT2 wires at the point where they are extend from the residual current unit. Cutting the RT1 and RT2 wires should be performed when the ZS_TF CBR is turned off. Removal of the RT1 and RT2 wires will not have an adverse effect on the operation of the residual current unit.

WARNING: Do not touch the RT1 and RT2 wires while voltage is being applied to the ZS_TF CBR main circuit as you may receive an electric shock.

WARNING: When the ZS_TF CBR is reverse fed, voltage may be present on RT1 and RT2 wires while the CBR main power toggle is in OFF position and the residual current unit is not tripped.

Notice: Do not apply external voltage to the RT1 and RT2 wires as this may damage to the residual current unit of the CBR or cause incorrect operation.

Notice: The Remote Trip feature is not considered a residual current test of the ZS_TF CBR as it does not operate on the full residual current path of the CBR. Testing of residual current protection of the ZS_TF CBR should only be performed through operation of the integrated test button or via use of external residual current testing equipment.

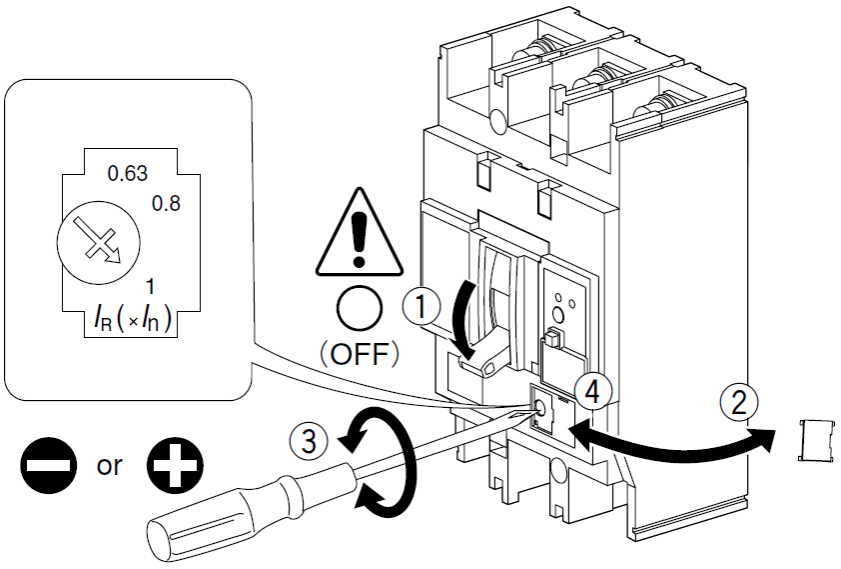
Notice: If the ZS_TF CBR has been fitted with the optional Trip Control Unit (TCU), do not use the standard Remote Trip feature of the CBR as this will cause incorrect operation of the TCU. Refer to Trip Control Unit (TCU) for more information.

Commissioning

Thermal Setting (I_r)

WARNING: Risk of nuisance tripping.
Only qualified personnel are to set the protection levels. Failure to respect these instructions may cause death, serious injuries or equipment damage.

WARNING: Setting I_r dial outside of the calibrated zone (0.63 - 1) may cause unpredictable behaviour of the MCCB.

	Action	Note / Illustration
1	Switch the MCCB to the OFF Position.	
2	Remove the transparent cover to access the I_r adjustment dial.	
3	Using a PH1, PH2 or PZ2 size screwdriver, rotate the I_r adjustment dial to the desired value of I_r. in Amperes. I_r calibration points are marked as follows: **Red**: 1.0 x I_n **Blue**: 0.8 x I_n **Black**: 0.63 x I_n	
4	Replace the transparent cover to prevent adjustments from being made by unauthorized personnel.	

Notice: The adjustments for I_r are continuous and not discrete.

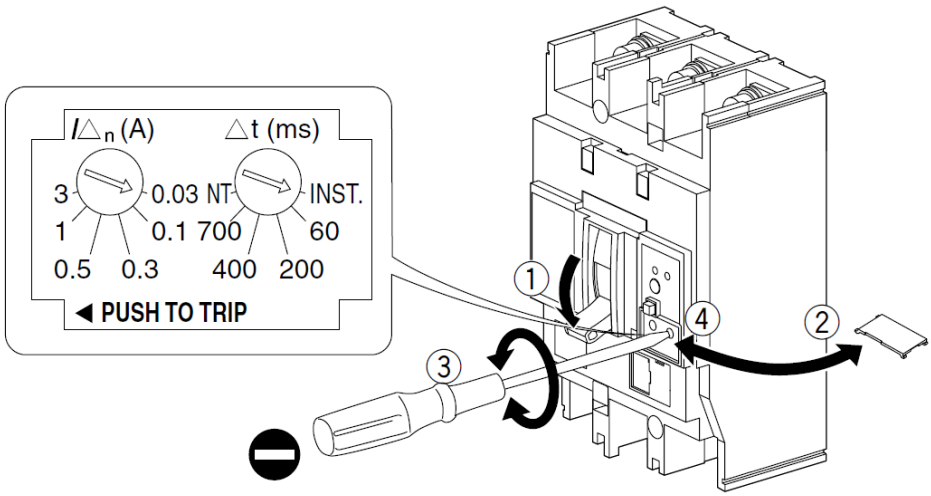
Notice: Due to the nature of thermal protection, it is not possible to set I_r to an exact value. Ambient temperatures and conductor temperatures will have an effect. The ZS_TF CBRs have been calibrated for operation at 50°C.

Commissioning

Residual Operating Current ($I\Delta_n$) and Time Delay (Δt) Setting

WARNING: Risk of nuisance tripping.
Only qualified personnel are to set the protection levels. Failure to respect these instructions may cause death, serious injuries or equipment damage.

WARNING: The residual operating current threshold ($I\Delta_n$) and non-actuating time delay (Δt) can be set to levels that are not suitable for personnel protection against earth leakage or earth fault currents.

	Action	Note / Illustration
1	Switch the CBR main toggle to the OFF position.	
2	Remove the transparent cover to access the $I\Delta_n$ (A) and Δt (ms) adjustment dials.	
3	Using a size SL3 slotted screwdriver, rotate the $I\Delta_n$ and Δt adjustment dials to the required settings.	
4	Replace the transparent cover to prevent adjustments from being made by unauthorized personnel.	

Notice: Setting the residual operating current $I\Delta_n$ adjustment dial to 30 mA will override the time delay setting Δt and set it to INST (no additional delay), regardless of the Δt time delay dial setting.

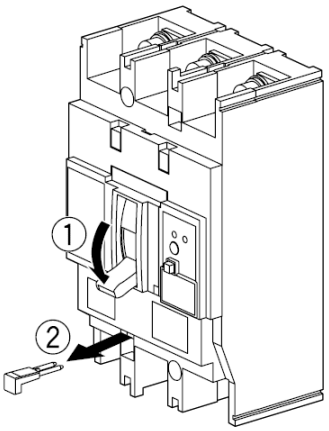
Notice: The settings for $I\Delta_n$ and Δt are not continuously adjustable and must be selected from the discrete labelled values.

Commissioning

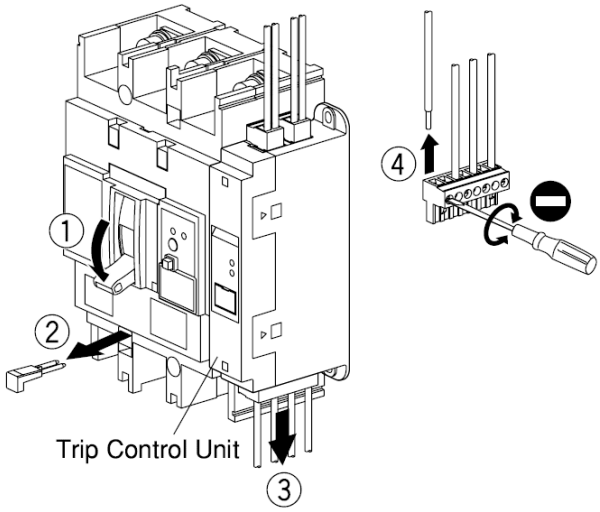
Dielectric Test Disconnect Plug

The ZS_TF CBR features a built-in dielectric disconnection test plug. This plug must be removed prior to performing dielectric testing on the CBR. The dielectric test plug can be found on the front and towards the bottom of the ZS_TF CBR between the 1st and 2nd left most main connection terminals.

The ZS_TF CBR should be switched OFF (1) before removal of the dielectric test disconnect plug (2).



Without optional Trip Control Unit (TCU)



With optional Trip Control Unit (TCU)
See TCU User Manual for complete instructions

Notice: If the ZS_TF CBR is dielectric tested and the dielectric test plug has not been removed, some components of the residual current unit PCB may be damaged by over voltage. In the event of failure of the residual current unit, the CBR must be replaced in its entirety.

Notice: Avoid dielectric withstand voltage tests and insulation resistance tests between poles with different polarity as this may damage the ZS_TF CBR.

Notice: The dielectric test plug must be reinstated after dielectric testing has been performed. If the dielectric test plug is not installed during normal operation of the CBR, the residual current unit will not function.

Commissioning

Dielectric Testing Methodology

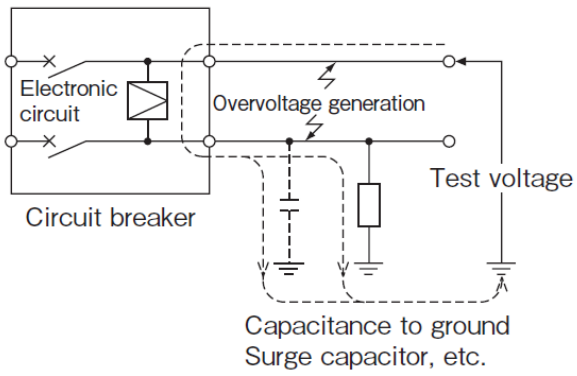
Please refer to the below table for permissible testing methods for performing dielectric testing on the ZS_TF CBRs.
The dielectric test disconnect plug should be removed prior to performing any of the below tests, and reinstated once testing has been completed.

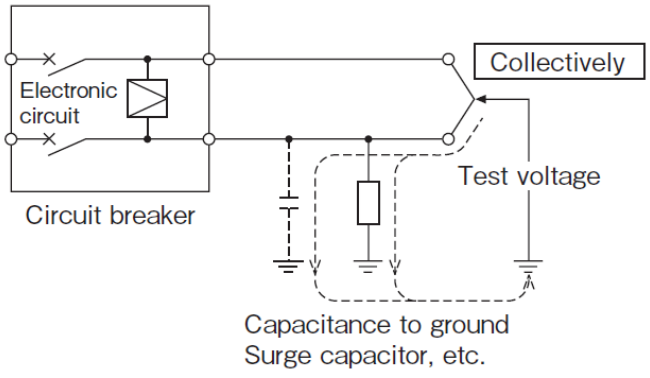
Test / Measurement points		Insulation Resistance Measurement (1)		Withstand Voltage Test (2)(3)	
Toggle Condition		ON	OFF	ON	OFF
Between main circuit live part and ground		✓	✓	✓ (4)	✓ (4)
Between left – centre (R-S), centre – right (S-T) poles	Line Side	✓	✓	✓	✓
	Load Side	✓	✓	✓	✓
Between left – right poles (R-T)	Line Side	×	✓	×	✓
	Load Side	×	×	×	×
Between power supply and load terminals		–	✓	–	✓
Between operation circuit live part and ground		✓	✓	✓	✓

✓	Test safe to perform
×	Do not perform test
–	Test not applicable

Notes:

1) Testing should be performed with a 500V dc insulation resistance tester. Higher test voltages may damage the CBR.
   Do not perform insulation resistance test between the left (R / L1 phase) and right (T / L3 phase) poles of the ZS_TF CBR on the line-side while the CBR is ON, or on the load-side in either ON or OFF positions, as this may damage the CBR.
2) The CBR may be damaged and require replacement if test voltage is applied to the CBR in conditions marked X in the table.
3) Withstand Voltage test voltage shall not exceed 2500V ac rms.
4) When performing a withstand voltage test between each pole of the main circuit live part and ground with the load wiring connected to the circuit breaker, perform the test between the main circuit live parts collectively and ground. There is a risk of failure if excessive voltage is applied between the poles via the capacitance to ground, or between the wiring and the impedance connected to ground (surge capacitor, arrester, noise filter, etc).Please see below diagrams.





Troubleshooting

In the event of a problem when using the TemBreak *PRO* system, this section provides advice on how to resolve issues.

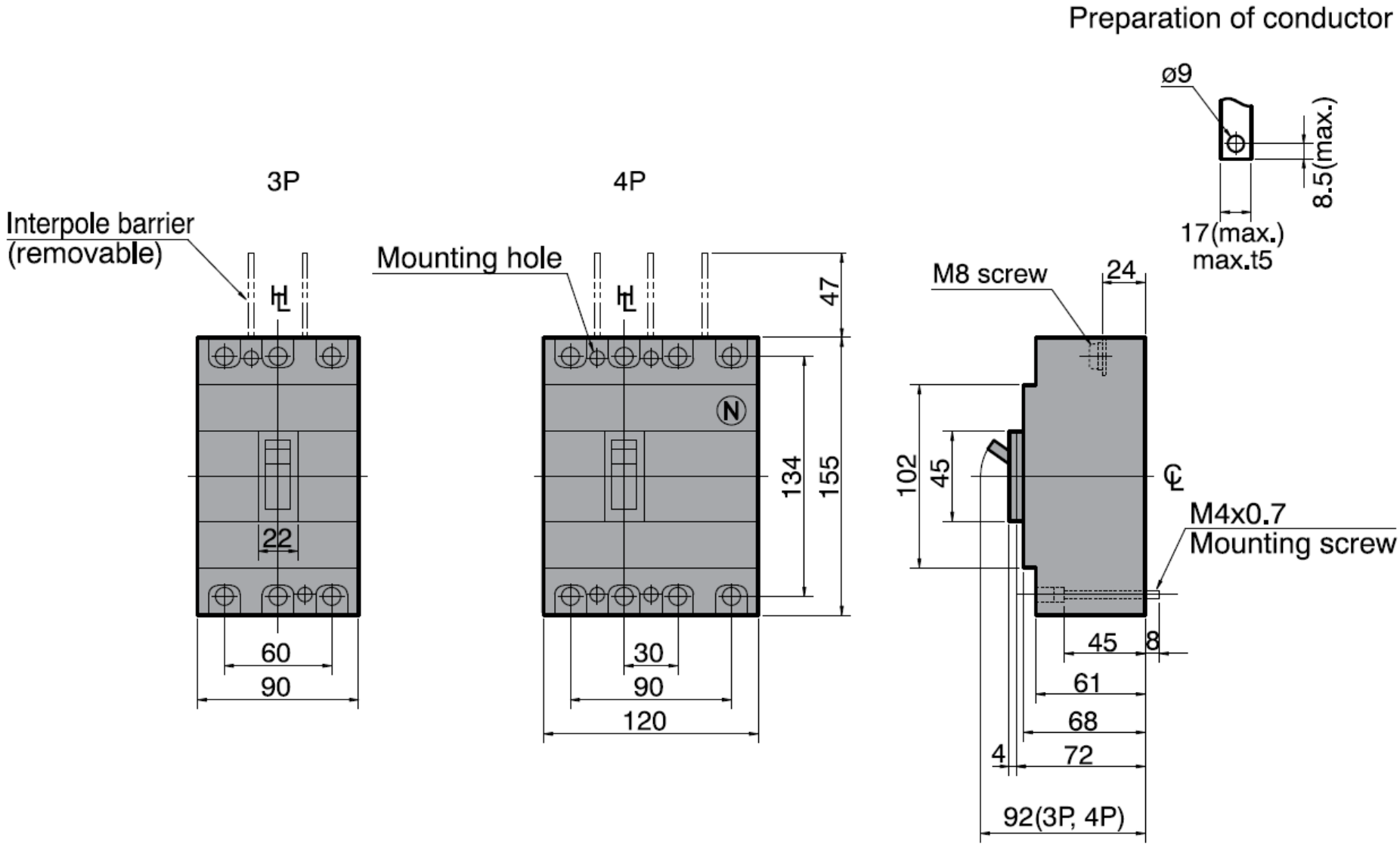
	Problem description	Possible cause	Remedial advice
1	Abnormal voltage on load side	Excessive wear of contacts	Replace MCCB
		Foreign matter interfering with contacts or contact surfaces	
2	Failure in ON position	Reset operation not conducted after tripping operation	Perform reset operation.
3	Failure in RESET position	Circuit breaker service life ended due to large number of switching cycles using Remote Trip	Replace MCCB
		Fault of tripping mechanism	Replace MCCB Dampen vibration of MCCB and review installation requirements
		Vibration and/or shock	
4	Nuisance tripping while rated current not reached	High proportion of high frequency distortion in load current.	Decrease distortion content of load circuit
		Electromagnetic induced interference (from nearby conductors or external radio sources)	Review nearby sources of conducted and radiated emissions (e.g. radio sources, high-speed switching devices including variable frequency drives)
		Excessive surge	Isolate and mitigate surge source (e.g. surge protection devices)
		Incorrect connection of control circuit for Remote Trip	Verify control wiring of RT1 and RT2 wires wiring
		Excessive inrush starting current due to load type	Review INST and STD protection settings for load type where applicable
5	Nuisance tripping due to starting current	Switching operation of star-delta motor starter, incorrect wiring	Verify and correct any issues with star-delta starter wiring with respect to the motor windings and phase sequence. Refer to motor and/or starter manufacturer
		Short-circuit in motor (e.g. windings, starter circuit)	Verify and correct any issues with motor wiring. Inspect and verify motor winding insulation. Refer to motor manufacturer
		Failure in selectivity/coordination with upstream circuit breaker or fuse	Review selectivity/coordination study and protection parameters of each device
		Incorrect protection settings	Review enabled protection settings ensuring correct pickup current and time-delay for load type. (e.g. LTD, STD, INST pickup currents and time delays)
6	Nuisance tripping due to residual current	Earth leakage in motor (e.g. windings, starter circuit)	Verify and correct any issues with motor wiring. Inspect and verify motor winding insulation. Refer to motor manufacturer
		Failure in residual current selectivity/coordination with upstream circuit breaker	Review residual current selectivity/coordination study and protection parameters of each device
		Incorrect protection settings	Review enabled protection settings ensuring correct IΔn residual current threshold and Δt non-actuating time delay are suitable for load type
7	No trip at pickup current	Failure in selectivity/coordination with upstream circuit breaker or fuse	Review selectivity/coordination study and protection parameters of each device
		Incorrect protection settings	Review enabled protection settings ensuring correct pickup current and time-delay for load type. (e.g. LTD, STD, INST pickup currents, and time delays)

Troubleshooting

	Problem description	Possible cause	Remedial advice
8	Residual current unit Power indication LED not illuminated	Incorrect power source connection	Confirm ZS CBR is connected to power source correctly See Annex G – Connection Diagrams
		Insufficient supply voltage	Residual current unit requires at least 200V AC to function correctly
		Dielectric test plug not present	Ensure dielectric test plug has been reinstated after completing dielectric testing
		Residual current unit has failed	Replace the ZS CBR. The residual current unit is not a repairable or replaceable component
9	Residual current unit Test button does not trip the CBR	Residual current unit not energized	See Troubleshooting item 8 "*Residual current unit Power indication LED not illuminated*"
		Residual current unit has failed	Replace the ZS CBR. The residual current unit is not a repairable or replaceable component
10	Residual current injection test does not trip the CBR	Incorrect protection settings	Review enabled protection settings ensuring correct IΔn residual current threshold and Δt time-delay settings for load type
		Incorrect testing procedure	Ensure testing equipment is capable of injecting residual current of at least 1x IΔn for a duration that is greater than Δt
		Residual current unit not energized	See Troubleshooting item 8 "*Residual current unit Power indication LED not illuminated*"
		Dielectric test plug not present	Ensure dielectric test plug has been reinstated after completing dielectric testing
		Residual current unit has failed	Replace the ZS CBR. The residual current unit is not a repairable or replaceable component
11	Remote Trip does not trip the CBR	Incorrect protection settings	Remote Trip will not function if residual current time delay (Δt) is set to No Trip (NT)
		Erroneous connection of control circuit for RT	Verify control wiring of RT1 and RT2 wires
		Residual current unit has failed	Replace the ZS CBR. The residual current unit is not a repairable or replaceable component

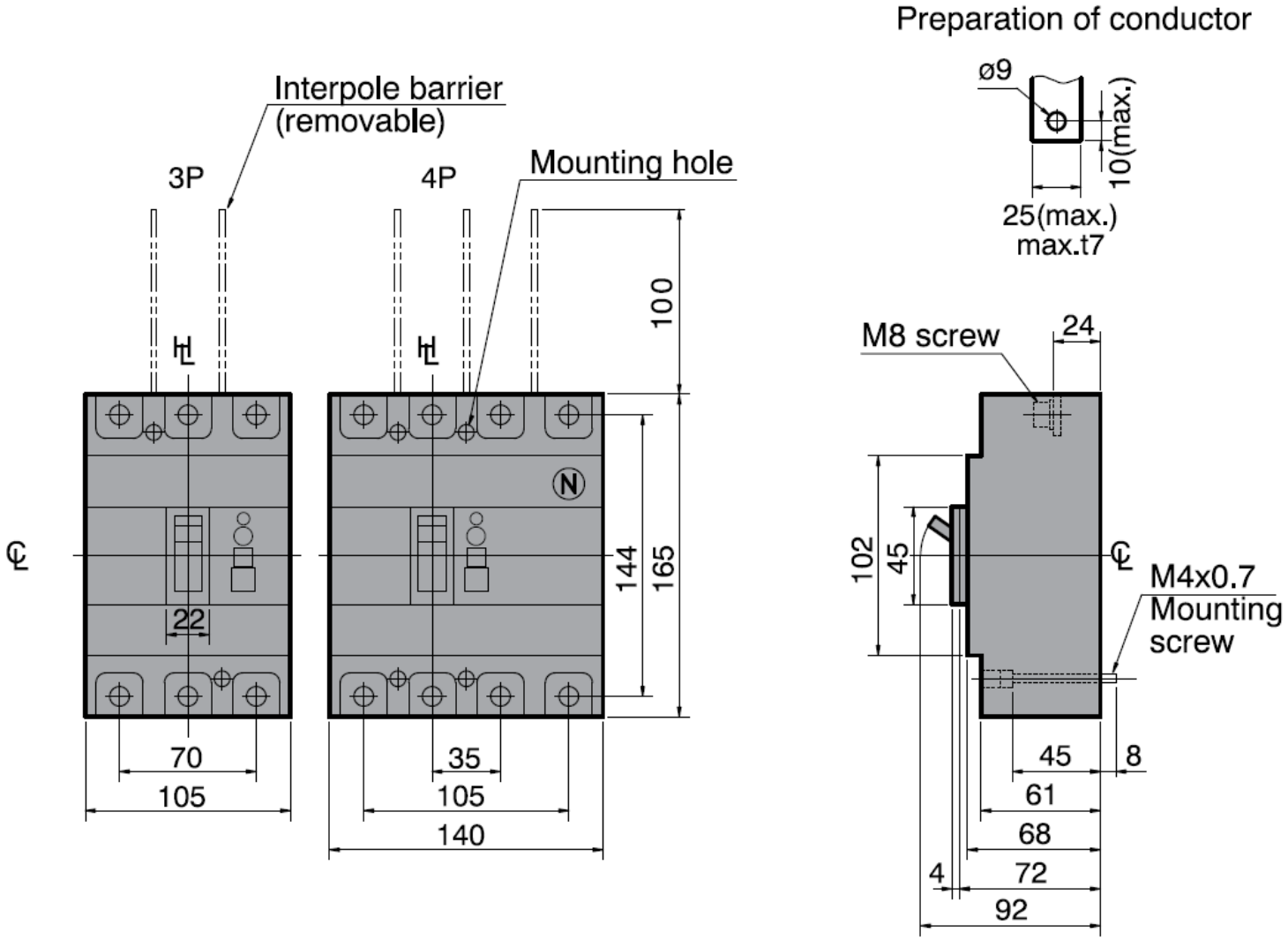
Annex A – Dimensions

ZS125 Dimensions



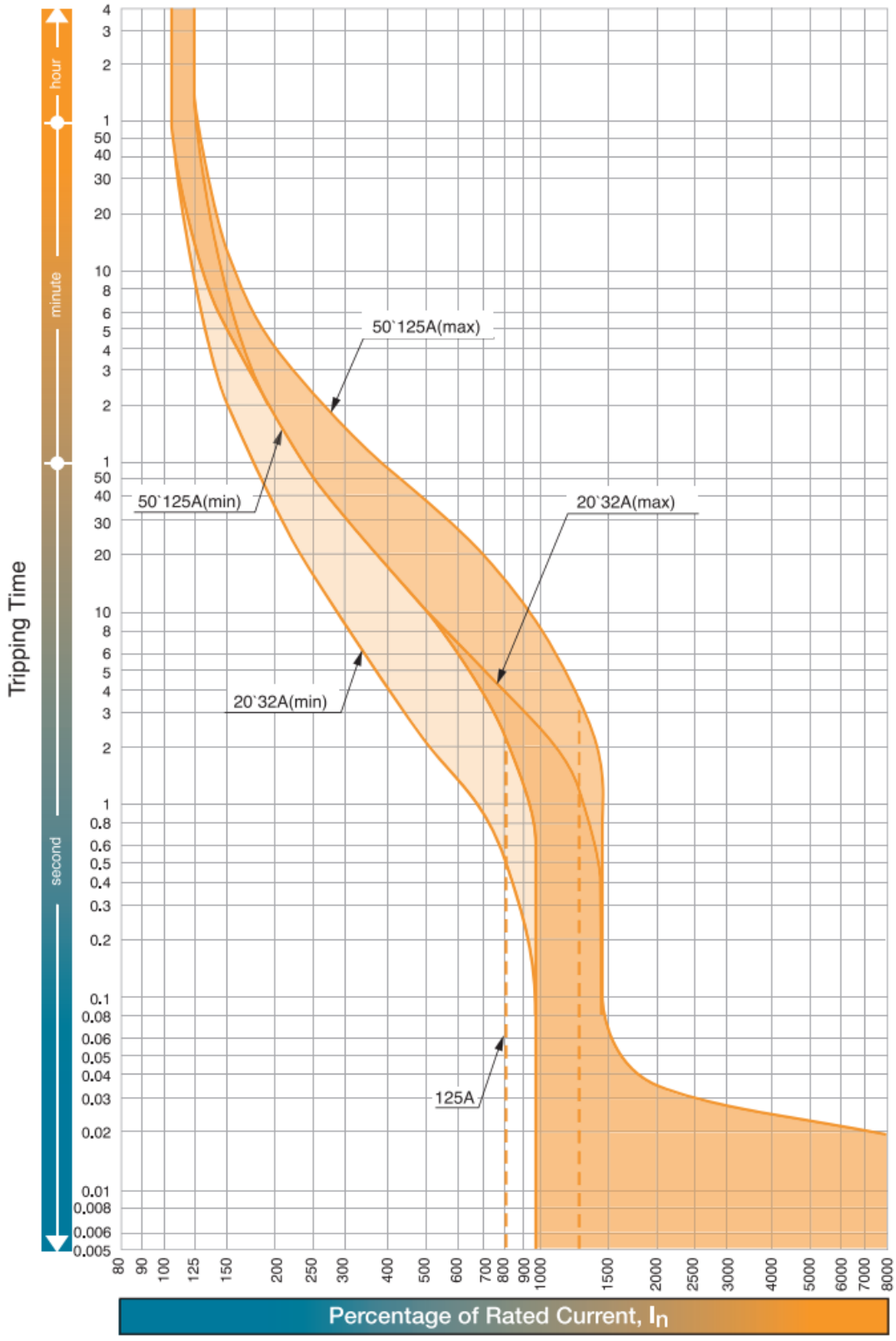
Annex A – Dimensions

ZS250 Dimensions



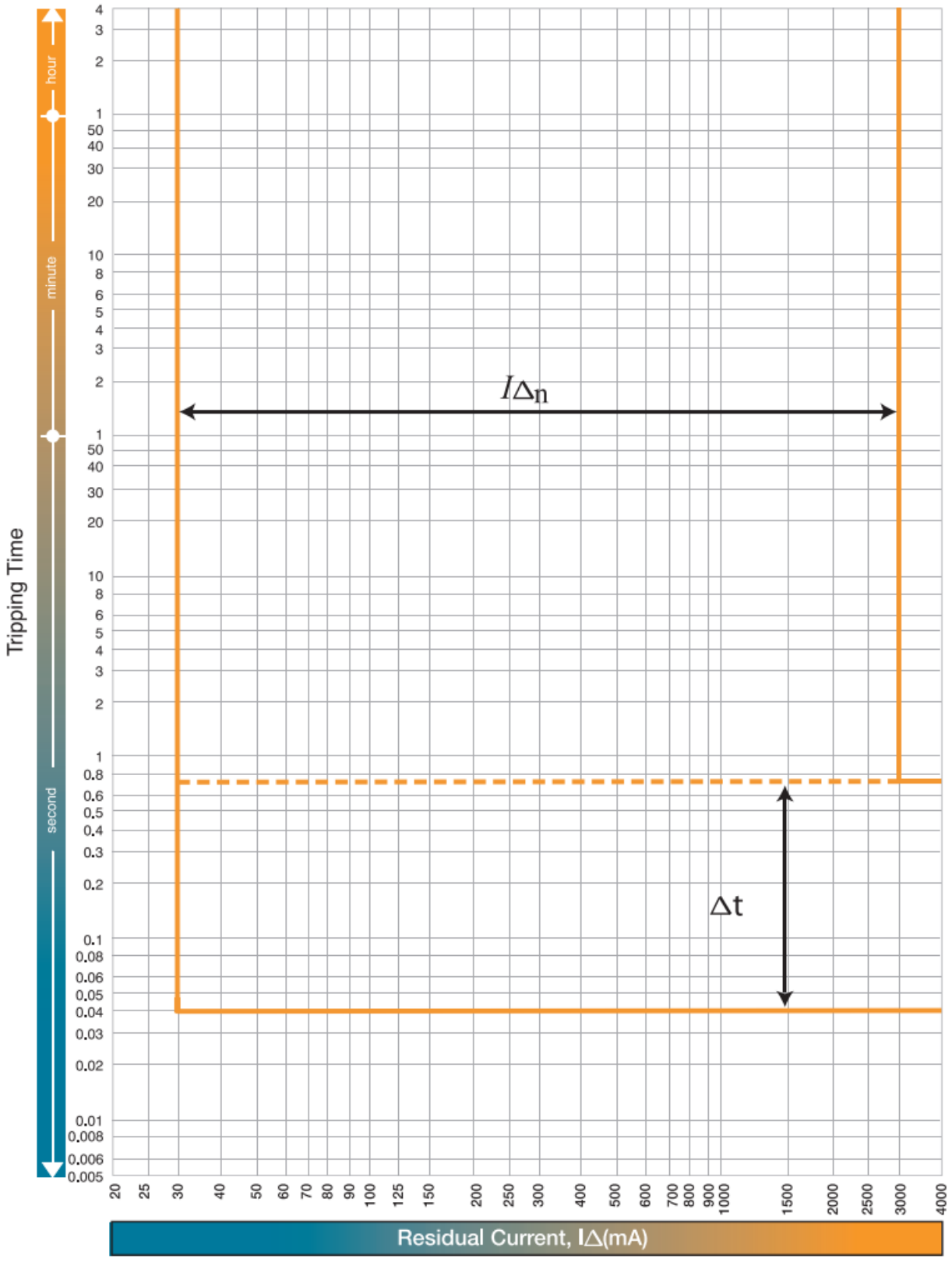
Annex B – Trip Curves

ZS125M



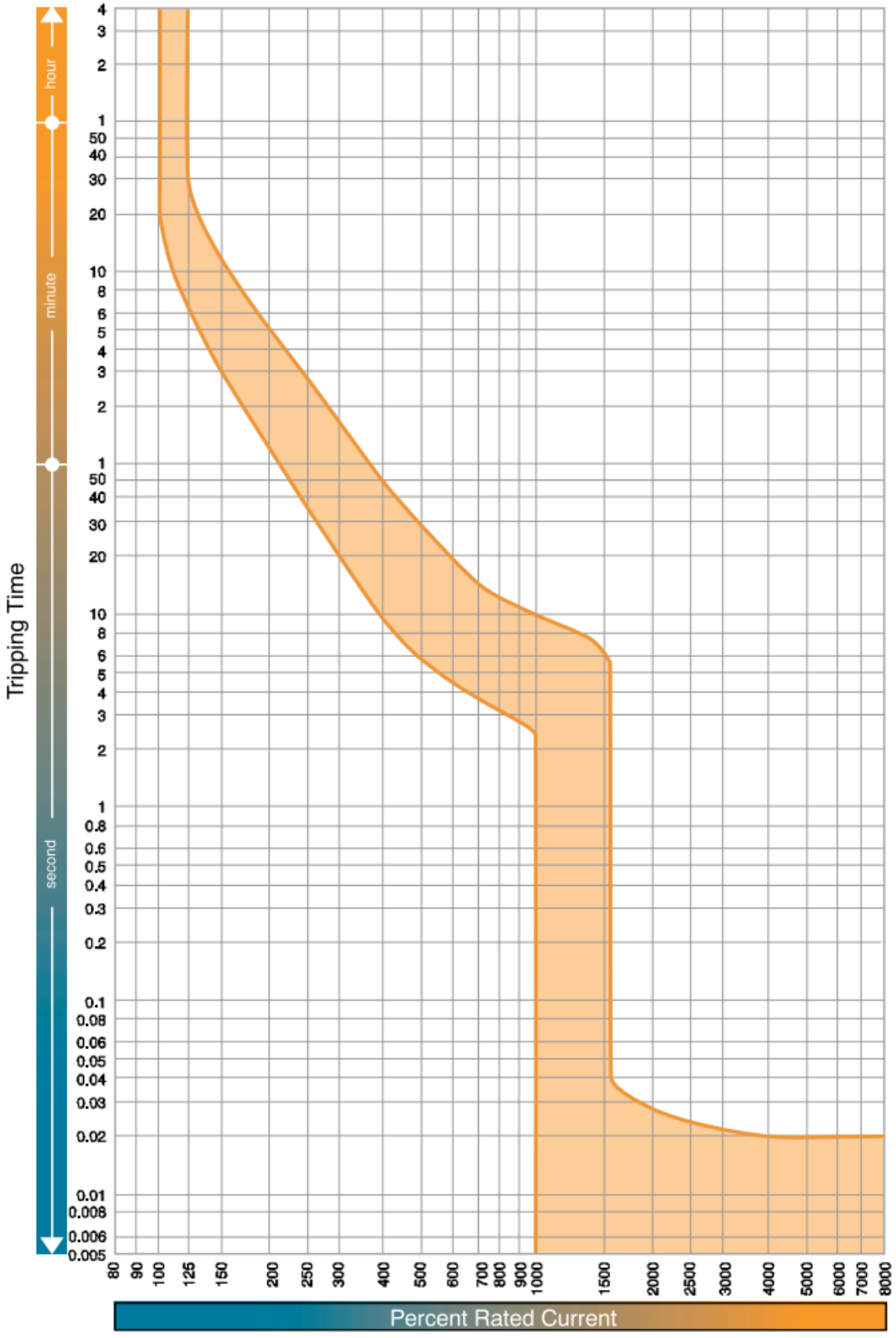
Annex B – Trip Curves

ZS125M Residual Current Characteristic



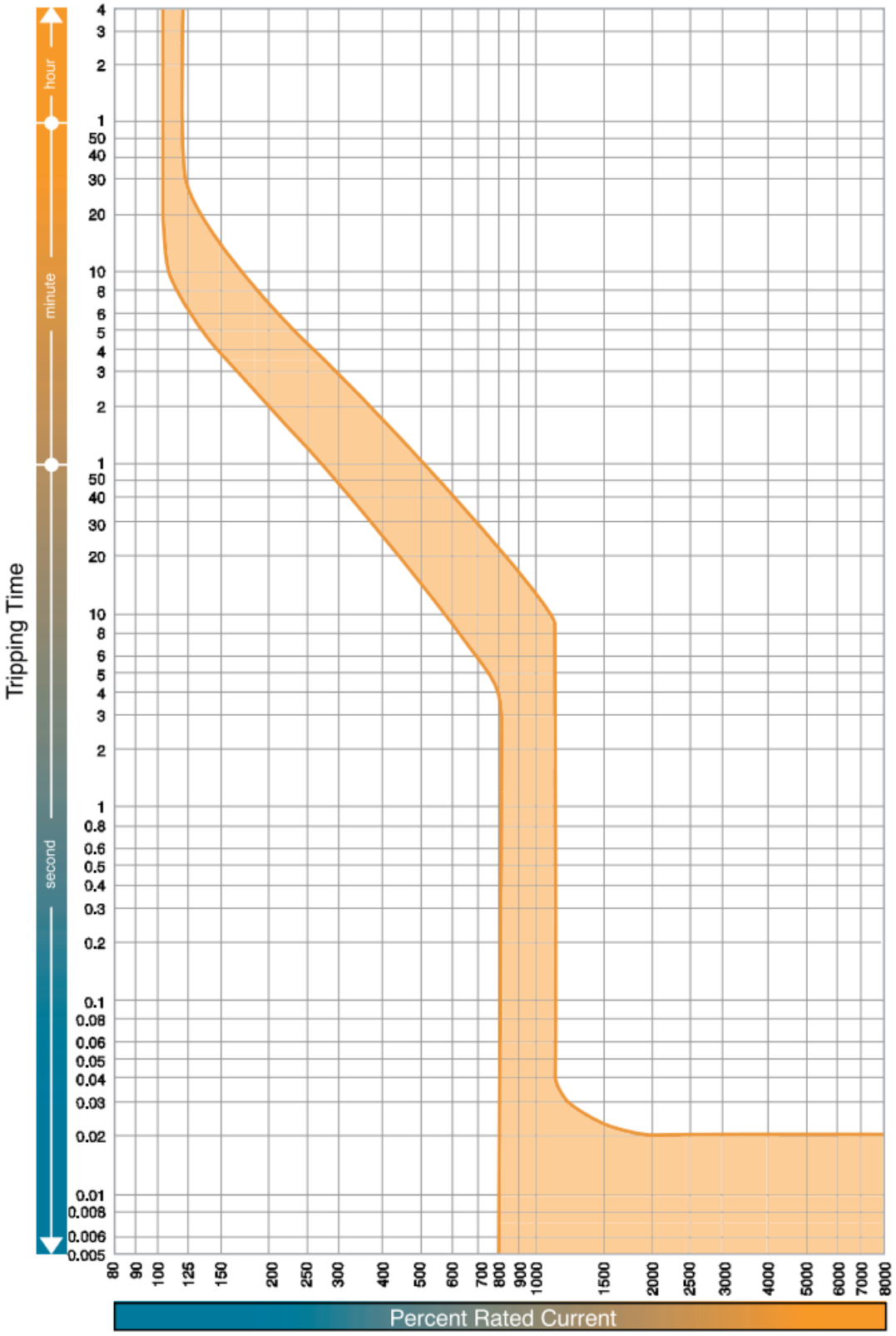
Annex B – Trip Curves

ZS250M 160A



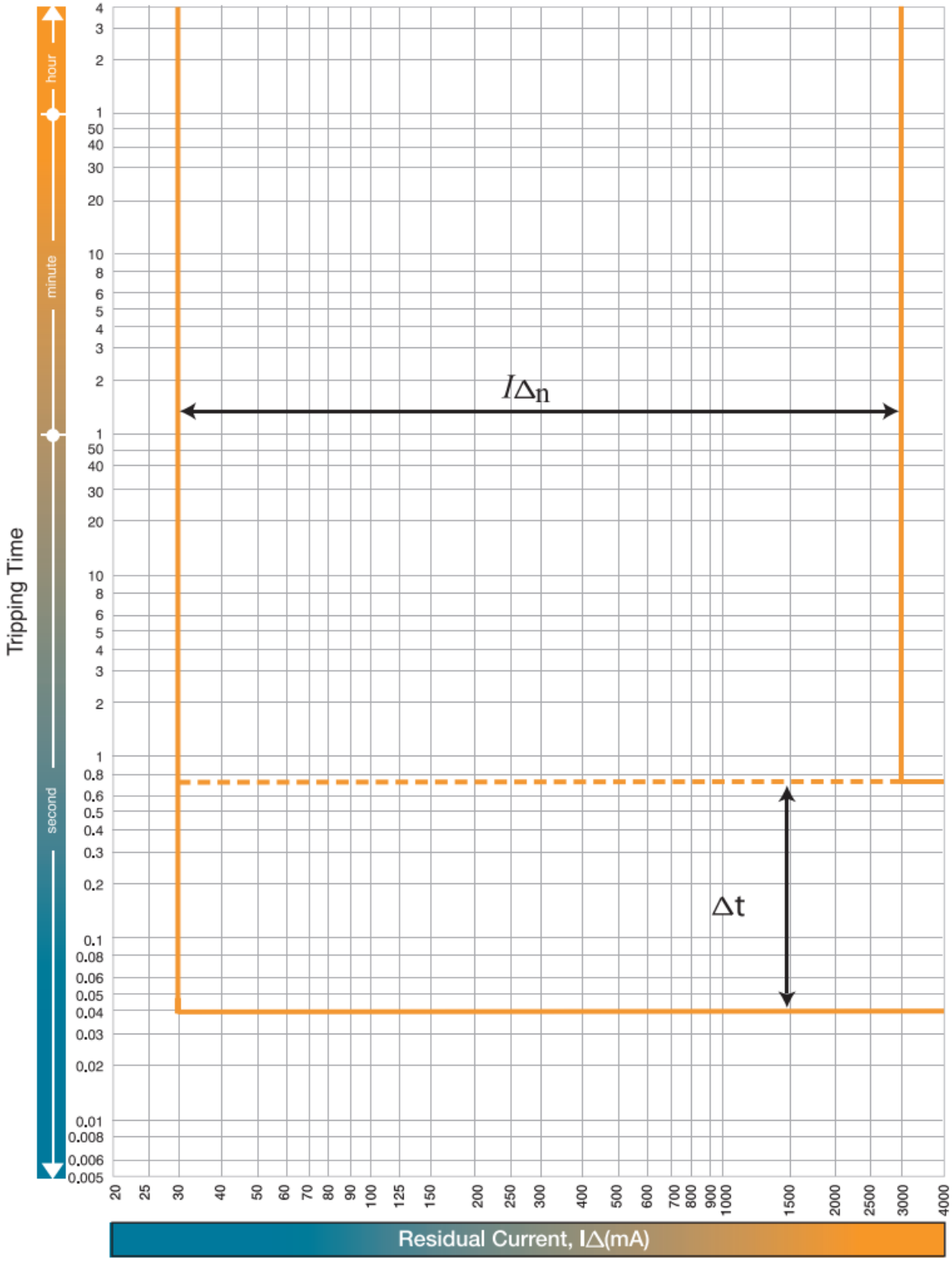
Annex B – Trip Curves

ZS250M 250A



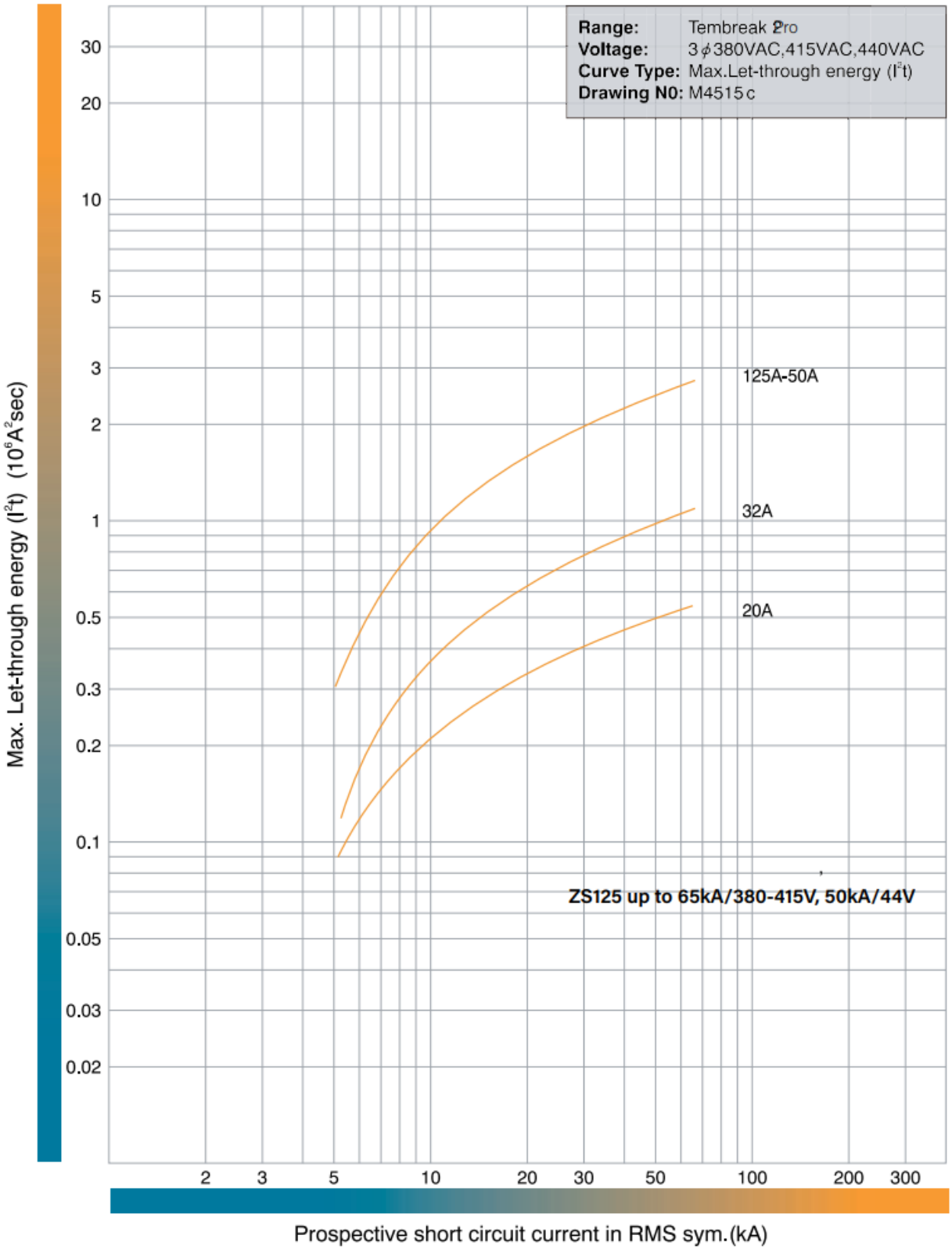
Annex B – Trip Curves

ZS250M Residual Current Characteristic



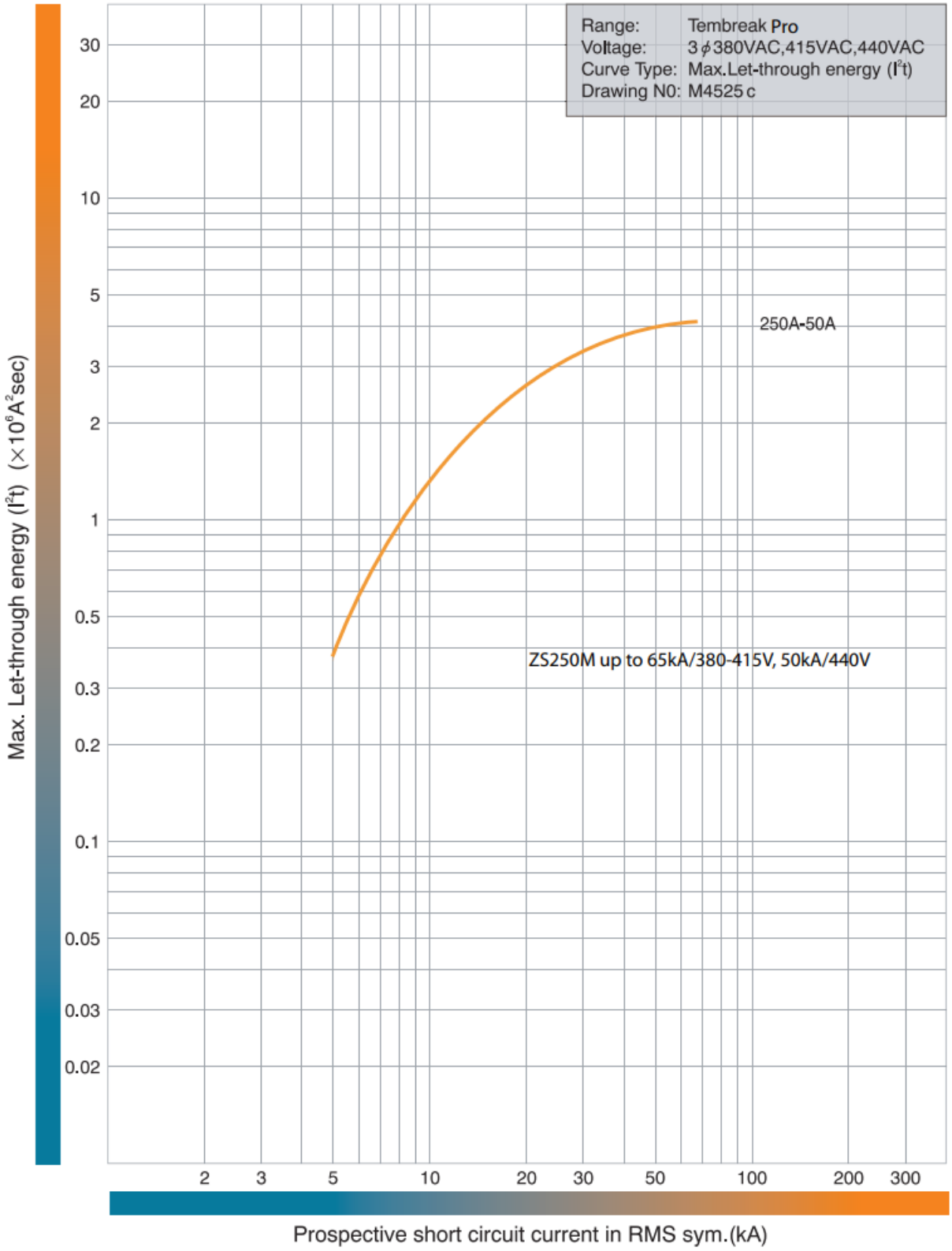
Annex C – I²t Let Through Curves

ZS125M



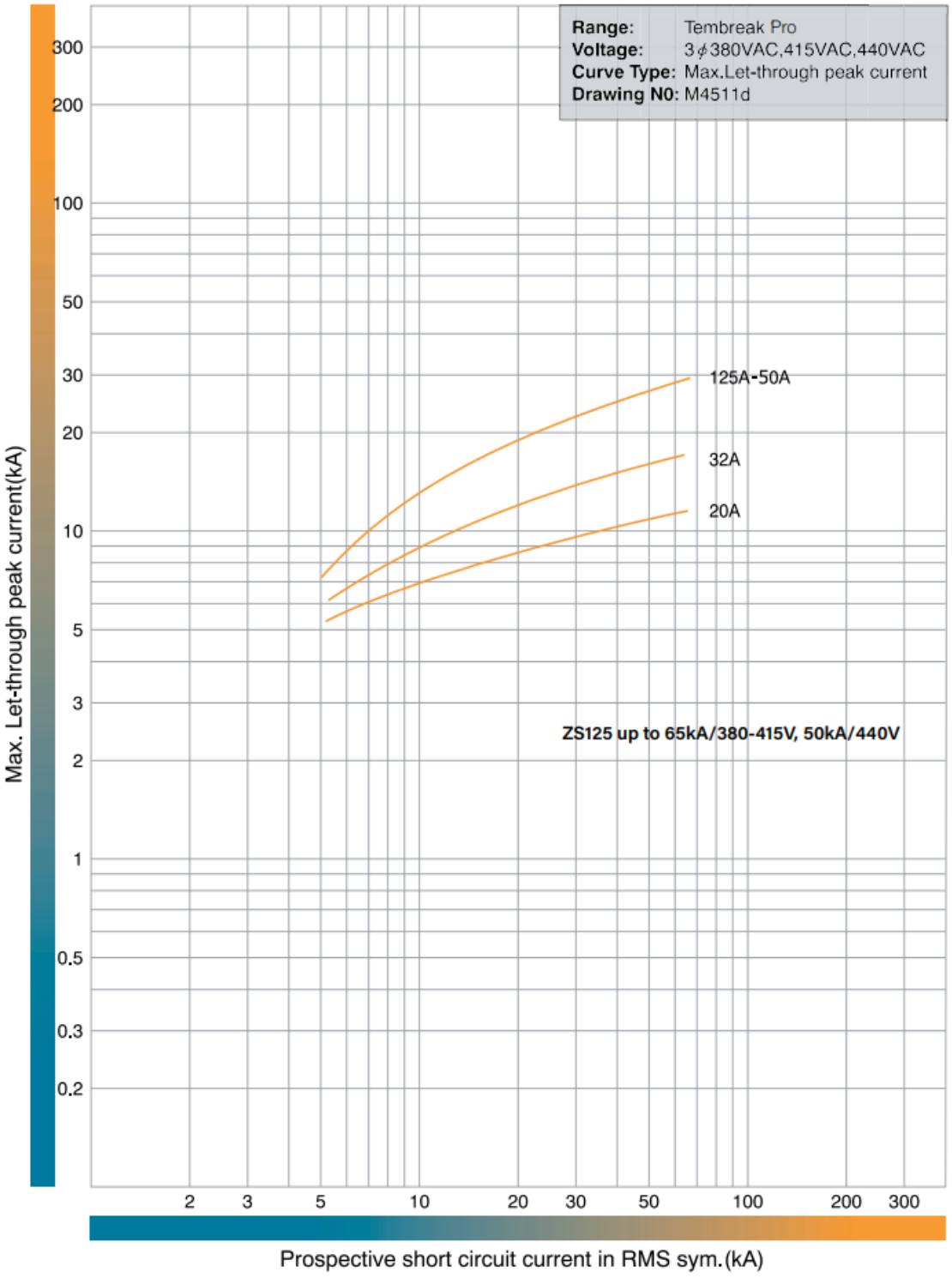
Annex C – I²t Let Through Curves

ZS250M



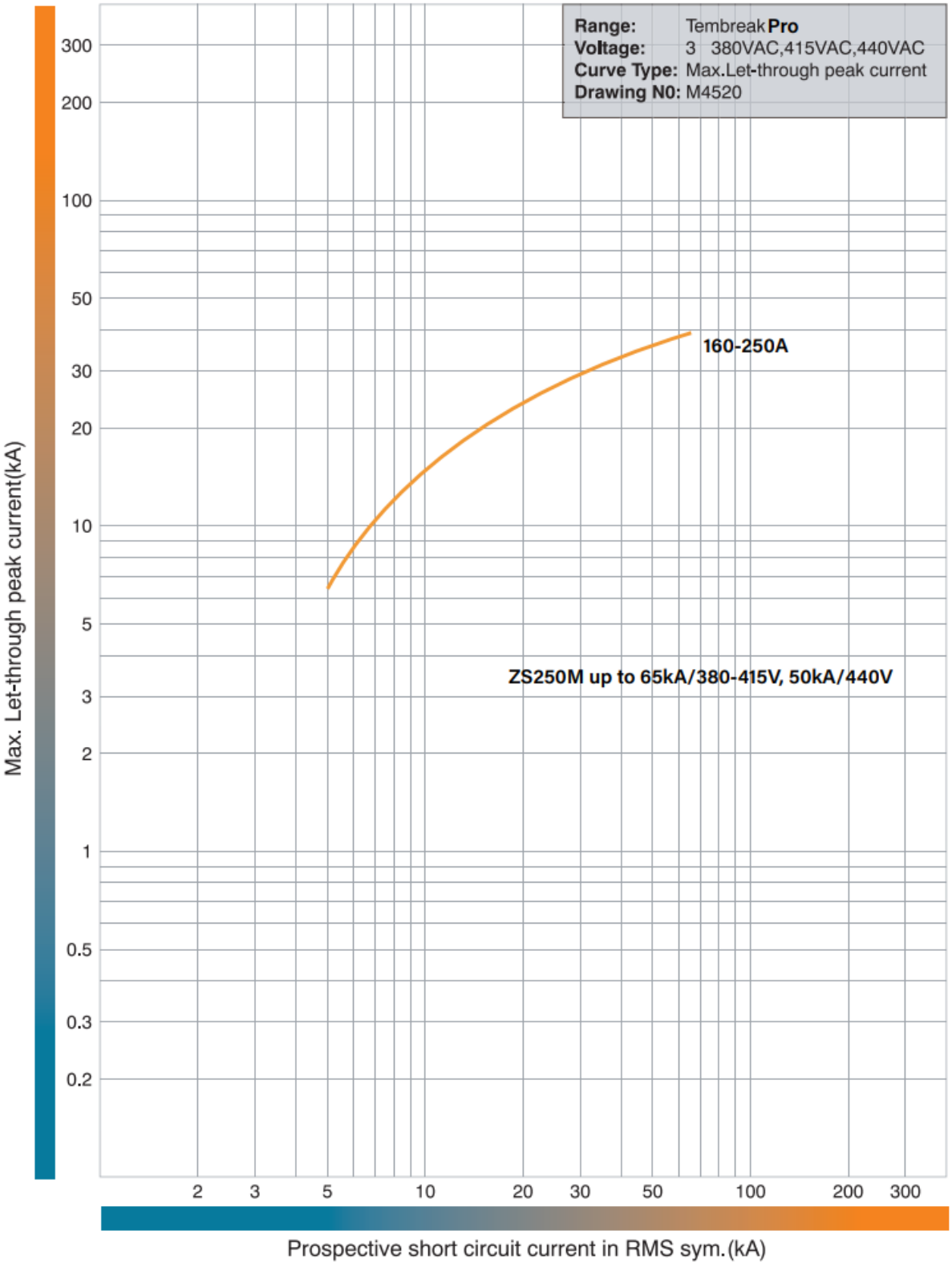
Annex D – Peak Let Through Curves

ZS125M



Annex D – Peak Let Through Curves

ZS250M



Annex E – Watts Loss

Resistance Watts Loss

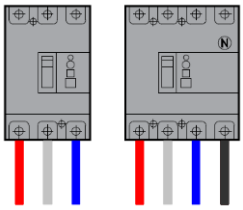
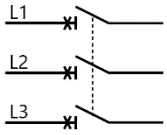
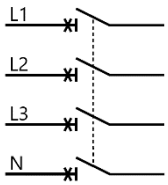
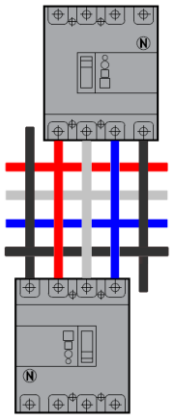
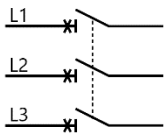
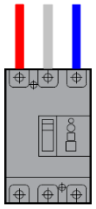
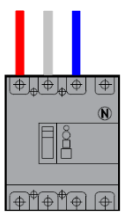
Frame	Rating In (A)	Resistance per pole (mΩ)	Watts Loss per pole Based on Resistance (W)	Pole numbers	Watts Loss per product Based on Resistance (W)
ZS125_TF	20	15	6	3/4P	18.0
	32	8	7.2		21.6
	50	1.8	4.5		13.5
	63	1.3	4.68		14.0
	100	0.8	8		24.0
	125	0.73	11.4		34.2
ZS250_TF	160	0.47	12.03	3/4P	36.1
	250	0.26	16.3		48.9

Annex F – Temperature Derating

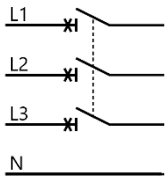
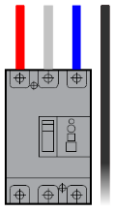
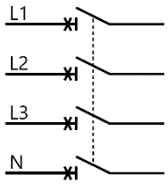
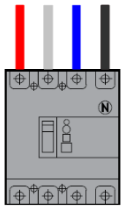
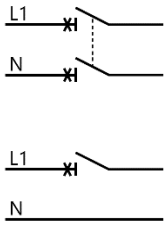
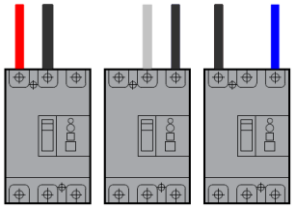
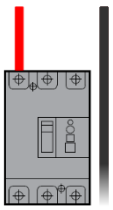
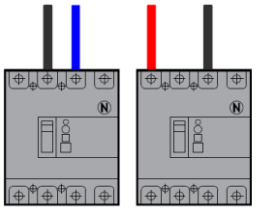
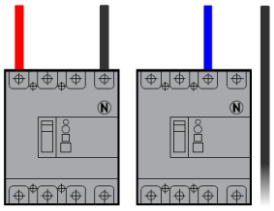
Front & Rear Connect

Calibration Temperature: 50°C														
MCCB Type	Connection type	Rated I_n	Rated Current (A)											
			10°C	15°C	20°C	25°C	30°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C
ZS125	Front Conn. Rear Conn.	20A	23.7	23.2	22.8	22.4	21.9	21.4	21.0	20.5	20.0	19.5	19.0	18.4	17.9
		32A	35.5	35.1	34.6	34.2	33.8	33.3	32.9	32.5	32.0	31.5	31.1	30.6	30.1
		50A	62.2	60.8	59.4	57.9	56.4	54.9	53.3	51.7	50.0	48.3	46.5	44.6	42.6
		63A	75.8	74.3	72.8	71.3	69.7	68.1	66.4	64.7	63.0	61.2	59.4	57.5	55.5
		100A	118	116	114	112	109	107	105	102	100	97	95	92	90
		125A	148	145	142	140	137	134	131	128	125	122	119	115	112
ZS250		160A	187	184	181	177	174	171	167	164	160	156	152	149	145
		250A	285	281	277	272	268	264	259	255	250	245	240	235	230

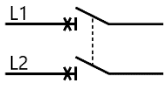
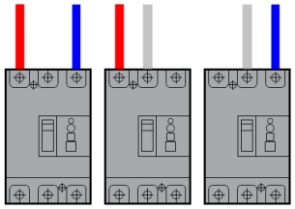
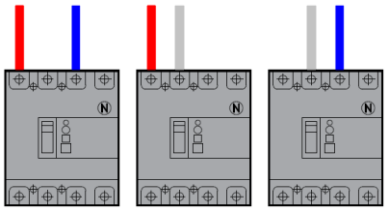
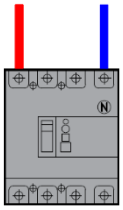
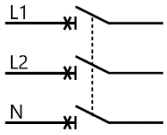
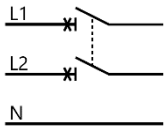
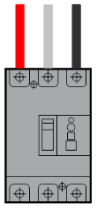
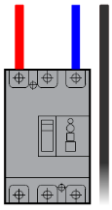
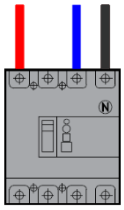
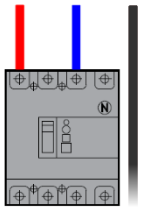
Annex G – Connection Diagrams

Connection Type	ZS CBR No. Poles	Diagram	Correct/Incorrect	Notes
Reverse Connection	3-pole and 4-pole		✓	Reverse (bottom) connection is permissible for both 3- and 4-pole ZS_TF CBRs. When a ZS_TF CBR is reverse connected, the Power LED located on the residual current unit on the front of the CBR will be illuminated before and after any over current or residual current trip.
Chassis Connection (3P) 	3-pole		✓	Reverse (bottom) connection is required for all ZS_TF CBRs when connected to a chassis. When a ZS_TF CBR is reverse connected, the Power LED located on the residual current unit on the front of the CBR will be illuminated before and after any over current or residual current trip.
Chassis Connection (3P+N) 	4-pole		✓	Reverse (bottom) connection is required for all ZS_TF CBR when connected to a chassis. For 4-pole systems the chassis Neutral poles must connect to CBR Neutral terminals. Switched or Solid Neutral models can be used. When a ZS_TF CBR is reverse connected, the Power LED located on the residual current unit on the front of the CBR will be illuminated before and after any over current or residual current trip.
3-phase 3-wire (3P) 	3-pole		✓	
	4-pole		✓	A 4-pole ZS_TF CBR can be used on a 3P system if the system phases use the 3 main poles of the CBR and the 4th Neutral pole of the CBR is not used.

Annex G – Connection Diagrams

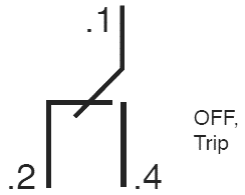
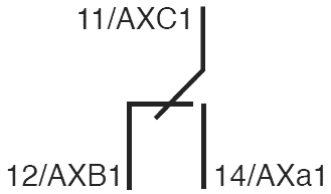
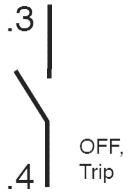
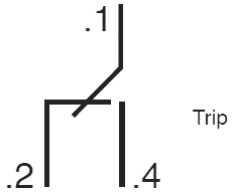
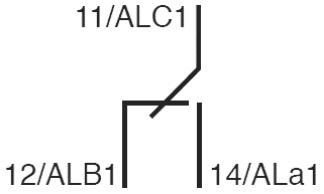
Connection Type	ZS CBR No. Poles	Diagram	Correct/Incorrect	Notes
3-phase 4-wire (3P+N) 	3-pole		✗	If a Neutral is present in the system, it must be monitored by the ZS_TF CBR so an imbalance will not occur. The CBR will trip if the Neutral is not connected.
	4-pole		✓	The phases of the system must connect to the 3 main phase poles of the ZS_TF CBR and the system Neutral must connect to the 4th Neutral pole of the CBR. Switched or Solid Neutral models can be used.
1-phase 2-wire (1P+N) 	3-pole		✓	
			✗	If a Neutral is present in the system, it must be monitored by the ZS_TF CBR so an imbalance will not occur. The CBR will trip if the Neutral is not connected.
	4-pole		✓	When using a 4-pole ZS_TF CBR on a 1P+N system the P and N wires must use any of the 3 main power poles of the 4-pole CBR.
			✗	If a Neutral is present in the system, it must be monitored by the ZS_TF CBR so an imbalance will not occur. The CBR will trip if the Neutral is not connected. If the Neutral is connected to the 4th Neutral pole of the ZS_TF CBR, the Test button of the CBR will not function.

Annex G – Connection Diagrams

Connection Type	ZS CBR No. Poles	Diagram	Correct/Incorrect	Notes
2-phase 2-wire (2P) 	3-pole		✓	
	4-pole		✓	
			✗	When using a 4-pole ZS_TF CBR on a 2P system both P wires must use any of the 3 main power poles and not the 4th Neutral pole.
2-phase 3-wire (2P+N)  	3-pole		✓	
			✗	If a Neutral is present in the system, it must be monitored by the ZS_TF CBR so an imbalance will not occur. The CBR will trip if the Neutral is not connected.
	4-pole		✓	Switched or Solid Neutral models can be used.
			✗	If a Neutral is present in the system, it must be monitored by the ZS_TF CBR so an imbalance will not occur. The CBR will trip if the Neutral is not connected.

Annex H – Wiring Diagrams & Terminal Designations

Internal Accessories

Accessory Type	Contact Type	Switching Arrangement	Connection Type	Wiring Diagram	Terminal Designation
Auxiliary	General Purpose	1 C/O	Terminal		1 – Common 2 – N/C 3 – N/O
			Pre-wired		11/AXC1 – Common 12/AXB1 – N/C 14/AXa1 – N/O
	Heavy Duty	1 N/O	Terminal		3 – Common 4 – N/O
		1 N/C	Terminal		1 – Common 2 – N/C
Alarm	General Purpose	1 C/O	Terminal		1 – Common 2 – N/C 4 – N/O
			Pre-wired		11/ALC1 – Common 12/ALB1 – N/C 14/Ala1 – N/O
	Heavy Duty	1 N/O	Terminal		3 – Common 4 – N/O
		1 N/C	Terminal		1 – Common 2 – N/C

Annex I – Internal Harmonics Protection

ZS_TF CBRs include a harmonics inhibition circuit which limits the CBRs reaction of earth leakage trip unit to high frequency harmonics. This feature makes the ZS_TF CBR suitable for use with AC Drives and other similar equipment known to generate line harmonics.

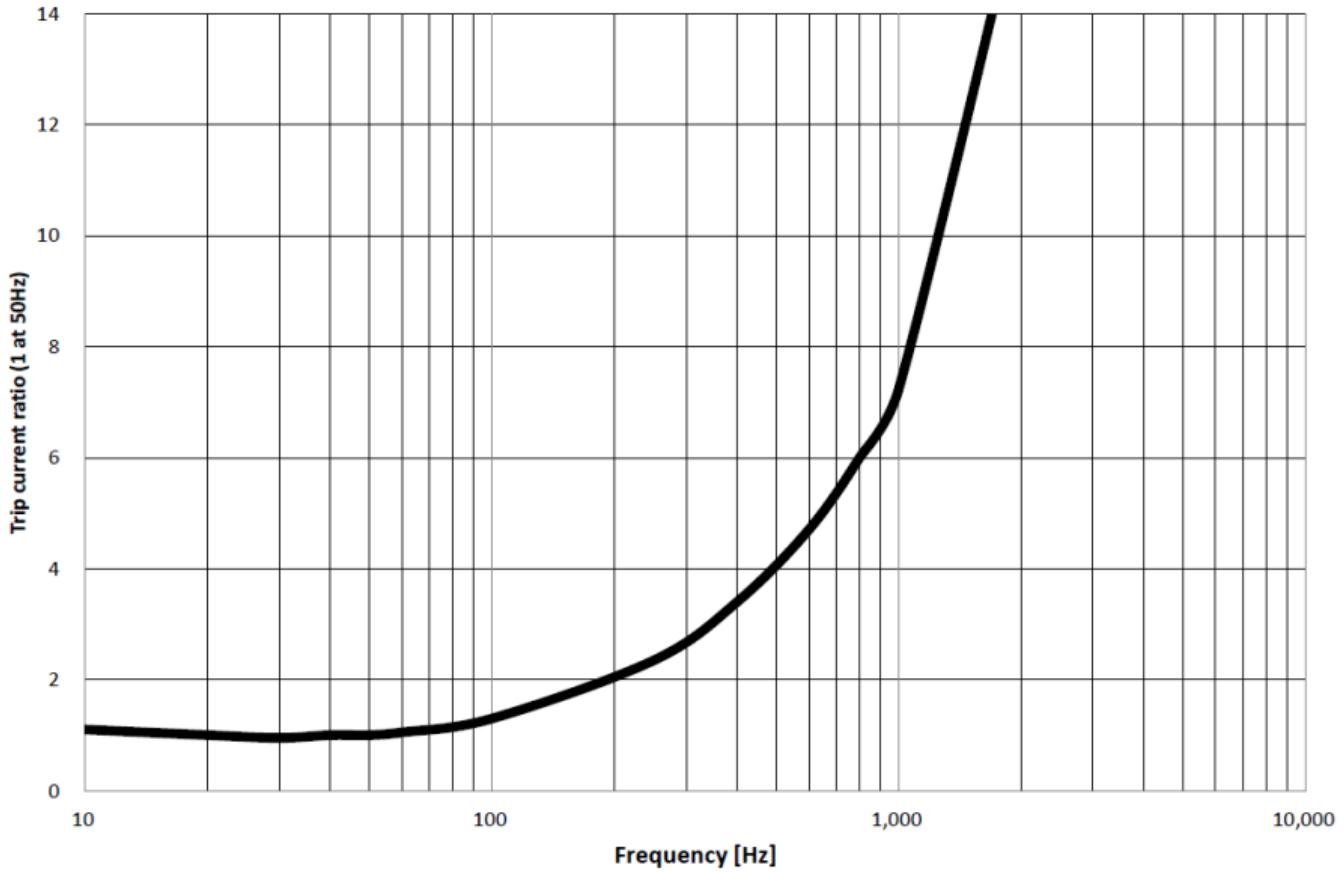
Variable Speed Drives and other similar semiconductor switching products can produce high levels of harmonics that can travel through electrical power systems and can cause other devices to react in different ways to these harmonics. If the harmonics are enough to significantly distort the voltage waveform for example, these harmonics when added together can cause unintended tripping of a circuit breaker or residual current device.

In the case of a ZS_TF CBR, the levels of harmonics can be different for each phase, resulting in different amplitudes, voltages and currents for each phase. This can be enough to cause the CBR to sense a phase imbalance, which causes the device to trip.

If the harmonics cannot be filtered out of the system, then an option is to use a residual current sensing device that is increasingly immune to high frequency harmonics, so it can in effect ride on the resulting waveform. The ”immunity” is the relay requiring more current to trip as the frequency increases, therefore decreasing the likelihood of the relay or CBR nuisance tripping. What is not wanted is a residual current device that, despite an increase in frequency, still only requires a low level of current (or the original 50Hz current) to trip it.

An ideal residual current device will operate in the region of 30-60Hz while seeing no harmonics. If harmonics start to appear, then at around 100Hz, the residual current relay will start to require higher currents to cause a trip.

The ZS_TF CBRs begin to react to high frequency at around 100Hz, as shown response curve below.



ZS Model MCCB with Integrated Residual Current Protection User Manual

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