

SIEMENS



3VA Molded Case Circuit Breakers

Totally Integrated Power – SENTRON

Manual

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3VA molded case circuit breakers

Manual

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Introduction

1.1 About this documentation

3VA molded case circuit breakers

As part of our portfolio of cost-effective power distribution products, we are offering extremely flexible molded case circuit breakers designed to protect personnel and material assets.

We can supply exactly the right molded case circuit breaker for every application.

Benefits

- Maximum flexibility thanks to the modular design of the internal and external accessories
- Outstanding selectivity, for example, makes planning very simple
- State-of-the-art manufacturing techniques
- All-round product support provided by integrated online support tools

Scope of validity of this document

This manual is a reference manual for technical information that users will need in order to configure and operate 3VA molded case circuit breakers.

1.2 Product-specific information

1.2.1 Target readers

Target readers of this documentation

The information contained in this manual is provided for the benefit of:

- Users
- Cubicle manufacturers
- Switchgear manufacturers
- Maintenance personnel

1.2.2 Technical Support

You can find further support on the Internet at:

Technical Support (<http://www.siemens.com/lowvoltage/technical-support>)

1.2.3 Reference documents

Further documents

You will find further information in the following documents:

Table 1- 1 Reference documents

Title	Article number		Link
3VA molded case circuit breakers catalog	DE	E86060-K8220-E480-A3	3VA molded case circuit breaker catalog (www.siemens.com/lowvoltage/infomaterial)
	EN	E86060-K8220-E480-A2-7600	
3VA molded case circuit breaker operating instructions			3VA molded case circuit breaker documentation (http://www.siemens.com/3VA-Documentation)
3VA Communication system manual	DE	3ZW1012-0VA20-0BB0	3VA molded case circuit breaker documentation (http://www.siemens.com/3VA-Documentation)
	EN	3ZW1012-0VA20-0BC0	
3VA molded case circuit breaker tables (updated daily)			3VA molded case circuit breaker documentation (http://www.siemens.com/3VA-Documentation)
Automatic transfer control device ATC5300 - Manual	DE	A5E02469034-01	Automatic transfer control device ATC5300 (http://support.automation.siemens.com/WW/view/de/41909986/0/en)
	EN	A5E02469035-01	
ATSE - Remote Control Software Manual	DE	A5E02469028-01	ATSE - Remote Control Software Manual (http://support.automation.siemens.com/WW/view/de/41909978)
	EN		
ATSE - Modbus Communication Protocol	DE	A5E02469001-01	ATSE - Modbus Communication Protocol (http://support.automation.siemens.com/WW/view/de/40761679)
	EN		
Grundlagen der Niederspannungsschalttechnik (Fundamentals of Low-Voltage Switchgear and Controlgear), Siemens AG © 2008	—		—
Hartmut Kiank, Wolfgang Fruth: Planungsleitfaden für Energieverteilungsanlagen (Planning Guide for Power Distribution Plants), Publicis Publishing	ISBN: A19100-L531-B115		—

Title	Article number	Link
Switching, Protection and Distribution in Low-Voltage Networks, substantially extended and revised edition 1997	ISBN 3-89578-041-3	—
Siemens: Residual Current Protective Devices, Low-Voltage Circuit Protection Technology Primer Siemens AG © 04 / 2009	E10003-E38-9T-B3011	—

Description

2.1 Overview - applications and portfolio

This chapter provides an overview of all molded case circuit breakers in the 3VA portfolio and describes the potential areas of application for different circuit breaker models.

The topics discussed in this chapter are listed below:

- Applications and possible uses
- Portfolio
- Possible configurations
- Detailed information about applications and possible uses
- Technical specifications
- Molded case circuit breakers and accessories in the system

2.1.1 Applications and possible uses

The two tables below show examples of applications and possible uses for the new 3VA molded case circuit breakers.

Possible uses

3VA molded case circuit breakers can be deployed in various fields where they perform a variety of different protection tasks. The following table (sorted according to breaking capacity) shows the areas in which 3VA molded case circuit breakers are used:

	Buildings				Industry	
Molded case circuit breakers	3VA1	3VA1 3VA2	3VA1 3VA2	3VA1 3VA2	3VA1 3VA2	3VA1 3VA2
Breaking capacity	Up to 25 kA	Up to 55 kA	Up to 85 kA	Up to 150 kA	Up to 110 kA	Up to 150 kA
Segments	Residential buildings	Commercial buildings	Infrastructure	Industrial buildings	Functional shell	Factory automation/ process automation
Examples	 Single high-rise building in the form of a residential building Building complexes Residential buildings	 Office blocks, banks, hotels, bowling alleys, cinemas, shopping malls, hospitals, universities and schools	 Airports, railway stations, sports stadiums, arenas, port facilities Trade fairs and exhibitions	 Industrial parks, warehouses, logistics centers	 Paper industry, computer centers, oil & gas industry, food and beverages industry	 Presses, electroplating plants, rolling mills, mills, agitators and blending plants, production lines

Functions and applications

3VA molded case circuit breakers are used in a variety of functions, as shown in the table below:

	3VA1	3VA2
Line protection	■	■
Switch disconnectors identical in design to a molded case circuit breaker in accordance with IEC 60947-3	■	
Standard applications up to 70 kA and thermal-magnetic trip units	■	
Applications in DC systems	■	
Generator protection		■
High breaking capacity		■
Selectivity		■
Communication functions		■

Molded case circuit breakers are primarily designed for the following applications:

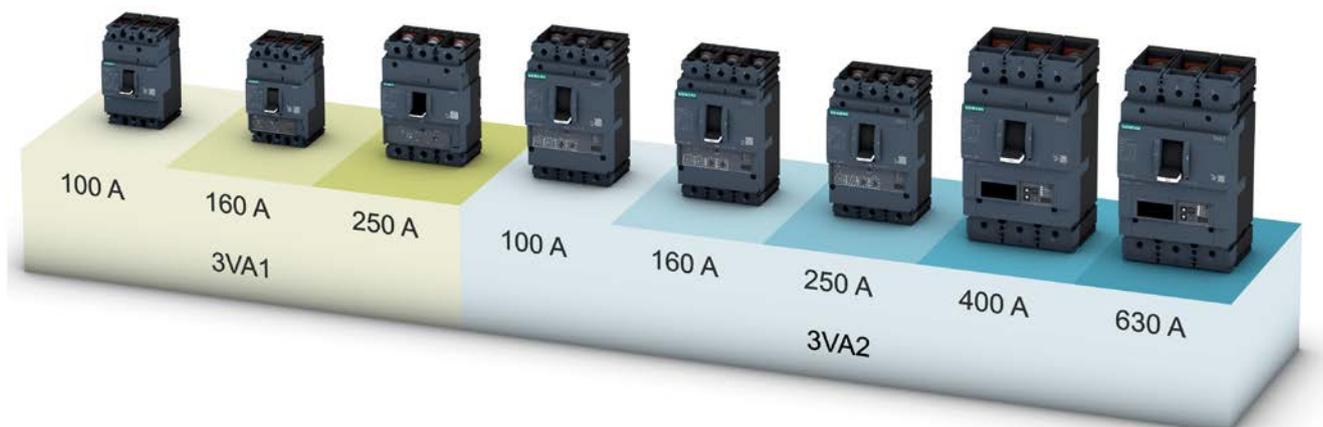
- Subdistribution systems
- Industrial distribution systems
- Final distribution systems
- On-site isolation
- Use in machines

2.1.2 Portfolio

The integrated 3VA portfolio consists of two different series of molded case circuit breakers in five different rated operational current versions (sizes).

Sizes

The new 3VA molded case circuit breakers set new standards in flexibility and the variety of modular accessories available. Standardized accessories suitable for use with several sizes of circuit breaker from all the 3VA ranges help to cut costs and save time.



The new 3VA1 molded case circuit breakers are available in 1 to 4-pole versions (3VA1 160 A) or in 3 and 4-pole versions (3VA1 100 A or 3VA1 250 A). The new 3VA2 molded case circuit breakers are available in 3 and 4-pole versions.

The circuit breakers are available with rated operational currents ranging from 16 A to 630 A and rated voltages up to 690 V, depending on the series and size.

3VA1 molded case circuit breakers



The new 3VA1 molded case circuit breakers reliably perform all the tasks associated with line protection.

Features

The key features of the 3VA1 series are:

- Compact design
- Depending on size: 1 and 2-pole versions in size 160 A, 3 and 4-pole versions in sizes 100 A, 160 A and 250 A
- Depending on size: Breaking capacity of 16 kA ... 70 kA at 415 V, 3 or 4-pole breakers and 36 kA at 240 V, 1-pole breakers
- Fixed-mounted, plug-in version
- Thermal-magnetic trip units
- AC/DC applications
- No derating up to +50 °C
- Modular and easy-to-fit internal accessories with diverse functions
- Uniform accessories platform across all 3VA molded case circuit breakers

Compact dimensions

Thanks to a mounting depth of 70 mm and a cover size of 45 mm, the 3VA1 molded case circuit breakers of sizes 100 A, 160 A and 250 A are ideal for protecting cables and lines in the plant area, especially for the INSTA electrical installation area. For these applications, there is also a wide range of accessories available such as adapters for installation on DIN rails, as well as residual current devices (RCD310 and RCD510) that can be side mounted.

Thermal-magnetic trip units

3VA1 molded case circuit breakers are equipped with a thermal-magnetic trip unit which provides overload and short-circuit protection. This has been developed for implementing economical, cost-efficient installations up to 250 A. It is suitable for use in three-phase networks, AC networks, 400 Hz applications, and with DC currents.

3VA2 molded case circuit breakers



The new 3VA2 molded case circuit breakers reliably perform all the tasks associated with line and generator protection.

This series is designed for applications with more exacting requirements:

- Increased breaking capacity
- Excellent selective protection
- Integrated metering function
- Connection to a fieldbus communication system

Features

The most important features of the 3VA2 series are:

- Compact dimensions
- 3 and 4-pole versions
- Four breaking capacity classes from 55 kA ... 150 kA
- Fixed-mounting, plug-in technology, draw-out technology
- Depending on size: Selective tripping at rated operational current difference 1 : 2.5
- Electronic Trip Units
- Retrofittable communication for ETU 5-series and 8-series
- Depending on the ETU: Integrated metering function
- AC applications
- No derating up to +50 °C
- Modular and easy-to-fit internal accessories with diverse functions
- Uniform accessories platform across all 3VA molded case circuit breakers
- Electronic Trip Units (ETU) with different setting values

Compact dimensions with function expansions

In addition to its expanded functionality, the 3VA2 molded case circuit breaker also comes with compact dimensions for fixed mounting, as a plug-in version and a draw-out version.

A cover size of 70 mm for the door cutout and a complete selection of breaking capacity classes from 55 kA to 150 kA at 415 V AC provide the necessary flexibility for planning.

Despite its compact size, the circuit breaker offers the following benefits:

- Extremely high breaking capacity
- Extremely good selectivity
- Electronic trip units, versions with and without integrated metering function and optional fieldbus communication interface

Selective contact system

With its contact system, the 3VA2 molded case circuit breaker is designed for fast selectivity tripping. The selective contact system ensures the following:

- Dynamic instantaneous short-circuit range
- High breaking capacity
- Selective protection response of the molded case circuit breakers in relation to each other
- Selective protection response of the molded case circuit breakers in relation to other protection devices such as downstream low-voltage fuses, etc.

Electronic Trip Unit (ETU)

The current sensor of the 3VA2 comprises an iron-cored transformer for the internal power supply and a Rogowski coil for precise current measurement. Each transformer can be optimized accordingly for its specific task. Thanks to the high accuracy of current measurement, the 3VA2 molded case circuit breaker is suitable for power/energy measurement. In addition, finer adjustment of ground fault current monitoring is possible.

The Electronic Trip Units (ETUs) provide the following protection functions:

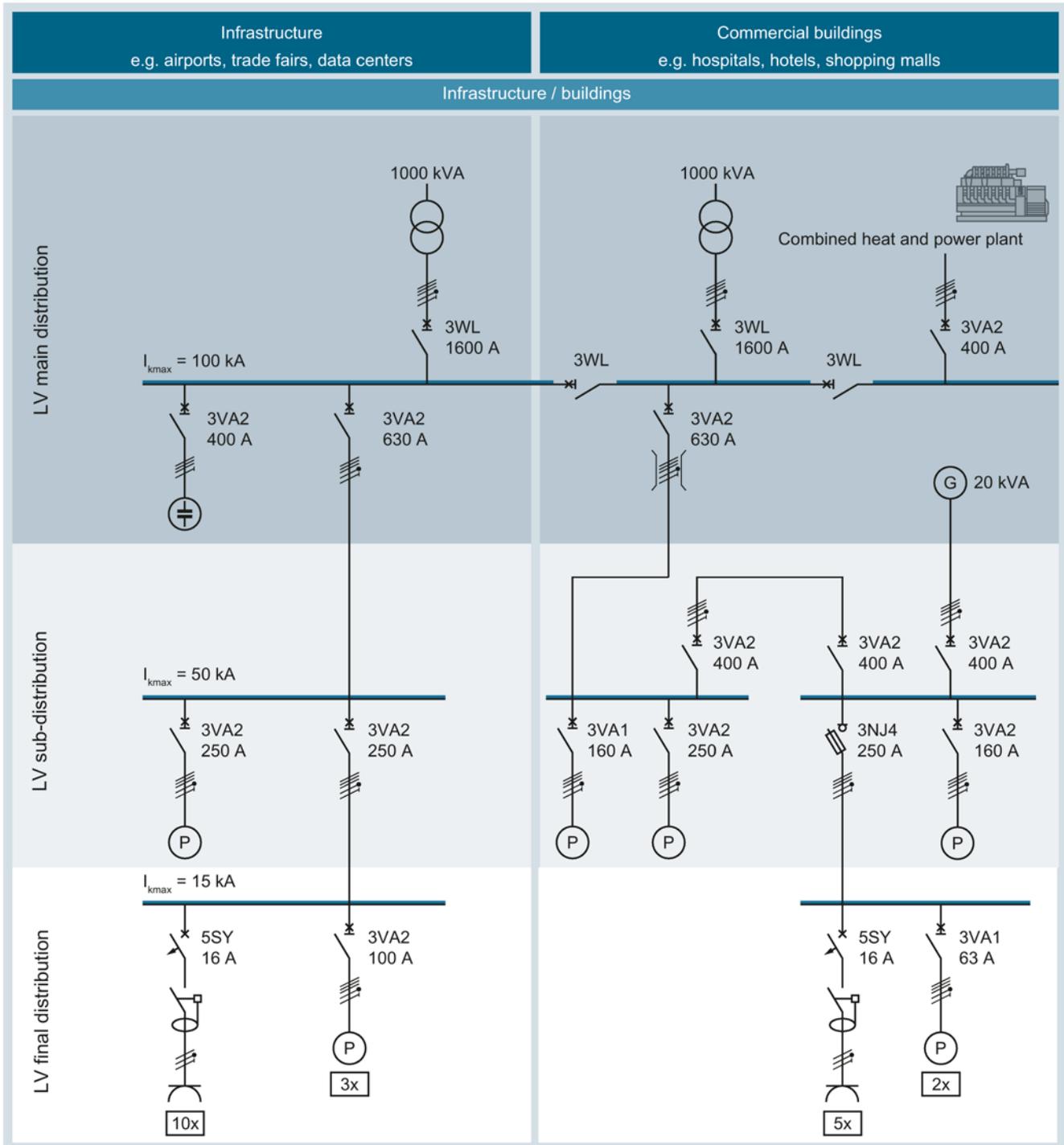
- Overload protection L ("L" = Long-time delay)
Adjustable in steps from 40% to 100% of the rated operational current of the molded case circuit breaker.
- Short-time delayed short-circuit protection S ("S" = Short-time delay) for time-selective response in case of a short circuit
- Instantaneous short-circuit protection I ("I" = instantaneous):
- Protection of the neutral conductor against overload and short-circuit ("N" = neutral)
- Protection against residual currents to ground ("G" = Ground fault).

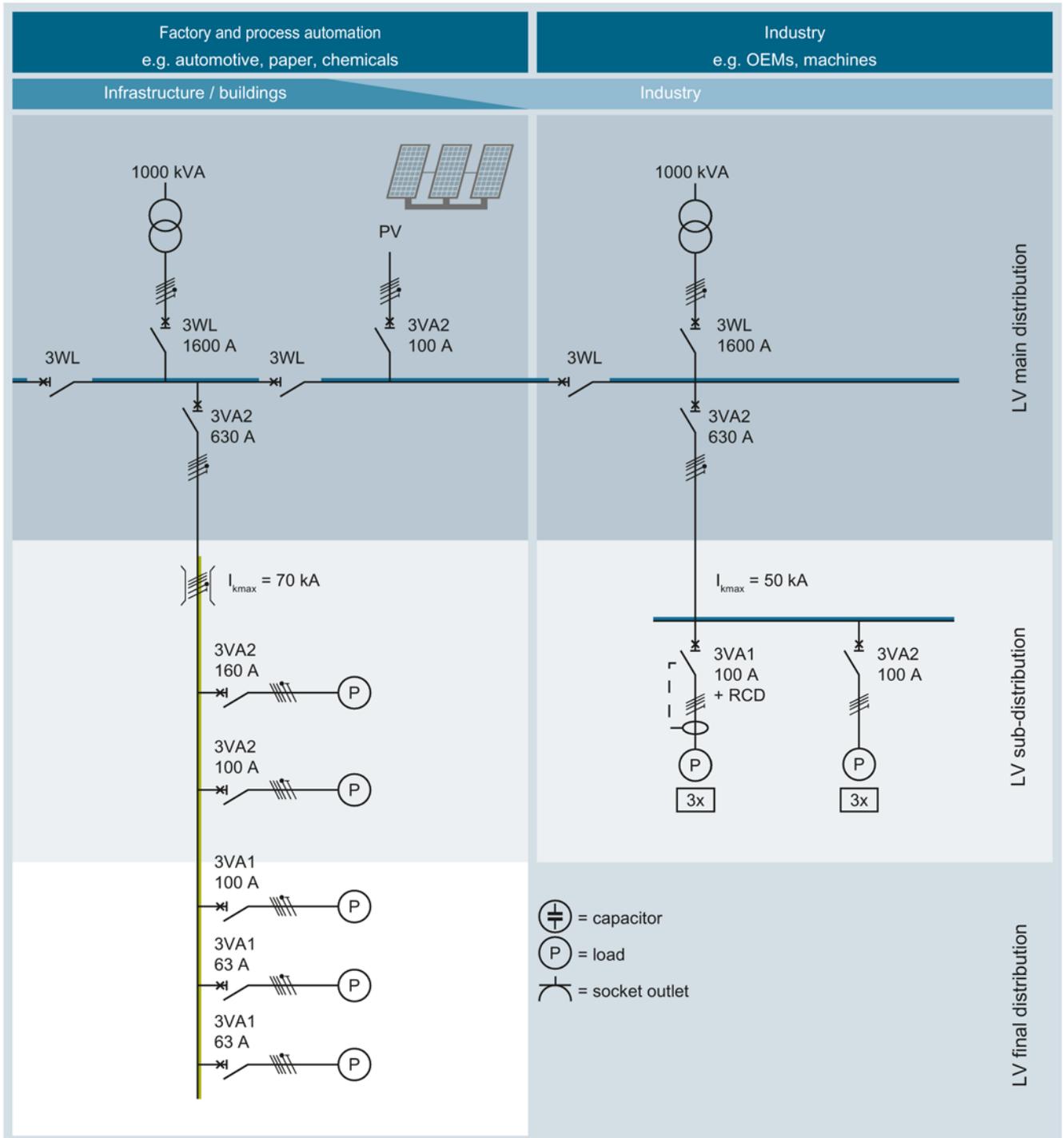
Energy management and communication

The Electronic Trip Units (ETUs) provide the following energy management and communication functions:

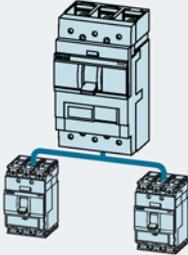
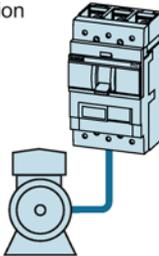
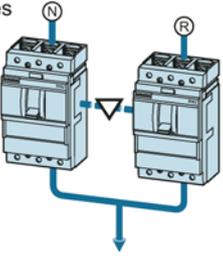
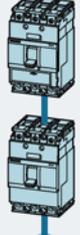
- Metering functions
- Communication
- Flexible, local, digital inputs and outputs via the EFB300 external function box
- Software commissioning support with powerconfig
- Testing and archiving with the TD300 and TD500 test devices (with powerconfig)

2.1.3 Application examples





2.1.4 Detailed information about applications and possible uses

Application	3VA1	3VA2	Description
<p>Line protection</p> 	■	■	<p>The trip units for line protection are designed to protect the following against overload and short circuits:</p> <ul style="list-style-type: none"> - cables - lines - predominantly non-motorized loads
<p>Generator protection</p> 		■	<p>The trip units are set appropriately to provide protection for generators.</p>
<p>Residual current protection</p> 	■	■	<p>Residual current devices afford fault protection (formerly referred to as: protection in case of indirect contact) and supplementary protection (formerly referred to as: protection in case of direct contact) in low-voltage systems in the event of failure of the basic insulation or contact with live parts. Their task is to prevent or reduce injury to personnel or livestock, or damage to property.</p>
<p>Transfer switches</p> 	■	■	<p>Transfer switches switch loads between two mutually independent supply systems.</p> <p>The purpose of transfer switches is to ensure a continuous power supply to the installation following failure of the normal power supply.</p>
<p>Switch disconnect</p> 	■		<p>Switch disconnectors are capable of switching equipment and parts of electrical installations when they are conducting their operational current under normal operating conditions. A switch disconnecter isolates individual circuits or items of equipment so that maintenance or repair work can be carried out.</p> <p>The switch disconnectors comply with IEC / EN 60947-3.</p>

See also

Applications (Page 105)

2.1.5 Technical specifications

3VA1 molded case circuit breakers for line protection																						
				100 A	160 A	160 A	160 A	250 A														
Number of poles				3, 4		1		2 ¹⁾														
Rated operational current				16 ... 100		16 ... 160		16 ... 250														
Rated operational voltage AC				690		240		415														
				B	N	S	N	S	N	S	M	H	S	M	H							
Rated ultimate short-circuit breaking capacity AC				I_{cu}	220 ... 240 V	kA	25	36	55	25	36	36	55	36	55	85	100	55	85	100		
				I_{cu}	380 ... 415 V	kA	16	25	36	5	6	25	36	25	36	55	70	36	55	70		
				I_{cu}	440 V	kA	8	16	25							16	25	36	55 ²⁾	25	36	36
				I_{cu}	500 V	kA	O. r.	O. r.	O. r.							O. r.	O. r.	O. r.	O. r.	10	15	15
				I_{cu}	690 V	kA	5	5	7							7	7	10	10	7	10	10
Rated service short-circuit breaking capacity AC				I_{cs}	220 ... 240 V	kA	25	36	55	25	36	36	55	36	55	85	100	55	85	100		
				I_{cs}	380 ... 415 V	kA	16	25	36	5	6	25	36	25	36	55	70	36	55	70		
				I_{cs}	440 V	kA	8	16	25							16	25	36	40 ²⁾	25	36	36
				I_{cs}	500 V	kA	O. r.	O. r.	O. r.							O. r.	O. r.	O. r.	O. r.	10	10	10
				I_{cs}	690 V	kA	5	5	5							5	5	5	5	5	5	5
IT system				V		Up to 690		Up to 415		Up to 415		Up to 690		Up to 690								
Rated operational voltage DC				DC		V		3-pole: 500 V 4-pole: 600 V		125		250		3-pole: 500 V 4-pole: 600 V		3-pole: 500 V 4-pole: 600 V						
Rated ultimate short-circuit breaking capacity DC				DC		kA		3-pole: Up to 55 kA at 500 V 4-pole: Up to 25 kA at 600 V		Up to 25 kA at 125 V		Up to 55 kA at 250 V		3-pole: Up to 100 kA at 500 V 4-pole: Up to 55 kA at 600 V		On request						
Rated service short-circuit breaking capacity DC				DC		kA		3-pole: Up to 55 kA at 500 V 4-pole: Up to 25 kA at 600 V		Up to 25 kA at 125 V		Up to 55 kA at 250 V		3-pole: Up to 100 kA at 500 V 4-pole: Up to 55 kA at 600 V		On request						
Trip unit				FTFM	TM210		■			■				■								
				ATFM	TM220											■						
				ATAM	TM240												■					■
				LI	ETU320																	
				LIG	ETU330																	
				LSI	ETU350																	
				LSI	ETU550/ETU850																	
				LSIG	ETU560/ETU860																	
Switch disconnectors																						
Rated operational current				50 °C		A						63, 100, 125, 160		250								
Rated operational voltage				AC (50/60 Hz)		V								690		690						
				DC		V								3-pole: 500 V 4-pole: 600 V		3-pole: 500 V 4-pole: 600 V						
Number of poles														3, 4		3, 4						
Rated short-circuit making capacity with upstream circuit breaker						kA								Up to 70 kA at 415 V		On request						
Permissible rated short-time current						kA								2		On request						

O. r. On request

- 1) A side plate must be installed (see chapter Insulating equipment (Page 191)) if the installation conditions on the right-hand side are such that the device is not finger-safe.
- 2) I_n 125 A, 160 A: $I_{cu} / I_{cs} = 36 \text{ kA} / 36 \text{ kA}$

3VA2 molded case circuit breakers for line protection				 400 A				 630 A				
Number of poles				3, 4				3, 4				
Rated operational current		I_n	50 °C	A				250 ... 400				
Rated operational voltage AC		U_e	AC (50/60 Hz)	V				690				
				M	H	C	L	M	H	C	L	
Rated ultimate short-circuit breaking capacity AC		I_{cu}	220 ... 240 V	kA	85	110	150	O. r.	85	110	150	O. r.
		I_{cu}	380 ... 415 V	kA	55	85	110	O. r.	55	85	110	O. r.
		I_{cu}	440 V	kA	55	85	110	O. r.	O. r.	O. r.	O. r.	O. r.
		I_{cu}	500 V	kA	36	55	85	O. r.	O. r.	O. r.	O. r.	O. r.
		I_{cu}	690 V	kA	5	5	5	O. r.	6	6	6	O. r.
Rated service short-circuit breaking capacity AC		I_{cs}	220 ... 240 V	kA	85	110	150	O. r.	85	110	150	O. r.
		I_{cs}	380 ... 415 V	kA	55	85	110	O. r.	55	85	110	O. r.
		I_{cs}	440 V	kA	55	85	110	O. r.	O. r.	O. r.	O. r.	O. r.
		I_{cs}	500 V	kA	36	55	85	O. r.	O. r.	O. r.	O. r.	O. r.
		I_{cs}	690 V	kA	5	5	5	O. r.	6	6	6	O. r.
IT system				V				Up to 690				
Rated operational voltage DC		U_e	DC	V								
Rated ultimate short-circuit breaking capacity DC		I_{cu}	DC	kA								
Rated service short-circuit breaking capacity DC		I_{cs}	DC	kA								
Trip unit		FTFM	TM210									
		ATFM	TM220									
		ATAM	TM240									
		LI	ETU320					■			■	
		LIG	ETU330					■			■	
		LSI	ETU350					■			■	
		LSI	ETU550/ETU850					■			■	
LSIG	ETU560/ETU860					■			■			
Switch disconnectors												
Rated operational current		I_n	50 °C	A								
Rated operational voltage		U_e	AC (50/60 Hz)	V								
		U_e	DC	V								
Number of poles												
Rated short-circuit making capacity with upstream circuit breaker		I_{cm}	kA									
Permissible rated short-time current		I_{cw}	kA									

O. r. On request

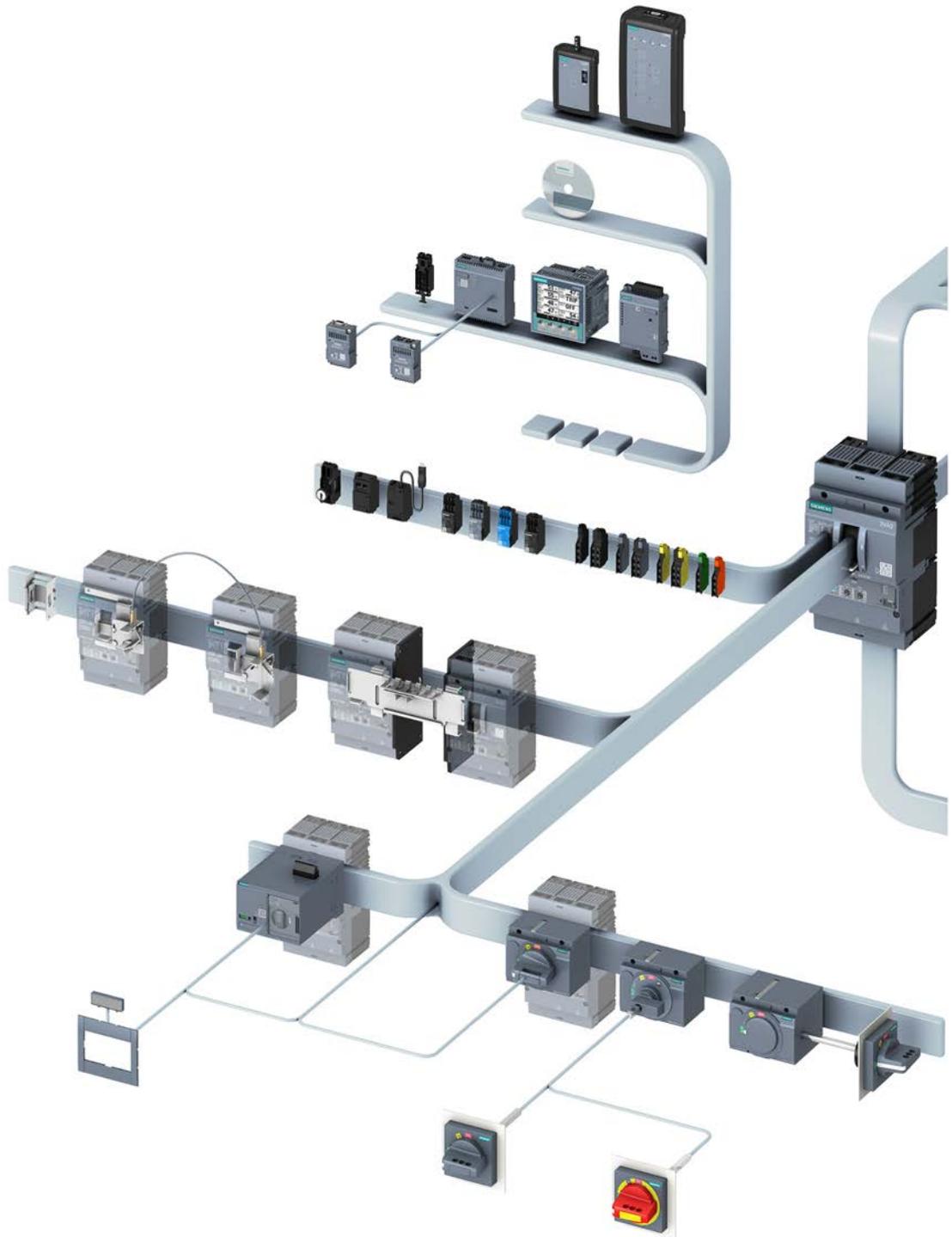
2.1.6 Molded case circuit breakers and accessories in the system

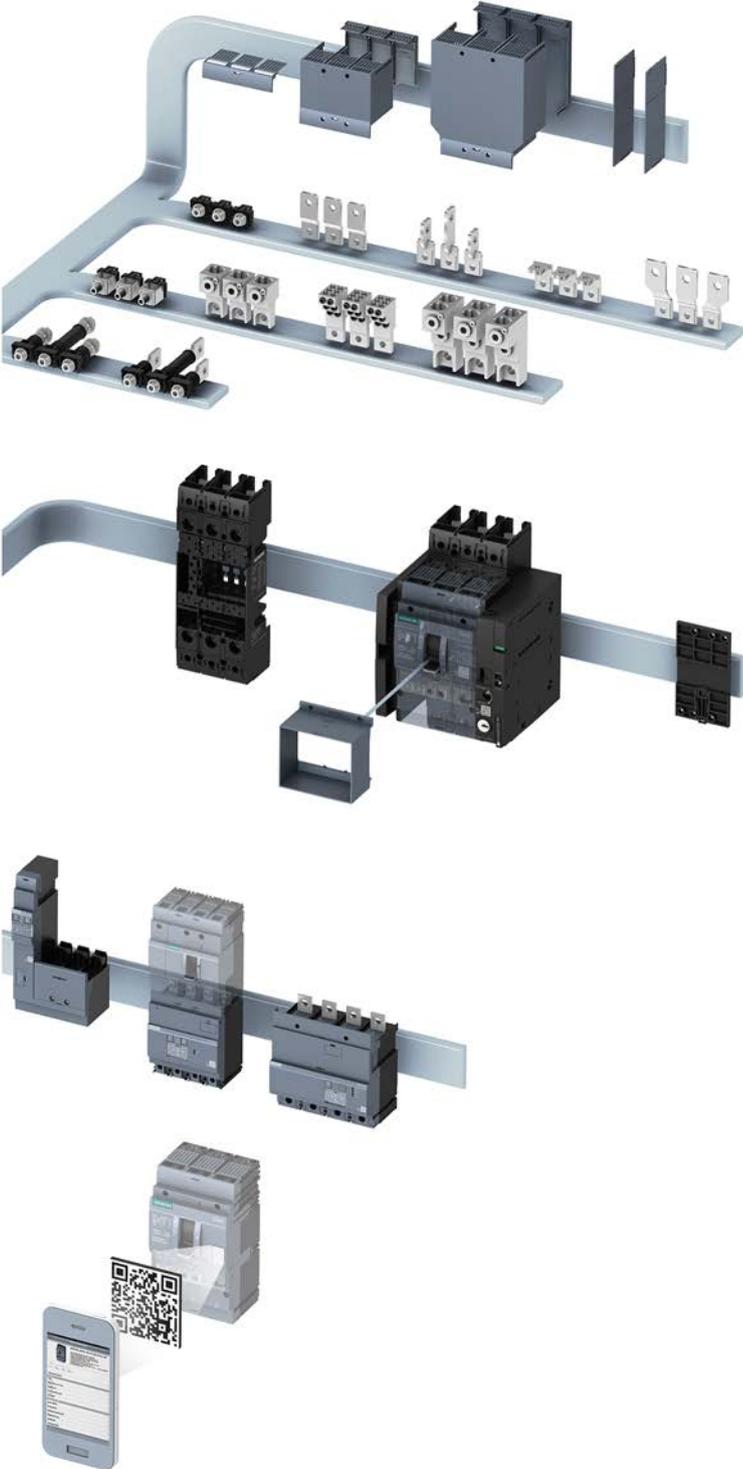
The new 3VA molded case circuit breakers come with a large portfolio of internal and external accessories which can be installed flexibly in any size of circuit breaker (depending on the type of accessory).

The table below indicates which accessories are compatible with particular molded case circuit breakers, and which sizes of breakers are compatible with the same accessory:

Accessories	3VA1			3VA2				
	100 A	160 A	250 A	100 A	160 A	250 A	400 A	630 A
Auxiliary switches and alarm switches	██							
Auxiliary releases	██							
Connection technology	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Plug-in technology		████████████████		████████████████	████████████████	████████████████	████████████████	████████████████
Draw-out technology			████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Front mounted rotary operator	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Door mounted rotary operator	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Side wall mounted rotary operator	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Motor operator		████████████████		████████████████	████████████████	████████████████	████████████████	████████████████
Locking and interlocking	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
Residual current device, side mounted		████████████████						
Residual current device, mounted loadside		████████████████		████████████████	████████████████	████████████████	████████████████	████████████████
Communications interface				████████████████	████████████████	████████████████	████████████████	████████████████
EFB300				████████████████	████████████████	████████████████	████████████████	████████████████
TD300 and TD500				████████████████	████████████████	████████████████	████████████████	████████████████
Escutcheon	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████	████████████████
DIN rail adapter	████████████████							

Overview of accessories in the system





2.2 Ergonomic design

This chapter provides an overview of the ergonomic design features of the new 3VA molded case circuit breakers and explains what makes them so special.

The topics discussed in this chapter are listed below:

- Optional installation variants
- Color-coded indication of switching position in the draw-out unit
- Clear status indication
- Active illumination
- Ergonomic handle
- Color-coded control elements
- Broad range of accessories
- Connection options

Integrated system

With their technical features and functional scope, the new 3VA molded case circuit breakers break new ground - but they also set new standards in ergonomic design.

When it comes to operation, functionality and installation, the new 3VA series is a fully integrated system. This principle is embodied in the basic units and in all internal and external accessories.

The benefits offered by the internal and external accessories available for the 3VA molded case circuit breakers are:

- Standardized methods of operation
- Standardized scope of functions
- Standardized installation procedures
- Standardized accessories for all breaker versions from 100 A to 630 A (e.g. auxiliary switches, auxiliary releases, etc.)

2.2.1 The right circuit breaker for any installation conditions



The new series of molded case circuit breakers can be equipped with additional components so that they can be installed as fully functional switches in any location, a feature of the product which affords maximum flexibility to system planners.

The following components can be installed to suit the installation location:

- Handle
- Front mounted rotary operator
- Door mounted rotary operator
- Side wall mounted rotary operator
- Motor operator



When the 3VA molded case circuit breaker is in the OFF position, it reliably disconnects all current paths of the circuit in accordance with IEC 60947-2 and IEC 60204-1 (VDE 0113). In the event of overvoltage between input and output, the reduced clearances prevent leakage currents at the surface and ensure that the dielectric strength is not degraded.

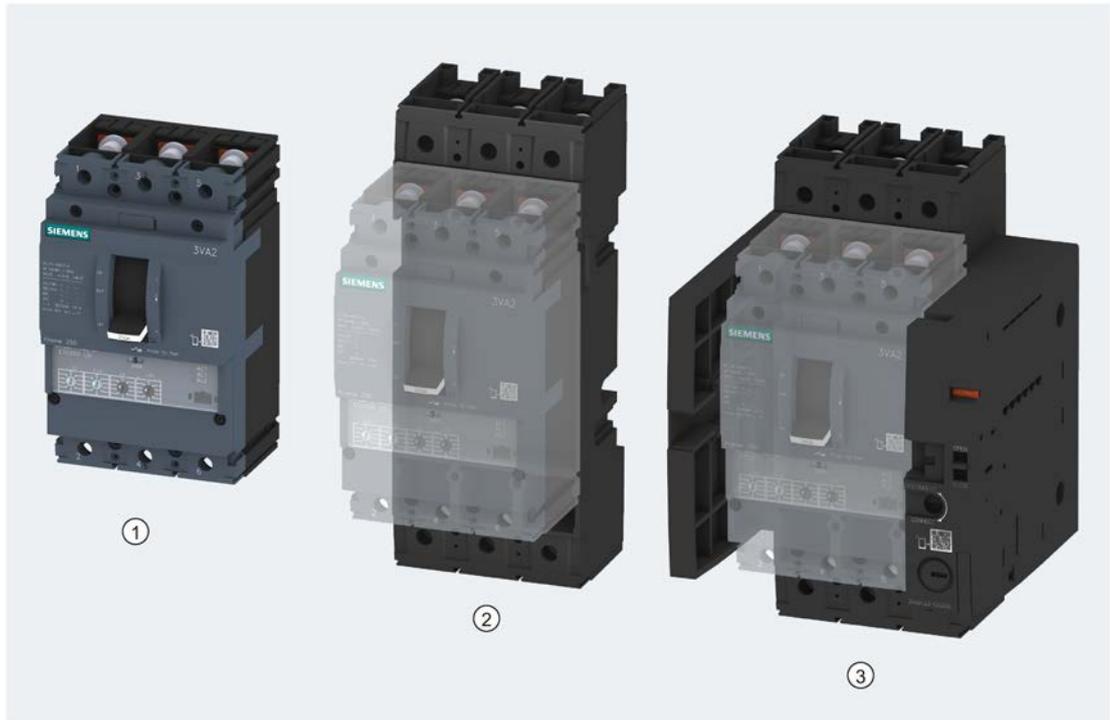
The main switch functionality is not diminished by installation of the following accessories:

- Motor operator
- Manual operator
- Residual current device



Optional installation variants

3VA molded case circuit breakers are available in the following installation variants:

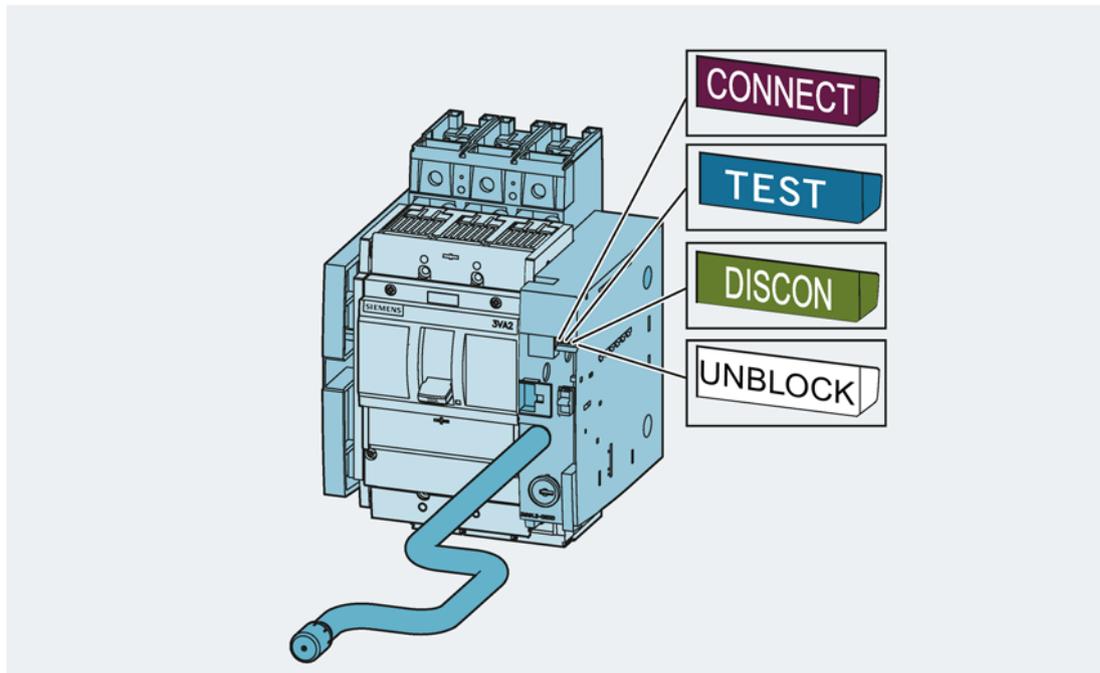


- Fixed mounted ①
- Plug-in technology ②
- Draw-out technology ③

All variants offer the full range of functions, e.g. they can be equipped with every kind of accessory. In addition, the last two variants are designed to allow speedy molded case circuit breaker replacement for maintenance purposes or visual indication of the electrical isolation in the main circuit.

Indication of switching positions in the draw-out unit

The picture below illustrates the colors used to indicate the switching position in the draw-out unit:



The switching position is indicated in a window of the draw-out unit and is clearly color-coded, enabling immediate identification of the current switching position of the molded case circuit breaker.

The draw-out unit has three switching positions:

- **CONNECT:**
The molded case circuit breaker is connected to the main circuit.
- **TEST:**
In the TEST position, the main contacts of the molded case circuit breaker are not connected to the main circuit, but only to the auxiliary circuit. It is therefore possible to check that the auxiliary circuit is functioning properly when the main circuit is open.
- **DISCONNECT:**
The molded case circuit breaker is not connected to the main circuit nor to the auxiliary circuit.
- **UNBLOCK:**
The molded case circuit breaker is not in any of the positions defined above and can be moved by means of the crank handle.

Motor operator for remote control

3VA molded case circuit breakers can also be controlled remotely. Whether the circuit breaker is controlled from "just" the other side of the closed cubicle door, or the breaker is switched on via a control room, operator panel, etc., is irrelevant.

Motor operators are available as accessories for remote control of the circuit breakers.

2.2.2 Ergonomic design of circuit breakers, handles and control elements

Ergonomic handle



With its wide surface area, the ergonomic handle is designed to assist manual operation of the circuit breaker. The white strip around the edge of the handle makes it easy to identify in conditions of poor visibility. The additional rated operational current information stamped on the white strip also significantly eases identification of the circuit breaker when it is one of many breakers in a large switchboard installation.

Clear status indication



The possible switching positions of manual rotary operators are listed below:

- ON - red marking
- TRIP - yellow marking
- OFF - green marking

The handle clearly engages in one of these positions depending on the status of the molded case circuit breaker. The switching positions are color-coded so that you can identify the status of the circuit breaker at a glance.

Active illumination



You can retrofit an active illumination kit to manual rotary operators. The illuminated indicator in the rotary handle signals the relevant switching position in the colors red, yellow and green. This provides clear visualization of the switching position on-site in conditions of poor visibility.

Color-coded control elements

The control elements on the thermal-magnetic and electronic trip units are color-coded.

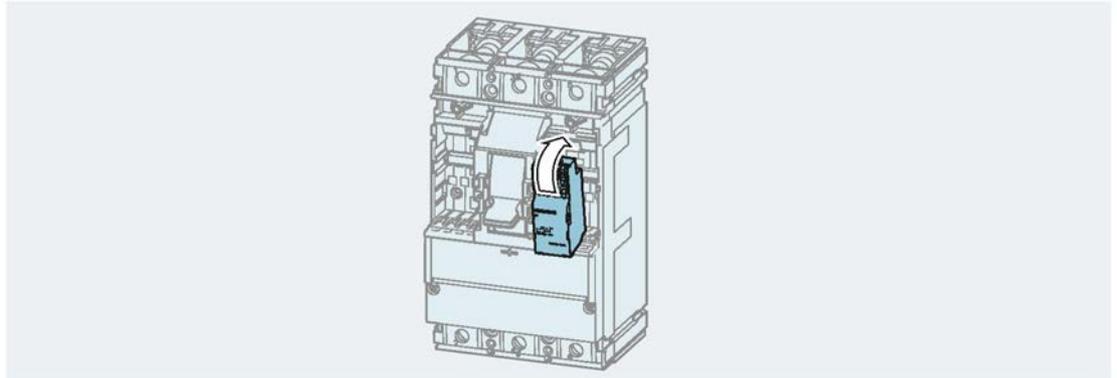


The color of each control element indicates that it performs a specific function, helping you to make the required settings quickly.

Color	Function
 Petrol blue	Overload protection
 Black	Short-circuit protection, ground-fault protection
 Gray	Protection of neutral conductor

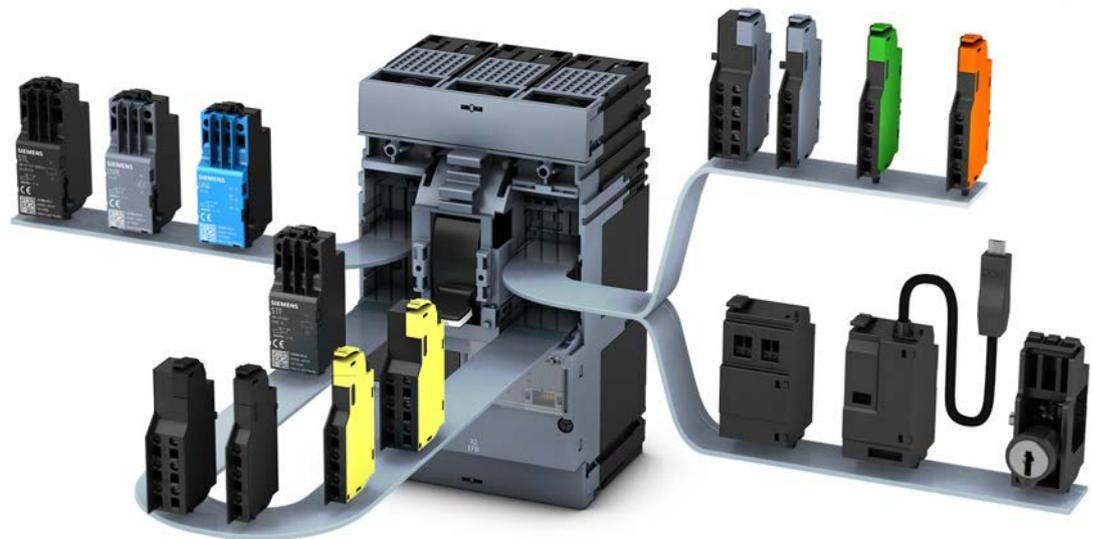
2.2.3 Wide range of accessories

The internal accessories (e.g. alarm and auxiliary switches, auxiliary releases, etc.) all belong to one family and can be installed on any size of 3VA1 or 3VA2 circuit breaker. The accessories are designed for quick and easy installation. The components are coded by color and design to ensure that they are always installed at the correct position in the circuit breaker.



Color coding of accessories

The internal accessories are color coded to clearly indicate their specific function.



A system of color coding has been used to clearly identify the specific functions of individual accessories:

Color	Auxiliary switches and alarm switches	Auxiliary releases
Black	Auxiliary switch AUX	Shunt trip left STL Shunt trip flexible STF
Gray	Leading changeover switch LCS	Undervoltage release UVR Undervoltage release with leading NO contacts UVR (LNO)
Yellow	Trip alarm switch TAS	
Orange	Short circuit alarm switch SAS	
Green	Electrical alarm switch EAS	
Blue		Universal release UNI

The cylinder lock and communication accessories included with the internal accessories in the picture above are explained in chapters Locking and interlocking (Page 269) and Communication and link-up to other systems (Page 360).

Fast assembly of motor operators

The motor operators have been designed for quick and easy assembly and disassembly. The internal accessories are therefore easily accessible.



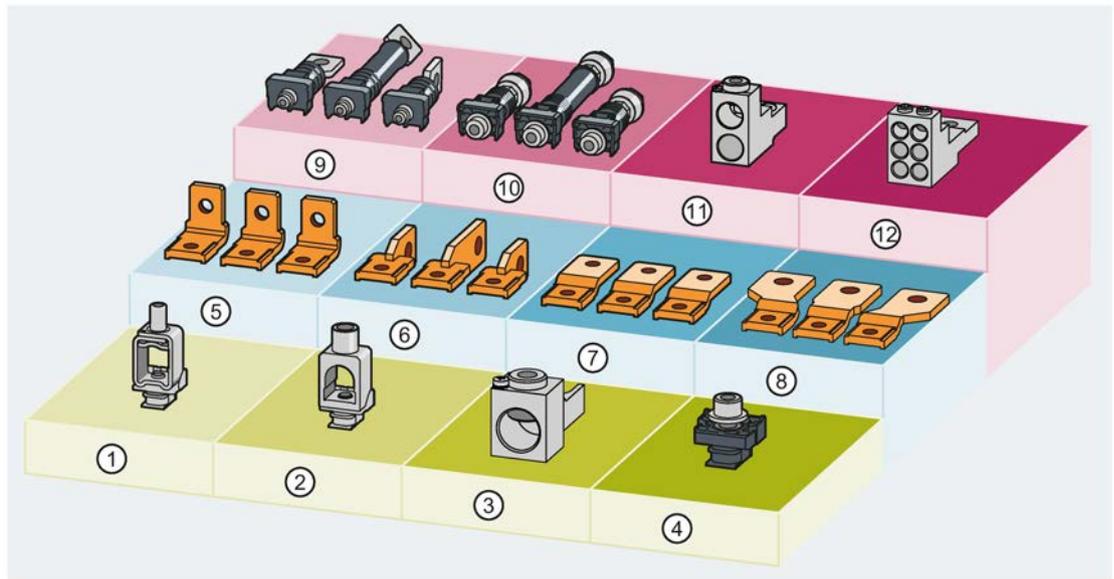
2.2.4 Connection technology

A large selection of connection systems is available for the new series of 3VA molded case circuit breakers.

The supported cable cross-sections are based on the size of the molded case circuit breaker and the cable terminals used. The terminals are fitted either internally or externally to the molded case circuit breaker.

The connection technology is easy to integrate in the new series of 3VA molded case circuit breakers.

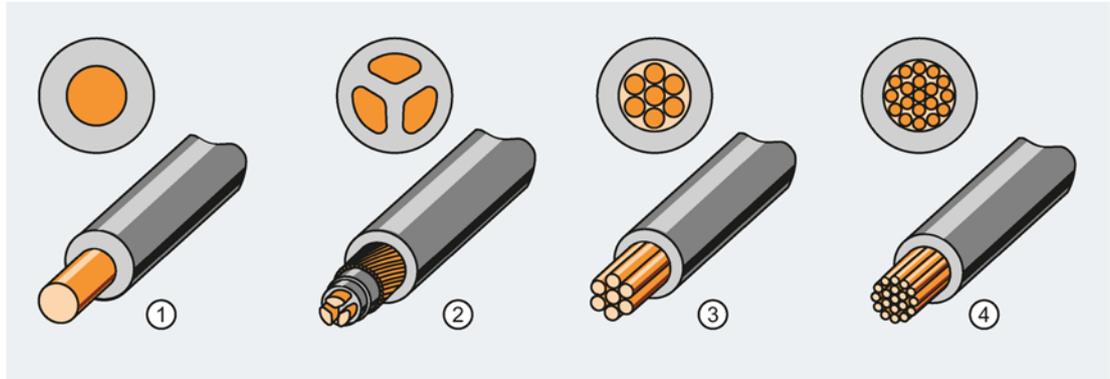
With it you can implement various front and rear main conductor connections for the molded case circuit breakers in all types of installation (fixed-mounted, plug-in and draw-out).



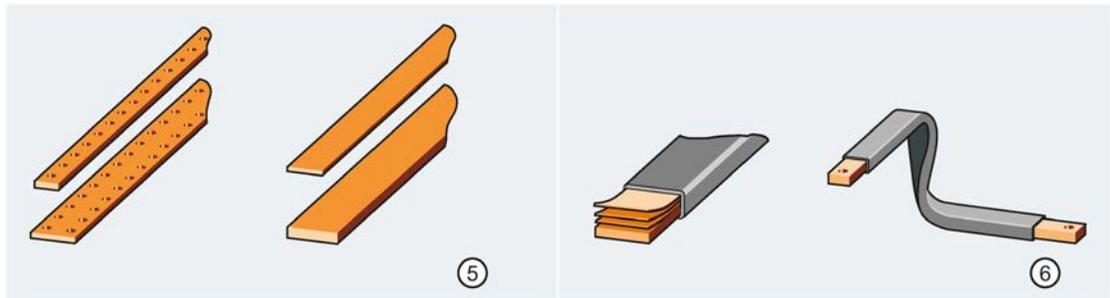
- | | |
|--------------------------------------|--|
| ① Box terminal | ⑦ Front connection bars extended |
| ② Circular conductor terminal | ⑧ Front connection bars broadened |
| ③ Circular conductor terminal, large | ⑨ Rear terminal flat |
| ④ Lug terminal | ⑩ Rear connecting stud |
| ⑤ Lug terminal, right-angled | ⑪ Circular conductor terminal for 2 cables |
| ⑥ Front connection bars edgewise | ⑫ Circular conductor terminal for 6 cables |

Cables and busbars

The new series of 3VA molded case circuit breakers are designed for connection to a variety of different cables and busbars:



- Different cable types, e.g.
 - ① Circular conductor
 - ② Sector-shaped conductor
 - ③ Stranded
 - ④ Finely stranded



- ⑤ Busbars
 - Rigid
 - Laminated or flexible
- ⑥ Laminated copper bar
- Different materials
 - Copper cables
 - Aluminum cables

2.3 Technical details

A summary of the technical features of 3VA molded case circuit breakers can be found in this chapter.

The topics discussed in this chapter are listed below:

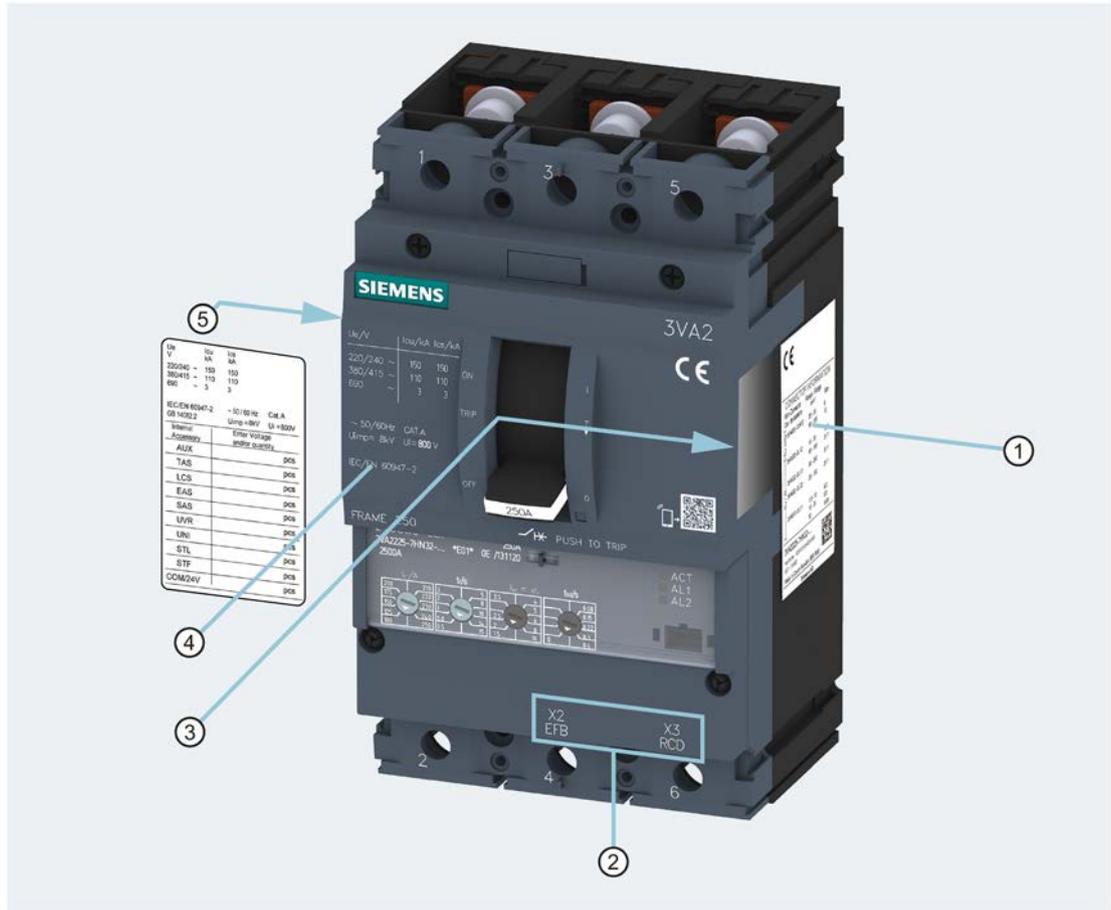
- Circuit breaker identification
- Operation
- Design and components – 3VA1
- Design and components – 3VA2
- Current limitation
- Breaking capacity

2.3.1 Circuit breaker identification

Each 3VA molded case circuit breaker can be clearly identified from various labels and plates attached to the unit.

Circuit breaker labeling

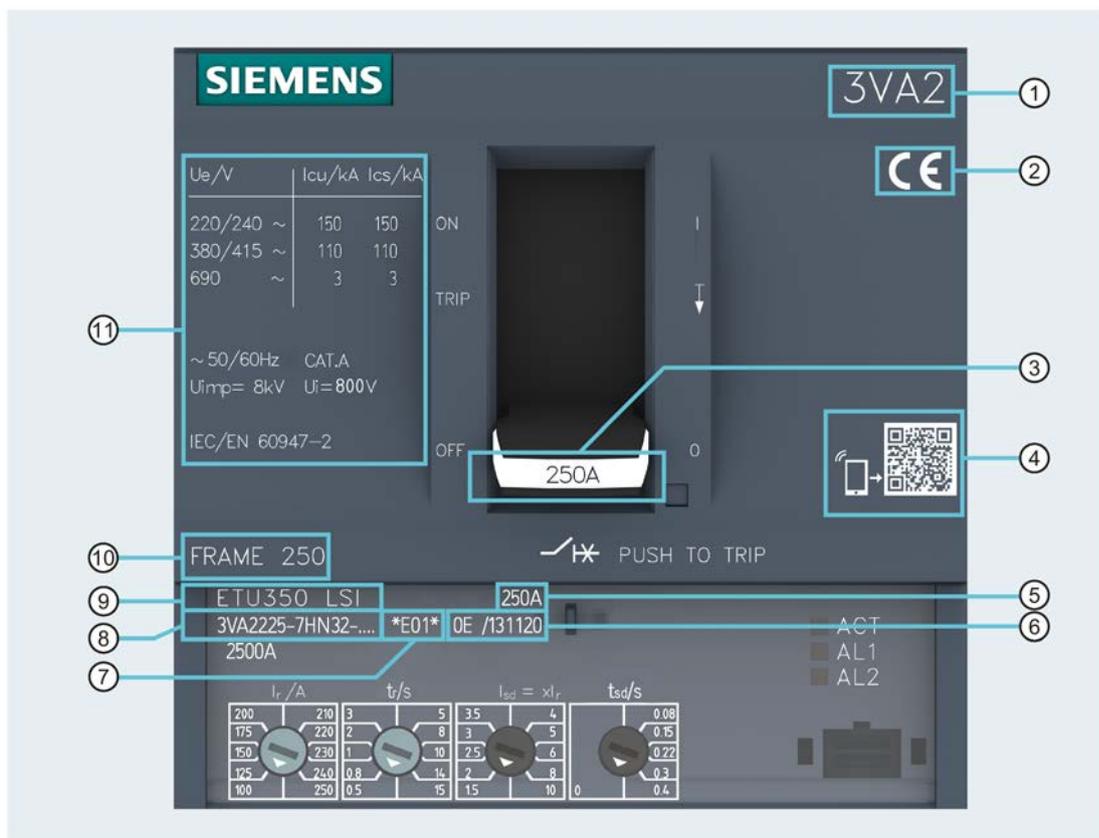
Each 3VA molded case circuit breaker has labels displaying all the important technical information, enabling unique identification:



- ① Connection information label
- ② ETU connection designations
- ③ Label insert (in accessories compartment)
- ④ Key electrical data
- ⑤ Internal accessories label

Front panel: Labeling

The following information is displayed on the front panel of the circuit breaker:



- | | |
|---------------------------------|------------------------------------|
| ① Circuit breaker designation | ⑦ Product version |
| ② Approvals | ⑧ Article number |
| ③ Rated operational current | ⑨ Trip unit type |
| ④ Knowledge Manager (see below) | ⑩ Size and breaking capacity class |
| ⑤ Rated operational current | ⑪ Key electrical data |
| ⑥ Date of manufacture | |

Knowledge Manager

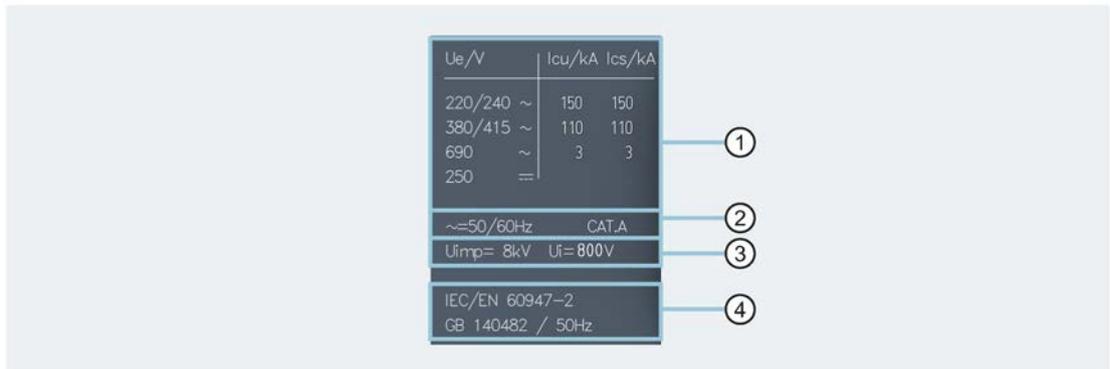
A QR code is attached in a clearly visible location to every 3VA molded case circuit breaker. This code can be scanned with a smartphone or a tablet PC. For the full range of QR code functions, use the "Industry Support" app supplied free of charge by Siemens.

It allows you to directly view or download all relevant product information.



2.3 Technical details

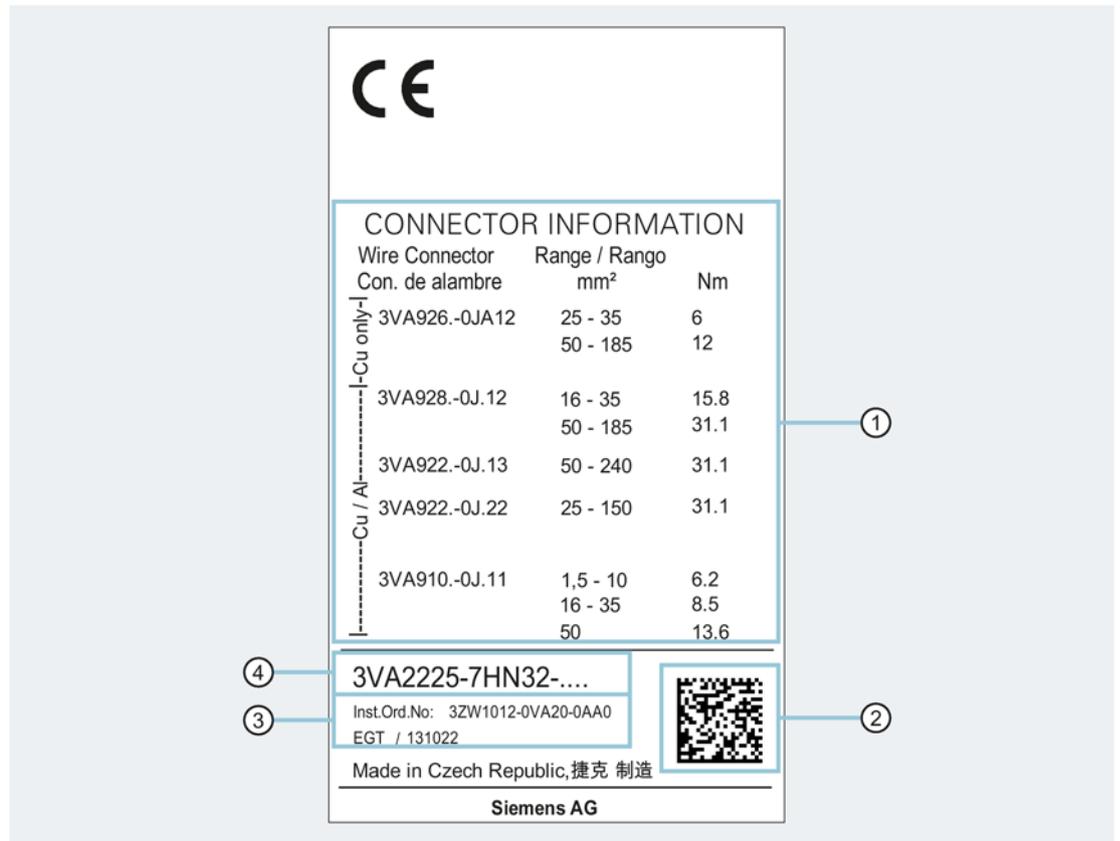
The key electrical data label on the molded case circuit breaker displays the following information:



- ① IEC breaking capacity values at various voltages
- ② Frequency, utilization category
- ③ Insulation data
- ④ Supported standards

Connection information label

The connection information label displays the following information:



① Information about cable connections

② Code for production

③ Article number for operating instructions

④ Article number

Label insert

The label insert can be found in the right-hand accessories compartment. When an accessory (e.g. motor operator or manual operator) is installed on the circuit breaker, this label can be attached to the accessory.

Breaker data		
3VA2225-7HN32-....		
Frame 250C In= 250A		
IEC/EN 60947-2 —/—/—		
Ue	Icu	Ics
V	kA	kA
220/240	~ 150	150
380/415	~ 110	110
690	~ 3	3
Cat. A		
~ = 50/60Hz		
U _{imp} = 8kV		U _i = 800V

The label insert displays the following information:

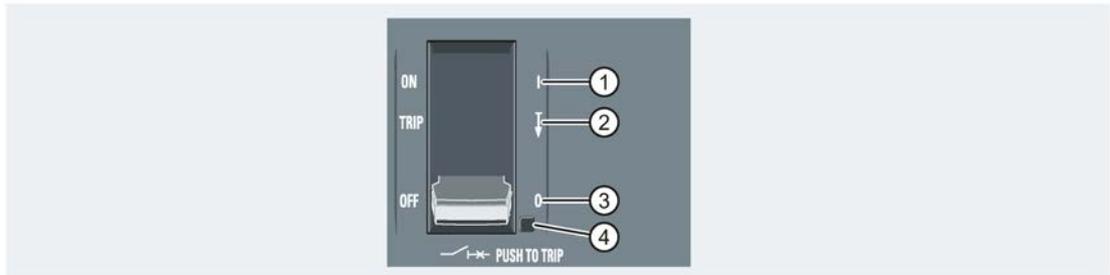
- Information about the molded case circuit breaker
- Article number
- Key electrical data

Internal accessories label

You can make a note of the number of installed accessories on the internal accessories label. This will enable you to ascertain which accessories are installed without removing the lid of the accessories compartment and to use the information, for example, to reorder components.

Ue V	Icu kA	Ics kA
220/240 ~	150	150
380/415 ~	110	110
690 ~	3	3
IEC/EN 60947-2		~ 50 / 60 Hz Cat. A
GB 14082.2		Uimp = 8kV Ui = 800V
Internal Accessory	Enter Voltage and/or quantity	
AUX	pcs	
TAS	pcs	
LCS	pcs	
EAS	pcs	
SAS	pcs	
UVR	pcs	
UNI	pcs	
STL	pcs	
STF	pcs	
COM/24V	pcs	

2.3.2 Operation



- ① ON: Main contacts closed ③ OFF: Main contacts open
 ② TRIP: Switching position following a trip ④ PUSH TO TRIP: Initiates a mechanical trip

The main contacts of the molded case circuit breakers are opened and closed by means of a handle mounted on the front of the unit. All contacts open and close simultaneously on all 3VA molded case circuit breakers in response to the following events:

- The handle is moved from OFF to ON.
- The handle is moved from ON to OFF.
- The tripping mechanism is activated by a trip unit.
- The tripping mechanism is activated by auxiliary releases (e.g. shunt trips, trip units).

Reclosing the circuit breaker contacts from the TRIP position

Follow the steps below to reclose the circuit breaker contacts from the TRIP position:

1. Move the handle to the OFF position.
2. Move the handle to the ON position.
 - The breaker contacts are now closed.

Free tripping

All 3VA molded case circuit breakers have a free tripping capability. This function ensures that the breaker cannot be prevented from tripping even if the operator blocks or is held manually in the ON position or if the breaker is about to close.

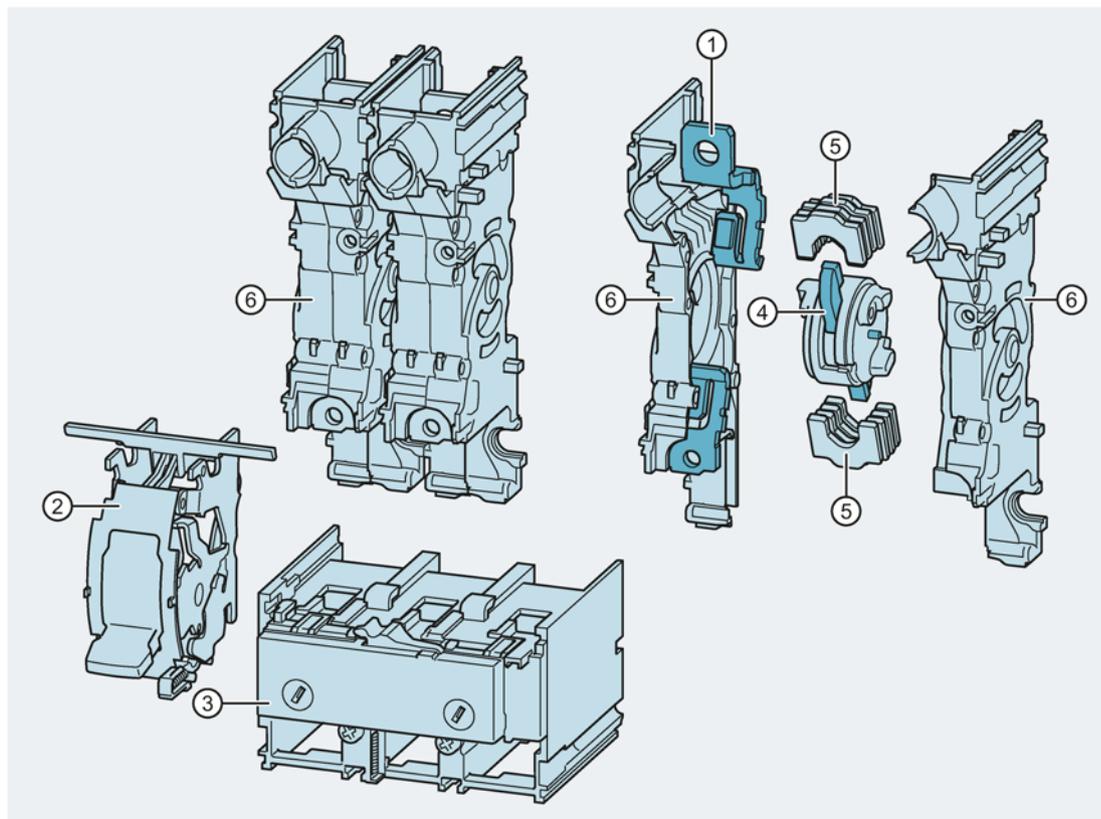
Follow the steps below to test the free tripping function in order to verify that the breaker's mechanical release system is working correctly:

1. Move the handle to the ON position.
2. Hold the handle in the ON position and press the button marked <PUSH TO TRIP>.
 - The circuit breaker trips and opens the main contacts.
 - The handle moves quickly into the TRIP position as soon as you release it.

Failure of the molded case circuit breaker to trip indicates that it is defective and must be replaced.

2.3.3 Design and components - 3VA1

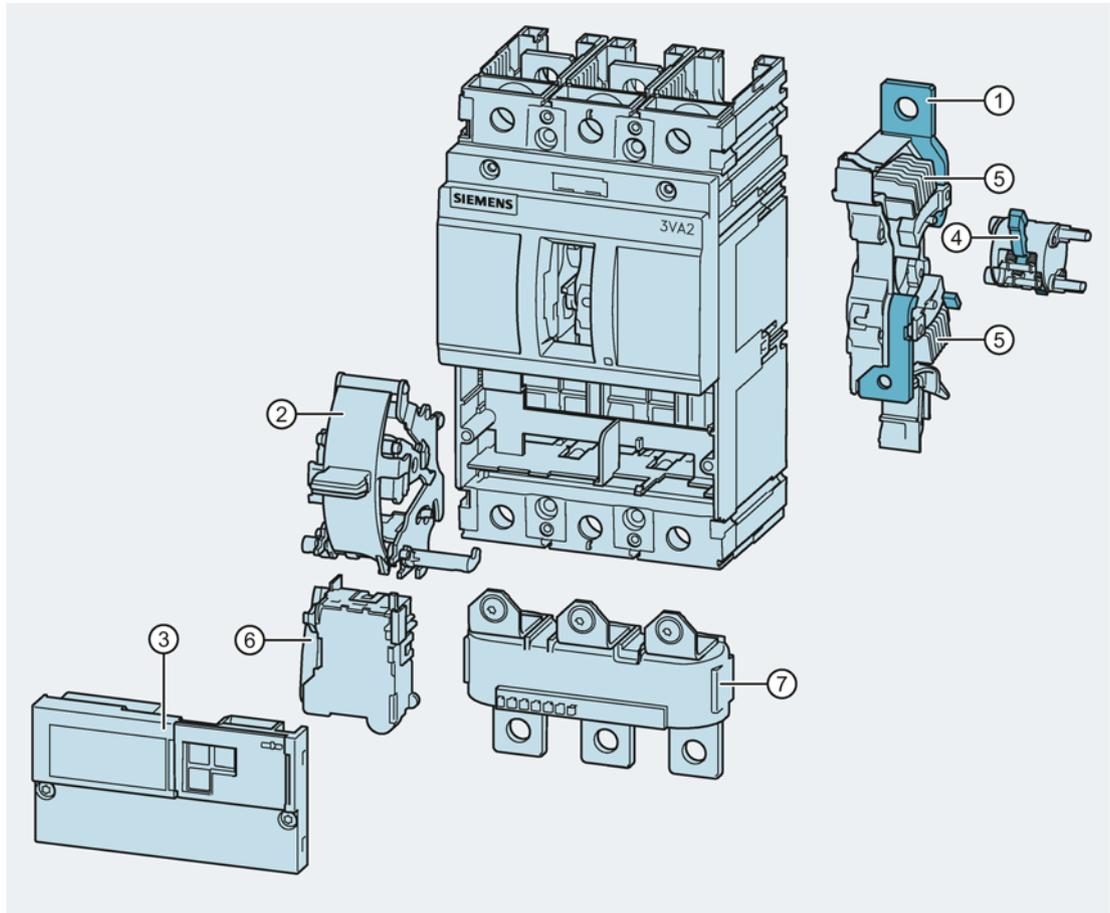
The design of the 3VA1 molded case circuit breaker is illustrated in the diagram below:



- | | |
|---------------------------------|---------------------------|
| ① Main connections | ④ Rotary contact system |
| ② Breaker mechanism with handle | ⑤ Arc plates |
| ③ Trip unit: TMTU | ⑥ Pole cassette enclosure |

2.3.4 Design and components - 3VA2

The design of the 3VA2 molded case circuit breaker is illustrated in the diagram below:



- ① Main connections
- ② Breaker mechanism with handle
- ③ Trip unit: ETU
- ④ Rotary contact system
- ⑤ Arc plates
- ⑥ Maglatch
- ⑦ Current sensor

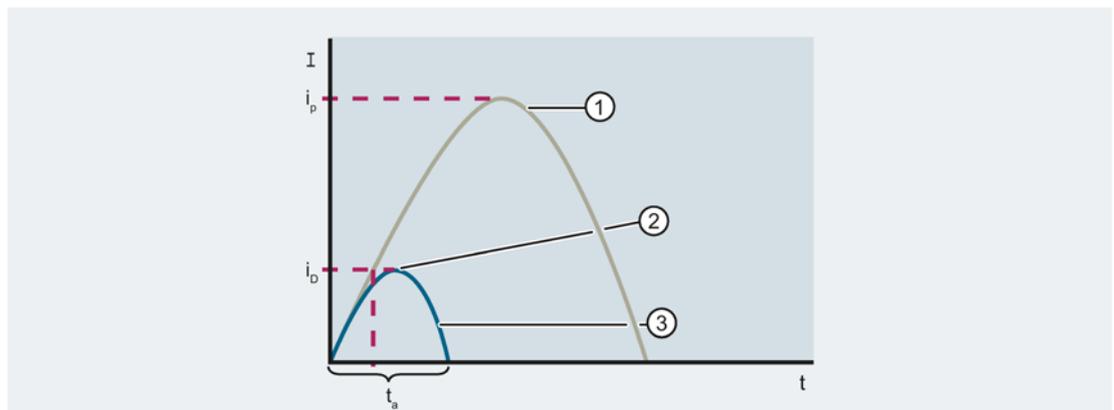
2.3.5 Current limitation

The term "current limitation" refers to the action of limiting the peak value of the prospective impulse short-circuit current i_p to a lower let-through current i_D .

The compact design of the breakers has been made possible by their excellent current limiting capabilities. In the event of a short circuit, the molded case circuit breaker significantly reduces the magnitude of let-through current, i.e. it reduces the current loading of downstream equipment (lower thermal load, fewer dynamic forces). The level of let-through energy is also reduced to a considerable extent.

3VA molded case circuit breakers are designed with a current-limiting capability. IEC EN 60947-2 (VDE 0660-101), section 2.3, page 12, defines current-limiting molded case circuit breakers in the following way:

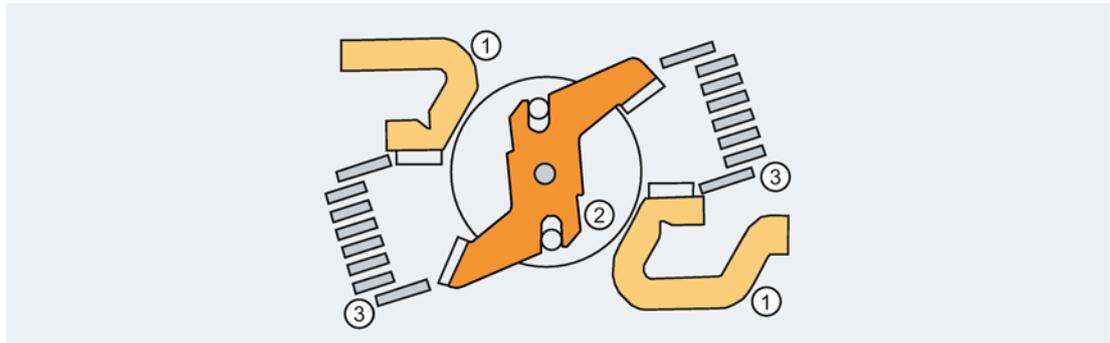
"Circuit breaker that prevents the let-through current from achieving the prospective peak value over a specific current range, and that limits the let-through energy (I^2t) to a value that is lower than the let-through energy of one half-wave of the symmetrical prospective current."



- ① Unlimited current
- ② Peak value of limited current
- ③ Limited current
- i_D Let-through current
- i_p Unlimited impulse short-circuit current
- t_a Break time

Double-rotary contact system

To achieve excellent current limiting, the 3VA molded case circuit breakers are equipped with a double-rotary contact system that opens dynamically on its own above the specified disengaging currents on the principle of magnetic repulsion before the expected peak value of the short-circuit current is reached. These limits have been coordinated and optimized to suit the overall device characteristics. This substantially reduces the thermal and mechanical loading on the molded case circuit breaker and the electrical installation.



- ① Fixed contacts
- ② Rotary contact system
- ③ Arc splitter chute

The switching pole cassettes are optimized for high breaking capacity, and their double-rotary contact system design enables extremely good current limiting thanks to the build-up of peak arc voltage generated at both contacts in the event of a short-circuit. This results in significant limitation of the let-through energy I^2t and the let-through current.

2.3.6 Breaking capacity

The rated ultimate short-circuit breaking capacity I_{cu} is the maximum value of the short-circuit current which the protective device is capable of disconnecting in accordance with regulations. Up to this value, the protective device is also allowed to be used in a network.

The new 3VA molded case circuit breakers are available with identical external dimensions but various breaking capacity classes according to size and rated operational current range.

Switching capacity of the 3VA1 series

Molded case circuit breaker 3VA1 Breaking capacity AC 50/60 Hz		 100 A 3- and 4-pole I_{cu} / I_{cs}			 160 A 1-pole I_{cu} / I_{cs}		 160 A 2-pole I_{cu} / I_{cs}		 160 A 3- and 4-pole I_{cu} / I_{cs}				 250 A 3- and 4-pole I_{cu} / I_{cs}		
		B	N	S	N	S	N	S	N	S	M	H	S	M	H
220 ... 240 V	kA	25 / 25	36 / 36	55 / 55	25 / 25	36 / 36	36 / 36	55 / 55	36 / 36	55 / 55	85 / 85	100 / 100	55 / 55	85 / 85	100 / 100
380 ... 415 V	kA	16 / 16	25 / 25	36 / 36	5 / 5	6 / 6	25 / 25	36 / 36	25 / 25	36 / 36	55 / 55	70 / 70	36 / 36	55 / 55	70 / 70
440 V	kA	8 / 8	16 / 16	25 / 25					16 / 16	25 / 25	36 / 36	55 / 40 ¹⁾	25 / 25	36 / 36	36 / 36
500 V	kA	O. r.	O. r.	O. r.					O. r.	O. r.	O. r.	O. r.	10 / 10	15 / 10	15 / 10
690 V	kA	5 / 5	5 / 5	7 / 5					7 / 5	7 / 5	10 / 5	10 / 5	7 / 5	10 / 5	10 / 5
IT system	V	up to 690			up to 415				up to 690						

O. r. On request

1) I_n 125 A, 160 A: $I_{cu} / I_{cs} = 36 \text{ kA} / 36 \text{ kA}$

Switching capacity of the 3VA2 series

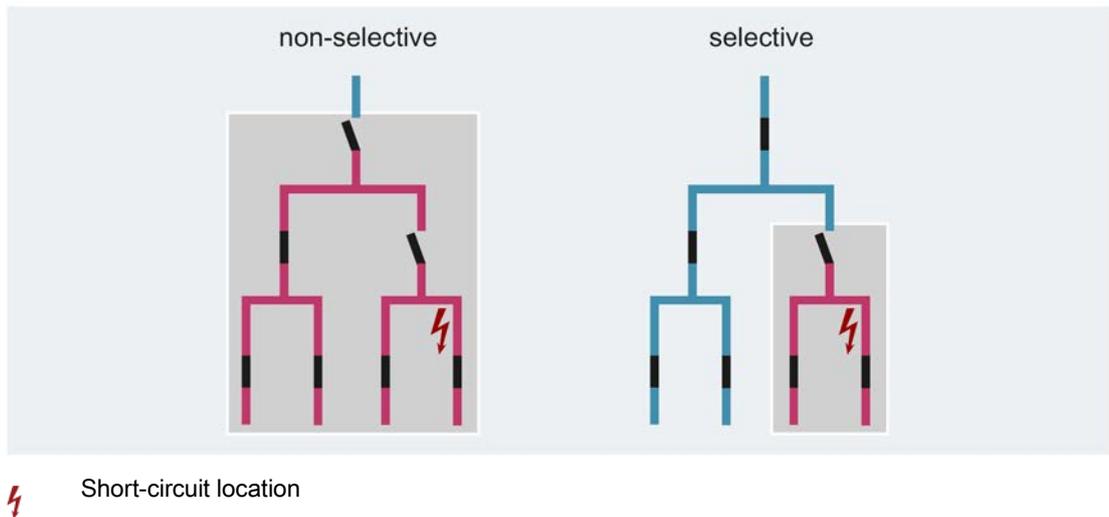
Molded case circuit breaker 3VA2 Breaking capacity AC 50/60 Hz		 100 A 3- and 4-pole I_{cu} / I_{cs}				 160 A 3- and 4-pole I_{cu} / I_{cs}				 250 A 3- and 4-pole I_{cu} / I_{cs}			
		M	H	C	L	M	H	C	L	M	H	C	L
220 ... 240 V / 50 Hz	kA	85 / 85	110 / 110	150 / 150	200 / 200	85 / 85	110 / 110	150 / 150	200 / 200	85 / 85	110 / 110	150 / 150	200 / 200
380 ... 415 V / 50 Hz	kA	55 / 55	85 / 85	110 / 110	150 / 150	55 / 55	85 / 85	110 / 110	150 / 150	55 / 55	85 / 85	110 / 110	150 / 150
440 V / 50 Hz	kA	55 / 55	85 / 85	110 / 110	150 / 150	55 / 55	85 / 85	110 / 110	150 / 150	55 / 55	85 / 85	110 / 110	150 / 150
500 V / 50 Hz	kA	36 / 36	55 / 55	85 / 85	100 / 100	36 / 36	55 / 55	85 / 85	100 / 100	36 / 36	55 / 55	85 / 85	100 / 100
690 V / 50 Hz	kA	2 / 2	2 / 2	2 / 2	24 / 18	2.5 / 2.5	2.5 / 2.5	2.5 / 2.5	24 / 18	3 / 3	3 / 3	3 / 3	24 / 18
IT system	V	up to 690											

Molded case circuit breaker 3VA2 Breaking capacity AC 50/60 Hz		 400 A 3- and 4-pole I_{cu} / I_{cs}				 630 A 3- and 4-pole I_{cu} / I_{cs}			
		M	H	C	L	M	H	C	L
220 ... 240 V	kA	85 / 85	110 / 110	150 / 150	On request	85 / 85	110 / 110	150 / 150	On request
380 ... 415 V	kA	55 / 55	85 / 85	110 / 110	On request	55 / 55	85 / 85	110 / 110	On request
440 V	kA	55 / 55	85 / 85	110 / 110	On request	On request	On request	On request	On request
500 V	kA	36 / 36	55 / 55	85 / 85	On request	On request	On request	On request	On request
690 V	kA	5 / 5	5 / 5	5 / 5	On request	6 / 6	6 / 6	6 / 6	On request
IT system	V	up to 690							

2.4 Selectivity

Switching devices connected in series, e.g. molded case circuit breakers and fuses, work in a coordinated manner to ensure that switching devices are tripped successively. The closest, upstream switching device before the location of the short-circuit must trip. The other switching devices on the same current run do not trip. The purpose of selectivity is to minimize the effects of a fault in terms of its duration and the area affected by the fault.

Selectivity is achieved when the circuit breakers are matched to each other by means of selection, configuring and trip settings in such a way that, in the event of a fault, only the breaker closest to the location of the fault trips.



Selective behavior

The selective behavior of molded case circuit breakers is mainly influenced by the following factors:

- Tripping value settings of the trip unit
- Tripping and break times
- Let-through current values
- Modes of switching of the relevant circuit breakers
 - Zero-current interrupter
 - Current limiter

The selective behavior of circuit breakers can be implemented technically by a variety of selectivity concepts:

- Current selectivity

The selectivity can be calculated in the overload range by comparing the time/current characteristics. In the short-circuit range, this comparison leads to values that are too low. The reason for this is that the trip unit behaves differently in the case of short-circuit currents compared to its long-term behavior, e.g. in the case of overload.

If the short-circuit currents differ sufficiently at the installation points of two molded case circuit breakers, the instantaneous short-circuit releases can normally be set such that if a short-circuit occurs behind the downstream circuit breaker, only this downstream breaker trips.

If the short-circuit currents are approximately the same at the installation points of the molded case circuit breakers, the grading of the tripping currents of the short-circuit releases only enables selectivity up to a specific short-circuit current .

This current is referred to as the ultimate selectivity value I_s .

- Time selectivity

Selectivity can be achieved by time selectivity up to the threshold values of the instantaneous short-circuit releases. To achieve this, the upstream circuit breaker requires delayed short-circuit releases, so that in the event of a fault, only the downstream circuit breaker will disconnect the part of the electrical installation affected by the fault from the supply.

Both the tripping delays and the tripping currents of the short-circuit releases are graded.

- Zone-selective interlocking - ZSI

Selective behavior is achieved by installing parallel control cables between the molded case circuit breakers. The electronic trip units then use a fast signal link to determine priorities in the tripping sequence.

Zone Selective Interlocking (ZSI) has been developed by SIEMENS in order to prevent unacceptably long tripping times when several molded case circuit breakers are connected in series.

ZSI enables the tripping delay to be reduced to 50 ms for the circuit breaker upstream from the location of the short circuit.

- Dynamic selectivity

This method is based on evaluation of the arc power which is generated in the arc chute when the contacts open dynamically in response to a short circuit. During this process, a smaller sized downstream molded case circuit breaker converts more energy in the arc chute than the larger, upstream molded case circuit breaker. A selective trip unit evaluates the energy conversion in both molded case circuit breakers. The downstream molded case circuit breaker trips, while the contacts of the upstream circuit breaker close again. Since both molded case circuit breakers perform a current limiting function, the residual current limit imposed in practice is higher than the limiting action specified for the individual molded case circuit breakers.

Full selectivity

There is an increasing demand for full selectivity in order to safeguard continuity of service by power distribution systems. A power system is said to be fully selective if only the protective device located upstream of the fault location when viewed in the direction of energy flow, i.e. from the infeed to the load, trips in the event of a fault.

Full selectivity always refers to the short-circuit current occurring at the installation point.

Partial selectivity

A system is said to be partially selective when selective tripping in response to a system fault is not ensured up to the maximum ultimate short-circuit breaking capacity I_{cu} of the switching devices. Selectivity is then ensured only up to a certain I_s current value (ultimate selectivity value). If the calculated prospective short-circuit current at the location of installation of the downstream protective device is lower than the ultimate selectivity value specified for the switching devices, then it is still possible to describe the system as fully selective.

If the values determined by the short-circuit current calculation (e.g. according to IEC/EN 60909, DIN VDE 0102) at the installation point of the downstream circuit breaker lie below the ultimate selectivity value listed in the respective table for the selected combination, selectivity is assured for all possible short circuits at the installation point.

If the calculated short-circuit current at the installation point is higher than the ultimate selectivity value, selective tripping by the downstream circuit breaker is only assured up to the value listed in the table. A judgment must be made as to whether the value can be considered to be sufficient because the probability of the maximum short-circuit occurring is low, for example. Otherwise, a circuit breaker combination should be chosen whose selectivity limit lies above the maximum short-circuit current.

Selectivity with 3VA2 molded case circuit breakers

Series 3VA2 circuit breakers are designed to deliver excellent selective tripping combined with optimum current limiting and outstanding breaking capacity.

3VA2 molded case circuit breakers have been specifically designed to meet the following requirements:

- System-wide, high selectivity with a rated operational current differential of 1 : 2.5 up to the miniature circuit breaker
- Selectivity in combination with high current limiting and high breaking capacity
- Cost-effective design / configuring of selective power distribution systems

These molded case circuit breaker requirements are achieved in engineering terms as follows:

- Rotary, double-break contact system for highly dynamic opening response
- Coordinated electronic trip units
- Dynamic selectivity

Depending on use of molded case circuit breakers with a rated operational current differential in a ratio of at least 1 : 2.5 and selection of suitable breaking capacity classes, you can achieve selective tripping of the area of the installation directly affected by the fault up to the maximum ultimate short-circuit breaking capacity.

You can find information on selectivity values for 3VA2 molded case circuit breakers on the Internet under the link for 3VA documentation (<http://www.siemens.com/3VA-Documentation>).

Electronic trip units and fast trip units

As a protective device, the molded case circuit breaker is required to clear electrical faults in the system. For this purpose, series 3VA2 circuit breakers are equipped with intelligent electronic trip units which can be combined with metering functions.

The tripping characteristic of the electronic trip units can be finely and flexibly adjusted. In the event of short circuits, a fast trip unit also responds according to the arc power from the arc chute. This selective trip unit ensures that major short circuits are cleared more quickly, while at the same time ensuring that medium short circuits are interrupted selectively.

2.5 Standards and guidelines

All the standards and guidelines with which 3VA molded case circuit breakers comply are summarized in this chapter.

The topics discussed in this chapter are listed below:

- Compliance with standards
- Electromagnetic compatibility
- Ambient conditions
- Degrees of protection

2.5.1 Compliance with standards

The standards fulfilled by the 3VA molded case circuit breakers include:

- IEC / EN 60947-1
- IEC / EN 60947-2
- IEC / EN 60947-2, Annexes B, H and M
- IEC / EN 60947-3
- IEC / EN 60947-6-1

2.5.2 Electromagnetic compatibility

The 3VA molded case circuit breakers meet the requirements of the following standards:

- CISPR11, Class A and Class B
- IEC / EN 60947-1, Appendix S
- IEC / EN 60947-2, Appendices B, F, J and N

The 3VA molded case circuit breakers are adequately resistant to the following factors:

- Electrostatic charge
- Electrostatic discharge
- Electromagnetic waves, e.g. from transmission systems, mobile phones, radio telephone sets and radar systems
- Overvoltage, e.g. caused by lightning
- Voltage surges

2.5.3 Certificates

You can find information on the available certification (CE, UL, CSA, FM, marine approvals) on the Internet (<http://support.automation.siemens.com/WW/view/en/54137334/134200>).

In the Entry List you can use the certificate type (general product approval, explosion protection, test certificates, shipbuilding, etc.) as a filter criterion.

2.5.4 Ambient conditions

Pollution degree

Operation of the 3VA1 and 3VA2 molded case circuit breakers is approved in accordance with IEC / EN 60947-1 and IEC / EN 60664-1 for pollution degree 3.

Ambient temperature

3VA molded case circuit breakers are used at ambient temperatures from -25 °C to +70 °C. Derating (reduction in rated operational current) is required at temperatures above +50 °C. You will find more information on the applicable derating factors in chapter Derating and temperature compensation (Page 489).

The permissible storage temperature in original Siemens packaging lies between -25 °C and +80 °C.

Special climatic requirements

3VA molded case circuit breakers including their accessories can also be used in challenging operating environments.

Harsh conditions of storage, transportation and stationary use

The molded case circuit breakers have been tested according to the relevant special test procedures defined in IEC / EN 60947-1, Appendix Q for **Class E** applications.

This class covers the areas MC3 + CC2 + SC1:

- Ambient temperature
- Humidity
- Vibration environment
- Shock environment

These ambient conditions can be referred to as "Open deck, damp and cold atmosphere without salt spray" or "Difficult, non-marine conditions".

The following standards-related criteria are complied with:

- IEC / EN 60068-2-2 "Bd" and IEC / EN 60068-2-1 "Ab":
Temperature range: -25 °C ... +70 °C
- IEC / EN 60068-2-30 "Db"
Humid heat up to +55 °C and air humidity up to 95 %
- IEC / EN 60068-2-6 "Fc"
Vibration test
- IEC / EN 60068-2-27 "Ea"
Shock resistance test

Between the tests of compliance with the standards and at the end of the tests, the usability of the devices is assured with the "Verification of operation characteristics".

Vibration resistance and shock resistance

3VA molded case circuit breakers are insensitive to vibrations and meet the requirements relating to mechanical and electromechanical vibration strength according to IEC / EN 60068 and the specifications of the shipbuilding societies.

The circuit breakers resist impacts of up to 10 g and are tested to withstand without damage their operating conditions with shock impact according to IEC / EN 60068-2 27 "Ea" with 150 m/s² / 11 ms.

Installation altitudes

When 3VA1 and 3VA2 molded case circuit breakers are used at up to 2000 m above sea level, the rated data will not change.

An installation altitude above 2000 m can lead to higher temperatures at the switching devices. The lower density of air can significantly reduce heat dissipation,

making it necessary to decrease rated operational voltage, the rated uninterrupted current and the short-circuit values.

Refer to the table below for the calculation factor for determining the key values:

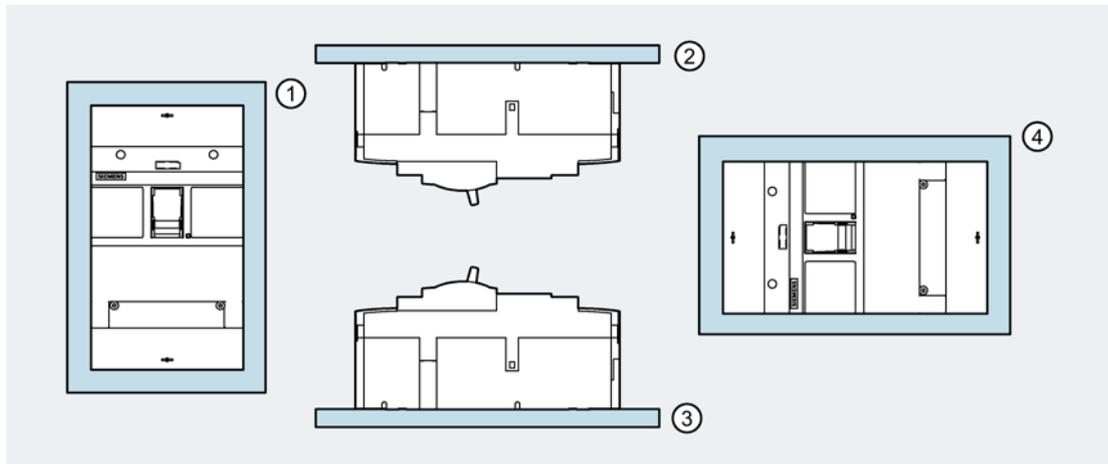
	Altitude			
	2000 m	3000 m	4000 m	5000 m
Breaking capacity I_{cu} / I_{cs}	1.0	0.9	0.8	0.7
Operating voltage U_{max}	1.0	0.9	0.8	0.7
Operating current $I_{max}^{1)}$	1.00	0.96	0.92	0.88
Setting current $I_r^{2)}$	1.00	1.02	1.04	1.06

1) At maximum ambient temperature +50 °C

2) Thermal-magnetic trip units only

2.5.5 Permissible mounting positions

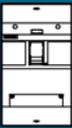
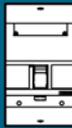
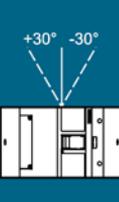
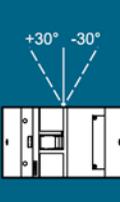
The permissible mounting positions for 3VA molded case circuit breakers are illustrated below:



- ① Vertical wall mounting
- ② Ceiling mounting
- ③ Floor mounting
- ④ Laterally rotated wall mounting

Further mounting positions, and mounting positions with accessories

The following table shows the possible variations on the mounting positions, as well as mounting positions with accessories:

	Wall mounting				Ceiling mounting	Floor mounting
	vertical upright	horizontal right	horizontal left	vertical rotated	suspended	recumbent
						
						
3VA1 molded case circuit breakers						
Basic circuit breaker (with internal accessories)	■	■	■	■	■	■
On DIN rail (with internal accessories)	■	■	■	■		■
3VA2 molded case circuit breakers						
Basic circuit breaker (with internal accessories)	■	■	■	■	■	■
3VA1 molded case circuit breaker (3 and 4-pole) and 3VA2 with accessories						
Connecting and interlocking	■	■	■	■	■	■
Plug-in and draw-out technology	■	■	■			
MO320 motor operator	■	■	■		up to 250 A	■
MO320 motor operator and plug-in/draw-out technology	■	■	■			■
Front mounted rotary operator	■	■	■	■	■	■
Door mounted rotary operator	■	■	■	■	■	■
Side wall mounted rotary operator	■	■	■	■	■	■
Side mounted RCD (RCD310, RCD510)	■	■	■	■	■	■
Loadside RCD basic type A (RCD320, RCD520)	■	■	■	■	■	■
Loadside RCD advanced type A (RCD820)	■	■	■	■	■	■
Modular RCD type A (MRCD)	■	■	■	■	■	■
3-pole on 60 mm busbar system (with internal accessories)	■					

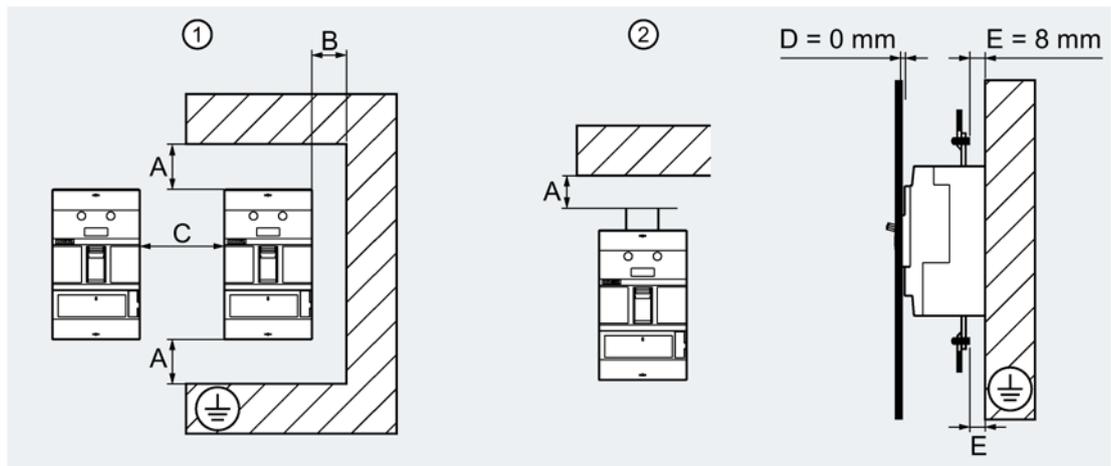
2.5.6 Safety clearances

During a short-circuit interruption, high temperatures, ionized gases and high pressures occur in and above the arcing chambers of the molded case circuit breaker.

Safety clearances are required to:

- allow pressure distribution
- prevent fire or damage caused by any diffused ionized gases
- prevent a flashover to grounded parts
- prevent arcing or short-circuit currents to live sections.

The following safety clearances apply to 3VA molded case circuit breakers:



- ① Molded case circuit breaker without accessories or with short terminal cover
- ② Molded case circuit breaker with accessories, e.g. phase barrier or long terminal cover
- A Minimum clearance between molded case circuit breaker and current paths (uninsulated and grounded metal), see tables below
- B Minimum clearance between molded case circuit breaker and side walls left / right (uninsulated and grounded metal), see tables below
- C Minimum clearance between two horizontally installed molded case circuit breakers, see tables below;
applicable to fixed-mounted and plug-in versions (see chapter Plug-in and draw-out technology (Page 201))
- D Minimum clearance between molded case circuit breaker and control cabinet door
- E Minimum clearance between live parts of connection system and grounded mounting plate

Minimum clearance for 3VA1 molded case circuit breakers:

3VA1 molded case circuit breakers Rated operational voltage	between devices	Distances [mm]							
		to grounded plate				to insulating material			
		3VA10, 3VA11 100 A, 160 A		3VA12 250 A		3VA10, 3VA11 100 A, 160 A		3VA12 250 A	
C	A	B	A	B	A	B	A	B	
3VA1 molded case circuit breaker or 3VA1 molded case circuit breaker combined with residual current device $U \leq 415 \text{ V}$									
without accessory or with short terminal cover	0	35	10	50	10	35	10	50	10
with short phase barriers (1st third) ¹⁾	0	0	10	5	10	0	10	5	10
with long phase barriers ²⁾	0	0	10	0	10	0	10	0	10
with long terminal cover	0	35	10	35	10	35	10	35	10
3VA1 molded case circuit breaker or 3VA1 molded case circuit breaker combined with residual current device $415 \text{ V} < U \leq 690 \text{ V}$									
with long phase barriers	0	0	10	0	10	0	10	0	10
with long terminal cover	0	35	10	35	10	35	10	35	10

- 1) Can be used for connection methods: box terminal, screw-type terminal, internal circular conductor terminal, and rear terminals
- 2) Can be used for connection methods: circular conductor terminal large, front connection bars extended, and front connection bars broadened

Minimum clearance for 3VA2 molded case circuit breakers:

3VA2 molded case circuit breakers Rated operational voltage	between devices	Distances [mm]											
		to grounded plate						to insulating material					
		3VA20 3VA21 3VA22 100 A 160 A 250 A		3VA23 250 A 400 A		3VA24 400 A 630 A		3VA20 3VA21 3VA22 100 A 160 A 250 A		3VA23 250 A 400 A		3VA24 400 A 630 A	
C	A	B	A	B	A	B	A	B	A	B	A	B	
3VA2 molded case circuit breaker or 3VA2 molded case circuit breaker combined with residual current device $U \leq 525 \text{ V}$													
without accessory or with short terminal cover	0	40	5	50	10	50	20	30	5	40	5	40	5
with short phase barriers (1st third) ¹⁾	0	0	5	0	10	0	20	0	5	0	5	0	5
with long phase barriers ²⁾	0	0	5	0	10	0	20	0	5	0	5	0	5
with long terminal cover	0	25	5	30	5	30	5	25	5	25	5	25	5
3VA2 molded case circuit breaker or 3VA2 molded case circuit breaker combined with residual current device $525 \text{ V} < U \leq 690 \text{ V}$													
with long phase barriers	0	0	20	O. r.	O. r.	O. r.	O. r.	0	5	O. r.	O. r.	O. r.	O. r.
with long terminal cover	0	35	10	O. r.	O. r.	O. r.	O. r.	20	5	O. r.	O. r.	O. r.	O. r.

- 1) Can be used for connection methods: box terminal, screw-type terminal, internal circular conductor terminal, and rear terminals
- 2) Can be used for connection methods: circular conductor terminal large, front connection bars extended, and front connection bars broadened
- O. r. On request

Note

In addition to the clearances stated above, any insulating equipment that might be required must also be considered, see chapter Insulating equipment (Page 191).

It must be ensured that the cable or busbar connection does not reduce the air insulation clearance.

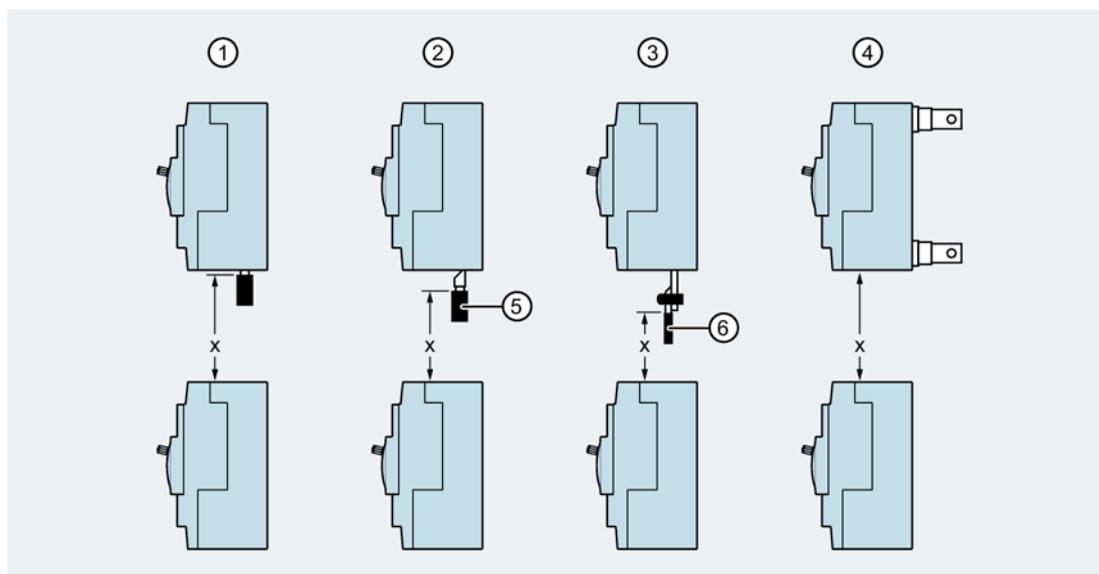
Accessory components can increase the width or height of the molded case circuit breaker. In this case the minimum clearances apply from the corresponding sides of the overall molded case circuit breaker/accessory combination.

NOTICE
Damage to the molded case circuit breaker and the system
Depending on the application, larger minimum clearances may be necessary.
Please observe the specifications regarding air and creepage distances in the applicable overriding guidelines (e.g. IEC 61439).

Safety clearances between molded case circuit breakers

No minimum clearance needs to be observed between the molded case circuit breakers on the longitudinal sides (see table above).

The following safety clearances apply to molded case circuit breakers installed directly on top of each other:



- x See tables below for minimum clearance
- ① Front connection with cable, direct
- ② Front connection with cable lug
- ③ Front connection with flat busbar
- ④ Rear connection with plug-in base or busbar terminals
- ⑤ Insulation of cable
- ⑥ Insulation of busbar

Minimum clearance for 3VA1 molded case circuit breakers:

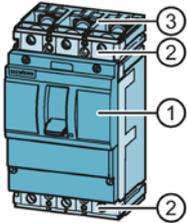
3VA2 molded case circuit breakers	100 A / 160 A x [mm]	250 A x [mm]
Rated operational voltage		
$U \leq 415 \text{ V}$	150	150
$415 \text{ V} < U \leq 690 \text{ V}$	150	150

Minimum clearance for 3VA2 molded case circuit breakers:

3VA2 molded case circuit breakers	100 A / 160 A / 250 A x [mm]	250 A / 400 A x [mm]	400 A / 630 A x [mm]
Rated operational voltage			
$U \leq 525 \text{ V}$	80	100	100
$525 \text{ V} < U \leq 690 \text{ V}$	150	200	100

2.5.7 Degrees of protection

3VA molded case circuit breakers comply with the following degrees of protection as defined by IEC 60529 and IEC 60947-1, Appendix C:

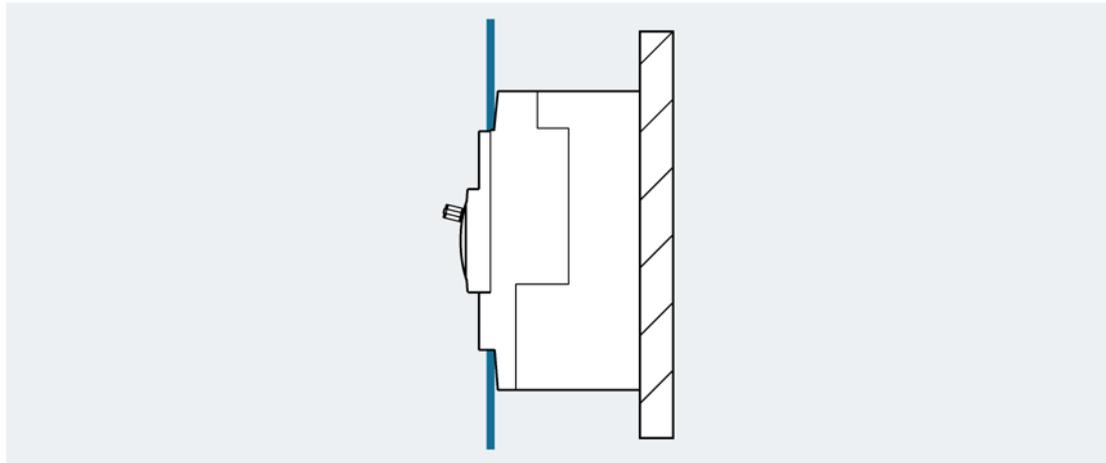


	Accessories cover		Terminal cover	
	Without	With	Without	With
Front panel without termination area ①	–	IP4x		
Front panel termination area ②			IP2x	IP4x
Infeed/load ends ③			IP3x	IP4x

Degree of protection IP40 is achieved when a 3VA molded case circuit breaker is installed in a switchboard with a door cutout including release (see below). The units can be upgraded to comply with higher degrees of protection up to IP65 by installation of the following components:

- Door mounted rotary operator
- Side wall mounted rotary operator

Maximum door cutout IP40:



Handle and release are freely accessible, the control cabinet door closes flush with the molded case circuit breaker.

2.5.8 Environmental protection

The 3VA1 and 3VA2 molded case circuit breakers meet the specifications of the European Environment Guideline 2002 / 95 / EU RoHS directive (Restriction of the use of certain hazardous substances in electrical and electronic equipment). The development and production processes have been devised to have the lowest possible environmental impact.

2.6 Protection system

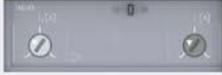
This chapter contains an overview of the protection system of 3VA molded case circuit breakers.

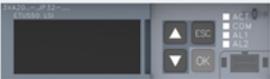
The topics discussed in this chapter are listed below:

- Description of functions
- Overload protection (L)
- Short-time delayed short-circuit protection (S)
- Instantaneous short-circuit protection (I)
- Ground-fault protection (G)
- Neutral conductor protection (N)
- ZSI - Zone Selective Interlocking
- Guide to setting the tripping characteristic

2.6.1 Description of functions

The protection function performed by the molded case circuit breaker in the power distribution network is defined by the choice of trip unit. There are two different types of trip unit, i.e. thermal-magnetic (TMTU) and electronic (ETU):

Protection	Thermal-magnetic TM 2-series	Electronic ETU 3-series
Trip unit	 TM210, TM220, TM240 Line protection	 ETU320, ETU330, ETU350 Line protection
Integrated functions		
Parameterizing	 Setting and reading the parameters in A	 Setting and reading the parameters in A and s
Status display		 Indicating the ETU status via LEDs
Interface		 Interface for test devices
Metering function		
Optional expansions		
		 EFB300 external function box for connecting to the ETU
		 TD300/TD500 test device

Protection	Electronic with display ETU 5-series	Electronic with display and metering function ETU 8-series
Trip unit	 ETU550, ETU560 Line protection	 ETU850, ETU860 Line protection
Integrated functions		
Parameterizing	 - Setting and reading the parameters via display and communication - Fine setting of the parameters - Reading the measured values	 - Setting and reading the parameters via display and communication - Fine setting of the parameters - Reading the measured values
Status display	 Indicating the ETU status via LEDs	 Indicating the ETU status via LEDs
Interface	 Interface for test devices	 Interface for test devices
Metering function		Metering function integrated
Optional expansions		
	 24 V module for continuous power supply (also without primary current through the molded case circuit breaker)	 24 V module for continuous power supply (also without primary current through the molded case circuit breaker)
	 EFB300 external function box for connecting to the ETU	 EFB300 external function box for connecting to the ETU
	 COM060 communication module	 COM060 communication module
	 COM800/COM100 breaker data server Interface to - PROFIBUS - PROFINET - Modbus RTU - Ethernet (Modbus TCP)	 COM800/COM100 breaker data server Interface to - PROFIBUS - PROFINET - Modbus RTU - Ethernet (Modbus TCP)
	 DSP800 external display for installing in the cubicle door	 DSP800 external display for installing in the cubicle door
	 TD300/TD500 test device	 TD300/TD500 test device

2.6.2 Characteristic curves

To design a low-voltage switchboard in accordance with the valid rules, the system planner needs to dimension the protection settings of the molded case circuit breakers.

The settings selected for the trip unit of a molded case circuit breaker depend on the type of equipment to be protected, e.g. switchboard and applications.

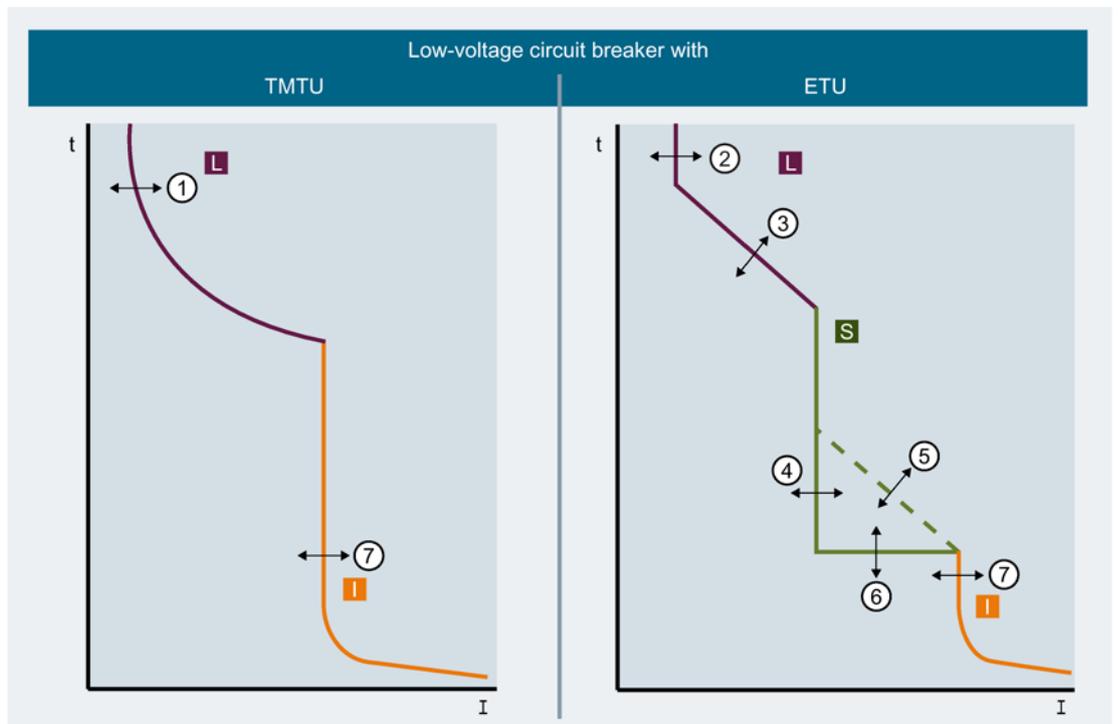
Tripping characteristics up to a tripping time of ≥ 1 ms are represented graphically. In order to ease the coordination of different protection devices, the current is specified as a multiple of the current setting value and the time is specified in seconds.

Tripping characteristics for thermal-magnetic trip units

Characteristics are displayed graphically in the double-log coordinate system (cf. IEC 60947-2, paragraph 4.7.4 and IEC 60269-1). The current : time ratio is 2 : 1.

Tripping characteristics for electronic trip units

Characteristics are displayed graphically in the double-log coordinate system (cf. IEC 60269-1). The current : time ratio is 1 : 1.



- | | |
|---|--|
| ① Response threshold of the long-time delayed protection, thermal | ⑥ Delay of the short-time delayed protection |
| ② Response threshold of the long-time delayed protection | ⑦ Response threshold of the instantaneous protection |
| ③ Delay of the long-time delayed protection | L Overload range |
| ④ Response threshold of the short-time delayed protection | S Short-time delayed short-circuit current range |
| ⑤ I^2t characteristic ON/OFF of the short-time delayed protection | I Instantaneous short-circuit current range |

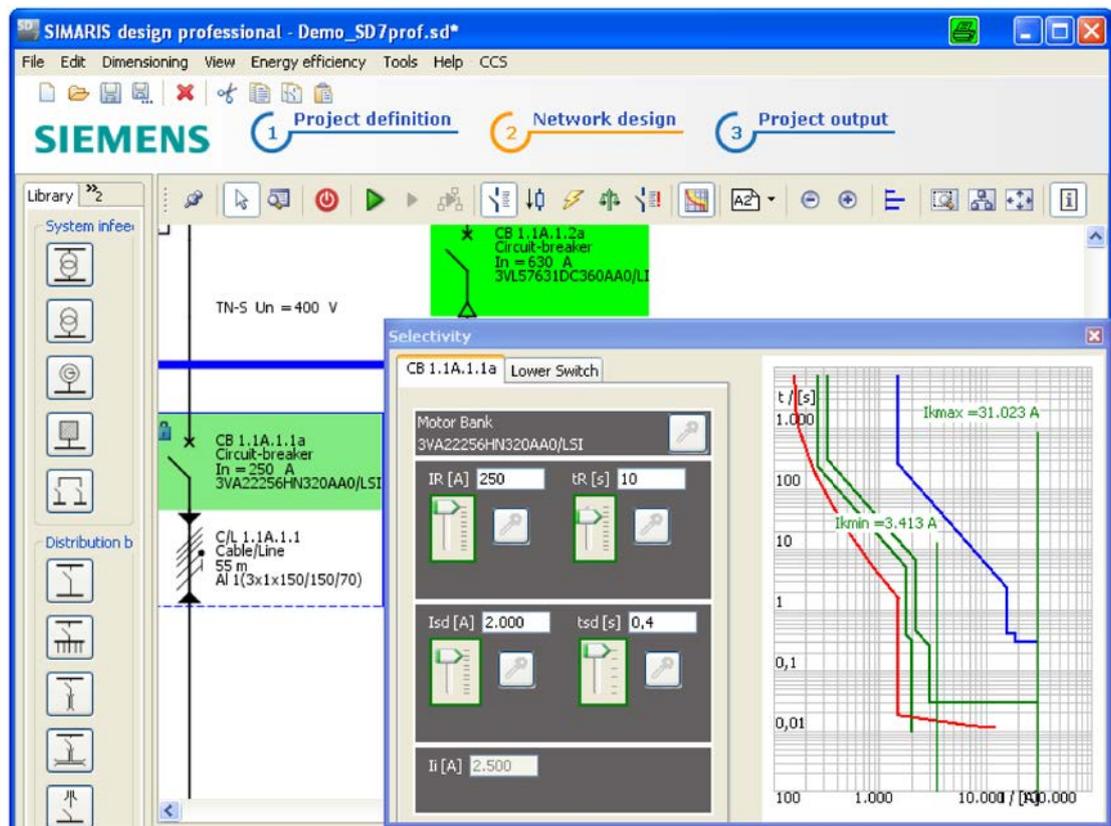
2.6.3 Guide to setting the tripping characteristic

Supplementary conditions

The settings selected for the trip unit of a molded case circuit breaker depend on the technical environment (e.g. switchboard and applications) and the type of equipment to be protected. The task of calculating and dimensioning the protection settings in accordance with the valid rules is the responsibility of the system planner.

SIMARIS design

The Siemens SIMARIS design software tool is a fast, simple and reliable tool for calculating and dimensioning networks in accordance with the valid rules:



For further information about SIMARIS design, please visit:

<http://www.siemens.com/simaris>

Basic rules for setting different trip parameters

Parameter	Buttons	Effect on characteristic curve	Brief description	Cause	Example
L	I_r/A 		Operating current of overload protection: ETU $I_r = 0.4 \dots 1 \times I_n$ TMTU $I_r = 0.7 \dots 1 \times I_n$ Absolute values in A	Optimization of the overload range by setting to the operational current of the circuit to be protected	Overload range from 300 A
	t_r/s 		Delay time (or time-lag class) in the overload range. The set time is the tripping time at $6 \times I_r$	Improved selectivity in the overload range in switchboards with several grade levels	The tripping time $t_r = 10$ s applies to $6 \times I_r$, in this case $6 \times 300 \text{ A} = 1800 \text{ A}$
S	$I_{sd} = x I_r/A$ 		Operating current of the short-time delayed short-circuit protection	Limitation of the short-circuit range in which the current has to be interrupted more quickly but possibly with a slight time delay	At $I_r = 300 \text{ A}$ and $I_{sd} = 5$: Tripping at 1500 A following delay t_{sd}
	t_{sd}/s 		Delay time of the short-time delayed short-circuit protection	Improved selectivity in the overload range in switchboards with several grade levels	$t_{sd} = 0.15$ s: Tripping after 0.15 s for current values between I_r and I_{sd}
I	I_i/A 		Operating current of the instantaneous short-circuit protection	Limitation of the short-circuit range in which the impermissibly high current has to be interrupted as quickly as possible	At $I_i = 2000 \text{ A}$: instantaneous tripping at currents $> 2000 \text{ A}$
N	$I_N = x I_r$ 		Operating current of the neutral conductor protection function	Protection of the neutral conductor for overcurrent and short-circuit	At $I_N = \text{ON}$, $I_N = 0.5 \times I_r$ and $I_r = 300 \text{ A}$, overload from 150 A in the neutral conductor, instantaneous tripping at 2000 A
G	$t_g = 0,1 \text{ s}$ $t_g = 0,3 \text{ s}$ 		Operating current of the ground-fault protection function and delay time to tripping	Line protection	At ground-fault currents from $I_g = 50 \text{ A}$: Tripping after time $t_g = 0.1 \text{ s}$

Setting the parameters for trip units ETU 5-series and 8-series

ETU 5-series and 8-series are equipped with an LCD.

Parameter settings can be adjusted via this LCD, values are input by means of buttons. The powerconfig software can also be used to input parameter settings. The TD500 test device and the COM800/COM100 breaker data server combined with the COM060 communication module can be used as the software interface.

2.6.4 Overload protection (L)

The ID letter for overload protection is L (stands for "Long-time delay").

The trip unit is inverse-time delayed and exhibits the following characteristics depending on the trip unit type:

- Bimetal characteristic with thermal-magnetic trip units
- I^2t characteristic with electronic trip units

The letters I_r refer to the current setting value, and t_r to the associated time delay.

The time delay with the device-specific reference point defines the current-dependent curve shape of the setpoint characteristic. With 3VA molded case circuit breakers, this trip unit reference point corresponds to 6 times the current setting value I_r . The following mathematical equation determines the remaining curve of the setpoint characteristic:

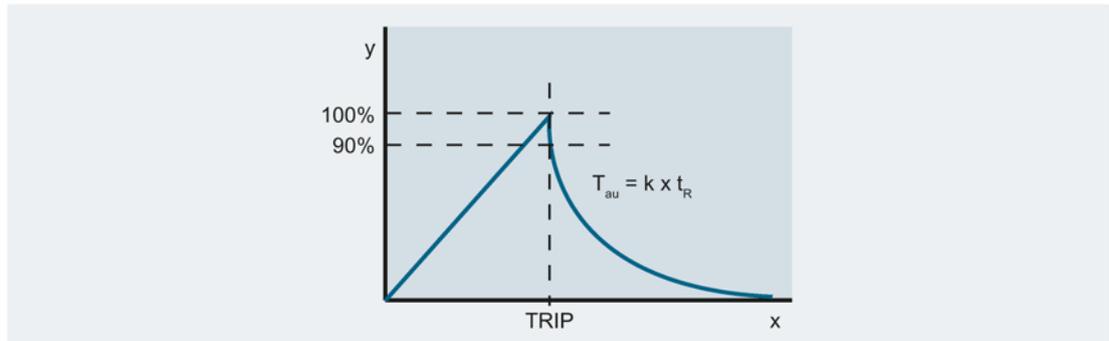
$$I^2t = \text{constant}$$

Thermal image

The electronic trip units feature a thermal image function that can be deactivated on some electronic trip units.

Thermal image activated (ON)

If the thermal image is activated, the previous thermal history is taken into account. After tripping, the thermal memories of the phases are set to a value corresponding to 85 % of the thermal equivalent of the warmest phase. This setting allows reclosure of the contacts of the molded case circuit breaker. This is followed by a cool-down period according to an exponential function with a time constant T_{au} (τ).



Thermal image deactivated (OFF)

The thermal image for ETU 5-series and 8-series can be deactivated to allow use of the TD500 test device for characteristic curve tests. The thermal image must remain activated in normal operation. When the image is deactivated, the thermal prehistory of the circuit breaker, the cables/busbars, other components of the lower-level power distribution system or an end consumer is ignored.

It is the responsibility of the commissioning engineer/operator to provide additional thermal overload protection for the lower-level power distribution system while the thermal image is deactivated.

2.6.5 Short-time delayed short-circuit protection (S)

The ID letter for short-time delayed short-circuit protection is "S" (stands for "Short-time delay"). The S function of the trip unit can be used to implement time-selective short-circuit tripping in low-voltage networks in which multiple molded case circuit breakers are installed in series.

The short-time delayed short-circuit protection function protects phases L1 to L3 and the neutral conductor. The protection function responds if the current in at least one phase exceeds the set tripping current I_{sd} for the set delay period t_{sd} .

The S release operates according to a characteristic with a current-dependent curve I^2t . The electronic trip units ETU 5-series and 8-series can be optionally switched over to a current-independent tripping characteristic.

2.6.6 Instantaneous short-circuit protection (I)

The ID letter for instantaneous short-circuit protection is "I" (stands for "Instantaneous").

This short-circuit protection function protects phases L1 to L3. The instantaneous short-circuit protection function responds if the instantaneous value equal to the rms of the current in at least one phase exceeds the instantaneous tripping current I_i .

2.6.7 Ground-fault protection (G)

The ID letter for ground-fault protection is "G" (ground fault).

The G protection detects residual currents between phases and grounded, electrically conductive parts. The ground-fault protection function responds if the ground fault current exceeds the set tripping current I_g for the set delay period t_g .

Ground-fault protection can be implemented as a current-independent and a current-dependent function (I^2t).

On 4-pole molded case circuit breakers and 3-pole molded case circuit breakers with external current transformer for N conductor, the G protection calculates the vector sum of the currents of the three phases and the neutral conductor. The G release trips the breaker or an alarm is issued via the communication system if the rms value of this vector sum exceeds the set trip value I_g for the duration of the set delay t_g .

2.6.8 Neutral conductor protection (N)

The ID letter for neutral conductor protection is "N".

The neutral conductor protection system protects the neutral conductor against overloads and short circuits.

The letters I_N refer to the current setting value; the associated setting time is identical to t_r .

Note

A neutral conductor with full cross sectional area (distributed neutral conductor of the same size as the phases) is normally protected by the phase protection system and does not require separate protection.

Neutral conductor protection

Neutral conductor protection must be implemented in accordance with the standards valid in the country of installation. Possible reasons for implementing neutral conductor overload protection are:

- The neutral conductor has a smaller cross section than the phase conductors.
- Harmonic levels in the installation are expected to be higher than normal.
- A large number of loads, or predominantly single-phase loads, will be connected.
- The neutral conductor will be isolated for functional reasons, e.g. because there are several voltage sources.
- The neutral conductor will be isolated for safety reasons, e.g. because work is in progress on disconnected units

Neutral conductor protection and 3VA2 molded case circuit breakers

The following versions of 3VA2 molded case circuit breaker have neutral conductor protection:

- All 3-pole versions with external current transformer for N conductor
- All 4-pole versions

Oversized neutral conductor protection can be implemented in combination with the electronic trip units ETU 5-series and 8-series. This might be necessary to provide protection against third-order harmonics and multiples thereof.

3VA2	Options	Neutral conductor protection	ETU 3-series	ETU 5-series	ETU 8-series
3-pole molded case circuit breaker	3-pole, 3 phases monitored	None	■		
3-pole molded case circuit breaker with external transformer for neutral conductor	3-pole, 3 phases monitored	None		■	■
	3-pole, 3 phases monitored + N (20% ¹⁾ ... 100% I _n)	Protection for user-defined cross section of neutral conductor		■	■
	3-pole, 3 phases monitored + N (100% ... 160% I _n)	Oversized neutral conductor		■	■
4-pole molded case circuit breaker	4-pole, 3 phases monitored	None	■	■	■
	4-pole, 3 phases monitored + N (50% I _r ²⁾)	Protection for half cross section of neutral conductor	■		
	4-pole, 4 phases monitored	Protection for full cross section of neutral conductor	■		
	4-pole, 3 phases monitored + N (20% ¹⁾ ... 100% I _n)	Protection for user-defined cross section of neutral conductor		■	■
	4-pole, 4 phases monitored + N (100% ... 160% I _n)	Oversized neutral conductor			■ ³⁾

N Neutral conductor protection

1) At rated operational currents $I_n \leq 63$ A: $I_N = 40\% \dots 100\% I_n$

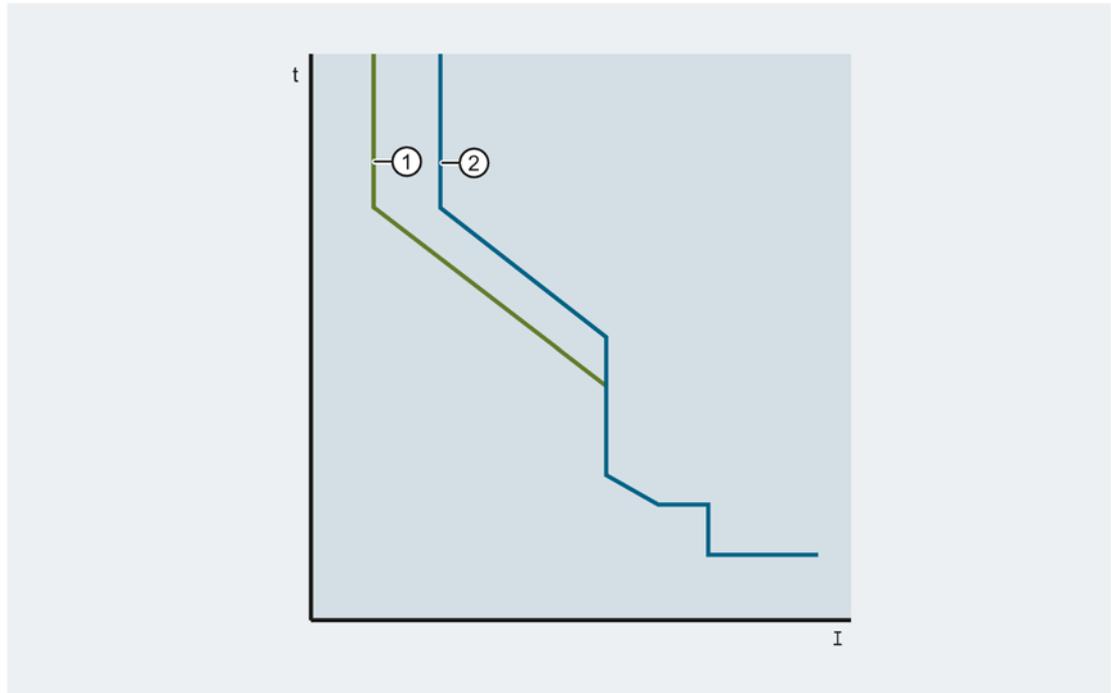
2) Applies to $I_n > 63$ A

3) Dependent on circuit breaker size and rated operational current

Parameters of the neutral conductor protection function

- Tripping current I_N :
Adjustable as a proportion of the current setting (I_r) for overload protection
- Tripping delay:
Corresponds to the delay setting (t_r) for overload protection
- Tripping current of the short-time delayed short-circuit protection:
Corresponds to the short-time delayed short-circuit protection (I_{sd})
- Tripping delay:
Corresponds to the delay setting for short-time delayed short-circuit protection (t_{sd})
- Instantaneous short-circuit protection:
Corresponds to the tripping current (I_i) for instantaneous short-circuit protection

Example of a neutral conductor protection characteristic



- ① Response threshold of the neutral conductor protection
- ② Response threshold of the long-time delayed protection

Adjustment of neutral conductor protection settings

The tripping current I_N can be adjusted:

- for ETU 3-series trip units via setting buttons
- for ETU 5-series and 8-series trip units
 - via the buttons on the ETU display
 - via a PC using powerconfig

2.6.9 Zone-selective interlocking ZSI

The microprocessor-controlled, zone-selective interlocking function has been developed in order to control the total breaking time in low-voltage networks with multiple molded case circuit breakers connected in series.

Regardless of the number of series-connected molded case circuit breakers, all short circuits in the network can be cleared within a maximum time period of 50 ms.

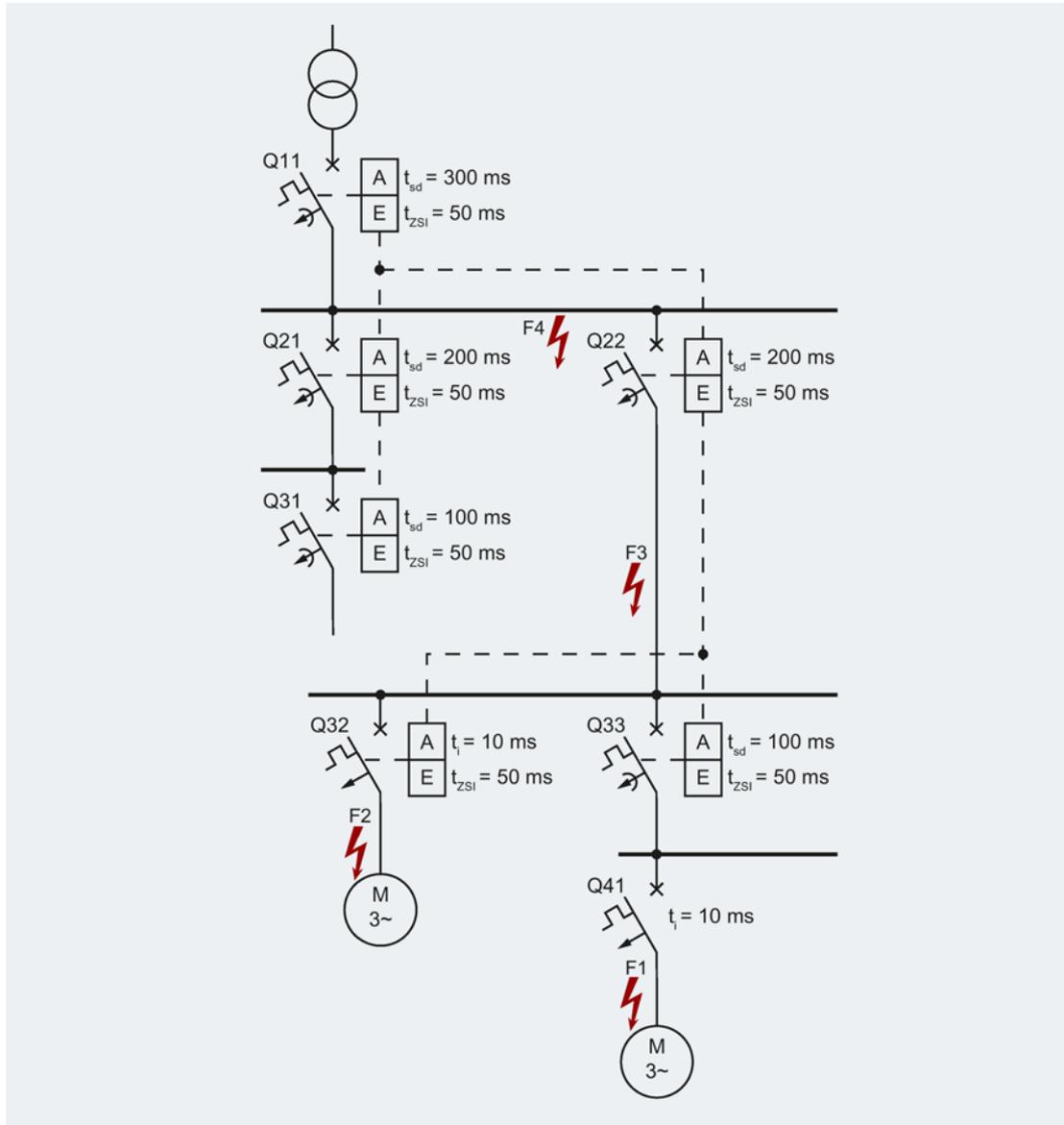
Note

Downward compatibility

The ZSI function of 3VA molded case circuit breakers is compatible with the ZSI functions of Siemens 3VL molded case circuit breakers and 3WL air circuit breakers.

Operating principle

The diagram below demonstrates the operating principle of zone-selective interlocking:



- | | | | |
|-----|---------------------------------------|-----------|--|
| --- | Communication cable | t_i | "Virtual" tripping time of I protection |
| A | Output, transmits the blocking signal | t_{SD} | Delay time setting of S protection |
| E | Input, receives the blocking signal | t_{ZSI} | Delay time of all molded case circuit breakers which detect the short circuit but do not receive a blocking signal when ZSI is activated |

The ZSI function acts on the S and G ranges of the tripping characteristic. Currents within the I range (instantaneous short circuit) continue to cause instantaneous tripping.

Fault 1

If the short-circuit current is sufficiently large, the trip units of molded case circuit breakers Q41, Q33, Q22 and Q11 are activated. Since Q41 clears the fault within $t_i = 10$ ms, none of the other molded case circuit breakers trips even though Q41 has no ZSI and cannot therefore transmit a blocking signal to Q33.

Fault 2

If the short-circuit current is sufficiently large, the trip units of molded case circuit breakers Q32, Q22 and Q11 are activated. As a result of the ZSI function, Q32 temporarily blocks Q22 which in turn temporarily blocks Q11. Depending on the magnitude of the short-circuit current, the fault is cleared either within $t_i = 10$ ms or $t_{zsi} = 50$ ms.

Fault 3

Q22 signals short-circuit protection to Q11 with the result that only Q22 trips when delay time $t_{zsi} = 50$ ms expires. Without the ZSI function, the fault would not be cleared until $t_{sd} = 200$ ms had expired.

Fault 4

The short circuit is detected only by Q11. Since Q11 does not receive a blocking signal from the downstream molded case circuit breakers, it trips after $t_{zsi} = 50$ ms. Without the ZSI function, Q11 would not trip until $t_{sd} = 300$ ms had expired.

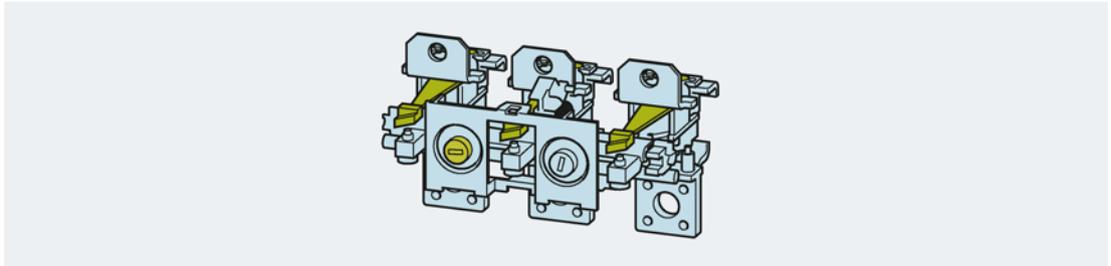
It is especially important to minimize breaking times when short circuits involving very high short-circuit currents occur.

2.7 Thermal-magnetic trip unit

A thermal-magnetic trip unit consists of a thermal trip unit for protecting against overload, and a magnetic trip unit for protecting against short circuits. Both trip units are series-connected.

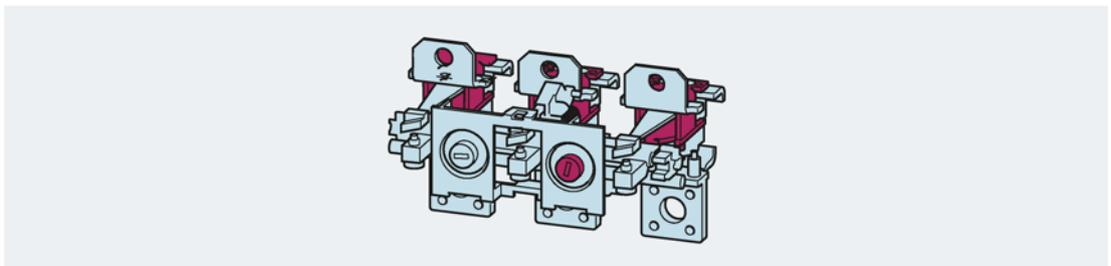
2.7.1 Thermal trip unit (L)

The thermal trip unit consists of a temperature-dependent bimetal that heats up as a result of the flow of current. This means the trip unit is current-dependent. The temperature rise in the bimetal strip depends not only on the current magnitude, but also on the ambient temperature of the molded case circuit breaker. All current values specified for thermal-magnetic trip units of 3VA circuit breakers refer to an ambient temperature of +50 °C.



2.7.2 Magnetic trip unit with short-circuit protection (I)

The magnetic trip unit with short-circuit protection comprises a yoke mounting through which a current path runs, and a flap armature that is kept at a distance from the yoke mounting by a tension spring.



If a short-circuit current flows along the current path, the magnetic field thus generated causes the flap armature to be moved towards the yoke mounting against the opposite force of the tension spring. The tripping time is almost current-independent and instantaneous. The flap armature releases the breaker mechanism and thus opens the switching contacts. Immediately after tripping, the flap armature is moved back to its starting position by the restoring force of the tension spring.

2.7.3 Application cases and trip unit types

The table below illustrates the applications for which different types of thermal-magnetic trip units can be used:

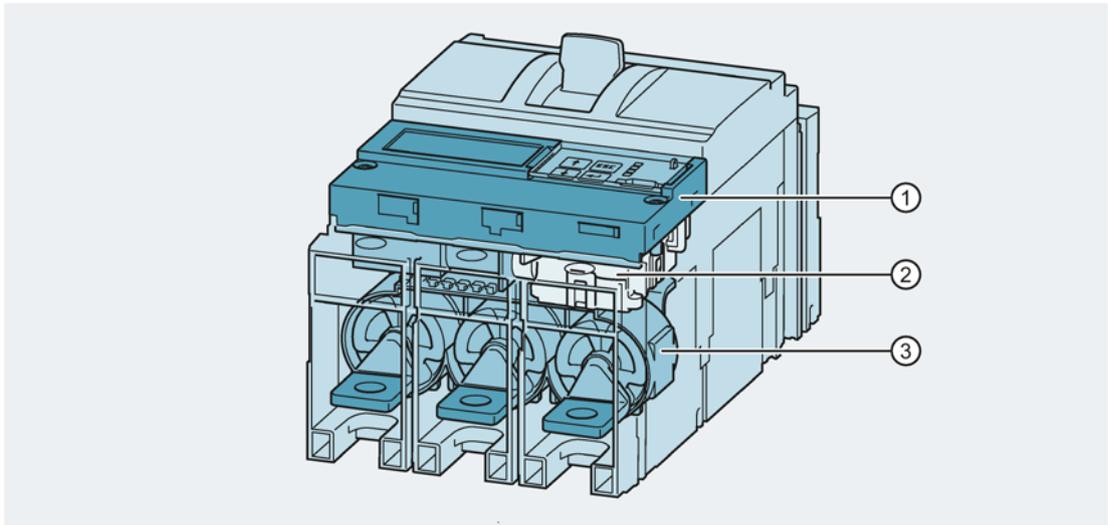
Protection	TM210 FTFM	TM220 ATFM	TM240 ATAM
Line protection	■	■	■
Version available with			
1-pole and 2-pole breakers	■		
3-pole breaker	■	■	■
4-pole breaker	■	■	■
Available protection parameters			
I_r adjustable		■	■
I_l adjustable			■
I_r fixed	■		
I_l fixed	■	■	
$I_N^{1)}$	■	■	■

1) For 4-pole molded case circuit breakers only, available without protection, 50% ($\geq I_n$ 100 A) and 100%

2.8 Electronic trip unit

An electronic trip unit is based on the following concepts:

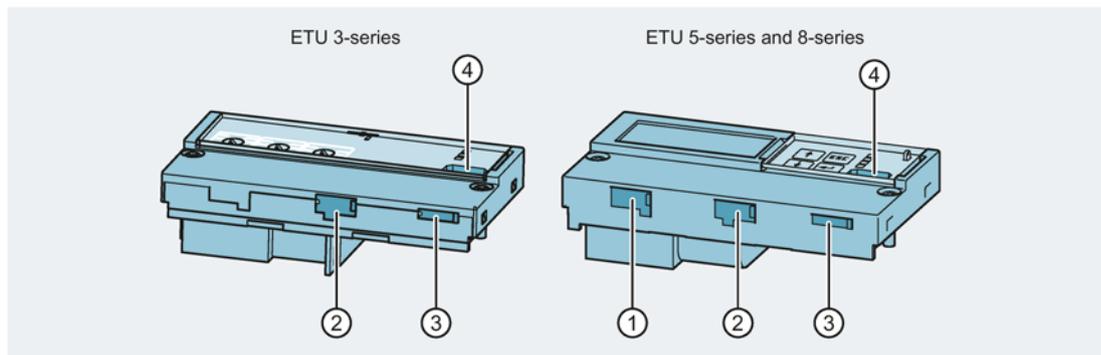
- Complete measurement of the current in the phases L1, L2 and L3, with N and currents to ground optional
- Rogowski coil
 - Very precise measurement of the current
 - Better ground-fault protection because the vectorial sum is more exact
- Evaluation of the current measurement values and constant comparison with the tripping limits
- Tripping by means of a maglatch



- ① Electronic Trip Unit (ETU)
- ② Maglatch
- ③ Current sensor

2.8.1 Connections

The connections on the ETU are illustrated in the diagram below:



- ① Interface for an external current transformer for N conductor
- ② Interface for connection of an EFB300 external function box
- ③ Interface for connection of an RCD820 residual current device
- ④ Connection for test devices TD300 and TD500

2.8.2 Protection functions

Protection	ETU320 LI	ETU330 LIG	ETU350 LSI
Line protection	■	■	■
Generator protection	■	■	■
Version available with			
3-pole without external neutral conductor transformer	■	■	■
3-pole with external neutral conductor transformer			
4-pole with protected neutral conductor transformer	■	■	■
Available protection parameters			
I_r	■	■	■
t_r at $6 \times I_r$	■	■	■
Characteristic in L range: $I^2 t_r$	■	■	■
Thermal image	■	■	■
Thermal image can be switched on/off			
I_{sd}			■
t_{sd} at $8 \times I_r$			■
Characteristic in S range: $I^2 t_{sd}$			■
Characteristic in S range: selectable $I^2 t_{sd} / t_{sd}$			
I_l	■	■	■
I_N ¹⁾	■	■	■
I_g		■	
t_g at $2 \times I_g$		■	
Characteristic in G range: $I^2 t_g$			
Characteristic in G range: selectable $I^2 t_g / t_g$			
Ground-fault alarm function			
ZSI	■	■	■
Features and options			
Setting by rotary switch	■	■	■
Setting by ETU display			
Data shown on ETU display			
Metering function			
Communication option			
Front interface	■	■	■

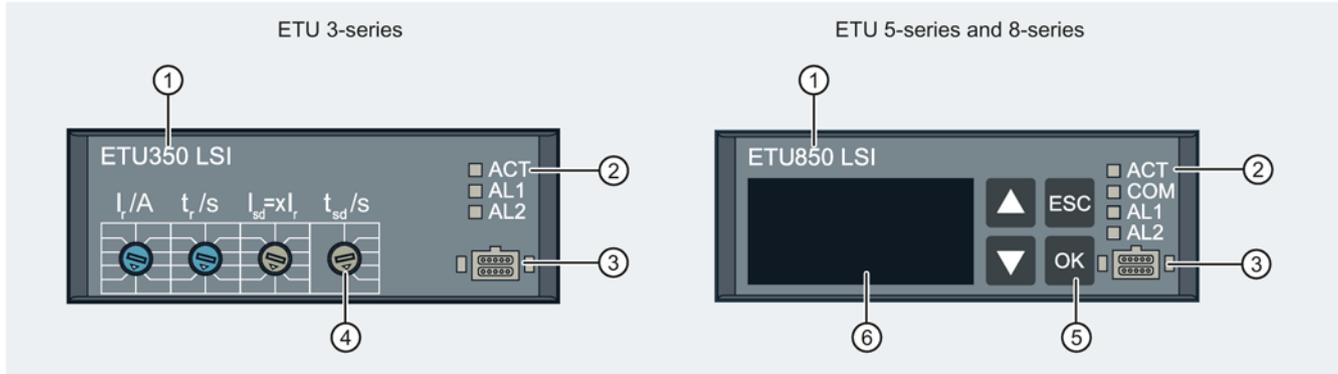
1) Available in a version with external current transformer for N conductor or 4-pole breaker

Protection	ETU550 LSI	ETU560 LSIG	ETU850 LSI	ETU860 LSIG
Line protection	■	■	■	■
Generator protection	■	■	■	■
Version available with				
3-pole without external neutral conductor transformer				
3-pole with external neutral conductor transformer	■	■	■	■
4-pole with protected neutral conductor transformer	■	■	■	■
Available protection parameters				
I_r	■	■	■	■
t_r at $6 \times I_r$	■	■	■	■
Characteristic in L range: $I^2 t_r$	■	■	■	■
Thermal image	■	■	■	■
Thermal image can be switched on/off	■	■	■	■
I_{sd}	■	■	■	■
t_{sd} at $8 \times I_r$	■	■	■	■
Characteristic in S range: $I^2 t_{sd}$	■	■	■	■
Characteristic in S range: selectable $I^2 t_{sd} / t_{sd}$	■	■	■	■
I_l	■	■	■	■
I_N ¹⁾	■	■	■	■
I_g		■		■
t_g at $2 \times I_g$		■		■
Characteristic in G range: $I^2 t_g$		■		■
Characteristic in G range: selectable $I^2 t_g / t_g$		■		■
Ground-fault alarm function		■		■
ZSI	■	■	■	■
Features and options				
Setting by rotary switch				
Setting by ETU display	■	■	■	■
Data shown on ETU display	■	■	■	■
Metering function			■	■
Communication option	■	■	■	■
Front interface	■	■	■	■

1) Available in a version with external current transformer for N conductor or 4-pole breaker

2.8.3 Operator controls

The following figure shows the available ETU types of the 3VA2 molded case circuit breakers. You can decide which ETU to install according to the area of application.



- ① Name of the ETU
- ② LED display

- ③ Front interface
- ④ Setting buttons

- ⑤ Pushbuttons
- ⑥ LCD

LED displays

The following table explains what the LED displays mean:

LED	Meaning	Description
<input type="checkbox"/> ACT	Off	Current flow in the main current path is less than 20 % I_n .
 ACT	Flashing	ETU 8-series: Missing 24 V DC external power supply for metering function.
 ACT	On	ETU ready, current flow greater than 20 % I_n .
<input type="checkbox"/> COM	Off	No communication with a COM800 via COM060.
 COM	Flashing	Flashing after switching on indicates that an internal COM060 communication module has been detected. After connection to this module is established, the LED will either go out (no external communication) or switch to steady illumination (see extra meaning).
 COM	On	Active communication to the COM800 breaker data server.
 ACT	On	Current flow between 90 % and 105 % I_n .
 AL1	On	
<input type="checkbox"/> AL2	Off	
 ACT	On	Current flow higher than 105 % I_n .
 AL1	On	
 AL2	On	
 ACT	On	Overtemperature alarm.
 AL1	Flashing	
 AL2	Flashing	
 ACT	Flashing	Internal fault on trip unit.
 COM	Flashing	
 AL1	Flashing	
 AL2	Flashing	

ETU 3-series units

3-series electronic trip units are equipped with setting buttons. A description of the operating principle of the setting buttons and operating instructions can be found in chapter Guide to setting the tripping characteristic (Page 74).

Displays on ETU 5-series and 8-series units

5-series and 8-series electronic trip units have an LCD display. The displayed values are refreshed once per second.



The following table explains what the symbols in the display mean:

Symbol	Meaning
	If this symbol is activated, the indicated value is a measured value.
	This symbol is shown when the first alarm threshold for this measured value was exceeded.
	This symbol is shown when the second alarm threshold for this measured value was exceeded.
	Display in parameter edit mode. The value can be changed with the <UP> and <DOWN> arrow keys.
	If TRIP is shown, the display indicates the information from the previous tripping operation.
	Name of the displayed value.

The following table explains what functions are performed by the buttons next to the display:

Symbol	Meaning
	Goes back to the previous screen page. Increases a parameter in parameter edit mode.
	Goes to the next screen page. Decreases a parameter in parameter edit mode.
	Goes to parameter edit mode when a parameter is displayed. Confirms a parameter in parameter edit mode.
	Goes to the standard display. Discards a parameter in parameter edit mode.

Displays on ETU 5-series and 8-series units

The basic structure comprises the following displays:

- Standard display
- Alarm display
- Measured value display
- Parameter display

If no selection is made within an adjustable time period, the standard display will appear.

Standard display**Alarm display**

Active alarms are displayed consecutively in screens AV1 ... AV5. If no alarms are active, these screens are concealed.



Measured value display

The table below explains the measured value display:

Number	Screen	Measured value	Description	ETU550	ETU560	ETU850	ETU860
MV 1		I_1	Instantaneous current I_1	■	■	■	■
MV 2		I_2	Instantaneous current I_2	■	■	■	■
MV 3		I_3	Instantaneous current I_3	■	■	■	■
MV 4		I_N	Instantaneous current in neutral conductor	■	■	■	■
MV 5		I_g	Instantaneous residual current to ground		■		■
MV 6		U_{12}	Instantaneous voltage U_1-U_2			■	■
MV 7		U_{23}	Instantaneous voltage U_2-U_3			■	■
MV 8		U_{31}	Instantaneous voltage U_3-U_1			■	■
MV 9		f	Instantaneous frequency			■	■
MV 10		P	Instantaneous active power (total)			■	■
MV 11		Q	Instantaneous reactive power (total)			■	■
MV 12		PF	Instantaneous power factor			■	■
MV 13		W	Active energy			■	■

Parameter display

The table below explains the parameter display:

Number	Screen	Parameter	Description	ETU550	ETU560	ETU850	ETU860
PV 1		I_r	Overload protection current	■	■	■	■
PV 2		t_r	Overload protection delay time	■	■	■	■
PV 4		ThM	Thermal image	■	■	■	■
PV 5		I_{sd}	Short-time delayed short-circuit current	■	■	■	■
PV 6		t_{sd}	Short-time delayed short-circuit current delay time	■	■	■	■
PV 7		I^2t_{sd}	Characteristic curve in S range	■	■	■	■
PV 8a		ZSI S	Zone Selective Interlocking	■	■	■	■
PV 8b		ZSI G	Zone Selective Interlocking in the event of a ground fault		■		■
PV 9		I_i	Instantaneous short-circuit protection current	■	■	■	■
PV 10		I_N	Overload protection in the neutral conductor	■ ¹⁾	■ ¹⁾	■ ¹⁾	■ ¹⁾
PV 11		I_g	Ground-fault protection current		■		■
PV 12		t_g	Ground-fault protection delay time		■		■
PV 13		I^2t_g	Characteristic curve for ground-fault protection		■		■
PV 14		I_{gA}	Ground fault alarm current		■		■

Setting and changing parameters

1. Use the arrow keys to navigate to the correct display.
2. Press the <OK> button.
 - Edit mode is active. Activation is confirmed by display of "pencil" symbol.



3. Use the arrow keys to adjust the parameter setting.
4. Confirm the setting with the <OK> button, or cancel the operation with <ESC>.
 - The setting is accepted with <OK>. The parameter display now appears.

"Tripped" display

After the ETU has initiated a trip, the "Tripped" display automatically appears:



This screen can be identified by the word "Trip" which is displayed in the top, right-hand corner. The displayed current value shows the current at the moment of tripping.

Press <ESC> to exit the display.

The additional information contained in the "Tripped" display is explained in the table below:

Number	Display in the title	Meaning	Unit
TV1	LT	Tripped by overload protection	A
TV2	ST	Tripped by short-time delayed short-circuit protection	A
TV3	Inst	Tripped by instantaneous short-circuit protection	A, kA
TV4	N	Tripped by overload in the neutral conductor	A
TV5	GF	Tripped by ground-fault protection	A
TV6	Temp	Tripped by overheating	%
TV12	RCD trip	Tripped by residual current device RCD820	A

Diagnostics display

When a TD500 test device is connected, you can use it to initiate a test. The following screen appears when a TD500 is connected. The bar flashes at a frequency of 0.5 Hz.



The bar travels from left to right while testing is in progress. The test ends with a trip.

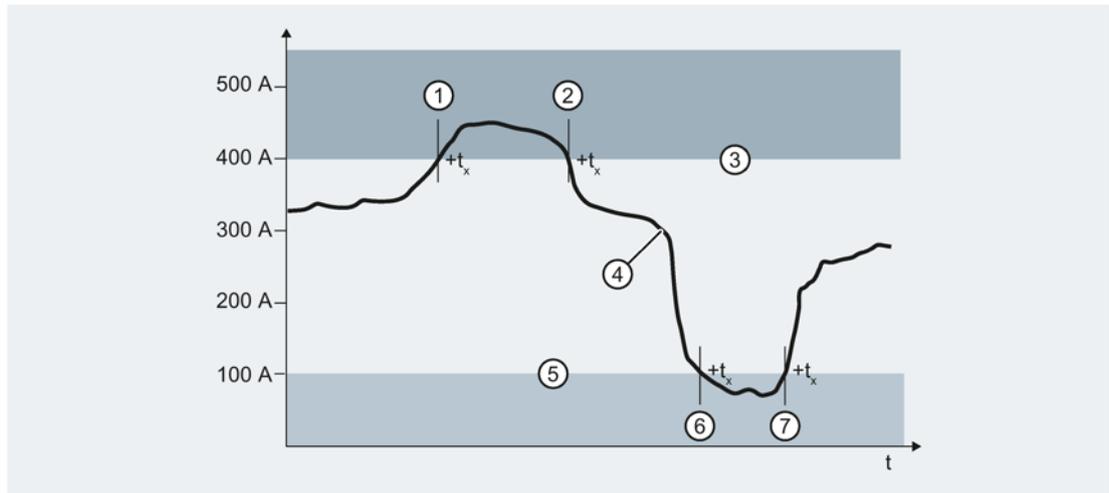
Activation limits

The table below shows the activation limits for the ETUs:

Current in one of the three phases	Meaning for the ETU
0 ... 20 % I_n	The ETU is not active.
> 20 % I_n	The protection of the ETU is active, and the display is active.

2.8.4 Load acceptance and load shedding - load management

3VA molded case circuit breakers equipped with an ETU 3-series or higher series provide two current thresholds for the purpose of implementing a local load management function. Load shedding is the upper threshold, and load acceptance the lower threshold.



- | | |
|----------------------------------|------------------------------------|
| ① Incoming alarm "load shedding" | ⑤ Parameter load acceptance 100 A |
| ② Outgoing alarm "load shedding" | ⑥ Incoming alarm "load acceptance" |
| ③ Parameter load shedding 400 A | ⑦ Outgoing alarm "load acceptance" |
| ④ Current in one phase | |

Note

No trip

Tripping is never initiated as a result of the current value crossing the upper or lower thresholds.

If the current in one phase exceeds the parameter setting for "load shedding", an incoming alarm "load shedding" is generated. Only when the current in all three phases drops below this threshold is an outgoing alarm "load shedding" generated.

The incoming and outgoing alarms can be output via an optional EFB module and transferred via the communication link.

The opposite applies for the load acceptance threshold. If the current in all three phases drops below the parameter setting, an incoming alarm "load acceptance" is generated. If only one of the three currents exceeds the parameter setting, an outgoing alarm "load acceptance" is generated.

To prevent these alarms being generated by brief current peaks and troughs, they can be delayed by the time t_x from 1 s to 15 s.

2.8.5 Measuring with a Rogowski coil

The Rogowski coil is a toroidal coil without a ferromagnetic core. It is used as a component in electronic measuring devices to measure alternating current.

Advantages of the current sensor:

- Each transformer can be optimized for its task and operating points
 - Transformers for power generation
 - Transformers for measurement
- Higher accuracy of current measurement and therefore higher accuracy for ground-fault currents

A power measurement is made possible by the more exact and more linear measurement of the current together with the integrated voltage tap in the molded case circuit breaker.

Accuracy levels of the specified measured values of the 8-series ETU, including the integrated current sensors

Measured value	Accuracy
Current	1 % in the range from 0.2 ... 1.2 I_n
Voltage	1 % in the range from 80 ... 800 V
Active power, active energy	Class 2 acc. to IEC 61557-12

Interpretation of measured values

IEC Convention	
Operation in all 4 quadrants (Q1, Q2, Q3, Q4)	Values of $\cos \phi$ in receiver operation (Q1, Q4)
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Q2</p> <p>$P < 0$ $Q > 0$ $PF < 0$</p> <p>Capacitive (Lead)</p> <p>Inductive (Lag)</p> <p>$P < 0$ $Q < 0$ $PF < 0$</p> <p>Q3</p> </div> <div style="width: 10%; text-align: center;"> <p>↑ Q</p> <p>→ P</p> </div> <div style="width: 45%;"> <p>Q1</p> <p>$P > 0$ $Q > 0$ $PF > 0$</p> <p>Inductive (Lag)</p> <p>Capacitive (Lead)</p> <p>$P > 0$ $Q < 0$ $PF > 0$</p> <p>Q4</p> </div> </div>	

PF Power factor

Measured current and voltage values are always positive.

The "normal" direction of energy flow of the 3VA molded case circuit breaker is top down (can also be adjusted using the powerconfig software), corresponding to operation in quadrants Q1 and Q4. If the molded case circuit breaker is supplied from below, it is operated in quadrants Q2 and Q3.

The following table provides an overview of the setting values:

Setting values ¹⁾				ETUs of the		Display		Communication	
				5-series	8-series	Display in ETU	DSP800	COM800 via COM060	
Overload protection	Current	I_r	A	■	■				
	Delay time	t_r	s	■	■				
	Switch thermal image on/off	ThM		■	■				
Short-time delayed short-circuit protection	Current	I_{sd}	A	■	■				
	Delay time	t_{sd}	s	■	■				
	Characteristic curve in S range	I^2t_{sd}		■	■				
	Zone selective interlocking	ZSI		■	■				
Instantaneous short-circuit protection	Current	I_i	A	■	■				
Overload protection in the neutral conductor	Current	I_N	A	■	■				
Ground-fault protection	Current	I_g	A	■	■				
	Delay time	t_g	s	■	■				
	Characteristic curve	I^2t_g		■	■				
	Alarm current	I_{gA}	A	■	■				

1) Depending on ETU version

Value can be read

Value can be edited

Metering function ¹⁾				ETUs		Display		Communication	
				5-series	8-series	Display in ETU	DSP800	COM800 via COM060	
Current	Phase and neutral conductor currents	I_1, I_2, I_3, I_N	A	■	■	👁️	👁️	👁️	
	Residual current to ground	I_g	A	■	■	👁️	👁️	👁️	
	Phase with highest load		A	■	■	👁️	👁️	👁️	
	Mean value over the three phase currents	$I_{LAVG}(I_1 + I_2 + I_3)/3$	A	■	■		👁️	👁️	
	Asymmetry of the phase currents	I_{nba}	%	■	■		👁️	👁️	
	THD of the 3 phases	$THDI_1, THDI_2, THDI_3$	%		■		👁️	👁️	
Voltage	Phase voltages incl. mean value	U_1, U_2, U_3, U_{phavg}	V		■	👁️	👁️	👁️	
	Voltages to N conductor incl. mean value	$U_{1N}, U_{2N}, U_{3N}, U_{Navg}$	V		■		👁️	👁️	
	Asymmetry of the voltages		%		■		👁️	👁️	
	THD phase/phase and phase/N	$THDI_1, THDI_2, THDI_3$	%		■		👁️	👁️	
Power	Active power, total and per phase	P_1, P_2, P_3, P_{tot}	kW		■	👁️ (P_{tot})	👁️	👁️	
	Apparent power, total and per phase	S_1, S_2, S_3, S_{tot}	kVA		■		👁️	👁️	
	Reactive power, total and per phase	Q_1, Q_2, Q_3, Q_{tot}	kVAr		■	👁️ (Q_{tot})	👁️	👁️	
	Fundamental power factor	$PF_1, PF_2, PF_3, PF_{avg}$			■	👁️ (PF_{avg})	👁️	👁️	
Energy	Active energy, infeed and feedback	E_p	kWh		■	👁️	👁️	👁️	
	Reactive energy, infeed and feedback	E_q	kVArh		■		👁️	👁️	
	Apparent energy	E_s	kVAh		■		👁️	👁️	
Frequency	Present frequency	f	Hz		■	👁️	👁️	👁️	
Maximum pointer function	Min/max current, voltage, power	with time stamp						👁️	

1) Depending on ETU version

👁️ Value can be displayed/read

2.8 Electronic trip unit

		ETUs of the		Display		Communication
		5-series	8-series	Display in ETU	DSP800	COM800 via COM060
Status, diagnostics and maintenance¹⁾						
Breaker status	On, Off, TRIP	■	■		👁	👁
Currently pending alarm messages		■	■	👁	👁	👁
Reason for last trip		■	■	👁	👁	👁
Event Log	of the last 100 events	■	■		👁	👁
	of the last 10 trips	■	■		👁	👁
	of the last 100 switching operations	■	■		👁	👁
Maintenance information	Trip counter after LSIG trips	■	■		👁	👁
	Operating hours counter	■	■		👁	👁
	Switching cycle counter	■	■		👁	👁
Position in the draw-out unit		■	■			👁
Identification						
Identification data of the breaker	Order No.	■	■		👁	👁
	Rated operational current, number of poles, I _{cu}	■	■		👁	👁
HW/FW version		■	■			👁
Power management functions						
Power demand values of the last demand period	Active, reactive and apparent power in fixed block or rolling block		■		👁	👁
Energy pulse output	S0 signal at EFB output		■			
Load monitoring	Load shedding/load pick-up, output via EFB	■	■		👁	👁
Threshold value parameters	10 freely adjustable monitoring parameters	■	■		👁	👁

1) Depending on ETU version

👁 Value can be displayed/read

Applications

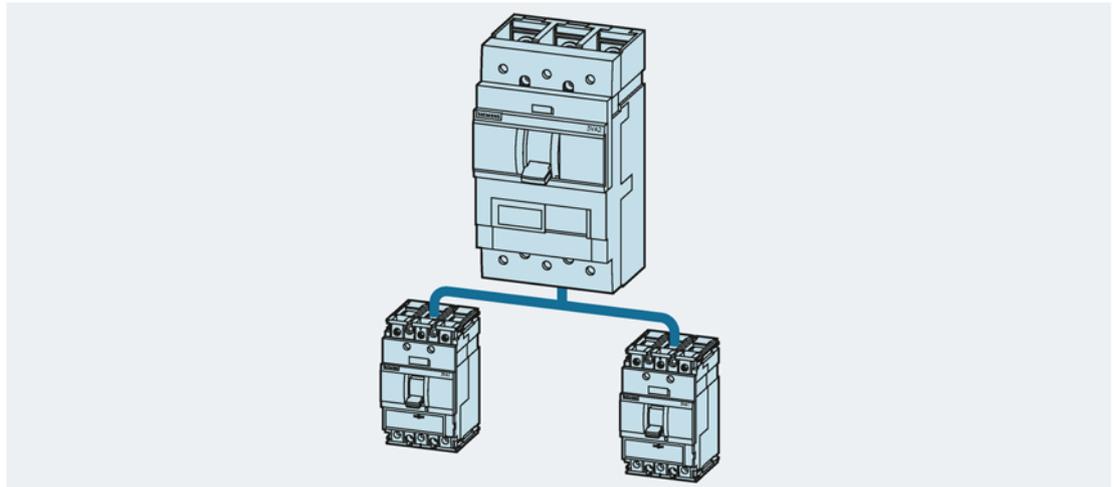
3.1 Line protection applications of 3VA molded case circuit breakers

The main applications of the circuit breakers as line protection components are:

- In main switchboards to provide protection for cables to subdistribution boards
- In subdistribution boards to provide protection for cables to small distribution boards
- Protection for mixed load (e.g. machine, lighting system, heating system, etc.)

The trip units for line protection are designed to provide overload and short-circuit protection for:

- Cables
- Leads
- Non-motor loads



3.1 Line protection applications of 3VA molded case circuit breakers

Suitable 3VA molded case circuit breakers and trip units

3VA molded case circuit breakers equipped with the following trip units are suitable for use in line protection applications:

- 3VA1 breakers with thermal-magnetic trip units
 - TM 2-series (Page 106)
- 3VA2 breakers with electronic trip units
 - ETU 3-series (Page 110)
 - ETU 5-series (Page 116)
 - ETU 8-series (Page 116)

3.1.1 Variants

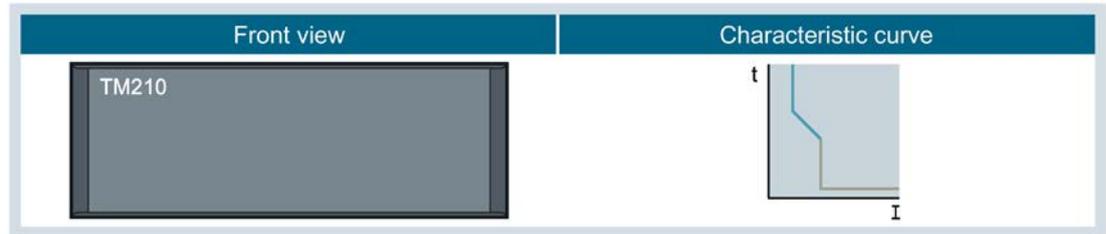
3.1.1.1 Thermal-magnetic trip units

Derating

Thermal-magnetic trip units employ a temperature-dependent bimetal to provide overload protection. The setting values are calibrated at an ambient temperature of +50 °C. Compensation factors must be applied for ambient temperatures other than +50 °C.

You will find more information and derating factors in chapter Derating and temperature compensation (Page 489).

Thermal-magnetic trip unit TM210 LI



Line protection FTFM - function LI

The thermal-magnetic trip unit TM210 has:

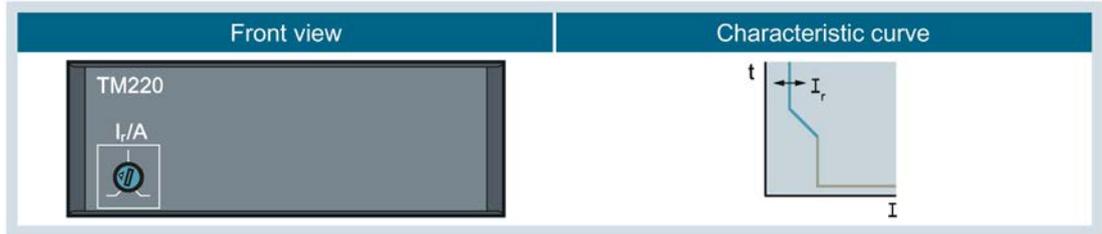
- fixed parameter setting I_r for overload protection (L)
- fixed parameter setting I_i for instantaneous short-circuit protection (I)
- With 4-pole versions only: Neutral conductor (N) protection permanently set to 0%, 50% or 100% I_r depending on version

Parameter TM210:

Size	I_n	I_r	I_i	$I_N^{1)}$		
3VA1	100 A	16 A	16 A	320 A	0 %	
		20 A	20 A			
		25 A	25 A			
		32 A	32 A			
		40 A	40 A			400 A
		50 A	50 A			500 A
		63 A	63 A			630 A
		80 A	80 A			800 A
		100 A	100 A			1000 A
	160 A	16 A	16 A	320 A	0 %, 100 %	
		20 A	20 A			
		25 A	25 A			
		32 A	32 A			
		40 A	40 A			400 A
		50 A	50 A			500 A
		63 A	63 A			630 A
		80 A	80 A			800 A
		100 A	100 A			1000 A
	125 A	125 A	1250 A	0 %, 50 %, 100 %		
	160 A	160 A	1600 A			

¹⁾ With 4-pole versions only:

Thermal-magnetic trip unit TM220 LI



Line protection ATFM - function LI

The thermal-magnetic trip unit TM220 has:

- adjustable parameter setting I_r for overload protection (L)
- fixed parameter setting I_i for instantaneous short-circuit protection (I)
- With 4-pole versions only: Neutral conductor (N) protection permanently set to 0%, 50% or 100% I_r depending on version

Parameter TM220:

Size	I_n	I_r	I_i	$I_N^{1)}$
3VA1	16 A	11 ... 16 A	320 A	0 %, 100 %
	20 A	14 ... 20 A		
	25 A	18 ... 25 A		
	32 A	22 ... 32 A		
	40 A	28 ... 40 A	400 A	
	50 A	35 ... 50 A	500 A	
	63 A	44 ... 63 A	630 A	
	80 A	56 ... 80 A	800 A	
	100 A	70 ... 100 A	1000 A	
	125 A	88 ... 125 A	1250 A	
160 A	112 ... 160 A	1600 A		

1) With 4-pole versions only:

Thermal-magnetic trip unit TM240 LI



Line protection ATAM - function LI

The thermal-magnetic trip unit TM240 has:

- adjustable parameter setting I_r for overload protection (L)
- adjustable parameter setting I_i for instantaneous short-circuit protection (I)
- With 4-pole versions only: Neutral conductor (N) protection permanently set to 0%, 50% or 100% I_r depending on version

Parameter TM240:

Size	I_n	I_r	I_i	$I_N^{1)}$	
3VA1	160 A	16 A	11 ... 16 A	0 %, 100 %	
		20 A	14 ... 20 A		
		25 A	18 ... 25 A		160 ... 320 A
		32 A	22 ... 32 A		
		40 A	28 ... 40 A		200 ... 400 A
		50 A	35 ... 50 A		250 ... 500 A
		63 A	44 ... 63 A		315 ... 630 A
		80 A	56 ... 80 A		400 ... 800 A
		100 A	70 ... 100 A		500 ... 1000 A
		125 A	88 ... 125 A		625 ... 1250 A
250 A	250 A	160 A	112 ... 160 A	0 %, 50 %, 100 %	
		200 A	140 ... 200 A		
		250 A	175 ... 250 A		1250 ... 2500 A

¹⁾ With 4-pole versions only:

3.1.1.2 Electronic trip units

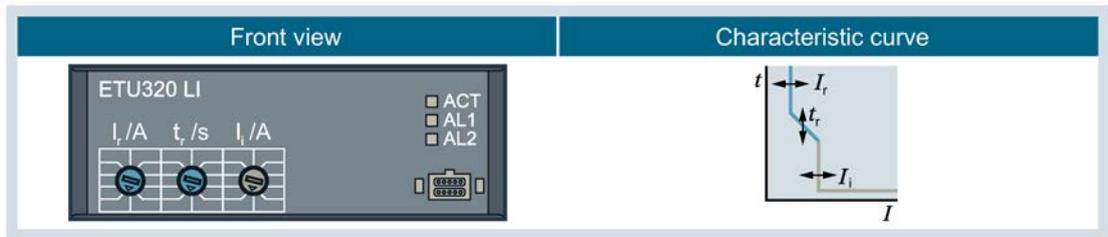
ETUs for line protection applications

The following electronic trip units are suitable for use in line protection applications:

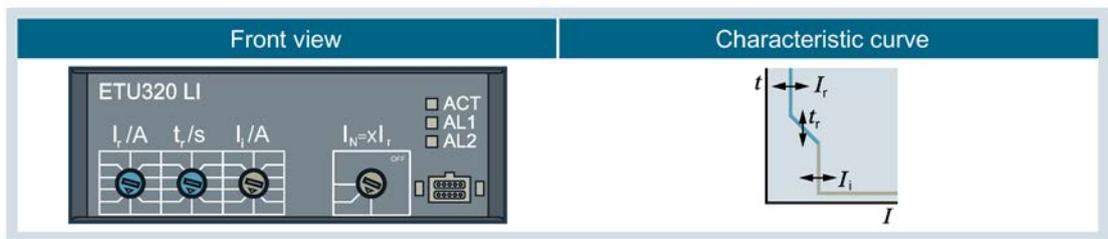
- ETU320 LI
- ETU330 LIG
- ETU350 LSI
- ETU550 LSI
- ETU560 LSI
- ETU850 LSI
- ETU860 LSI

Electronic trip unit ETU320 LI

ETU320 LI 3-pole:



ETU320 LI 4-pole:



Line protection - function LI

The electronic trip unit ETU320 has:

- adjustable parameter settings I_r and t_r for overload protection (L)
- adjustable parameter setting I_l for instantaneous short-circuit protection (I)
- With 4-pole versions only: Neutral conductor protection (N) which can be deactivated

ETU320 parameters:

Size		I_n	I_r	t_r	I_i	$I_N^{1)}$
3VA2	M/H/C/L	25 A	10 ... 25 A	0.5 ... 17 s	38 ... 300 A	$I_N = 1 \times I_r$; OFF
		40 A	16 ... 40 A		60 ... 480 A	
		63 A	25 ... 63 A		95 ... 756 A	
		100 A	40 ... 100 A		150 ... 1200 A	
	160 A	25 A	10 ... 25 A		38 ... 300 A	$I_N = 1 \times I_r$; OFF
		40 A	16 ... 40 A		60 ... 480 A	
		63 A	25 ... 63 A		95 ... 756 A	
		100 A	40 ... 100 A		150 ... 1200 A	
	250 A	160 A	63 ... 160 A		240 ... 1600 A	$I_N = 0.5; 1 \times I_r$; OFF
		250 A	100 ... 250 A		240 ... 1920 A	
	400 A	250 A	100 ... 250 A		375 ... 2500 A	
		400 A	160 ... 400 A		375 ... 3000 A	
M/H/C	630 A	160 ... 400 A	600 ... 4800 A			
	630 A	250 ... 630 A	600 ... 4000 A			
L	630 A	160 ... 400 A	945 ... 5670 A			
	630 A	250 ... 630 A	945 ... 5670 A			

1) With 4-pole versions only:

Overload protection L:

- I_r adjustable in 10 steps of 0.4 to 1.0 x I_n
- t_r adjustable in 10 steps of 0.5 to 12 / 15 s or 17 s
 t_r is the tripping time at 6 x I_r

The ETU320 LI has a permanently active thermal image.

Instantaneous short-circuit protection I:

- I_i adjustable in 10 steps of 1.5 to 9 / 10 / 11 / 12 x I_n
(depending on size)

Neutral conductor protection N:

The neutral conductor protection function is available for 4-pole molded case circuit breakers only.

- I_N $I_n < 100$ A: 1.0 x I_r or OFF
 $I_n \geq 100$ A: 0.5 / 1.0 x I_r or OFF

Electronic trip unit ETU330 LIG

ETU330 LIG 3-pole:



ETU330 LIG 4-pole:



Line protection - function LIG

The electronic trip unit ETU330 has:

- adjustable parameter settings I_r and t_r for overload protection (L)
- adjustable parameter setting I_i for instantaneous short-circuit protection (I)
- adjustable parameter settings I_g and t_g for ground-fault protection (G)
- With 4-pole versions only: Neutral conductor protection (N) which can be deactivated

ETU330 parameters:

Size		I_n	I_r	t_r	I_i	I_g	t_g	$I_N^{1)}$			
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 17 s	38 ... 300 A	5 ... 25 A	$I_N = 1 \times I_r$; OFF			
			40 A	16 ... 40 A		60 ... 480 A	8 ... 40 A				
		63 A	25 ... 63 A	95 ... 756 A		13 ... 63 A	$I_N = 0.5; 1 \times I_r$; OFF				
		100 A	40 ... 100 A	150 ... 1200 A		20 ... 100 A					
	160 A	25 A	10 ... 25 A	0.1 ... 0.3 s		38 ... 300 A	5 ... 25 A	$I_N = 1 \times I_r$; OFF			
		40 A	16 ... 40 A			60 ... 480 A	8 ... 40 A				
		63 A	25 ... 63 A			95 ... 756 A	13 ... 63 A				
		100 A	40 ... 100 A			150 ... 1200 A	20 ... 100 A				
	250 A	160 A	63 ... 160 A			0.5 ... 15 s	240 ... 1600 A	32 ... 160 A	$I_N = 0.5; 1 \times I_r$; OFF		
		250 A	100 ... 250 A				240 ... 1920 A	32 ... 160 A			
	400 A	250 A	100 ... 250 A				0.5 ... 17 s	375 ... 2500 A		50 ... 250 A	
		400 A	160 ... 400 A					375 ... 3000 A		50 ... 250 A	
M/H/C	630 A	400 A	160 ... 400 A		0.5 ... 12 s			600 ... 4000 A		80 ... 400 A	
		630 A	250 ... 630 A					600 ... 4800 A		80 ... 400 A	
L	630 A	400 A	160 ... 400 A					0.5 ... 17 s		945 ... 5670 A	126 ... 630 A
		630 A	250 ... 630 A							600 ... 4400 A	80 ... 400 A
		630 A	250 ... 630 A	0.5 ... 12 s						945 ... 5670 A	126 ... 630 A

1) With 4-pole versions only:

Overload protection L:

- I_r adjustable in 10 steps of 0.4 to $1.0 \times I_n$
- t_r adjustable in 10 steps of 0.5 to 12 / 15 s or 17 s
 t_r is the tripping time at $6 \times I_r$

The ETU330 LIG has a permanently active thermal image.

Instantaneous short-circuit protection I:

- I_i adjustable in 10 steps of 1.5 to 9 / 10 / 11 / 12 $\times I_n$
(depending on size)

Ground-fault protection G:

- I_g adjustable in 5 steps of 0.2 / 0.25 / 0.4 / 0.6 to $1.0 \times I_n$
(depending on size)
- t_g adjustable to 100 ms or 300 ms, at $2 \times I_g$ in each case

The ground-fault protection cannot be deactivated.

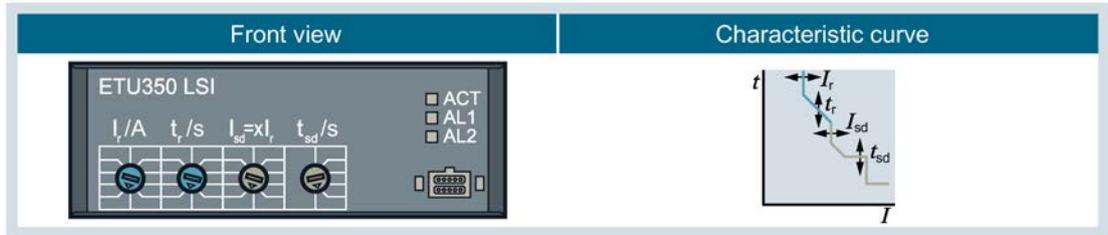
Neutral conductor protection N:

The neutral conductor protection function is available for 4-pole molded case circuit breakers only.

- I_N $I_n < 100$ A: $1.0 \times I_r$ or OFF
 $I_n \geq 100$ A: 0.5 / $1.0 \times I_r$ or OFF

Electronic trip unit ETU350 LSI

ETU350 LSI 3-pole:



ETU350 LSI 4-pole:



Line protection - function LSI

The electronic trip unit ETU350 has:

- adjustable parameter settings I_r and t_r for overload protection (L)
- adjustable parameter settings I_{sd} and t_{sd} for short-time delayed short circuit protection (S)
- fixed parameter setting I_i for instantaneous short-circuit protection (I)
- With 4-pole versions only: Neutral conductor protection (N) which can be deactivated

ETU350 parameters:

Size		I_n	I_r	t_r	I_{sd}	t_{sd}	I_i	$I_N^{1)}$															
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 17 s	1.5 ... 10 x I_r	0 ... 0.4 s	300 A	$I_N = 1 \times I_r$; OFF														
			40 A	16 ... 40 A				480 A															
			63 A	25 ... 63 A				756 A															
			100 A	40 ... 100 A				1200 A		$I_N = 0.5; 1 \times I_r$; OFF													
	M/H/C	160 A	25 A	10 ... 25 A				0.5 ... 15 s	1.5 ... 9 x I_r	0 ... 0.4 s	300 A	$I_N = 1 \times I_r$; OFF											
			40 A	16 ... 40 A							480 A												
			63 A	25 ... 63 A							756 A												
			100 A	40 ... 100 A							1200 A												
	M/H/C	250 A	160 A	63 ... 160 A							0.5 ... 17 s	1.5 ... 10 x I_r	0 ... 0.4 s	1600 A	$I_N = 0.5; 1 \times I_r$; OFF								
			250 A	100 ... 250 A										2500 A									
	L	400 A	250 A	100 ... 250 A										0.5 ... 12 s		1.5 ... 9 x I_r	0 ... 0.4 s	3000 A	$I_N = 0.5; 1 \times I_r$; OFF				
			400 A	160 ... 400 A														4000 A					
L	630 A	400 A	160 ... 400 A	0.5 ... 17 s	1.5 ... 10 x I_r	0 ... 0.4 s	4800 A											$I_N = 0.5; 1 \times I_r$; OFF					
		630 A	250 ... 630 A				5670 A																
L	630 A	400 A	160 ... 400 A				0.5 ... 12 s													1.5 ... 9 x I_r	0 ... 0.4 s	4400 A	$I_N = 0.5; 1 \times I_r$; OFF
		630 A	250 ... 630 A																			5670 A	

1) With 4-pole versions only:

Overload protection L:

- I_r adjustable in 10 steps of 0.4 to 1.0 x I_n
- t_r adjustable in 10 steps of 0.5 to 12 / 15 s or 17 s
 t_r is the tripping time at 6 x I_r

The ETU350 LSI has a permanently active thermal image.

Short-time delayed short circuit protection S:

- I_{sd} adjustable in 10 steps of 1.5 to 9 / 10 x I_r
- t_{sd} adjustable in 6 steps of 0 to 0.4 s
with the reference point at $I_{sd} = 8 \times I_r$

The curve shape is $I^2t = \text{constant}$.**Instantaneous short-circuit protection I:**

- I_i Not adjustable: Permanently set to 9 / 10 / 11 / 12 x I_n
(depending on rated operational current and breaker size)

Neutral conductor protection N:

The neutral conductor protection function is available for 4-pole molded case circuit breakers only.

- I_N $I_n < 100$ A: 1.0 x I_r or OFF
 $I_n \geq 100$ A: 0.5 / 1.0 x I_r or OFF

5-series and 8-series electronic trip units

Parameter input via display unit

With 5-series and 8-series electronic trip units, it is possible to set more parameters and scale the selection of parameters more finely than for 3-series trip units.

Parameters are set via the display unit and its buttons. This functionality is available, however, only if a separate, dedicated power supply is connected to the molded case circuit breakers.

Potential alternatives for this power supply:

- 24 V supplied externally via:
 - EFB300 external function box
 - temporarily connected TD300 or TD500 test device
 - internal 24 V module
 - internal COM060 communication module
- Current flow $> 20 \% I_n$ in one of the 3 phases

A description of the parameter display can be found in chapter "Operator controls (Page 90)".

Additional features of 8-series units

In addition to the features shared with 5-series trip units, 8-series units also offer:

- An integrated voltage tap, plus an external voltage tap in the case of 3-pole molded case circuit breakers
- Additional sensing of power measurements (function requires an external 24 V supply)

Electronic trip units ETU550 LSI and ETU850 LSI

ETU550 LSI 3-pole and 4-pole units:



ETU850 LSI 3-pole and 4-pole units:



Line protection - function LSI

The electronic trip units ETU550 and ETU850 have:

- adjustable parameter settings I_r and t_r for overload protection (L)
- adjustable parameter settings I_{sd} and t_{sd} for short-time delayed short circuit protection (S)
- adjustable parameter setting I_i for instantaneous short-circuit protection (I)
- With 4-pole versions: adjustable parameter setting I_N for neutral conductor protection (N) can be activated optionally for 3-pole versions

3.1 Line protection applications of 3VA molded case circuit breakers

ETU550 / ETU850 parameters (3-pole version):

Size		I_n	I_r	t_r	I_{sd}	t_{sd}	I_l	$I_N^{1)}$		
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 25 s	15 ... 250 A	0.05 ... 0.5 s	38 ... 300 A	10 ... 40 A	
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 63 A	
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	25 ... 100 A	
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 160 A	
		160 A	25 A	10 ... 25 A		15 ... 250 A		38 ... 300 A	10 ... 40 A	
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 63 A	
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	25 ... 100 A	
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 160 A	
		250 A	160 A	63 ... 160 A		0.5 ... 20 s		96 ... 1600 A	240 ... 1600 A	32 ... 250 A
			160 A	63 ... 160 A		0.5 ... 25 s		96 ... 1600 A	240 ... 1920 A	32 ... 250 A
			250 A	100 ... 250 A		0.5 ... 15 s		150 ... 2500 A	375 ... 2500 A	50 ... 400 A
			250 A	100 ... 250 A		0.5 ... 25 s		150 ... 2500 A	375 ... 3000 A	50 ... 400 A
	400 A	250 A	100 ... 250 A	0.5 ... 25 s	150 ... 2500 A	375 ... 3000 A	50 ... 400 A			
		400 A	160 ... 400 A	0.5 ... 17 s	240 ... 4000 A	600 ... 4000 A	80 ... 630 A			
	M/H/C	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	600 ... 6000 A	80 ... 630 A		
			500 A	200 ... 500 A	0.5 ... 20 s	300 ... 5000 A	750 ... 7000 A	100 ... 800 A		
		630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 6300 A	126 ... 1000 A			
		630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A	126 ... 1000A			
	L	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	600 ... 4400 A	80 ... 630 A		
			630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A	126 ... 1000A		

1) only 3-pole version with external current transformer for N conductor

ETU550 / ETU850 parameters (4-pole version):

Size		I_n	I_r	t_r	I_{sd}	t_{sd}	I_l	I_N		
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 25 s	0.05 ... 0.5 s	38 ... 300 A	10 ... 40 A		
			40 A	16 ... 40 A			24 ... 400 A	60 ... 480 A	16 ... 63 A	
			63 A	25 ... 63 A			38 ... 630 A	95 ... 756 A	25 ... 100 A	
			100 A	40 ... 100 A			60 ... 1000 A	150 ... 1200 A	20 ... 100 A	
		160 A	25 A	10 ... 25 A			15 ... 250 A	38 ... 300 A	10 ... 40 A	
			40 A	16 ... 40 A			24 ... 400 A	60 ... 480 A	16 ... 63 A	
			63 A	25 ... 63 A			38 ... 630 A	95 ... 756 A	25 ... 100 A	
			100 A	40 ... 100 A			60 ... 1000 A	150 ... 1200 A	20 ... 160 A	
		250 A	160 A	63 ... 160 A			0.5 ... 20 s	96 ... 1600 A	240 ... 1600 A	32 ... 160 A
			160 A	63 ... 160 A			0.5 ... 25 s	96 ... 1600 A	240 ... 1920 A	32 ... 250 A
			250 A	100 ... 250 A			0.5 ... 15 s	150 ... 2500 A	375 ... 2500 A	50 ... 250 A
			250 A	100 ... 250 A			0.5 ... 25 s	150 ... 2500 A	375 ... 3000 A	50 ... 400 A
	400 A	250 A	100 ... 250 A	0.5 ... 25 s	150 ... 2500 A	375 ... 3000 A	50 ... 400 A			
		400 A	160 ... 400 A	0.5 ... 17 s	240 ... 4000 A	600 ... 4000 A	80 ... 400 A			
	M/H/C	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	600 ... 6000 A	80 ... 500 A		
			500 A	200 ... 500 A	0.5 ... 20 s	300 ... 5000 A	750 ... 7000 A	100 ... 500 A		
		630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A	126 ... 630 A			
		630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A	126 ... 630 A			
	L	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	600 ... 4400 A	80 ... 500 A		
			630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A	126 ... 630 A		

Overload protection L:

- I_r adjustable from 0.4 to $1.0 \times I_n$ in absolute current values
 $I_r < 50$ A: In steps of 0.5 A
 $I_r \geq 50$ A: In steps of 1 A
- t_r adjustable from 0.5 to 12 / 15 / 17 / 20 / 25 s (depending on rated operational current and breaker size)
with a reference point of $6 \times I_r$.
In steps of 0.1 s

The ETU550 LSI and ETU850 LSI units have a thermal image.

Short-time delayed short circuit protection S:

- I_{sd} adjustable from 0.6 to $9 / 10 \times I_n$
 $I_{sd} < 50$ A: In steps of 0.5 A
 $I_{sd} \geq 50$ A: In steps of 1 A
- t_{sd} adjustable from 0.05 to 0.5 s
with a reference point of $I_{sd} = 8 \times I_r$
in steps of 0.01 s

The curve shape $I^2t = \text{constant}$ can be deactivated.

Instantaneous short-circuit protection I:

- I_i Breaker sizes 100 A to 400 A:
adjustable from 1.5 to $10 / 12 \times I_n$
Size 630 A:
see tables above
In steps of 1 A

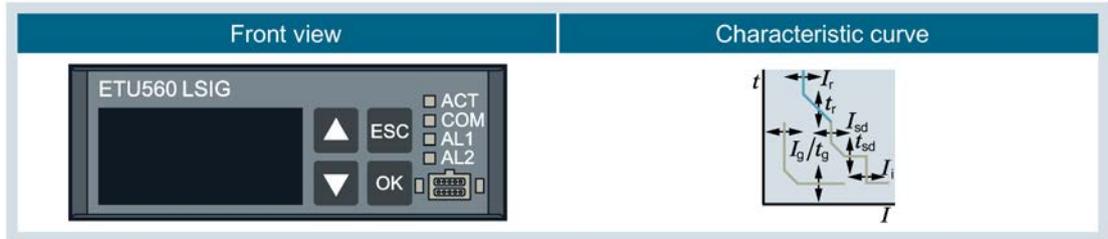
Neutral conductor protection N:

The neutral conductor protection function is available only for 3-pole molded case circuit breakers with external current transformer for N conductor for 4-pole molded case circuit breakers.

- I_N adjustable in steps of 1 A
3-pole breakers with external current transformer for N conductor:
 $I_n < 63$ A: 0.4 to $1.6 \times I_n$
 $I_n \geq 63$ A: 0.2 to $1.6 \times I_n$
4-pole breakers:
 $I_n < 63$ A: 0.4 to $1.6 \times I_n$
 $I_n \geq 63$ A: 0.2 to 1.0 or $1.6 \times I_n$

Electronic trip units ETU560 LSIG and ETU860 LSIG

ETU560 LSIG 3-pole and 4-pole units:



ETU860 LSIG 3-pole and 4-pole units:



Line protection - function LSIG

The electronic trip units ETU560 and ETU860 have:

- adjustable parameter settings I_r and t_r for overload protection (L)
- adjustable parameter settings I_{sd} and t_{sd} for short-time delayed short circuit protection (S)
- adjustable parameter setting I_i for instantaneous short-circuit protection (I)
- adjustable parameter settings I_g and t_g for ground-fault protection (G)
- With 4-pole versions: adjustable parameter setting I_N for neutral conductor protection (N) optionally available for 3-pole versions

3.1 Line protection applications of 3VA molded case circuit breakers

ETU560 / ETU860 parameters (3-pole version):

Size		I_n	I_r	t_r	I_{sd}	t_{sd}	I_l	I_g	t_g	$I_N^{1)}$	
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 25 s	15 ... 250 A	0.05 ... 0.5 s	38 ... 300 A	15 ... 25 A	0.05 ... 0.8 s	10 ... 40 A
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 40 A		16 ... 63 A
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	16 ... 63 A		25 ... 100 A
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 100 A		20 ... 160 A
	M/H/C/L	160 A	25 A	10 ... 25 A	0.5 ... 20 s	15 ... 250 A	0.05 ... 0.5 s	38 ... 300 A	15 ... 25 A	0.05 ... 0.8 s	10 ... 40 A
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 40 A		16 ... 63 A
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	16 ... 63 A		25 ... 100 A
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 100 A		20 ... 160 A
	M/H/C/L	250 A	160 A	63 ... 160 A	0.5 ... 25 s	96 ... 1600 A	0.05 ... 0.5 s	240 ... 1920 A	32 ... 160 A	0.05 ... 0.8 s	32 ... 250 A
			250 A	100 ... 250 A	0.5 ... 15 s	150 ... 2500 A		375 ... 2500 A	50 ... 250 A		50 ... 400 A
	M/H/C/L	400 A	250 A	100 ... 250 A	0.5 ... 25 s	150 ... 2500 A	0.05 ... 0.5 s	375 ... 3000 A	50 ... 250 A	0.05 ... 0.8 s	50 ... 400 A
			400 A	160 ... 400 A	0.5 ... 17 s	240 ... 4000 A		600 ... 4000 A	80 ... 400 A		80 ... 630 A
	M/H/C	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	0.05 ... 0.5 s	600 ... 6000 A	80 ... 400 A	0.05 ... 0.8 s	80 ... 630 A
			500 A	200 ... 500 A	0.5 ... 20 s	300 ... 5000 A		750 ... 7000 A	100 ... 500 A		100 ... 800 A
			630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A		945 ... 5670 A	126 ... 630 A		126 ... 1000 A
	L	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	0.05 ... 0.5 s	600 ... 4400 A	80 ... 400 A	0.05 ... 0.8 s	80 ... 630 A
630 A			250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	600 ... 5670 A		126 ... 630 A	126 ... 1000 A		

1) only 3-pole version with external current transformer for N conductor

ETU560 / ETU860 parameters (4-pole version):

Size		I_n	I_r	t_r	I_{sd}	t_{sd}	I_l	I_g	t_g	I_N	
3VA2	M/H/C/L	100 A	25 A	10 ... 25 A	0.5 ... 25 s	15 ... 250 A	0.05 ... 0.5 s	38 ... 300 A	15 ... 25 A	0.05 ... 0.8 s	10 ... 40 A
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 40 A		16 ... 63 A
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	16 ... 63 A		25 ... 100 A
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 100 A		20 ... 100 A
	M/H/C/L	160 A	25 A	10 ... 25 A	0.5 ... 20 s	15 ... 250 A	0.05 ... 0.5 s	38 ... 300 A	15 ... 25 A	0.05 ... 0.8 s	10 ... 40 A
			40 A	16 ... 40 A		24 ... 400 A		60 ... 480 A	16 ... 40 A		16 ... 63 A
			63 A	25 ... 63 A		38 ... 630 A		95 ... 756 A	16 ... 63 A		25 ... 100 A
			100 A	40 ... 100 A		60 ... 1000 A		150 ... 1200 A	20 ... 100 A		20 ... 160 A
	M/H/C/L	250 A	160 A	63 ... 160 A	0.5 ... 25 s	96 ... 1600 A	0.05 ... 0.5 s	240 ... 1920 A	32 ... 160 A	0.05 ... 0.8 s	32 ... 250 A
			250 A	100 ... 250 A	0.5 ... 15 s	150 ... 2500 A		375 ... 2500 A	50 ... 250 A		50 ... 250 A
	M/H/C/L	400 A	250 A	100 ... 250 A	0.5 ... 25 s	150 ... 2500 A	0.05 ... 0.5 s	375 ... 3000 A	50 ... 250 A	0.05 ... 0.8 s	50 ... 400 A
			400 A	160 ... 400 A	0.5 ... 17 s	240 ... 4000 A		600 ... 4000 A	80 ... 400 A		80 ... 400 A
	M/H/C	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	0.05 ... 0.5 s	600 ... 6000 A	80 ... 400 A	0.05 ... 0.8 s	80 ... 500 A
			500 A	200 ... 500 A	0.5 ... 20 s	300 ... 5000 A		750 ... 7000 A	100 ... 500 A		100 ... 500 A
			630 A	250 ... 630 A	0.5 ... 12 s	378 ... 5670 A		945 ... 5670 A	126 ... 630 A		126 ... 630 A
	L	630 A	400 A	160 ... 400 A	0.5 ... 25 s	240 ... 4000 A	0.05 ... 0.5 s	600 ... 4400 A	80 ... 400 A	0.05 ... 0.8 s	80 ... 500 A
630 A			250 ... 630 A	0.5 ... 12 s	378 ... 5670 A	945 ... 5670 A		126 ... 630 A	126 ... 630 A		

3.1 Line protection applications of 3VA molded case circuit breakers

Overload protection L:

- I_r adjustable from 0.4 to $1.0 \times I_n$ in absolute current values
 $I_r < 50$ A: In steps of 0.5 A
 $I_r \geq 50$ A: In steps of 1 A
- t_r adjustable from 0.5 to 12 / 15 / 17 / 20 / 25 s (depending on rated operational current and breaker size)
with a reference point of $6 \times I_r$.
In steps of 0.1 s

The ETU560 LSIG and ETU860 LSIG units have a thermal image which can be deactivated.

Short-time delayed short circuit protection S:

- I_{sd} adjustable from 0.6 to $9 / 10 \times I_n$
 $I_{sd} < 50$ A: In steps of 0.5 A
 $I_{sd} \geq 50$ A: In steps of 1 A
- t_{sd} adjustable from 0.05 to 0.5 s
with a reference point of $I_{sd} = 8 \times I_r$
in steps of 0.01 s

The curve shape $I^2t = \text{constant}$ can be deactivated.

Instantaneous short-circuit protection I:

- I_i Breaker sizes 100 A to 400 A:
adjustable from 1.5 to $10 / 12 \times I_n$
Size 630 A:
see tables above
In steps of 1 A

Ground-fault protection G:

4-pole breakers or 3-pole breakers with external current transformer for N conductor detect ground fault currents by calculating the vector sum of the phase currents and the neutral conductor current.

- I_g adjustable from 0.2 / 0.25 / 0.4 / 0.6 to $1.0 \times I_n$
In steps of 1 A
- t_g adjustable from 0.05 to 0.8 s
with a reference point of $2 \times I_g$
In steps of 0.01 s

An alarm threshold I_{gA} between 0.2 to $1 \times I_n$ can also be set. In steps of 1 A

The current-dependent curve shape $I^2t = \text{constant}$ can be deactivated.

The ground-fault protection function G can be deactivated.

Neutral conductor protection N:

The neutral conductor protection function is available only for 3-pole molded case circuit breakers with external current transformer for N conductor for 4-pole molded case circuit breakers.

- I_N adjustable in steps of 1 A

3-pole breakers with external current transformer for N conductor:

$I_n < 63$ A: 0.4 to 1.6 x I_n

$I_n \geq 63$ A: 0.2 to 1.6 I_n

4-pole breakers:

$I_n < 63$ A: 0.4 to 1.6 x I_n

$I_n \geq 63$ A: 0.2 to 1.0 or 1.6 x I_n

3.1.2 Overview of 3VA molded case circuit breakers in line protection applications

3VA molded case circuit breakers for line protection Electrical characteristics according to IEC 60947-2				3VA1 molded case circuit breakers													
				100 A 3VA10		160 A 3VA11		160 A 3VA11		160 A 3VA11		250 A 3VA12					
Number of poles				3, 4		1		2		3, 4		3, 4					
Rated operational current I_n [A]				100		160		160		160		250					
Rated operational voltage, max.				AC 50 / 60 Hz U_e [V]		690		240		415		690					
				DC U_e [V]		600		125		250		600		600			
Rated insulation voltage U_i [V]				800		500		500		800		800					
Rated impulse withstand voltage U_{imp} [kV]				8		8		8		8		8					
Use in IT systems				■		■		■		■		■					
Frequency [Hz]				0 ... 400		0 ... 400		0 ... 400		0 ... 400		0 ... 400					
Rated ultimate short-circuit breaking capacity AC				220 ... 240 V I_{cu} [kA]		25 36 55		25 36		36 55		36 55 85 100		55 85 100			
				380 ... 415 V I_{cu} [kA]		16 25 36		5 6		25 36		25 36 55 70		36 55 70		25 36 36	
				440 V I_{cu} [kA]		8 16 25						16 25 36 55 ¹⁾		25 36 36		10 15 15	
				500 V I_{cu} [kA]		O. r. O. r. O. r.						O. r. O. r. O. r. O. r.		10 15 15			
				690 V I_{cu} [kA]		5 5 7						7 7 10 10		5 7 10			
Rated service short-circuit breaking capacity AC				220 ... 240 V I_{cs} [kA]		25 36 55		25 36		36 55		36 55 85 100		55 85 100			
				380 ... 415 V I_{cs} [kA]		16 25 36		5 6		25 36		25 36 55 70		36 55 70		25 36 36	
				440 V I_{cs} [kA]		8 16 25						16 25 36 40 ¹⁾		25 36 36		10 10 10	
				500 V I_{cs} [kA]		O. r. O. r. O. r.						O. r. O. r. O. r. O. r.		10 10 10			
				690 V I_{cs} [kA]		5 5 5						5 5 5 5		5 5 5			
Rated ultimate short-circuit breaking capacity DC I_{cu} [kA]				DC		3-pole: up to 55 kA at 500 V 4-pole: up to 25 kA at 600 V		up to 25 kA at 125 V		up to 55 kA at 250 V		3-pole: up to 100 kA at 500 V 4-pole: up to 55 kA at 600 V		on request			
Rated service short-circuit breaking capacity DC I_{cs} [kA]				DC		3-pole: up to 55 kA at 500 V 4-pole: up to 25 kA at 600 V		up to 25 kA at 125 V		up to 55 kA at 250 V		3-pole: up to 100 kA at 500 V 4-pole: up to 55 kA at 600 V		on request			
Trip unit				Thermal-magnetic		T non-adjustable, M non-adjustable TM210 FTFM		■		■		■		■			
				T adjustable, M non-adjustable TM220 ATFM													
				T adjustable, M adjustable TM240 ATAM													
Electronic				Electronic		ETU320 LI, ETU330 LIG, ETU350 LSI											
						ETU550 LSI, ETU560 LSIG, ETU850 LSI, ETU860 LSIG											
Service life				Mechanical		15000		15000		15000		15000		15000			
				Electrical 50/60 Hz 380 ... 415 V		Switching cycles		8000		8000		8000		8000			
Switching frequency				Switching cycles/hour		120		120		120		120		120			
Power loss at max. rated current per pole														see chapter "Power loss"			
General information																	
Standards and specifications				IEC 60947-2													
Utilization category according to IEC 60947-2				A		A		A		A		A		A			
Overvoltage category				IV		IV		IV		IV		IV		IV			
Pollution degree according to IEC 60684-1				3		3		3		3		3		3			
Power and infeed direction				Variable													
Standard connection system				Screw-type terminal, box terminal								Screw-type terminal					
Versions				Fixed		Fixed		Fixed		Fixed/plug-in		Fixed/plug-in/ draw-out					
Isolating features according to IEC 60947				■		■		■		■		■					
Dimensions and weights																	
Dimensions, fixed-mounted with standard connections				Width [A] [mm]		76.2		25.4		50.8		76.2		105			
				Height [B] [mm]		130		130		130		130		158			
				Depth [C], without handle [mm]		70		70		70		70		70			
				Depth [D], with handle [mm]		85		85		85		85		85			
Weight				[kg]		0.90/1.15		0.35		0.60		0.90/1.15		1.8/2.3			

O. r. On request

1) I_n 125 A, 160 A: $I_{cu} / I_{cs} = 36 \text{ kA} / 36 \text{ kA}$

For the rated ultimate short-circuit breaking capacity and rated service short-circuit breaking capacity with direct current, see chapter DC network applications of the 3VA molded case circuit breaker (Page 132).

3.1 Line protection applications of 3VA molded case circuit breakers

3VA molded case circuit breakers for line protection Electrical characteristics according to IEC 60947-2				3VA2 molded case circuit breakers																			
				100A 3AV20		160 A 3VA21		250 A 3VA22		400 A 3VA23		630 A 3VA24											
Number of poles				3, 4		3, 4		3, 4		3, 4		3, 4											
Rated operational current				100		160		250		400		630											
Rated operational voltage, max.				AC 50/60 Hz		690		690		690		690											
				DC																			
Rated insulation voltage				800		800		800		800		800											
Rated impulse withstand voltage				8		8		8		8		8											
Use in IT systems				■		■		■		■		■											
Frequency				50 ... 60		50 ... 60		50 ... 60		50 ... 60		50 ... 60											
				M	H	C	L	M	H	C	L	M	H	C	L	M	H	C	L	M	H	C	L
Rated ultimate short-circuit breaking capacity AC				220 ... 240 V		85 110 150 200		85 110 150 200		85 110 150 200		85 110 150 O.r.		85 110 150 O.r.									
				380 ... 415 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		55 85 110 O.r.							
				440 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		O.r. O.r. O.r. O.r.							
				500 V		36 55 85 100		36 55 85 100		36 55 85 100		36 55 85 100		36 55 85 O.r.		O.r. O.r. O.r. O.r.							
Rated service short-circuit breaking capacity AC				220 ... 240 V		85 110 150 200		85 110 150 200		85 110 150 200		85 110 150 O.r.		85 110 150 O.r.									
				380 ... 415 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		55 85 110 O.r.							
				440 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		O.r. O.r. O.r. O.r.							
				500 V		36 55 85 100		36 55 85 100		36 55 85 100		36 55 85 100		36 55 65 O.r.		O.r. O.r. O.r. O.r.							
Rated ultimate short-circuit breaking capacity DC				220 ... 240 V		85 110 150 200		85 110 150 200		85 110 150 200		85 110 150 O.r.		85 110 150 O.r.									
				380 ... 415 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		55 85 110 O.r.							
				440 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		O.r. O.r. O.r. O.r.							
				500 V		36 55 85 100		36 55 85 100		36 55 85 100		36 55 85 100		36 55 65 O.r.		O.r. O.r. O.r. O.r.							
Rated service short-circuit breaking capacity DC				220 ... 240 V		85 110 150 200		85 110 150 200		85 110 150 200		85 110 150 O.r.		85 110 150 O.r.									
				380 ... 415 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		55 85 110 O.r.							
				440 V		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 150		55 85 110 O.r.		O.r. O.r. O.r. O.r.							
				500 V		36 55 85 100		36 55 85 100		36 55 85 100		36 55 85 100		36 55 65 O.r.		O.r. O.r. O.r. O.r.							
Rated ultimate short-circuit breaking capacity DC				DC																			
Rated service short-circuit breaking capacity DC				DC																			
Trip unit				Thermal-magnetic		T non-adjustable, M non-adjustable		TM210 FTFM															
				T adjustable, M non-adjustable		TM220 ATFM																	
Electronic				Electronic		ETU320 LI, ETU330 LIG, ETU350 LSI		■		■		■		■									
						ETU550 LSI, ETU560 LSIG, ETU850 LSI, ETU860 LSIG		■		■		■		■		■							
Service life				Mechanical		20000		20000		20000		20000		15000									
Switching frequency				Electrical 50/60 Hz		380 ... 415 V		Switching cycles		12000		10000		6000		6000		4000					
Power loss at max. rated current per pole				Switching cycles/hour		120		120		120		120		120		120							
see chapter "Power loss"																							
General information																							
Standards and specifications																							
Utilization category according to IEC 60947-2						A		A		A		A		A		A		A					
Overvoltage category						IV		IV		IV		IV		IV		IV		IV					
Pollution degree according to IEC 60684-1						3		3		3		3		3		3		3					
Power and infeed direction						Variable		Variable		Variable		Variable		Variable		Variable		Variable					
Standard connection system						Screw-type terminal, box terminal		Screw-type terminal		Screw-type terminal		Screw-type terminal		Screw-type terminal		Screw-type terminal		Screw-type terminal					
Versions						Fixed/plug-in/draw-out		Fixed/plug-in/draw-out		Fixed/plug-in/draw-out		Fixed/plug-in/draw-out		Fixed/plug-in/draw-out		Fixed/plug-in/draw-out		Fixed/plug-in/draw-out					
Isolating features according to IEC 60947						■		■		■		■		■		■		■					
Dimensions and weights																							
Dimensions, fixed-mounted with standard connections				Width [A]		[mm]		105		105		105		138		138		138					
				Height [B]		[mm]		181		181		181		248		248		248		248			
				Depth [C], without handle		[mm]		86		86		86		110		110		110		110			
				Depth [D], with handle		[mm]		107		107		107		137.5		137.5		137.5		137.5			
Weight				3-pole/4-pole		[kg]		3.20/4.20		3.20/4.20		3.20/4.20		4.0/5.1		4.2/5.4		4.2/5.4					

O. r. On request

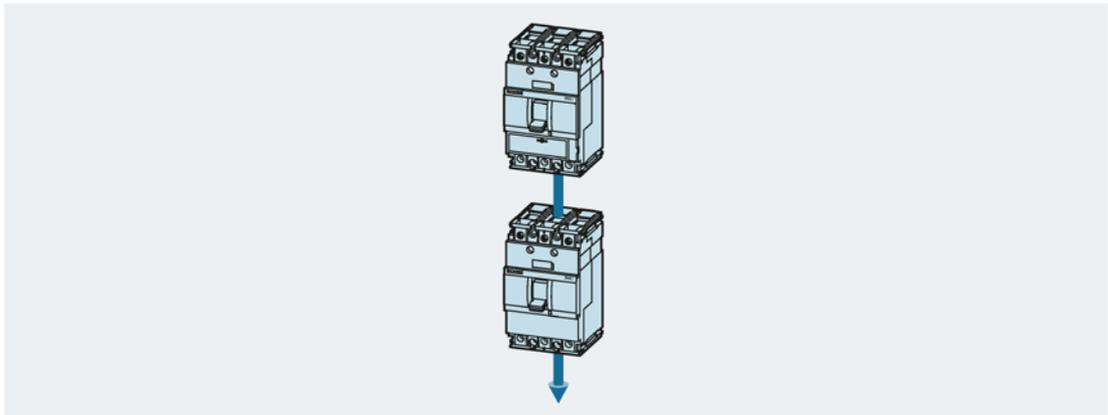
3.2 Use of the 3VA1 breaker as a switch disconnecter

Switch disconnectors are deployed as:

- Disconnectors in subdistribution and final distribution boards
- Bus couplers
- Disconnectors for machine line-ups, e.g. as maintenance or repair breakers
- Operator controls and disconnectors for cables, busbars and device line-ups
- Application as mains supply disconnectors
- Application as main switches
- Isolation of small distribution systems in industrial/commercial buildings
- Disconnection of loads

Switch disconnectors are capable of switching equipment and parts of electrical installations when they are conducting their operational current under normal operating conditions.

Switch disconnectors do not have an overload or short-circuit release. For this reason, a molded case circuit breaker or a fuse must be installed upstream of every switch disconnecter. Refer to chapter Upstream protection of switch disconnectors (Page 130).



Compatibility of 3VA switch disconnectors and accessories

3VA1 switch disconnectors have been developed from the 3VA1 molded case circuit breaker design. Both share the same attributes listed below:

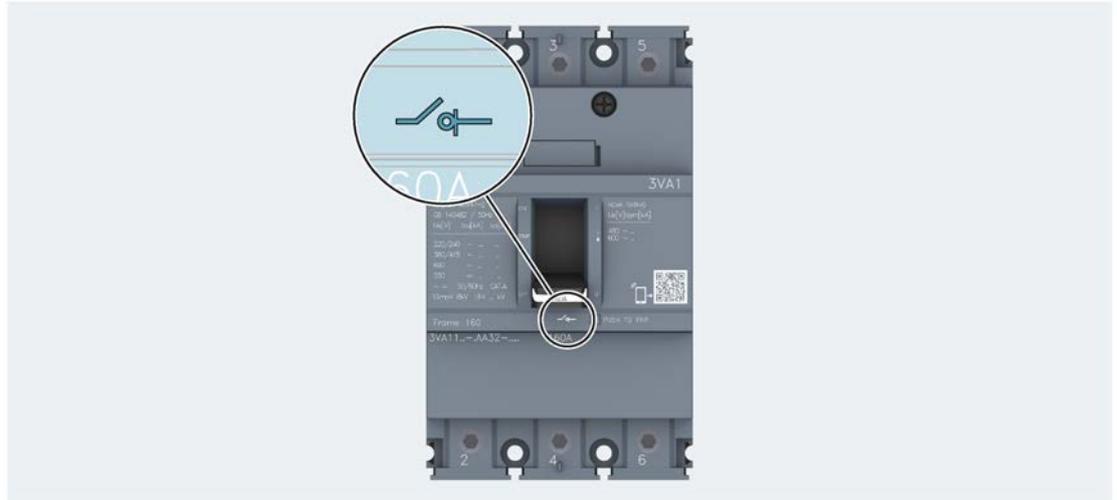
- Sizes
- Dimensions
- Mounting options
- Procedure for installing accessories

This means that a shunt trip can trip the switch disconnectors by remote control, or that the disconnecter can be opened or closed by a side wall mounted rotary operator.

Isolating features

A switch disconnecter isolates individual circuits or items of equipment so that maintenance or repair work can be carried out. This is a health and safety requirement.

In compliance with IEC 60947-3, the symbol below is clearly displayed on the front panel of switch disconnectors:



In accordance with the requirements of the standard regarding isolating function, the 3VA1 switch disconnecter features:

- the switch disconnecter symbol
- a correctly dimensioned isolating distance in the OFF position

When the switch disconnecter handle is in the OFF position, the isolating distance between the main contacts is guaranteed to meet the requirements stipulated by standards pertaining to isolating features. This also applies when manual or motor operators installed on the disconnecter are in the OFF position.

Only when the disconnecter is in this safe position can it be locked by various methods (e.g. door mounted rotary operator, motor operator).

Making capacity

Switch disconnectors have a predefined rated making and rated breaking capacity. As a result, loads are reliably switched on and off up to the specified breaking capacity.

Features

Switch disconnectors are primarily designed to conduct uninterrupted current up to the magnitude of the permissible rated uninterrupted current I_u .

Another important feature of these devices is their rated short-circuit making capacity I_{cm} , as this defines the capability of the switch disconnecter to withstand dynamic and thermal current loads. Current loads can reach very high values when the switch disconnecter makes on a short circuit. Switch disconnectors are designed to withstand these short-circuit currents without sustaining damage up to the value of their rated short-circuit making capacity.

Utilization categories for switch disconnectors

Utilization categories are differentiated according to the following criteria:

- The relationship between operational current and rated operational current
- The relationship between operational voltage and rated operational voltage
- Power factor (p.f.)
- Time constant

The utilization category is also identified by a letter:

A - for frequent operation

B - for infrequent operation, e.g. disconnectors which are used only to isolate parts of electrical installations for maintenance purposes.

It is important to note, however, that the term "frequent operation" does not mean that the switch disconnecter may be used to start up, accelerate or shut down individual motors in normal operation.

For example, a switch disconnecter with a rated operational current I_e of 160 A and a rated operational voltage U_e of 400 V AC may be used for frequent switching of a mixture of resistive and inductive loads including moderate overload only if it can conduct a making current I of 480 A ($3 \times I_e$) and withstand a making voltage U of 420 V AC ($1.05 \times U_e$) with a power factor of 0.65. This capability corresponds to utilization category AC-22A.

3.2 Use of the 3VA1 breaker as a switch disconnecter

Type of current	Utilization category		Typical applications	Rated operational current	Verification of rated making and breaking capacity					
	A	B			Switch on			Switch off		
					I / I_e	U / U_e	$\cos \varphi$	I_c / I_e	U_r / U_e	$\cos \varphi$
AC voltage	AC-21A	AC-21B	Switching of resistive loads including moderate overload	All values	1.5	1.05	0.95	1.5	1.05	0.95
	AC-22A	AC-22B	Switching of mixed resistive and inductive loads including moderate overload	All values	3	1.05	0.65	3	1.05	0.65
	AC-23A	AC-23B	Switching of motors or other high-inductance loads	$0 < I_e \leq 100 \text{ A}$	10	1.05	0.45	8	1.05	0.45
				$100 \text{ A} < I_e$	10	1.05	0.35	8	1.05	0.35
Type of current	Utilization category		Typical applications	Rated operational current	I / I_e	U / U_e	L / R ms	I_c / I_e	U_r / U_e	L / R ms
	A	B								
Direct voltage	DC-21A	DC-21B	Switching of resistive loads including moderate overload	All values	1.5	1.05	1	1.5	1.05	1
	DC-22A	DC-22B	Switching of mixed resistive and inductive loads including moderate overload	All values	4	1.05	2.5	4	1.05	2.5
	DC-23A	DC-23B	Switching of high-inductance loads	All values	4	1.05	15	4	1.05	15

- I Making current
- I_c Breaking current
- I_e Rated operational current
- U Applied voltage
- U_e Rated operational voltage
- U_r Recovery voltage

3.2.1 Overview of 3VA1 as switch disconnectors

				3VA1 switch disconnectors		
3VA1 / SD100 switch disconnectors						
Electrical characteristics according to IEC 60947-3				160 A 3VA11	250 A 3VA12	
Rated continuous current at 50° C		I_u	[A]	63, 100, 125, 160	250	
Number of poles				3, 4	3, 4	
Utilization category	AC-21A		[A]	63, 100, 125, 160	250	
	AC-22A		[A]	63, 100, 125, 160	250	
	AC-23A		[A]	63, 100, 125, 160	250	
	DC-21A		[A]	63, 100, 125, 160	250	
	DC-22A		[A]	63, 100, 125, 160	250	
	DC-23A		[A]	63, 100, 125, 160	250	
Rated operational voltage, max.	AC (50 / 60 Hz)	U_e	[V]	690	690	
	DC	U_e	[V]	3-pole: 500 4-pole: 600	3-pole: 500 4-pole: 600	
Rated insulation voltage		U_i	[V]	800	800	
Rated impulse withstand voltage		U_{imp}	[kV]	8	8	
Use in IT systems				■	■	
Rated short-circuit making capacity	Switch disconnector only (min.)	I_{cm}	[kA]	3	on request	
	With additional line-side 3VA1 circuit breaker (max.)	I_{cm}	[kA]	70 kA at 415 V 3 kA at 690 V	on request	
Max. permissible let-through energy	380 ... 415 V	I^2t	[A ² s]	475 000	on request	
	690 V	I^2t	[A ² s]	475 000	on request	
Max. let-through current	380 ... 415 V	I_c	[kA]	20	on request	
	690 V	I_c	[kA]	3	on request	
Rated short-time withstand current	t = 0.5 s	I_{cw}	[kA]	2	3	
	t = 1 s	I_{cw}	[kA]	2	3	
Service life	Mechanical		Switching cycles	15000	on request	
	Electrical	AC-22A 50 / 60 Hz	380 ... 415 V	Switching cycles	8000	on request
			690 V	Switching cycles	on request	on request
		AC-23A 50 / 60 Hz	380 ... 415 V	Switching cycles	8000	on request
			690 V	Switching cycles	on request	on request
		DC22A	250 V	Switching cycles	8000	on request
			500 V	Switching cycles	8000	on request
	DC23A	600 V	Switching cycles	on request	on request	
		250 V	Switching cycles	8000	on request	
			500 V	Switching cycles	8000	on request
		600 V	Switching cycles	on request	on request	

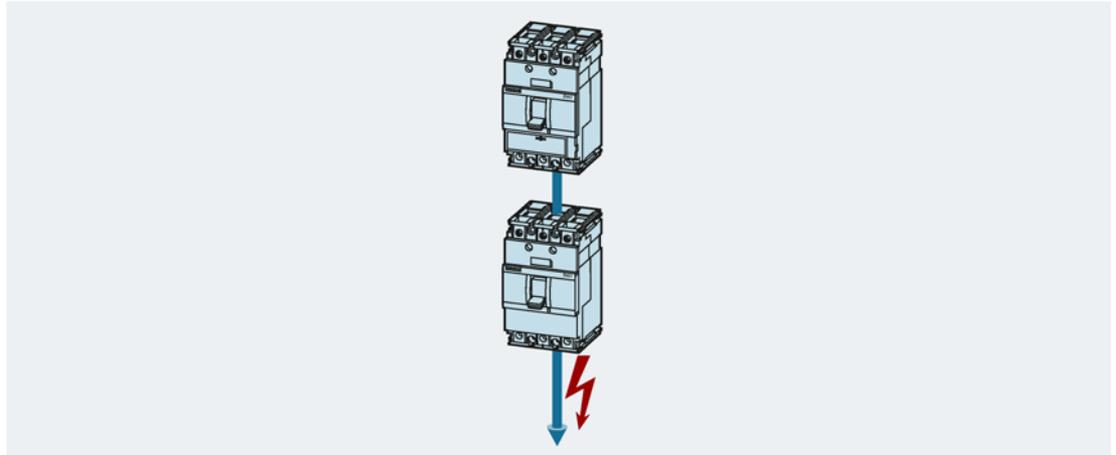
3.2.2 Upstream protection of switch disconnectors

Switch disconnectors are not equipped with an integral overload or short-circuit release. For this reason, a molded case circuit breaker or a fuse must be installed upstream of every switch disconnector.

The coordination tables given below contain the following information:

- The correct assignment of molded case circuit breakers to the switch disconnectors which require protection
- The maximum permissible rms short-circuit current kA rms for each combination of molded case circuit breaker and switch disconnector

Protection of 3VA1 switch disconnectors at 50 / 60 Hz by a 3VA1 molded case circuit breaker



Downstream switch disconnector		Upstream molded case circuit breaker												
		Current rating		100 A			160 A				250 A			
		Type	3VA10			3VA11				3VA12				
		U_e [V]	I_{cu} [kA]		B	N	S	N	S	M	H	S	M	H
160 A	3VA11...AA... 63 A, 100 A	220 ... 240	25	36	55	36	55	85	100	on request				
		380 ... 415	16	25	36	25	36	55	70					
		690	2	2	2	2	2	2	2					
250 A	3VA11...AA... 250 A	220 ... 240	on request											
		380 ... 415												
		690												

More combinations can be found on the Internet (<http://www.siemens.com/3VA-Documentation>).

Combinations with other protective devices can be configured at any time by means of SIMARIS design or using the characteristics maximum let-through energy I^2t_{max} and maximum let-through current $I_{c,max}$ of the 3VA1 switch disconnector. You will find these characteristics in the technical product data sheets and in the table in chapter Overview of 3VA1 as switch disconnectors (Page 130).

Note

In the event of a fault, all switching devices in the affected branch must be function-tested (see Regular maintenance (Page 419)).

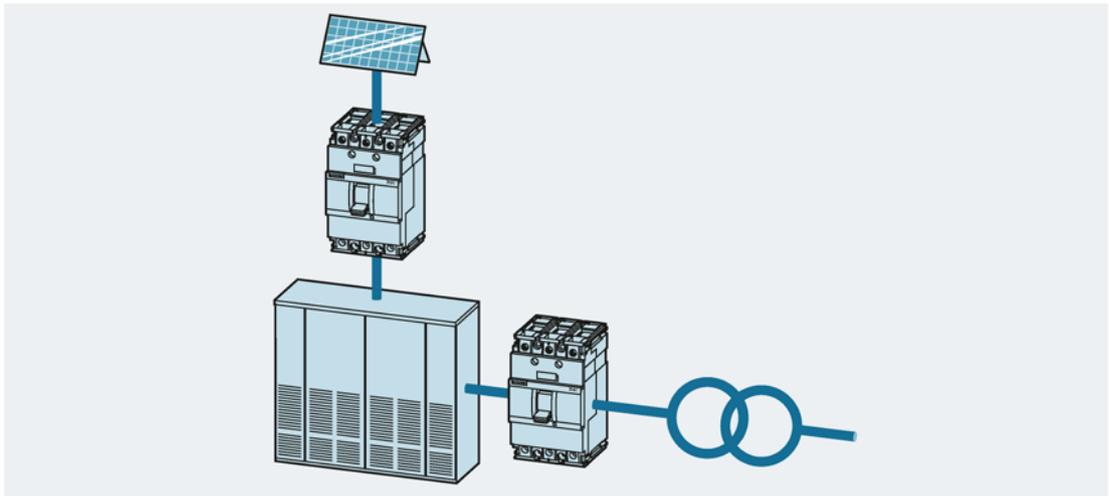
3.3 DC network applications of the 3VA molded case circuit breaker

3.3.1 Introduction

The main applications for 3VA circuit breakers in DC installations or networks are:

- Public transport systems, e.g. electric cars, underground rail networks and streetcars
- UPS systems
- Photovoltaic plants
- Wind power plants

3VA1 molded case circuit breakers as line protection devices with thermal trip units and magnetic trip units with short-circuit protection are suitable for use in DC networks.



Features specific to direct current

Short-circuits are interrupted in DC networks by a method similar to the one applied to high alternating currents, i.e. by current limiting. A high arc voltage develops in molded case circuit breakers, which forces a current zero when the arc voltage exceeds the value of the recovery voltage. The current rise, however, is determined by the time constant and not the make time or power factor.

Overloads are interrupted by a completely different principle to the method applied in AC networks. With direct currents, there is no periodic zero crossing and thus also no period of time without magnetic energy in the circuit during which the conditions for extinguishing the arc are favorable. The arc is not extinguished until the arc voltage exceeds the line voltage and the current reduces to zero. In other words, a high arc voltage must be developed in order to interrupt the direct current.

The rated operational current values are generally the same for DC and AC applications.

With DC applications, the breaking capacity depends only on:

- The arc extinction method used
- The line voltage

3.3.2 Variants

The same thermal-magnetic trip units used as line protection devices in AC installations are also available for protecting DC installations.

However, a correction factor must be applied to the magnetic trip unit.

Correction factor for the magnetic trip unit for DC systems		
3VA10 100 A	3VA11 160 A	3VA12 250 A
0.7	0.7	0.85

Example:

3VA1 160 A, TM240 ATAM:

If the switching device is to trip instantaneously in response to an overcurrent of 1200 A, the parameter I_i for instantaneous short-circuit protection (I) must be set to:

$$I_i = 1200 \text{ A} \times 0.7 = 840 \text{ A.}$$

For further information on trip units and details about setting parameters, please refer to chapter "Line protection applications of 3VA molded case circuit breakers (Page 105)".

It is not possible to use electronic trip units for this application.

3.3.3 Breaking capacity with direct current

3VA molded case circuit breakers for DC applications DC breaking capacity				3VA1 molded case circuit breakers								
				100 A / 3VA10		160 A / 3VA11				250 A / 3VA12		
				3-pole	4-pole	1-pole	2-pole	3-pole	4-pole	3-pole	4-pole	
Rated ultimate short-circuit breaking capacity I_{cu} / Rated service short-circuit breaking capacity I_{cs}	at 125 V DC	1 switching pole	B [kA]									
			N [kA]			16 / 16	16 / 16					
			S [kA]			25 / 25	25 / 25					
			M [kA]									
			H [kA]									
	at 250 V DC	2 switching poles	B [kA]	25 / 25	25 / 25							
			N [kA]	36 / 36	36 / 36		36 / 36	36 / 36	36 / 36			
			S [kA]	55 / 55	55 / 55		55 / 55	55 / 55	55 / 55	55 / 55	55 / 55	55 / 55
			M [kA]					85 / 85	85 / 85	85 / 85	85 / 85	85 / 85
			H [kA]					100 / 100	100 / 100	100 / 100	100 / 100	100 / 100
	at 500 V DC	3 switching poles	B [kA]	25 / 25	25 / 25							
			N [kA]	36 / 36	36 / 36			36 / 36	36 / 36			
			S [kA]	55 / 55	55 / 55			55 / 55	55 / 55	55 / 55	55 / 55	55 / 55
			M [kA]					85 / 85	85 / 85	85 / 85	85 / 85	85 / 85
			H [kA]					100 / 100	100 / 100	100 / 100	100 / 100	100 / 100
	at 600 V DC	4 switching poles	B [kA]		8 / 8							
			N [kA]		16 / 16				16 / 16			
			S [kA]		25 / 25				25 / 25		25 / 25	
			M [kA]						36 / 36		36 / 36	
			H [kA]						55 / 55		55 / 55	

O. r. On request

3.3.4 Recommended circuit configurations for DC systems

Max. permissible direct voltage U_e		DC 1-pole disconnection Grounded system	DC 2-pole (all-pole) disconnection Grounded system Non-grounded system	
125 V DC	1 switching pole			
250 V DC	2 switching poles			
500 V DC ¹⁾	3 switching poles			
600 V DC ¹⁾	4 switching poles			

GF Ground-fault monitoring

¹⁾ $U_e > 250$ V DC: DC insulating plate is mandatory for sizes 3VA10 and 3VA11 with a non-insulated mounting plate (see chapter Insulating equipment (Page 191))

Note

DC 2-pole (all-pole disconnection), grounded system

The grounded pole must always be assigned to the individual conducting path, so that in the event of a ground fault there are always 2 conducting paths in series in a circuit with 3-pole molded case circuit breakers, and 3 conducting paths in series in a circuit with 4-pole molded case circuit breakers.

Note

DC 2-pole (all-pole disconnection), non-grounded system

If there is no possibility of a double ground fault occurring, or if any ground fault that does occur is dealt with immediately (ground-fault monitoring), 500 V will be the maximum permissible direct voltage. In a non-grounded system, all poles must be disconnected.

Further circuits are available on request.

3.4 400 Hz network applications of 3VA molded case circuit breakers

400 Hz networks are used for:

- Ground power supply systems for aircraft
- On-board electrical systems of marine craft and aircraft
- Other external stations of airports which are protected by uninterruptible power supplies, e.g. radar installations, data processing equipment, communication systems

It is important to supply the on-board electrical systems of aircraft with a very smooth DC voltage. This can be generated more easily by 400 Hz power supplies than by 50 Hz networks. Moreover, the power transmitters (transformers) are smaller and lighter by comparison with 50 Hz networks, two important arguments for using 400 Hz on-board electrical systems in aircraft and some marine craft.

Suitable 3VA molded case circuit breakers and trip units

3VA molded case circuit breakers equipped with 2-series thermal-magnetic trip units are suitable for use in 400 Hz networks.

Features specific to 400 Hz supplies

The thermal overload release of the 3VA1 molded case circuit breaker comprises a bimetal through which current flows, causing temperature rise. With currents at 400 Hz frequency, the temperature rise in the bimetal is higher than at 50 Hz. This is due to eddy-current losses and the reduction in the available conductor cross section as a result of the skin effect. The rated operational current must therefore be reduced by 10 % of the value used in 50/60 Hz applications.

Furthermore, a correction factor must be applied to the magnetic trip unit.

Correction factor at 400 Hz		
3VA10 100 A	3VA11 160 A	3VA12 250 A
0.7	0.7	on request

Example:

3VA1 160A, TM240 ATAM:

- Reduction by 10%:
Maximum permissible rated operational current for 400 Hz applications =
 $160 \text{ A} \times 0.9 = 144 \text{ A}$
- Correction factor 0.7:
If the switching device is to trip instantaneously in response to an overcurrent of 1200 A, the parameter I_i for instantaneous short-circuit protection (I) must be set to $I_i = 1200 \text{ A} \times 0.7 = 840 \text{ A}$.

For further information on trip units and details about the setting parameters, please refer to chapter Line protection applications of 3VA molded case circuit breakers (Page 105).

It is not possible to use electronic trip units for this application.

See also

Temperature compensation with thermal-magnetic trip units of the TM 2-series (Page 491)

3.5 IT system applications of 3VA molded case circuit breakers

The main advantage of IT systems is that they safeguard continuity of service by electrical installations and are therefore deployed predominantly in consumer installations where availability of electrical power is a priority. As a general rule, circuits are interrupted only if two insulation faults occur simultaneously.

Preferred applications for IT systems are therefore:

- In buildings with rooms used for medical purposes
- For operation of mobile generators
- In certain industries, e.g.:
 - in the chemical industry
 - in the oil industry
 - in the steel industry
 - in mining

The IT system is a low-voltage power supply network with increased failure-safety in the event of ground faults. In an IT system, live phases are not connected to ground. A ground fault does not cause system shutdown. DIN EN 60204-1 (VE 0113) therefore stipulates that an insulation monitoring device must be installed in order to indicate ground faults. In the unusual event that a fault on the load side coincides with a second fault on the line side, the full phase-to-phase voltage is connected across one contact of the breaker. Siemens 3VA molded case circuit breakers for line protection, whether they are equipped with a thermal-magnetic trip unit or an electronic trip unit, are suitable for use in IT systems.

Accordingly, the molded case circuit breakers meet the requirements of standard IEC / DIN EN 60947-2 Annex H up to a maximum voltage ($U_{e, max.}$) of 690 V AC.

3.5.1 Selection criteria for 3VA molded case circuit breakers

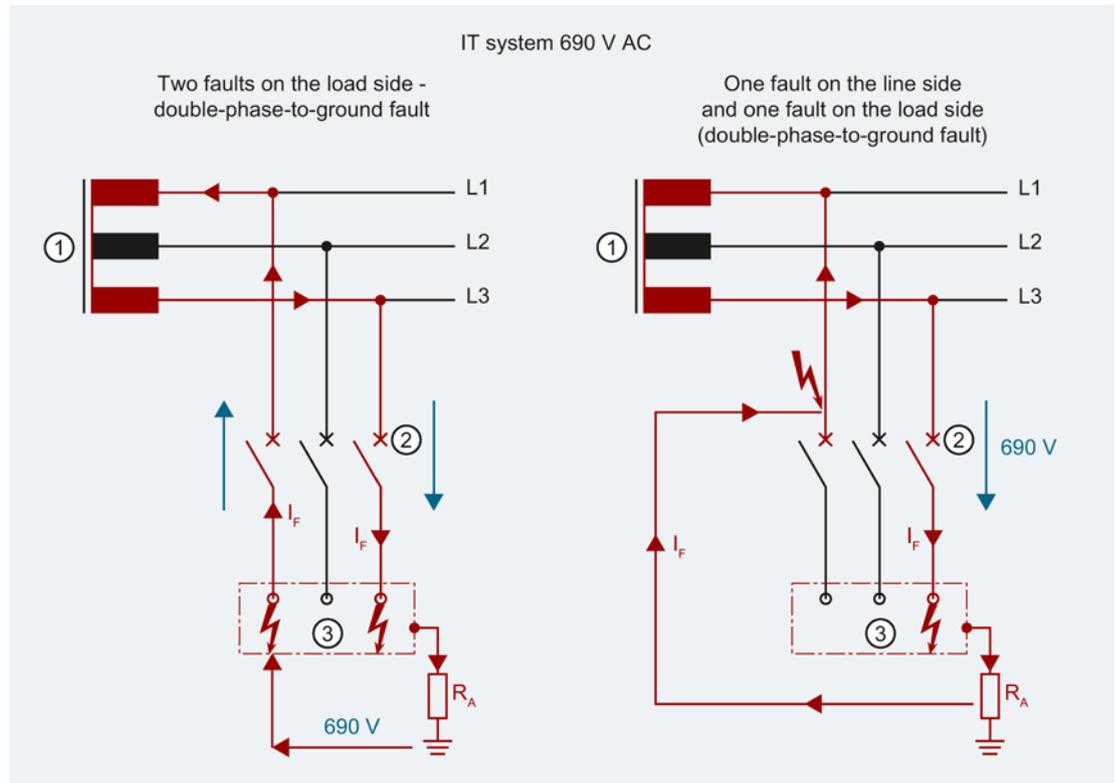
The circuit breakers are always dimensioned and selected irrespective of the system type in which they will be deployed.

The circuit breaker is always selected according to the maximum potential short-circuit current in the IT system. The device is selected in accordance with the relevant I_{cu} values of the 3VA molded case circuit breaker.

If the system operator takes measures to ensure that a double-phase-to-ground fault cannot develop on the line side or load side of the circuit breaker, the breaking capacity I_{cu} / I_{cs} remains unchanged in IT systems. If this cannot be ensured, the values in accordance with the standard IEC 60947-2 Annex H apply for single-pole short circuits.

3.5.2 Fault situation

The most critical fault for molded case circuit breakers in ungrounded IT systems is a double-phase-to-ground fault on the infeed and load ends of the molded case circuit breaker. If this fault occurs, the entire phase-to-phase voltage is applied across one pole of the molded case circuit breaker.



- ① Ungrounded transformer
 ② Molded case circuit breaker
 ③ Exposed conductive part
 R_A Contact resistance of exposed conductive part ground

Two faults on the load side - double-phase-to-ground fault

- A fault develops between two phases and an exposed conductive part or ground.
- A voltage of 690 V is applied at the main contacts. This voltage is disconnected by two breaker poles.
- The molded case circuit breaker is rated for I_{cu}/I_{cs} at 690 V.

One fault on the line side and one fault on the load side (double-phase-to-ground fault)

- Single-pole short circuit, the full phase-to-phase voltage of 690 V is applied to main contact L3.
- Selection of the molded case circuit breaker according to their suitability as defined in IEC 60947-2, Annex H.

4.1 Overview of accessories for 3VA molded case circuit breakers

4.1.2 Possible combinations of accessories

The tables below indicate the combinability of different accessories. The boxes to the right of the grey diagonal line indicate whether or not accessories can be combined.

Examples:

Circular conductor terminal, 2 cables, and insulating plate broadened (green lines in table below):

Common box: contains square sym- Accessories can be combined
bol

Circular conductor terminal, 2 cables, and terminal cover (red lines in table below):

Common box: is empty Accessories cannot be combined

	Locking and interlocking	Misc.	Connection technology	Communication
	Sliding bar with Bowden cable Interlocking module for rotary operators Sliding bar Rear interlock Padlock device Cylinder lock adapter for accessories compartment Cylinder lock (type Ronis) Bowden cable 90 - 600 mm Bowden cable 600 - 1000 mm Bowden cable 1000 - 1500 mm Mounting plate for rear interlock Mounting screw kit	Handle extension Rear terminal flat Rear connecting studs Lug terminal, right-angled Insulating plate Insulating plate, broadened	Lug terminal Front connection bars extended Front connection bars broadened Front connection bars edgewise Box terminal Circular conductor terminal Circular conductor terminal, large Circular conductor terminal, 2 cables Circular conductor terminal, 6 cables Phase barriers Terminal cover, extended Terminal cover, short Terminal cover, broadened	24 V module COM060 communication module Voltage tap for metering function External current transformer for N conductor EFB300 external function box
Misc.				
Connection technology				
Communication				

4.1 Overview of accessories for 3VA molded case circuit breakers

	Front mounted rotary operator	Side wall mounted rotary operator	Door mounted rotary operator	Cylinder lock (type Ronis)	Cylinder lock adapter for manual operators	Illumination kit	Cylinder lock (type Kaba)	Door interlocking system	Extended DIN rail for N/PE terminal	Shaft 600 mm	Variable depth adapter	Rotary operator with shaft stub	Supplementary handle for door mounted rotary operator	Motor operator	Side mounted residual current device	RCD basic/advanced type A	Conversion kit for draw-out unit	Complete kit for draw-out unit	Conversion kit for plug-in unit	Complete kit for plug-in unit	DIN rail adapter	Auxiliary circuit connector for draw-out unit	Auxiliary circuit connector for plug-in unit	Position signaling switch	Door feedthrough	Communication interface for draw-out unit	Cylinder lock (type Ronis)	Cylinder lock adapter for draw-out unit
Manual operators																												
Front mounted rotary operator																												
Side wall mounted rotary operator																												
Door mounted rotary operator																												
Cylinder lock (type Ronis)																												
Cylinder lock adapter for manual operators																												
Illumination kit																												
Cylinder lock (type Kaba)																												
Door interlocking system																												
Extended DIN rail for N/PE terminal																												
Shaft 600 mm																												
Variable depth adapter																												
Rotary operator with shaft stub																												
Supplementary handle for door mounted rotary operator																												
M																												
Motor operator																												
RCD																												
Side mounted residual current device																												
RCD basic/advanced type A																	1)	1)	1)	1)								
Plug-in and draw-out technology																												
Conversion kit for draw-out unit																												
Complete kit for draw-out unit																												
Conversion kit for plug-in unit																												
Complete kit for plug-in unit																												
DIN rail adapter																												
Auxiliary circuit connector for draw-out unit																												
Auxiliary circuit connector for plug-in unit																												
Position signaling switch																												
Door feedthrough																												
Communication interface for draw-out unit																												
Cylinder lock (type Ronis)																												
Cylinder lock adapter for draw-out unit																												
Locking and interlocking																												
Sliding bar with Bowden cable																												
Interlocking module for rotary operators																												
Sliding bar																												
Rear interlock																												
Padlock device																												
Cylinder lock adapter for accessories compartment																												
Cylinder lock (type Ronis)																												
Bowden cable 90 - 600 mm																												
Bowden cable 600 - 1000 mm																												
Bowden cable 1000 - 1500 mm																												
Mounting plate for rear interlock																												

1) only 4-pole 3VA molded case circuit breakers

4.2 Internal accessories

4.2.1 Mounting locations on 3VA molded case circuit breakers

The portfolio of internal accessories includes:

- Auxiliary switches
- Alarm switches
- Auxiliary releases
- COM060 communication module
- 24 V module
- Cylinder lock (type Ronis)

The following tables show the alternative mounting locations for internal accessories, which depend on the size and pole number of the circuit breaker.

3VA1 molded case circuit breakers:

3VA1 Internal accessories		3VA1 160 A 2-pole			3VA1 100 A 3- and 4-pole					3VA1 160 A 3- and 4-pole					3VA1 250 A 3- and 4-pole									
Mounting location		23	22	21	23	22	21	11	12	13	23	22	21	11	12	13	24	23	22	21	11	12	13	14
Auxiliary switches	AUX_HQ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	AUX_HQ_el	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	AUX_HP	■	■	■							■	■	■	■	■	■	■	■	■	■	■	■	■	■
	LCS_HQ													■	■	■					■	■	■	■
	LCS_HQ_el													■	■	■					■	■	■	■
	LCS_HP													■	■	■					■	■	■	■
Alarm switches	TAS_HQ	■	■		■	■		■	■		■	■		■	■		■	■						
	TAS_HQ_el	■	■		■	■		■	■		■	■		■	■		■	■						
	TAS_HP	■	■								■	■		■	■		■	■		■	■			
	EAS_HQ																							
	EAS_HQ_el																							
	SAS_HQ									■						■								■
SAS_HQ_el									■						■								■	
Auxiliary releases	Shunt trip left	■	■	■	■	■	■				■	■	■				■	■	■					
	STL (EI)	■	■	■	■	■	■				■	■	■				■	■	■					
	Shunt trip flexible	■	■	■							■	■	■				■	■	■					
	Electromagnetic release				■	■	■				■	■	■				■	■	■					
	Undervoltage release	■	■	■	■	■	■				■	■	■				■	■	■					
	Undervoltage release with leading NO contacts	■	■	■	■	■	■				■	■	■				■	■	■					
	Universal release	■	■	■	■	■	■				■	■	■				■	■	■					
Communication module																								
24 V module																								
Cylinder lock (type Ronis)													■	■	■							■	■	■

4.2 Internal accessories

3VA2 molded case circuit breakers:

3VA2 100/160/250 A Internal accessories		3VA2 100/160/250 A 3-pole								3VA2 100/160/250 A 4-pole													
Mounting location		24	23	22	21	11	12	13	14	34	33	32	31	24	23	22	21	11	12	13	14		
Auxiliary switches	AUX_HQ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
	AUX_HQ_el	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
	AUX_HP	▬				▬				▬				▬									
Leading changeover switch	LCS_HQ					■												■					
	LCS_HQ_el					■												■					
	LCS_HP					▬												▬					
Trip alarm switch	TAS_HQ			■	■	■	■									■	■	■	■				
	TAS_HQ_el			■	■	■	■									■	■	■	■				
	TAS_HP			▬		▬										▬		▬					
Electrical alarm switch	EAS_HQ								■												■		
	EAS_HQ_el								■												■		
Short circuit alarm switch	SAS_HQ																						
	SAS_HQ_el																						
Shunt trip left	STL		▬													▬							
	STL (EI)		▬													▬							
Shunt trip flexible	STF		▬				▬									▬				▬			
Electromagnetic release	RCR																						
Undervoltage release	UVR		▬													▬							
Undervoltage release with leading NO contacts	UVR (LNO)		▬													▬							
Universal release	UNI		▬													▬							
Communication module	COM060					▬												▬					
24 V module						▬												▬					
Cylinder lock (type Ronis)						▬												▬					

3VA2 400/630 A Internal accessories		3VA2 400/630 A 3-pole										3VA2 400/630 A 4-pole														
Mounting location		25	24	23	22	21	11	12	13	14	15	35	34	33	32	31	25	24	23	22	21	11	12	13	14	15
Auxiliary switches	AUX_HQ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	AUX_HQ_el	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	AUX_HP	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Leading changeover switch	LCS_HQ						■															■				
	LCS_HQ_el						■															■				
	LCS_HP						■															■				
Trip alarm switch	TAS_HQ			■	■		■	■											■	■		■	■			
	TAS_HQ_el			■	■		■	■											■	■		■	■			
	TAS_HP			■	■		■	■											■	■		■	■			
Electrical alarm switch	EAS_HQ										■															■
	EAS_HQ_el										■															■
Short circuit alarm switch	SAS_HQ																									
	SAS_HQ_el																									
Auxiliary releases	Shunt trip left		■	■	■	■													■	■	■					
	STL (EI)		■	■	■	■													■	■	■					
	Shunt trip flexible		■	■	■	■	■	■											■	■	■	■	■			
	Electromagnetic release																									
	RCR																									
Undervoltage release	UVR		■	■	■	■													■	■	■					
	UVR (LNO)		■	■	■	■													■	■	■					
	UNI		■	■	■	■													■	■	■					
Communication module	COM060						■	■	■	■											■	■	■	■	■	
24 V module							■	■	■	■											■	■	■	■	■	
Cylinder lock (type Ronis)							■	■	■	■											■	■	■	■	■	

4.2.2 Auxiliary and alarm switches

The auxiliary and alarm switches for 3VA molded case circuit breakers belong to an integrated range of accessories. They can be installed in all sizes of all breakers up to 630 A.

The auxiliary and alarm switches can be very simply snapped into place and connected up in accessories compartments provided on the front panel of the unit to the left and right of the handle.

All auxiliary and alarm switches are designed as changeover contacts and therefore provide a high degree of flexibility for planning and installation purposes.

HQ and HP switches

The switches are available in versions HQ and HP. HQ switches are 7 mm wide, and HP switches 14 mm wide.



Both switch versions can be combined extremely flexibly in a molded case circuit breaker. This level of compatibility means that two HQ switches can be optionally installed in place of one HP switch.

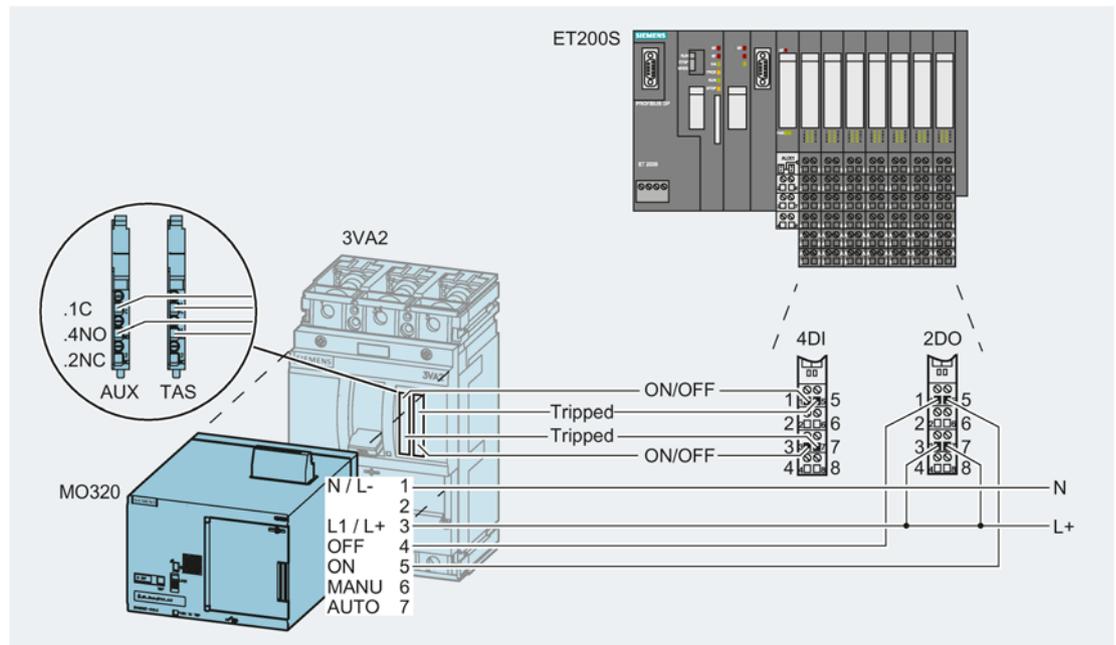
HQ and HP switches have the same functionality, but differ in terms of the following features:

- Connection technology
 - HQ: One conductor per contact point
 - HP: Two conductors per contact point possible (loop-through)
- Key electrical data
 - HQ: max. 250 V; max. 6 A
 - HP: max. 600 V; max. 10 A

Individual key electrical data can be found at the end of this chapter.

All HQ switches are also available in a version compatible with electronic circuitry (HP el).

The diagram below uses the example of an ET200S to illustrate the conventional method of connecting the electronics-compatible auxiliary switch AUX, the trip alarm switch TAS and the motor operator MO320 to a distributed I/O unit.



Further information about contact reliability can be found at the end of this chapter.

Auxiliary switches AUX



The purpose of auxiliary switches is to signal the position of the main contacts of the molded case circuit breaker. The contacts of the auxiliary switch open and close simultaneously with the main contacts of the molded case circuit breaker.

Leading changeover switches LCS



Leading changeover switches signal the opening of the main contacts with a lead time of 20 ms in advance of circuit breaker trips and are thus used for load shedding, for example.

Trip alarm switches TAS



Trip alarm switches signal every circuit breaker trip, regardless of the cause of the trip. The trip alarm switches are operated whenever the molded case circuit breaker switches to the TRIP position.

Electrical alarm switches EAS



Electrical alarm switches are operated as soon as the main contacts of the molded case circuit breaker open in the event that the breaker is tripped by the ETU. They indicate the following conditions:

- Overload L and neutral conductor overload
- Short-circuit S, I
- Ground-fault tripping G
- Residual current device RCD820

The electrical alarm switch is not operated:

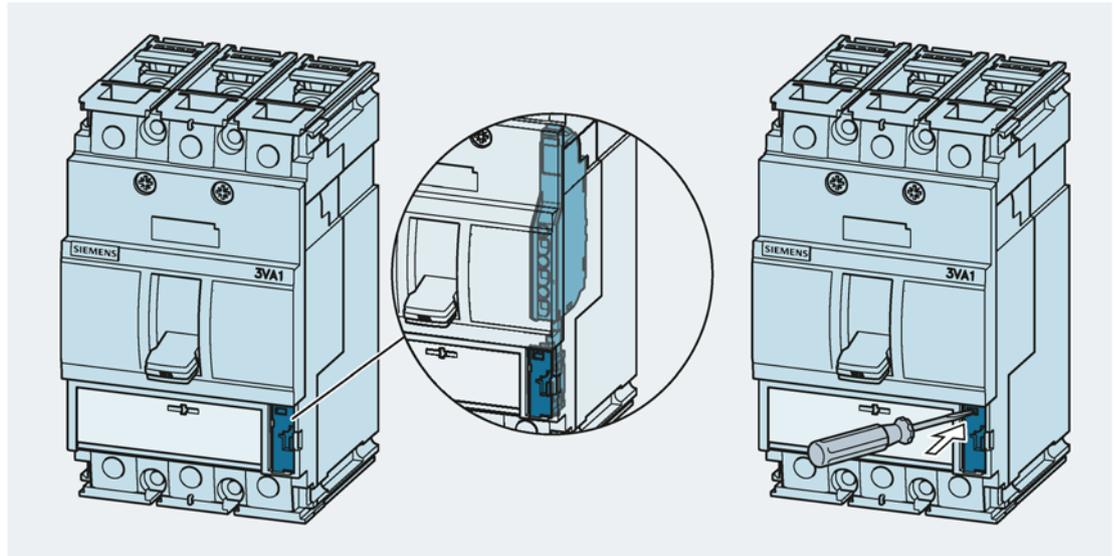
- When the breaker is tripped manually
 - PUSH TO TRIP
 - When the breaker is withdrawn from the plug-in/draw-out socket when the main contacts are closed
- When activated via an auxiliary release
 - Shunt trip STL, STL(EI), STF
 - Undervoltage release UVR, UVR (LNO)
 - Universal release UNI

Electrical alarm switches are compatible only with 3VA2 molded case circuit breakers equipped with electronic trip units (ETU).

Short circuit alarm switches SAS



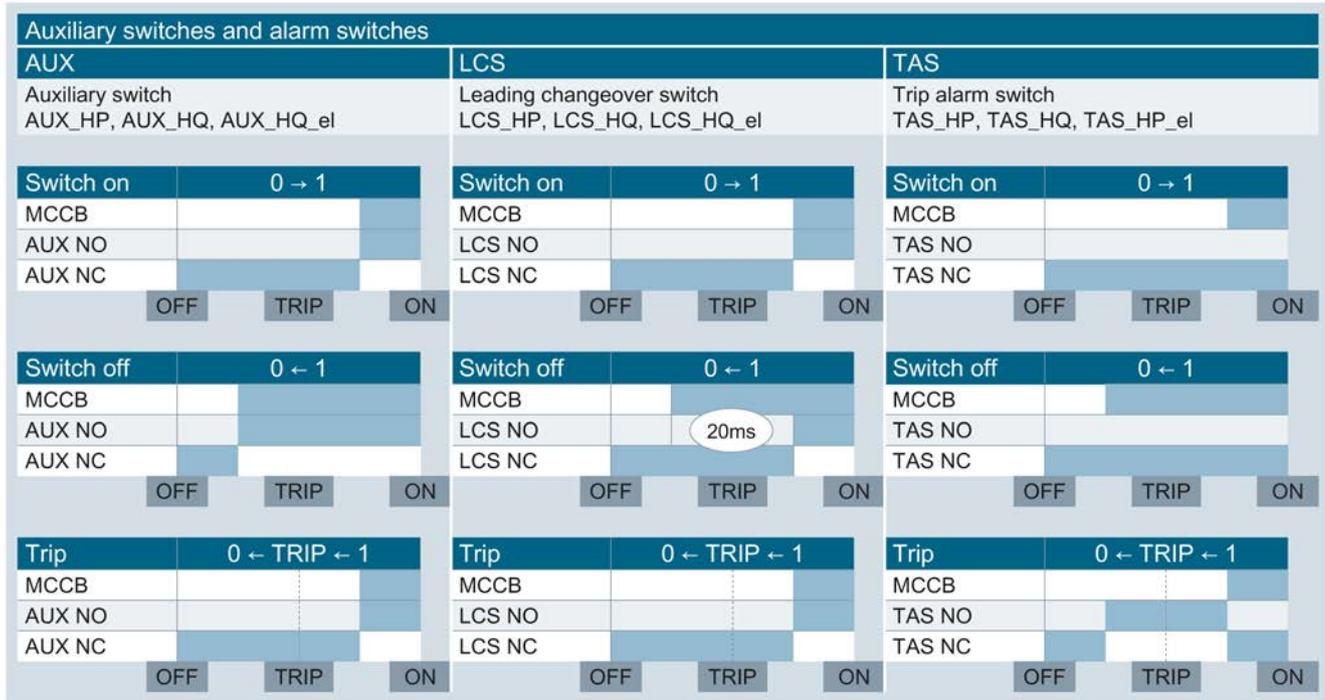
Short circuit alarm switches signal trips only if they have been initiated by a short circuit. These events are also indicated on the molded case circuit breaker.



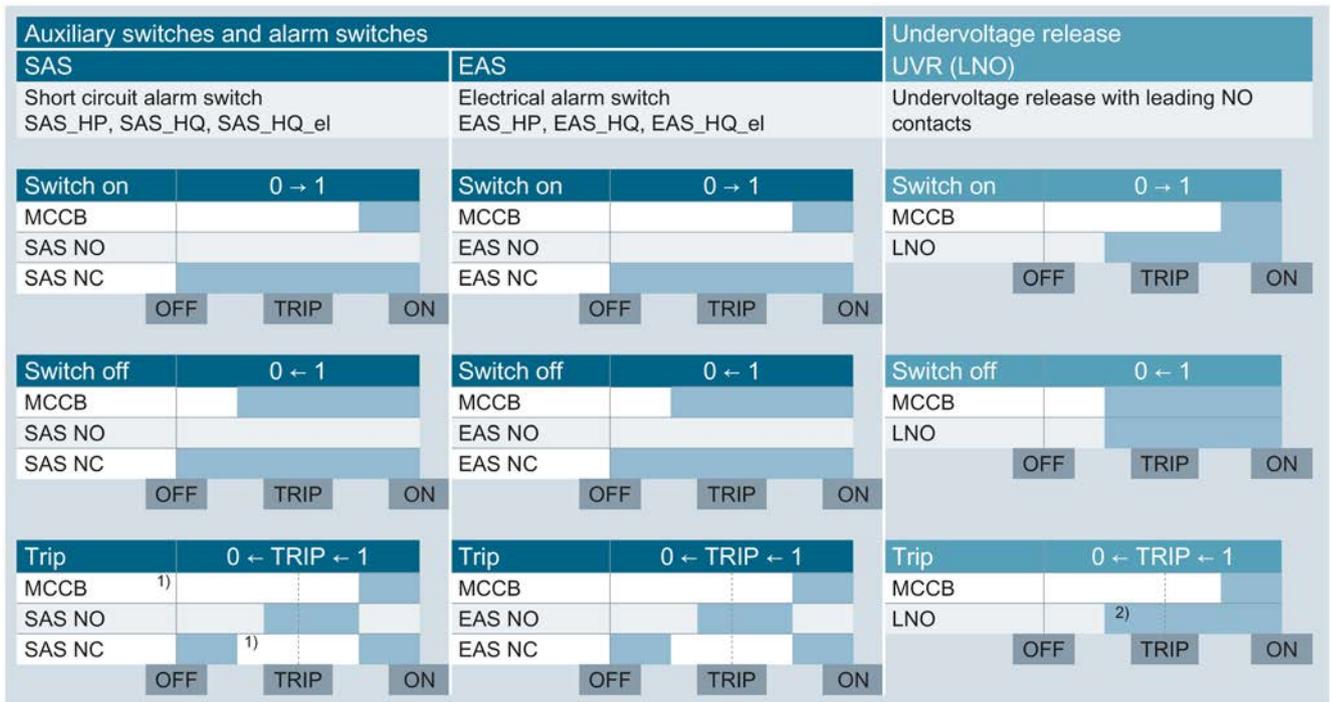
The trip must be reset by deliberate acknowledgement of the fault before the molded case circuit breaker is switched to ON again.

Short circuit alarm switches are only compatible with 3VA1 molded case circuit breakers. On breakers equipped with electronic trip units, the short circuit alarm function is performed by the electronic trip unit (ETU) and the EFB300 external function box.

4.2.3 Contact sequence diagrams



- Main contacts open
- Auxiliary contacts open
- Contacts closed



- Main contacts open
- Auxiliary contacts open
- Contacts closed

- 1) Manual reset by tool necessary after tripping
Automatic reset by motor operator MO320
- 2) Following a trip, the main contacts are open, but the contacts of the UVR (LNO) are still closed. The switches must be moved to the OFF switching position in order to disconnect the control circuit in all poles.

4.2.4 Technical specifications of auxiliary and alarm switches

Technical specifications Auxiliary switches and alarm switches			HQ					HQ_el					HP		
			AUX	LCS	TAS	EAS	SAS	AUX	LCS	TAS	EAS	SAS	AUX	LCS	TAS
Overall width			mm					7					14		
Graphical symbol															
Conductor cross-section		Screw-type terminal (per contact)	1 x (0.5 mm ² - 1.5 mm ²)					2 x (0.75 mm ² - 2.5 mm ²)							
		Screw-type terminal (per contact)	1 x (AWG20 - AWG16)					2 x (AWG18 - AWG14)							
		Screw-type terminal (per contact)	1 x (0.5 mm ² - 1.0 mm ²)					2 x (0.75 mm ² - 1.0 mm ²)							
		Screw-type terminal (per contact)	1 x (AWG20 - AWG16)					2 x (AWG18 - AWG16)							
	Tightening torque (connecting cables)	Nm	0.4 ^{+0.1}												
Stripped length	mm	15													
Rated insulation voltage	U _i	V AC	690 Overvoltage category III Pollution degree 3												
Rated impulse withstand voltage	U _{imp}	kV	4					6							
Rated operational voltage	IEC 60947														
	U _e	V AC 50 Hz	240					24					600		
		V DC	250					24					250		
	UL / CSA														
U _e	V AC 60 Hz	300					24					600			
	V DC	250					24					250			
Protective separation IEC 60947-1			Auxiliary current paths are protectively separated up to 500 V ^{1) 2)}												

- 1) HP switches lined up side by side up to 440 V
- 2) HP switches without adjacent switches; not in mounting locations 11 and 21 up to 690 V

Technical specifications Auxiliary switches and alarm switches				HQ					HQ_el					HP						
				AUX	LCS	TAS	EAS	SAS	AUX	LCS	TAS	EAS	SAS	AUX	LCS	TAS				
Conventional free-air thermal current				$I_{th} = I_o$		A	6					0.3					10			
Rated making capacity						A	6					0.3					10			
Rated operational current				AC-12		12 V	A	6					0.3					10		
						24 V	A	6					0.3					10		
						48 V	A	6										10		
						125 V	A	6										10		
						220/240 V	A	6										10		
						280/440 V	A											6		
						600 V	A											2		
				AC-15		12 V	A	3					0.3					6		
						24 V	A	3					0.3					6		
						48 V	A	3										6		
						125 V	A	3										6		
						220/240 V	A	3										6		
						280/440 V	A											2		
				DC-12		12 V	A	6					0.1					6		
						24 V	A	4					0.1					6		
						48 V	A	2										2		
						110 V	A	0.5										0.6		
						250 V	A	0.25										0.3		
				DC-13		12 V	A	1					0.07					3		
						24 V	A	0.8					0.07					3		
48 V	A	0.4										0.8								
110 V	A	0.2										0.2								
250 V	A	0.1										0.1								
Short-circuit protection		Fuses	Type gG/gL			according to the specifications relating to rated operational current														
		Miniature circuit breakers	Characteristic type B			according to the specifications relating to rated operational current														
Lead time relative to main contacts ¹⁾		LCS		ms		> 20														
Switching frequency		Switching operations per hour				240														
Degree of protection		Accessories cover closed				IP40														
		Accessories cover open				IP20														
Minimum load		At 24 V DC		mA		70					0.5					70				
		At 5 V DC		mA							1									

1) In combination with manual switching operations, but not when motor operators are used

4.2.5 Auxiliary releases

Auxiliary releases allow remote electrical tripping of the circuit breaker. They can be used to monitor control or main circuits in order to implement a protective system against accidental restart following a power failure, for example.

Auxiliary releases therefore perform a main circuit monitoring function in addition to the main circuit monitoring performed by the trip unit.

Auxiliary releases are extremely easy to install. No tools are required because these 21 mm wide components are simply snapped into place in the accessories compartments to the left and right of the handle. The accessories are connected by screw terminals for auxiliary conductors with a cross-section of up to 1.5 mm². The terminals are mounted on the front of the unit for easy access.

The shunt trips are suitable for use in electrical interlocks. An attempt to switch on a circuit breaker while the interlock voltage is applied to the shunt trip leads to a so-called "no-load switching operation", i.e. the basic breaker always returns to the TRIP position and the main contacts never close.

Note

All auxiliary releases are reverse-polarity-protected.

Shunt trips left STL



Shunt trips of type STL can be fitted in the left-hand accessories compartment as an alternative to an undervoltage release. The units are available with five rated voltages in the following range:

- 24 to 600 V AC 50/60 Hz
- 12 to 250 V DC

They have a maximum power consumption of 58 VA which is significantly lower than the power consumption of the flexible shunt trip versions.

Switches (permanent signal) or buttons (minimum signal duration 40 ms) can be used to control shunt trips.

Shunt trips flexible STF



Shunt trips of type STF can be fitted in the left-hand and the right-hand (3VA2 only) accessories compartment. They are therefore suitable for combining different auxiliary releases in one switch.

The units are available with six rated voltages in the following range:

- 24 to 600 V AC 50/60 Hz

Due to their design, their power consumption ranges up to maximum 750 VA and is therefore higher than the power consumption of STL versions.

Undervoltage releases UVR



Undervoltage releases trip the molded case circuit breaker in the event that the rated voltage fails or drops to between 70 % and 35 % of its normal value (in compliance with the relevant standard).

The main contacts of the basic breaker cannot be reclosed until the rated voltage of the UVR reaches 85 % of its normal value. The breaker main contacts cannot close until the UVR rated voltage reaches this level.

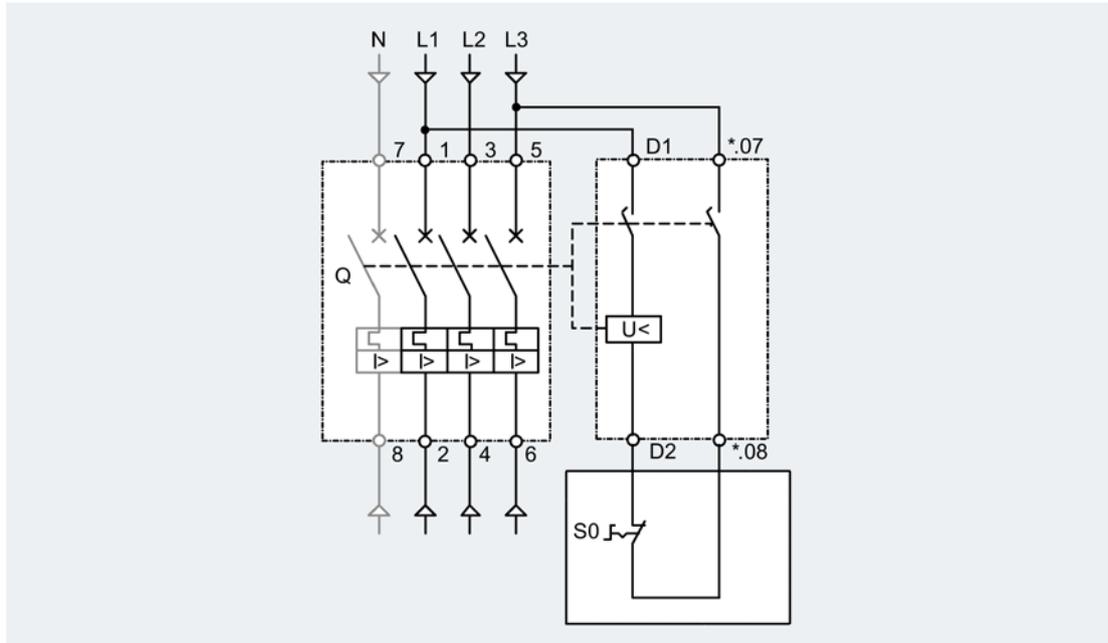
The units are available with rated voltages in the following range:

- 24 to 480 V AC 50/60 Hz
- 12 to 250 V DC

Undervoltage releases with leading NO contacts UVR (LNO)



The UVR release is protected against open circuits when combined with an EMERGENCY STOP pushbutton. The two installed NO (auxiliary) contacts allow the control circuits to be isolated after the breaker has tripped. The undervoltage release with leading NO contacts UVR (LNO) is therefore an ideal component for installation in the EMERGENCY STOP circuit of a 3VA molded case circuit breaker or switch disconnecter as the main switch for a machine or installation. Safe disconnection of the main current paths and safe isolation of the EMERGENCY-STOP circuit requires the molded case circuit breaker to be switched OFF.



- Q 3VA molded case circuit breakers
- S0 EMERGENCY-STOP pushbutton (to be provided by customer)
- U< Undervoltage release with leading NO contacts

Universal releases UNI



A universal release is a single, 21 mm wide component in which a shunt trip and an undervoltage release are combined. These are subject to the same tripping conditions as the individual devices. A single component with minimal footprint can therefore perform both functions.

The three available rated voltages are identical in each case for both the shunt trip and the undervoltage release. These rated voltages are:

- 12 V DC
- 24 V DC
- 48 V DC

Technical specifications of shunt trips and releases

Technical specifications Auxiliary releases				STL	STF	UVR	UVR (LNO)	UNI	
Overall width				mm					21
Graphical symbol									
Conductor cross-section		Screw-type terminal (per contact)	Number x mm ²	1 x (0.5 mm ² - 1.5 mm ²)					
		Screw-type terminal (per contact)	Number x AWG	1 x (AWG20 - AWG16)					
		Screw-type terminal (per contact)	Number x mm ²	1 x (0.5 mm ² - 1.0 mm ²)					
		Screw-type terminal (per contact)	Number x AWG	1 x (AWG20 - AWG16)					
	Tightening torque (connecting cables)			Nm	0.4 ^{+0.1}				
Stripped length			mm	10					
Rated insulation voltage				U _i	V AC	690 Oversvoltage category III Pollution degree 3			
Power consumption U ₀	12 - 30	V DC	W	7.0 - 50	-		< 2.5	< 2.5	
	48 - 60	V DC	W	20.0 - 30	-		< 2.5	< 2.5	
	110 - 127	V DC	W	30.0 - 40	-		< 2.5	< 2.5	
	220 - 250	V DC	W	28.0 - 35.0	-		< 2.5	< 2.5	
	24	V AC 50/60 Hz	VA	20	-		< 2.0	< 2.0	
	48 - 60	V AC 50/60 Hz	VA	20.0 - 30	-		< 2.0	< 2.0	
	110 - 127	V AC 50/60 Hz	VA	30.0 - 40	-		< 2.0	< 2.0	
	208 - 277	V AC 50/60 Hz	VA	16.0 - 35	-		see table below		
	380 - 600	V AC 50/60 Hz	VA	10.0 - 30	-		see table below		
	24	V AC 50/60 Hz	VA	-	300				
	48 - 60	V AC 50/60 Hz	VA	-	340 - 600				
	110 127	V AC 50/60 Hz	VA	-	500 - 650				
	208 - 277	V AC 50/60 Hz	VA	-	360 - 650				
380 - 500	V AC 50/60 Hz	VA	-	330 - 600					
600	V AC 50/60 Hz	VA	-	300					

Technical specifications Auxiliary releases				STL	STF	UVR	UVR (LNO)	UNI
								
Power consumption U_e	12	V DC	W			< 2.5	< 2.5	
	24	V DC	W			< 2.5	< 2.5	
	48	V DC	W			< 2.5	< 2.5	
	60	V DC	W			< 2.5	< 2.5	
	125 - 127	V DC	W			< 2.5	< 2.5	
	220- 230	V DC	W			< 2.5	< 2.5	
	250	V DC	W			< 2.5	< 2.5	
	24	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	48	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	60	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	110	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	120 - 127	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	208 - 230	V AC 50/60 Hz	VA			< 2.0	< 2.0	
	380 - 400	V AC 50/60 Hz	VA			< 2.5	< 2.5	
	440 - 480	V AC 50/60 Hz	VA			< 2.5	< 2.5	
		12	V DC (Cat II; PELV/SELV)	W				
	24	V DC (Cat II; PELV/SELV)	W					UVR: < 2.5 SHT: 20
	48	V DC (Cat II; PELV/SELV)	W					UVR: < 2.5 SHT: 20
Rated impulse withstand voltage	U_{imp}	kV		6		4		0.5
Making current	I_{max}	at V		1.5 A / 24 V AC	18 A / 24 V AC	5 mA / 480 V	5 mA / 480 V	1.5 A / 24 V
Maximum tripping time		ms		< 10				
Service life	Electrical trips			8500				
	Mechanical switching cycles of circuit breaker			25000				
Priority with respect to other control signals				Given				
Degree of protection	Accessories cover closed			IP 40				
	Accessories cover open			IP 20				
Minimum signal duration		ms		40	40			40
Response voltage of shunt trip: Pick-up (circuit breaker trips)		Us/V %		70 ... 110				70 ... 110
Response voltage of undervoltage release:	Pick-up (circuit breaker can be switched on)	Us/V %		85 ... 110				
	Release (circuit breaker trips)	Us/V %		35 ... 70				
Tripping frequency		Tripping operations per hour		Unlimited	120	Unlimited		
Suitable for electrical interlocking of MCCBs				No	No	Yes		

4.2.6 Time-delay devices for undervoltage releases

Undervoltage releases can also be equipped with external, electronic time-delay control devices which prevent unintentional tripping in response to brief voltage dips during periods of disrupted operation.

Time-delay device for UVR with fixed delay setting



The simple time-delay device with fixed delay setting is available for the following voltages:

- 110 V and 230 V AC
- 24 V DC

The delay time setting is 100 - 200 ms.

The device can be screw-mounted or attached to a 35 mm DIN rail.

You will find a circuit diagram in section Time-delay device for undervoltage releases in chapter Accessories.

4.2.7 COM060 communication module

You can find information about the COM060 communication module in chapter 3VA concept 3VA-line (Page 369).

4.3 Connection system

The chapter "Connection technology" contains useful information and provides a summarized description of the 3VA connection system. It provides a helpful guide to connecting cables or busbars to a molded case circuit breaker and so helps to ensure the safety of personnel and material assets. Mistakes which affect the operational safety of electrical installations can be avoided.

Contents

The chapter discusses the following topics:

- General information about cables and busbars
- Portfolio of connection components for 3VA molded case circuit breakers with
 - Front cable connection
 - Front busbar connection / cable lug connection
 - Rear busbar connection / cable lug connection
- Further connection accessories

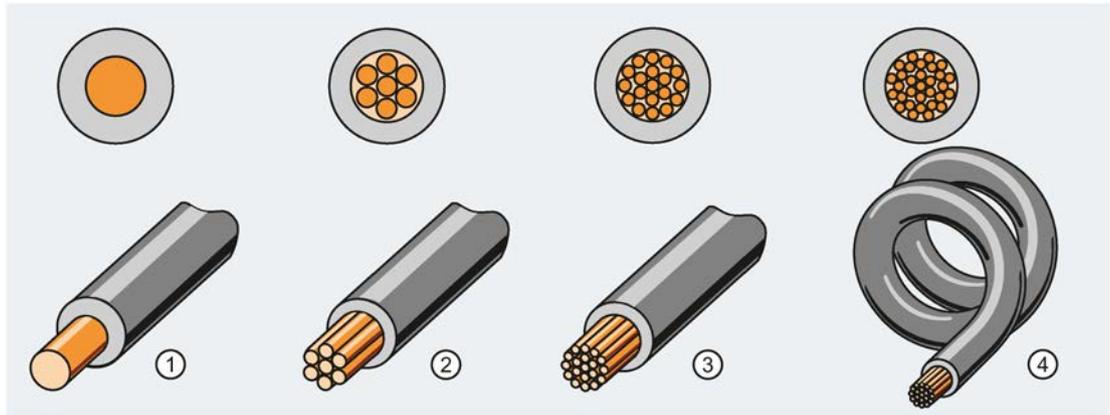
4.3.1 General information about cables and busbars

Cables and busbars: Cables

Cable designation and cable classes

A key design feature of a cable is its flexibility. This is primarily determined by the number of cores inside the cable.

Cable classes as defined by IEC 60228:



- ① Class 1 - cable with solid conductor
- ② Class 2 - cable with stranded conductors
- ③ Class 5 - cable with finely stranded conductors
- ④ Class 6 - cable with a large number of extra finely stranded conductors

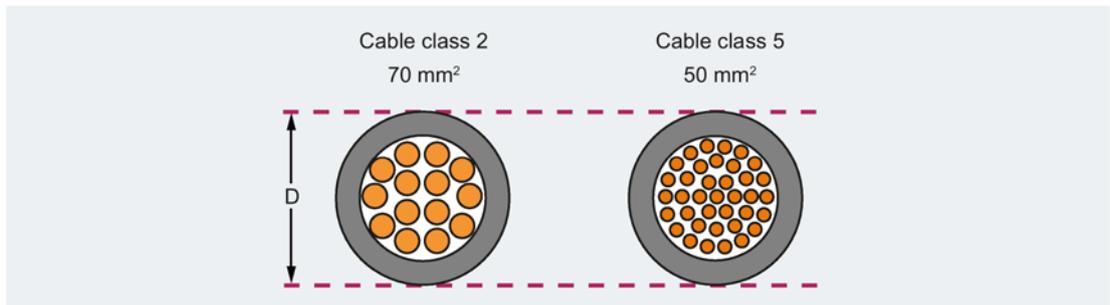
The conductors in class 1 and 2 cables are inflexible conductors, either solid or stranded. These are used predominantly in applications with low-curvature bending radii and in fixed or inflexible installations.

The flexible conductors of classes 5 and 6 are suitable for high-curvature cable bending radii.

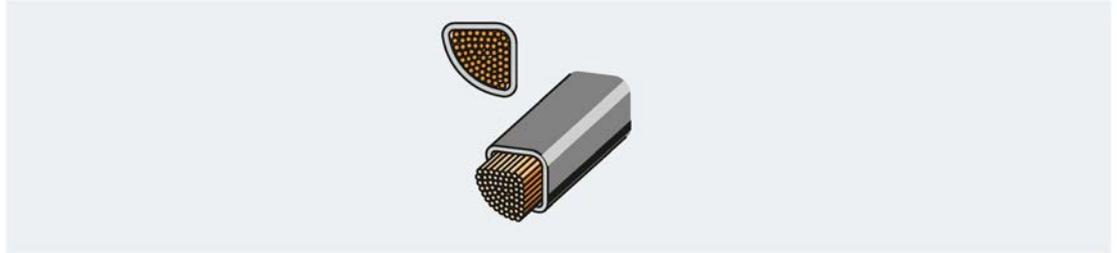
The cable conductors used in low-voltage power distribution installations mainly belong to classes 1, 2, 5 and 6.

Cables with solid conductors in class 1 used for these applications normally have a cross section of 16 mm² or less.

Please note: Solid-conductor cables in classes 1 and 2 are smaller in diameter than cables in classes 5 and 6 even when their cross sectional area is the same. As a result, cables with the same diameter from different classes may have different connection cross sections.



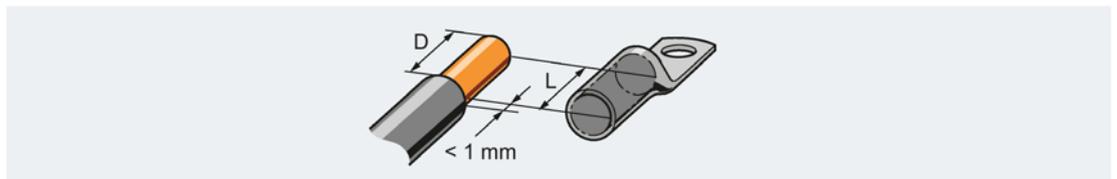
Solid and stranded sector-shaped conductors are also used.



Cable lugs and wire-end ferrules

Cables are connected by means of lugs and wire-end ferrules to the molded case circuit breaker in order to provide stable, safe connections. These elements help to make solid connections at the breaker.

The cable is first stripped over the distance L before the cable lug or wire-end ferrule is attached to the cable.



The cable must be stripped carefully to ensure that the correct amount of insulating material is removed. If too much material is removed, it will not be possible to make a secure connection between the cable and cable lug or wire-end ferrule.

Compression cable lugs compliant with DIN 46235 have ideal heat transfer characteristics for connecting busbar connectors. By contrast, "Tubular cable lugs with narrow palm for switching devices" (designation "SG" for example) must be used to make direct cable connections in the termination area of the molded case circuit breaker. These cable lugs vary in design depending on make. All cable lugs of this kind with the dimensions stipulated in standard IEC 609437-1, Annex P are basically suitable.

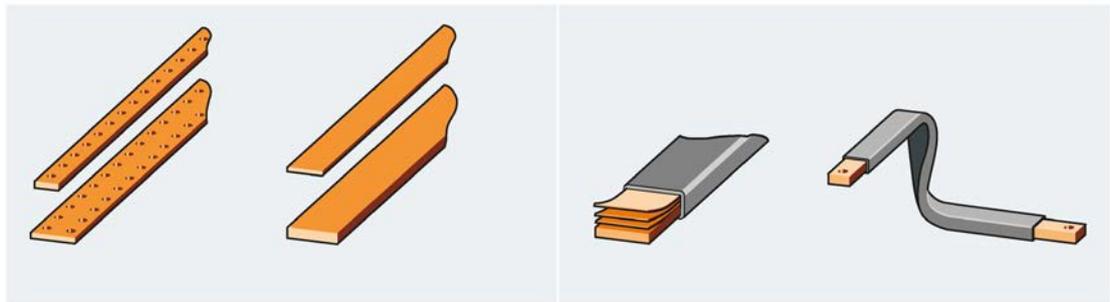
Cables and busbars: Busbars

In addition to cables, the busbar is also widely used in electrical connections, especially in cubicles.

Some of the reasons for using busbars include:

- High-curvature bending radii which are unsuitable for cables of large cross section
- Lack of space
- Heat dissipation, air circulation
- ...

Rigid and in some cases flexible busbars are used in the examples of applications listed above.



Rigid busbars are made of copper or aluminum. Pre-punched aluminum busbars, some of which are threaded, are often used.

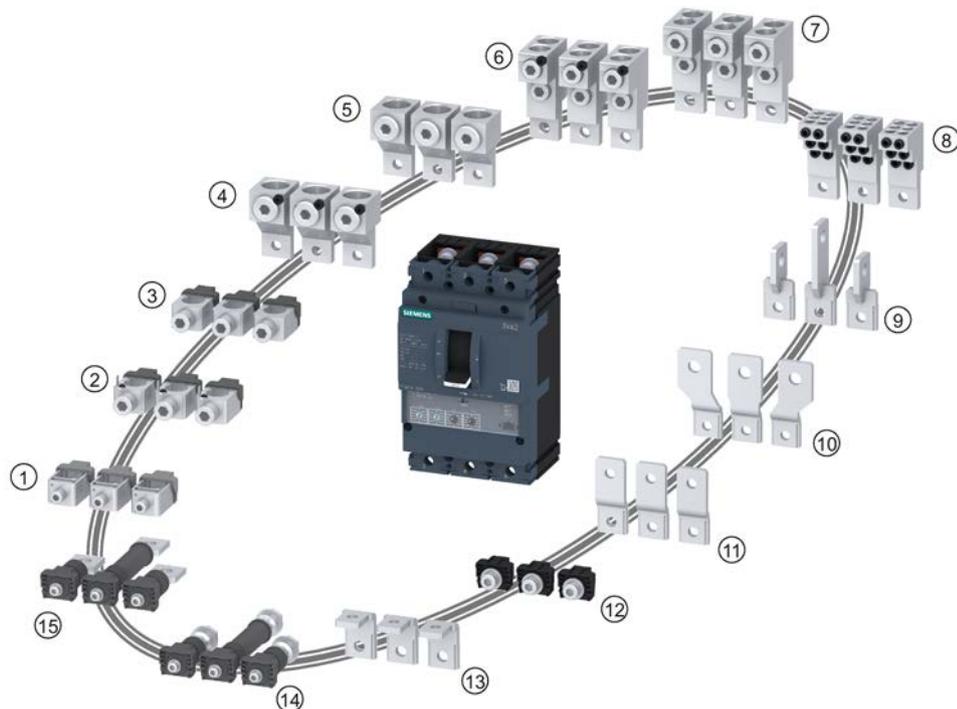
Flexible busbars are chosen for applications which demand a high degree of flexibility and high-curvature bending radii. These consist of bundles of copper or aluminum strips.

4.3.2 Portfolio of connection components for 3VA molded case circuit breakers

4.3.2.1 General overview

3VA molded case circuit breakers employ connection technology which is designed to support uncomplicated and convenient commissioning of the breakers in such a way that all installation requirements are fulfilled.

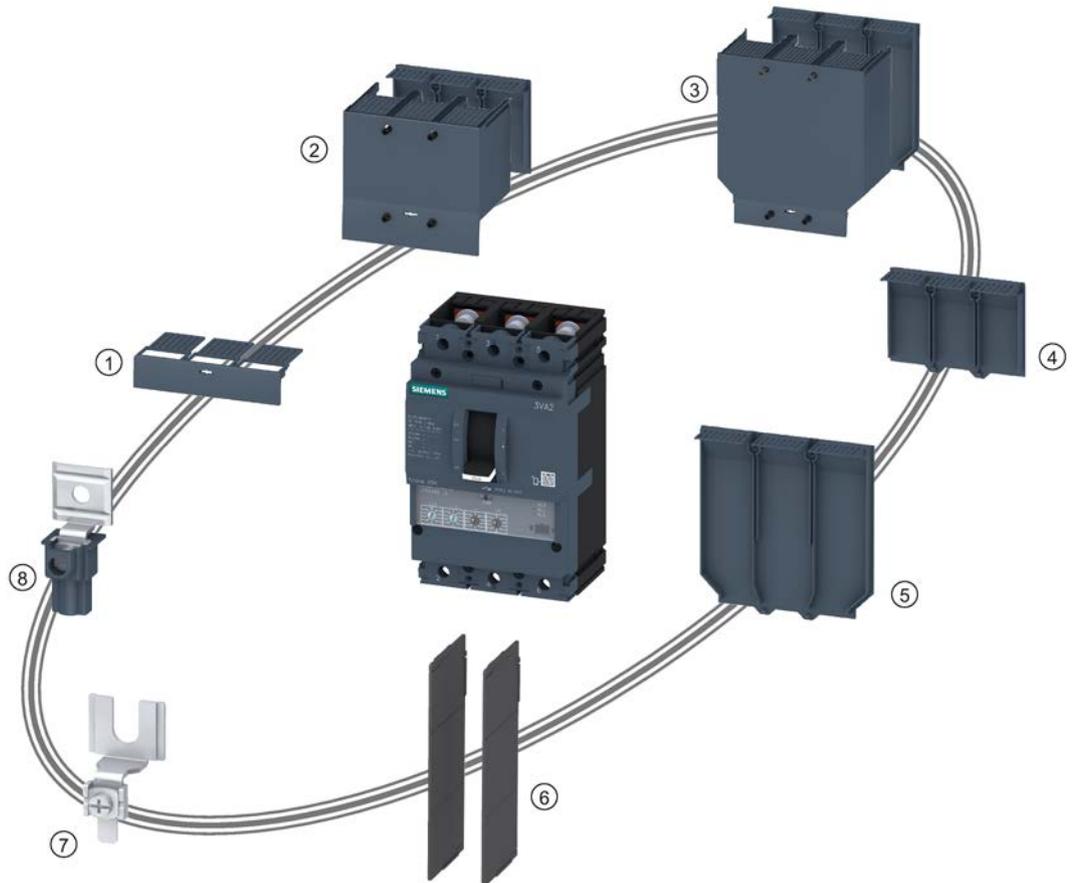
To meet this objective, an extensive portfolio of connection components is available.



- | | |
|--|-----------------------------------|
| ① Box terminal | ⑨ Front connection bars edgewise |
| ② Circular conductor terminal with auxiliary conductor terminal | ⑩ Front connection bars broadened |
| ③ Circular conductor terminal | ⑪ Front connection bars extended |
| ④ Circular conductor terminal, large, with auxiliary conductor terminal | ⑫ Lug terminal |
| ⑤ Circular conductor terminal, large | ⑬ Lug terminal, right-angled |
| ⑥ Circular conductor terminal, 2 cables, with auxiliary conductor terminal | ⑭ Rear connecting stud |
| ⑦ Circular conductor terminal, 2 cables | ⑮ Rear terminal flat |
| ⑧ Circular conductor terminal, 6 cables | |

4.3 Connection system

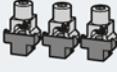
Furthermore, the connection accessories (see chapter Further connection accessories (Page 191)) can be optionally installed to insulate the termination area of the 3VA molded case circuit breaker and so provide protection against accidental contact. An auxiliary conductor terminal can be implemented quickly using accessory components which are available by special order.



- ① Terminal cover
- ② Terminal cover, extended
- ③ Terminal cover, broadened
- ④ Insulating plate
- ⑤ Insulating plate, broadened
- ⑥ Phase barriers
- ⑦ Auxiliary conductor terminal for busbars
- ⑧ Auxiliary conductor terminal for box terminal

The table below lists all the main conductor connection systems available for 3VA molded case circuit breakers and also indicates which type of cables or busbars are compatible with each connection system. A basic distinction is made between front and rear connections.

The illustration in the table shows the 3-piece pack for the 3-pole molded case circuit breaker. All connection systems are also available in 4-piece packs for 4-pole molded case circuit breakers.

Connection technology		Cables and busbars			
Front connections	Illustration				
Box terminal		■			■
Circular conductor terminal		■			
Circular conductor terminal with auxiliary conductor terminal		■			
Circular conductor terminal, large		■			
Circular conductor terminal, large, with auxiliary conductor terminal		■			
Circular conductor terminal, 2 cables		■			
Circular conductor terminal, 2 cables, with auxiliary conductor terminal		■			
Circular conductor terminal, large, 6 cables		■			
Lug terminal ¹⁾			■	■	■
Front connection bars extended			■	■	■
Front connection bars broadened			■	■	■
Front connection bars edgewise			■	■	■
Rear connections					
Rear terminal flat			■	■	■
Rear connecting studs			■	■	■
Lug terminal, right-angled			■	■	■

1) A box terminal can be installed at the lug terminal to allow a cable to be connected directly.

4.3 Connection system

The entire portfolio of connection systems for 3VA molded case circuit breakers can be deployed in unmodified form for the following applications:

- On all fixed-mounted versions of molded case circuit breaker
- On all molded case circuit breakers equipped with plug-in technology
- On all molded case circuit breakers equipped with draw-out technology

The connection components described above are identical for fixed-mounted breakers, for plug-in and for draw-out versions.

Connection technology available from or installed at the factory

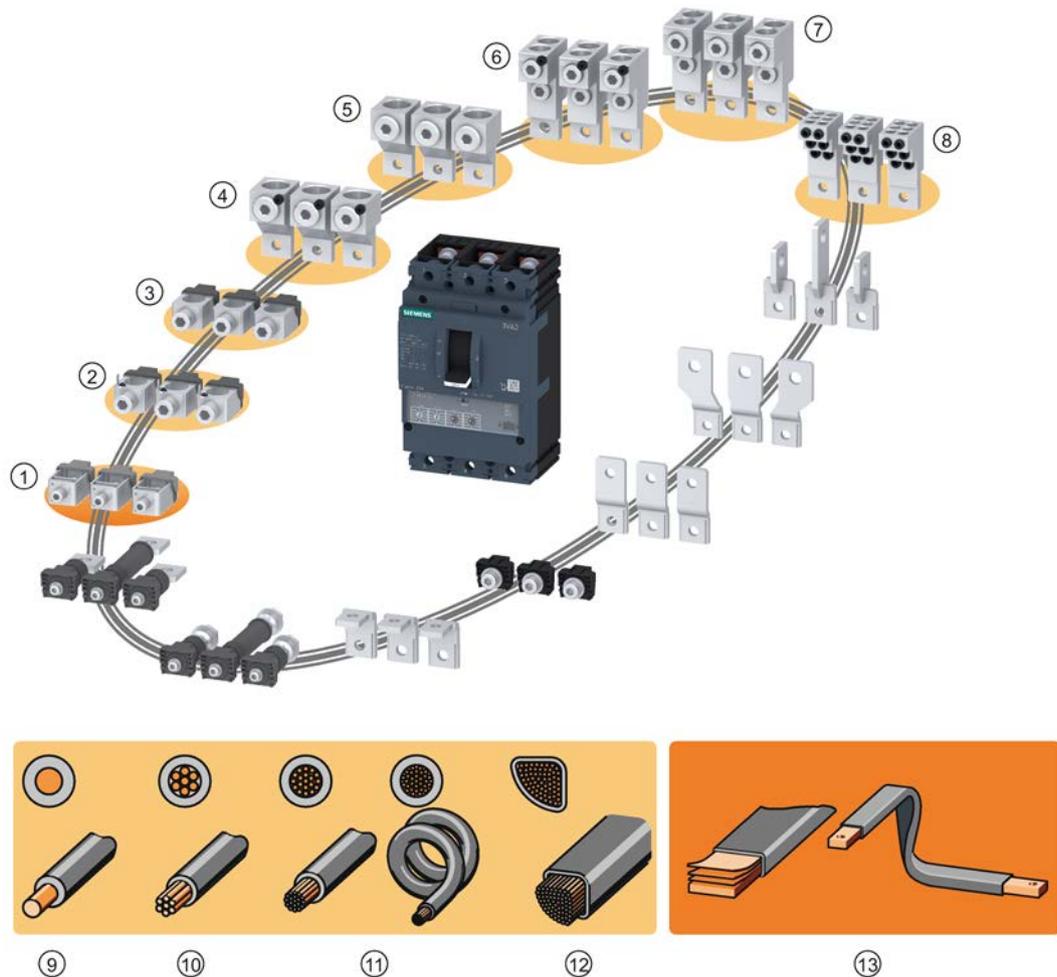
All 3VA molded case circuit breakers are available as standard with a lug terminal (clip-in nut and clamping screw) at the infeed and load ends.

For units up to size 160 A, a box terminal for direct cable connection can be optionally selected instead of the lug terminal. The box terminal is preassembled and installed at the factory.

Connection technology from factory	Illustration	3VA1			3VA2				
		100 A	160 A	250 A	100 A	160 A	250 A	400 A	630 A
Lug terminal		■	■	■	■	■	■	■	■
Box terminal (optional)		■	■		■	■			

4.3.2.2 Front cable connection

The diagram below illustrates all the components available for implementing a direct cable connection at the molded case circuit breaker. The only exception is the box terminal as this can be used to connect busbars as well as cables.



Connection technology

- ① Box terminal
- ② Circular conductor terminal with auxiliary conductor terminal
- ③ Circular conductor terminal
- ④ Circular conductor terminal, large, with auxiliary conductor terminal
- ⑤ Circular conductor terminal, large
- ⑥ Circular conductor terminal, 2 cables, with auxiliary conductor terminal
- ⑦ Circular conductor terminal, 2 cables
- ⑧ Circular conductor terminal, 6 cables

Cables and busbars

- ⑨ Solid conductor, class 1
- ⑩ Stranded conductor, class 2
- ⑪ Flexible conductors, classes 5 and 6
- ⑫ Sector-shaped conductors
- ⑬ Flexible busbars

4.3 Connection system

Box terminal



The box terminal as a factory-assembled connection can be optionally selected as an alternative to the lug terminal (see chapter Front busbar and cable lug connections (Page 181)) for all 3VA molded case circuit breakers up to size 160A. The 3VA breaker is then shipped with preassembled box terminals.

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199).

In addition to directly connected cables, flexible busbars can also be connected to box terminals.

The tables below show all the types and sizes of cable and flexible busbar that can be connected to a box terminal.

3VA1 molded case circuit breakers:

Designation			Box terminal			
Connection technology	MLFB		3VA915.-0JA10	3VA925.-0JA11	3VA925.-0JA12	
	For installation in 3VA1		100 A 160 A	250 A	250 A	
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	1.5 ... 50 mm ²	6 ... 95 mm ²	50 ... 150 mm ²
			Finely stranded conductors	1.5 ... 50 mm ²	10 ... 95 mm ²	95 ... 150 mm ²
			Stranded conductors	1.5 ... 70 mm ²	6 ... 120 mm ²	50 ... 185 mm ²
			Solid conductors	1.5 ... 16 mm ²	6 ... 16 mm ²	–
		Aluminum cable	Stranded conductors	–	–	–
			Solid conductors	–	–	–
		Stripped length cable L		12 mm	19	19 mm
		Tightening torque in Nm		1.5 ... 16 mm ² [5 Nm] 25 ... 70 mm ² [8 Nm]	6 ... 25 mm ² [6 Nm] 35 ... 120 mm ² [10 Nm]	50 ... 185 mm ² [10 Nm]
Flexible copper busbar	Connection examples in commonly used sizes	2x ... 6x [13 x 0.5] – 2x ... 9x [9 x 0.8]	2x ... 6x [13 x 0.5] – 2x ... 6x [15.5 x 0.8] – 2x ... 6x [20 x 1]	6x [13 x 0.5] – 4x ... 6x [15.5 x 0.8] – 3x ... 6x [20 x 1]		

3VA2 molded case circuit breakers

Designation			Box terminal				
Connection technology	MLFB		3VA916.-0JA12	3VA926.-0JA12	3VA948.-0JA13		
	For installation in 3VA2		100 A 160 A 250 A	100 A 160 A 250 A	400 A 630 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	6 ... 95 mm ²	25 ... 150 mm ²	35 ... 240 mm ²	
			Finely stranded conductors	10 ... 95 mm ²	35 ... 150 mm ²	35 ... 240 mm ²	
			Stranded conductors	6 ... 120 mm ²	25 ... 185 mm ²	35 ... 300 mm ²	
			Solid conductors	6 ... 16 mm ²	–	–	
		Aluminum cable	Stranded conductors	–	–	–	
			Solid conductors	–	–	–	
		Stripped length cable L			19 mm	19 mm	25 mm
		Tightening torque in Nm			6 ... 25 mm ² [6 Nm] 35 ... 120 mm ² [10 Nm]	25 ... 35 mm ² [6 Nm] 50 ... 185 mm ² [12 Nm]	35 ... 95 mm ² [16 Nm] 120 ... 300 mm ² [28 Nm]
Flexible copper busbar	Connection examples in commonly used sizes		2x ... 6x [13 x 0.5] – 2x ... 6x [15.5 x 0.8] – 2x ... 6x [20 x 1]	4x ... 6x [15.5 x 0.8] – 4x ... 6x [20 x 1]	2x ... 10x [20 x 1] – 2x ... 10x [24 x 1]		

Box terminals can be ordered

- as a pack of 3
- as a pack of 4

Circular conductor terminal with and without auxiliary conductor terminal



The circular conductor terminal is available under separate article numbers depending on whether it is ordered with or without an auxiliary conductor terminal. With the exception of the bore for the auxiliary conductor terminal, both circular conductor terminals are technically identical, i.e. the same cable cross sections can be connected to both variants.

Note

All auxiliary conductor terminals included in the 3VA molded case circuit breaker portfolio have a maximum current-carrying capacity of 6 A.

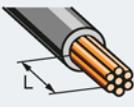
Suitable cable cross-sections: Cables with a maximum cross-section up to 2.5 mm² can be connected.

The circular conductor terminal is an internal component, i.e. it is contained within the external contour of the molded case circuit breaker. As a result, the size of cable cross section which can be connected is limited by the geometry of the breaker's termination area.

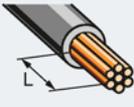
The tables below show all the types and sizes of cable which can be connected to a circular conductor terminal.

4.3 Connection system

3VA1 molded case circuit breakers:

Designation			Circular conductor terminal with/without auxiliary conductor terminal			
Connection technology	MLFB	Without auxiliary conductor terminal	3VA911.-0JB11	3VA925.-0JB12		
		With auxiliary conductor terminal	3VA911.-0JG11	3VA925.-0JG12		
For installation in 3VA1			100 A 160 A	250 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	1.5 ... 35 mm ²	35 ... 150 mm ²	
			Finely stranded conductors	1.5 ... 35 mm ²	35 ... 150 mm ²	
			Stranded conductors	1.5 ... 50 mm ²	35 ... 185 mm ²	
			Solid conductors	2.5 ... 16 mm ²	–	
		Aluminum cable	Stranded conductors	4 ... 50 mm ²	35 ... 185 mm ²	
			Solid conductors	4 ... 16 mm ²	–	
		Stripped length cable L			12.2 mm	20 mm
		Tightening torque in Nm			1.5 ... 6 mm ² [6.2 Nm] 10 ... 50 mm ² [11.3 Nm]	35 ... 185 mm ² [22.6 Nm]

3VA2 molded case circuit breakers:

Designation			Circular conductor terminal with/without auxiliary conductor terminal				
Connection technology	MLFB	Without auxiliary conductor terminal	3VA910.-0JB11	3VA926.-0JB12	3VA938.-0JB13		
		With auxiliary conductor terminal	3VA910.-0JG11	3VA926.-0JG12	3VA938.-0JG13		
For installation in 3VA2			100 A 160 A 250 A	100 A 160 A 250 A	400 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	1.5 ... 35 mm ²	16 ... 120 mm ²	50 ... 240 mm ²	
			Finely stranded conductors	1.5 ... 35 mm ²	25 ... 150 mm ²	50 ... 240 mm ²	
			Stranded conductors	1.5 ... 50 mm ²	16 ... 185 mm ²	50 ... 300 mm ²	
			Solid conductors	1.5 ... 16 mm ²	16 mm ²	–	
		Aluminum cable	Stranded conductors	4 ... 50 mm ²	16 ... 185 mm ²	50 ... 300 mm ²	
			Solid conductors	4 ... 16 mm ²	16 mm ²	–	
		Stripped length cable L			18 mm	20 mm	28 mm
		Tightening torque in Nm			1.5 ... 10 mm ² [6.2 Nm] 16 ... 35 mm ² [8.5 Nm] 50 mm ² [13.6 Nm]	16 ... 35 mm ² [15.8 Nm] 50 ... 185 mm ² [31.1 Nm]	50 ... 300 mm ² [42.4 Nm]

Circular conductor terminals with or without auxiliary conductor terminal can be ordered

- as a pack of 3
- as a pack of 4

Circular conductor terminal, large, with and without auxiliary conductor terminal



The circular conductor terminal, large, is available under separate article numbers depending on whether it is ordered with or without an auxiliary conductor terminal. With the exception of the bore for the auxiliary conductor terminal, both circular conductor terminals are technically identical, i.e. the same cable cross sections can be connected to both variants.

Note

All auxiliary conductor terminals included in the 3VA molded case circuit breaker portfolio have a maximum current-carrying capacity of 6 A.

Suitable cable cross-sections: Cables with a maximum cross-section up to 2.5 mm² can be connected.

The circular conductor terminal large is an external terminal, i.e. it projects beyond the external contour of the breaker's termination area. This means that cables with a larger cross section can be connected.

The extended terminal cover plus the required assembly materials are supplied as standard with all circular conductor terminals, large. This isolates the termination area, providing degree of protection IP4x at the front of the molded case circuit breaker and degree of protection IP2x at the infeed and load ends (see chapter Insulating equipment (Page 191)).

The table below shows all the types and sizes of cable which can be connected to a circular conductor terminal large.

Designation			Circular conductor terminal, large with/without auxiliary conductor terminal				
Connection technology	MLFB	Without auxiliary conductor terminal	3VA911.-0JJ12	3VA921.-0JJ13	3VA922.-0JJ13		
		With auxiliary conductor terminal	3VA911.-0JC12	3VA921.-0JC13	3VA922.-0JC13		
	For installation in	3VA1	100 A 160 A	250 A			
		3VA2			100 A 160 A 250 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	25 ... 95 mm ²	50 ... 185 mm ²	50 ... 185 mm ²	
			Finely stranded conductors	25 ... 120 mm ²	50 ... 185 mm ²	50 ... 185 mm ²	
			Stranded conductors	25 ... 150 mm ²	50 ... 240 mm ²	50 ... 240 mm ²	
			Solid conductors	–	–	–	
		Aluminum cable	Stranded conductors	25 ... 150 mm ²	50 ... 240 mm ²	50 ... 240 mm ²	
			Solid conductors	–	–	–	
		Stripped length cable L			28.5 mm	32 mm	32 mm
		Tightening torque in Nm			25 ... 150 mm ² [28.5 Nm]	50 ... 240 mm ² [31.1 Nm]	50 ... 240 mm ² [31.1 Nm]

Circular conductor terminals large with or without auxiliary conductor terminal can be ordered

- as a pack of 3
- as a pack of 4

Circular conductor terminal, 2 cables, with and without auxiliary conductor terminal



The circular conductor terminal, 2 cables, is available under separate article numbers depending on whether it is ordered with or without an auxiliary conductor terminal. With the exception of the bore for the auxiliary conductor terminal, both circular conductor terminals are technically identical, i.e. the same cable cross sections can be connected to both variants.

Note

All auxiliary conductor terminals included in the 3VA molded case circuit breaker portfolio have a maximum current-carrying capacity of 6 A.

Suitable cable cross-sections: Cables with a maximum cross-section up to 2.5 mm² can be connected.

The circular conductor terminal 2 cables is an external terminal, i.e. it projects beyond the external contour of the breaker's termination area. The 2-cable capacity of the terminal allows cables with large cross sectional area to be connected.

The extended terminal cover plus the required assembly materials are supplied as standard with all circular conductor terminals, 2 cables. This isolates the termination area, providing degree of protection IP4x at the front of the molded case circuit breaker and degree of protection IP2x at the infeed and load ends (see chapter Insulating equipment (Page 191)).

The table below shows all the types and sizes of cable which can be connected to a circular conductor terminal 2 cables.

Designation		Circular conductor terminal, 2 cables with/without auxiliary conductor terminal				
Connection technology	MLFB	Without auxiliary conductor terminal	3VA921.-0JJ22	3VA922.-0JJ22	3VA940.-0JJ23	
		With auxiliary conductor terminal	3VA921.-0JC22	3VA922.-0JC22	3VA940.-0JC33	
	For installation in	3VA1	250 A			
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	25 ... 70 mm ²	25 ... 70 mm ²	70 ... 185 mm ²
			Finely stranded conductors	25 ... 150 mm ²	25 ... 150 mm ²	70 ... 240 mm ²
		Aluminum cable	Stranded conductors	25 ... 150 mm ²	25 ... 150 mm ²	70 ... 300 mm ²
			Solid conductors	–	–	–
		Stranded conductors	25 ... 150 mm ²	25 ... 150 mm ²	70 ... 300 mm ²	
		Solid conductors	–	–	–	
		Stripped length cable L	25 mm / 50 mm	25 mm / 50 mm	31 / 58.5 mm	
		Tightening torque in Nm	25 ... 150 mm ² [31.1 Nm]	25 ... 150 mm ² [31.1 Nm]	70 ... 300 mm ² [42.2 Nm]	

Circular conductor terminals 2 cables with or without auxiliary conductor terminal can be ordered

- as a pack of 3
- as a pack of 4

Circular conductor terminal, 6 cables



The circular conductor terminal, 6 cables is an external terminal, i.e. it projects beyond the external contour of the breaker's termination area. It can hold up to 6 cables. One of the six bores in the terminal can be used to implement an auxiliary conductor terminal.

The extended terminal cover plus the required assembly materials are supplied as standard with all circular conductor terminals, 6 cables. This isolates the termination area, providing degree of protection IP4x at the front of the molded case circuit breaker and degree of protection IP2x at the infeed and load ends (see chapter Insulating equipment (Page 191)).

The table below shows all the types and sizes of cable which can be connected to a circular conductor terminal, 6 cables.

3VA1 molded case circuit breakers:

Designation		Circular conductor terminal, 6 cables			
Connection technology	MLFB	3VA911.-0JF60	3VA921.-0JF60		
	For installation in 3VA1	100 A 160 A	250 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	1.5 ... 25 mm ²	1.5 ... 25 mm ²
			Stranded conductors	1.5 ... 25 mm ²	1.5 ... 25 mm ²
		1.5 ... 35 mm ²		1.5 ... 35 mm ²	
		1.5 ... 16 mm ²		1.5 ... 16 mm ²	
		Aluminum cable	Stranded conductors	4 ... 35 mm ²	4 ... 35 mm ²
			Solid conductors	4 ... 16 mm ²	4 ... 16 mm ²
		Stripped length cable L		12 / 24 / 38.5 mm	14 / 26 / 38.5 mm
Tightening torque in Nm		1.5 mm ² [2.8 Nm] 2.5 ... 10 mm ² [6.2 Nm] 16 ... 25 mm ² [8.5 Nm] 35 mm ² [11.3 Nm]	1.5 mm ² [2.8 Nm] 2.5 ... 10 mm ² [6.2 Nm] 16 ... 25 mm ² [8.5 Nm] 35 mm ² [11.3 Nm]		

4.3 Connection system

3VA2 molded case circuit breakers:

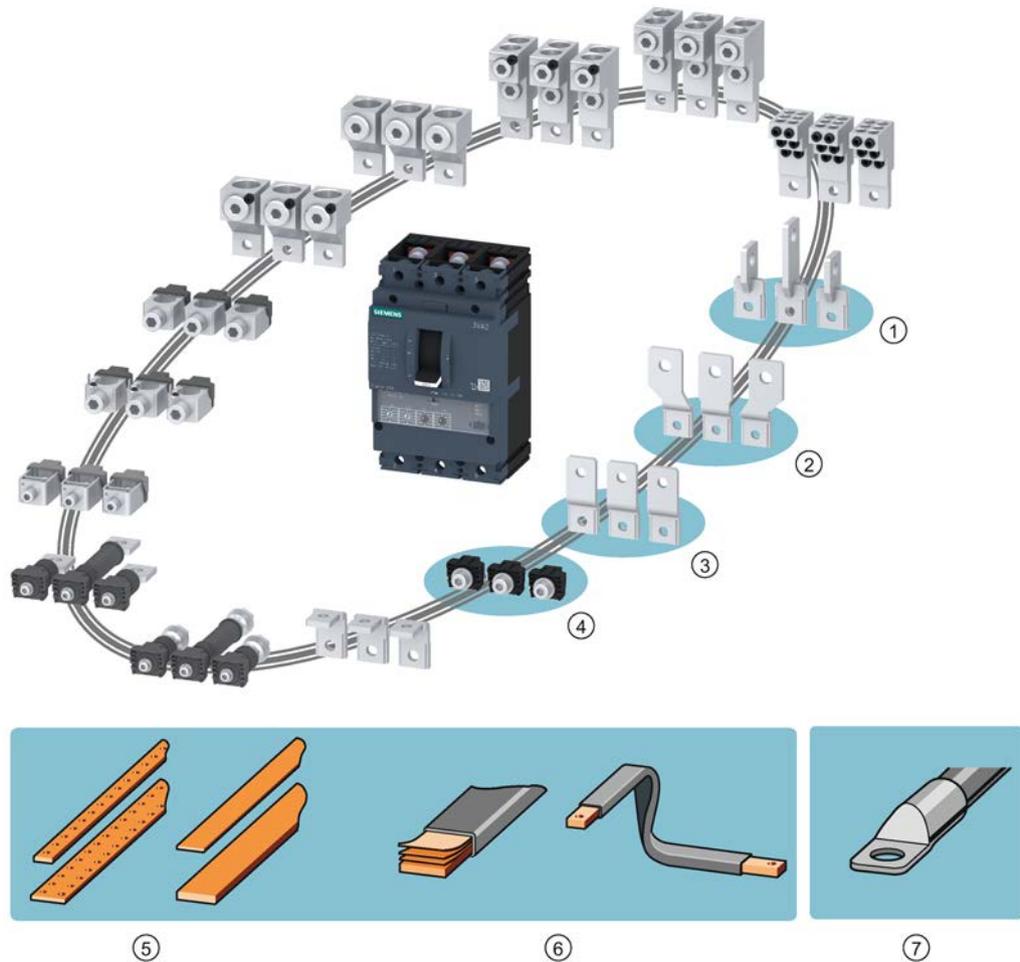
Designation			Circular conductor terminal, 6 cables			
Connection technology	MLFB		3VA922.-0JF60	3VA930.-0JF60		
	For installation in 3VA2		100 A 160 A 250 A	400 A 630 A		
Cables and busbars	Cable connection 	Copper cable	Finely stranded conductors with end sleeve	1.5 ... 25 mm ²	1.5 ... 25 mm ²	
			Finely stranded conductors	1.5 ... 25 mm ²	1.5 ... 25 mm ²	
			Stranded conductors	1.5 ... 35 mm ²	1.5 ... 35 mm ²	
			Solid conductors	1.5 ... 16 mm ²	1.5 ... 16 mm ²	
		Aluminum cable	Stranded conductors	4 ... 35 mm ²	4 ... 35 mm ²	
			Solid conductors	4 ... 16 mm ²	4 ... 16 mm ²	
		Stripped length cable L			14 / 26 / 38.5 mm	18 / 34.5 mm
		Tightening torque in Nm			1.5 mm ² [2.8 Nm] 2.5 ... 10 mm ² [6.2 Nm] 16 ... 25 mm ² [8.5 Nm] 35 mm ² [11.3 Nm]	1.5 mm ² [2.8 Nm] 2.5 ... 10 mm ² [6.2 Nm] 16 ... 25 mm ² [8.5 Nm] 35 mm ² [11.3 Nm]

Circular conductor terminals, 6 cables can be ordered

- as a pack of 3
- as a pack of 4

4.3.2.3 Front busbar and cable lug connections

The diagram below illustrates all the components available for implementing a busbar or cable lug connection on the front panel of the 3VA molded case circuit breaker.



Connection technology

- ① Front connection bars edgewise
- ② Front connection bars broadened
- ③ Front connection bars extended
- ④ Lug terminal

Cables and busbars

- ⑤ Busbars
- ⑥ Flexible busbars
- ⑦ Cable lugs

4.3 Connection system

Lug terminal



With a lug terminal connection, it is possible to connect busbars and cable lugs directly to the jumper lug of the 3VA molded case circuit breaker.

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199).

The table below provides an overview of the minimum and maximum sizes of cables and busbars which can be connected by a lug terminal.

Designation				Lug terminal			
Connection technology	MLFB			3VA911.-0QA00	3VA921.-0QA00	3VA920.-0QA00	3VA940.-0QA00
	3VA1			100 A 160 A	250 A		
	For installation in 3VA2					100 A 160 A 250 A	400 A 630 A
Cables and busbars	Busbar connection (rigid & flexible)	Width maximum	W_{max} [mm]	17	25	25	35
		Thickness maximum	T_{max} [mm]	6.5	8.5	8.5	10
		Thickness minimum	T_{min} [mm]	0	0	0	1
		Hole diameter	\varnothing [mm]	6.5	8.5	8.5	11
		Length H_1	H_1 [mm]	8	10	10	14.5
		Length H_2	H_2 [mm]	10	10	10	15
	Cable connection with cable lug	Width maximum	W_{max} [mm]	17	25	25	35
		Thickness maximum	T_{max} [mm]	6.5	8.5	8.5	10
		Thickness minimum	T_{min} [mm]	0	0	0	1
		Hole diameter	\varnothing [mm]	6.5	8.5	8.5	11
		Dimension H_1	H_1 [mm]	8	10	10	14.5
		Dimension H_2	H_2 [mm]	10	10	10	15

Lug terminals can be ordered

- as a pack of 3
- as a pack of 4

Front connection bars extended



Front connection bars extended can be installed to connect larger busbars and cable lugs outside the termination area of a 3VA molded case circuit breaker. The front connection bars therefore extend the jumper lug of the breaker.

All front connection bars extended are supplied as standard with phase barriers to provide insulation between individual phases (see chapter Insulating equipment (Page 191)).

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199).

The table below provides an overview of the minimum and maximum sizes of cables and busbars which can be connected by front connection bars extended.

Designation		Front connection bars extended				
Connection technology	MLFB	3VA915.-0QB00	3VA925.-0QB00	3VA926.-0QB00	3VA948.-0QB00	
		3VA1	100 A 160 A	250 A		
	For installation in 3VA2			100 A 160 A 250 A	400 A 630 A	
Cables and busbars	Busbar connection (rigid & flexible)	Width maximum W_{max} [mm]	22	32	32	40
		Thickness maximum T_{max} [mm]	8	10	10	12.5
		Thickness minimum T_{min} [mm]	1	1.5	1.5	2
		Hole diameter \varnothing [mm]	6.6	11	11	11
		Length H_1 [mm]	12	20	20	20
		Length H_2 [mm]	10	12.5	12.5	15
	Cable connection with cable lug	Width maximum W_{max} [mm]	22	32	32	40
		Thickness maximum T_{max} [mm]	8	10	10	12.5
		Thickness minimum T_{min} [mm]	1	1.5	1.5	2
		Hole diameter \varnothing [mm]	6.6	11	11	11
	Dimension H_1 [mm]	12	20	20	20	
	Dimension H_2 [mm]	10	12.5	12.5	15	

Front connection bars extended can be ordered

- as a pack of 3
- as a pack of 4

4.3 Connection system

Front connection bars broadened



Front connection bars broadened can be installed to connect very large busbars and cable lugs outside the termination area of a 3VA molded case circuit breaker. Front connection bars broadened increase the distance between pole centers of the jumper lugs of the molded case circuit breaker.

All front connection bars broadened are supplied as standard with phase barriers to provide insulation between individual phases (see chapter Insulating equipment (Page 191)).

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199)).

The table below provides an overview of the minimum and maximum sizes of cables and busbars which can be connected by front connection bars broadened.

Designation				Front connection bars broadened			
Connection technology	MLFB			3VA915.-0QB00	3VA925.-0QC00	3VA926.-0QB00	3VA948.-0QB00
	3VA1			100 A 160 A	250 A		
	For installation in					100 A 160 A 250 A	400 A 630 A
Cables and busbars	Busbar connection (rigid & flexible)	Width maximum	W_{max} [mm]	30	35	35	60
		Thickness maximum	T_{max} [mm]	8	10	10	12.5
		Thickness minimum	T_{min} [mm]	1	1.5	1.5	2
		Hole diameter	\varnothing [mm]	9	11	11	14
		Length H_1	H_1 [mm]	12	20	20	20
		Length H_2	H_2 [mm]	10	12.5	12.5	20
	Cable connection with cable lug	Width maximum	W_{max} [mm]	30	35	35	60
		Thickness maximum	T_{max} [mm]	8	10	10	12.5
		Thickness minimum	T_{min} [mm]	1	1.5	1.5	2
		Hole diameter	\varnothing [mm]	9	11	11	14
		Dimension H_1	H_1 [mm]	12	20	20	20
		Dimension H_2	H_2 [mm]	10	12.5	12.5	20

Front connection bars broadened can be ordered

- as a pack of 3
- as a pack of 4

Front connection bars edgewise



Front connection bars edgewise can be installed to connect large busbars and cable lugs outside the termination area of a 3VA molded case circuit breaker. The jumper lug of the breaker is turned by 90° when front connection bars edgewise are fitted.

All front connection bars edgewise are supplied as standard with phase barriers to provide insulation between individual phases (see chapter Insulating equipment (Page 191)).

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199)).

The table below provides an overview of the minimum and maximum sizes of cables and busbars which can be connected by front connection bars edgewise.

Designation		Front connection bars edgewise					
Connection technology	MLFB		3VA915.-0QD00	3VA925.-0QD00	3VA926.-0QD00	3VA948.-0QD00	
		3VA1	100 A 160 A	250 A			
	For installation in	3VA2			100 A 160 A 250 A	400 A 630 A	
Cables and busbars	Busbar connection (rigid & flexible)	Width maximum	W_{max} [mm]	20	25	25	40
		Thickness maximum	T_{max} [mm]	6	7	7	8
		Thickness minimum	T_{min} [mm]	1	1.5	1.5	2
		Hole diameter	\varnothing [mm]	6.6	11	11	11
		Length H_1	H_1 [mm]	12	15	15	20
		Length H_2	H_2 [mm]	10	12.5	12.5	15
	Cable connection with cable lug	Width maximum	W_{max} [mm]	20	25	25	40
		Thickness maximum	T_{max} [mm]	6	7	7	8
		Thickness minimum	T_{min} [mm]	1	1.5	1.5	2
		Hole diameter	\varnothing [mm]	6.6	11	11	11
	Dimension H_1	H_1 [mm]	12	15	15	20	
	Dimension H_2	H_2 [mm]	10	12.5	12.5	15	

Front connection bars edgewise can be ordered

- as a pack of 3
- as a pack of 4

4.3.2.4 Rear busbar and cable lug connections

The diagram below illustrates all the components available for implementing a busbar or cable lug connection on the rear panel of the 3VA molded case circuit breaker.



- Connection technology
- ① Lug terminal, right-angled
 - ② Rear connecting stud
 - ③ Rear terminal flat

- Cables and busbars
- ④ Busbars
 - ⑤ Flexible busbars
 - ⑥ Cable lugs

Lug terminal, right-angled

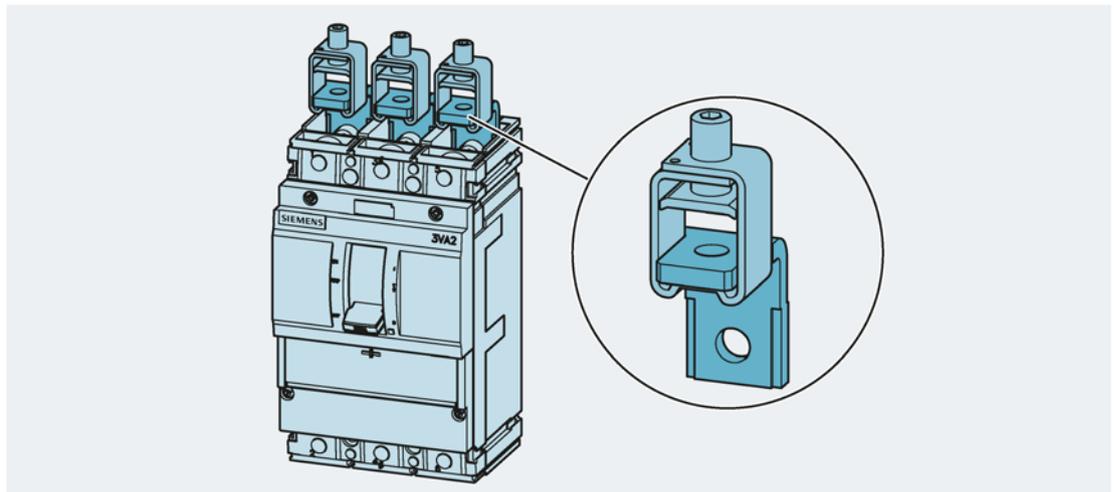


The right-angled lug terminal can be installed to connect busbars and cable lugs outside the termination area on the rear panel of a 3VA molded case circuit breaker. The jumper lug of the breaker is turned by 90° at right angles, allowing the busbar or cable lug to be connected at the rear.

Note

Right-angled lug terminals may only be connected to phases 1, 3 and 5 (top terminals) owing to the gases expelled by 3VA molded case circuit breakers.

In addition, a box terminal can also be attached to the right-angled lug terminal allowing direct connection of a cable.

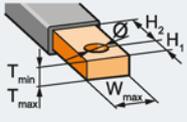
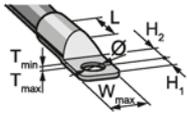


All right-angled lug terminals are supplied as standard with phase barriers to provide insulation between individual phases (see chapter Insulating equipment (Page 191)).

A special terminal can be installed to provide an auxiliary conductor connection. For further information, please refer to chapter Auxiliary conductor terminal (Page 199).

4.3 Connection system

The table below provides an overview of the minimum and maximum sizes of cables and busbars which can be connected by means of the right-angled lug terminal.

Designation				Lug terminal, right-angled			
Connection technology	MLFB			3VA911.-0QG00	3VA921.-0QG00	3VA922.-0QG00	3VA940.-0QG00
	3VA1			100 A 160 A	250 A		
	For installation in 3VA2					100 A 160 A 250 A	400 A 630 A
Cables and busbars	Busbar connection (rigid & flexible)		Width maximum W_{max} [mm]	22	32	32	40
			Thickness maximum T_{max} [mm]	8	10	10	12.5
			Thickness minimum T_{min} [mm]	1	1.5	1.5	2
			Hole diameter \varnothing [mm]	6.6	11	11	11
			Length H_1 [mm]	12	20	20	20
			Length H_2 [mm]	10	12.5	12.5	15
	Cable connection with cable lug		Width maximum W_{max} [mm]	22	32	32	40
			Thickness maximum T_{max} [mm]	8	10	10	12.5
			Thickness minimum T_{min} [mm]	1	1.5	1.5	2
			Hole diameter \varnothing [mm]	6.6	11	11	11
			Dimension H_1 [mm]	12	20	20	20
			Dimension H_2 [mm]	10	12.5	12.5	15

Right-angled lug terminals can be ordered

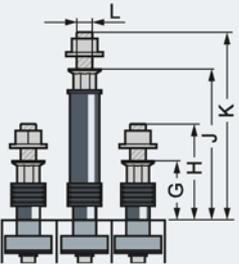
- as a pack of 3
- as a pack of 4

Rear connecting studs



The rear connecting studs can be installed to connect busbars and cable lugs to the rear panel of a 3VA molded case circuit breaker.

The dimensions of rear connecting studs are given in the table below:

Designation		Rear connecting studs				
Connection technology	MLFB	3VA911.-0QF00	3VA921.-0QF00	3VA940.-0QF00	3VA940.-0QF00	
	3VA1	100 A 160 A	250 A			
	For installation in 3VA2			100 A 160 A 250 A	400A 630A	
Dimensions of rear connecting studs		G [mm]	28	36	36	45
	H [mm]	66	59	59	75	
	J [mm]	85	93	93	105	
	K [mm]	123	116	116	135	
	L Hexagon nut	M8	M10	M10	M12	

Rear connecting studs can be ordered

- as a pack of 3 (2 short studs and 1 long stud)
- as a pack of 4 (2 short studs and 2 long studs)
- as a pack of 1 (1 short stud)
- as a pack of 1 (1 long stud)

Note

In order to achieve degree of protection IP40, terminal covers (flat version) must also be attached when a rear connecting stud is installed.

4.3 Connection system

Rear terminal flat



The rear terminal flat can be installed to connect busbars and cable lugs to the rear panel of a 3VA molded case circuit breaker.

The rear terminal flat can be rotated in steps of 45°, i.e. it can be installed at an angle of 0°, 45° or 90°:



The dimensions of rear terminals flat are given in the table below:

Designation		Rear terminal flat					
Connection technology	MLFB		3VA911.-0QE00	3VA921.-0QE00	3VA940.-0QE00	3VA940.-0QE00	
	3VA1		100 A 160 A	250 A			
	For installation in	3VA2			100 A 160 A 250 A	400A 630A	
Dimensions for rear terminal flat		A	[mm]	51	43	43	50
		B	[mm]	63	55.5	55.5	65
		C	[mm]	108	100	100	115
		D	[mm]	120.5	112.5	112.5	130
		E	[mm]	8.4	10.5	10.5	13.2
		F	[mm]	16	22	22	29.4

Rear terminals flat can be ordered

- as a pack of 3 (2 short terminals flat and 1 long terminal flat)
- as a pack of 4 (2 short terminals flat and 2 long terminals flat)
- as a pack of 1 (1 short terminal flat)
- as a pack of 1 (1 long terminal flat)

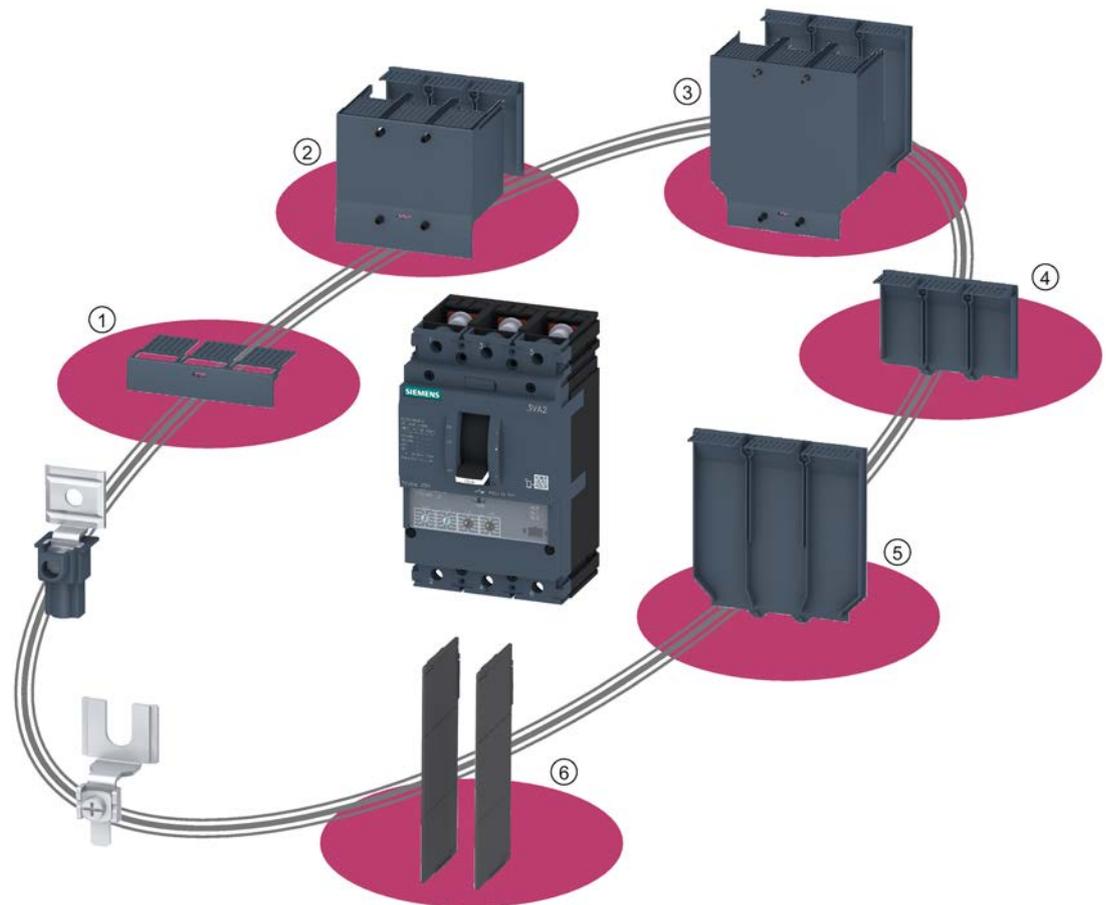
Note

In order to achieve degree of protection IP40, terminal covers (flat version) must also be attached when a rear terminal flat is installed.

4.3.3 Further connection accessories

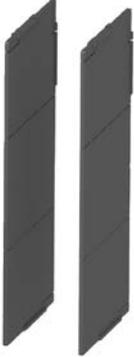
4.3.3.1 Insulating equipment

The portfolio of connection accessories includes a broad range of insulating equipment. The diagram below provides an overview of insulation accessories available for 3VA molded case circuit breakers.



- ① Terminal cover
- ② Terminal cover, extended
- ③ Terminal cover, broadened
- ④ Insulating plate
- ⑤ Insulating plate, broadened
- ⑥ Phase barriers

Phase barriers



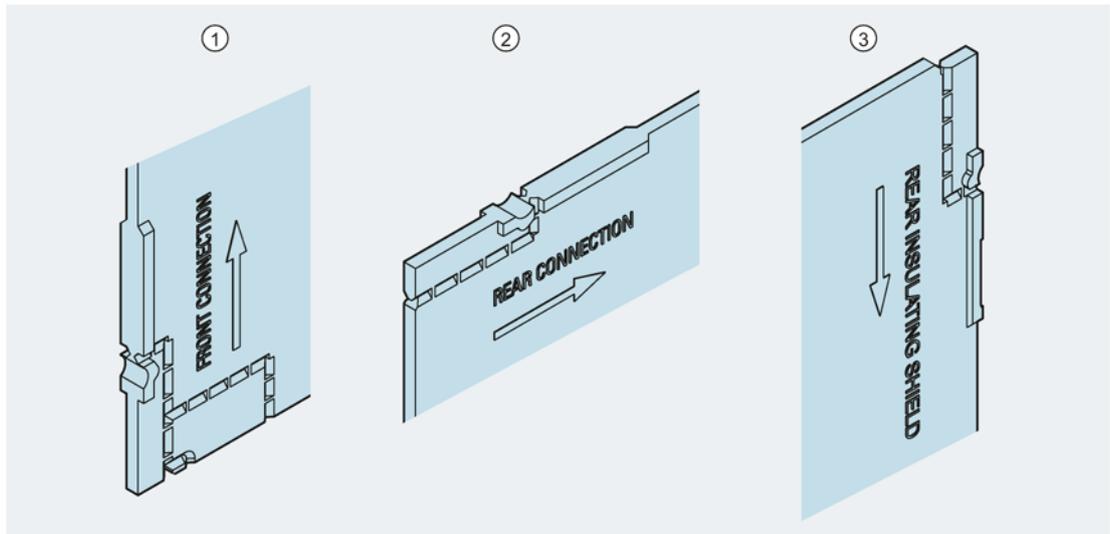
Phase barriers provide insulation between the individual phases of the molded case circuit breaker. They are simply snapped into place on the 3VA molded case circuit breaker.

Phase barriers can be used in combination with the insulating plate and the broadened insulating plate. in order to provide additional insulation from the mounting plate.

Phase barriers are compatible with:

- Box terminal
- Circular conductor terminal
- Front connection bar extended (included in scope of supply)
- Front connection bar broadened (included in scope of supply)
- Front connection bar edgewise (included in scope of supply)
- Lug terminal right-angled (included in scope of supply)
- Other insulation accessories: Insulating plate or insulating plate, broadened

Depending on the intended purpose of the phase barriers, they must be snapped into position in the direction indicated by the arrows below:



- ① Front connection
- ② Rear connection for right-angled lug terminal
- ③ In combination with insulating plate

Terminal cover, extended terminal cover and broadened terminal cover

All terminal covers afford degree of protection IP40 at the front of the breaker and degree of protection IP20 at the infeed and load ends provided that they are correctly installed (cutting of grille structure).

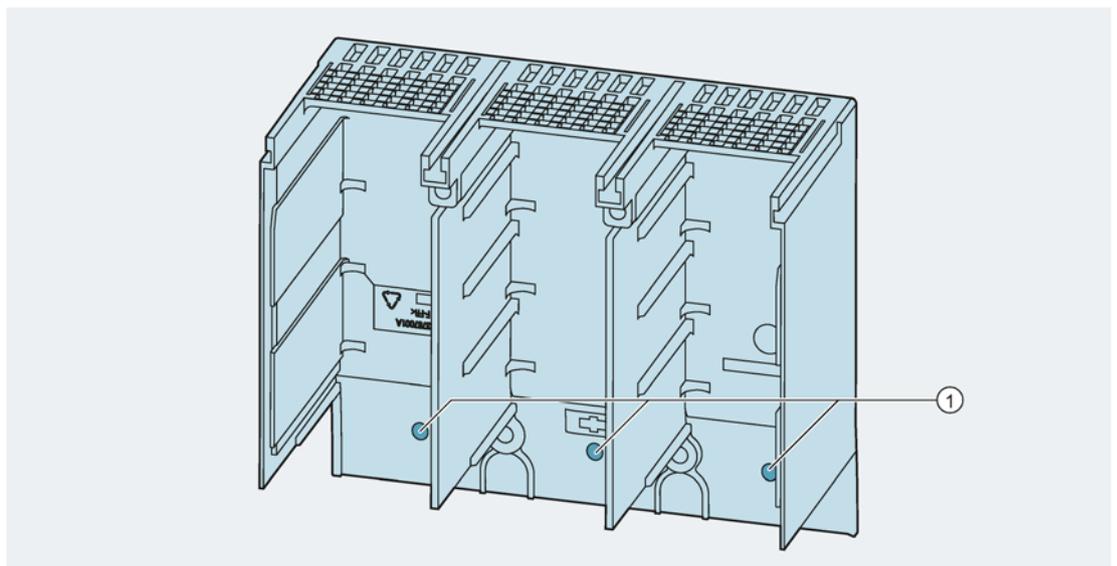
All terminal covers have a marking on the inside face which can be drilled through before the cover is installed. A voltage detector can be inserted through this bore to test for safe isolation.

WARNING

Reduced degree of protection

If a hole is drilled through the terminal cover, degree of protection IP40 is no longer afforded.

Suitable precautions must be taken to safeguard against any hazards posed by this loss of protection.



① Marking for bores

Phase barriers can also be installed on all terminal covers in order to maintain the required clearances and creepage distances which might be reduced as a result of ionized gas following a short circuit.

4.3 Connection system



Terminal cover

The terminal cover is compatible with:

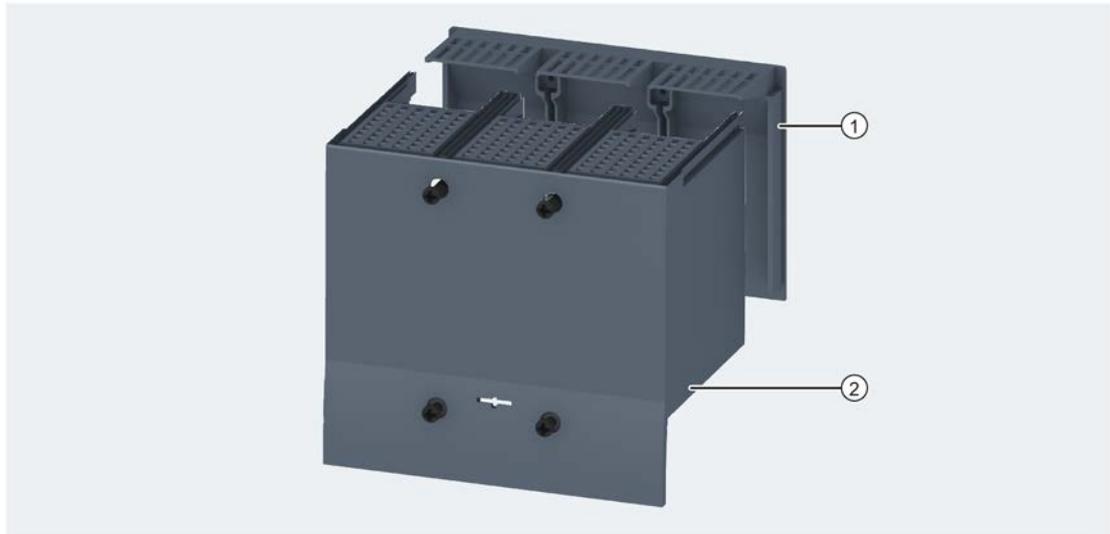
- Box terminals
- Circular conductor terminals
- Lug terminals

The terminal cover is simply snapped into place on 3VA1 breakers, or is snapped into place and secured with 2 screws on 3VA2 breakers.



Extended terminal cover

The extended terminal cover always consists of two parts:



- ① Rear insulating plate, provides insulation from the cubicle mounting plate
- ② Front half, pushed over the molded case circuit breaker from the front

The insulating plate is fitted to the rear panel of the molded case circuit breaker and then secured by 2 screws to the front half of the terminal cover. The extended terminal cover is also secured by 2 additional screws to the molded case circuit breaker itself.

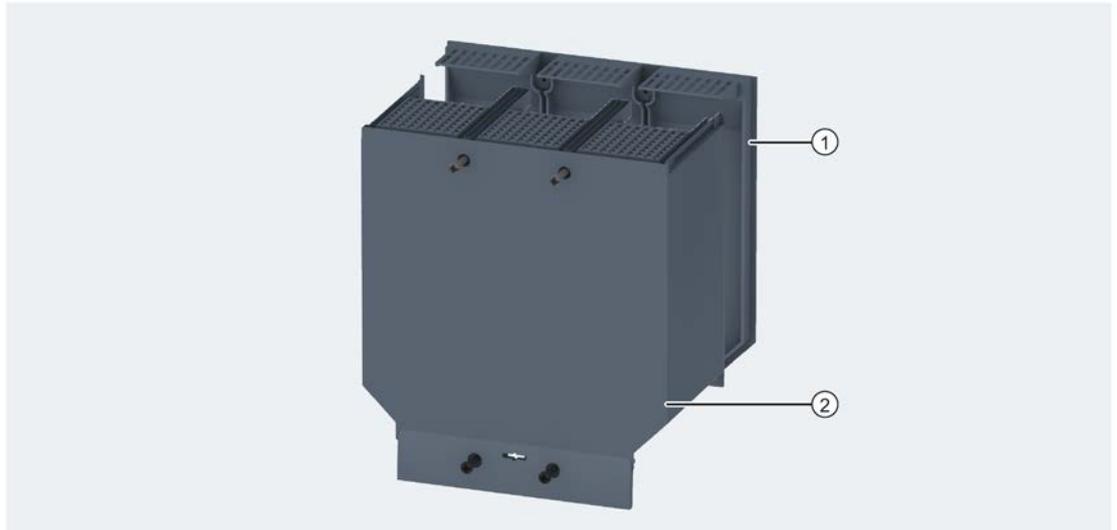
The extended terminal cover is compatible with:

- Circular conductor terminals, large (extended terminal cover included in scope of supply)
- Circular conductor terminals, 2 cables (extended terminal cover included in scope of supply)
- Circular conductor terminals, 6 cables (extended terminal cover included in scope of supply)
- Front connection bars extended
- Front connection bars edgewise



Broadened terminal cover

The broadened terminal cover always consists of two parts:



- ① Rear insulating plate, provides insulation from the cubicle mounting plate
- ② Front half, pushed over the molded case circuit breaker from the front

The insulating plate is fitted to the rear panel of the molded case circuit breaker and then secured by 2 screws to the front half of the terminal cover. The broadened terminal cover is also secured by 2 additional screws to the molded case circuit breaker itself.

The broadened terminal cover is compatible with:

- Front connection bars broadened

Insulating plate and broadened insulating plate



In certain cases it may be necessary to provide insulation from the cubicle mounting plate. The insulating plates for the 3VA molded case circuit breakers are designed for this purpose.

The insulating plate is fitted to the rear panel of the molded case circuit breaker and can be installed in combination with phase barriers.

Potential applications:

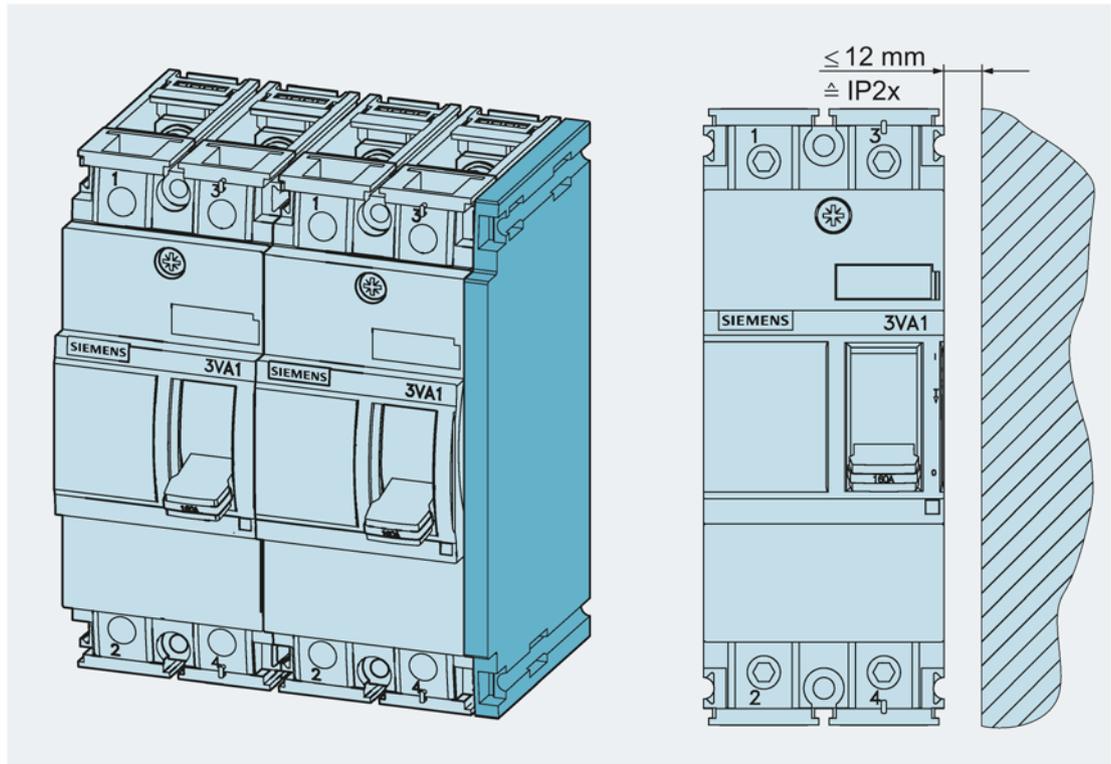
- Insulating plate:
 - Connection bar extensions
 - Non-insulated, straight conductors / terminals
- Insulating plate, broadened
 - Broadened connection bars



Side plate for 3VA1 2-pole

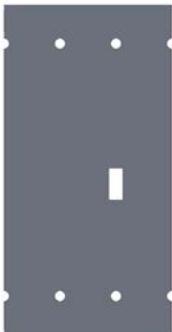


<p>⚠ CAUTION</p> <p>Risk of injury</p> <p>A side plate must be fitted if the side surface at the handle end of a 2-pole 3VA1 breaker with current rating $I_n > 100$ A is freely accessible.</p> <p>For further information, please refer to Operating Instructions 3ZW1012-0VA10-2AA0.</p>



The order number for the side plate is 3VA9112 - 0SG20.

DC insulating plate



A DC insulating plate must be installed on 3-pole and 4-pole molded case circuit breakers for some applications:

- $U_e > 415$ V AC: For IT system applications and entry of incoming feeder cables through the bottom panel of the circuit breaker with non-insulated mounting plate
- $U_e > 250$ V DC: with non-insulated mounting plate

For further information, please refer to Operating Instructions 3ZW1012-0VA10-0AA0

The order numbers for the DC insulating plates are 3VA9113-0SG10 (3-pole) and 3VA9114-0SG10 (4-pole)

Insulating equipment

Voltage level		Insulated cables and busbars e.g. insulated cable, insulated cable lug, insulated busbar, Flexibar, rear connecting studs, rear terminal flat	Non-insulated cables and busbars e.g. non-insulated cable, non-insulated cable lug, non-insulated busbar, connection bar extensions, external circular conductor terminals
3VA1	≤ 415 V	If the cable or busbar is still insulated at the point at which it enters the terminal compartment, no additional insulating equipment is required.	Additional insulating equipment is required such as phase barriers, extended/broadened terminal cover
	> 415 V	Additional insulating equipment is always required: 1. Phase to phase: Phase barriers or extended/broadened terminal covers 2. Phase to mounting plate: Insulating plates or extended/broadened terminal covers	
3VA2	≤ 525 V	If the cable or busbar is still insulated at the point at which it enters the terminal compartment, no additional insulating equipment is required.	Additional insulating equipment is required such as phase barriers, extended/broadened terminal cover
	> 525 V	Additional insulating equipment is always required: 1. Phase to phase: Phase barriers or extended/broadened terminal covers 2. Phase to mounting plate: Insulating plates or extended/broadened terminal covers	

Touch protection

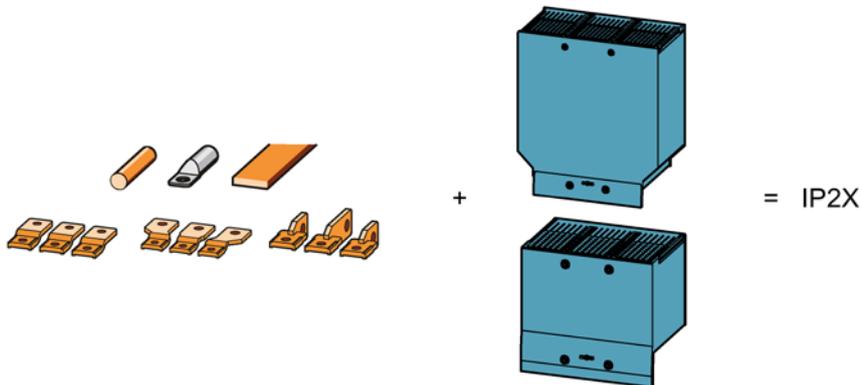
Insulated cables and busbars

With insulated cables and busbars that have insulation that reaches inside the terminal compartment of the 3VA molded case circuit breaker, the unit is classed as finger-safe (IP2X) if it is also equipped with a terminal cover. This protection is guaranteed only if the unit is installed and wired correctly.



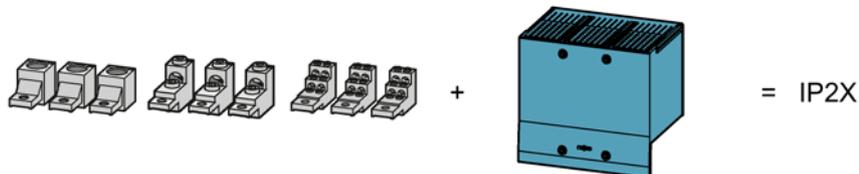
Non-insulated cables and busbars

With non-insulated cables and busbars, and front connection bars extended or front connection bars broadened, the unit is classed as finger-safe (IP2X) if it is also equipped with an extended or broadened terminal cover. This protection is guaranteed only if the unit is installed and wired correctly.



External circular conductor terminals

External circular conductor terminals are supplied as standard with an extended terminal cover. The external circular conductor terminals are classed as finger-safe (IP2X) on condition that the extended terminal cover is correctly installed.



4.3.3.2 Auxiliary conductor terminal

An auxiliary conductor terminal can be implemented easily using components from the 3VA molded case circuit breaker equipment portfolio.

Note

All auxiliary conductor terminals implemented on 3VA molded case circuit breakers have a maximum permissible current-carrying capacity of 6 A.
The auxiliary conductor terminal pickoff must be taken into account at the breaker planning stage. Suitable cable cross-sections: Cables with a maximum cross-section up to 2.5 mm² can be connected.

All circular conductor terminals can be ordered with auxiliary conductor terminal under a separate article number. The circular conductor terminal is then supplied with a bore for the auxiliary conductor terminal. A ring lug can be installed in this bore. The screw required is supplied.

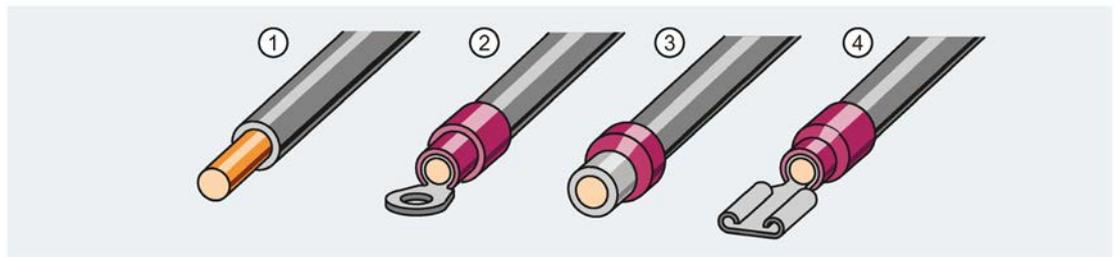


Auxiliary conductor terminal for box terminal



This auxiliary conductor terminal is inserted in the box terminal with the cable.

The following connections can be selected for the auxiliary conductor pickoff:



- ① Bare conductor
- ② Ring lug

- ③ Wire-end ferrule
- ④ Cable lug (connector)

Auxiliary conductor terminal for busbar connection

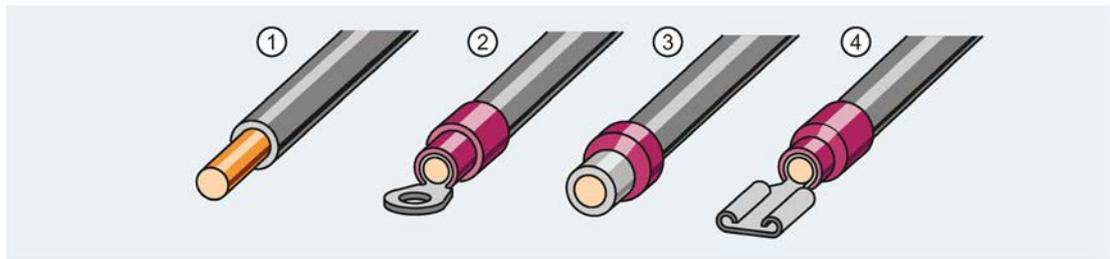


This auxiliary conductor terminal is installed at the 3VA molded case circuit breaker with the busbar.

It can also be installed using:

- Front connection bars extended
- Front connection bars broadened
- Front connection bars edgewise
- Lug terminals, right-angled

The following connections can be selected for the auxiliary conductor pickoff:



- ① Bare conductor
- ② Ring lug

- ③ Wire-end ferrule
- ④ Cable lug (connector)

4.4 Plug-in and draw-out technology

4.4.1 Introduction

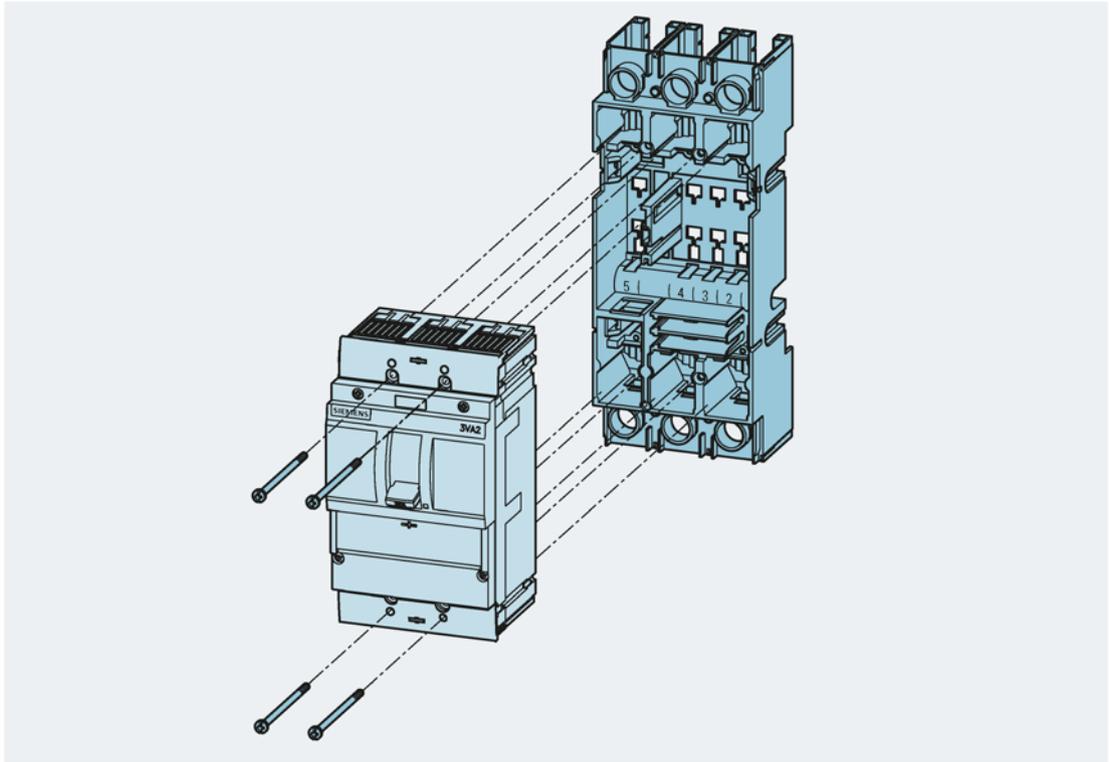
With most applications, 3VA molded case circuit breakers are installed in a fixed position in switchboards or distribution boards. The breaker is normally secured by fastening bolts directly to the mounting plate or other suitable supporting stays of the cubicle. The cables or busbars of the main circuits are connected directly to the 3VA molded case circuit breaker by various terminals or connectors. A rigid, permanent connection is thus created between the 3VA molded case circuit breaker and the cubicle.

With certain applications such as those where regular maintenance and overhaul of circuit breakers is required, for example, it must be possible to replace the 3VA molded case circuit breakers quickly. To meet this requirement, 3VA molded case circuit breakers can be converted to plug-in and draw-out units.

The main differences between plug-in units and draw-out units are convenience of operation and the potential for functional expansion.

Plug-in technology

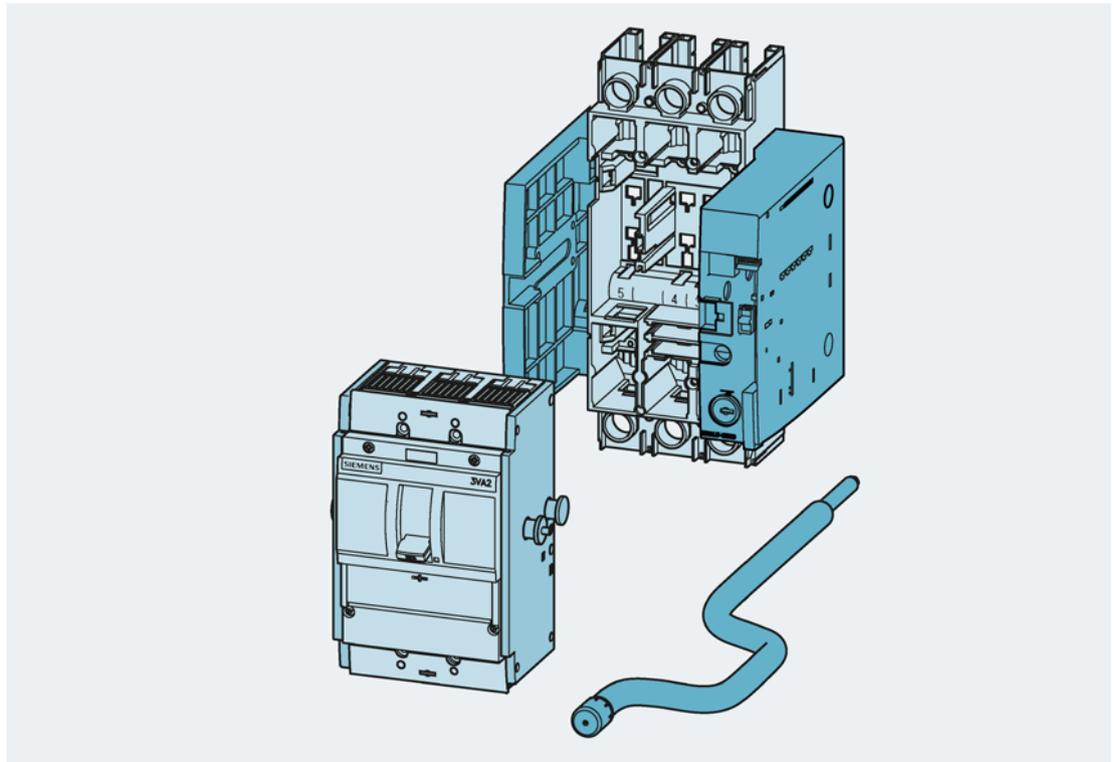
Plug-in technology is the less expensive and more space-saving of the two solutions. The 3VA molded case circuit breaker is inserted in the appropriate plug-in socket and fitted with plug-in contacts which make a keyed, friction-locked connection with the corresponding mating contacts (tulip-type contacts) in the plug-in socket. In this case, the device is plugged in and withdrawn manually.



Draw-out technology

Like the plug-in versions, draw-out versions of 3VA molded case circuit breakers are equipped with plug-in contacts at the main current paths. In addition, side walls including guide and support bolts are bolted to the sides of the 3VA molded case circuit breakers.

In this case, the mating contacts are in the draw-out socket. This is also equipped with a guide mechanism via which the molded case circuit breaker is moved into the draw-out socket by means of a crank handle in order to connect the breaker to the main circuits. The operator can clearly read from a position indicator whether the breaker is properly connected to the main circuits or is 100% safely isolated from them (so that it can be withdrawn).



4.4 Plug-in and draw-out technology

Cable connection

With plug-in and draw-out circuit breakers, the cables or busbars are connected to the plug-in socket or the draw-out socket. The termination areas for these versions are designed in the same way as those of the molded case circuit breaker, i.e. all the connection technology which is available for 3VA molded case circuit breakers can be used in the same way for the plug-in and draw-out sockets.

3VA plug-in and draw-out units

Plug-in and draw-out technology as it is implemented in 3VA molded case circuit breakers is described below. But 3VA switch disconnectors in MCCB design can also be converted to plug-in or draw-out technology. The information given below therefore applies analogously to 3VA switch disconnectors.

 WARNING
Formation of arcs between contacts and irreparable damage to circuit breakers and installation
When the 3VA molded case circuit breaker is moved into or out of the socket when the main contacts are closed (breaker position ON), arcs can form between contacts and result in irreparable damage to the circuit breaker or the electrical installation, and possibly cause physical injury to personnel.
Do not move the 3VA molded case circuit breaker into or out of the plug-in socket or the socket of the draw-out unit unless the main contacts are open, i.e. unless the breaker is in the OFF position.

Before moving the molded case circuit breaker into or out of the socket, use the handle to switch it to the OFF position. In order to prevent operating errors, 3VA molded case circuit breakers are equipped with an autotrip plunger when they are converted to plug-in or draw-out units. This plunger automatically trips the circuit breaker (breaker position TRIP) and thus opens the main contacts whenever an attempt is made to move a unit into or out of the socket when the breaker contacts are closed.

4.4.2 Overview of variants / products

Installation overview

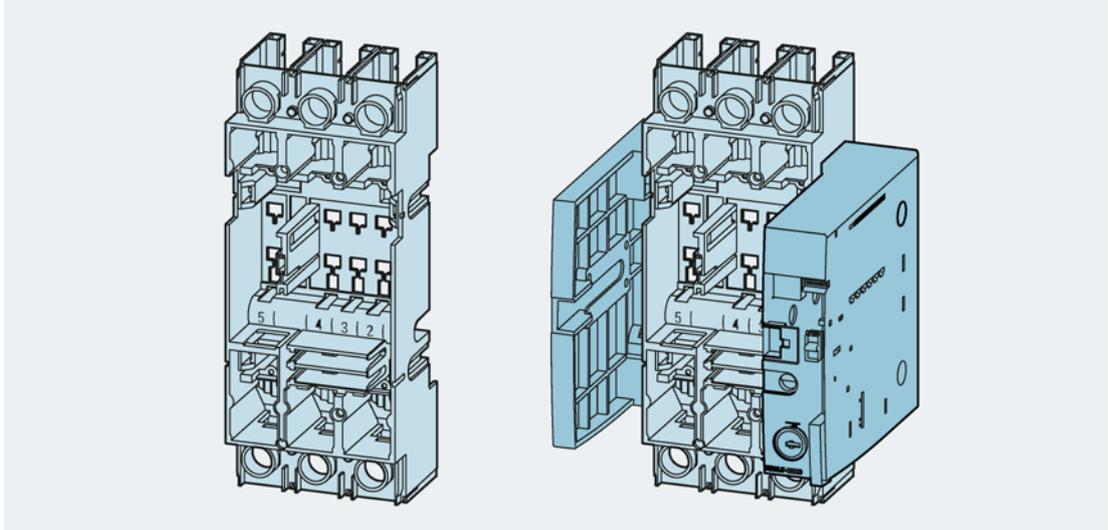
3-pole and 4-pole 3VA molded case circuit breakers are available in a version for fixed mounting, as a plug-in version and a draw-out version, as shown in the table below:

	Size	Fixed-mounted	Plug-in	Draw-out
3VA1	100 A, 3-pole	■		
	100 A, 4-pole	■		
	160 A, 1-pole	■		
	160 A, 2-pole	■		
	160 A, 3-pole	■	■	
	160 A, 4-pole	■	■	
	250 A, 3-pole	■	■	■
	250 A, 4-pole	■	■	■
3VA2	160 A, 3-pole	■	■	■
	160 A, 4-pole	■	■	■
	250 A, 3-pole	■	■	■
	250 A, 4-pole	■	■	■
	400 A, 3-pole	■	■	■
	400 A, 4-pole	■	■	■
	630 A, 3-pole	■	■	■
	630 A, 4-pole	■	■	■

Apart from the complete kit for plug-in or draw-out technology, a plug-in or draw-out "conversion kit" for the 3VA molded case circuit breaker can be ordered as a separate item. These conversion kits are used to prepare 3VA molded case circuit breakers in advance so that ready-assembled units are available at short notice in the event that a defective breaker needs to be replaced.

4.4.3 General information

With plug-in and draw-out circuit breakers, the cables or busbars are connected to the plug-in socket or the draw-out socket. The same socket unit is used for the same sizes of both variants.



The incoming and outgoing feeder ends of the socket unit termination area is designed to match the relevant 3VA molded case circuit breaker. The major benefit of this design feature is that all terminal and connection variants of the 3VA molded case circuit breaker are fully compatible with the corresponding plug-in or draw-out unit. To facilitate the ordering process, the components used in combination with plug-in and draw-out units have been given separate article numbers. Furthermore, an optional terminal cover for the molded case circuit breaker can also be installed as a terminal cover over the plug-in socket or draw-out socket.

The connection systems available for a 3VA rated current version and the sizes of cable or busbar cross section which are compatible with various connection types are described in detail in chapter Connection system (Page 165).

4.4.4 Information about installation, built-on and built-in components

Securing plug-in and draw-out units to the mounting plate

Bolts supplied with complete kit

Supplied with each complete kit for plug-in or draw-out technology:

- 4 fastening bolts, metric thread, Phillips pan head

The fastening bolts are used to attach the relevant socket unit to a mounting plate or supporting stay. Sets of fastening bolts can also be ordered separately as spare parts. Fastening bolts with an inch thread are also available.

Mounting positions

The permissible mounting positions are described in Chapter Permissible mounting positions (Page 62).

See also

Connection system (Page 165)

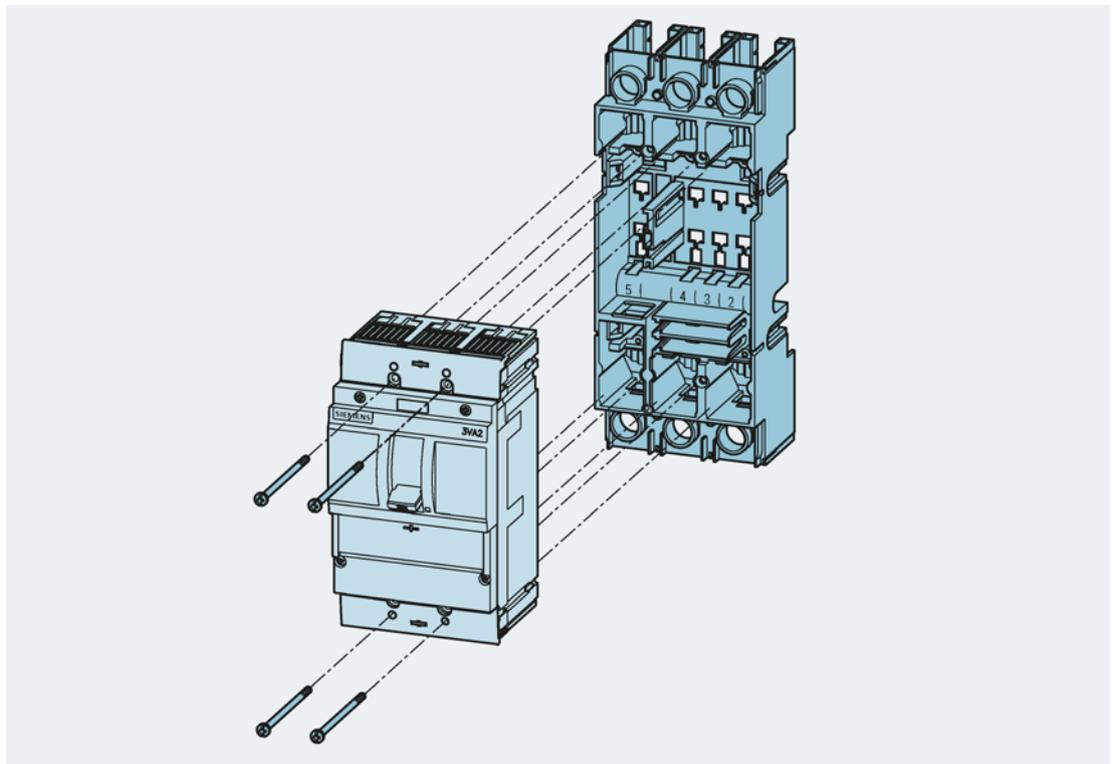
4.4.5 Plug-in technology

4.4.5.1 Product description

Applications

The plug-in versions of 3VA molded case circuit breakers are designed for use in complex applications for which speedy replacement of molded case circuit breakers is a basic requirement. Plug-in technology can be used, for example, when clear visual evidence of safe electrical isolation of circuits is essential, e.g. when overhaul work is in progress.

Description



With a plug-in system, the molded case circuit breaker is moved into and out of the plug-in socket manually.

 **WARNING**

Risk of large magnetic forces in the event of short circuits

Accident hazard posed by short circuit events. The molded case circuit breaker can be ejected from its socket by the resulting magnetic forces.

The 3VA molded case circuit breaker must be bolted securely in position in the socket. The complete kit for plug-in technology contains assembly bolts for this purpose.

A complete kit for plug-in technology contains all the components required to convert the fixed mounting version of a 3VA molded case circuit breaker or 3VA switch disconnecter to a plug-in version.

A complete kit for plug-in technology contains:

- Plug-in socket
- 4 fastening bolts for installing the socket in the cubicle
- 4 fastening bolts for securing the 3VA molded case circuit breaker in the plug-in socket
- Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
 - 3-pole: 6 plug-in contacts
 - 4-pole: 8 plug-in contacts
- Autotrip plunger
- 2 screw-mounted terminal covers for the 3VA molded case circuit breaker
- Cable cages (see chapter Cable cage (Page 235))

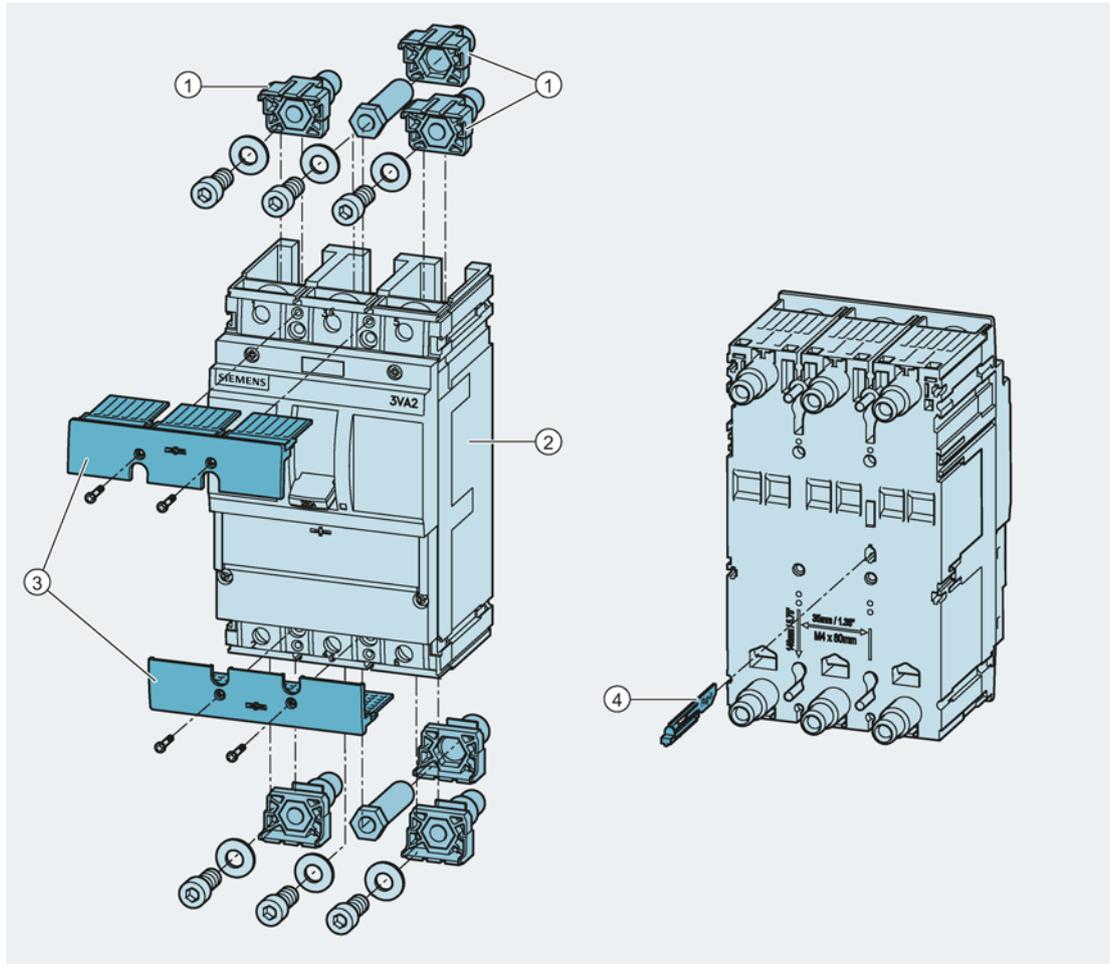
A conversion kit for plug-in technology contains:

- Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
 - 3-pole: 6 plug-in contacts
 - 4-pole: 8 plug-in contacts
- Autotrip plunger
- 2 screw-mounted terminal covers for the 3VA molded case circuit breaker
- Cable cages (see chapter Cable cage (Page 235))

4.4 Plug-in and draw-out technology

Scope of supply of the 3VA molded case circuit breaker and the 3VA switch disconnecter in molded case circuit breaker design:

- For 3-pole version up to 250 A: 2 assembly bolts
- For 3-pole version up to 630 A and 4-pole version: 4 assembly bolts



- ① Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
- ② 3VA molded case circuit breaker
- ③ Screw-mounted terminal cover for the molded case circuit breaker
- ④ Autotrip plunger

Terminal covers

As described above, two screw-mounted terminal covers are included in the plug-in socket complete kit and the plug-in socket conversion kit. These feature molded grips to ease withdrawal of the molded case circuit breaker from its socket. Since it requires significant force to remove a molded case circuit breaker from its socket, the plug-in terminal covers are bolted to the contact unit.

If the termination area of the plug-in socket needs to be protected by terminal covers, a variety of models of terminal cover are available to order as options for this purpose.

Autotrip plunger

An autotrip plunger is supplied as standard with every complete kit and every conversion kit for converting a 3VA molded case circuit breaker to plug-in technology. The plunger performs safety functions in operation.

When a 3VA molded case circuit breaker is converted to a 3VA plug-in unit, this plunger is installed from the rear of the device and latched. The plunger performs safety functions in operation. It prevents the molded case circuit breaker from being switched to the ON position if the breaker is not correctly bolted to the socket. For further information, see also section "Signal 'Plug-in unit - MCCB correctly bolted to plug-in socket'" in chapter Position signaling switches (Page 225).

WARNING

Make sure that the autotrip plunger is correctly installed

The molded case circuit breaker cannot be safely moved into or out of the socket without an autotrip plunger. Moving it into or out of the socket when the main contacts are closed (breaker position ON) can cause arcs to form between contacts and result in irreparable damage to the circuit breaker or the electrical installation, and possibly cause physical injury to personnel.

Once installed, the autotrip plunger cannot be dismantled again!

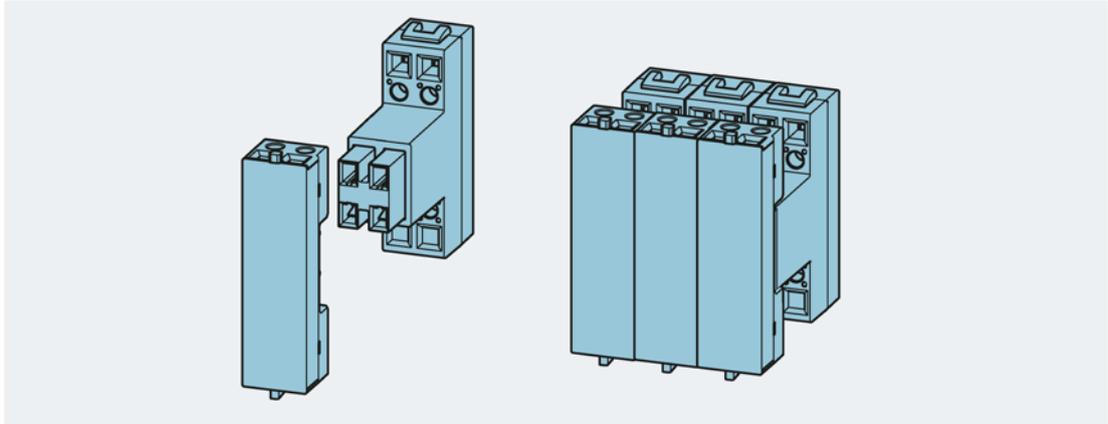
Note the color coding and labels for the autotrip plunger:

- Plug-in technology: Black, labeled "Plug-in"
- Draw-out technology: Grey, labeled "Draw-out"

Auxiliary circuit connectors

Molded case circuit breakers or switch disconnectors in molded case circuit breaker design are frequently equipped with internal accessories, e.g. with an auxiliary switch, auxiliary release, etc. A broad range of internal accessory components is also available for the 3VA molded case circuit breaker. For further information, please refer to chapter Internal accessories (Page 146).

To ensure that the electrical connections required by plug-in units can be quickly and safely disconnected, auxiliary circuit connectors can be installed.



The breaker-end half is attached to the underside of the molded case circuit breaker and electrically connected to the internal accessories. Appropriate openings and cable ducts are provided in the molded case circuit breaker for routing stranded wires. The plug-in socket half of the auxiliary circuit connector is inserted in the socket and electrically connected to the customer's installation.

When the molded case circuit breaker is inserted into the plug-in socket, the internal accessories in the breaker are quickly connected to the customer's installation without the use of tools.

Note

Plug-in and draw-out units use different versions of the auxiliary circuit connector. The draw-out version has a longer, movable telescopic rail because the distance to be bridged in the draw-out socket is longer.

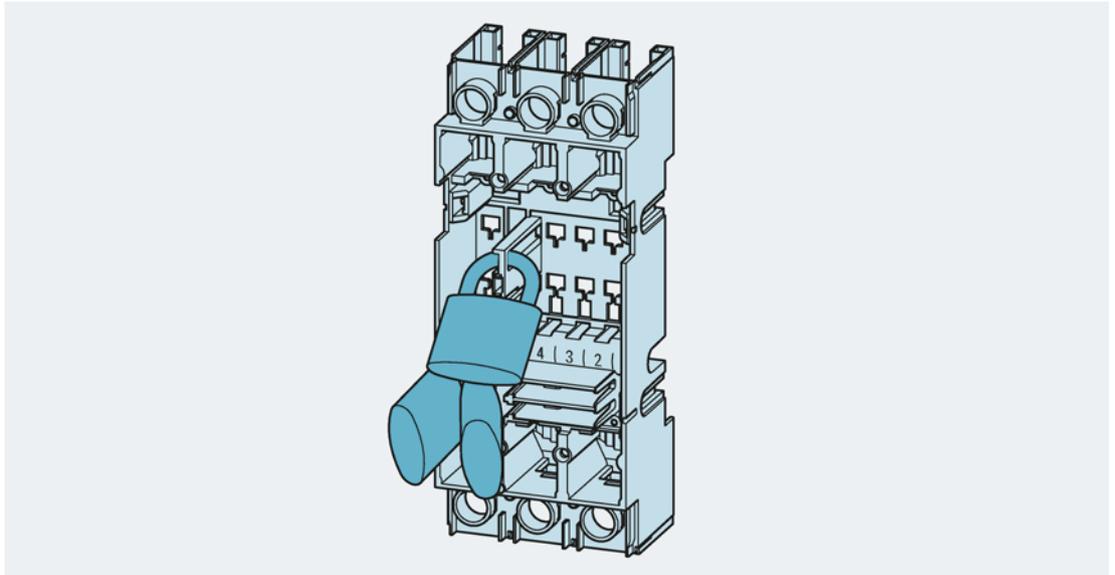
Further details about auxiliary circuit connectors can be found in chapter Auxiliary circuit connector (Page 231).

Position signaling in the plug-in socket

Several position signaling switches (number depends on socket size) can be fitted in the plug-in socket. Auxiliary switches are capable of signaling "Plug-in unit - MCCB correctly bolted to plug-in socket" via electrical connections.

For further information, please refer to chapter Position signaling switches (Page 225).

Padlocks for preventing insertion of a molded case circuit breaker



The socket unit can be locked by padlocks to prevent the insertion of a 3VA molded case circuit breaker while maintenance or overhaul work is in progress. Using these locks to prevent insertion and operation of a molded case circuit breaker helps to protect personnel and the installation itself. The socket unit of the plug-in socket is equipped with three openings for padlocks.

Openings for padlocks:

- Up to 3 padlocks
- Shackle diameter 8 mm (3/8")

4.4 Plug-in and draw-out technology

Benefits of plug-in technology

- Defective molded case circuit breakers can be replaced quickly and easily
- Clear visual evidence of safe electrical isolation of main circuits
- Remote signaling of molded case circuit breaker positions:
 - "INSERTED": The 3VA molded case circuit breaker is properly inserted and bolted to the socket
 - "WITHDRAWN": The bolts have been removed and the 3VA molded case circuit breaker removed
- Plug-in socket can be locked by padlocks to prevent insertion of a molded case circuit breaker
- Degree of protection IP20 at all termination points
- No grounding required

See also

Locking and interlocking (Page 269)

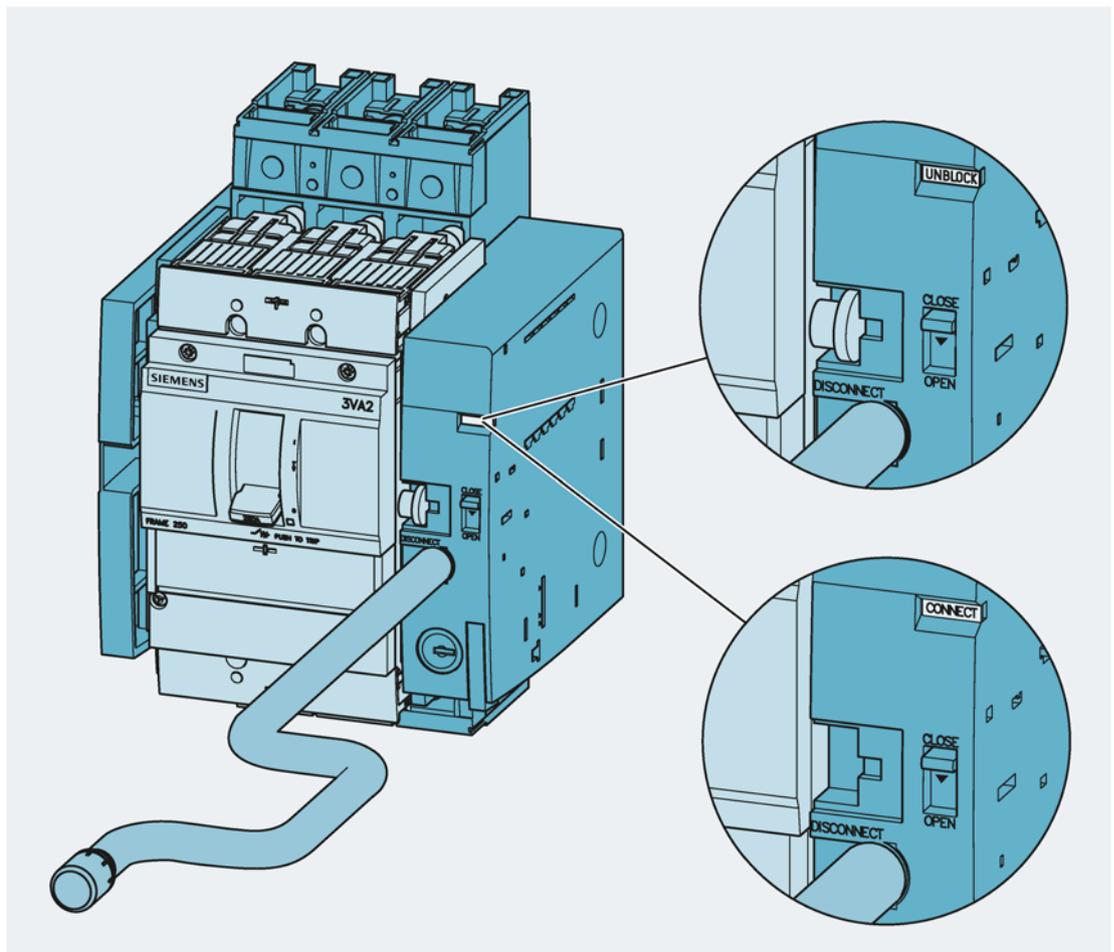
4.4.5.2 Combination with other accessories

Accessories group	Component
Manual operators	Front mounted rotary operator
	Door mounted rotary operator
Remote-controlled operator	MO320 motor operator
Interlocks	Rear interlocking module
	Bowden cable interlock for handle
	Bowden cable interlock (for front mounted rotary operators)
Padlock devices for handle	

4.4.6 Draw-out technology

4.4.6.1 Product description

Typical applications for draw-out versions of 3VA molded case circuit breakers are installations in which inspections and overhauls need to be carried out at regular intervals and, for reasons of safety, clear visual evidence of safe electrical isolation of plant sections must be provided at short notice so that work can commence. Draw-out versions of 3VA molded case circuit breakers are also suitable for applications which require that molded case circuit breakers or switch disconnectors can be replaced very rapidly when necessary.



In the draw-out version, the 3VA molded case circuit breaker is supported by the side walls of the draw-out unit and can be moved into three defined positions by rotation of a crank handle. The current breaker position is indicated by the position indicator.

Defined positions

- **CONNECT position:** The molded case circuit breaker is connected to the main circuits. The auxiliary circuits are also electrically connected to the installation via the auxiliary circuit connectors.
This is the normal operating position of the molded case circuit breaker.
- **TEST position:** The main circuits are not connected to the installation. The auxiliary circuits are connected to the installation via auxiliary circuit connectors.
The auxiliary circuits can be function-tested with the breaker in the TEST position even when the installation itself is not live.
- **DISCON position:** Neither the main circuits nor the auxiliary circuits are connected to the installation.
The molded case circuit breaker is electrically isolated.

If the molded case circuit breaker is not in any of these defined positions, the switching position indicator displays the word UNBLOCK on a white background. When the breaker is in this position, its main contacts cannot be closed if the autotrip plunger is correctly installed (see below).

Move the molded case circuit breaker into a defined position

Note

If the switch position indication is CONNECT, TEST or DISCON, the sliding clutch of the crank gear is engaged and rotation of the crank handle has no effect.

By removing and reinserting the crank handle, it is possible to disengage the gear. The switching position indicator will then show UNBLOCK. The molded case circuit breaker can now be moved to a new position.

1. If the crank handle is inserted in the crankcase, pull it out.
2. Insert the crank handle into the crankcase again.
By removing and reinserting the crank handle, it is possible to disengage the gear.
3. Turn the crank handle until the switching position indicator shows the required position.

Remove the molded case circuit breaker

1. Move the molded case circuit breaker into the DISCON position.
The molded case circuit breaker is electrically isolated.
2. To disengage the lock, press the safety lock slide underneath the switching position indicator downwards as indicated by the arrow.
3. Remove the molded case circuit breaker.

Components of a complete kit for draw-out technology

A complete kit for draw-out technology contains all the components required to convert the fixed mounting version of a molded case circuit breaker or switch disconnecter to a draw-out version.

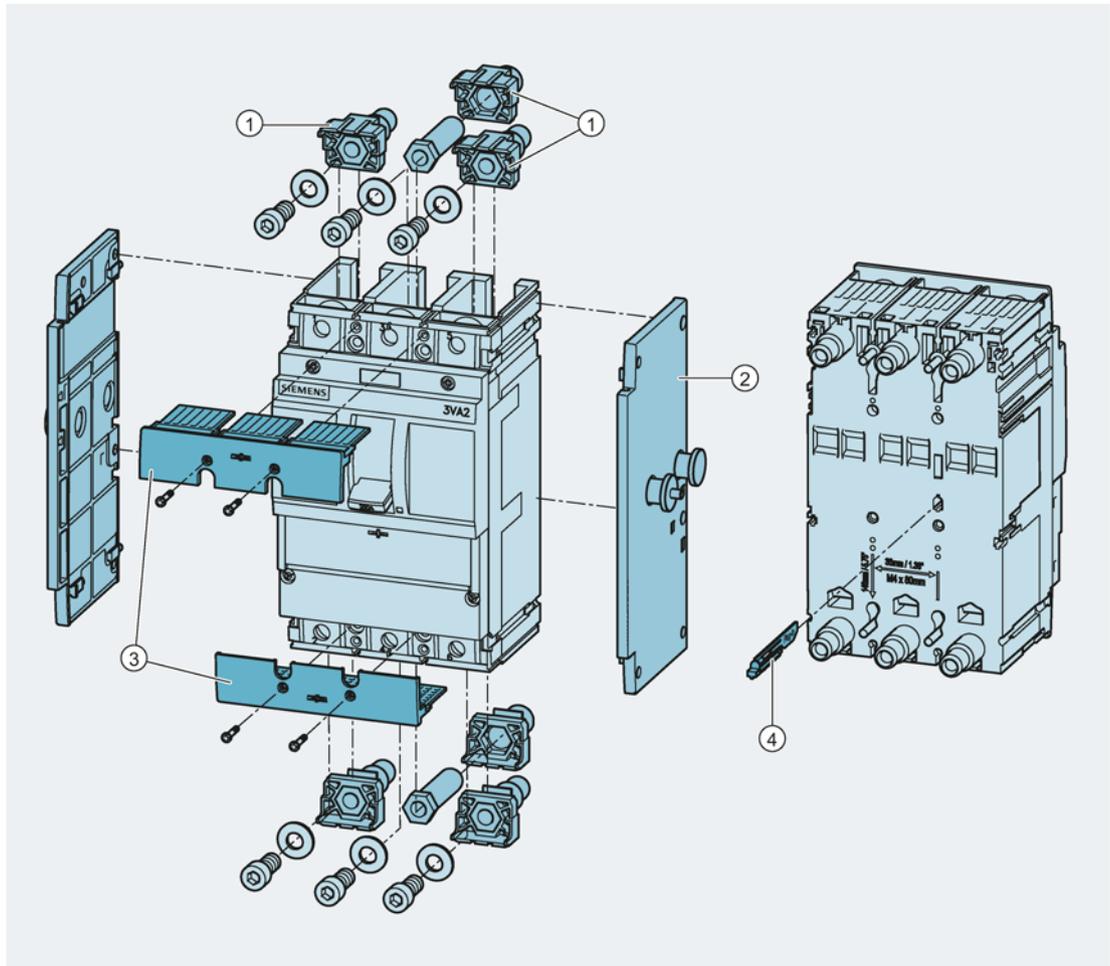
- Draw-out socket including side walls with the mechanical components required to guide the molded case circuit breaker into and out of the socket under the control of a crank handle
- 4 fastening bolts for installing the socket in the cubicle
- Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
 - 3-pole: 6 plug-in contacts
 - 4-pole: 8 connectors
- Side walls with guide bolts for mounting on the molded case circuit breaker
- Autotrip plunger
- 2 screw-mounted terminal covers for the 3VA molded case circuit breaker

Note**Information about the crank handle**

The crank handle is not supplied as part of the complete kit and must be ordered separately.

Components of a conversion kit for draw-out technology

- Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
 - 3-pole: 6 plug-in contacts
 - 4-pole: 8 plug-in contacts
- Side walls with guide bolts for mounting on the molded case circuit breaker
- Autotrip plunger
- 2 screw-mounted terminal covers for the 3VA molded case circuit breaker



- ① Plug-in contacts for attachment to the main terminals of the 3VA molded case circuit breaker
- ② Side walls with guide bolts for mounting on the molded case circuit breaker
- ③ Screw-mounted terminal cover for the molded case circuit breaker
- ④ Autotrip plunger

Installation instructions

The draw-out socket is permanently mounted in the cubicle by means of the fastening bolts included in the complete kit for draw-out technology.

The molded case circuit breaker / switch disconnecter in molded case circuit breaker design is supplied with two assembly bolts (3-pole version) or four assembly bolts (4-pole version). These bolts are not required if the device is to be converted to a draw-out unit.

Terminal cover

Two terminal covers are included in the scope of supply of the complete kit for draw-out technology and the conversion kit for draw-out technology for the molded case circuit breaker. These two terminal covers are intended for installation over the molded case circuit breaker. If terminal covers are to be attached to the busbars of the draw-out socket, they must be ordered separately, see chapter Insulating equipment (Page 191).

Autotrip plunger

An autotrip plunger is supplied as standard with every complete kit and every conversion kit for converting a molded case circuit breaker to draw-out technology.

WARNING

Make sure that the autotrip plunger is correctly installed

The molded case circuit breaker cannot be safely moved into or out of the socket without an autotrip plunger. Moving it into or out of the socket when the main contacts are closed (breaker position ON) can cause arcs to form between contacts and result in irreparable damage to the circuit breaker or the electrical installation, and possibly cause physical injury to personnel.

Once installed, the autotrip plunger cannot be dismantled again!

Note the color coding and labels for the autotrip plunger:

- Plug-in technology: Black, labeled "Plug-in"
- Draw-out technology: Grey, labeled "Draw-out"

When a 3VA molded case circuit breaker is converted to a 3VA draw-out unit, this plunger is installed from the rear of the device and latched.

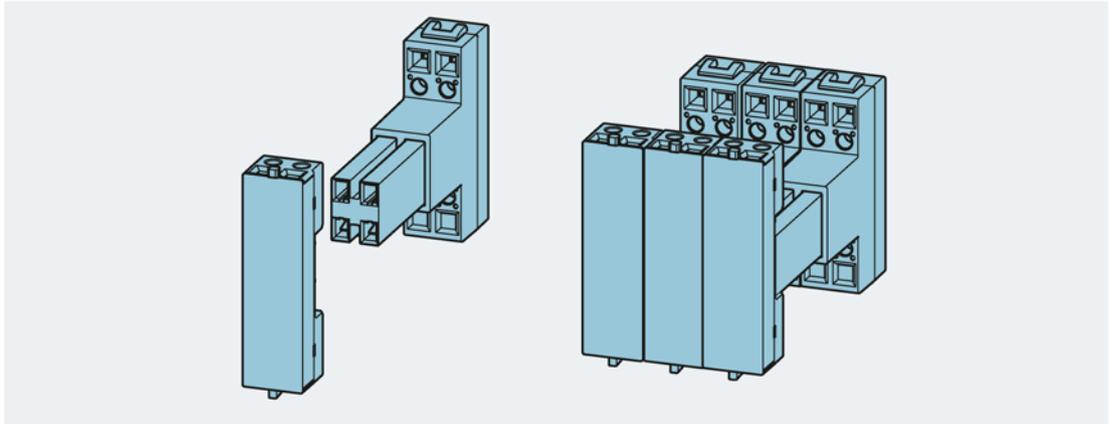
The plunger performs various safety functions in operation:

- It prevents closure of the main contacts of the molded case circuit breaker when the breaker is inserted in the draw-out socket and in an undefined position (switching position indication is UNBLOCK).
- It allows the breaker to be closed in the defined positions TEST and CONNECT.
- It trips the molded case circuit breaker (TRIP) when the breaker's main contacts are closed (switching position ON) and an attempt is made to move the breaker out of one of the three defined positions CONNECT, TEST or DISCON using the crank handle.

Auxiliary circuit connectors

3VA molded case circuit breakers or 3VA switch disconnectors are frequently equipped with internal accessories, e.g. auxiliary switches and auxiliary releases. A broad range of internal accessory components is also available for the 3VA molded case circuit breaker. For further information, please refer to chapter Internal accessories (Page 146).

To ensure that the electrical connections required by draw-out units can be quickly and safely disconnected, auxiliary circuit connectors can be installed.



The breaker-end half is attached to the underside of the molded case circuit breaker and electrically connected to the internal accessories. Appropriate openings and cable ducts are provided in the 3VA molded case circuit breaker for routing stranded wires. The socket-end half of the auxiliary circuit connector with the movable telescopic rail is inserted in the socket and electrically connected to the customer's installation.

When the molded case circuit breaker is inserted into the draw-out unit, an electrical connection between the internal accessories in the breaker and the customer's installation is quickly established.

Note

Plug-in and draw-out units use different versions of the auxiliary circuit connector.

The draw-out version has a longer, movable telescopic rail because the distance to be bridged in the draw-out socket is longer.

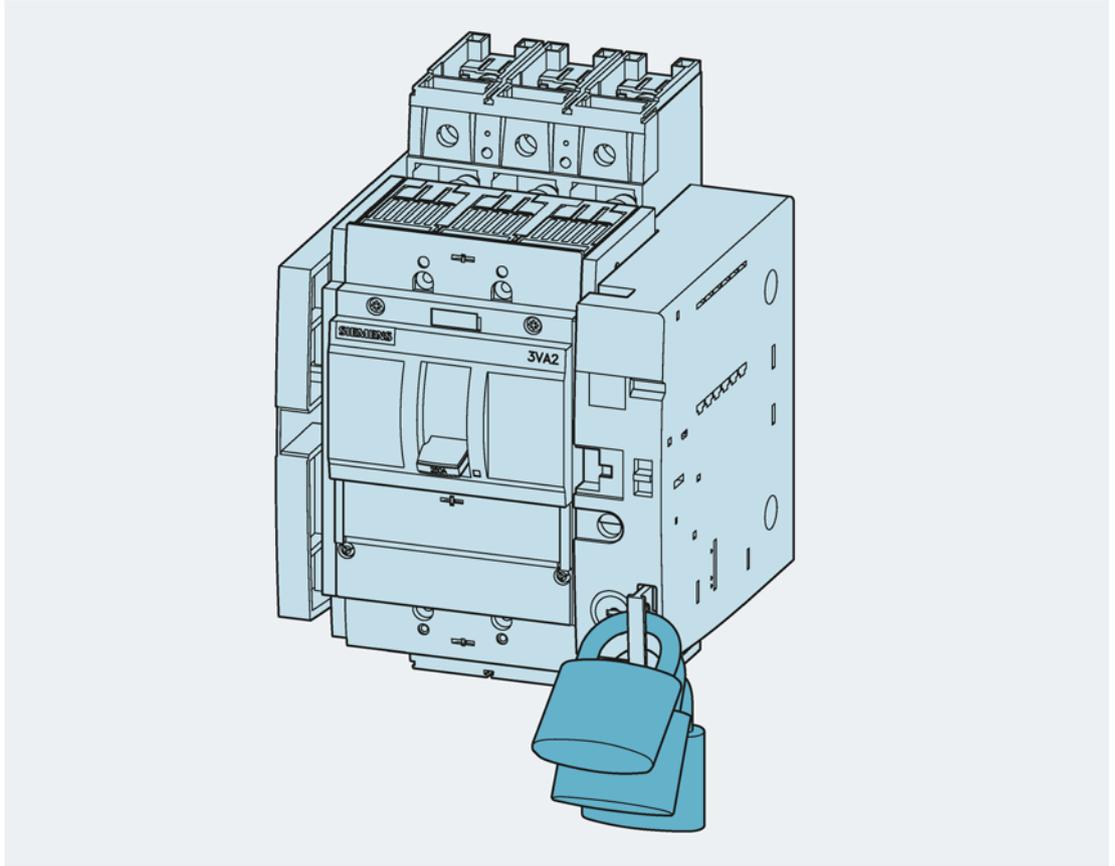
Further details about auxiliary circuit connectors can be found in chapter Auxiliary circuit connector (Page 231).

Position signaling in the draw-out socket

Several position signaling switches (number depends on socket size) can be installed in the right-hand side wall of the draw-out socket. These auxiliary switches are capable of signaling breaker positions DISCON, TEST and CONNECT. The auxiliary switches also output a position indication signal if the molded case circuit breaker in the draw-out socket is not in one of the positions specified above. For information, please refer to chapter Position signaling switches (Page 225).

Protection against unauthorized operation of molded case circuit breaker

Padlocks for protection against unauthorized operation



To provide protection against unauthorized operation of the molded case circuit breaker, padlocks can be inserted through the plastic frame opening of the padlock locking unit on the right side panel of the draw-out socket. The plastic frame is simple to pull out. The crank handle opening is mechanically sealed when the plastic frame is in the OUT position.

Openings for padlocks in plastic frame:

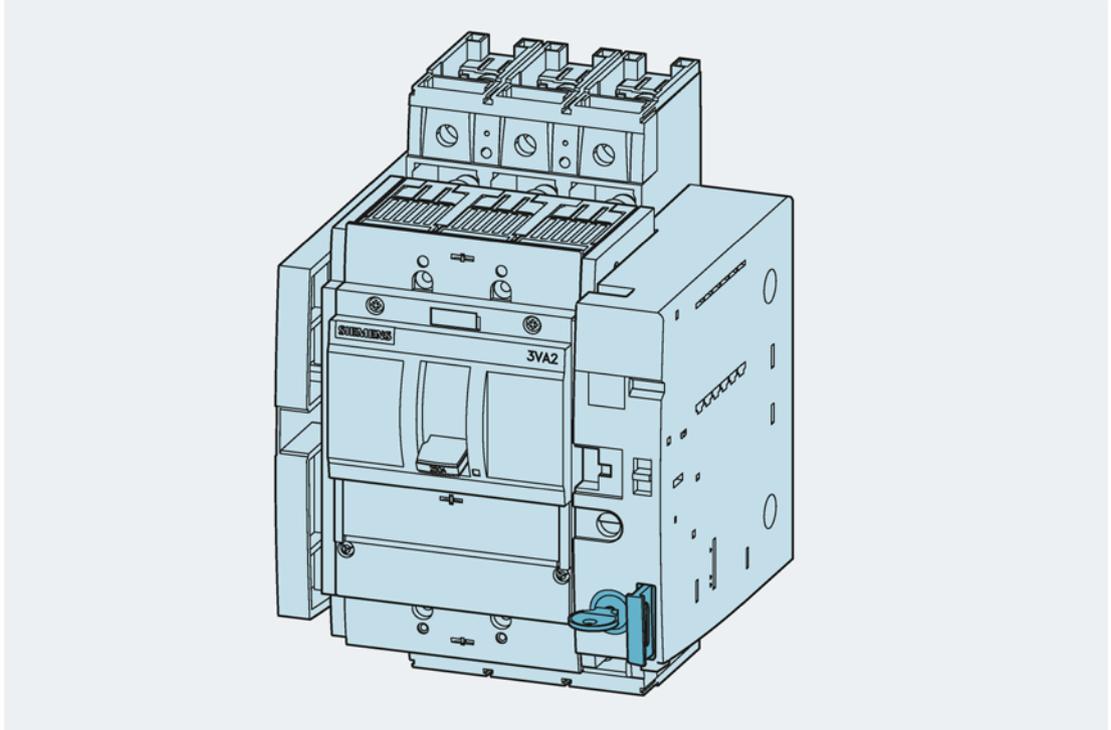
- Up to 3 padlocks
- Shackle diameter 8 mm (3/8 inch)

Attach padlocks

1. Move the molded case circuit breaker into the CONNECT, TEST or DISCON position.
The breaker must be in one of these positions before the plastic frame can be pulled out.
2. Pull out the plastic frame.
The crank handle opening is sealed off.
3. Insert padlock shackles through the plastic frame and lock padlocks as illustrated above.

Cylinder lock for protection against unauthorized operation

A cylinder lock can be retrofitted in the right-hand side panel of the draw-out socket. Like the plastic frame and padlocks, this cylinder lock is capable of locking a molded case circuit breaker in either the CONNECT, TEST or DISCON position. The cylinder lock utilizes the locking mechanism of the plastic frame. This is evident from the way the plastic frame moves into or out of the socket as the cylinder lock is turned.



Signaling of locked/unlocked status

The locked or unlocked status of a draw-out unit can be signaled electrically. This requires the installation of a position signaling switch (3VA9987-0KB00) in the right-hand side panel of the draw-out socket. This switch signals whether the plastic frame described above is in the "IN" or "OUT" position. For further details, refer to chapter Position signaling switches (Page 225).

Integration of molded case circuit breaker position signal into a communication network

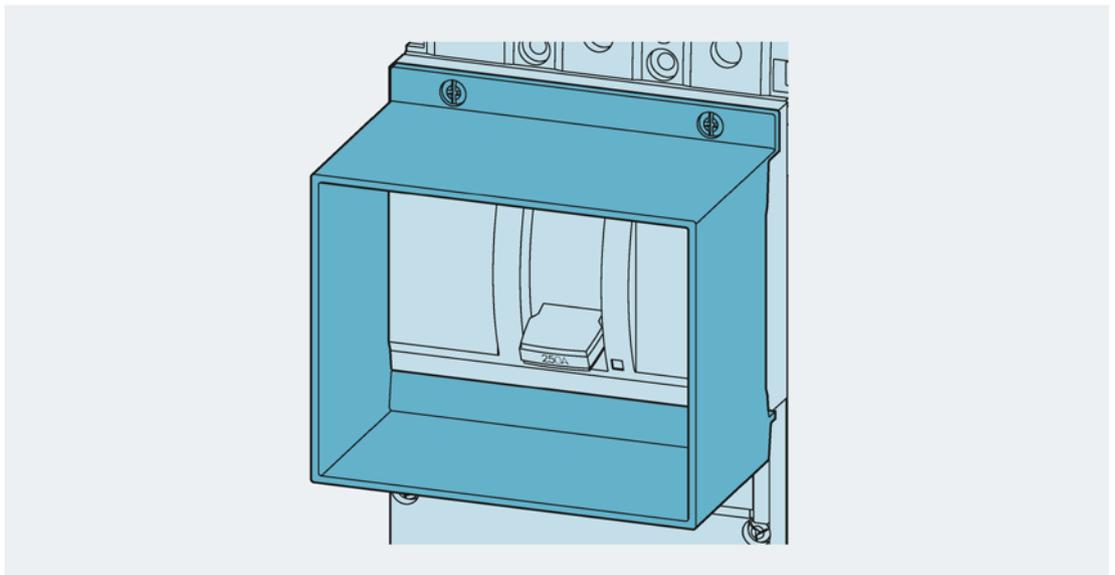
The COM800 breaker data server can be used to interrogate various states of multiple molded case circuit breakers so that the information can be transferred by means of bus systems. This status information includes states such as "Breaker tripped", "Breaker on", "Breaker off", reason for tripping, etc. Actual current and voltage measurements can also be transmitted depending on the version of 3VA circuit breaker installed. To provide this communications capability, the molded case circuit breaker itself is equipped with a COM060 communication module which functions as the breaker's actual communications interface.

In addition to the status information listed above, the position of the molded case circuit breaker in the draw-out unit can also be transferred. For this purpose, the molded case circuit breaker and the draw-out socket must be equipped with the communications interface for the draw-out unit. This kit allows the position of the molded case circuit breaker in the draw-out unit to be picked up and transferred to the COM060 communication module and from there to the higher-level communication network. For further information about the communication kit for draw-out units, please refer to chapter Communications interface for draw-out unit (Page 230).

Operation through the cubicle door

The molded case circuit breaker can be optionally installed in the cubicle in such a way that the breaker can be operated even when the cubicle door is closed. Draw-out versions of molded case circuit breakers can then be switched on or off when the cubicle door is not open. This is made possible by a cutout in the cubicle door which allows access to the main control elements, i.e the handle and the <PUSH TO TRIP> button of the molded case circuit breaker, but prohibits access to other live components inside the cubicle. This solution is referred to as a "door feedthrough".

Door feedthroughs are mounted on the front of the molded case circuit breaker and securely attached to the breaker by means of two bolts and a latch.



The door cutout must be positioned such that it is flush with the door feedthrough. It must also be positioned in such a way as to minimize the size of the gap between the feedthrough walls and the cutout. An escutcheon can be fitted as well in order to obtain an optimum finish.

An opening in the cubicle through which the crank handle can be inserted must be provided in addition to the cutout for the door feedthrough.

With its straight sides, the door feedthrough is designed to allow the molded case circuit breaker to be moved through positions DISCON, TEST and CONNECT, while at the same time providing a permanently tight seal around the feedthrough area (degree of protection IP30) and preventing access to live components inside the cubicle.

4.4 Plug-in and draw-out technology

Markings are visible on the door feedthrough to help the user identify the current position of the molded case circuit breaker as it is moved into or out of the cubicle. Since mounting dimensions may vary slightly, however, these markings should be regarded as a rough guide only. The crank handle mechanism provides the user with feedback information about the molded case circuit breaker position, e.g. whether it has been correctly inserted.

Benefits of draw-out technology

- Defective molded case circuit breakers can be replaced quickly and easily
- Clear visual evidence of safe electrical isolation of main circuits
- Molded case circuit breaker and accessories can be function-tested in the TEST position
- Remote signaling of molded case circuit breaker positions CONNECT, TEST and DISCON
- Padlocks and / or cylinder locks can be used to lock draw-out unit so that the molded case circuit breaker cannot be inserted or removed by unauthorized persons
- Molded case circuit breaker can be operated through the cubicle door
- Degree of protection IP20 at all termination points
- No grounding required

See also

Locking and interlocking (Page 269)

4.4.6.2 Combination with other accessories

Accessories group	Component
Manual operators	Front mounted rotary operator
	Door mounted rotary operator
Remote-controlled operator	MO320 motor operator
Interlocks	Rear interlocking module
	Bowden cable interlock for handle
	Bowden cable interlock (for front mounted rotary operators)
Padlock devices for handle	

See also

Locking and interlocking (Page 269)

4.4.7 Accessories for plug-in and draw-out units

4.4.7.1 Description of individual product variants

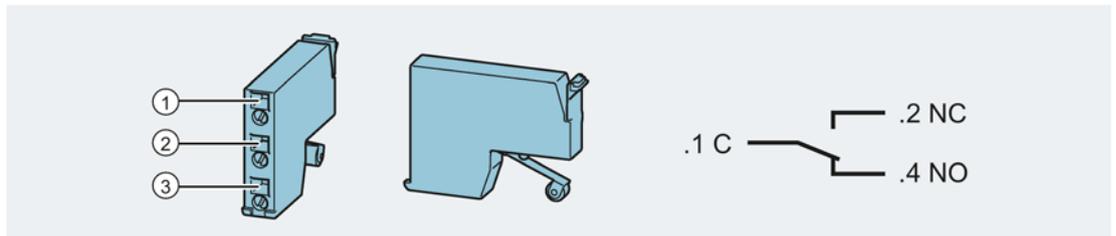
Position signaling switches

These auxiliary switches are capable of signaling a variety of states via electrical connections. The position signaling switch is available in only one version.

Applications:

- Signal "Position of breaker in the draw-out unit"
- Signal "Draw-out unit locked / open"
- Signal "Plug-in unit - MCCB correctly bolted to plug-in socket"

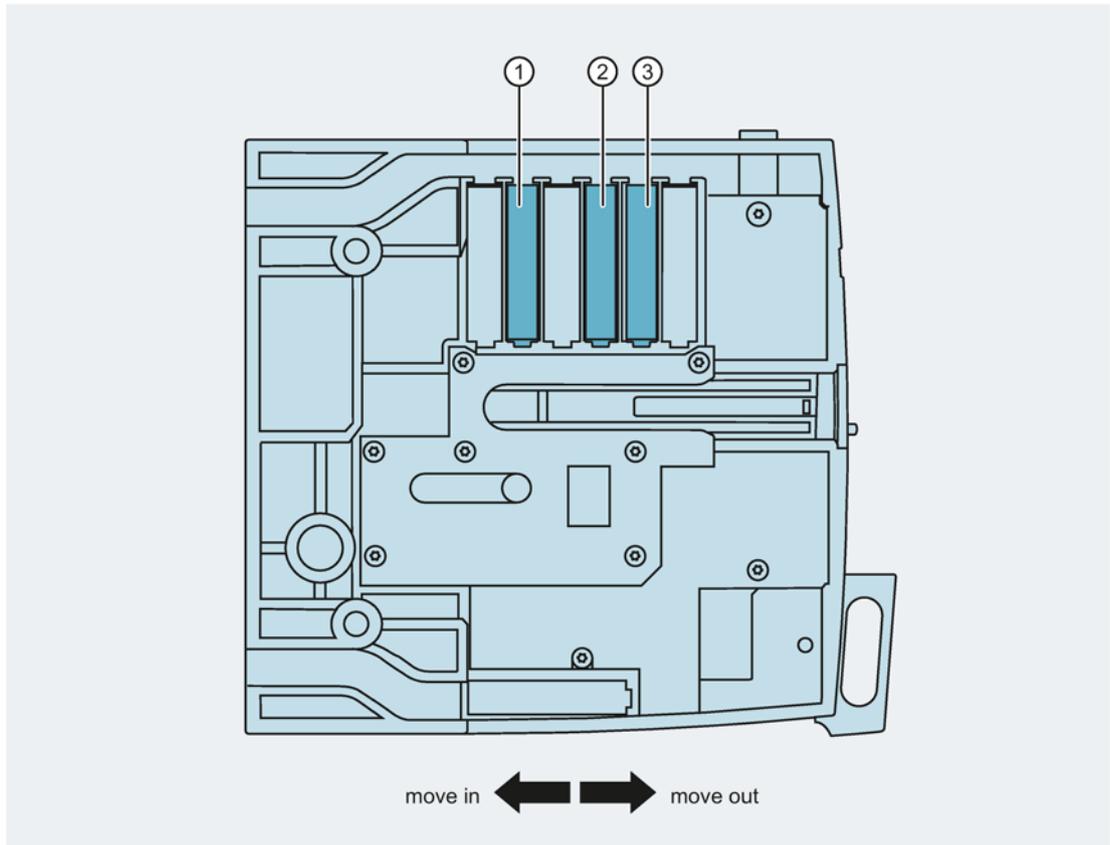
The position signaling switches are changeover switches, i.e. they have three terminals:



- ① NO contact
- ② NC contact
- ③ Common potential contact

Signal "Position of molded case circuit breaker in the draw-out unit"

Up to three position signaling switches can be integrated in the draw-out unit in order to transmit breaker position information to monitoring and control systems. They are installed in the right-hand side wall of the unit at the positions indicated in the diagram below:



- ① 41a or 41b: Detects position CONNECT
- ② 42a or 42b: Detects position TEST
- ③ 43a or 43b: Detects position DISCON

Signal "Position of molded case circuit breaker in the draw-out unit"

It is irrelevant whether the position signaling switch is inserted in slot a or b. The other slots can be used for the signaling switches supplied with the communications interface kit or for an additional position signaling switch.

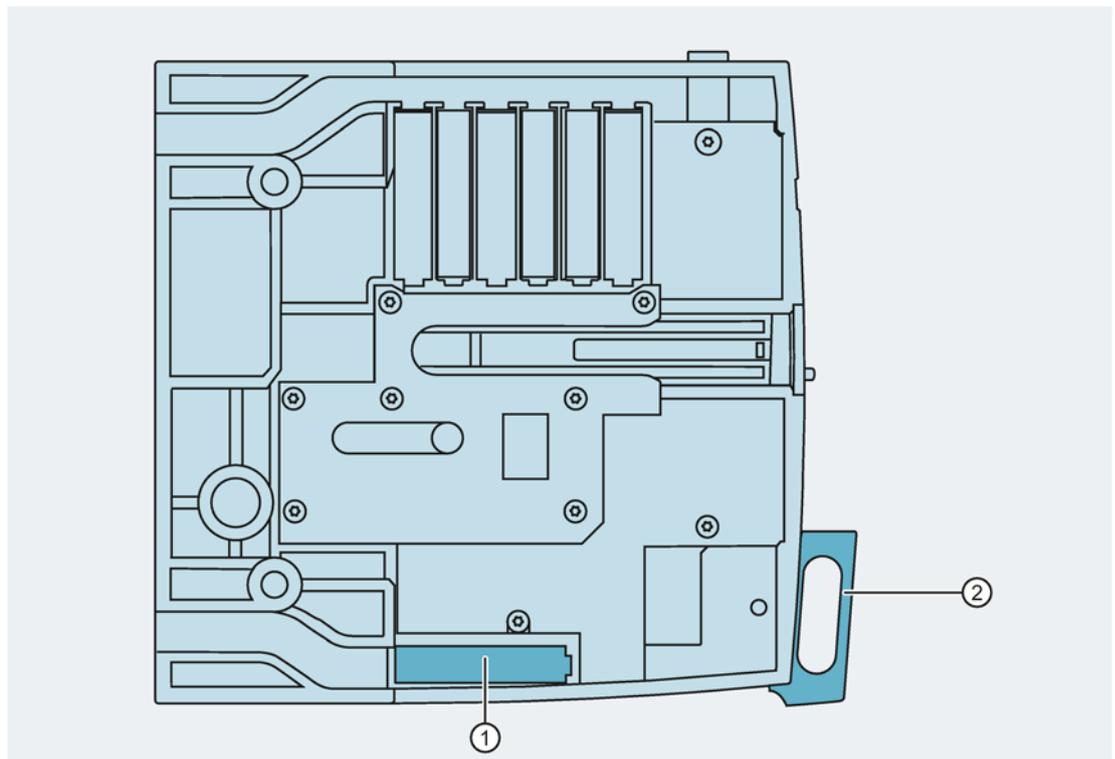
If the molded case circuit breaker in the draw-out unit is moved into a defined position with the crank handle, the appropriate position signaling switch outputs a signal which can be used in other electrical circuits such as visual or acoustic alarm displays

If the molded case circuit breaker is not in any of the defined positions, the switching position indicator displays the word UNBLOCK on a white background. In this position, the molded case circuit breaker is either off (position OFF, contacts open) or tripped (position TRIP, contacts open). The breaker main contacts cannot be closed with the breaker in the UNBLOCK state.

Depending on the position of the molded case circuit breaker in the draw-out unit, the outputs of the position signaling switches assume one of the following states:

Position signaling switch		Position of circuit breaker			
		DISCON	TEST	CONNECT	UNBLOCK
DISCON	NC	Open	Closed	Closed	Closed
	NO	Closed	Open	Open	Open
TEST	NC	Closed	Open	Closed	Closed
	NO	Open	Closed	Open	Open
CONNECT	NC	Closed	Closed	Open	Closed
	NO	Open	Open	Closed	Open

Signal "Draw-out unit locked / open"



- ① Slot for position signaling switch for signal "Draw-out unit locked / open"
- ② Plastic frame for padlock locking unit

4.4 Plug-in and draw-out technology

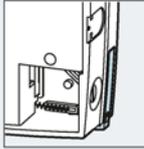
Signal "Draw-out unit locked / open"

A position signaling switch to transmit this signal is installed in position 44 of the right-hand side wall of the draw-out unit.

A position signaling switch in position 44 outputs a signal which indicates whether the padlock locking unit is in the OUT position, thereby locking the draw-out unit.

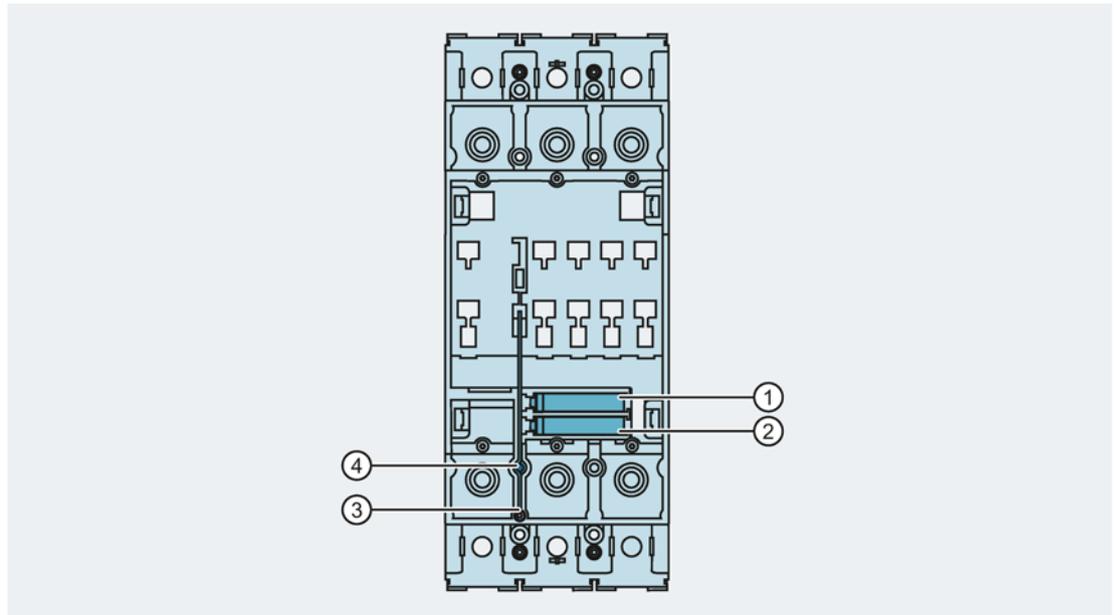
The draw-out unit can be locked in the defined breaker positions CONNECT, TEST and DISCON by padlocks or a cylinder lock (available as retrofit component). The position of the molded case circuit breaker cannot be changed when the draw-out is locked. In the locked state, the opening for the crank handle is mechanically sealed and the handle cannot be inserted.

To lock the unit using padlocks, the padlock locking unit on the draw-out unit must be pulled out manually so that the shackles of the padlocks can be inserted through the opening. When the draw-out unit is locked by the cylinder lock, the padlock locking unit moves out automatically as the cylinder lock is turned because it is mechanically coupled with the cylinder lock in the draw-out unit. The position of the padlock locking unit ultimately determines the position of the contacts of the position signaling switch.

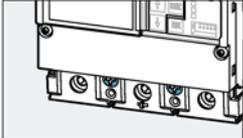
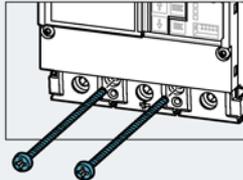
	NO	NC
	Closed	Open
	Open	Closed

Signal "Plug-in unit - MCCB correctly bolted to plug-in socket"

This option is provided for plug-in units only. Depending on the socket size, up to two position signaling switches can be installed in slot No. 46.



- ① Slot 46 for position signaling switch of the plug-in socket
- ② Slot 46 for position signaling switch of the plug-in socket
- ③ Mechanical system for actuation of position signaling switches when the bolt is tightened
- ④ Bolt hole which determines the signal output by the position signaling switches

	NO	NC
	Closed	Open
	Open	Closed

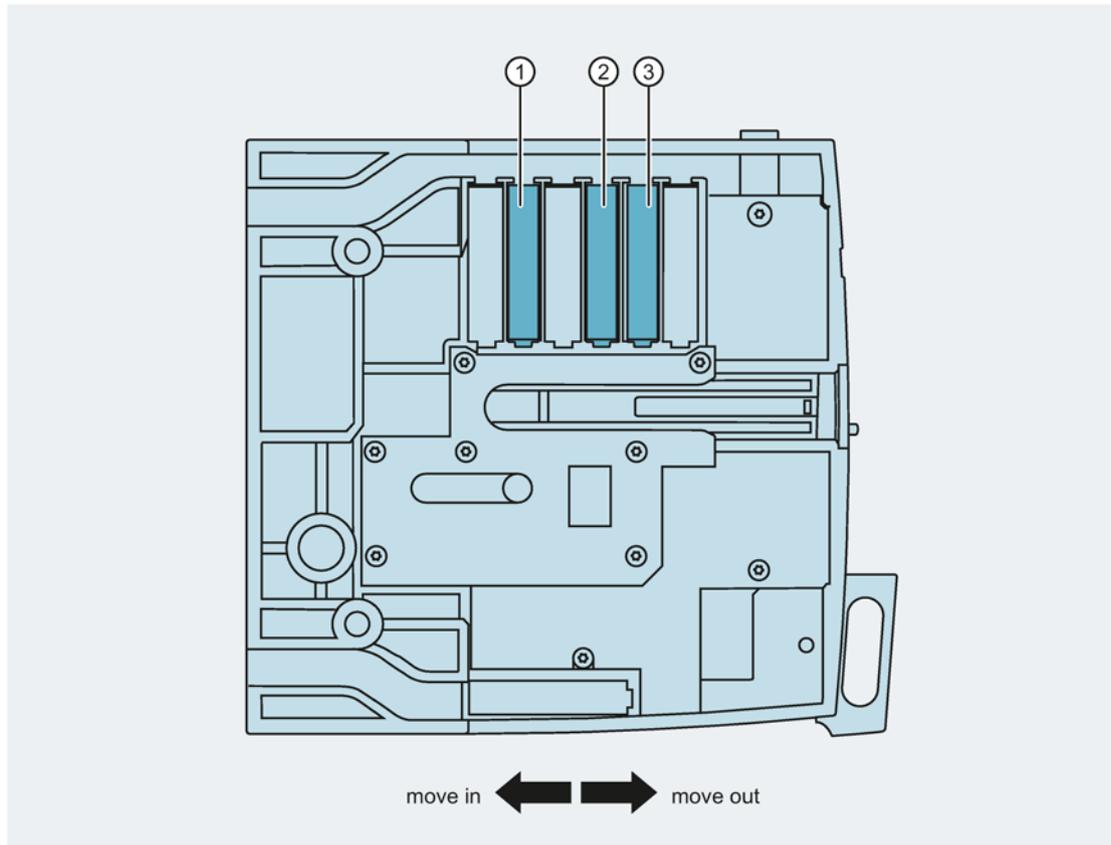
With this application, the position signaling switches indicate whether the molded case circuit breaker is inserted in the plug-in socket and secured by at least one bolt. The reason for this application is that the molded case circuit breaker needs to be secured in position by fastening bolts in the plug-in socket. The four fastening bolts supplied with the complete kit for plug-in technology must be used for this purpose.

Communications interface for draw-out unit

The pre-assembled cable set which functions as the communications interface for the draw-out unit consists of a pre-assembled cable with a mini USB port at one end and three special position signaling switches at the other. It is also supplied with another cable with mini USB connector and tab connector.

Attaching the cable set

1. Insert the 3 position signaling switches of the cable set in the right-hand side wall according to the color coding of the cables, see diagram below. It is irrelevant whether the switches are inserted in slots a or b.



- ① CONNECT: Position signaling switch with green cables
- ② TEST: Position signaling switch with blue cables
- ③ DISCON: Position signaling switch with red cables

The remaining slots are normally used to install standard position signaling switches.

2. Remove the seal over the opening for the micro USB port on the right-hand side wall.
3. Insert the USB connector attached to the cable set into the micro USB port in the right-hand side wall.

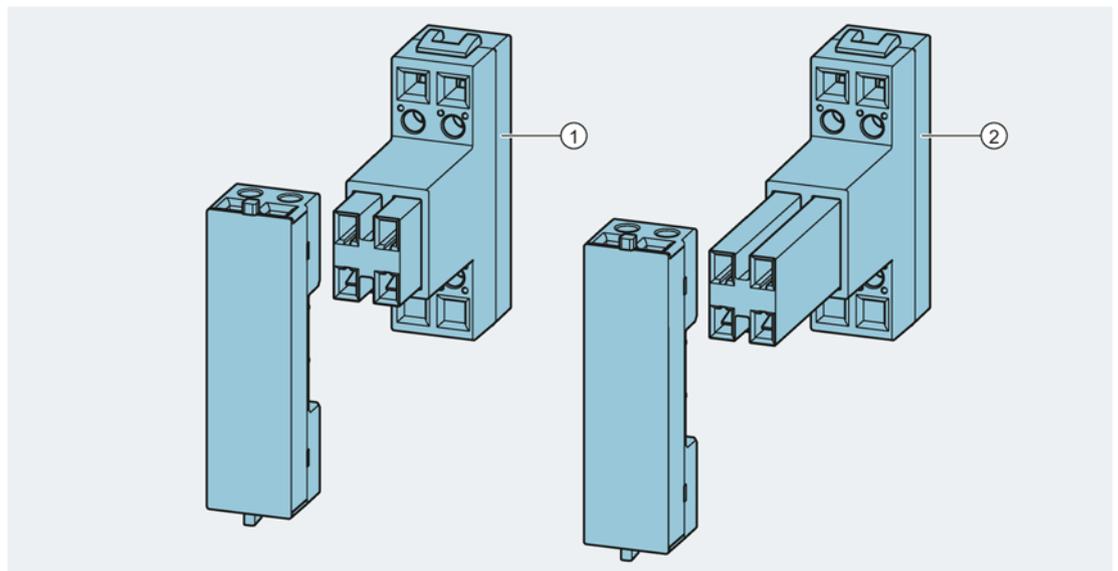
4. Store the cable in the space available behind the side wall.
5. Connect the position signaling switches and the COM060 communication module to the USB connector and tab connector of the second cable.

The cable with pre-assembled USB and tab connectors can also be ordered as an individual item for installation on molded case circuit breakers prepared for use as draw-out units.

For detailed instructions on how to install the communications interface for the draw-out unit, please refer to the relevant Operating Instructions (<http://support.automation.siemens.com/WW/view/en/80597324>).

For instructions on how to transfer data via the remote transmission link, please refer to the Operating Instructions for the COM800 breaker data server.

Auxiliary circuit connector



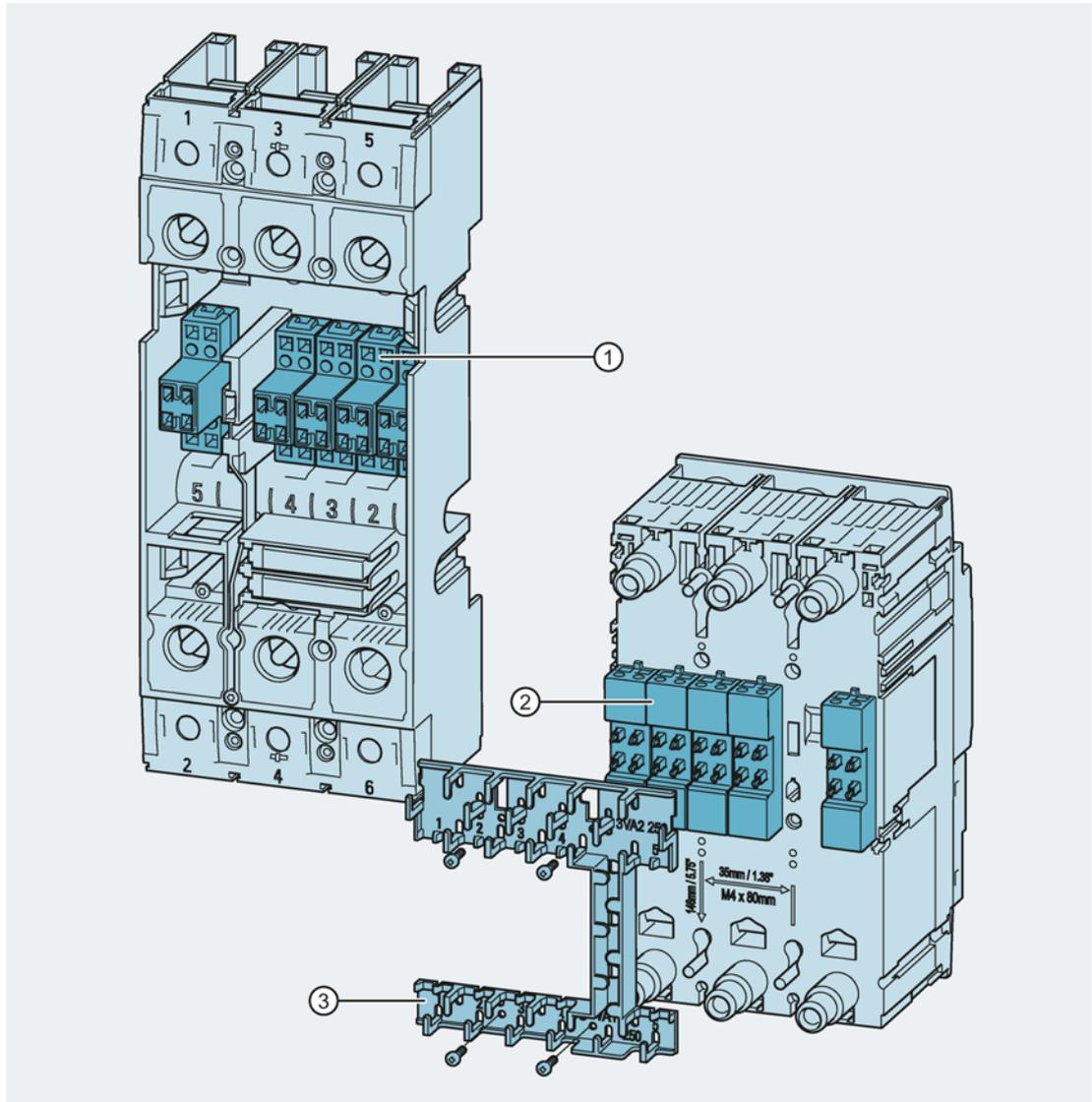
- ① Plug-in technology
- ② Draw-out technology

Auxiliary circuit connectors are required only if the molded case circuit breaker to be converted to plug-in or draw-out technology is equipped with internal accessories. Plug-in units use a different design of auxiliary circuit connector than draw-out units.

The number of auxiliary circuit connectors required depends on the accessories to be installed in the molded case circuit breaker and ultimately on the number of electrical connections which need to be brought out of the molded case circuit breaker. Each auxiliary circuit connector can be used to connect up to four cables. Accordingly, the breaker-end and socket-end halves of the auxiliary circuit connectors have four screw-type terminals which are labeled ".1" to ".4".

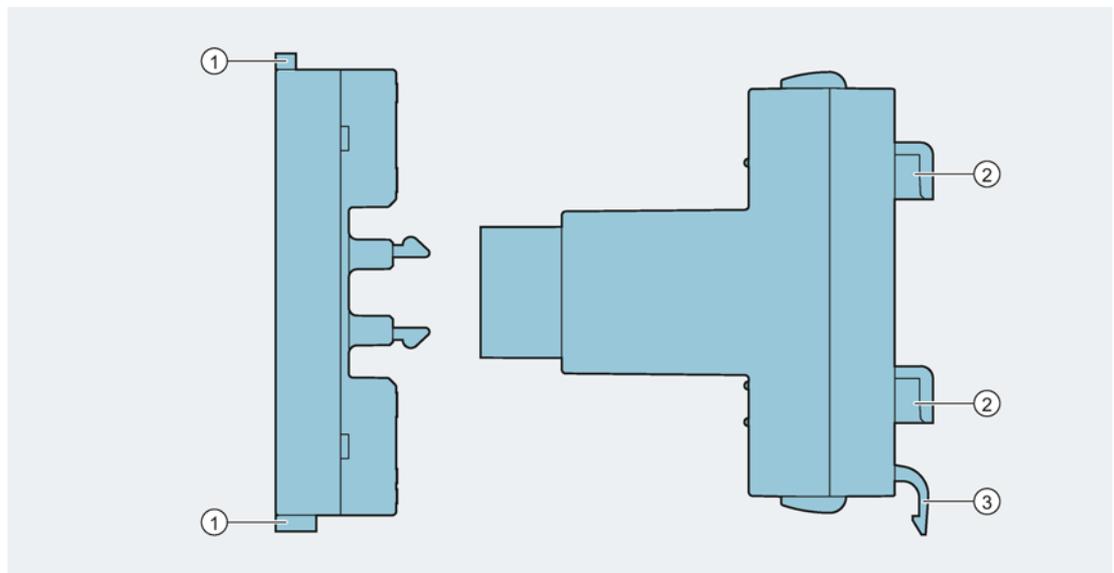
4.4 Plug-in and draw-out technology

A total of nine auxiliary circuit connectors can be installed depending on the size of the molded case circuit breaker and the size of the plug-in or draw-out socket. The slots for auxiliary circuit connectors are labeled from right to left in the socket, starting at 1.



- ① Socket-end auxiliary circuit connector
- ② Breaker-end auxiliary circuit connector
- ③ Cable cage

Cable cages are used to attach the breaker-end half of the auxiliary circuit connector to the underside of the molded case circuit breaker. Slot numbers are also printed on the cable cages. The design of the cable cages for the top and bottom halves of the molded case circuit breaker is different so that the cages cannot be mixed up or installed in the wrong position. The fixing tongues of the breaker-end half of the auxiliary circuit connectors latch into small recesses in the cable cages which are screw-mounted to the rear panel of the circuit breaker. The auxiliary circuit connectors are securely fixed once the cable cages have been installed.



- ① Fixing tongue (breaker end)
- ② Fixing hook (socket end)
- ③ Latching element (socket end)

The socket-end half of the auxiliary circuit connectors is simply snapped into the socket.

Various cable routing openings and ducts are provided in the socket and the molded case circuit breaker. For further details, please refer to the operating instructions for the complete kits for plug-in or draw-out technology.

See also

Cable cage (Page 235)

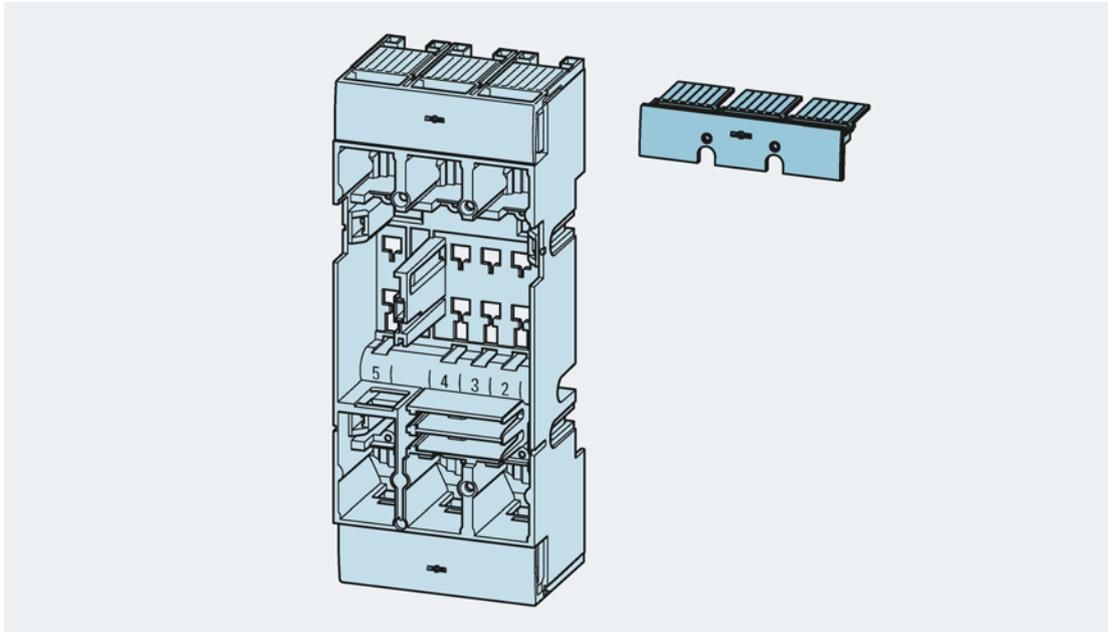
Door feedthrough

Door feedthroughs must be installed for applications which require

- direct operation of a molded case circuit breaker even when the cubicle door is closed,
- the draw-out version of a molded case circuit breaker to be electrically isolated from or connected to the installation while the cubicle door is closed,
- prevention of access to live components inside the cubicle.

Door feedthroughs are mounted over the front of the molded case circuit breaker and securely attached to the breaker by means of two bolts and a latch.

Terminal cover for a molded case circuit breaker converted to plug-in or draw-out technology

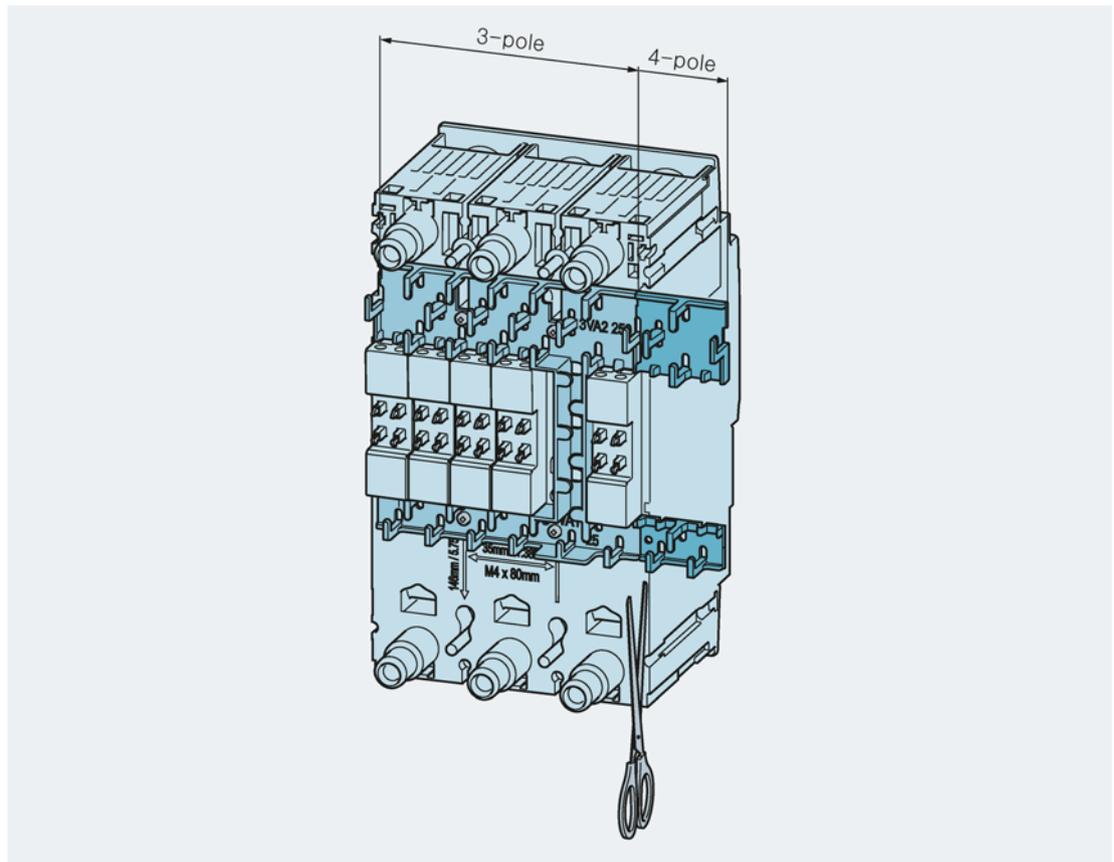


Terminal covers available to order as additional accessories are used to cover the termination area of plug-in and draw-out units. Two screw-mounted terminal covers are included in the complete kits and the conversion kits for plug-in and draw-out technology. These feature molded grips to ease withdrawal of the molded case circuit breaker from its socket. Since it requires significant force to remove a molded case circuit breaker from its socket, the plug-in terminal covers are bolted to the contact unit.

These terminal covers can be ordered separately as a spare part.

Cable cage

Cable cages are used to attach the breaker-end half of auxiliary circuit connectors to the molded case circuit breaker. They are also designed to act as cable ducts for installing wires from internal accessories to the auxiliary circuit connector. For further information about cable cages, please refer to chapter Auxiliary circuit connector (Page 231).



Cable cages consist of a top half and a bottom half. These parts are designed such that they cannot be mounted in the wrong position at the rear of the molded case circuit breaker.

Cable cages are included in the scope of supply of the conversion kits and complete kits for converting molded case circuit breakers to plug-in or draw-out units and are therefore also supplied with complete kits. They are available as standard only in the broadened version for 4-pole units. For use on 3-pole units, part of the cable cage need only be cut away (at the required breaking point).

4.4.7.2 Overview of technical specifications

Technical specifications of the accessories for internal components of molded case circuit breakers in plug-in and draw-out technology:

Position signaling switch			
Article No.			3VA9987-0KB00
Rated operating voltage U_e		V	400 AC
		V	250 AC
Rated insulation voltage U_i		V	500 AC
Rated frequency f_n		Hz	50 / 60
Rated operating current I_e / U_e	AC-13	12 V	A 6
		24 V	A 6
		48 V	A 6
		110 V	A 6
		230 V	A 6
	DC-15	12 V	A 6
		24 V	A 3
		48 V	A 1
		110 V	A 0.5
		230 V	A 0.25
Thermal current I_{th}		A	6
Contact switching			001
Conductor cross section S		mm ²	0.5 ... 1
Degree of protection of terminals (when breaker is connected)			IP20

Auxiliary circuit connector			
Article No.			3VA9987-0KP90
			3VA9987-0KD90
Rated operating voltage U_e		V	400 AC
		V	250 AC
Rated insulation voltage U_i		V	500 AC
Rated frequency f_n		Hz	50 / 60
Thermal current I_{th}		A	6
Conductor cross section S		mm ²	0.5 ... 1
Degree of protection of terminals (when breaker is connected)			IP20

4.4.7.3 Combination with other accessories

Information about combination with other accessories

- The communications interface for the draw-out unit and the switches for signaling the position of the molded case circuit breaker in the draw-out unit are mutually compatible. For further information, please refer to the following chapters:
Position signaling switches (Page 225)
Communications interface for draw-out unit (Page 230)
- The switches for signaling whether or not the molded case circuit breaker is locked have no influence on other accessories described in chapter Position signaling switches (Page 225)

Note

No transfer of "locked / not locked" signals

The information "locked / not locked" cannot be transferred via the COM060 communication module.

- A molded case circuit breaker which requires a communications interface to transfer signals must be equipped with a COM060 communication module.
- When internal accessories are integrated in a molded case circuit breaker, auxiliary circuit connectors and cable cages for plug-in and draw-out technology must also be installed.
- Door feedthroughs are required only if the molded case circuit breaker needs to be operated when the cubicle door is closed. The door feedthrough is compatible with position signaling switches, communications interface and auxiliary circuit connectors with cable cages.
- The terminal cover for plug-in technology can be installed in combination with any other internal accessories. It does not have any effect on other accessories.
- A variable depth adapter (see section Door mounted rotary operator (Page 244)) can be used in conjunction with the door mounted rotary operator in order to compensate the racking distance and so allow the molded case circuit breaker to be moved out when the cubicle door is closed.

4.5 Manual operators

The manual operators for 3VA molded case circuit breakers are described in this chapter.

Overview of manual operators



The manual operators available for 3VA molded case circuit breaker are listed below:

- Front mounted rotary operator (optionally with door interlock)
- Door mounted rotary operator
 - Fixing bracket for long shafts
 - Variable depth adapter for draw-out units
 - Supplementary handle for door mounted rotary operator
- Side wall mounted rotary operator (optionally with mounting plate)

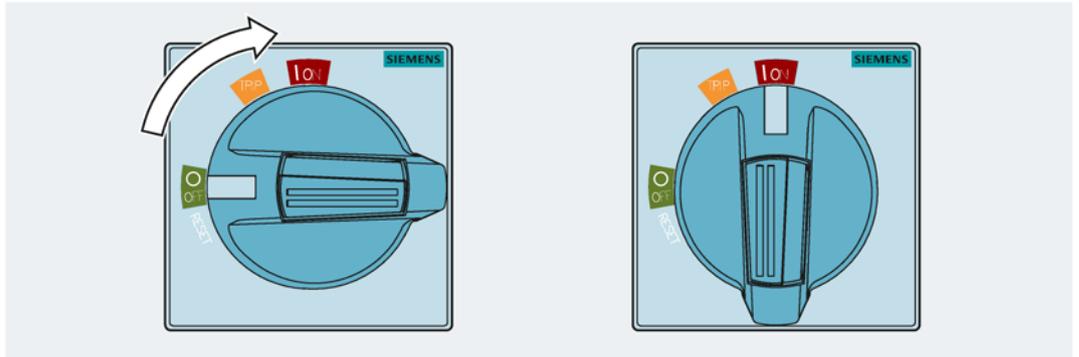
The following accessories are available for all manual operators:

- Illumination kit
- Locking and interlocking devices

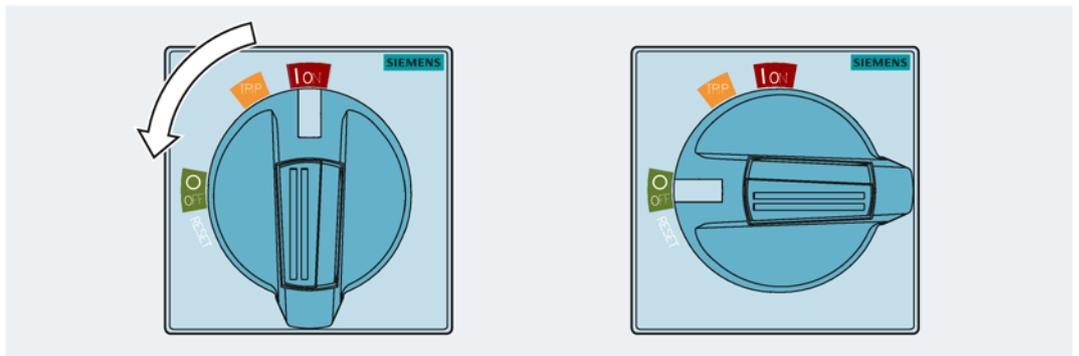
4.5.1 Opening, closing and resetting the 3VA molded case circuit breaker

Opening and closing

- To close the 3VA molded case circuit breaker:
Turn the manual operator to the ON (I) position.

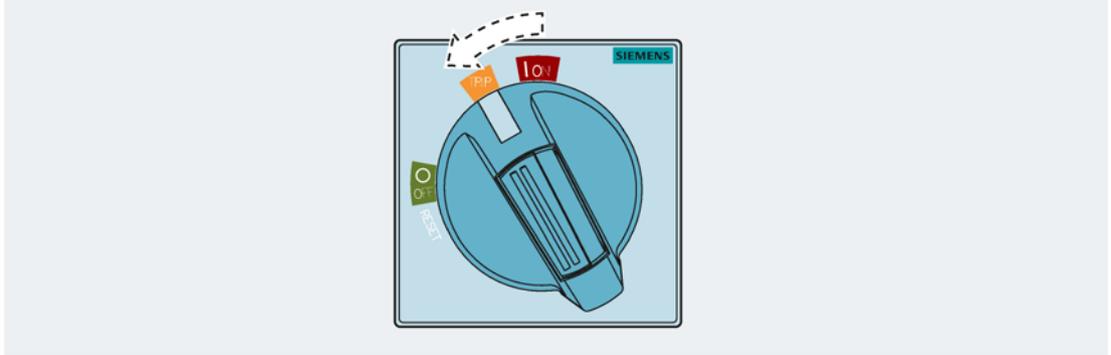


- To open the 3VA molded case circuit breaker:
Turn the manual operator to the OFF (O) position.



Resetting the manual operator after the molded case circuit breaker has tripped

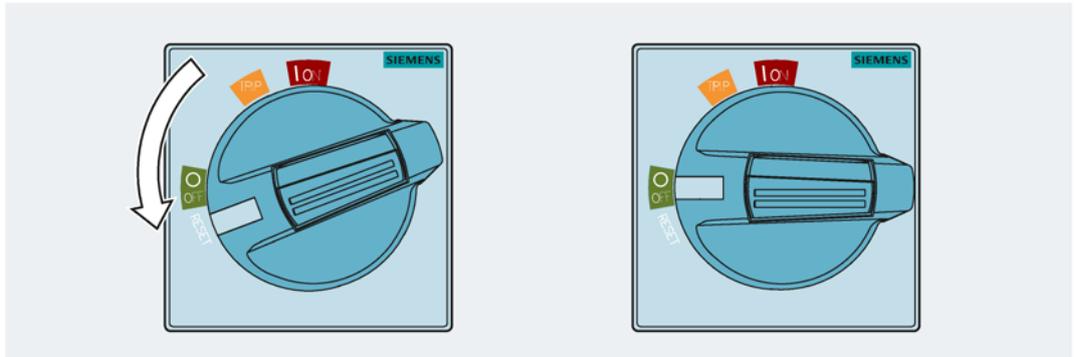
When the molded case circuit breaker trips, the manual operator moves automatically from the ON (I) to the TRIP position.



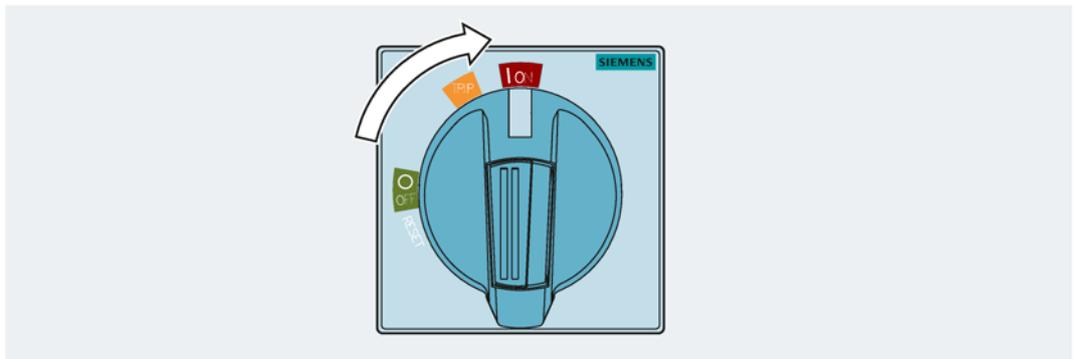
The molded case circuit breaker remains in the tripped state until the manual operator is reset:

1. Clear the fault which has caused the molded case circuit breaker to trip.
2. Turn the manual operator counter-clockwise to the limit stop (RESET position, just beyond OFF (O)).

The manual operator remains in the OFF (O) position.



3. Turn the manual operator to the ON (I) position.

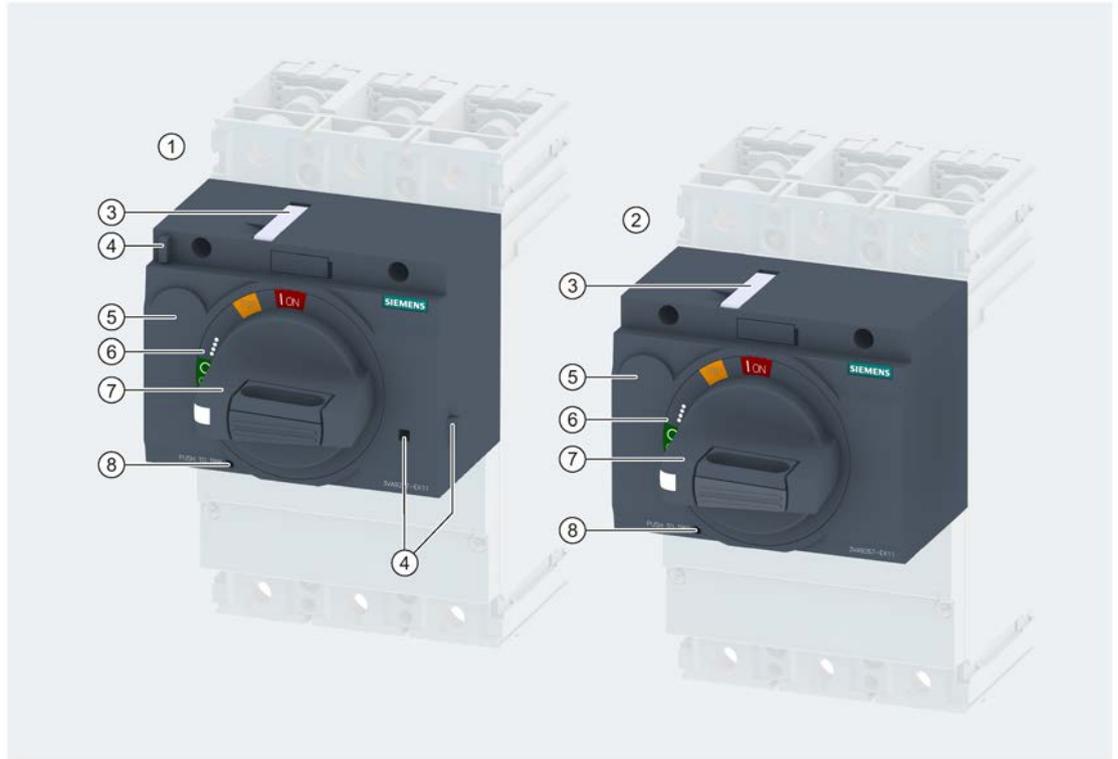


The molded case circuit breaker is closed again.

4.5.2 Front mounted rotary operator

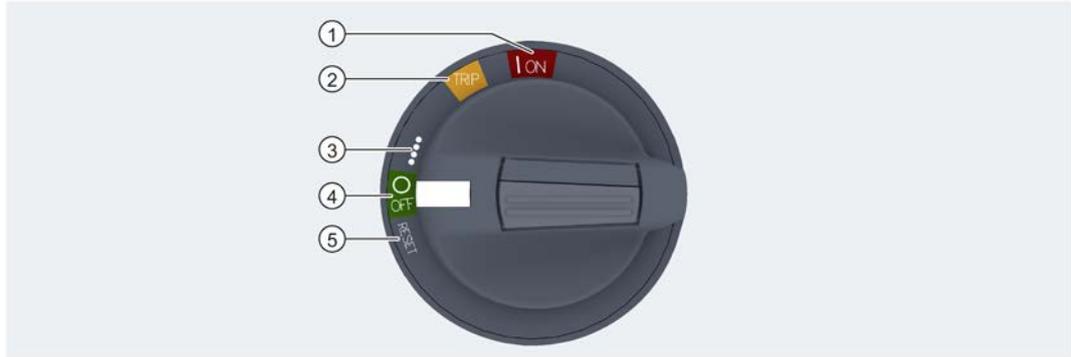
The front mounted rotary operator is available in two versions:

- With door interlock
- Without door interlock



- | | |
|--|--|
| ① Front mounted rotary operator with door interlock | ⑤ Cylinder lock device |
| ② Front mounted rotary operator without door interlock | ⑥ Switching position indicator (see below) |
| ③ Device for up to 3 padlocks | ⑦ Handle with device for up to 3 padlocks |
| ④ Door interlocking elements | ⑧ Trip unit button <PUSH TO TRIP> |

Switching position indicator of front mounted rotary operator



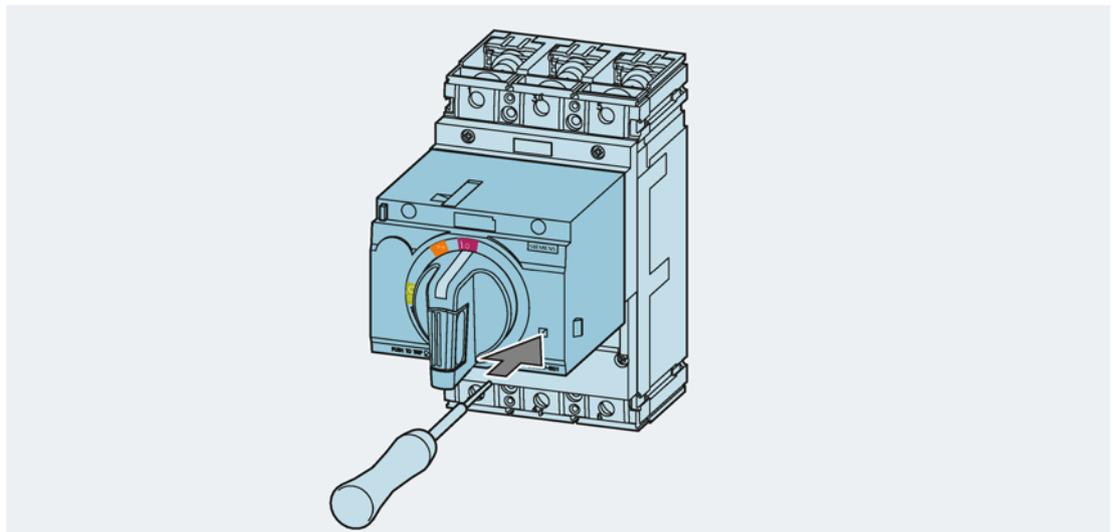
- ① ON: Breaker closed
- ② TRIP: Breaker tripped
- ③ Mounting position
- ④ OFF: Breaker open
- ⑤ RESET: Reset following a trip

Front mounted rotary operator with door interlock

The front mounted rotary operator with door interlock projects through the cubicle door. This arrangement ensures that the molded case circuit breaker can be switched on only when the control cabinet door is closed. The door is locked automatically when the front mounted rotary operator is turned to position ON (I).

Overriding the door interlock

The door interlock can be overridden by a deliberate action. This means that the door can be opened with the operator in position ON (I) so that maintenance can be carried out, for example.

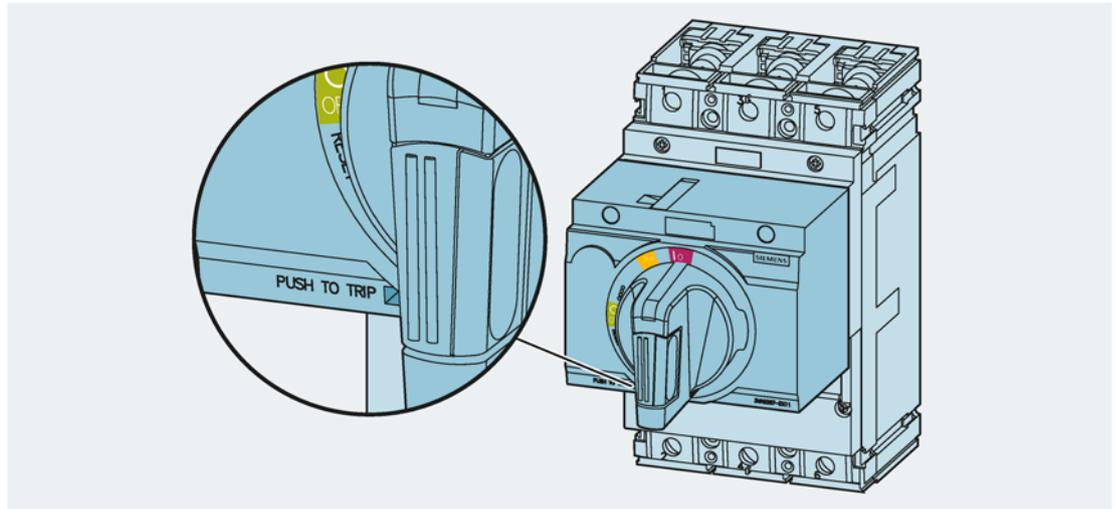


Procedure

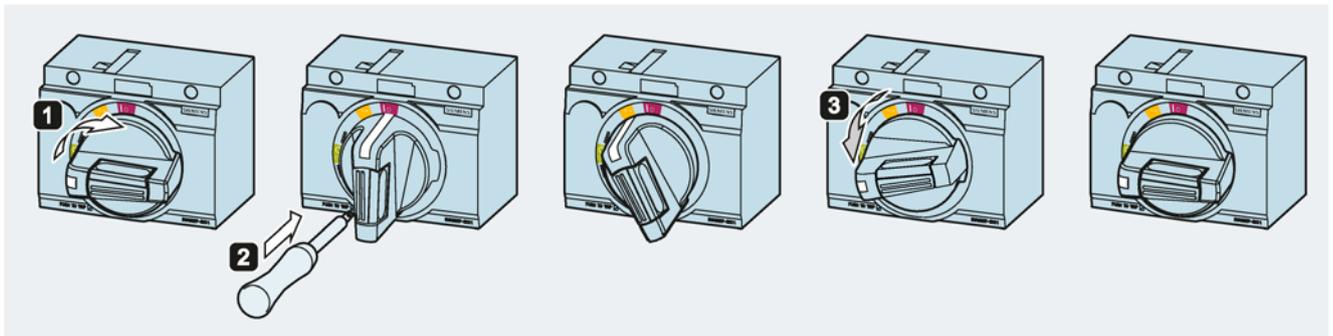
1. Press the door interlocking pin with a sharp object.
2. Hold the pin down while the door is opened.

Testing the tripping mechanism

The button <PUSH TO TRIP> can be pressed to perform a function test on the tripping mechanism.



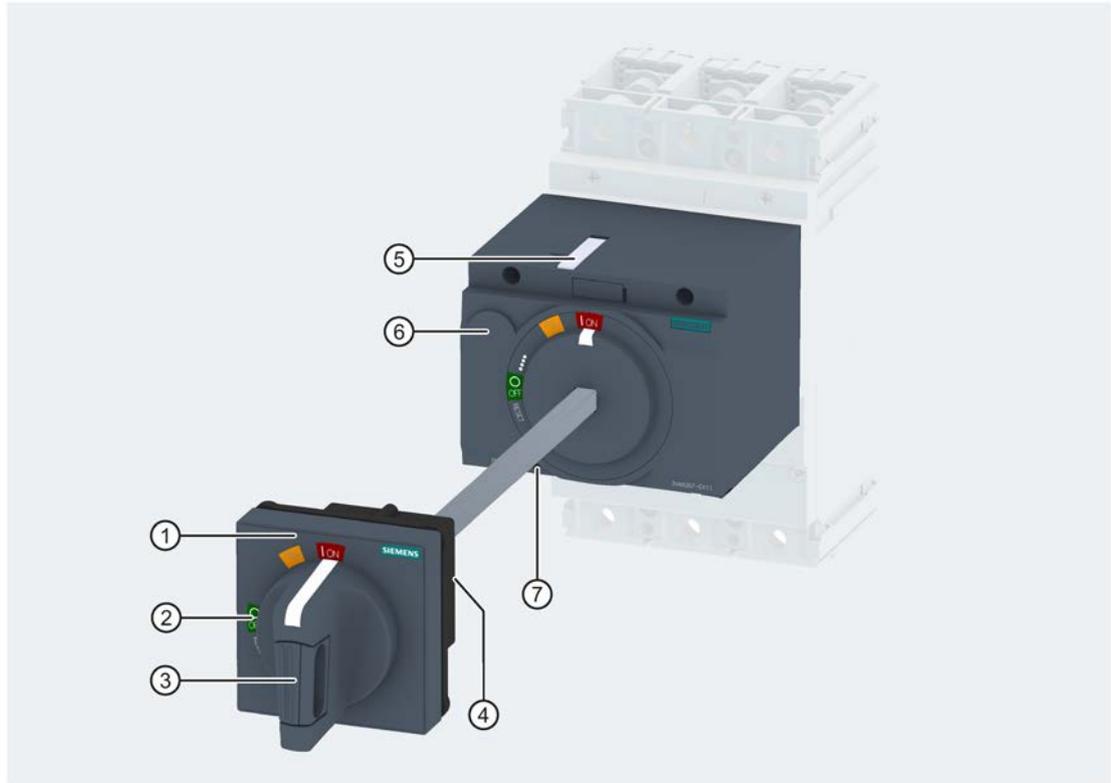
Procedure



1. Turn the front mounted rotary operator to position ON (I) in order to close the molded case circuit breaker.
2. Press the button <PUSH TO TRIP> with a tool such as a screwdriver.
The front mounted rotary operator moves from position ON (I) to position TRIP. The molded case circuit breaker is now in the tripped state.
3. Turn the front mounted rotary operator counter-clockwise to the limit stop (RESET position, just beyond OFF(O)).
The front mounted rotary operator remains in the OFF (O) position, the molded case circuit breaker can now be closed again.

4.5.3 Door mounted rotary operator

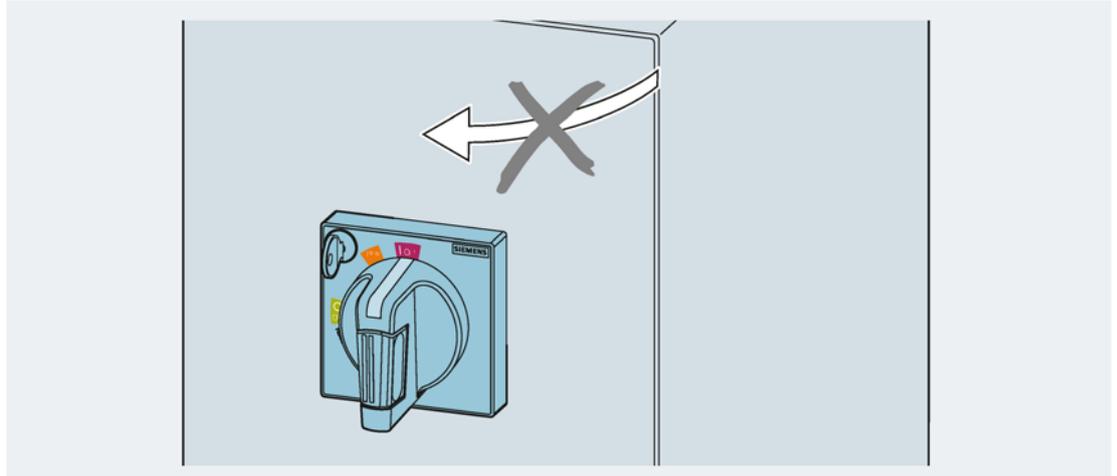
With the door mounted rotary operator installed, it is possible to operate the molded case circuit breaker through the control cubicle door without opening the door.



- ① Door mounted rotary operator
- ② Switching position indicator ON, TRIP, mounting position, OFF, RESET
For mounting position, see chapter Front mounted rotary operator (Page 241)
- ③ Handle with device for up to 3 padlocks
- ④ Tolerance compensator
- ⑤ Device for up to 3 padlocks
- ⑥ Cylinder lock device
- ⑦ Trip unit button <PUSH TO TRIP>

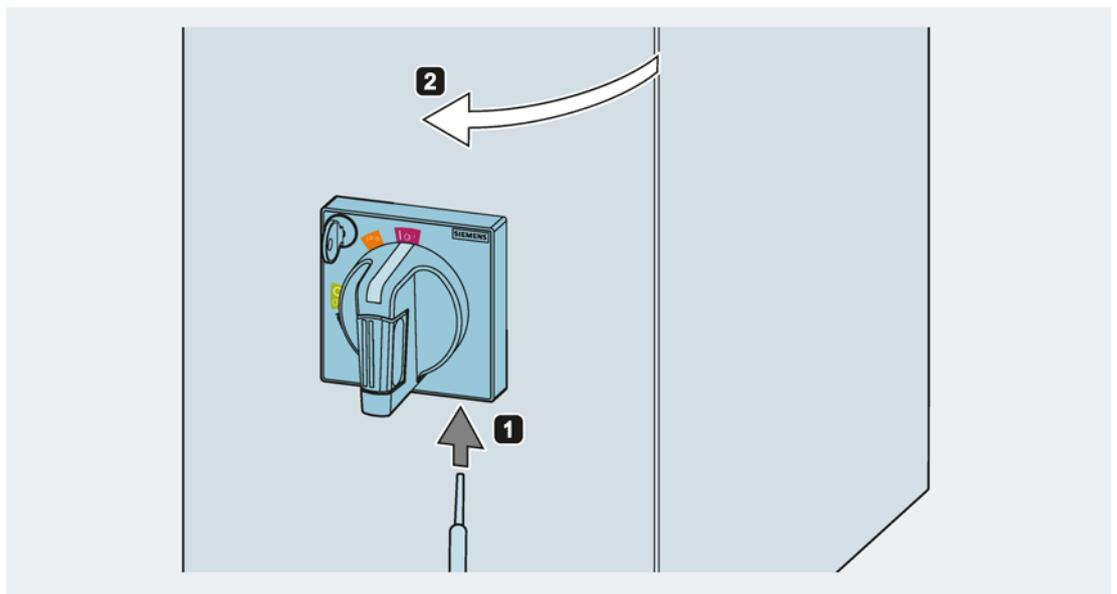
Door interlock with door mounted rotary operator

The door interlock of the door mounted rotary operator locks the door as soon as the door mounted rotary operator is turned to position ON (I).



Overriding the door interlock

The door interlock can be overridden by a deliberate action. This means that the door can be opened with the operator in position ON (I) so that maintenance can be carried out, for example. It is also possible to disable the door interlock completely. For details, see the Operating Instructions 3ZW1012-0VA01-4DA0.

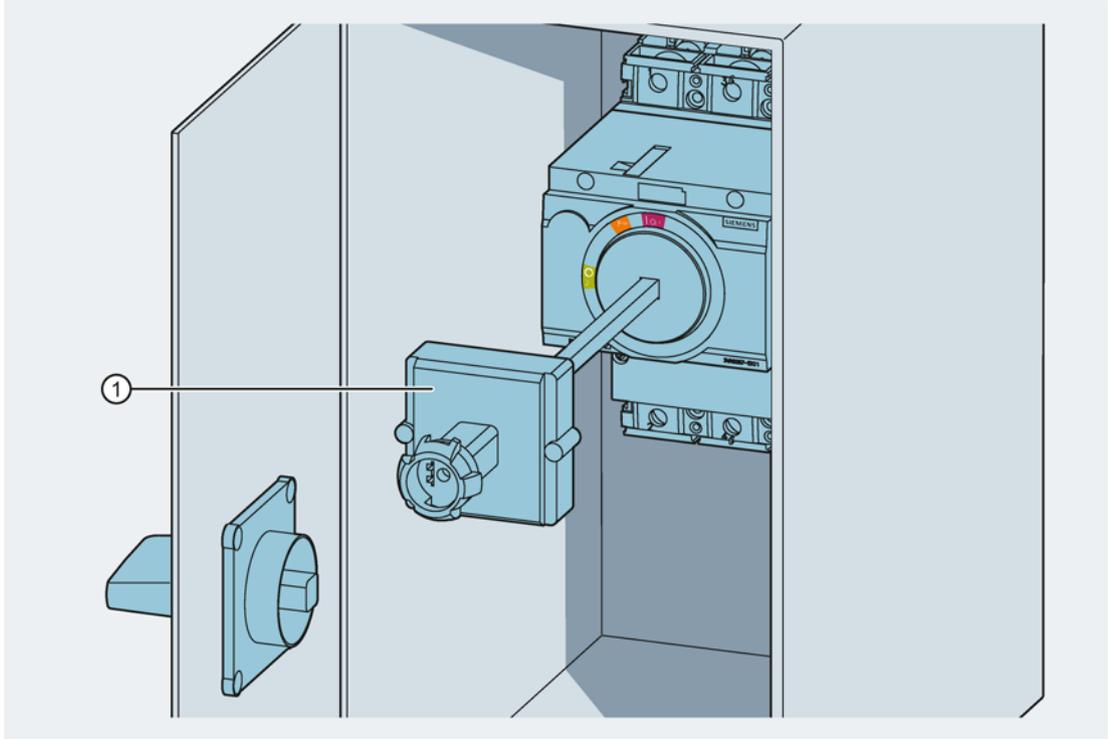


Procedure

1. Press the door interlocking pin with a sharp object.
2. Hold the pin down while the door is opened.

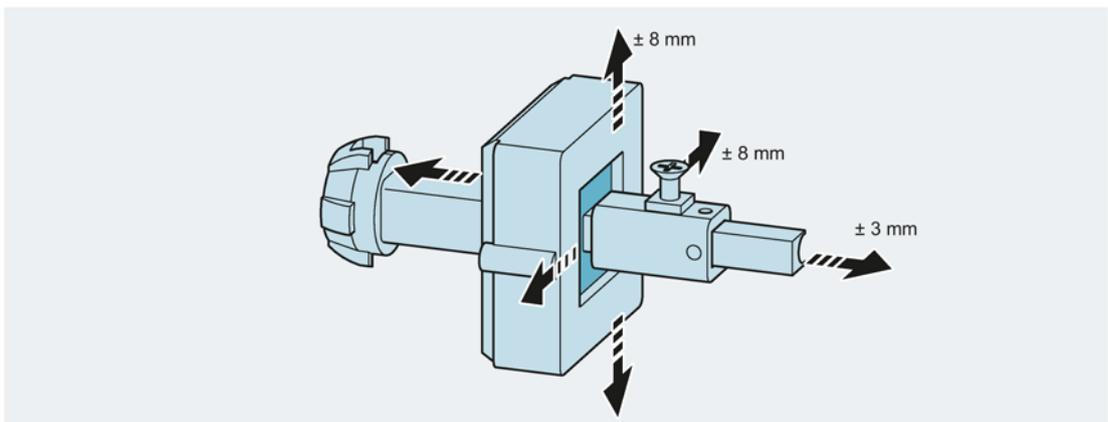
Tolerance compensator

Door mounted rotary operators are supplied as standard with a tolerance compensator. This device compensates any potential minor offset between the rotary switch of the cubicle doors and the shaft of the door mounted rotary operator.



① Tolerance compensator

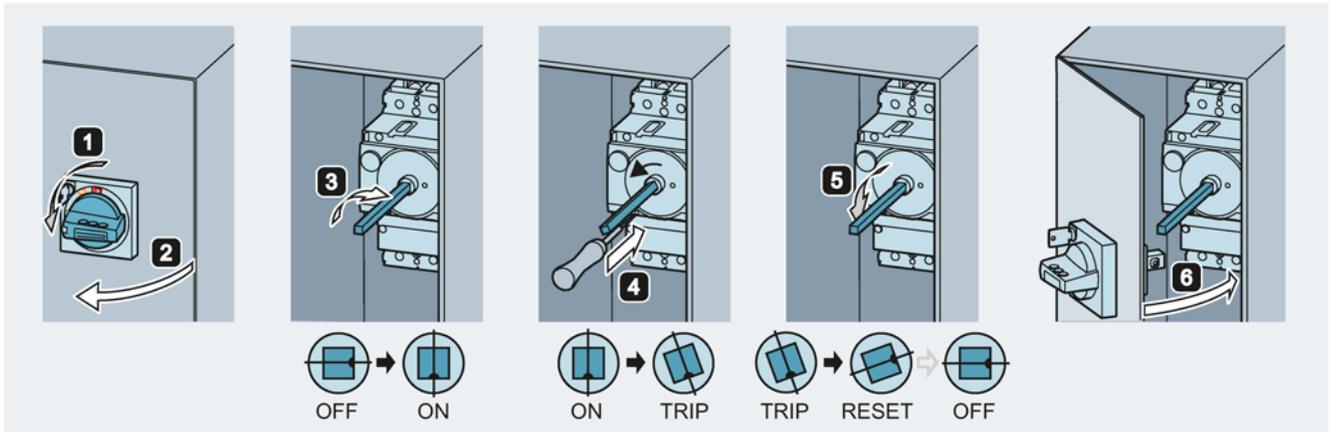
Offset compensator



Testing the tripping mechanism

The button <PUSH TO TRIP> can be pressed to perform a function test on the tripping mechanism.

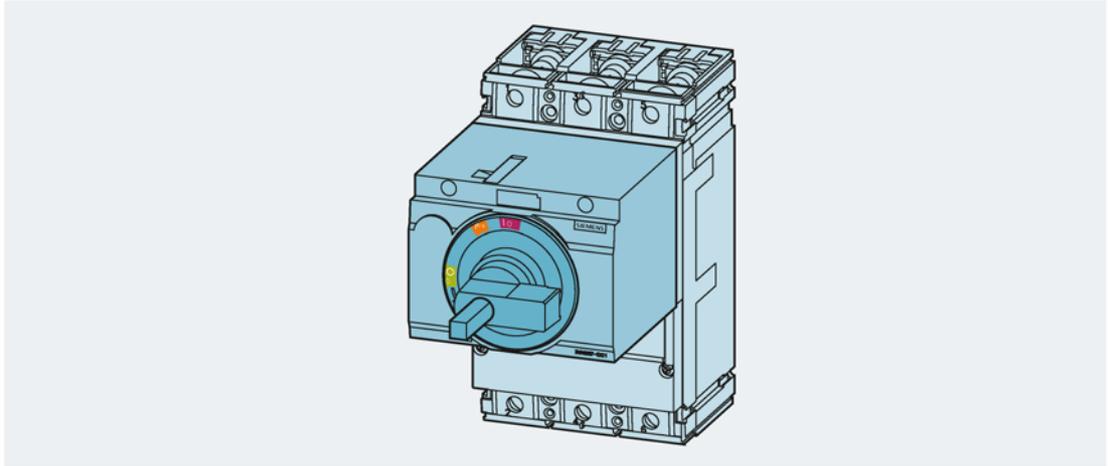
Procedure



1. Turn the door mounted rotary operator to the OFF (O) position.
2. Open the cubicle door.
3. Use a tool to turn the shaft to the ON (I) position in order to close the molded case circuit breaker.
Alternatively, the supplementary handle for the door mounted rotary operator can also be used to close the breaker.
4. Press the button <PUSH TO TRIP> with a tool such as a screwdriver.
The door mounted rotary operator moves from position ON (I) to position TRIP. The molded case circuit breaker is now in the tripped state.
5. Turn the door mounted rotary operator counter-clockwise to the limit stop (RESET position, just beyond OFF (O)).
The manual operator remains in the OFF (O) position.
6. Close the cubicle door.
The molded case circuit breaker can now be closed again.

Supplementary handle for door mounted rotary operator

The supplementary handle can be used to operate the molded case circuit breaker when the cubicle door is open.



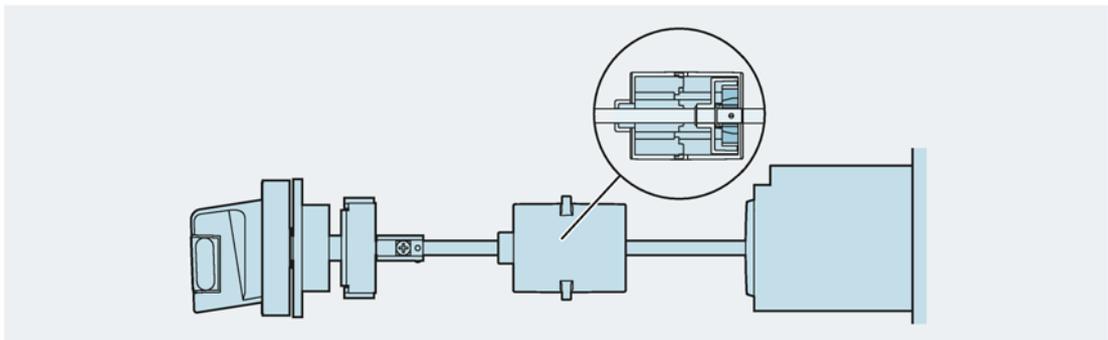
Use the supplementary handle to close the molded case circuit breaker:

A deliberate action is required to turn the molded case circuit breaker to the ON (I) position:

1. Push in the supplementary handle.
2. Turn the supplementary handle to the ON (I) position in order to close the molded case circuit breaker.

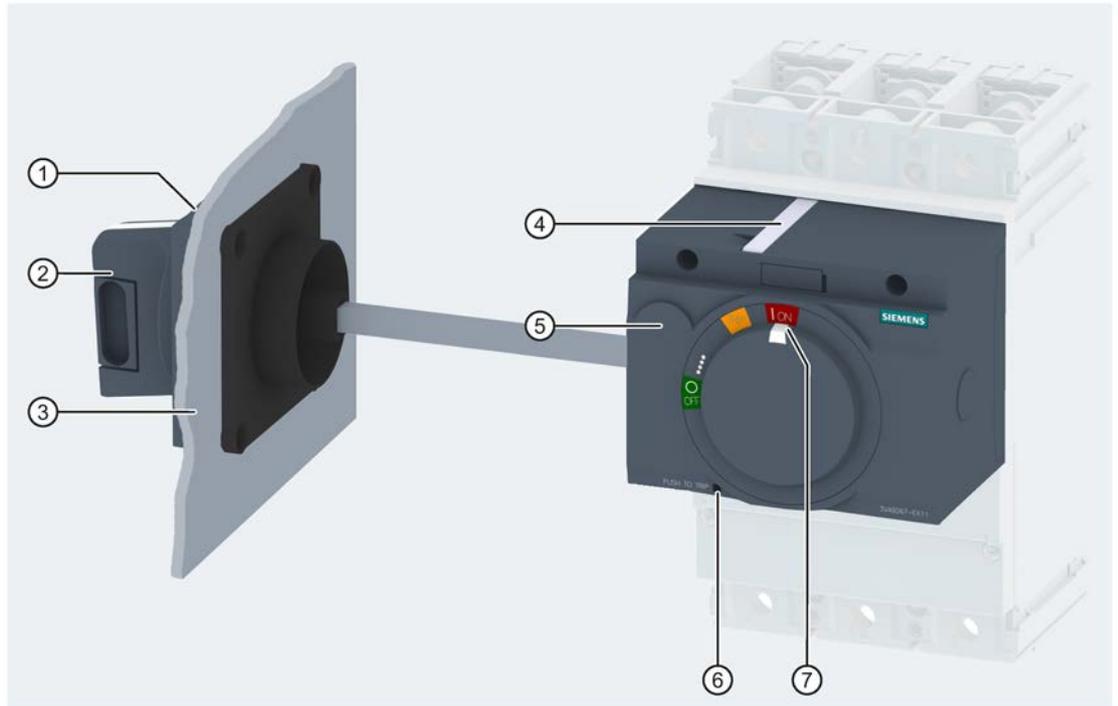
Variable depth adapter

The variable depth adapter can be installed to compensate the distance traveled between the TEST and DISCON positions with draw-out units. With this device installed, the cubicle door need not be opened when the breaker is in the TEST or DISCON position. See also chapter Draw-out technology (Page 215)



4.5.4 Side wall mounted rotary operator

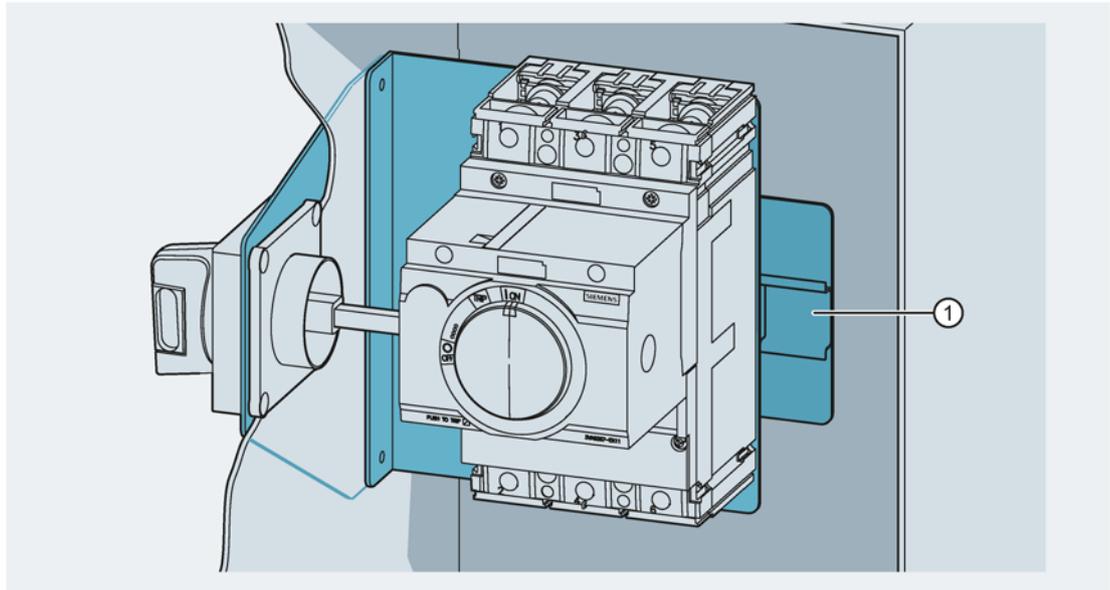
The side wall mounted rotary operator allows the molded case circuit breaker to be operated through the right-hand or left-hand side wall of the cubicle.



- ① Side wall mounted rotary operator
- ② Handle with device for up to 3 padlocks
- ③ Side wall of cubicle
- ④ Device for up to 3 padlocks
- ⑤ Device for cylinder lock
- ⑥ Trip unit button <PUSH TO TRIP>
- ⑦ Switching position indicator ON, TRIP, mounting position, OFF, RESET
For mounting position, see chapter Front mounted rotary operator (Page 241)

Side wall mounted rotary operator with mounting plate

The side wall mounted rotary operator is available in a version with mounting plate for molded case circuit breakers up to 250 A. The mounting plate can be installed on the right-hand or left-hand side panel. The space on the mounting plate can be used to install other components.



If there is insufficient space available on the mounting plate to install terminals, a terminal plate ① can be bolted to the cubicle.

4.5.5 Locking and interlocking for manual operators

The following locking and interlocking systems are deployed:

- Locking by the handle
- Locking and interlocking by the rotary operator
- Mutual interlocking by Bowden cables

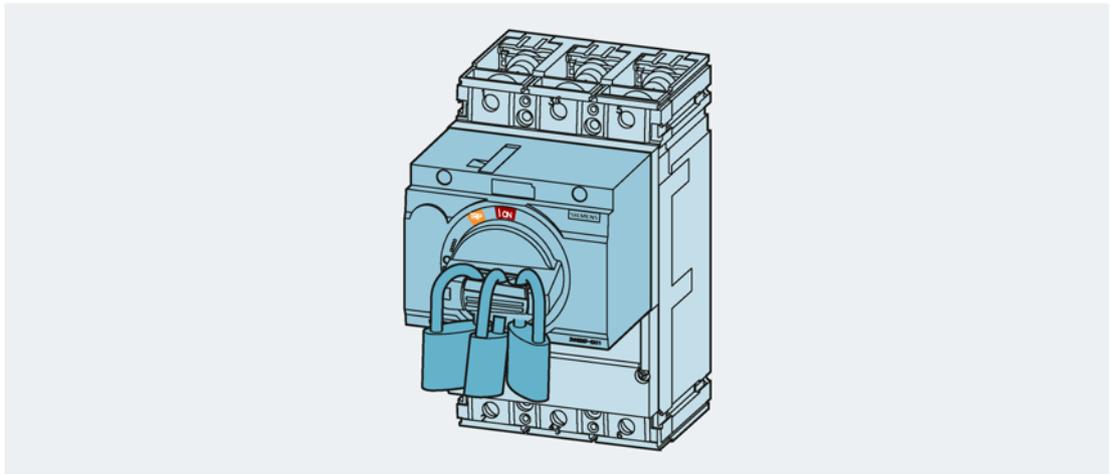
4.5.5.1 Locking by the handle

The following manual operators can be locked by the handle:

- Front mounted rotary operator
- Door mounted rotary operator
- Side wall mounted rotary operator

Up to three padlocks with a shackle diameter of between 5 and 8 mm can be used to lock the rotary operators. Padlocks are not included in the scope of supply.

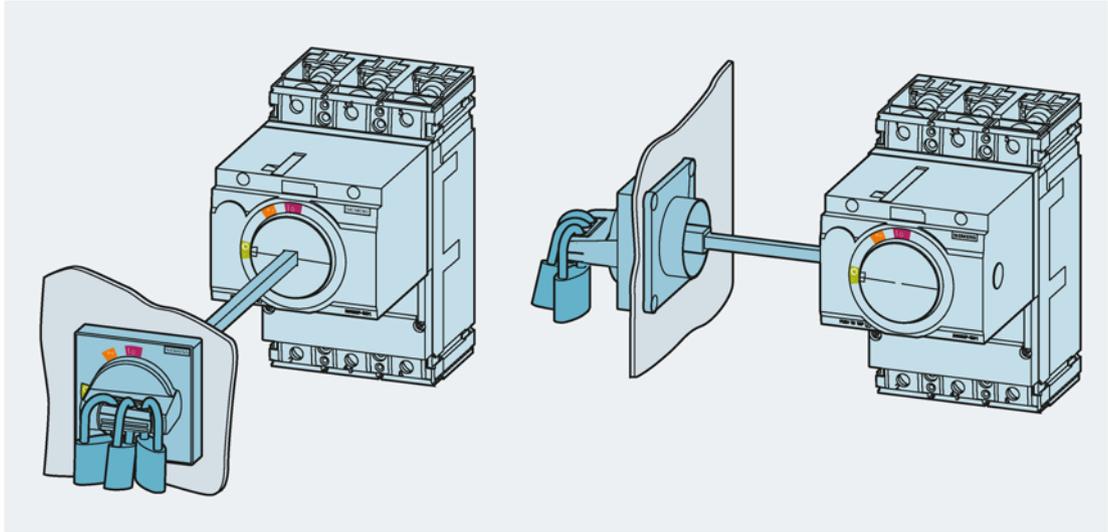
Front mounted rotary operator



Lockable switching positions:

- Position OFF (O)
- Position ON (I)
Possible only if the front mounted rotary operator has been modified accordingly during installation.

Door mounted rotary operator and side wall mounted rotary operator



Lockable switching positions:

- Position OFF (O)
When the door mounted rotary operator or the side wall mounted rotary operator is locked in the OFF (O) position, the molded case circuit breaker cannot be closed, nor can the cubicle door be opened. The door interlock cannot be overridden.
- Position ON (I)
Possible only if the door mounted rotary operator or the side wall mounted rotary operator has been modified accordingly during installation.

Note

No impairment of protection functions

Locking the rotary operators in the ON (I) position does not impair the protective functionality of the molded case circuit breakers. In the event of a fault, the molded case circuit breaker trips in the normal way.

When the rotary operator is unlocked, the switching position changes to TRIP.

4.5.5.2 Locking and interlocking by the rotary operator

The following manual operators can be locked and interlocked by the rotary operator:

- Front mounted rotary operator
- Rotary operator with shaft stub
- Door mounted rotary operator
- Side wall mounted rotary operator

The manual operators can be locked by up to three padlocks with a shackle diameter of between 5 and 8 mm or by means of cylinder locks (type Ronis). Manual operators can be interlocked only by means of cylinder locks (type Ronis).

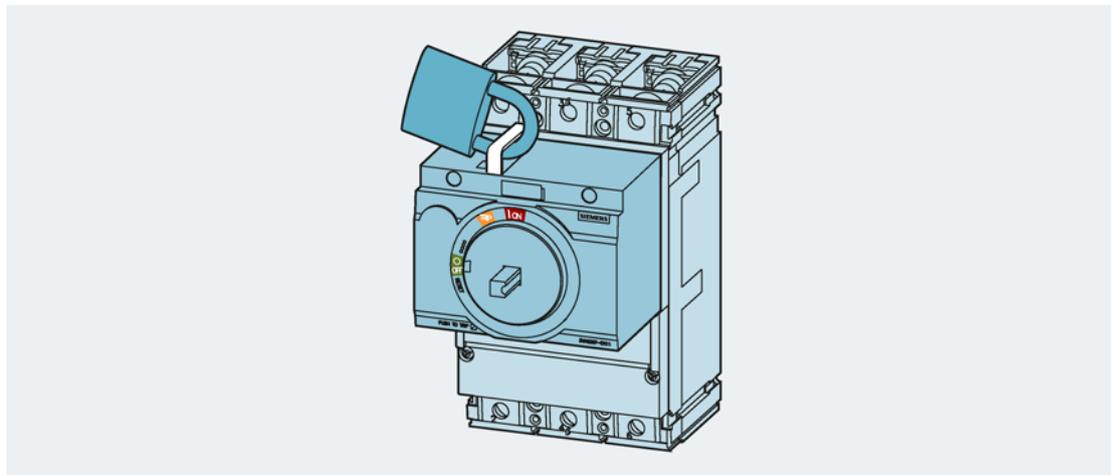
In addition, door mounted rotary operators and side wall mounted rotary operators can also be locked or interlocked by additional cylinder locks (type Kaba) at the masking frame in the cubicle door or side panel.

Padlocks and cylinder locks are not included in the scope of supply of manual rotary operators.

Locking with padlocks

All rotary operators are equipped with a padlock locking unit. This locking unit is simply pulled out of the rotary operator.

Example of rotary operator with shaft stub:



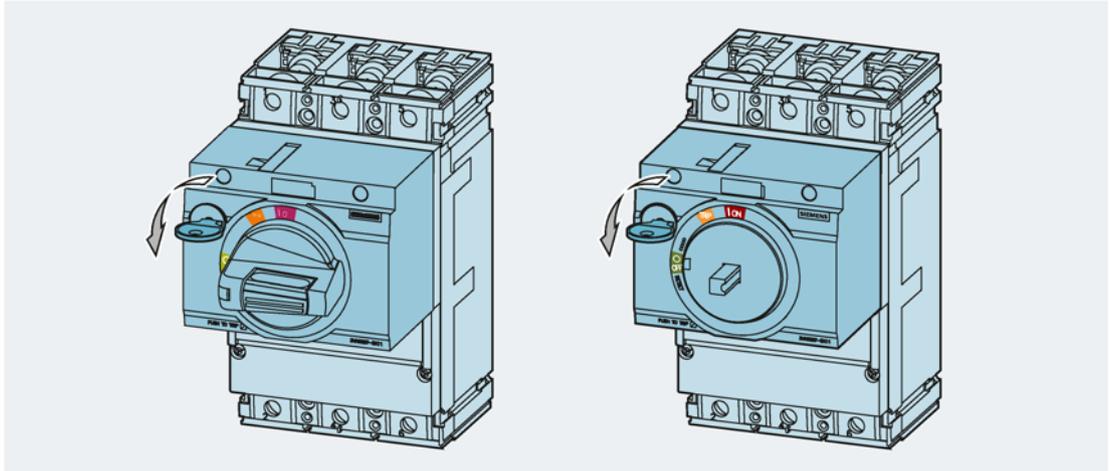
Lockable switching positions:

- Position OFF (O)

Locking or interlocking using a cylinder lock (type Ronis)

Rotary operators can be locked or interlocked (depending on how the lock holder is installed) by means of the cylinder lock (type Ronis).

Example of a front mounted rotary operator and a rotary operator with shaft stub:



Locking with cylinder lock (type Ronis):

The cylinder lock (type Ronis) locks the rotary operators in the OFF (O) position.

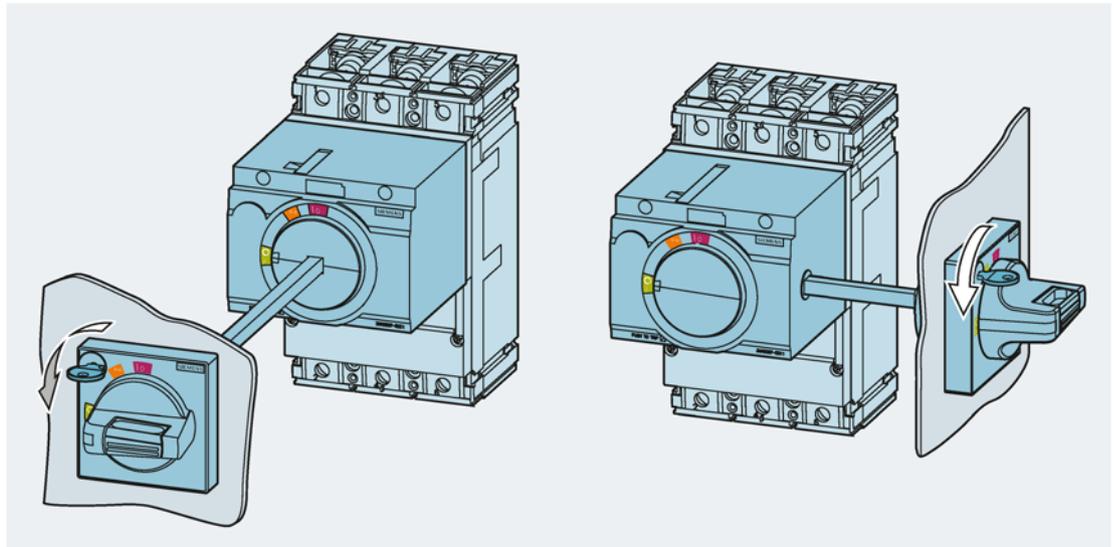
Mutual interlocking with cylinder lock (type Ronis):

By using the cylinder lock insert for interlocking, it is possible to establish a mutual interlock between an unlimited number of rotary operators. This requires that the keys of all molded case circuit breakers locked in the open position are removed from the lock and stored in a safe place. Only the key of the rotary operator which is in the ON (I) position is left in the cylinder lock. This key cannot be removed while the rotary operator is in the ON (I) position. The key can be removed only after the rotary operator has been turned to the OFF (O) position, the cylinder lock turned to the "locked" position so that the molded case circuit breaker is interlocked. See also chapter Cylinder locks for implementing interlocks between multiple 3VA molded case circuit breakers (Page 277).

Locking with cylinder lock (Kaba)

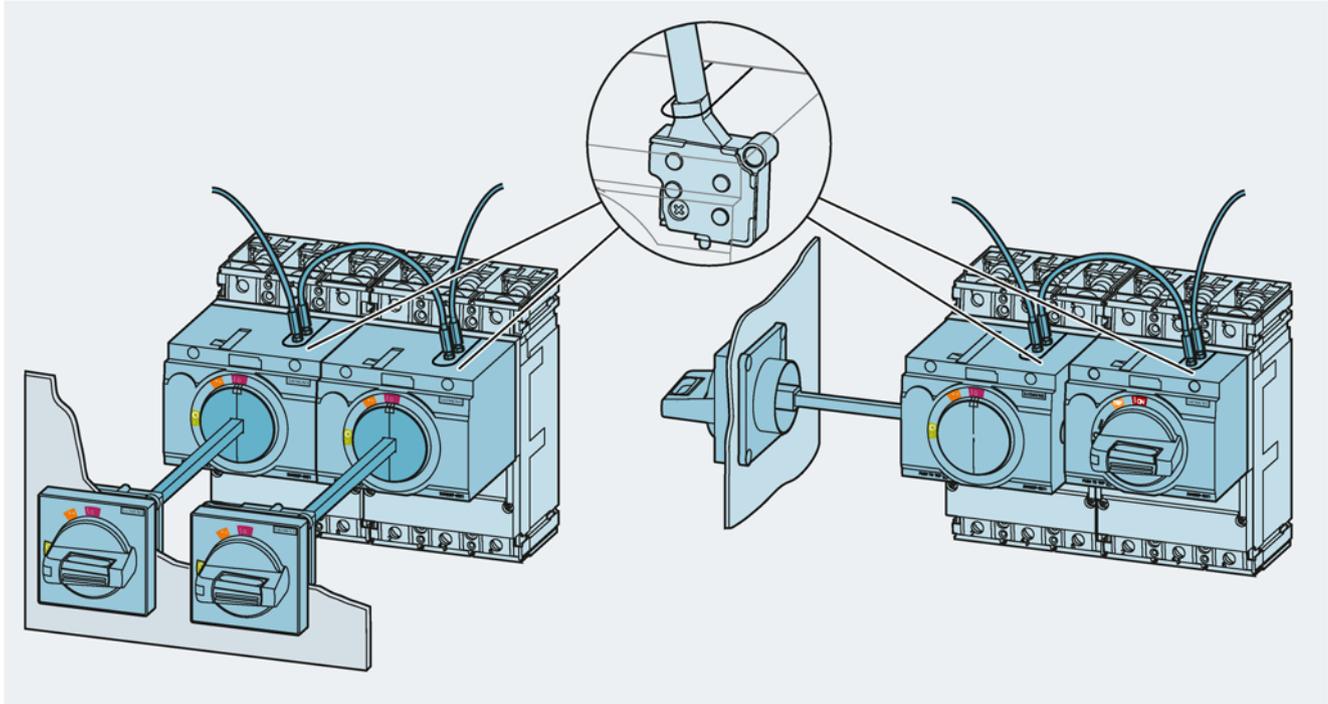
The door mounted rotary operator and the side wall mounted rotary operator can be locked by means of a cylinder lock (type Kaba) fitted in the cubicle door or side panel.

The cylinder lock (type Kaba) is not included in the scope of supply.



4.5.5.3 Mutual interlocking of 3VA molded case circuit breakers by means of Bowden cables

Bowden cables can be used to implement a mutual interlock between up to three 3VA molded case circuit breakers. For this purpose, Bowden cable modules are fitted in the manual operator.



Possible combinations of breaker positions

When a Bowden cable interlock is installed for two manual operators, the two interlocked 3VA molded case circuit breakers can assume the following positions:

Molded case circuit breaker A	Molded case circuit breaker B
ON	OFF
OFF	ON
OFF	OFF

When a Bowden cable interlock is installed for three manual operators, the three interlocked 3VA molded case circuit breakers can assume the following positions:

Molded case circuit breaker A	Molded case circuit breaker B	Kompaktleistungsschalter C
ON	OFF	OFF
OFF	ON	OFF
OFF	OFF	ON
OFF	OFF	OFF

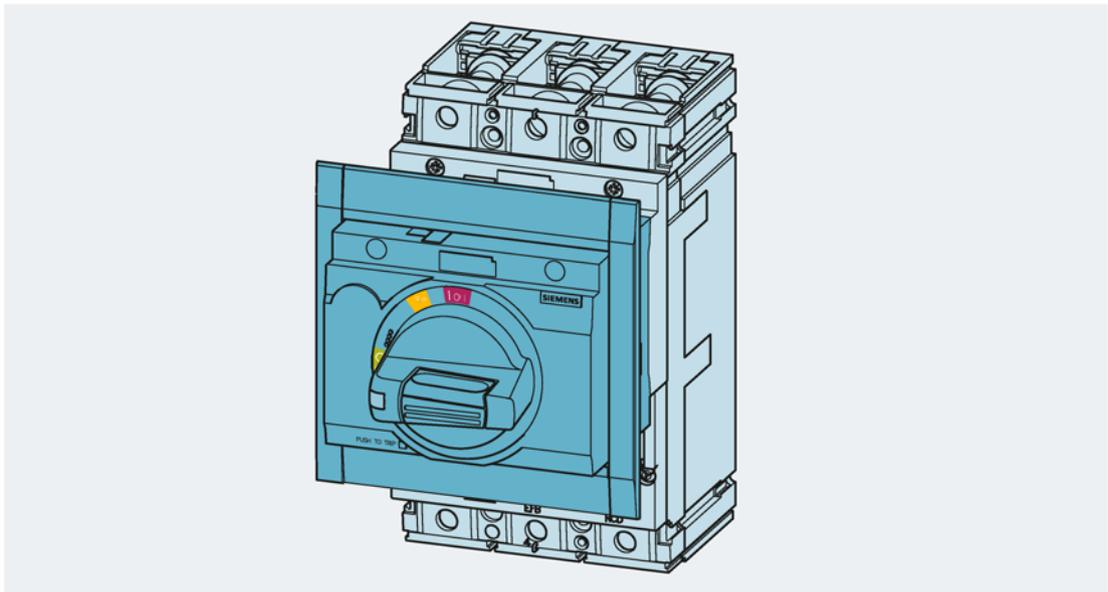
Interlocks can be implemented between the following 3VA molded case circuit breakers:

										
			3VA1			3VA2				
			100 A	160 A	250 A	100 A	160 A	250 A	400 A	630 A
	3VA1	100 A	■	■	■	■	■	■		
		160 A	■	■	■	■	■	■		
		250 A	■	■	■	■	■	■	■	■
	3VA2	100 A	■	■	■	■	■	■	■	■
		160 A	■	■	■	■	■	■	■	■
		250 A	■	■	■	■	■	■	■	■
		400 A			■	■	■	■	■	■
		630 A			■	■	■	■	■	■

4.5.6 Degree of protection

Operator	IP degree of protection
Front mounted rotary operator	IP30
Front mounted rotary operator in control cubicle door with escutcheon	IP30
Door mounted rotary operator	IP65
Side wall mounted rotary operator	IP65

When fitted with an escutcheon (see illustration below), a front mounted rotary operator installed in the cubicle door has degree of protection IP30.



Note

To ensure that the control cabinet door can still be opened, the front mounted rotary operator must not project over the cover frame by more than 5 mm when the door is closed.

4.5.7 Accessories

Illumination kit



With this kit installed, the front edge of the handle of the front mounted operator of the door mounted rotary operator or side wall mounted rotary operator lights up to indicate the switching position of the circuit breaker. The illumination kit can be ordered with the operator as a pre-assembled accessory, or individually as a retrofit component.

The illumination kit operates on a 24 V DC supply.

Its power consumption is 0.16 W.

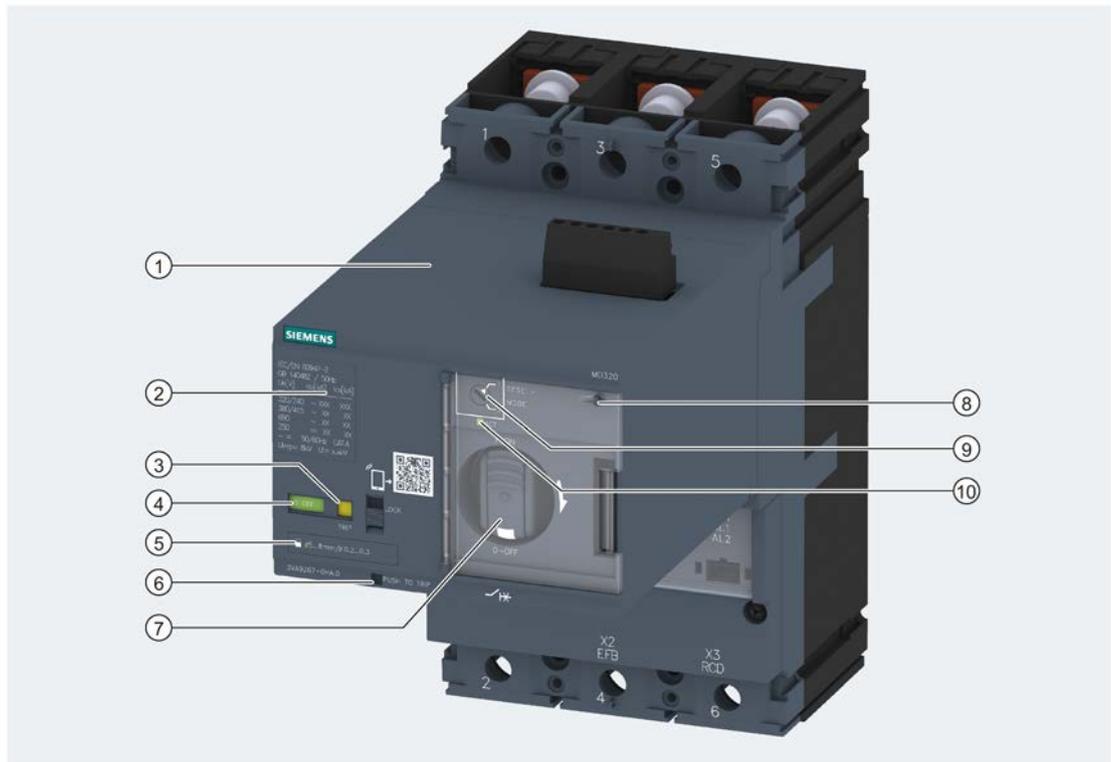
4.6 Motor operators

4.6.1 Motor operator MO320



The motor operator MO320 transmits commands via electrical control cables to open and close the molded case circuit breaker. The source of commands transmitted via electrical control cables can be a pushbutton or a PLC, for example.

Motor operators must also be used in conjunction with automatic transfer control devices.



- | | |
|--|-----------------------------------|
| ① Motor operator MO320 | ⑥ Trip unit button <PUSH TO TRIP> |
| ② Characteristic data of the molded case circuit breaker | ⑦ Handle for manual operation |
| ③ LED "TRIP" | ⑧ Seal |
| ④ Switching position indicator ON/OFF | ⑨ Reset mode setting |
| ⑤ Device for padlocks | ⑩ LED "Active" |

Description of front panel

The front panel of the motor operator MO320 features a switching position indicator and an LED labeled "TRIP". With its clear switching position indication, the motor operator MO320 meets the requirements pertaining to isolating features stipulated by IEC / EN 60947-1.

Switching position indication on the front panel

	ON	The main contacts of the molded case circuit breaker are closed.
	OFF	The main contacts of the molded case circuit breaker are open.
	Off and LED TRIP lit	The molded case circuit breaker is in TRIP position.

LED status displays

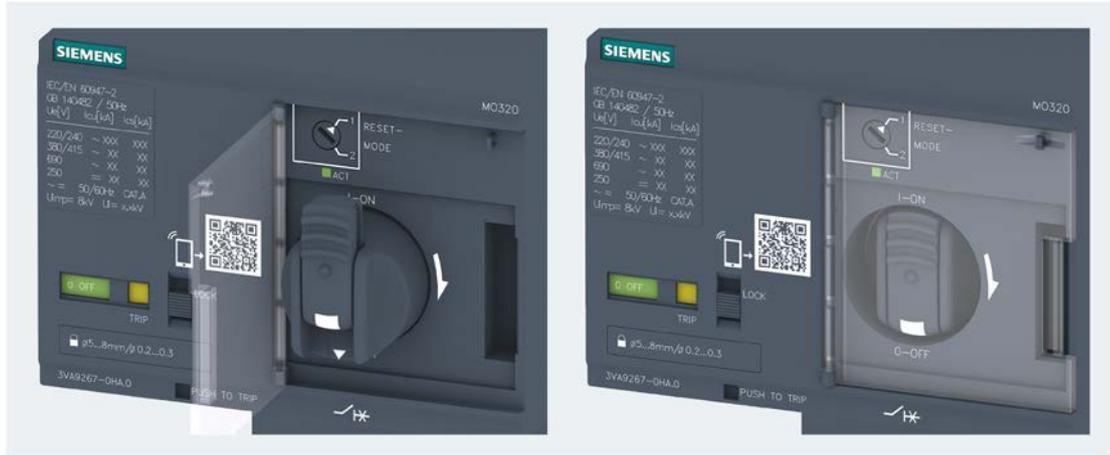


ACT	TRIP	Status
<input type="checkbox"/>	<input type="checkbox"/>	No power supply
	<input type="checkbox"/>	Internal error
	<input type="checkbox"/>	Normal operating status
		Tripped if TRIP LED is illuminated
		Device defective

See also chapter Faults, causes of faults and rectification of faults (Page 267).

4.6.1.1 MANUAL, AUTO and LOCK modes

The motor operator MO320 is switched to MANUAL or AUTO mode when the plastic window is opened (MANUAL) or closed (AUTO).



MANUAL:

When the plastic window is open, the motor operator MO320 is in MANUAL mode. The motor operator is moved to position ON (I) or OFF (O) by manual operation of the handle.

AUTO:

When the plastic window is closed, the motor operator MO320 is in AUTO mode. The motor operator can be operated via control cables, e.g. in response to signals issued by a pushbutton or by control commands output by a PLC.

LOCK:

The motor operator can be locked in the OFF (O) position to prevent reclosure of the breaker. The padlock locking device snaps out if the slide above it is moved to the "LOCK" position.

Up to three padlocks with a shackle diameter of between 5 and 8 mm can be inserted through the openings in the padlock locking unit. Padlocks are not included in the scope of supply.

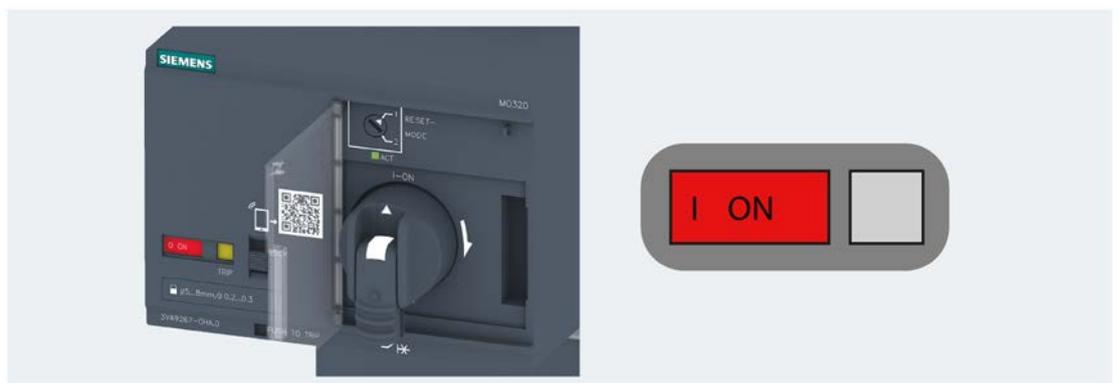


4.6.1.2 Opening, closing and resetting the 3VA molded case circuit breaker

Opening and closing in MANUAL mode

The plastic window is open, the motor operator is in MANUAL mode. The supply to the LEDs is also disconnected, but the motor operator remains fully operational.

- Close the 3VA molded case circuit breaker:
Turn the handle clockwise until the switching position indicator displays ON (I).
The molded case circuit breaker is now ON (I). The main contacts are closed.



4.6 Motor operators

- Open the 3VA molded case circuit breaker:
Turn the handle clockwise until the switching position indicator displays OFF (O).
The molded case circuit breaker is now OFF (O). The main contacts are open.



Opening and closing in AUTO mode

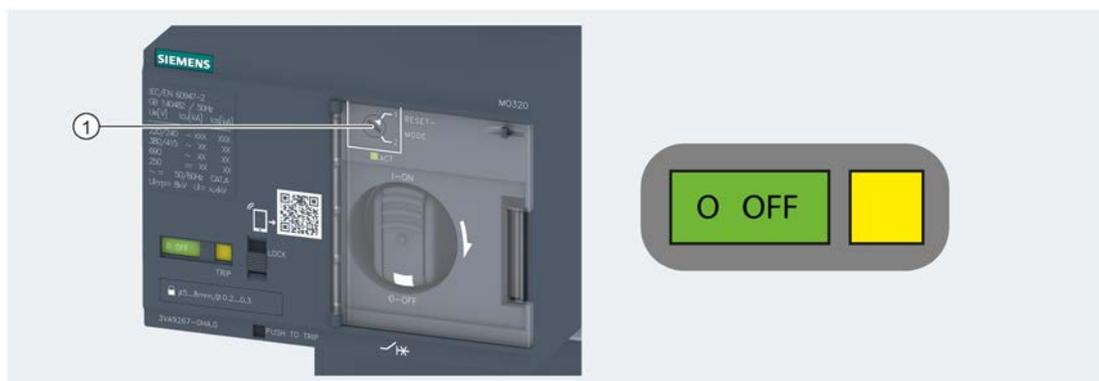
The plastic window is closed, the motor operator is in AUTO mode. The 3VA molded case circuit breaker can be closed or opened only under the control of electrical signals.



- Close the 3VA molded case circuit breaker by means of an electrical ON signal at the terminal block:
The molded case circuit breaker is ON (I). The main contacts are closed. The switching position indicator on the front panel of the motor operator displays ON (I).
- Open the 3VA molded case circuit breaker by means of an electrical OFF signal at the terminal block:
The molded case circuit breaker is OFF (O). The main contacts are separated. The switching position indicator on the front panel of the motor operator displays OFF (O).

Resetting the molded case circuit breaker

If the 3VA molded case circuit breaker has tripped, the LED labeled "TRIP" lights up



① Reset mode setting

The method by which the 3VA molded case circuit breaker is reset by the motor operator depends on the selected reset mode.

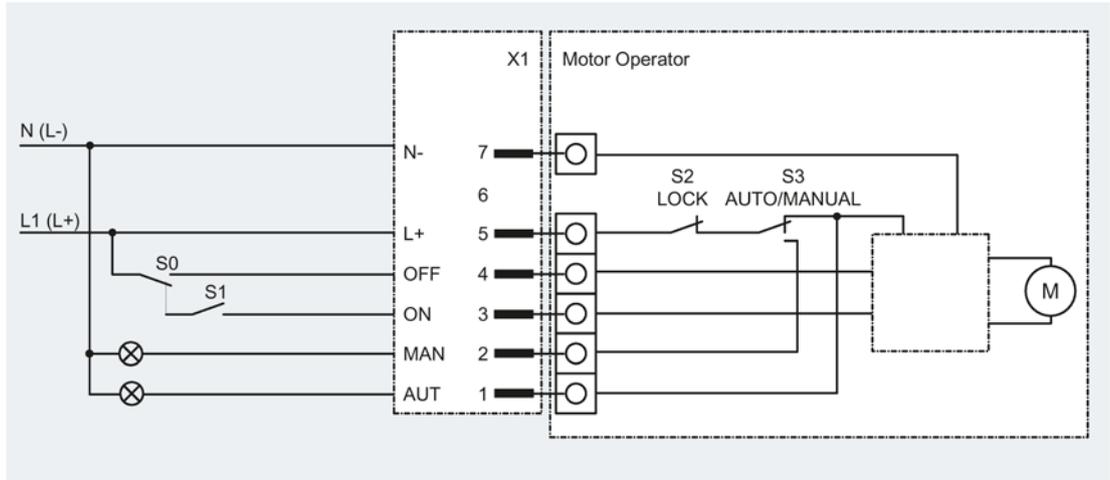
Reset modes

The reset mode can be selected. After the molded case circuit breaker has tripped, the selected reset mode determines the response of the motor operator in the TRIP position.

Motor operator response to tripping of the 3VA molded case circuit breaker depending on the reset mode selection:

Reset mode	Requirements	Operating mode	Setting Rotary button	Description
Operating mode 1: Automatic reset	Plastic window closed, motor operator is in AUTO position.	AUTO		If the molded case circuit breaker has tripped, the motor operator moves it automatically from position TRIP to position OFF.
Operating mode 2: Manual reset or reset by remote control	Plastic window open or closed, motor operator is in the MANUAL or AUTO position.	MANUAL / AUTO		MANUAL operating mode: The motor operator must be reset locally by means of the handle (switching position OFF (O)). AUTO operating mode: The motor operator must be reset with an OFF signal transferred via control cables (e.g. pushbutton, PLC).

Connection diagram for control of the motor operator MO320



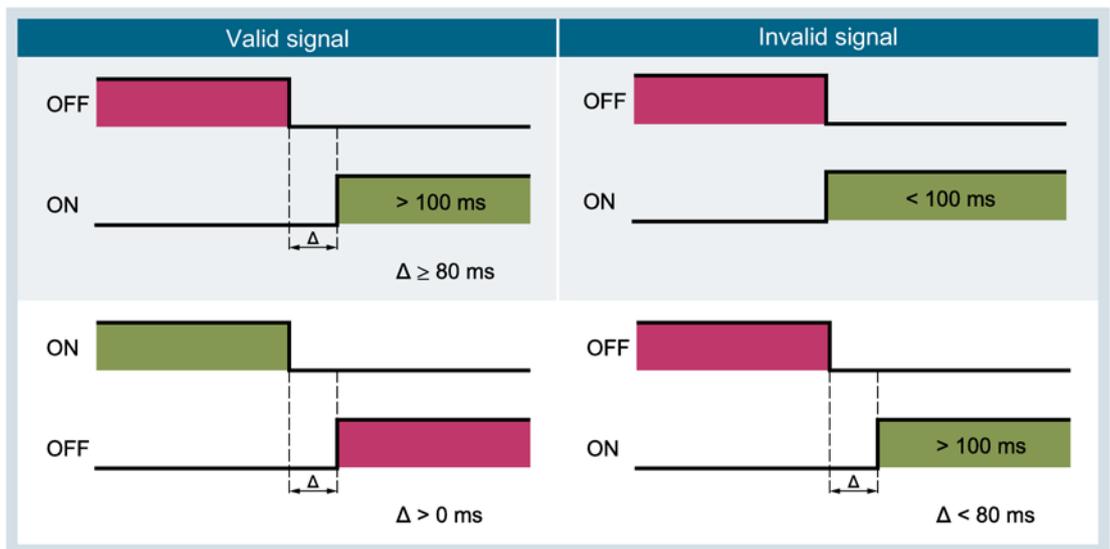
Note

An EMERGENCY-STOP circuit is implemented by means of shunt trips (Page 146).

For further circuit diagrams, see chapter "Circuit diagrams" (Page 423).

The M0320 motor operator is edge-controlled, i.e. it reacts only to the positive edge of an ON or OFF command at the relevant terminals 3 and 4. In this case, the OFF signal is dominant, i.e. the motor operator will be switched off in response to an OFF edge even if an ON signal is applied.

The MO320 requires a pause period of 80 ms between the end of an OFF signal and the edge of an ON signal. Since the OFF signal is dominant, it does not require a pause period.



4.6.1.3 Faults, causes of faults and rectification of faults

Causes of faults	LED display		Remedy
	ACT	TRIP	
Defects			
Unit is defective (e.g. defective microswitch)			Cannot be repaired, replace the unit
Faults			
Excessively long switching time (e.g. blocked motor)		<input type="checkbox"/>	Reset fault by 2 x OFF signal (< 1 s)
Incorrect switching position after command (e.g. OFF position after ON signal)		<input type="checkbox"/>	Reset fault by 2 x OFF signal (< 1 s) or manual correction of switching position
Undefined switching position		<input type="checkbox"/>	Reset fault by 2 x OFF signal (< 1 s) or manual correction of switching position
Fault during automatic reset		<input type="checkbox"/>	Reset fault by 2 x OFF signal (< 1 s)
Undefined reset mode (e.g. rotary button not in position 1 or 2)		<input type="checkbox"/>	Set the reset mode correctly, reset fault by 2 x OFF signal (< 1 s) or manual actuation

4.6.2 Technical specifications

Motor operator MO320

		MO320 motor operator			
		160 A	3VA1 250 A	250 A	3VA2 630 A
Ambient temperature (operation)	°C	-25 ... +70			
Ambient temperature (storage)	°C	-40 ... +80			
Rated control supply voltage (control supply voltage range)		24 ... 60 V DC (0.85 ... 1.26) 110 ... 230 V AC / 110 ... 250 V DC (0.85 ... 1.1)			
Rating	W/VA	250, max. 500 (60 ms)			
Breaking capacity (outputs)	24 ... 60 V DC	A			
	110 ... 230 V AC	A			
	110 ... 250 V DC	A			
Input impedance	24 ... 60 V DC	kΩ			
	110 ... 230 V AC	kΩ			
	110 ... 250 V DC	kΩ			
Make time, typical	ms	< 800	< 900	< 1000	< 1700
Break time, typical	ms	< 800	< 900	< 1000	< 1400
Pulse duration, minimum	ms	100			
Maximum switching frequency	1/h	120			
Degree of protection		IP20, with escutcheon IP30			
Connectable conductor cross sections	mm ²	1.5 ... 2.5			
Tightening torque	Nm	0.4			
Stripped length	mm	7			
	A	4			
DIAZED fuse		Operational class gG Characteristic: slow			
Miniature circuit breakers		C characteristic to DIN VDE 0641			

4.7 Locking and interlocking

4.7.1 General information

With all types of 3VA molded case circuit breaker, a basic distinction is made between:

- Locking of molded case circuit breakers
- Interlocking of molded case circuit breakers

4.7.1.1 Locking

Padlock devices can be used to lock 3VA molded case circuit breakers in the OFF (O) or ON (I) position. A molded case circuit breaker cannot be operated when it is locked.

Locking a molded case circuit breaker in the OFF (O) position



In order to prevent closure of a 3VA molded case circuit breaker, it can be locked in the OFF (O) position by a padlock. Once it is locked, the 3VA molded case circuit breaker is safely locked in the OFF (O) position. It can be unlocked again only by an authorized person.

The padlock devices for locking the 3VA molded case circuit breaker in the OFF (O) position ensure safe separation of the main contacts as defined by IEC 60947-2.

Locking a molded case circuit breaker in the ON (I) position



It is also possible to safely lock a 3VA molded case circuit breaker in the ON (I) position using a padlock device. The breaker contacts cannot be opened when it is locked in this position. A 3VA molded case circuit breaker can be released from its ON position again only by an authorized person.

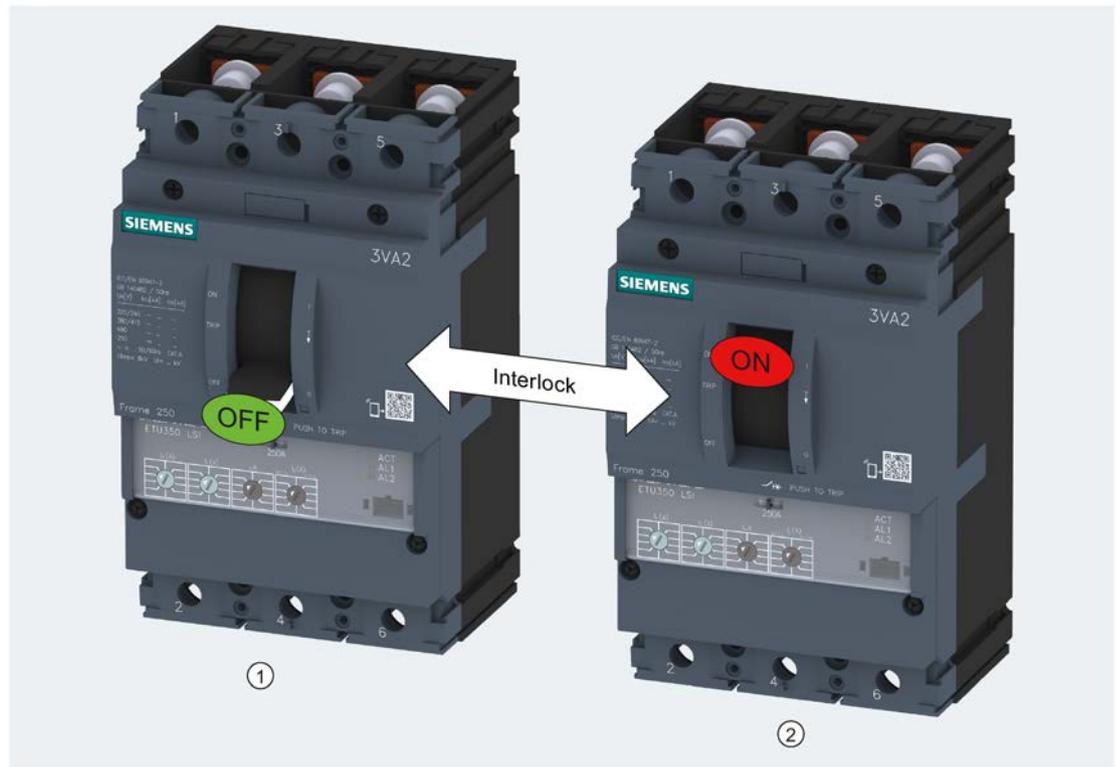
The TRIP function, i.e. the protective functionality of the 3VA molded case circuit breaker, is not affected by locking the breaker in the ON (I) position. In the event of a fault, the 3VA molded case circuit breaker trips in the normal way.

4.7.1.2 Interlocking

The available interlocking devices can be used to implement a mutual interlock between at least two 3VA molded case circuit breakers.

The interlocking device only ever releases one 3VA molded case circuit breaker at a time, thereby ensuring that only the released circuit breaker can be operated. All other 3VA molded case circuit breakers remain in the safe OFF (O) position and are blocked by the interlock.

Principle of two mutually interlocked 3VA molded case circuit breakers:



- ① Molded case circuit breaker blocked/locked in the safe switching state OFF (O)
- ② Molded case circuit breaker released for operation

The following interlocking systems are available for 3VA molded case circuit breakers:

- Front interlock
- Rear interlock

Front interlock

All front interlocks are installed on the front panel of the 3VA molded case circuit breaker. Front interlocks make it impossible to install some other external accessories such as motor operator, rotary operators, etc. They also partially restrict access to internal accessories compartments.

Rear interlock

The rear interlock does not affect the front panel of the 3VA molded case circuit breaker. All components of the interlocking system are concealed behind the molded case circuit breaker or the mounting plate.

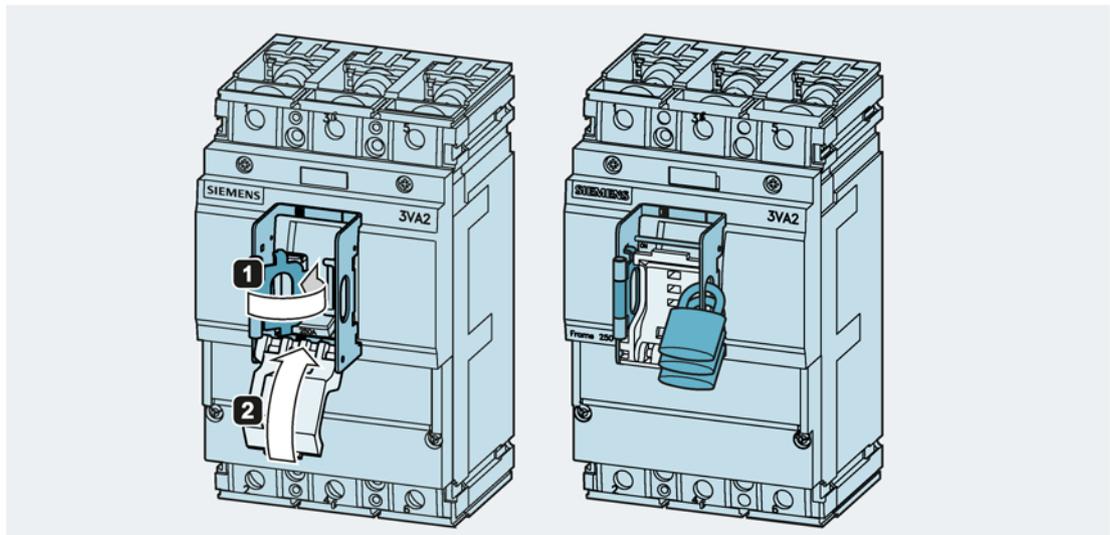
4.7.2 Locking

The following locking devices are available for 3VA molded case circuit breakers:

- Padlock device for the handle
- Cylinder locks for locking the 3VA molded case circuit breaker

4.7.2.1 Padlock device for the handle

The padlock device for the handle is directly attached to the handle of the 3VA molded case circuit breaker and latched in place.

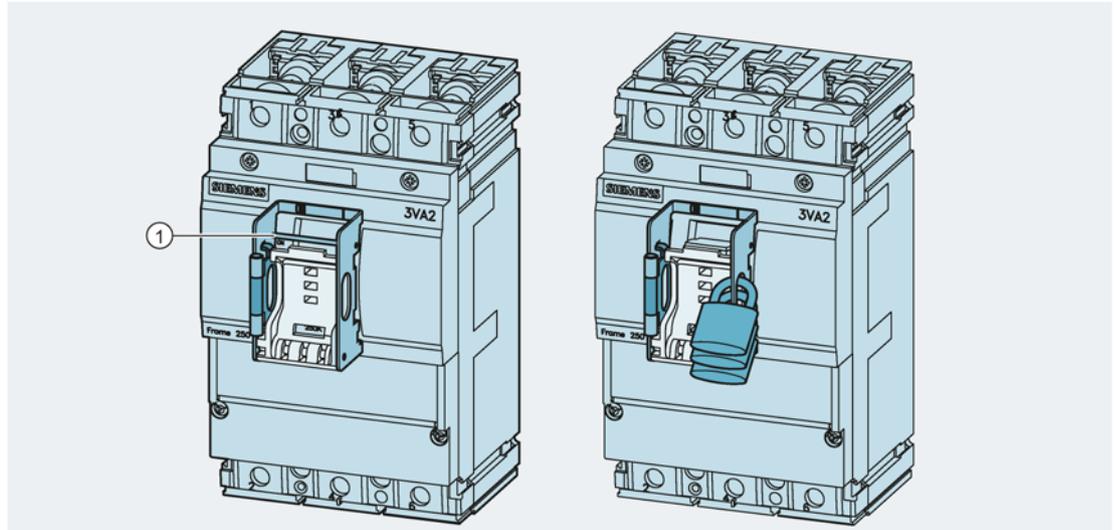


Note

For installation instructions, please refer to operating instructions "Padlock device for the handle".

When the padlock device for the handle is installed, the 3VA molded case circuit breaker can be locked in the OFF (O) position by up to three padlocks (shackle diameter 4.5 to 8.5 mm).

If the application requires the 3VA molded case circuit breaker to be locked in the ON (I) position as well, the metal pin ① must be removed by pliers from the handle, see illustration below. This deliberate action is a safety precaution and prevents accidental locking of the breaker in the ON position.



① Metal pin

Padlock devices in INSTA distribution boards

Installed padlock devices for the handle of 3VA1 molded case circuit breakers in rated current versions 100 A, 160 A and 250 A have a cover size of 45 mm. They are therefore suitable for installation in INSTA distribution boards.

Installation of other accessories

When the padlock device for the handle is fitted, some other accessories cannot be installed, see chapter Possible combinations of accessories (Page 142).

4.7.2.2 Cylinder locks for locking the 3VA molded case circuit breaker

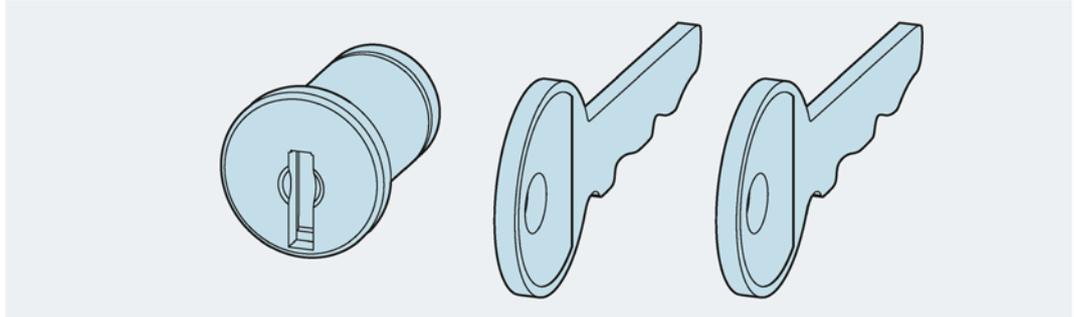
The 3VA molded case circuit breaker can also be locked in the OFF (O) or ON (I) position by means of a cylinder lock (type Ronis). The 3VA molded case circuit breaker is protected against further operation once it has been locked.

Cylinder locks (type Ronis) can be fitted to all types of 3VA molded case circuit breaker. The cylinder lock is installed in an accessories compartment of the 3VA molded case circuit breaker.

4.7 Locking and interlocking

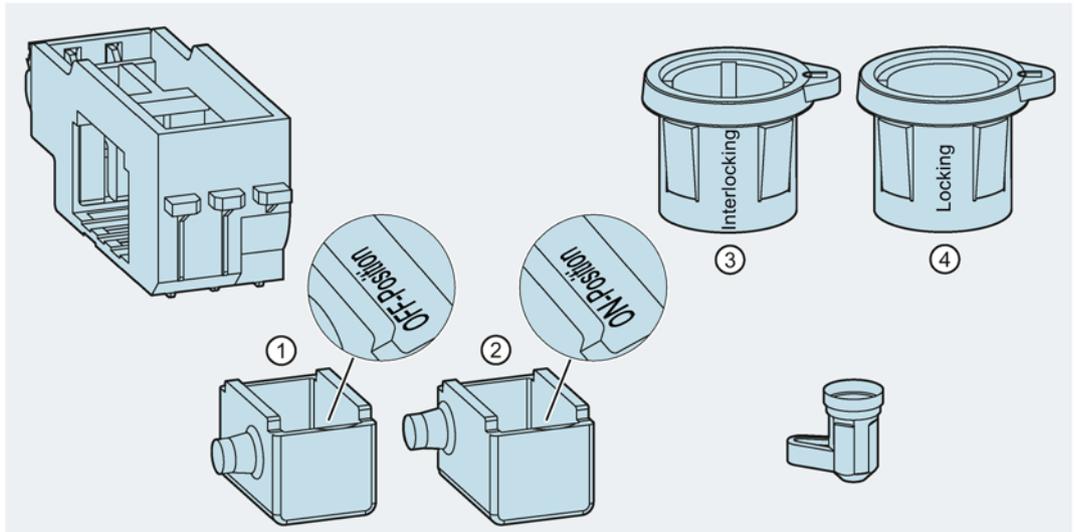
To provide a cylinder lock, the following 2 components need to be ordered:

- One cylinder lock (type Ronis)
1 lock and 2 keys are always included in the order.



Selection of the lock number is highly flexible, i.e. it can be selected from a choice of four different lock numbers. If different cylinder lock numbers are required for multiple locks, they can be selected from the predefined article numbers stated in the catalog.

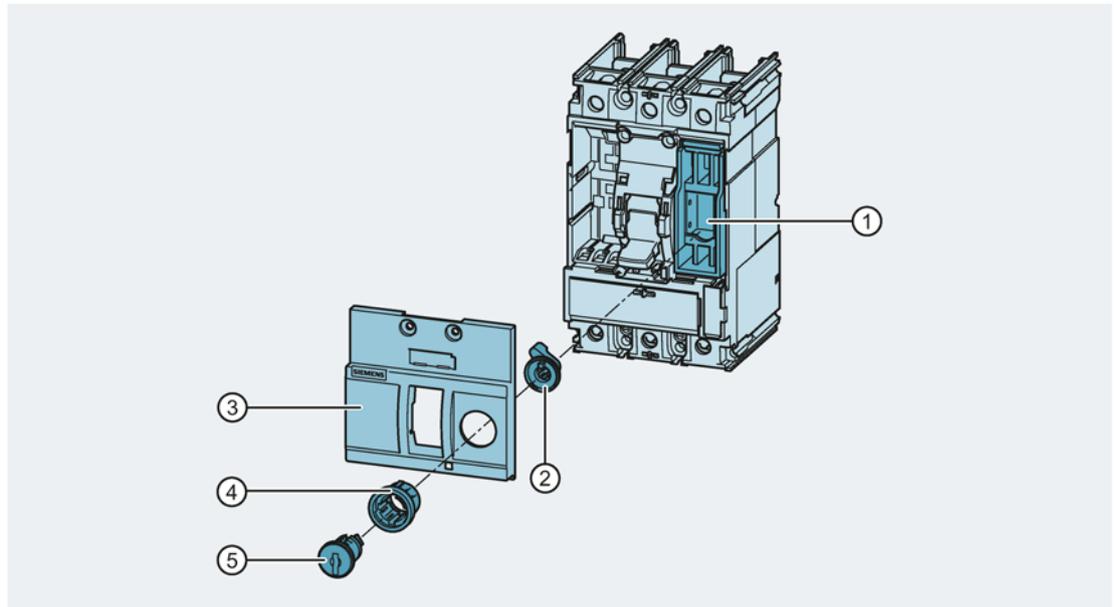
- One adapter kit
The adapter kit transfers the motion of the lock to the switching mechanism.
The article number includes the adapter kit and two cylinder lock housings. One cylinder lock housing (locking) is used for locking applications and the other housing (interlocking) for interlocking applications.



- ① Slide for locking in the OFF position
- ② Slide for locking in the ON position
- ③ Cylinder lock housing for locking
- ④ Cylinder lock housing for interlocking

Locking in the OFF (O) position

The cylinder lock (type Ronis) is installed with the adapter kit and the cylinder lock housing for locking in the right-hand accessories compartment of the 3VA molded case circuit breaker so that the breaker can be locked in the OFF (O) position. The slide for locking in the OFF position is fitted for this purpose.



- | | |
|---------------------------------------|-------------------------------------|
| ① Adapter kit with OFF position slide | ④ Cylinder lock housing for locking |
| ② Actuating lever | ⑤ Cylinder lock (type Ronis) |
| ③ Lid of accessories compartment | |

1. Remove the lid of the accessories compartment ③ from the 3VA molded case circuit breaker.
2. Drill a hole through the lid at the position marked on the rear face and smooth down the drilled surface with a file.
3. Insert a cylinder lock (type Ronis) ⑤ and the locking version of the cylinder lock housing ④ in the drilled hole and connect it securely to the accessories compartment lid ② via the actuating lever.
4. Install the adapter kit ① in the right-hand accessories compartment of the 3VA molded case circuit breaker.
5. Reattach the accessories compartment lid to the 3VA molded case circuit breaker.

To lock the 3VA molded case circuit breaker in the OFF (O) position, the key must be turned to the vertical "locked" position.



Locking in the ON (I) position

For safety reasons, a deliberate action is required to lock the breaker in the ON (I) position. The slide for locking in the ON position must be used for this purpose. Further information can be found in the relevant operating instructions.

Use of cylinder locks (type Ronis) for other applications

Cylinder locks (type Ronis) can also be used in the following applications:

- For locking the racking distance in draw-out units, see chapter Draw-out technology (Page 215)
- For locking in the manual operators of the 3VA molded case circuit breaker, see chapter Manual operators (Page 238)

Installation of other accessories

When the cylinder lock is fitted in the accessories compartment of the circuit breaker, some other accessories cannot be installed, see chapter Possible combinations of accessories (Page 142).

4.7.3 Front interlocking

Front interlocks are installed on the front panel of the 3VA molded case circuit breaker.

The following interlocking devices are available for 3VA molded case circuit breakers:

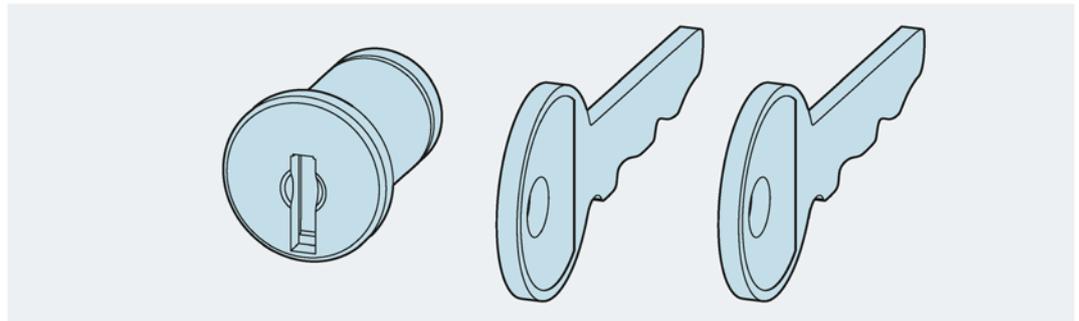
- Cylinder locks for implementing interlocks between an unlimited number of molded case circuit breakers
- Sliding bar with Bowden cable
- Sliding bar

4.7.3.1 Cylinder locks for implementing interlocks between multiple 3VA molded case circuit breakers

Cylinder locks (type Ronis) can be installed in the accessories compartments not only to lock molded case circuit breakers, see chapter Cylinder locks for locking the 3VA molded case circuit breaker (Page 273), but also to implement mutual interlocks between an unlimited number of 3VA molded case circuit breakers. The purpose of this system is to ensure that only one single 3VA molded case circuit breaker included in the interlock application can be in the ON (I) position at any given time.

In order to implement a mutual interlock between multiple 3VA molded case circuit breakers, the following two components must be ordered for each circuit breaker to be included in the interlock arrangement:

- One cylinder lock (type Ronis)
1 lock and 2 keys are always included in the order

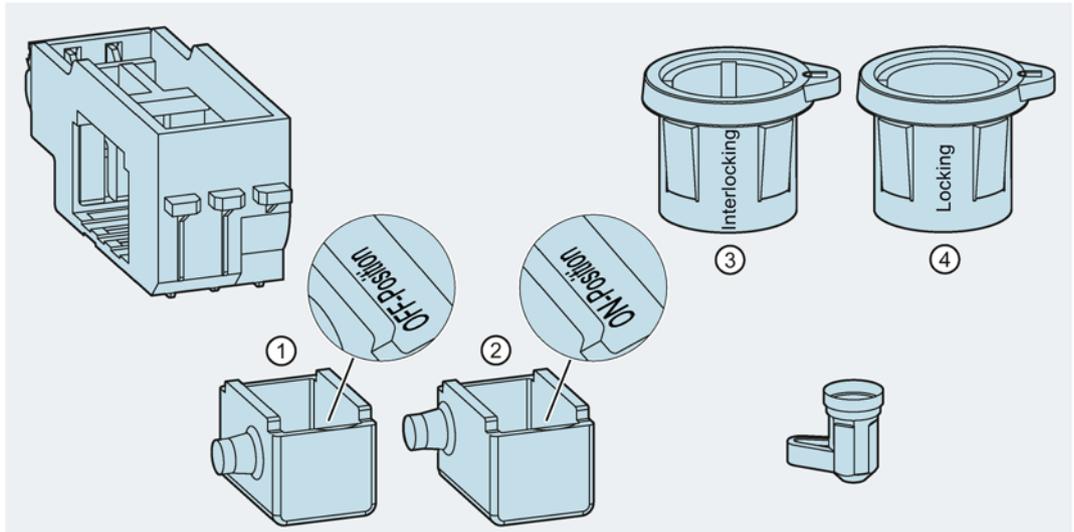


Note

It is important to order the same lock number for all circuit breakers to be included in the interlock arrangement!

4.7 Locking and interlocking

- One adapter kit
The adapter kit transfers the motion of the lock to the switching mechanism.
The article number includes the adapter kit and two cylinder lock housings.

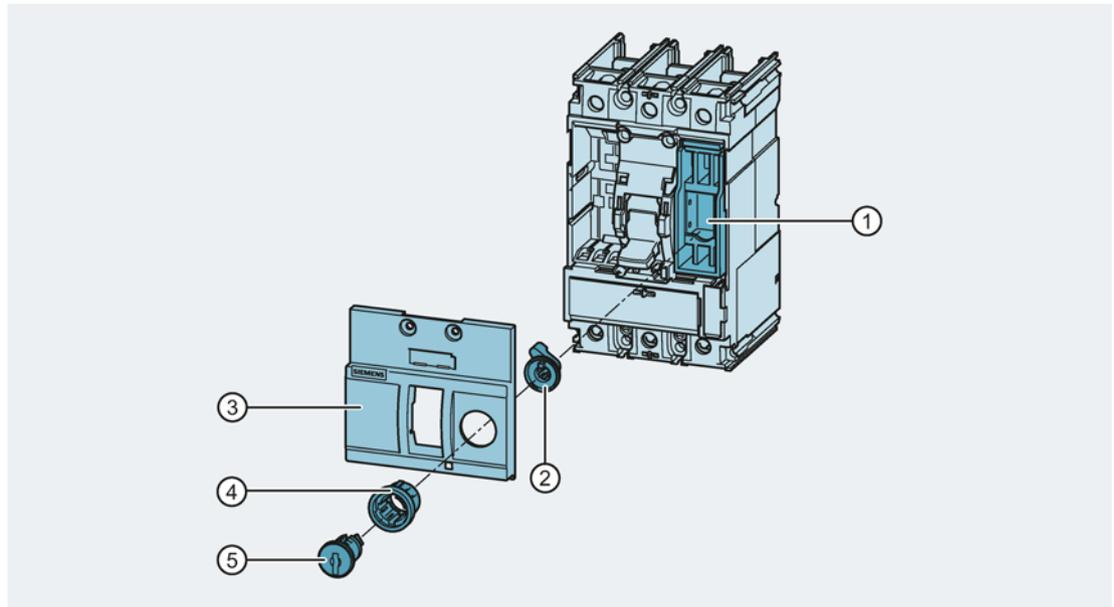


- ① Slide for locking in the OFF position
- ② Slide for locking in the ON position
- ③ Locking version of cylinder lock housing
- ④ Interlocking version of cylinder lock housing

In order to implement a mutual interlock between three 3VA molded case circuit breakers, for example, three cylinder locks (type Ronis) with the same lock number and 3 adapter kits suitable for the relevant circuit breakers must be ordered.

Installing the cylinder lock in the accessories compartment

The cylinder lock (type Ronis) is installed together with the adapter kit and the interlocking version of the cylinder lock housing in the right-hand accessories compartment of the molded case circuit breaker.



- | | | | |
|---|--------------------------------|---|--|
| ① | Adapter kit | ④ | Cylinder lock housing for interlocking |
| ② | Actuating lever | ⑤ | Cylinder lock (type Ronis) |
| ③ | Lid of accessories compartment | | |

1. Remove the lid of the accessories compartment ③ from the 3VA molded case circuit breaker.
2. Drill a hole through the lid at the position marked on the rear face and smooth down the drilled surface with a file.
3. Insert a cylinder lock (type Ronis) ⑤ and the interlocking version of the cylinder lock housing ④ in the drilled hole and connect it securely to the accessories compartment lid ② via the actuating lever.
4. Install the adapter kit ① in the right-hand accessories compartment of the 3VA molded case circuit breaker.
5. Reattach the accessories compartment lid to the 3VA molded case circuit breaker.

A cylinder lock (type Ronis) is installed at each 3VA molded case circuit breaker to be included in the interlock arrangement.

Interlocking of molded case circuit breakers

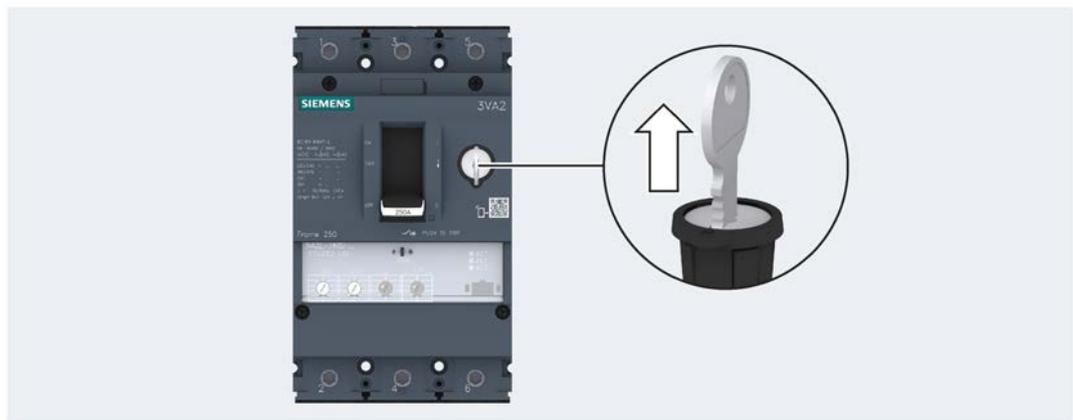
 WARNING
Use of more than one key poses safety hazard and/or risk of damage to property
Leave only 1 key inserted in one of the circuit breakers included in the interlock arrangement.
Store all other keys in a safe place or lock them away.

In order to ensure reliable functioning of the interlock, only 1 key is left in one circuit breaker included in the interlock arrangement. This one key serves as the release instrument for only one molded case circuit breaker at a time.

1. Move all 3VA molded case circuit breakers in the interlock arrangement to the OFF position and lock them (turn the cylinder lock to the horizontal "locked" position).



2. Remove all keys.



All 3VA molded case circuit breakers in the interlock arrangement are now safely locked in the OFF (O) position and cannot be operated.

3. Insert **one single** key in one circuit breaker included in the interlock; store or lock away **all other** keys.

- Use the single key to turn the cylinder lock of the 3VA molded case circuit breaker to be released to the "unlocked" position.
Once the key is in the "unlocked" position, it must not be removed.



- Move the handle of the released 3VA molded case circuit breaker to the ON (I) position.

Releasing a different molded case circuit breaker

- Move the handle of the currently released molded case circuit breaker to the OFF (O) position.
- Turn the cylinder lock to the vertical "locked" position and remove the key.
This 3VA molded case circuit breaker is now safely locked in the OFF (O) position and cannot be operated.
- Use the same key to turn the cylinder lock of the 3VA molded case circuit breaker to be released to the horizontal "unlocked" position.
- Move the handle of the released 3VA molded case circuit breaker to the ON (I) position.

Interlock combinations

The following interlock combinations can be implemented with cylinder locks:

- All 3VA1 and 3VA2 molded case circuit breakers can be mutually interlocked.
- Interlocks can be implemented between all sizes of breakers.
- Mutual interlocks can be implemented between all 2-pole, 3-pole and 4-pole molded case circuit breakers.

Installation of other accessories

When the cylinder lock is fitted in the accessories compartment of the circuit breaker, some other accessories cannot be installed, see chapter Possible combinations of accessories (Page 142).

See also

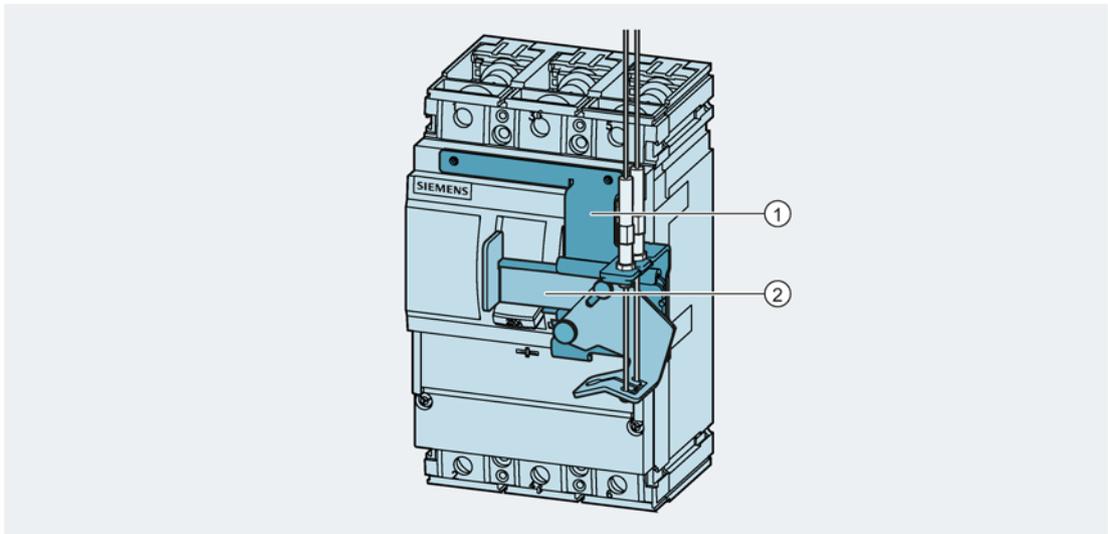
Manual operators (Page 238)

Draw-out technology (Page 215)

4.7.3.2 Sliding bar with Bowden cable: Modules for sliding bar with Bowden cable

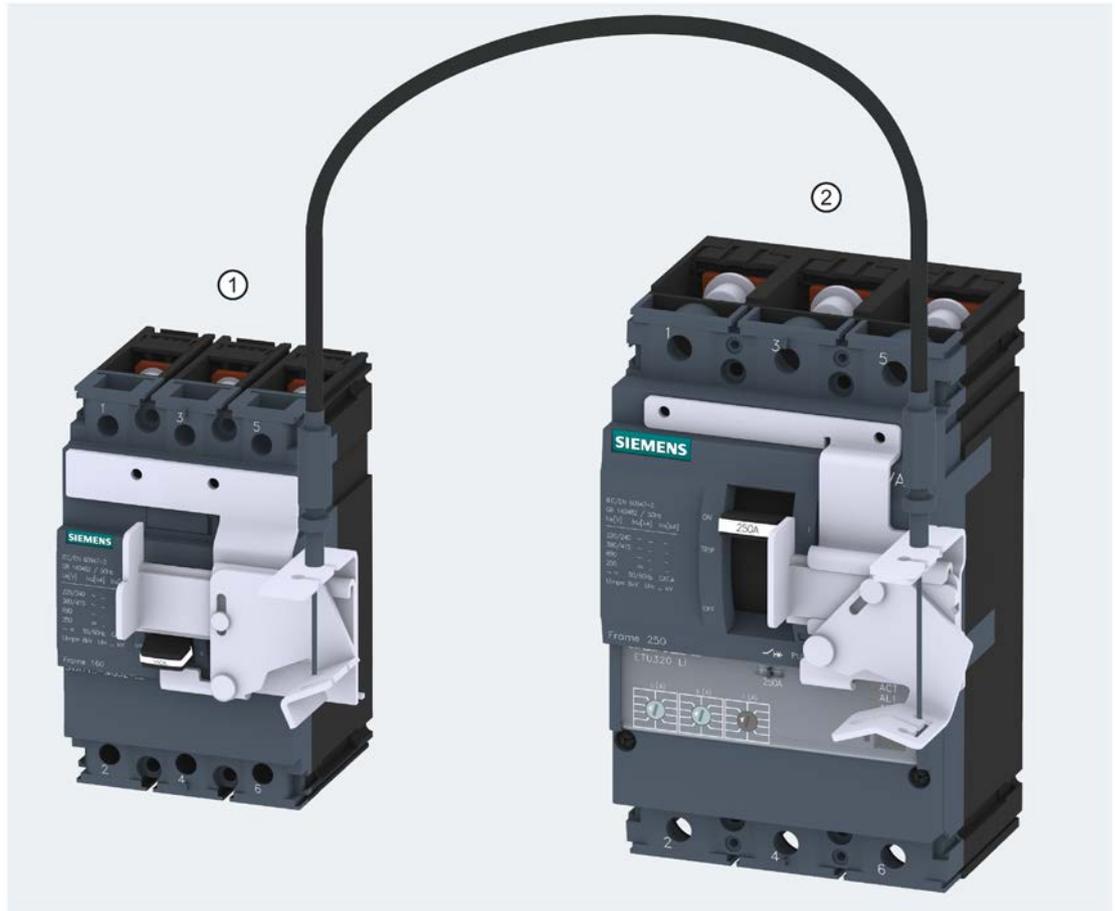
A mutual interlock between up to three molded case circuit breakers can be implemented by means of the front Bowden cable interlock. This interlock functions according to the blocking principle: If one of the circuit breakers included in the interlock is unlocked, the Bowden cables move in such a way as to ensure that the other molded case circuit breakers are locked in the OFF (O) position.

In order to implement a front Bowden cable interlock, sliding bar modules must be mounted on the 3VA molded case circuit breakers to be included in the interlock arrangement. Each of these modules is equipped with a slide which blocks or releases operation of the handle.



- ① Sliding bar module
- ② Slide

A Bowden cable must be installed in addition to the sliding bar modules. This cable prevents the slides from releasing more than one molded case circuit breaker at any one time. As a result, only one 3VA molded case circuit breaker at a time can be operated and only **one** molded case circuit breaker can be in the ON (I) position.



- ① 3VA1 160 molded case circuit breaker, blocked by slide
- ② 3VA2 250 molded case circuit breaker, released by slide

Note

For installation instructions, please refer to operating instructions "Sliding bar modules".

Bowden cable lengths

The following lengths of Bowden cable can be ordered:

- 0.5 m
- 1.0 m
- 1.5 m

4.7 Locking and interlocking

Interlock combinations

Interlocks can be implemented between the following 3VA molded case circuit breakers:

						
			3VA1		3VA2	
			100 A / 160 A 2-, 3- and 4-pole	250 A 3- and 4-pole	100 A / 160 A / 250 A 3- and 4-pole	400 A / 630 A 3- and 4-pole
	3VA1	100 A / 160 A 2-, 3- and 4-pole	■	■	■	■
		250 A 3- and 4-pole	■	■	■	■
	3VA2	100 A / 160 A / 250 A 3- and 4-pole	■	■	■	■
		400 A / 630 A 3- and 4-pole	■	■	■	■

Possible combinations of handle positions

When a sliding bar with Bowden cable is installed to interlock **two** 3VA molded case circuit breakers, the following combinations of handle position are possible:

Molded case circuit breaker 1	Molded case circuit breaker 2
ON / TRIP	OFF
OFF	ON / TRIP
OFF	OFF

When a sliding bar with Bowden cable is installed to interlock **three** 3VA molded case circuit breakers, the following combinations of handle position are possible:

Molded case circuit breaker 1	Molded case circuit breaker 2	Molded case circuit breaker 3
ON / TRIP	OFF	OFF
OFF	ON / TRIP	OFF
OFF	OFF	ON / TRIP
OFF	OFF	OFF

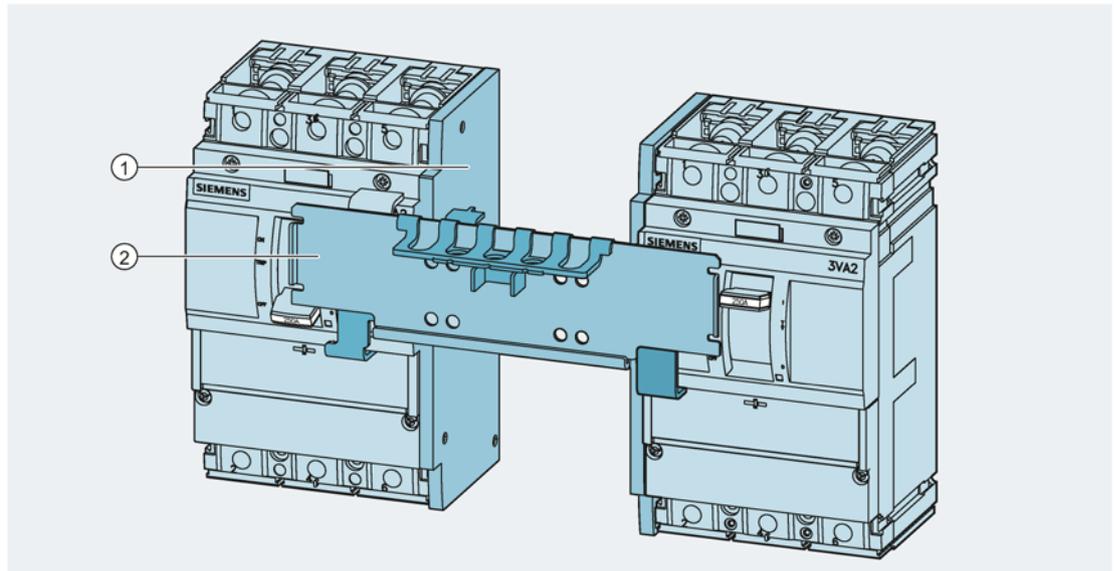
Installation of other accessories

When the front Bowden cable interlock module is fitted, some other accessories cannot be installed, see chapter Possible combinations of of accessories (Page 142).

4.7.3.3 Sliding bar

The sliding bar can be used to implement an interlock between three 3VA molded case circuit breakers of the same size. Up to three padlocks (shackle diameter of between 4.5 and 8 mm) can be attached in order to lock the bar in position.

Installing the sliding bar



- ① Side plate
- ② Locking slide

1. Attach two side plates ① to the sides of the 3VA molded case circuit breakers.
2. Attach the locking slide ② securely to the two side plates.

Locking the handle

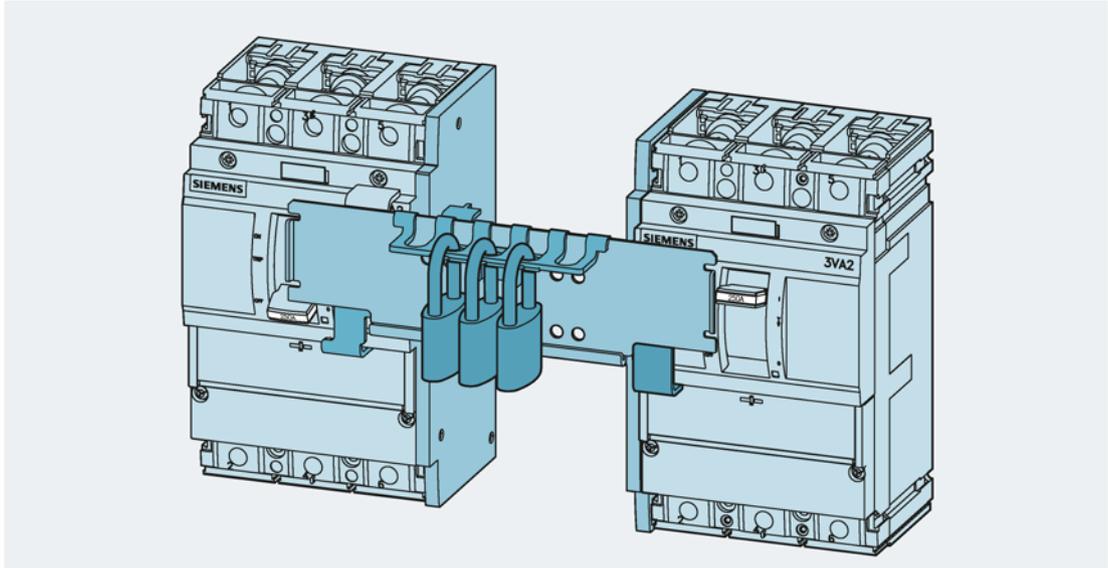
The handle of the 3VA molded case circuit breaker to be locked is blocked when the locking slide is moved into position.

Up to three commercially available padlocks (shackle diameter 4.5 to 8 mm) can be fitted to lock the slide in position and prevent operation of the blocked handle. The blocked 3VA molded case circuit breaker is thus always locked in the safe OFF (O) position, while the released circuit breaker can still be operated.

If the locking slide is in the midway position and locked there by padlocks, both or all three of the molded case circuit breakers can be blocked or held securely in the OFF (O) position.

4.7 Locking and interlocking

Example of an interlock between two 3VA molded case circuit breakers:



Scope of delivery

The order number includes the following items:

- 2 side plates
- 1 locking slide

Interlock combinations

The following interlock combinations can be implemented with the sliding bar:

- Interlocks can be implemented between the same rated current versions of molded case circuit breakers:
 - 3VA1 100/160 A with 3VA1 100/160 A
 - 3VA2 100/160/250 A with 3VA2 100/160/250 A
 - 3VA2 400/630 A with 3VA2 400/630 A
- Mutual interlocks can be implemented between the same sizes of all 2-pole, 3-pole and 4-pole molded case circuit breakers.

Possible combinations of handle positions

When a sliding bar interlock between **two** 3VA molded case circuit breakers is locked by padlocks, the following combinations of sliding bar position are possible:

Molded case circuit breaker 1	Molded case circuit breaker 2
ON / TRIP	OFF
OFF	ON / TRIP
OFF	OFF

When a sliding bar interlock between **three** 3VA molded case circuit breakers is locked by padlocks, the following combinations of handle position are possible:

Molded case circuit breaker 1	Molded case circuit breaker 2	Molded case circuit breaker 3
ON / TRIP	OFF	OFF
OFF	ON / TRIP	OFF
OFF	OFF	ON / TRIP
OFF	OFF	OFF

Installation of other accessories

When the front sliding bar is fitted, some other accessories cannot be installed, see chapter Possible combinations of accessories (Page 142).

4.7.4 Rear interlock

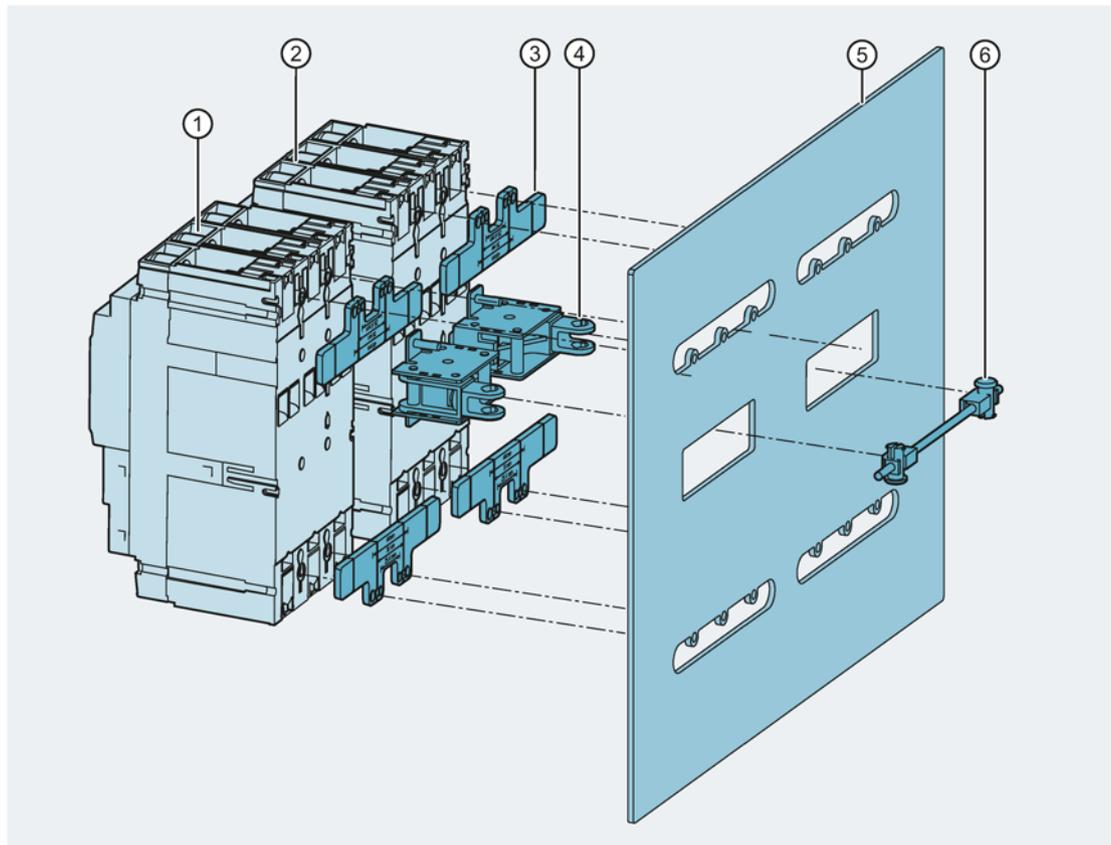
Rear interlock

The rear interlock system is capable of creating an interlock between two 3VA molded case circuit breakers and does not restrict the number of accessories which can be assembled on the front panel of the molded case circuit breaker.

The rear interlock operates according to the following principle: When one molded case circuit breaker is closed, the other circuit breaker is prevented from closing by a tappet which engages in the breaker mechanism directly from the rear panel of the molded case circuit breaker.

The rear interlock is provided by two interlocking modules which are attached at the rear of the molded case circuit breakers and behind the mounting plate. The two interlocking modules are interconnected by means of the interlocking rod.

Machining work to the cubicle mounting plate is required.



- | | | | |
|---|-------------------------------|---|------------------------|
| ① | Molded case circuit breaker 1 | ④ | Interlocking modules |
| ② | Molded case circuit breaker 2 | ⑤ | Cubicle mounting plate |
| ③ | Mounting accessories | ⑥ | Interlocking rod |

Note

For installation instructions, please refer to the operating instructions for the rear interlock.

Scope of delivery

The order number includes the following items:

- Two interlocking modules
- Mounting accessories
- Interlocking rod

Interlock combinations

The following interlock combinations are possible:

- All 3VA1 and 3VA2 molded case circuit breakers can be mutually interlocked.
- Interlocks can be implemented between all sizes of breakers.
- Mutual interlocks can be implemented between all 2-pole, 3-pole and 4-pole molded case circuit breakers.

Handle positions

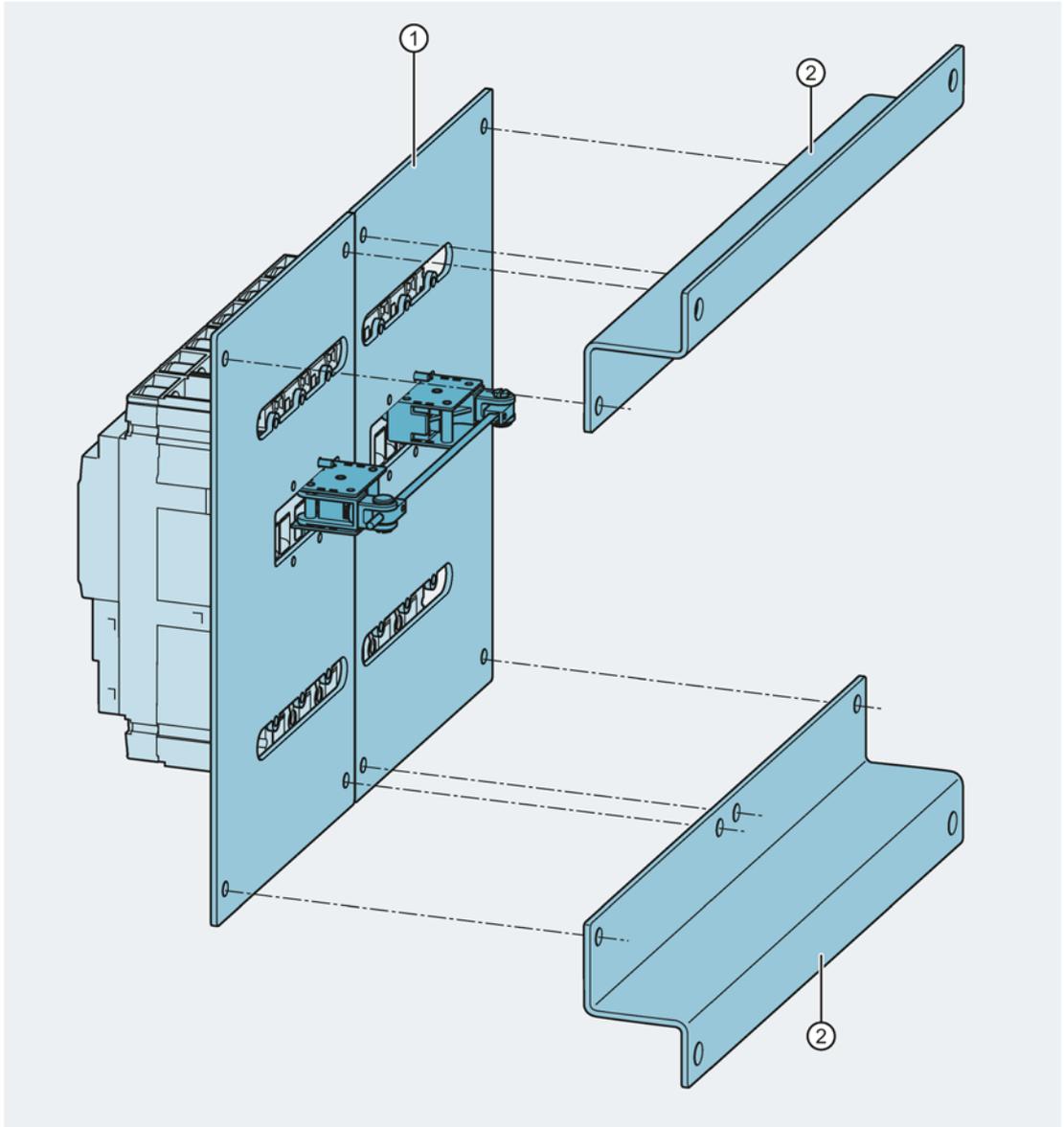
When a rear interlock is installed between two 3VA molded case circuit breakers, the following combinations of handle position are possible:

Molded case circuit breaker 1	Molded case circuit breaker 2
ON / TRIP	OFF
OFF	ON / TRIP
OFF	OFF

4.7 Locking and interlocking

Aid to facilitate installation of rear interlock

An installation aid is available for all 3VA molded case circuit breakers. It facilitates installation of the rear interlock and reduces the amount of work required to the cubicle mounting plate.



- ① Mounting plates (specific to molded case circuit breaker)
- ② DIN rail

1. Assemble installation frame:
 - Place mounting plates ① on the molded case circuit breaker.
 - Install rear interlock.
 - Bolt the DIN rails ② to the adapter plates.
2. Bolt the assembled installation frame to the cubicle mounting plate.

No further work to the cubicle mounting plate is required.

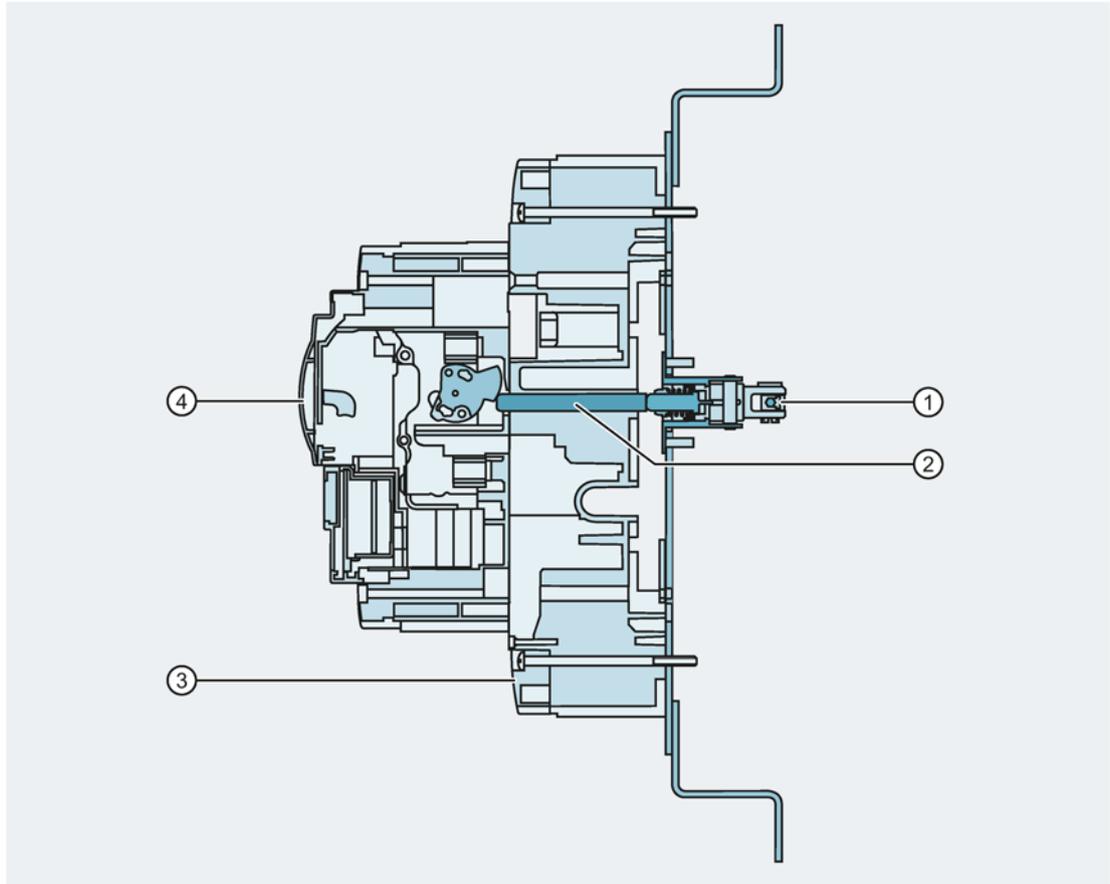
The same rear interlock combinations can be implemented regardless of whether or not the installation aid is used.

Note

For installation instructions, please refer to the operating instructions for the rear interlock.

Rear interlock for plug-in and draw-out units

In order to use a rear interlock for plug-in or draw-out versions of the molded case circuit breakers, the tappet needs to be lengthened. The tappet extension transfers the interlocking motion of the modules through the plug-in socket or the draw-out socket.



- | | |
|-----------------------|-------------------------------|
| ① Interlocking module | ③ Plug-in or draw-out socket |
| ② Tappet extension | ④ Molded case circuit breaker |

The rear interlock for plug-in or draw-out units is available as a complete kit containing all the required components:

- Two interlocking modules
- Mounting accessories
- Interlocking rod
- All the required tappet extensions

An installation aid must be ordered separately if it is required.

Interlock combinations

The same rear interlock combinations can be implemented for plug-in and draw-out versions as for fixed-mounted versions.

4.8 Residual current devices

Residual current devices afford fault protection (formerly referred to as: protection in case of indirect contact) and supplementary protection (formerly referred to as: protection in case of direct contact) in low-voltage systems. In the event of a basic insulation failure or direct contact with live components, they provide some degree of protection to persons, material assets and livestock against harm.

Operating principle of a residual current device

In fault-free electrical installation, the vector sum of the load currents of all connected conductors equals zero. A residual current occurring in the protected circuit as the result of an insulation fault, for example, induces a voltage in the secondary winding of a summation current transformer. The evaluation electronics system monitors the induced voltage and transmits a trip command to the RCD trip unit if the trip criterion is fulfilled. The molded case circuit breaker with residual current protection combination is designed to ensure that the molded case circuit breaker contacts open if the residual current exceeds a preset value.

4.8.1 Portfolio

The new portfolio of residual current devices includes three different RCD designs so that an optimum solution is available for every conceivable type of application:

- Side mounted
- Loadside
- Modular

Since all residual current devices can be set to between 0.03 A and maximum 5 A or 30 A, they are suitable for use in the following applications:

- Personnel protection: $I_{\Delta n} \leq 30 \text{ mA}$ with instantaneous tripping

Note

In order to protect personnel, it is necessary to seal the transparent protective cover so that the 30 mA setting range cannot be changed.

- Fire protection: $I_{\Delta n} \leq 300 \text{ mA}$
- Protection in the case of indirect contact
- Ground-fault protection

4.8 Residual current devices

While residual current devices attached to the circuit breakers are supplied with voltage from all connected phases of the system to be monitored, the modular residual current device (MRCD) is supplied from a 1-phase auxiliary voltage source (internal or external). The modular residual current device utilizes an undervoltage release (UVR) or a shunt trip.

The recommended applications for different RCD designs are thus as follows:

	Mounted residual current device (RCD)	Modular residual current device (MRCD)	
		with shunt trip	with undervoltage release
Protection in case of direct contact	++	-	++
Operational safety	++	+	-
Integration into existing installations	-		++
Flexibility	+		++
Assembly/wiring overhead	+		-

- + Suitable
- Less suitable

Sizes



Special "BASIC" residual current devices have been developed for use with 3VA1 molded case circuit breakers.

Basic RCD310 and Basic RCD510



Side-mounted residual current devices are available for 3VA1 molded case circuit breakers and 3VA1 switch disconnectors with box terminals up to 250 A. These residual current devices are optimally designed for installation in distribution boards.

Features

The key features of the RCD310 and RCD510 series are:

- Type A
- Response current $I_{\Delta n}$ adjustable in 8 steps from 0.03 A to 5 A
- Compact, L-shaped design
- Cover size 45 mm
- 3 and 4-pole versions
- LEDs to signal "ready" state and pre-alarms
- Tripped signal at device and via electrical contacts
- Signal must be acknowledged via the RESET button on the residual current device
- Through-hole technology allows connection of cables to circuit breaker's box terminals
- Electromagnetic release (RCR) with dual functionality
- Suitable for mounting on DIN rail
- Suitable for use as a display unit only

Special characteristics

There are two different functional types of side mounted residual current device, i.e. the RCD310 and the RCD510. The differences in functionality between these two types are explained by the list of features below.

- Time delay:
 - RCD310 without time delay (instantaneous)
 - RCD510 has an adjustable time delay Δt of 0 to 3000 ms
- Number of poles:
 - RCD310 is available only in a 4-pole version
 - RCD510 is available in 3-pole and 4-pole versions
- Rated operating current:
 - RCD310 available only up to 160 A (3VA11)
 - RCD510 available up to 250 A

Advantages

- Slimline, side mounted design (30 mm) leaves space for other components in the distribution board.
- The residual current devices, the 3VA1 molded case circuit breakers and the 3VA1 switch disconnectors all have a cover size of 45 mm, so that they are easy to install, for example, adjacent to miniature circuit breakers in a distribution board.
- With the DIN rail adapter accessory installed, RCD310 and RCD510 units up to 160 A can be mounted easily on a DIN rail.
The side-mounted residual current devices also feature a screw mounting option so that they can be attached directly to a mounting plate.

Basic RCD320 and Basic RCD520



Features

The key features of the RCD320 and RCD520 series are:

- Type A
- Response current $I_{\Delta n}$ adjustable in 8 steps from 0.03 A to 5 A
- Compact design
- Cover size 45 mm
- 3 and 4-pole versions
- LEDs to signal "ready" state and pre-alarms
- Tripped signal at device and via electrical contacts
- Signal must be acknowledged via the RESET button on the residual current device
- Suitable for use in 1-phase and 3-phase systems

Special characteristics

The differences between the two RCD320 and RCD520 residual current devices designed for loadside mounting are explained below:

- Time delay:
 - RCD320 without time delay (instantaneous)
 - RCD520 with an adjustable delay time Δt from 0 to 3000 ms
- Number of poles:
 - RCD320 is available only in a 4-pole version
 - RCD520 is available in 3-pole and 4-pole versions
- Rated operating current:
 - RCD320 available only up to 160 A (3VA11)
 - RCD520 available up to 250 A

A special "ADVANCED" residual current device has been developed for use with 3VA2 molded case circuit breakers.

Advanced RCD820



The RCD820 series is suitable for use in applications with exacting technical requirements:

- High residual current response values
- Long delay time settings for selective grading
- Onboard interface to a fieldbus communication system
- Graded alarm system

Features

The key features of the RCD820 series are:

- Residual current devices available with ratings up to 630 A
- Type A
- Response current $I_{\Delta n}$ adjustable in 10 steps from 0.03 A to 30 A
- Delay time Δt adjustable in 10 steps from 0 to 10000 ms
- 3 and 4-pole versions
- LEDs to signal "ready" state, pre-alarms and communication status
- Auxiliary contacts for tripped signals and pre-alarms
- With remote acknowledgement and remote commissioning capability
- Remote tripping possible via communication link or auxiliary contact
- Suitable for use in 1-phase and 3-phase systems
- Suitable for use as a display unit only

Modular residual current device



The modular residual current device (MRCD) is ideal for applications which require a high degree of flexibility. It can be retrofitted easily in an existing installation, for example, in order to provide residual current protection without the need for any major modifications to the existing application.

Thanks to its modular design, it is compatible with all breaker designs and can therefore be combined with 3VA1 molded case circuit breakers and with circuit breakers from the 3VA2 series.

Note

For possible combinations, please refer to Chapter Modular residual current device (Page 355). Further tested combinations available on request.

The key features of the MRCD are:

- Digital modular residual current device type A (compliant with IEC 60947-2 Annex M)
- Response current $I_{\Delta n}$ adjustable in 7 steps from 0.03 A to 3 A
- Delay time Δt adjustable in 12 steps from 0 to 10 seconds
- Compact design
- Cover size 45 mm
- Suitable for 1-pole, 2-pole, 3-pole or 4-pole circuit breakers
- Summation current transformer with a diameter ranging from 35 mm to 210 mm
- Operated by means of 6 buttons
- Output of status and current measured value on color display screen
- Fault cause is displayed in the event of faults
- Two relay contacts, one for alarm (warning of continuous rise in residual current) and one for trip, which can be programmed independently of one another
- Voltage of monitored circuit of up to max. 690 V AC
- For installation on 35 mm DIN rail

4.8.1.1 Possible combinations of residual current devices and 3VA circuit breakers

Overview of possible combinations of residual current devices and 3VA circuit breakers			3VA1						3VA2							
			100 A		160 A		250 A		100 A		160 A		250 A		400 A	
Residual current device	Installation		3p	4p	3p	4p	3p	4p	3p	4p	3p	4p	3p	4p	3p	4p
Basic RCD310	Side mounted				F											
Basic RCD510	Side mounted				F	F	F	F								
Basic RCD320	Loadside				F ¹⁾											
Basic RCD520	Loadside				F ¹⁾	F ¹⁾	F ¹⁾	F ¹⁾								
Advanced RCD820	Loadside							F	F	F	F	F	F	F	F	F
MRCD	Flexible		F	F	F-PI	F-PI	On request	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO	F-PI-DO

- 3p 3-pole
- 4p 4-pole
- F Fixed-mounted circuit breaker
- PI Plug-in circuit breaker
- DO Draw-out circuit breaker
- ¹⁾ Not compatible with switch disconnector

4.8.2 Residual current devices for mounting on circuit breakers

The RCD310, RCD510, RCD320, RCD520 and RCD820 residual current devices are available as accessories for mounting on specific 3VA molded case circuit breakers up to the largest circuit breaker size/current rating.

Combination with circuit breakers

After a residual current device has been mounted on a molded case circuit breaker or switch disconnector, the specifications of the breaker or disconnector remain unchanged with respect to the following characteristics:

- Standards
- Conductor cross-sections
- Use of connection accessories
- Isolating features
- Selective behavior

When a basic type residual current device is mounted on a 3VA1 molded case circuit breaker or a 3VA1 switch disconnector, the electrical rating of the equipment combination is automatically downgraded to the lower electrical rating of the residual current device.

Example:

U _e : 3VA1	≤ 690 V AC
3VA1 and Basic residual current device	≤ 480 V AC

For more information, refer to chapter Technical specifications (Page 352).

Residual current devices

Standards

The combination of molded case circuit breaker and residual current device conforms to IEC 60947-2 Annex B.

Power supply

The residual current devices do not require an external power supply, but tap a supply from the main current paths of the molded case circuit breaker or switch disconnector.

Guaranteed to function properly

Proper functioning of the residual current device is guaranteed even with only one phase and N (applies to RCD320, RCD520 and RCD820) or two phases (alternating current or pulsating direct voltage).

Direction of incoming supply

The direction of incoming supply to the combination of circuit breaker and residual current device is optional, i.e. it can be connected at the top or bottom. The performance of the residual current devices is not impaired by regenerative feedback from motors.

Device type

All residual current devices meet the requirements for device type A, i.e. they are capable of detecting all sinusoidal AC residual currents and pulsating DC residual currents.

Combination with external accessories**DIN rail adapters**

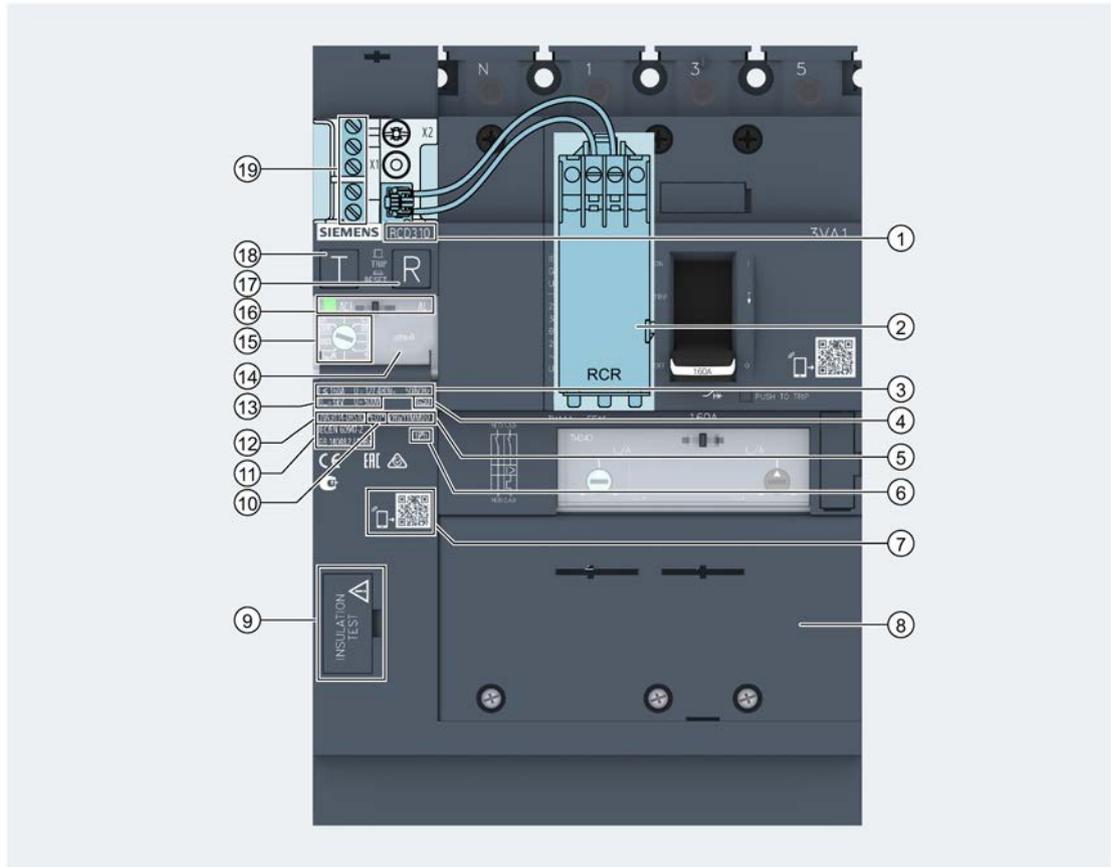
DIN rail adapters are available as accessories for side-mounted residual current devices RCD310 and RCD510 up to 160 A. These permit fast and easy installation of residual current devices on 35 mm DIN rails compliant with IEC / EN60715 TH35-7.5 and TH35-15.

For further information, please refer to chapter DIN rail adapter (Page 415).

4.8.2.1 Side mounted residual current devices Basic RCD310 and Basic RCD510

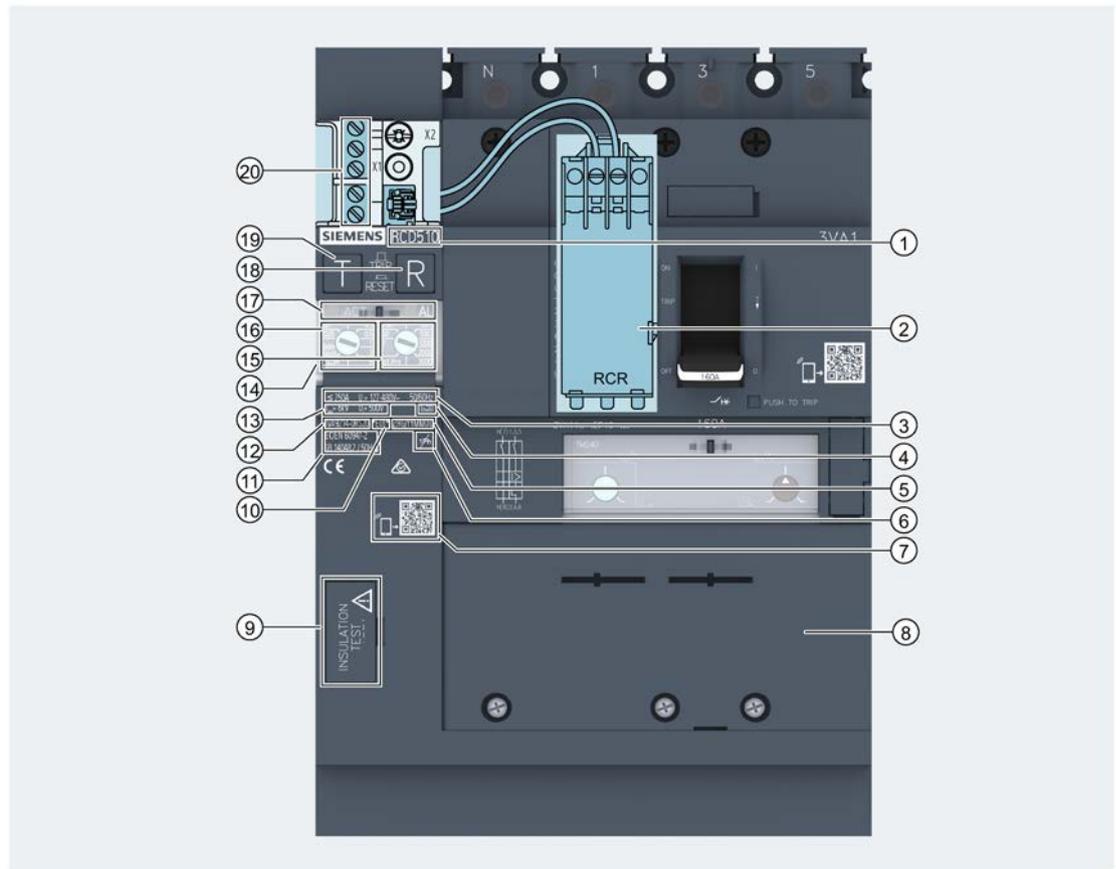
Front view of Basic RCD310 and Basic RCD510

RCD310



- | | |
|---|---|
| ① Type designation | ⑩ Standard |
| ② Electromagnetic release (RCR = Residual Current Release) | ⑪ Article number |
| ③ Maximum rated operational current, rated operational voltage and frequency | ⑫ Rated insulation voltage and rated impulse strength |
| ④ Device type | ⑬ Transparent protective cover over setting buttons |
| ⑤ Location and date of manufacture | ⑭ Setting button for response current |
| ⑥ Only suitable for use in 3-phase systems | ⑮ LED: ACTIVE and pre-alarm |
| ⑦ Knowledge Manager | ⑯ Reset button / tripped display |
| ⑧ Contact hazard protective cover over main current paths with sealing option | ⑰ Test button (test device) |
| ⑨ Circuit breaker | ⑱ Auxiliary contacts |
| ⑩ Product version | |

RCD510



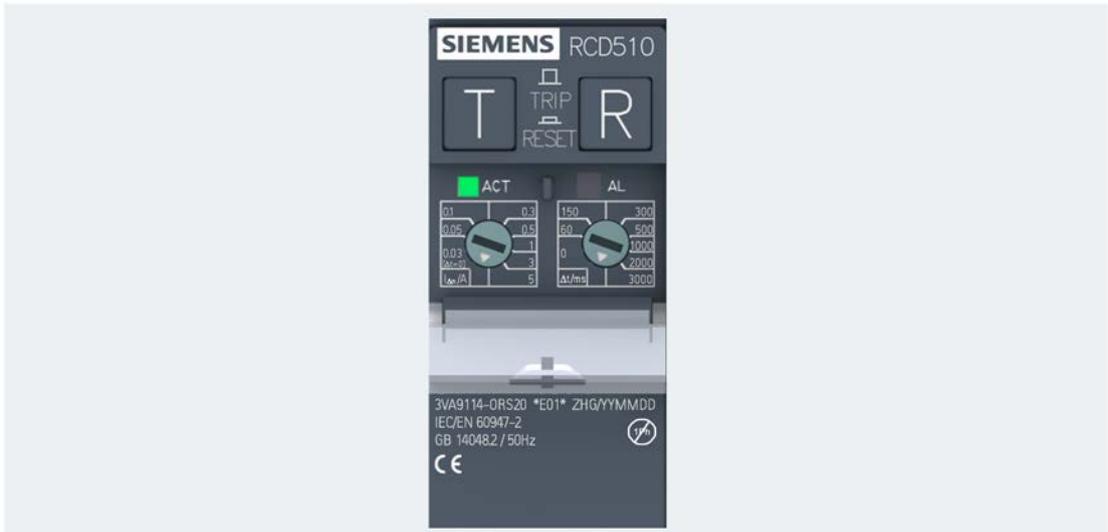
- | | |
|---|---|
| ① Type designation | ⑪ Standard |
| ② Electromagnetic release (RCR = Residual Current Release) | ⑫ Article number |
| ③ Maximum rated operational current, rated operational voltage and frequency | ⑬ Rated insulation voltage and rated impulse strength |
| ④ Device type | ⑭ Transparent protective cover over setting buttons |
| ⑤ Location and date of manufacture | ⑮ Setting button for delay time |
| ⑥ Only suitable for use in 3-phase systems | ⑯ Setting button for response current |
| ⑦ Knowledge Manager | ⑰ LED: ACTIVE and pre-alarm |
| ⑧ Contact hazard protective cover over main current paths with sealing option | ⑱ Reset button / tripped display |
| ⑨ Circuit breaker | ⑲ Test button (test device) |
| ⑩ Product version | ⑳ Auxiliary contacts |

Description of front panel view

Display elements

"Ready" signals and alarms

- "Ready" signal of the residual current device:
The LED labeled "ACT" stands for ACTIVE and lights up when the device is ready to operate.



- Pre-alarm:
Both the Basic RCD310 and the Basic RCD510 feature an alarm LED labeled "AL" (pre-alarm) which lights up promptly to indicate potential shutdown of the installation due to residual current.

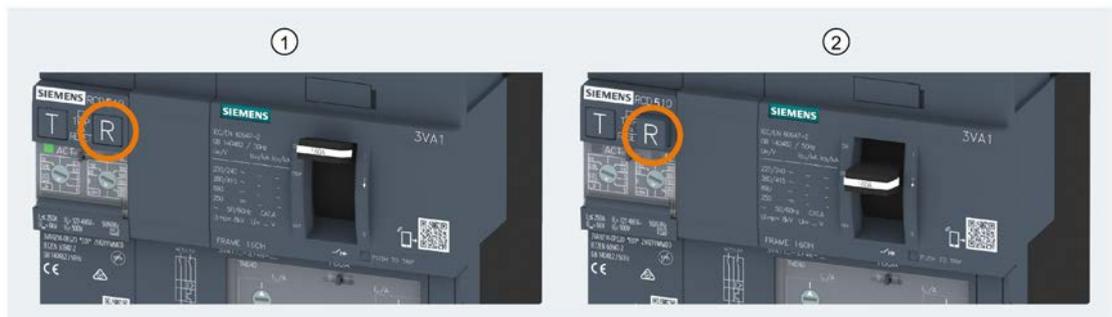


LED displays

LED	Status	Description
<input type="checkbox"/>	ACT Off	Residual current device is not in operation
	ACT Flashing	Residual current device is malfunctioning
	ACT On	Residual current device is operating normally
	ACT On	The residual current I_{Δ} is higher than 30 % of the set response current ($I_{\Delta n}$ value)
	AL On	
	ACT Flashing	Possible causes: - The residual current device is defective - The white setting arrow of the $I_{\Delta n}$ or Δt setting button is resting between two setting ranges
	AL Flashing	

Tripped display

The <RESET> button is not only used to reset the residual current device, but also as a mechanical indication that the unit has "tripped". If a residual current is detected or the button <TEST> is pressed, the button <RESET> is automatically released and so signals that the residual current device has tripped. Even when the residual current device is at zero potential, the <RESET> remains in the "TRIP" position.

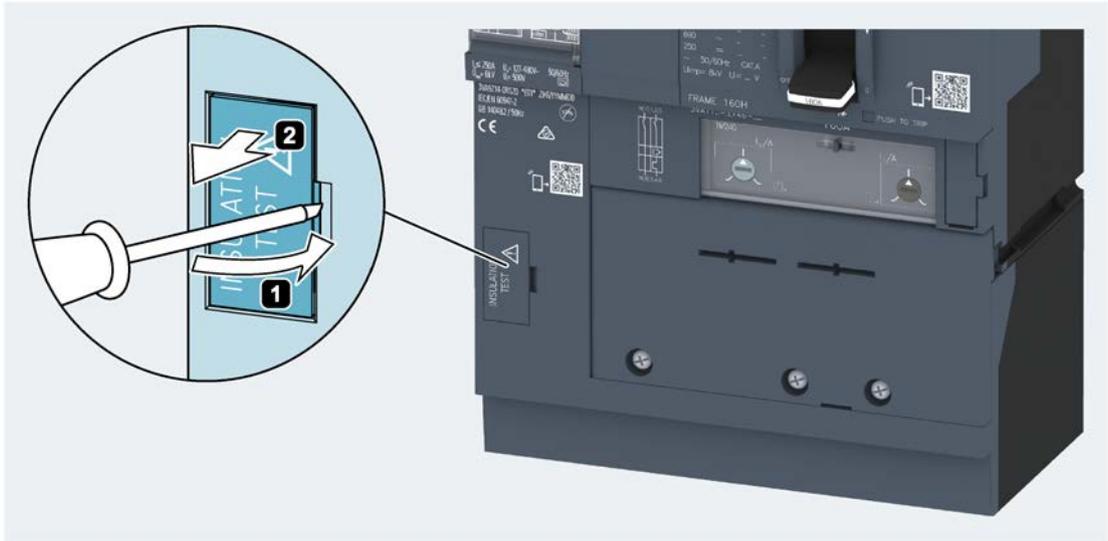


- ① Residual current device is operating normally and has not tripped
- ② Residual current device has tripped

Operator controls

Insulation tests

It is absolutely essential to isolate the evaluation electronics circuit while insulation tests are in progress in order to protect the circuit against potential damage on the one hand and to prevent detection of insulation faults due to the power pack on the other. This is done simply by withdrawing (15 - 17 mm) the circuit breaker which is anchored in the enclosure.



Disconnection of the main conductor connections is thus unnecessary. On completion of the tests, the circuit breaker must be pushed back into position before the residual current device is commissioned.

Testing and resetting the residual current device

Testing

Depending on operating conditions, the test button on the front panel of the residual current device should be pressed in order to function-test the device. The test button is labeled with the letter "T". If the test button is pressed, the device is tested immediately irrespective of the current delay time setting.

If the test button is pressed, a residual current is simulated on a test winding attached to the summation current transformer. If the residual current device is functioning properly, it must trip the molded case circuit breaker/switch disconnecter.

The test button must be held down for at least 2 seconds. The design of the test button prevents unintentional actuation.

Note

The residual current device can be successfully tested only if it is connected to a rated operational voltage which equals at least 85% of the minimum rated operational voltage.

Resetting

If the residual current device trips the molded case circuit breaker/switch disconnecter due to a high residual current or actuation of the test button, the <RESET> button on the RCD is released. At the same time, the trip alarm switch which is mechanically coupled with the <RESET> button also signals that a trip has occurred.

The <RESET> button is labeled with the letter "R".

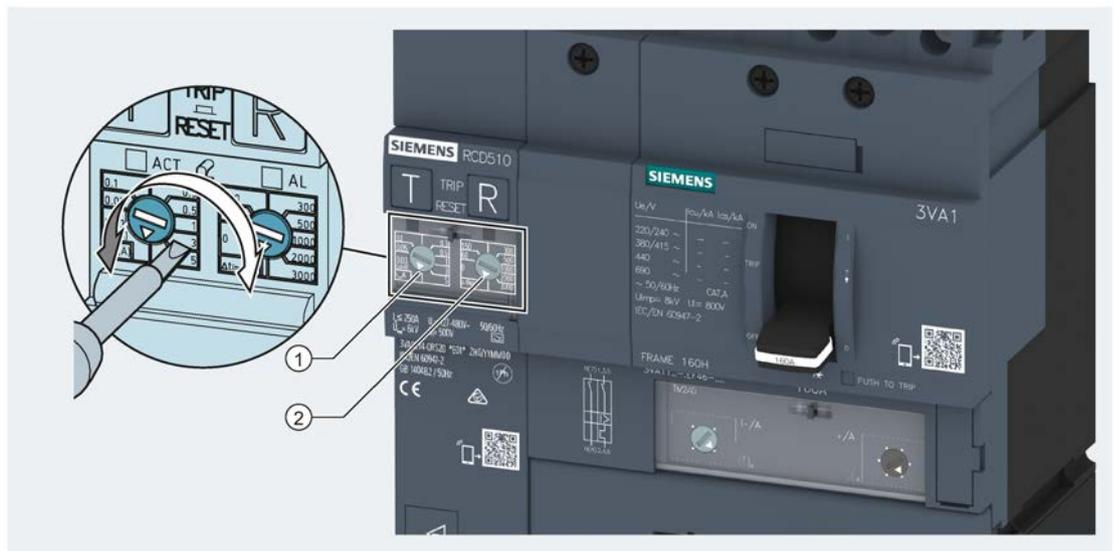
The following actions must be taken in order to reset the residual current device and reclose the main contacts of the molded case circuit breaker:

1. Press the <RESET> button on the residual current device.
The "tripped" signal at the signaling contacts is canceled, the residual current device is now reset.
2. Reset and switch on the molded case circuit breaker or switch disconnector.

Note

If the main contacts of the molded case circuit breaker/switch disconnecter are closed before the residual current device has been reset, the molded case circuit breaker/switch disconnecter will be tripped again immediately (approx. 0.8 s) by the residual current device. This also applies if the fault which leads to the trip has already been rectified.

Parameterization of the residual current device



- ① Setting button for response current $I_{\Delta n}$
- ② Setting button for delay time Δt (RCD510 only)

Button for setting the response current $I_{\Delta n}$

The response current can be set in 8 steps, ranging from 0.03 A to maximum 5 A. Each response current has a dedicated setting range. The corresponding response current is set as soon as the button is latched in the setting range.

If the white setting arrow is resting between two setting ranges, the residual current device is automatically set to 0.03 A for safety reasons.

If the response current is set to 0.03 A, the delay time setting Δt is deactivated and the breaker is tripped instantaneously in order to afford personal protection in the case of direct contact.

The factory setting for the response current is 0.03 A.

Button for setting the delay time Δt (RCD510 only)

The delay time on RCD510 units can be set in 8 steps, ranging from 0 (instantaneous) to a maximum value of 3000 ms.

Each delay time has a dedicated setting range. The corresponding delay time is set as soon as the button is latched in the setting range.

If the white setting arrow is resting between two setting ranges, the residual current device trips instantaneously in response to residual currents.

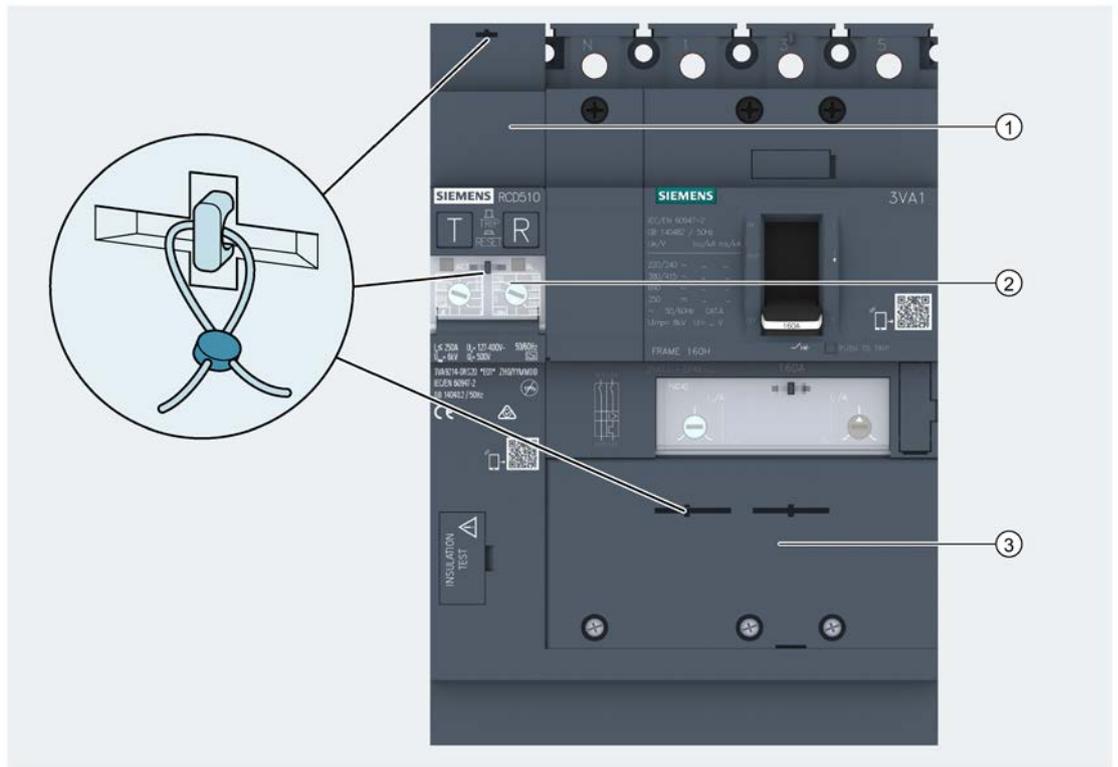
The factory setting for the tripping delay is 0 ms.

The delay time is not adjustable on the RCD310. The RCD310 always trips instantaneously.

Recommended procedure for setting the response current and the delay time

1. Switch off the molded case circuit breaker/switch disconnecter.
2. Open the transparent protective cover over the setting buttons.
3. Adjust the setting values for response current and delay time on the residual current device to the maximum value in each case.
4. Switch on the molded case circuit breaker/switch disconnecter.
The LED labeled "ACT" on the residual current device now lights up, the residual current device is ready.
5. Reduce the setting for the response current until the LED labeled "AL" lights up.
The residual current is now 30% higher than the response current setting.
6. By turning the setting button clockwise, set the next higher response current.
The LED "AL" goes out, the correct response current is now set.
7. Set the required delay time.
8. Close the transparent protective cover over the setting buttons.
The device is now fully parameterized.

Sealable protective covers of the residual current device



- ① Contact hazard protective cover over auxiliary contacts
- ② Transparent protective cover over setting buttons
- ③ Contact hazard protective cover over main current paths

Transparent protective cover over setting buttons

In order to prevent unauthorized access to the setting buttons for $I_{\Delta n}$ and Δt , the transparent cover over the settings buttons can be optionally sealed.

Contact hazard protective cover over main current paths including sealing option

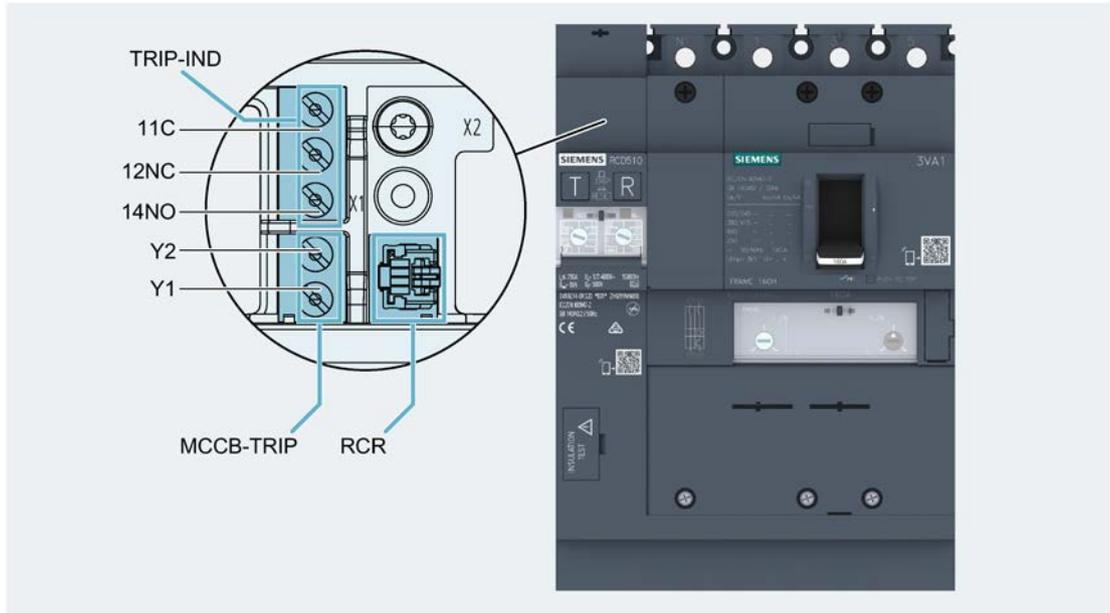
After the residual current device RCD310 or RCD510 has been mounted on the 3VA1 molded case circuit breaker or 3VA1 switch disconnector, a contact hazard protective cover is installed over the main current paths to protect against direct contact. This cover can be sealed optionally in order to block any attempt to dismantle the residual current device from the molded case circuit breaker/switch disconnector.

Terminals

Note

Cables for the following terminals must be routed separately from the main circuits. Their maximum cable length is 300 m.

A number of auxiliary contacts which perform different functions are located underneath a contact hazard protective cover:



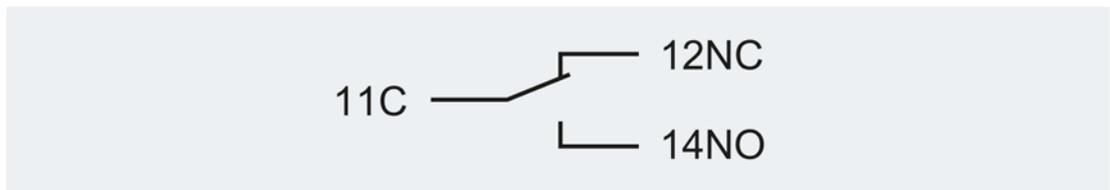
Alarm switches

TRIP-IND (TRIP INDICATOR)

A tripped signal can be output via the floating contact for display via a warning lamp, for example. This trip alarm switch operates as soon as the residual current exceeds the response current setting value and has therefore caused the residual current device to trip.

The standard trip alarm switch has changeover contacts and screw-type connections.

The terminal designations of the relevant contact are shown in the diagram below.



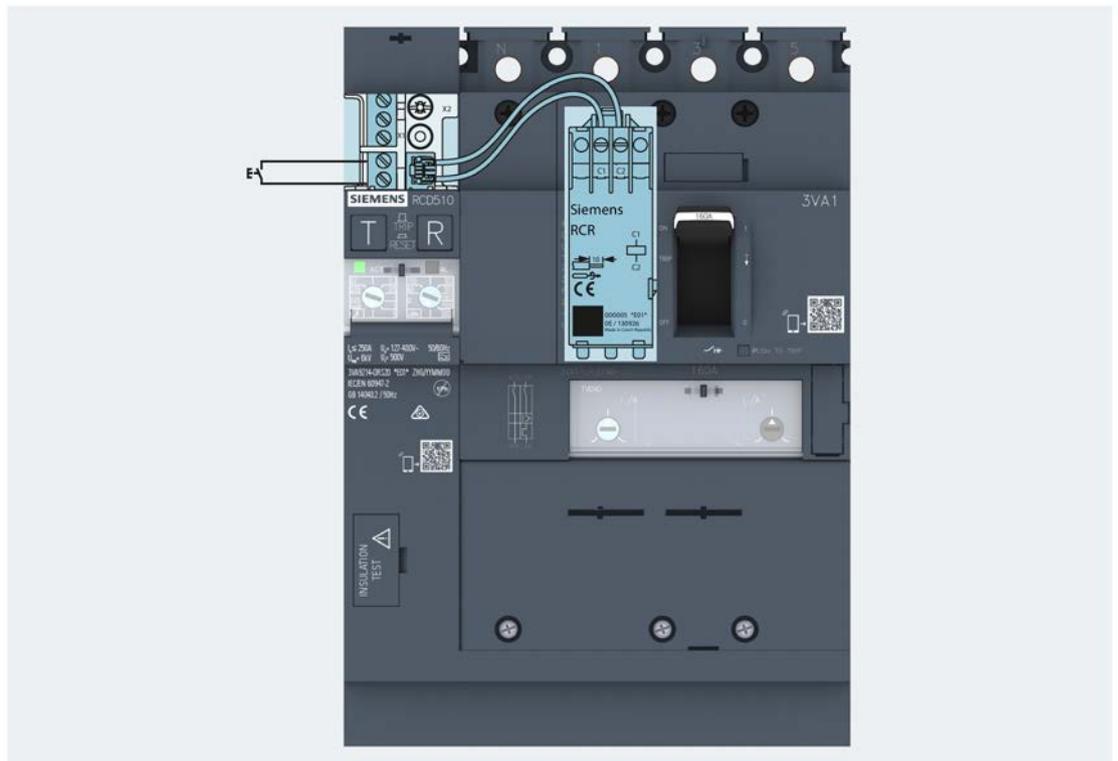
External control of the residual current release (RCR)

MCCB-TRIP

Although the RCR is utilized by the residual current device, it can also be accessed externally via a floating contact by means of the auxiliary contact MCCB-TRIP. The floating contact must be capable of switching a 5 mA current with a voltage supply of 24 V DC.

The RCR functions as a shunt trip, allowing the circuit breaker to be tripped by remote control. External tripping of the molded case circuit breaker or switch disconnecter via the RCR does not affect the residual current device. In other words, neither the "tripped" display on the residual current device nor the auxiliary contacts for the "tripped" signal are activated in the event of an external trip.

It is not possible, however, to connect the contacts named above of several residual current devices in parallel.



4.8 Residual current devices

Status indicators

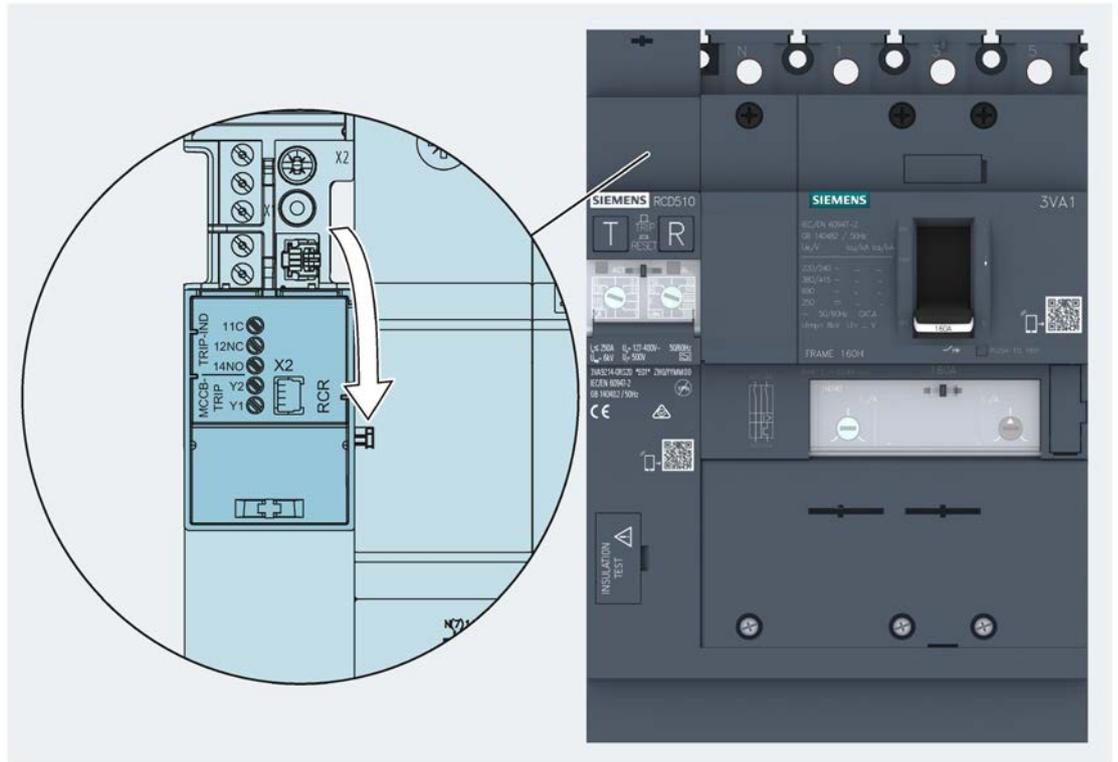
The table below illustrates the behavior of pre-alarm and tripped signals on RCD310 or RCD510 units in response to various user actions and residual currents.

Breaker status prior to user action	ON	ON	TRIP	OFF	ON	ON	TRIP	TRIP		
Residual current I_{Δ}	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$> 30\% I_{\Delta n}$	$\geq 100\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$		
User action	None	RCD: MCCB-TRIP 	MCCB: TRIP → OFF 	MCCB: OFF → ON 	None	None	RCD: Reset 	MCCB: TRIP → OFF 		
Breaker status following user action	ON	TRIP	OFF	ON	ON	TRIP	TRIP	OFF		
Signals at RCD310 or RCD510 following user action	LEDs									
	Pre-alarm	AL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Mechanical display									
	Tripped signal	TRIP								
Alarm switches										
Tripped signal	TRIP-IND									

Terminal labeling and cable installation

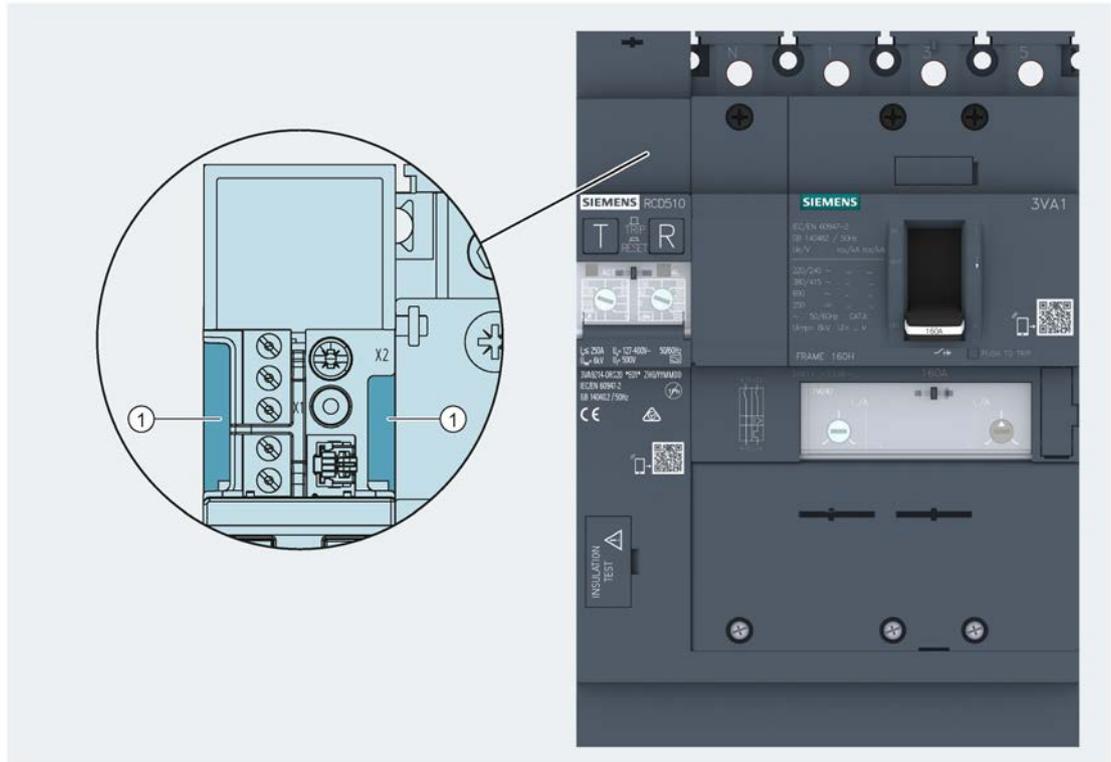
Labeling of terminals

The labels for individual terminals are printed on the rear of the contact hazard protection cover for auxiliary contacts.



Cable installation

Cable ducts for bringing out cables are provided to the left and right on the residual current device.



① Cable duct

Other labels on front panel

Approvals

The residual current device bears the CE mark. For an overview of all approvals, please refer to Appendix (Page 505).

For all queries relating to approvals, please contact Technical Support (Page 12).

Technical specifications

$I_n \leq \dots A$: Specifies the highest permissible rated operational current of the molded case circuit breaker/switch disconnecter with which the residual current device may be combined.

$U_e \sim \dots V$: Specifies the operating voltage range of the residual current device.

$\dots Hz$: Specifies the operating frequency range of the residual current device.

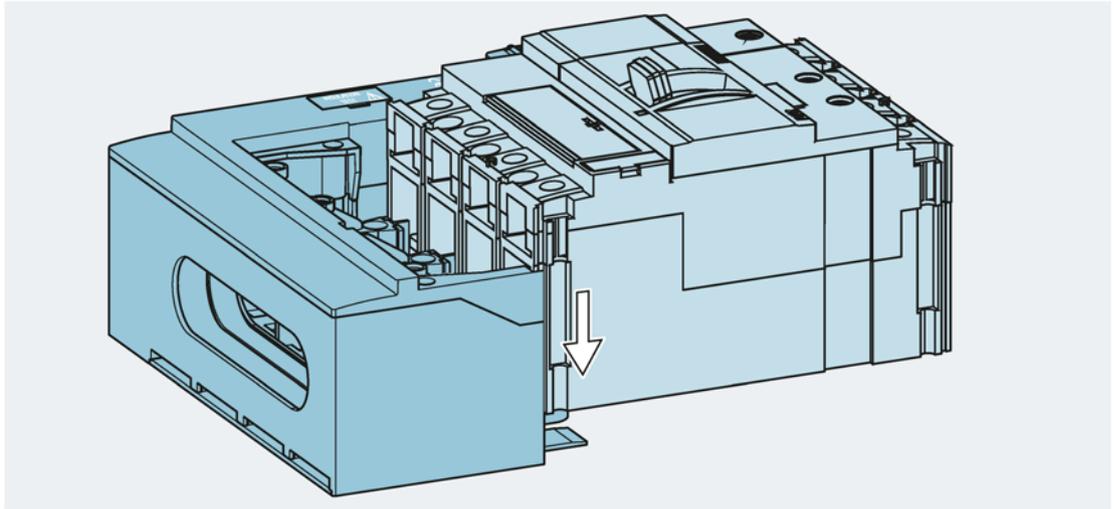


Denotes the response behavior to residual currents.

Installation

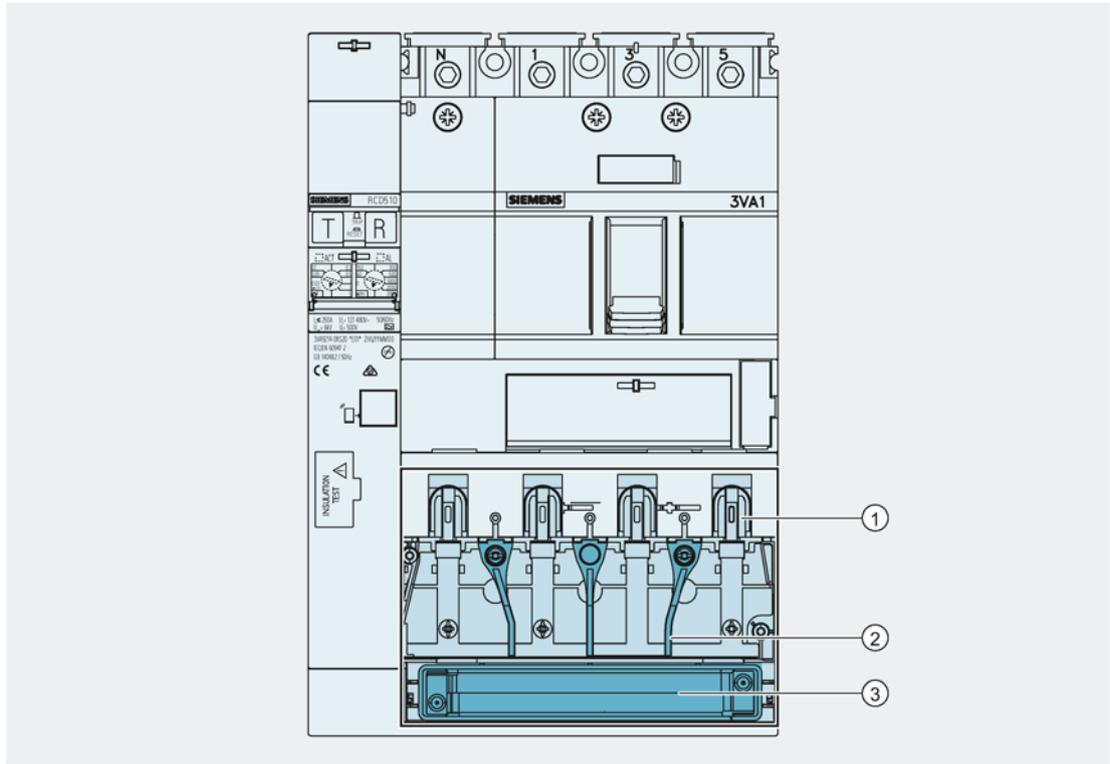
The side mounted residual current device is attached to the left-hand side of the molded case circuit breaker or switch disconnecter. No tools are required:

1. Push the molded case circuit breaker/switch disconnecter onto the residual current device along the guides at the top.
2. Push the molded case circuit breaker/switch disconnecter backwards until its rear panel is flush with the rear panel of the residual current device.



3. Place the contact hazard protective cover over the circuit breaker/RCD assembly.
4. Attach the assembly to a mounting plate using the fastening screws or mount it on a DIN rail adapter.

The side mounted residual current devices feature through-hole technology.



- ① Box terminals of the molded case circuit breaker
- ② Phase barriers
- ③ Summation current transformer

With this technology, the cables are simply guided through the summation current transformer ③ and connected directly to the box terminals ① of the molded case circuit breaker or switch disconnecter.

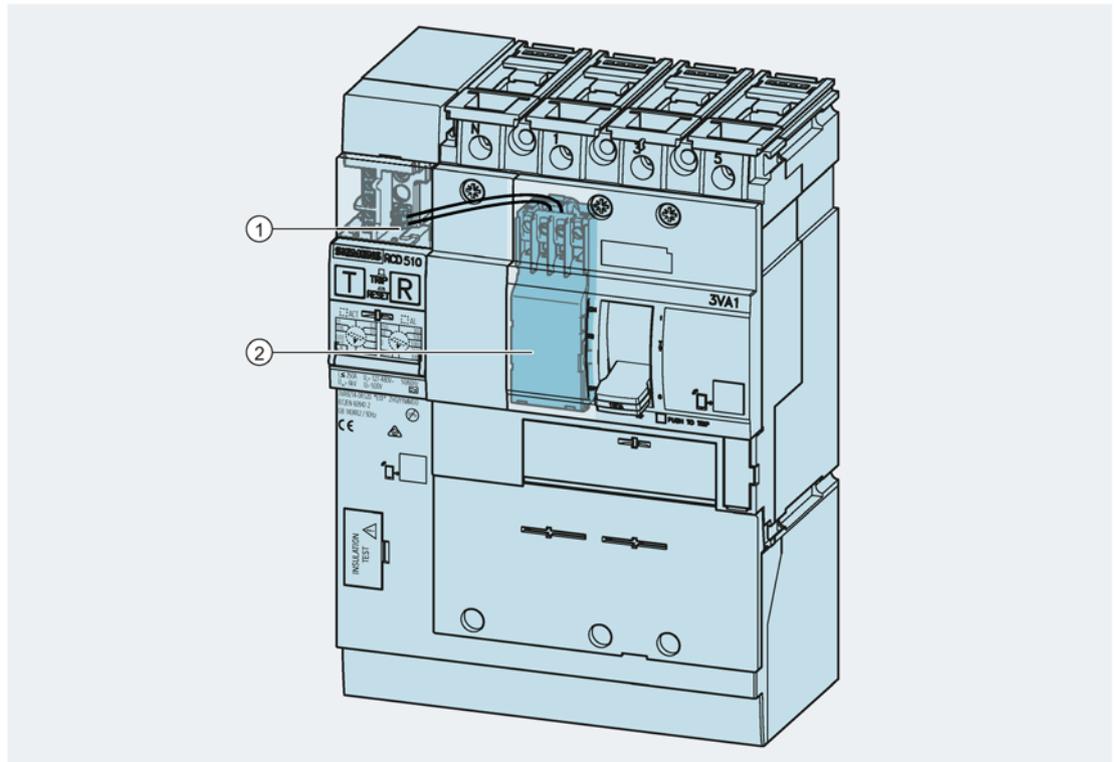
The phase barriers ② not only ensure safe operation, but also serve as a guide for correct routing of cables.

Tripping

In the event of a fault, the side mounted residual current device employs a residual current release (RCR) to trip the molded case circuit breaker or switch disconnecter. This release is installed in the accessories compartment to the left of the handle.

The RCR and the connecting cable are included in the scope of supply of the side mounted residual current device.

The release is connected to the "RCR" contacts on the residual current device via a plug-in connection and receives a trip command if the residual current reaches or exceeds the preset value.



- ① Plug-in connection for RCR
- ② RCR

Use of the residual current device as a pure display unit

The RCD310 and RCD510 residual current devices can also operate as pure display units without a tripping function, i.e. they detect and signal residual currents, but do not trip the molded case circuit breaker or switch disconnecter nor interrupt the circuit.

To operate the RCD310 or RCD510 as a pure display unit, the residual current release (RCR) and its connecting cable are simply not installed. The residual current device can perform all its normal functions, e.g. status signaling, in "display mode."

Note

Because the RCR and its connecting cable have not been installed, the LED "ACT" flashes continuously.

Function overview

The table below provides an overview of all the functions and data which are available in the residual current device environment:

		RCD310	RCD510	at residual current device	via electrical contacts
Setting values					
Response current	$I_{\Delta n}$ A	■	■		
Delay time	Δt ms		■		
Status, diagnostics and maintenance					
Ready signal	ACT	■	■		
Pre-alarm	AL	■	■		
Trip	TRIP	■	■		
Residual current device fault		■	■		
Connection to RCR interrupted		■	■		
Reset functions		■	■		
Identification					
Identification data of residual current device	Order No.	■	■		
	Production date	■	■		
	Serial number	■	■		
Hardware version		■	■		

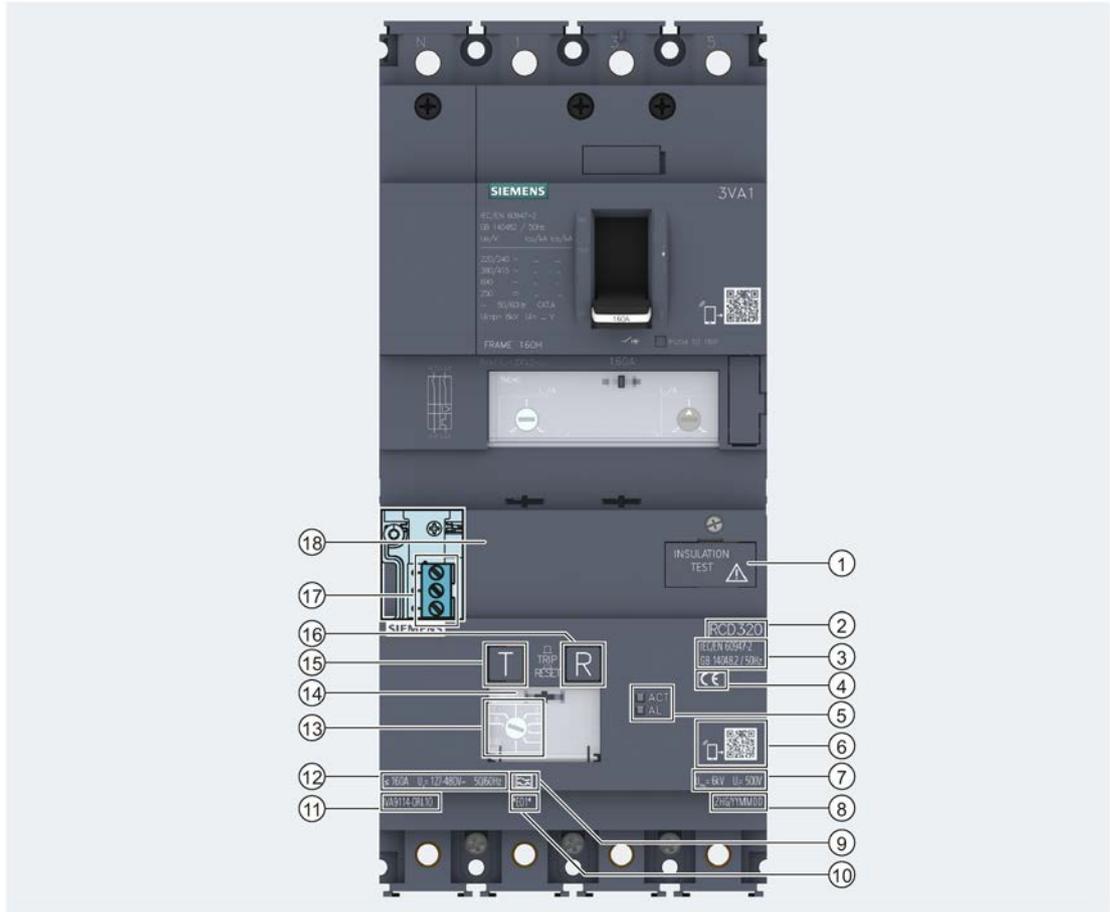
- Value can be read
- Value can be edited
- Commands

4.8.2.2 Loadside residual current devices Basic RCD320 and Basic RCD520

Loadside residual current devices are also available to order for 3VA1 molded case circuit breakers.

Front view of Basic RCD320 and Basic RCD520

RCD320



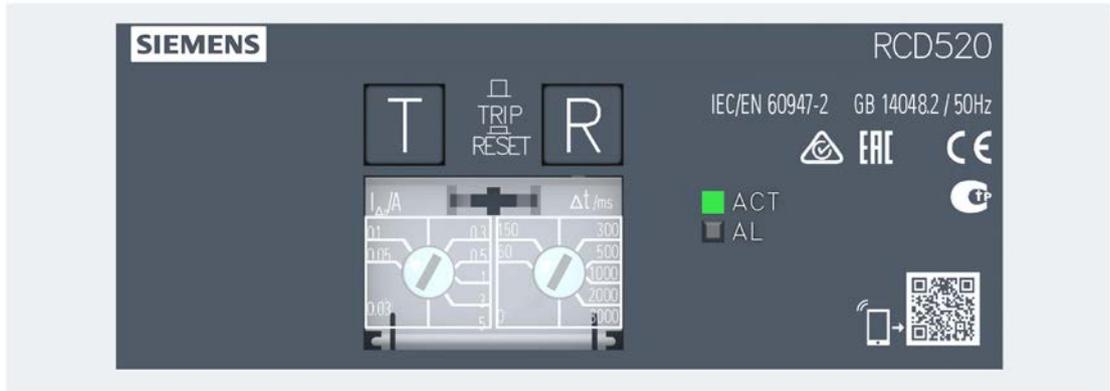
- ① Circuit breaker
- ② Type designation
- ③ Standard
- ④ Approvals
- ⑤ LED: ACTIVE and pre-alarm
- ⑥ Knowledge Manager
- ⑦ Rated insulation voltage and rated impulse strength
- ⑧ Location and date of manufacture
- ⑨ Device type
- ⑩ Product version
- ⑪ Article number
- ⑫ Maximum rated operational current, rated operational voltage and frequency
- ⑬ Setting button for response current
- ⑭ Transparent protective cover over setting buttons
- ⑮ Test button (test device)
- ⑯ Reset button / tripped display
- ⑰ Auxiliary contacts
- ⑱ Contact hazard protective cover over main current paths with sealing option

Description of front panel view

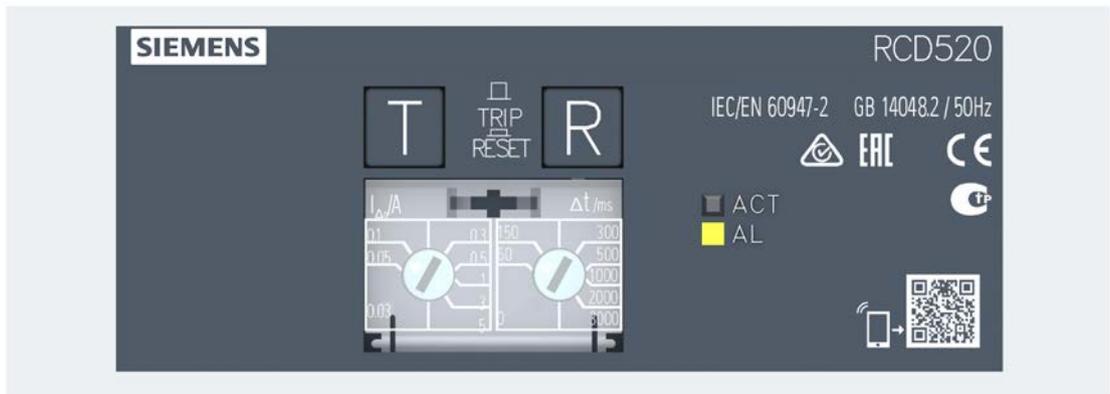
Display elements

"Ready" signals and alarms

- "Ready" signal of the residual current device:
The LED labeled "ACT" stands for ACTIVE and lights up when the device is ready to operate.



- Pre-alarm:
Both the Basic RCD320 and the Basic RCD520 feature an alarm LED labeled "AL" (pre-alarm) which lights up promptly to indicate potential shutdown of the installation due to residual current.

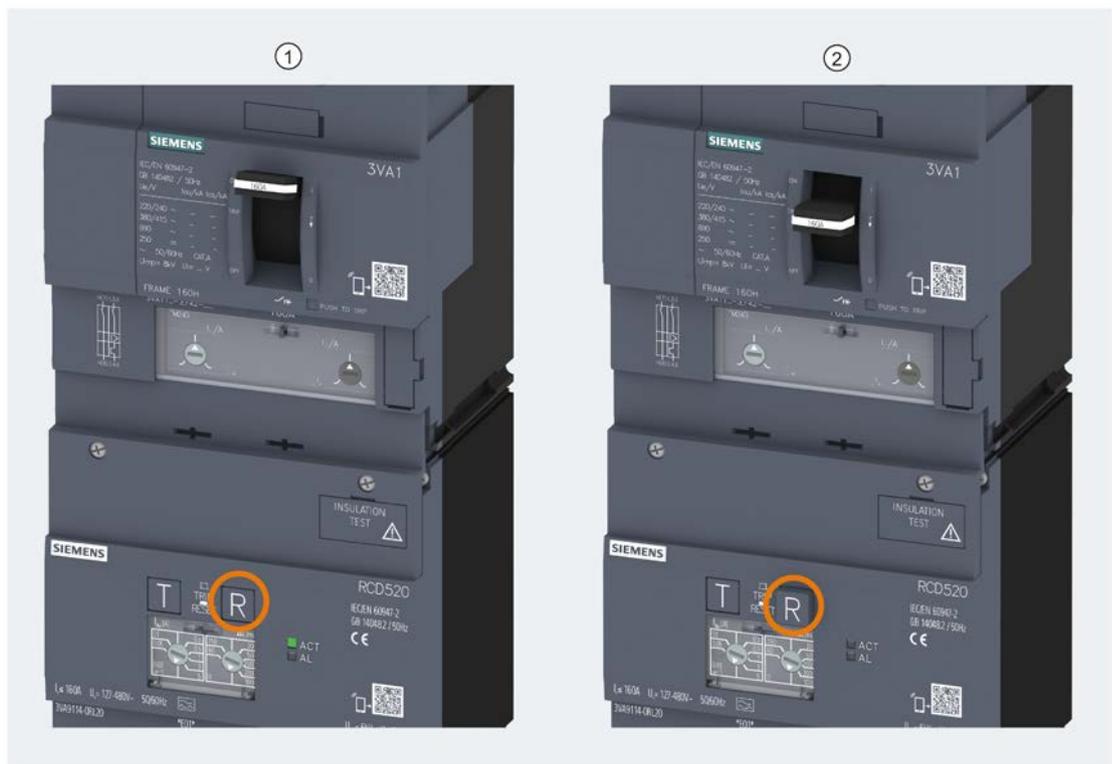


LED displays

LED	Status	Description
<input type="checkbox"/>	ACT Off	Residual current device is not in operation
	ACT Flashing	Residual current device is malfunctioning
	ACT On	Residual current device is operating normally
	ACT On	The residual current I_{Δ} is higher than 30 % of the set response current ($I_{\Delta n}$ value)
	AL On	
	ACT Flashing	Possible causes: - The residual current device is defective - The white setting arrow of the $I_{\Delta n}$ or Δt setting button is resting between two setting ranges
	AL Flashing	

Tripped display

The <RESET> button is not only used to reset the residual current device, but also as a mechanical indication that the unit has "tripped". If a residual current is detected or the button <TEST> is pressed, the button <RESET> is automatically released and so signals that the residual current device has tripped. Even when the residual current device is at zero potential, the <RESET> remains in the "TRIP" position.

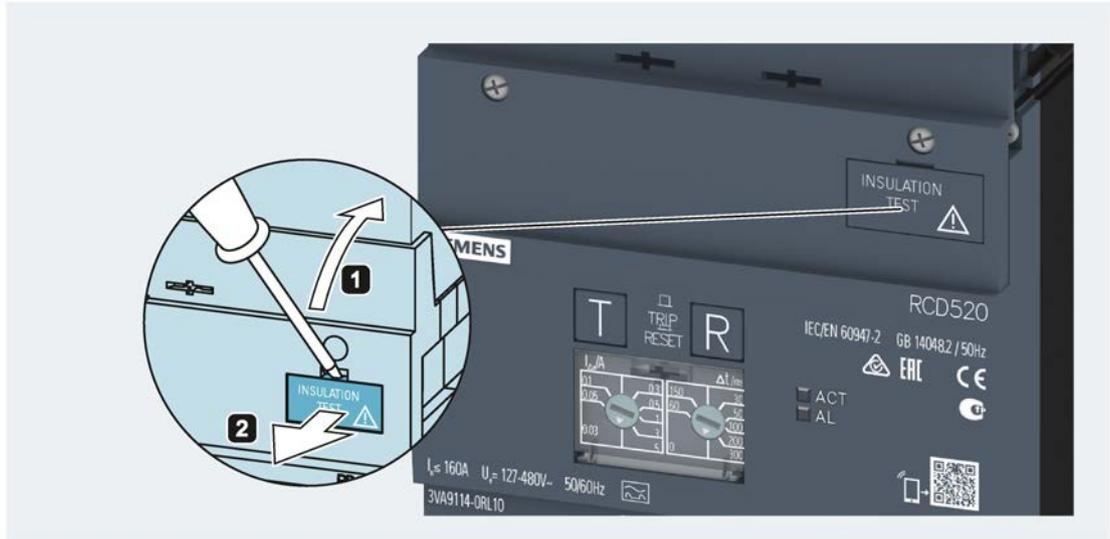


- ① Residual current device is operating normally ② Residual current device has tripped and has not tripped

Operator controls

Insulation tests

It is absolutely essential to isolate the evaluation electronics circuit while insulation tests are in progress in order to protect the circuit against potential damage on the one hand and to prevent detection of insulation faults due to the power pack on the other. This is done simply by withdrawing (15 - 17 mm) the circuit breaker which is anchored in the enclosure.



Disconnection of the main conductor connections is thus unnecessary. On completion of the tests, the circuit breaker must be pushed back into position before the residual current device is commissioned.

Testing and resetting the residual current device

Testing

Depending on operating conditions, the test button on the front panel of the residual current device should be pressed in order to function-test the device. The test button is labeled with the letter "T". If the test button is pressed, the device is tested immediately irrespective of the current delay time setting.

If the test button is pressed, a residual current is simulated on a test winding attached to the summation current transformer. If the residual current device is functioning properly, it must trip the molded case circuit breaker.

The test button must be held down for at least 2 seconds. The design of the test button prevents unintentional actuation.

Note

The residual current device can be successfully tested only if it is connected to a rated operational voltage which equals at least 85% of the minimum rated operational voltage.

Resetting

If the residual current device trips the molded case circuit breaker due to a high residual current or actuation of the test button, the <RESET> button on the RCD is released. At the same time, the trip alarm switch which is mechanically coupled with the <RESET> button also signals that a trip has occurred.

The <RESET> button is labeled with the letter "R".

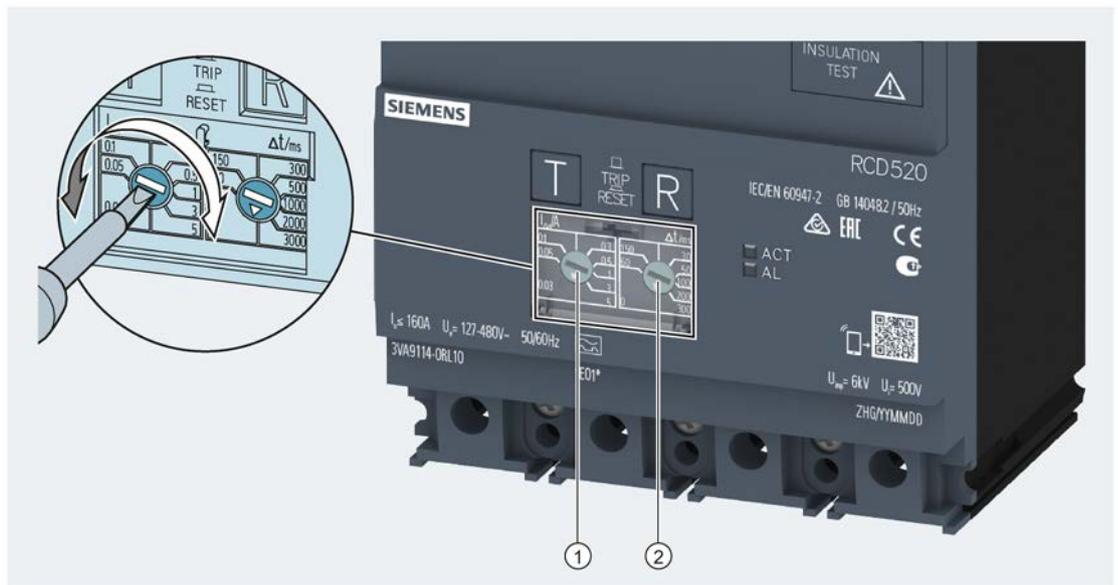
The following actions must be taken in order to reset the residual current device and reclose the main contacts of the molded case circuit breaker:

1. Press the <RESET> button on the residual current device.
The "tripped" signal at the signaling contacts is canceled, the residual current device is now reset.
2. Reset and switch on the molded case circuit breaker.

Note

The molded case circuit breaker cannot be switched on before the <RESET> button on the residual current device has been actuated.

Parameterization of the residual current device



- ① Setting button for response current $I_{\Delta n}$
- ② Setting button for delay time Δt (RCD520 only)

Button for setting the response current $I_{\Delta n}$

The response current can be set in 8 steps, ranging from 0.03 A to maximum 5 A. Each response current has a dedicated setting range. The corresponding response current is set as soon as the button is latched in the setting range.

If the white setting arrow is resting between two setting ranges, the residual current device is automatically set to 0.03 A for safety reasons.

If the response current is set to 0.03 A, the delay time setting is deactivated and the breaker is tripped instantaneously in order to afford personal protection in the case of direct contact.

The factory setting for the response current is 0.03 A.

Button for setting the delay time Δt (RCD520 only)

The delay time on the RCD520 residual current device can be set in 8 steps, ranging from 0 (instantaneous) to a maximum value of 3000 ms.

Each delay time has a dedicated setting range. The corresponding delay time is set as soon as the button is latched in the setting range.

If the white setting arrow is resting between two setting ranges, the residual current device trips instantaneously in response to residual currents.

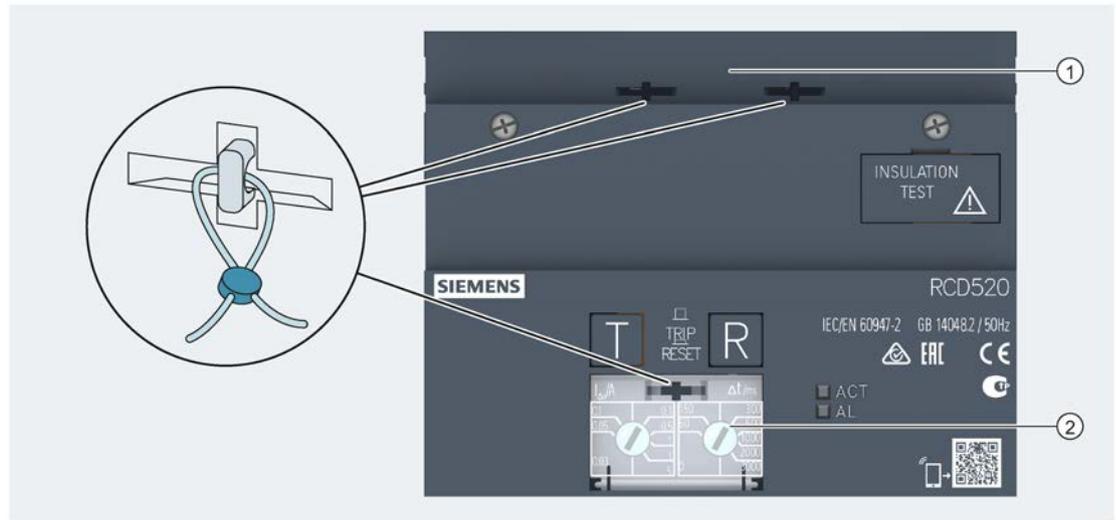
The factory setting for the tripping delay is 0 ms.

The delay time is not adjustable on the RCD320. The RCD320 always trips instantaneously.

Recommended procedure for setting the response current and the delay time

1. Switch off the molded case circuit breaker.
2. Open the transparent protective cover over the setting buttons.
3. Adjust the setting values for response current and delay time on the residual current device to the maximum value in each case.
4. Switch on the molded case circuit breaker.
The LED labeled "ACT" on the residual current device now lights up, the residual current device is ready.
5. Reduce the setting for the response current until the LED labeled "AL" lights up.
The residual current is now 30% higher than the response current setting.
6. By turning the setting button clockwise, set the next higher response current.
The LED "AL" goes out, the correct response current is now set.
7. Set the required delay time.
8. Close the transparent protective cover over the setting buttons.
The device is now fully parameterized.

Sealable protective covers of the residual current device



- ① Contact hazard protective cover over main current paths and auxiliary contacts
- ② Transparent protective cover over setting buttons

Transparent protective cover over setting buttons

In order to prevent unauthorized access to the setting buttons for $I_{\Delta n}$ and Δt , the transparent cover over the settings buttons can be optionally sealed.

Contact hazard protective cover over main current paths and auxiliary contacts including sealing option

After the residual current device RCD320 or RCD520 has been mounted on the 3VA1 molded case circuit breaker, a contact hazard protective cover is installed over the main current paths to protect against direct contact. This cover can be sealed optionally in order to block any attempt to dismantle the residual current device from the molded case circuit breaker.

Terminals

Note

Cables for the following terminals must be routed separately from the main circuits. Their maximum cable length is 300 m.

A number of auxiliary contacts which perform different functions are located underneath the contact hazard protective cover:



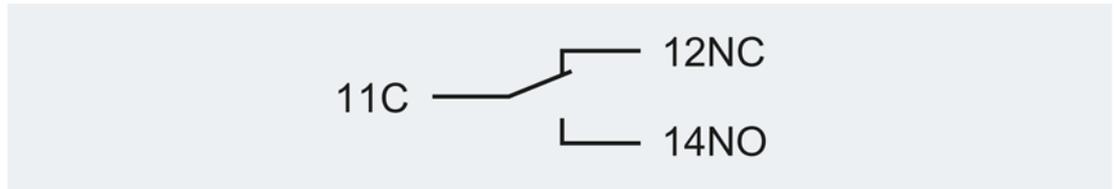
Alarm switch

TRIP-IND (TRIP INDICATOR)

A tripped signal can be output via the floating contact for display via a warning lamp, for example. This trip alarm switch operates as soon as the residual current exceeds the response current setting value and has therefore caused the residual current device to trip.

The standard trip alarm switch has changeover contacts and screw-type connections.

The terminal designations of the relevant contact are shown in the diagram below.



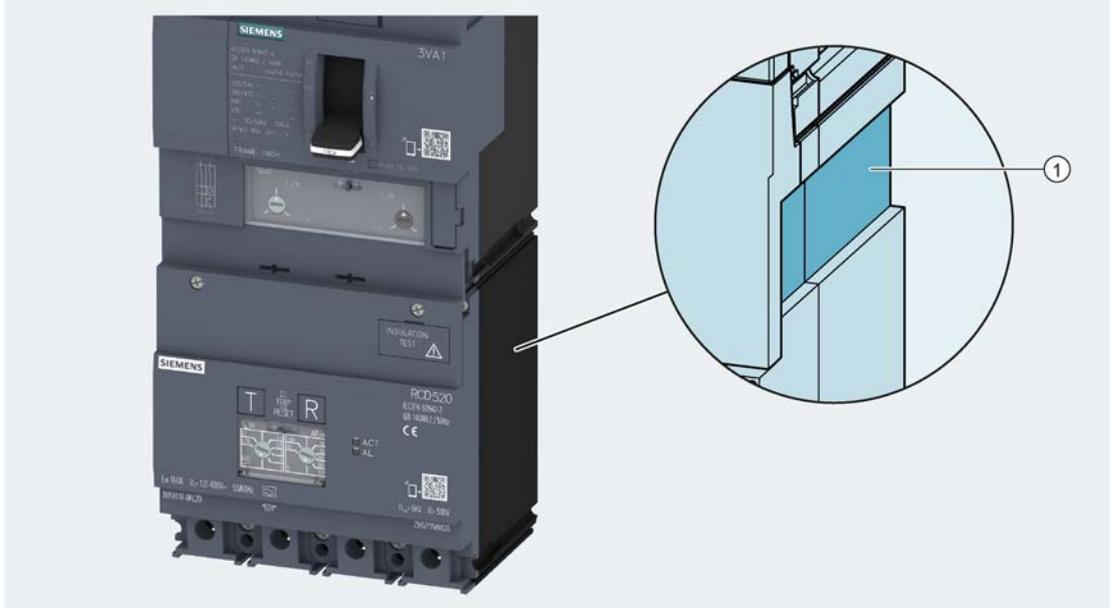
Status indicators

The table below illustrates the behavior of pre-alarm and tripped signals on RCD320 or RCD520 units in response to various user actions and residual currents.

Breaker status prior to user action	ON	ON	ON	TRIP	TRIP
Residual current I_{Δ}	$\leq 30\% I_{\Delta n}$	$> 30\% I_{\Delta n}$	$\geq 100\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$
User action	None	None	None	RCD: Reset 	MCCB: TRIP → OFF
Breaker status following user action	ON	ON	TRIP	TRIP	OFF
LEDs					
Pre-alarm	AL				
Mechanical display					
Tripped signal	TRIP				
Alarm switches					
Tripped signal	TRIP-IND				

Cable installation

Cable ducts for bringing out cables are provided to the left and right on the residual current device.



① Cable duct

Other labels on front panel

Approvals

The residual current device bears the CE mark. For an overview of all approvals, please refer to Appendix (Page 505).

For all queries relating to approvals, please contact Technical Support (Page 12).

Technical specifications

$I_n \leq \dots A$: Specifies the highest permissible rated operational current of the molded case circuit breaker with which the residual current device may be combined.

$U_e \sim \dots V$: Specifies the operating voltage range of the residual current device.

$\dots Hz$: Specifies the operating frequency range of the residual current device.



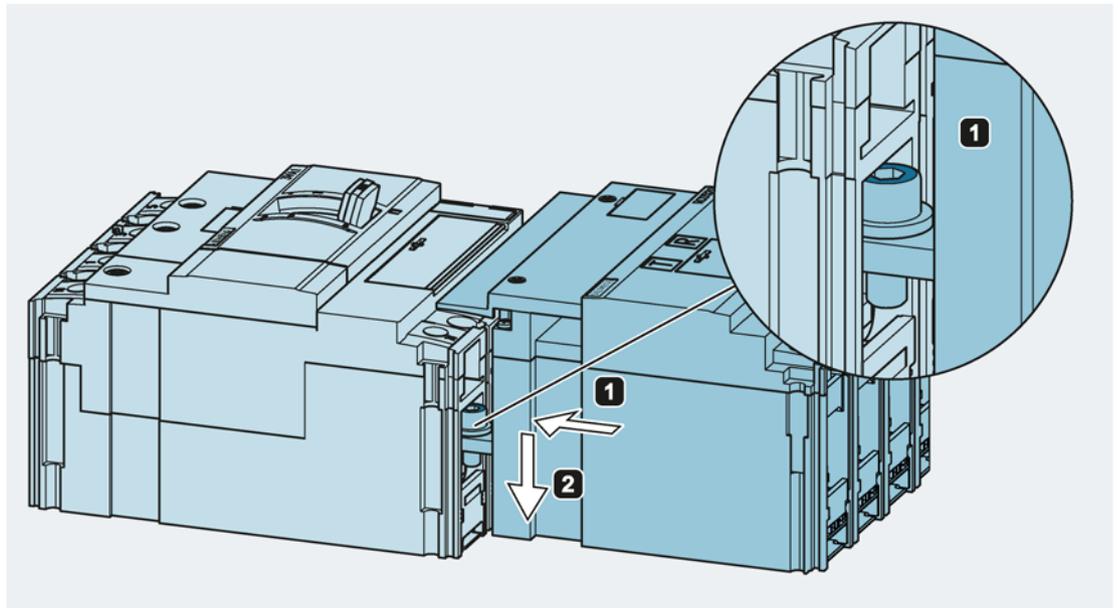
Denotes the response behavior to residual currents.

Installation

Installation

Regardless of the type of connection system installed on the 3VA1 molded case circuit breaker, the residual current devices RCD320 and RCD520 are mounted on the load side (i.e. beneath the thermal-magnetic trip unit) of the breaker:

1. Dismantle the loadside connection components of the molded case circuit breaker and install the supplied connection components for the residual current device.
2. Insert the residual current device into the T slots of the molded case circuit breaker.



3. Push the residual current device backwards until its rear panel is flush with the rear panel of the molded case circuit breaker.
4. Screw the molded case circuit breaker to the residual current device. Special connecting screws are provided on the line side of the residual current device for this purpose.
5. Place a contact hazard protective cover over the circuit breaker/RCD assembly.
6. Reinstall the loadside connection components of the molded case circuit breaker at the outgoing feeder end of the residual current device.
7. Attach the assembly to a mounting plate using the fastening screws.

Note

Since the outgoing feeder end of the residual current device has exactly the same connection contours as the 3VA1 molded case circuit breaker, all connection accessories such as phase barriers, terminal covers, etc. can also be mounted on the residual current device.

4.8 Residual current devices

Tripping

The molded case circuit breaker is tripped by means of a direct-acting tappet which engages in the breaker mechanism from the residual current device. The electromagnetic trip unit is integrated in the residual current device.

Function overview

The table below provides an overview of all the functions and data which are available in the residual current device environment:

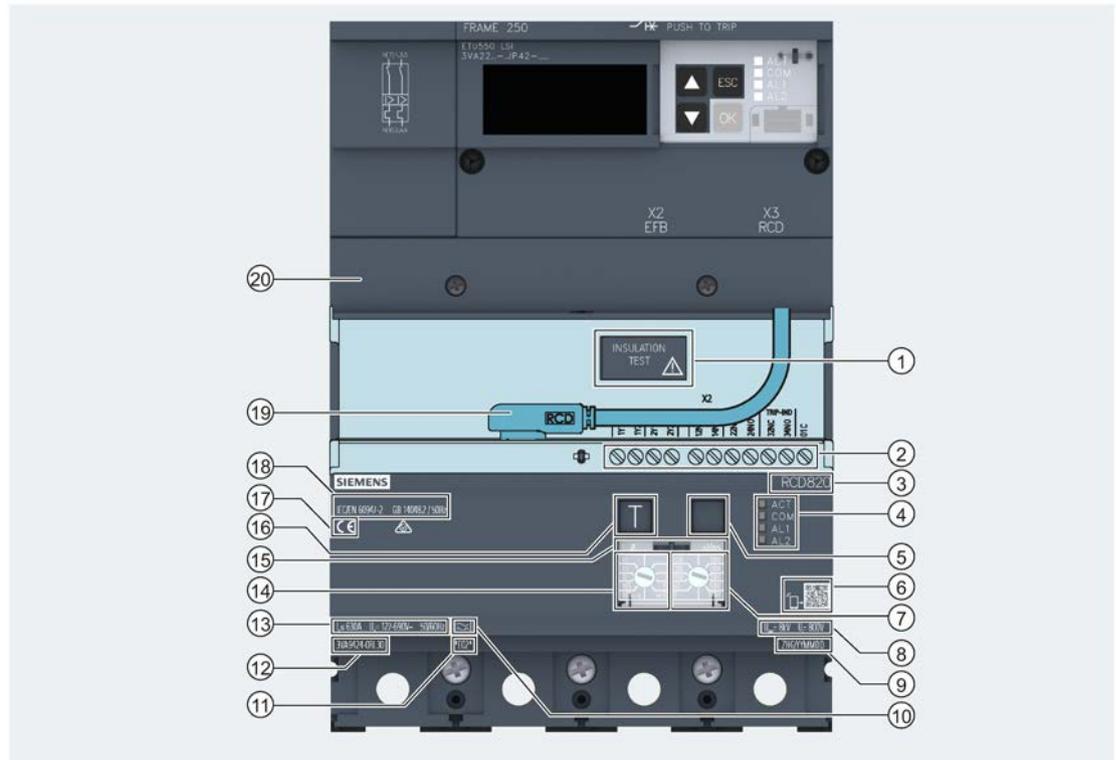
			RCD320	RCD520	at residual current device	via electrical contacts
Setting values						
Response current	$I_{\Delta n}$	A	■	■		
Delay time	Δt	ms		■		
Status, diagnostics and maintenance						
Ready signal	ACT		■	■		
Pre-alarm	AL		■	■		
Trip	TRIP		■	■		
Residual current device fault			■	■		
Connection to maglatch interrupted			■	■		
Reset functions			■	■		
Identification						
Identification data of residual current device	Order No.		■	■		
	Production date		■	■		
	Serial number		■	■		
Hardware version			■	■		

- Value can be read
- Value can be edited
- Command

4.8.2.3 Loadside residual current device Advanced RCD820

The "Advanced" residual current devices of type RCD820 are available as an accessory for 3VA2 molded case circuit breakers.

Front view of Advanced RCD820

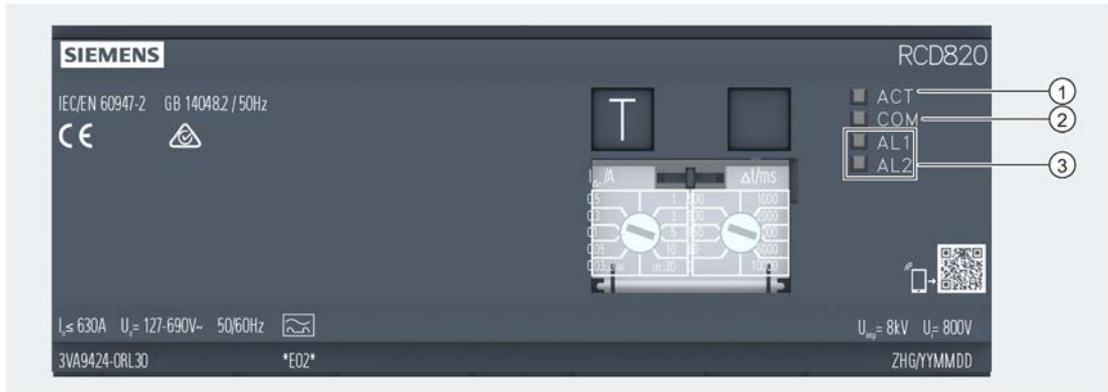


- | | |
|---|---|
| ① Circuit breaker | ⑪ Product version |
| ② Auxiliary contacts | ⑫ Article number |
| ③ Type designation | ⑬ Maximum rated operational current, rated operational voltage and frequency |
| ④ LED: ACTIVE, communication, pre-alarm | ⑭ Setting button for response current |
| ⑤ Tripped display | ⑮ Transparent protective cover over setting buttons |
| ⑥ Knowledge Manager | ⑯ Test button (test device) |
| ⑦ Setting button for delay time | ⑰ Approval |
| ⑧ Rated insulation voltage and rated impulse strength | ⑱ Standard |
| ⑨ Location and date of manufacture | ⑲ RCD-to-ETU connecting cable |
| ⑩ Device type | ⑳ Contact hazard protective cover over main current paths with sealing option |

Description of front panel view

Display elements

"Ready" signals, communication status and alarms



- "Ready" signal of the residual current device:
The LED labeled "ACT" ① stands for ACTIVE and lights up when the device is ready to operate.
- Communication status:
The LED labeled "COM" ② stands for COMMUNICATION and indicates the communication status of the residual current device.
- Pre-alarms:
The Advanced RCD820 has two LEDs labeled "AL1" (ALARM 1) ③ and "AL2" (ALARM 2) ③ which light up successively or simultaneously to promptly indicate potential shutdown of the installation due to residual current.

LED displays

LED	Status	Description
<input type="checkbox"/> ACT	Off	Residual current device is not in operation
 ACT	Flashing	<ul style="list-style-type: none"> - Residual current device is malfunctioning - Residual current device is not functioning as a trip unit (no cable is connected between the ETU and RCD) - Residual current device is integrated into communication system only - Residual current device is not connected to a supply voltage - Break in connecting cable between RCD and ETU
 ACT	On	Residual current device is operating normally.
<input type="checkbox"/> COM	Off	<p>Communication function of the residual current device is inoperative. This can happen, for example, if</p> <ul style="list-style-type: none"> - a 3VA2 molded case circuit breaker is equipped with an ETU 5-series or 8-series, but not with a communication module. - a 3VA2 molded case circuit breaker is equipped with an ETU 3-series, but the ETU is not equipped with a communication interface. - Residual current device is not functioning as a trip unit (no cable is connected between the RCD and ETU)
 COM	Flashing	<p>Fault in communication system of the residual current device.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> - Break in connecting cable between RCD and ETU
 COM	On	<p>The communication system of the residual current device is active. Even when the molded case circuit breaker is switched off, communication remains active on condition that</p> <ul style="list-style-type: none"> - the communication system is working properly, - the ETU is connected to an external power supply through the COM060 communication module.
 ACT	On	<p>The residual current I_{Δ} is higher than 30 % of the set response current ($I_{\Delta n}$ value).</p>
 AL1	On	
<input type="checkbox"/> AL2	Off	
 ACT	On	<p>The residual current I_{Δ} is higher than 60 % of the set response current ($I_{\Delta n}$ value).</p>
 AL1	On	
 AL2	On	
 ACT	Flashing	<p>Possible causes:</p> <ul style="list-style-type: none"> - The residual current device is defective. - The white setting arrow of the Δt setting button is resting between two setting ranges.
 COM	Flashing	
 AL1	Flashing	
 AL2	Flashing	

Tripped display

If the residual current device is tripped by a residual current, a remote trip command or actuation of the test button, the trip is signaled mechanically on the RCD, i.e. by a rotating disk.



① Residual current device is operating normally and has not tripped

② Residual current device has tripped

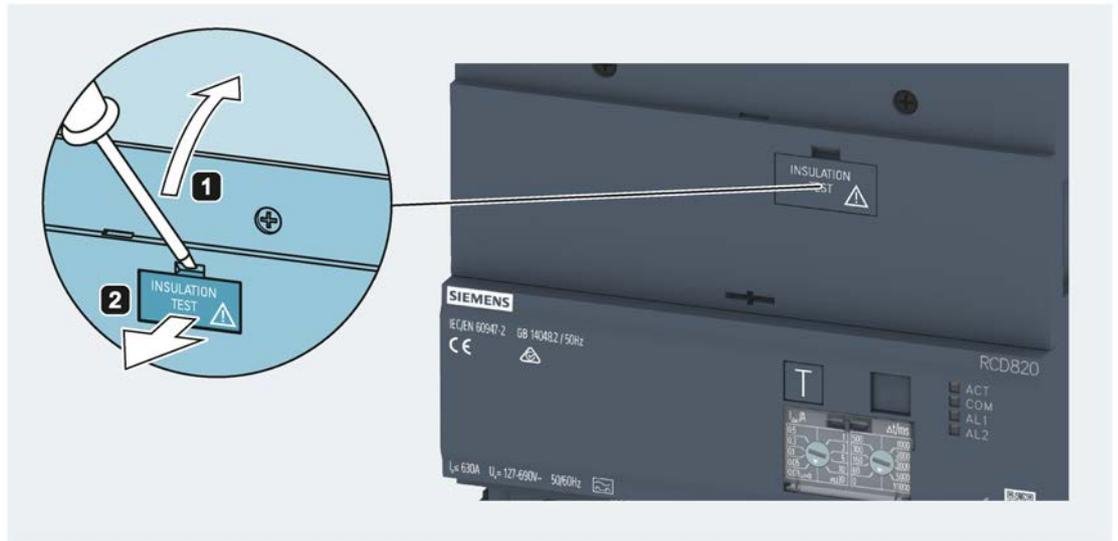
Note

In the case of infeed from below, an auxiliary switch must be connected by means of auxiliary contacts CB-S to ensure correct functioning of the tripped display (for description, see auxiliary contacts CB-S).

Operator controls

Insulation tests

It is absolutely essential to isolate the evaluation electronics circuit while insulation tests are in progress in order to protect the circuit against potential damage on the one hand and to prevent detection of insulation faults due to the power pack on the other. This is done simply by withdrawing (15 - 17 mm) the circuit breaker which is anchored in the enclosure.



Disconnection of the main conductor connections is thus unnecessary. On completion of the tests, the circuit breaker must be pushed back into position before the residual current device is commissioned.

Testing and resetting the residual current device

Testing

Depending on operating conditions, the test button on the front panel of the residual current device should be pressed in order to function-test the device. The test button is labeled with the letter "T". If the test button is pressed, the device is tested immediately irrespective of the current delay time setting.

If the test button is pressed, a residual current is simulated on a test winding attached to the summation current transformer. If the residual current device is functioning properly, it must trip the molded case circuit breaker.

The test button must be held down for at least 2 seconds. The design of the test button prevents unintentional actuation.

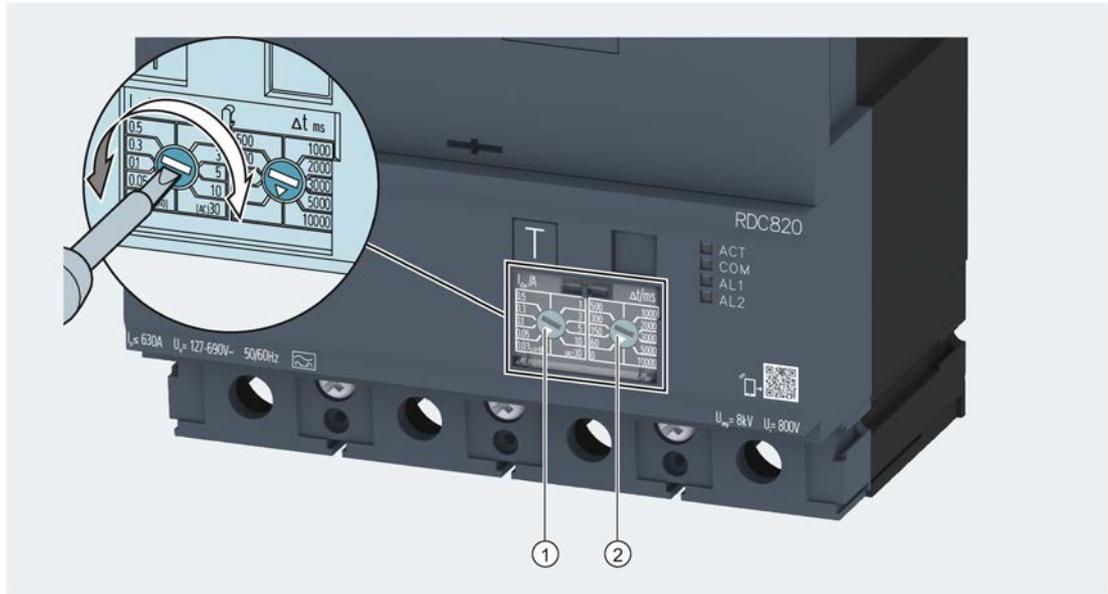
Note

The residual current device can be successfully tested only if it is connected to a rated operational voltage which equals at least 85% of the minimum rated operational voltage.

Resetting

The residual current device and the "tripped" display are reset by means of the handle of the molded case circuit breaker, or the handle of the manual operator or by means of the motor operator.

Parameterization of the residual current device



- ① Setting button for response current $I_{\Delta n}$
- ② Setting button for delay time Δt

Button for setting the response current $I_{\Delta n}$

The response current can be set in 10 steps, ranging from 0.03 A to maximum 30 A. A residual current of type A is detected within the 0.03 A to 10 A range. If the response current is set to 30 A, the device detects only residual currents of type AC (i.e. purely sinusoidal currents).

Each response current has a dedicated setting range. The corresponding response current is set as soon as the button is latched in the setting range.

If the white setting arrow is resting between two setting ranges, the residual current device is automatically set to 0.03 A for safety reasons.

If the response current is set to 0.03 A, the delay time setting is deactivated and the breaker is tripped instantaneously in order to afford personal protection in the case of direct contact.

The factory setting for the response current is 0.03 A.

Button for setting the delay time Δt

The delay time can be set in 10 steps, ranging from 0 (instantaneous) to a maximum value of 10000 ms.

Each delay time has a dedicated setting range. The corresponding delay time is set as soon as the button is latched in the setting range.

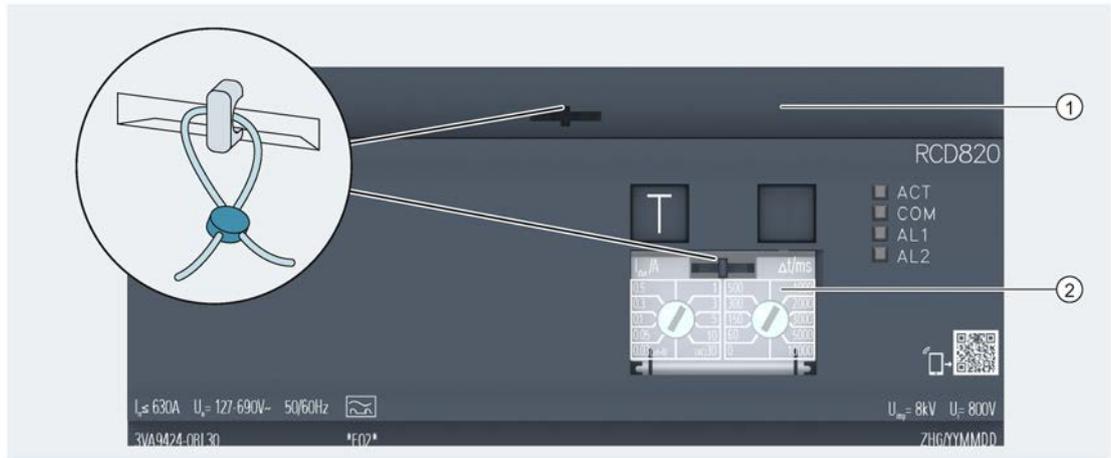
If the white setting arrow is resting between two setting ranges, the residual current device trips instantaneously in response to residual currents.

The factory setting for the tripping delay is 0 ms.

Recommended procedure for setting the response current and the delay time

1. Switch off the molded case circuit breaker.
2. Open the transparent protective cover over the setting buttons.
3. Adjust the setting values for response current and delay time on the residual current device to the maximum value in each case.
4. Switch on the molded case circuit breaker.
The LED labeled "ACT" on the residual current device now lights up, the residual current device is ready.
5. Reduce the setting for the response current until the LED labeled "AL1" lights up.
The residual current is now 30% higher than the response current setting.
6. By turning the setting button clockwise, set the next higher response current.
The LED "AL1" goes out, the correct response current is now set.
7. Set the required delay time.
8. Close the transparent protective cover over the setting buttons.
The device is now fully parameterized.

Sealable protective covers of the residual current device



- ① Contact hazard protective cover over main current paths and auxiliary contacts
- ② Transparent protective cover over setting buttons

Transparent protective cover over setting buttons

In order to prevent unauthorized access to the setting buttons for $I_{\Delta n}$ and Δt , the transparent cover over the settings buttons can be optionally sealed.

Contact hazard protective cover over main current paths and auxiliary contacts including sealing option

After the residual current device RCD820 has been mounted on the 3VA2 molded case circuit breaker, a contact hazard protective cover is installed over the main current paths to protect against direct contact. This cover can be sealed optionally in order to block any attempt to dismantle the residual current device from the molded case circuit breaker.

Terminals

Note

Cables for the following terminals must be routed separately from the main circuits. Their maximum cable length is 300 m.

A number of auxiliary contacts which perform a broad range of functions are located underneath the contact hazard protective cover.

Alarm switch

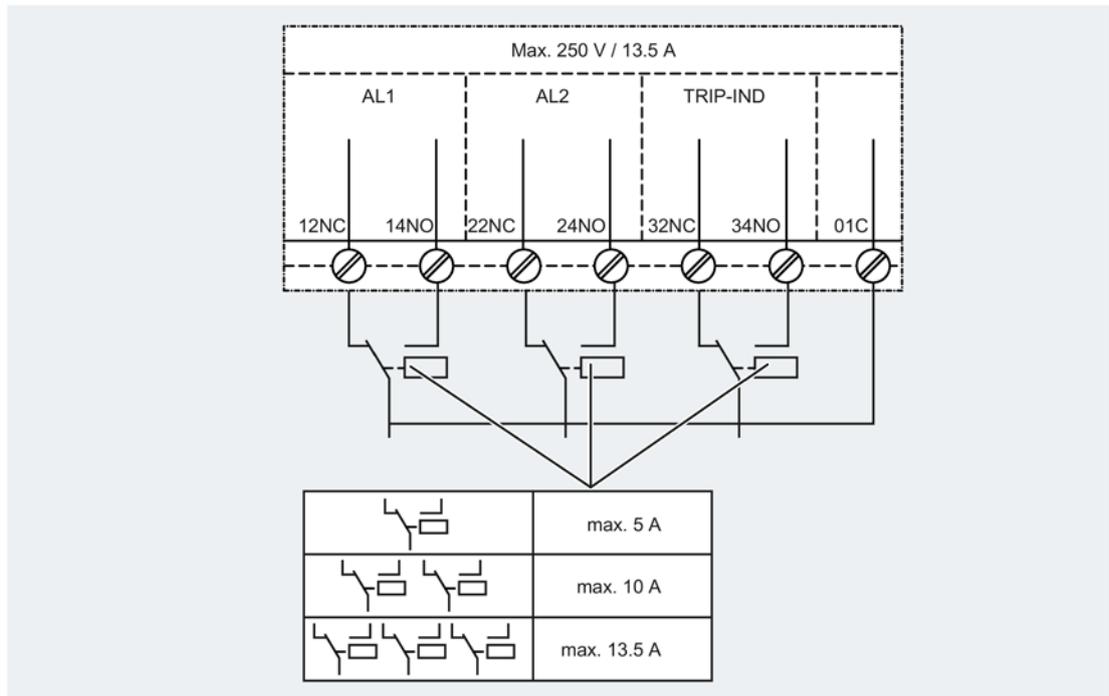
Floating auxiliary contacts for 3 different alarms are provided:

- AL1
Signaling switch for pre-alarm threshold 1. This auxiliary switch operates as soon as the residual current exceeds 30 % of the operating current setting value.
- AL2
Signaling switch for pre-alarm threshold 2. This auxiliary switch operates as soon as the residual current exceeds 60 % of the operating current setting value.
- TRIP-IND (TRIP INDICATOR)
A tripped signal can be output via this auxiliary switch for connection to a warning lamp, for example. The switch operates as soon as the residual current reaches or exceeds the response current setting value and has therefore caused the residual current device to trip.

The standard auxiliary switches for pre-alarms and tripped signals have changeover contacts and screw-type connections.

4.8 Residual current devices

The terminal designations of the relevant contact, the maximum rated voltage and the current carrying capacity are shown in the diagram below.



Each relay contact has a maximum rated operational current of 5 A at 230 V AC. Since the terminals have a maximum current carrying capacity of 13.5 A, the current flow across the common terminal (01C = Common) must be limited to 13.5 A when all three signaling switches are used.

The relays for the pre-alarm signals (AL1 and AL2) drop out again as soon as the residual current reaches or exceeds the relevant pre-alarm thresholds.

The relay for the tripped signal (TRIP-IND) drops out again as soon as the residual current device is reset again by means of the molded case circuit breaker handle, or the handle of the manual or motor operator.

Since the relay for the tripped signal (TRIP-IND) is a bistable relay, the relay contact states remain "stored" even in the event of a power outage. When the power supply recovers, the indicated relay contact states are those which existed before the power outage.

Other auxiliary inputs

Two further auxiliary inputs in the form of screw terminals are also provided:

REMOTE-T

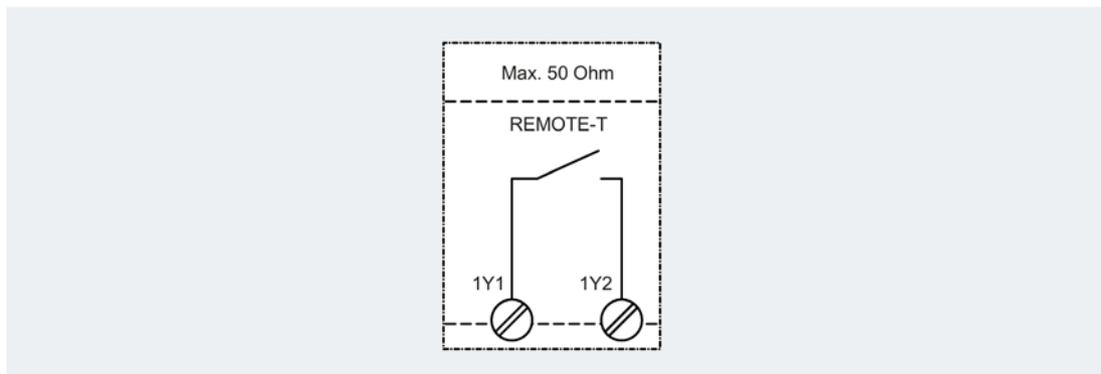
The residual current device can be remotely tripped via this auxiliary input for test purposes ("Remote test button"), for example.

To utilize this function, the customer must connect, for example, a pushbutton (NO contact) to terminals 1Y1 and 1Y2 by means of a two-core, twisted cable which must not be more than 300 m in length. The switching contact should have a minimum breaking capacity of 5 V / 1 mA. The residual current device trips if the pushbutton is actuated for at least 2 ms. The terminals 1Y1 and 1Y2 are galvanically isolated from the mains supply (functional extra low voltage, FELV).

In special cases, such as cable installation outdoors, the amplitude of overvoltages (e.g. overvoltages due to thunderstorms) between the conductor and ground must be limited to 2.5 kV by suitable routing of the cable or other protection measures.

Each residual current device requires a separate NO contact and cable for remote tripping. It is not possible to use one cable and connect two or more residual current devices in parallel.

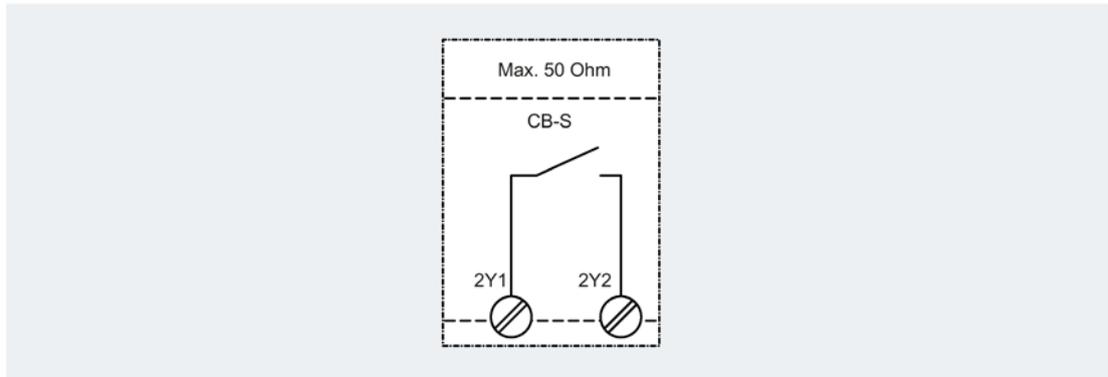
It is necessary to use an unshielded cable or a shielded, twisted-pair cable with a maximum capacitance of 36 nF as well as a maximum resistance of 50 ohms (total length out and back).



CB-S (Circuit Breaker Switch)

If the molded case circuit breaker / RCD820 assembly has an infeed from below (reverse feed), it is absolutely essential to install a standard auxiliary switch (NO contact) 3VA9988-0AA13 for interrogation of the circuit breaker status to allow resetting of the tripped signal.

This switch is installed in the accessories compartment of the molded case circuit breaker. The auxiliary switch is then connected to terminals 2Y1 and 2Y2 of the floating contact CB-S. It is necessary to use an unshielded or shielded twisted-pair cable, no more than 1 m in length, with a maximum capacitance of 36 nF as well as a maximum resistance of 50 ohms (total length out and back).

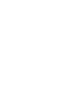


When the molded case circuit breaker is reset and then switched on again, the contacts .1C and .2NC of the auxiliary switch are closed and the tripped display on the residual current device is reset.

The auxiliary switch is not included in the scope of supply and must be ordered separately. The method for connecting the auxiliary switch to auxiliary contact CB-S is described in the Operating Instructions for the RCD820 residual current device.

Status indicators

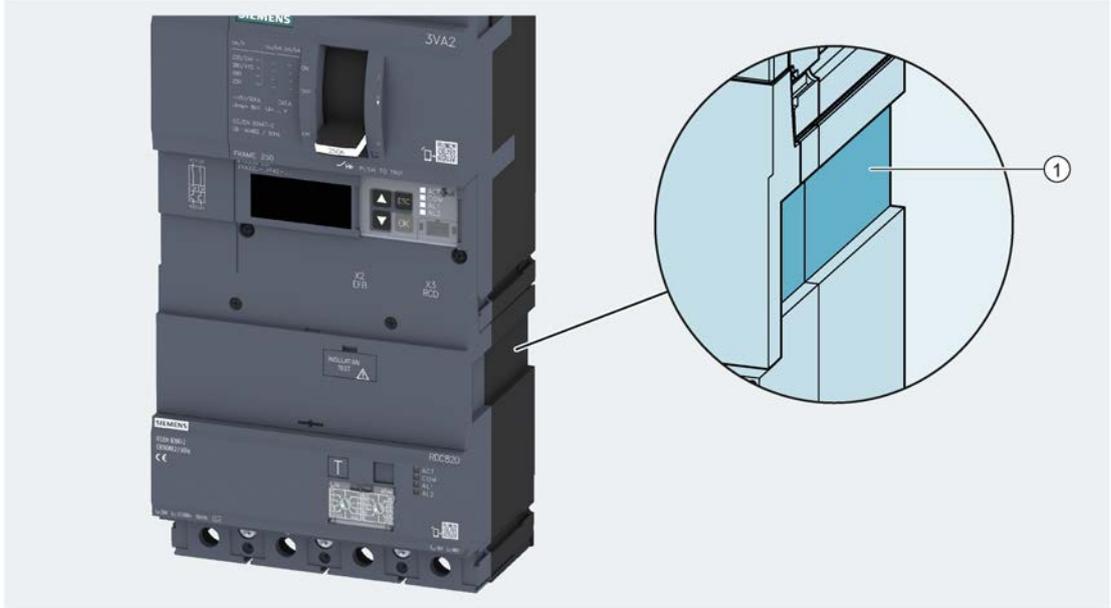
The table below illustrates the behavior of pre-alarm and tripped signals on RCD820 devices in response to various user actions and residual currents.

Breaker status prior to user action	ON	ON	TRIP	OFF ¹⁾	ON	ON	ON	TRIP		
Residual current I_{Δ}	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$	$60\% I_{\Delta n} > I_{\Delta} > 30\% I_{\Delta n}$	$\geq 60\% I_{\Delta n}$	$\geq 100\% I_{\Delta n}$	$\leq 30\% I_{\Delta n}$		
User action	None	RCD: REMOTE-T 1Y1  1Y2	MCCB: TRIP → OFF 	MCCB: OFF → ON 	None	None	None	MCCB: TRIP → OFF 		
Breaker status following user action	ON	TRIP	OFF ¹⁾	ON	ON	ON	TRIP	OFF ²⁾		
Signals at RCD820 following user action	LEDs									
	Pre-alarm 1	AL 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>
	Pre-alarm 2	AL 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>
	Mechanical display									
	Tripped signal	TRIP								
	Alarm switches									
	Pre-alarm 1	AL 1								
	Pre-alarm 2	AL 2								
	Tripped signal	TRIP-IND								

- 1) Infeed at top
- 2) Infeed at bottom

Cable installation

Cable ducts for bringing out cables are provided to the left and right on the residual current device.



① Cable duct

Other labels on front panel

Approvals

The residual current device bears the CE mark. For an overview of all approvals, please refer to Appendix (Page 505).

For all queries relating to approvals, please contact Technical Support (Page 12).

Technical specifications

$I_n \leq \dots A$: Specifies the highest permissible rated operational current of the molded case circuit breaker with which the residual current device may be combined.

$U_e \sim \dots V$: Specifies the operating voltage range of the residual current device.

$\dots Hz$: Specifies the operating frequency range of the residual current device.



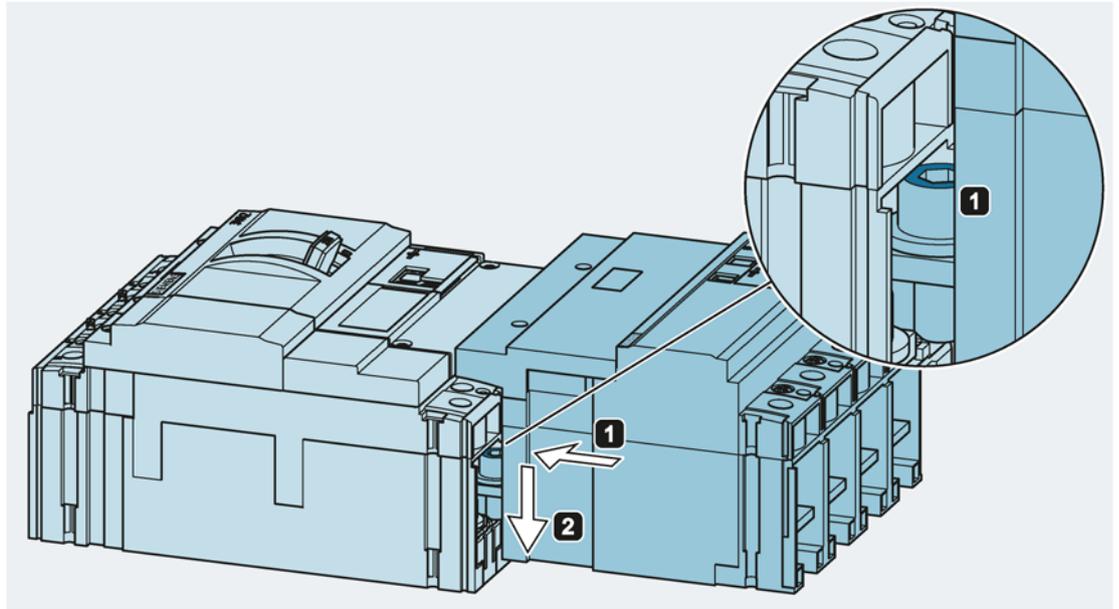
Denotes the response behavior to residual currents.

Installation

Installation

Regardless of the type of connection system installed on the 3VA2 molded case circuit breaker, the RCD820 is mounted underneath the electronic trip unit of the circuit breaker.

1. Dismantle the loadside connection components of the molded case circuit breaker and install the supplied connection components for the residual current device.
2. Insert the residual current device into the T slots of the molded case circuit breaker.



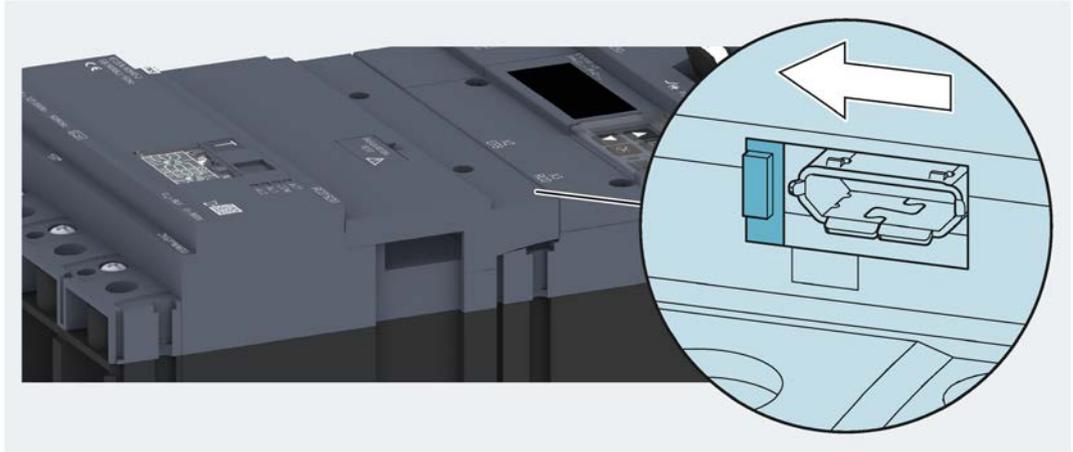
3. Push the residual current device backwards until its rear panel is flush with the rear panel of the molded case circuit breaker.
4. Screw the molded case circuit breaker to the residual current device. Special connecting screws are provided on the line side of the residual current device for this purpose.
5. Place a contact hazard protective cover over the circuit breaker/RCD assembly.
6. Reinstall the loadside connection components of the molded case circuit breaker at the outgoing feeder end of the residual current device.
7. Attach the assembly to a mounting plate using the fastening screws.

Note

Since the outgoing feeder end of the residual current device has exactly the same connection contours as the 3VA2 molded case circuit breaker, all connection accessories such as phase barriers, terminal covers, etc. can also be mounted on the residual current device.

Installation of the RCD-ETU connecting cable

1. Remove the contact hazard protective cover.
2. Open the slide over the interface <X3 RCD>. The slide is fitted as a protective guard (e.g. to protect the interface against soiling).

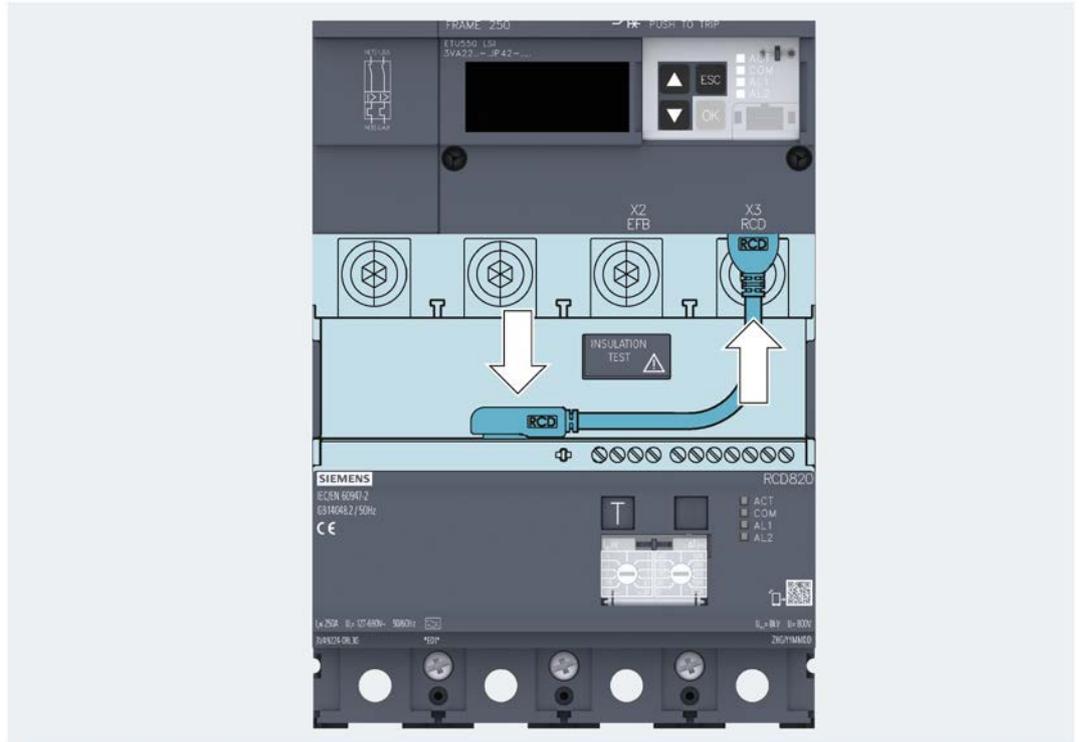


3. Insert one end of the connecting cable into the interface on the residual current device. The interfaces and the connecting cable are labeled to ensure that the cable ends are inserted in the right interfaces.

Note

Plug in or remove the RCD-ETU cable only when the residual current device is deenergized.

4. Insert the other end of the connecting cable into the interface <X3 RCD> on the ETU.



The RCD-to-ETU connecting cable is free of silicone and halogen and is electrically isolated from the main circuits.

The connecting cable is included in the scope of supply.

Tripping

The residual current device utilizes the maglatch of the electronic trip unit (ETU) in order to trip the molded case circuit breaker. It therefore needs to be connected to the ETU of the molded case circuit breaker. This connection is made by means of the RCD-ETU connecting cable.

Use of the residual current device as a pure display unit

The RCD820 residual current device can also operate as a pure display unit without a tripping function, i.e. it detects and signals residual currents, but does not trip the molded case circuit breaker or interrupt the circuit.

If the RCD820 device is to operate as a pure display unit, the connecting cable between the residual current device and the ETU of the molded case circuit breaker can simply be omitted. With the exception of its communications interface functionality, the residual current device can perform all its normal functions, e.g. status signaling via LEDs or alarm switches, etc., in "display mode". Since there is no connection between the RCD and the ETU, the LED "ACT" flashes continuously and the LED "COM" is not illuminated even if an ETU 5-series or 8-series is installed.

Communications interface

The RCD-ETU connecting cable not only carries the trip command, but also acts as the communications interface between the residual current device and the 3VA communication system.

Precondition for interface functionality:

- The 3VA2 molded case circuit breaker is equipped with a communication-capable, electronic trip unit (ETU 5-series or 8-series).
- The molded case circuit breaker is linked to the communication system via a COM060 communication module.

If the residual current device is linked to the communication system, the link can be used not only to interrogate the device for important status, diagnostic, maintenance and identification data, but also to transmit commands.

The residual current device is normally supplied with power by the main current paths. If the molded case circuit breaker is switched off, this power supply is also disconnected (infeed at top). In order to maintain the link to the communication system when the power supply from the main current paths is disconnected, the residual current device is supplied with the necessary power by the COM060 communication module.

The table below provides an overview of all the functions and data which are available in the residual current device environment:

			RCD820	at residual current device	via electrical contacts	DSP800 display	via COM interface
Setting values							
Response current	$I_{\Delta n}$	A	■				
Delay time	Δt	ms	■				
Status, diagnostics and maintenance							
Ready signal	ACT		■				
Communications interface	COM		■				
Pre-alarm 1	AL1		■				
Pre-alarm 2	AL2		■				
Trip	TRIP		■				
Residual current device fault			■				
Connection to maglatch interrupted			■				
Reset functions			■				
Identification							
Identification data of residual current device	Order No.		■				
	Production date		■				
	Serial number		■				
Hardware version			■				

Value can be read

Value can be edited

Commands

1) Reset by means of the molded case circuit breaker handle, or the handle of the manual or motor operator

2) Reset in combination with motor operators

3) On request

4.8 Residual current devices

4.8.2.4 Technical specifications

Residual current devices									
General information				RCD310	RCD510	RCD320	RCD520	RCD820	
Standards and Specifications				IEC 60947-2 Annex B					
Pollution degree				III					
Ambient temperature during	operation	°C	-25 ... +70						
	storage	°C	-25 ... +80						
Mechanical									
Sizes			3VA11	3VA11 / 3VA12	3VA11	3VA11 / 3VA12	3VA20 / 3VA21 / 3VA22 / 3VA23 / 3VA24		
Overvoltage category to IEC 60497-1 Annex H	Main conducting paths		Category IV						
	Auxiliary conducting paths		Category III						
Number of poles	3-pole			■			■	■	
	4-pole		■	■	■	■	■	■	
Design			Side (L shape)	Side (L shape)	Loadside	Loadside	Loadside		
Mounting position				as for 3VA circuit breaker					
Possibility of sealing settings				■	■	■	■	■	
DIN rail mounting				■	■ (up to 160 A)				
Conductor cross sections of main terminals of residual current device		mm ²	as for 3VA circuit breaker						
Recommended tightening torque		Nm	as for 3VA circuit breaker						
Degree of protection		Device front panel	IP 40						
Weight	3-pole		kg	0.81	3VA11: 0.81 3VA12: 0.70	0.81	3VA11: 0.75 3VA12: 1.12	3VA20/21/22: 1.34 3VA23/24: 2.85	
	4-pole		kg	0.91	3VA11: 0.91 3VA12: 0.99	0.89	3VA11: 0.89 3VA12: 1.34	3VA20/21/22: 1.68 3VA23/24: 3.71	
Dimensions	3-pole		W x H x D	mm	106.4 x 187 x 70	3VA11: 106.4 x 187 x 70 3VA12: 135 x 228 x 70	76.2 x 100 x 70	3VA11: 76.2 x 100 x 70 3VA12: 105 x 115 x 70	3VA20/21/22: 104.6 x 115 x 86 3VA23/24: 137.6 x 150 x 110
	4-pole		W x H x D	mm	131.8 x 187 x 70	3VA11: 131.8 x 187 x 70 3VA12: 170 x 228 x 70	101.6 x 100 x 70	3VA11: 101.6 x 100 x 70 3VA12: 140 x 115 x 70	3VA20/21/22: 139.6 x 115 x 86 3VA23/24: 183.3 x 150 x 110

Residual current devices							
Electrical			RCD310	RCD510	RCD320	RCD520	RCD820
Rated operational current	I_n	A	up to 160	up to 250	up to 160	up to 250	up to 630
Rated operational frequency	f	Hz	50/60	50/60	50/60	50/60	50/60
Sensitivity	Type A  (pulse current sensitive)		■	■	■	■	■
Rated operational voltage	3 AC	U_e V AC	127-480	127-480	127-480	127-480	127-690
	1 AC	U_e V AC			100-277	100-277	100-400
Rated response current	$I_{\Delta n}$	A	0.03 / 0.05 / 0.1 / 0.3 / 0.5 / 1.00 / 3.00 / 5.00	0.03 / 0.05 / 0.1 / 0.3 / 0.5 / 1.00 / 3.00 / 5.00	0.03 / 0.05 / 0.1 / 0.3 / 0.5 / 1.00 / 3.00 / 5.00	0.03 / 0.05 / 0.1 / 0.3 / 0.5 / 1.00 / 3.00 / 5.00	0.03 / 0.05 / 0.1 / 0.3 / 0.5 / 1.00 / 3.00 / 5.00 / 10.00 / 30.00
Delay time	Δt	s	Instantaneous	Instantaneous / 0.06 / 0.15 / 0.3 / 0.5 / 1.00 / 2.00 / 3.00	Instantaneous	Instantaneous / 0.06 / 0.15 / 0.3 / 0.5 / 1.00 / 2.00 / 3.00	Instantaneous / 0.06 / 0.15 / 0.3 / 0.5 / 1.00 / 2.00 / 3.00 / 5.00 / 10.00
Residual current frequency measurement range	f	Hz	50/60	50/60	50/60	50/60	50/60
Operating range of test device (Test function)	U_t	V AC	108 ... 480	108 ... 480	108 ... 480 ¹⁾	108 ... 480 ¹⁾	108 ... 690 ¹⁾
Suitable for use			in 3-phase systems	in 3-phase systems	in 1- and 3-phase systems	in 1- and 3-phase systems	in 1- and 3-phase systems
Rated isolation voltage	U_i	V AC	500	500	500	500	800
Rated impulse withstand voltage	U_{imp}	kV	6	6	6	6	8
Self-supply			■	■	■	■	■
Test functions	on the device	Test key	■	■	■	■	■
	Remote tripping	Electrically via changeover contacts					■
		Via communication interface					■
Reset functions	on the device		■	■	■	■	■ ₂₎
	Remotely	Electrically via changeover contacts					■ ₃₎
		Via communication interface					■ ₃₎
Visual displays	on the device	mech. Indicator for tripped signals	■	■	■	■	■
		LED - ACTIVE	■	■	■	■	■
		LED - COM (communication interface)					■ ₄₎
		LED - Pre-alarm signal 1 (from 30% $I_{\Delta n}$)	■	■	■	■	■
	Electrical (changeover contacts)	LED - Pre-alarm signal 2 (from 60% $I_{\Delta n}$)					■
		Tripped signal	■	■	■	■	■
		Pre-alarm signal 1 (from 30% $I_{\Delta n}$)					■
		Pre-alarm signal 2 (from 60% $I_{\Delta n}$)					■
Communication					■ ₄₎		
Infeed from top/bottom		■	■	■	■	■	
Vibration and shock resistance							IEC 60068-2-6 / IEC 60068-2-27 / IEC 60068-2-47

- 1) 85 V AC minimum voltage (with phase to neutral conductor) for operation of the test function
- 2) Reset by means of the circuit breaker handle
- 3) On request
- 4) Requirement: The 3VA2 molded case circuit breaker is equipped with an ETU 5-series or 8-series

4.8 Residual current devices

Auxiliary switches and alarm switches on residual current device									
General information			RCD310	RCD510	RCD320	RCD520	RCD820		
Standards and specifications			IEC 60947-5						
Mechanical									
Conductor cross sections	Solid	mm ²	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75		
	Stranded	mm ²	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75		
	Finely stranded	mm ²	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75	1 x 0.5 ... 1.5 2 x 0.5 ... 0.75		
	Finely stranded with end sleeve	mm ²	1 x 0.5 ... 1.5 2 x 0.5	1 x 0.5 ... 1.5 2 x 0.5	1 x 0.5 ... 1.5 2 x 0.5	1 x 0.5 ... 1.5 2 x 0.5	1 x 0.5 ... 1.5 2 x 0.5		
Recommended tightening torque		Nm	0.5 ... 0.6	0.5 ... 0.6	0.5 ... 0.6	0.5 ... 0.6	0.5 ... 0.6		
Electrical									
Conventional free-air thermal current		$I_m = I_e$	A	10	10	10	10	5	
Rated operational current	AC-12	24 V	I_e	A	10	10	10	10	5
		48 V	I_e	A	10	10	10	10	5
		110 V	I_e	A	10	10	10	10	5
		125 V	I_e	A	10	10	10	10	5
		230 V	I_e	A	10	10	10	10	5
	250 V	I_e	A	10	10	10	10	5	
	DC-12	24 V	I_e	A	4	4	4	4	4
		30 V	I_e	A	4	4	4	4	4
		125 V	I_e	A	0.4	0.4	0.4	0.4	0.5
		250 V	I_e	A	0.2	0.2	0.2	0.2	0.2
Short-circuit protection: max. fuse, quick-response		A gG/gL	10	10	10	10	5		

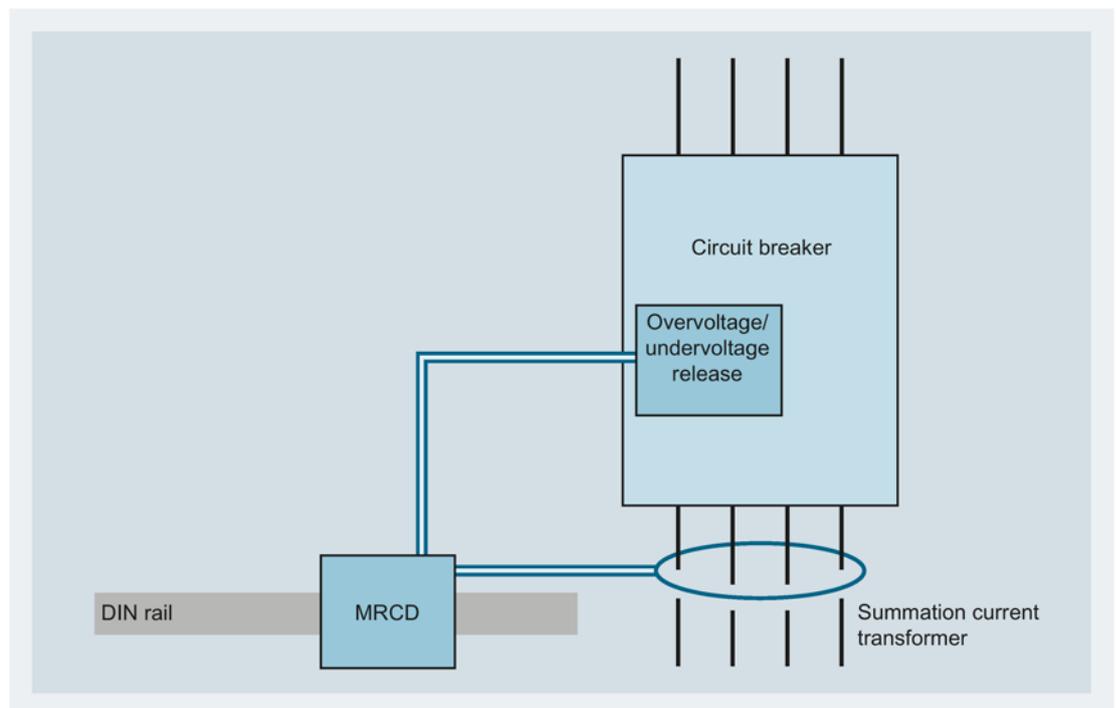
4.8.3 Modular residual current device

Thanks to its design, the modular residual current device type A (MRCD) 5SV8101-6KK is compatible with all molded case circuit breaker designs and can therefore be combined with 3VA1 molded case circuit breakers/switch disconnectors and with molded case circuit breakers from the 3VA2 series.

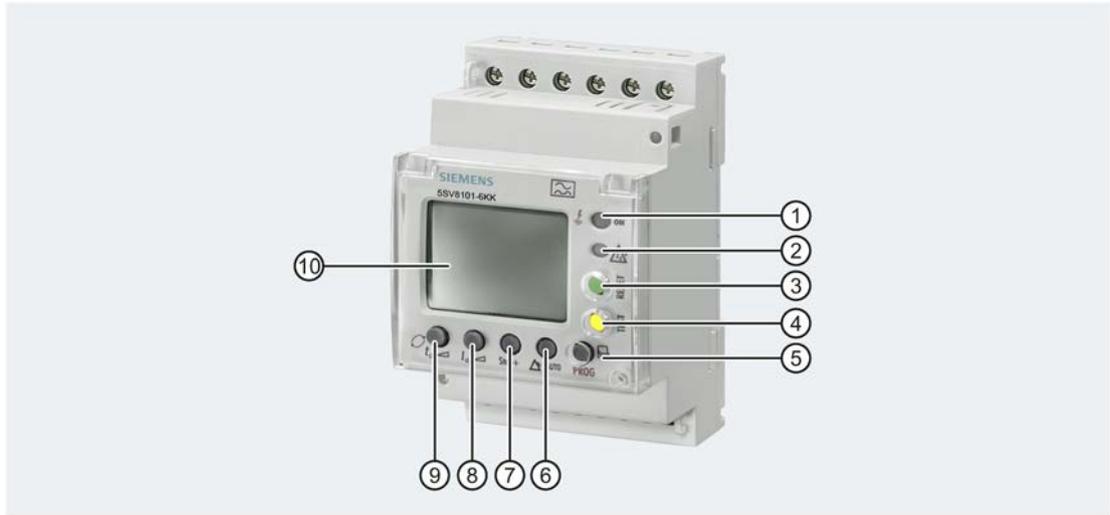
The modular residual current device is installed on a DIN rail (35 mm) as close as possible to the molded case circuit breaker/switch disconnector.

Operating principle

The modular residual current device is connected to a summation current transformer through which all live conductors (including neutral conductor where applicable) must be routed. The residual current is detected in the summation current transformer and transferred to the MRCD. If this current exceeds the limit value for the set rated residual current $I_{\Delta n}$, the residual current device trips the molded case circuit breaker/switch disconnector by means of a shunt trip or undervoltage release.



Front view



- ① LED ready to operate and tripped display
- ② LED alarm display
- ③ Reset button
- ④ Test button
- ⑤ Setting button for alarm/frequency
- ⑥ Setting button for auto (reclose) for alarm
- ⑦ Setting button for factory setting (0.03 A, instantaneous)
- ⑧ Setting button for residual current
- ⑨ Setting button for non-tripping time
- ⑩ Display

Description of front panel view

Display of ready-to-operate and tripped and alarm states

The status of LED ① indicates whether the device is ready to operate or has tripped:

- Green LED: The device is in operation.
- Red LED: The set residual current has exceeded the response current, the device has tripped.

LED ② is an alarm indication:

- Yellow LED: The set residual current has exceeded the response current alarm threshold.

Parameterization of the MRCD

For a description of MRCD parameterization procedures and other operating options, please refer to the operating instructions for the unit.

Summation current transformer



Summation current transformer 5SV8702-0KK (35 mm inside diameter)

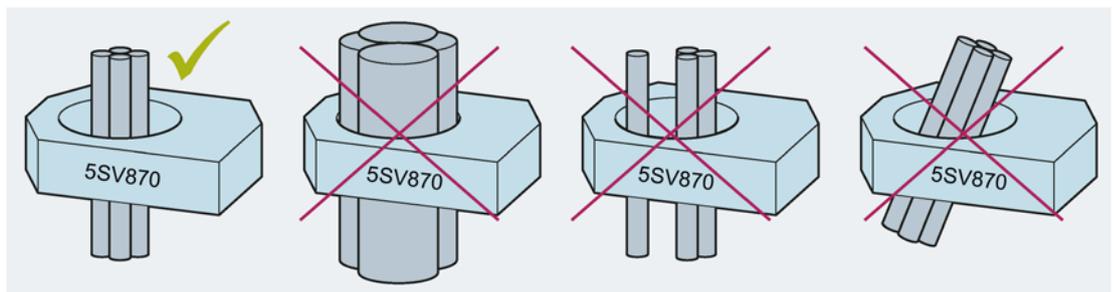
Suitable summation current transformers

Depending on the rated operational current or maximum current of the circuit to be monitored, the following summation current transformers can be used:

Type	Rated operational current	Max. current
5SV8702-0KK	80 A	480 A
5SV8703-0KK	200 A	1200 A
5SV8704-0KK	250 A	1500 A
5SV8705-0KK	500 A	3000 A
5SV8706-0KK	600 A	3600 A

Alignment of conductors in the summation current transformer

In order to prevent measurement errors or spurious tripping, it is important to ensure that the conductors are properly aligned or arranged in the summation current transformer.



Note

The summation current transformer used for the application must have an inside diameter which is at least 1.5 times larger than the outside diameter of the conductors which pass through it.

4.8 Residual current devices

When installing the MRCD, the summation current transformer and the release, make sure that they are positioned as close as possible to one another so that the cables from the MRCD to the transformer and from the MRCD to the molded case circuit breaker/switch disconnecter are as short as possible (please observe the specified minimum clearances!) Further information about the cables to be used is available on request.

Combinations of molded case circuit breaker, MRCD and shunt trip/undervoltage release

Modular residual current devices, molded case circuit breakers, and shunt trips or undervoltage releases UVR can be combined as indicated in the tables below:

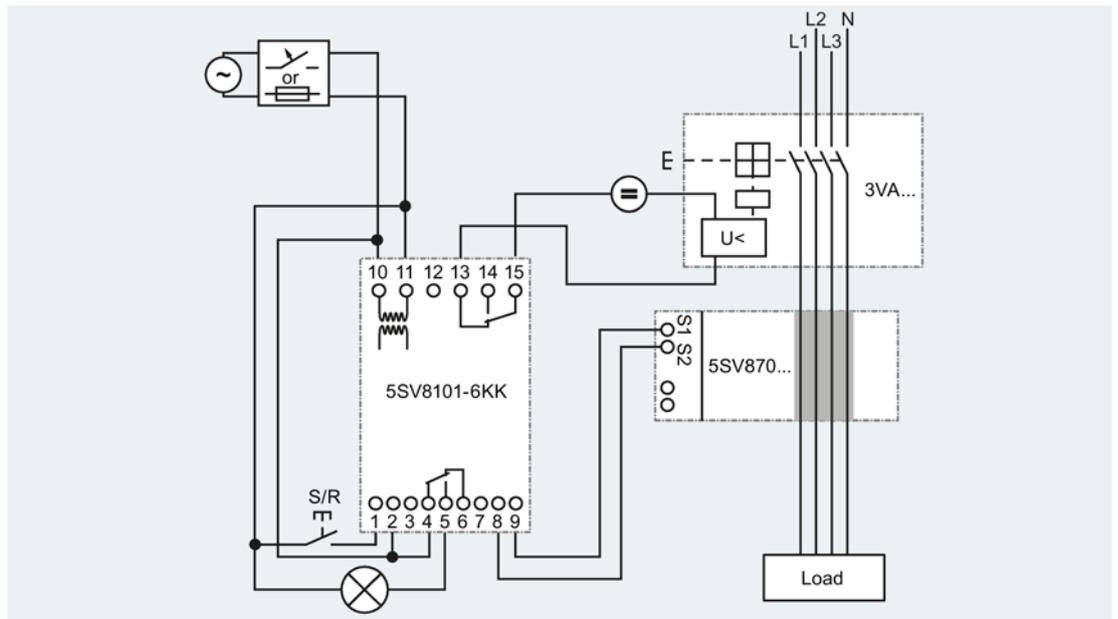
Molded case circuit breaker	Shunt trip	Voltage	
		50/60 Hz V AC	V DC
3VA10 (16 ... 100 A) 3VA11 (16 ... 160 A) 3VA20 (25 ... 100 A)	3VA9988-0BL30	24	12 ... 30
3VA21 (25 ... 160 A) 3VA22 (160 ... 250 A) 3VA23 (250 ... 400 A)	3VA9988-0BL32	110 ... 127	110 ... 127
3VA24 (400 ... 630 A)	3VA9988-0BL33	208 ... 277	220 ... 250

Molded case circuit breaker	Undervoltage release (UVR)	Voltage	
		50/60 Hz V AC	V DC
3VA10 (16 ... 100 A) 3VA11 (16 ... 160 A)	3VA9908-0BB11	–	24
3VA20 (25 ... 100 A)	3VA9908-0BB20	24	–
3VA21 (25 ... 160 A) 3VA22 (160 ... 250 A) 3VA23 (250 ... 400 A)	3VA9908-0BB24	120 ... 127	–
3VA24 (400 ... 630 A)	3VA9908-0BB25 ¹⁾	208 ... 230	–

¹⁾ Suitability for use with 3VA23 and 3VA24 molded case circuit breakers on request

Example of wiring

The circuit diagram below shows a typical MRCD circuit with an undervoltage release.



The MRCD has a separate power supply (230 V) in the example application.

4.9 Communication and link-up to other systems

4.9.1 Description of application and basic function

The standards demanded of molded case circuit breakers in terms of their electrical and mechanical properties, cost-effectiveness and adaptability are increasing as a result of ongoing rationalization and automation. The merging of power distribution engineering and information technology has opened up a diverse range of new applications for molded case circuit breakers.

Potential applications

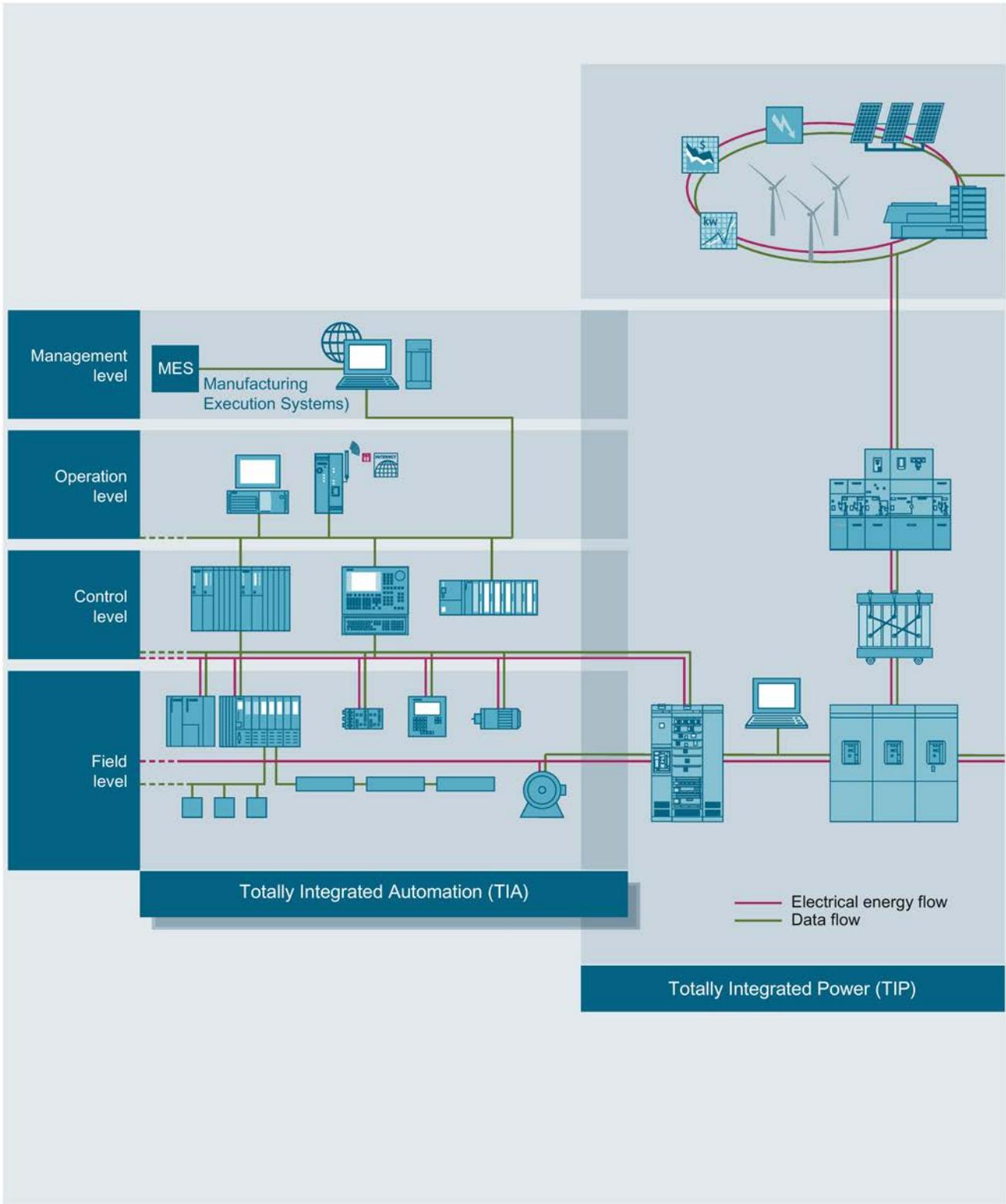
The power distribution system can be integrated into the information system of the relevant application, but it can also have its own independent information system.

Siemens considers the following three scenarios as potential applications:

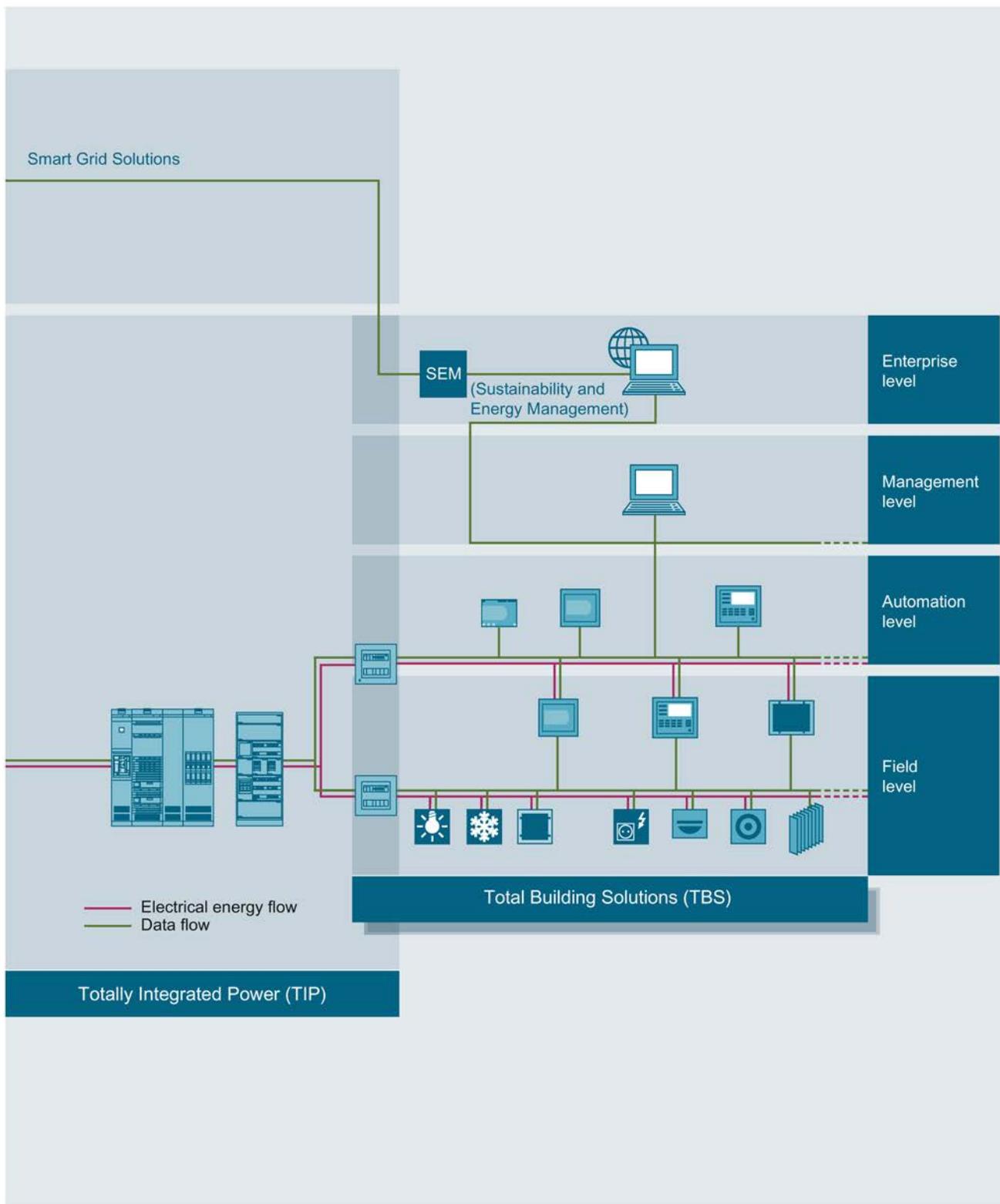
- Totally Integrated Automation (TIA) for production facilities
- Total Building Solution (TBS) for non-residential buildings
- Totally Integrated Power (TIP) as the power distribution system for the two applications above
- Power management with powermanager

The TIP application scenario offers coordinated power distribution in all phases and on all levels as well as the benefit of an integrated information and communication structure.

Totally Integrated Automation (TIA) and Totally Integrated Power (TIP)



Total Building Solution (TBS) and Totally Integrated Power (TIP)



4.9 Communication and link-up to other systems

Communication during all life phases of a power distribution system

Communication provides useful support during all life phases of a power distribution system, i.e. during

- engineering and installation,
- operation, and
- maintenance and expansion.

The communication functionality of 3VA2 molded case circuit breakers can be used in different ways to perform various tasks such as

- commissioning by installation personnel,
- operations management by the maintenance department,
- power management by accounting managers, and
- process control by production managers.

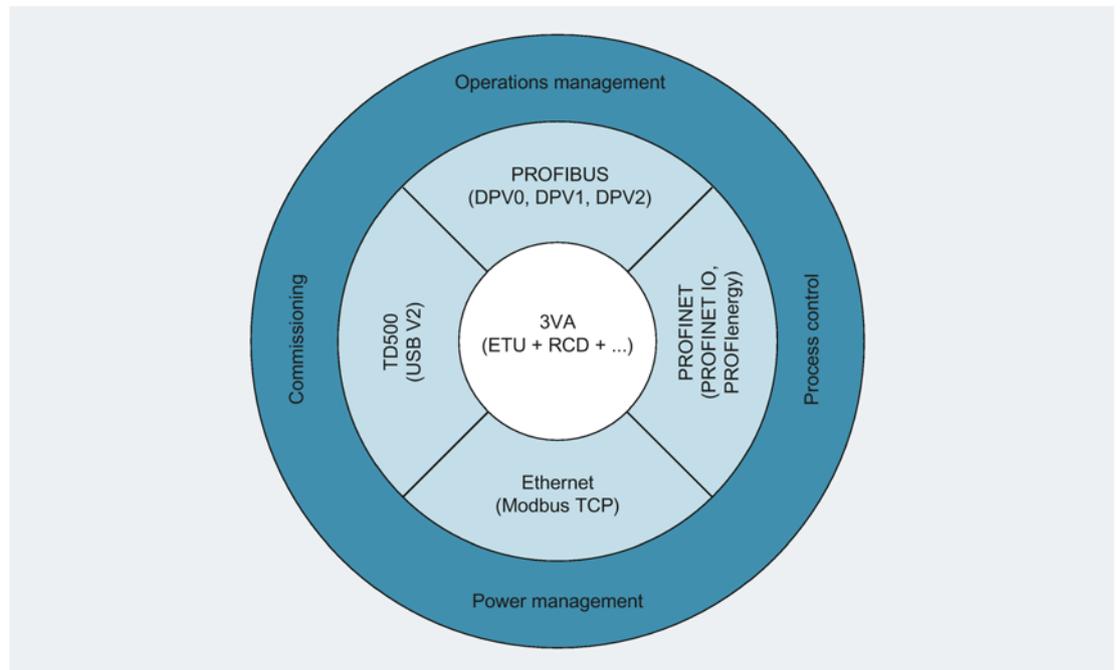
Power distribution	Tasks	Life phases			Communication-based functions
		Engineering & installation	Operation	Maintenance	
	Commissioning	- Set protection parameters - Document completed tests			- Set protection parameters - Transfer measured values - Control circuit breakers - Monitor states - Record operational events - Log faults - Archive test results - Document settings
	Operations management		- Fault management - Service management - Maintenance management	- Optimize settings - Document changes/modifications - Evaluate causes of tripping - Analyze statistics - Isolate switchgear sections	
	Power management		- Make power flows transparent - Allocate costs - Prevent peak loads		
	Process control		- Monitor plant utilization - Monitor equipment - Commission or decommission equipment - Record energy costs		

3VA2 molded case circuit breakers can adapt to operate with the communication systems implemented for individual fields of activity.

The communication capability of the 3VA2 is supported by the electronic components of the molded case circuit breaker such as the ETU electronic trip unit and the RCD residual current device. Information is made available for individual tasks via a range of different

communication interfaces and protocols, such as

- PROFIBUS - PROFINET
- Modbus RTU
- Ethernet (Modbus TCP) and
- TD500 test device.



Maintenance management example

Information for preventive maintenance, e.g. number of switching cycles or operating hours, enables timely planning of personnel and material. Plant availability increases as a result and irreparable damage to sensitive plant components caused by failures can be avoided. Communication provides fast access to specific information about the location and cause of power failures.

One example of tripping information:

Trip caused by 2317 A short circuit in phase L2 on August 27, 2013 at 14:27 p.m.

The specific details contained in this message are the basis for fast correction of the fault and create a significant potential for cost savings.

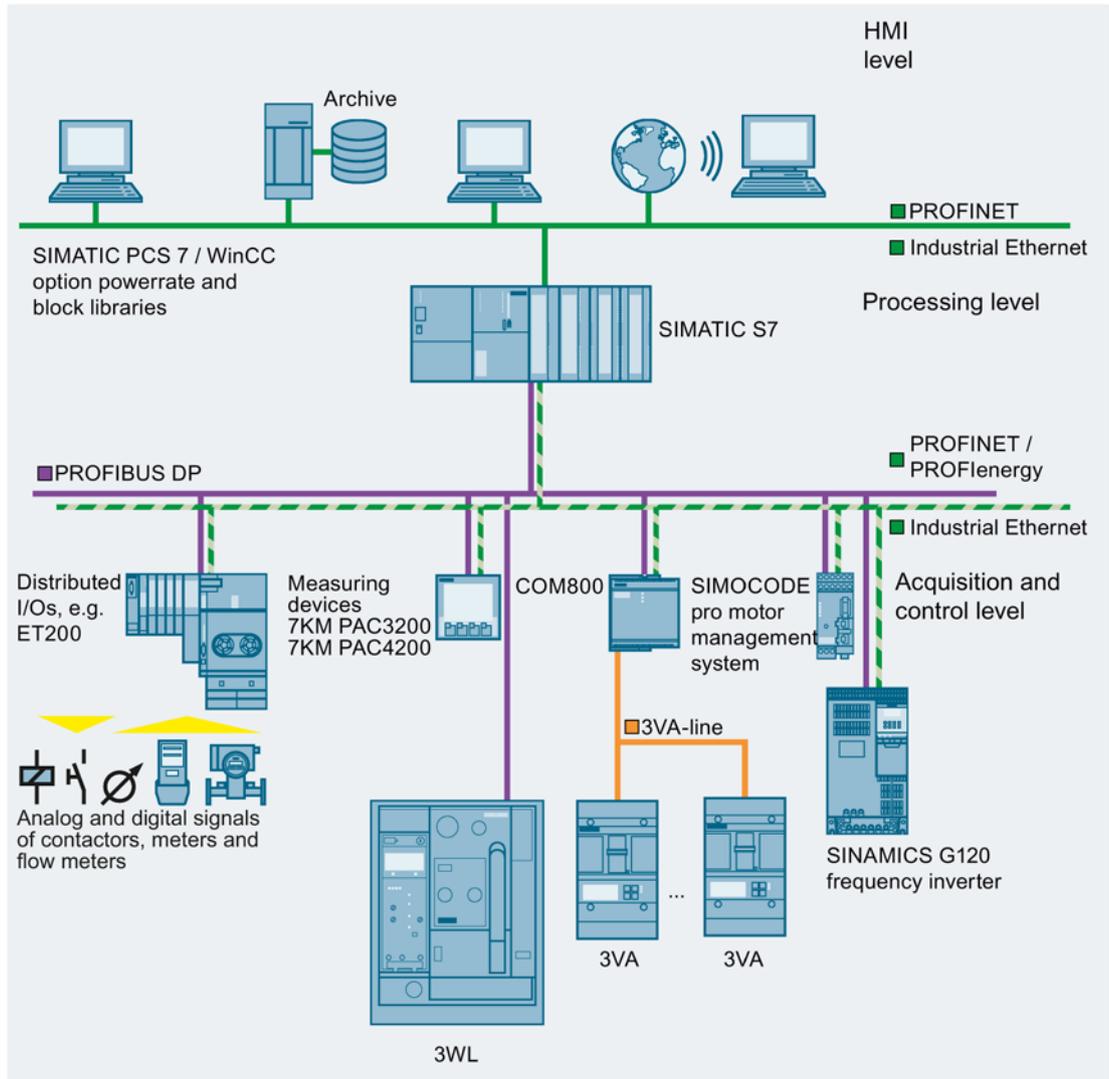
Statistics and cost-effectiveness

Recording of electrical power, energy and the power factor opens up further possibilities. Energy profiles for power distribution structures can be created and the costs can be clearly allocated thanks to the transparent representation of energy consumption for business administration analysis. Energy costs can later be optimized by compensating for load peaks and troughs.

Automation technology

SIMATIC-based solutions for the process and manufacturing industry

A key feature of the process and manufacturing industry is its very high power consumption. It therefore makes sense to integrate a power data management system into existing systems.



Communication via PROFIBUS DP

PROFIBUS DP enables integration of a wide range of devices:

- Devices for the protection of distribution boards and loads: Protective devices, such as circuit breakers
- Open-loop and closed-loop control devices: Frequency converters, motor management systems and soft starters
- Equipment for acquisition of the following information:
 - Electrical measured variables: via 7KM PAC3200/4200 measuring devices
 - Non-electrical measured variables: via analog/digital converters

PROFINET and PROFIenergy

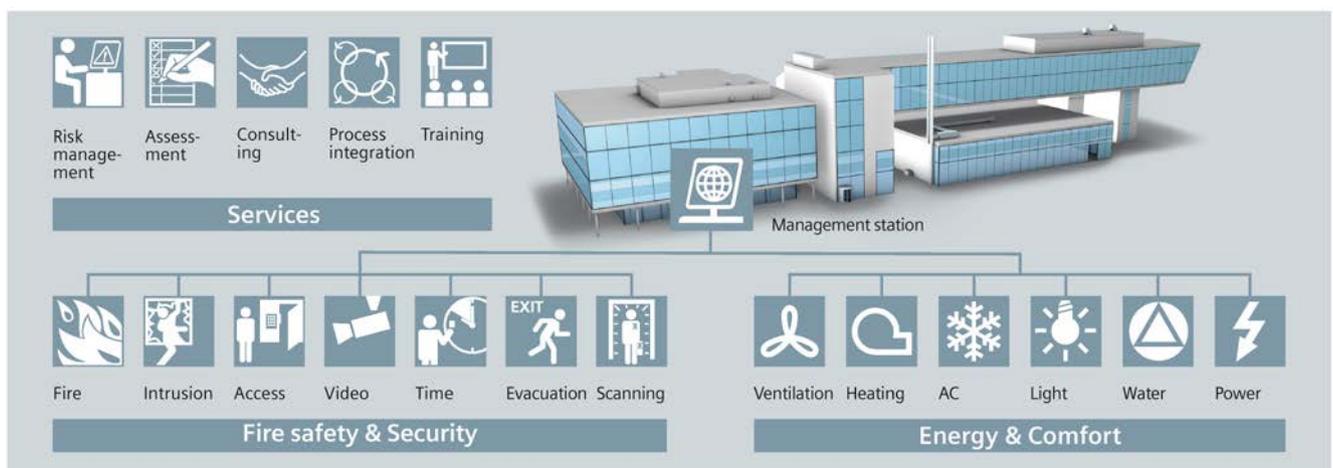
An increasing number of devices in automation technology offer PROFINET. A 7KM PAC Switched Ethernet PROFINET expansion module is also available for the 3VA molded case circuit breakers and the 7KM PAC3200 and 7KM PAC4200 measuring devices.

PROFIenergy is a "Common Application Profile" from Profibus International. Thanks to PROFIenergy it is possible to create a power data management system with standardized device interfaces.

Building automation

Intelligent buildings with Total Building Solutions

Unlike structures of the past, modern buildings need to meet many different criteria. Building services with integrated disciplines such as building automation, fire safety, security, lighting, and low-voltage power distribution are often indispensable and form the core of a total building solution. The objective of a total building solution is to achieve optimum integration of these disciplines in order to make buildings safer, more comfortable, more economical, and more efficient.



3VA molded case circuit breakers are particularly helpful in meeting power consumption and comfort targets and should be incorporated via a communication interface into the building automation system of the Designo total building solution.

Power management with powermanager

Siemens offers the powermanager software application, which is designed for power and plant monitoring applications. When used in conjunction with SENTRON measuring devices such as 3VA, 3WL, 3VL and PAC as well as equipment supplied by third parties, powermanager is a power monitoring system that reduces energy costs and increases the availability of electrical supply and distribution systems.

powermanager acquires the measured variables that are needed to optimize power consumption and so reduce costs. These variables not only include energy and power values, but also electrical parameters such as current, voltage, or power factor. Not only is this system able to display values, but also to monitor and archive them for later analysis. In addition, the load monitoring function is capable of monitoring a specified setpoint and making recommendations as to which loads should be connected and disconnected.

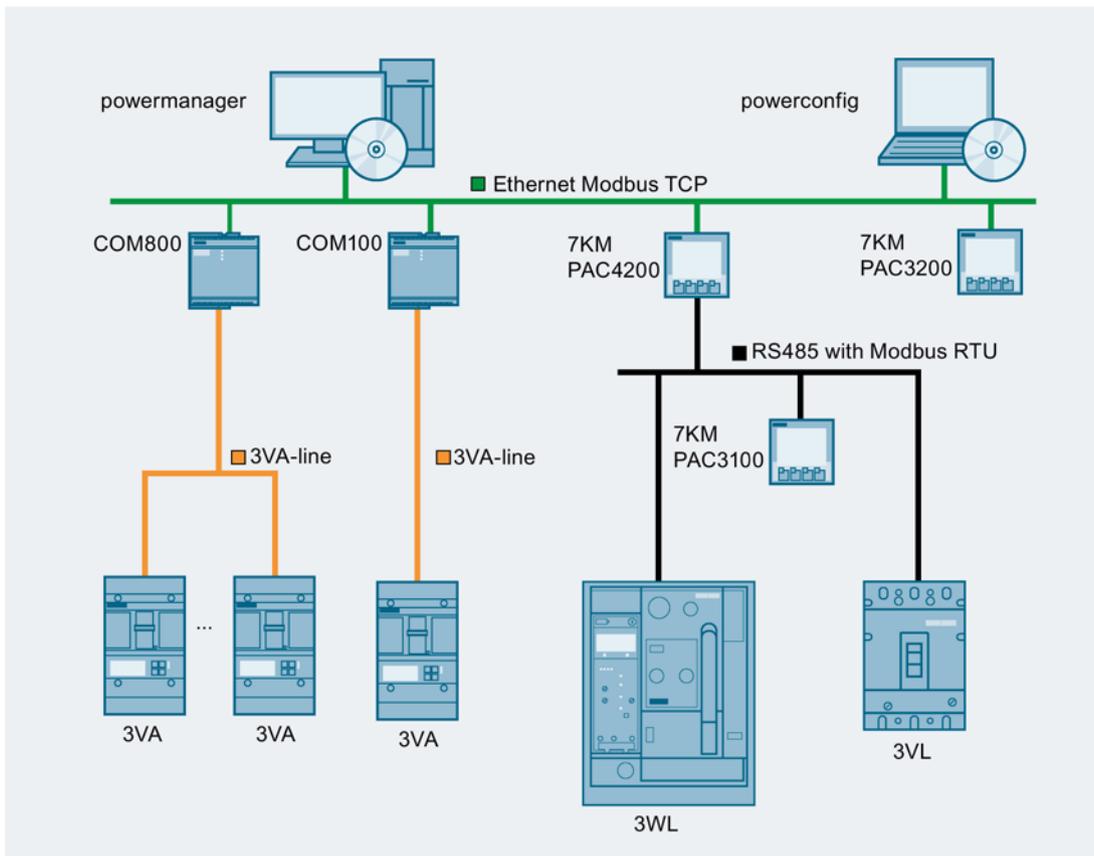
Identifying savings potential

The power monitoring software has been tested by the TÜV Rheinland for its suitability to support a power management system in accordance with ISO 50001.

Functionality and user-friendliness

The salient features and functions of the power monitoring software are as follows:

- Good scalability
- Enhanced report templates
- Response plans
- Mass parameterization
- Virtual measuring points for computing customer-specific parameters
- Load monitoring function for monitoring specified power limits for freely definable time periods
- Switching recommendations in the event of limit violations
- Remote control of circuit breakers



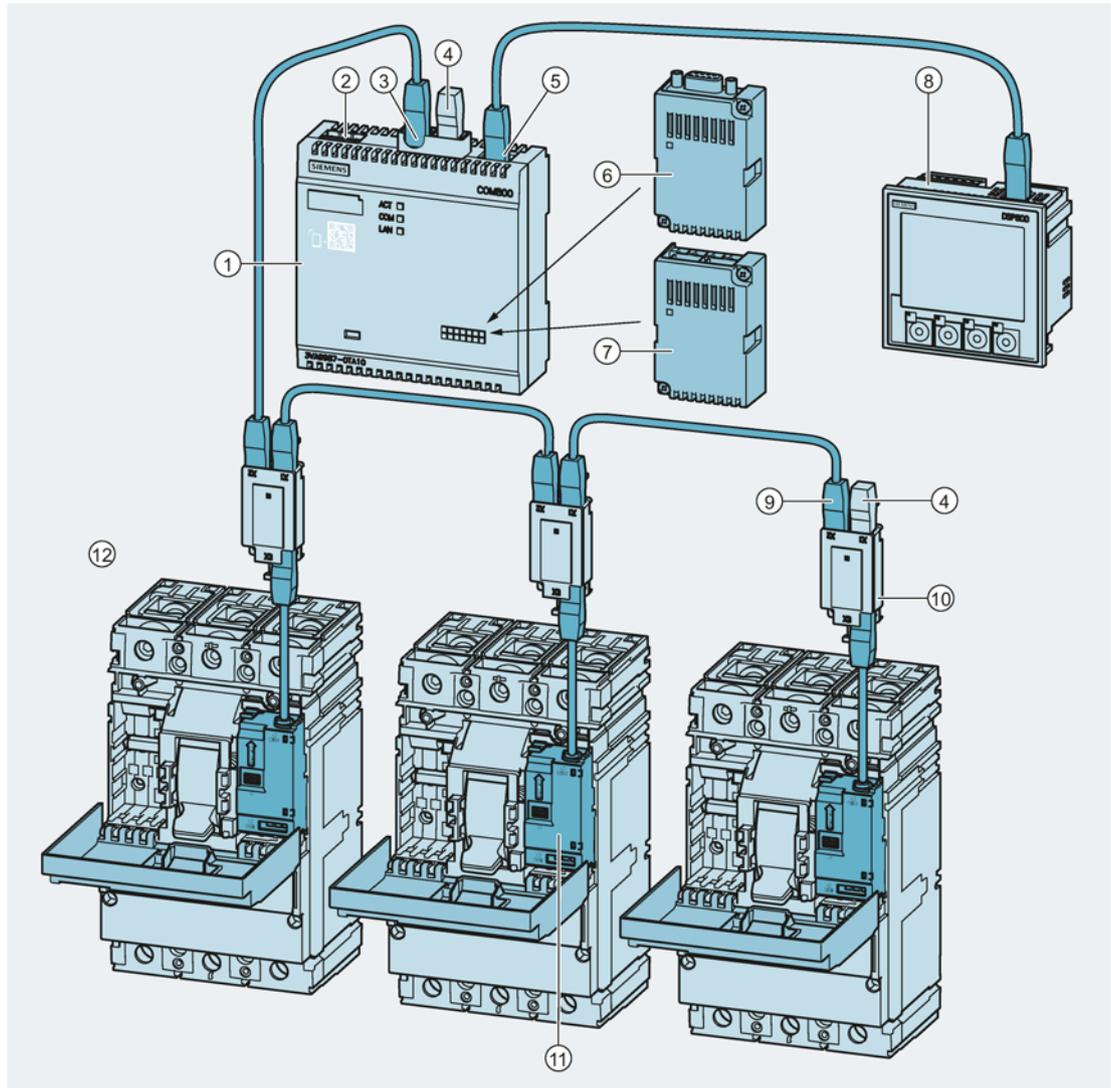
4.9.2 3VA concept 3VA-line

3VA molded case circuit breakers employ a flexible communication concept which can be tailored to specific customer requirements.

This concept is described in general terms below.

Communication concept structure

The structure of the modular communication concept is illustrated in the diagram below



- ① COM800 breaker data server
- ② 24 V supply
- ③ 3VA-line connection
- ④ Terminating resistor
- ⑤ Integrated Ethernet interface with Ethernet (Modbus TCP)
- ⑥ 7KM PAC PROFIBUS DP expansion module
- ⑦ 7KM PAC Switched Ethernet PROFINET expansion module
- ⑧ DSP800 display (powermanager and powerconfig can also be connected)
- ⑨ Connecting cable
- ⑩ T-Connector
- ⑪ COM060 communication module integrated in 3VA2 molded case circuit breaker
- ⑫ Up to a total of 8 3VA2 molded case circuit breakers per COM800

The flexible communication solution with the COM800 breaker data server

3VA2 molded case circuit breakers utilize an innovative, modern communication concept. This concept is based on the COM800 breaker data server which can link up to eight 3VA2 molded case circuit breakers to different fieldbus systems.



The COM800 / COM100 breaker data servers (see below, section "The smart communication solution with a COM100") provides an integrated Ethernet interface for operation of the circuit breaker with powerconfig, powermanager, the DSP800 display and all third-party systems which support the Ethernet (Modbus TCP) protocol.

If the Switched Ethernet PROFINET and PROFIBUS DPV 1 expansion modules are installed, the 3VA2 molded case circuit breaker can be modularly integrated into the PROFINET and PROFIBUS landscape of TIA (Totally Integrated Automation), i.e. of the SIMATIC system.

The communication equipment for the molded case circuit breakers can be installed and connected up extremely easily, reliably and efficiently thanks to the connector system used. The 24 V DC supply to the electronic trip units is also reliably provided by these connections.

The COM800 breaker data server utilizes independent supplementary functions to deliver valuable information about the connected molded case circuit breakers and the power distribution system.

- Expansion of the tripping history on the basis of the scope, quantity and time stamps of trip events
- Generation of minimum and maximum values
- Monitoring of limits for measured variables of the electronic trip units
- Power demand

You can find additional information in the 3VA Communication system manual (see Reference documents (Page 12)).

Further features of the COM800 breaker data server:

- Write-protect switch for the COM800 breaker data server and connected molded case circuit breakers
- For mounting on a 35 mm DIN rail or screw mounting by integrated fixing lugs
- Integrated Ethernet interface: Modbus TCP
- Access by powerconfig software to the COM800 breaker data server and connected molded case circuit breakers

COM800 / COM100 breaker data server and DSP800 display

The DSP800 display is designed for mounting in the cubicle door and can be optionally connected to the Ethernet (Modbus TCP) interface integrated in the COM800 / COM100 breaker data server. The DSP800 is the display unit for the breaker data server and therefore displays the data of up to eight 3VA2 molded case circuit breakers connected to the server.

The start page of the DSP800 displays the status and maximum current of all 3VA2 devices. All the detailed information about individual molded case circuit breakers can be selected via the efficiently structured menu. This includes

- Measured values of ETU 5-series and 8-series
- ETU setting parameters
- Status
- Diagnostics



The smart communication solution with a COM100

For applications involving only one 3VA2 molded case circuit breaker, the COM100 is an ideal alternative to the COM800 breaker data server.

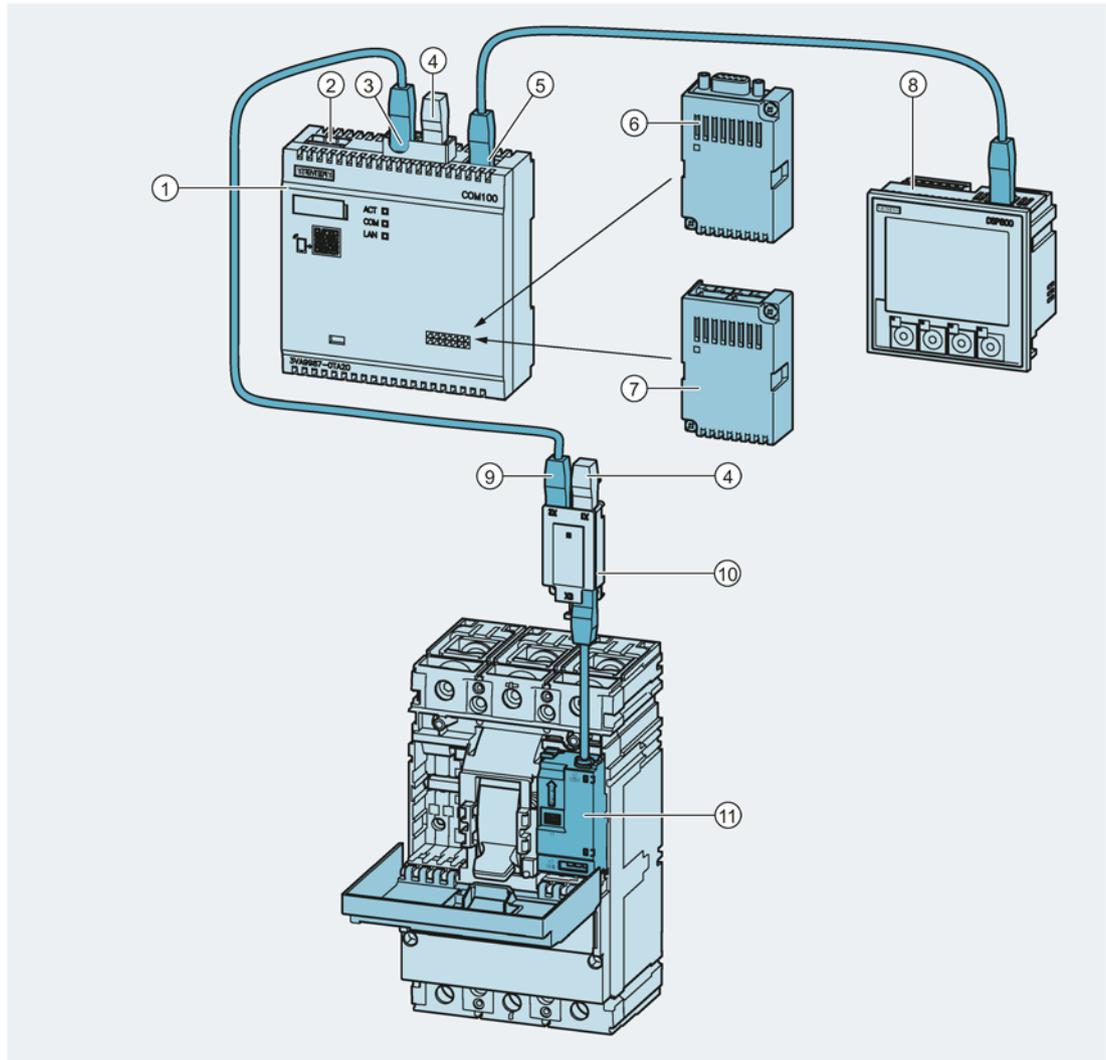


The COM100 is identical in design to the COM800 breaker data server, i.e. it is connected directly to the COM060 communication module in the 3VA2 molded case circuit breaker by means of a cable. By contrast with the flexibility offered by the COM800 breaker data server, only one single 3VA2 molded case circuit breaker can be connected to each COM100 unit.

Like the COM800 breaker data server, the COM100 features an on-board Ethernet (Modus TCP) interface and the option to install an additional PROFINET or PROFIBUS module.

Structure of the COM100 communication concept

The structure of the modular communication structure is illustrated in the diagram below:



- ① COM100
- ② 24 V supply
- ③ 3VA-line connection
- ④ Terminating resistor
- ⑤ Integrated Ethernet interface with Ethernet (Modbus TCP)
- ⑥ 7KM PAC PROFIBUS DP expansion module
- ⑦ 7KM PAC Switched Ethernet PROFINET expansion module
- ⑧ DSP800 display
- ⑨ Connecting cable
- ⑩ T-Connector
- ⑪ COM060 communication module integrated in 3VA2 molded case circuit breaker

4.9.3 Commissioning and testing of electronic trip units using powerconfig

powerconfig

powerconfig performs the following functions for 3VA molded case circuit breakers:

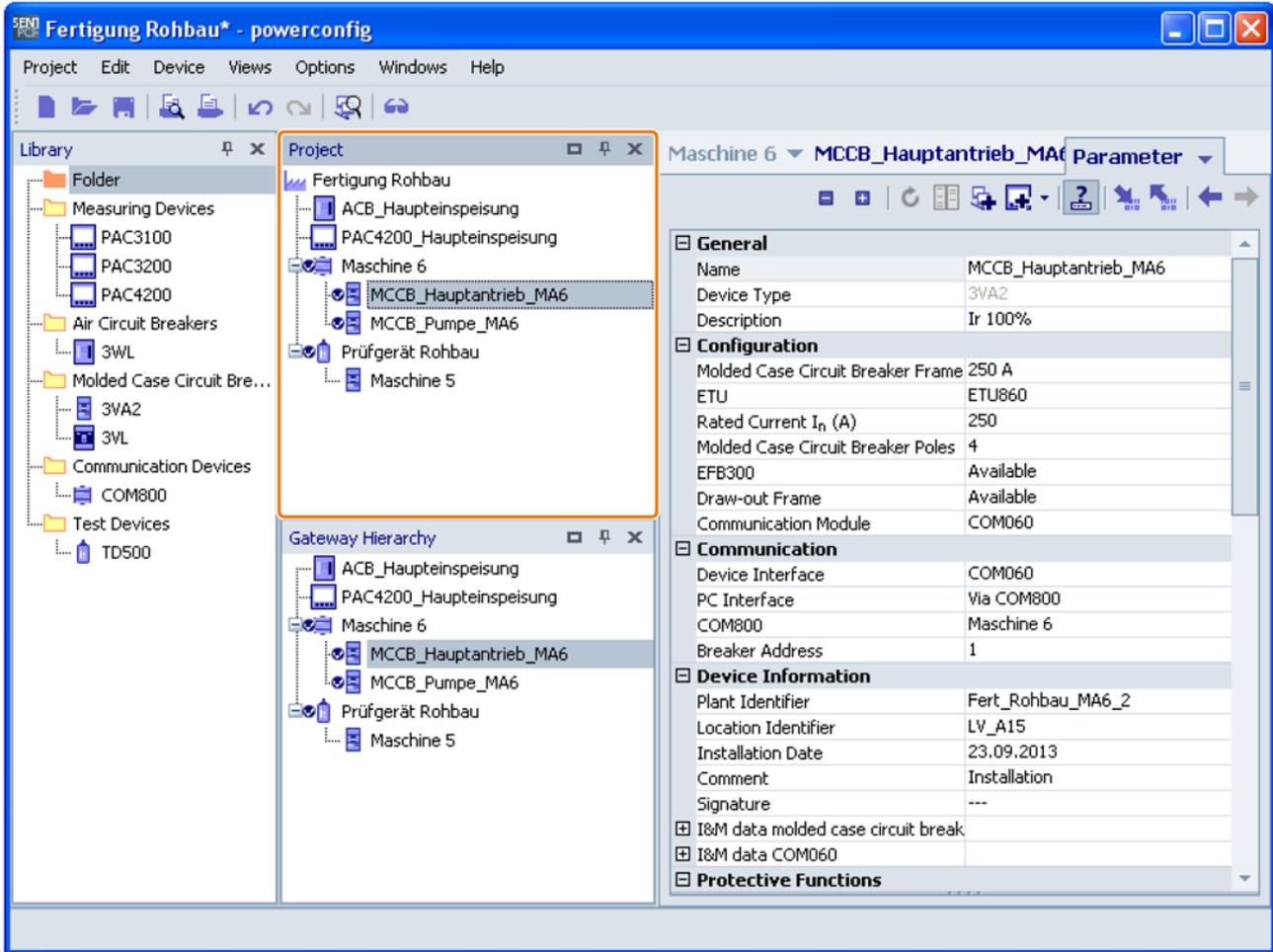
- Parameterization of 3VA ETUs and other 3VA components
- Testing of 3VA
- Commissioning of 3VA
- Statistical analysis of 3VA
- Readout of measured variables such as energy, current, voltage and power from 3VA molded case circuit breakers
- Readout of minimum and maximum values from 3VA molded case circuit breakers
- Diagnosis of 3VA

The PC on which powerconfig is installed is connected to the 3VA molded case circuit breaker by means of the COM800 / COM100 breaker data server (optionally with modules) or the TD500 test device.

The TD500 test device is required in order to perform function tests.

4.9 Communication and link-up to other systems

3VA molded case circuit breakers and, in some cases, other devices supported by powerconfig are combined in powerconfig to form a project if they are technically, organizationally, or otherwise related.

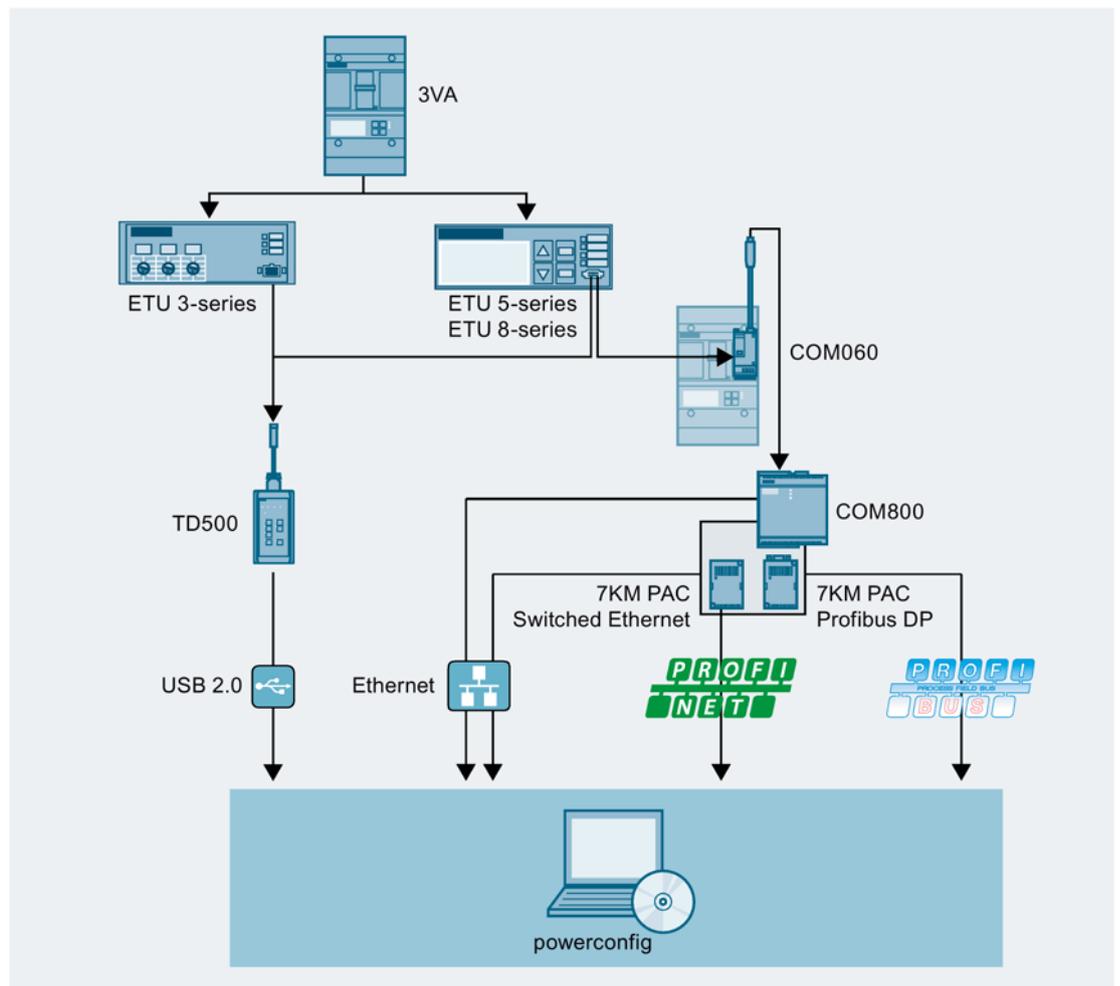


Electronic trip units (ETU), the EFB300 external function box and the communication structure can be commissioned easily by means of the powerconfig software. On completion of the commissioning process, the ETU settings can be stored as a project on the PC and printed out.

powerconfig can also be used to perform ETU trip tests. A test report is generated automatically and stored in the project every time a test is carried out.

powerconfig supports a variety of different device communication interfaces depending on the SENTRON device used:

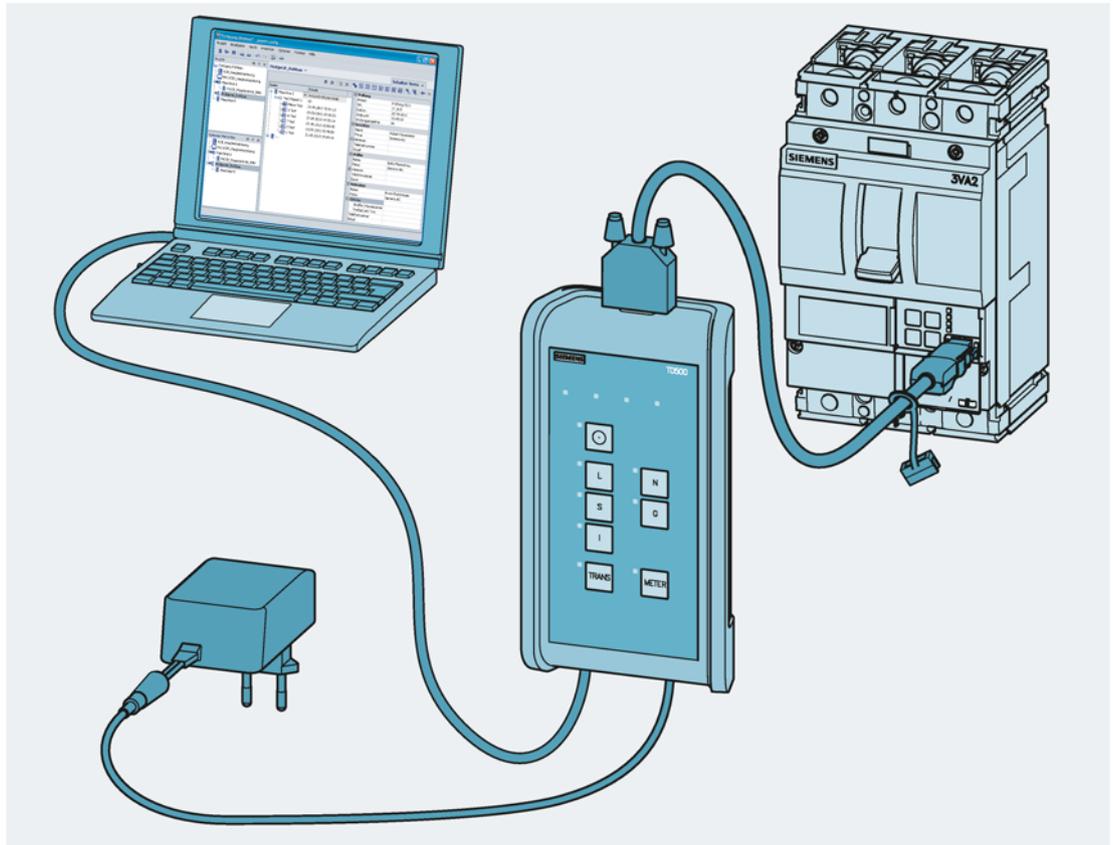
- USB
- Ethernet (Modbus TCP)
- PROFINET
- PROFIBUS



The possible means of connection of the COM800 / COM100 breaker data server are described in detail in the 3VA Communication system manual (see Reference documents (Page 12)).

4.9 Communication and link-up to other systems

With 3VA2 molded case circuit breakers and ETUs 3-series, the powerconfig software application is linked to the ETU interface via the USB interface on the PC and the interface on the TD500 test device.



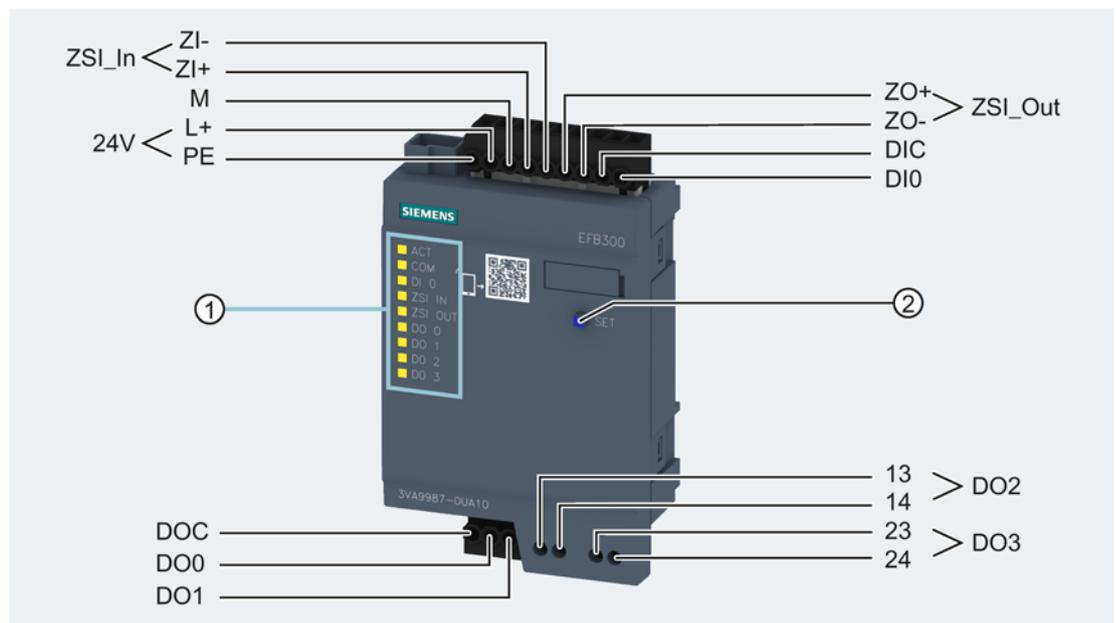
4.10 EFB300 external function box

4.10.1 General information

3VA molded case circuit breakers equipped with the electronic trip unit systems ETU 3-series, ETU 5-series and ETU 8-series can be optionally upgraded with an EFB300 external function box.

The EFB300 external function box receives information from the ETU via a cable connection. This information can be used to output active trip alarms and tripping reasons (configurable using powerconfig), which are attributable to a thermal overload event, as remote feedback via four digital outputs.

Zone selective interlocking functionality (ZSI, see chapter Zone Selective Interlocking (Page 81)) can also be implemented via the EFB300. The EFB300 also supplies the ETU with power which means that the ETU can be parameterized via the display even when a 3VA molded case circuit breaker is in the de-energized state.



- ① LED display
- ② <SET> button
- ZSI Zone Selective Interlocking
- DI Digital input
- DO 0 ... 3 Digital output

4.10.2 Power supply

The EFB300 external function box is supplied with 24 V DC and acts as a power supply for the connected ETU. This allows the ETU to remain operational even when a 3VA molded case circuit breaker has tripped.

4.10.3 Functions of the digital input and digital outputs

Functions of the digital input

Active alarms transmitted by the ETU can be acknowledged via the digital input.

Functions of the digital outputs

With the powerconfig software application, it is possible to selectively assign signals transmitted by the connected ETU to the four digital outputs of the EFB300. powerconfig can be accessed via the TD500 test device or by means of the COM800 or COM100 breaker data server through the interface to the communication system.

The following signals (dependent on the ETU) can be assigned:

- **All reasons for ETU tripping** (L, S, I, N and G) plus
Phase loss
Underload
Blocking
- **Overload alarms AL 1 and AL 2**
- **Pre-trip alarm for overload protection**
An alarm is output in advance of a trip event, allowing time for a load to be shut down before a maximum output or current limit is exceeded.
- **Load shedding/load pick up**
By means of the load shedding and load pick up signals, a load can be switched off or connected automatically depending on the capacity utilization of the 3VA molded case circuit breaker.
- **RCD trip**
- **Energy pulse** (with ETU 8-series only)
An energy pulse (S0 signal pulse) contains information pertaining to the consumption of a specific quantity of energy. The data are transmitted by weighted pulses, i.e. a specific number of pulses are transferred to represent one kWh unit.
Settings for the energy pulse, see table on next page.

Example of energy pulse:

Energy meter source:	Active energy kWh
Pulses per unit:	5
Unit:	20 kWh
Pulse length:	30 ms
Output of 140 kWh:	Output of 35 pulses, each 30 ms in length

Overview of functions available with EFB300 external function box

Version available with		ETU320 LI	ETU330 LIG	ETU350 LSI	ETU550 LSI	ETU560 LSIG	ETU850 LSI	ETU860 LSIG
3-pole breaker without external neutral conductor transformer		■	■	■				
3-pole breaker with external neutral conductor transformer					■	■	■	■
4-pole breaker with protected neutral conductor transformer		■	■	■	■	■	■	■
Configurable trip alarms and output signals								
Trip reason overload		■	■	■	■	■	■	■
Trip reason short-time delayed short-circuit				■	■	■	■	■
Trip reason instantaneous short circuit		■	■	■	■	■	■	■
Trip reason overload at neutral conductor			■	■	■	■	■	■
Trip reason ground fault protection			■	■		■	■	■
Trip reason overtemperature		■	■	■	■	■	■	■
Trip reason RCD (residual current)		■	■	■	■	■	■	■
Alarm level 1 for overload		■	■	■	■	■	■	■
Alarm level 2 for overload		■	■	■	■	■	■	■
Pre-trip alarm for overload		■	■	■	■	■	■	■
Temperature alarm		■	■	■	■	■	■	■
Alarm ground-fault protection			■	■		■	■	■
Alarm to indicate internal ETU fault		■	■	■	■	■	■	■
Undershooting of threshold for load reconnection		■	■	■	■	■	■	■
Overshooting of threshold for load shedding		■	■	■	■	■	■	■
Energy pulse							■	■
Energy source	Apparent energy (kVAh)						■	■
	Active energy (kWh) import						■	■
	Active energy (kWh) export						■	■
	Reactive energy (kvarh) inductive						■	■
	Reactive energy (kvarh) capacitive						■	■
Weighted pulse	1 ... 1000 (in steps of 1 in kWh or kVAh)						■	■
Pulse width	30 ... 500 ms (in steps of 10 ms)						■	■
Time-delayed Zone Selective Interlocking ZSI			■	■	■	■	■	■
Load monitoring		■	■	■	■	■	■	■

4.10.4 Zone-selective interlocking ZSI

Description

The microprocessor-controlled, zone-selective interlocking function ZSI has been developed in order to control the total breaking time in low-voltage networks with multiple molded case circuit breakers connected in series.

Advantage of ZSI:

Regardless of the number of series-connected molded case circuit breakers, all short circuits in the network can be cleared within a maximum time period of 50 ms. Short-circuit clearance times should be minimized, particularly in the case of system short circuits of very large magnitude.

Note

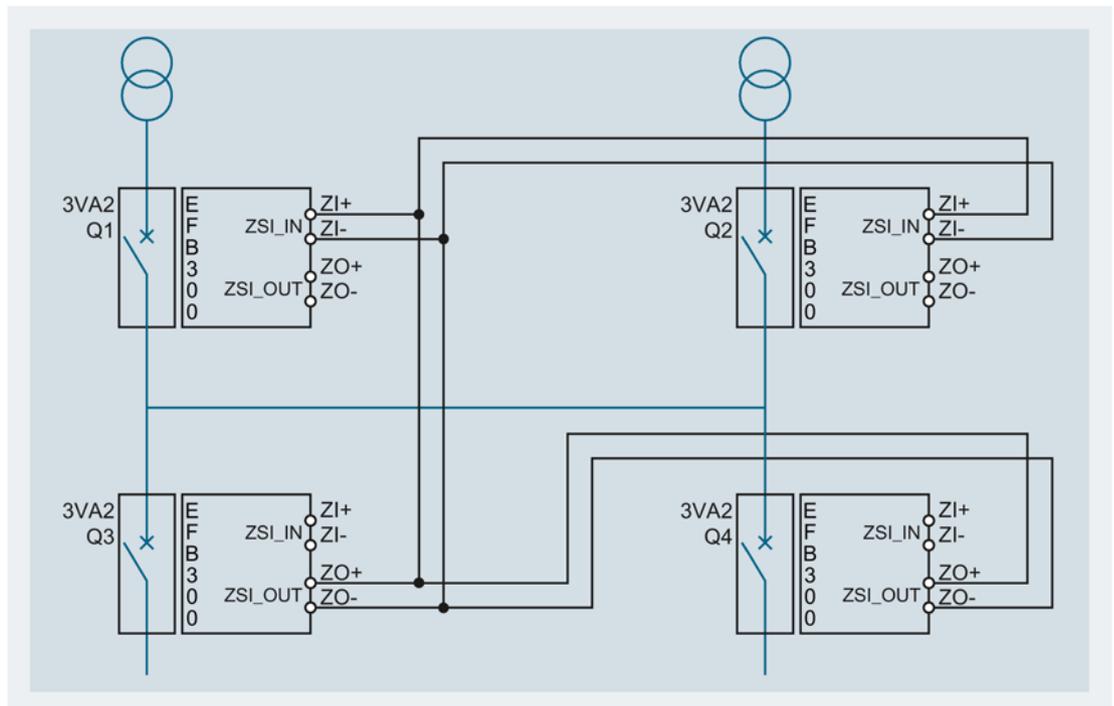
Downward compatibility

The ZSI function is downward-compatible with the ZSI function of the 3VL and 3WL series of molded case circuit breakers.

Connection

Use of the ZSI function is conditional upon the connection of a dedicated EFB300 external function box to each 3VA2 molded case circuit breaker. The EFB300 allows molded case circuit breakers to communicate with one another, a capability which is a basic requirement for the ZSI function.

To permit utilization of the ZSI function, EFB300 external function boxes must be interconnected as illustrated below:



See also

Zone-selective interlocking ZSI (Page 81)

4.10.5 <SET> button

The <SET> button performs the following functions depending on mode:

- Operating mode: Acknowledgment of signals
- Test mode: Execution of a test function

Operating mode

The EFB300 external function box is in operating mode during operation. Operation of the EFB300 is indicated by steady illumination of the LED labeled "ACT".

If a tripped signal is present at an output (output is activated), the user can acknowledge the signal or reset the output. This can be done by various methods:

- By application of a signal to the digital input of the EFB300
- By brief actuation of the <SET> button on the EFB300
- By actuation of the <ESC> button on the ETU

LED states in operating mode

LED	Meaning	Description
<input type="checkbox"/> ACT	Off	EFB300 not active
 ACT	On	EFB300 ready
<input type="checkbox"/> COM	Off	No communication link with ETU
 COM	Flashing (2 Hz)	Establishing communication link with ETU
 COM	On	Communication link with ETU established
<input type="checkbox"/> DI 0	Off	Input not activated
 DI 0	On	Input activated
<input type="checkbox"/> ZSI IN	Off	ZSI function not activated
 ZSI IN	On	ZSI function activated
<input type="checkbox"/> ZSI OUT	Off	No ZSI Out signal transmitted
 ZSI OUT	On	ZSI Out signal transmitted
<input type="checkbox"/> DO 0	Off	No valid reason for trip signal
 DO 0	On	Active trip signal
<input type="checkbox"/> DO 1	Off	No valid reason for trip signal
 DO 1	On	Active trip signal
<input type="checkbox"/> DO 2	Off	No valid reason for trip signal
 DO 2	On	Active trip signal
<input type="checkbox"/> DO 3	Off	No valid reason for trip signal
 DO 3	On	Active trip signal

 Steady illumination

 Flashing

Off

Simultaneous flashing of all LEDs indicates that the EFB300 is defective.

ACT	COM	DI 0	ZSI IN	ZSI OUT	DO 0	DO 1	DO 2	DO 3	
									EFB300 defective

 Flashing

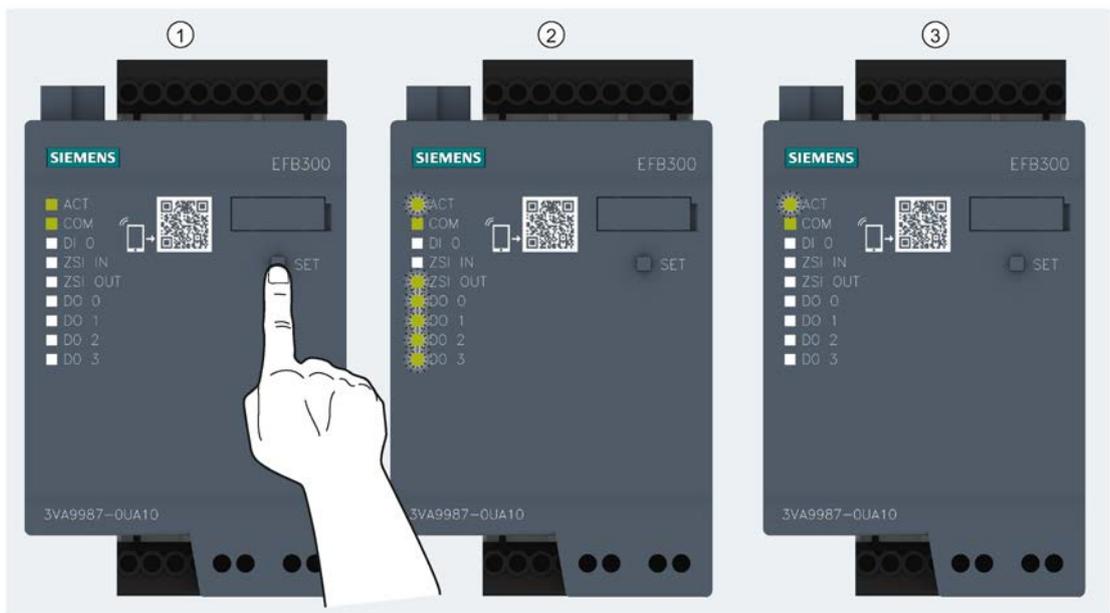
Test mode

All inputs and outputs can be activated or deactivated manually in test mode. This can be done to determine whether the digital outputs and the ZSI bus are functioning properly and wired correctly.

The LED labeled "ACT" flashes to indicate that test mode is active. The powerconfig software can also be used to test outputs.

Activating test mode and performing tests

1. In order to activate test mode, press the <SET> button for at least 2 seconds ① until all the LEDs for the outputs light up briefly ②. Test mode is activated when the LED labeled "ACT" starts to flash ③.



2. Press the <SET> button briefly.
LED "ZSI_OUT" flashes, the ZSI output is selected.



3. In order to activate the selected output, press the <SET> button for longer than 2 seconds.
The LED of the selected output changes from flashing to steady illumination to indicate activation of the selected output.

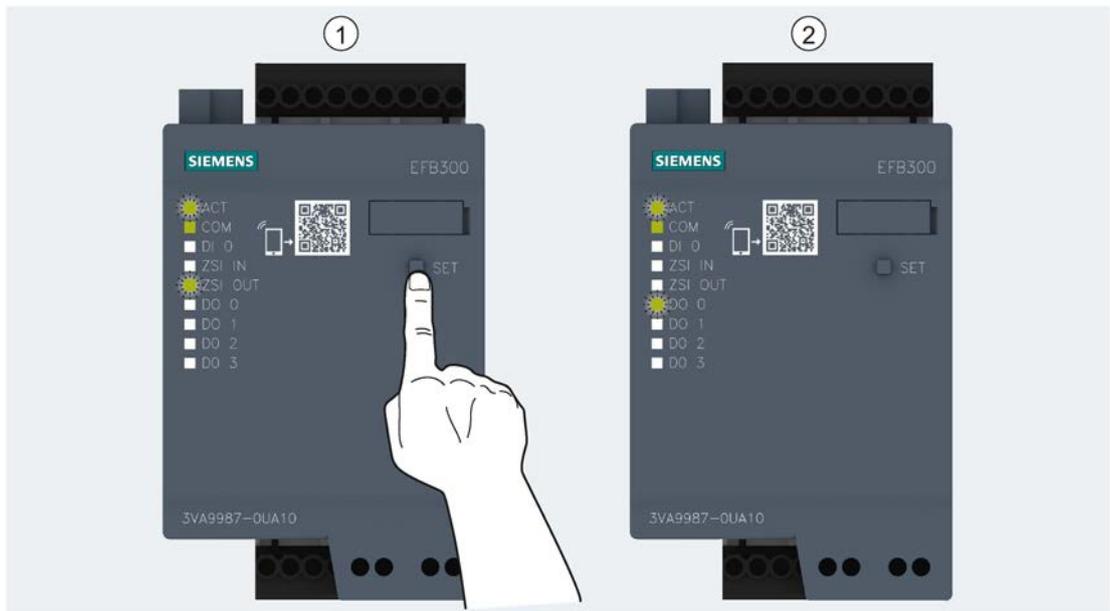


4.10 EFB300 external function box

- 4. In order to deactivate the output again, press the <SET> button again for longer than 2 seconds.
The LED of the activated output will change from steady illumination to flashing. The output is deactivated, but still selected.



- 5. In order to select the next output, press the <SET> button briefly ①.
The LED of the next output starts to flash ②, the output is selected.



- 6. Repeat steps 3 to 5 in order to check the wiring of all digital outputs in succession.

Terminating test mode

If the <SET> button is not pressed for a period of three minutes after selection of an output, test mode is terminated automatically and the EFB300 reverts to operating mode.

Alternative method:

After working through the entire menu structure (only the LED labeled "ACT" flashes), press the <SET> button for longer than 2 seconds.

LED states in test mode

LED	Meaning	Description
<input type="checkbox"/> ACT	Off	EFB300 not active
 ACT	Flashing (2 Hz)	Test mode active
<input type="checkbox"/> COM	Off	No communication link with ETU
 COM	Flashing (2 Hz)	Establishing communication link with ETU
 COM	On	Communication link with ETU established
<input type="checkbox"/> DI 0	Off	Input not activated
 DI 0	On	Input activated
<input type="checkbox"/> ZSI IN	Off	ZSI function not activated
 ZSI IN	On	ZSI function activated
<input type="checkbox"/> ZSI OUT	Off	No ZSI Out signal transmitted
 ZSI OUT	On	ZSI Out signal transmitted
<input type="checkbox"/> DO 0	Off	Output not selected
 DO 0	Flashing (2 Hz)	Output selected
 DO 0	On	Output selected and activated
<input type="checkbox"/> DO 1	Off	Output not selected
 DO 1	Flashing (2 Hz)	Output selected
 DO 1	On	Output selected and activated
<input type="checkbox"/> DO 2	Off	Output not selected
 DO 2	Flashing (2 Hz)	Output selected
 DO 2	On	Output selected and activated
<input type="checkbox"/> DO 3	Off	Output not selected
 DO 3	Flashing (2 Hz)	Output selected
 DO 3	On	Output selected and activated

 Steady illumination

 Flashing

Off

4.10.6 Technical specifications

Dimensions and weights		
Suitability for application		Installation in fixed switchboard inside enclosed rooms
Type of mounting		
DIN rail (35 mm)		Yes
Flat mounting		Yes
Mounting position		Vertical
Width	mm	70
Height	mm	115
Depth	mm	34
Weight (net)	g	145
Functions		
ETU power supply		Yes
Data exchange with ETU		Yes
Digital input and output module		Yes
Supply		
Rated power dissipation P_v	VA	4
Rated control supply voltage U_c	V DC	24
Operating range	x U_c	$\pm 20\%$
Power consumption	A	≤ 0.16
Communication with molded case circuit breakers		
Number of 3VA-line interfaces		1
Length of cable	m	1.5
ZSI		
Number of breakers which can be connected to ZSI IN		≤ 20
Number of breakers which can be connected to ZSI OUT		≤ 8
Cable for ZSI		Flexible, shielded (min. 85 % coverage), twisted cable, max. capacitance: 200 nF/km (cable/shield), 160 nF/km (cable/cable), inductance 0.65 H/km, total cable resistance: max. 28 ohms
Cable length for ZSI		< 600 m / 0.75 mm ² (AWG 18) < 1200 m / 1.5 mm ² (AWG 16) < 2000 m / 2.5 mm ² (AWG 14)

4.10 EFB300 external function box

Digital input		
Number of digital inputs		1
Rated operational voltage	V DC	24
Working range		+ 20 % IEC: SELV/PELV
Voltage value for reliable detection of a "1" signal	V	15
Voltage value for reliable detection of a "0" signal	V	≤ 5
Digital outputs		
Number of relays		2
Voltage		IEC: ≤ 250 V AC/DC
Rated uninterrupted current		6 A
Rated switching capacity	AC-12 / 250 V AC-15 / 250 V DC-12 / 250 V DC-13 / 250 V	A 6 A 3 A 0.2 A 0.1
Output current for signal <1>	mA	10 ... 27
Output current for signal <0>	mA	≤ 0.2
Design of fuse link for short-circuit protection of auxiliary contacts of output relay	A	6
Specified fuse for auxiliary contacts		Fuse links, operating class gL/gG 6A
Overvoltage category		III (relays) I (all others)
Number of semiconductor outputs		2
Rated voltage		24 V DC ± 20 % IEC: SELV/PELV
Rated operational current	mA	100
Connection elements and terminals		
Design of electrical connection		
- inputs for supply voltage		removable / plug-in
- at inputs for supply voltage		Screw-type terminal
Type of connectable conductor cross-sections		
- solid	mm ²	0.5 ... 2.5
- finely stranded / with end sleeve	mm ²	0.5 ... 2.5
- with AWG cables / solid		1 x 21 ... 14; 2 x 21 ... 16
Tightening torque	Nm	0.4 ... 0.5
Electromagnetic compatibility		
Conducted or radiated emissions		EN 61000-6-3 / FCC Class A and marine engineering requirements
Immunity in industrial environments		EN 61000-6-2 and marine engineering requirements
Ambient conditions		
Ambient temperature		
- during operation	°C	-25 ... +60
- during operation with derating of rated operational current of digital outputs to 80 mA	°C	-25 ... +70
- during storage and transportation	°C	-25 ... +70
Pollution degree		3
Degree of protection and protection class		
Degree of protection (according to IEC 60529)		IP20

4.11 Test devices

Test devices are required in order to perform local tests on 3VA2 molded case circuit breakers equipped with electronic trip units (ETUs).

Two versions of the test devices are available:

- TD300 activation and trip box
- TD500 test device

Functional scope of test devices

ETU	TD300 activation and trip box			TD500 test device		
	3-series	5-series	8-series	3-series	5-series	8-series
Activation of ETUs		■	■	■	■	■
Mechanical trip tests	■	■	■	■	■	■
Testing of trip functions				■	■	■
Testing of metering function				■	■	■
Testing of transformers ¹⁾				■	■	■
Connection to a PC with powerconfig				■	■	■
ETU parameterization					■ ²⁾	■ ²⁾
Saving test results				■	■	■

1) One energy transformer, one Rogowski coil

2) Via powerconfig

4.11.1 The TD300 activation and trip box

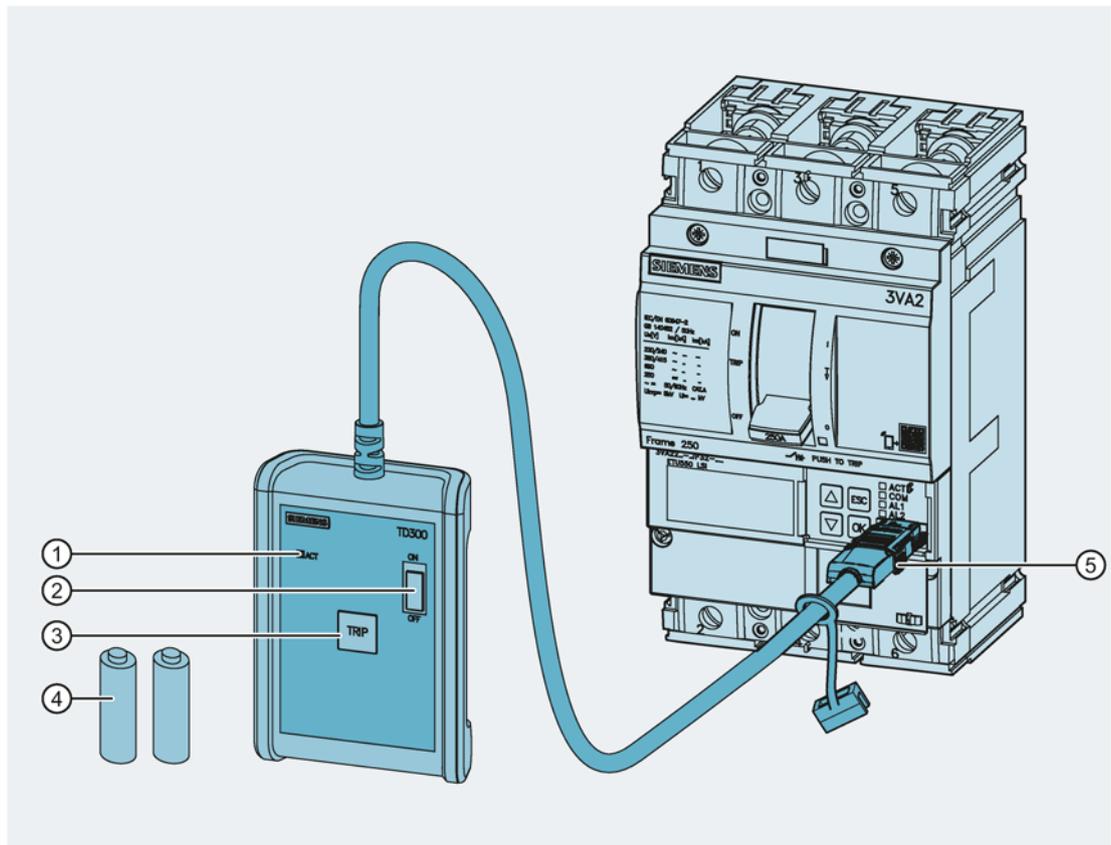
The TD300 activation and trip box is a mobile, battery-operated local test device. Its purpose is:

- To supply the ETU with power so that the ETU can be parameterized when the molded case circuit breaker is switched off and de-energized.
- To test and service the electronic trip unit (ETU).

The power supply is provided by two AA batteries included in the scope of supply.

The TD300 activation and trip box is designed for ease of handling with dimensions of 76 x 107 x 25 mm (W x H x D).

Description of the TD300 activation and trip box



- ① LED "ACT" for indicating the battery status
- ② Slide switch ON/OFF
- ③ <TRIP> pushbutton for testing the molded case circuit breaker
- ④ 2 1.5 V AA batteries
- ⑤ Plug-in connector for insertion in the test socket on the ETU

4.11.1.1 Operation and execution of the tripping function

**CAUTION**

Personal injury, spurious tripping and irreparable damage to the TD300 activation and trip box

Use of the TD300 when the molded case circuit breaker is not de-energized can result in personal injury, spurious tripping of the circuit breaker and irreparable damage to the TD300.

Disconnect the molded case circuit breaker from the power supply before using the TD300 activation and trip box.

TD300: Connect, switch on and off, disconnect

Connect the TD300 to the 3VA2 molded case circuit breaker

1. Disconnect the molded case circuit breaker from the power supply.
2. Insert the connecting cable in the test socket of the ETU.

Switch the TD300 on and off

1. Check whether the molded case circuit breaker is disconnected from the power supply. If it is not, disconnect it.
2. Push the slide switch to ON.
The LED labeled "ACT" on the TD300 lights up and the ETU display is activated. The TD300 is ready.

If the "ACT" LED does not light up:

- Push the slide switch to OFF.
- Detach the connecting cable from the molded case circuit breaker.
- Replace the batteries.
- Follow the correct sequence of steps to connect the unit to the molded case circuit breaker again.
- Push the slide switch to ON.

3. Push the slide switch to OFF.
The LED labeled "ACT" on the TD300 goes out to indicate that the unit is switched off.

Disconnect the TD300 from the 3VA2 molded case circuit breaker

1. Switch off the molded case circuit breaker (OFF position).
2. Detach the connecting cable from the molded case circuit breaker.

LED states when the TD300 and the molded case circuit breaker are switched on

TD300	ETU				Description
ACT	ACT	COM	AL1	AL2	
					
			<input type="checkbox"/>	<input type="checkbox"/>	TD300 and ETU are ready
<input type="checkbox"/>	 	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	The batteries on the TD300 need to be replaced
					TD300 is ready ETU is not ready

Test the molded case circuit breaker (mechanical trip test)

1. Connect the TD300 to the molded case circuit breaker in the correct sequence and switch on.
2. Switch on the molded case circuit breaker (ON position).
3. Press the pushbutton labeled <TRIP> on the TD300.

The molded case circuit breaker trips:

The molded case circuit breaker is functioning correctly.

The molded case circuit breaker does not trip:

- Switch off the TD300.
- Switch off the molded case circuit breaker (OFF position).
- Detach the connecting cable from the molded case circuit breaker.
- Connect the TD300 correctly to the molded case circuit breaker again and switch on.
- Repeat the trip test (by pressing the pushbutton labeled <TRIP> on the TD300).
- If the molded case circuit breaker fails to trip again, contact Technical Support (Page 12) .

4.11.1.2 Technical specifications of TD300

Mechanical characteristics		
Height	mm	107
Width	mm	76
Depth	mm	25
IP degree of protection		IP30
Ambient temperature		
- in operation	°C	-10 ... +40
- in storage	°C	-40 ... +50
- with installed battery		
- in storage	°C	0 ... +25
Mounting position		Any
Interface to circuit breaker		
Number of circuit breakers / directly connectable		1
Length / of connecting cable	m	1
Power supply		
Type of batteries		AA, alkaline, 1.5 V
Approvals / certificates:		
Declaration of conformity		
 EG-Konf.		

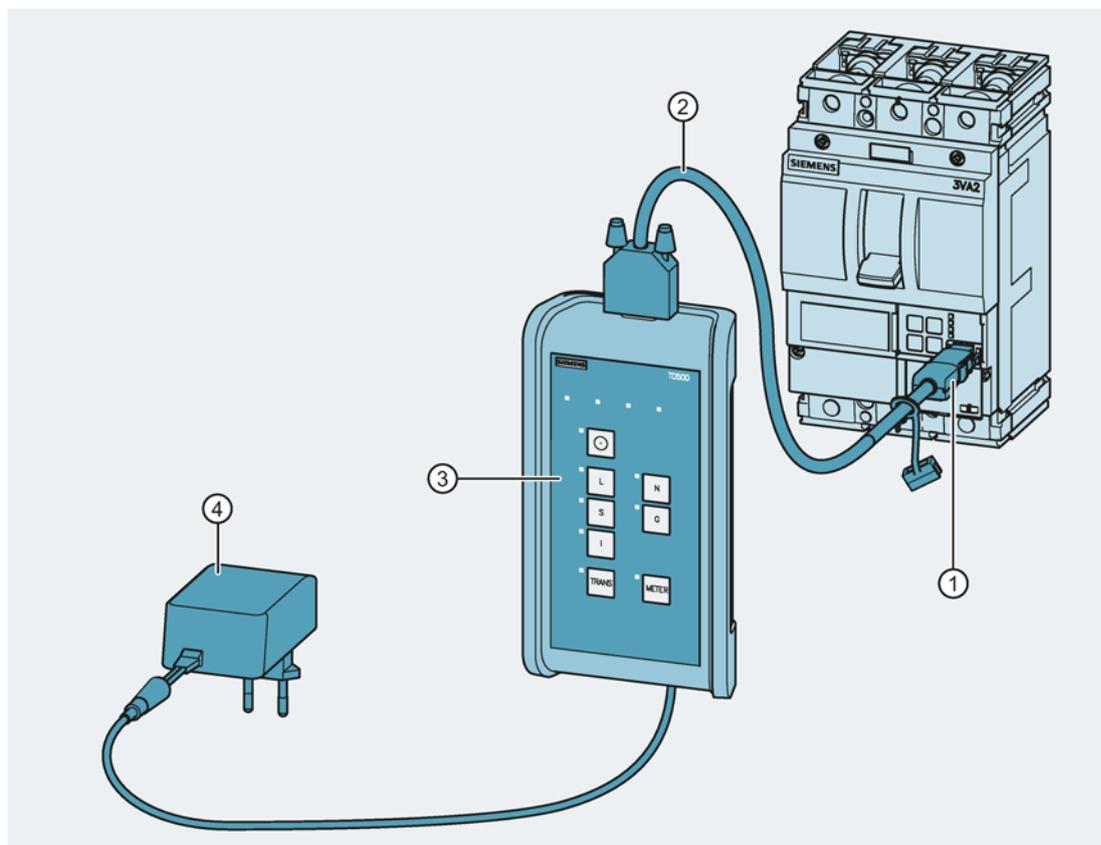
4.11.2 The TD500 test device

The TD500 mobile test device can be used to test the different causes of ETU trips. It is therefore useful for checking the proper functioning and correct wiring of all connected system components before the 3VA2 molded case circuit breaker is commissioned. The system behaves as it would in the case of a real trip event. The molded case circuit breaker trips when the set delay times expire and signals all alarms and tripped signals from connected components.

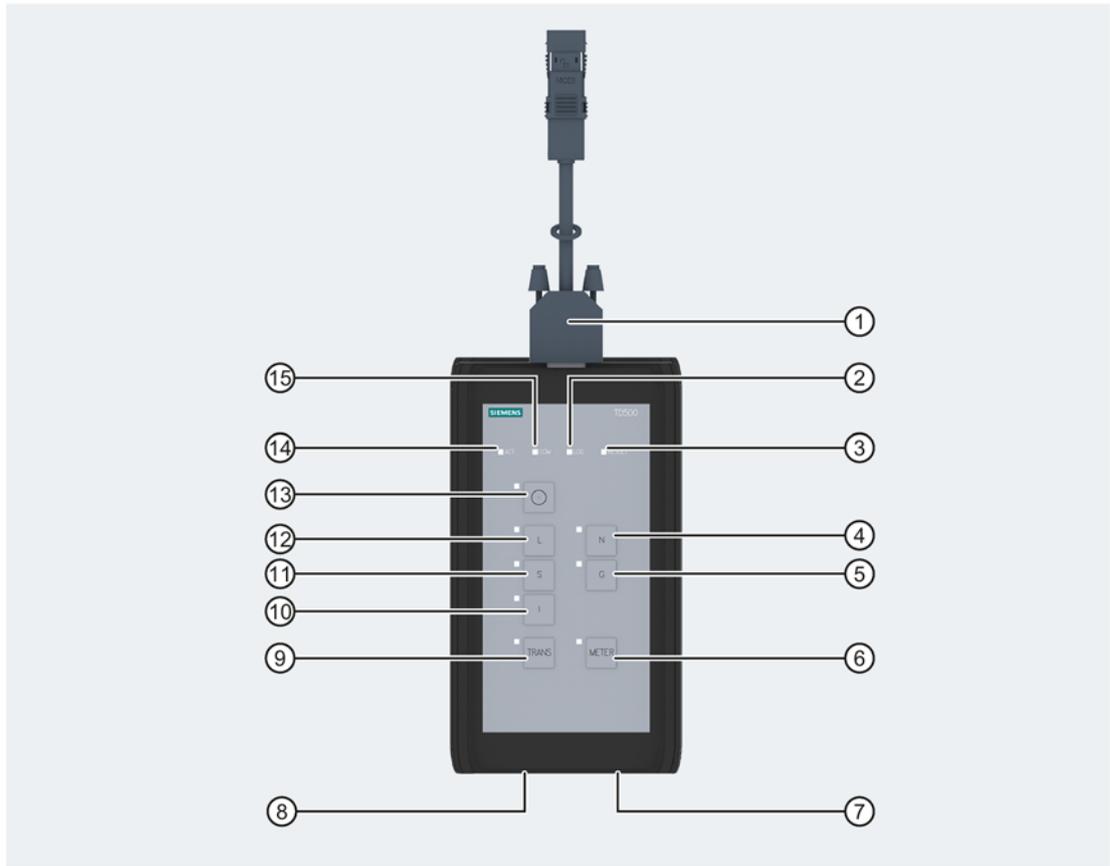
Benefits of the TD500 test device

- A TD500 test device via powerconfig can be used to successively parameterize all 3VA2 molded case circuit breakers directly in situ.
- The device can store up to 100 test results.
- Using the TD500 test device and the powerconfig software, it is possible to read out all diagnostic data of the 3VA2 molded case circuit breaker either digitally or as a hardcopy.
- In addition, test functions can be performed directly on the PC with the powerconfig software.

Description of the TD500



- ① Plug-in connector for insertion in the test socket on the ETU
- ② TD500-to-ETU connecting cable
- ③ TD500 test device
- ④ Power supply unit



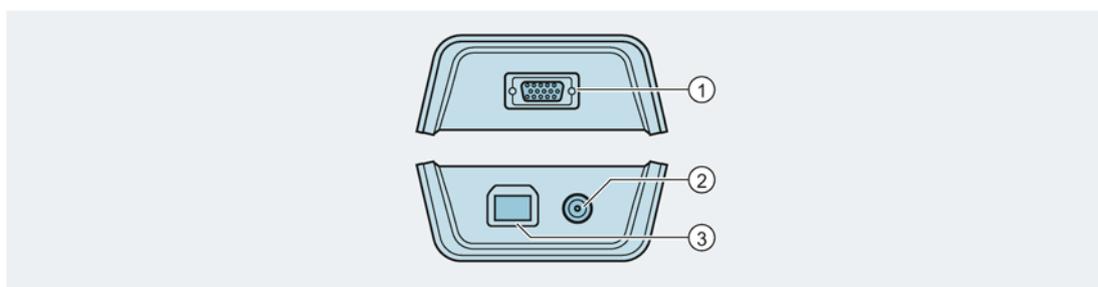
- ① Connecting cable for ETU
- ② LED "LOG" (available memory status)
- ③ LED "RESULT"
- ④ Pushbutton for neutral trip test N
- ⑤ Pushbutton for ground fault trip test G
- ⑥ Pushbutton for meter test (current measurement display)
- ⑦ PC connection
- ⑧ Mains cable connection
- ⑨ Pushbutton for transformer test
- ⑩ Pushbutton for instantaneous short-circuit trip test I
- ⑪ Pushbutton for short-time delayed short-circuit test S
- ⑫ Pushbutton for overload trip test L
- ⑬ Pushbutton for ETU Power ON/OFF
- ⑭ LED "ACT" (status)
- ⑮ LED "COM" (communication status)

LED display

LED	Meaning	Description
<input type="checkbox"/> ACT	Off	TD500 switched off
 ACT	On	TD500 ready
<input type="checkbox"/> COM	Off	No communication link with ETU
 COM	Flashing (2 Hz)	- Establishing communication link with ETU - Communications error - TD500 not ready
 COM	On	Communication link established with ETU
<input type="checkbox"/> LOG	Off	No free memory space The TD500 device can continue to be used, but the results of the trip tests will no longer be stored on the TD500. The device is still capable of executing all test functions.
 LOG	Flashing (2 Hz)	Available memory space < 25 % The TD500 device can continue to be used without restriction, but there is only enough memory space available to store a few test results. In order to ensure safe storage of test results, save the existing results to a PC and delete the contents of the TD500 memory using powerconfig.
 LOG	On	Free memory space ≥ 25 % The TD500 device can continue to be used without restriction.
<input type="checkbox"/> RESULT	Off	No test has been carried out and no test result has been recorded.
 RESULT	Flashing red (2 Hz)	It has not been possible to establish whether or not the molded case circuit breaker is functioning correctly.
 RESULT	On	No faults have been detected.

Interfaces of the TD500 test device

The diagram below shows the physical interfaces of the TD500 test device.



- ① Top of unit: Connection to 3VA2 molded case circuit breaker
- ② Bottom of unit on right: 24 V DC supply
- ③ Bottom of unit on left: Connection to PC

Compatibility with molded case circuit breakers

The TD500 test device can be connected to all 3VA2 molded case circuit breakers equipped with ETU 3-series, 5-series and 8-series. The connecting cable from the test device is inserted in the test socket of the ETU.

Data stored in the TD500

The following data are stored in the TD500:

- Article number
- ETU parameter settings
- Causes of ETU trips

Note

Readout of data and clearing of the internal memory of the TD500

Using a PC and the powerconfig software, you can read these data out of the TD500 and clear its internal memory.

Test functions of the TD500

The relevant pushbutton must be pressed in order to start a specific test. The molded case circuit breaker is tripped electronically when the pushbutton is actuated. This is essential to allow effectual testing of the electronic and mechanical control elements of the circuit breaker.

Test	Description
L test	Overload function test The circuit breaker trips when the time setting t_r elapses
S test	Function test on the short-time delayed short-circuit protection system The circuit breaker trips when the time t_{sd} set on the ETU elapses
I test	Function test on the instantaneous short-circuit protection system The circuit breaker trips instantaneously
N test	Function test on neutral conductor protection system The circuit breaker trips when the time t_r set on the ETU elapses
G test	Function test on ground fault protection system The circuit breaker trips when the time t_g set on the ETU elapses
TRANS test	Function test on transformers (energy and Rogowski transformers) One energy transformer and one Rogowski transformer is tested The circuit breaker trips after a delay of several seconds
METER test	Function test on the measured value display In order to test the displayed current measurement The circuit breaker does not trip during this test

4.11.2.1 Operation and execution of test functions

Connecting and disconnecting the TD500

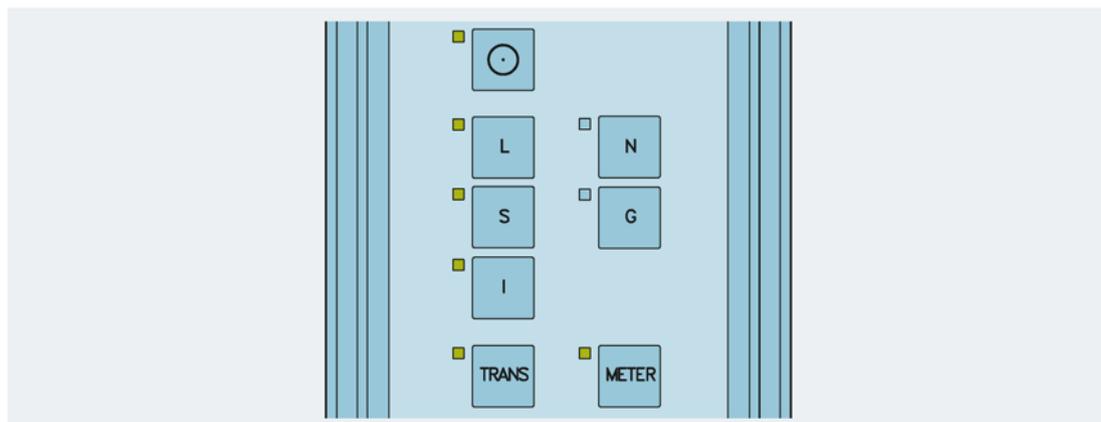
<p>⚠ CAUTION</p> <p>Personal injury, malfunctions and false test results</p> <p>Failure to connect the TD500 test device to the molded case circuit breaker according to the sequence of steps specified below can result in personal injury, malfunctions and false test results.</p> <p>Disconnect the molded case circuit breaker from the power supply before connecting the TD500.</p> <p>Strictly adhere to the sequence of steps described below for connecting the two devices.</p>

Connecting the TD500 to the 3VA2 molded case circuit breaker

1. Disconnect the molded case circuit breaker from the power supply.
2. Insert the connecting cable in the socket on top of the TD500 test device.
3. Insert the connecting cable in the test socket of the ETU.
4. Insert the cable of the power supply unit in the socket on the bottom of the TD500 test device.
5. Connect the power supply unit to a socket.
The TD500 test device is now switched on and ready.
6. Press the pushbutton labeled <ETU Power ON/OFF>  on the TD500 test device.
The ETU is now powered via the TD500 and activated. Successful communication between the TD500 and ETU is indicated by illumination of the LED labeled "COM" on the TD500.

All test functions available for the connected ETU are indicated by illumination of the appropriately labeled LEDs.

Example: In this example, the L, S and I releases, the transformers (TRANS) and the current meter (METER) can be tested on the connected ETU:

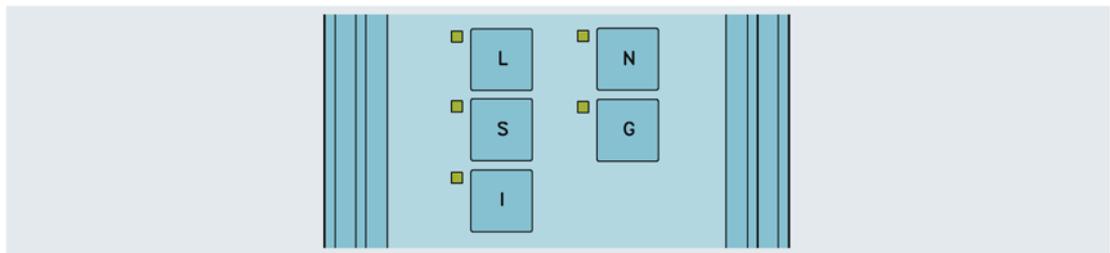


Disconnecting the TD500 from the 3VA2 molded case circuit breaker

1. Switch off the 3VA2 molded case circuit breaker.
2. Press the pushbutton labeled <ETU Power ON/OFF>  on the TD500 test device. The LED labeled "COM" on the TD500 goes out. The ETU is now no longer powered via the TD500 and is deactivated.
3. Disconnect the power supply unit from the socket.
4. Detach the power supply unit cable from the TD500.
5. Detach the connecting cable between the TD500 and the ETU.

Test tripping functions L, S, I, N and G

1. Connect the TD500 to the 3VA2 molded case circuit breaker as described above.
2. Switch on the 3VA2 molded case circuit breaker.
3. To test the tripping function, press one of the pushbuttons <L>, <S>, <I>, <N> or <G> on the TD500 test device.



- When a pushbutton is pressed, its LED flashes while the test is in progress.
 - The ETU trips when the set trip times expire and the molded case circuit breaker switches from "ON" to "TRIP".
 - On completion of the test, the LED of the selected pushbutton changes from flashing to steady illumination.
4. Wait for the test to end and evaluate the test result by the status of the LED labeled "RESULT":

Test was successful:

The LED "RESULT" lights up green.

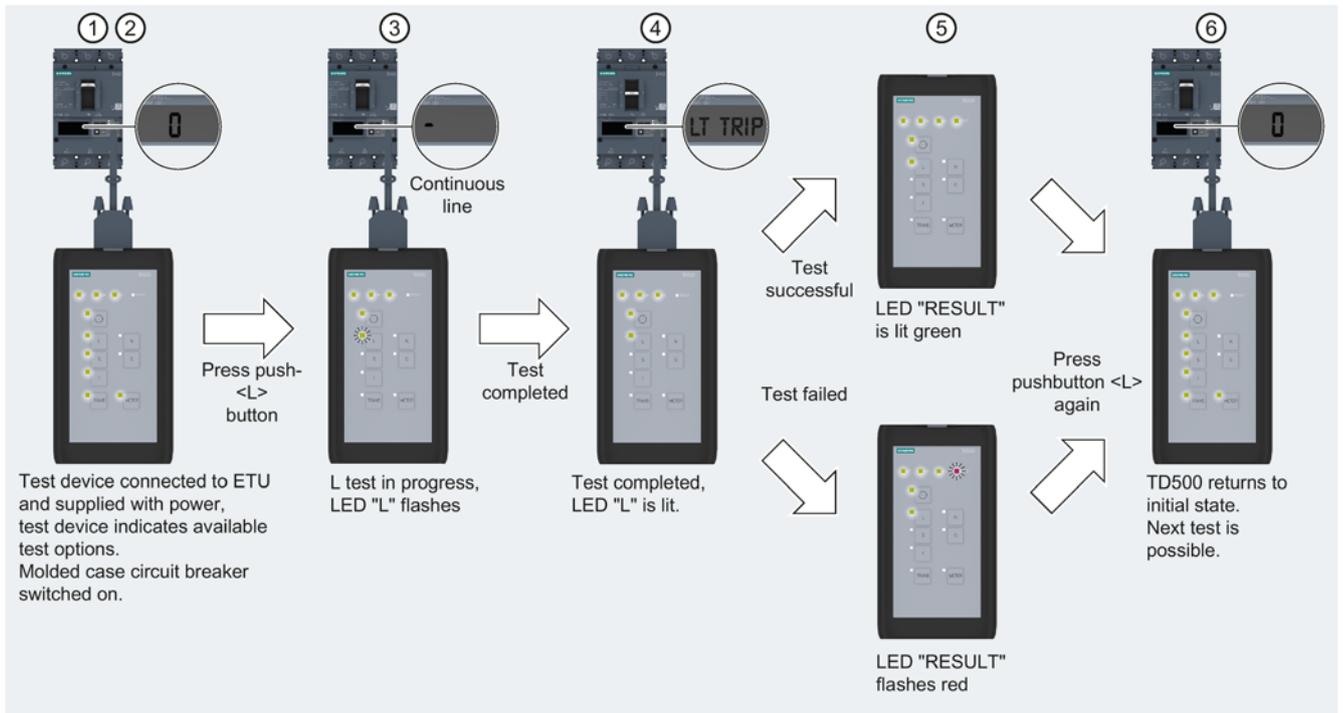
Test was unsuccessful:

The LED "RESULT" flashes red.

Repeat the test. If the test fails again, contact Technical Support (Page 12) .

5. Press the pushbutton for the same tripping function again in order to confirm the test result and restore the TD500 to its initial state.
6. Switch on the molded case circuit breaker again (ON position) in order to carry out further tripping function tests.

Example: Testing the tripping function L on an ETU550 LSI



1. Connect the TD500 test device to the 3VA2 molded case circuit breaker.
2. Switch on the 3VA2 molded case circuit breaker.
3. Press pushbutton <L> on the TD500 test device.
The LED in the pushbutton <L> starts to flash.
4. Wait until the LED in the pushbutton <L> changes from flashing to steady illumination.
The test is completed.
5. Evaluate the test result by the status of the LED labeled "RESULT":
LED "RESULT" is **illuminated steadily in green**: **The test was successful.**
LED "RESULT" flashes **red**: **The test was unsuccessful** and must be repeated. If the test fails again, contact Technical Support (Page 12) .
6. Press the pushbutton <L> again in order to confirm the test result and restore the TD500 to its initial state.

Carry out a meter test

The purpose of the meter test is to determine whether the ETU is measuring and displaying current correctly. A test current of $0.4 \times I_{rated}$ is fed into the ETU. The current value measured by the ETU is then checked to confirm that it matches the test current.

Note

The molded case circuit breaker does **not** need to be switched to position "ON" for this test.

Execute the test

1. Connect the TD500 test device to the 3VA2 molded case circuit breaker.
2. Press the pushbutton labeled <METER> ①.



The LED in the <METER> pushbutton begins to flash. The test takes approximately 30 seconds.

3. Wait until the LED in the pushbutton <METER> changes from flashing to steady illumination.
The test is completed.

4. Evaluate the test result by the status of the LED labeled "RESULT":

LED "RESULT" is **illuminated steadily in green**: **The test was successful.**

LED "RESULT" flashes **red**: **The test was unsuccessful** and must be repeated. If the test fails again, contact Technical Support (Page 12) .

5. Press the pushbutton <METER> again in order to confirm the test result and restore the TD500 to its initial state.

Test transformers

This procedure tests the transformers (energy transformer or Rogowski coil) to determine the following:

- Are transformers installed in the ETU?
- Are transformers correctly installed in the ETU?
- Are the installed transformers functioning correctly?

Note

In order to carry out this test, it is absolutely essential to disconnect all external power supplies (e.g. EFB300, COM800, COM100, 24 V module) to the electronics.

Execute the test

1. Disconnect all external power supplies to the electronics.
2. Connect the TD500 test device to the 3VA2 molded case circuit breaker.
3. Switch on the 3VA2 molded case circuit breaker.
4. Press the pushbutton labeled <TRANS> ①.



The LED in the <TRANS> pushbutton begins to flash. The test takes several seconds.

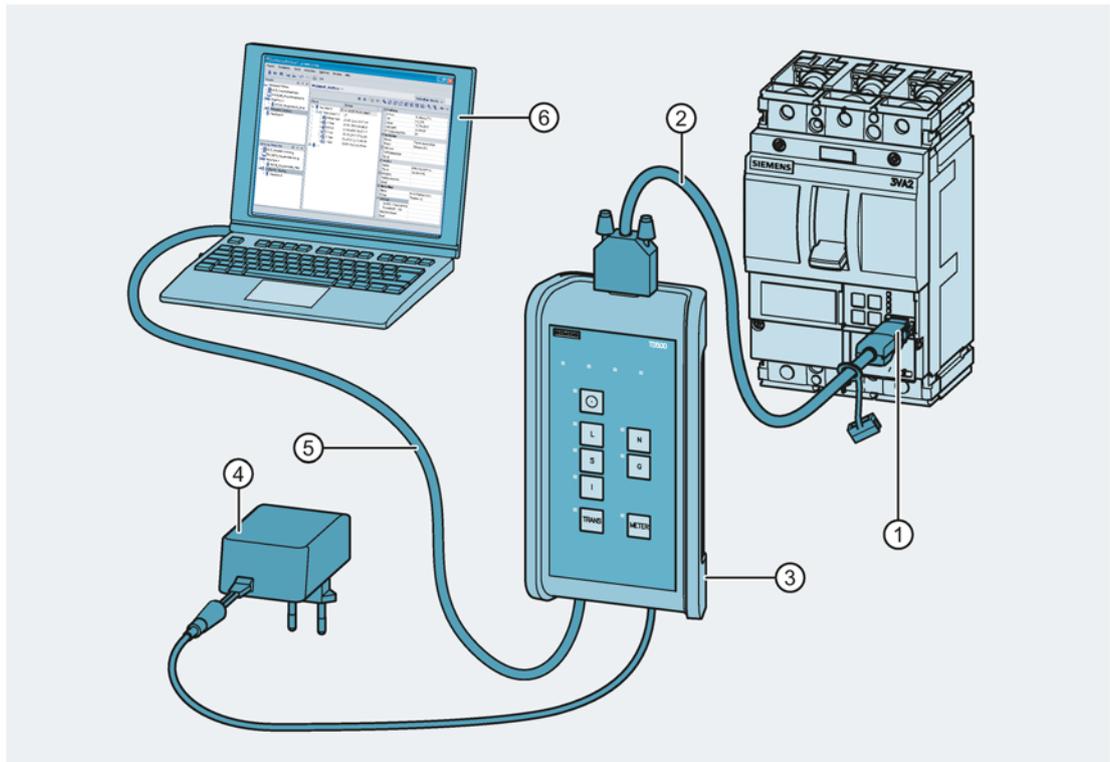
5. Wait until the LED in the pushbutton <TRANS> changes from flashing to steady illumination.
The test is completed.
6. Evaluate the test result by the status of the LED labeled "RESULT":
LED "RESULT" is **illuminated steadily in green: The test was successful.**
LED "RESULT" flashes **red: The test was unsuccessful** and must be repeated. If the test fails again, contact Technical Support (Page 12) .
7. Press the pushbutton <TRANS> again in order to confirm the test result and restore the TD500 to its initial state.

4.11.2.2 Executing the test functions using a PC and powerconfig

In addition to its capabilities as a stand-alone test device, the TD500 can also act as a PC interface to the ETU.

If the TD500 test device is connected both to the ETU and a PC, the protective functions can be triggered from a PC on which the powerconfig software is installed. A test log for the molded case circuit breaker is generated and stored in the powerconfig project. The test log can be printed out.

Connections between ETU - TD500 - PC



- | | |
|---|---------------------------------|
| ① Plug-in connector for insertion in the test socket on the ETU | ④ Power supply unit |
| ② TD500-to-ETU connecting cable | ⑤ USB connecting cable |
| ③ TD500 test device | ⑥ PC with powerconfig installed |

4.11.2.3 Parameterizing using the powerconfig software

In addition to test functions, the powerconfig software package also provides tools for assigning parameters to ETU 5-series and 8-series.

These tools allow you to:

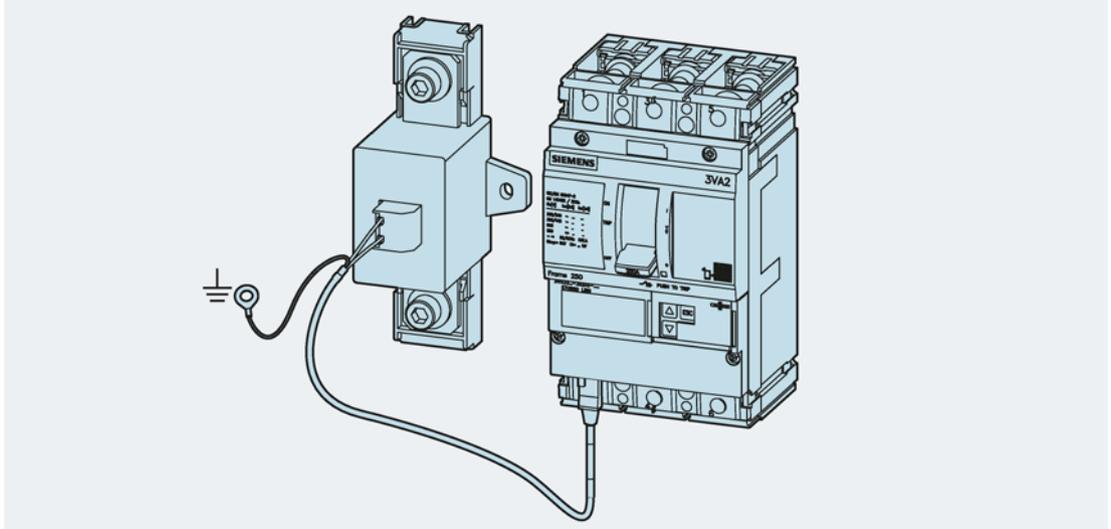
- assign parameters to ETU 5-series and 8-series
- store parameter settings for ETU 5-series and 8-series in the powerconfig project and print them out

4.11.2.4 Technical specifications

Mechanical characteristics		
Dimensions		
Length	mm	190
Width	mm	105
Depth	mm	42
Degree of protection		IP30
Ambient conditions		
Ambient operating temperature	°C	-10 ... +40
Storage temperature	°C	-40 ... +80
Normal position of use		Any
Interface to molded case circuit breakers		
Number of directly connectable molded case circuit breakers		1
Length of cable	m	1.5
Power supply		
Number of electrical connections / for external network		1
External power supply unit		
Input voltage	V AC	100 ... 240
Output voltage	V DC	12
Interface to PC		
Number of interfaces / acc. to USB		1

4.12 External current transformer for N conductor

The external current transformer for N conductor is a current transformer for 3-pole 3VA2 molded case circuit breakers with ETU 5-series and 8-series.



Technical specifications

	Rated current I_n		
	25 ... 150 A	160 ... 250 A	400 ... 630 A
Rated frequency	50/60 Hz		
Rated operational voltage U_e	Max. 690 V		
Rated impulse strength U_{imp}	8 kV		
Rated insulation voltage U_i	0.8 kV		
IP degree of protection	IP00		
Ambient temperature	-25 °C ... 50 °C		
> 50 °C: Derating	7.5 % / 10 K		
Max. bar temperature	115 °C at 50 °C ambient temperature		

4.13 Escutcheon

Molded case circuit breakers or supplementary motor operators or front mounted rotary operators for molded case circuit breakers are often installed in cubicles or distribution boards in such a way that only the operating device is directly accessible. Busbars, cables and the termination area of the molded case circuit breaker are covered by metal or plastic plates in order to prevent direct contact with live components. The cubicle door itself is often designed as a protective cover.

Cutouts must be made in these covers

- in order to allow access to control elements,
- which are designed to prevent direct contact with cables, and
- which are large enough in size that the cover can be closed easily.

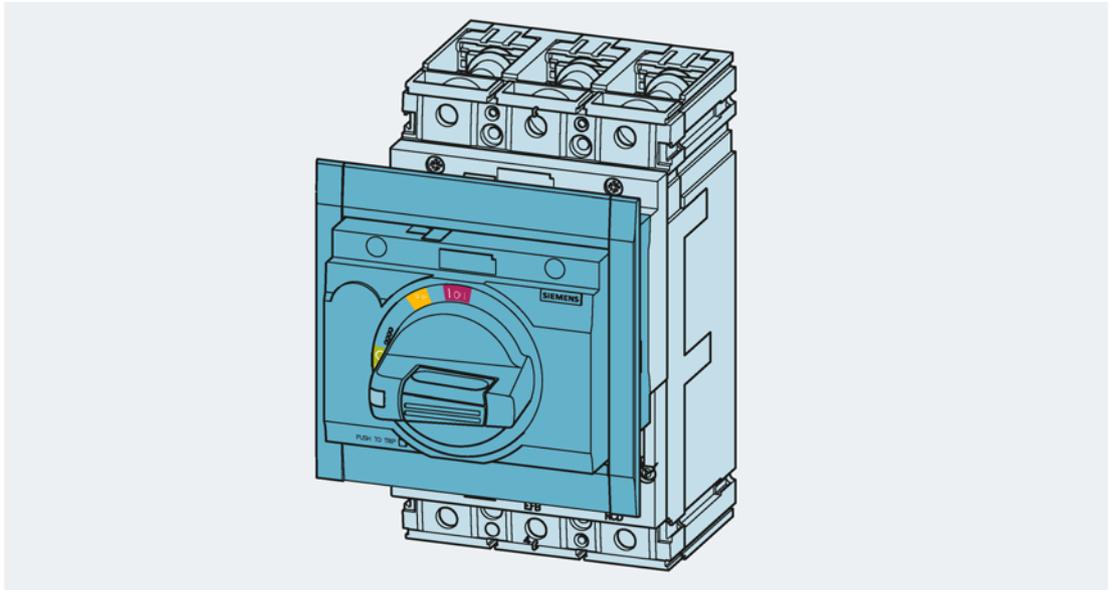
All these requirements necessitate gap dimensions of a few millimeters between the cutout and the unit.

Escutcheons are installed in cases where the gap size needs to be minimized and the gaps covered. The use of escutcheons makes for a clean-lined, attractive cubicle front face and provides a higher degree of protection (IP30).

4.13.1 Product description

Escutcheons are available for the following items of equipment from the 3VA product range:

- 3VA1 / 3VA2 molded case circuit breakers, 3-pole or 4-pole: Handle area only
- 3VA1 / 3VA2 molded case circuit breakers, 3-pole or 4-pole: Area around handle and trip unit
- Front mounted rotary operator
- Loadside residual current devices, 3-pole or 4-pole
- Door feedthroughs



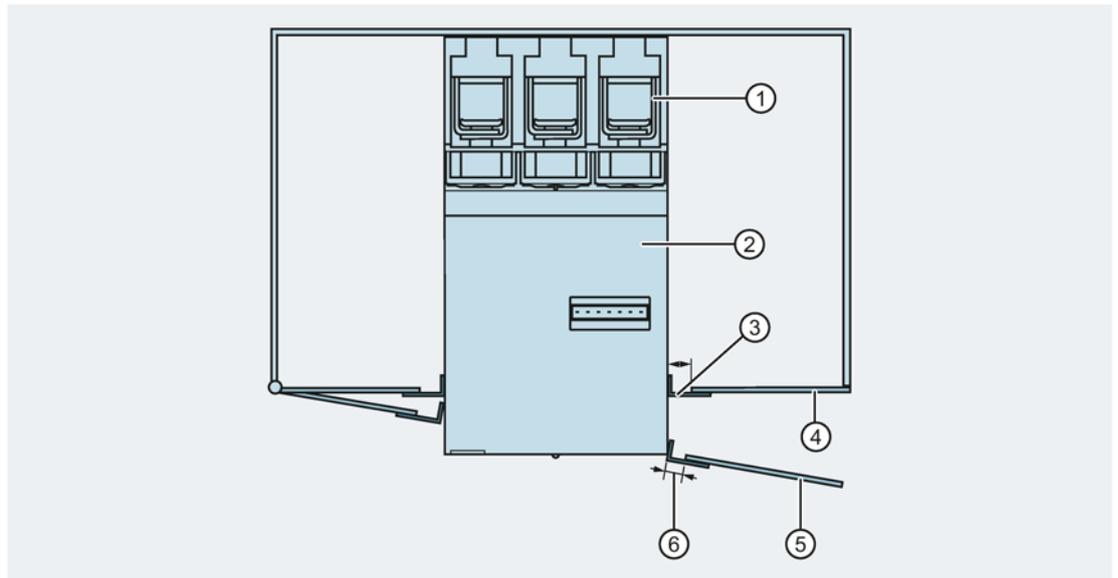
Installation

1. Cut out an opening in the cover plate.
Refer to the operating instructions for the correct cutout dimensions.
2. Insert the escutcheon into the cutout from the front and fasten by means of small spring steel sheets at the rear of the cover plate.

The fastening system is designed such that the the escutcheon can move in the cutout. In other words, the escutcheon is "float-mounted". Tolerance compensation by around ± 3 mm is thus afforded in the horizontal direction and by as much as ± 6 mm in the vertical direction. This tolerance compensation is necessary in order to achieve the small gap dimensions of max. ± 0.5 mm between the escutcheon and the unit on the one hand and, on the other, to compensate tolerances in the cubicle, for example, which are always intrinsic to the cubicle design.

Typical tolerance compensation examples are:

- Tolerance compensation of the door angle with right-hinged or left-hinged doors
- Tilting of devices under their own weight when they are fastened to thin mounting plates



- ① Molded case circuit breaker
- ② Motor operator
- ③ Escutcheon
- ④ Cubicle door (closed)
- ⑤ Cubicle door (open)
- ⑥ Tolerance compensator

Note

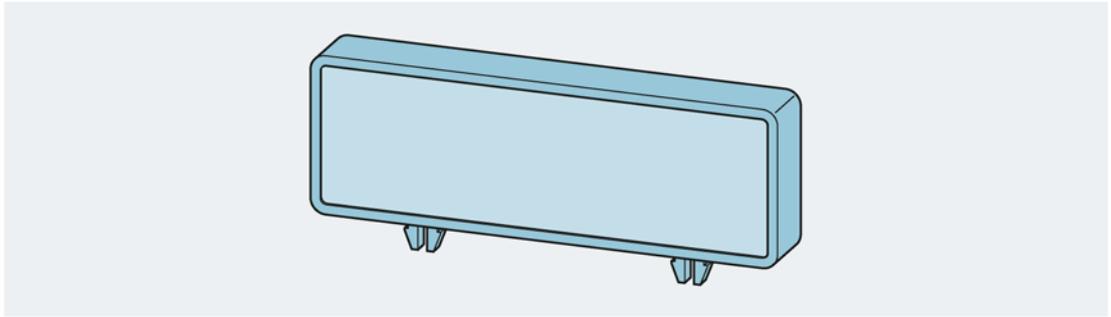
To ensure that the control cabinet door can still be opened, a front-mounted accessory component must not project over the escutcheon by more than 5 mm when the door is closed.

4.13.2 Labeling plate

A supplementary labeling plate (3VA9087-0SX10) is available for the escutcheon.

It can be latched in position in the center of any of the four sides of the escutcheon. Paper or plastic labels displaying plant-specific information are attached by adhesive to the labeling plate.

The scope of supply includes 10 labeling plates and 10 aluminum-colored labels.



4.14 DIN rail adapter

4.14.1 Introduction

Description of application and basic function

The DIN rail adapter is used to mount molded case circuit breakers on 35 mm DIN rails of meter or distribution cubicles, for example. DIN rail adapters are available exclusively for 3VA1 molded case circuit breakers in sizes 100 A and 160 A since, on the one hand, DIN rails are not designed to support heavy weights and, on the other, only molded case circuit breakers with thermal-magnetic trip units and rated operational currents up to maximum 160 A are normally installed in distribution boards.

The DIN rail adapters are snapped onto the rear panel of the molded case circuit breaker or fastened by screws. With an adapter installed, the circuit breaker is simple to attach to a DIN rail. This is done by placing the circuit breaker with attached DIN rail adapter from above onto the DIN rail and then pressing the bottom half of the circuit breaker lightly against the rail until the adapter engages.

Overview of variants and products

3VA9181-0SH10	DIN rail adapter for MCCB 3VA1 160 A, 1-pole
3VA9182-0SH10	DIN rail adapter for MCCB 3VA1 160 A, 2-pole
3VA9187-0SH10	DIN rail adapter for MCCB 3VA1 100 A and 160 A, 3-pole / 4-pole
3VA9187-0SH20	DIN rail adapter for MCCB 3VA1 160 A, 3-pole / 4-pole and side mounted RCD

4.14.2 Information about installation, assembly and attachment

3VA1 160 1-pole and 2-pole molded case circuit breakers



3VA1 160 1-pole molded case circuit breakers

To attach these to a DIN rail, a 3VA9181-0SH10 DIN rail adapter is required. This DIN rail adapter is not attached by screws to the molded case circuit breaker, but simply snapped into place on the rear panel.

3VA1 160 2-pole molded case circuit breakers

To attach 2-pole molded case circuit breakers to 35 mm DIN rails, a 3VA9182-0SH10 DIN rail adapter is required. This adapter is fitted with threaded nuts. The molded case circuit breakers are screwed onto the adapter by means of the fastening screws supplied with the circuit breakers. The nuts supplied with the circuit breakers are not required.

3VA1 100 and 3VA1 160 3-pole and 4-pole molded case circuit breakers



To attach 3-pole and 4-pole molded case circuit breakers to 35 mm DIN rails, a 3VA9187-0SH10 DIN rail adapter is required. This adapter is fitted with threaded nuts. The molded case circuit breakers are screwed onto the adapter by means of the fastening screws supplied with the circuit breakers. The nuts supplied with the circuit breakers are not required.

3VA1 100 and 3VA1 160 3-pole and 4-pole molded case circuit breakers with side mounted residual current device



The 3VA9187-0SH20 DIN rail adapter has been specially developed for use with molded case circuit breakers combined with side mounted residual current device. This DIN rail adapter is also fitted with threaded nuts so that the molded case circuit breaker/residual current device assembly can be fastened to it by means of the screws included in the scope of supply of both devices.

Assembly instructions

The molded case circuit breaker must first be attached to the DIN rail adapter. 3-pole molded case circuit breakers must be attached such that their right-hand edge (when viewed from above) is flush with the DIN rail adapter. With 4-pole molded case circuit breakers, the N pole is situated opposite on the left-hand side (when viewed from above). The screws are inserted in the fastening holes between phases 1 and 2, and between phases 2 and 3, in the molded case circuit breaker.

After the molded case circuit breaker has been attached to the DIN rail adapter, the residual current device must also be mounted on the adapter. After the residual current device has been secured in position on the DIN rail adapter, the main current paths of the residual current device and the molded case circuit breaker must be checked to ensure that they are properly aligned and connected.

Information about combination with other accessories

DIN rail adapters are normally used to install molded case circuit breakers (possibly with side mounted residual current device) in distribution boards. The standard cover is then fitted over the circuit breakers. The front panel (45 mm high) is the only part of the device which protrudes through the cover. With this arrangement, it is not possible to use front mounted accessories.

When molded case circuit breakers including DIN rail adapter are installed on rails in an open system cubicle without a cover, it is possible to use front mounted accessories such as motor operator, rotary operator with shaft stub, front mounted rotary operator and the front mounted Bowden cable interlock module.

The following accessories are compatible with molded case circuit breakers and DIN rail adapters:

Manual operators	Front mounted rotary operator
Interlocks	Sliding bar unit (2 or 3 breakers)
	Bowden cable interlock (for front mounted rotary operators)
Residual current device	Side mounted residual current device
	Modular residual current device

4.14 DIN rail adapter

Service and maintenance

5.1 Notes

Qualified personnel

It is essential to refer to this documentation when setting up and operating the relevant equipment / system. The equipment / system may only be serviced and maintained by qualified personnel. For the purpose of the safety information in these operating instructions, a "qualified person" is someone who is authorized to energize, ground, and tag equipment, systems, and circuits in accordance with established safety procedures.

Maintenance category

Maintenance category	Maintenance interval
Inspection	Annually
Maintenance	As required; 10 years after delivery at the latest
Corrective maintenance	As required; 20 years after delivery or after 1000 switching cycles at the latest

5.2 Regular maintenance

Recommended maintenance/inspection intervals

Following initial commissioning, the equipment/system must be inspected at least once per year.

In addition, an inspection should be carried out after 1000 trips at rated operational current.

If the molded case circuit breaker or switch disconnecter is operated in an atmosphere that is dust-laden or in which corrosive vapors, gases, or salt spray is present, it is advisable to adjust the inspection intervals accordingly, e.g. to twice per year.

Inspection procedure recommended for 3VA molded case circuit breakers / switch disconnectors

Schedule of inspections/tests	Inspection/test procedures
3VA molded case circuit breakers / switch disconnectors	
Check that connections are tight	<ul style="list-style-type: none"> - Check the tightening torque of the connecting screws (80% of the tightening torque is recommended) - Visually inspect the incoming and outgoing cables - Visually inspect the connection accessories - Replace any damaged connection accessories after cleaning the termination area
Inspect the exterior surfaces of the molded case circuit breaker / switch disconnector	<ul style="list-style-type: none"> - Examine all visible surfaces for oxidation, residues or other adverse effects - Remove residues with a lint-free, dry and clean cloth. Never use chemical cleaning agents or water!
Check the protection parameters	Check that the trip unit is correctly set for the prevailing conditions in the installation and adjust the settings if necessary.
Test the electrical and mechanical functions of the molded case circuit breaker / switch disconnector	Move the handle from OFF to ON, and from ON to OFF, in order to check the mechanical function of the molded case circuit breaker contacts
Test the tripping function with the <PUSH TO TRIP> button	Press the <PUSH TO TRIP> button. The molded case circuit breaker / switch disconnector must trip and move to the "TRIP" position.
Residual current device	
Test the tripping function with the <PUSH TO TRIP> button	Press the <PUSH TO TRIP> button. The molded case circuit breaker must trip and you must be able to switch it on again afterward.
Undervoltage release	
Test the tripping function	<ol style="list-style-type: none"> 1. Open the molded case circuit breaker. 2. Set the operational voltage (terminals D1 and D2) to 0 V. 3. Close the molded case circuit breaker (move handle to ON). The molded case circuit breaker must trip and move to the "TRIP" position.

Optional inspection procedure for the ETU of the 3VA2 molded case circuit breaker

What needs to be tested/inspected?	What is the correct test/inspection procedure?
The various protective trip functions of the ETU need to be tested	<p>Test the individual protective functions LSING in the ETU using the TD500 test device.</p> <p>The circuit breaker must trip at the end of each test.</p> <p>The current transformer and the metering function can also be tested for proper functioning.</p> <p>Refer to section "Test devices".</p>

5.3 Maintenance following tripping of a molded case circuit breaker

If a 3VA molded case circuit breaker trips on overcurrent (overload, short circuit) or residual current (ground fault or via residual current device), the cause of the trip must be identified and rectified before the molded case circuit breaker is switched on again.

In the case of 3VA1 molded case circuit breakers with thermal-magnetic trip units, the cause of tripping can be determined, for example, with the assistance of the short circuit alarm switches SAS. With 3VA2 molded case circuit breakers, the cause of tripping can be output via the EFB300 external function box. With electronic trip units ETU 5-series and 8-series, the cause of tripping can be indicated on the LCD display and optionally transferred via communication modules.

An inspection as described in chapter Regular maintenance (Page 419) should be carried out every time the molded case circuit breaker is tripped by the trip unit. In addition, all black residues on the molded case circuit breaker must be removed as they might contain conductive particles. The molded case circuit breaker should then be switched on and off without load at least five times.

5.4 Fault diagnostics

Description of problem	Possible fault cause	Remedial action
Repeated tripping	The protection settings of the ETU are not correct	Check whether the current setting of the ETU matches the rated current of the supply system.
	Fluctuations in the voltage of the undervoltage release	Check the voltage at the undervoltage release. The connection of other high-consumption loads (such as motor operators) to the same power source may cause the voltage to dip briefly in some cases.
	Ambient temperature too high	The protection settings are specified for a particular reference point. Erroneous tripping can occur if the ambient temperature is higher than the specified reference or if other ambient conditions have not been given due consideration (e.g. derating for draw-out technology when installation location is above 2000 m). Pay due attention to ambient conditions and appropriate derating.
	Shunt trip is activated	The trip is initiated by the shunt trip STL or STF. Check the causes of unintentional shunt trip activation.
	Tripping by residual current device	Check the insulation in the low-voltage network and at the loads.
	Tripping by ground fault	Check the insulation in the low-voltage network and at the loads.
Molded case circuit breaker cannot be switched on by the handle or manual operators	No voltage supply to the undervoltage release	Check the voltage supply UVR to the undervoltage release.
	Shunt trip STL or STF is connected to voltage	Check the voltage.
	Molded case circuit breaker is locked, e.g. by sliding bar or cylinder locks in the manual operators	Unlock the circuit breaker.
	Molded case circuit breaker is interlocked, e.g. by a front interlock	Release the circuit breaker.
Molded case circuit breaker cannot be switched on via motor operator	No voltage supply to the undervoltage release	Check the voltage supply UVR to the undervoltage release.
	Shunt trip STL or STF is connected to voltage	Check the voltage.
	Molded case circuit breaker is locked, e.g. by cylinder lock in the motor operator	Unlock the circuit breaker.
	Molded case circuit breaker cannot be switched on or off via the communication interface if the write protection slide switch on the COM800 is set to OFF	Check the position of the write protection slide switch on the COM800.

See also

Technical Support (Page 12)

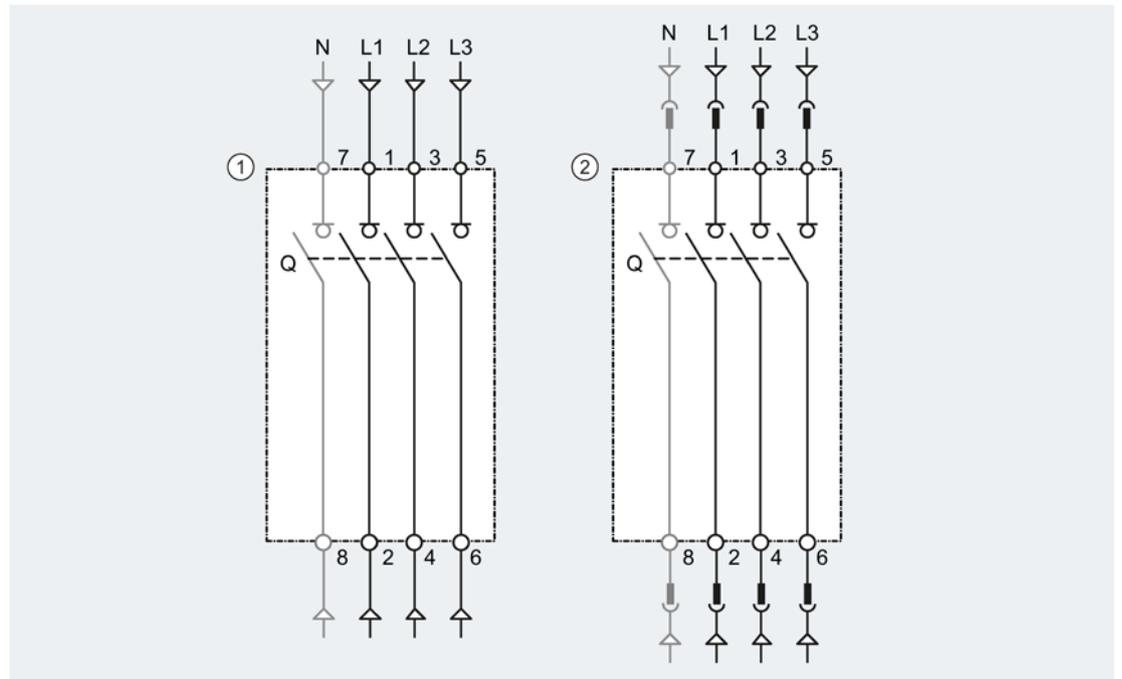
Technical specifications

6.1 Circuit diagrams

6.1.1 3VA1 molded case circuit breakers

6.1.1.1 Basic units

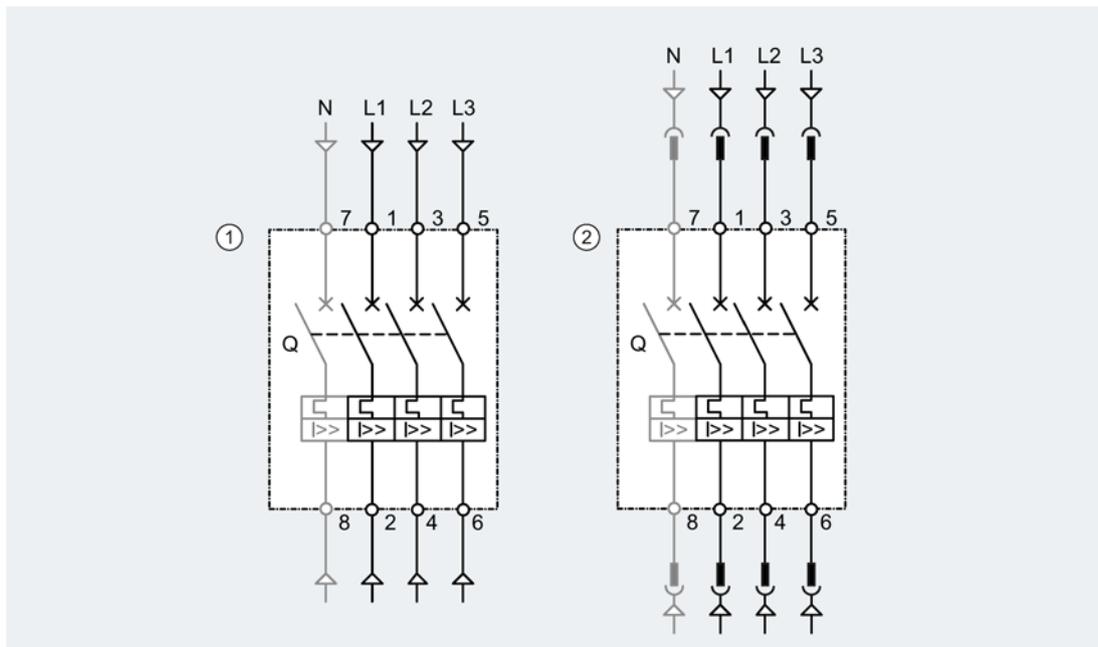
Switch disconnectors



- ① Fixed mounting, 3-pole and 4-pole
- ② Plug-in/draw-out units, 3-pole and 4-pole

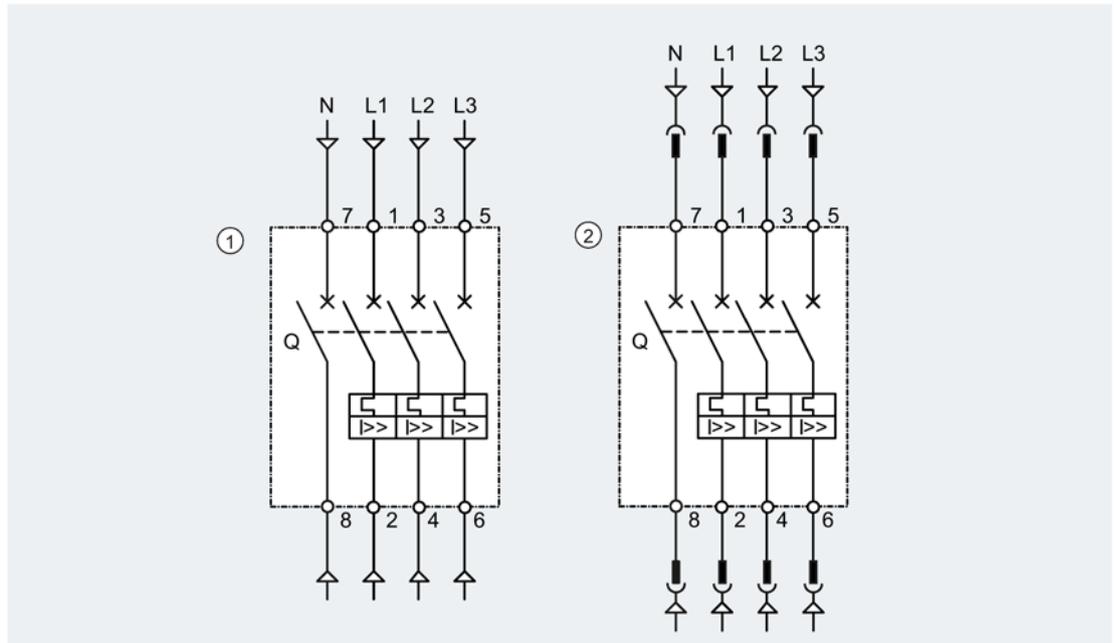
3VA1 molded case circuit breakers with thermal-magnetic trip unit

Fixed mounting and plug-in/draw-out units, 3-pole and 4-pole



- ① Fixed mounting, 3-pole and 4-pole
- ② Plug-in/draw-out units, 3-pole and 4-pole

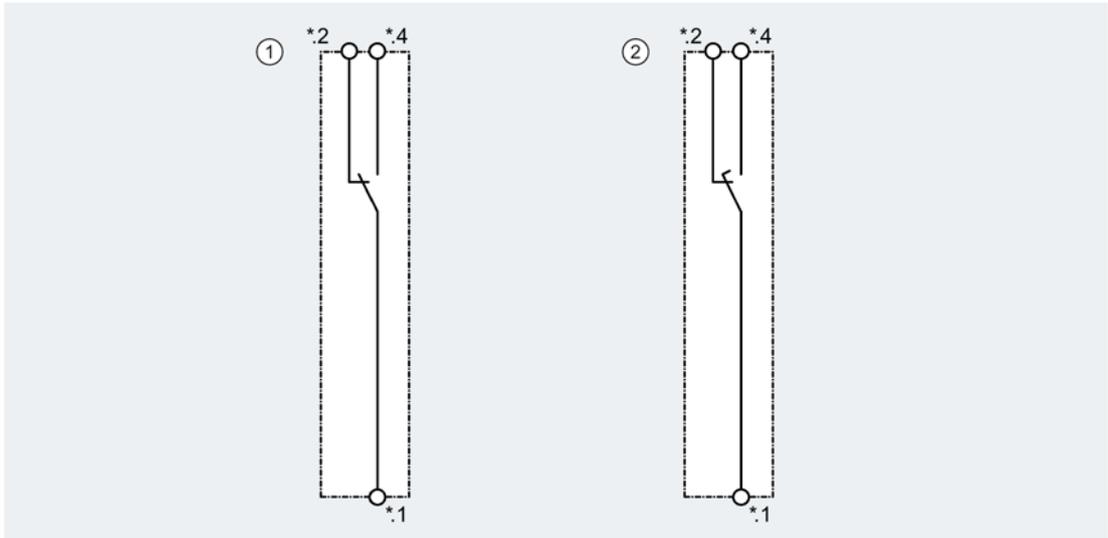
Fixed mounting and plug-in/draw-out units, 4-pole, unprotected N conductor



- ① Fixed mounting, 4-pole, unprotected N conductor
- ② Plug-in and draw-out units, 4-pole, unprotected N conductor

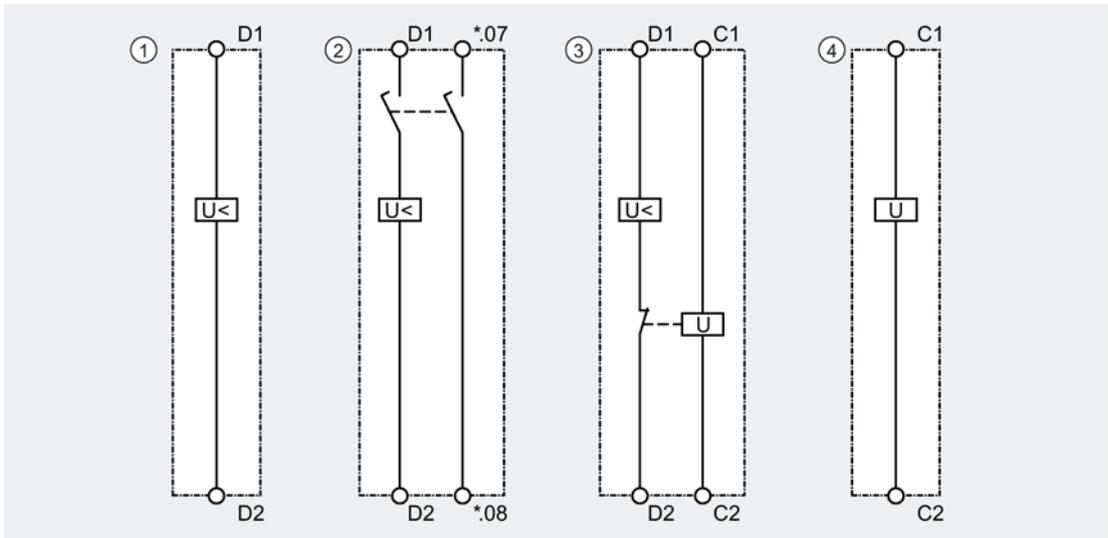
6.1.1.2 Accessories

Auxiliary switches, alarm switches and position signaling contacts



- ① Changeover contacts for auxiliary switches AUX, trip alarm switches TAS and electrical alarm switches EAS, position signaling switches for plug-in and draw-out units
- ② Leading changeover contacts for leading changeover switch LCS

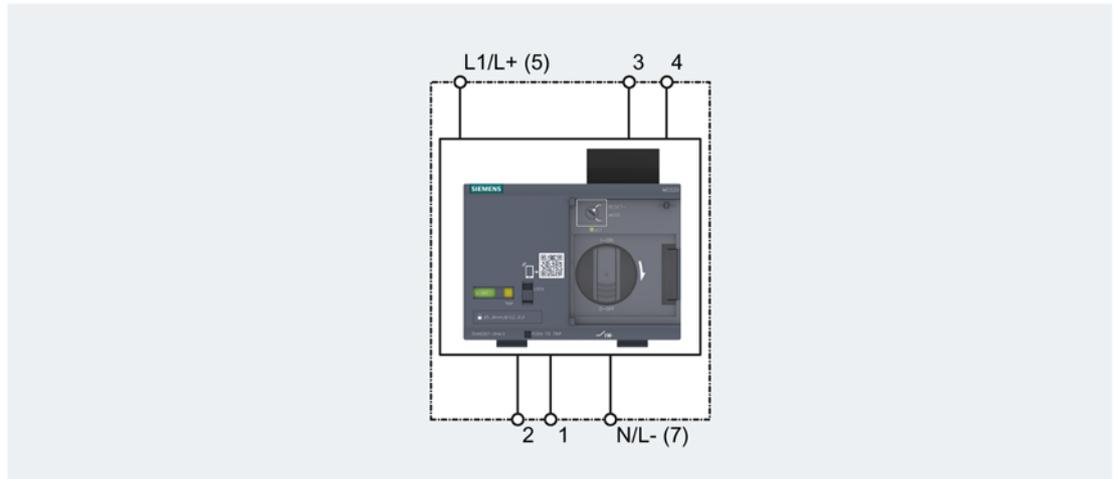
Auxiliary releases



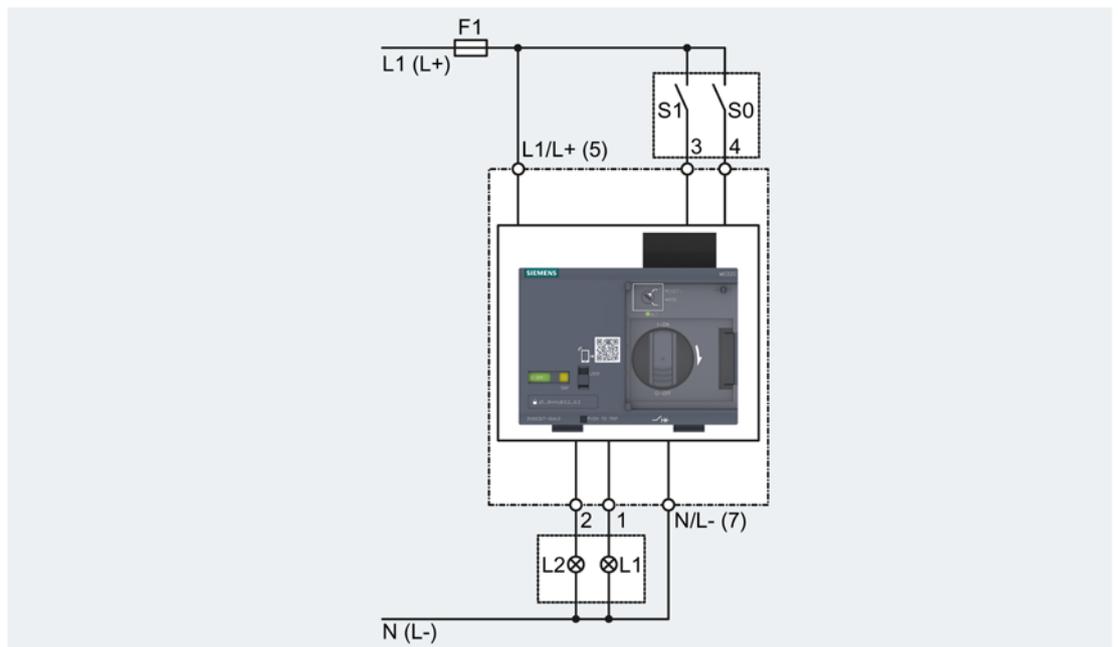
- ① Undervoltage release UVR
- ② Undervoltage release with leading NO contacts UVR (LNO)
- ③ Universal release UNI
- ④ Shunt trip

Motor operators

Front mounted motor operator

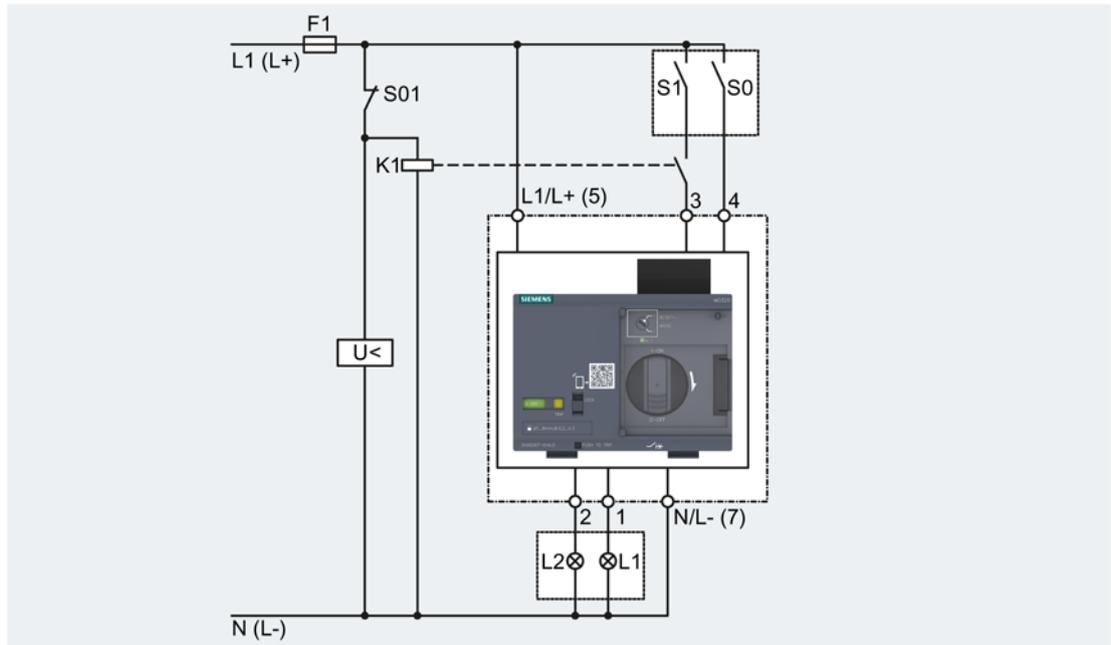


Motor operator actuation controlled via control cable



- S0 OFF (to be provided by customer)
- S1 ON (to be provided by customer)
- F1 Fuse in the control circuit (to be provided by customer)
- L1 Indicator light AUTO mode (to be provided by customer)
- L2 Indicator light MAN mode (to be provided by customer)

Motor operator actuation controlled via control cable and undervoltage release



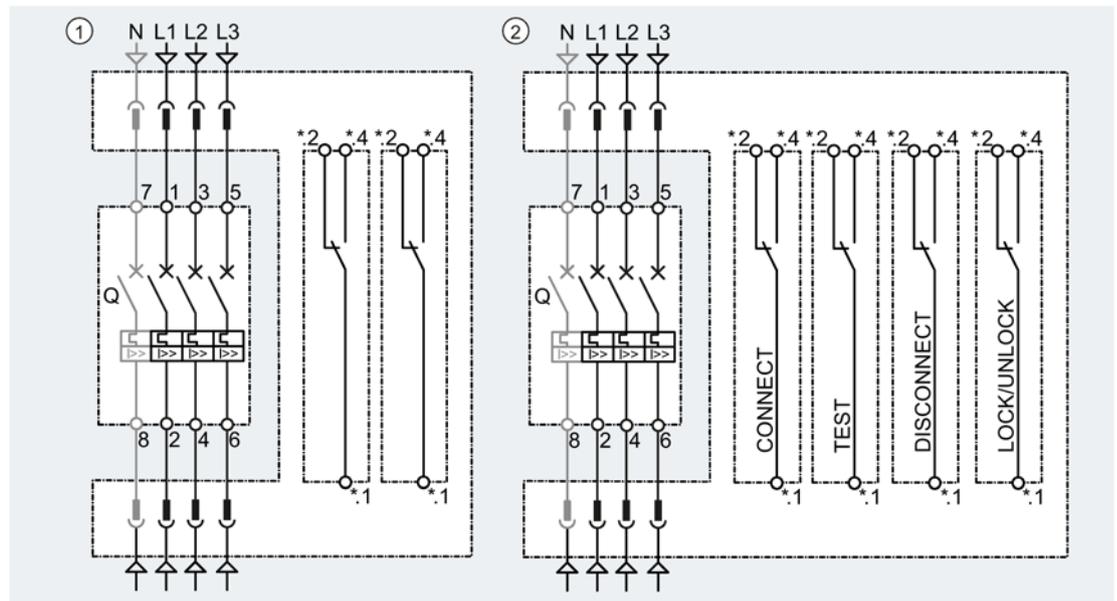
- S0 OFF (to be provided by customer)
- S1 ON (to be provided by customer)
- S01 Remote command (to be provided by customer)
- K1 Auxiliary contactor (to be provided by customer)
- U< Undervoltage release (to be provided by customer)
- F1 Fuse in the control circuit (to be provided by customer)
- L1 Indicator light AUTO mode (to be provided by customer)
- L2 Indicator light MAN mode (to be provided by customer)

This circuit is deployed in order to prevent no-load operation of the molded case circuit breaker. The contact of auxiliary contactor K1 prevents no-load operation when the undervoltage release "U<" is de-energized.

No-load operations subject the molded case circuit breaker to high stresses. If the undervoltage release is de-energized, auxiliary contactor K1 has not picked up. The contact in the ON circuit (control circuit) of the motor operator is thus not closed, that is, the molded case circuit breaker cannot be switched.

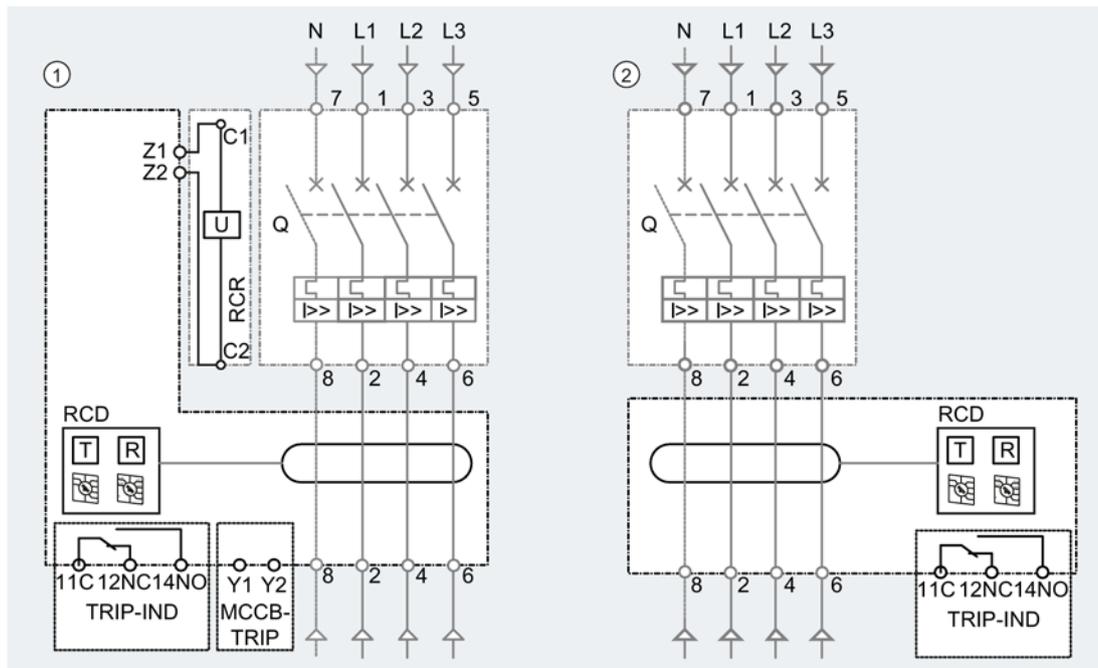
This auxiliary contactor is not necessary when the undervoltage release is supplied uninterrupted (e.g. pushbutton S01) from the same source as the motor operator itself (e.g. contact 3).

Plug-in and draw-out units



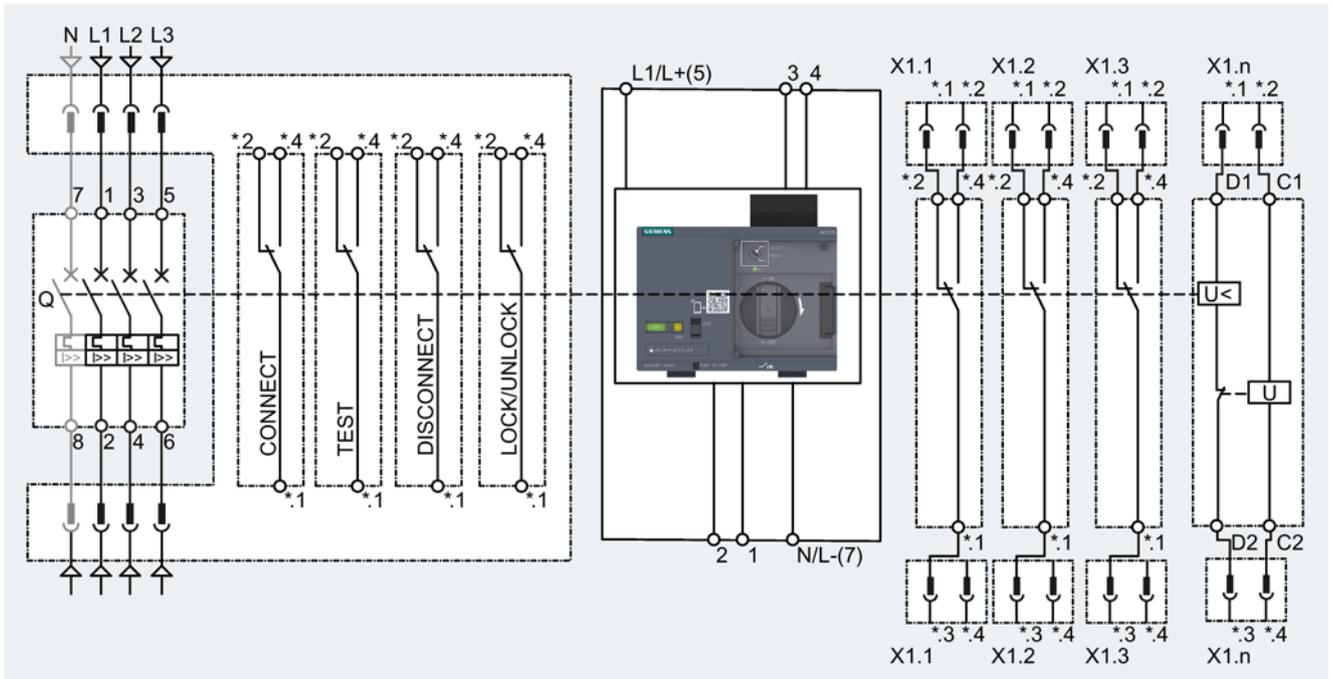
- ① Plug-in units, 3-pole and 4-pole, with two optionally integrated position signaling switches for signaling "Plug-in unit - MCCB correctly bolted to plug-in socket".
- ② Draw-out units, 3-pole and 4-pole, with an optional switch for signaling the condition "Draw-out unit locked / open" and six optionally integrated position signaling switches for signaling "Position of breaker in the draw-out unit".

RCD basic



- ① Side mounted RCD basic, 3-pole and 4-pole
- ② Loadside RCD basic, 3-pole and 4-pole

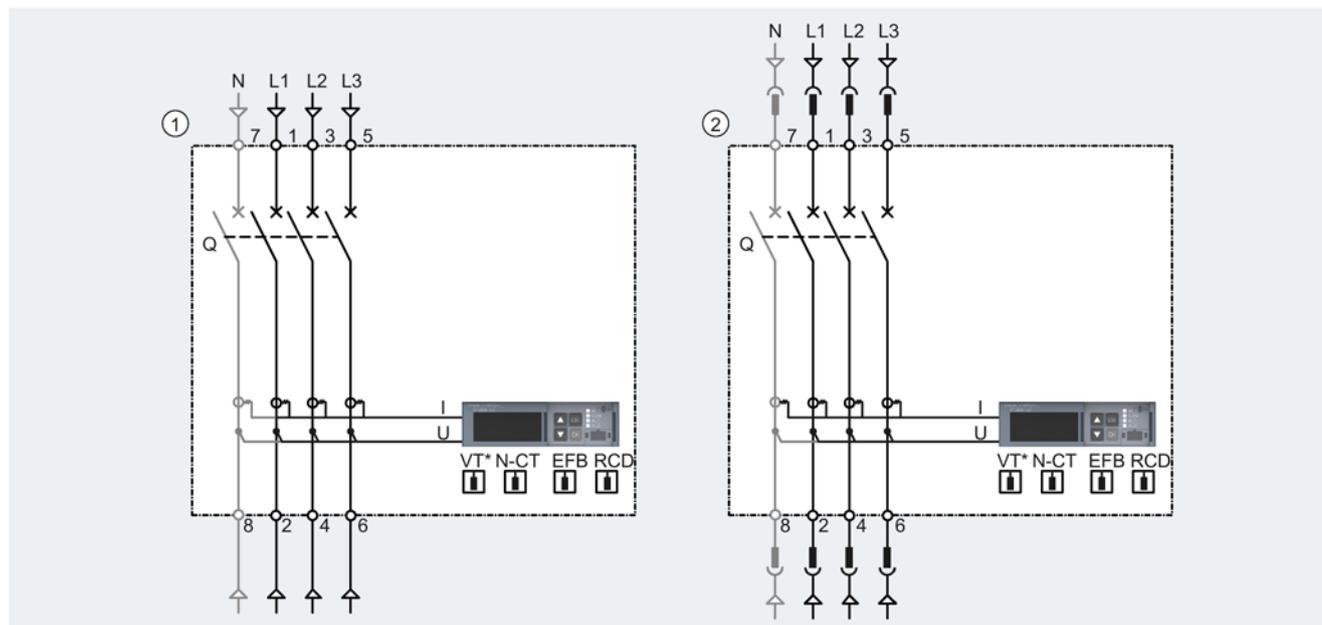
6.1.1.3 Example: 3VA1 molded case circuit breaker with built-on/built-in accessories



6.1.2 3VA2 molded case circuit breakers

6.1.2.1 Basic units

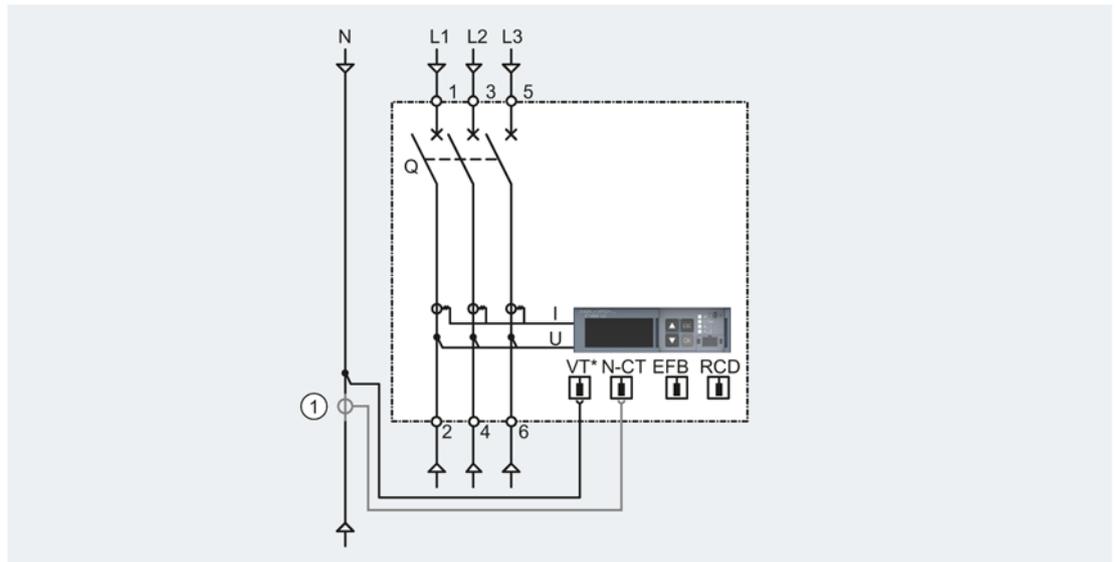
Fixed mounting and plug-in/draw-out units, 3-pole and 4-pole



① Fixed mounting, 3-pole and 4-pole
* Voltage tap

② Plug-in/draw-out units, 3-pole and 4-pole

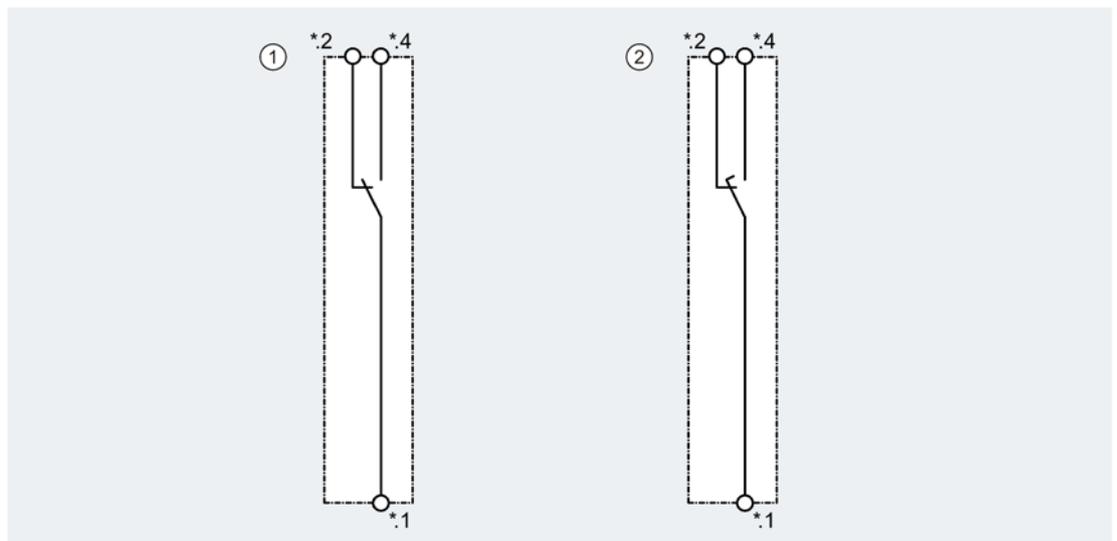
Fixed mounting, 3-pole 3VA2 molded case circuit breaker in 5-wire system



- ① Optional external current transformer for N conductor (gray line)
- * Voltage tap

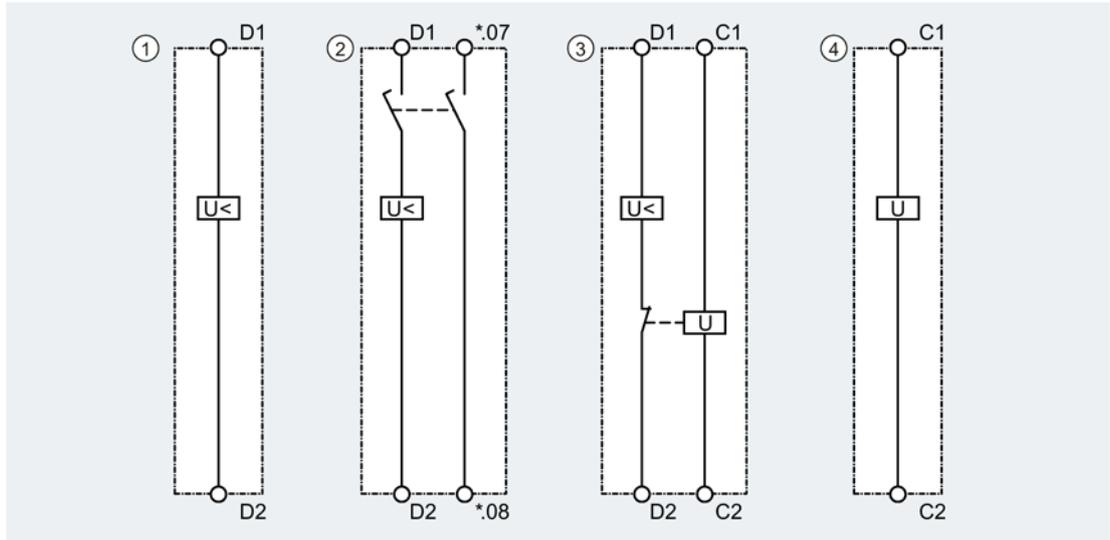
6.1.2.2 Accessories

Auxiliary switches, alarm switches and position signaling contacts



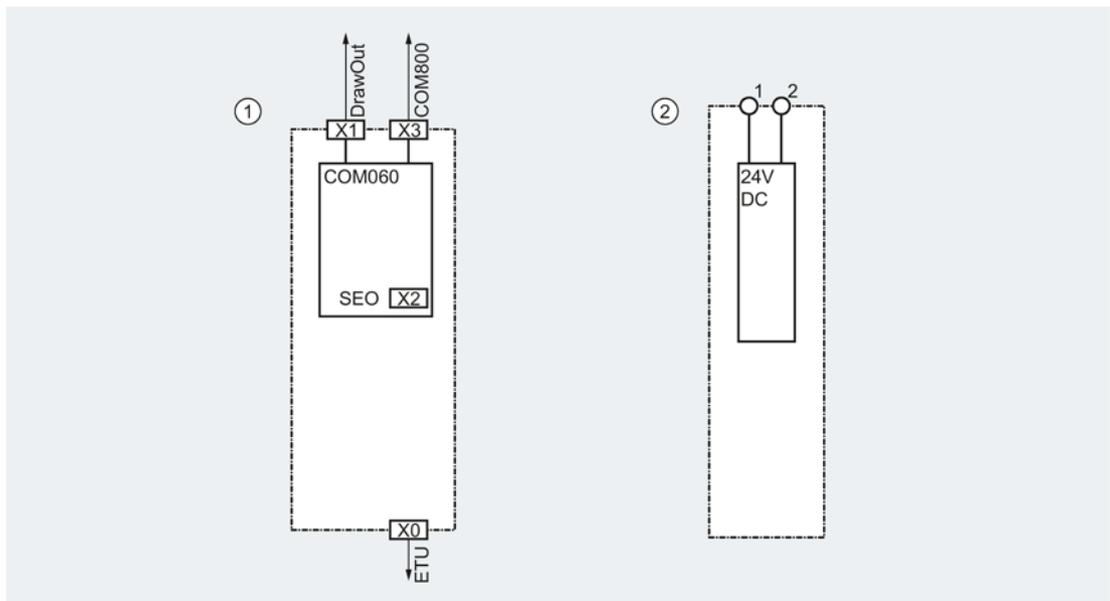
- ① Changeover contacts for auxiliary switches AUX, trip alarm switches TAS and electrical alarm switches EAS, position signaling switches for plug-in and draw-out units
- ② Leading changeover contacts for leading changeover switch LCS

Auxiliary releases



- ① Undervoltage release UVR
- ② Undervoltage release with leading NO contacts UVR (LNO)
- ③ Universal release UNI
- ④ Shunt trip

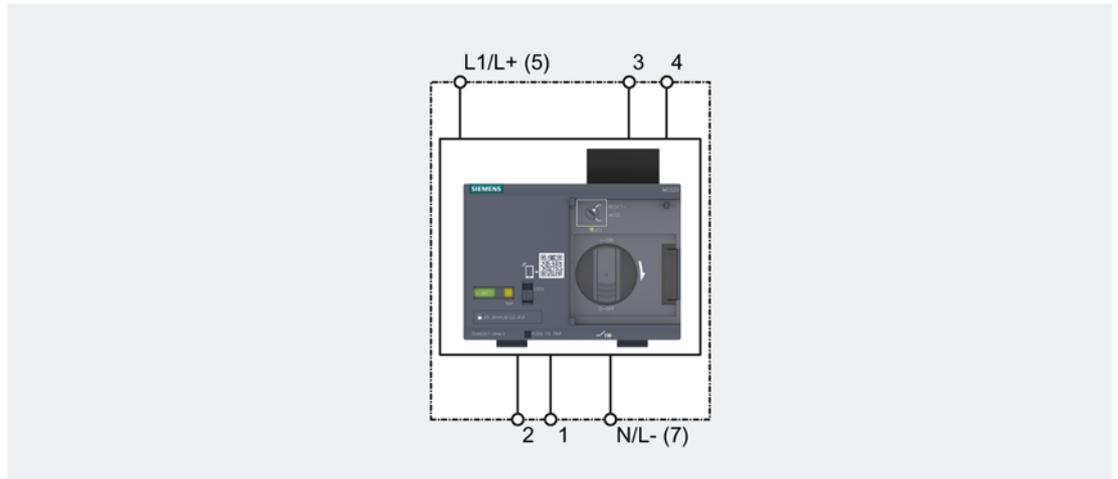
Other internal accessories



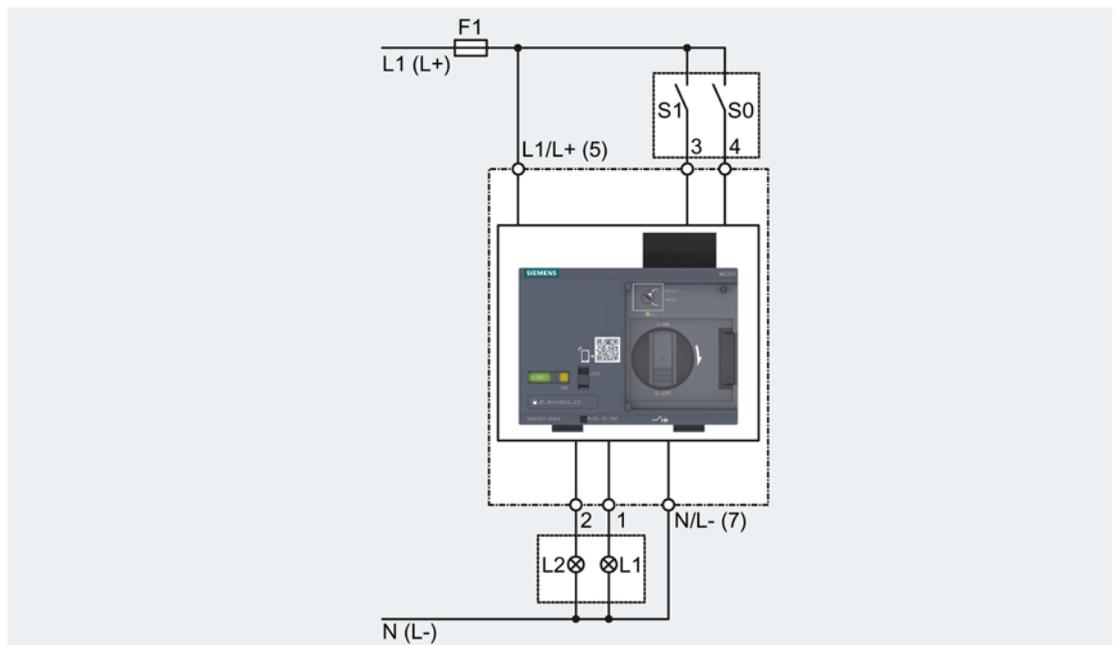
- ① COM060 communication module
- ② 24 V module

Motor operators

Front mounted motor operator

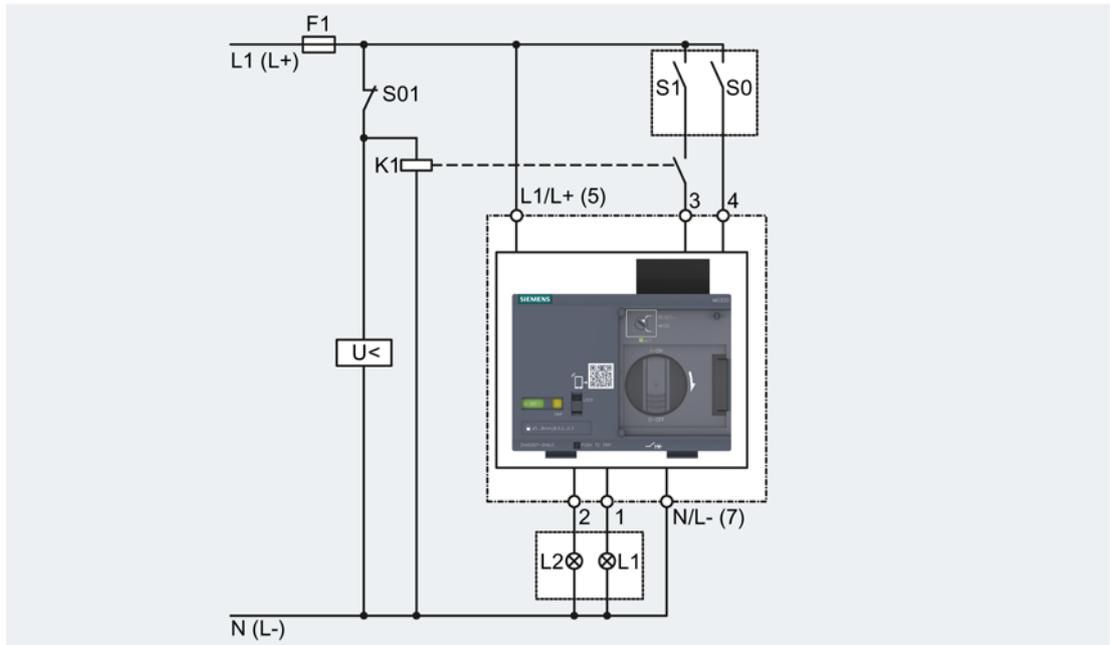


Motor operator actuation controlled via control cable



- S0 OFF (to be provided by customer)
- S1 ON (to be provided by customer)
- F1 Fuse in the control circuit (to be provided by customer)
- L1 Indicator light AUTO mode (to be provided by customer)
- L2 Indicator light MAN mode (to be provided by customer)

Motor operator actuation controlled via control cable and undervoltage release



- S0 OFF (to be provided by customer)
- S1 ON (to be provided by customer)
- S01 Remote command (to be provided by customer)
- K1 Auxiliary contactor (to be provided by customer)
- U< Undervoltage release (to be provided by customer)
- F1 Fuse in the control circuit (to be provided by customer)
- L1 Indicator light AUTO mode (to be provided by customer)
- L2 Indicator light MAN mode (to be provided by customer)

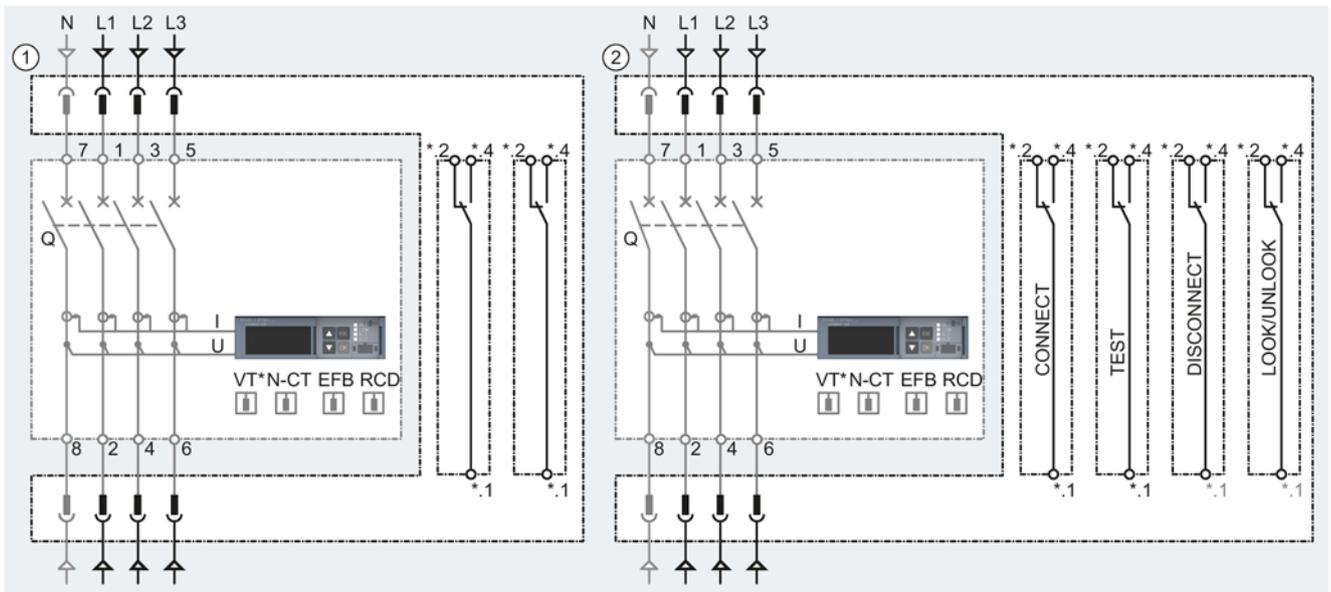
This circuit is deployed in order to prevent no-load operation of the molded case circuit breaker. The contact of auxiliary contactor K1 prevents no-load operation when the undervoltage release "U<" is de-energized.

No-load operations subject the molded case circuit breaker to high stresses. If the undervoltage release is de-energized, auxiliary contactor K1 has not picked up. The contact in the ON circuit (control circuit) of the motor operator is thus not closed, that is, the molded case circuit breaker cannot be switched.

This auxiliary contactor is not necessary when the undervoltage release is supplied uninterrupted (e.g. pushbutton S01) from the same source as the motor operator itself (e.g. contact 3).

Plug-in and draw-out units

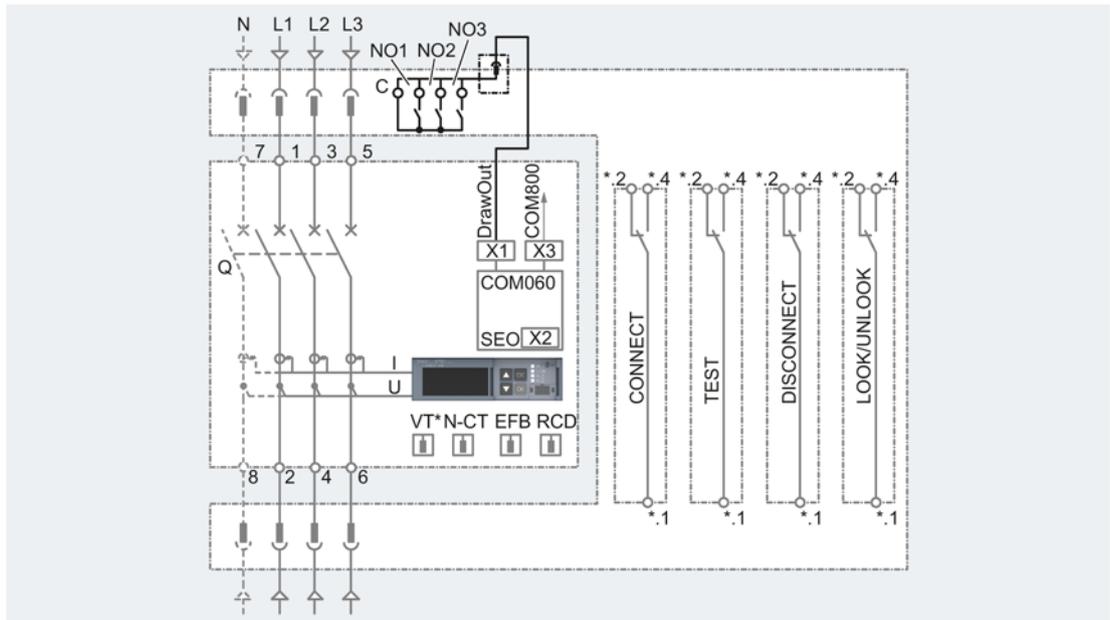
Plug-in and draw-out units



- ① Plug-in units, 3-pole and 4-pole, with two optionally integrated position signaling switches for signaling "Plug-in unit - MCCB correctly bolted to plug-in socket".
- ② Draw-out units, 3-pole and 4-pole, with an optional switch for signaling the condition "Draw-out unit locked / open" and six optionally integrated position signaling switches for signaling "Position of breaker in the draw-out unit".

* Voltage tap

Draw-out units with communication interface

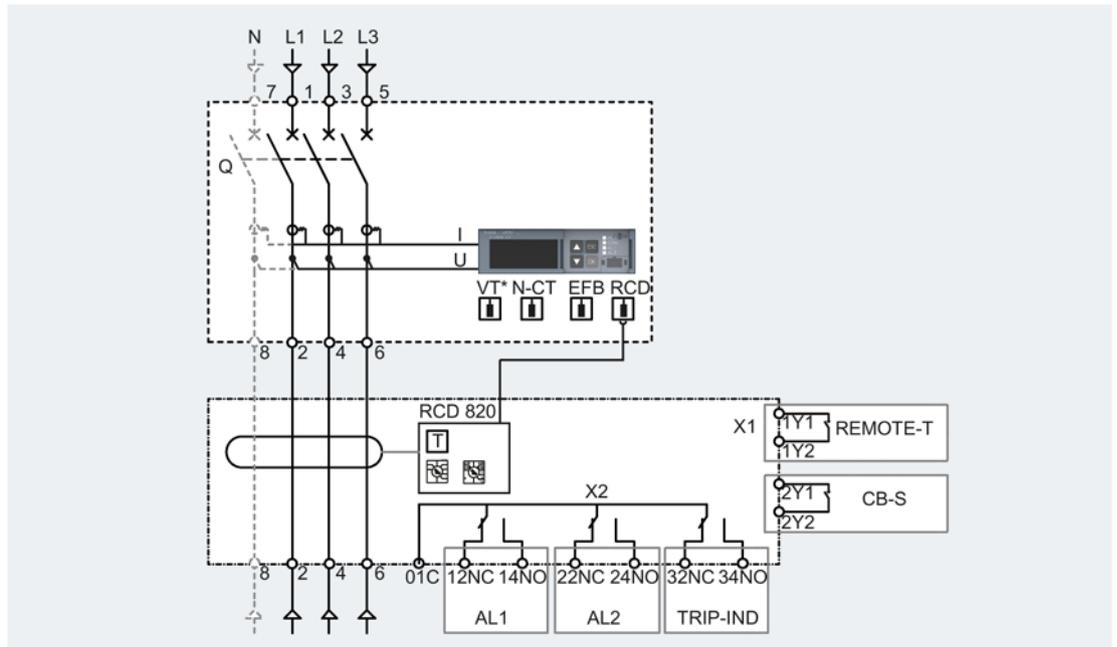


* Voltage tap

Draw-out units, 3-pole and 4-pole, with an optional switch for signaling the condition "Draw-out unit locked / open" and three optionally integrated position signaling switches for signaling "Position of breaker in the draw-out unit".

RCD advanced

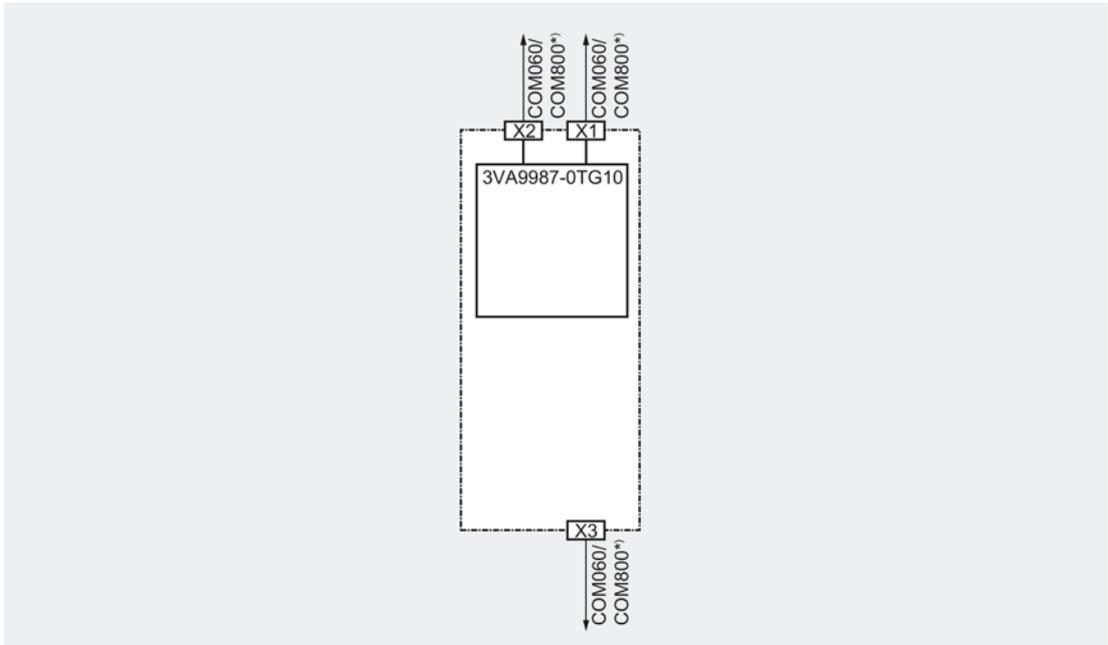
Loadside RCD, 3-pole and 4-pole



* Voltage tap

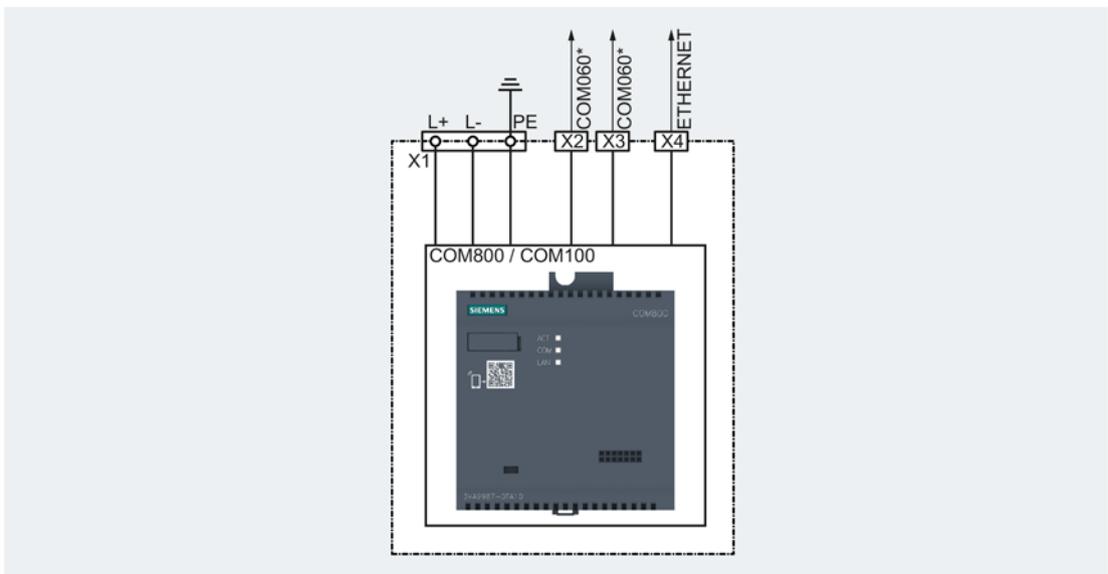
Other external accessories

T-Connector



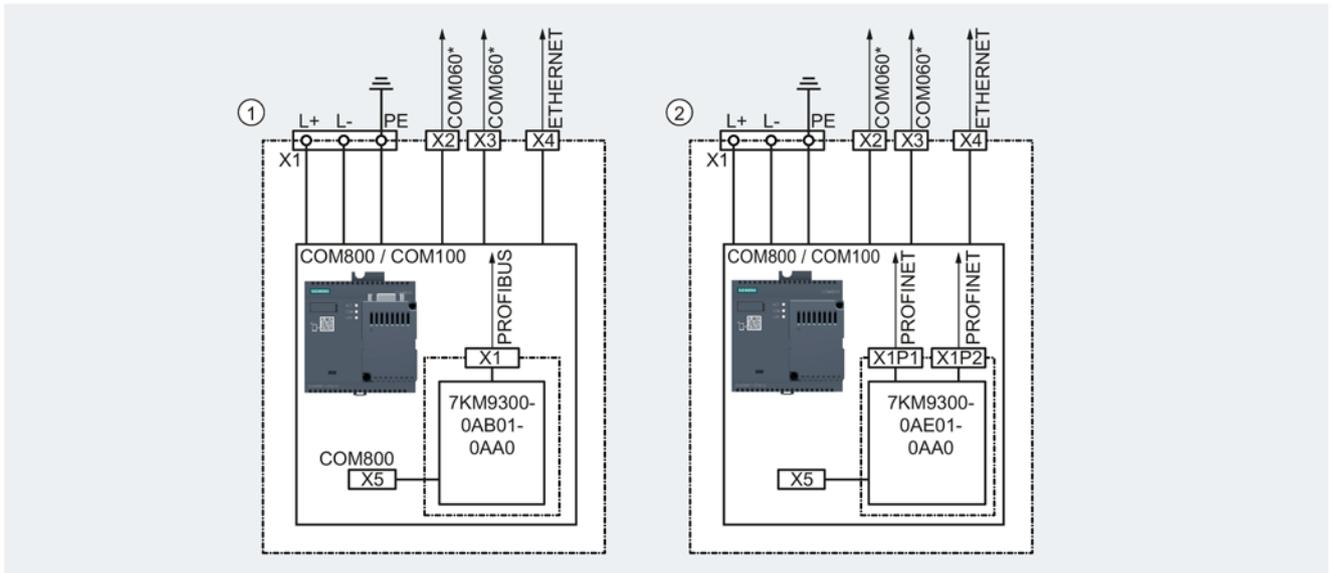
* A connection can also be optionally equipped with a bus terminating resistor.
The T-Connector is included in the scope of supply of the COM060 communication module.

COM800 / COM100 breaker data server



* A connection can also be optionally equipped with a bus terminating resistor.

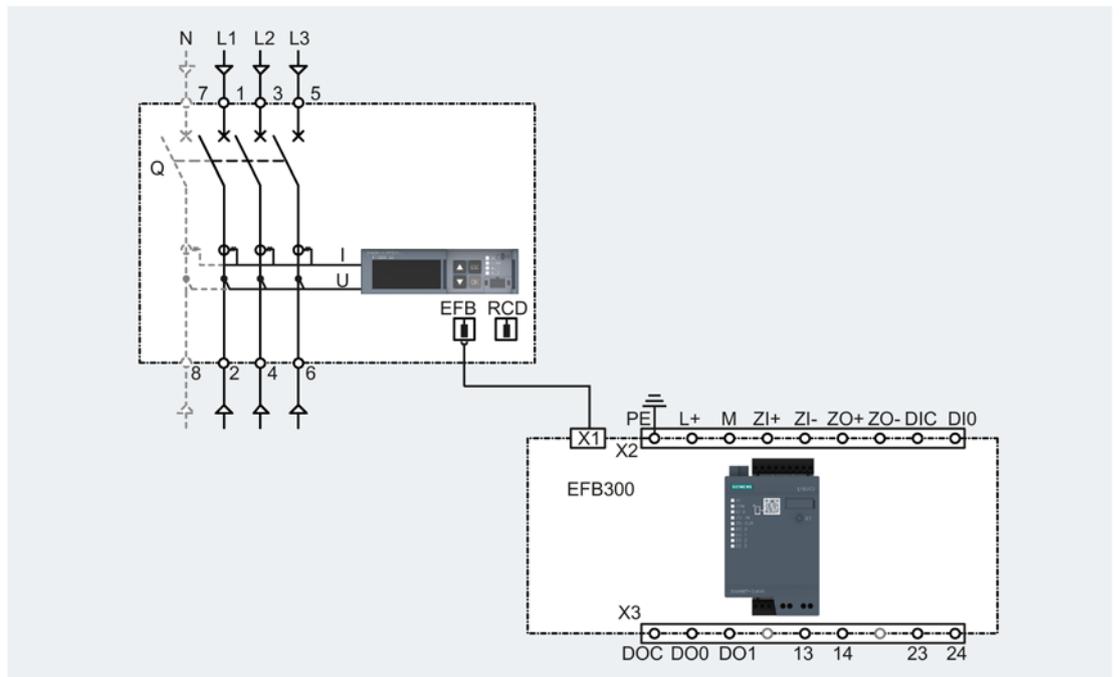
COM800 / COM100 breaker data server with expansion modules



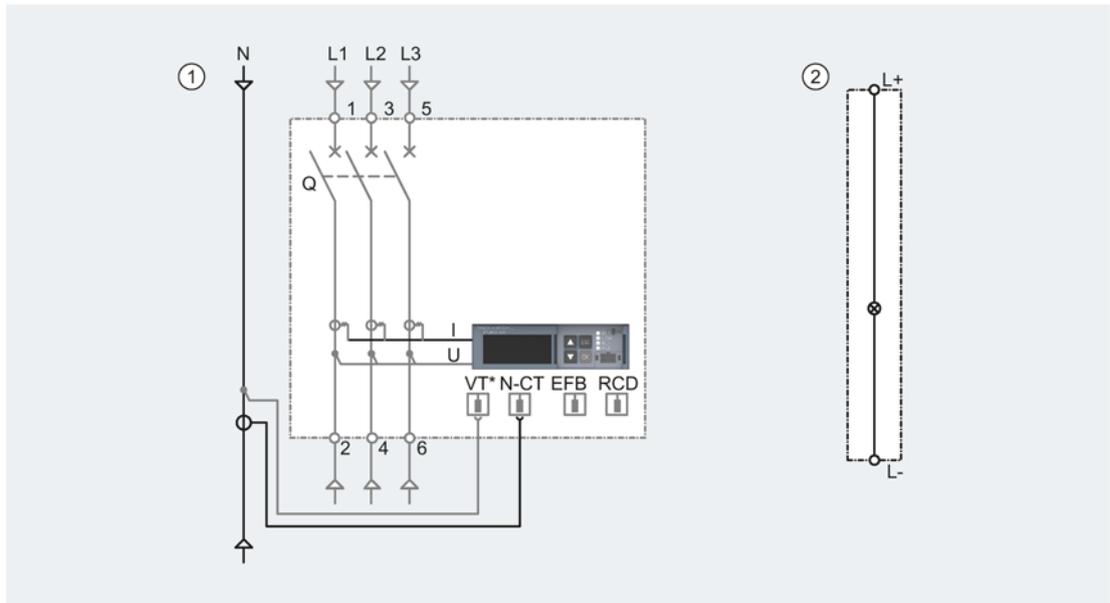
- ① COM800 / COM100 breaker data server with 7KM PAC PROFIBUS DP expansion module
- ② COM800 / COM100 breaker data server with 7KM PAC Switched Ethernet PROFINET expansion module

* A connection can also be optionally equipped with a bus terminating resistor.

EFB300 external function box



External current transformer for N conductor and illumination kit (24 V DC) for manual handle

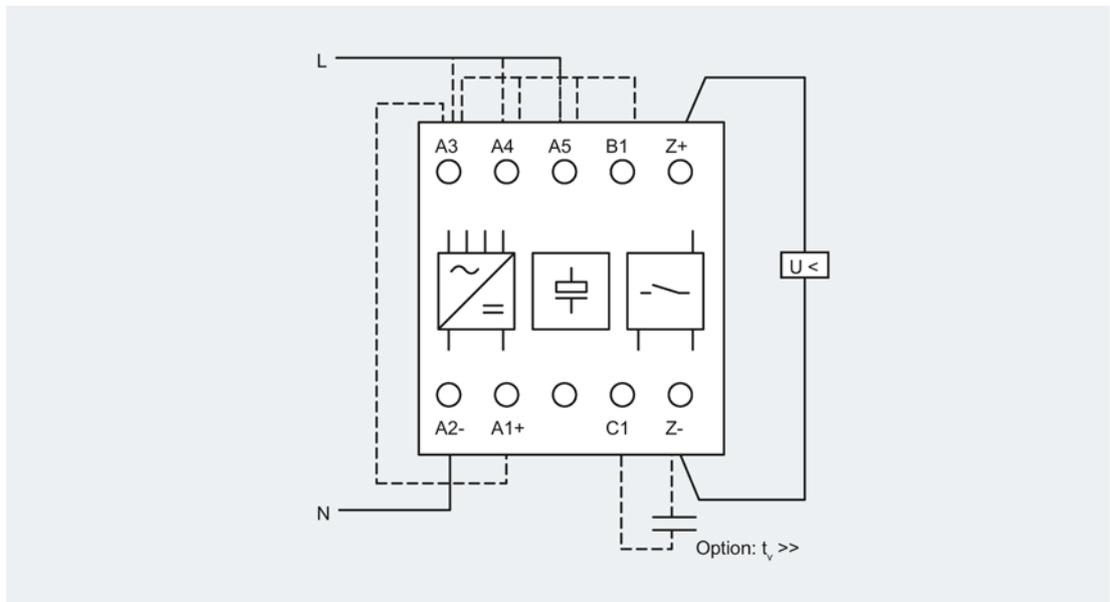


① Connection for external current transformer for N conductor

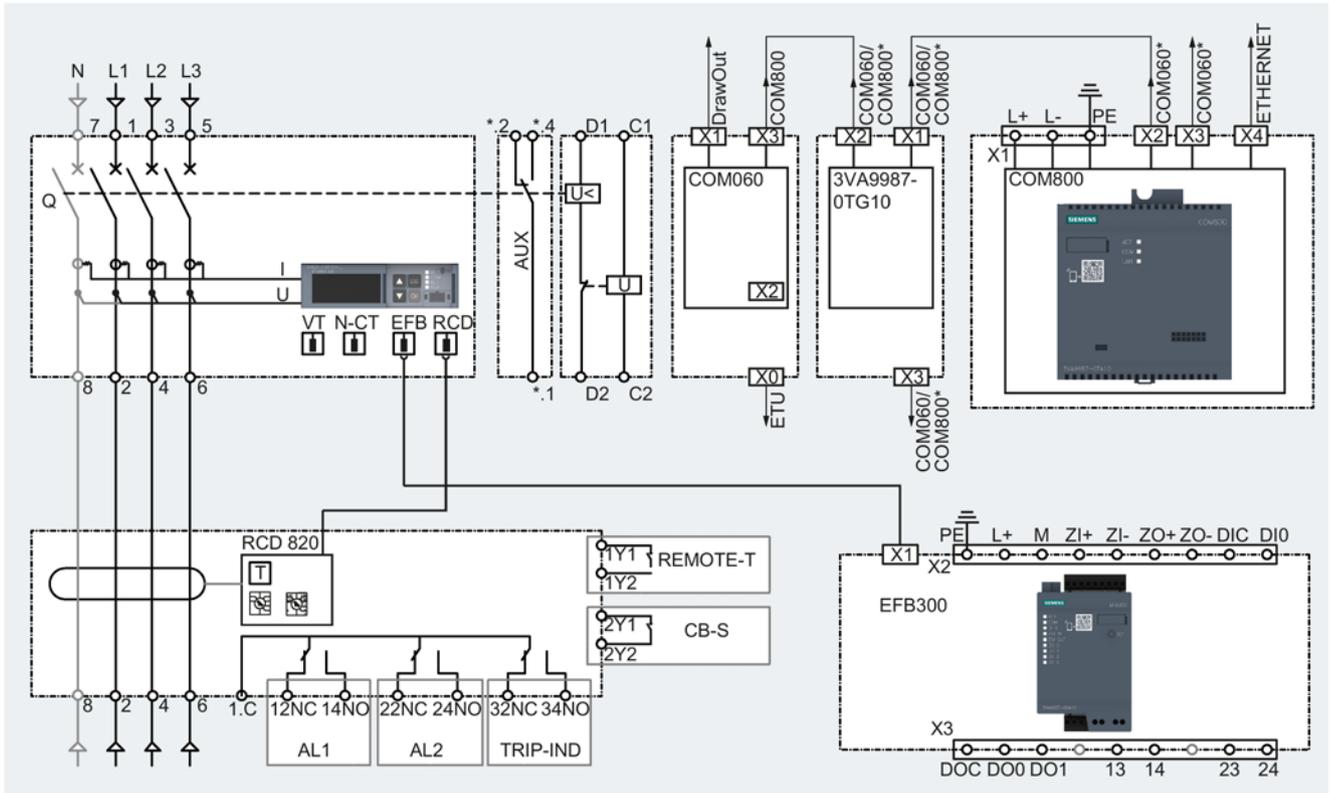
② Illumination kit (24 V DC) for manual handle

* Voltage tap

Time-delay device for undervoltage releases



6.1.2.3 Example: 3VA2 molded case circuit breaker with built-on/built-in accessories



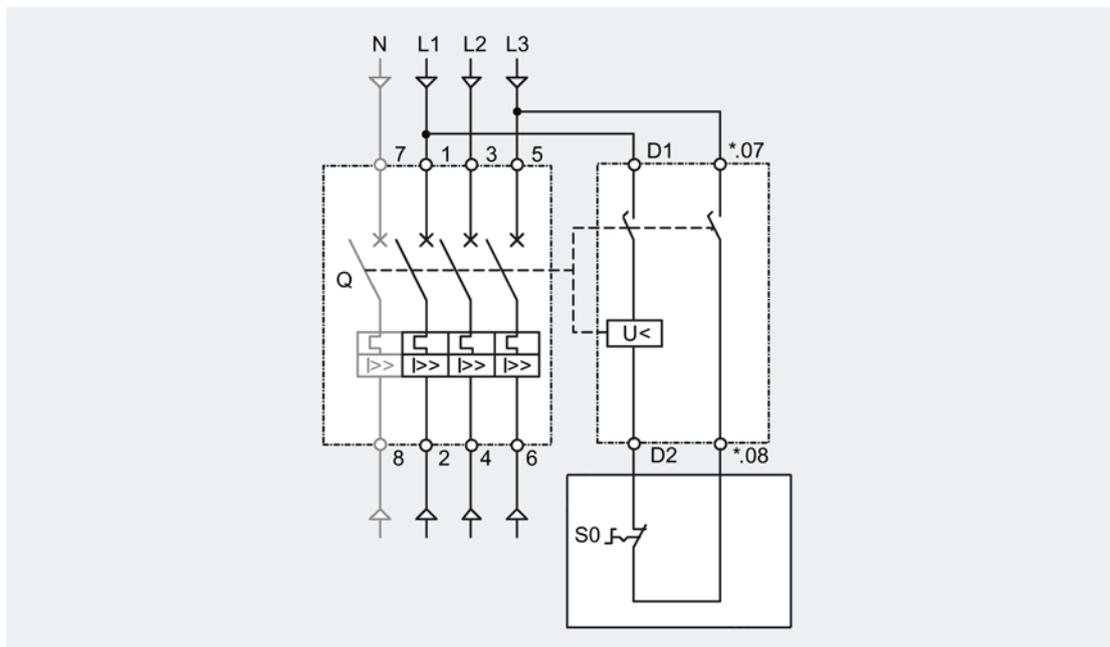
* A connection can also be optionally equipped with a bus terminating resistor.

6.1.3 Application examples

6.1.3.1 Main switch application with EMERGENCY-STOP function in accordance with Machinery Directive IEC/EN 60204-1

When the molded case circuit breaker is in the OFF or TRIP position, all outgoing control cables from the circuit breaker are de-energized. The contacts of the EMERGENCY-STOP pushbutton are therefore also de-energized whenever the molded case circuit breaker is switched off.

EMERGENCY-STOP circuit with 3VA molded case circuit breaker and undervoltage release with leading NO contacts UVR (LNO)

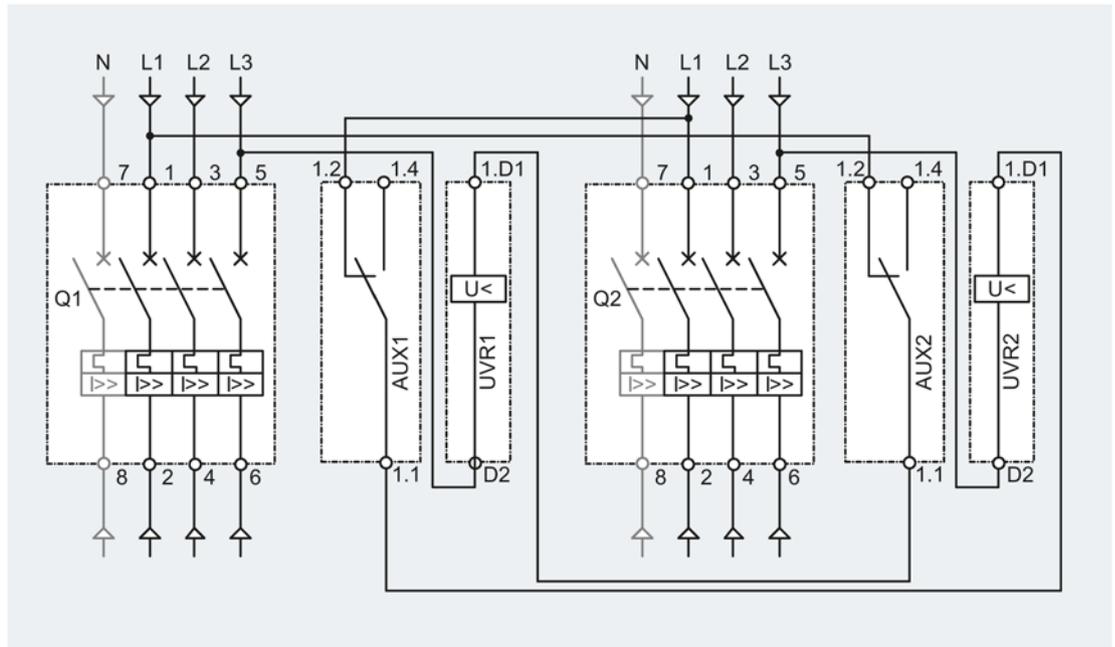


- Q 3VA molded case circuit breaker
- U< Undervoltage release with leading NO contacts UVR (LNO)
- S0 EMERGENCY-STOP (to be provided by customer)

Note

The undervoltage release with leading NO contacts UVR (LNO) must not be connected to phases L1 and L3 for 690 V AC applications. In this case, it is connected to phase L1 and the N conductor or to a control voltage supply up to maximum 480 V AC.

6.1.3.2 Electrical interlocking of two 3VA molded case circuit breakers with undervoltage releases



- Q 1 Molded case circuit breaker 1
- UVR Undervoltage release in molded case circuit breaker 1
- 1
- AUX 1 Auxiliary switch in molded case circuit breaker 1
- Q 2 Molded case circuit breaker 2
- UVR Undervoltage release in molded case circuit breaker 2
- 2
- AUX 2 Auxiliary switch in molded case circuit breaker 2

Note

The undervoltage release UVR must not be connected to phases L1 and L3 for 690 V AC applications. In this case, it is connected to phase L1 and the N conductor or to a control voltage supply up to maximum 480 V AC.

6.2 Dimensional drawings

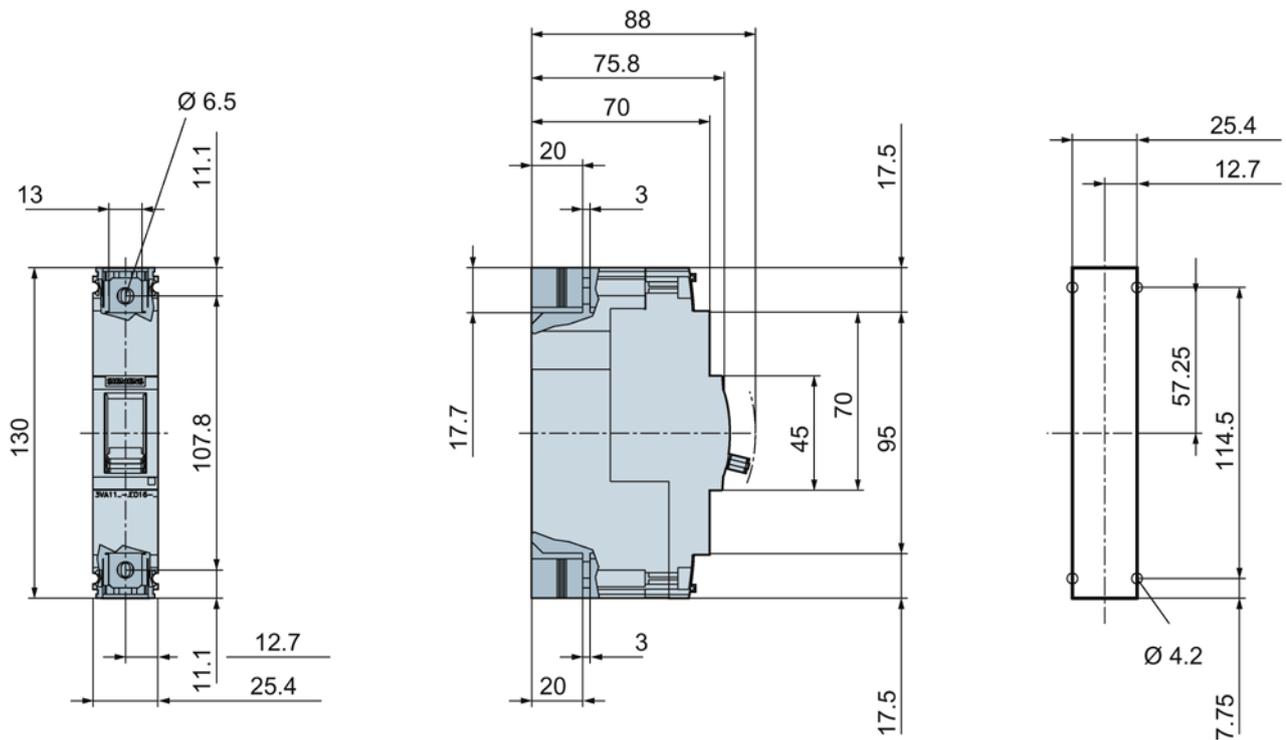
Note

Hole drilling templates can be ordered via the Internet from the Siemens ComMaterials Platform (https://siemens-merchandising.ippag.com/nbc_requirelogin_sml.php?language=en).

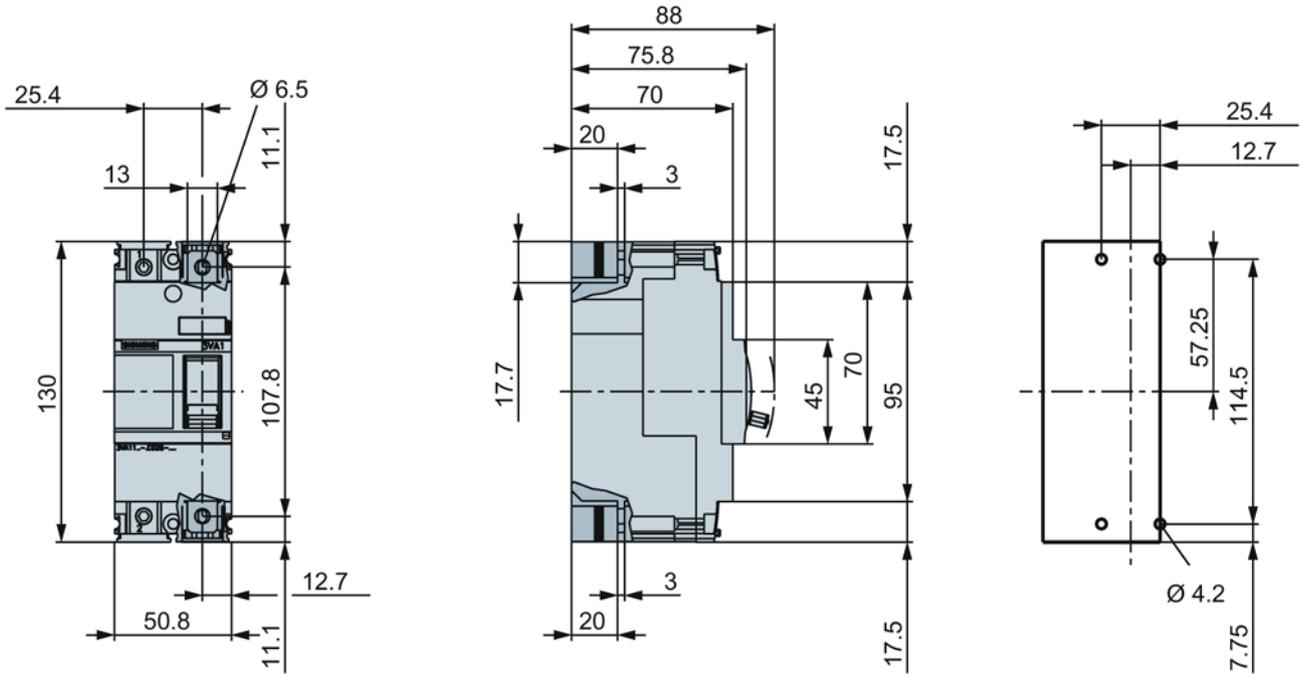
6.2.1 Dimensions of basic units

6.2.1.1 3VA10 and 3VA11

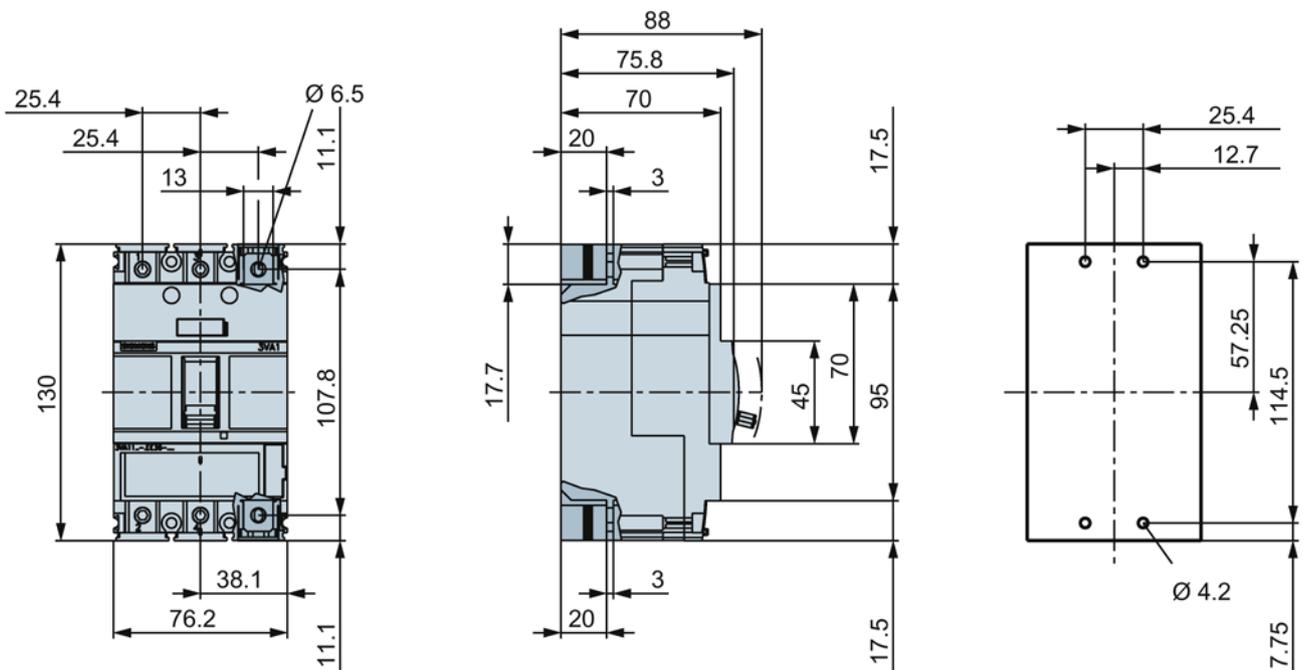
3VA11 160 A 1-pole



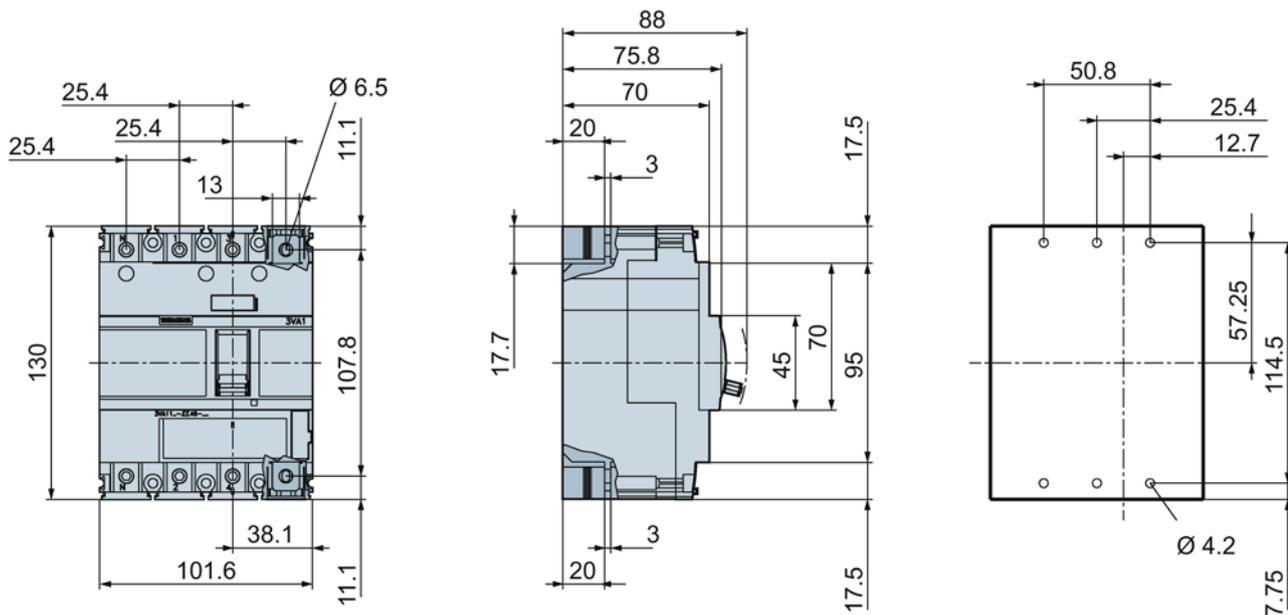
3VA11 160 A 2-pole



3VA10 100 A / 3VA11 160 A 3-pole

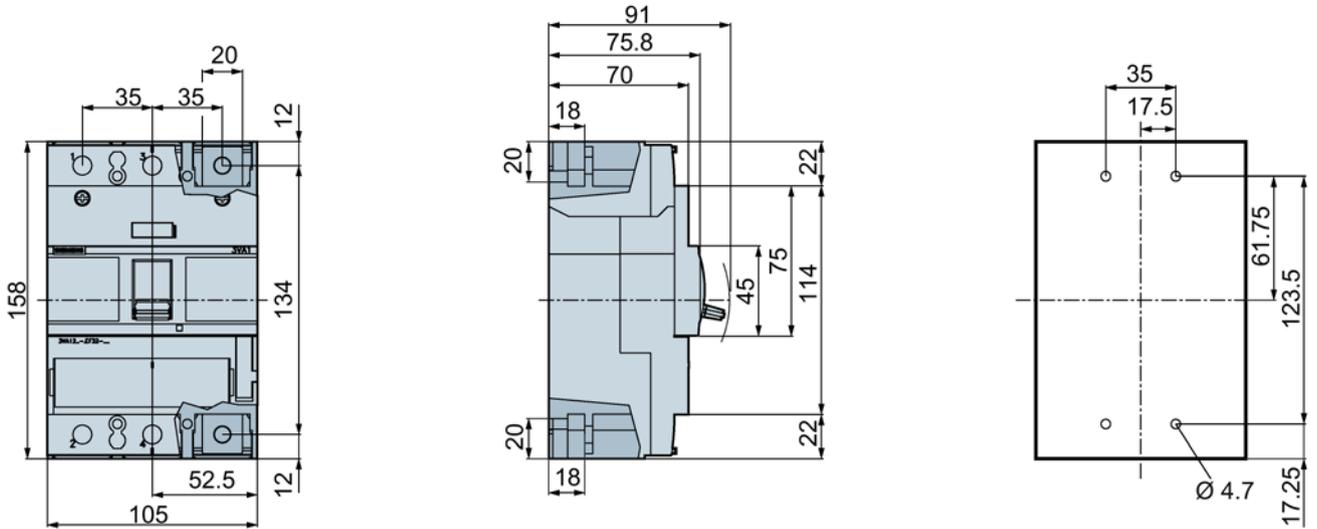


3VA10 100 A / 3VA11 160 A 4-pole

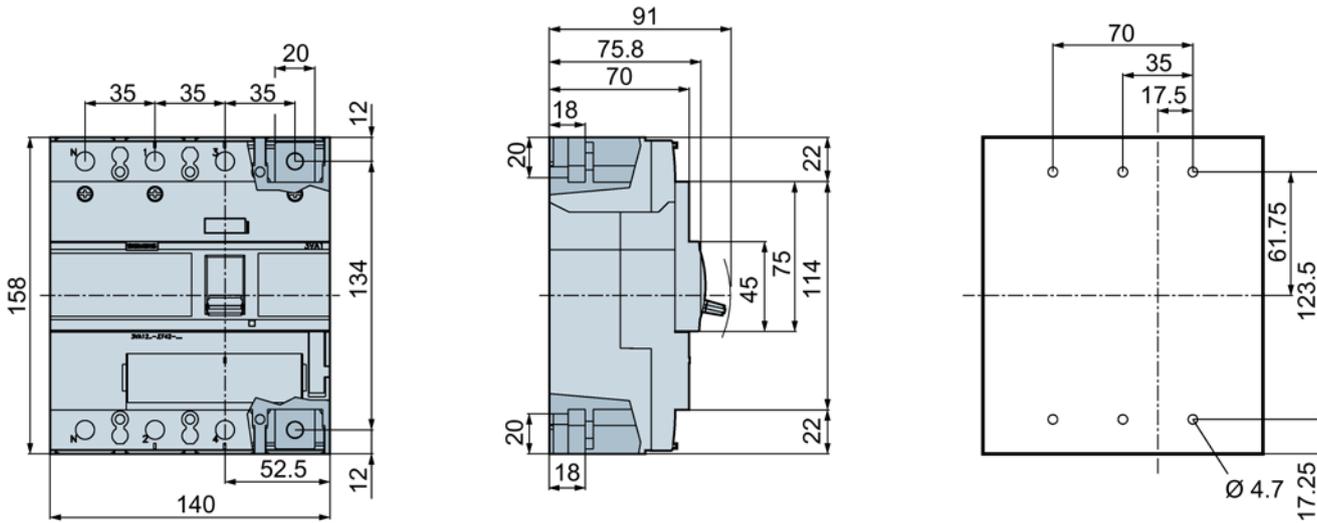


6.2.1.2 3VA12

3VA12 250 A 3-pole

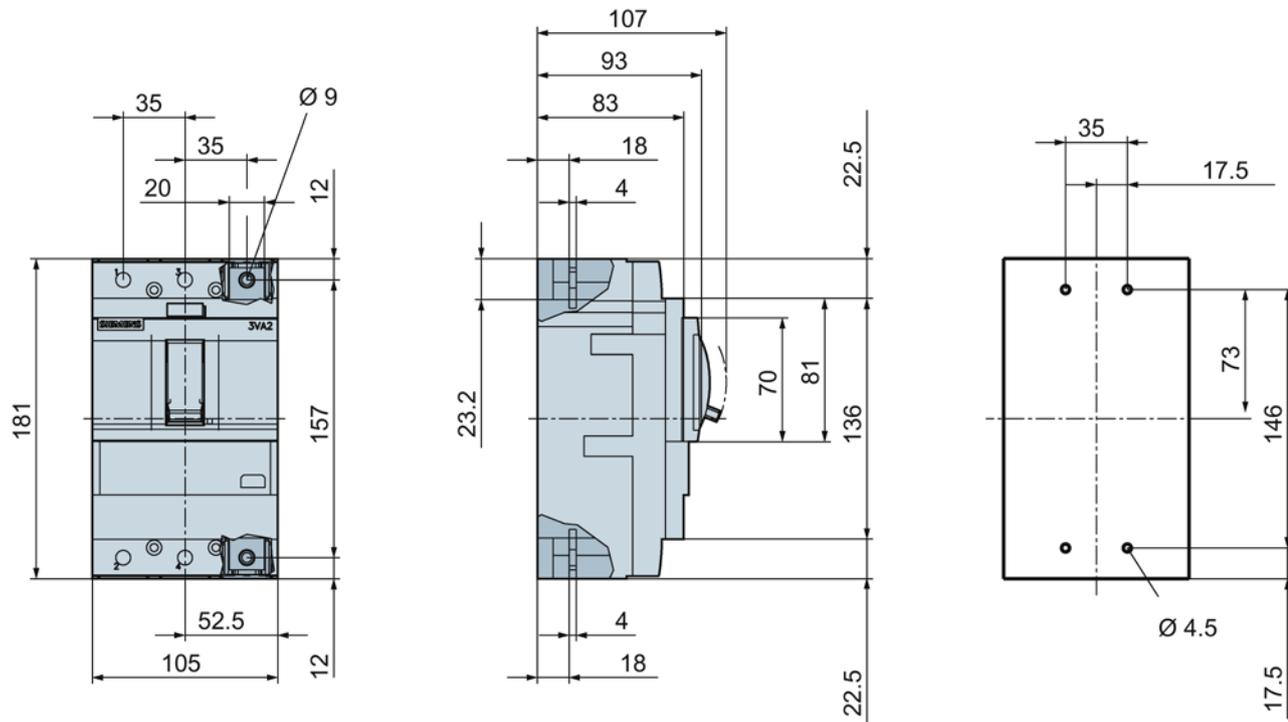


3VA12 250 A 4-pole

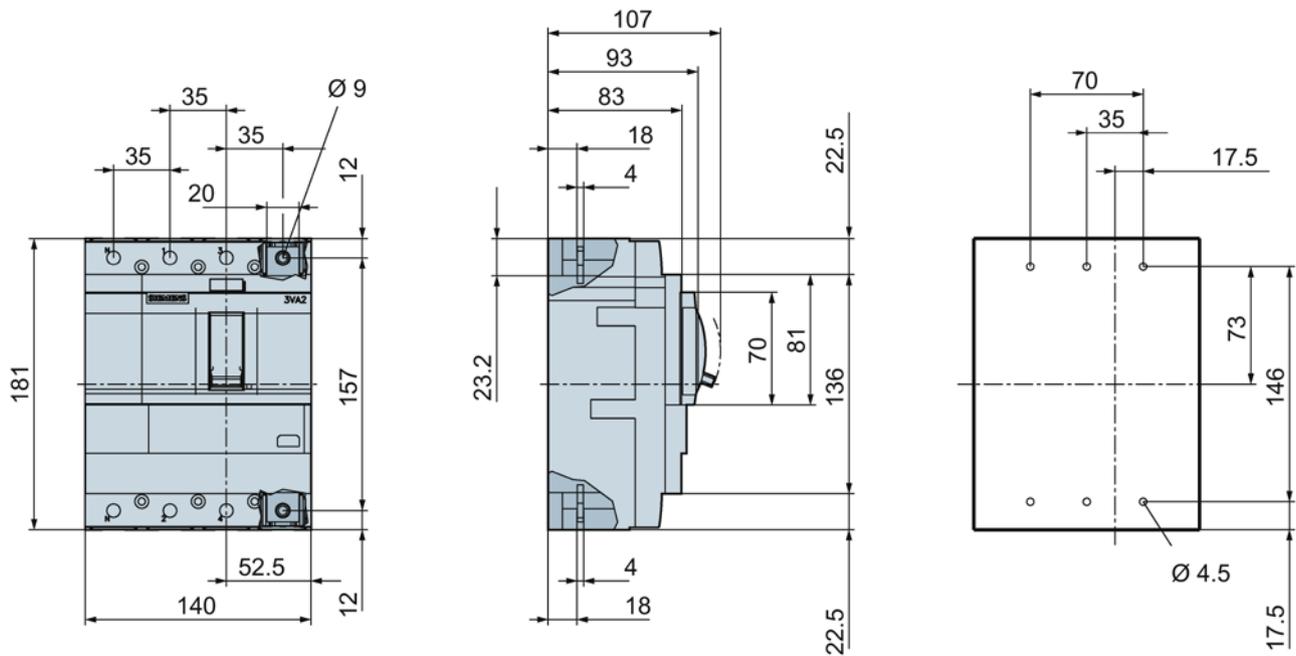


6.2.1.3 3VA20

3VA20 100 A / 3VA21 160 A / 3VA22 250 A 3-pole

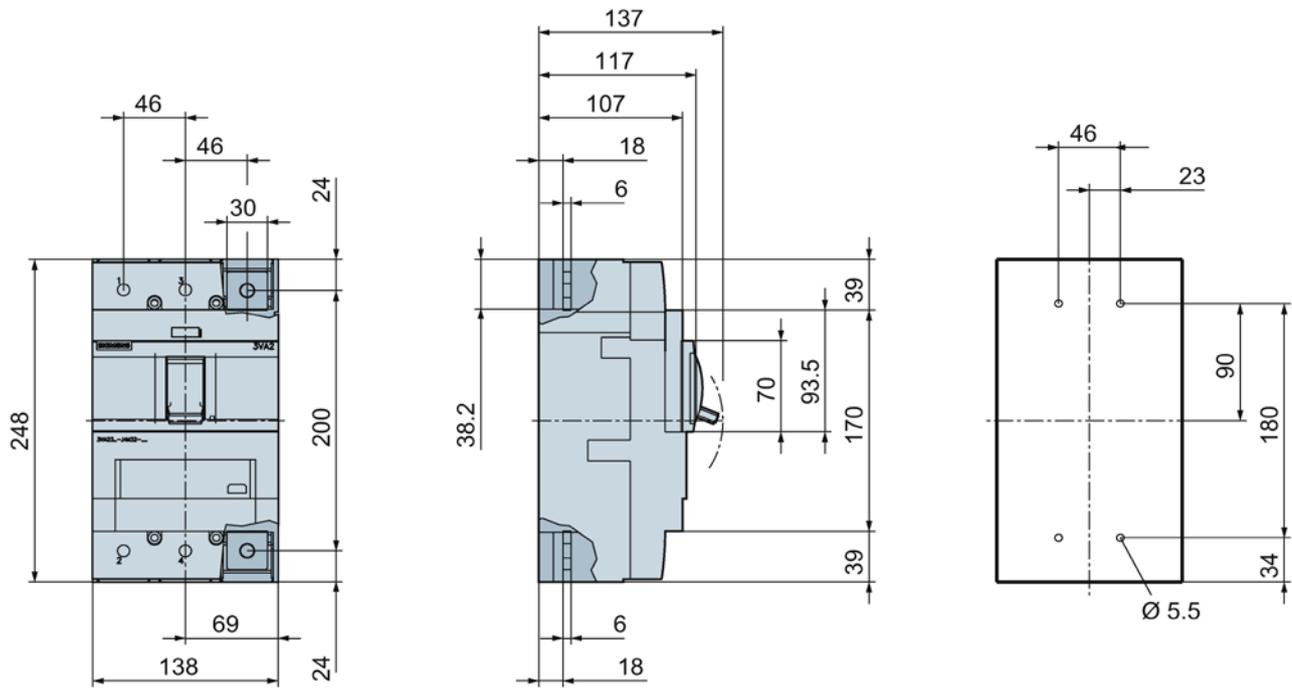


3VA20 100 A / 3VA21 160 A / 3VA22 250 A 4-pole

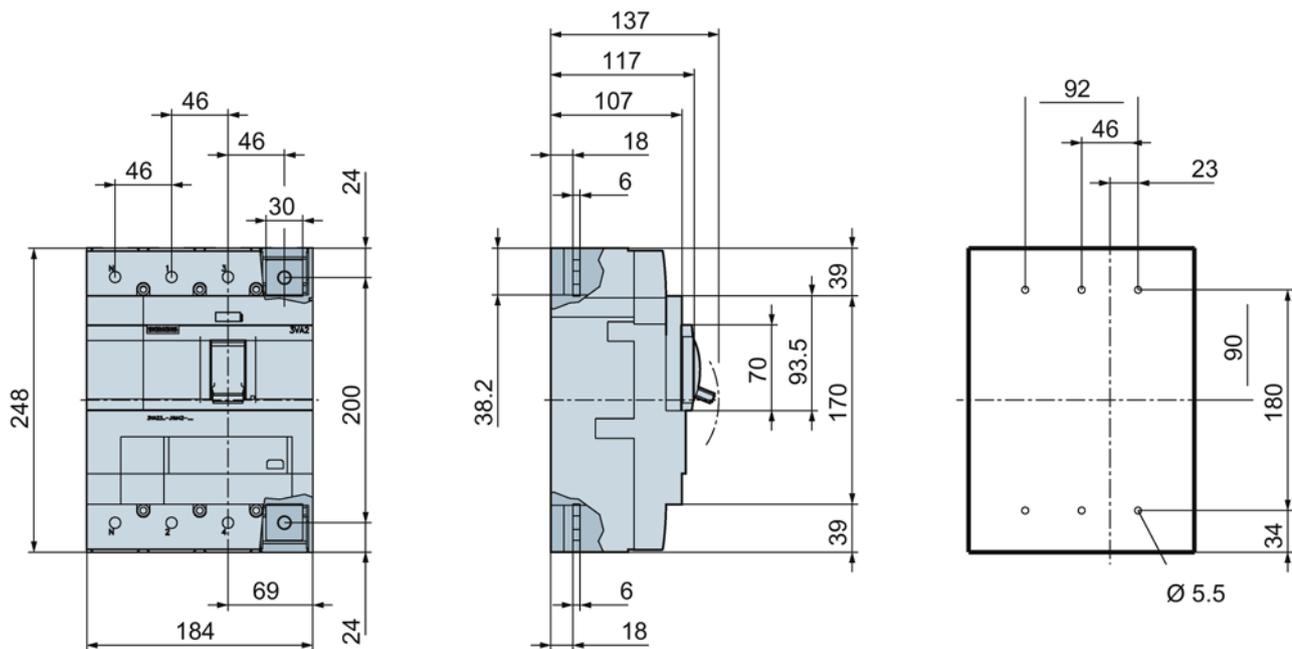


6.2.1.4 3VA23

3VA23 400 A / 3VA24 630 A 3-pole



3VA23 400 A / 3VA24 630 A 4-pole

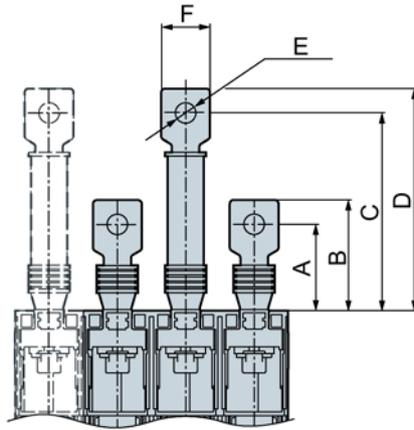


6.2.2 Dimensions of accessories

6.2.2.1 Connection technology

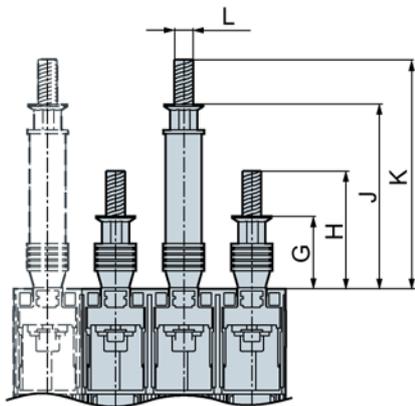
Rear busbar and cable lug connections for plug-in and draw-out molded case circuit breakers

Rear terminal flat



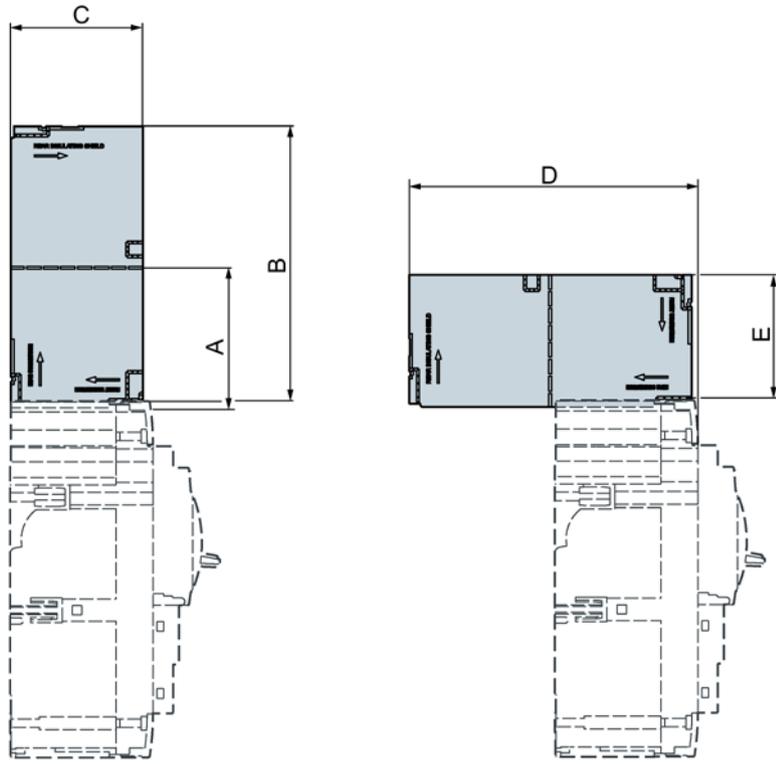
		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	51		43	50
B	[mm]	63		55.5	65
C	[mm]	108		100	115
D	[mm]	120.5		112.5	130
E	[mm]	8.4		10.5	13.2
F	[mm]	16		22	29.4

Rear connecting stud



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
G	[mm]	28		36	45
H	[mm]	66		59	75
J	[mm]	85		93	105
K	[mm]	123		116	135
L	[mm]	M8		M10	M12

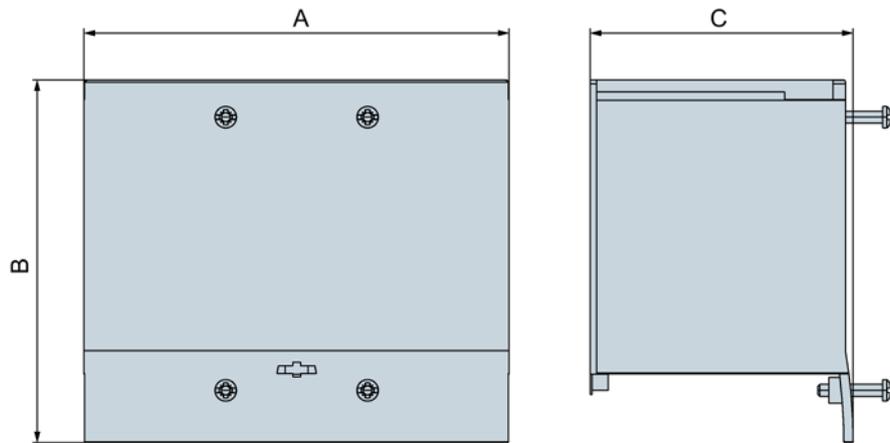
Phase barrier



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	38.5 / 68.5	45 / 96.7	73	87.2
B	[mm]	96.6	136.9	141.2	166.5
C	[mm]	61.2	62.7	68.4	87.2
D	[mm]	100.2	141.7	146.1	174.4
E	[mm]	57.8	57.9	63.4	79.3

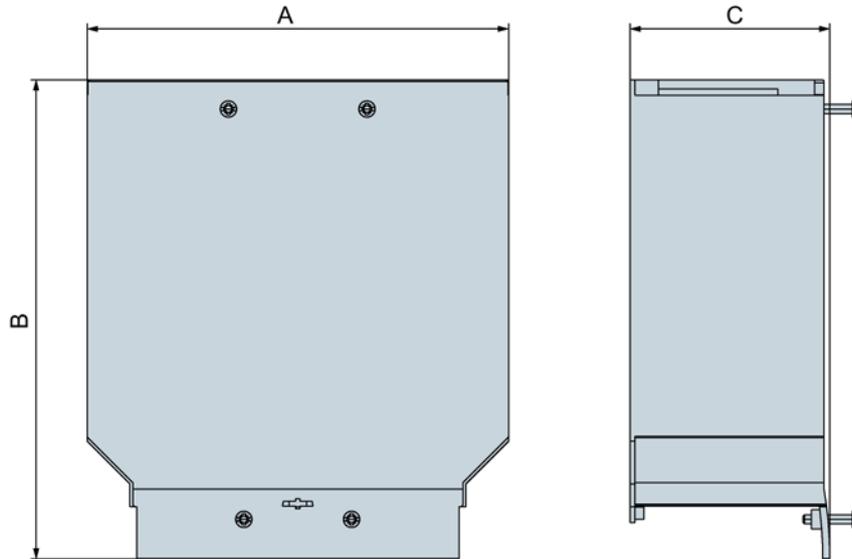
Terminal cover

Extended terminal cover



		3VA1						3VA2			
		100 / 160			250			100 / 160 / 250		400 / 630	
		2-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole	
A	[mm]	50.8	76.2	101.6	105	140	105	140	138	184	
B	[mm]	82.4			89.3		89.6		103.8		
C	[mm]	67			64.9		72.7		93.9		

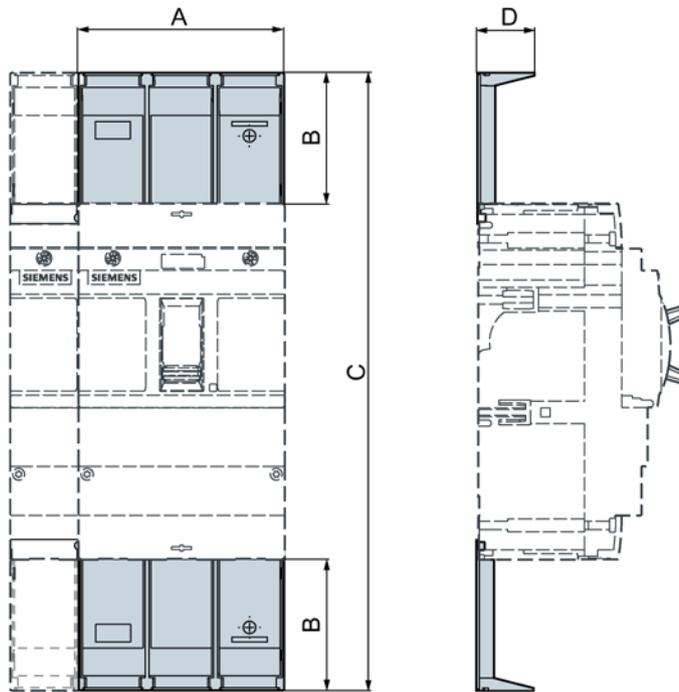
Broadened terminal cover



		3VA1				3VA2			
		100 / 160		250		100 / 160 / 250		400 / 630	
		3-pole	4-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole
A	[mm]	106.5	141,5	136.5	181.8	136.8	181.8	212	282
B	[mm]	114		155.6		155.9		187,5	186.6
C	[mm]	65		64.9		72.7	73.7	93.5	94.5

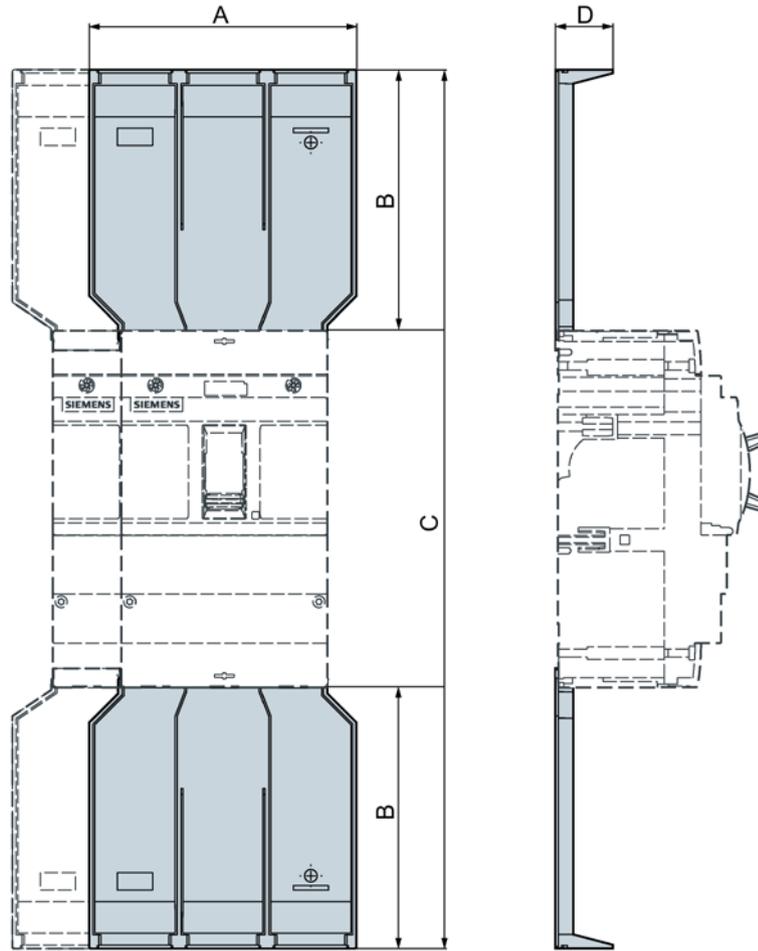
Insulating plate

Insulating plate



		3VA1					3VA2			
		100 / 160			250		100 / 160 / 250		400 / 630	
		2-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole
A	[mm]	50.8	76.2	101.6	105	140	105	140	138	182.2
B	[mm]	52			67.4		67.4		64.9	
C	[mm]	234			292.8		315.8		377.8	
D	[mm]	7			29.2		29.2		33.2	

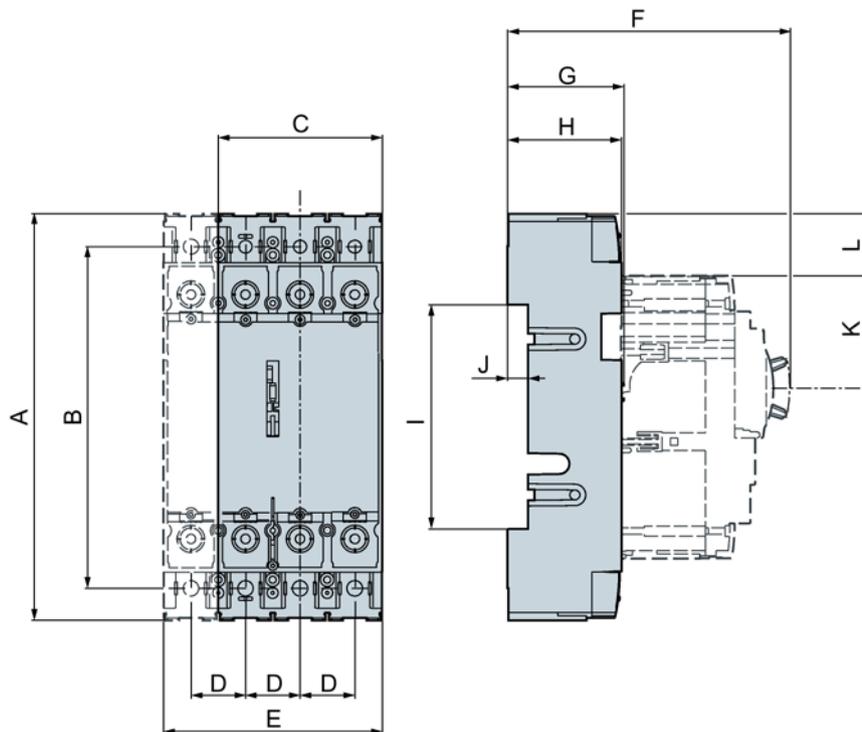
Broadened insulating plate



		3VA1				3VA2			
		100 / 160		250		100 / 160 / 250		400 / 630	
		3-pole	4-pole	3-pole	4-pole	3-pole	4-pole	3-pole	4-pole
A	[mm]	106.5	141,5	136.8	181.8	136.8	181.8	212	282
B	[mm]	96.5		133.7		133.7		147.5	
C	[mm]	323		425.4		448.4		543	
D	[mm]	26.8		29.5		29.5		37.3	

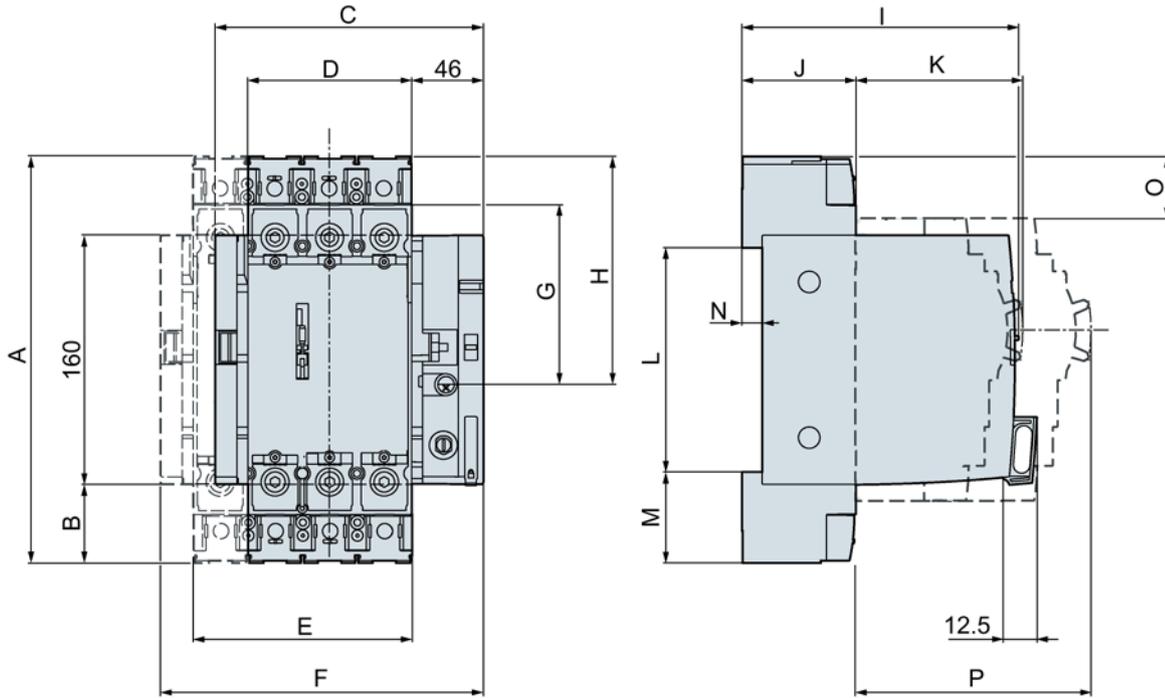
6.2.2.2 Plug-in and draw-out units

Plug-in socket



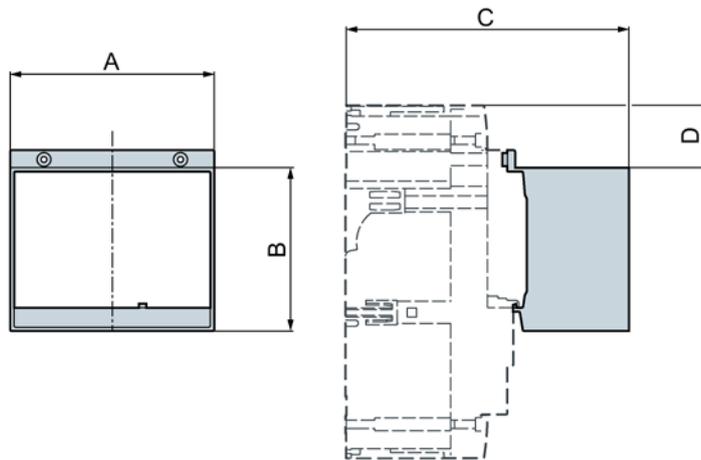
		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	186.1	237	261	327
B	[mm]	153.8	196	220	279
C	[mm]	76.2	105	105	138
D	[mm]	25.4		35	46
E	[mm]	101.6		140	184
F	[mm]	153	155.4	180	232
G	[mm]		66.5	74.5	95.5
H	[mm]		65	73	94
I	[mm]	122.3	149.5	144	192
J	[mm]		5	13	34
K	[mm]	60	79	70	98
L	[mm]	28	39.5	40	39.5

Draw-out unit



		3VA1	3VA2	
		250	100 / 160 / 250	400 / 630
A	[mm]	237	261	327
B	[mm]	38.5	50.5	83.5
C	[mm]		172	205
D	[mm]		105	138
E	[mm]		140	184
F	[mm]		207	251
G	[mm]	104	115.6	140.5
H	[mm]	134.5	146.5	179.5
I	[mm]	169.5	178	199
J	[mm]	65	73	94
K	[mm]	90.4	107	
L	[mm]	149.5	144	192
M	[mm]	43.8	58.5	67.5
N	[mm]	5	13	34
O	[mm]	39.5	40	
P	[mm]	132.4	149	

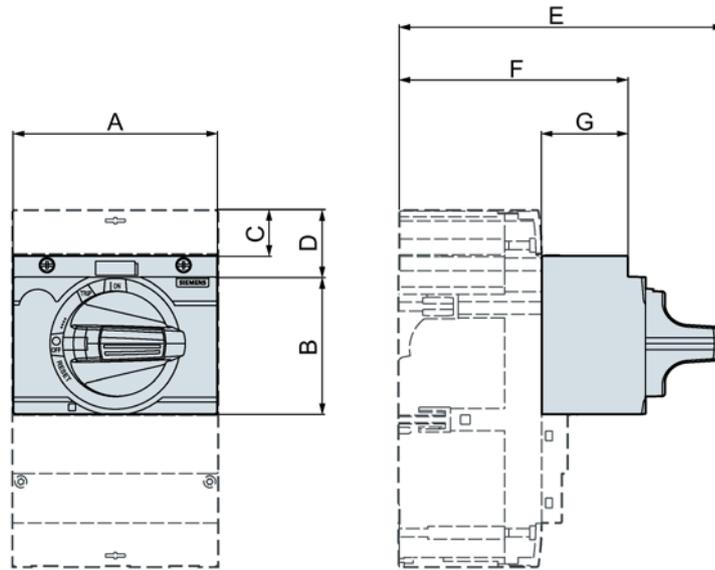
Door feedthrough



		3VA1 250	3VA2 100 / 160 / 250	3VA2 400 / 630
A	[mm]	104.6		137.6
B	[mm]	84		
C	[mm]	129.3	145.3	172
D	[mm]	34	31.5	51

6.2.2.3 Manual operators

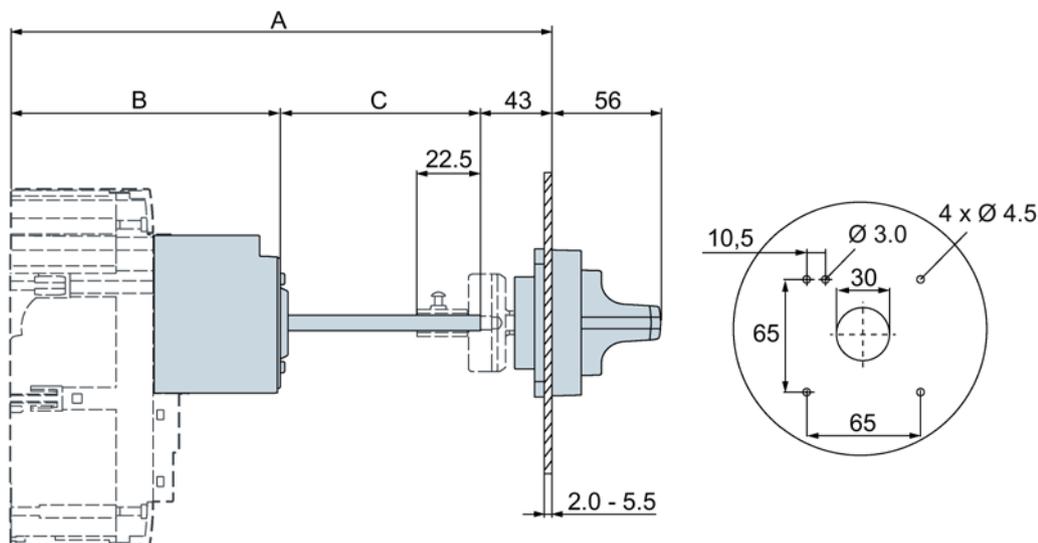
Front mounted rotary operator



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	77	105	105	138
B	[mm]	45	45	71	71
C	[mm]	18	23	23	39
D	[mm]	43	53	34	62
E	[mm]	157	157	176	200
F	[mm]	110	109	127	151
G	[mm]	47	46	57	59

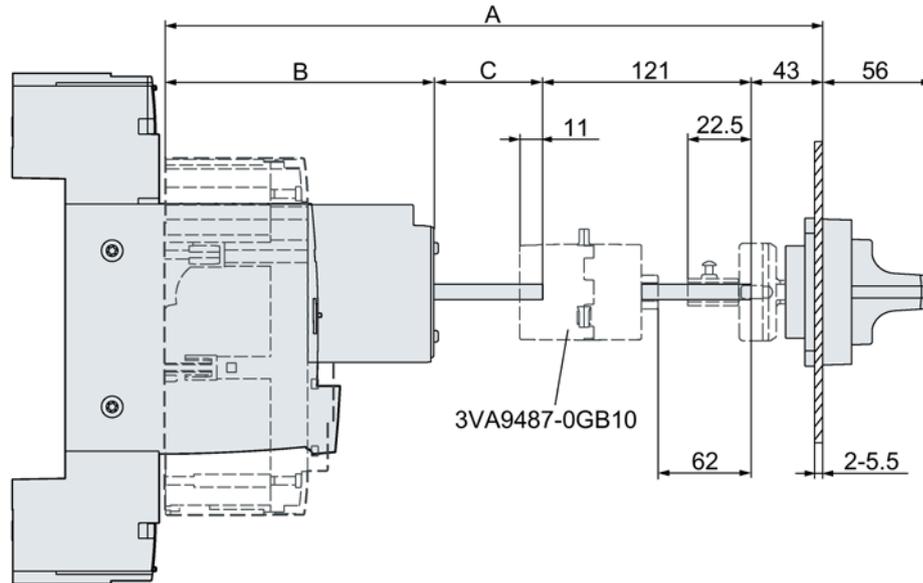
Door mounted rotary operator

Door mounted rotary operator



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A _{min}	[mm]	191		210	234
A _{max}	[mm]	440		460	483
B	[mm]	119	115	141	165
C _{min}	[mm]	29	33	26	
C _{max}	[mm]	278	282	276	275

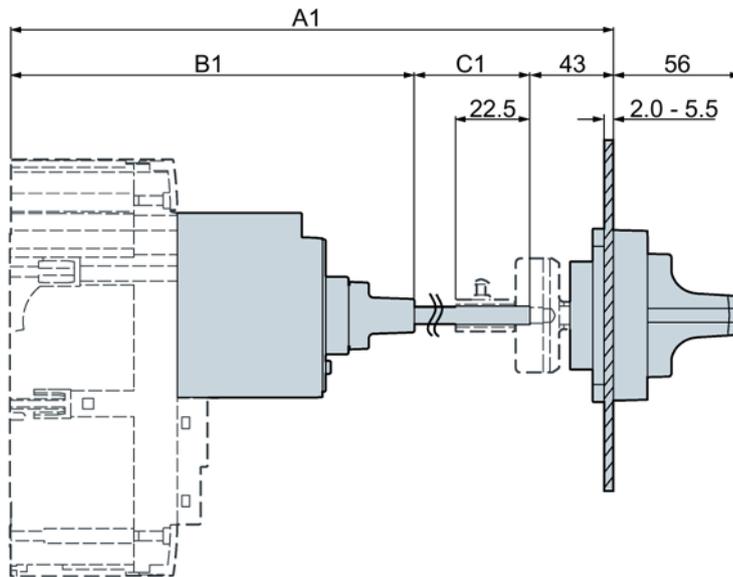
Door mounted rotary operator with variable depth adapter (3VA9487 - 0GB10)



		3VA1	3VA2	
		250	100 / 160 / 250	400 / 630
A _{min}	[mm]	290	320	345
A _{max}	[mm]	550	583	605
B	[mm]	115	141	165
C _{min}	[mm]	11	15	16
C _{max}	[mm]	271	278	276

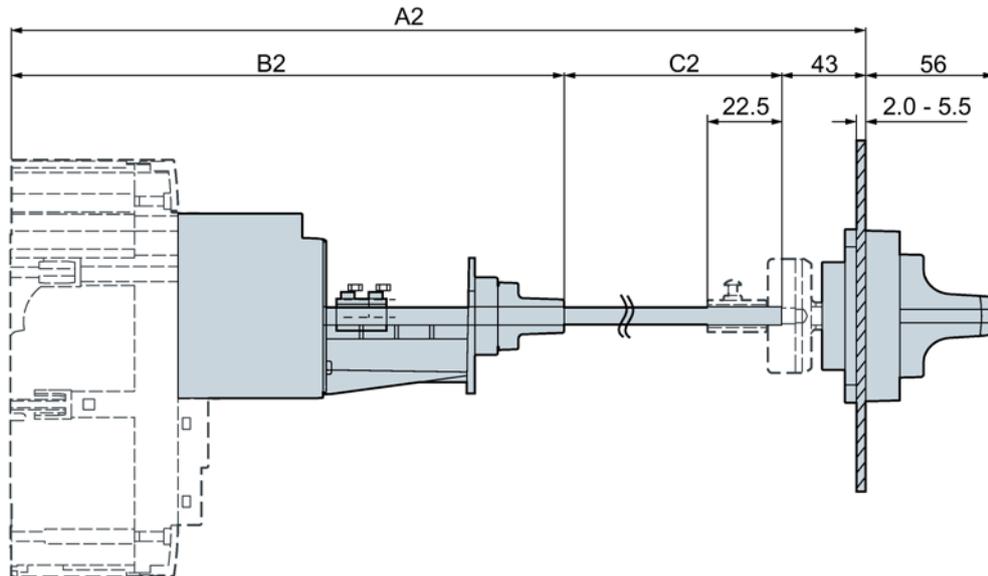
Supplementary handle for door mounted rotary operator

3VA9.87 - 0GC...



		3VA1		3VA2	
		100 / 160 / 250		100 / 160 / 250	400 / 630
A1 _{min}	[mm]	226	246	270	
A1 _{max}	[mm]	440	460	483	
B1	[mm]	158	177	201	
C1 _{min}	[mm]	23	23		
C1 _{max}	[mm]	237	238		

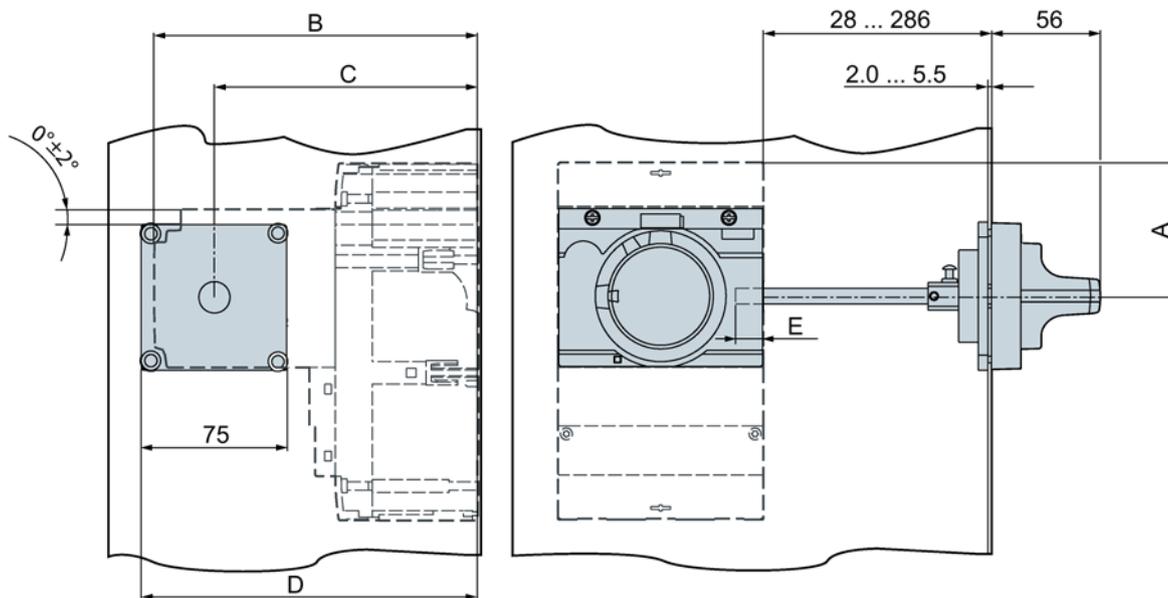
3VA9.87 - 0GA80



	3VA1		3VA2	
	100 / 160 / 250		100 / 160 / 250	400 / 630
A2 _{min}	[mm]	294	313	337
A2 _{max}	[mm]	744	766	790
B2	[mm]	225	244	268
C2 _{min}	[mm]	23	23	
C2 _{max}	[mm]	468	470	

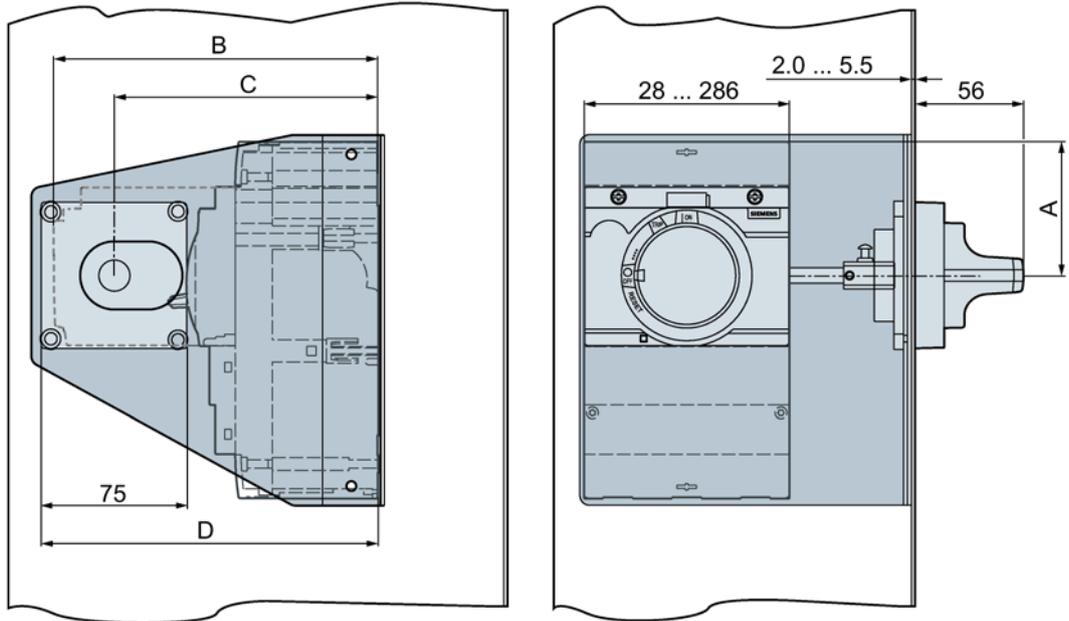
Side wall mounted rotary operator

Side wall mounted rotary operator



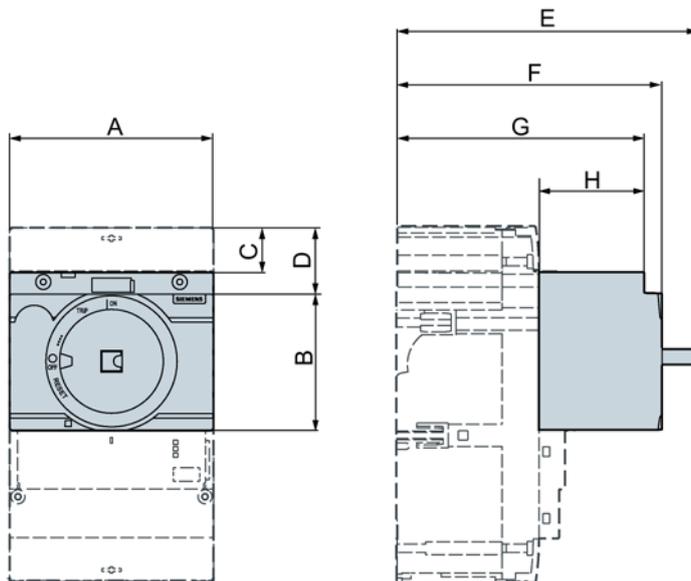
		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	65	75	68	96
B	[mm]	147	145	167	190
C	[mm]	119	117	135	159
D	[mm]	157	155	173	197
E	[mm]	15	29	29	45

Side wall mounted rotary operator with mounting plate



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	65	75	68	96
B	[mm]	147	145	167	190
C	[mm]	119	117	135	159
D	[mm]	157	155	173	197

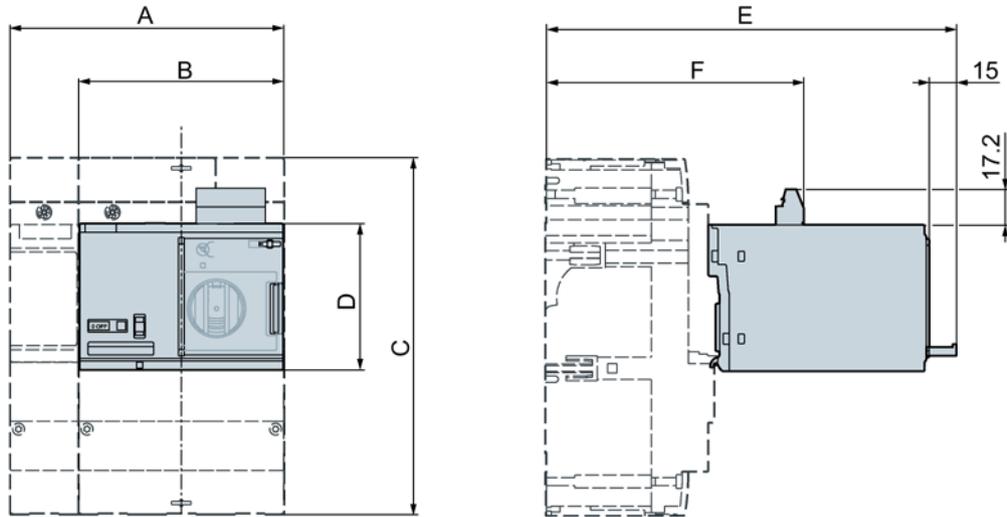
Rotary operator with shaft stub



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	77	105	105	138
B	[mm]	45	45	71	71
C	[mm]	18	23	23	39
D	[mm]	43	53	34	62
E	[mm]	131	138	160	183
F	[mm]	118	115	137	160
G	[mm]	110	109	127	151
H	[mm]	47	46	57	59

6.2.2.4 Motor operators

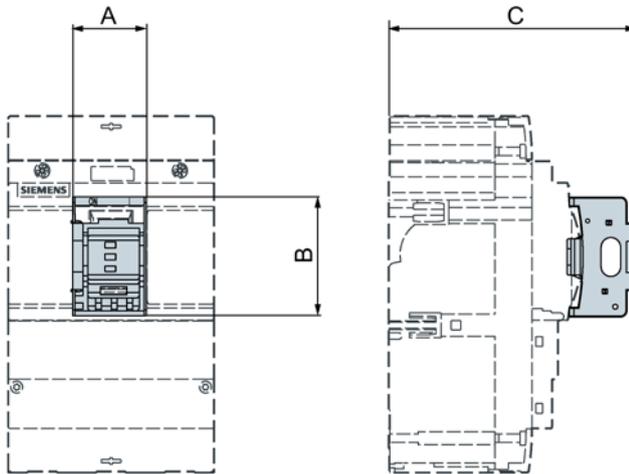
MO320 motor operator



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	101.5	139.6	139.6	183.6
B	[mm]	76.2	104.6	104.6	137.6
C	[mm]	130	158	178	247
D	[mm]	70	75	75	92
E	[mm]	181	201.4	217.9	241
F	[mm]	121.1	126.6	143.1	170.2

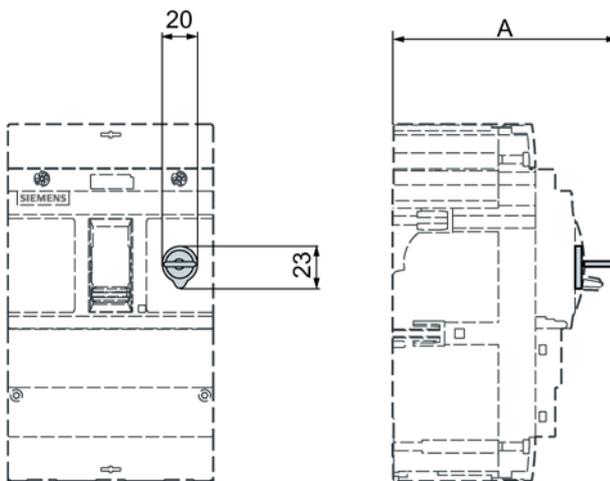
6.2.2.5 Locking and interlocking

Padlock device for the handle



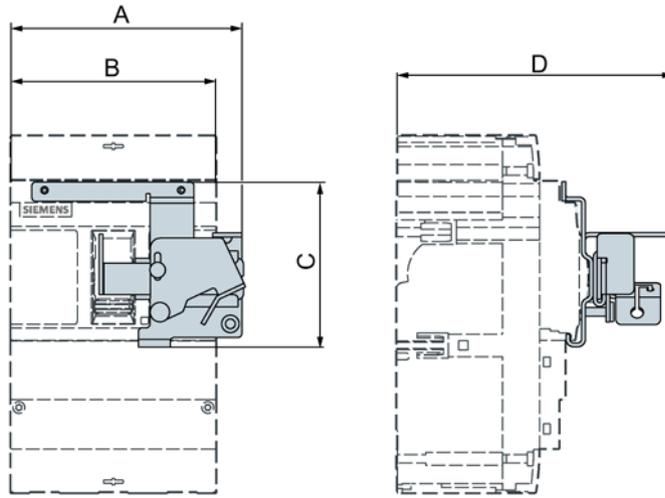
		3VA1		3VA2	
		100 / 160 / 250		100 / 160 / 250	400 / 630
A	[mm]	29		39	
B	[mm]	45		61	
C	[mm]	108	127	151	

Locking or interlocking with cylinder lock



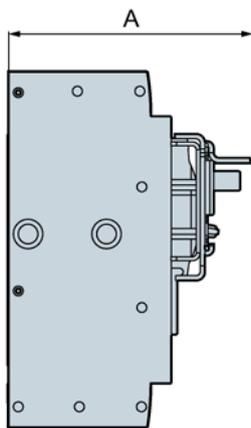
		3VA1		3VA2	
		100 / 160 / 250		100 / 160 / 250	400 / 630
A	[mm]	104.8		122	146

Sliding bar with Bowden cable



		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A	[mm]	98	116	119	138.5
B	[mm]	76.5	105	104.6	137.6
C	[mm]	73.5	80	85	97.5
D	[mm]	114		140.5	164.5

Sliding bar

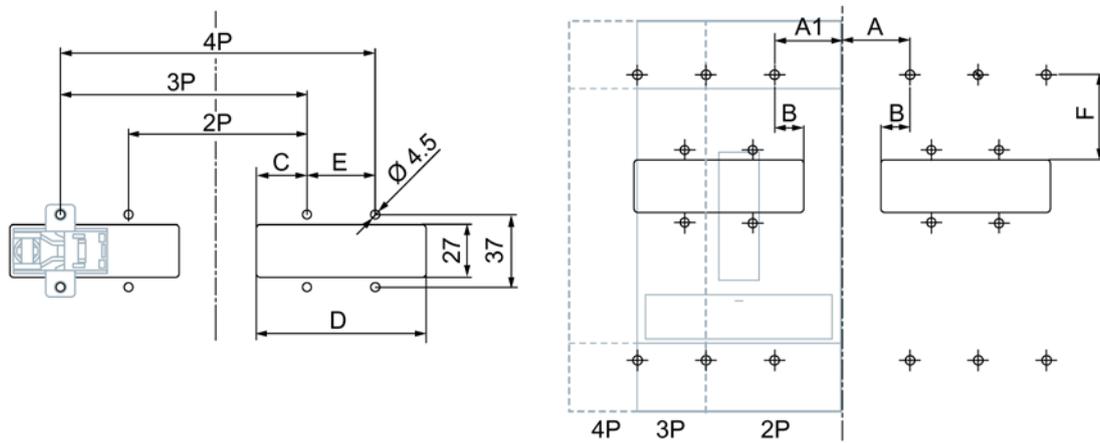


		3VA1	3VA2	
		100 / 160 / 250	100 / 160 / 250	400 / 630
A	[mm]	105	125	150

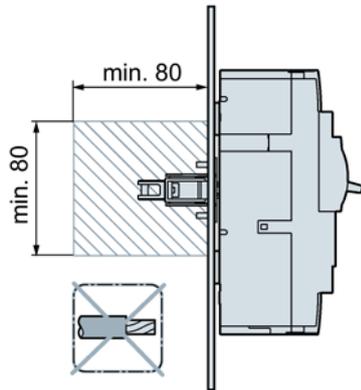
Rear interlock

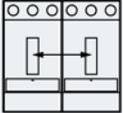
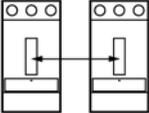
Rear interlock

3VA9088 - 0VM10 / 3VA9088 - 0VM30 / MCCB

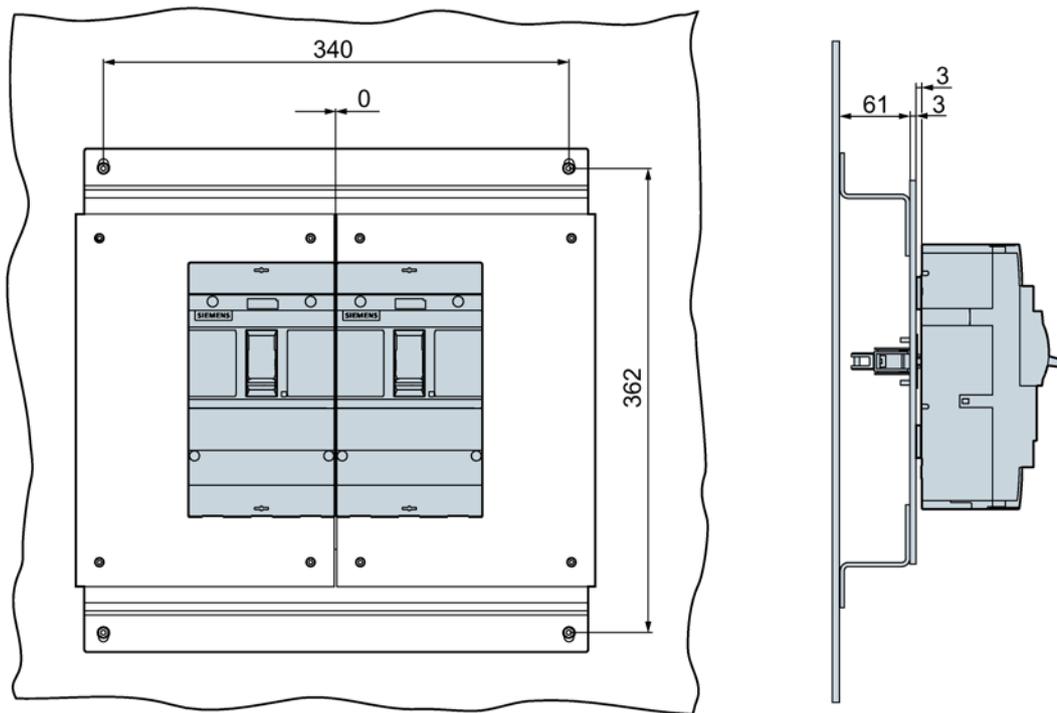


3VA9... - 0KP00 / 3VA9... - 0KD00



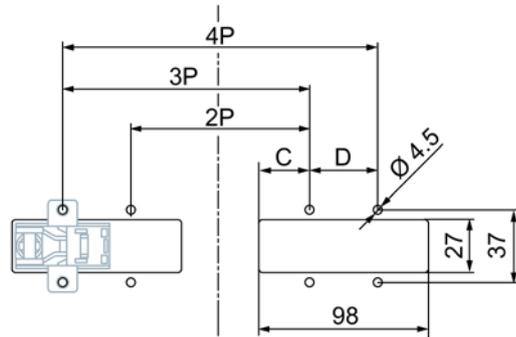
		3VA1		3VA2	
		100 / 160	250	100 / 160 / 250	400 / 630
A/A1 _{min}	 [mm]	25.4	34.8	34.8	45.8
A/A1 _{max}	 [mm]	98	99.8	97.8	
B	[mm]	15	14	15	
C	[mm]	26	25.4	26	
D	[mm]	77.4	85	87	98
E	[mm]	25.4	35	35	46
F	[mm]	37.3		43.5	57.4

Mounting plates and DIN rail

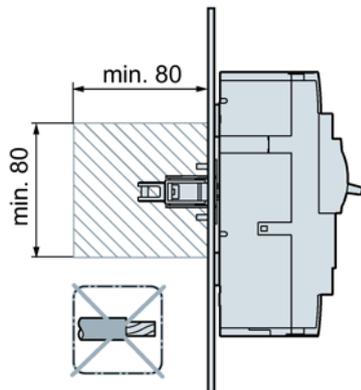
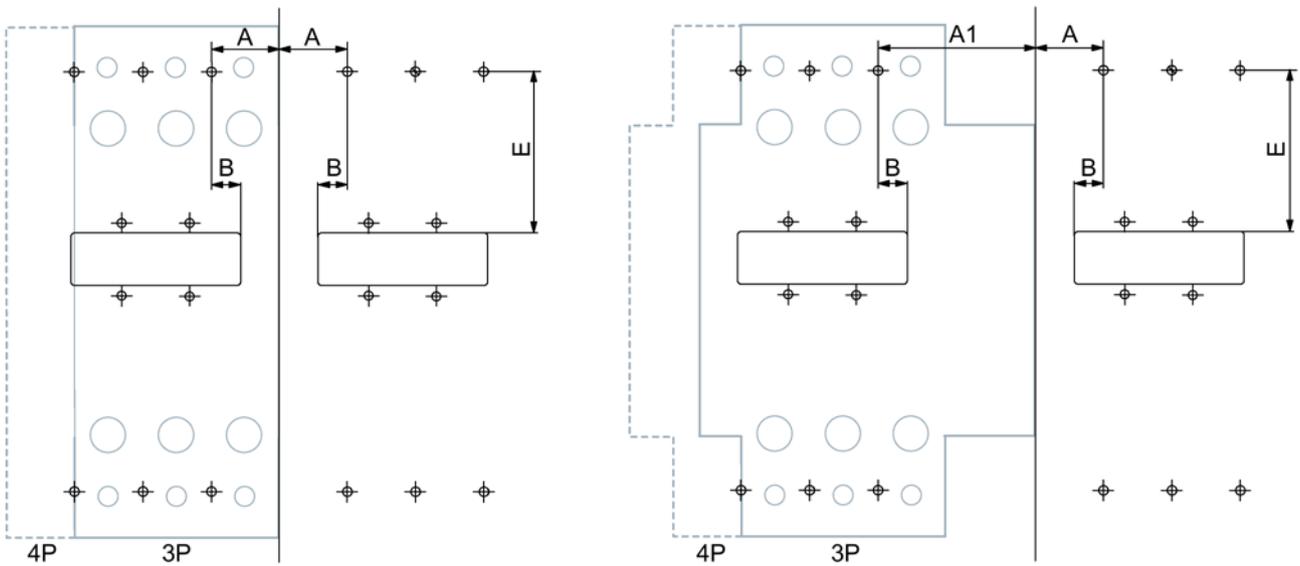


Rear interlock for plug-in and draw-out units

3VA9088 - 0VM30



3VA9... - 0KP00 / 3VA9... - 0KD00

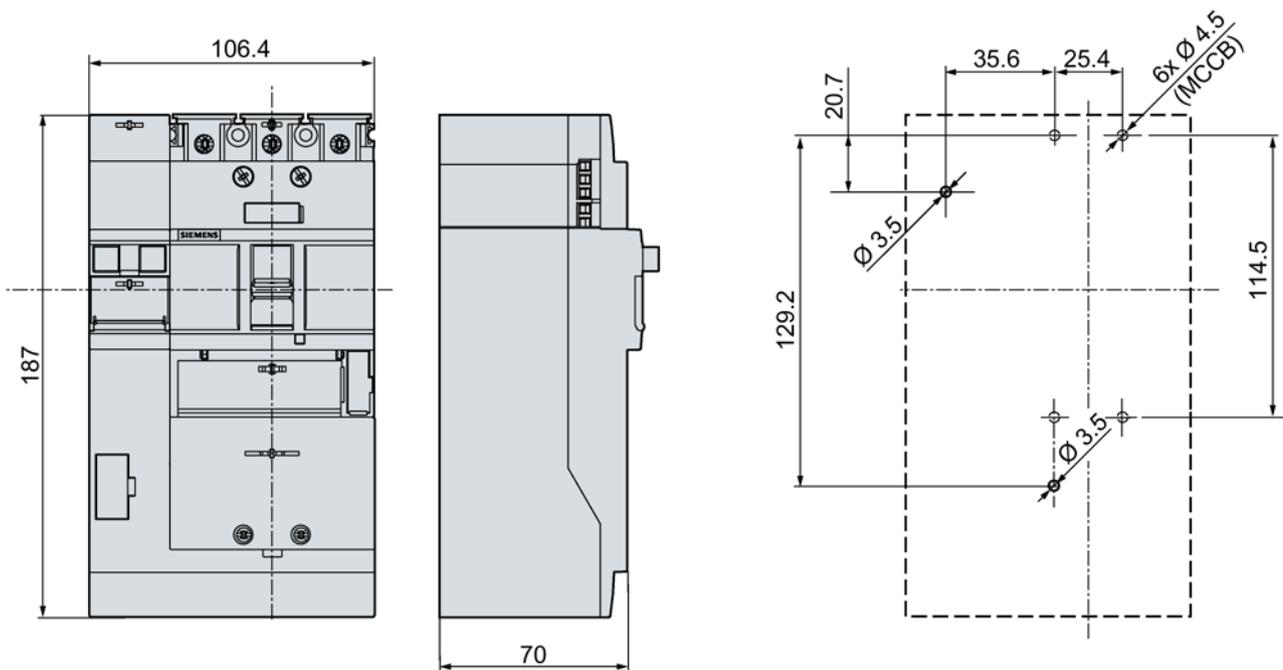


		3VA1		3VA2		
		100 / 160	250	100 / 160 250	400 / 630	
A _{min}		Plug IN 3VA9... - 0KP00 [mm]	25.4	34.8	34.8	45.8
A _{min}		Draw OUT 3VA9... - 0KD00 [mm]	46.4	55.8	55.8	66.8
A1 _{min}		Plug IN 3VA9... - 0KP00 [mm]	71.4	80.8	80.8	91.8
A _{max}		Plug IN 3VA9... - 0KP00 [mm]	98	99.8	97.8	97.8
A _{max}		Draw OUT 3VA9... - 0KD00 [mm]	77	78.8	76.8	76.8
A1 _{max}		Draw OUT 3VA9... - 0KD00 [mm]	52	53.8	51.8	51.8
B		[mm]	15	14	15	15
C		[mm]	26	25.4	26	26
D		[mm]	25.4	35	35	46
E		[mm]	60.3	68.3	75	96.9

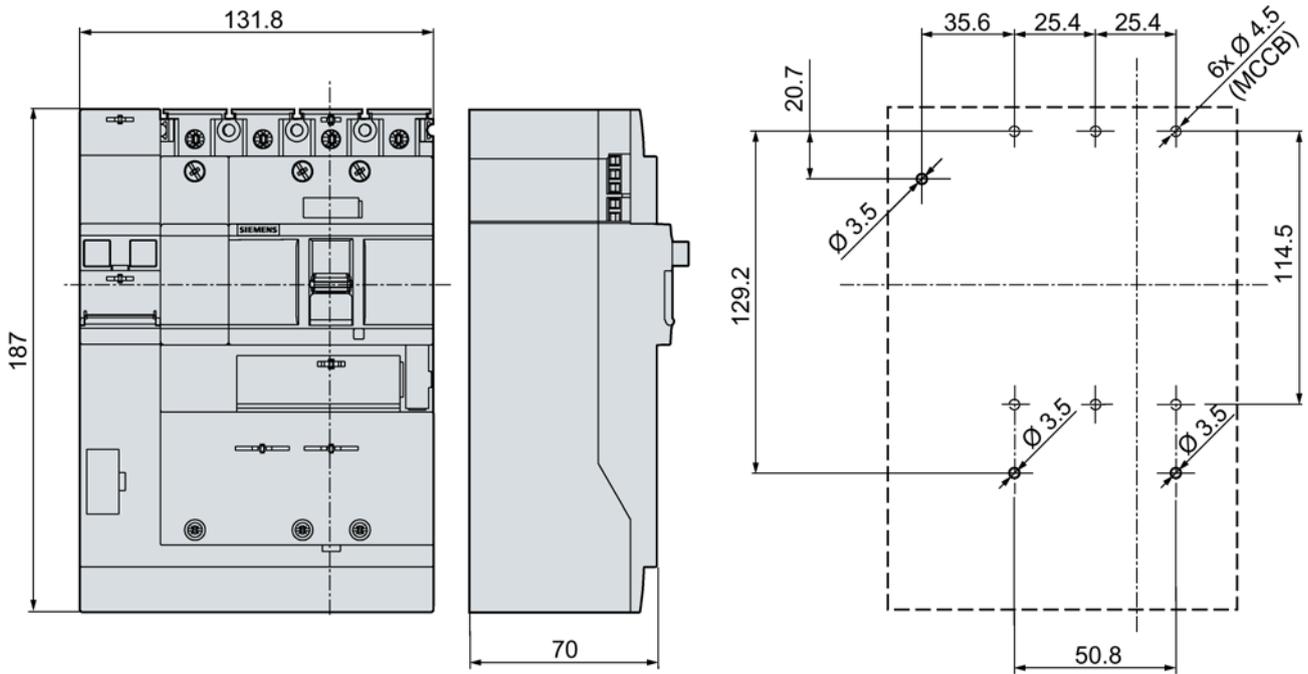
6.2.2.6 Residual current devices

Side-mounted residual current devices Basic RCD310 and Basic RCD510

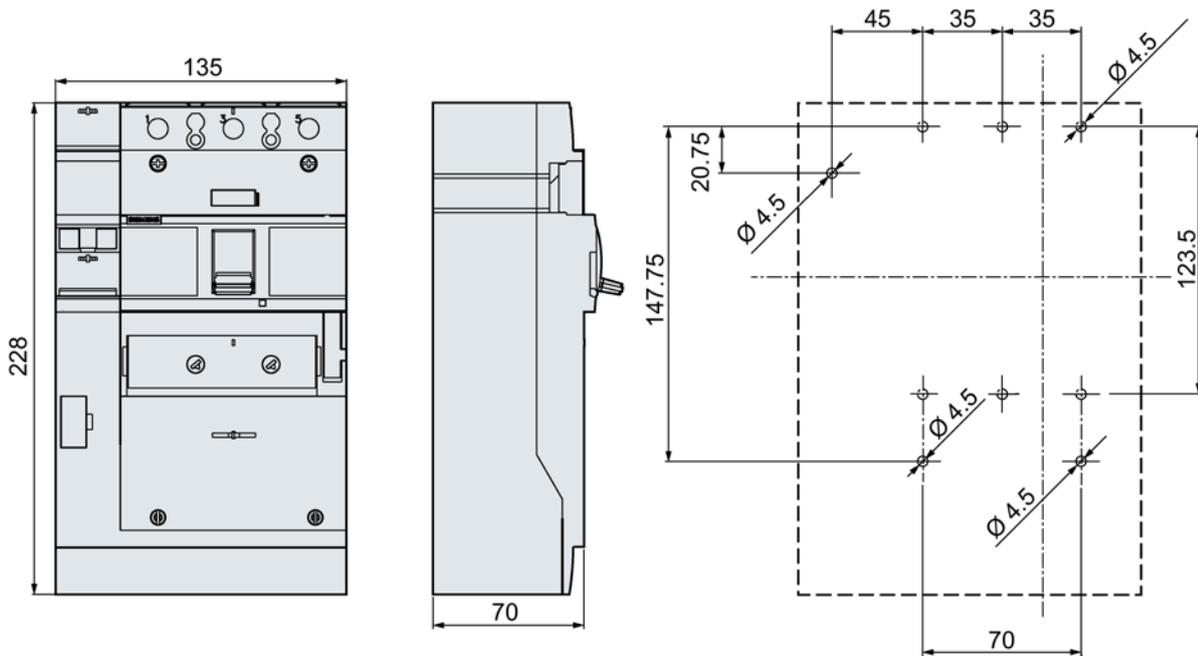
With 3-pole 3VA1 molded case circuit breaker size 160 A



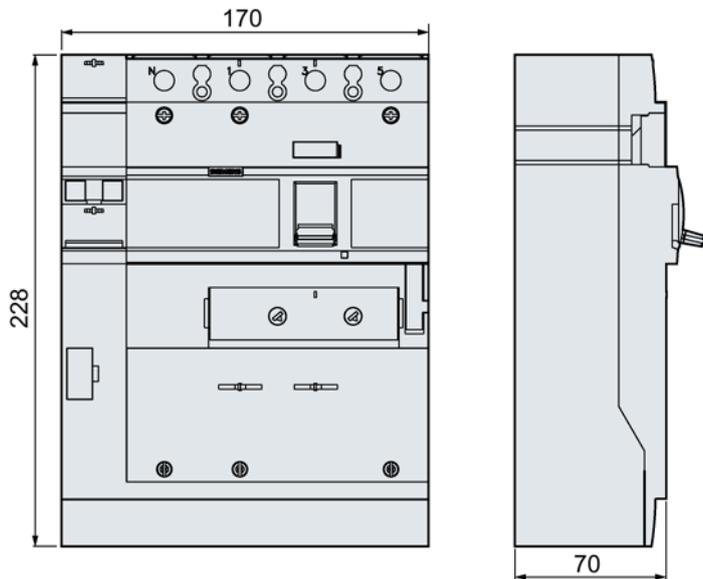
With 4-pole 3VA1 molded case circuit breaker size 160 A



With 3-pole 3VA1 molded case circuit breaker size 250 A (Basic RCD510 only)

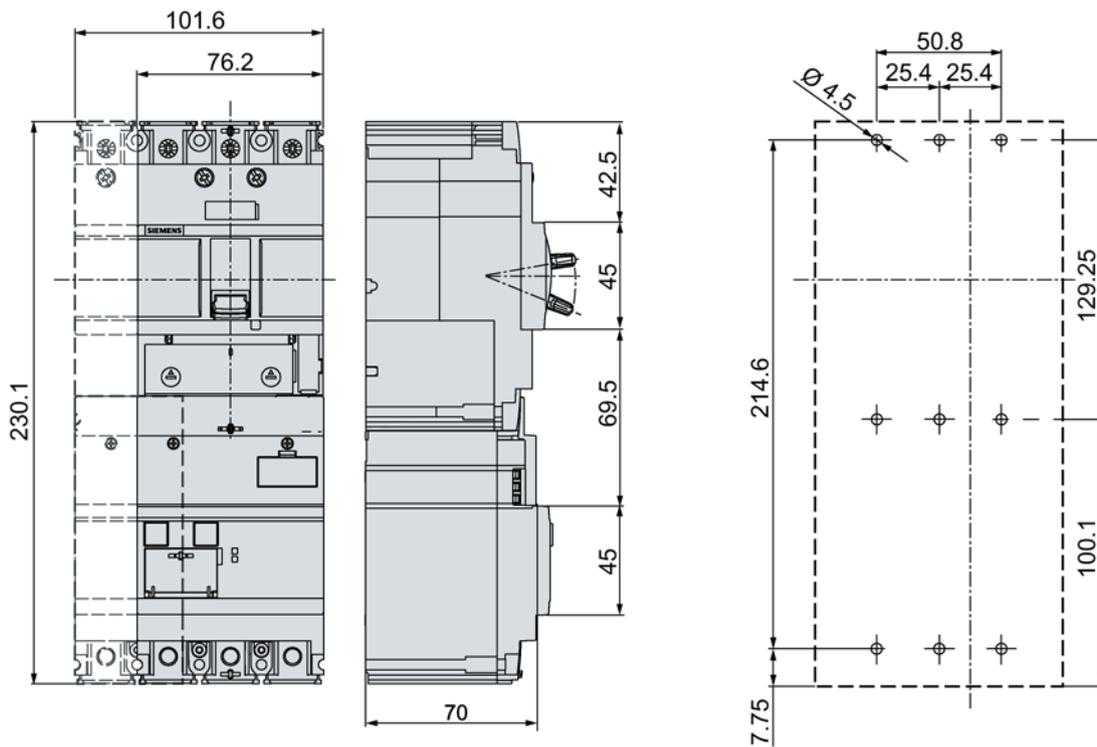


With 4-pole 3VA1 molded case circuit breaker size 250 A (Basic RCD510 only)

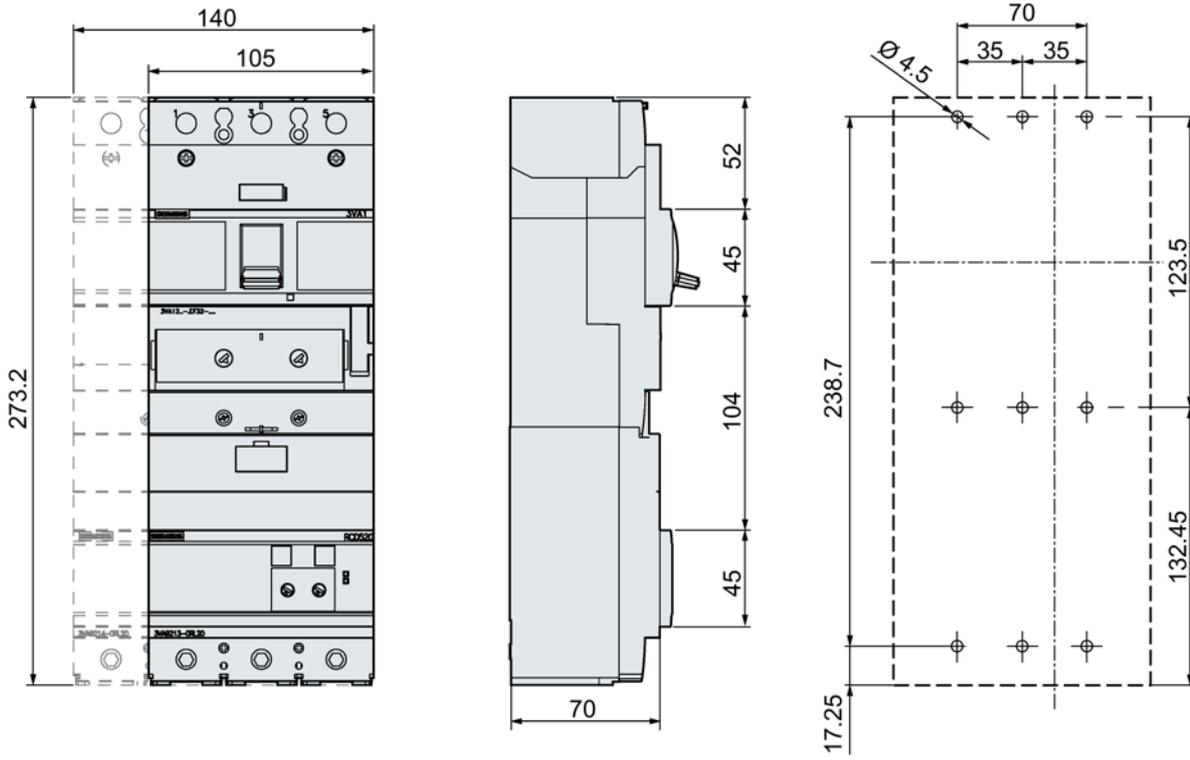


Loadside residual current devices Basic RCD320 and Basic RCD520

With 3VA1 molded case circuit breaker size 160 A

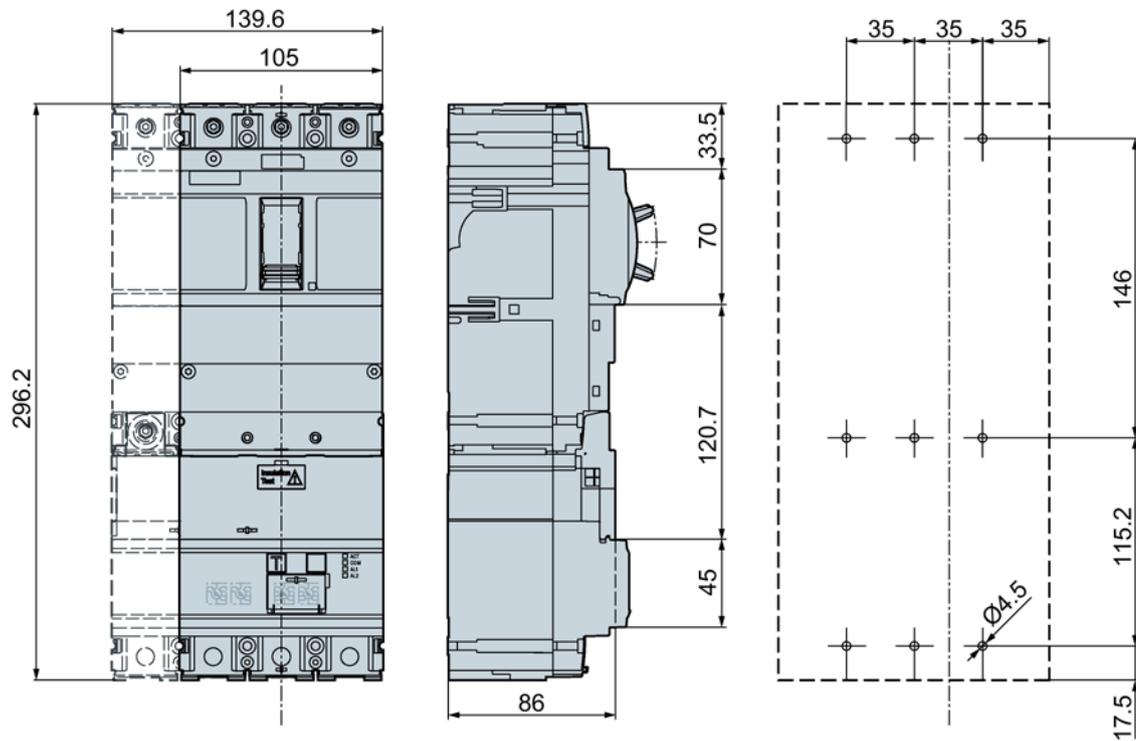


With 3VA1 molded case circuit breaker size 250 A (Basic RCD520 only)

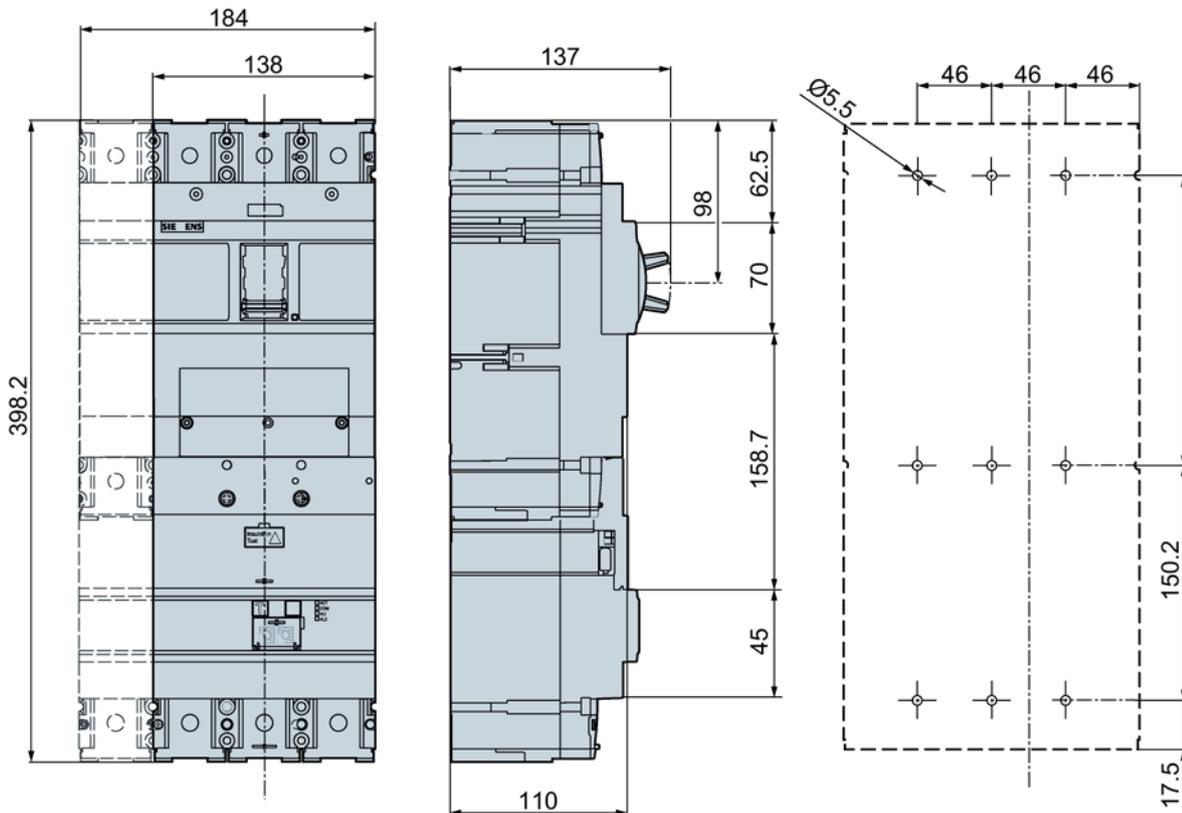


Loadside residual current device Advanced RCD820

With 3VA2 molded case circuit breaker sizes 100 A to 250 A

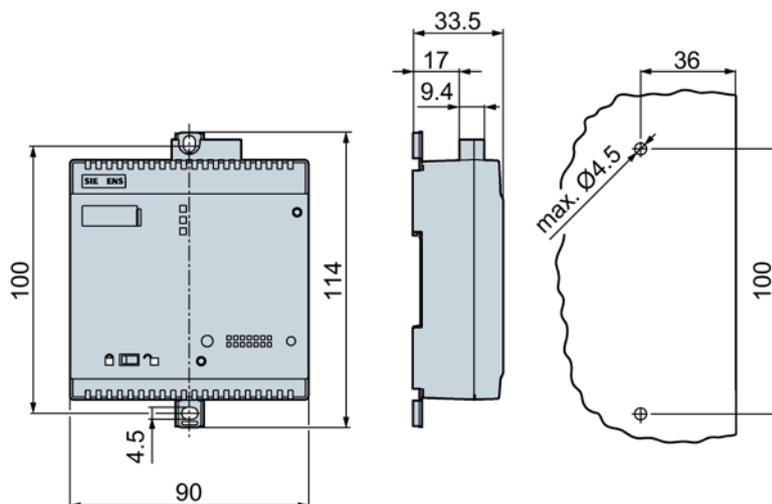


With 3VA2 molded case circuit breaker sizes 400 A to 630 A

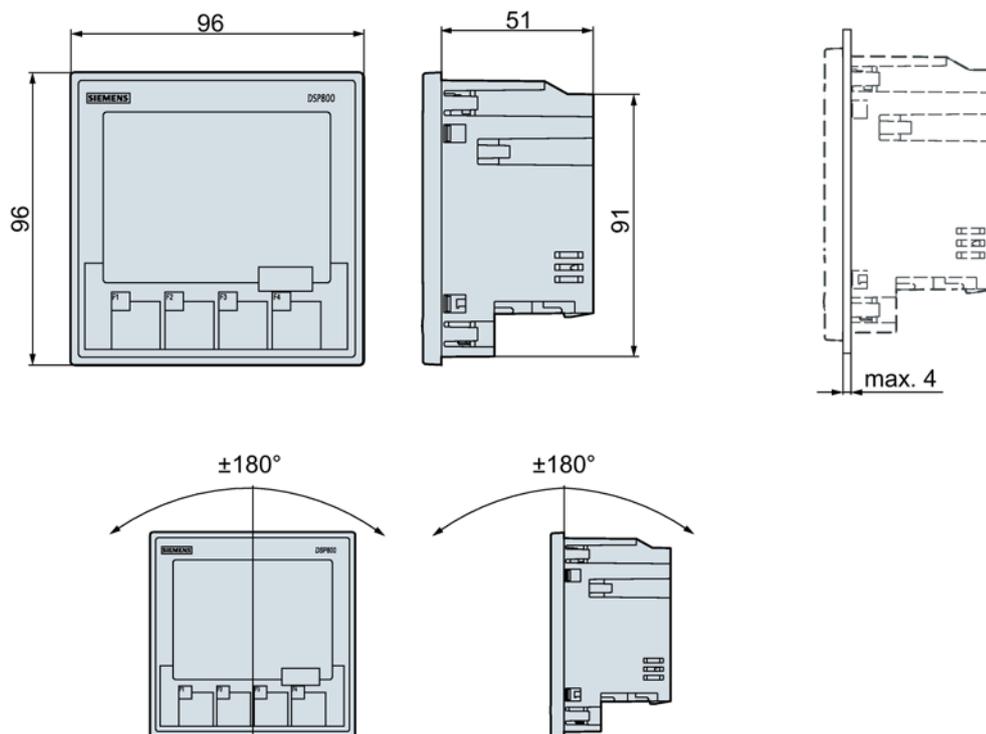


6.2.2.7 Communication and system integration

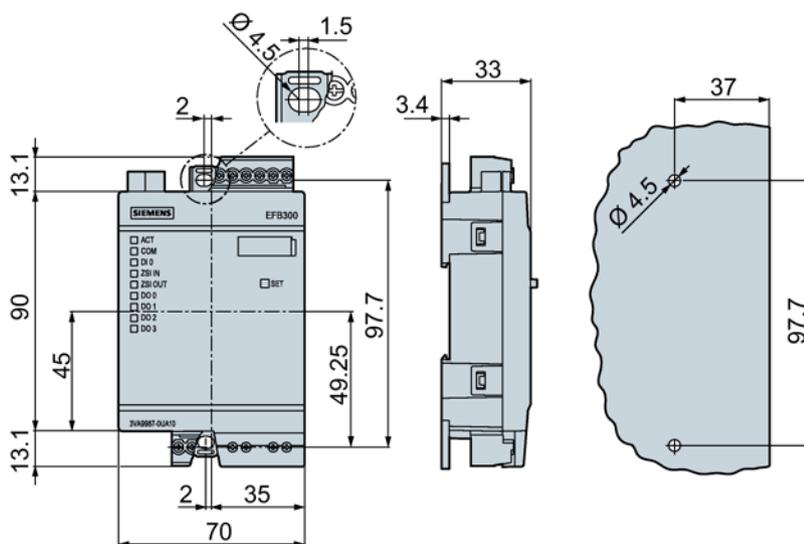
COM800 and COM100 breaker data server



DSP800 display



6.2.2.8 EFB300 external function box



6.2.2.9 Test devices

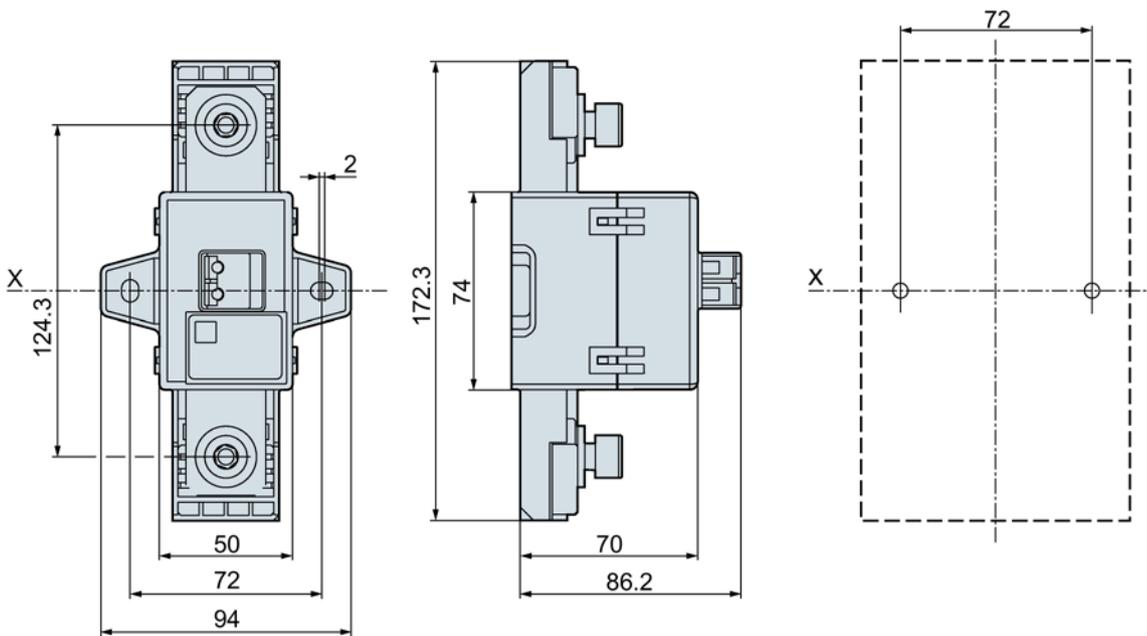
TD300 activation and trip box

Refer to chapter Technical specifications of TD300 (Page 397).

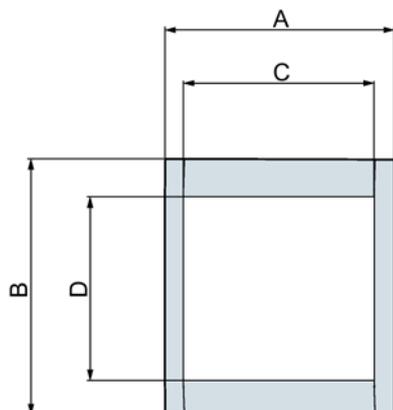
TD500 test device

Refer to chapter Technical specifications (Page 409).

6.2.2.10 External current transformer for N conductor



6.2.2.11 Escutcheon



	A [mm]	B [mm]	C [mm]	D [mm]
3VA9053 - 0SB10	98.2	85.65	76.2	45.65
3VA9053 - 0SB20	98.2	110.7	76.2	70.7
3VA9253 - 0SB10	126.6	85.65	104.6	45.65
3VA9253 - 0SB20	126.6	124.7	104.6	84.7
3VA9257 - 0SB30	126.6	115.8	104.6	75.8
3VA9383 - 0SB10	159.6	110.7	137.6	70.7
3VA9303 - 0SB40	159.6	85.65	137.6	45.65
3VA9353 - 0SB20	159.6	149.3	137.6	109.3
3VA9387 - 0SB30	159.6	132.8	137.6	92.8
3VA9163 - 0SB10	126.6	110.7	104.6	70.7
3VA9163 - 0SB20	126.6	140.8	104.6	100.8
3VA9167 - 0SB30	126.6	120.8	104.6	80.8
3VA9363 - 0SB20	159.6	162.3	137.6	122.3
3VA9054 - 0SB10	123.6	85.65	101.6	45.65
3VA9054 - 0SB20	123.6	110.7	101.6	70.7
3VA9254 - 0SB10	161.6	85.65	139.6	45.65
3VA9254 - 0SB20	161.6	124.7	139.6	84.7
3VA9384 - 0SB10	205.6	110.7	183.6	70.7
3VA9304 - 0SB40	205.6	85.65	183.6	45.65
3VA9354 - 0SB20	205.6	149.3	183.6	109.3
3VA9164 - 0SB10	161.6	110.7	139.6	70.7
3VA9164 - 0SB20	161.6	140.8	139.6	100.8
3VA9364 - 0SB20	205.6	162.3	183.6	122.3

6.3 Power losses

6.3.1 Power losses of 3VA1 molded case circuit breakers

	I_n [A]	3VA1 Breaker Power loss PV			3VA1 Breaker with UVR Power loss PV		3VA1 Breaker external accessories Additional Power loss PV		
		1-pole [W]	2-pole [W]	3- / 4-pole [W]	2-pole [W]	3- / 4-pole [W]	Rear terminals 3- / 4-pole [W]	Plug-In / Draw-Out unit 3- / 4-pole [W]	RCD (load side) 3- / 4-pole [W]
3VA10	16	–	–	10.6	–	13.1	0.1	0.1	0.1
	20	–	–	12.0	–	14.5	0.1	0.2	0.1
	25	–	–	8.5	–	11.0	0.2	0.3	0.1
	32	–	–	10.6	–	13.1	0.3	0.4	0.2
	40	–	–	10.8	–	13.3	0.4	0.7	0.4
	50	–	–	14.6	–	17.1	0.6	1.1	0.6
	63	–	–	17.3	–	19.8	1.0	1.7	0.9
	80	–	–	19.2	–	21.7	1.6	2.7	1.5
	100	–	–	25.0	–	27.5	2.5	4.2	2.4
3VA11	16	3.5	7.1	10.6	9.6	13.1	0.1	0.1	0.1
	20	4.0	8.0	12.0	10.5	14.5	0.1	0.2	0.1
	25	2.8	5.7	8.5	8.2	11.0	0.2	0.3	0.1
	32	3.5	7.1	10.6	9.6	13.1	0.3	0.4	0.2
	40	3.6	7.2	10.8	9.7	13.3	0.4	0.7	0.4
	50	4.9	9.7	14.6	12.2	17.1	0.6	1.1	0.6
	63	5.8	11.5	17.3	14.0	19.8	1.0	1.7	0.9
	80	6.4	12.8	19.2	15.3	21.7	1.6	2.7	1.5
	100	8.3	16.7	25.0	19.2	27.5	2.5	4.2	2.4
	125	7.7	15.5	23.2	18.0	25.7	3.8	6.6	3.7
	160	12.7	25.3	38.0	27.8	40.5	6.3	10.8	6.1
3VA12	160	–	–	33.0	–	35.5	On request		
	200	–	–	42.0	–	44.5			
	250	–	–	57.0	–	59.5			

Note

The specified power loss applies to 3-pole and 4-pole devices in the case of 3-phase, symmetrical loading.

6.3.2 Power losses of 3VA2 molded case circuit breakers

	I_n [A]	3VA2 Breaker Power loss PV		3VA2 Breaker with UVR Power loss PV		3VA2 Breaker external accessories Additional Power loss PV		
		I_{cu}/I_{cs} M, H, C-class 3- / 4-pole [W]	I_{cu}/I_{cs} L-class 3- / 4-pole [W]	I_{cu}/I_{cs} M, H, C-class 3- / 4-pole [W]	I_{cu}/I_{cs} L-class 3- / 4-pole [W]	Rear terminals 3- / 4-pole [W]	Plug-In / Draw-Out unit 3- / 4-pole [W]	RCD (load side) 3- / 4-pole [W]
3VA20	25	0.84	0.50	3.34	3.00	0.1	0.1	0.2
	40	2.2	1.2	4.7	3.7	0.3	0.3	0.6
	63	5.4	3.0	7.9	5.5	0.7	0.8	1.5
	100	13.5	7.7	16.0	10.2	1.7	2.0	3.9
3VA21	25	0.6	0.5	3.1	3.0	0.1	0.1	0.2
	40	1.6	1.2	4.1	3.7	0.3	0.3	0.6
	63	4.0	3.1	6.5	5.6	0.7	0.8	1.5
	100	10.0	7.7	12.5	10.2	1.7	2.0	3.9
	160	25.5	19.7	28.0	22.2	4.4	5.0	10
3VA22	160	19.7	19.7	22.2	22.2	4.4	5.0	10
	250	48.0	48.0	50.5	50.5	10.8	12.3	24.3
3VA23	250	27.0	27.0	29.5	29.5	2.8	5.0	30.0
	400	70.0	70.0	72.5	72.5	7.3	12.0	75.0
3VA24	400	70.0	70.0	72.5	72.5	7.3	12.0	75.0
	500	105.0	105.0	107.5	107.5	11.3	48.0	On request
	630	175.0	175.0	177.5	177.5	18.0	69.0	63.0

Note

The specified power loss applies to 3-pole and 4-pole devices in the case of 3-phase, symmetrical loading.

6.4 Derating and temperature compensation

6.4.1 Derating of 3VA1 molded case circuit breakers

The temperature inside the molded case circuit breaker is influenced by the ambient temperature and the current-dependent power loss generated inside the unit. To prevent overloading of 3VA1 molded case circuit breakers under difficult thermal conditions, the maximum rated continuous operational current must be limited as a function of the ambient temperature.

		Rated operational current I_n [A]	Max. rated continuous operational current										
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]				
Fixed-mounted	3VA10, 3VA11	16	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	No derating up to the rated operational current I_n of the molded case circuit breaker	15	15	15	
		20								19	19	19	
		25								24	24	23	23
		32								31	31	30	30
		40								39	39	38	37
		50								49	48	46	45
		63								62	61	60	58
		80								78	77	75	74
		100								98	96	94	91
		125								122	120	117	114
	160	158	155	153	150								
	3VA12	3-, 4-pole	160	156	151	147	142						
			200	194	188	182	176						
			250	243	237	230	223						

No derating up to the rated operational current I_n of the molded case circuit breaker

Note

These values do not apply to all mounting conditions for molded case circuit breakers and may deviate depending upon factors such as cables and busbars, packing density, ventilation, etc.

Please observe the applicable overriding guidelines (e.g. IEC 61439).

Derating in combination with accessories

None of the accessories from the extensive range available for 3VA1 molded case circuit breakers has an influence on the thermal response thresholds of the switching devices except for two accessories that require additional correction factors. These are:

		Rated operational current I_n [A]	Max. rated continuous operational current							
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]	
Fixed-mounted / Plug-in technology	3VA10, 3V11	16				15	14	14	14	
		20		19	18	18	17	17	17	
		25	24	23	23	22	22	21	21	
		32	30	29	29	28	28	27	27	
		40	37	36	36	35	35	34	33	
		50	47	46	45	44	43	41	41	
		63	59	58	57	56	55	54	52	
		80	74	73	72	70	69	68	67	
		100	95	92	90	88	86	85	82	
		125	118	115	113	110	108	105	103	
	160	150	148	144	142	140	138	135		
	3VA12	3-, 4-pole	160	150	145	141	137	133	129	125
			200	187	181	176	171	165	160	155
			250	231	225	220	214	209	202	196

No derating up to the rated operational current I_n of the molded case circuit breaker

		Rated operational current I_n [A]	Max. rated continuous operational current							
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]	
Side mounted residual current devices Basic RC310 / Basic RC510	3VA11	16				15	15	15	15	
		20				18	18	18	18	
		25		24	24	23	23	22	22	
		32		31	31	30	30	29	29	
		40		39	39	38	38	37	36	
		50		49	49	48	47	45	44	
		63		62	61	60	59	58	56	
		80		79	78	76	75	73	72	
		100		99	97	95	93	91	88	
		125		123	121	118	116	113	111	
	160		158	155	153	150	148	146		
	3VA12	3-, 4-pole	160		157	152	148	143	140	135
			200		196	190	184	179	173	167
			250	249	243	238	231	225	219	212

No derating up to the rated operational current I_n of the molded case circuit breaker

		Rated operational current I_n [A]	Max. rated continuous operational current						
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]
Loadside residual current devices Basic RCD320 and Basic RCD520	3VA11 3-, 4-pole	16				15	14	14	14
		20		19	18	18	17	17	17
		25	24	23	23	22	22	21	21
		32	30	29	29	28	28	27	27
		40	37	36	36	35	35	34	33
		50	47	46	45	44	43	41	41
		63	59	58	57	56	55	54	52
		80	74	73	72	70	69	68	67
		100	95	92	90	88	86	85	82
	125	118	115	113	110	108	105	103	
	160	150	148	144	142	140	138	135	
	3VA12 3-, 4-pole	160	156	152	147	144	139	135	131
		200	195	190	184	178	173	167	162
		250	241	236	230	224	218	212	205

No derating up to the rated operational current I_n of the molded case circuit breaker

6.4.2 Temperature compensation with thermal-magnetic trip units of the TM 2-series

The trip units for 3VA1 molded case circuit breakers are factory-calibrated to a temperature of 50 °C. The thermal response threshold of the trip unit changes when the circuit breaker is operated in a higher or lower ambient temperature. To obtain the characteristic tripping times at a specific ambient temperature, it is necessary to apply correction factors when setting the thermal trip units.

Correction factor TK is applied to compensate for the ambient temperature.

The first step in calculating the correction factor TK is to determine the setting factor at 50 °C:

$$EF(50\text{ °C}) = \frac{I}{I_n}$$

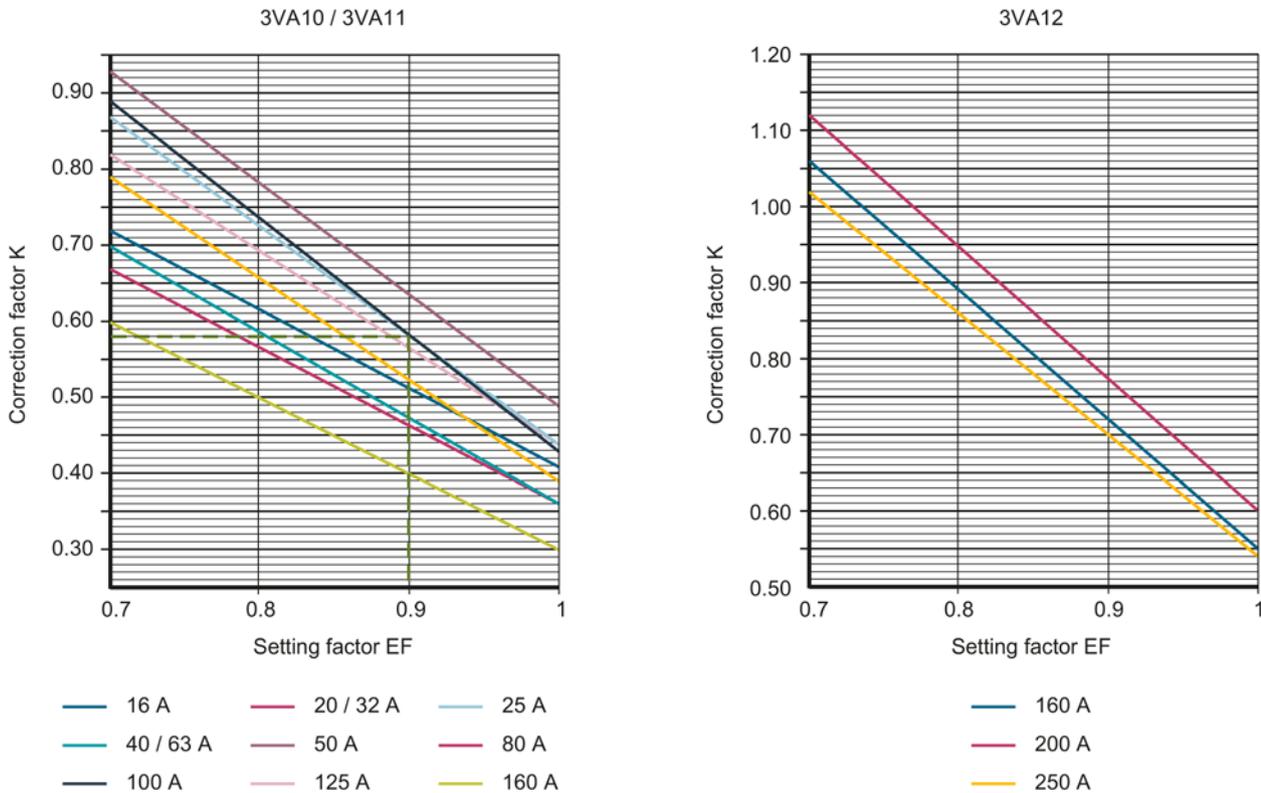
EF(50 °C) Setting factor at 50 °C

I System current

I_n Rated operational current of the molded case circuit breaker

6.4 Derating and temperature compensation

Using the setting factor calculated at 50 °C, it is possible to read the correction factor K off the following charts:



--- No derating up to the rated operational current I_n of the molded case circuit breaker

Using the two calculated values, it is possible to determine the temperature compensation TK and finally the setting value for the trip unit $I_{r(TU)}$:

$$TK(T_U) = \left(\frac{K \cdot (T_U - 50 \text{ °C})}{100} + 1 \right)$$

TK(T_U) Temperature compensation for molded case circuit breaker with service temperature T_U

K Correction factor

T_U Service temperature of molded case circuit breaker

Trip unit setting value:

$$I_{r(TU)} = I_n \cdot EF(50 \text{ °C}) \cdot TK$$

$I_{r(TU)}$ Trip unit setting value with service temperature T_U

The operational current must never exceed the maximum rated operational current I_n of the molded case circuit breaker. If the current calculated for the operating conditions is higher than the rated operational current of the unit, a molded case circuit breaker with the appropriate rated operational current must be deployed.

Example 1: Correction of setting values as a function of ambient temperature

Starting point:

On a 3VA1 100 A molded case circuit breaker with a TM240 100 A trip unit, the real tripping threshold for various different service temperatures must be set to a required system current of $I = 90$ A.

- **Ambient temperature 60 °C:**

$$\text{Setting factor } EF(50 \text{ °C}) = (90 / 100) = 0.9$$

$$\text{Correction factor } K = 0.58 \text{ (see chart above)}$$

$$\text{Temperature compensation } TK(60 \text{ °C}) = (0.58 \cdot (60 \text{ °C} - 50 \text{ °C}) / 100) + 1 = 1.058$$

$$\text{Setting value } I_{r(60 \text{ °C})} = 100 \text{ A} \cdot 0.9 \cdot 1.058 = \mathbf{95 \text{ A}}$$

- **Ambient temperature 40 °C:**

$$\text{Setting factor } EF(50 \text{ °C}) = (90 / 100) = 0.9$$

$$\text{Correction factor } K = 0.58$$

$$\text{Temperature compensation } TK(40 \text{ °C}) = (0.58 \cdot (40 \text{ °C} - 50 \text{ °C}) / 100) + 1 = 0.942$$

$$\text{Setting value } I_{r(40 \text{ °C})} = 100 \text{ A} \cdot 0.9 \cdot 0.942 = \mathbf{85 \text{ A}}$$

If the setting value calculated for the thermal trip unit $I_{r(TU)}$ is outside the possible setting range, an appropriate molded case circuit breaker with a higher or lower rated operational current must be selected and the compensation calculation then performed again.

Note

These values do not apply to all mounting conditions for molded case circuit breakers and may deviate depending upon factors such as cables and busbars, packing density, ventilation, etc.

Please observe the applicable overriding guidelines (e.g. IEC 61439).

Example 2: Calculation of the tripping time

Starting point:

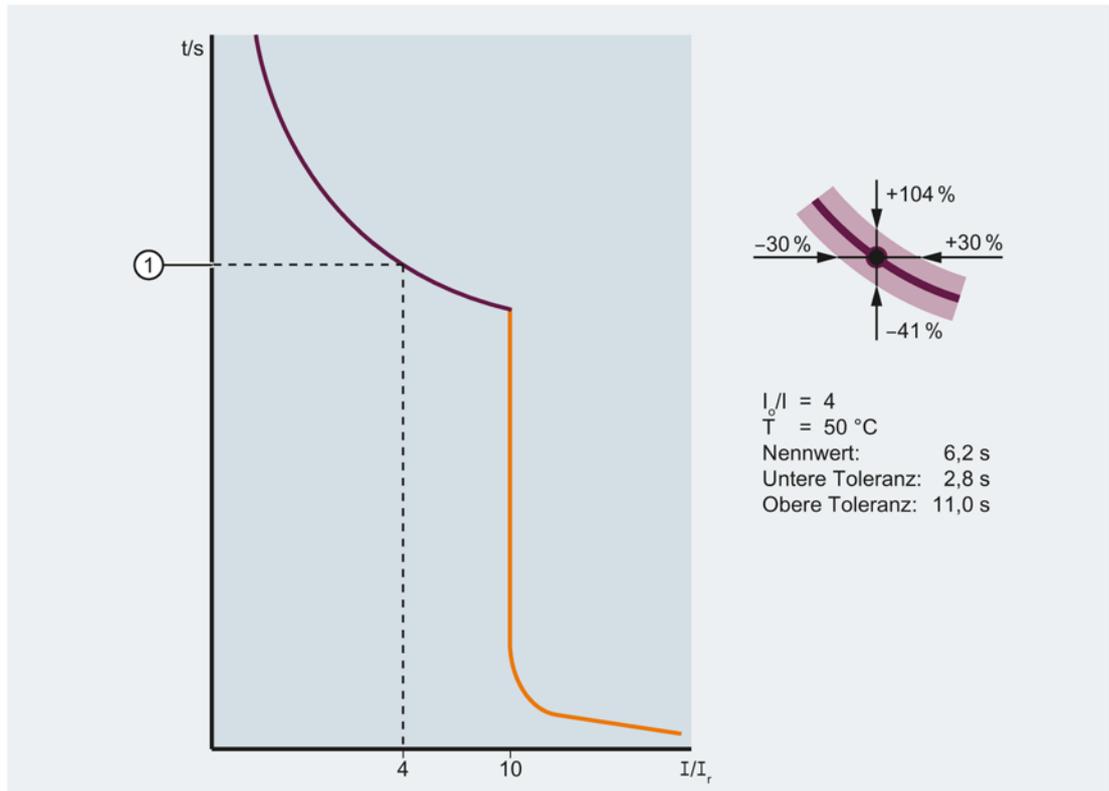
Based on the example above, the tripping time for an overcurrent $I_o = 360 \text{ A}$ will now be calculated.

To compensate for the ambient temperature of $60 \text{ }^\circ\text{C}$, rather than $50 \text{ }^\circ\text{C}$, the thermal trip unit has been set $I_{r(60 \text{ }^\circ\text{C})} = 95 \text{ A}$ for a system current $I = 90 \text{ A}$.

The first step is to calculate the ratio between the overcurrent and the system current:

$$I_o/I = 360 \text{ A} / 90 \text{ A} = 4$$

Using this value, it is now possible to read the tripping time from the characteristics chart:



① Tripping time (schematic representation)

Inclusion of accessories

None of the accessories from the extensive range available for 3VA1 molded case circuit breakers has an influence on the thermal response thresholds of the switching devices except for two accessories that require additional correction factors. These are:

- Plug-in version / draw-out version
- Residual current devices

None of the other accessories has an influence on the thermal response thresholds of trip units.

The table below shows the correction factors of setting value I_r for the trip units of 3VA1 molded case circuit breakers in plug-in / draw-out technology and for 3VA1 molded case circuit breakers combined with residual current devices:

3VA1 molded case circuit breakers with accessories	Correction factor (calibration temperature 50 °C)	
	3VA10 / 3VA11	3VA12
3VA1 fixed-mounted	1.00	1.00
3VA1 plug-in version, draw-out version	0.90	0.88
3VA1 with side mounted residual current device (Basic RCD310 / Basic RCD510)	0.97	0.95
3VA1 with loadside residual current device (Basic RCD320 / Basic RCD520)	0.91	0.92

Example

Starting point:

The current loading of a 3VA1 molded case circuit breaker is calculated to be 90 A and the ambient temperature 65 °C for a given application. The plug-in version of the molded case circuit breaker will be used.

The appropriate size of molded case circuit breaker is determined first on the basis of the correction factor for 3VA1 plug-in technology (see table above):

Design of assembly at 50°C: $I_r = (90 \text{ A} / 0.9) = 100 \text{ A}$

It is therefore necessary to select a molded case circuit breaker that allows a setting value of 100 A on the thermal trip unit at a calibration temperature of 50 °C. A 3VA1 molded case circuit breaker 160 A with $I_n = 125 \text{ A}$ is therefore used for the application.

The temperature compensation is then calculated according to the method described above:

- **Ambient temperature 65 °C:**
 - Setting factor $EF(50 \text{ °C}) = (100 / 125) = 0.8$
 - Correction factor $K = 0.69$ (from chart)
 - Temperature compensation of switching device $TK(65 \text{ °C}) = (0.69 \cdot (65 \text{ °C} - 50 \text{ °C}) / 100) + 1 = 1.1$
 - Setting value $I_{r(65 \text{ °C})} = 125 \text{ A} \cdot 0.9 \cdot 1.1 = 124 \text{ A}$

Note

These values do not apply to all mounting conditions for molded case circuit breakers and may deviate depending upon factors such as cables and busbars, packing density, ventilation, etc.

Please observe the applicable overriding guidelines (e.g. IEC 61439).

6.4.3 Use of terminals with auxiliary conductor connection

When terminals with auxiliary conductor connection are used, the total current from the main circuit and auxiliary conductor must not exceed the maximum rated operational current of the molded case circuit breaker.

6.4.4 Additional correction factors with frequencies other than 50/60 Hz for 3VA1 molded case circuit breakers

The temperature rise in the bimetal is greater at frequencies above 50/60 Hz. This is due to eddy-current losses and the reduction in the available conductor cross section as a result of the skin effect.

The rated operational current must therefore be reduced from the value used in 50/60 Hz applications.

3VA10 / 3VA11 Frequencies	Correction factor for the thermal trip unit
< 150 Hz	1.0
150 Hz ... 400 Hz	0.9

3VA12 Frequencies	Correction factor for the thermal trip unit
< 100 Hz	1.0
100 Hz ... 250 Hz	0.95
250 Hz ... 400 Hz	0.90

In an application with 400 Hz, this means the following for the example from chapter Derating of 3VA1 molded case circuit breakers (Page 489) with a 3VA1 molded case circuit breaker when current $I_r = 90 \text{ A}$ is required:

- Setting value $I_{r(400 \text{ Hz})} = 90 \text{ A} \cdot 0.9 = 86 \text{ A}$

Where ambient temperatures differ from the calibration temperature, temperature compensation as described in chapter Derating of 3VA1 molded case circuit breakers (Page 489) must be performed.

In addition, a correction factor for setting the magnetic trip unit as a function of frequency must be applied.

	DC	Correction factor for the magnetic trip unit at frequency f [Hz]								
		20	50/60	100	150	200	250	300	350	400
3VA10 3VA11	0.7	1.05	1	1	0.95	0.9	0.85	0.80	0.75	0.70
3VA12	0.85	on request								

Example

Starting point:

A 3VA1 molded case circuit breaker 100 A with a TM240 trip unit is used for a 400 Hz application. The molded case circuit breaker is required to trip instantaneously in response to an overcurrent of 900 A.

The maximum permissible rated continuous operational current is calculated first:

$$100 \text{ A} \cdot 0.9 = \mathbf{90 \text{ A}}$$

The setting value for instantaneous short-circuit protection (I_i) is then determined on the basis of the correction factor from the table above:

$$I_i = 900 \text{ A} \cdot 0.7 = \mathbf{630 \text{ A}}$$

6.4.5 Correction factors with direct current for the thermal-magnetic trip units of 3VA1 molded case circuit breakers

With DC systems, a correction factor must be applied to the magnetic trip unit.

Correction factor for the magnetic trip unit for DC systems		
3VA10 100 A	3VA11 160 A	3VA12 250 A
0.7	0.7	0.85

Where ambient temperatures differ from the calibration temperature, temperature compensation as described in chapter Derating of 3VA1 molded case circuit breakers (Page 489) must be performed.

Example:

Starting point:

A 3VA1 molded case circuit breaker 160 A with a TM240 trip unit is used in a DC system. The molded case circuit breaker is required to trip instantaneously in response to an overcurrent of 1200 A.

The setting value for the instantaneous short-circuit protection (I_i) is:

$$I_i = 1200 \text{ A} \cdot 0.7 = \mathbf{840 \text{ A}}$$

6.4.6 Derating for the 3VA1 switch disconnecter

The 3VA1 SD switch disconnectors do not have a trip unit. The temperature inside the switch disconnecter is however influenced by the ambient temperature and the current-dependent power loss generated inside the unit. Nonetheless, 3VA1 switch disconnectors up to 125 A do not require derating up to 70 °C.

To prevent overloading of switch disconnectors up to 125 A under difficult thermal conditions, the maximum rated continuous operational current must be limited as a function of the ambient temperature:

			Rated operational current I_n [A]	Max. rated continuous operational current						
				40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]
Fixed-mounted	3VA11 LBS	3-, 4-pole	63							
			80							
			100							
			125							
			160							
	3VA12 LBS	3-, 4-pole	250	On request						

 No derating up to the rated operational current I_n of the molded case circuit breaker

Limitation of the rated continuous operational current in combination with accessories

The table below shows the maximum rated continuous operational current for the plug-in version of switch disconnectors in sizes 160 A and 250 A and for switch disconnectors combined with residual current devices:

		Rated operational current I_n [A]	Max. rated continuous operational current							
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]	
Side mounted residual current devices Basic RCD310 / Basic RCD510	3VA11 LBS	3-, 4-pole	63	No derating up to the rated operational current I_n of the molded case circuit breaker						
		80								
		100								
		125								
		160								
	3VA12 LBS	3-, 4-pole	250	on request						
Plug-in technology	3VA11 LBS	3-, 4-pole	63	No derating up to the rated operational current I_n of the molded case circuit breaker						
		80								
		100								
		125								
		160	150							
	3VA12 LBS	3-, 4-pole	250	on request						

No derating up to the rated operational current I_n of the molded case circuit breaker

None of the other available accessories require derating of the 3VA1 switch disconnector.

6.4.7 Derating for the electronic trip units of 3VA2 molded case circuit breakers

The current measuring circuits of the electronic trip units of 3VA2 molded case circuit breakers are not affected by the ambient temperature. The Rogowski coils integrated in the trip unit measure the current and compare it to the set tripping threshold. Higher or lower ambient temperatures do not influence the tripping threshold, which means that it is not necessary to apply correction factors.

Limitation of the rated operational current

The temperature inside the molded case circuit breaker is nonetheless influenced by the ambient temperature and the current-dependent power loss generated inside the unit. To prevent overloading of molded case circuit breakers under difficult thermal conditions, the maximum rated continuous operational current must therefore be limited as a function of the ambient temperature in some cases:

The table below specifies the maximum rated continuous operational current as a function of the ambient temperature and the installed accessories. The operational current must never exceed the maximum rated operational current of the molded case circuit breaker.

6.4 Derating and temperature compensation

Internal accessories	Electronic trip unit (ETU)	Rated operational current I_n [A]	Max. rated continuous operational current						
			40 °C [A]	45 °C [A]	50 °C [A]	55 °C [A]	60 °C [A]	65 °C [A]	70 °C [A]
Fixed-mounted	Basic circuit breaker	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	Undervoltage/ universal release	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
Undervoltage/ universal release and COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker							
Plug-in and draw-out versions	Basic circuit breaker	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	Undervoltage/ universal release	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
Undervoltage/ universal release and COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker							
Residual current device	Basic circuit breaker	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	Undervoltage/ universal release	3-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
		5- and 8-series							
	COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker						
Undervoltage/ universal release and COM060	5- and 8-series	No derating up to the rated operational current I_n of the molded case circuit breaker							

COM060 COM060 communication module

 No derating up to the rated operational current I_n of the molded case circuit breaker

Note

These values do not apply to all mounting conditions for molded case circuit breakers and may deviate depending upon factors such as cables and busbars, packing density, ventilation, etc.

Please observe the applicable overriding guidelines (e.g. IEC 61439).

When terminals with auxiliary conductor connection are used, the total current from the main circuit and auxiliary conductor must not exceed the maximum rated operational current of the molded case circuit breaker.

Example 1

Starting point:

A plug-in version of a 3VA2 molded case circuit breaker 160 A with an ETU350 LSI trip unit is to be operated at 70 °C:

$$I_{r(\max 70^\circ \text{C})} = \mathbf{160 \text{ A}}$$

No derating is required.

Example 2

Starting point:

A plug-in version of a 3VA2 molded case circuit breaker 250 A with an ETU850 LSI trip unit is to be operated at 60 °C with the COM060 communication module:

$$I_{r(\max 60^\circ \text{C})} = \mathbf{205 \text{ A}}$$

Appendix

A.1 Standards and approvals

Description

Table A- 1 Series 3VA1 and 3VA2 molded case circuit breakers conform to the following international standards

Standard		Title
CISPR11	Class A	Limits and methods of measurement of radio interference suppression of equipment in industrial environments.
	Class B	Limits and methods of measurement of radio interference suppression of equipment in domestic environments.
IEC 60664-1		Insulation coordination for equipment within low-voltage systems.
IEC 60068-2-1 "Ab"		Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2 "Bd"		Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-27 "Ea"		Environmental testing - Part 2-27: Tests - Test Ea and guidance Shock
IEC 60068-2-30 "Db"		Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 + 12 hours)
IEC 60068-2-52		Environmental testing - Part 2: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution)
IEC 60068-2-6 "Fc"		Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)
IEC 60228 Class 1		Solid conductors
IEC 60228 Class 2		Stranded conductors
IEC 60228 Class 5		Flexible conductors
IEC 60228 Class 6		Very flexible conductors (more flexibility than Class 5)
IEC 60364-4-41		Electrical installations of buildings - Part 4-41: Protection for safety - Protection against electric shock
VDE 0100-410		
IEC 60529		Degrees of protection provided by enclosures (IP code)
IEC 60947-1 / DIN EN 60947-1 (VDE 0600-100)		Low-voltage switchgear and controlgear – General rules
IEC / EN 60947-1		Low-voltage switchgear and controlgear – General rules
IEC / EN 60947-1, Annex S		Digital inputs and/or digital outputs contained in switchgear and controlgear
IEC / EN 60947-2 Edition 4.1, 05.2009		Low-voltage switchgear and controlgear - Part 2: Circuit-Breakers
IEC / EN 60947-2 A1		
IEC / EN 60947-2, Annex B		Circuit-breakers incorporating residual current protection

Standard	Title
IEC / EN 60947-2, Annex H	"Test sequence for circuit-breakers for IT systems" "Circuit-breakers for IT systems"
IEC / EN 60947-3 / DIN EN 60947-3 (VDE 0660-107)	Low-voltage switchgear and controlgear – Switches, disconnectors, switch-disconnectors and fuse-combination units
IEC 60947-4-1 / DIN EN 60947-4-1 (VDE 0660-102)	Low-voltage switchgear and controlgear: Contactors and motor-starters
IEC / EN 61000-4-2	Electrostatic discharge immunity test
IEC / EN 61000-4-3	Radiated, radio-frequency, electromagnetic field immunity test
IEC / EN 61000-4-4	Electrical fast transient/burst immunity test
IEC / EN 61000-4-5	Surge immunity test
IEC / EN 61000-4-6	Immunity to conducted disturbances, induced by radio-frequency fields
IEC 61557-12	Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. - Equipment for testing, measuring or monitoring of protective measures - Part 12: Performance measuring and monitoring devices (PMD)
UL489 Annex SE	"Firmware analysis for safety-relevant applications in electronic trip units"
	RoHS Directive 2002/95/EC (Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment).

3VA molded case circuit breakers conform to the following national standards

Please go to (<http://www.siemens.com/3VA-Documentation>) for a list of national standards to which 3VA molded case circuit breakers conform.

Certification by marine classification societies

Please go to (<http://www.siemens.com/3VA-Documentation>) for a list of marine classification societies which have certified 3VA molded case circuit breakers.

ESD guidelines

B.1 Electrostatic sensitive devices (ESD)

ESD components are destroyed by voltage and energy far below the limits of human perception. Voltages of this kind occur as soon as a device or an assembly is touched by a person who is not electrostatically discharged. ESD components which have been subject to such voltage are usually not recognized immediately as being defective, because the malfunction does not occur until after a longer period of operation.

ESD Guidelines

NOTICE

Electrostatic sensitive devices

Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed or damaged by improper handling.

- You must discharge your body electrostatically immediately before touching an electronic component. To do this, touch a conductive, grounded object, e.g., a bare metal part of a switch cabinet or the water pipe.
- Always hold the component by the plastic enclosure.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices on conductive bases.
- Always store and transport electronic modules or components in ESD-safe conductive packaging, e.g. metallized plastic or metal containers. Leave the component in its packaging until installation.

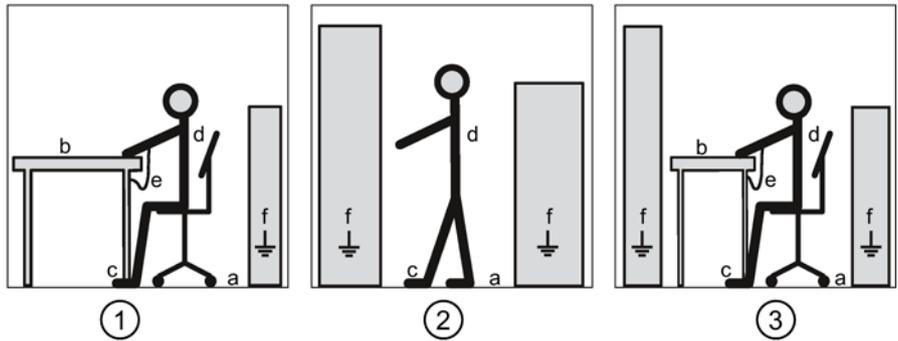
NOTICE

Storage and transport

If you have to store or transport the component in non-conductive packaging, you must first pack the component in ESD-safe, conductive material, e.g., conductive foam rubber, ESD bag.

B.1 Electrostatic sensitive devices (ESD)

The diagrams below illustrate the required ESD protective measures for electrostatic sensitive devices.



- (1) ESD seat
- (2) ESD standing position
- (3) ESD seat and ESD standing position

Protective measures

- a Conductive floor
- b ESD table
- c ESD footwear
- d ESD smock
- e ESD bracelet
- f Cubicle ground connection

Figure B-1 ESD work center

List of abbreviations

C.1 Table of abbreviations

Summary

Table C- 1 Meaning of abbreviations used in this document

Abbreviation	Meaning
AC	AC voltage
ACT	ACTIVE (ready signal)
AL	ALARM (pre-alarm)
ASCII [Modbus interface]	American Standard Code for Information Interchange
ATAM	Adjustable Thermal Adjustable Magnetic Trip Unit (adjustable thermal overload trip unit, adjustable magnetic trip unit with short-circuit protection)
ATFM	Adjustable Thermal Fixed Magnetic Trip Unit (adjustable thermal overload trip unit, permanently set magnetic trip unit with short-circuit protection)
ATSE	Automatic Transfer Switching Equipment
AUX	Auxiliary switch
C	Common
CB-S	Circuit Breaker Switch (standard auxiliary switch (NO contact))
CD	Compact Disk
COM-DO	COM-Draw-out-Kit
DC	Direct voltage
DIN	Deutsches Institut für Normierung e. V. (German Institute for Standardization)
DISCON	DISCONNECT
DO	Draw out
EFB	External Function Box
ESD	Electrostatic sensitive devices
EMC	Electromagnetic compatibility
EN	European Standard
ETU	Electronic trip unit
FTAM	Fixed thermal adjustable magnetic trip unit (permanently set thermal overload trip unit, adjustable magnetic trip unit with short-circuit protection)
FTFM	Fixed thermal fixed magnetic trip unit (permanently set thermal overload trip unit, permanently set magnetic trip unit with short-circuit protection)
G	Ground fault (protection)
GF [tripping characteristic]	Ground fault
HH-fuse	High-voltage fuses

Abbreviation	Meaning
I	Instantaneous (short-circuit protection)
I	Isolated
I- / O-	Input / Output
IEC	International Electrotechnical Commission
INST [tripping characteristic]	INST [tripping characteristic]
INSTA	Final distribution area
IP	International Protection
IT	Injection Tester
IT	Isolated ground, French: "Isolé Terre"
L	Long-time delay (overload protection)
L	Overload protection
LBS	Load Break Switch (switch disconnecter)
LCS	Leading changeover switch
LI	Overload protection (L) and instantaneous short-circuit protection (I)
LIG	Overload protection (L), instantaneous short-circuit protection (I) and ground-fault protection (G)
LIN	Overload protection (L), instantaneous short-circuit protection (I) and neutral-conductor protection (N)
LSI	Overload protection (L), short-time delayed short-circuit protection (S) and instantaneous short-circuit protection (I)
LSIN	Overload protection (L), short-time delayed short-circuit protection (S), instantaneous short-circuit protection (I) and neutral-conductor protection (N)
LSING	Overload protection (L), short-time delayed short-circuit protection (S), instantaneous short-circuit protection (I) and ground-fault protection (N)
LT [tripping characteristic]	Partial overload range of the characteristic curve of a switching device
MCCB	Molded case circuit breaker
MO	Motor operator
MRCD	Modular residual current device [without integrated trip device]
N	Neutral conductor
NC	Normally closed contact
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association.
NO	Normally open contact
LV	Low voltage
LV fuse	Low-voltage fuse
PAC	Power Analysis & Control
PI	Plug-in (unit)
RCD	Residual Current Device
R	RESET
RCR	Residual Current Release
REC	Reclose (automatic reset)
RJ [connector]	Registered Jack

Abbreviation	Meaning
RMS	Root Mean Square
RS [interface]	Formerly: Radio Selector; now usually: Recommended Standard
RTU [Modbus interface]	Remote Terminal Unit
SAS	Short circuit alarm switch
PLC	Programmable logic controller
ST	Shunt trip
STF	Shunt trip flexible
STL	Shunt trip left
T	Test
T [IT systems]	French: Terre (ground)
TC	Test device for molded case circuit breaker or MRCD, suitable for systems with grounded phase
TCP	Transmission Control Protocol
TD	Test Device
TM	Thermal Magnetic
TMTU	Thermal Magnetic Trip Unit
TRIP-IND	TRIP INDICATOR (trip alarm switch)
TRUE RMS	TRUE root-mean-square
TU	Trip Unit
UAR	Universal release
UL	Underwriters Laboratories Inc.
UR	Undervoltage release
USB	Universal Serial Bus
UPS	Uninterruptible power supply
UVR	Undervoltage release
UVR (LNO)	Undervoltage release with leading NO contacts
VDE	Verein Deutscher Ingenieure (Association of German Electrical Engineers)
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
ZSI	Zone Selective Interlocking
ZSS	Zone Selective Interlocking

C.1 Table of abbreviations

Table C- 2 Meaning of symbols and abbreviations

Sym- bol/abbreviation	Meaning
Δt	Delay time
$I_{\Delta n}$	Residual current; rated residual current; response current
I_1	Inrush current
I'_{KG}	Initial balanced short-circuit current
I^2t	Let-through energy
I_B	Take-over current
I_b	Pickup value blocking protection
I_{cm}	Making capacity; rated short-circuit making capacity
I_{cn}	Rated breaking capacity; rated short-circuit breaking capacity
I_{cs}	Maximum short-circuit breaking capacity (partial selectivity); rated service short-circuit breaking capacity
I_{cu}	Maximum short-circuit breaking capacity (full selectivity); rated ultimate short-circuit breaking capacity
I_{cw}	Rated short-time withstand current; rated short-time current
I_d	Prospective current; residual current; response residual current
I_D	Let-through current
I_g	Ground-fault protection; ground-fault release; ground-fault current setting value
I_i	Instantaneous tripping current; instantaneous short-circuit protection; instantaneous magnetic protection; rated tripping current of instantaneous trip
I_k	Short-circuit current
I_{kD}	Uninterrupted short-circuit current
$I_{k\ MAX}$	Maximum short-circuit current
$I_{k\ max\ line}$	Uninterrupted short-circuit current of system
I_n	Rated operational current
I_{nG}	Rated operational current (generator)
I_P	Rated peak withstand current, impulse short-circuit current
I_r	Thermal protection; setting current; response value; current setting value of adjustable overload protection (pickup value overload protection)
I_s	Limit current with selectivity; maximum short-circuit current for selectivity limit
I_{sc}	Prospective current
I_{sd}	Short-time delayed tripping current; response current of S protection; short-time delayed short-circuit release; short-time delayed short-circuit protection; delay time of S protection
I_{th}	Conventional free-air thermal current
I_U	Rated uninterrupted current
R_A	Contact resistance of exposed conductive part ground
t_1	Time of inrush current
t_2	Ramp up time
t_A	Safety clearance
t_b	Delay time (delay of blocking time)
t_d	Response time

Sym- bol/abbreviation	Meaning
t_g	Delay time associated with the adjustable response current; trip time associated with ground-fault current setting value
t_i	"Virtual" trip time of I protection; highest trip time associated with rated tripping current of instantaneous trip
T_p	Trip time; delay time; time-lag class
t_f	Trip time associated with current setting value of adjustable overload protection
t_{sd}	Trip time associated with short-time delayed tripping current; delay time of S protection
t_s	Fuse operating time
t_{ZSI}	Delay time of all molded case circuit breakers which detect the short circuit but do not receive a blocking signal when ZSI is activated.
U	Voltage across main contacts of the molded case circuit breaker
U_e	Maximum voltage; rated operating voltage
U_{Nn}	System rated voltage

Conversion tables

The U.S. units can be converted to the corresponding European/metric units using the conversion tables listed.

Note

No liability assumed for completeness or accuracy

No liability can be assumed for the completeness or accuracy of the values listed in this section of the manual.

Conversion of North American cross section dimensions into metric cross section dimensions

Metric cross-sections in accordance with VDE (Verband Deutscher Elektroingenieure (Association of German Electrical Engineers)) (mm²) ↔ conductor cross-sections in accordance with AWG (American Wire Gauge) or kcmil (Thousand Circular Mills)

AWG ↔ mm² conversion table

	AWG / kcmil	Diameter d/mm	mm ²	Metric equivalent [mm ²]
AWG	20	0.81 ¹⁾	0.52	0.75
	18	1.02 ¹⁾	0.82	1
	16	1.29 ¹⁾	1.3	1.5
	14	1.63 ¹⁾	2.08	2.5
	12	2.05 ¹⁾	3.31	4
	10	2.59 ¹⁾	5.26	6
	8	3.26 ¹⁾	8.4	10
	6	4.12 ¹⁾	13.3	16
	4	5.19 ¹⁾	21.2	25
	2	6.54 ¹⁾	33.6	35
	1	7.34 ¹⁾	42.4	50
	1 / 0	8.25 ¹⁾	53.5	—
	2 / 0	9.27 ¹⁾	67.4	70
	3 / 0	10.4 ¹⁾	85.0	95
4 / 0	11.68 ¹⁾	107	120	

1) Diameters over Solid Conductors and Cross-Sectional Area for All Solid and Stranded Conductors
Source: Standard UL 83

kcmil ↔ mm² conversion table

	AWG / kcmil	Diameter d/mm	mm²
kcmil	250	14.6 ¹⁾	126
	300	16 ¹⁾	152
	350	17.3 ¹⁾	177
	400	18.49 ¹⁾	203
	500	20.65 ¹⁾	253
	600	22.68 ¹⁾	304
	800	26.16 ¹⁾	405
	1000	29.26 ¹⁾	507
	1500	35.86 ¹⁾	760
	2000	41.45 ¹⁾	1010

1) Diameter over Round Concentric-Lay-Stranded Conductors for Classes B, C and D
Source: Standard UL83

Other conversions

Conversion factors for units of length

Length	Conversion factor
1 inch (")	25.4 millimeters (mm)
1 centimeter	0.3937 inches (")

Conversion factors for units of weight

Weight	Conversion factor
1 ounce (Oz.)	28.35 grams (g)
1 pound (lb.)	0.454 kilograms (kg)
1 kilogram (kg)	2.205 pounds (lb.)

Pound (lb.)

Conversion for units of temperature

Temperature	
100 degrees Centigrade (°C)	212 degrees Fahrenheit (°F)
80 °C	176 °F
60 °C	140 °F
40 °C	104 °F
20 °C	68 °F
0 °C	32 °F
- 5 °C	23 °F
- 10 °C	14 °F
- 15 °C	5 °F
- 20 °C	- 4 °F
- 25 °C	- 13 °F
- 30 °C	- 22 °F

Conversion factors for tightening torques

Tightening torque	Conversion factor
1 Newton meter (Nm)	8.85 lbF in, 8.85 lb-in (inch-pound)
1.36 Newton meter (Nm)	1 lbF ft, 1 lb-ft (foot-pound)
0.113 Newton meter (Nm)	1 lbF in, 1 lb-in (inch-pound); 1 / 12 lb-ft

Glossary

AUTO

Method of remote operation of the motor operators via control cables, e.g. PLC.

Breaking capacity

The breaking capacity is the rms value of the current at a specific $\cos \phi$ (power factor) and a specific voltage which can be safely interrupted by a switching device or fuse under prescribed conditions. The rms value of the symmetrical component applies in the case of alternating current.

I^2t characteristic

The I^2t characteristic is a curve which represents the minimum or maximum values of I^2t in relation to breaking times as a function of the prospective current under defined operating conditions.

I^2t value

The I^2t value is the thermal value of a prospective or a limited short-circuit current (let-through current).

Let-through current

The let-through current I_b is the maximum instantaneous current value during the breaking time of a switching device or fuse. Limited short-circuit currents occur if the switching device reduces the amplitude of the short-circuit current due to, for example, resistance, switching delay and peak arc voltage. The let-through current of a device such as a current-limiting fuse or a current-limiting molded case circuit breaker determines the thermal load (I^2t value) imposed on equipment connected downstream of the device (current limiting).

LOCK

Operating mode of motor operators; the operating mechanism is locked and cannot be operated.

Making capacity

The making capacity is the value of the prospective making current which the switching device can safely conduct at the instant of closing under prescribed conditions for a specific circuit.

For molded case circuit breakers, the making capacity is expressed as the maximum possible instantaneous value of the potential prospective current at the input terminals for the specified voltage.

MANUAL

Local, manual operating mode of motor operators.

Protective characteristic

The protective characteristic is determined by the rated operational current and the setting and tripping values of the circuit breaker.

Rated breaking capacity

The rated breaking capacity is the maximum current that can be interrupted by a switching device under certain conditions.

Rated frequency

Design frequency for a switching device and reference value for other characteristics of the device.

Rated making capacity

The rated making capacity is the maximum current that a switching device can conduct at the instant of closing in accordance with the utilization category at the relevant rated operational voltage.

Rated operational current

The rated operational current I_n for molded case circuit breakers is equivalent to the rated uninterrupted current I_U and to the conventional free-air thermal current I_{th} .

Rated operational voltage

The rated operational voltage U_e of a switching device, e.g. a molded case circuit breaker, is the voltage which serves as a reference to state other characteristics of the device. The maximum rated operational voltage must never be higher than the rated insulation voltage.

With multi-phase circuits, the specified voltage is generally the phase-to-phase voltage.

Rated peak withstand current, impulse short-circuit current

Maximum permissible instantaneous (peak) value of the prospective short-circuit current in the current path under the highest load. It characterizes the dynamic short-circuit strength of a switching device.

Rated residual current

The rated residual current $I_{\Delta n}$ is the fault (residual) current for which residual current-operated circuit breakers are designed. The residual current rating is declared on the rating plate of the device.

Rated service short-circuit breaking capacity

The rated service short-circuit breaking capacity I_{cs} is the short-circuit current determined by the operational voltage that a molded case circuit breaker is capable of interrupting repeatedly (test sequence 0 - C0 - CO, formerly P - 2). After a molded case circuit breaker has interrupted a short circuit, it can continue to carry the rated operational current despite increased self-heating and will trip again in the event of a short circuit.

Rated short-circuit breaking capacity

The rated short-circuit breaking capacity I_{cn} of a molded case circuit breaker is the maximum current that the circuit breaker can safely interrupt at a specific rated operational voltage and rated frequency. It is specified as an rms value.

With AC molded case circuit breakers, the rated short-circuit breaking capacity must be independent of the magnitude of the DC component. The rated short-circuit breaking capacity also ensures that the molded case circuit breaker can interrupt every current up to the rated short-circuit breaking capacity in the event of a line-frequency recovery voltage with 110% of the rated operational voltage.

This applies:

- To alternating current at every value of the power factor, but not lower than the value defined in the relevant test specification.
- To direct current (unless otherwise specified by the manufacturer) with every time constant, but not greater than the value defined in the relevant test specification.

The short-circuit breaking capacity does not apply in the event of a recovery voltage at line frequency above 110% of the rated operational voltage.

Rated short-circuit making capacity

The rated short-circuit making capacity I_{cm} of a molded case circuit breaker is the maximum current that the circuit breaker can safely interrupt at a specific rated operational voltage and rated frequency. Unlike other characteristic data, this is specified as a peak value.

With AC molded case circuit breakers, the rated short-circuit making capacity must be at least equal to the rated short-circuit breaking capacity multiplied by a factor n .

The rated short-circuit making capacity is calculated to allow the molded case circuit breaker to conduct the current during closing at a voltage of up to 110% inclusive of the rated operational voltage.

Rated short-time current

Permissible rms value of the AC component of the prospective short-circuit current which the switching device is capable of conducting for a specific time period, e.g. from 0.05 s to 1 s (thermal short-circuit strength).

Rated short-time withstand current

The rated short-time withstand current I_{cw} is specified as an rms value of the short-circuit current and characterizes the thermal strength of a circuit of a switchgear assembly under brief load conditions. The rated short-time withstand current calculation normally refers to a period of 1 s. The reference time must be specified if it deviates from the above. The rated short-time withstand current is specified for the distribution and/or main busbars of a switchgear assembly.

Rated ultimate short-circuit breaking capacity

The rated ultimate short-circuit breaking capacity I_{cu} is the maximum short-circuit current that a molded case circuit breaker is capable of interrupting (test sequence 0 - C0, formerly P - 1). After the molded case circuit breaker has cleared the short circuit, it is capable of tripping with increased tolerances under overload conditions.

Limit value of rated ultimate short-circuit breaking capacity I_{cu} .

The rated ultimate short-circuit breaking capacity I_{cu} is the maximum value of the short-circuit current which the protective device is capable of disconnecting in accordance with regulations. Up to this value, the protective device is also allowed to be used in a network.

Rated ultimate short-circuit breaking capacity

The rated ultimate short-circuit breaking capacity I_{cu} is the maximum short-circuit current that a molded case circuit breaker is capable of interrupting (test sequence 0 - C0, formerly P - 1). After the molded case circuit breaker has cleared the short circuit, it is capable of tripping with increased tolerances under overload conditions.

Limit value of rated ultimate short-circuit breaking capacity I_{cu} .

The rated ultimate short-circuit breaking capacity I_{cu} is the maximum value of the short-circuit current which the protective device is capable of disconnecting in accordance with regulations. Up to this value, the protective device is also allowed to be used in a network.

Rated uninterrupted current

The rated uninterrupted current I_U of a switching device, e.g. a molded case circuit breaker, is a current that the device can conduct in uninterrupted operation (for weeks, months or years). This current is specified by the manufacturer.

Rating

The rating is the power that a switching device is capable of switching at the associated rated operational voltage in accordance with the utilization category, e.g. power contactor utilization category AC-3:37 kW at 400 V.

Remote control

Or AUTO; method of remote operation of the motor operators via control cables, e.g. PLC.

Short circuit

Connection with a negligibly low impedance between two points of different potential in an electric circuit. The short-circuit current is a multiple of the rated operating current. Short circuits can cause thermal or mechanical damage to switching devices and other parts of an electrical installation.

Short-circuit strength

This is the resistivity of a switching device in the closed state, along with its components (e.g. trip units), or a complete switchboard to the electrodynamic and thermal stresses which arise in the event of a short circuit.

The characteristic for the dynamic stress is the rated peak withstand current, which is the maximum instantaneous value of the short-circuit current.

The characteristic for the thermal stress of the short-circuit current is the root-mean-square value of the short-circuit current throughout its duration.

Tripping current of overload release

The current value at which a trip unit trips within a specified time.

Tripping current, ground fault

When the ground fault current reaches or exceeds this limit value, the ground-fault protection, for example, of a molded case circuit breaker, is tripped.

Tripping current, instantaneous

When this current limit is exceeded, the circuit breaker trips instantaneously.

Tripping current, overload

When this uninterrupted current limit is exceeded within a predefined time period, the circuit breaker trips (inverse-time delayed tripping!).

Tripping current, short-time delayed

When this current limit is exceeded, the circuit breaker trips after a predefined time delay.

Tripping time

Period of time from the instant of commencement of trip command output to the moment at which the command becomes irrevocable (timing concept for the tripping of circuit breakers).

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