SIEMENS

SENTRON

Protection devices

3VL IEC molded case circuit breakers

System Manual

Edition 11/2013

Answers for Infrastructure & Cities.

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3VL IEC molded case circuit breakers

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Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING
indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
indicates that property damage can result if proper precautions are not taken.

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Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Table of contents

1 About this document

1.1 Introduction

Purpose of this manual

This manual is intended for reference purposes. The information in this manual enables you to configure and operate the SENTRON 3VL system.

Audience

This manual is aimed at people with the required qualifications to commission and operate the SENTRON 3VL system.

1.2 Technical Support

You can find further support on the Internet at:

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

2 Product-specific information

2.1 Important notes

Validity

This manual applies to SENTRON molded case circuit breakers with the following designations:

- VL160X
- VL160
- VL250
- VL400
- VL630
- VL800
- VL1250
- VL1600

Standards and certifications

The 3VL molded case circuit breakers comply with the following regulations:

- IEC 60947-2 / DIN EN 60947-2
- IEC 60947-1 / DIN EN 60947-1
- Isolating features in accordance with IEC 60947-2 / DIN EN 60947-2
- As a network disconnecting device (main control switches) according to EN 60204 and DIN VDE 0113, and additionally also with the requirements for "disconnecting units with features for stopping and switching off in an emergency" (EMERGENCY-STOP switches) in conjunction with lockable rotary operating mechanisms (red-yellow) and terminal covers. Not in conjunction with motorized operating mechanisms.

Operating conditions

Suitable enclosures must be provided for operation in areas with severe ambient conditions (such as dust, caustic vapors, hazardous gases).

Disclaimer of liability

The products described here were developed to perform safety-oriented functions as part of an overall installation or machine. A complete safety-oriented system generally features sensors, evaluation units, signaling units, and reliable shutdown concepts. It is the responsibility of the manufacturer to ensure that a system or machine is functioning properly as a whole. Siemens AG, its regional offices, and associated companies (hereinafter referred to as "Siemens") cannot guarantee all the properties of a whole plant or machine that has not been designed by Siemens.

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See also

Standards and specifications (Page 308)

2.2 Ordering data

Order number scheme

The table below describes the order number scheme according to which all circuit breakers can be located and combined to suit the individual application:

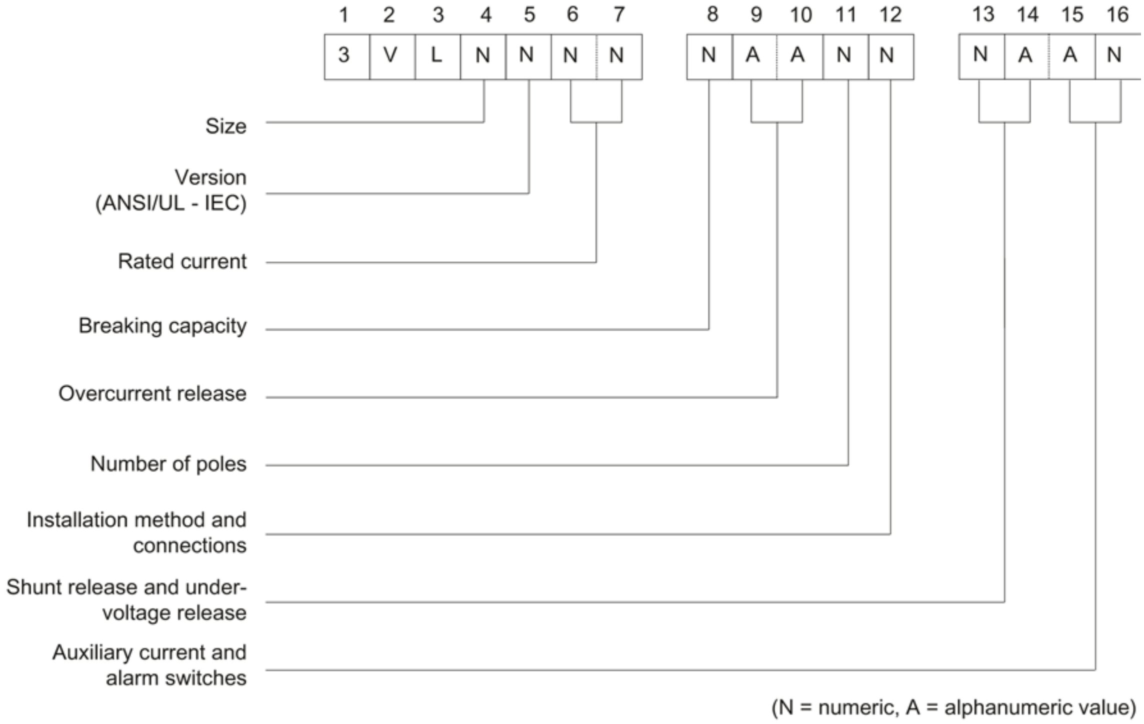


Figure 2-1 Overview of the order number system

3 Product description

3.1 Overview 3VL

3VL molded case circuit breakers are climate-proof. They are designed for operation in enclosed areas. Suitable enclosures must be provided for operation in areas with severe ambient conditions (such as dust, caustic vapors, hazardous gases).

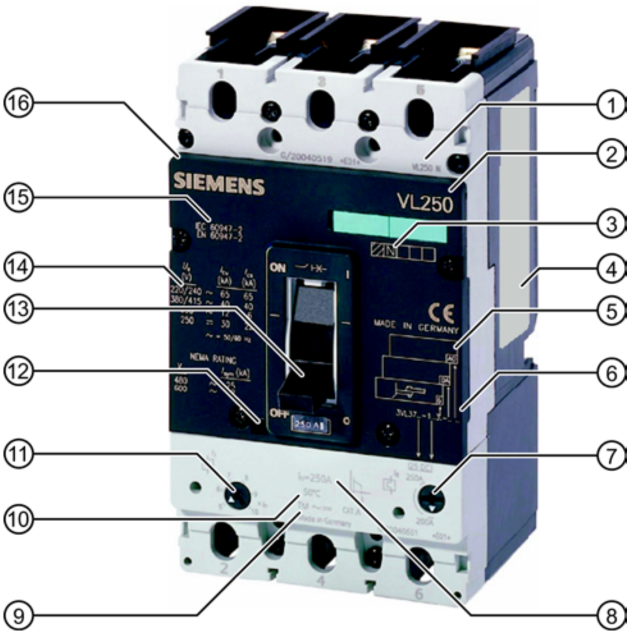
SENTRON VL types

The type designations of all available molded case circuit breakers are oriented around the rated current.

Type designation	Maximum rated current (A)
VL160X / 3VL1	160
VL160 / 3VL2	160
VL250 / 3VL3	250
VL400 / 3VL4	400
VL630 / 3VL5	630
VL800 / 3VL6	800
VL1250 / 3VL7	1250
VL1600 / 3VL8	1600

Rating plate and ID number

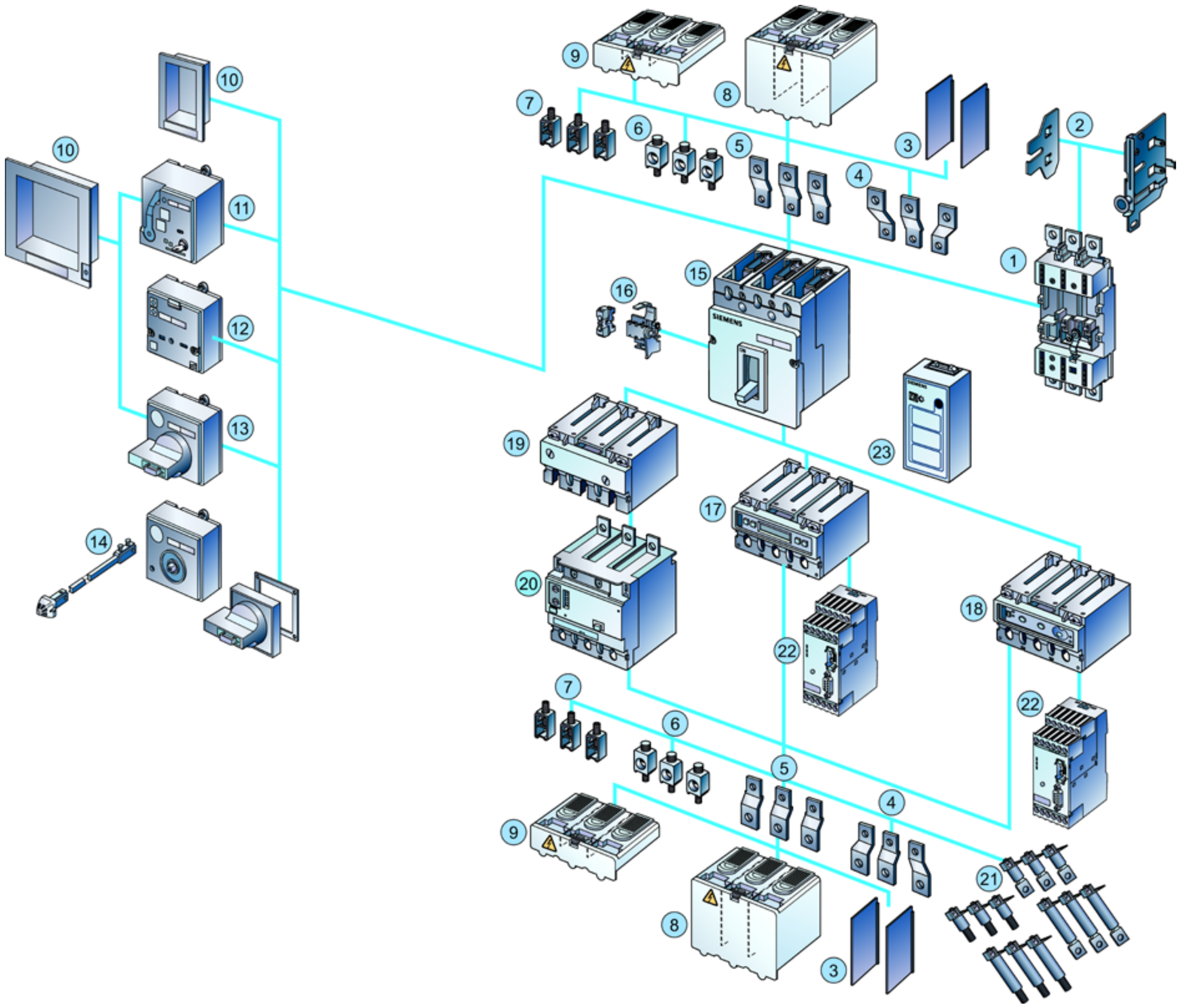
The figure shows all the operator elements, setting options and names corresponding to the precise specified use of the molded case circuit breaker.



(1)	Size specification and switching capacity (N, H or L)
(2)	Molded case circuit breaker type
(3)	Indication of switching capacity
(4)	Rating plate
(5)	Accessories ID fields
(6)	Order number
(7)	Overcurrent setting
(8)	I_n rated current of the molded case circuit breaker
(9)	Overcurrent release type TM (thermal-magnetic)
(10)	Reference temperature
(11)	Short-circuit release / setting
(12)	Test key
(13)	Toggle lever with 3 positions
(14)	Switching capacity
(15)	Standards
(16)	Accessories cover (removable)

Figure 3-1 3VL molded case circuit breakers - labeling and operator controls

SENTRON VL accessories



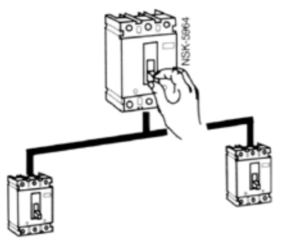
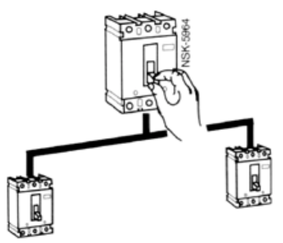
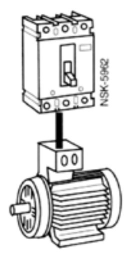
(1)	Withdrawable/plug-in base	(13)	Front-operated rotary operating mechanism
(2)	Side panels of withdrawable unit	(14)	Door-coupling rotary operating mechanism
(3)	Phase barriers	(15)	3VL molded case circuit breaker
(4)	Front connecting bars for increased pole spacing	(16)	Internal accessories
(5)	Straight connecting bars	(17)	Electronic trip unit LCD ETU
(6)	Circular conductor terminal for Al / Cu	(18)	Electronic trip unit with communication function
(7)	Box terminal for Cu	(19)	Thermal/magnetic overcurrent release
(8)	Extended terminal cover	(20)	RCD module
(9)	Standard terminal cover	(21)	Rear terminals - flat and round
(10)	Masking/cover frame for door cutout	(22)	COM20 / 21 communication module to the PROFIBUS DP / MODBUS RTU
(11)	Motorized operating mechanism with stored energy mechanism (SEO)	(23)	Battery power supply with test function for electronic trip units (ETUs)
(12)	Motorized operating mechanism (MO)		

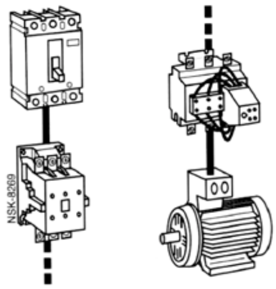
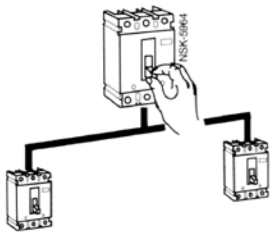
Figure 3-2 SENTRON VL accessories

3.2 Application overview

The following overview shows the most frequently occurring applications.

Application overview

Application	Type	Description
 3- and 4-pole molded case circuit breakers	VL160X VL160 VL250 VL400 VL630 VL800 VL125 VL1600	**System protection** The releases for system protection are designed to protect cables and non-motorized loads against overload and short-circuit.
 3- and 4-pole molded case circuit breakers	VL160 VL250 VL400 VL630 VL800 VL125 VL1600	**Generator protection** The overload and short-circuit releases can be used for optimized protection of generators.
 3-pole molded case circuit breakers	VL160 VL250 VL400 VL630	**Motor protection** The overload and short-circuit releases are designed for optimal protection and direct starting of three-phase AC squirrel-cage motors. The molded case circuit breakers for motor protection have phase-failure sensitivity and a thermal image that protects the motor against overheating. The adjustable time lag class enables users to adjust the overload release to the startup conditions of the motor to be protected.

Application	Type	Description
 3-pole molded case circuit breakers	VL160 VL250 VL400 VL630	**Starter combination** Starter combinations consist of: molded case circuit breaker + contactor + overload relay. The molded case circuit breaker handles short-circuit protection and the isolating function. The contactor has the task of switching the load feeder normally. The overload relay handles overload protection that can be specially matched to the motor. The molded case circuit breaker for starter combination is therefore equipped with an adjustable and instantaneous short-circuit release.
 3- and 4-pole molded case circuit breakers	VL160X VL160 VL250 VL400 VL630 VL800 VL1250 VL1600	**Non-automatic air circuit breakers** These molded case circuit breakers are used as incoming circuit breakers, main switches or isolating switches without overload protection. They have fixed short-circuit releases so that back-up fuses are not necessary.

3.3 Configuration

3.3.1 Functional principle

Mechanical design

All 3VL molded case circuit breakers have a trip-free mechanism that ensures the trip process is not prevented even if the operating mechanism is blocked or manually held in the "ON" position.

The contacts are opened and closed by a toggle lever positioned in the center. This is attached to the front side on all molded case circuit breakers.

All 3VL molded case circuit breakers are "joint trip units". This means all contacts open or close simultaneously when the molded case circuit breaker toggle lever is moved from "OFF" to "ON" or from "ON" to "OFF", or when the tripping mechanism is activated by an overcurrent or with the help of the auxiliary trips (shunt release or undervoltage release).

Current limiting

The 3VL molded case circuit breakers are designed on the principle of magnetic repulsion of the contacts. The contacts open before the expected peak-value of the short-circuit current is reached. Magnetic repulsion of the contacts very considerably reduces the thermal load I^2t as well as the mechanical load resulting from the impulse short-circuit current I_P of the system components that occur during a short-circuit.

You can find more information in the chapter Use in motor protection (Page 64).

3.3.2 Subdivision according to power ranges

VL160X molded case circuit breakers

The most important components of the VL160X molded case circuit breakers are the three current paths with the incoming and outgoing terminals. The fixed and movable contacts are arranged in such a way as to guarantee magnetic repulsion of the contacts. In conjunction with the arcing chambers, a dynamic impedance is generated that causes current limitation. This reduces the damaging effects of excessively high values I^2t and I_p.

The overcurrent release is a factory-installed thermal-magnetic device. It is equipped with fixed or adjustable overload releases and a fixed short-circuit release in each pole.

To the right and left of the centrally positioned toggle lever of every SENTRON VL molded case circuit breaker is a double-insulated accessory compartment for installing auxiliary switches or alarm switches as well as shunt releases and undervoltage releases.

VL160 to VL630 molded case circuit breakers

The arrangement of current paths, contact configuration and switch mechanism of the VL160 to VL630 molded case circuit breakers corresponds to that of the VL160X molded case circuit breaker. The designs diverge with regard to the overcurrent release.

- The overcurrent releases are available in a thermal-magnetic version and in an electronic version.
- Thermal-magnetic overcurrent releases are available with adjustable overload releases and short-circuit releases.

VL800 to VL1600 molded case circuit breakers

The arrangement of the current paths and switch mechanisms is identical to that of the VL160X to VL630 molded case circuit breakers.

However, the VL800 to VL1600 molded case circuit breakers are only available in the version with electronic trip unit. As with all electronic trip units for the SENTRON VL molded case circuit breakers from Siemens, the current transformers (one per phase) are accommodated within the overcurrent release enclosure.

All 3VL molded case circuit breakers with electronic trip units measure the actual RMS current. This method is the most accurate way of measuring currents in electrical distribution systems with extremely high harmonics.

3.3.3 Thermal-magnetic overcurrent trip units

A thermal-magnetic overcurrent release consists of two components - a thermal release for protecting against overload, and a magnetic release for protecting against short-circuit. Both release components are series-connected.

Thermal release

The thermal release consists of a temperature-dependent bimetal that heats up as a result of the flow of current. This means the release is current-dependent. The heating of the bimetal strip depends on the ambient temperature of the molded case circuit breaker. All current values specified for 3VL for thermal-magnetic releases refer to an ambient temperature of 40 °C. Where ambient temperatures deviate from this, the values in the tables in the chapter Use at altitudes above 2000 meters (Page 142) are to be used.

Magnetic release

The magnetic release 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 now 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 release time is almost current-independent and instantaneous. The flap armature releases the switching lock and thus opens the switching contacts before the short-circuit current can reach its maximum; a current limiting effect is thus achieved. Immediately after release, the flap armature is moved back to its starting position by the opposite force of the tension spring.

3.3.4 Electronic overcurrent trip unit (ETU)

Electronic trip units (ETUs)

In contrast to thermal-magnetic releases/trip units (TMTUs) where the overcurrent trip is caused by a bimetal strip or magnetic release, electronic trip units (ETUs) use electronics with current transformers. The ETU captures the actual currents and compares them with the default specifications.

All 3VL molded case circuit breakers with electronic overcurrent trips measure the actual RMS current (true RMS). This is the most accurate method of measuring.

ETUs are available from the VL160 molded case circuit breaker up to and including the VL1600. The VL800, VL1250 and VL1600 molded case circuit breakers are only available in the version with electronic trip unit.

Configuration

The electronic overcurrent tripping system consists of:

- 3 to 4 (3-pole or 4-pole) current transformers that also provide their own power supply.

  This means an external auxiliary voltage is not required.
- Evaluation electronics with microprocessor
- Tripping solenoid

In all versions with electronic trip units for the 3VL molded case circuit breakers, the current transformers are located in the same enclosure as the trip unit. At the output of the electronic overcurrent tripping module, there is a tripping solenoid that trips the molded case circuit breaker in the event of an overload or short-circuit. In all electronic trip units, the tripping solenoid is located within the trip unit, except in the shipbuilding ETUs of sizes VL160 and VL250. In these ETUs, the tripping solenoid is located in the left accessories compartment.

Power supply

The protection functions of the electronic trip unit are guaranteed without additional auxiliary voltage. The overcurrent releases are supplied with energy via internal current transformers. The protection function is set via rotary encoding switches on the ETU or via an LCD display.

In the case of an LCD display, the electronic trip unit must be activated. This requires a 3-phase (3-pole) load current of at least 20% or, in the case of a single-phase (single-pole) load, 30% of the relevant rated current of the molded case circuit breaker. If this load current is not available, the necessary auxiliary energy can be supplied via a battery power supply (order no. 3VL9000-8AP01). With communication-capable, molded case circuit breakers, the trip unit is powered by means of the COM20 or COM21 module.

Battery supply device

The handheld tester for electronic trip units is used as a local test device for the 3VL molded case circuit breakers with electronic trip unit, and it can be used as an external voltage supply for the electronic trip units (ETU and LCD-ETU). The portable battery power supply is fed by two standard 9 V block batteries.

Test function:

- Test tripping

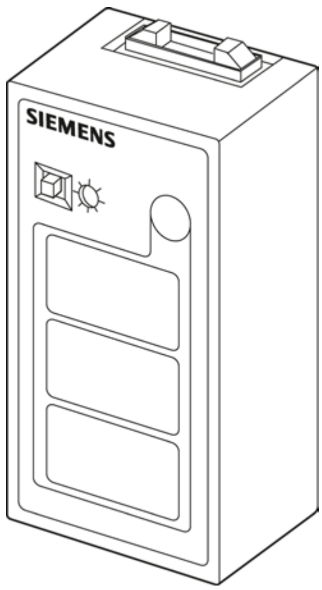


Figure 3-3 Battery supply device

4-pole molded case circuit breakers

The four-pole molded case circuit breakers for system protection can be supplied in all 4 poles with or without current transformers. The trip units in the 4th pole (N) can be set to 50% or 100% of the current in the 3 main current paths dependent on the size, so that safe protection of the neutral conductor can be guaranteed even with a reduced cross-section. In the case of LCD-ETUs, the neutral conductor protection can be adjusted in steps from 50% to 100% or switched off.

3.4 Mechanical operating mechanisms

3.4.1 Toggle lever operating mechanism

In the basic version, the 3VL molded case circuit breakers have a toggle lever as actuator, which is also an indicator of the switching position. The "Tripped" position is also displayed in addition to the "ON" and "OFF" positions.

The toggle lever goes to the "tripped" position when the internal trip mechanism is activated by an overcurrent situation, e.g. overload or short-circuit, or if the Test key is operated.

Activation by an undervoltage release or shunt release will also cause the toggle lever to move to the "Tripped" position.

The toggle lever must be returned to the "OFF/RESET" position before the molded case circuit breaker can be activated again. This enables the internal release mechanism to be reset. 3VL molded case circuit breakers with toggle lever operation comply with the "Network disconnecting device" condition (5.3.2 Section c) and 5.3.3) according to DIN EN 60204-1 (VDE 0113-1) in conjunction with a locking device.

Toggle lever positions

OFF
RESET

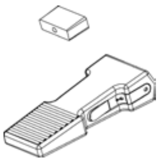
Tripped

Toggle lever positions

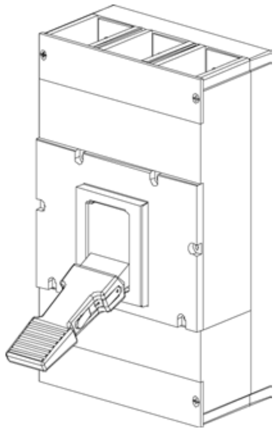
Toggle lever extension

Toggle lever extensions enable user-friendly operation of the molded case circuit breaker toggle lever.

- VL160X to VL250: toggle lever extension not necessary / not available
- VL400 to VL800: possible as option
- VL1250 to VL1600: included in the scope of supply / optional installation



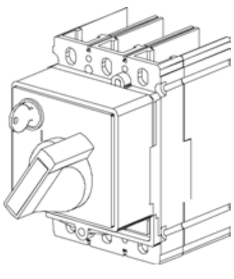
Toggle lever extension



Use of toggle lever extension

3.4.2 Rotary mechanism on front (optional)

The front-operated rotary operating mechanism converts the vertical movement of the toggle lever into rotary motion. The molded case circuit breaker is switched on/off or tripped with the help of the front-operated rotary operating mechanism. The rotary motion on the switching knob is converted to vertical motion on the toggle lever.



Rotary mechanism

The front-operated rotary operating mechanism is mounted directly on the molded case circuit breaker. 3VL molded case circuit breakers with rotary mechanism comply with the "Network disconnecting device" condition of DIN EN 60204-1 (DIN VDE 0113-1).

Degree of protection

The front-operated rotary operating mechanism has degree of protection IP30.

Interlocking

Lockable in the "OFF" position with up to 3 padlocks.

A safety lock can also be used.

Application

Standard application:

- Black knob
- Gray indicator plate

Network disconnecting device with features for stopping and shutting down in an emergency:

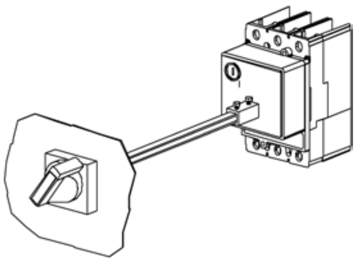
- Red knob
- Yellow indicator plate

Accessories

Optionally, up to 4 changeover contacts can be used. Two contacts can be used as leading NO contacts and two contacts as leading NC contacts. These are equipped with 1.5 m long connection cables.

3.4.3 Door-coupling rotary operating mechanism (optional)

The door-coupling rotary operating mechanism is available for installation in control cabinets and distribution boards.



Door-coupling rotary operating mechanism

3VL molded case circuit breakers with door-coupling rotary mechanism comply with the "Network disconnecting device" condition of DIN EN 60204-1 (DIN VDE 0113-1)

The door-coupling rotary operating mechanism is designed as follows:

- Rotary mechanism on the front with shaft stub (without knob)
- Shaft coupling
- 300 mm extension shaft (600 mm optional, retaining bracket required)
- Actuator

Degree of protection

This mechanism offers degree of protection IP65.

Interlocking

Lockable in the "OFF" position with up to 3 padlocks. A safety lock can also be used.

Application

Standard application:

- Black knob
- Gray indicator plate

Network disconnecting device with features for stopping and shutting down in an emergency:

- Red knob
- Yellow indicator plate

Accessories

Leading auxiliary switches when switching ON and OFF

The leading auxiliary switches (changeover switches) are available as accessories for front-operated rotary operating mechanisms and door-coupling rotary operating mechanisms.

The following applications are possible:

- Leading auxiliary switch for switching from "ON" to "OFF"
- Leading auxiliary switch for switching from "OFF" to "ON"

Each version, leading auxiliary switch for switching on and off, can be equipped with one or two changeover switches. The connecting cables of the auxiliary switches are 1.5 m long.

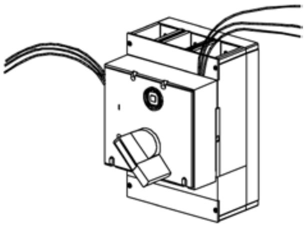


Figure 3-4 Rotary operating mechanism with leading auxiliary switches

3.4.4 Side panel rotary operating mechanism (optional)

The side panel rotary operating mechanism is available for installation in control cabinets and distribution boards.

Interlocking

Lockable in the "OFF" position with up to 3 padlocks.

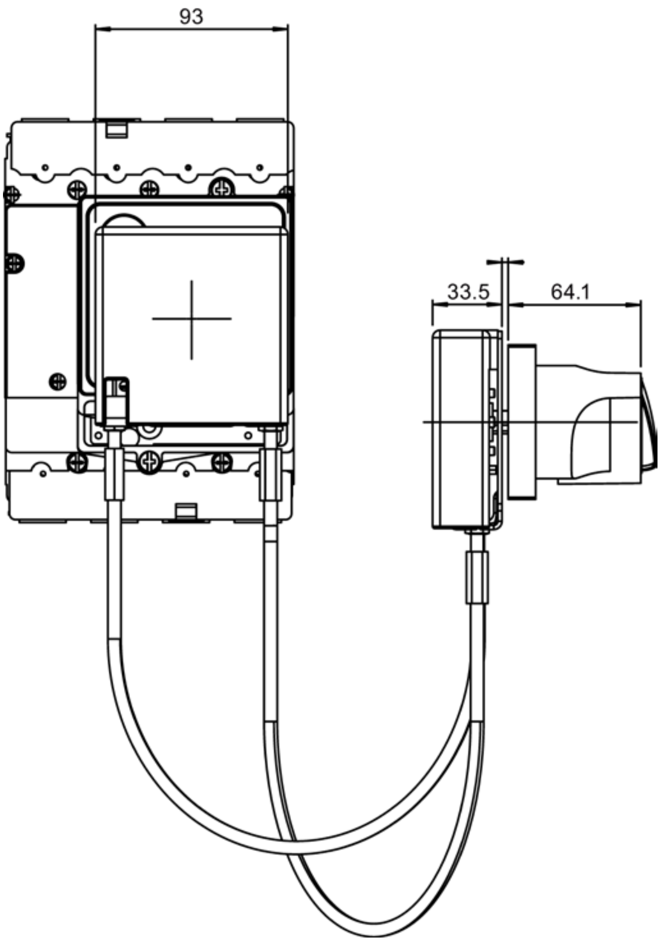


Figure 3-5 Side panel rotary operating mechanism

The side panel rotary operating mechanism is structured as follows:

- Rotary mechanism on the front with shaft stub (without knob)
- Bowden wire operation on the switch
- 2 Bowden wires
- Bowden wire operation for panel-mounting (side panel of the distribution board)
- Actuator

Application

Standard application:

- Black knob
- Gray indicator plate

Network disconnecting device with features for stopping and shutting down in an emergency:

- Red knob
- Yellow indicator plate

Accessories

Leading auxiliary switches when switching ON and OFF

The leading auxiliary switches (changeover switches) are available as accessories for side panel rotary operating mechanisms.

The following applications are possible:

- Leading auxiliary switch for switching from "ON" to "OFF"
- Leading auxiliary switch for switching from "OFF" to "ON"

Each version, leading auxiliary switch for switching on and off, can be equipped with one or two changeover switches. The connecting cables of the auxiliary switches are 1.5 m long.

3.5 Motorized operating mechanisms (optional)

Motorized operating mechanisms enable the molded case circuit breaker to be switched on/off locally or by remote control. For electrical and mechanical locking of the operating mechanism, they are equipped as standard with a locking device for padlocks.

The motorized operating mechanism with stored energy mechanism (SEO) can be optionally equipped with a cylinder lock for locking in the OFF position.

Motorized operating mechanisms can also be actuated manually. Two types of mechanisms are offered.

Note

molded case circuit breakers with motorized operating mechanisms **cannot** be used as network disconnecting devices in accordance with DIN EN 60204-1 (VDE 0113-1).

3.5.1 Motorized operating mechanism with stored energy mechanism (SEO)

SEO for VL160X-VL800

- The motorized operating mechanism with stored energy mechanism (SEO) is suitable for synchronization tasks.
- The motor charges a motorized operating mechanism with stored energy mechanism and moves the SENTRON VL toggle lever to the "OFF/RESET" position.
- The motorized operating mechanism with stored energy operate discharges when actuated, quickly switching the SENTRON VL toggle lever to the "ON" position.
- A mode switch allows local (Manual) or remote (Auto) operation to be selected.
- The manual actuator handle is located on the front of the operating mechanism cover.

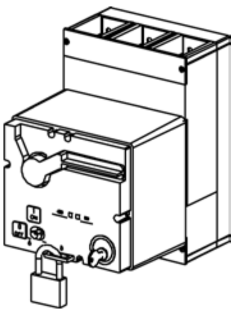


Figure 3-6 Motorized operating mechanism with stored energy mechanism

3.5.2 Motorized operating mechanism (MO)

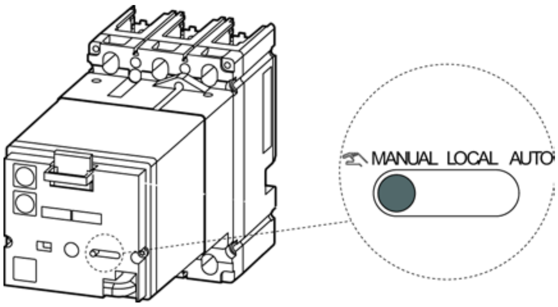
Motorized operating mechanism for VL160x-VL1600

The motorized operating mechanism (MO) is required for remote switching of molded case circuit breakers. Thanks to its fast break time, it is perfectly suited to transfer control systems.

The integrated switch position indicator of the motorized operating mechanism (MO) indicates the ON, OFF and TRIP states.

The LOCAL, MANUAL or AUTO modes can be selected with the mode switch:

LOCAL	Operation using pushbuttons on-site
MANUAL	Manual operation with the help of an Allen key on the front of the motorized operating mechanism (MO)
AUTO	Remote control via control wire



Note

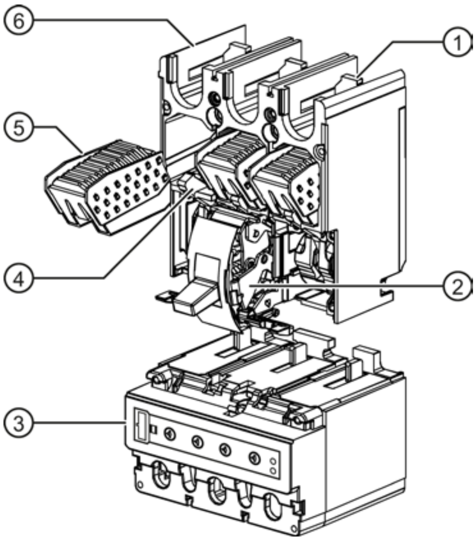
The Allen key for manual operation is located on the front of the device.

Functions 4

4.1 Protection functions

4.1.1 Overcurrent release

The 3VL molded case circuit breakers are designed on the principle of magnetic repulsion of the contacts. The contacts open before the expected peak-value of the short-circuit current is reached. Magnetic repulsion of the contacts very considerably reduces the thermal load I^2t as well as the mechanical load resulting from the impulse short-circuit current I_p of the system components that occur during a short-circuit.



(1) Main connections
(2) Breaker mechanism
(3) Overcurrent release
(4) Movable contact arm
(5) Arc chute
(6) Enclosure

Figure 4-1 Interior view MCCB

4.1.2 Function overview of the overcurrent release

VL160 to VL1600

Table 4- 1 Meaning of symbols

✓	Function available
—	Function not available

Table 4- 2 Function overview

Order No. supplement	Releases	System protection	System / generator protection	Motor protection	Starter protection	Non-automatic circuit breakers	Function Release type
DK	M	—	—	—	✓	—	I
DE	M	—	—	—	—	✓	I
EE	M	—	—	—	—	✓	I
DA	TM 2)	✓	—	—	—	—	LI
DD	TM 2)	✓	—	—	—	—	LI
DC	TM 2)	✓	—	—	—	—	LI
EH	TM 2)	✓	—	—	—	—	LI
EJ	TM 2)	✓	—	—	—	—	LI
EA	TM 2)	✓	—	—	—	—	LIN
EC	TM 2)	✓	—	—	—	—	LIN
EM	TM 2)	✓	—	—	—	—	LIN
SP	ETU10M 3)	—	—	✓	—	—	LI
MP	ETU10M 3)	—	—	✓	—	—	LI
SB	ETU10	✓	—	—	—	—	LI
MB	ETU10	✓	—	—	—	—	LI
LB	ETU10	✓	—	—	—	—	LI
TA	ETU10	✓	—	—	—	—	LIN
NA	ETU10	✓	—	—	—	—	LIN
LA	ETU10	✓	—	—	—	—	LIN
TB	ETU10	✓	—	—	—	—	LI
NB	ETU10	✓	—	—	—	—	LI
SL	ETU12	✓	—	—	—	—	LIG
ML	ETU12	✓	—	—	—	—	LIG
SF	ETU12	✓	—	—	—	—	LIG
MF	ETU12	✓	—	—	—	—	LIG
TN	ETU12	✓	—	—	—	—	LING
NN	ETU12	✓	—	—	—	—	LING
SE	ETU20	—	✓	—	—	—	LSI
ME	ETU20	—	✓	—	—	—	LSI

Order No. supplement	Releases	System protection	System / generator protection	Motor protection	Starter protection	Non-automatic circuit breakers	Function Release type
LE	ETU20	—	✓	—	—	—	LSI
TE	ETU20	—	✓	—	—	—	LSI
NE	ETU20	—	✓	—	—	—	LSI
TF	ETU20	—	✓	—	—	—	LSIN
NF	ETU20	—	✓	—	—	—	LSIN
LF	ETU20	—	✓	—	—	—	LSIN
SG	ETU22	—	✓	—	—	—	LSIG
MG	ETU22	—	✓	—	—	—	LSIG
SH	ETU22	—	✓	—	—	—	LSIG
MH	ETU22	—	✓	—	—	—	LSIG
TH	ETU22	—	✓	—	—	—	LSING
NH	ETU22	—	✓	—	—	—	LSING
SS	ETU30M 3)	—	—	✓	—	—	LI
MS	ETU30M 3)	—	—	✓	—	—	LI
LS	ETU30M 3)	—	—	✓	—	—	LI
UP	LCD-ETU40M 3)	—	—	✓	—	—	LI
UH	LCD-ETU40	—	✓	—	—	—	LI, LS, LSI
UJ	LCD-ETU40	—	✓	—	—	—	LI, LSI, LIN, LSIN
UL	LCD-ETU42	—	✓	—	—	—	LSIG
UM	LCD-ETU42	—	✓	—	—	—	LSIG
UN	LCD-ETU42	—	✓	—	—	—	LSIG, LSING

1) Size dependent
2) TM to I_n = 630 A
3) Motor protection to I_n = 500 A
L: Long time delay
S: Short time delay
I: Instantaneous
N: Neutral protection
G: Ground fault

4.1.3 Setting options of the overcurrent release

VL160 to VL1600

In view of the large number of setting options of the individual overcurrent releases, an overview in table form is useful for calculating the optimal operating point.

Table 4- 3 Overcurrent tripping method - setting options

Order No. supplement	Releases	Setting options					
		L	S[1]		I[1]	G	
		Overload protection	Short-circuit protection (short-time delayed)		Short-circuit protection (instantaneous)	Ground-fault protection	
		I_r = x I_n	I_{sd} = x Ir	t_{sd} [s]	I_i = x I_n	I_g = I_n	t_g [s]
DK	M[5]	—	—	—	7 ... 15	—	—
DE	M[5]	—	—	—	8 … 18	—	—
EE	M[5]	—	—	—	8 … 18	—	—
DA	TM[2][5]	1	—	—	9 … 18 [4]	—	—
DD	TM[2][5]	0,8 ... 1	—	—	9 … 18 [4]	—	—
DC	TM[2][5]	0,8 ... 1	—	—	5 ... 10	—	—
EH	TM[2][5]	1	—	—	9 … 18 [4]	—	—
EJ	TM[2][5]	0,8 ... 1	—	—	5 ... 10	—	—
EA	TM[2][5]	1	—	—	9 … 18 [4]	—	—
EC	TM[2][5]	0,8 ... 1	—	—	5 ... 10	—	—
EM	TM[2][5]	0,8 ... 1	—	—	5 ... 10	—	—
SP	ETU10M[3]	0,4 ... 1	—	—	1,25 ... 11	—	—
MP	ETU10M[3]	0,4 ... 1	—	—	1,25 ... 11	—	—
SB	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
MB	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
LB	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
TA	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
NA	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
LA	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
TB	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
NB	ETU10	0,4 ... 1	—	—	1,25 ... 11	—	—
SL	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
ML	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
SF	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
MF	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
TN	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
NN	ETU12	0,4 ... 1	—	—	1,25 ... 11	0.6 ... 1, OFF	0,1 … 0,3
SE	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
ME	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—

Order No. supplement	Releases	Setting options					
		L	S[1]		I[1]	G	
		Overload protection	Short-circuit protection (short-time delayed)		Short-circuit protection (instantaneous)	Ground-fault protection	
		I_r = x I_n	I_{sd} = x Ir	t_{sd} [s]	I_i = x I_n	I_g = I_n	t_g [s]
LE	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
TE	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
NE	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
TF	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
NF	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
LF	ETU20	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	—	—
SG	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
MG	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
SH	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
MH	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
TH	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
NH	ETU22	0,4 ... 1	1,5 ... 10	0 ... 0,5	11	0.6 ... 1, OFF	0,1 … 0,3
SS	ETU30M[3]	0,4 ... 1	—	—	06.08.2011	—	—
MS	ETU30M[3]	0,4 ... 1	—	—	06.08.2011	—	—
LS	ETU30M[3]	0,4 ... 1	—	—	06.08.2011	—	—
UP	LCD-ETU40M[3]	0,4 ... 1	—	—	1,25 ... 11	—	—
UH	LCD-ETU40	0,4 ... 1	1,5 ... 10	0 ... 0,5	1,25 ... 11	—	—
UJ	LCD-ETU40	0,4 ... 1	1,5 ... 10	0 ... 0,5	1,25 ... 11	—	—
UL	LCD-ETU42	0,4 ... 1	1,5 ... 10	0 ... 0,5	1,25 ... 11	0,4 ... 1	0,1 ... 0,5
UM	LCD-ETU42	0,4 ... 1	1,5 ... 10	0 ... 0,5	1,25 ... 11	0,4 ... 1	0,1 ... 0,5
UN	LCD-ETU42	0,4 ... 1	1,5 ... 10	0 ... 0,5	1,25 ... 11	0,4 ... 1	0,1 ... 0,5

[1] Size dependent

[2] TM to I_n = 630 A

[3] Motor protection to I_n = 500 A

[4] Fixed

[5] With single-pole load, tripping occurs at 130% of the set instantaneous short-circuit current.

4.1.4 General technical data of the overcurrent release

VL160 to VL1600

Table 4- 4 Meaning of symbols

✓	Function available
—	Function not available

Order No. supplement	Releases	Thermal image	Phase failure	Communication capability [4]	Ground-fault protection	Number of poles	N pole protected [1]
DK	M	—	—	—	—	3	—
DE	M	—	—	—	—	3	—
EE	M	—	—	—	—	4	—
DA	TM [2]	✓	—	—	—	3	—
DD	TM [2]	✓	—	—	—	3	—
DC	TM [2]	✓	—	—	—	3	—
EH	TM [2]	✓	—	—	—	4	—
EJ	TM [2]	✓	—	—	—	4	—
EA	TM [2]	✓	—	—	—	4	100 %
EC	TM [2]	✓	—	—	—	4	60 %
EM	TM [2]	✓	—	—	—	4	100 %
SP	ETU10M [3]	✓	40% I_R	—	—	3	—
MP	ETU10M [3]	✓	40% I_R	✓	—	3	—
SB	ETU10	✓	—	—	—	3	—
MB	ETU10	✓	—	✓	—	3	—
LB	ETU10	✓	—	—	—	3	—
TA	ETU10	✓	—	—	—	4	50 / 100 %
NA	ETU10	✓	—	✓	—	4	50 / 100 %
LA	ETU10	✓	—	—	—	4	50 / 100 %
TB	ETU10	✓	—	—	—	4	—
NB	ETU10	✓	—	✓	—	4	—
SL	ETU12	✓	—	—	①	3	—
ML	ETU12	✓	—	✓	①	3	—
SF	ETU12	✓	—	—	②	3	—
MF	ETU12	✓	—	✓	②	3	—
TN	ETU12	✓	—	—	②	4	50 / 100 %
NN	ETU12	✓	—	✓	②	4	50 / 100 %
SE	ETU20	✓	—	—	—	3	—
ME	ETU20	✓	—	✓	—	3	—

LE	ETU20	✓	—	—	—	3	—
TE	ETU20	✓	—	—	—	4	—
NE	ETU20	✓	—	✓	—	4	—
TF	ETU20	✓	—	—	—	4	50 / 100 %
NF	ETU20	✓	—	✓	—	4	50 / 100 %
LF	ETU20	✓	—	—	—	4	50 / 100 %
SG	ETU22	✓	—	—	①	3	—
MG	ETU22	✓	—	✓	①	3	—
SH	ETU22	✓	—	—	②	3	—
MH	ETU22	✓	—	✓	②	3	—
TH	ETU22	✓	—	—	②	4	50 / 100 %
NH	ETU22	✓	—	✓	②	4	50 / 100 %
SS	ETU30M 3)	✓	40% I_R	—	—	3	—
MS	ETU30M 3)	✓	40% I_R	✓	—	3	—
LS	ETU30M 3)	✓	40% I_R	—	—	3	—
UP	LCD-ETU40M 3)	✓	5 to 50% I_R	✓	—	3	—
UH	LCD-ETU40	✓	—	✓	—	3	—
UJ	LCD-ETU40	✓	—	✓	—	4	50 … 100%, OFF
UL	LCD-ETU42	✓	—	✓	①	3	—
UM	LCD-ETU42	✓	—	✓	① / ③	3	—
UN	LCD-ETU42	✓	—	✓	②	4	50 … 100%, OFF

1) Size dependent
2) TM to I_n = 630 A
3) Motor protection to I_n = 500 A
4) With COM20/COM21

Further information on ①, ② and ③

Further information for ①, ② and ③ can be found in chapter:

Ground-fault protection (Page 49)

Table 4- 5 Image references for ①, ② and ③

No.	Meaning	Information in image
①	Vectorial summation current formation (3-conductor system)	• "Molded case circuit breaker in balanced systems"
②	Vectorial summation current formation (4-conductor system)	• "3-pole molded case circuit breaker, current transformer in neutral conductor current" • "4-pole molded case circuit breaker, current transformer installed internally"
③	Direct recording of the ground-fault current at the neutral point of the transformer	• "3-pole molded case circuit breaker, current transformer at the grounded neutral point of the transformer"

Table 4- 6 General data II

Order No. supplement	Releases	I^2t (ON/OFF)	Trip class (t_C)	Time-lag class (t_R)	Thermal-magnetic release	Magnetic release	Electronic trip unit	LCD display
DK	M	—	—	—	—	✓	—	—
DE	M	—	—	—	—	✓	—	—
EE	M	—	—	—	—	✓	—	—
DA	TM 2)	—	—	—	✓	—	—	—
DD	TM 2)	—	—	—	✓	—	—	—
DC	TM 2)	—	—	—	✓	—	—	—
EH	TM 2)	—	—	—	✓	—	—	—
EJ	TM 2)	—	—	—	✓	—	—	—
EA	TM 2)	—	—	—	✓	—	—	—
EC	TM 2)	—	—	—	✓	—	—	—
EM	TM 2)	—	—	—	✓	—	—	—
SP	ETU10M 3)	—	10	—	—	—	✓	—
MP	ETU10M 3)	—	10	—	—	—	✓	—
SB	ETU10	—	—	2.5 ... 30	—	—	✓	—
MB	ETU10	—	—	2.5 ... 30	—	—	✓	—
LB	ETU10	—	—	2.5 ... 30	—	—	✓	—
TA	ETU10	—	—	2.5 ... 30	—	—	✓	—
NA	ETU10	—	—	2.5 ... 30	—	—	✓	—
LA	ETU10	—	—	2.5 ... 30	—	—	✓	—
TB	ETU10	—	—	2.5 ... 30	—	—	✓	—
NB	ETU10	—	—	2.5 ... 30	—	—	✓	—
SL	ETU12	—	—	2.5 ... 30	—	—	✓	—
ML	ETU12	—	—	2.5 ... 30	—	—	✓	—

Order No. supplement	Releases	I^2t (ON/OFF)	Trip class (t_C)	Time-lag class (t_R)	Thermal-magnetic release	Magnetic release	Electronic trip unit	LCD display
SF	ETU12	—	—	2.5 ... 30	—	—	✓	—
MF	ETU12	—	—	2.5 ... 30	—	—	✓	—
TN	ETU12	—	—	2.5 ... 30	—	—	✓	—
NN	ETU12	—	—	2.5 ... 30	—	—	✓	—
SE	ETU20	✓	—	—	—	—	✓	—
ME	ETU20	✓	—	—	—	—	✓	—
LE	ETU20	✓	—	—	—	—	✓	—
TE	ETU20	✓	—	—	—	—	✓	—
NE	ETU20	✓	—	—	—	—	✓	—
TF	ETU20	✓	—	—	—	—	✓	—
NF	ETU20	✓	—	—	—	—	✓	—
LF	ETU20	✓	—	—	—	—	✓	—
SG	ETU22	✓	—	—	—	—	✓	—
MG	ETU22	✓	—	—	—	—	✓	—
SH	ETU22	✓	—	—	—	—	✓	—
MH	ETU22	✓	—	—	—	—	✓	—
TH	ETU22	✓	—	—	—	—	✓	—
NH	ETU22	✓	—	—	—	—	✓	—
SS	ETU30M [3]	—	10, 20, 30	—		—	✓	—
MS	ETU30M [3]	—	10, 20, 30	—	—	—	✓	—
LS	ETU30M [3]	—	10, 20, 30	—	—	—	✓	—
UP	LCD-ETU40M [3]	—	5, 10, 15, 20, 30	—	—	—	✓	✓
UH	LCD-ETU40	✓	—	2.5 ... 30	—	—	✓	✓
UJ	LCD-ETU40	✓	—	2.5 ... 30	—	—	✓	✓
UL	LCD-ETU42	✓	—	2.5 ... 30	—	—	✓	✓
UM	LCD-ETU42	✓	—	2.5 ... 30	—	—	✓	✓
UN	LCD-ETU42	✓	—	2.5 ... 30	—	—	✓	✓

2) TM to I_n = 630 A

3) Motor protection to I_n = 500 A

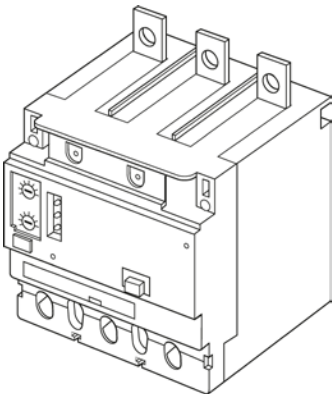
4.1.5 Differential current protection with RCD module

The molded case circuit breaker with differential current protection is very often used to implement a double function:

- Protection of systems against overload and short-circuit currents.
- Protection of cables and electrical equipment against damage from ground faults.

The SENTRON VL RCD modules are offered as accessories for the VL160X, VL160, VL250 and VL400 molded case circuit breakers with thermal-magnetic overcurrent releases. This combination is called molded case circuit breaker with differential current protection of type A. Type A means tripping is guaranteed both in the case of faults in sinusoidal alternating currents and in the case of faults in pulsating direct currents. These units have an adjustable trip time delay Δt. The values for the rated fault current $I_{\Delta n}$ can also be adjusted.

In a fault-free system, the sum of the currents in the summation current transformer of the RCD module is zero. A ground fault current occurring in the circuit as the result of an insulation fault produces a differential current that induces a voltage in the secondary winding of the current transformer. The evaluation electronics monitors the induced voltage and transmit a trip command to the RCD trip unit if the trip criterion is met. The molded case circuit breaker with differential current protection combination is designed to open he molded case circuit breaker contacts if the differential current reaches a specific value.



Note

The RCD module can only be combined with 3VL molded case circuit breakers with thermal-magnetic overcurrent release. It cannot be combined with a molded case circuit breaker with ETU.

Standard features

- Mechanical trip display:

The Reset button on the RCD pops out when the RCD module trips the molded case circuit breaker.

- Reset button:

This must be manually reset after the molded case circuit breaker has been tripped by the RCD module. The molded case circuit breaker can only be reset and switched on again after the RCD module has been reset.

- Cover:

Modifiable settings for Δt and $I_{\Delta n}$.

A sealable transparent cover is available for preventing modification.

- The RCD module has three LEDs:
  - Green LED flashes: "Active" -> indicates that the RCD module is functional
  - Yellow LED flashes: The fault current is between 25% < I_{Δ}< 50% of the set $I_{\Delta n}$ value
  - Red LED flashes: The fault current I_{Δ} is greater than 50% of the set $I_{\Delta n}$ value

- Test button:

The functionality of the RCD module is checked with the test button. If the test button is pressed, differential current is simulated on a test winding attached to the summation current transformer. When functioning correctly, the RCD module must trip the molded case circuit breaker.

The test button must be pressed for at least the set delay time Δt.

- A line disconnector:
  - makes it possible to disconnect the evaluation electronics of the RCD module from the circuit without removing the primary cable or the busbars (e.g. before insulation tests).
  - Limitation of the maximum RMS withstand voltage to an RMS value of 3500 V AC for this feature, i.e. the RMS value of the voltage for max. 60 seconds for one insulation test must not exceed 3500 V.
- Protection function from 50 V AC between phase and neutral conductor
- The RCD module has a surge current withstand capability of I_{peak} = 2000 A. The standard surge wave is defined as 8 / 20-µs waveform.
- The RCD module does not trip in the case of making currents.

$\Delta t \geq 0$ I_{rms} = 3000 A

$\Delta t \geq$ 60ms $I_{peak} = 20 \times I_n \times \sqrt{2}$

- The molded case circuit breaker with differential current protection combination can be supplied from both sides.
- Matching molded case circuit breaker standard accessories – covers, phase barriers, wire connectors.

Special features of the VL160X

- The molded case circuit breaker is tripped via an electromagnetic trip relay installed in the breaker accessories compartment to the left of the toggle lever. The trip unit in the molded case circuit breaker is connected to the RCD module and receives a trip command when the preset fault currents are reached.
- Internal accessories can still be installed to the right of the toggle lever.
- The Reset button functions in exactly the same way as on the RCD modules VL160 to 400 and is accessible via the molded case circuit breaker accessories cover supplied with this module.

Note

Motorized operating mechanism with stored energy mechanisms and rotary operating mechanisms cannot be installed with this product.

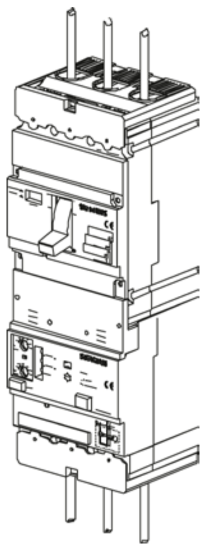
Special features of VL160, VL250, VL400

- The molded case circuit breaker is tripped by means of a direct-acting tappet from the RCD module to the system protection switch. The electromagnetic trip unit is integrated in the RCD module.
- The Reset button pops out beyond the surface of the RCD module cover to indicate that the RCD module has tripped the system protection switch. This unit prevents the system protection switch contacts from closing before the Reset button of the RCD module has been manually reset.
- This has the same design as the system protection switch accessories including the accessories for external operating mechanisms as well as for fixed-mounted assembly, plug-in assembly and withdrawable assembly.
- An auxiliary switch (changeover contact) is available. The contacts change status when the RCD module trips the system protection switch.
- Remote tripping is supported. The customer connects a switch (NO contact) to terminals X13.1 and X13.3 via a twisted-pair cable. The switching contact must have a minimum switching capacity of 5 V/1 mA (e.g. SIEMENS 3SB3). If the NO contact is actuated, the RCD module trips. The connection terminals X13.1 and X13.3 are galvanically isolated from the system by means of a transformer (functional extra low voltage, FELV). The maximum trip time of the molded case circuit breaker with differential current protection is 50 ms regardless of the set trip time delay Δt. In special cases, such as routing of the cable outside, ensure by means of suitable cable routing or protection measures that the amplitude of overvoltages (e.g. overvoltages due to thunderstorms) between the conductor and ground is limited to 2.5 kV.

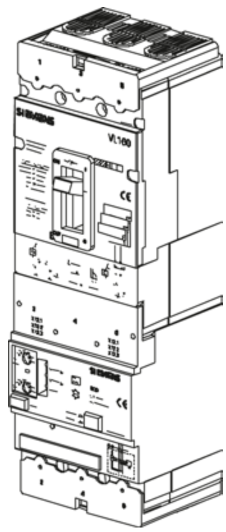
Special requirements

- Every RCD module requires a separate cable for remote tripping. It is not possible to use one cable and connect two or more RCD modules in parallel. It is possible to use two or more switches in parallel for remote tripping of an RCD module.
- Use an unshielded or 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).
- With a shielded cable, the shield must not be applied to the PE conductor of the system.
- A separate conductor must connect terminal X13.2 with the ground busbar (E or PE). This connection is recommended for the prevention of electrostatic charge on the remote tripping cable. This applies in particular when long cables (> 10 m) are used. If this is not the case, the remote tripping cable is isolated.

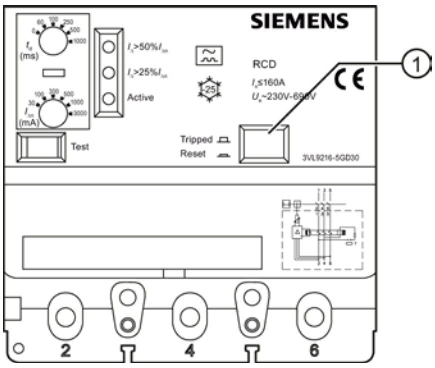
Design of the RCD module



VL160X with RCD module I



VL160 with RCD module



① Reset

Figure 4-2 RCD module for VL160

4.1.6 Single-pole operation with RCD module

Connection of the RCD module for single-pole operation

All 3-pole or 4-pole molded case circuit breakers with RCD module can be operated with 2 poles (L to N), since the power supply of the RCD module is supplied from all three external conductors, and on 4-pole devices additionally from the N conductor.

Apart from the test current circuit, the RCD module is unrestricted in functionality if at least 2 conductors are connected.

When connecting the RCD module, you only have to ensure that the test current circuit connected to current path 1-2 and 3-4 (marking) is functioning or is supplied with power.

The following connections are possible in 2-pole operation:

2-pole operation with a 3-pole molded case circuit breaker

- Connection of the network to current path 1-2 and 3-4 (any incoming supply side)

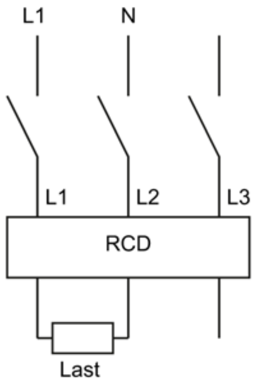


Figure 4-3 3-pole RCD

Note

Single-pole load

Series connection of the current paths is not necessary in the case of single-pole load.

2-pole operation with 4-pole molded case circuit breakers

- Connection of the network to current path 1-2 and 3-4 (any incoming supply side) or
- connection of the network to current path 1-2 and N; however, a jumper is required here from N to current path 3-4 (on the input or output side)

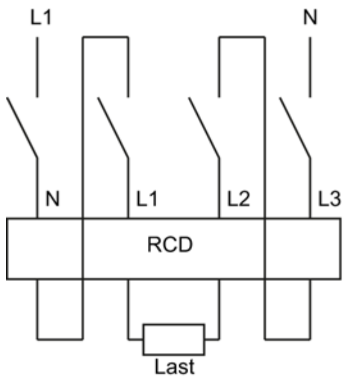


Figure 4-4 4-pole RCD

4.1.7 Ground-fault protection

Ground fault trip "G" (ground fault overcurrent protection) captures fault currents flowing to ground that can cause fires in the plant.

Several molded case circuit breakers connected in series can be assigned time-graded discrimination by means of the adjustable delay time. The delays can be reduced to 100 ms by using a ZSI system.

Measurement method 1: Vectorial summation current formation

Ground fault detection in balanced systems

The three phase currents are evaluated using vectorial summation current formation.

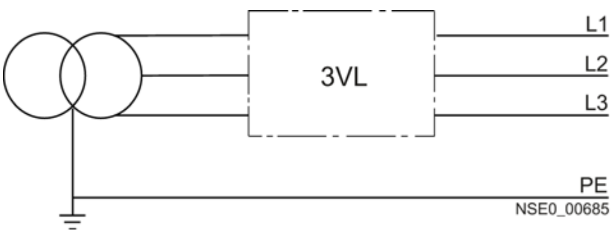


Figure 4-5 molded case circuit breaker in balanced system

Ground fault detection in unbalanced systems

The neutral conductor current is measured directly. Only the ground-fault current is measured for the 3-pole circuit breakers. In the case of the 4-pole circuit breakers, the neutral conductor overload protection is also measured.

The overcurrent release calculates the ground-fault current using the vectorial summation of the three phase currents and the neutral conductor current.

The 4th current transformer of the neutral conductor is installed internally in the case of 4-pole molded case circuit breakers.

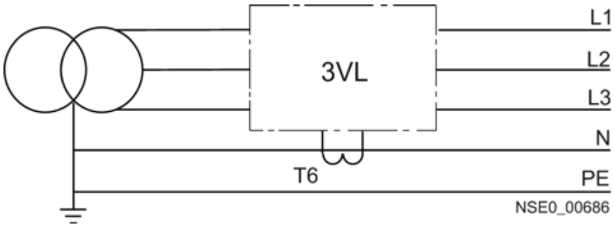


Figure 4-6 3-pole molded case circuit breaker, current transformer in neutral conductor current

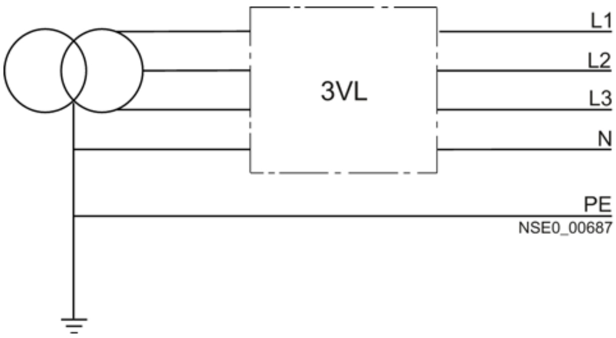


Figure 4-7 4-pole molded case circuit breaker, current transformer installed internally

Measurement method 2: Direct detection of the ground-fault current via a current transformer in the grounded neutral point of the transformer

The current transformer is installed direct in the grounded neutral point of the transformer.

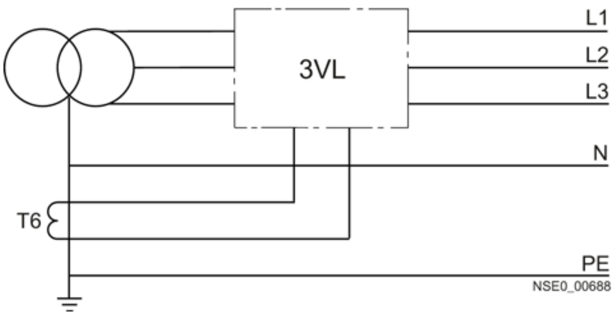


Figure 4-8 3-pole molded case circuit breaker, current transformer in the grounded neutral point of the transformer

4.2 Internal accessories

4.2.1 Possible complements for the insulated accessory compartments

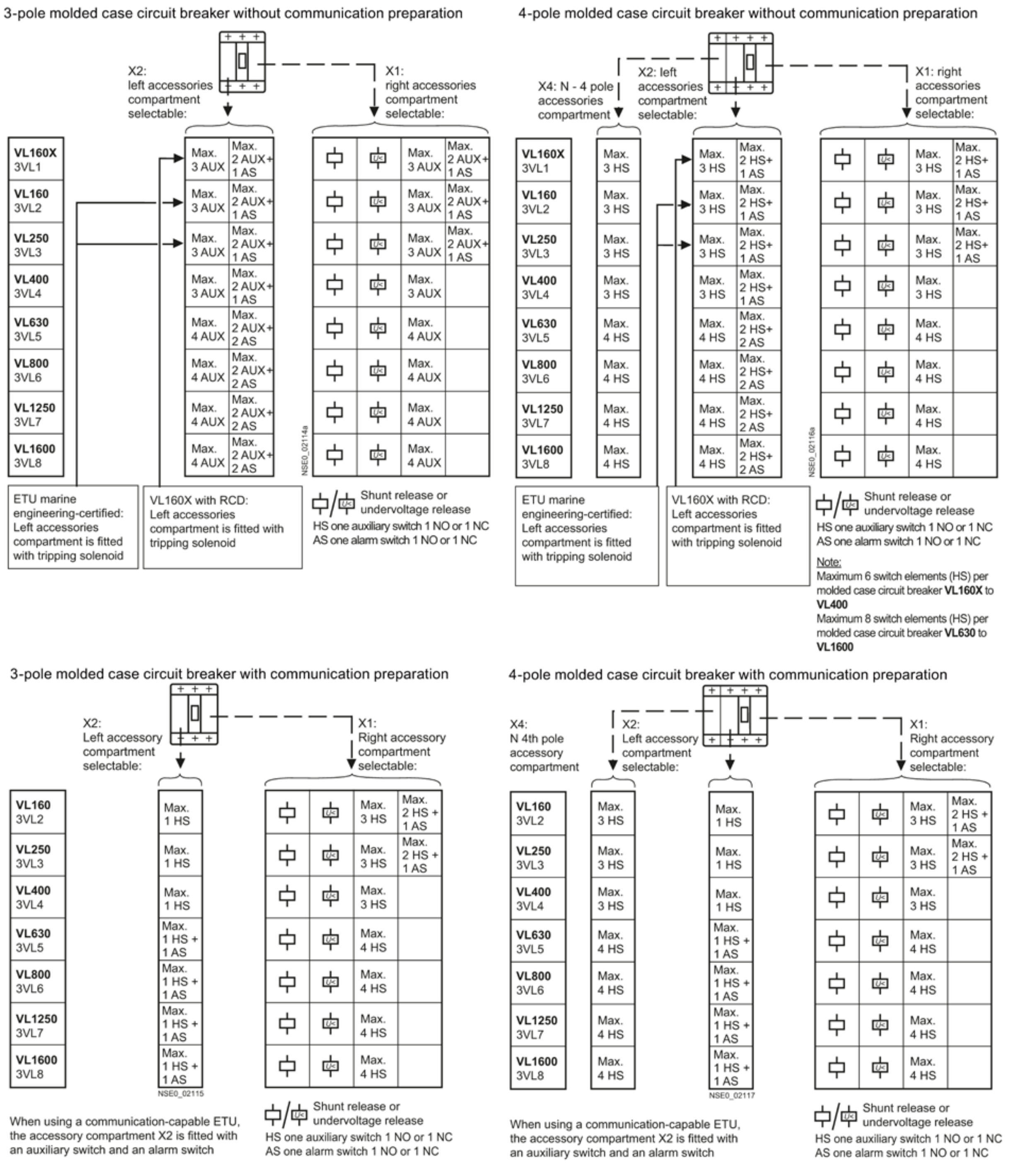


Figure 4-9 Possible complements for the insulated accessory compartments

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Note

ETU with communication 3-pole (3VL_7__-_M*) or 4-pole (3VL_7__-_N*)

If a communication-capable ETU is used, the left-hand accessory compartment X2 contains an auxiliary switch and an alarm switch.

Note

Max. no. of contact blocks

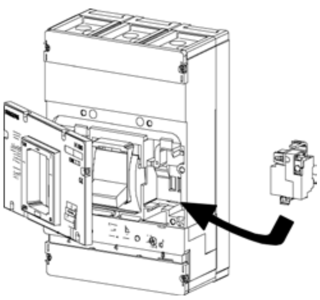
Maximum 6 contact blocks (HS) per molded case circuit breaker VL160X to VL400

Maximum 8 contact blocks (HS) per molded case circuit breaker VL630 to VL1600

4.2.2 Undervoltage release

Molded case circuit breaker with undervoltage release

If there is no voltage present, closing of the molded case circuit breaker is not possible. If voltage is not applied to the releases, operation of the circuit breaker will result in no-load switching.



Undervoltage release

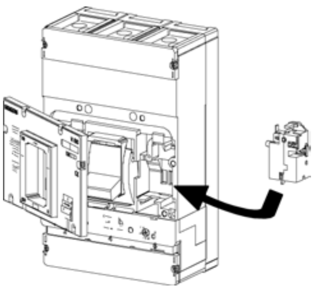
The undervoltage release trips the molded case circuit breaker when the voltage fails. Tripping can occur within a voltage range of 0.7 to 0.35 x U_S. Tripping occurs under 0.35 x U_S. Re-closure of the molded case circuit breaker contacts is only possible once the voltage has reached a value of 0.85 to 1.1 x U_S. Undervoltage releases can be installed for electronic locking.

Undervoltage releases are installed in the right accessory compartment of the 3VL molded case circuit breakers.

4.2.3 Shunt release

Molded case circuit breaker with shunt release

The molded case circuit breaker with shunt release is used for remote protection. The shunt release is used for remote tripping of the molded case circuit breaker. The molded case circuit breaker is tripped by applying the operating voltage at the shunt release.



Shunt release

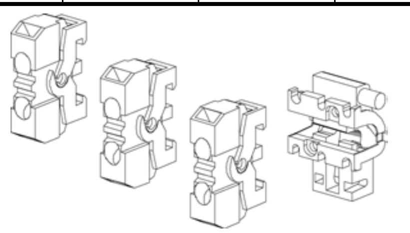
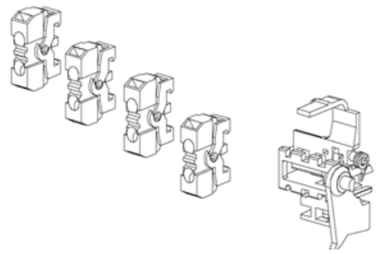
It is designed for short-time operation and is therefore equipped with an interrupt contact for self-protection. Shunt releases are installed in the right accessory compartment of the 3VL molded case circuit breakers.

4.2.4 Auxiliary switches and alarm switches

Auxiliary and alarm switches are used to indicate the switching status of the molded case circuit breaker

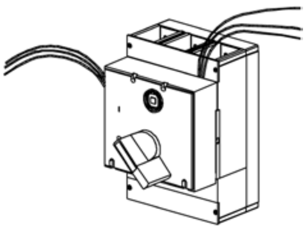
Auxiliary switches show the position of the main contacts ("ON" or "OFF").

Alarm switches transmit a signal when the molded case circuit breaker trips due to a short-circuit or overcurrent, or when the shunt release, undervoltage release, test button, or RCD module trips.

Family 1				Family 2			
VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
							

Leading auxiliary switches when switching ON and OFF

The leading auxiliary switches (changeover switches) are available as accessories for front-operated rotary operating mechanisms and door-coupling rotary operating mechanisms.



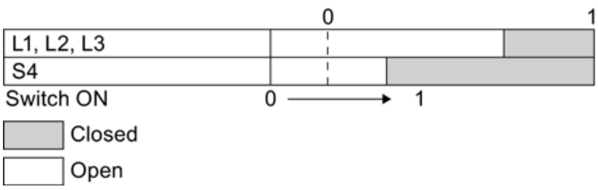
The following applications are possible:

Leading auxiliary switch for switching from "ON" to "OFF"

Leading auxiliary switch for switching from "OFF" to "ON"

Each version, leading auxiliary switch for switching on and off, can be equipped with one or two changeover switches. The connecting cables of the auxiliary switches are 1.5 m long.

Leading auxiliary switch when switching from "OFF" to "ON" (leading NO contact)

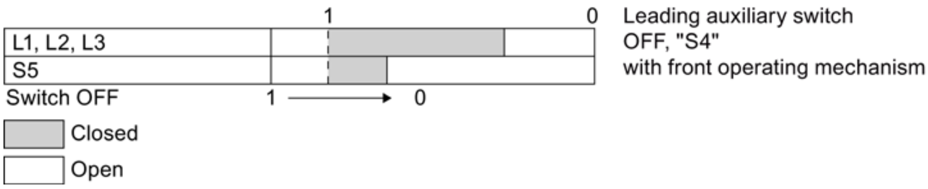


Leading auxiliary switch
ON, "S4"
with front operating mechanism

Application example:

If the molded case circuit breaker is equipped with an undervoltage release, and the leading auxiliary switch is installed in the rotary operating mechanism, the leading NO contacts make it possible to supply the undervoltage release with power before the main contacts can be closed.

Leading auxiliary switch for switching off (leading NC contact)



Application example:

In applications with thyristors, it is necessary to reset the power electronics of the converter before the main circuit is switched off.

Molded case circuit breakers with leading auxiliary switches create a leading signal that enables selective deceleration of the thyristor.

Application planning

5

5.1 Use with frequency converters

Combination of frequency converter and 3VL molded case circuit breaker

3VL molded case circuit breakers can be used as protection devices on the primary side in systems in which frequency converters, variable-speed drives, and electronic motor control devices are used. The thermal-magnetic and electronic trip units of the 3VL molded case circuit breakers can be used in these applications. On account of RMS measurement, the SENTRON VL trip units are not influenced by harmonics.

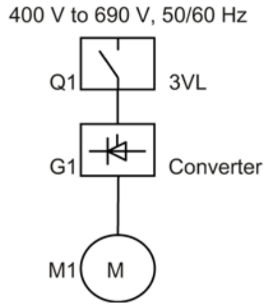


Figure 5-1 Frequency converters

Note

Alternative circuit breakers

SIRIUS 3RV circuit breakers can also be used for applications up to approximately 45 kW .

SIRIUS soft starters and 3VL molded case circuit breakers

For more detailed information, please refer to the soft starter catalogs and the selection guides.

Visit our site on the Internet at:

Soft starter (http://www.siemens.de/sanftstarter)

Frequency converters / variable-speed drives and 3VL molded case circuit breakers

Please refer to the relevant catalogs for information on the new SINAMICS series, MICROMASTER 4, and SIMOVERT MASTERDRIVES.

5.2 Use of capacitor banks

Capacitor banks are used, for example, for reactive power compensation. In reactive power compensation, also called power factor correction, the undesired reactive power of loads in AC systems is reduced. Reactive power compensation is usually performed by compensating inductive reactive power with capacitive load.

A combination of fixed and central compensations are used depending on the design of the low-voltage system and the loads involved.

Molded case circuit breaker for protecting and switching capacitor banks

According to the relevant standards DIN VDE 0560 Part 41 / EN 60831-1 / IEC 70, capacitors must operate under normal operating conditions with the current's RMS value being up to 1.3 times the rated current of the capacitor. In addition, a further tolerance of up to 15% of the real value of the power must be taken into consideration.

The maximum current with which the selected molded case circuit breaker can be constantly loaded, and which it must also be able to switch, is calculated as follows:

$I_{N\,max} = I_N \times 1.5$ (RMS value, RMS current)

Important values for selecting the molded case circuit breaker

More detailed information in the technical data: Capacitor banks (Page 152)

Abbr.	Designation
Q_n	Capacitor bank rated power in kVA
U_N	Rated voltage of the capacitor
I_N	Rated current of the capacitor bank
$I_{N\,max}$	Maximum expected rated current
I_i	Value for setting the instantaneous short-circuit release
I_R	Value for setting the inverse-time delayed overload release

The following applies:

$I_N = Q_N / (\sqrt{3} \times U_N)$

$I_R = I_{Nmax} = I_N \times 1.5$

$I_i > 9 \times I_R$ (minimum)

5.3 Transformer protection on the primary side

The molded case circuit breaker as transformer protection on the primary side

When switching on low-voltage AC transformers, the extremely high inrush current peaks place special demands on the trip unit or on the making capacity of the molded case circuit breakers if these are also used to switch the transformer.

For most applications, an inrush current of 20 to 30 times the rated operating current is expected in practice and must be taken into account when selecting the molded case circuit breakers.

The maximum short-circuit current I_k of the 3VL molded case circuit breakers is 11 x I_n (rated current). A molded case circuit breaker in the lower setting range must therefore be used for transformer protection on the primary side.

Example: A transformer with 500 A rated current; 20 times the inrush current

Selected: ETU with I_n = 1000 A; setting range 0.4 - 1 x I_n = 400 A to 1000 A

50% of I_n = 500 A; I_i = 11 x I_n = 1000 A x 11 = 11000 A = 22 x current setting

---

Note

Disconnection of molded case circuit breaker

It is imperative to ensure that the minimum short-circuit current I_{kmin} in accordance with VDE 0100 can be disconnected using a protection facility (e.g. molded case circuit breaker).

The 3VL molded case circuit breaker can be disconnected using the short-time-delayed short-circuit release (S), e.g. a 3VL with an ETU20, where it is possible to set the delay time to up to 500 ms depending on the duration of the inrush current.

The short delay "bridges" the inrush current peak and the short-circuit protection can then respond at low current values after a delay.

CAUTION

Molded case circuit breaker with phase failure protection

Molded case circuit breakers with phase failure protection must not be used. Their trip units have protection against unbalanced network load which cannot be deactivated and can lead to unintentional trips.

5.4 Use in DC systems

The 3VL molded case circuit breakers 160X to VL630 with thermal overload and magnetic short-circuit trip units (TMTU) are suitable for use in DC systems.

The 3VL 160 to VL1600 molded case circuit breakers with electronic trip units (ETUs) are **not** suitable for switching DC.

Selection criteria for molded case circuit breakers

The following are the most important criteria for selecting the optimal molded case circuit breaker for protecting a DC system:

- The rated current determines the size of the molded case circuit breaker.
- The rated voltage determines the number of series-connected poles required for breaking - 3 or 4 poles.
- The maximum short-circuit current at the connection point determines the breaking capacity.
- The type of supply determines the circuit design.

Ampacity of current path

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

Switching DC currents

In AC circuits, arc quenching is facilitated because the current flows through zero. These preconditions do not apply for DC.

For this reason, a high arc voltage must be developed to interrupt the direct current.

Therefore, the breaking capacity depends on the arc quenching method and the line voltage. Several switching contacts can be connected in series in order to achieve a higher arc voltage.

Furthermore, the effects to be expected in the event of a ground fault or double ground fault must also be considered.

Setting of the trip values

- Thermal overload release ("L" release):

  Same settings as in 50 / 60 Hz systems.
- Instantaneous short-circuit release ("I" release):

  The threshold values of the instantaneous short-circuit release ("I" release) increase by 30 to 40%. See also Chap. 9

Example:

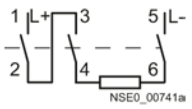
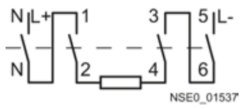
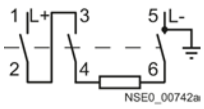
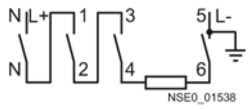
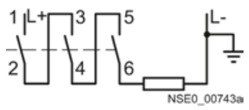
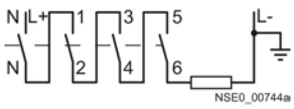
4000 A + 30% = 5200 A
There is also a tolerance of ± 20%

At the I_i = 4000 A setting, the instantaneous short-circuit release responds at approx. 5200 A ± 20%.

As the current has to flow through all of the conducting paths, the following connections are recommended in order to satisfy the thermal tripping characteristics.

Recommended connections for DC systems

Table 5- 1 Recommended connections / maximum permitted DC voltage U_e

Circuit with 3-pole molded case circuit breakers	**Circuit with 4-pole molded case circuit breakers** 1)	
 ≤ 250 V DC Switching capacity N	 ≤ 500 V DC Switching capacity H	**2-pole switching (ungrounded system)** If there is no possibility of a ground fault, or if every ground fault is rectified immediately (ground-fault monitoring), then the maximum permitted DC voltage is 600 V for both circuits. On an ungrounded system, all poles must be switched off.
 ≤ 500 V DC Switching capacity H	 ≤ 600 V DC Switching capacity L	**2-pole switching (grounded system)** The grounded pole is always assigned to the individual conducting path, so that there are always 2 conducting paths in series in a circuit with 3-pole circuit breakers in the event of a ground fault and 3 conducting paths in series in a circuit with 4-pole circuit breakers in the event of a ground fault.
 ≤ 600 V DC Switching capacity L	 ≤ 600 V DC Switching capacity L	**1-pole switching (grounded system)**

1) With 4 conducting paths in series, either the 4th pole must be equipped with a 100% release, or the 4th pole (N) must be equipped with neither an overload release nor a short-circuit release.

Recommended connections for DC systems with voltages of more than 600 V DC (e.g. photovoltaic plants)

Detailed information on request.

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

5.5 Use in IT systems

Use of the 3VL molded case circuit breakers in IT systems

The 3VL molded case circuit breakers up to size VL1250 have been tested in accordance with IEC / EN 60947-2, Annex H (testing sequence for molded case circuit breakers for IT systems) up to a maximum voltage (U_i max.) of 690 V AC. The 3VL8 and 3VL7 (1250 A) cannot be used in an IT system.

The 3VL molded case circuit breakers for system protection from SIEMENS, optionally available with thermal overload and electromagnetic short-circuit releases, or electronic trip units, are suitable for use in IT systems. The molded case circuit breakers also meet the requirements of IEC 60947-2 Annex H (EN 60947-2, Annex H). The respective options are required here, and the necessary safety clearances (ventilation clearances) must be observed.

Selection criteria for molded case circuit breakers

The devices are always dimensioned and selected independently of the relevant system type. The circuit breaker is always selected in accordance with the maximum short-circuit current in the IT system. The device is selected in accordance with the relevant I_{cu} values of the 3VL molded case circuit breaker. The neutral conductor is not grounded by definition in the IT system.

The system operator ensures that no double ground fault can occur on the input or output side of the molded case circuit breaker. In this case, the switching capacity of the IT systems remains unchanged.

If this is not guaranteed, the values in accordance with the standard IEC 60947-2 Annex H apply for single-pole short-circuits.

Fault situation

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

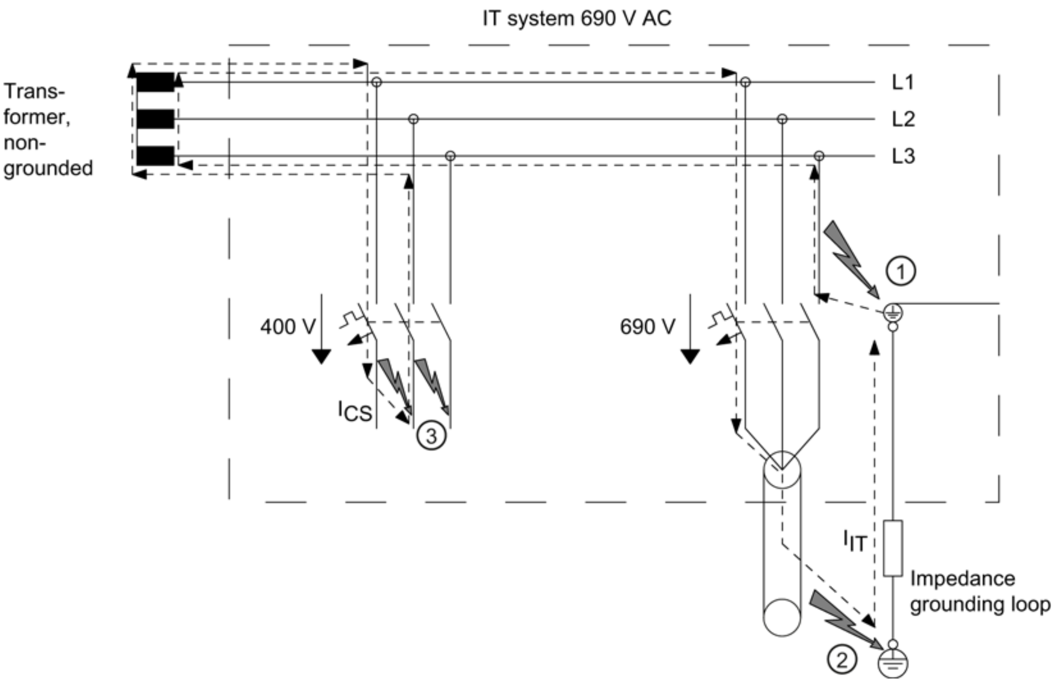


Figure 5-2 Double ground fault (ground fault and short-circuit to frame)

Explanation of the illustration

- Faults ① and ② simultaneously:
  - Double ground fault on the load and infeed side
  - Single-pole short-circuit, the full phase-to-phase voltage of 690 V is applied to main contact L1
  - Selection of the molded case circuit breaker according to their suitability as defined in IEC 60947-2, Annex H
- Fault ③
  - 2 or 3-pole short-circuit
  - Multi-pole short-circuit, a voltage of 690 V /√ 1.73 = 400 V is applied at the main contacts
  - The design of the molded case circuit breaker is in accordance with I_{cu}/I_{cs}

See also

Standards and specifications (Page 308)

5.6 Use in motor protection

The overload and short-circuit releases are designed for optimal protection and direct starting of three-phase AC squirrel-cage motors. The molded case circuit breakers for motor protection are sensitive for phase failures and have an adjustable trip class.

The ETUs operate with a microprocessor.

Note

The 3VL circuit breakers with motor protection function are suitable for use in IE2 motors. You can obtain detailed information for the use of the 3VL molded case circuit breaker with IE3 motors on request.

Operating principle of the overcurrent releases

The tripping characteristic curves of the inverse-time delayed overload releases are specially designed for overload protection of 3-phase AC motors.

With the inverse-time delayed overload release "L", the value I_R can be set to be 0.4 to 1.0 times the rated current I_n of the molded case circuit breaker. This occurs in 0.01 increments (e.g. 0.40 / 0.41 / 0.42 ... 0.99 / 1.0 x I_n), so that the molded case circuit breaker exactly matches the rated current of the motor to provide optimal protection.

The current transformers in the 3VL molded case circuit breaker not only measure the load current, they also supply power to the electronic trip unit. No external auxiliary power supply is required.

This independence from an external energy supply guarantees a high standard of safety.

Area of application

Machine tools, manufacturing systems, presses, fans, air-conditioning units and packaging machines all require motors that must be protected. This is the main area of application of the 3VL molded case circuit breakers for motor protection.

Trip class

The 3VL molded case circuit breakers offer the option of selecting from various trip units with fixed or adjustable trip classes that are suitable for differing motor applications.

ETU 10 M

This version is equipped with a thermal image, phase failure sensitivity and the fixed trip class 10.

ETU 30 M

This version is equipped with an adjustable trip class 10 to class 30 in addition to the thermal image and phase failure sensitivity.

ETU 40 M

This version enables the parameters and the trip class 5 to class 30 to be configured step by step using a menu on the LCD display that is built into the trip unit.

Trip classes

Trip class 5 is used for motors that have very simple start-up characteristics (those with a short start-up time and a small mass moment of inertia). The class 30 releases are used to protect motors that have to withstand difficult start-up characteristics (long start-up time and large mass moment of inertia). The motor must be suitable for heavy-duty starting.

The trip class must be selected so that it corresponds to the overload factor of the motor under operating conditions. You can find further information at the end of this chapter in the figure "Current-time curve before and after overload, with thermal image".

Definition of the trip class

The trip class specifies the release time for balanced 3-pole loads, starting from the cold state, with 7.2 times the set current I_r according to IEC 60947-4-1. Combinations with class 10 are normally used.

Applications that require a longer start-up time, such as fans with large blade diameters, require a higher trip class.

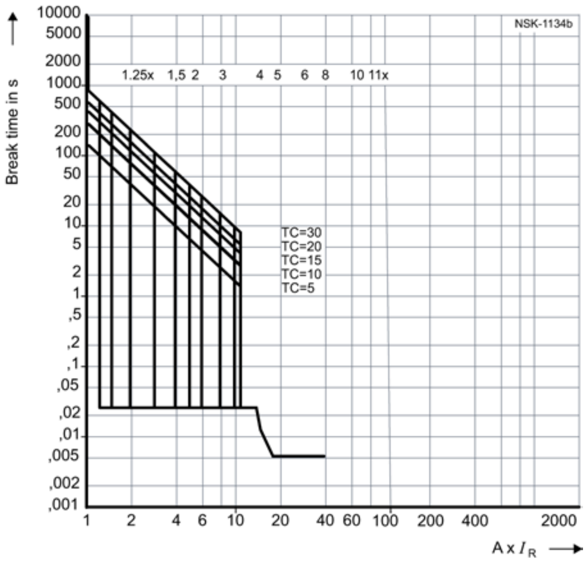


Figure 5-3 ETU with trip classes 5, 10, 15, 20, 30

Tripping characteristic curve for molded case circuit breakers with electronic trip unit.

Thermal image

All 3VL molded case circuit breakers with electronic trip unit have a "thermal image" which takes the pre-loading of the AC motor into consideration. The tripping times of the current-dependent delayed overload releases are only valid for the unloaded (cold) state.

The pre-loading of the 3-phase AC motor must be taken into consideration in order to prevent damage to the motor, e.g. after being frequently switched on without sufficient cooling time.

Siemens offers the 3VL molded case circuit breakers with fixed thermal image to provide maximum protection for the motor.

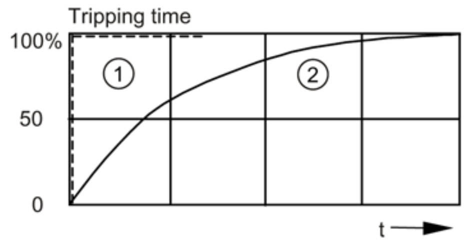
Functional principle of the thermal image

During operation, a thermal model of the motor is simulated in the ETU. This reduces the response time of the molded case circuit breaker with thermal image such that further overloads cannot damage the motor windings. The motor is switched off within a time limit that is specified by the pre-loading.

An overload may also be the switch-on current of the motor.

After an overcurrent tripping, the tripping times are reduced in accordance with the tripping characteristic curves.

A cooling time defined by the size of the motor is required before the motor can be switched on again. This prevents the motor from being excessively thermally loaded by a current immediately after an overload release occurs.



① Without "thermal image"

② With "thermal image"

Figure 5-4 Response time of the trip unit after overload release

Phase failure sensitivity

The "phase failure sensitivity" function is also integrated into the 3VL molded case circuit breaker for motor protection. This ensures that the motor is reliably protected against overheating if a phase interruption or a large fluctuation occurs.

The specified operational current I_R is automatically reduced to 80% of the set value if the RMS values of the operational currents in the three phases differ by 5 to 50% (depending on release type).

Deviations of more than 50% mean the value of the current in the least loaded phase drops to a level below 50% of the maximum loaded phase.

5.7 Use in unusual environments:

If the 3VL molded case circuit breakers are to be used outside closed control cabinets or in difficult operating conditions, the following information must be taken into account at the planning stage:

Reduction factors under unusual operating conditions

- Altitude in excess of 2000 meters
- Temperature above 50 °C
- Frequencies outside the 50 / 60 Hz range
- Humidity
- etc.

You can find further details in DIN ISO 2533 "Standard Atmosphere".

Use at altitudes above 2,000 meters

The lower air density at altitudes above 2,000 meters affects the key electrical data of molded case circuit breakers. The table in the Technical data (Page 142) shows the derating factors that have to be taken into account when using the molded case circuit breakers at altitudes above 2,000 m.

Use at different ambient temperatures

A reduction (derating) of the rated operational current of the 3VL molded case circuit breakers is necessary if the ambient temperature around the molded case circuit breaker exceeds 50 °C. The reference temperature is 40 °C for molded case circuit breakers with RCD modules or for plug-in / withdrawable versions.

The permissible load for various ambient temperatures with reference to the rated operational current of the molded case circuit breaker are shown in the technical data.

Furthermore, the following points must be taken into consideration, because each one of these factors can influence the rated operational current and permissible load.

- Type of molded case circuit breaker (fixed-mounted, plug-in or withdrawable version)
- Type of main connection (vertical/horizontal busbar, cable)
- Ambient temperature around the molded case circuit breaker
- Altitude derating factors
- Temperature derating factors based on different trip units and connections
- Increased degree of protection

Thermal-magnetic overcurrent releases

Thermal-magnetic overcurrent releases are calibrated to 50 °C. As a result, the tripping times of the thermal overcurrent releases increase for a constant current at low temperatures.

To correct the tripping times, the thermal overcurrent release settings must be changed by the factor from the table "Derating factors for thermal-magnetic overcurrent releases" in the technical data (lower settings).

Use in systems with other frequencies

If low-voltage switching devices designed for 50 / 60 Hz are to be used at other line frequencies, the following points must be taken into consideration:

- Thermal effects on the system components
- Switching capacity
- Service life of the contact system
- Tripping characteristics of the overcurrent releases
- Behavior of the accessories

Thermal rating of the system components and conductors depending on the line frequency

Molded case circuit breakers designed for alternating current of 50 / 60 Hz can be used at lower frequencies for at least the same rated currents. However,the permissible operating current must be reduced at frequencies higher than 100 Hz to ensure the specified temperature rise limits are not exceeded.

Influence of temperature and humidity on overcurrent releases

The relevant reduction in the rated operating current (derating) of the 3VL molded case circuit breakers is also necessary if the operating temperature of 50 °C or 70 °C is exceeded at a relative humidity level (non-condensing) of 95%.

Thermal-magnetic TM releases

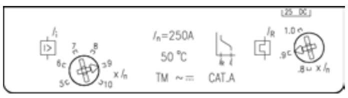


Figure 5-5 Thermal-magnetic TM
0 °C to +70 °C, ☂ 95%

The SENTRON VL thermal-magnetic releases are designed for use in ambient temperatures up to 70 °C and a relative humidity level (non-condensing) up to 95%. The appropriate correction factors must be applied for ambient temperatures above 50 °C. You can find more information in Chapter 11.4 "Reduction factors"

Electronic trip unit ETU

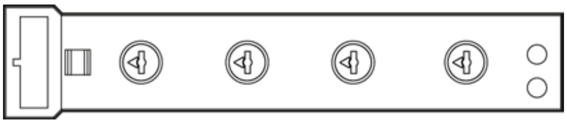


Figure 5-6 Standard ETU
-25 °C to +70 °C, ☂ 95%

The 3VL electronic trip units are designed for use in ambient temperatures up to 70 °C and a relative humidity (non-condensing) up to 95%.

Electronic trip unit LCD ETU

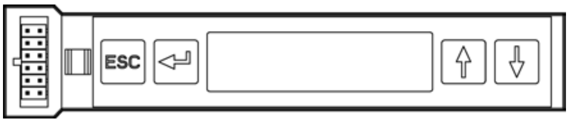


Figure 5-7 LCD-ETU
-25 °C to +70 °C, ☂ 95%

The high-quality electronic trip units LCD ETUs are designed for use in ambient temperatures up to 70 °C and a relative humidity (non-condensing) up to 95%. The appropriate correction factors must be applied for ambient temperatures above 50 °C.

5.8 Use in series connection

In the case of molded case circuit breakers connected in series, the overload and short-circuit protection is described as "selective" when, from the point of view of the direction of energy flow, only the circuit breaker immediately upstream of the fault trips.

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 overloads.

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 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 selectivity limit.

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 are below the selectivity limit listed in the respective table for the selected combination, selectivity is guaranteed for all possible short-circuits at the installation point.

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

Time selectivity

Selectivity can be achieved by time selectivity up to the threshold values of the instantaneous short-circuit release. 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 faulted system component from the supply.

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

Zone-selective interlocking - ZSI

Zone-selective interlocking (ZSI) has been developed by SIEMENS for the 3VL molded case circuit breakers to prevent long, undesired release 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.

When selecting, ensure that the molded case circuit breaker can handle the initial balanced short-circuit current I_K at the installation point.

The following are required for the ZSI function:

- A COM20 or COM21 communication module
- A communication-capable ETU

You can find further details in the following manuals:

- "SENTRON WL and SENTRON VL circuit breakers with communication capability - PROFIBUS" (Order No. A5E01051347)
- "SENTRON WL and SENTRON VL circuit breakers with communication capability - Modbus" (Order No. A5E02126886)

5.9 Use in transfer control system

The 3KC ATC5300 transfer control device (automatic transfer control device) together with two 3VL molded case circuit breakers with motorized operating mechanism (MO), forms the transfer control system that can be used to switch automatically or manually between two low-voltage power distribution systems.

Overview of the 3KC ATC5300 transfer control device

The ATC5300 controls the transfer between two power supplies fully automatically, while taking account of set limit values and delay times. It detects fluctuations occurring in the main power supply quickly and switches to the standby power supply. The control device only switches to the standby power supply after it has ensured that the standby supply is providing the required quality. The devices switch back to the main power supply, taking into consideration the set parameters, once the required quality has been restored. If the standby power supply and/or the main power supply is fed by a generator, the control device also offers a wide range of settings, such as a generator lead time, generator delay time, and generator start test at specified times.

The ATC5300 can be used for the following applications:

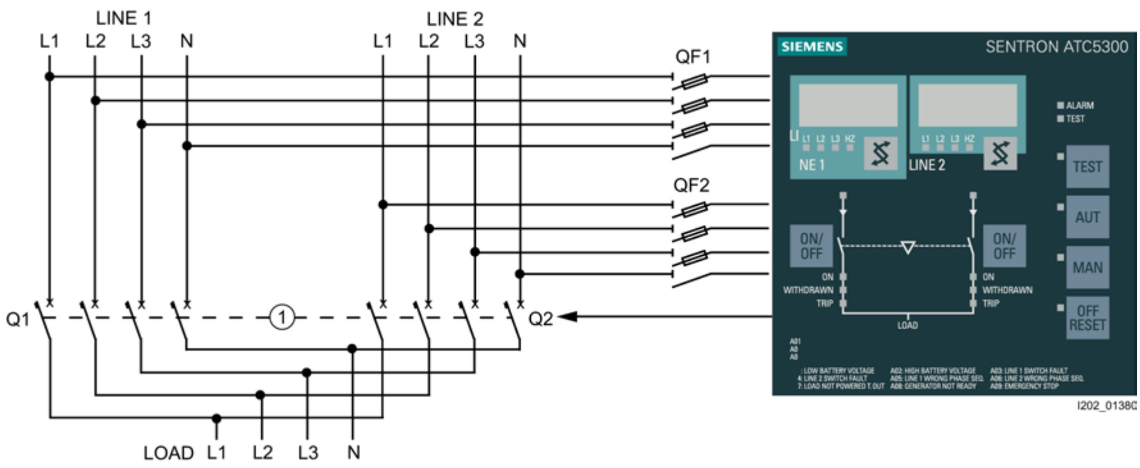
- Supply of UPS (uninterruptible power supply) systems
- Emergency supply of public buildings, hotels and airports
- Supply of data centers and communication systems
- Supply of industrial processes requiring a high level of operational continuity.

Note

You can find more detailed information on the 3KC ATC5300 transfer control device in the Industry Mall (www.siemens.com/industrymall).

Structure of the transfer control system

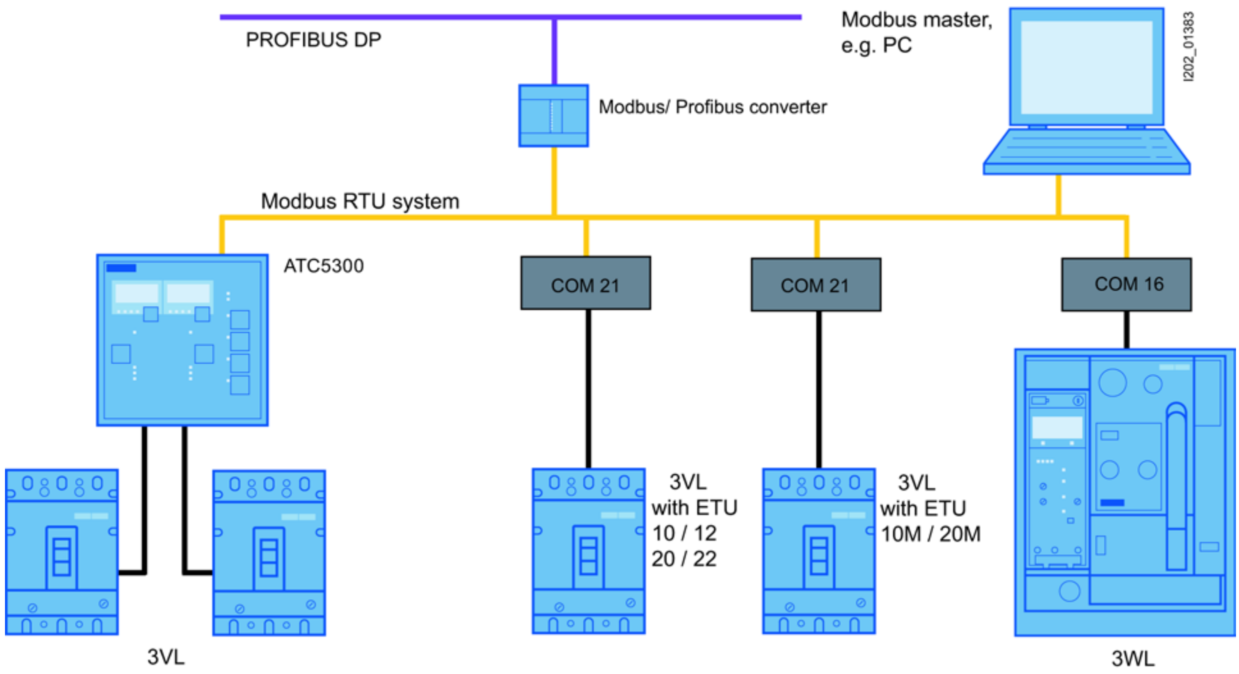
- Infeeds line 1 (main system) and line 2 (standby system) are connected to the ATC5300.
- In case of system disturbances, the ATC5300 activates the 3VL molded case circuit breakers Q1 and Q2 accordingly
- The 3VL molded case circuit breakers must be equipped with the following accessories:
  – One motorized operating mechanism per molded case circuit breaker
  – One alarm switch per molded case circuit breaker
  – Two auxiliary switches 1NO/1NC per molded case circuit breaker



① Electrical interlock

3KC ATC5300 transfer control device in a Modbus RTU network

The ATC5300 supports the Modbus communication protocol (RTU or ASCII) via the RS485 interface.

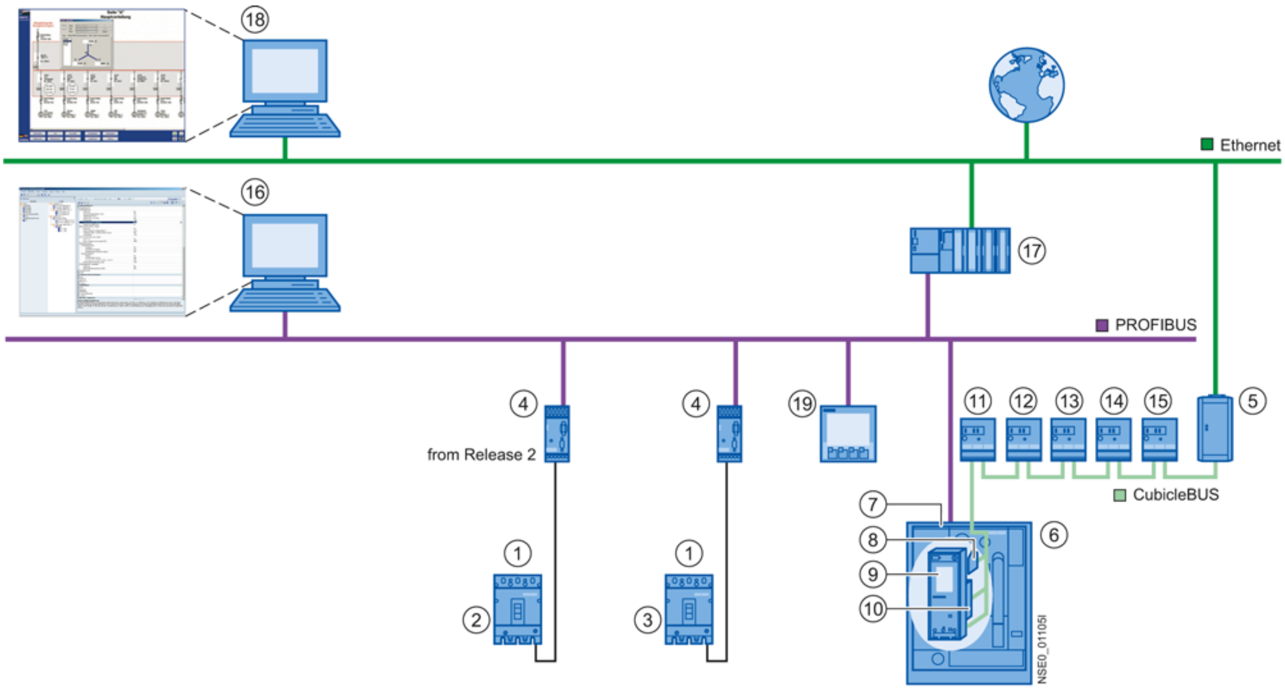


Easy system integration through integrated Modbus interface, for integrating into a power management system, for example

5.10 Use in communication environment

The 3VL molded case circuit breakers with communication-capable ETUs can be integrated into PROFIBUS or MODBUS RTU networks via the COM20 / COM21 communication modules.

Network topology



1. 3VL molded case circuit breakers
2. Electronic Trip Unit LCD
3. Electronic Trip Unit
4. COM20 Release 2 PROFIBUS module[1] Including ZSS
5. BDA *Plus* with Ethernet interface
6. 3WL air circuit breakers
7. COM15 PROFIBUS module[2]
8. Breaker status sensor (BSS)
9. Electronic Trip Unit
10. Measurement function *Plus*
11. Zone Selective Interlocking modules
12. Digital output module with relay contacts
13. Digital output module with relay contacts, configurable
14. Analog output modules
15. Digital input module
16. powerconfig as of V2.3
17. PLC, e. g. SIMATIC S7
18. e. g. Powermanager or SIMATIC powerrate
19. 7KM PAC measuring devices

[1] For a MODBUS-RTU connection the COM21 module is required.
[2] For a MODBUS-RTU connection the COM16 module is required.

Network topology

> **Note**
>
> When using communication-capable ETUs, the left-hand accessory compartment X2 contains an auxiliary switch and an alarm switch.

More information

- System manual - SENTRON 3WL / 3VL circuit breakers with communication capability - Modbus
- System manual - SENTRON 3WL / 3VL circuit breakers with communication capability - PROFIBUS

Installing/mounting 6

6.1 Installation methods

Installation overview

The 3VL molded case circuit breakers are available in **fixed-mounted, plug-in** or **withdrawable** versions, **3-pole** or **4-pole**.

Table 6- 1 Overview of installation methods

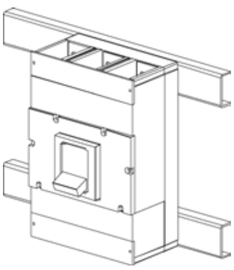
Molded case circuit breaker type	Fixed	Plug-in	Withdrawable part
VL160X	x	x	-
VL160	x	x	x
VL250	x	x	x
VL400	x	x	x
VL630	x	x	x
VL800	x	-	x
VL1250	x	-	x
VL1600	x	-	x

Fixed mounting

Mounting on mounting plate

The 3VL molded case circuit breakers can be mounted direct onto the mounting plate. If busbars or terminals are used to connect the circuit breaker on the back of the mounting plate, the appropriate safety clearances must be observed.

Technical overview (Page 132)



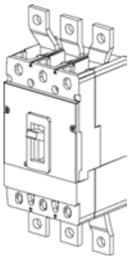
Mounting on 8US busbar adapter system

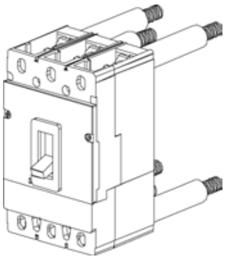
The 3VL to 630A molded case circuit breakers can be mounted on device adapters for busbar systems.

You can find further information on this subject in the system manual for busbar systems.

Busbar connections

Busbars or cables can be connected direct to the front of busbar extensions or to bolts for connections on the back. If straight busbar extensions are used, terminal covers or phase barriers are recommended.



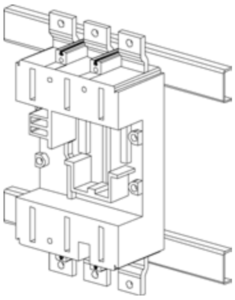


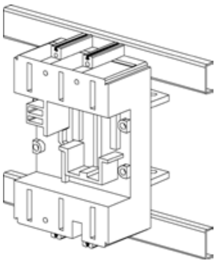
Plug-in version

Mounting plate

Plug-in bases with flat terminals on the front or rear are available for direct connection of cables or busbars. The plug-in base is attached direct to the mounting plate supplied by the customer.

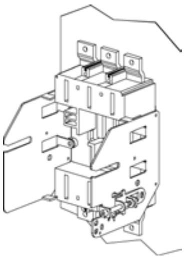
The appropriate safety clearances must be observed. Terminal covers or phase barriers are available for the front connecting bars. Molded case circuit breakers cannot be removed from the plug-in base in the "ON" position. The molded case circuit breaker will go to the "tripped" position if attempts are made to remove it while in the "ON" position.

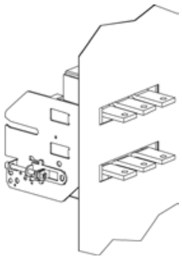




Withdrawable version

The 3VL molded case circuit breakers can be used as withdrawable devices. They can be connected on either the front or the back. Terminal covers are provided and are required for final installation.





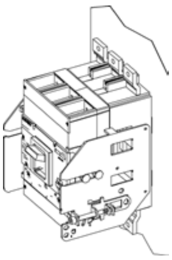
In the connected position, the molded case circuit breaker is completely engaged, and all contacts - supply, outgoing and auxiliary contacts - are connected to the guide frame. The molded case circuit breaker is ready for operation.

Note

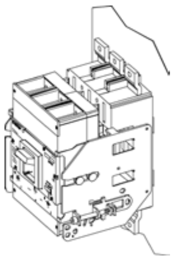
Safety interlock

A safety interlock prevents the molded case circuit breaker from being removed when it is switched on. The safety interlock causes the molded case circuit breaker to switch off so that the arc which occurs inside the circuit breaker when current flows can be extinguished.

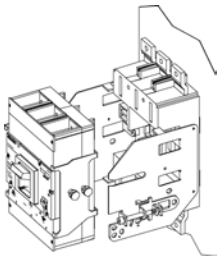
The molded case circuit breaker can be installed in and removed from the guide frame when it is in the removable position.



Connected position



Disconnected position



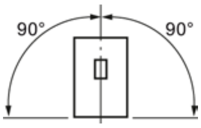
Removable position

6.2 Mounting and safety clearances

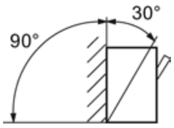
Permissible mounting positions

All 3VL molded case circuit breakers can be mounted in the positions shown:

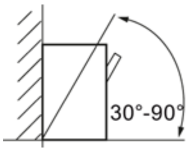
Unlimited:



There is a separate mounting assembly for VL800 to VL1600 molded case circuit breakers with guide frame in lateral installation position.



Limited:



- Use of the internal accessories possible
- Permissible current load factor 0.9
- Not allowed: motorized operating mechanisms, rotary operating mechanisms, plug-in assembly / withdrawable assembly

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 short circuit to grounded parts
- prevent arcing or short-circuit currents to live sections

Table 6- 2 Permissible safety clearances in accordance with IEC 60947

Molded case circuit breaker type	Switching capacity	Minimum footprint m^3	A ≤ 415 V	A > 415-690 V		B ≤ 690 V	C ≤ 690 V	D ≤ 690 V
			With or without covers	Without covers	With covers			
VL160X	N, H	0,011	35 mm	70 mm	35 mm	25 mm	25 mm	35 mm
VL160	N, H, L	0,011	50 mm	100 mm	50 mm	25 mm	25 mm	35 mm
VL250	N, H, L	0,015	50 mm	100 mm	50 mm	25 mm	25 mm	35 mm
VL400	N, H, L	0,036	50 mm	100 mm	50 mm	25 mm	25 mm	35 mm
VL630	N, H, L	0,18	50 mm	100 mm	50 mm	25 mm	25 mm	35 mm
VL800	N, H, L	0,22	50 mm	100 mm	50 mm	25 mm	25 mm	35 mm
VL1250	N, H, L	0,22	70 mm	100 mm	70 mm	30 mm	30 mm	50 mm
VL1600	N, H, L	0,264	100 mm	100 mm	100 mm	100 mm	30 mm	100 mm

N: Standard
H: High
L: Very high

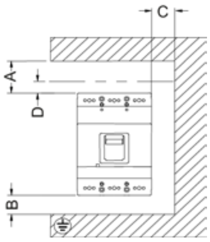


Figure 6-1 Safety clearances

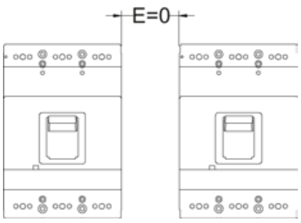


Figure 6-2 No minimum clearance between two horizontally or vertically installed molded case circuit breakers

Table 6- 3 Definition of the permissible safety clearances in [mm] between

A:	Molded case circuit breakers and busbars (uninsulated and grounded metal); terminal cover required above 600 V AC, 500 V DC
B:	Molded case circuit breaker terminal and lower panel
C:	Sides of the molded case circuit breaker and side panels left / right (uninsulated and grounded metal)
D:	Molded case circuit breaker and non-conductive parts with at least 3 mm thick insulation (insulator, insulated bar, painted plate)

If uninsulated conductors are connected to terminals 1, 3, 5, they must be insulated from each other independently of the direction of the mains supply. This can be achieved using phase barriers or terminal covers.

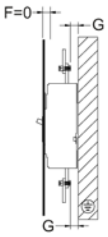
Terminal covers must be used for the main terminals at voltages of > 600 V AC or > 500 V DC.

Note

We recommend you also insulate connections 2, 4 and 6 from each other for additional safety.

Minimum clearance between two horizontally or vertically installed molded case circuit breakers

Ensure the busbar or cable connection does not reduce the air insulation clearance. The permissible clearance between two molded case circuit breakers applies for both fixed-mounted and plug-in versions. Some accessories may increase the width of the circuit breaker.



F No minimum clearance is required between the molded case circuit breaker and the control cabinet door

Figure 6-3 Minimum clearance between the molded case circuit breaker and metal

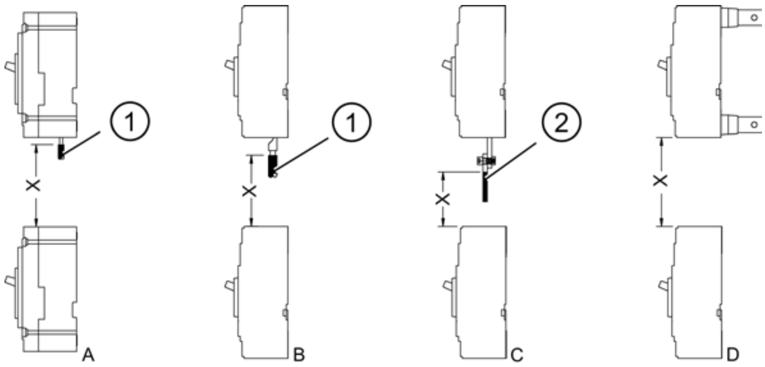
The clearance between the terminal and the grounded metal must be G ≥ 12 mm.

If the clearance to ground G is < 12 mm, live parts must be insulated or a suitable barrier must be installed.

NOTICE
Depending on the application, appropriate air and creepage distances must be observed that are described in standards IEC 61439-1 and 61439-2.

Safety clearances between molded case circuit breakers

Minimum clearance to be maintained between two molded case circuit breakers installed immediately above one another with different connection methods.



A Font connection with cable, direct
B Front connection with cable lug
C Front connection with flat connecting bar
D Rear connection with plug-in base or busbar terminals
① Insulation
② Insulation of busbar

Figure 6-4 Table of different connection types

Table 6- 4 Safety clearances to be maintained between molded case circuit breakers

Molded case circuit breaker type	**VL160X**	**VL160**	**VL250**	**VL400**	**VL630**	**VL800**	**VL1250**	**VL1600**
Switching capacity	N, H	N, H, L			N, H, L			
x ≤ 690 V	160 mm				200 mm			

6.3 Locking devices

6.3.1 Locking devices for a padlock

Locking device for the toggle lever

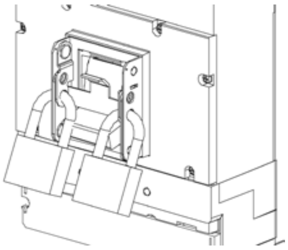


Figure 6-5 Locking device for the toggle lever

The locking device for the toggle lever is designed to be easily attached to the molded case circuit breaker escutcheon. This device allows the lever to be locked in the "OFF" position. The locking device for the toggle lever can be installed in 3-pole and 4-pole molded case circuit breakers. Up to 3 padlocks with diameters from 5 to 8 mm may be used. (Not for the VL160X with RCD module)

Locking device for front-operated rotary operating mechanism

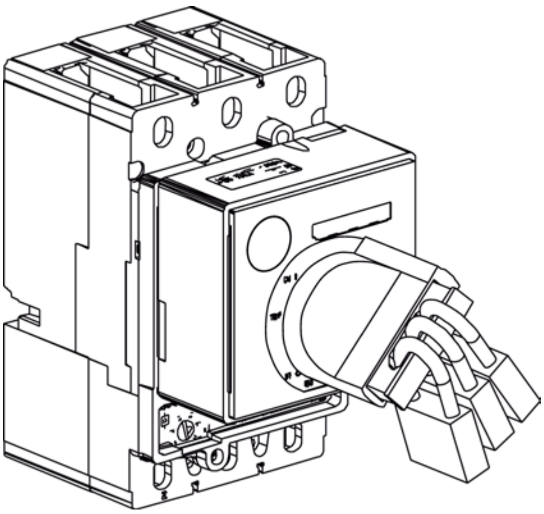


Figure 6-6 Locking device for front-operated rotary operating mechanism

Locking device for motorized operating mechanism (MO)

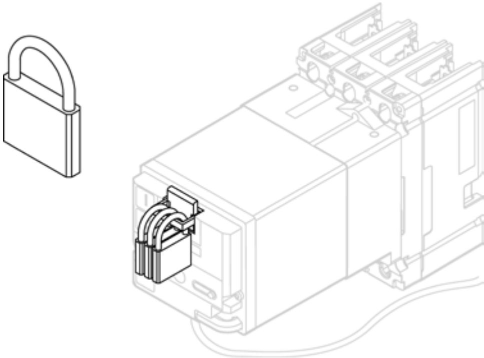


Figure 6-7 Locking motorized operating mechanism

Locking mechanism for motorized operating mechanism with stored energy mechanism (SEO)

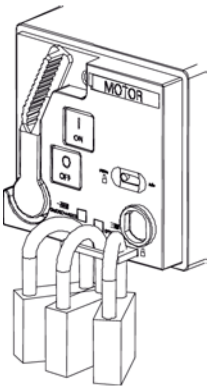


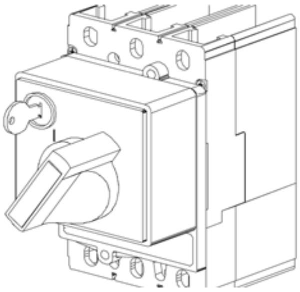
Figure 6-8 Locking device for motorized operating mechanisms with stored energy mechanism

6.3.2 Locking device with a safety lock

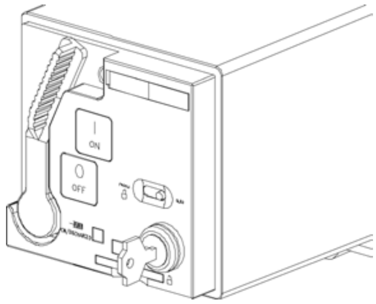
Safety lock for the rotary operating mechanism and the motorized operating mechanism

A safety lock can be used for both rotary operating mechanisms and motorized operating mechanisms with stored energy mechanism (SEO).

The safety lock is used to lock the molded case circuit breaker in the "OFF" position. The key can only be removed when the molded case circuit breaker is in the "OFF" position. The key cannot be removed when the rotary operating mechanism or the motorized operating mechanism is in the "ON" position.



Front-operated rotary operating mechanism with optional locking device

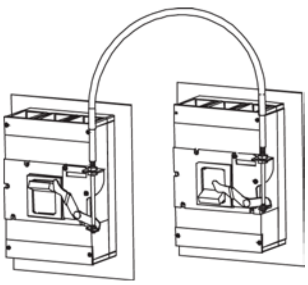


Motorized operating mechanism with stored energy mechanism (SEO) for VL160X to VL800 with optional locking device

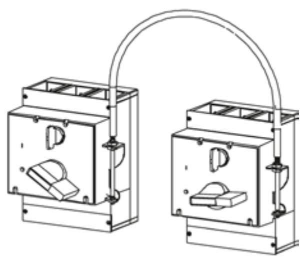
6.3.3 Mutual interlocking of two molded case circuit breakers

Mutual interlocking of two molded case circuit breakers (Bowden wire) in the fixed-mounted, plug-in and withdrawable versions

Possible interlocking



With toggle lever



With rotary operating mechanism / door coupling rotary operating mechanism

Two 3VL molded case circuit breakers can be mutually mechanically interlocked using a Bowden wire and the locking modules.

Use of this accessory kit means only one of the molded case circuit breakers is in the "ON" position at any time.

Fixed-mounted and plug-in molded case circuit breakers use different interlocking modules. However, these are compatible with each other. This enables both to be used in interlock circuits.

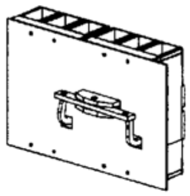
Two molded case circuit breakers can be mounted side by side or one above the other. The distance between the two molded case circuit breakers depends on the length of the Bowden wire and its minimum bending radius. The cable comes in lengths of 0.5, 1.0 and 1.5 m. The minimum bending radius for each cable is 60 mm. The length of the Bowden wire must not be altered by the customer. The Bowden wire has a mechanical endurance of 10,000 operations. Each Bowden wire must be ordered separately.

The combination options of the molded case circuit breakers with Bowden wire interlocking is described in Table 12-1 of Chapter 12.6.

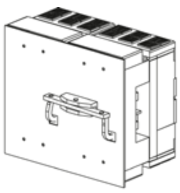
Note

Not possible in combination with the motorized operating mechanism.

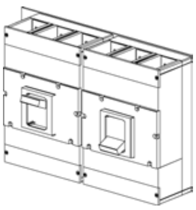
Mutual interlocking (rear interlocking module) of two molded case circuit breakers in the fixed-mounted, plug-in and withdrawable versions



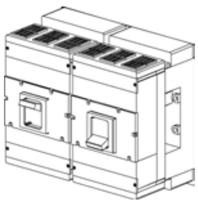
Fixed-mounted version
(lock at rear)



Plug-in version
(lock at rear)



Fixed-mounted version
(lock at front)



Plug-in version
(lock at front)

The rear interlocking module enables mutual mechanical interlocking of two 3VL molded case circuit breakers of the same size. The rear interlocking module is attached behind the molded case circuit breakers to the mounting plate supplied by the customer.

A tappet on each end of the rocker mechanically accesses each of the breakers through an opening in the mounting plate and the base of the molded case circuit breakers. The rear interlocking module prevents both molded case circuit breakers from being in the "ON" position at the same time.

The rear interlocking module can be used with fixed-mounted, plug-in and withdrawable molded case circuit breakers.

Cross wiring of internal accessories via the rear of the molded case circuit breakers is not prevented.

This locking version is possible with all operating mechanism types (toggle lever, rotary operating mechanism, and motorized operating mechanism).

Connecting 7

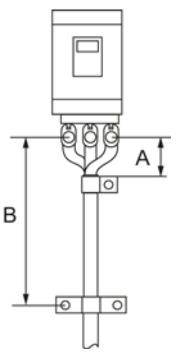
7.1 Cables and busbars

The 3VL molded case circuit breaker can be connected using cables, flexible copper bars or busbars.

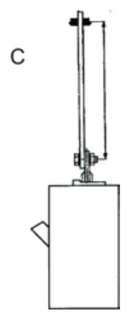
Thermal and electrodynamic stresses affect these conductors in the event of a short-circuit. To avoid dangerous effects, it is necessary to asses them correctly and to take appropriate measures to suppress them.

The diagrams and tables below show the recommended maximum clearance between the molded case circuit breaker and the first point.

Overview of cable and busbar mounting methods



Cable mounting



Busbar mounting

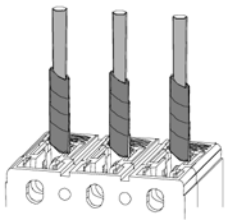
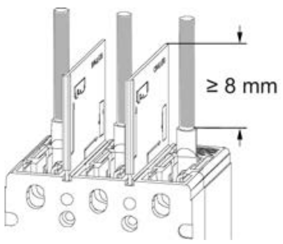
Table 7- 1 Recommended cable mounting clearances

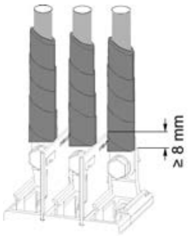
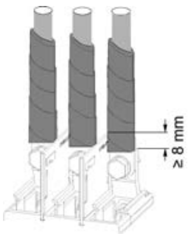
	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
A cable mm	100	100	130	150	300			
B cable mm	400	400	400	400	600			
C bar mm	250							

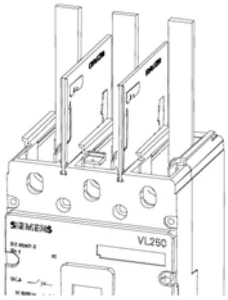
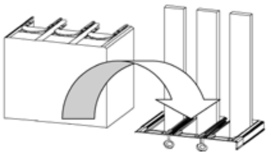
This table applies for all switching capacities.

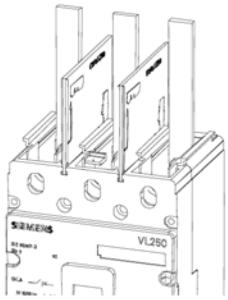
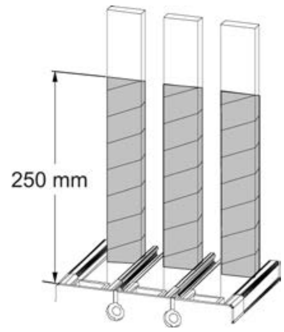
Rated operating voltage: $U_e \leq$ 600 V AC / 500 V DC

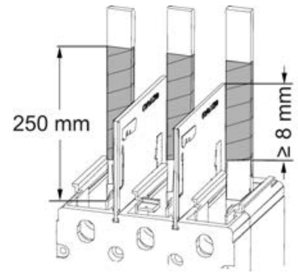
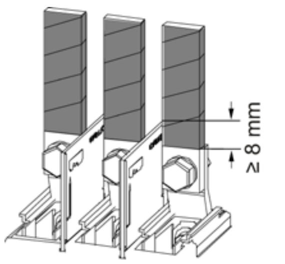
Table 7- 2 Connection methods ($U_e \leq$ 600 V AC / 500 V DC)

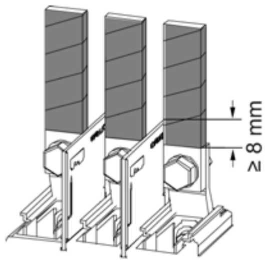
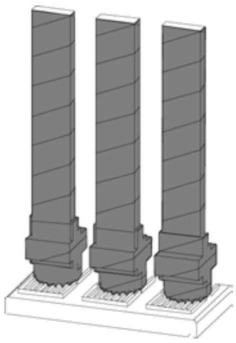
Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for $U_e \leq$ 600 V AC / 500 V DC							
 • Cable installed directly, e.g. via box terminal or multiple feed-in terminal • Insulated up to the circuit breaker • **Accessories:** – None	N H	N H L	N H L	N H L	N H L	N H L	N H L	Not appli-cable
 • Cable with cable lug • Clearance between non-insulated conductor and the end of the phase barrier at least 8 mm • **Accessories:** – Phase barriers – Cable lug – Terminals with screw connection	N H	N H L	N H L	N H L	N	N	N	Not appli-cable

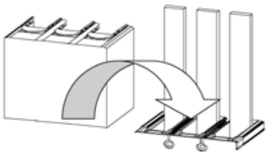
Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for $U_e \leq$ 600 V AC / 500 V DC							
 • Cable with cable lug • Front connecting bars, standard • Insulation 8 mm above phase barrier • **Accessories:** – Phase barriers – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N	N	N	Not appli-cable
 • Cable with cable lug • Front connecting bars, for increased pole spacing • Insulation 8 mm above phase barrier • **Accessories:** – Phase barriers – Terminals with screw connection – Front connecting bars for increased pole spacing	N H	N H L	N H L	N H L	N	N	N	N

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 600 V AC / 500 V DC							
 • Connecting bar, directly installed • Without insulation • **Accessories:** – Phase barriers – Terminals with screw connection	N	N	N	N	N	N	N	N
 • Connecting bar, directly installed • With extended terminal cover • Without insulation • **Accessories:** – Extended terminal cover – Terminals with screw connection	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for $U_e \leq$ 600 V AC / 500 V DC							
REVERSE FEED  • Connecting bar, directly installed • Incoming supply from overcurrent release side (REVERSE FEED) • Without insulation • **Accessories:** – Phase barriers – Terminals with screw connection	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L
 • Connecting bar, directly installed • Insulation 250 mm from the circuit breaker • **Accessories:** – Terminals with screw connection	N H	N H L	N H L	N H L	N	N	N	N

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for $U_e \leq 600$ V AC / 500 V DC							
 • Connecting bar, directly installed • Insulation 8 mm above phase barrier and 250 mm from circuit breaker • **Accessories:** – Phase barriers – Terminals with screw connection	N H	N H L	N H L	N H L	N	N	N	N
 • Connecting bar • Front connecting bars, standard • Insulation 8 mm above phase barrier and 250 mm from circuit breaker • **Accessories:** – Phase barriers – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N	N	N	N

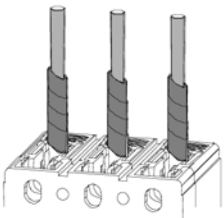
Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 600 V AC / 500 V DC							
 • Connecting bar • Front connecting bars, • for increased pole spacing • Insulation 8 mm above phase barrier and 250 mm from circuit breaker • **Accessories:** – Phase barriers – Terminals with screw connection – Front connecting bars for increased pole spacing	N H	N H L	N H L	N H L	N	N	N	N
 • Connecting bar • Front connecting bars, standard • Insulation 250 mm from the circuit breaker • **Accessories:** – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L

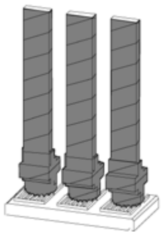
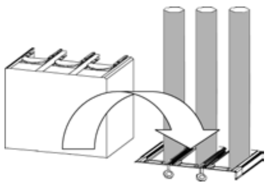
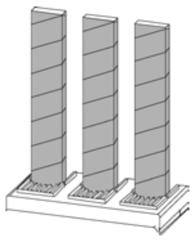
Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 600 V AC / 500 V DC							
 • Connecting bar • Front connecting bars, standard • With extended connection cover • Without insulation • **Accessories:** – Extended terminal cover – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L

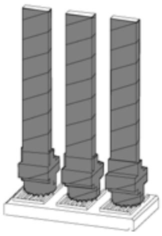
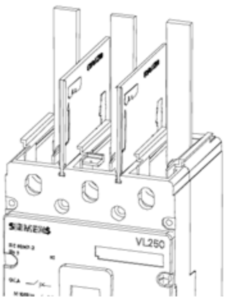
N: Low
H: High
L: Very high

Rated operating voltage: U_e ≤ 690 V AC / 600 V DC

Table 7- 3 Connection methods (U_e ≤ 690 V AC / 600 V DC)

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 690 V AC / 600 V DC							
 • Cable installed directly, e.g. via box terminal or multiple feed-in terminal • Insulated up to the circuit breaker • **Accessories:** – Standard terminal cover	N H	N H L	N H L	N H L	N H L	N H L	N H L	Not appli-cable

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 690 V AC / 600 V DC							
 • Cable with cable lug • Front connecting bars, standard • Insulated up to the circuit breaker • Accessories: – Standard terminal cover – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N H L	N H L	N H L	Not applicable
 • Cable with cable lug • With extended connection cover • Accessories: – Extended terminal cover – Terminals with screw connection	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L
 • Connecting bar, directly installed • Insulation 250 mm from the circuit breaker • Accessories: • Standard terminal cover • Terminals with screw connection	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L

Circuit breaker dimensions	VL160X	VL160	VL250	VL400	VL630	VL800	VL1250	VL1600
	Permissible switching capacity class for U_e ≤ 690 V AC / 600 V DC							
 • Connecting bar • Front connecting bars, standard • Insulation 250 mm from the circuit breaker • Accessories: – Standard terminal cover – Terminals with screw connection – Front connecting bars, standard	N H	N H L	N H L	N H L	N H L	N H L	N H L	N H L
REVERSE FEED  • Connecting bar, directly installed • Incoming supply from overcurrent release side (REVERSE FEED) • Without insulation • Accessories: – Phase barriers – Terminals with screw connection	N	N H L	N H L	N H L	N H L	N H L	N H L	N H L

N: Low
H: High
L: Very high

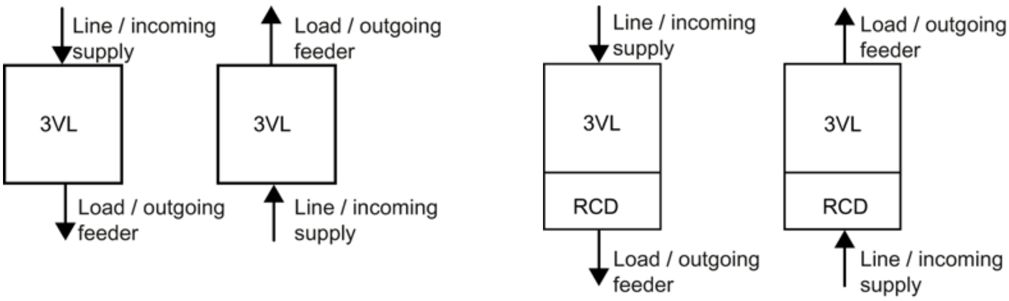
7.2 Main connection types for fixed mounting

Main conductor connection for SENTRON 3VL fixed-mounted version

There are various methods of connecting the molded case circuit breaker main conductors for fixed mounting.

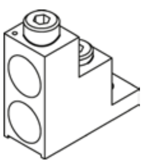
Network connection

The 3VL molded case circuit breakers can be supplied with power from above and below.

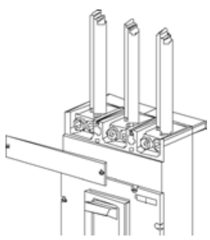


Multiple feed-in terminal for circular conductors (copper/aluminum)

The multiple feed-in terminals for incoming supply and outgoing feeders consist of an aluminum body with tin coating to prevent oxidation. Both aluminum and copper cables may be used. Only one conductor is permitted per terminal. The multiple feed-in terminals are available for the VL400 to VL1250 molded case circuit breakers.



Multiple feed-in terminals

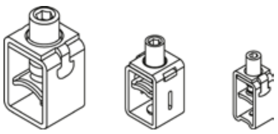


Use of multiple feed-in terminals

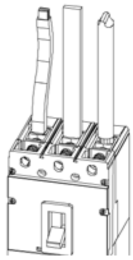
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Box terminals (copper cables or bars)

The VL160X to VL250 can be supplied optionally with box terminal or with screw-type connection. The terminal is designed to connect either a conductor or a solid/flexible copper bar.



Box terminals

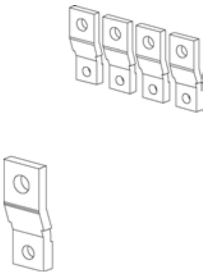


Box terminals with solid/flexible copper bars or cables

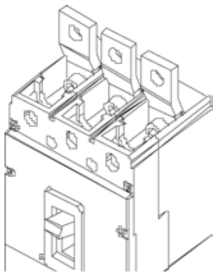
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Front connecting bars

Connecting bars are used to connect the circuit breakers to busbars or cables in electrical systems. Front connecting bars are supplied with the SENTRON VL1600 as standard. Phase barriers are also included. Extended terminal covers can be fitted if necessary.



Front connecting bar



Use of front connecting bars

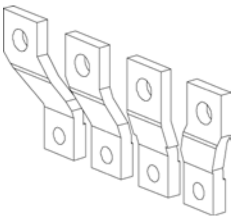
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Front connecting bars for increased pole spacing

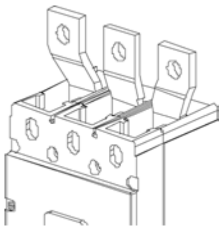
Front connecting bars for increased pole spacing are used to establish busbar connections in switchboards or other electrical equipment. Normal use enables adjustment to the next largest molded case circuit breaker. Phase barriers are also included.

Note

Front connecting bars for increased pole spacing cannot be combined with extended terminal covers!



Front connecting bars with increased pole spacing

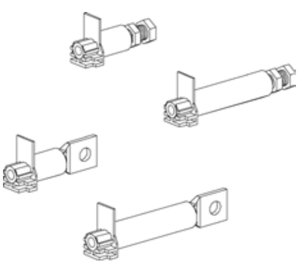


Use of front connecting bars with increased pole spacing

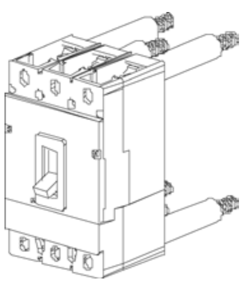
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Rear terminals

Rear terminals are used to adapt the 3VL molded case circuit breakers to switchboards or other applications that require rear connection. They are bolted direct to a standard 3VL molded case circuit breaker without requiring any modification. Molded case circuit breakers mounted in switchboards or other electrical equipment may be removed from the front by removing the fixing screw that connects the molded case circuit breaker to the terminal.



Round terminals

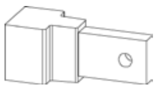


Use of the terminals

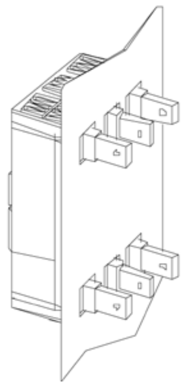
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Rear flat busbar terminals

Rear flat busbar terminals are used to adapt VL630 to VL1600 molded case circuit breakers to switchboards or other applications that require rear connection. The rear busbars are bolted direct to a standard 3VL molded case circuit breaker without requiring any modification. A vertical or horizontal connection is established, depending on the way the busbar terminals are mounted to the rear of the circuit breaker. Molded case circuit breakers mounted in switchboards or other electrical equipment with the help of rear flat busbar terminals may be removed from the front by removing the fixing screw that connects the molded case circuit breaker to the terminal.



Busbar

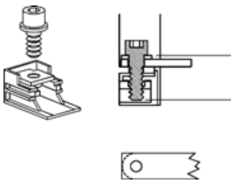


Busbar

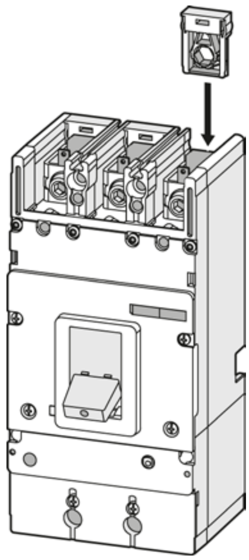
For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

Terminals with screw connection

The screw-type terminal with metric thread slides onto the incoming and outgoing terminal of the 3VL molded case circuit breaker and acts as a threaded adapter for connecting busbars or cable lugs. The customer is responsible for providing screws and washers for the terminals and busbars if the size specified below is exceeded. Screw-type terminals are supplied for use with the SENTRON VL400 to VL1250 as standard.



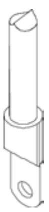
Terminals with screw connection



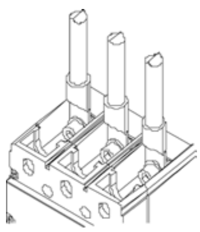
Establishing terminals with screw connection

For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

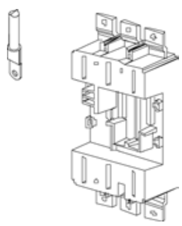
Connection with cable lugs



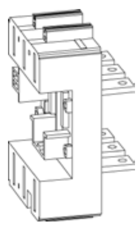
Cable lug



Use of cable lug No. 1



Use of cable lug No. 2



Use of cable lug No. 3

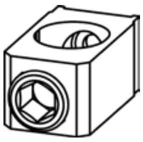
Cable lugs (ring cable lugs) are used to connect the cables to the terminals of the molded case circuit breaker.

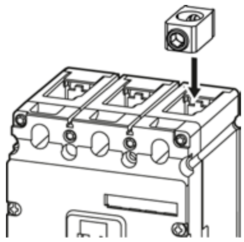
Cable lugs in accordance with DIN 46220 with a narrow flange are recommended (VL1 to VL4).

Connection terminal for circular conductors (copper/aluminum)

Circular conductor terminals for the incoming supply and outgoing feeders consist of an aluminum body with tin plating to prevent oxidation. Both aluminum and copper cables may be used. Only one conductor is permitted per terminal.

The circular conductor terminals are available for the VL160X to VL400 molded case circuit breakers.





For additional information, refer to the technical data in the chapter Configuration of main connections (Page 136).

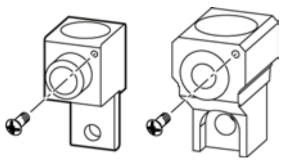
Auxiliary conductor terminal

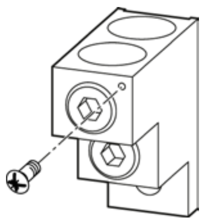
The 3VL offers two versions of auxiliary conductors for voltage tap.

A) Connection with lug to circular conductor terminal (voltage tap)

The 3VL1-3VL7 circular conductor terminals are provided with an M3 hole. Using the screw with contact washer provided, cable lugs up to 2.5 mm² can be connected.

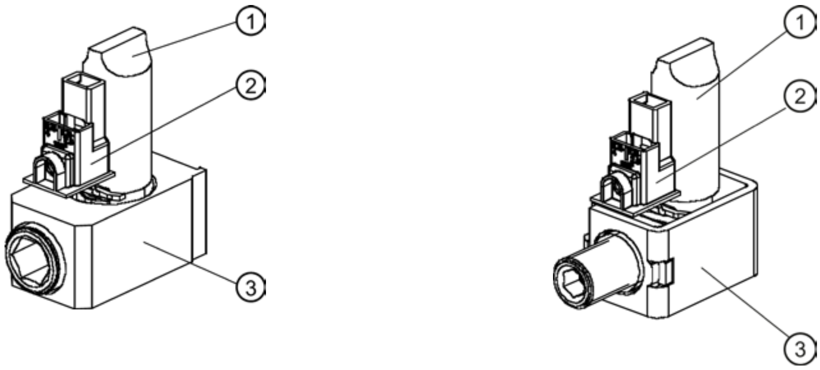
The maximum load of the auxiliary conductor connection I_{max} = 500 mA must not be exceeded.





B) Connection with auxiliary conductor terminal in box or circular conductor terminal

The auxiliary connection terminal is an additional component that is inserted into a circular conductor terminal or steel box terminal additionally to the main conductor.



① Main conductor

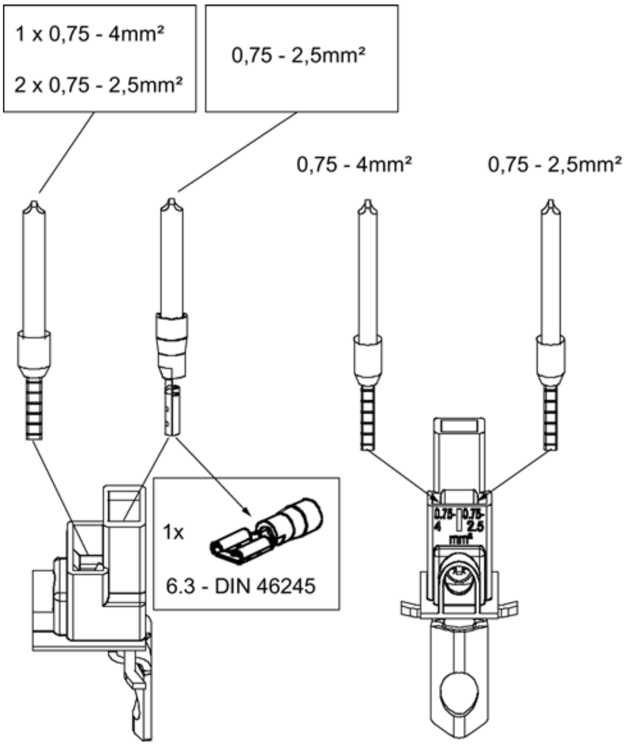
② Auxiliary conductor terminal

③ Circular conductor terminal

The maximum load of the auxiliary conductor connection I_{max} = 6 A must not be exceeded.

Several auxiliary conductors can be connected to the auxiliary connection terminal:

- 1 x stranded with core end sleeve max. 4 mm² + 1 x stranded with AMP connector 6.3
- 1 x stranded with core end sleeve max. 4 mm² + 1 x stranded with core end sleeve max. 2.5 mm²



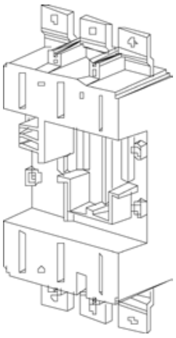
7.3 Main connection methods for plug-in and withdrawable version

Main conductor connection for plug-in and withdrawable version

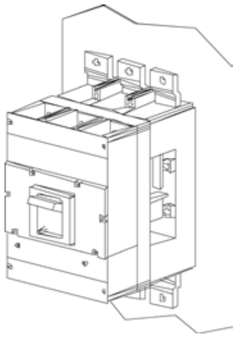
There are different methods of connecting the molded case circuit breaker main conductors for the plug-in and withdrawable version.

Plug-in base: Connection on the front with busbar connection pieces

Plug-in bases simplify installation and removal of the 3VL molded case circuit breakers. The molded case circuit breaker has been developed together with the plug-in base in such a way as to prevent disconnection in the "ON" position. Busbars or cables can be connected on the front. A connection cover is supplied and is to be used both for the incoming and the outgoing side. An additional phase barrier for insulation between the connections is possible (see Connection covers/barriers and phase barriers). If the molded case circuit breaker is in the connected position, the primary voltage is supplied via multiple terminal contacts in the guide frame.



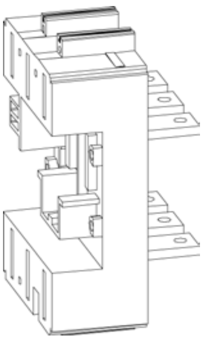
Plug-in base (front)



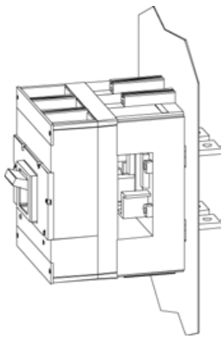
Plug-in base with busbar connection (busbar covers are not shown)

Plug-in base: Connection on the back with flat busbar terminals

Busbars and cables can be connected on the back. Vertical and horizontal connections are possible depending on the configuration of the connecting bars.



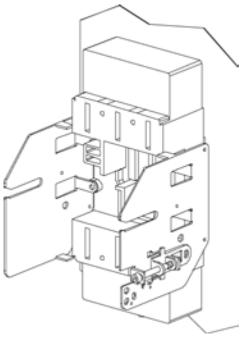
Plug-in base (rear)



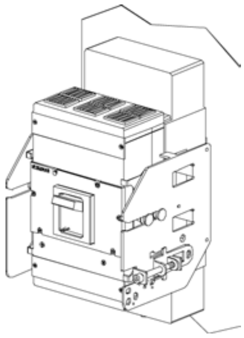
Plug-in base with rear flat busbar terminals

Withdrawable version: Connection on the front with busbar connection pieces

The withdrawable version enables the insertion and removal of the 3VL molded case circuit breaker without requiring the disconnection of incoming or outgoing cables or busbars. A special operating mechanism, attached to the stationary assembly, is used to insert or remove the molded case circuit breaker. A mechanical interlock prevents the circuit breaker from being moved from the connected position to the disconnected position when it is switched on. The molded case circuit breaker will trip before the multiple clamping contacts between the molded case circuit breaker and the guide frame open. A locking device with padlock is provided on the stationary arm of the withdrawable unit. The customer can lock the circuit breaker in either the disconnected or connected position.



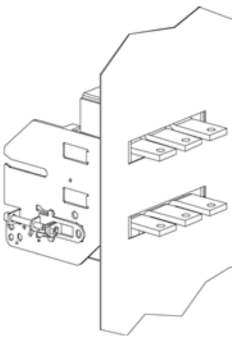
Withdrawable version with front busbar connections and terminal covers



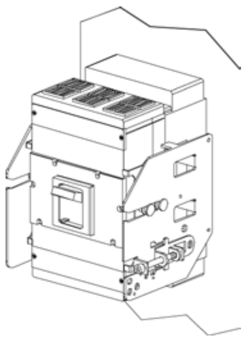
Withdrawable version with front busbar connections

Withdrawable version: Connection on the back with flat busbar terminals

It is possible to configure the busbars for horizontal connection when the withdrawable assembly with rear flat busbar terminals is used. A separate kit is available for vertical connection of molded case circuit breakers up to and including VL250.



Withdrawable version with rear flat busbar connections (rear)



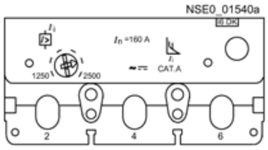
Withdrawable version with front flat busbar connections (front)

8 Displays and operator controls

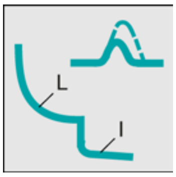
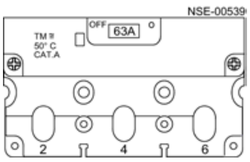
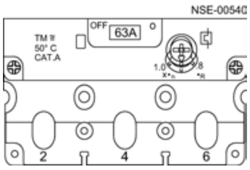
8.1 Overcurrent trip unit without LCD display

The different setting options of the individual overcurrent releases without LCD display are explained using the examples listed:

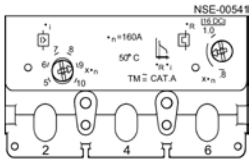
Magnetic overcurrent releases M VL160-VL630

Characteristic curve	Application	View
	**Starter protection M, I function** Short-circuit protection, adjustable I_i = 7 to 15 x I_n, for VL160 to VL630 (size dependent) "DK" version	

Thermal-magnetic overcurrent releases TM VL160X

Characteristic curve	Application	View
	**System protection TM, LI / LIN function** Overload protection fixed, short-circuit protection fixed "DA", "EH" and "EA/EL" versions	
	**System protection TM, LI / LIN function** Overload protection adjustable I_R = 0.8 to 1 x I_n Short-circuit protection fixed "DD" version	

Thermal-magnetic overcurrent releases TM VL160-VL630

Characteristic curve	Application	View
	**System protection TM, LI / LIN function** Overload protection adjustable I_R = 0.8 to 1 x I_n Short-circuit protection adjustable I_i = 5 to 10 x I_n for VL160 to VL630 "DC", "EJ", "EM" and "EC" versions	

Electronic trip units ETU VL160-VL1600

The electronic trip units include the following operating features:

- No auxiliary voltage is necessary for the tripping system. The tripping system draws its supply from the main connecting cables. Reliable tripping is thus ensured.
- All ETUs have a thermal image
- A flashing green LED indicates correct operation of the microprocessor
- Overload status (I > 1.05 x I_R) is indicated by a permanent yellow LED (alarm)
- Integrated self-test function
- Plug-in socket for tester
- Communication connection to PROFIBUS DP or Modbus RTU for ETUs with communication preparation

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Note

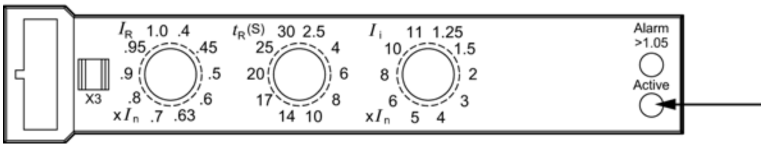
Signal output to the COM20 / COM21

Communication preparation (1 auxiliary switch and 1 alarm switch) is already integrated into the left accessory compartment for all ETUs with communication preparation and wired to the ETU. The cable to the COM20 / COM21 is included in the scope of supply.

LED display

LED display of the ETU VL160 – VL1600 electronic trip units

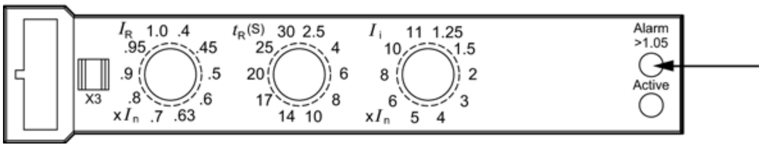
- Active LED



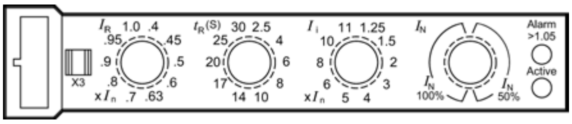
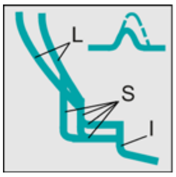
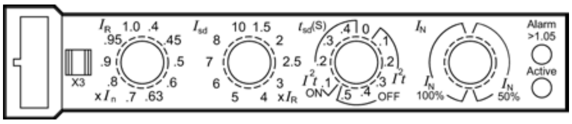
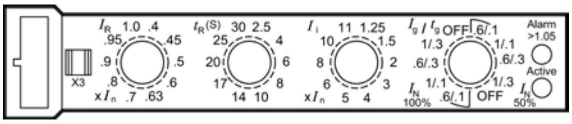
The protective function of the molded case circuit breaker is always guaranteed regardless of the current status of the ETU.

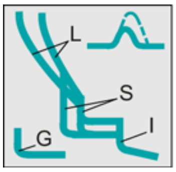
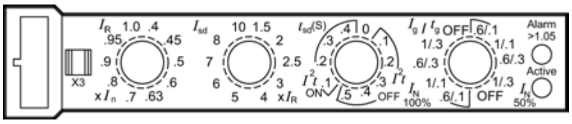
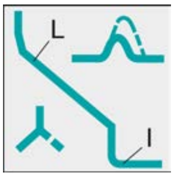
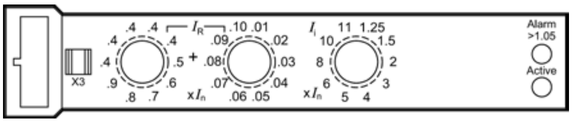
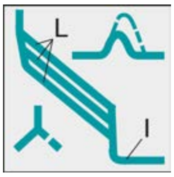
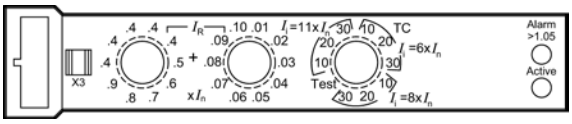
Color	LED OFF	LED flashes	LED ON (continuous light)
Green	ETU not activated	Normal status, the flashing green LED signals that the microprocessor is functioning properly.	The LED is in continuous light mode when the current flow of the processor is below the activation limit, in other words, when the load current flow is too low.

- Alarm LED



Color	LED OFF	LED flashes	LED ON (continuous light)
Yellow/orange	No overload	--	Signals overload, $I > 1.05 \times I_R$

Characteristic curve	Application	View
	**ETU10 for system protection, LI/LIN function** Overload protection I_R = 0.4; 0.45; 0.5 to 0.95; 1 x I_n, time-lag class t_R = 2.5 to 30 Short-circuit protection (instantaneous) I_i = 1.25 to 11 x I_n (size dependent) "SB", "MB", "LB", "TB" and "NB" versions Neutral conductor protection I_n = 50% / 100% x I_R, "TA", "LA" and "NA" versions	
	**ETU20 for system and generator protection, LSI / LSIN function** Overload protection I_R = 0.4; 0.45; 0.5 to 0.95; 1 x I_n Short-circuit protection (short-time delay) I_{sd} = 1.5 to 10 x I_R, t_{sd} = 0 to 0.5 s I^2t selectable on / off Short-circuit protection (instantaneous) I_i = 11 x I_n (fixed setting, size dependent) "SE", "ME", "LE", "TE" and "NE" versions Neutral conductor protection I_n = 50% / 100% x I_R, "TF", "LF" and "NF" versions	
	**ETU12 for system protection, LIG / LING function** Overload protection I_R = 0.4; 0.45; 0.5 to 0.95; 1 x I_n time-lag class t_R = 2.5 to 30 Short-circuit protection (instantaneous) I_i = 1.25 to 11 x I_n (size dependent) On 4-pole molded case circuit breakers: neutral conductor protection 50% / 100% × I_R "TN"and "NN" versions Ground-fault protection: I_g = 0.6 / 1.0 I_n, t_g = 0.1 / 0.3 s measuring method No. 1: (G_R) vectorial summation current formation in the three phases and neutral conductor (4-conductor systems); $I_{\Delta n}$ = I_n, versions "SL", "SF", "ML", "MF", "TN", and "NN"	

Characteristic curve	Application	View
	**ETU22 for system and generator protection, LSIG / LSING function** Overload protection I_R = 0.4; 0.45; 0.5 to 0.95; 1 x I_n, Short-circuit protection (short-time delayed) I_{sd} = 1.5 to 10 x I_R, t_{sd} = 0 to 0.5 s I^2t selectable on / off Short-circuit protection (instantaneous) I_i = 11 x I_n (fixed setting, size dependent) On 4-pole molded case circuit breakers: neutral conductor protection 50% / 100% × I_R "TH" and "NH" versions Ground-fault protection: I_g = 0.6 / 1.0 I_n, t_g = 0.1 / 0.3 s Measuring method No. 1: (G_R) vectorial summation current formation in the three phases and neutral conductor (4-wire systems); $I_{\Delta n}$ = I_n, versions "SG", "MG", "SH", "MH", "TH", "NH"	
	**ETU10M for motor and generator protection, LI function** Finely adjustable overload protection I_R = 0.41; 0.42 to 0.98; 0.99; 1 x I_n, Trip class t_C = 10 (fixed setting) Thermal image Short-circuit protection (instantaneous) I_i = 1.25 to 11 x I_n (size dependent) with phase failure sensitivity (40% I_R fixed setting) "SP" and "MP" versions	
	**ETU30M for motor and generator protection, LI function** Finely adjustable overload protection I_R = 0.41; 0.42 to 0.98; 0.99; 1 x I_n, Trip class t_C = 10, 20, 30 Thermal image Short-circuit protection (instantaneous) I_i = 6 to 11 x I_n with phase failure sensitivity (40% I_R fixed setting) "SS", "MS" and "LS" versions	

8.2 Overcurrent trip unit with LCD display

The electronic trip units with LCD display have the following operating features:

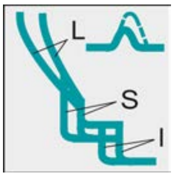
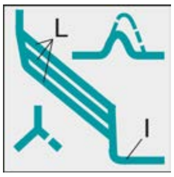
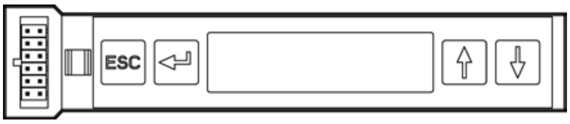
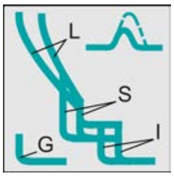
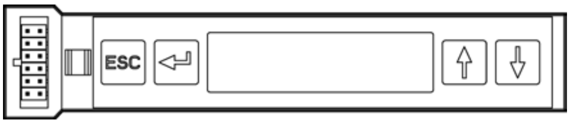
- No auxiliary voltage is necessary for the tripping system.
- Current display
- Correct microprocessor operation is displayed.
- Overload status ($I > 1.05 \times I_R$) is indicated by "overload" on the LCD display
- Direct, user-friendly, menu-driven setting of the absolute values of the protection parameters in absolute ampere values via buttons
- Integrated self-test function
- Plug-in socket for tester
- Communication link to PROFIBUS DP and MODBUS RTU possible

Note

Signal output to the COM20 / COM21

Communication preparation (1 auxiliary switch and 1 alarm switch) is already integrated into the left accessory compartment for all LCD-ETUs and wired to the LCD-ETU. The COM20 / COM21 cable is included in the scope of supply.

Electronic trip unit LCD ETU

Characteristic curve	Application	View
 	**ETU40 for system protection, LI / LSI / LSIN function,** **ETU40M motor / generator protection, LI** function Overload protection I_R = 0.4 to 1 x I_n, Trip class t_C = 5 to 30 at ETU40M Time-lag class t_R = 2.5 to 30 at ETU40 Thermal image selectable on / off, with phase failure sensitivity with ETU40M (5 ... 50% I_R adjustable) "UP" version Short-circuit protection (short-time delayed) on ETU40 I_{sd} = 1.5 to 10 x I_R, t_{sd}[1)] = 0 to 0.5 s I^2t selectable on / off on ETU40 "UH" and "UJ" versions Short-circuit protection (instantaneous) I_i = 1.25 to 11 x I_n (size dependent)	
	**ETU42 for system protection,LSIG/LSING function** Overload protection I_R = 0.4 to 1 x I_n Time-lag class t_R = 2.5 to 30 Thermal image selectable on/off Short-circuit protection (short-time delayed) I_{sd} = 1.5 to 10 x I_R, t_{sd}[1)] = 0 to 0.5 s I^2t selectable on / off Short-circuit protection (instantaneous) I_i = 1.25 to 11 x I_n (size dependent) Ground-fault protection: Measuring method No. 1: (G_R) vectorial summation current formation in the three phases and neutral conductor (4-conductor systems); $I_{\Delta n}$ = 0.4 to 1 x I_n, "UL", "UM" and "UN" versions Measuring method No. 2: (G_{GND}) direct measurement of the ground-fault current using a current transformer, I_g = 0.4 to 1 x I_n, t_g = 0.1 to 0.5 s; "UM" version On 4-pole molded case circuit breakers: neutral conductor protection N: 50 to 100% I_R selectable or adjustable.	

1) For t_{sd} = 0, the ST function must be set to the value "disabled".

MENU on the LCD display of the overcurrent release

The following languages are available:

- English (default)
- German, French, Italian, Spanish

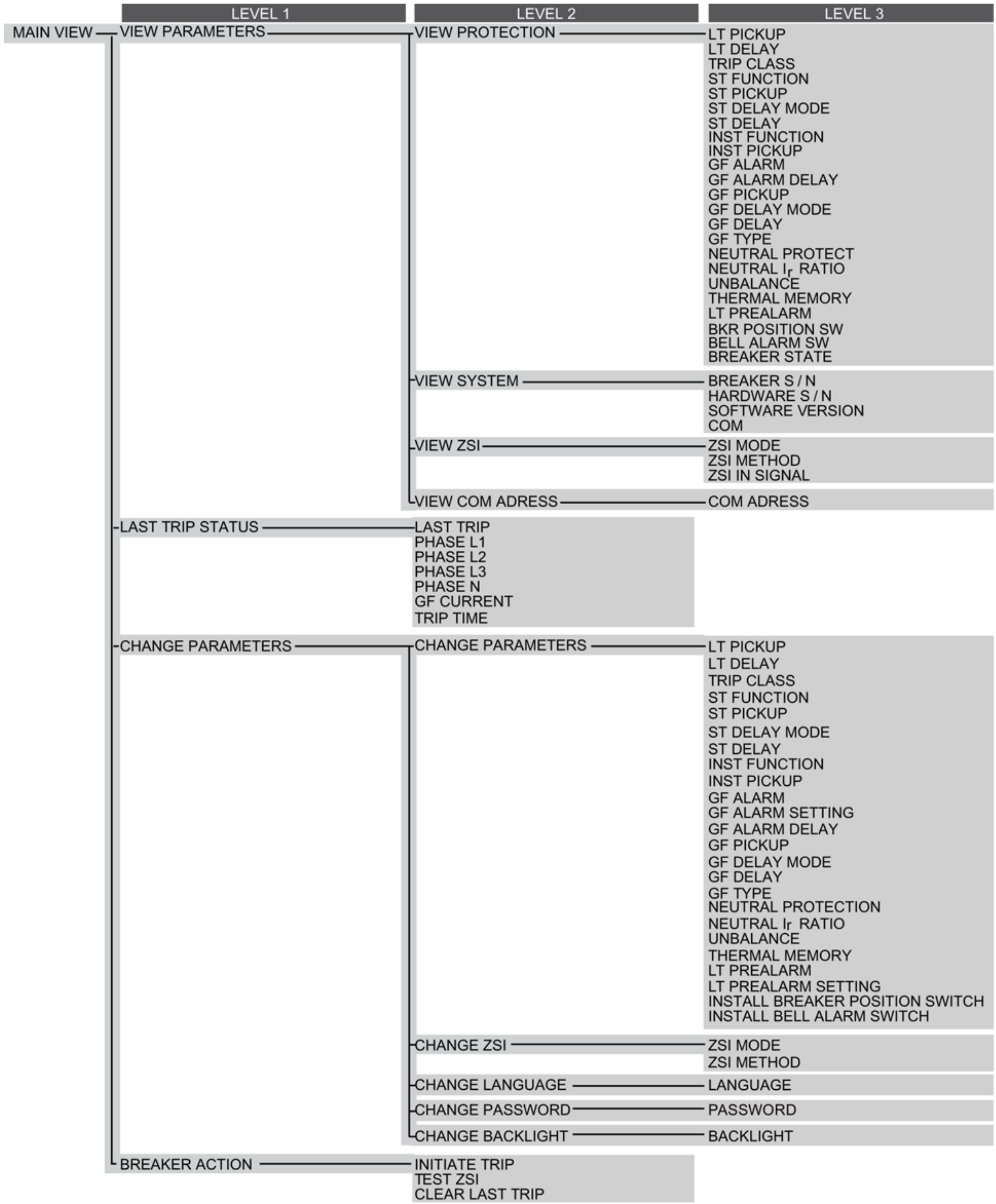


Figure 8-1 MENU on the LCD display of the overcurrent release

Commissioning

The overcurrent release must be activated before it can be parameterized. A minimum load current of approximately 20% of the relevant rated current I_n of the molded case circuit breaker is required.

Note

The factory-set "LCD-ETU" with the maximum settings for the overload release and the short-circuit release must be adapted during commissioning.

Changing the parameters for the overload and short-circuit releases during operation to a value below the current operating value causes instantaneous tripping.

If this minimum load current is not available, the required auxiliary power can be supplied using the 3VL9000-8AP01 hand-held tester. In molded case circuit breakers with communication capability, the trip unit is supplied with power by the COM20/21 Release 2.

Parameter assignment / addressing 9

9.1 Setting the parameters

Settings on the ETU

Note

Adjusting settings

The overcurrent release is preset with the maximum settings for the overload release and the short-circuit release. You must adjust these settings to the requirements of the system when installing the molded case circuit breakers.

Changing the setting values for the overload and short-circuit releases during operation to a value below the present operating value causes instantaneous tripping.

The protection parameters to be set on the electronic trip unit of the molded case circuit breaker depend on the technical environment (switchgear, cables), the network configuration, and the type of equipment to be protected. There are no fixed protection settings. The protection parameters can be determined by the relevant electrical planning engineer.

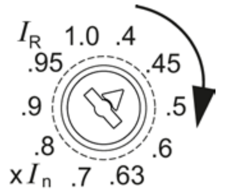
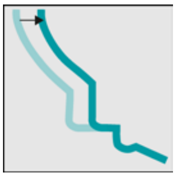
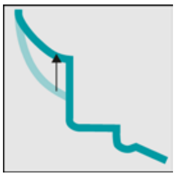
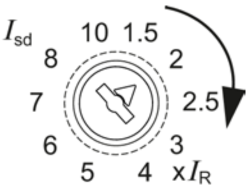
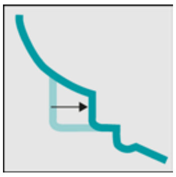
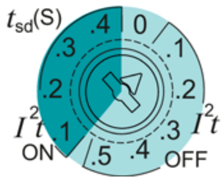
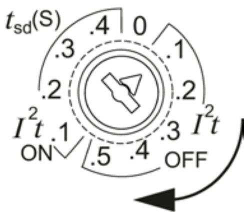
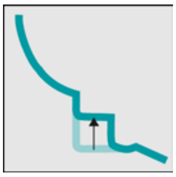
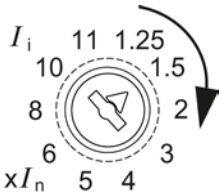
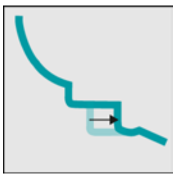
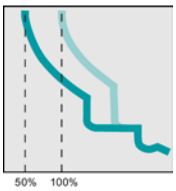
The Siemens software tool SIMARIS Design offers a simple, quick and safe solution for dimensioning switching and protective devices.

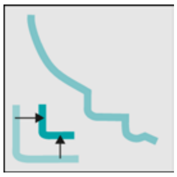
Internet link to SIMARIS (www.siemens.com/simaris)

Tripping characteristic curve and settings parameters

The time/current characteristic of a trip unit offers the best method for calculating the tripping characteristics of a trip unit. The tripping characteristic reflects the response of the circuit breaker in the event of a fault, e.g. overload or short-circuit. The time required to trip is defined at a specific current. The tripping characteristic is split into different sections. Each section reflects the tripping response of the circuit breaker at a specific current level Depending on the type of tripping, the trip units can be supplied with or without the S, N, or G functions (L, S, I, N, G designations in accordance with IEC 60947-2, Annex K).

- L long time delay = overload protection with current-dependent long time delay and current-dependent tripping curve (I^2t = constant)
- S short time delay (short-circuit protection with short-time delay) = short-circuit protection with current-dependent or current-independent short time delay and current-dependent tripping curve (I^2t_{sd} = constant)
- I Instantaneous = short-circuit protection with instantaneous adjustable tripping.
- N Neutral protection = protection of the neutral conductor with adjustable, current-dependent tripping curve.
- G Ground fault = ground-fault protection with current-independent short-time delay

Parameter		Setting buttons	Effect on characteristic curve	Brief description	Cause
L	I_R			Tripping current of the overload protection I_R = 0.4 to 1 x I_n	Setting to the operating current of the circuit to be protected
	t_R			Delay (or time-lag class) in the overload range. The set time is the tripping time at 6 x I_R. t_R = 2.5 to 30 s	Improved selectivity in the overload range in switchgear with several grade levels when the rated currents differ only slightly
S	I_{sd}			Tripping current of the short-time delayed short-circuit protection I_{sd} = 1.5 to 10 x I_R	Short-circuit release with time delay. In this way, time selectivity can be achieved with downstream switching devices.
	I^2t_{sd}			Change from a constant time delay to a I^2t characteristic curve in the short-circuit range I^2t_{sd} = ON or OFF	Improved selectivity with downstream switchgear, e.g. LVHRC fuses
	t_{sd}			Delay time of the short-circuit protection. Please note: The selection between t_{sd} = constant and I^2t characteristic t_{sd} [1)] = 0 to 0.5 s with the position of the rotary encoding switch	Improved selectivity of the short-circuit protection in switchgear with several grade levels
I	I_i			Tripping current of the instantaneous short-circuit release I_i = 1.25 to 11 x I_n	Instantaneous short-circuit tripping for immediate shutdown of the molded case circuit breaker when the permissible short-circuit current is exceeded
N	I_N			Tripping current of the neutral conductor protection I_N = 0.5 or 1 x I_R	Overload protection of a neutral conductor or protection of a conductor with reduced cross-section

Parameter		Setting buttons	Effect on characteristic curve	Brief description	Cause
G	I_g/t_g			Tripping current and time delay of the ground-fault protection I_g = Off, 1 or 0.6 x I_n t_g = Off, 0.1 s or 0.3 s	Protection from short-circuit to ground and thus prevention of arcs. Ground-fault protection is part of the fire protection.

[1)] For LCD ETUs, the ST function must be set to the value "disabled" for t_{sd} = 0.

Setting of the protection parameter for line and generator protection

The settings are variable depending on the trip unit (ETU10, ETU12, ETU20, ETU22, LCD-ETU40 and LCD-ETU42). The following parameters can be set depending on the version:

L overload release I_R:

The overload release I_R is set to the operating current I_B of the circuit to be protected. This takes place with the help of the left rotary encoding switch I_R that is set to the factor I_B/I_n (example: I_B = 250 A, I_n = 315 A => setting factor 250 / 315 = 0.79 corresponds to 0.8 on the rotary encoding switch).

Delay time t_r :

The delay time (or time-lag class) t_r can be set using another rotary encoding switch. The set time is the tripping time at 6 x I_r. In this way, selectivity to other molded case circuit breakers can be achieved in the overload range, for example, when the rated current range does not differ much.

S short-time delayed short-circuit protection I_{sd} :

The short-time delay short-circuit protection can be set with regard to the tripping value of the current I_{sd} and the delay time t_{sd}. I_{sd} refers to the tripping value of the overload release I_R and can be set between 1.5 to 10 x I_R (depending on the molded case circuit breaker).

Delay time t_{sd} :

Depending on the requirements and on the trip unit, selectivity to the other molded case circuit breakers can be achieved with appropriate selection of the delay time t_{sd}. If the rotary encoding switch is in the "ON" range, this means the delay time is current-dependent. The I^2t value is constant. For example, the higher the current, the faster the circuit breaker will trip (equivalent to the overload release I_R). In contrast, the delay time in the "OFF" position is current-independent, that is, constant. If the current reaches the set value I_{sd}, the circuit breaker trips after the set time t_{sd}. The degree to which the current exceeds the value I_{sd} is not important. The set time is the tripping time at 8 x I_r.

I^2t waveform:

A I^2t waveform of the characteristic curve can be switched in (depending on the ETU), the delay time t_{sd} is based on the reference point 8 x I_R. Two different procedures are used to form the characteristic curve. As well as a fixed time delay for all currents in the characteristic curve section, the I^2t characteristic can also be used. The tripping time falls continuously as the current increases, and the product of squared current and time remains constant.

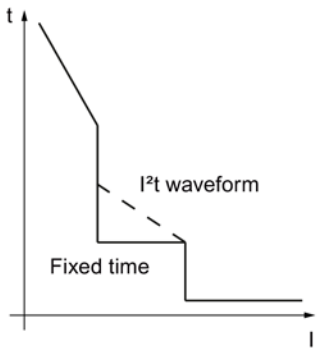


Figure 9-1 I^2t

I instantaneous short-circuit protection I_i:

On some trip units, the instantaneous short-circuit release I_i can also be set. This refers to the rated current I_n of the molded case circuit breaker. It must always be noted that either the instantaneous short-circuit release (I_i) or the delayed short-circuit release (I_{sd}) handles personnel protection. The tripping current of the short-circuit release of the molded case circuit breaker is set to a value that is at least 20% (tolerance of the trip unit) lower than the lowest short-circuit current at the installation location and simultaneously higher than the maximum operating current +20%. This guarantees that the circuit breaker will trip within the required time even with the smallest short-circuit current, and that correct currents will not result in unwanted trips.

G ground-fault protection I_g:

The tripping value of the of the ground-fault release I_g is fixed to the rated breaker current on the ETU12 and ETU22. The tripping current of the ground-fault release can be set to between 0.6 and 1 x I_n, and the delay time t_g can be set between 0.3 s and 0.6 s. The measuring methods for the ground-fault protection are specified on the representation of the trip unit. On the ETU42, the tripping current of the ground-fault release can be set to between 0.4 and 1 x I_n, and the delay time can be set between 0.1 s and 0.5 s.

Note

Ground-fault protection

It must be noted that the ground-fault protection is not a residual-current operated circuit breaker (FI or RCD in the building installation). Fault currents to ground therefore cannot be detected, only ground "short"-circuits.

9.2 Setting the protection parameters for motor protection (ETU10M, ETU30M and LCD-ETU 40M)

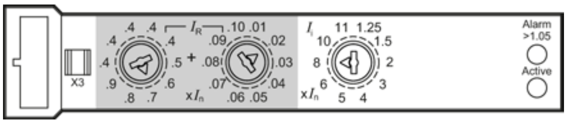
The selection of the molded case circuit breaker is oriented around the rated operating current of the motor; the releases are specially designed for overload protection of 3-phase motors.

Overload release I_R:

The overload release I_R is set to the rated current of the motor, in the same way as protection parameters for line and generator protection. The overload protection is finely adjustable with the left rotary encoding switch (first decimal place) and the center rotary encoding switch (second decimal place) in the range between I_R = 0.41; 0.42 to 0.98; 0.99; 1 x I_n (I_n = rated breaker current).

Example

Adjusting to the motor current 360 A is carried out for the rotary encoding switch left and center (ETU10M and ETU30M) (rated breaker current I_n = 500 A) as follows:



Overload protection setting

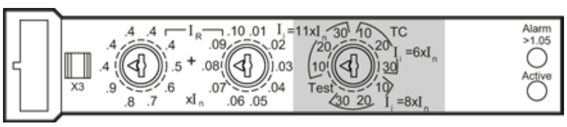
Setting I_R / rated breaker current I_n = 360 A / 500 A = 0.72

1. Setting the rotary encoding switch left factor 0.7
2. Setting the rotary encoding switch center factor 0.02

Short-circuit release I_i

Furthermore, instantaneous short-circuit release I_i can also be set depending on the trip unit. This setting value refers to the rated current I_n of the molded case circuit breaker. As with line and generator protection, the minimum short-circuit must be taken into account when selecting the setting.

With the ETU30M version, you must note that the setting of the short-circuit release is selected in combination with the time-lag class. The rotary encoding switch is divided into three areas here, corresponding to the values 6, 8 or 11 x I_n. The desired time-lag class can be selected within these ranges.



Setting the time-lag class/trip class

The 3VL molded case circuit breaker offers the option of selecting from various time-lag classes or trip classes for different motor applications.

One version (ETU10M) contains a thermal image and phase failure sensitivity based on a fixed trip class 10.

With the ETU30M, both the time-lag class TC and the tripping current of the short-circuit release are set in combination with the right rotary encoding switch.

The other version (ETU40M) with an LCD trip unit permits step by step setting from class 5 to 30. The setting in accordance with CLASS 5 is only used on motors with an extremely low overload capacity. In CLASS 30, by contrast, the motor must be suitable for starting under a heavy load. That is, the trip class must be adapted to the start-up time of the motor.

Definition of the trip class

The trip class specifies the start-up times during the motor start in accordance with IEC 60947-4-1. The trip class is defined by the tripping time at 7.2-times the set current level (in the cold state). Combinations with CLASS 10 are generally used.

The tripping times are as follows:

- CLASS 5 between 0.5 and 5 secs,
- CLASS 10 between 4 and 10 secs,
- CLASS 20 between 6 and 20 secs,
- CLASS 30 between 9 and 30 secs.

Applications such as fans, require longer start-up times.

Phase failure sensitivity

The "phase failure sensitivity" function is also integrated into the trip units for motor protection ETU10M, ETU30M and ETU40M. This ensures that the motor is reliably protected against overheating if a phase interruption or a large fluctuation occurs. The phase failure sensitivity protects 3-phase AC motors against overheating while only 2 phases are active. The specified operating current IR is automatically reduced to 80% of the set value if the RMS values of the operating currents in the three phases in the case of the ETU10M and ETU30M trip units differ by more than 40%. If an adjustable phase unbalance of 5 to 50% is set on the ETU40M trip unit, the set operating current I_R is automatically reduced to 87% of the set value.

Thermal image

All releases with overload protection function have a "thermal image" which takes the pre-loading of the AC motor into consideration. The function of the fixed thermal image cannot be switched off (except on the ETU40M). Following an overload trip of the molded case circuit breaker, the tripping time is reduced by the thermal pre-loading of the molded case circuit breaker in such a way that further overloads cannot harm the motor windings.

After an overload trip, the tripping times are reduced in accordance with the tripping characteristic curves so that the inrush current can already cause a trip. A cooling time dependent on the size of the motor is required before the motor can be switched on again.

Service and maintenance 10

10.1 Preventive measures

Maintenance

> **⚠ DANGER**
>
> **Qualified personnel**
>
> Functionality tests and maintenance tasks must only be carried out by qualified personnel due to the dangers associated with electrical equipment.

The following inspection intervals must be defined by the operator (qualified skilled personnel) depending on the conditions of use of the relevant 3VL molded case circuit breaker:

- At least 1 x per year
- After severe high-energy shutdowns
- After trips caused by the electronic overcurrent release
- After shutdowns caused by the thermal overcurrent release
- After shutdowns caused by the magnetic instantaneous overcurrent release
- Additional testing of downstream molded case circuit breakers.

Inspection

The following checks must be carried out within the scope of the inspection(s) and/or after 1,000 rated current shutdowns. Please proceed as follows:

- External circuit breaker housing
  - Examine all visible surfaces for oxidation, residues or other adverse effects.
  - Remove residues with a lint-free, dry and clean cloth. (Never use chemical cleaners or water)

NOTICE
Damage to the molded case circuit breaker
Never carry out repairs to the plastic casing or the interior of the circuit breaker! Molded case circuit breakers contain only maintenance-free components.

- Electrical and mechanical functions of the circuit breaker
  - Test the operating lever to check the mechanical functioning of the molded case circuit breaker contacts
- Function of the mechanical on and off switch
  - Operate the trip button, if available. Return the molded case circuit breaker to the starting position after each operation.
- Main circuits and control circuits, function.
- Check connections are tight
  - Check the tightening torque of the connecting screws (80% of the tightening torque recommended)
  - Visual inspection of the incoming and outgoing cables
  - Visual inspection of the connection accessories
  - Replace damaged terminal accessories after cleaning the terminal area
- Check and, if necessary, correct the settings of the overcurrent release in accordance with the system conditions
  - Electronic molded case circuit breaker releases must only be tested with a device especially supplied for this purpose (MLFB: 3VL9000-8AP01).

The operator (customer) must arrange for the disposal of the molded case circuit breaker or the replaced parts at the end of their service life in accordance with the currently applicable legal requirements and guidelines.

10.2 Troubleshooting

Notes on troubleshooting

Table 10- 1 Troubleshooting

Circuit breaker status	Causes of faults	Corrective action
Overload causes circuit breaker to trip:	Excessive current	The circuit breaker is functioning correctly and switches off an overload that occurs. Check to see if the operating current has exceeded the thermal tripping limit.
	Connecting cable not correctly connected to the circuit breaker	Carry out a visual inspection of the terminals for discoloration. Cables can become loose during service due to various reasons such as vibration (machine tool applications) and cold flow (for aluminum cables)
	Ambient temperature too high	This can be a problem on hot summer days or in areas subject to extreme heat. Although all 3VL molded case circuit breakers are calibrated for use at an ambient temperature of 50 °C, the temperatures in the enclosures can exceed this level. It may be necessary to consider derating the I_n or I_R values. See the Chapters Use in unusual environments, and Derating factors
	Overcurrent release not correctly connected to the circuit breaker.	If none of the above suggestions apply, the overcurrent release must be removed from the molded case circuit breaker and inspected for discoloration. The tightening torque values are listed in the operating manual supplied with every circuit breaker.
Short-circuit causes circuit breaker to trip:	Excessive making current, e.g. motor	Adjust the magnetic trip rating to the next highest setting or until the circuit breaker does not trip when the motor is started.
	High current peaks, e.g. when changing from star to delta in star-delta starters.	A current peak of up to 20 times the rated current of the motor can occur when changing from star to delta. In this case, the short-circuit release "I" must be set to a higher value. However, this may result in the loss of the desired higher motor protection function.

Circuit breaker status	Causes of faults	Corrective action
Mechanical and electrical functions:	High humidity	The molded case circuit breakers must not be used in environments with high humidity since this can cause dielectric and insulation problems. In such environments, appropriate measures need to be taken, such as placing the circuit breaker in an enclosure.
	Corrosion	The molded case circuit breakers are not designed to be used in aggressive environments. In such environments, the circuit breaker should be installed in a housing.
	Function of the internal accessories	Determine what type of internal accessories are installed. Remove the molded case circuit breaker cover and determine the type of accessories using the circuit breaker order number. Then check for correct functioning. • Undervoltage release: Ensure the correct voltage is connected to the undervoltage release since otherwise, the circuit breaker cannot be tripped. • Shunt release: Ensure the voltage is not applied to the shunt release since this can also prevent the circuit breaker from tripping. • Auxiliary and alarm switches: The auxiliary and alarm switches do not have any effect on the protection function of the molded case circuit breaker.

11 Technical data

11.1 General data - 3VL molded case circuit breakers

Type	VL160X 3VL1	VL160 3VL2	VL250 3VL3	VL400 3VL4	VL630 3VL5	VL800 3VL6	VL1250 3VL7	VL1600 3VL8
Max. rated current I_n [A]	160	160	250	400	630	800	1250	1600
N pole [A]	160	160	250	400	630	800	1250	1600
Rated insulation voltage U_i in accordance with IEC 60947-2								
Main current paths [V AC]	800	800	800	800	800	800	800	800
Auxiliary circuits [V AC]	690	690	690	690	690	690	690	690
Rated impulse withstand voltage U_{imp}								
Main current paths [kV]	8	8	8	8	8	8	8	8
Auxiliary circuits [kV]	4	4	4	4	4	4	4	4
Rated operating voltage U_e								
IEC 50 / 60 Hz [V AC]	690 4)	690	690	690	690	690	690	690
IEC DC3)	500	600	600	600	600	-1)	-1)	-1)
NEMA 60 Hz [V AC]	600	600	600	600	600	600	600	600
Utilization category (IEC 60947-2)	A	A	A	A	A	A	A	A
Permissible ambient temperature								
Operation [°C] 2)	0 to +70	-25 to +70	-25 to +70	-25 to +70	-25 to +70	-25 to +70	-25 to +70	-25 to +70
Storage [°C]	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80	-40 to +80

1) Breaker cannot be used for direct current.
2) Exception: 3VL molded case circuit breaker with TMTU: 0 °C ... 70 °C
3) The values apply for at least 3 current paths in series and extremely high breaking capacity L. For switching direct current, the maximum permissible direct voltage per current path must be observed.
4) VL160X in the 16 A and 20 A version cannot be used at 690 V.

Note

For more information, see the following chapter:

Use in DC systems (Page 60) under "Suggested circuits for DC networks"

Type	VL160X 3VL1	VL160 3VL2	VL250 3VL3	VL400 3VL4	VL630 3VL5	VL800 3VL6	VL1250 3VL7	VL1600 3VL8
Permissible load at different ambient temperatures directly next to the molded case circuit breaker, related to the rated current of the molded case circuit breaker								
• Molded case circuit breaker for system protection / generator protection								
TM/ETU up to 50 °C [%]	100 /-	100 / 100	100 / 100	100 / 100	100 / 100	- / 100	- / 100	- / 100
TM/ETU up to 60 °C [%]	93 / -	93 / 95	93 / 95	93 / 95	93 / 95	- / 95	- / 95	- / 95
TM/ETU up to 70 °C [%]	86 / -	86 / 80	86 / 80	86 / 80	86 / 80	- / 80	- / 80	- / 80
• Molded case circuit breaker for motor protection								
ETU to 50 °C [%]	-	100	100	100	100	-	-	-
ETU at 60 °C [%]	-	95	95	95	95	-	-	-
ETU at 70 °C [%]	-	80	80	80	80	-	-	-
• Molded case circuit breakers for starter combinations and non-automatic air circuit breakers								
TM to 50 °C [%]	100	100	100	100	100	100	100	100
TM at 60 °C [%]	93	93	93	93	93	93	93	93
TM at 70 °C [%]	86	86	86	86	86	86	86	86

Type	VL160X 3VL1	VL160 3VL2	VL250 3VL3	VL400 3VL4	VL630 3VL5	VL800 3VL6	VL1250 3VL7	VL1600 3VL8
Weights of 3-pole molded case circuit breakers [kg]								
• Basic breaker without overcurrent release	-	1,5	1,6	4,2	7,8	14,2	21	27,3
• Thermal-magnetic overcurrent release	-	0,7	0,7	1,5	1,2	-	-	-
• Electronic trip unit	-	0,9	0,9	1,7	1,5	1,8	4,0	4,0
• Basic breaker with thermal-magnetic overcurrent release	2,0	2,2	2,3	5,7	9,0	-	-	-
• Basic breaker with electronic trip unit	-	2,4	2,5	5,9	9,3	16,0	25,0	31,3
Weights of 4-pole molded case circuit breakers [kg]								
• Basic breaker without overcurrent release	-	2,0	2,2	5,5	9,7	18,2	27,5	34,8
• Thermal-magnetic overcurrent release	-	1,0	1,0	1,9	1,5	-	-	-
• Electronic trip unit	-	1,1	1,1	2,1	2,0	2,3	6,0	6,0
• Basic breaker with thermal-magnetic overcurrent release	2,5	3,0	3,2	7,4	11,2	-	-	-
• Basic breaker with electronic trip unit	-	3,1	3,3	7,6	11,7	20,5	33,5	40,8

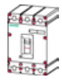
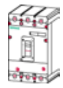
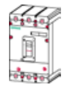
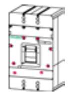
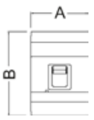
Rated short-circuit breaking capacity in accordance with IEC 60947-2								
See the chapter Technical overview (Page 132)								
• **Service life make-break operations**	20000	20000	20000	20000	10000	10000	3000	3000
• **Service life electrical make-break operations**	10000	10000	10000	10000	5000	3000	1500	1500
• **Max. switching frequency [1/h]**	120	120	120	120	60	60	30	30
• **Connection types**	See the chapter Connecting (Page 89)							

11.2 Technical overview

The technical overview lists all the operating data and dimensions as well as the possible overcurrent tripping methods and the switching capacities of the 3VL molded case circuit breakers. The RCD blocks overview contains the relevant operating data.

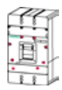
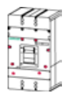
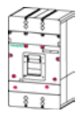
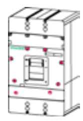
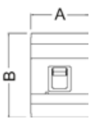
VL160X, VL160 to VL400

Table 11- 1 Technical overview VL160X, VL160 to VL400

			VL160X		VL160		VL250		VL400	
										
Rated current I_n at 50 °C ambient temperature			16 to 160 A		50 to 160 A		200 to 250 A		200 to 400 A	
Number of poles			3	4	3	4	3	4	3	4
		mm A	105	139	105	139	105	139	139	183
		mm B	157	157	175	175	175	175	279	279
		mm C	81	81	81	81	81	81	102	102
		mm D	107	107	107	107	107	107	138	138
Overcurrent release										
Thermal-magnetic TM			X	X	X	X	X	X	X	X
Electronic trip unit ETU			--	--	X	X	X	X	X	X

VL630 to VL1600

Table 11- 2 Technical overview VL630 to VL1600

			VL630		VL800		VL1250		VL1600	
										
Rated current I_n at 50 °C ambient temperature			315 to 630 A		800 A		1000 to 1250 A		1600 A	
Number of poles			3	4	3	4	3	4	3	4
		mm A	190	253	190	253	229	305	229	305
		mm B	279	279	406	406	406	406	406	406
		mm C	102	102	114	114	152	152	152	152
		mm D	138	138	151	151	207	207	207	207
Overcurrent release										
Thermal-magnetic TM			X	X	--	--	--	--	--	--
Electronic trip unit ETU			X	X	X	X	X	X	X	X

Standard breaking capacity VL160X, VL160 to VL400

Table 11- 3 SENTRON VL - N rated breaking current (kA) symmetrical (standard breaking capacity)

Type	SENTRON	VL160X	VL160	VL250	VL400
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	65/65	65/65	65/65	65/65
	Up to 415 V AC	55/55	55/55	55/55	55/55
	Up to 440 V AC	25/20	25/20	25/20	35/26
	Up to 500/525 V AC	18/14	25/20	25/20	25/20
	Up to 690 V AC	8/4 [1)]	12/6	12/6	15/8
	Up to 250 V DC	30/30	32/32	32/32	32/32
	Up to 500 V DC	--	--	--	--
	Up to 600 V DC	--	--	--	--

[1)] For rated currents from 25 A. VL160X in the 16 A and 20 A version cannot be used at 690 V.

Standard breaking capacity VL630 to VL1600

Table 11- 4 SENTRON VL - N rated breaking current (kA) symmetrical (standard breaking capacity)

Type	SENTRON	VL630	VL800	VL1250	VL1600
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	65/65	65/65	65/35	65/35
	Up to 415 V AC	55/55	55/55	55/28	55/28
	Up to 440 V AC	35/26	35/26	35/26	35/26
	Up to 500/525 V AC	25/20	25/20	25/20	25/20
	Up to 690 V AC	20/10	20/10	20/10	20/10
	Up to 250 V DC	30/30	--	--	--
	Up to 500 V DC	--	--	--	--
	Up to 600 V DC	--	--	--	--

High breaking capacity VL160X, VL160 to VL400

Table 11- 5 SENTRON VL - H rated breaking current (kA) symmetrical (high breaking capacity)

Type	SENTRON	VL160X	VL160	VL250	VL400
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	100/75	100/75	100/75	100/75
	Up to 415 V AC	70/70	70/70	70/70	70/70
	Up to 440 V AC	42/32	50/38	50/38	50/38
	Up to 500/525 V AC	30/23	40/30	40/30	40/30
	Up to 690 V AC	12/6 1)	12/6	12/6	15/8
	Up to 250 V DC	30/30	32/32	32/32	32/32
	Up to 500 V DC	30/30	32/32	32/32	32/32
	Up to 600 V DC	--	--	--	--

1) For rated currents from 25 A. VL160X in the 16 A and 20 A version cannot be used at 690 V.

High breaking capacity VL630 to VL1600

Table 11- 6 SENTRON VL - H rated breaking current (kA) symmetrical (high breaking capacity)

Type	SENTRON	VL630	VL800	VL1250	VL1600
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	100/75	100/75	100/50	100/50
	Up to 415 V AC	70/70	70/70	70/35	70/35
	Up to 440 V AC	50/38	50/38	50/38	50/38
	Up to 500/525 V AC	40/30	40/30	40/30	40/30
	Up to 690 V AC	20/10	20/10	30/15	30/15
	Up to 250 V DC	30/30	--	--	--
	Up to 500 V DC	30/30	--	--	--
	Up to 600 V DC	--	--	--	--

Very high breaking capacity VL160X, VL160 to VL400

Table 11- 7 SENTRON VL - L rated breaking current (kA) balanced (very high breaking capacity)

Type	SENTRON	VL160X	VL160	VL250	VL400
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	--	200/150	200/150	200/150
	Up to 415 V AC	--	100/75	100/75	100/75
	Up to 440 V AC	--	75/50	75/50	75/50
	Up to 500/525 V AC	--	50/38	50/38	50/38
	Up to 690 V AC	--	12/6	12/6	15/8
	Up to 250 V DC	--	32/32	32/32	32/32
	Up to 500 V DC	--	32/32	32/32	32/32
	Up to 600 V DC	--	32/32	32/32	30/32

Very high breaking capacity VL630 to VL1600

Table 11- 8 SENTRON VL - L rated breaking current (kA) balanced (very high breaking capacity)

Type	SENTRON	VL630	VL800	VL1250	VL1600
		I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}	I_{cu}/I_{cs}
IEC 60947-2	Up to 240 V AC	200/150	200/150	200/100	200/100
	Up to 415 V AC	100/75	100/75	100/50	100/50
	Up to 440 V AC	75/50	75/50	75/50	75/50
	Up to 500/525 V AC	50/38	50/38	50/38	50/38
	Up to 690 V AC	20/10	20/10	35/17	35/17
	Up to 250 V DC	30/30	--	--	--
	Up to 500 V DC	30/30	--	--	--
	Up to 600 V DC	30/30	--	--	--

Further information

For more information, see the following chapter:

Use in DC systems (Page 60)
Section "Suggested circuits for DC networks"

11.3 Configuration of main connections

Main connections

Molded case circuit breakers	Connection overview and further options				
	Box terminals	Terminals with screw connection with metric thread for flat connection	Circular conductor terminal / multiple feed-in terminal	Rear terminals	Front-accessible connecting bars
VL160X	□	□	x	x	x
VL160	□	□	x	x	x
VL250	□	□	x	x	x
VL400	x	○	x[2)3)]	x	x
VL630	x[1)]	○	x[2)]	x	x
VL800	--	○	x[2)]	x	x
VL1250	--	○	x[2)]	x	x
VL1600	--	x	--	x	○

○ Scope of supply
□ Optional scope of supply
x Available
-- Not available
1) Connecting terminal plate for flexible busbar; not for 690 V AC / 600 V DC.
2) Multiple feed-in terminal
3) Circular conductor terminal also available.

Conductor cross-sections

Type	VL160X 3VL1	VL160 3VL2	VL250 3VL3	VL400 3VL4	VL630 3VL5	VL800 3VL6	VL1250 3VL7	VL1600 3VL8
Box terminal[2)]								
• Solid or stranded cable; copper only [mm²]	2.5 to 95	2.5 to 95	25 to 185	50 to 300	-	-	-	-
• Finely stranded with end sleeve [mm²]	2.5 to 50	2.5 to 50	25 to 120	50 to 240	-	-	-	-
• Flexible busbar [mm]	12 x 10	12 x 10	17 x 10	25 x 10	-	-	-	-
• Connecting terminal plate for flexible busbar[1)] [mm]	-	-	-	-	2 units 10 × 32	-	-	-
Circular conductor terminal								
• Solid or stranded cable; Cu or Al [mm²]	16 to 70	16 to 70	25 to 185	50 to 300	-	-	-	-

Type	VL160X 3VL1	VL160 3VL2	VL250 3VL3	VL400 3VL4	VL630 3VL5	VL800 3VL6	VL1250 3VL7	VL1600 3VL8
• Finely stranded with end sleeve [mm²]	10 to 50	10 to 50	25 to 120	50 to 240	-	-	-	-
Circular conductor terminal with auxiliary conductor connection								
• Solid or stranded cable; Cu or Al [mm²]	16 to 150	16 to 150	120 to 240	-	-	-	-	-
• Finely stranded with end sleeve [mm²]	16 to 120	16 to 120	120 to 185	-	-	-	-	-
Multiple feed-in terminal[2)]								
• Solid or stranded cable; Cu or Al [mm²]	-	-	-	2 units 50 to 120	2 units 50 to 240	3 units 50 to 240	4 units 50 to 240	-
• With terminal cover; Cu or Al [mm²]	-	-	-	2 units 70 to 300	-	-	-	-
• Finely stranded with end sleeve	-	-	-	2 units 50 to 95	2 units 50 to 185	3 units 50 to 185	4 units 50 to 185	-
Direct connection								
• Direct connection of busbars; Cu or Al [mm]	17 x 7	22 x 7	24 x 7	32 x 10	40 x 10	2 x 40 x 10	2 x 50 x 10	3 x 60 x 10
• Screw for terminals with screw connection	M6	M6	M8	M8	M6	M8	M8	-

1) Not for 690 V AC / 600 V DC
2) Cross-sections in accordance with IEC 6099

Conductor cross-sections for internal accessories for terminals with screw connection

Table 11- 9 Conductor cross-sections for internal accessories for terminals with screw connection: UVR, shunt, auxiliary switches, alarm switches

• Solid [mm²]	0.75 to 1.5
• Finely stranded with end sleeve [mm²]	0.75 to 1.0

See installation instructions for details.

Tightening torques for cables and leads

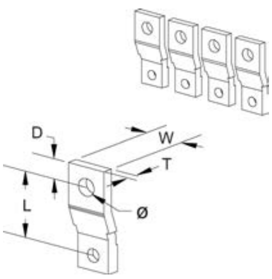
Molded case circuit breakers	Connection type	Conductor	Conductor cross-section mm²	Tightening torque	Tool Allen key	Connection screw
VL160X	Terminals with screw connection with metric thread for flat connection	Al / Cu	7 x 17 (busbar)	6 Nm	5 mm	M6
	Box terminal	Cu	2,5 – 10 16 – 95	4 Nm 8 Nm	4 mm	--
		Flexible copper busbar	12 x 10	8 Nm	4 mm	--
	Circular conductor connection	Al / Cu	16 – 70	14 Nm	4 mm	--
	Circular conductor connection with terminal cover	Al / Cu	16 – 35 50 – 150	31 Nm 42 Nm	5 mm	--
VL160	Terminals with screw connection with metric thread for flat connection	Al / Cu	7 x 22 (busbar)	6 Nm	5 mm	M6
	Box terminal	Cu	2,5 – 10 16 – 95	4 Nm 8 Nm	4 mm	--
		Flexible copper busbar	12 x 10	8 Nm	4 mm	--
	Circular conductor connection	Al / Cu	16 – 70	14 Nm	4 mm	--
	Circular conductor connection with terminal cover	Al / Cu	16 – 35 50 – 150	31 Nm 42 Nm	5 mm	--
VL250	Terminals with screw connection with metric thread for flat connection	Al / Cu	7 x 24 (busbar)	10 Nm	6 mm	M8
	Box terminal	Cu	25 – 185	12 Nm	5 mm	--
		Flexible copper busbar	17 x 10	12 Nm	5 mm	--
	Circular conductor connection	Al / Cu	25 – 35 50 – 185	14 Nm 31 Nm	8 mm	--
	Circular conductor connection with terminal cover	Al / Cu	120 – 150 285 – 240	25 Nm 30 Nm	8 mm	--
VL400	Terminals with screw connection with metric thread for flat connection	Al / Cu	10 x 32 (Busbar)	15 Nm	6 mm	M8
	Box terminal	Cu	50 – 300	25 Nm	8 mm	--
		Flexible copper busbar	25 x 10	25 Nm	8 mm	--
	Circular conductor connection	Al / Cu	95 – 120 150 – 300	31 Nm 56 Nm	12 mm	--
	Multiple feed-in terminal (2 cables)	Al / Cu	50 –120	31 Nm	8 mm	--
	Multiple feed-in terminal with terminal cover	Al / Cu	70 – 300	42 Nm	8 mm	--

Molded case circuit breakers	Connection type	Conductor	Conductor cross-section mm^2	Tightening torque	Tool Allen key	Connection screw
VL630	Terminals with screw connection with metric thread for flat connection	Al / Cu	1x 40 x 10 (busbar)	15 Nm	5 mm	M6
	Multiple feed-in terminal (2 cables)	Al / Cu	50 – 240	34 Nm	8 mm	--
	Connecting terminal plate for flexible copper busbars	Cu	10 x 32 (busbar)	15 Nm	5 mm	M6
VL800	Terminals with screw connection with metric thread for flat connection	Al / Cu	2x 40 x 10 (busbar)	24 Nm	6 Nm	M8
	Multiple feed-in terminal (3 cables)	Al / Cu	50 – 240	42 Nm	8 mm	--
VL1250	Terminals with screw connection with metric thread for flat connection	Al / Cu	2x 50 x 10 (busbar)	24 Nm	6 mm	M8
	Multiple feed-in terminal (4 cables)	Al / Cu	50 – 240	42 Nm	8 mm	--
VL1600	Terminals with screw connection with metric thread for flat connection	Al / Cu	3x 60 x 10 (busbar)	24 Nm	6 mm	--

Front connecting bars

Table 11- 10 Front connecting bars

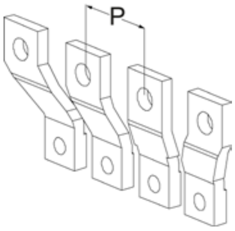
Dimensions (mm)	VL160X/ VL160	VL250	VL400	VL630	VL800	VL1250 / VL1600
Width (W)	20	22	30,5	42	51	60
Length (L)	44,5	44,5	81,75	69,75	91,5	102,25
Clearance (D)	10	13	15	15	15	20
Thickness (T)	6,5	6,5	9,5	9,5	9,5	16
inside (∅)	7	11	11	11	13	13



Front connecting bars for increased pole spacing

Table 11- 11 Front connecting bars for increased pole spacing

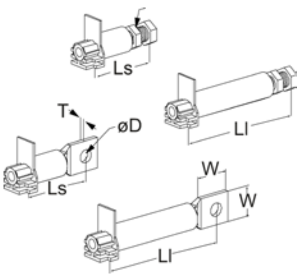
Dimensions (mm)	VL160X / VL160	VL250	VL400	VL630	VL800
Pole clearance (P)	44,5	44,5	63,5	76	76



Rear terminals

Table 11- 12 Rear terminals

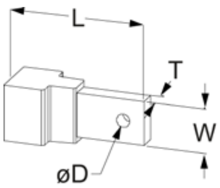
Thread round terminal	VL160X / VL160	VL250	VL400
Short length (Ls) mm	66	66	73
Long length (Ll) mm	123	123	131
Thread	M12	M12	M12
Flat terminal	VL160X / VL160	VL250	VL400
Short length (Ls) mm	51,5	51,5	98
Long length (Ll) mm	108,5	108,5	157
Bore hole Ø	11	11	11
W / W / T	25 / 25 / 4	25 / 25 / 4	28 / 28 / 8



Rear flat busbar terminals

Table 11- 13 Rear flat busbar terminals

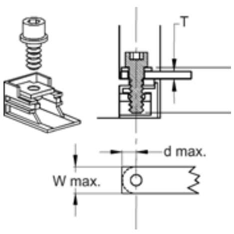
mm	VL630	VL800	VL1250	VL1600
Width (W)	32	50	50	60
Length (L)	66,5	142	142	178
inside (∅ D)	11	13 (2x)	13 (2x)	13 (2x)
Allen key/hex wrench opening	6 / -	6 / -	6 / -	- / 18
Tightening torque for fixing screw	15 Nm	15 Nm	15 Nm	30 Nm



Terminals with screw connection

Table 11- 14 Terminals with screw connection

Molded case circuit breaker		VL160X	VL160	VL250	VL400	VL630	VL800	VL1250
Screw	mm	M6 x 20	M6 x 20	M8 x 20	M8 x 25	M6 x 40	M8 x 50	M8 x 50
Busbar thickness T	mm	1 - 7	1 - 7	1 - 7	3 - 10	5 - 10	10 - 20	20 - 30
Max. torque	Nm	6	6	10	15	15	24	24
Busbar d_{max} W_{max}	mm mm	6 19	9 24	9 24	10 32	10 42	13 50	13 50



11.4 Derating factors

The tables for derating factors apply for 3VL molded case circuit breakers used under difficult operating conditions in the following areas:

11.4.1 Use at altitudes above 2000 meters

Table 11- 15 Derating factors for high altitudes

Molded case circuit breaker	Characteristic values	Altitude (m)						
		2000	3000	4000	5000	6000	7000	8000
All	Breaking capacity I_{CU}/I_{CS}	1,0	0,9	0,8	0,7	0,6	0,5	0,4
	Operating voltage U_{max}	1,0	0,9	0,8	0,7	0,6	0,5	0,4
	Operating current I_{max} 1)	1,00	0,96	0,92	0,88	0,84	0,80	0,76
	Set current I_r 2)	1,00	1,02	1,04	1,06	1,08	1,10	1,12

1) At max. ambient temperature 50 °C

2) Thermal-magnetic releases only

See also

Use in unusual environments: (Page 67)

11.4.2 Use under diverse ambient temperatures

Thermal-magnetic overcurrent releases

Fixed mounting:

Table 11- 16 Derating factors of thermal-magnetic overcurrent release

Molded case circuit breaker	I_n At 50 °C [A]	Cross-section Cu [mm²] min.	Cross-section Al [mm²] min.	Max. rated uninterrupted current according to the ambient temperature x I_n			
				40 °C	50 °C	60 °C	70 °C
VL160X	16	2,5	4	1	1	0,93	0,86
	20	2,5	4	1	1	0,93	0,86
	25	4	6	1	1	0,93	0,86
	32	6	10	1	1	0,93	0,86
	40	10	10	1	1	0,93	0,86
	50	10	16	1	1	0,93	0,86
	63	16	25	1	1	0,93	0,86
	80	25	35	1	1	0,93	0,86
	100	35	50	1	1	0,93	0,86
	125	50	70	1	1	0,93	0,86
	160	70	95	1	1	0,93	0,86
VL160	50	10	16	1	1	0,93	0,86
	63	16	25	1	1	0,93	0,86
	80	25	35	1	1	0,93	0,86
	100	35	50	1	1	0,93	0,86
	125	50	70	1	1	0,93	0,86
	160	70	95	1	1	0,93	0,86
VL250	200	95	120	1	1	0,93	0,86
	250	120	185	1	1	0,93	0,86
VL400	200	95	120	1	1	0,93	0,86
	250	120	185	1	1	0,93	0,86
	315	185	2x120	1	1	0,93	0,86
	400	240	2x150	1	1	0,93	0,86
VL630	315	185	2x120	1	1	0,93	0,86
	400	240	2x150	1	1	0,93	0,86
	500	2x150	2x185	1	1	0,93	0,86
	630	2x185	2x240	1	1	0,93	0,86

Plug-in or withdrawable version:

Table 11- 17 Derating factors thermal-magnetic overcurrent releases (plug-in or withdrawable version)

Molded case circuit breaker	Release Thermal-magnetic TM		Coefficient at			
	From [A]	To [A]	40 °C	50 °C	60 °C	70 °C
VL160X	16	40	1	1	1	1
VL160 & VL160X	50	100	1	1	1	1
	125	160	1	0,9	0,9	0,9
VL250	200	250	1	0,9	0,9	0,9
VL400	200	250	1	1	1	1
	315	400	1	0,9	0,9	0,9
VL630	315	400	1	1	1	1
	500	630	1	0,85	0,85	0,85

Example for VL250:

- I_n = 200 A at 50 °C
- Ambient temperature = 60 °C

1. Fixed-mounted version:
   I_n = 200 x 0.93[1)] = 186 A
   Set I_R to the next lowest value -> I_R = 0.9 = 180 A
2. Plug-in or withdrawable version:
   I_n = 200 x 0.93[1)] x 0.9[2)] = 167 A
   -> Calculation of overall derating = 0.93 x 0.9 = 0.837
   -> Set I_R to the next lowest value -> I_R = 0.8 = 160 A

1) Derating factor from the table "Derating factors of thermal-magnetic overcurrent releases"

2) Coefficient for plug-in or withdrawable version from the table "Derating factors for thermal-magnetic overcurrent releases (plug-in or withdrawable version)"

Thermal-magnetic overcurrent release + RCD module

Fixed mounting:

Table 11- 18 Derating factors for thermal-magnetic overcurrent release + RCD module (fixed mounting)

Molded case circuit breaker	I_n At 50 °C [A]	Cross-section Cu [mm²] min.	Cross-section Al [mm²] min.	Max. rated uninterrupted current according to the ambient temperature x I_n			
				40 °C	50 °C	60 °C	70 °C
VL160X	16	2,5	4	1	1	0,93	0,8
	20	2,5	4	1	1	0,93	0,8
	25	4	6	1	1	0,93	0,8
	32	6	10	1	1	0,93	0,8
	40	10	10	1	1	0,93	0,8
	50	10	16	1	1	0,93	0,8
	63	16	25	1	1	0,93	0,8
	80	25	35	1	1	0,93	0,8
	100	35	50	1	1	0,93	0,8
	120	50	70	1	1	0,93	0,8
	160	70	95	1	1	0,93	0,8
VL160	50	10	16	1	1	0,93	0,8
	63	16	25	1	1	0,93	0,8
	80	25	35	1	1	0,93	0,8
	100	35	50	1	1	0,93	0,8
	125	50	70	1	1	0,93	0,8
	160	70	95	1	1	0,93	0,8
VL250	200	95	120	1	1	0,86	0,8
	250	120	185	1	1	0,86	0,8
VL400	200	95	120	1	1	0,86	0,8
	250	120	185	1	1	0,86	0,8
	315	185	2x120	1	1	0,86	0,8
	400	240	2x150	1	1	0,86	0,8

Plug-in or withdrawable version:

Table 11- 19 Derating factors for thermal-magnetic overcurrent release + RCD module (plug-in or withdrawable version)

Molded case circuit breaker	Release Thermal-magnetic TM		Coefficient at			
	From [A]	To [A]	40 °C	50 °C	60 °C	70 °C
VL160X	16	40	1	1	1	1
VL160 & VL160X	50	100	1	0,97	0,97	0,97
	125	160	1	0,88	0,88	0,88
VL250	200	250	1	0,85	0,85	0,85
VL400	200	250	1	0,97	0,97	0,97
	315	400	1	0,85	0,85	0,85

Electronic trip unit

Fixed mounting:

Table 11- 20 Derating factors for electronic trip unit (fixed mounting)

Molded case circuit breaker	I_n At 50 °C [A]	Cross-section Cu [mm²] min.	Cross-section Al [mm²] min.	Max. rated uninterrupted current according to the ambient temperature x I_n			
				40 °C	50 °C	60 °C	70 °C
VL160	63	16	25	1	1	1	0,8
	100	35	50	1	1	1	0,8
	160	70	95	1	1	1	0,8
VL250	200	95	120	1	1	1	0,8
	250	120	185	1	1	0,95	0,8
VL400	315	185	2x120	1	1	1	0,8
	400	240	2x150	1	1	0,95	0,8
VL630	630	2x185	2x240	1	1	0,95	0,8
VL800	800	500	--	1	1	0,95	0,8
VL1250	1000	600	--	1	1	1	0,8
	1250	800	--	1	1	0,95	0,8
VL1600	1600	1000	--	1	1	0,95	0,8

Note

The electronic trip units with order No. supplement (9th and 10th position) Sx, Mx, Lx, Tx, Nx and Ux have a thermal self-protection feature that trips the breaker if the electronics components reach 100 °C.

Plug-in or withdrawable version:

Table 11- 21 Derating factors for electronic trip units (plug-in or withdrawable version)

Molded case circuit breaker	Release ETU		Coefficient at			
	From [A]	To [A]	40 °C	50 °C	60 °C	70 °C
VL160	63	100	1	1	1	1
	125	160	1	0,9	0,9	0,9
VL250	200	250	1	0,9	0,9	0,9
VL400	315	400	1	0,9	0,9	0,9
VL630	--	630	1	0,85	0,85	0,85
VL800	--	800	1	0,9	0,9	0,9
VL1250	1000	1250	1	0,95	0,95	0,95
VL1600	--	1600	1	0,8	0,8	0,8

Example for VL250:

- I_n = 250 A at 50 °C
- Ambient temperature = 60 °C

1. Fixed-mounted version:
   I_n = 250 x 0.95[1)] = 237 A
   Set I_R to the next lowest value -> I_R = 0.95 = 237 A
2. Plug-in or withdrawable version:
   I_n = 250 x 0.95[1)] x 0.9[2)] = 213 A
   -> Calculation of overall derating = 0.95 x 0.9 = 0.885
   -> Set I_R to the next lowest value -> I_R = 0.8 = 200 A

[1)] Derating factor from the table "Derating factors of electronic trip units (fixed mounting)"

[2)] Coefficient for plug-in or withdrawable version from the table "Derating factors for electronic trip units (plug-in or withdrawable version)"

Response values for minimum and maximum settings on the thermal release

Table 11- 22 Setting values I_r dependent on the ambient temperature (0 °C … 35 °C)

Size	In [A]	Ambient temperature									
		0 °C		10 °C		20 °C		30 °C		35 °C	
		Tripping values for minimum and maximum settings on the thermal release									
		min	max*	min	max*	min	max*	min	max*	min	max*
VL160X	16	-	19	-	19	-	18	-	17	-	17
	20	22	24	20	23	19	22	18	22	18	21
	25	-	30	-	29	-	28	-	27	-	27
	32	34	38	32	37	30	36	29	35	28	34
	40	43	48	41	46	39	45	36	43	35	42
	50	54	60	51	58	48	56	46	54	44	53
	63	68	76	64	73	61	71	57	68	55	67
	80	85	96	81	93	76	90	72	86	70	85
	100	108	120	102	116	97	112	91	108	88	106
	125	135	150	128	145	121	140	114	135	111	133
	160	169	192	160	186	151	179	143	173	138	170
VL160	50	54	63	51	60	48	58	46	55	44	54
	63	68	79	64	76	61	72	57	69	55	68
	80	85	100	81	96	76	92	72	88	70	86
	100	108	125	102	120	97	115	91	110	88	108
	125	135	156	128	150	121	144	114	138	111	134
	160	169	200	160	192	151	184	143	176	138	172
VL250	200	216	250	205	240	194	230	182	220	177	215
	250	270	313	256	300	242	288	228	275	221	269
VL400	200	216	240	205	232	194	224	182	216	177	212
	250	270	300	256	290	242	280	228	270	221	265
	315	338	378	320	365	303	353	285	340	276	334
	400	432	480	410	464	387	448	365	432	354	424
VL630	315	338	378	320	365	303	353	285	340	276	334
	400	432	480	410	464	387	448	365	432	354	424
	500	540	600	512	580	484	560	456	540	442	530
	630	675	756	640	731	605	706	570	680	553	668

* For TMTUs with fixed setting, the value for "max" applies.

Example for VL160:

The I_r of a VL 160X with adjustable TMTU and I_n = 63 A refers to 50 °C and can be adjusted there in the range 50 A … 63 A. At an ambient temperature of 30 °C, these values change so that the adjustable range for Ir is 57 A … 68 A.

Table 11- 23 Setting values I_r dependent on the ambient temperature (40 °C … 70 °C)

Size	In [A]	Ambient temperature							
		40 °C		50 °C		60 °C **		70 °C **	
		Tripping values for minimum and maximum settings on the thermal release							
		min	max*	min	max*	min	max*	min	max*
VL160X	16	-	17	-	16	-	15	-	15
	20	17	21	16	20	15	19	14	18
	25	-	26	-	25	-	24	-	23
	32	27	33	25	32	23	31	22	29
	40	34	42	32	40	30	38	28	37
	50	43	52	40	50	37	48	34	46
	63	54	66	50	63	47	60	43	58
	80	67	83	63	80	59	77	54	74
	100	86	104	80	100	74	96	69	92
	125	107	130	100	125	93	120	86	115
	160	134	166	125	160	116	154	108	147
VL160	50	43	53	40	50	37	48	34	45
	63	54	66	50	63	47	60	43	57
	80	67	84	63	80	59	76	54	72
	100	86	105	80	100	74	95	69	90
	125	107	131	100	125	93	119	86	113
	160	134	168	125	160	116	152	108	144
VL250	200	171	210	160	200	149	190	138	180
	250	214	263	200	250	186	238	172	225
VL400	200	171	208	160	200	149	192	138	184
	250	214	260	200	250	186	240	172	230
	315	268	328	250	315	233	302	215	290
	400	342	416	320	400	298	384	275	368
VL630	315	268	328	250	315	233	302	215	290
	400	342	416	320	400	298	384	275	368
	500	428	520	400	500	372	480	344	460
	630	535	655	500	630	465	605	430	580

* For TMTUs with fixed setting, the value for "max" applies.

** For temperatures in excess of 50 °C, the derating factors also have to be observed. (see Auto-Hotspot)

11.5 Power loss

Power loss for fixed-mounted molded case circuit breakers

Thermal-magnetic overcurrent releases (TM)

The table below shows the **power loss and the current path resistance for thermal-magnetic overcurrent releases (TM)**. The power loss applies for I_n with 3-phase balanced load. The specified power loss is the sum of all current paths. The current path resistance is only a guide value and can fluctuate.

Table 11- 24 Power loss for thermal-magnetic overcurrent releases (TM)

Type	Rated current [A]	Power loss [W]	Path resistance [mΩ]
VL160X	16	11	14
	20	17	14
	25	7	3,7
	32	11	3,6
	40	16	3,3
	50	15	2,0
	63	18	1,5
	80	24	1,3
	100	22	0.73
	125	31	0,66
	160	41	0,53
VL160	50	16	2,1
	63	21	1,8
	80	27	1,4
	100	27	0,90
	125	36	0,77
	160	55	0,63
VL250	200	60	0,47
	250	71	0,38
VL400	200	60	0,50
	250	84	0,45
	315	120	0,40
	400	175	0,36
VL630	315	85	0,29
	400	120	0,25
	500	170	0,23
	630	230	0,19

Electronic trip units (ETU / LCD-ETU)

The table below shows the **power loss for electronic trip units (ETU / LCD-ETU)**. The power loss applies for I_n with 3-phase balanced load. The specified power loss is the sum of all current paths.

The current path resistance is only a guide value and can fluctuate.

Table 11- 25 Power loss for electronic overload releases (ETU / LCD-ETU)

Type	Rated current [A]	Power loss [W]	Path resistance [mΩ]
VL160	63	7	0,59
	100	16	0,53
	160	40	0,52
VL250	200	42	0,35
	250	60	0,32
VL400	315	60	0,2
	400	90	0,19
VL630	630	160	0,13
VL800	800	250	0,13
VL1250	1000	135	0,045
	1250	210	0,045
VL1600	1600	260	0,034

Starter combinations

The table below shows the **power loss and the current path resistance for starter combinations**. The power loss applies for I_n with 3-phase balanced load. The specified power loss is the sum of all current paths. The current path resistance is only a guide value and can fluctuate.

Table 11- 26 Power loss for starter combinations

Type	Rated current [A]	Power loss [W]	Path resistance [mΩ]
VL160	63	7	0,59
	100	16	0,53
	160	40	0,52
VL250	250	60	0,32
VL400	200	30	0,25
	250	42	0,22
	315	60	0,20
VL630	315	59	0,20
	500	118	0,16

Molded case non-automatic circuit breakers

The table below shows the **power loss and the current path resistance for molded case non-automatic circuit breakers.** The power loss applies for I_n with 3-phase balanced load. The specified power loss is the sum of all current paths. The current path resistance is only a guide value and can fluctuate.

Table 11- 27 Power loss for molded case circuit breakers

Type	Rated current [A]	Power loss [W]	Path resistance [mΩ]
VL160X	100	13	0,43
	160	34	0,44
VL160	100	16	0,53
	160	40	0,52
VL250	250	60	0,32
VL400	400	90	0,19
VL630	630	160	0,13
VL800	800	250	0,13
VL1250	1250	210	0,045
VL1600	1600	260	0,034

11.6 Capacitor banks

Selection of the molded case circuit breaker for protecting and switching capacitors

This table takes account of only a few typical applications and combinations. The appropriate selection must be made for all other applications.

Table 11- 28 Selection examples for capacitor protection circuits

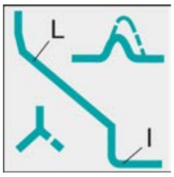
Rated voltage [50 Hz]	Q_c capacitor bank power [kvar]	Capacitor rated current x 1.5 = I_R of the SENTRON VL [A]	Upstream 3VL molded case circuit breaker		
			Type	I_R [A]	I_i [A]
230 V	15	56	VL160	50-63	600
	30	113	VL160	100-125	1000
400 V	25	54	VL160	50-63	600
	50	108	VL160	100-125	1000
	100	216	VL250	200-250	2000
415 V	20	42	VL160	40-50	600
	40	84	VL160	80-100	1000
525 V	25	42	VL160	40-50	600
	50	84	VL160	80-100	1000

11.7 Motor Protection

The following characteristic values in the relevant tables apply for the 3VL molded case circuit breakers in motor protection with different trip classes:

- Trip class ETU10M fixed
- Trip class ETU30M adjustable
- Trip class ETU40M adjustable

Molded case circuit breakers for motor protection with fixed trip class ETU10M



Molded case circuit breaker characteristic curve for motor protection with fixed trip class ETU10M

These molded case circuit breakers possess an adjustable overload and short-circuit release and a fixed trip class.

They are current-limiting and have a phase failure sensitivity feature Communication via PROFIBUS DP and Modbus RTU is possible.

Table 11- 29 Molded case circuit breakers for motor protection with fixed trip class ETU10M

Molded case circuit breaker	Rated current I_n	Max. rated power of the motor at 50 Hz AC		Adjustable range of the overload protection I_R	Adjustable range of the short-circuit protection I_I	Trip class TC
	[A]	[kW]		[A]	[A]	[s]
		380 / 415 V	500 V			
VL160	63	30	37	0.41-1.0 x I_n	1.25-11 x I_n	10
	100	37, 45	55	0.41-1.0 x I_n	1.25-11 x I_n	10
	160	55, 75	75, 90	0.41-1.0 x I_n	1.25-11 x I_n	10
VL250	200	90, 110	110, 132	0.41-1.0 x I_n	1.25-11 x I_n	10
	250	132	160	0.41-1.0 x I_n	1.25-11 x I_n	10
VL400	315	160	200	0.41-1.0 x I_n	1.25-11 x I_n	10
	315	200	250	0.41-1.0 x I_n	1.25-11 x I_n	10
VL630	500	250	355	0.41-1.0 x I_n	1. 5-12.5 x I_n	10

Molded case circuit breakers for motor protection with adjustable trip class ETU30M

Molded case circuit breaker characteristic curve for motor protection with adjustable trip class ETU30M

These molded case circuit breakers possess an adjustable overload and short-circuit release and an adjustable trip class.

They are current-limiting and have a phase failure sensitivity feature Communication via PROFIBUS DP and Modbus RTU is possible.

Table 11- 30 Molded case circuit breakers for motor protection with adjustable trip class ETU30M

Molded case circuit breaker	**Rated current I_n**	**Max. rated power of the motor at 50 Hz AC**		**Adjustable range of the overload protection I_R**	**Adjustable range of the short-circuit protection I_I**	**Trip class TC**
	[A]	**[kW]**		**[A]**	**[A]**	**[s]**
		380 / 415 V	**500 V**			
VL160	63	30	37	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
	100	37, 45	55	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
	160	55, 75	75, 90	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
VL250	200	90, 110	110, 132	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
	250	132	160	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
VL400	315	160	200	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
	315	200	250	0.41-1.0 x I_n	6/8/11 x I_n	10/20/30
VL630	500	250	355	0.41-1.0 x I_n	6/8/12.5 x I_n	10/20/30

Molded case circuit breakers for motor protection with adjustable trip class ETU40M

Molded case circuit breaker characteristic curve for motor protection with adjustable trip class ETU40M

These molded case circuit breakers possess an adjustable overload and short-circuit release and an adjustable trip class. They are current-limiting and have a phase failure sensitivity feature. They are also equipped with an LCD display for indicating the current and for parameterization.

Communication via PROFIBUS and Modbus RTU is possible.

Table 11- 31 Molded case circuit breakers for motor protection with adjustable trip class ETU40M

Molded case circuit breaker	**Rated current I_n**	**Max. rated power of the motor at 50 Hz AC**		**Adjustable range of the overload protection I_R**	**Adjustable range of the short-circuit protection I_I**	**Trip class TC**
	[A]	**[kW]**		**[A]**	**[A]**	**[s]**
		380 / 415 V	**500 V**			
VL160	63	30	37	25-63	1.25-11 x I_n	5/10/15/20/30
	100	37, 45	55	40-100	1.25-11 x I_n	5/10/15/20/30
	160	55, 75	75, 90	63-160	1.25-11 x I_n	5/10/15/20/30
VL250	200	90, 110	110, 132	80-200	1.25-11 x I_n	5/10/15/20/30
	250	132	160	100-250	1.25-11 x I_n	5/10/15/20/30
VL400	315	160	200	126-315	1.25-11 x I_n	5/10/15/20/30
	315	200	250	126-315	1.25-11 x I_n	5/10/15/20/30
VL630	500	250	355	200-500	1.25-12.5 x I_n	5/10/15/20/30

11.8 Motorized operating mechanisms

Table 11- 32 Overview of motorized operating mechanisms

Type	3VL1	3VL2	3VL3	3VL4	3VL5	3VL6	3VL7	3VL8
Motorized operating mechanism (MO)	x	x	x	x	x	x	x	x
Motorized operating mechanism with stored energy mechanism (SEO) for network synchronization	x	x	x	x	x	x		

x: Available

Motorized operating mechanism with stored energy mechanism (SEO)

Table 11- 33 Motorized operating mechanism with stored energy mechanism (SEO)

Type of molded case circuit breaker		3VL1 / 3VL2 / 3VL3	3VL4	3VL5 / 3VL6
Type of motorized operating mechanism with stored energy mechanism (SEO)		**3VL9300-3M_00**	**3VL9400-3M_00**	**3VL9600-3M_00**
Power consumption	[VA / W]	< 100	< 200	< 250
Rated control supply voltage U_s	50 / 60 Hz [V AC]	42 … 48 / 60 / 110 … 127 / 220 … 250		
	DC [V]	24 / 42 … 48 / 60 / 110 … 127 / 220 … 250		
NEOZED fuse (performance class gG, characteristic slow)	24 V	9 A		
	42 / 60 V	4 A		
	110 / 250 V	2 A		
Miniature circuit breaker (C characteristic in accordance with DIN VDE 0641)	24 V	6 A		
	42 / 60 V	4 A		
	110 / 250 V	2 A		
Operating range	[V]	0.85 … 1.1 x U_s		
Min. command duration at U_s	[ms]	50		
Max. command duration, connection-dependent [1)]	—	Jog or continuous command		
Total closing time	[ms]	< 100		
OFF time	[s]	< 5		
Interval between the commands OFF and ON	[s]	> 5		
Interval between the commands ON and OFF	[s]	> 1		
Max. permissible switching frequency	[1/h]	120		60

1) Note the idle times between ON and OFF.

Motorized operating mechanism (MO)

Table 11- 34 Motorized operating mechanism (MO)

Type of molded case circuit breaker		3VL1	3VL2 / 3VL3	3VL4	3VL5 / 3VL6	3VL7 / 3VL8
Type of motorized operating mechanism (MO)		**3VL9100-3M_10**	**3VL9300-3M_10**	**3VL9400-3M_10**	**3VL9600-3M_10**	**3VL9800-3M_10**
Power consumption	[VA / W]	< 100				< 150
Rated control supply voltage U_s	50 / 60 Hz [V AC]	42 … 60 / 110 … 127 / 220 … 250				
	DC [V]	24 / 42 … 60 / 110 … 127 / 220 … 250				
NEOZED fuse (performance class gL /gG)	24 V	6 A				
	42 … 60 V	6 A				
	110 V	4 A				
	220 V	2 A				
Miniature circuit breaker (C characteristic in accordance with DIN VDE 0641) [1]	24 V	C 6 A				
	42 … 60 V	C 6 A				
	110 V	C 4 A				
	220 V	C 2 A				
Operating range	[V]	0.85 … 1.1 x U_s				
Min. command duration at U_s	[ms]	50				
Max. command duration, connection-dependent [1]	—	Jog or continuous command				
Total closing time	[s]	< 1				
OFF time	[s]	< 1				
Interval between the commands OFF and ON	[s]	≥ 10				
Interval between the commands ON and OFF	[s]	≥ 10				
Max. permissible switching frequency	[1 / h]	120				30
Switching capacity of the floating contact (switch position of the mode selector)	—	16 A / 250 V AC; 0.4 A / 125 V DC; 0.2 A / 250 V DC (Switching capacity in accordance with UL 1054)				

[1] Note the idle times between ON and OFF.

11.9 RCD modules

The RCD modules have the following technical data for their system protection function:

Table 11- 35 Overview of RCD modules

<table>
<tr><th rowspan="2">RCD module, molded case circuit breaker for system protection
3- and 4-pole</th><th>Rated current I_n</th><th>Differential currents $I_{\Delta n}$
Adjustable</th><th>Delay time t_d
Adjustable</th><th>Rated operational voltage U_e</th></tr>
<tr><th>[A]</th><th>[A]</th><th>[s]</th><th>[V AC]</th></tr>
<tr><td>VL160X</td><td>160</td><td rowspan="4">0,03
0,10
0,30
0,50
1,00
3,00</td><td rowspan="4">Instantaneous
0,06
0,10
0,25
0,50
1,00</td><td>127-480</td></tr>
<tr><td>VL160</td><td>160</td><td>127-480
230-690</td></tr>
<tr><td>VL250</td><td>250</td><td>127-480
230-690</td></tr>
<tr><td>VL400</td><td>400</td><td>127-480
230-690</td></tr>
</table>

Table 11- 36 Tripped signaling switch in the RCD module [1)]

Rated operating voltage [V AC]	250
Thermal rated current I_{th} [A]	2
Rated making capacity [A]	2
Rated operating current [A]	2
Rated breaking capacity, inductive, cos φ = 0.7 [A]	0,5
Rated breaking capacity, resistive [A]	2
Quick-response backup fuse [A]	2

1) DC rated operating voltage max. 125 V, minimum load 50 mA at 5 V DC.

11.10 Undervoltage release

Technical data of the undervoltage releases of the 3VL molded case circuit breakers:

Table 11- 37 Undervoltage releases for VL160X, VL160 to VL400

		VL160X	VL160	VL250	VL400
Operating voltage [V]					
Release (circuit breaker trips)		0.35-0.70 U_s	0.35-0.70 U_s	0.35-0.70 U_s	0.35-0.70 U_s
Pick-up (circuit breaker can be switched on)		0.85-1.10 U_s	0.85-1.10 U_s	0.85-1.10 U_s	0.85-1.10 U_s
Power consumption					
AC 50 / 60 Hz [VA]	110-127 V	1,5	1,5	1,5	1,5
	220-250 V	1,5	1,5	1,5	1,5
	208 V	1,8	1,8	1,8	1,8
	277 V	2,1	2,1	2,1	2,1
	380-415 V	1,6	1,6	1,6	1,6
	440-480 V	1,8	1,8	1,8	1,8
	500-525 V	2,05	2,05	2,05	2,05
	600 V	2,4	2,4	2,4	2,4
DC [W]	12 V	0,75	0,75	0,75	0,75
	24 V	0,8	0,8	0,8	0,8
	48 V	0,8	0,8	0,8	0,8
	60 V	0,8	0,8	0,8	0,8
	110-127 V	0,8	0,8	0,8	0,8
	220-250 V	0,8	0,8	0,8	0,8
Max. opening time [ms]		50	50	50	50

Table 11- 38 Undervoltage release for VL630 to VL1600

		VL630	VL800	VL1250	VL1600
Operating voltage [V]					
Release (circuit breaker trips)		0.35-0.70 U_s	0.35-0.70 U_s	0.35-0.70 U_s	0.35-0.70 U_s
Pick-up (circuit breaker can be switched on)		0.85-1.10 U_s	0.85-1.10 U_s	0.85-1.10 U_s	0.85-1.10 U_s
Power consumption					
AC 50 / 60 Hz [VA]	110-127 V	1,1	1,1	1,1	1,1
	220-250 V	2,1	2,1	2,1	2,1
	208 V	2,2	2,2	2,2	2,2
	277 V	1,6	1,6	1,6	1,6
	380-415 V	2,0	2,0	2,0	2,0
	440-480 V	2,3	2,3	2,3	2,3
	500-525 V	2,9	2,9	2,9	2,9
DC [W]	12 V	1,2	1,2	1,2	1,2
	24 V	1,4	1,4	1,4	1,4
	48 V	1,5	1,5	1,5	1,5
	60 V	1,6	1,6	1,6	1,6
	110-127 V	1,2	1,2	1,2	1,2
	220-250 V	1,5	1,5	1,5	1,5
Max. opening time [ms]		80	80	80	80

11.11 Time-delay device for undervoltage releases

The time-delay device for undervoltage releases has the following technical data:

Table 11- 39 Time-delay device for undervoltage releases, 3TX4701-0A

	VL160X … VL400	VL630 … VL1600
Rated control supply voltage U_s [V AC / DC]	220 ... 250	220 ... 250
Control voltage for undervoltage release [V DC]	220 ... 250	220 ... 250
Conductor cross-sections		
• Finely stranded with core end sleeve [mm²]	2 x (0.5 ... 1.5)	2 x (0.5 ... 1.5)
• Solid conductor [mm²]	2 x (0.5 ... 1.5)	2 x (0.5 ... 1.5)
For delay time / protective circuit, refer to the chapter "Circuit diagrams (Page 293)".		

11.12 Shunt release

Technical data of the shunt releases of the 3VL molded case circuit breakers

Table 11- 40 Shunt releases for VL160X, VL160 to VL400

		VL160X	VL160	VL250	VL400
Response voltage: Pick-up (circuit breaker trips) [V]		0.7-1.10 U_s	0.7-1.10 U_s	0.7-1.10 U_s	0.7-1.10 U_s
Power consumption					
AC 50 / 60 Hz [VA]	24	480	480	480	480
	48-60 V	401 - 501	401 - 501	401 - 501	401 - 501
	110-127 V	424 - 489	424 - 489	424 - 489	424 - 489
	208-277 V	533 - 736	533 - 736	533 - 736	533 - 736
	380-600 V	408 - 645	408 - 645	408 - 645	408 - 645
DC [W]	24 V	594	594	594	594
	48 - 60 V	740 - 925	740 - 925	740 - 925	740 - 925
	110 - 127 V	559 - 648	559 - 648	559 - 648	559 - 648
	220 - 250 V	722 - 820	722 - 820	722 - 820	722 - 820
Max. in-service period [s]		Interrupts automatically			
Max. opening time [ms]		20	20	20	20
Fuse (slow) [A]		4 (AC 24, 48-60, 110-127 V, 208-277 V) 2 (all others)			
Molded case circuit breaker, [A] C characteristic		5			

Note

The power consumption of the shunt releases for approx. 20 ms should be taken into account when selecting the power supply for the control circuit, for example by means of a corresponding short-time overload capability of the power supply used.

Table 11- 41 Shunt release for VL630 to VL1600

		VL630	VL800	VL1200	VL1600
Response voltage: Pick-up (circuit breaker trips) [V]		0.7-1.10 U_s	0.7-1.10 U_s	0.7-1.10 U_s	0.7-1.10 U_s
Power consumption					
AC 50 / 60 Hz [VA]	24	480	480	480	480
	48-60 V	401 - 501	401 - 501	401 - 501	401 - 501
	110-127 V	424 - 489	424 - 489	424 - 489	424 - 489
	208-277 V	533 - 736	533 - 736	533 - 736	533 - 736
	380-600 V	408 - 645	408 - 645	408 - 645	408 - 645
DC [W]	24 V	594	594	594	594
	48-60 V	740 - 925	740 - 925	740 - 925	740 - 925
	110-127 V	559 - 648	559 - 648	559 - 648	559 - 648
	220-250 V	722 - 820	722 - 820	722 - 820	722 - 820
Max. in-service period [s]		Interrupts automatically			
Max. opening time [ms]		20	20	20	20
Fuse (slow) [A]		4 (AC 24, 48-60, 110-127 V, 208-277 V) 2 (all others)			
Molded case circuit breaker, [A] C characteristic		5			

Note

The power consumption of the shunt releases for approx. 20 ms should be taken into account when selecting the power supply for the control circuit, for example by means of a corresponding short-time overload capability of the power supply used.

11.13 Auxiliary switches and alarm switches

Technical data of the auxiliary and alarm switches of the 3VL molded case circuit breakers:

Table 11- 42 Auxiliary switches and alarm switches

Technical data		
Rated insulation voltage U_i with degree of pollution in accordance with IEC 60947-1	400 V Class 3	
Rated impulse withstand voltage U_{imp}	6 kV	
Conventional thermal current I_{th}	10 A	
Rated operating current I_e **Rated operating voltage U_e** • Alternating current 50 / 60 Hz, AC-12	 at U_e 24 V 48 V 110 V 230 V 400 V 600 V	 I_e 10 A 10 A 10 A 10 A 10 A 10 A
• Alternating current 50 / 60 Hz, AC-15	at U_e 24 V 48 V 110 V 230 V 400 V 600 V	I_e 6 A 6 A 6 A 6 A 3 A 1 A
• Direct current, DC-12	at U_e 24 V 48 V 110 V 230 V	I_e 10 A 5 A 2.5 A 1 A
• Direct current, DC-13	at U_e 24 V 48 V 110 V 230 V	I_e 3 A 1.5 A 0.7 A 0.3 A
Contact reliability Test voltage/test current	 5 V/1 mA	

Technical data	
Short-circuit protection weld-free in accordance with IEC 60947-5-1 • NEOZED fuse links, utilization category gL / gG • Miniature circuit breaker with C characteristic in accordance with IEC 60898 (VDE 0641)	10 A TDz, 16 A D 10 A
Conductor cross-sections • Stranded, with end sleeves in accordance with DIN 46228 • Solid or stranded (metric) • Solid or stranded (AWG)	2 × (0.5 ... 1.5) mm² 2 × (1 ... 2.5) mm² 2 × AWG 18 ... 14
Tightening torques • Connection screws	0.8 Nm
Rated voltage • Switching devices	300 V AC
Continuous current	10 A

11.14 Position signaling switch

Position signaling switch

When a molded case circuit breaker is mounted in a withdrawable or plug-in assembly, the position signaling switch, which is equipped with a changeover contact, is used to indicate whether the molded case circuit breaker is in the connected or withdrawn position. Two position signaling switches can be mounted in each withdrawable or plug-in base.

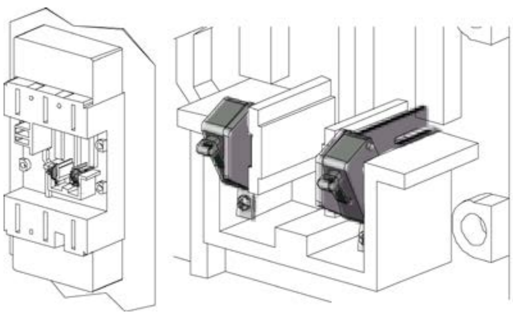


Figure 11-1 Position signaling switch

Technical data of the position signaling switches of the 3VL molded case circuit breakers:

Table 11- 43 Position signaling switch

Technical data		
Conductor cross-sections Screw-type terminal	0.75 .. 2.5 mm^2	
Tightening torques Screws for cable connection	0.5 Nm	
Rated operating temperature	–40 °C to +85 °C	
Data in accordance with IEC/EN 61058		
Rated operating current I_e with rated operating voltage U_e Standard operation	At U_e 250 V AC / 400 V AC	I_e 16 A / 10 A
Rated making capacity	At 250 V AC 16 A	At 400 V AC 10 A
Rated thermal current I_{th}	16 A	
Rated operating voltage	250 V AC	400 V AC
Rated breaking capacity cosφ = 1 (resistive) cosφ = 0.7 (inductive)	At 250 V AC 16 A 4 A	At 400 V AC 10 A 4 A
Short-circuit fuse (quick-response)	At 250 V AC 16 A	At 400 V AC 10 A
Data according to UL 1054		
Rated operating current I_e with rated operating voltage U_e Alternating current Standard operation	With U_e, power, [horsepower] 125 / 250 V AC, 1 HP	I_e 16 A
Flammability class	UL94V-0	

11.15 Leading auxiliary switches in front-operated rotary operating mechanism

Technical data of the leading auxiliary switches in front-operated rotary operating mechanism:

Table 11- 44 Leading auxiliary switches in front-operated rotary operating mechanism

Rated operating voltage [V] AC		230
Thermal rated current I_{th} [A]		2
Rated making/breaking capacity		
	Resistive [A]	2
	Inductive [A] cos φ = 0.7	0,5
Rated operating voltage [V] AC		230
Rated operating current [A]		2
Quick-response backup fuse [A]		2

11.16 Ground-fault detection

The individual overcurrent releases have different ground-fault detection:

Table 11- 45 Overview of ground-fault protection classes

Release	Ordering data	Ground-fault detection
ETU22	SG, MG	Vectorial summation current formation (3-conductor system)
ETU22	SH, NH	Vectorial summation current formation (4-conductor system)
ETU22	TH, NH	Vectorial summation current formation (4-conductor system)
LCD-ETU42	UL	Vectorial summation current formation (3-conductor system)
LCD-ETU42	UM	Vectorial summation current formation (3-conductor system)/direct recording of the ground-fault current in the neutral point of the transformer
LCD-ETU42	UN	Vectorial summation current formation (4-conductor system)

11.17 IP degrees of protection

All 3VL molded case circuit breakers are constructed with degree of protection IP20 regardless of size and version.

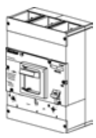
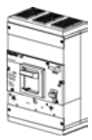
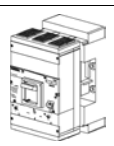
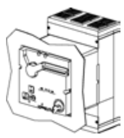
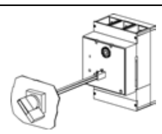
For 3VL6 in withdrawable version, degree of protection IP20 cannot be achieved. The IP degree of protection is less than IP20.

A wide range of additional accessories is available for the basic version of the 3VL molded case circuit breaker in IP20.

The accessories listed below are designed to provide a higher degree of protection:

The degree of protection in accordance with IEC 60529 is listed in the table below:

Table 11- 46 Overview of degrees of protection

Molded case circuit breaker	Protection	Degree of protection
	**Molded case circuit breaker** Finger-proof Protected against solid foreign bodies with a diameter of 12.5 mm or larger.	**IP20**
	**Molded case circuit breaker with terminal cover** Protected against access to live parts with a tool. Protected against solid foreign bodies with a diameter of 2.5 mm or larger.	**IP30**
	**Plug-in molded case circuit breaker** Finger-proof protection against solid foreign bodies with a diameter of 12.5 mm or larger.	**IP20** **IP30**[1)]
	**Molded case circuit breaker with masking frame and motorized operating mechanism** Protected against access to live parts with a wire. Protected against solid foreign bodies with a diameter of 1.0 mm or larger.	**IP40**[2)]
	**Molded case circuit breaker with masking frame for door cutout** Protected against access to live parts with a wire. Protected against solid foreign bodies with a diameter of 1.0 mm or larger.	**IP40**[2)]
	**Molded case circuit breaker with masking frame and front-operated rotary operating mechanism** Protected against access to live parts with a wire. Protected against solid foreign bodies with a diameter of 1.0 mm or larger.	**IP40**[2)]
	**Molded case circuit breaker with door coupling rotary operating mechanism** Protected against ingress of dust and water jets from any direction.	**IP65**[2)]

1) If the molded case circuit breaker is installed and the supplied covers are mounted.
2) Depending on the degree of protection of the enclosure

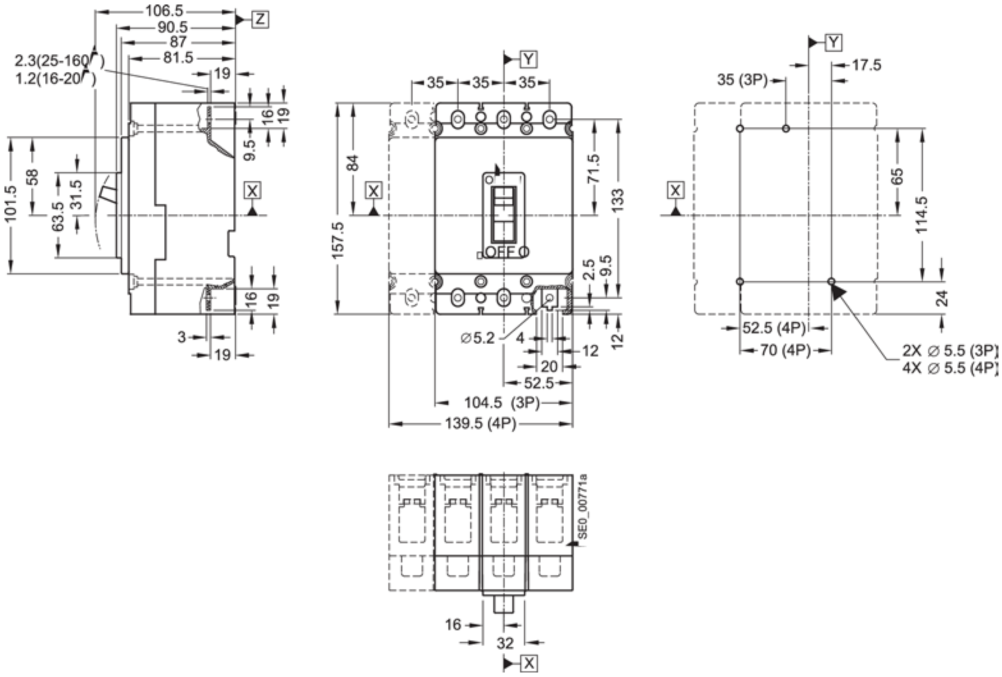
12 Dimensional drawings

All dimensions are in mm.

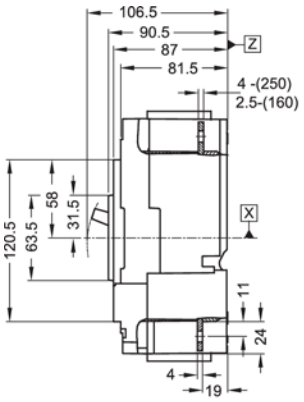
12.1 VL160X (3VL1), VL160 (3VL2), and VL250 (3VL3), 3- and 4-pole, to 250 A

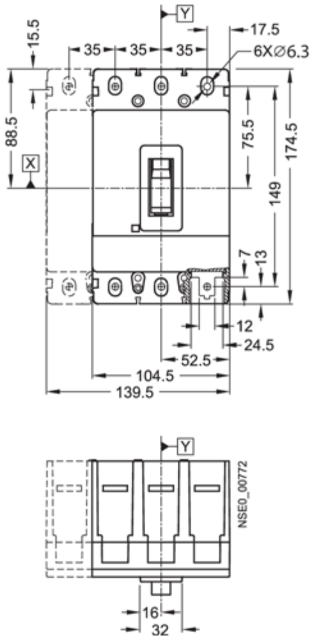
12.1.1 Molded case circuit breakers

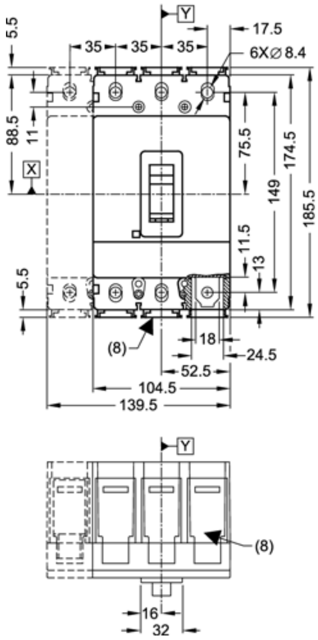
VL160X (3VL1) molded case circuit breakers

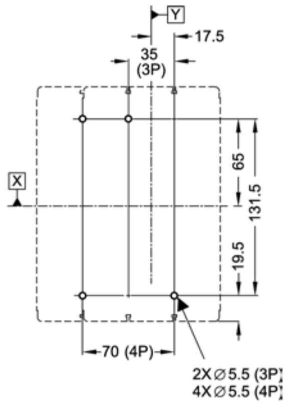


Molded case circuit breakers VL160 / VL250 (3VL2 / 3VL3)	Molded case circuit breakers VL160 (3VL2)	Molded case circuit breakers VL250 (3VL3)	Molded case circuit breakers VL160 and VL250 (3VL2 and 3VL3)









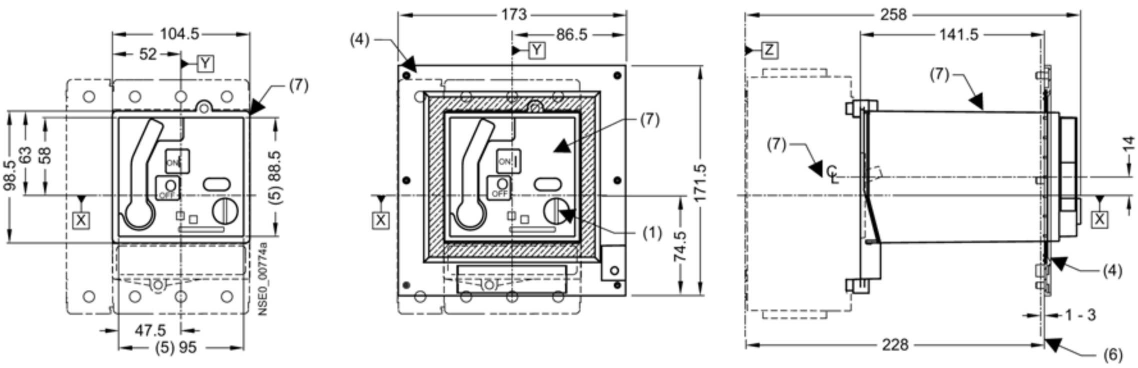
Note

The 5.5 mm extension at each end of the VL250 (3VL3) molded case circuit breaker is only to be observed when using box terminals or circular conductor terminals (8).

12.1.2 Operating mechanisms

Motorized operating mechanism with stored energy mechanism (SEO)

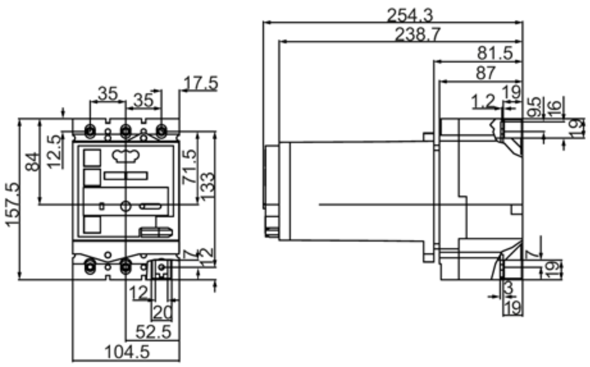
VL160X (3VL1), VL160 (3VL2), and VL250 (3VL3)

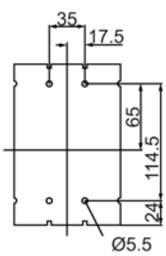


(1) Safety locks
(4) Masking frame for door cutout (for circuit breakers with operating mechanism)
(5) Grading for cover
(6) External surface of cabinet door
(7) Motorized operating mechanism with stored energy mechanism

Motorized operating mechanism (MO)

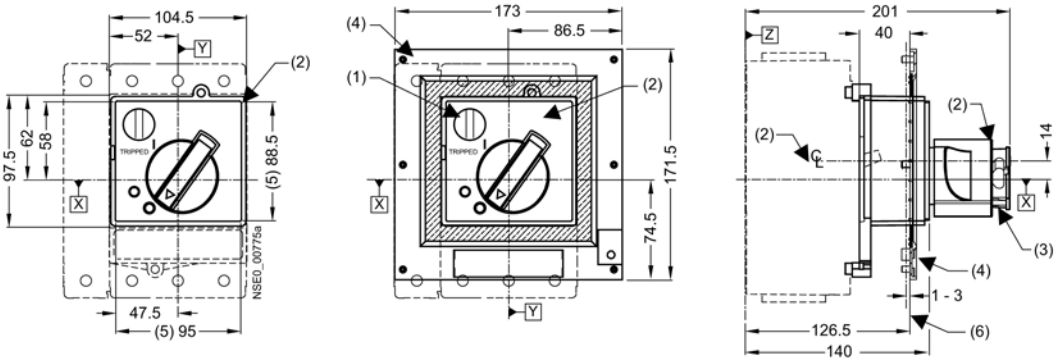
VL160X (3VL1)





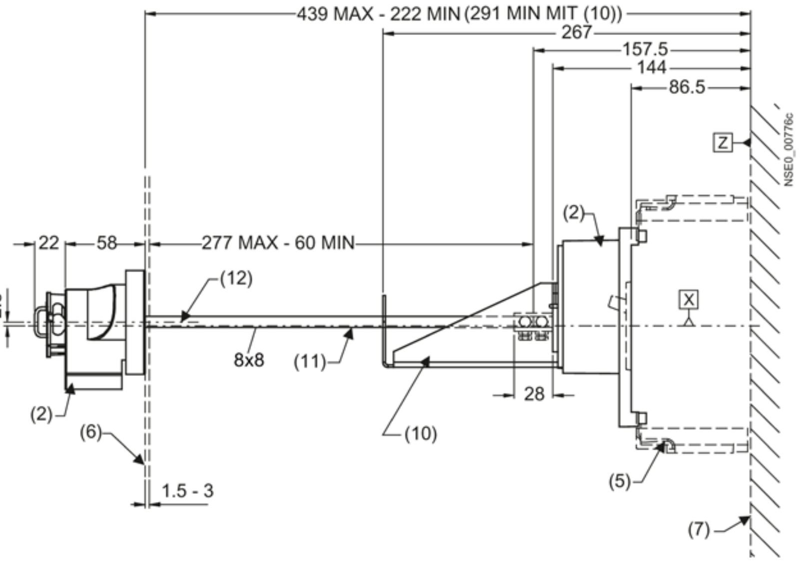
VL160 (3VL2), and VL250 (3VL3)

Front-operated rotary operating mechanism



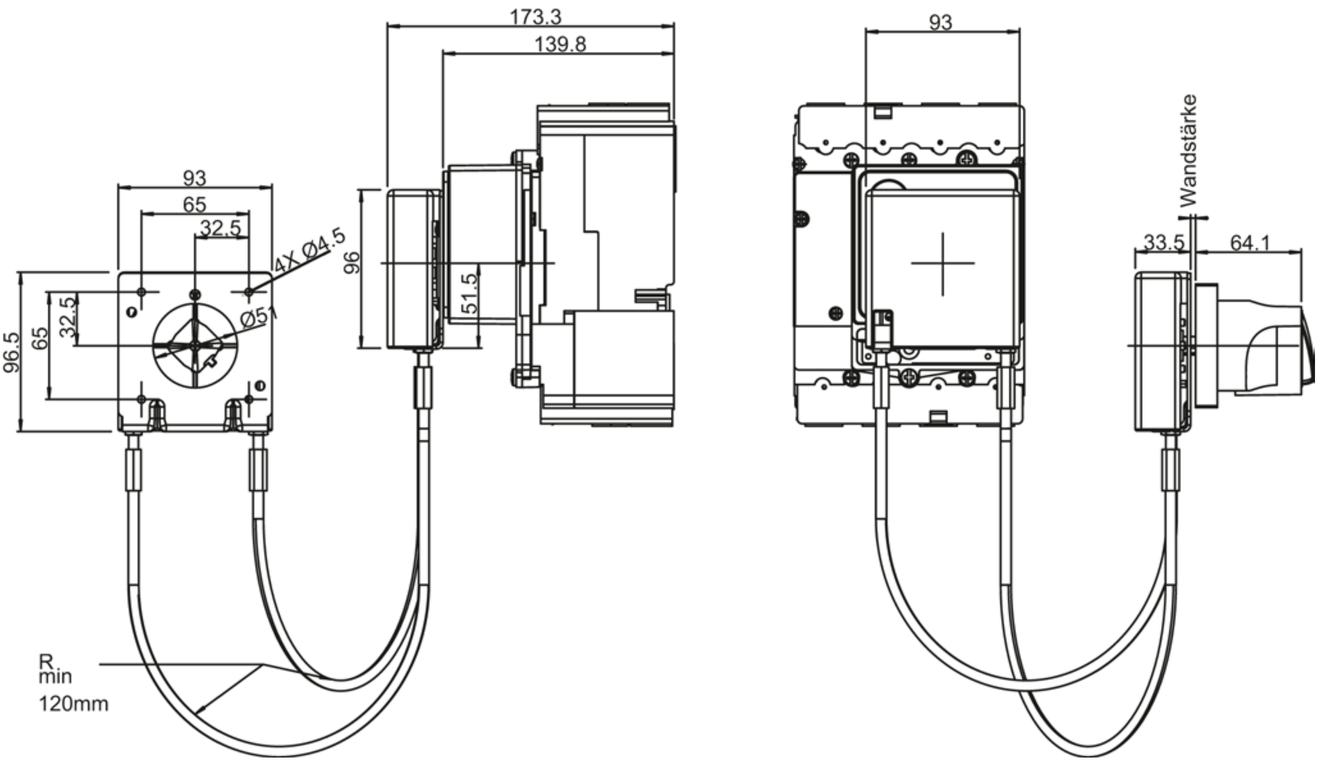
(1)	Safety locks
(2)	Front-operated rotary operating mechanism
(3)	Padlock barrier
(4)	Masking frame for door cutout
(5)	Grading for cover
(6)	External surface of cabinet door

Molded case circuit breaker with door-coupling rotary operating mechanism

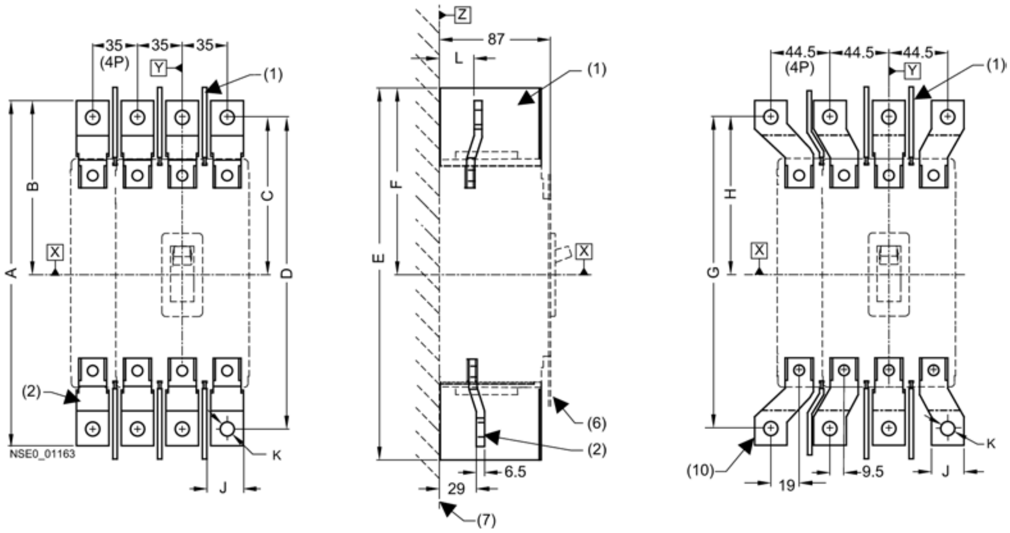


(2)	Door-coupling rotary operating mechanism	(10)	Supporting bracket
(5)	Terminal covers	(11)	Extension
(6)	External surface of cabinet door	(12)	Center line of operating mechanism shaft
(7)	Mounting level		

Molded case circuit breaker with side panel rotary operating mechanism



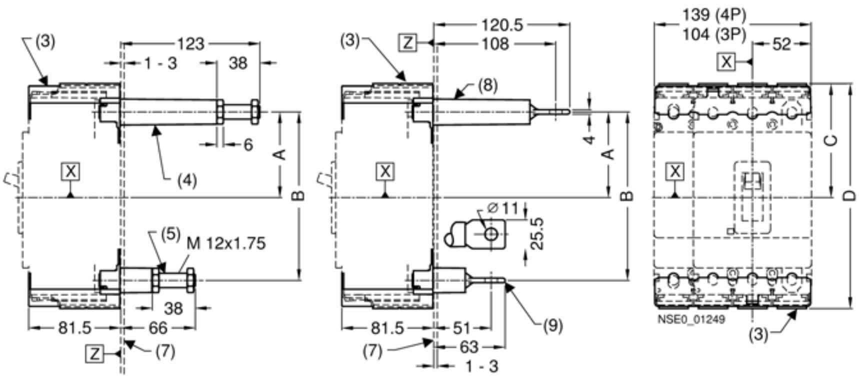
12.1.3 Connections and phase barriers



(1) Interphase barrier
(2) Front connecting bars
(6) External surface of cabinet door
(7) Mounting level
(10) Front connecting bars for increased pole spacing

Type	A	B	C	D	E	F	G	H	J	K	L
VL160X (3VL1)	242	126	116	222	266,5	138,5	222	116	20	7	27
VL160 (3VL2)	258	130	120	238	283,5	143	238	120	20	7	27
VL250 (3VL3)	263,5	133	120	238	283,5	143	238	120	22	11	29

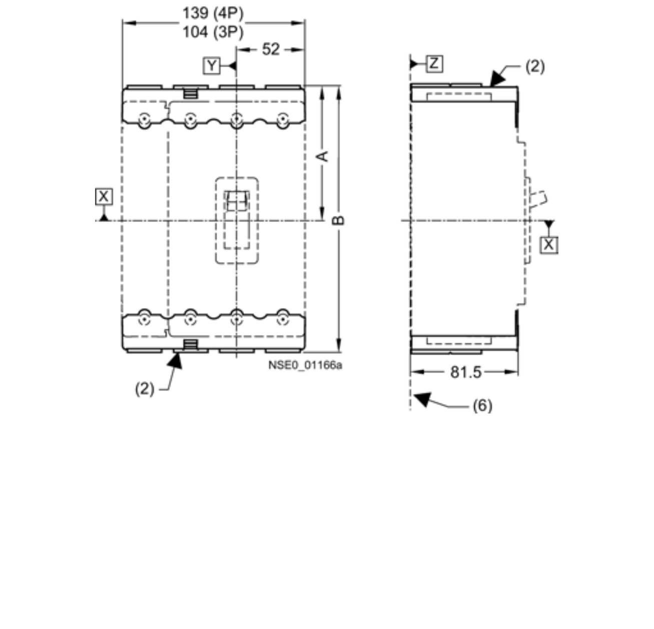
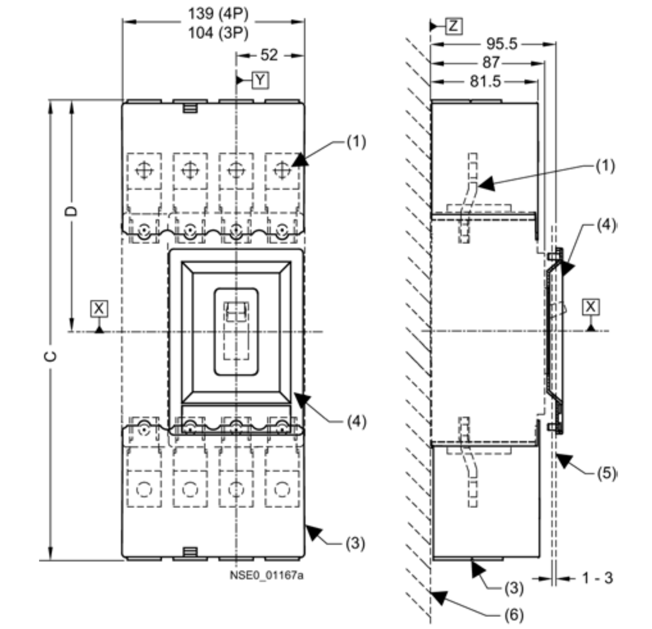
Molded case circuit breaker with rear connections – long and short



(3) Terminal covers (standard)
(4) Rear connection threaded bolt (long)
(5) Rear connection threaded bolt (short)
(7) Mounting level
(8) Rear flat terminals (long)
(9) Rear flat terminals (short)

Type	A	B	C	D
VL160X (3VL1)	71,5	133	96	182
VL160 (3VL2)	75,5	149	101	199
VL250 (3VL3)	75,5	149	101	199

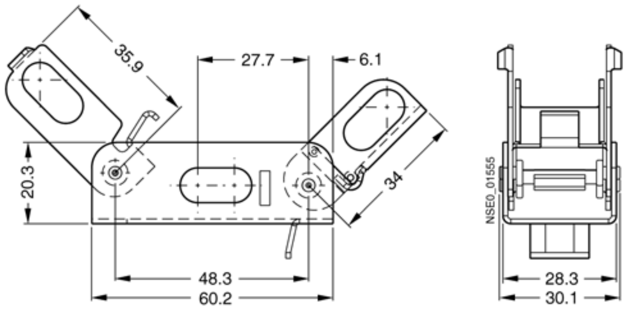
12.1.4 Terminal covers

Terminal covers, standard	Extended terminal covers
	

(1)	Front connecting bars
(2)	Terminal covers (standard)
(3)	Terminal covers (extended)
(4)	Masking frame for door cutout (for molded case circuit breakers with toggle lever)
(5)	External surface of cabinet door
(6)	Mounting level

Type	A	B	C	D
VL160X (3VL1)	96	182	326,5	168,5
VL160 (3VL2)	101	199	343	173
VL250 (3VL3)	101	199	343	173

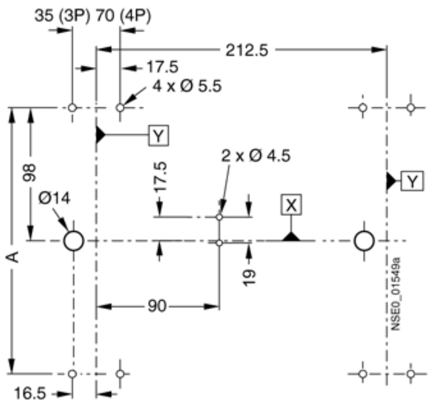
12.1.5 Locking device for the toggle lever



12.1.6 Rear interlocking module

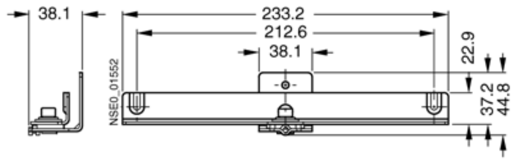
Rear interlocking module for plug-in / withdrawable molded case circuit breakers, with front connection, with/without RCD module (withdrawable module only without RCD module)

For other detailed dimension drawings, please refer to the mounting instructions for the rear interlocking module.



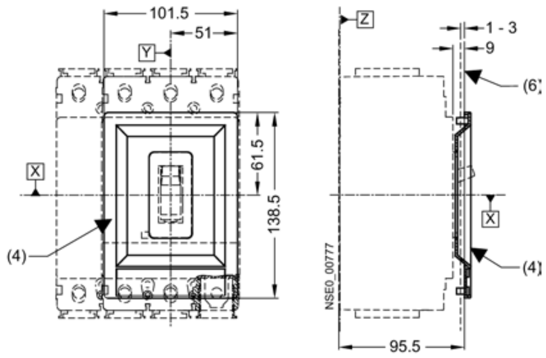
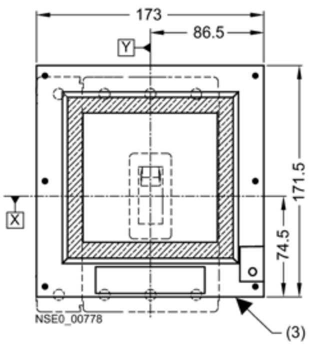
Type		A
Without RCD module	VL160X (3VL1), VL160 (3VL2), VL250 (3VL3)	194
With RCD module – "plug-in version" only	VL160X (3VL1), VL160 (3VL2), VL250 (3VL3)	315

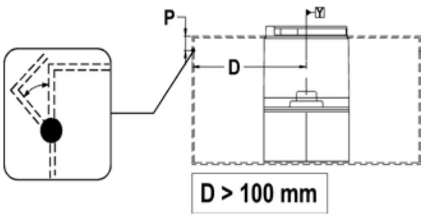
Rear interlocking module



12.1.7 Accessories

Molded case circuit breaker with door-coupling rotary operating mechanism

Masking frame for door cutout for molded case circuit breakers with toggle lever	Masking frame for door cutout for molded case circuit breakers with operating mechanism
	

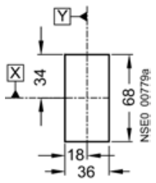
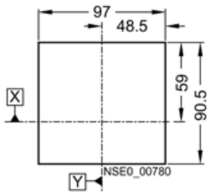
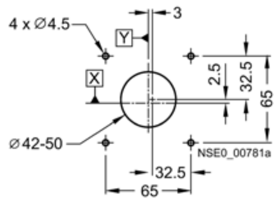


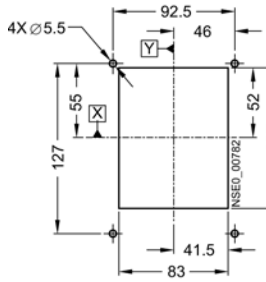
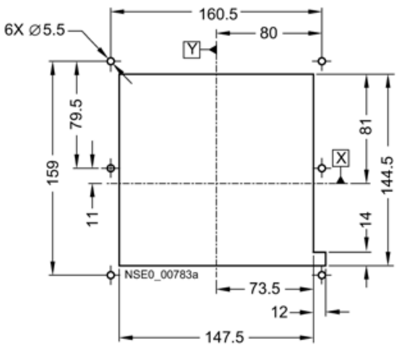
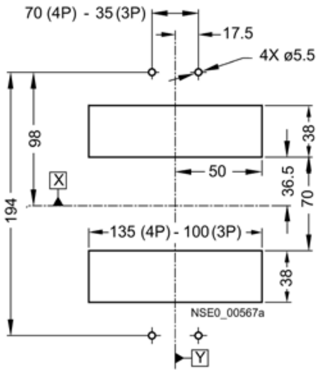
(3) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(4) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

(6) External surface of cabinet door

12.1.8 Door cutouts

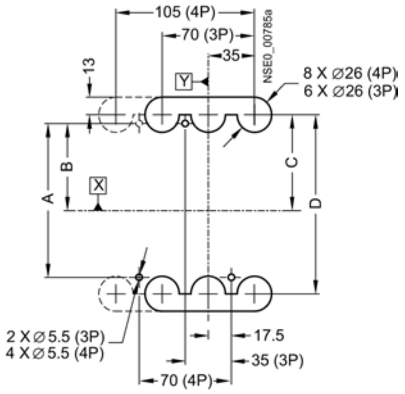
Door cutout Toggle lever (without masking frame)	Door cutout Front-operated rotary operating mechanism and motorized operating mechanism with stored energy mechanism (without masking frame)	Door cutout Door coupling rotary operating mechanism
		

Door cutout toggle lever (with masking frame)	Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon (with masking frame)	Drilling template and cutout for plug-in base with connecting bars on rear
		

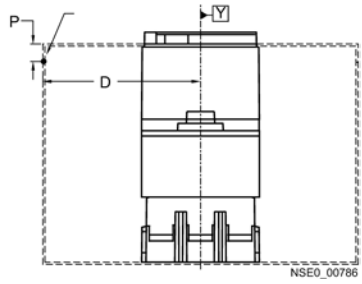
Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

<table>
<tr><th>Drilling template and cutout for rear connection</th><th>Door hinge point (see arrow)</th></tr>
<tr><td>



</td><td>



D > A from table + (P x 5)

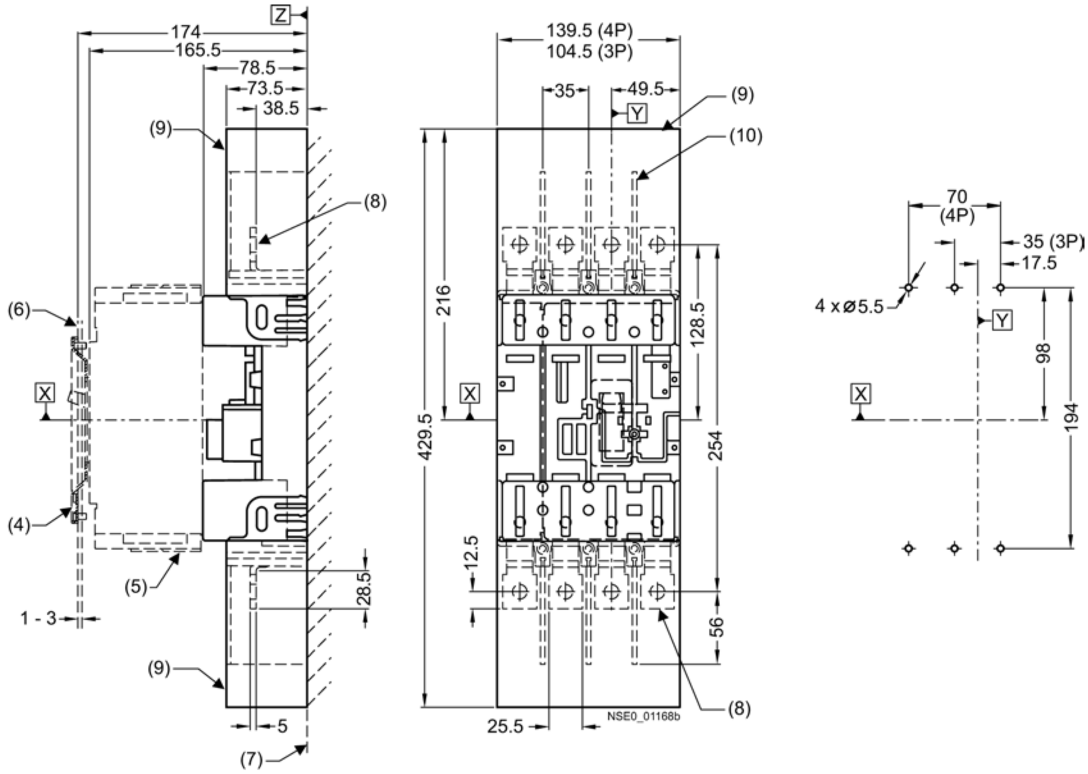
</td></tr>
</table>

Type	A	B	C	D
VL160X (3VL1)	114,5	65	71,5	133
VL160 (3VL2)	131,5	65	75,5	149
VL250 (3VL3)	131,5	65	75,5	149

Combination	A
Molded case circuit breaker only	100
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism	100
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

12.1.9 Plug-in base and accessories

Plug-in base with front connecting bars and drilling template for plug-in base with front connecting bars



(4) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

(5) Terminal covers (standard)

(6) External surface of cabinet door

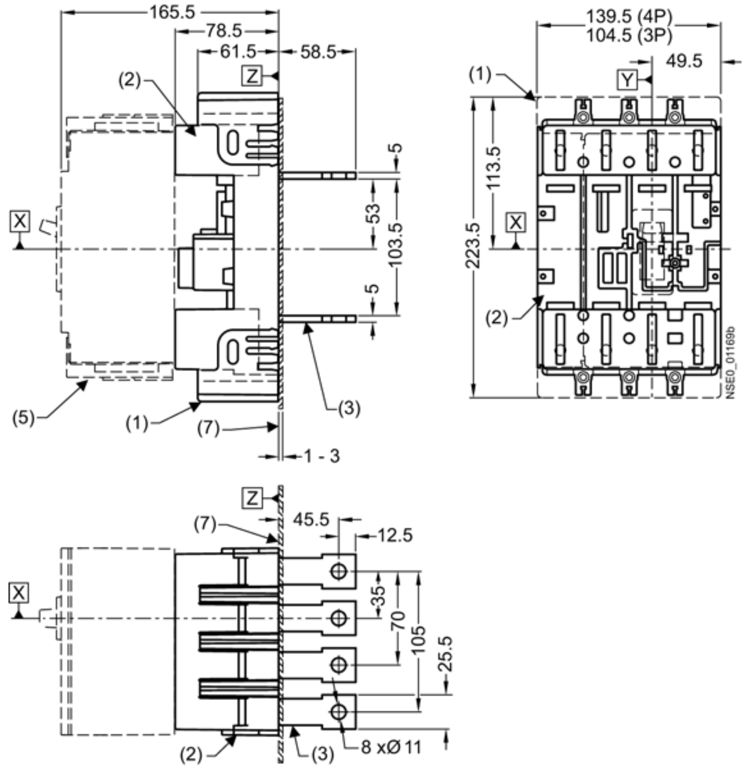
(7) Mounting level

(8) Plug-in base with front connecting bars

(9) Plug-in base with terminal covers on the front

(10) Phase barriers

Plug-in base with flat rear terminals



(1) Plug-in base with rear terminal covers

(2) Plug-in base

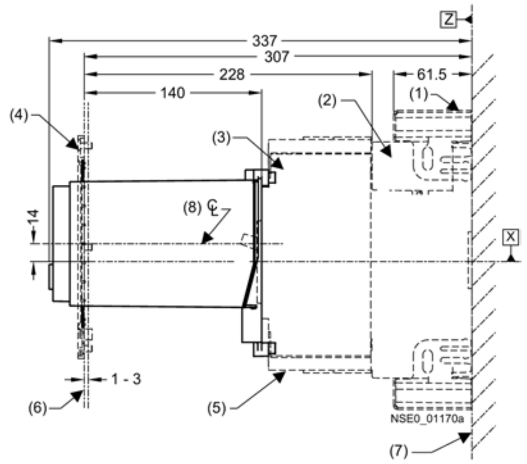
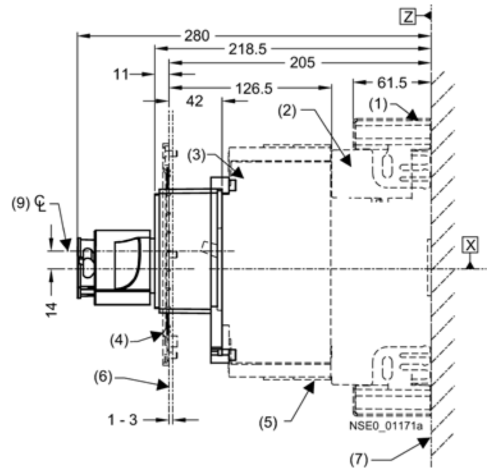
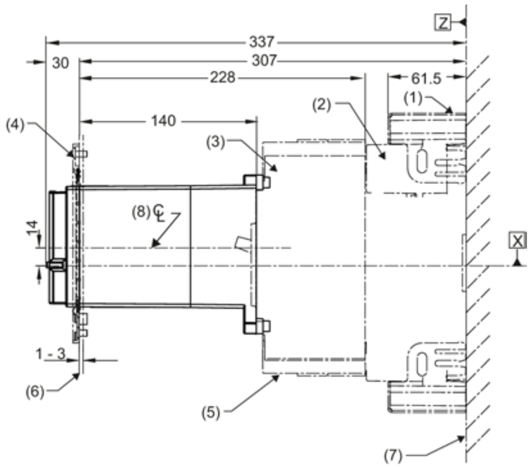
(3) Plug-in base with flat rear terminals

(5) Terminal covers (standard)

(7) Mounting level

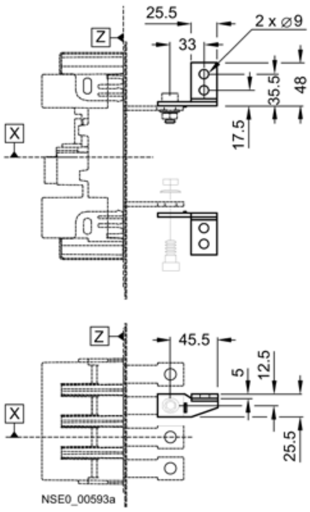
12.1.10 VL160X (3VL1), 3- and 4-pole, up to 160 A

12.1.10.1 Plug-in base and accessories

<table>
<tr><th>VL160X (3VL1) molded case circuit breaker with motorized operating mechanism with stored energy mechanism, mounted on plug-in base</th><th>VL160X (3VL1) molded case circuit breaker with front-operated rotary operating mechanism mounted on plug-in base</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>VL160X (3VL1) molded case circuit breaker with motorized operating mechanism mounted on plug-in base</td><td></td></tr>
<tr><td>
</td><td></td></tr>
</table>

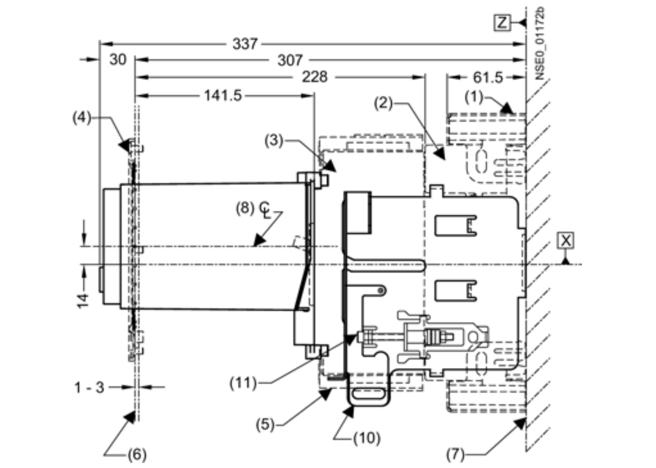
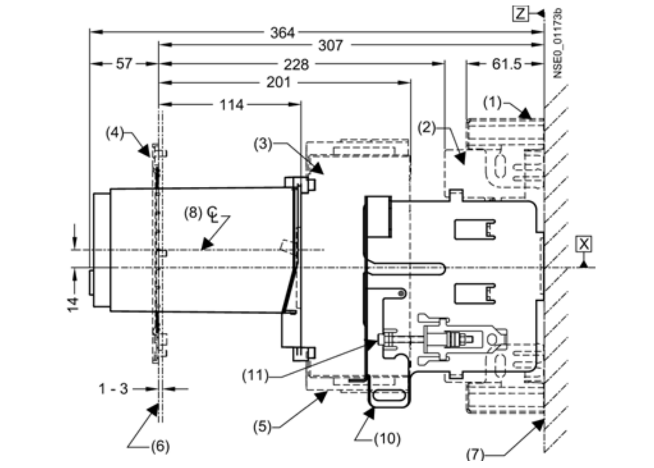
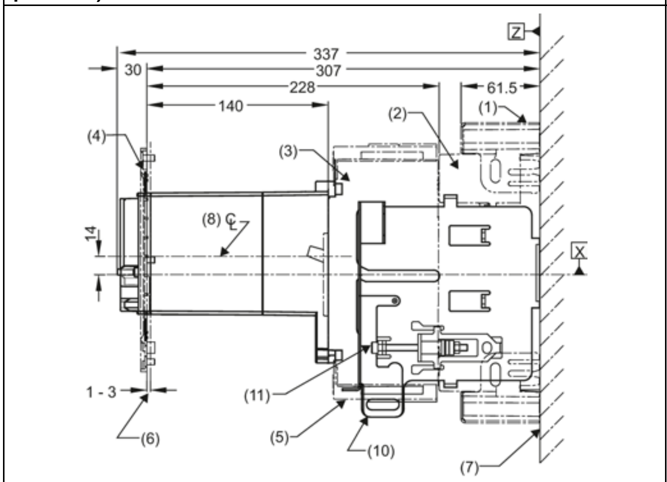
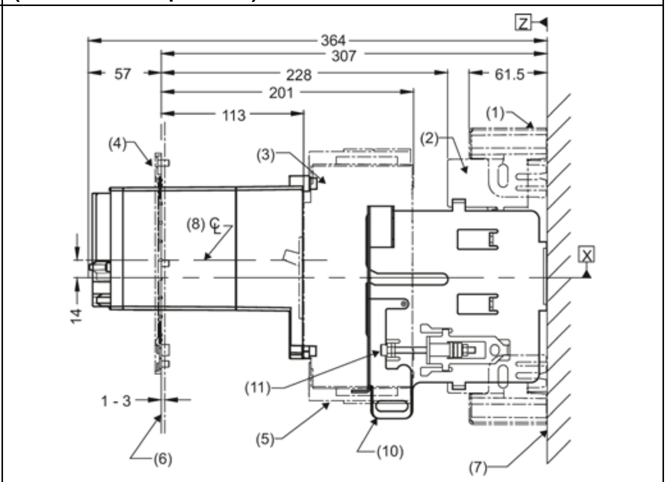
(1)	Plug-in base with terminal covers	(6)	External surface of cabinet door
(2)	Plug-in base	(7)	Mounting level
(3)	Molded case circuit breakers	(8)	Motorized operating mechanism with stored energy mechanism
(4)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)	(9)	Front-operated rotary operating mechanism
(5)	Terminal covers (standard)		

Connection adapter 90° angle

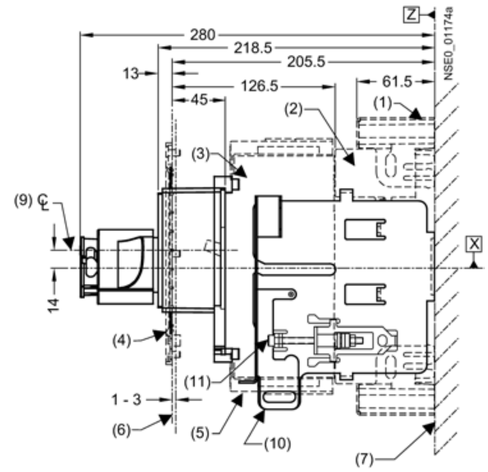
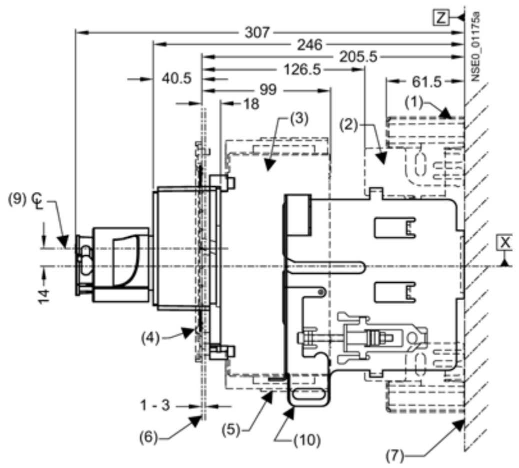


12.1.11 VL160 (3VL) and VL250 (3VL3), 3- and 4-pole, up to 250 A

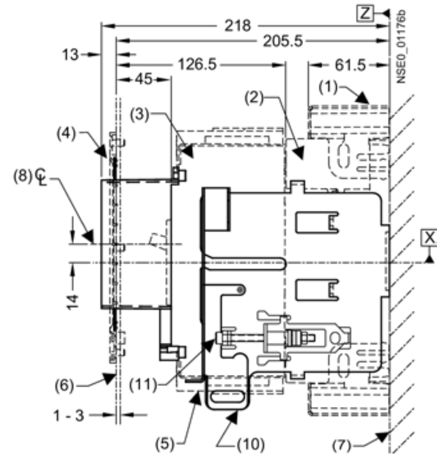
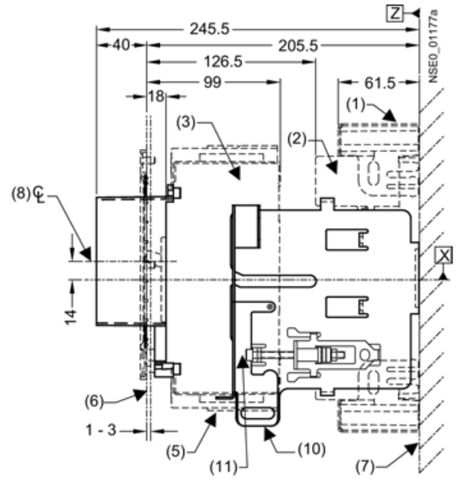
12.1.11.1 Withdrawable version and accessories

<table>
<tr><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with motorized operating mechanism with stored energy mechanism (connected position)</th><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with motorized operating mechanism with stored energy mechanism (disconnected position)</th></tr>
<tr><td>
</td><td>
</td></tr>
<tr><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with motorized operating mechanism (connected position)</th><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with motorized operating mechanism (disconnected position)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

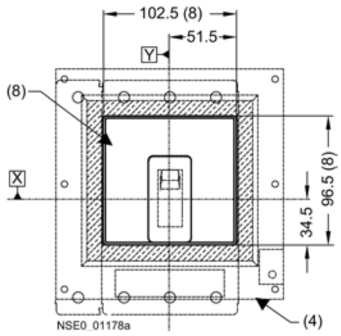
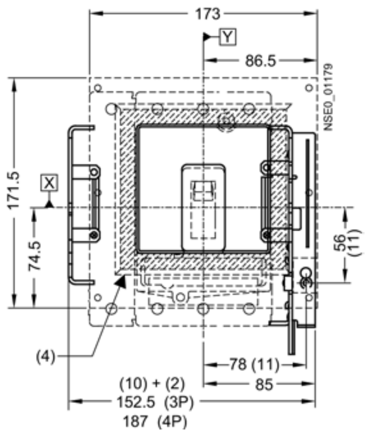
(1) Plug-in base with terminal covers
(2) Plug-in base
(3) Molded case circuit breaker
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Motorized operating mechanism with stored energy mechanism
(10) Locking device for the racking mechanism
(11) Racking mechanism

VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with front-operated rotary operating mechanism (connected position)	VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with front-operated rotary operating mechanism (disconnected position)
	

(1) Plug-in base with terminal covers
(2) Plug-in base
(3) Molded case circuit breaker
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(9) Front-operated rotary operating mechanism
(10) Locking device for the racking mechanism
(11) Racking mechanism

VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with extended escutcheon (connected position)	VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with extended escutcheon (disconnected position)
	

(1) Plug-in base with terminal covers
(2) Plug-in base
(3) Molded case circuit breaker
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Extended escutcheon
(10) Locking device for the racking mechanism
(11) Racking mechanism

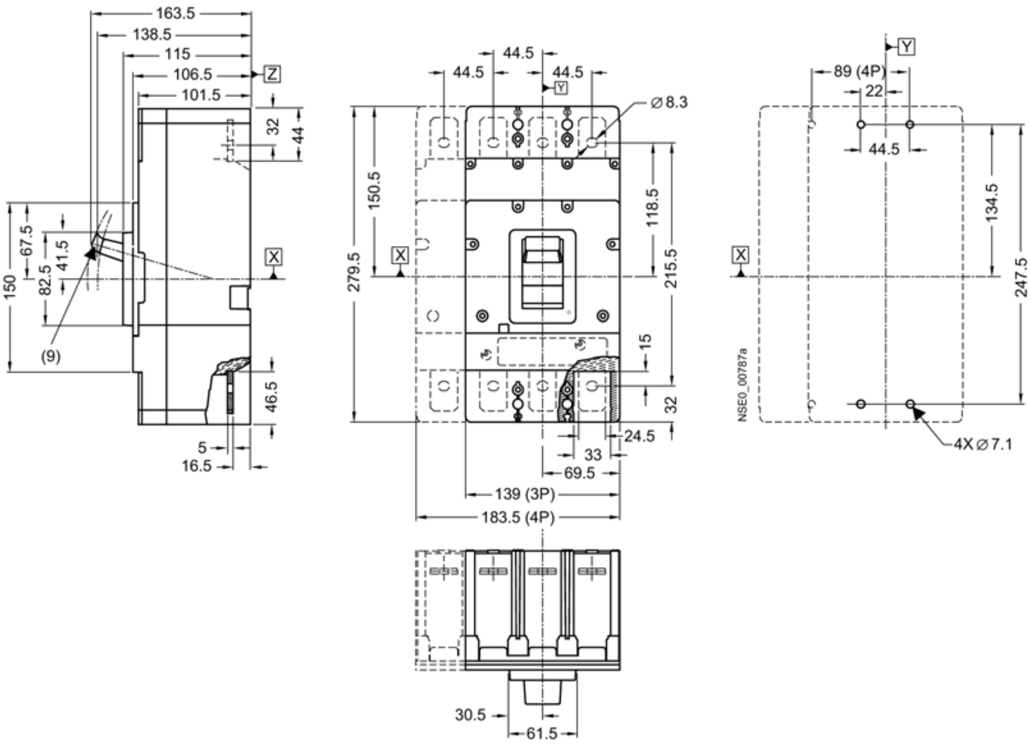
<table>
<tr><th>Extended escutcheon installation dimensions</th><th>Withdrawable version installation dimensions</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(8) Extended escutcheon
(11) Racking mechanism

12.2 VL400 (3VL4), 3- and 4-pole, up to 400 A

12.2.1 Molded case circuit breakers

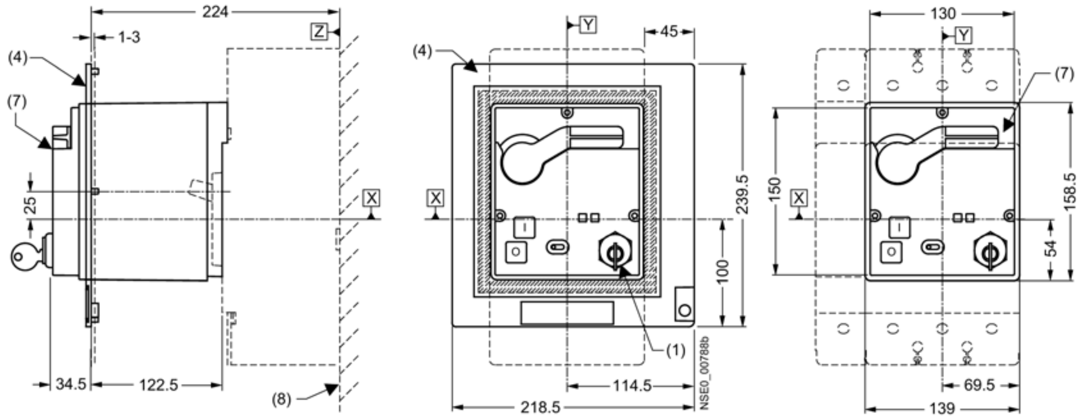
VL400 (3VL4) molded case circuit breaker



(9) Toggle lever extension

12.2.2 Operating mechanisms

Motorized operating mechanism with stored energy mechanism (SEO)



(1) Safety lock
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(7) Motorized operating mechanism with stored energy mechanism
(8) Mounting level

Motorized operating mechanism (MO)

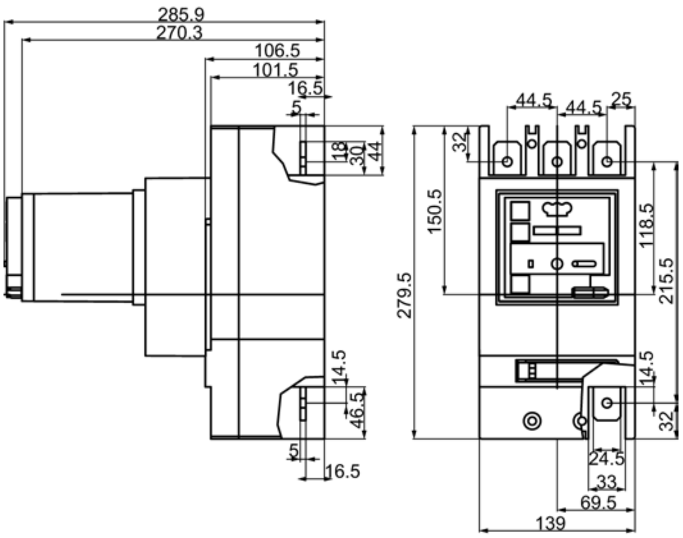
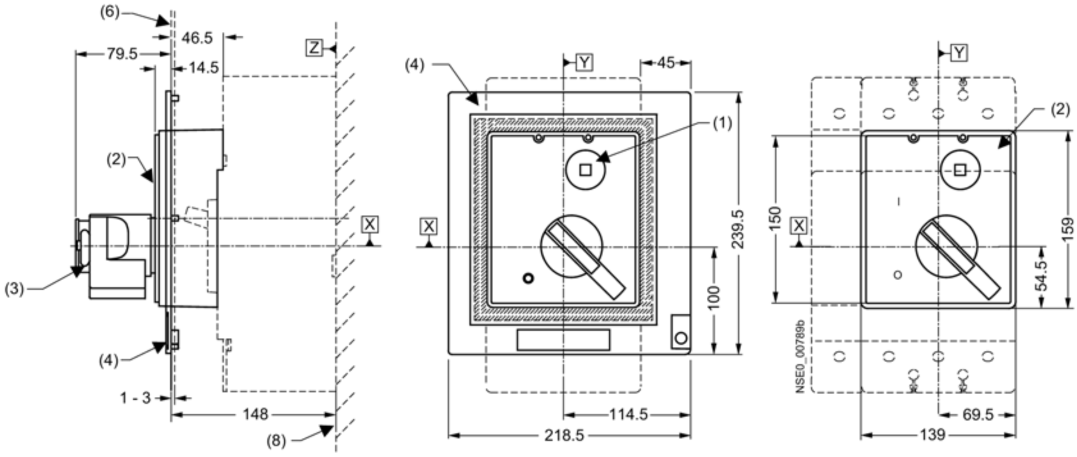


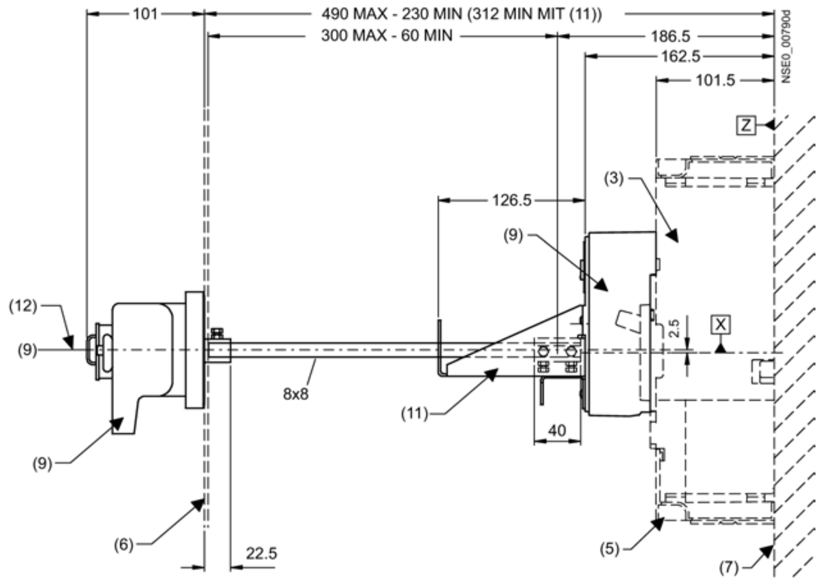
Figure 12-1 Front view and side view of the MO 3VL4 motorized operating mechanism

Front-operated rotary operating mechanism



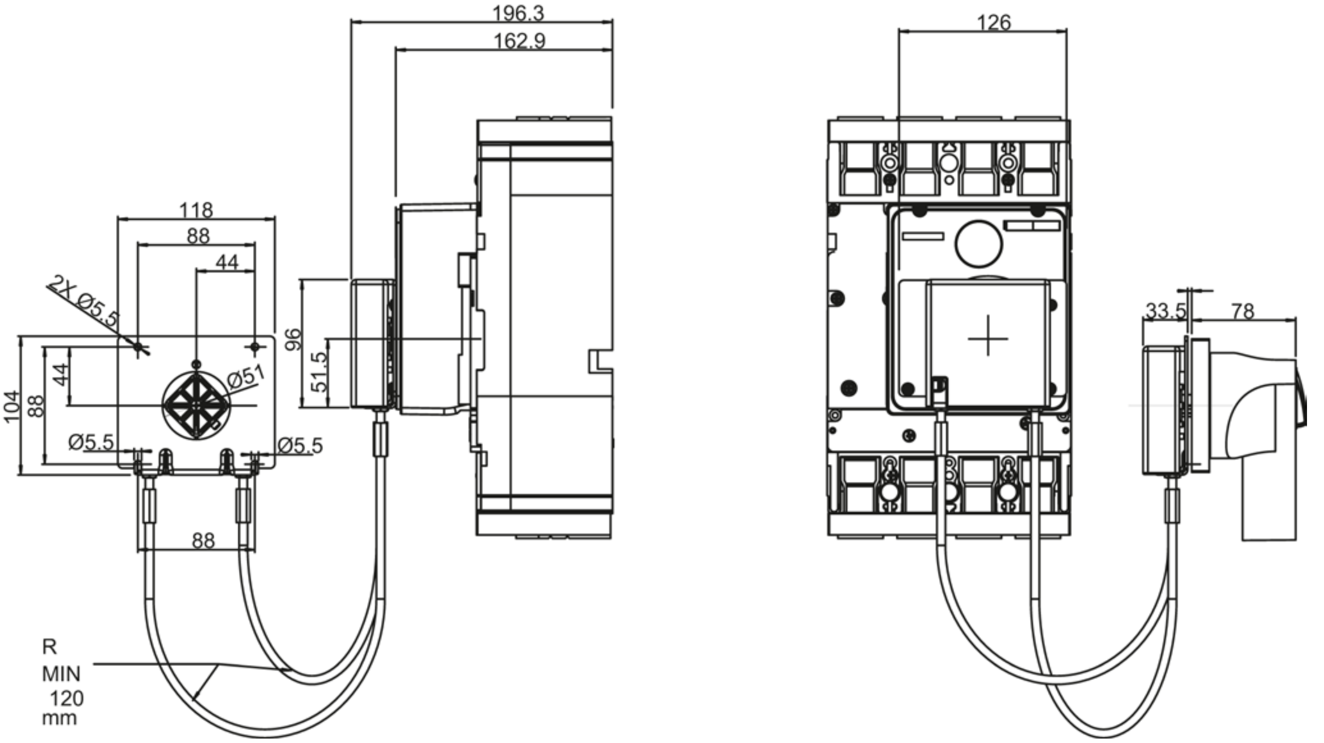
(1) Safety lock
(2) Front-operated rotary operating mechanism
(3) Padlock barrier
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(6) External surface of cabinet door
(8) Mounting level

Molded case circuit breaker with door-coupling rotary operating mechanism

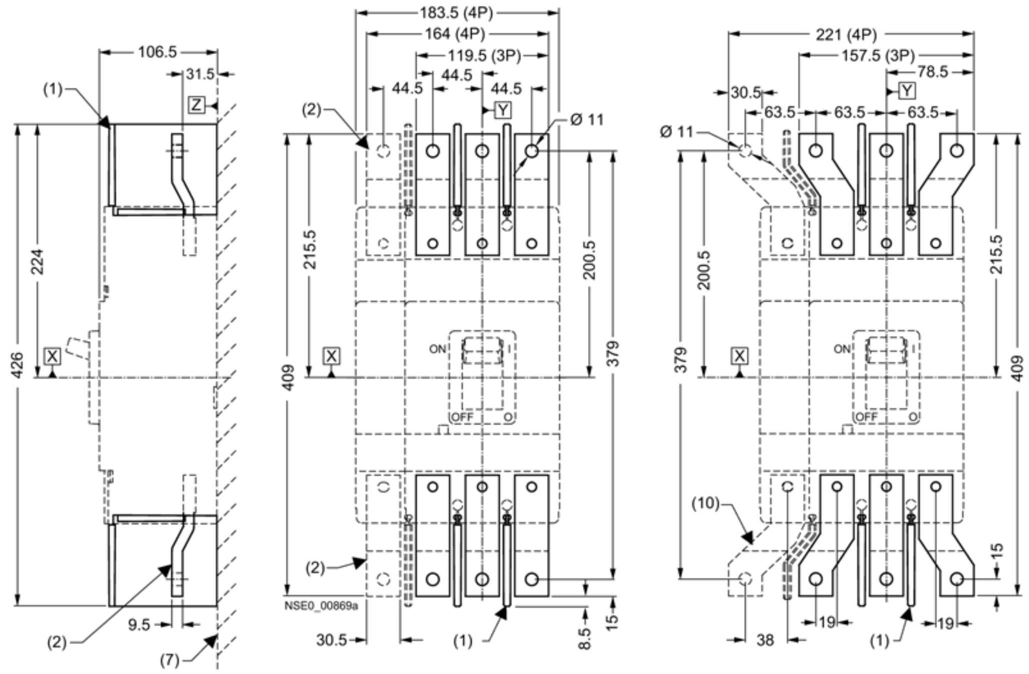


(3)	Molded case circuit breaker
(5)	Terminal covers (standard)
(6)	External surface of cabinet door
(7)	Mounting level
(9)	Door-coupling rotary operating mechanism
(11)	Supporting bracket
(12)	Center line of operating mechanism shaft

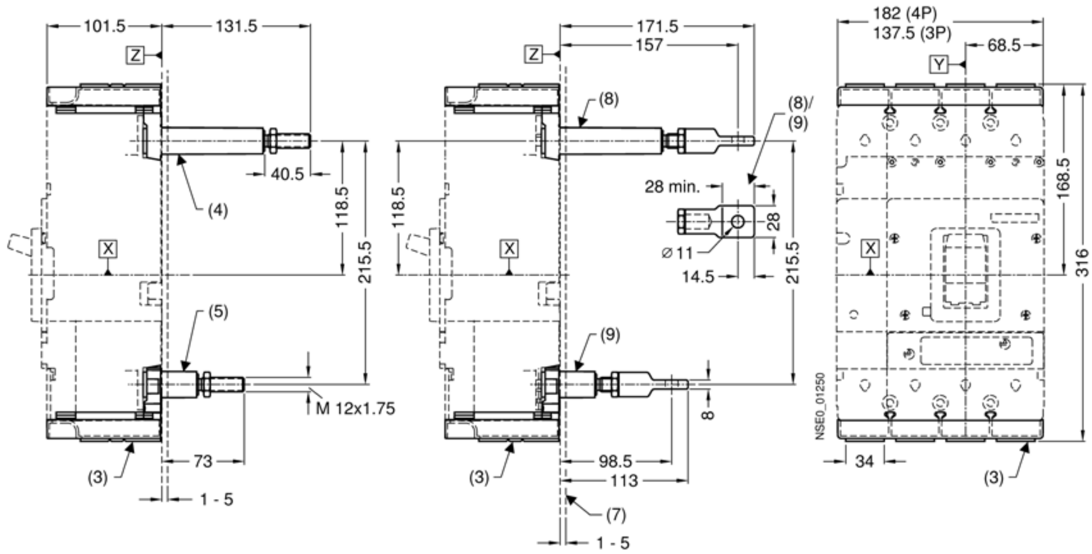
Molded case circuit breaker with side panel rotary operating mechanism



12.2.3 Connections and phase barriers



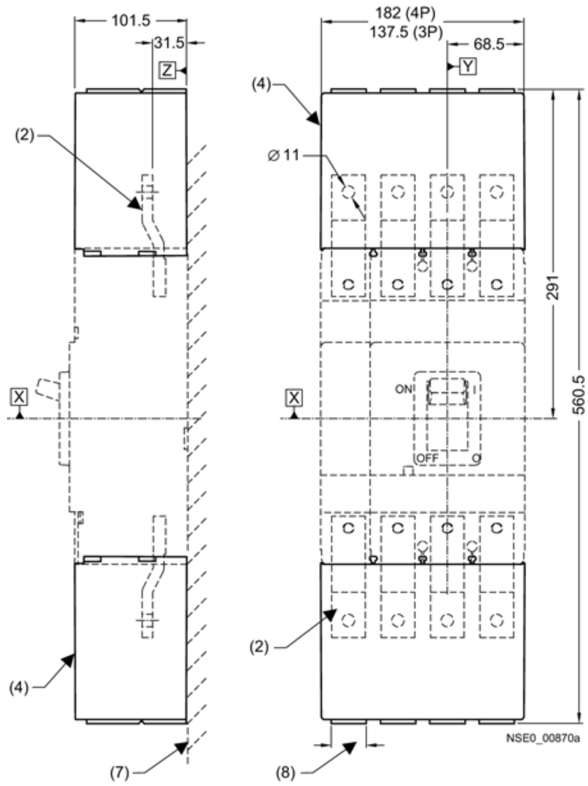
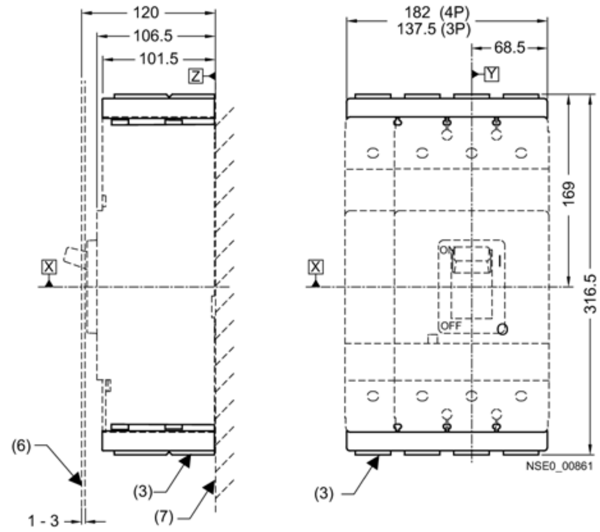
(1) Interphase barrier
(2) Front connecting bars
(7) Mounting level
(10) Front connecting bars for increased pole spacing



(3) Terminal covers (standard)
(4) Rear connection (long)
(5) Rear connection (short)
(7) Mounting level
(8) Rear flat terminals (long)
(9) Rear flat terminals (short)

12.2.4 Terminal covers

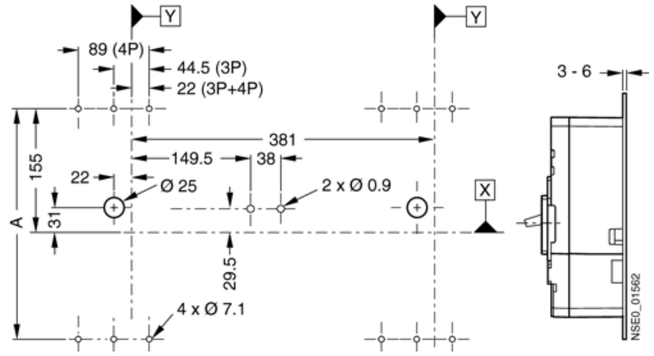
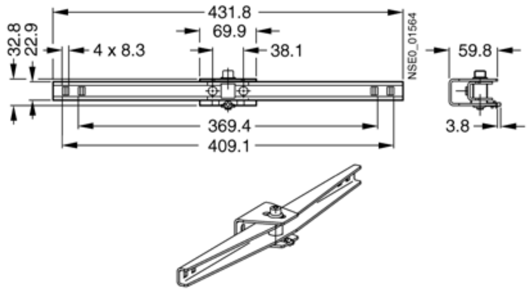
Table 12- 1

Molded case circuit breaker installation note	Front connecting bars
	

(2) Front connecting bars
(3) Terminal covers (standard)
(4) Terminal covers (extended)
(6) External surface of cabinet door
(7) Mounting level
(8) Cutout

12.2.5 Rear interlocking module

Table 12- 2

Rear interlocking module for plug-in/withdrawable circuit breakers for front connection, with/without RCD module	Rear interlocking module
 For other detailed dimension drawings, please refer to the mounting instructions for the rear interlocking module.	

Type	A
Without RCD module VL400 (3VL4)	289
With RCD module VL400 (3VL4)	449

12.2.6 Locking devices, locking device for toggle lever and accessories

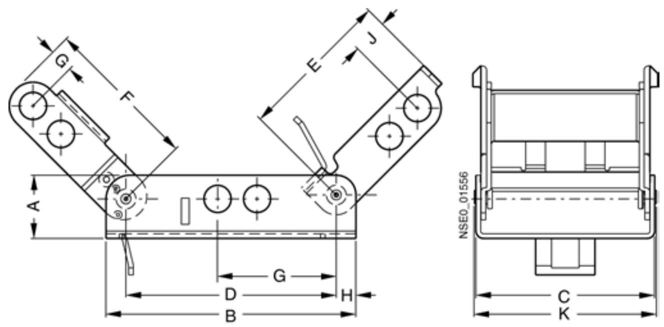
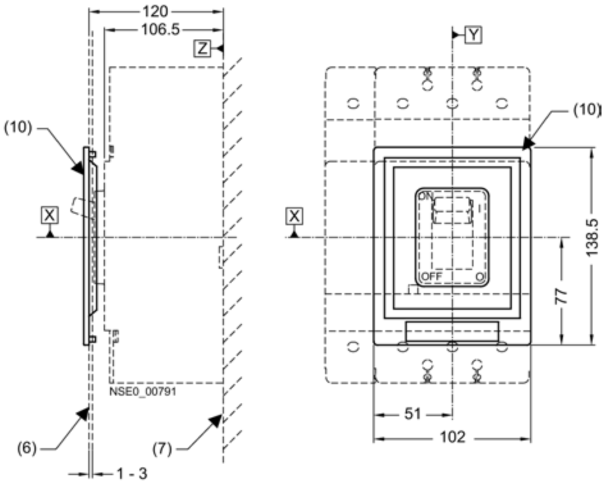


Table 12- 3

Type	A	B	C	D	E	F	G	H	I	K
3VL9 4	20,3	80,3	57,4	52,8	49,3	49,8	6,35	6,3	11,2	58,5
3VL9 6	21,6	79,8	71,1	62,0	50,4	46,5	12,9	8,9	8,6	72,2
3VL9 8	21,6	110,5	88,9	96,5	77,2	69,1	11,7	5,1	24,8	90,0

Masking frame for door cutout for molded case circuit breakers with toggle lever



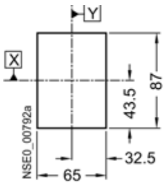
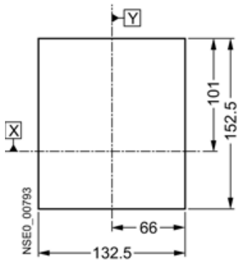
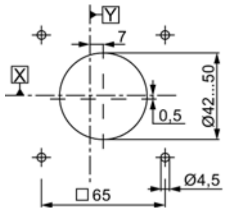
(6) External surface of cabinet door

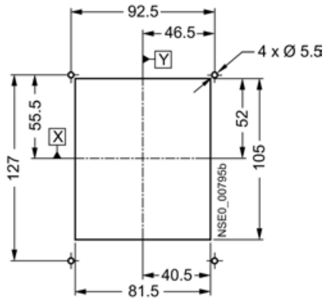
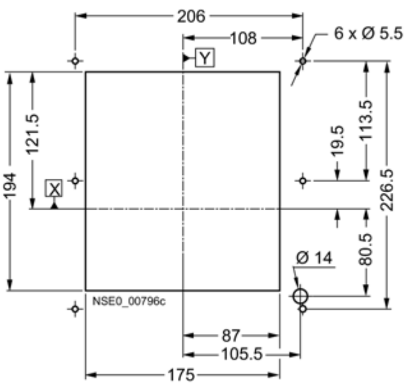
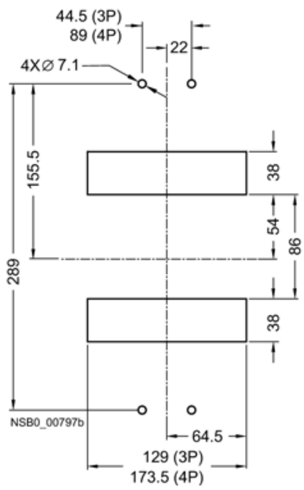
(7) Mounting level

(10) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

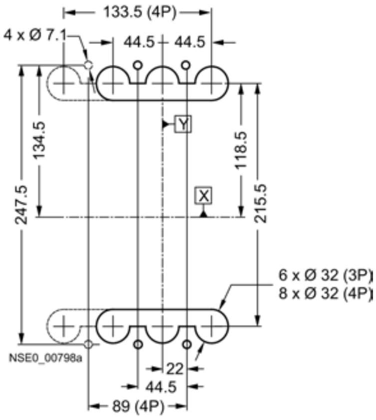
12.2.7 Door cutouts

Table 12- 4

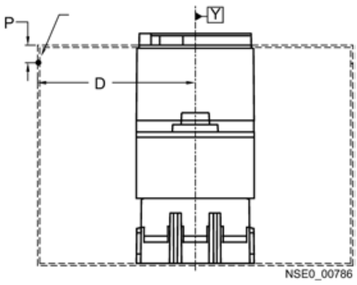
Door cutout toggle lever operating mechanism (without masking frame)	Door cutout front-operated rotary operating mechanism and motorized operating mechanism with stored energy mechanism (without masking frame)	Door cutout Door coupling rotary operating mechanism
		

Door cutout toggle lever operating mechanism (with masking frame)	Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon (with masking frame)	Drilling template and cutout for plug-in base with flat connecting bars on rear
		

Drilling template and cutout for rear connection



Door hinge point (see arrow)



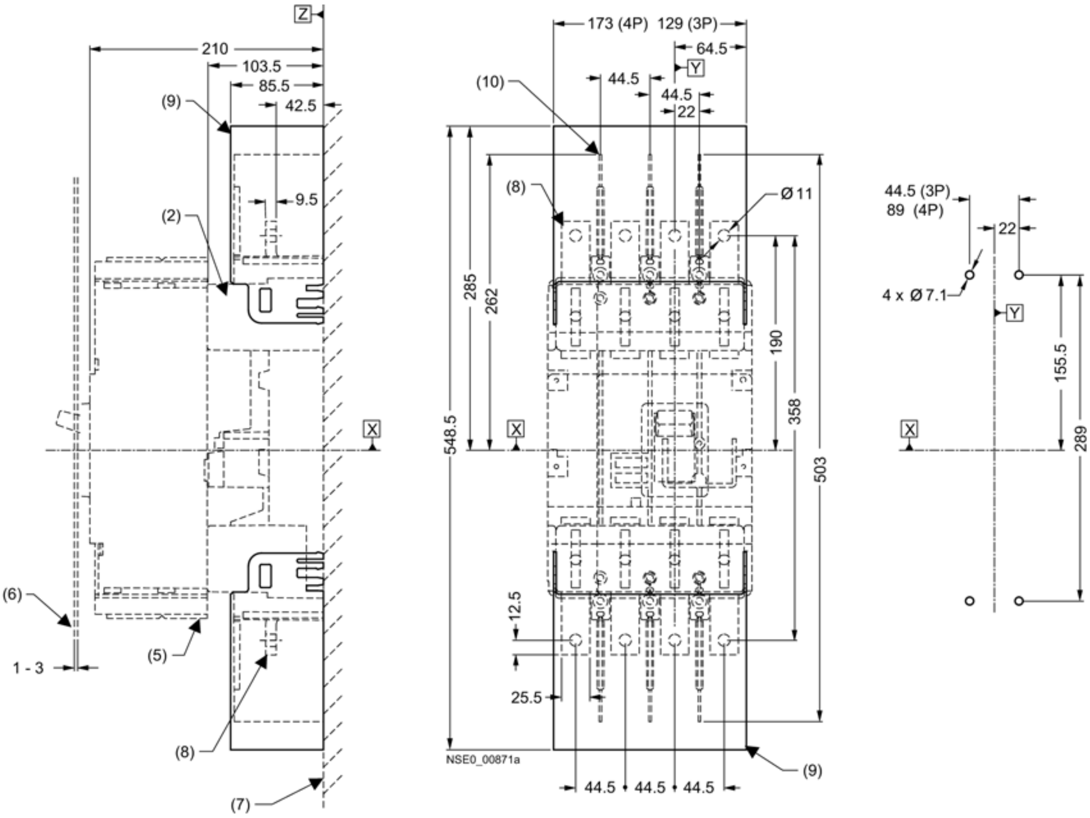
Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

Combination	A
Molded case circuit breaker only	150
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	150
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

12.2.8 Plug-in base and accessories

Plug-in base and drilling template; plug-in base with front connecting bars



(2) Plug-in base

(5) Terminal covers (standard)

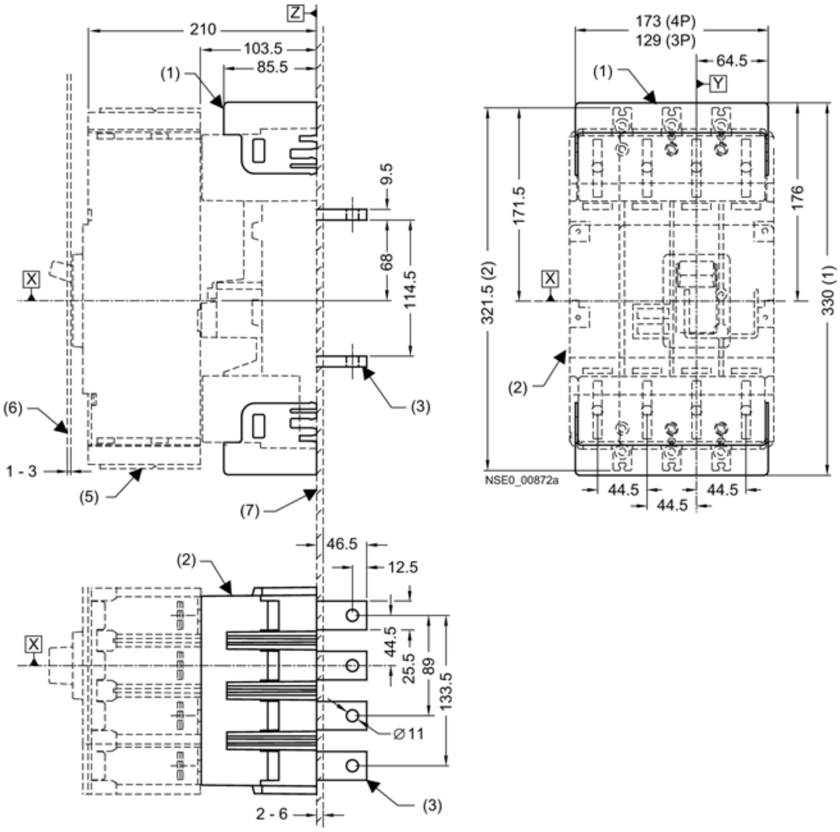
(6) External surface of cabinet door

(7) Mounting level

(8) Plug-in base with front connecting bars

(9) Plug-in base with terminal covers on the front

(10) Interphase barrier



(1) Plug-in base with rear terminal covers

(2) Plug-in base

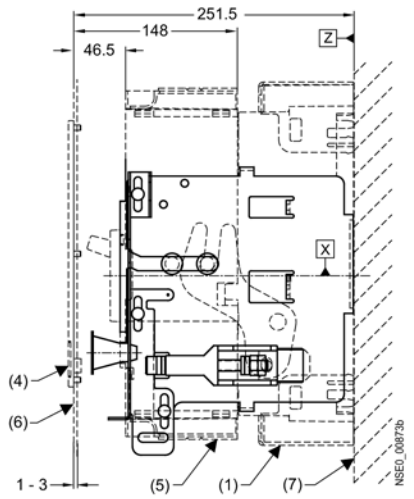
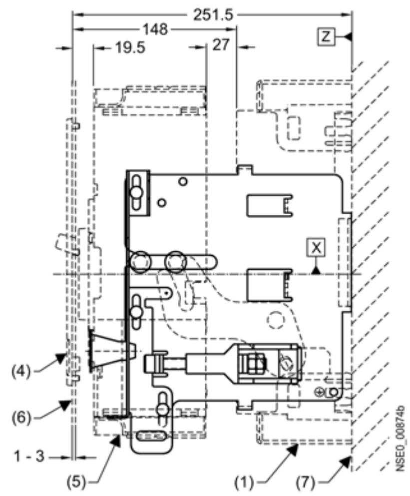
(3) Plug-in base with rear flat connecting bars

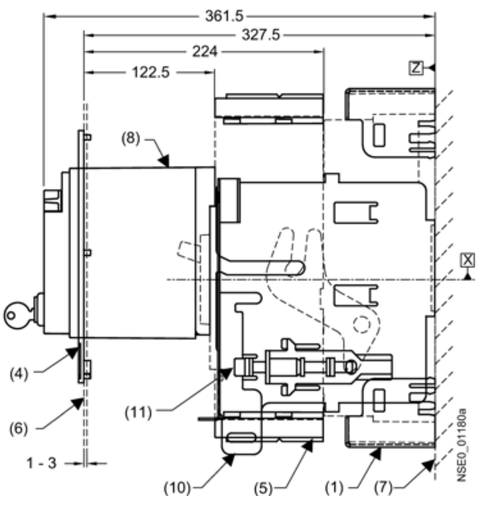
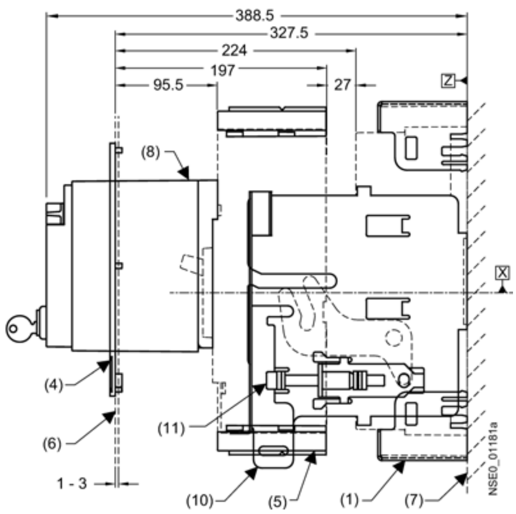
(5) Terminal covers (standard)

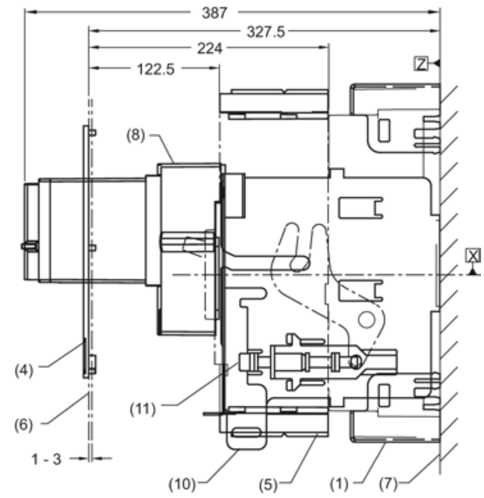
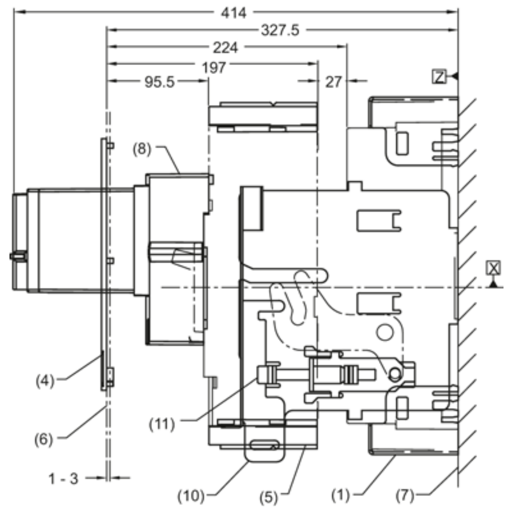
(6) External surface of cabinet door

(7) Mounting level

Table 12- 5

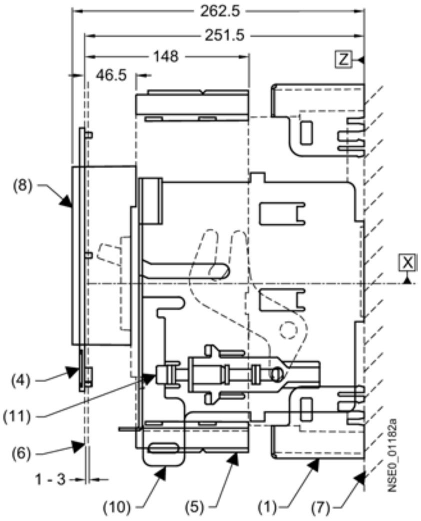
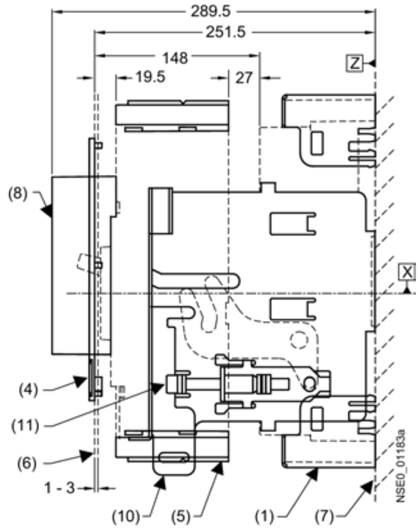
3VL4 circuit breaker in the withdrawable unit (connected position)	3VL4 circuit breaker in the withdrawable unit (disconnected position)
	

Withdrawable module motorized operating mechanism with stored energy mechanism (connected position)	Withdrawable module motorized operating mechanism with stored energy mechanism (disconnected position)
	

Withdrawable module motorized operating mechanism (connected position)	Withdrawable module motorized operating mechanism (disconnected position)
	

(1) Plug-in base with terminal covers
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Motorized operating mechanism with stored energy mechanism
(10) Locking device for the racking mechanism
(11) Racking mechanism

Table 12- 6

Withdrawable module extended escutcheon (connected position)	Withdrawable module extended escutcheon (disconnected position)
	

(1) Plug-in base with terminal covers

(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(5) Terminal covers (standard)

(6) External surface of cabinet door

(7) Mounting level

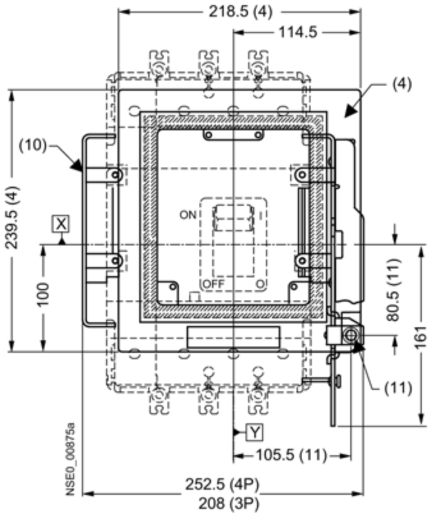
(8) Extended escutcheon

(9) Front-operated rotary operating mechanism

(10) Locking device for the racking mechanism

(11) Racking mechanism

Extended escutcheon mounted on guide rail



(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

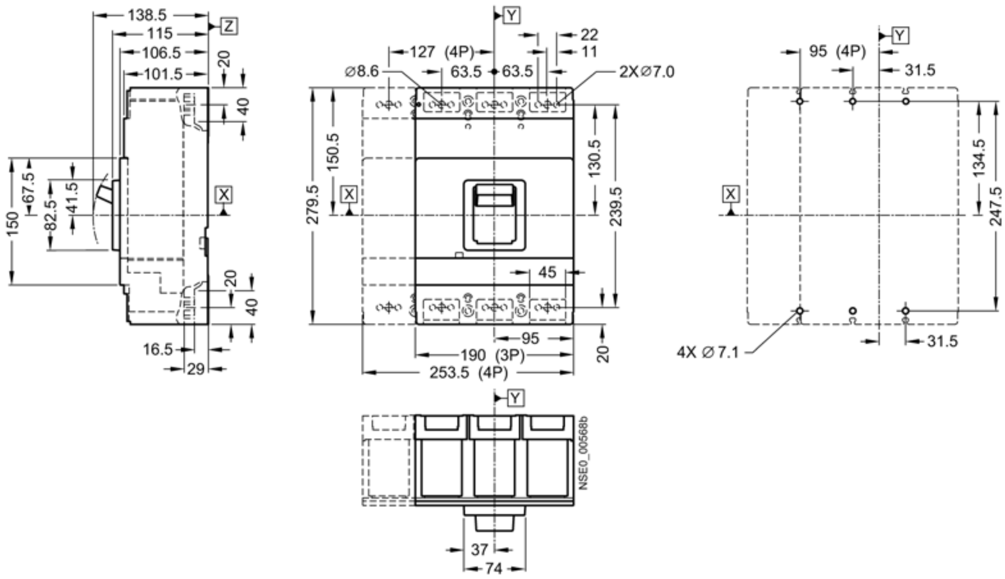
(10) Locking device for the racking mechanism

(11) Racking mechanism

12.3 VL630 (3VL5), 3- and 4-pole, up to 630 A

12.3.1 Molded case circuit breakers

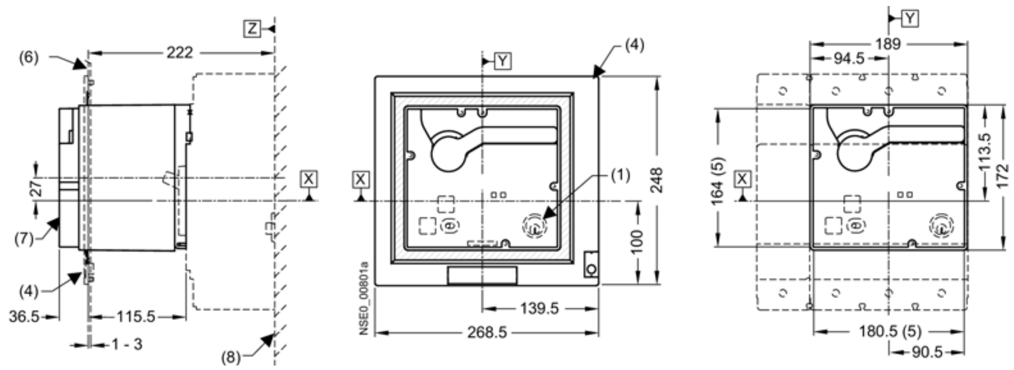
VL630 (3VL5) molded case circuit breaker



12.3.2 Operating mechanisms

Motorized operating mechanism with stored energy mechanism (SEO)

VL630 (3VL5)



(1)	Safety lock	(7)	Motorized operating mechanism with stored energy mechanism
(4)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)	(8)	Mounting level
(6)	External surface of cabinet door		

Motorized operating mechanism (MO)

VL630 (3VL5) and VL800 (3VL6)

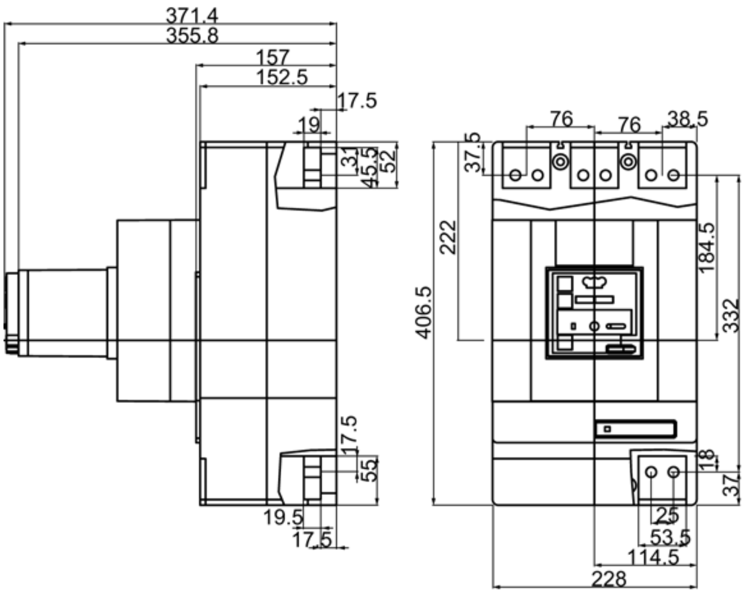
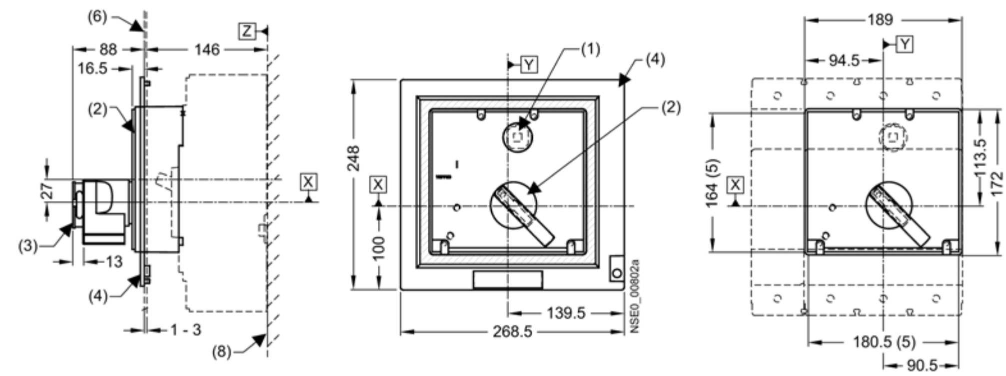


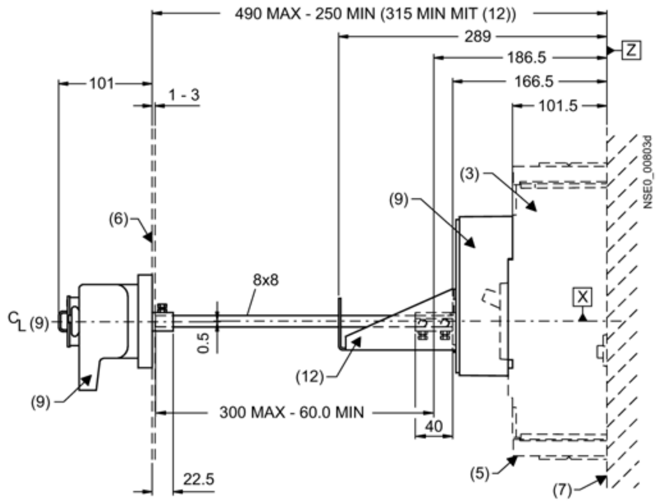
Figure 12-2 New_front view and side view of the 3VL5 and 3VL6 motorized operating mechanisms (MO)

Front-operated rotary operating mechanism

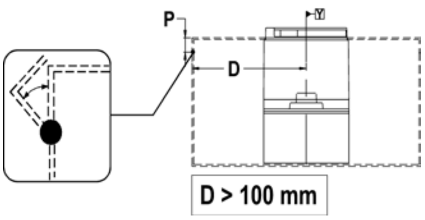


(1) Safety lock
(2) Front-operated rotary operating mechanism
(3) Padlock barrier
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Grading for cover
(6) External surface of cabinet door
(8) Mounting level

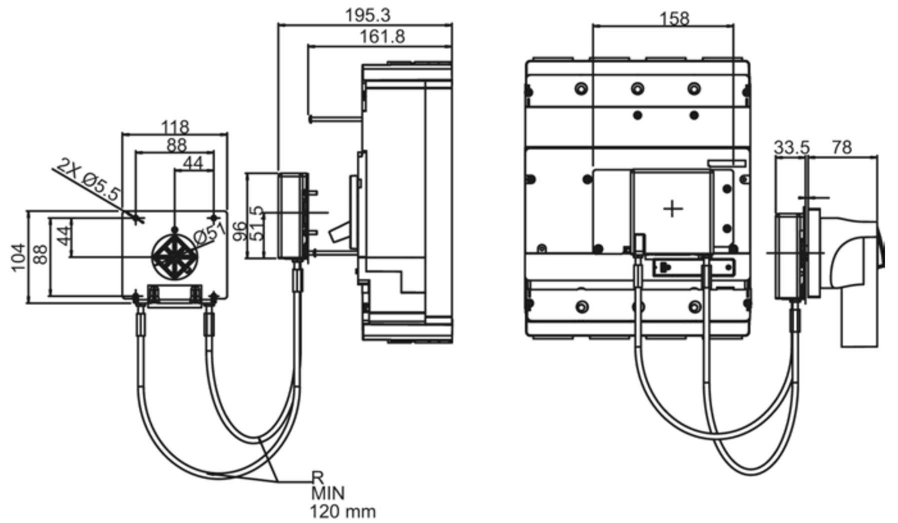
Molded case circuit breaker with door-coupling rotary operating mechanism



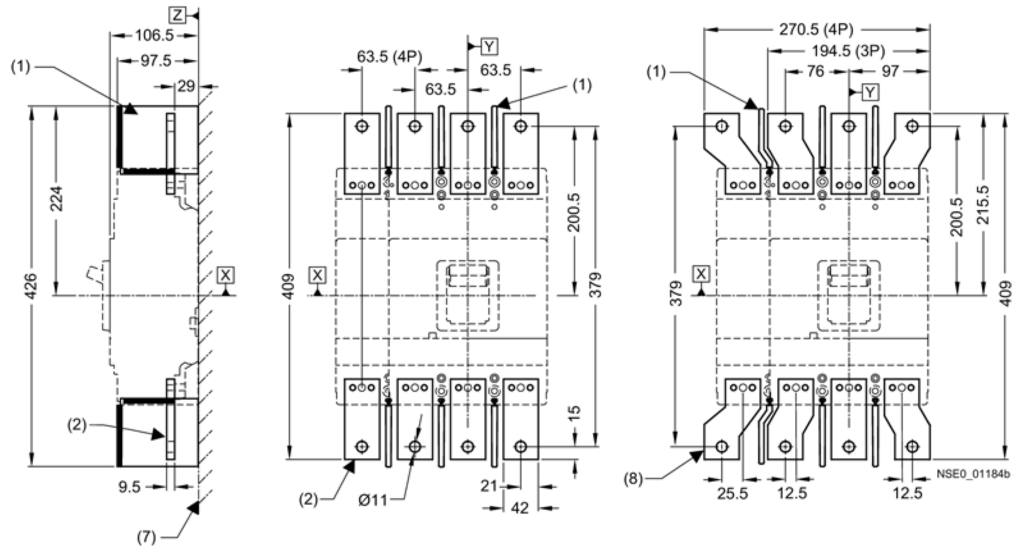
(3) Molded case circuit breaker
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(9) Door-coupling rotary operating mechanism
(12) Supporting bracket



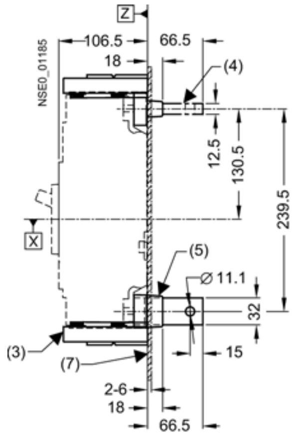
Molded case circuit breaker with side panel rotary operating mechanism



12.3.3 Connections and phase barriers

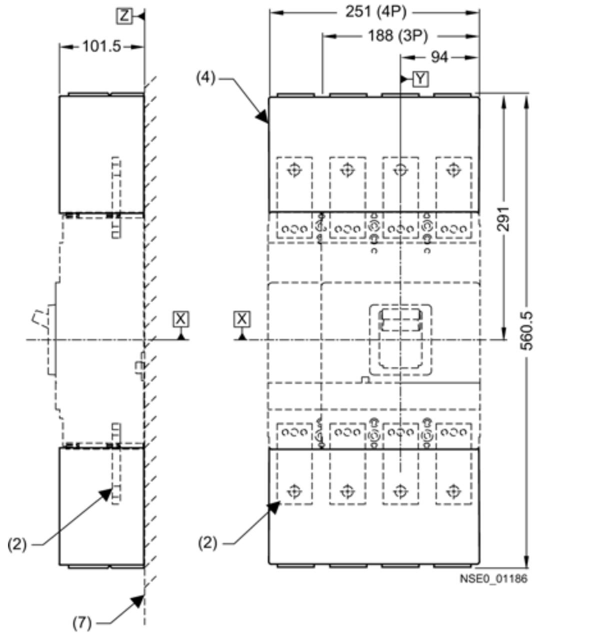


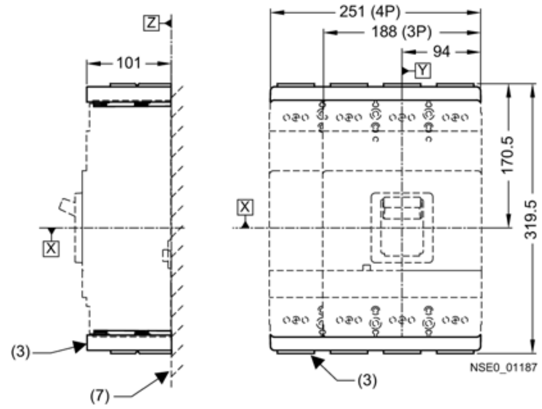
(1)	Interphase barrier	(7)	Mounting level
(2)	Front connecting bars	(8)	Front connecting bars for increased pole spacing



(3)	Terminal covers (standard)	(5)	Rear connection (vertical connection)
(4)	Rear connection (horizontal connection)	(7)	Mounting level

12.3.4 Terminal covers



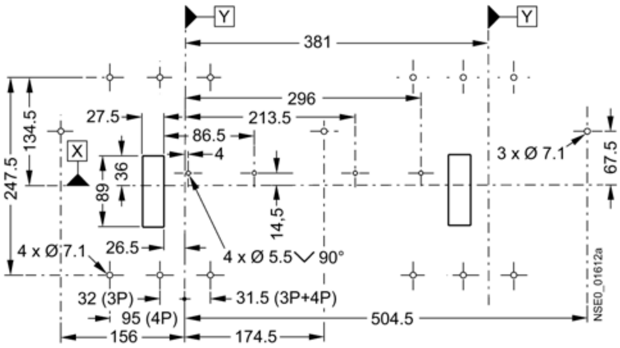


(2)	Front connecting bars
(3)	Terminal covers (standard)
(4)	Terminal covers (extended)
(7)	Mounting level

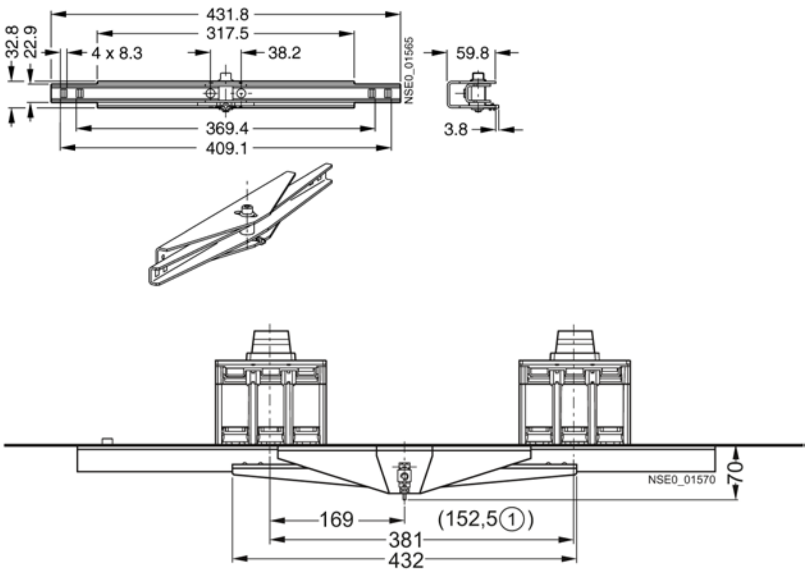
12.3.5 Rear interlocking module

Rear interlocking module for plug-in/withdrawable molded case circuit breakers for front connection

Rear interlocking module for plug-in/withdrawable molded case circuit breakers for front connection.



Rear interlocking module



(1) For withdrawable module

12.3.6 Locking and locking device for toggle lever

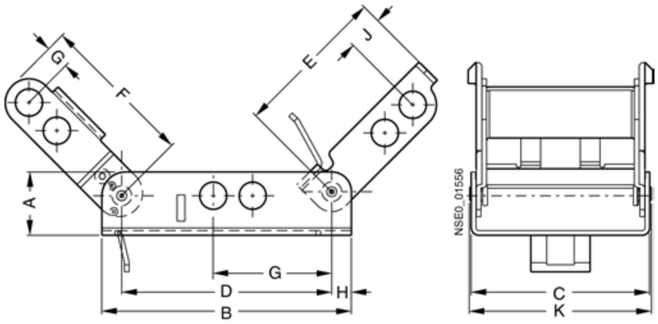
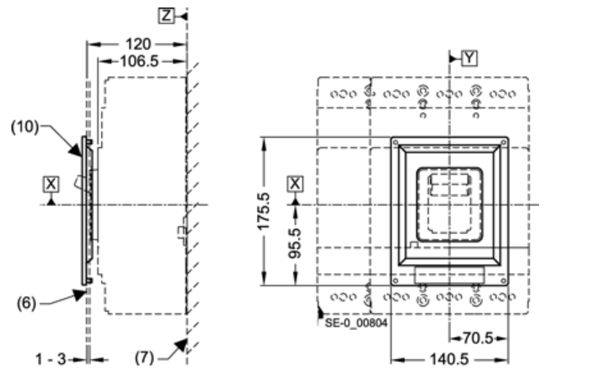
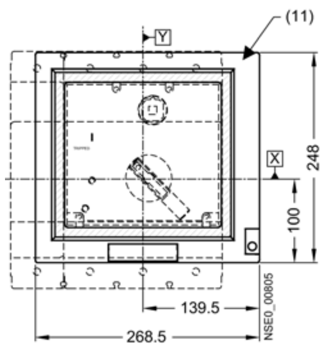


Table 12- 7

Type	A	B	C	D	E	F	G	H	I	K
3VL9 4	20,3	80,3	57,4	52,8	49,3	49,8	6,35	6,3	11,2	58,5
3VL9 6	21,6	79,8	71,1	62,0	50,4	46,5	12,9	8,9	8,6	72,2
3VL9 8	21,6	110,5	88,9	96,5	77,2	69,1	11,7	5,1	24,8	90,0

12.3.7 Accessories

Masking frames for door cutouts

Masking frame for door cutout for molded case circuit breakers with toggle lever	Masking frame for door cutout for molded case circuit breakers with operating mechanism
	

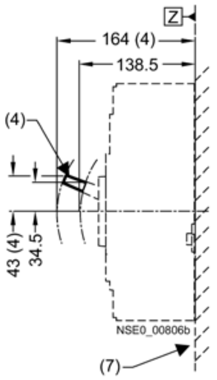
(6) External surface of cabinet door

(7) Mounting level

(10) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

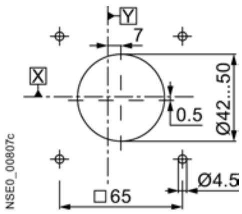
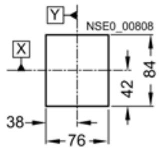
(11) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

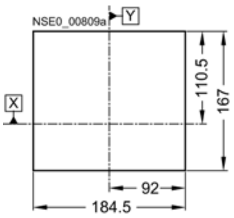
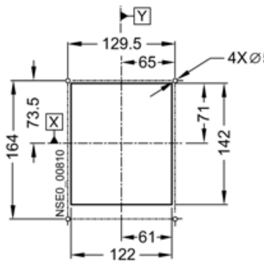
Toggle lever extension



(4) Toggle lever extension
(7) Mounting level

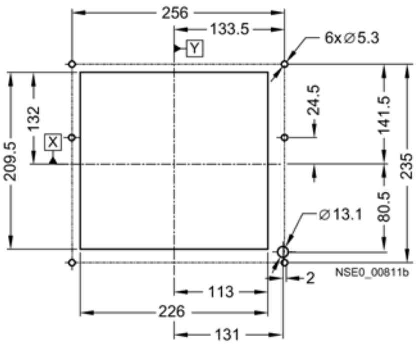
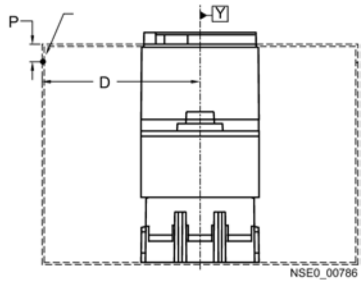
12.3.8 Door cutouts

Door cutout door coupling rotary operating mechanism	Door cutout toggle lever operating mechanism (without masking frame)
	

Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon (without masking frame)	Door cutout toggle lever operating mechanism (with masking frame)
	

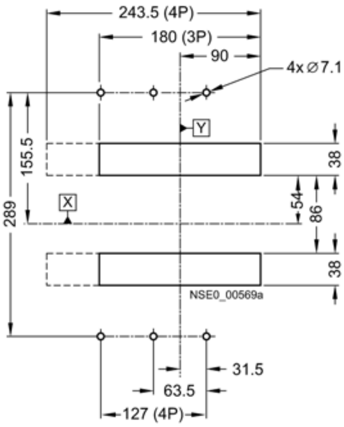
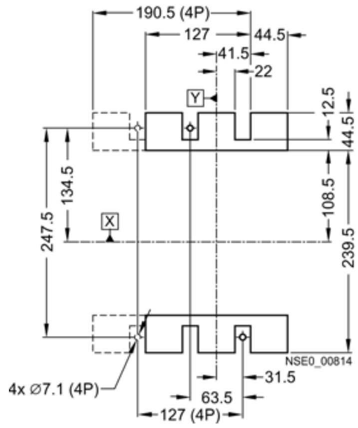
Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon (with masking frame)	**Door hinge point (see arrow)**
	 D > A from table + (P x 5)

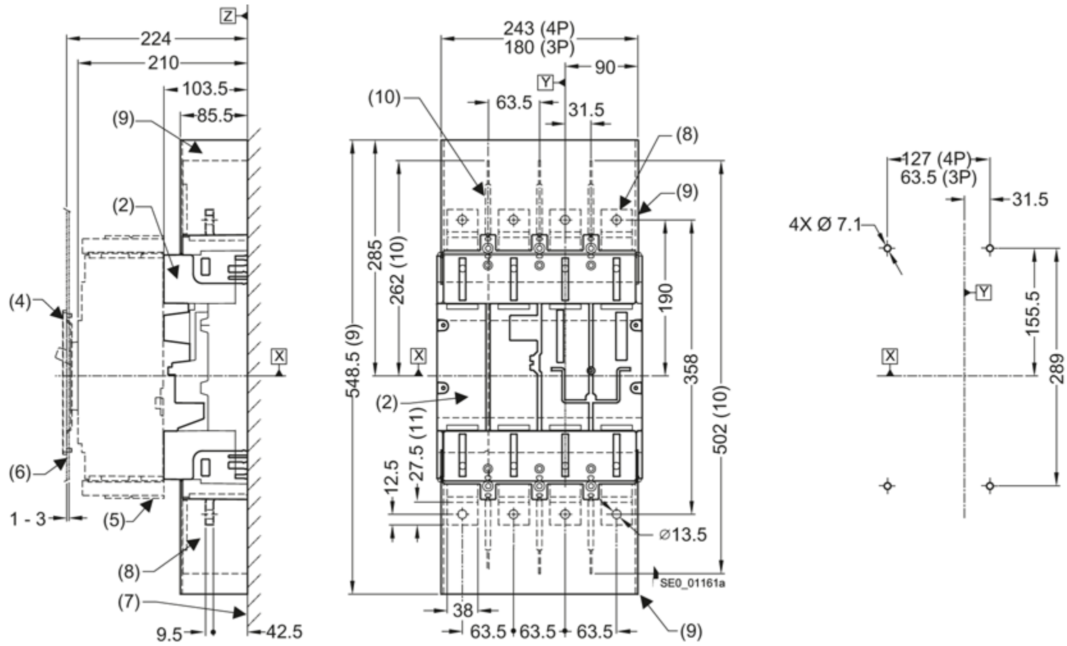
Combination	**A**
Molded case circuit breaker only	150
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	150
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

Table 12- 8

Drilling template and cutout for plug-in base (with flat connecting bars on rear)	**Drilling template and cutout for molded case circuit breakers (with flat connecting bars on rear)**
	

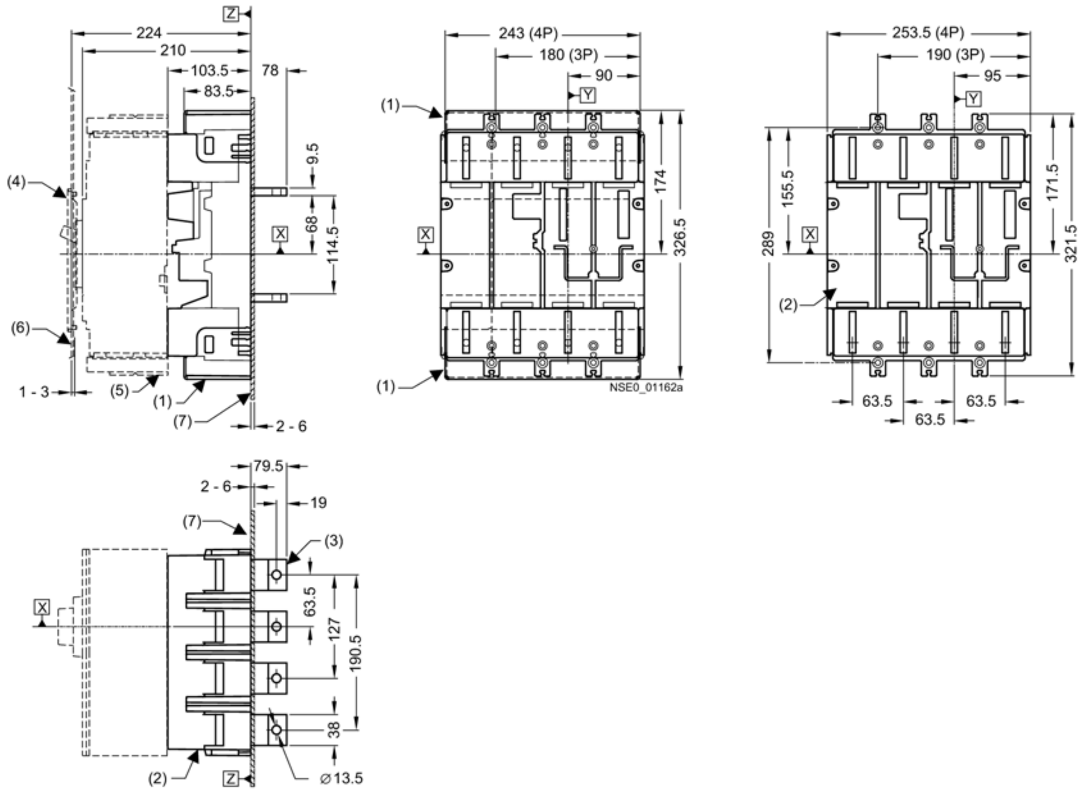
12.3.9 Plug-in base and accessories

Plug-in base with terminal covers on the front and drilling template for plug-in base with front connecting bars



(2) Plug-in base
(4) Masking frame for door cutout (for molded case circuit breakers with toggle lever)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Plug-in base with front connecting bars
(9) Plug-in base with terminal covers on the front
(10) Interphase barrier
(11) Connection surface

Plug-in base, with terminal covers, rear flat connecting bars on plug-in base



(1) Plug-in base with rear terminal covers

(2) Plug-in base

(3) Plug-in base with rear flat connecting bars

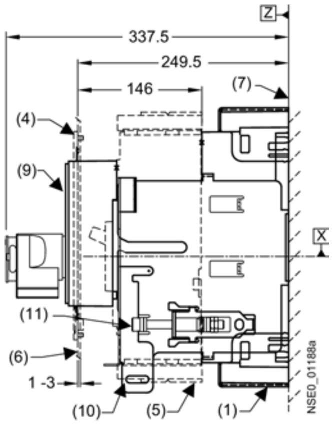
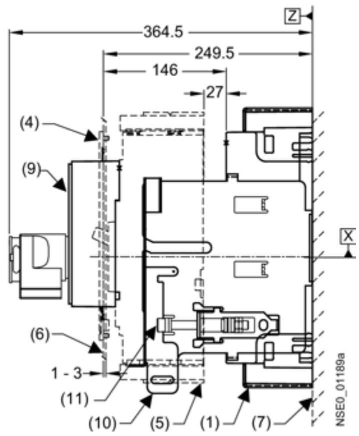
(4) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

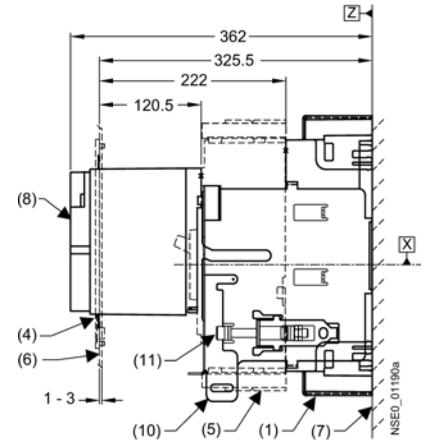
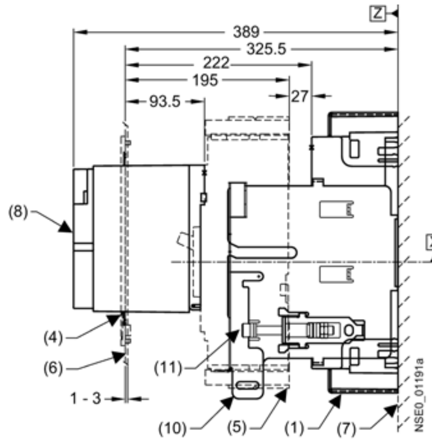
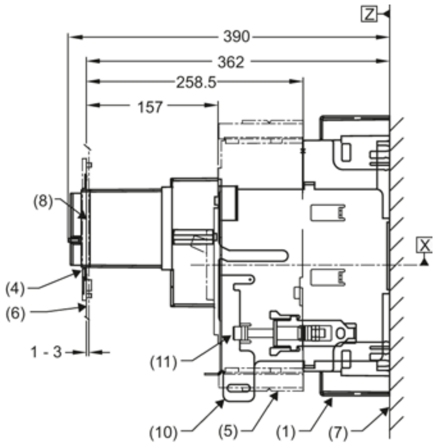
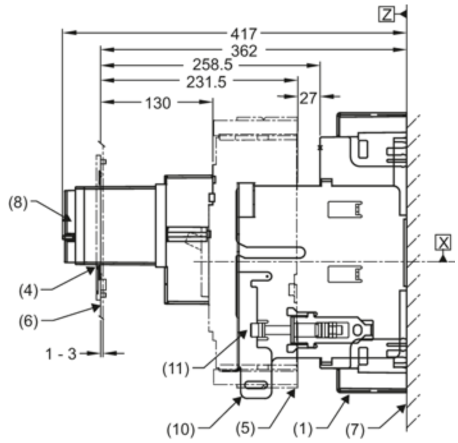
(5) Terminal covers (standard)

(6) External surface of cabinet door

(7) Mounting level

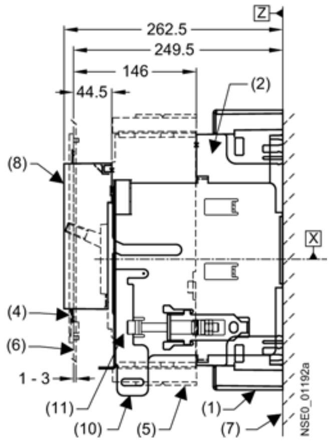
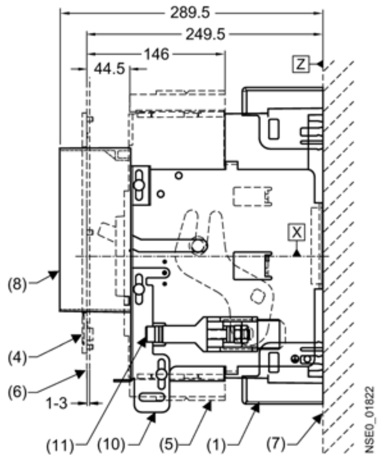
12.3.10 Withdrawable version and accessories

VL630 (3VL5) molded case circuit breaker with rotary operating mechanism in withdrawable design (connected position)	VL630 (3VL5) molded case circuit breaker with rotary operating mechanism in withdrawable design (disconnected position)
	

VL630 (3VL5) molded case circuit breaker with motorized operating mechanism with stored energy mechanism in withdrawable design (connected position)	VL630 (3VL5) molded case circuit breaker with motorized operating mechanism with stored energy mechanism in withdrawable design (disconnected position)
	
VL630 (3VL5) molded case circuit breaker with motorized operating mechanism in withdrawable design (connected position)	**VL630 (3VL5) molded case circuit breaker with motorized operating mechanism in withdrawable design (disconnected position)**
	

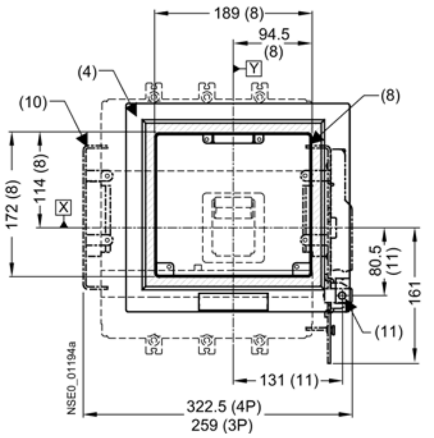
(1) Plug-in base with terminal covers
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Motorized operating mechanism with stored energy mechanism
(9) Front-operated rotary operating mechanism
(10) Locking device for the racking mechanism
(11) Racking mechanism

Table 12- 9

VL630 (3VL5) molded case circuit breaker with extended escutcheon in withdrawable design (connected position)	VL630 (3VL5) molded case circuit breaker with extended escutcheon in withdrawable design (disconnected position)
	

(1) Plug-in base with terminal covers
(2) Plug-in base
(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5) Terminal covers (standard)
(6) External surface of cabinet door
(7) Mounting level
(8) Extended escutcheon
(10) Locking device for the racking mechanism
(11) Racking mechanism

VL630 (3VL5) molded case circuit breaker with extended escutcheon in withdrawable design



(4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(8) Extended escutcheon

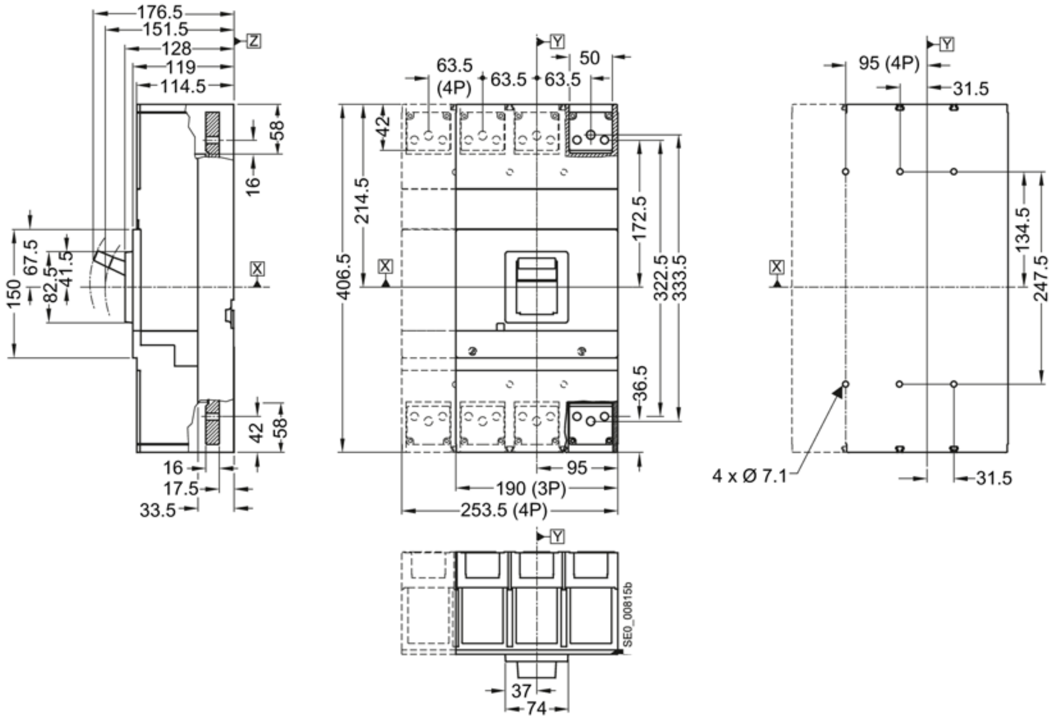
(10) Locking device for the racking mechanism

(11) Racking mechanism

12.4 VL800 (3VL6), 3- and 4-pole, up to 800 A

12.4.1 Molded case circuit breakers

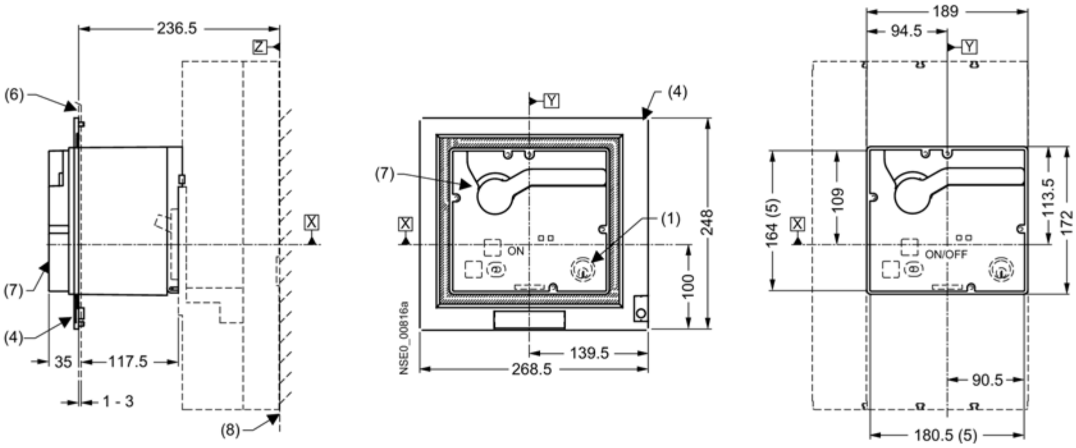
VL800 (3VL6) molded case circuit breaker



12.4.2 Operating mechanisms

Motorized operating mechanism with stored energy mechanism (SEO)

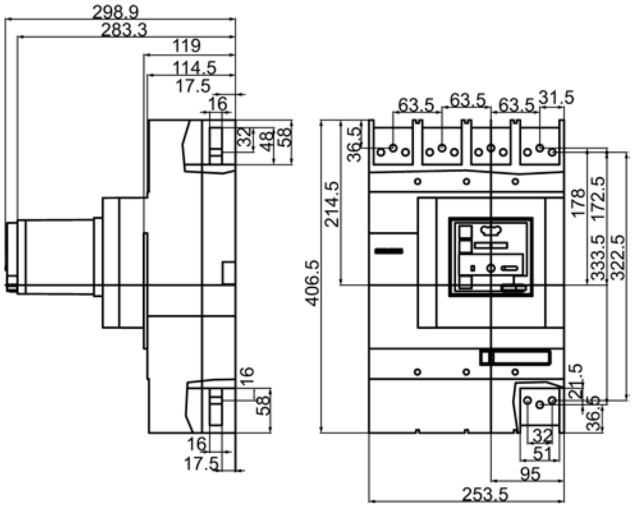
VL800 (3VL6)



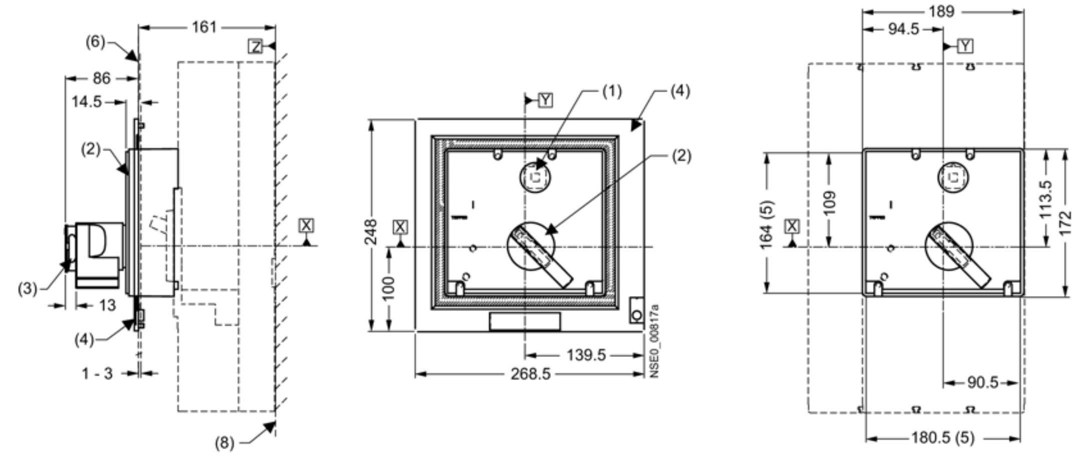
(1)	Safety lock
(4)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(5)	Grading for cover
(6)	External surface of cabinet door
(7)	Motorized operating mechanism with stored energy mechanism
(8)	Mounting level

Motorized operating mechanism (MO)

VL800 (3VL6)

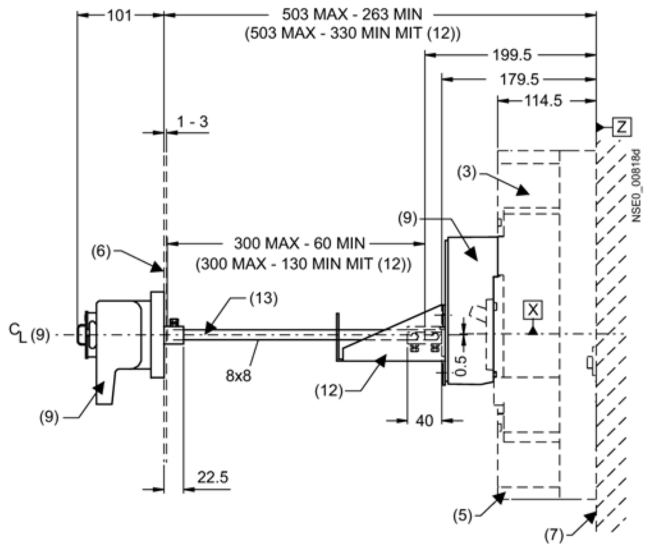


Front-operated rotary operating mechanism

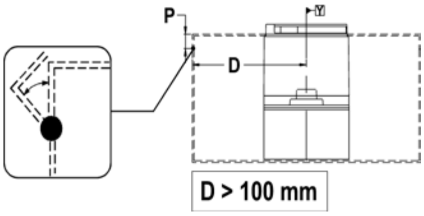


- (1) Safety lock
- (2) Front-operated rotary operating mechanism
- (3) Padlock barrier
- (4) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
- (6) External surface of cabinet door
- (8) Mounting level

Molded case circuit breaker with door-coupling rotary operating mechanism

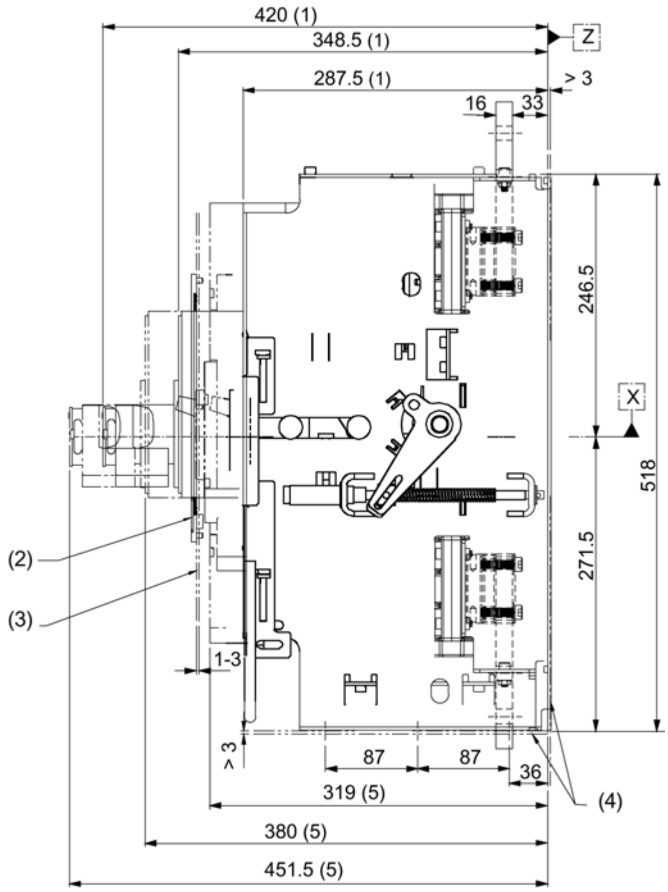


- (3) Molded case circuit breaker
- (5) Terminal covers (standard)
- (6) External surface of cabinet door
- (7) Mounting level
- (9) Door-coupling rotary operating mechanism
- (12) Supporting bracket
- (13) Center line of operating mechanism shaft



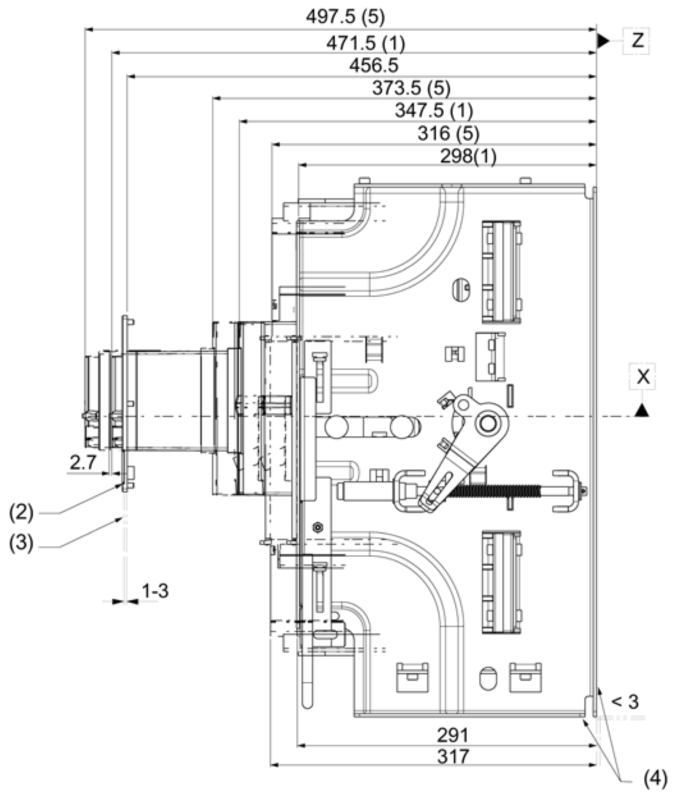
12.4.3 Withdrawable version

Withdrawable version with front-operated rotary operating mechanism, insert position and remove position



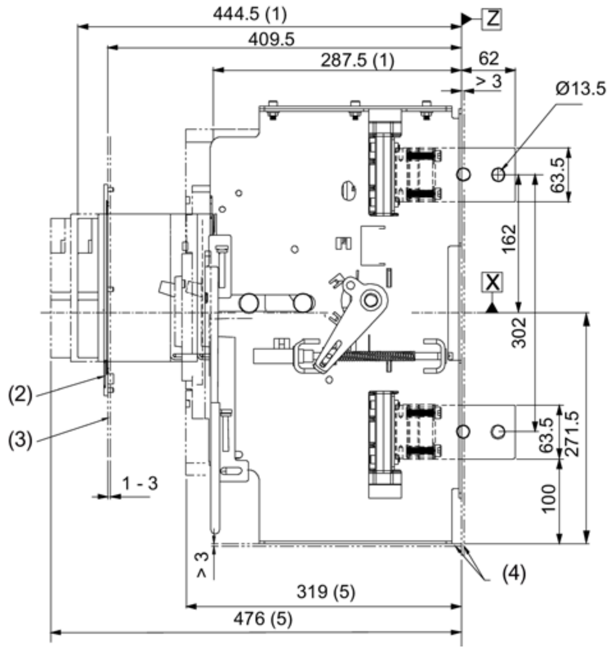
(1)	Connected position	(4)	Mounting level
(2)	Masking frame for door cutout	(5)	Disconnected position
(3)	External surface of cabinet door		

Withdrawable version with motorized operating mechanism, insert position and remove position



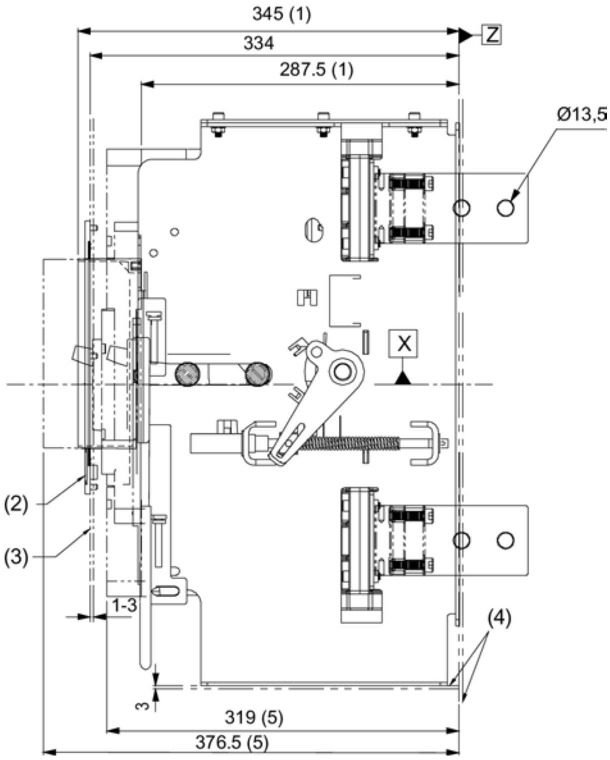
(1)	Connected position	(4)	Mounting level
(2)	Masking frame for door cutout	(5)	Disconnected position
(3)	External surface of cabinet door		

Withdrawable version with motorized operating mechanism with stored energy mechanism, insert position and remove position

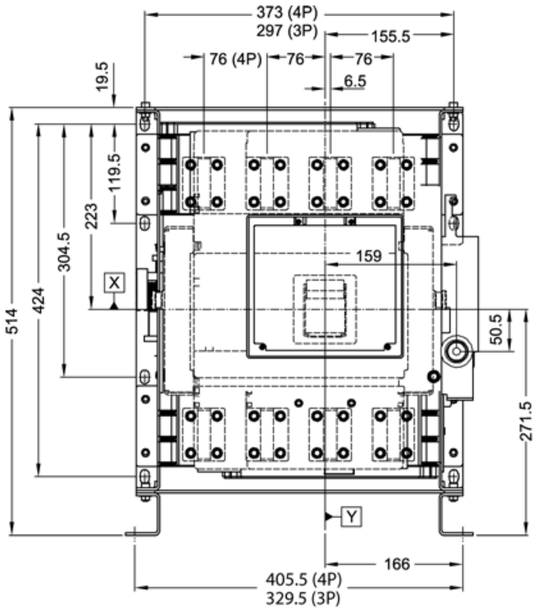
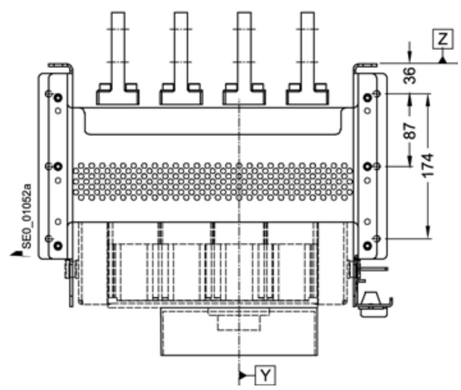
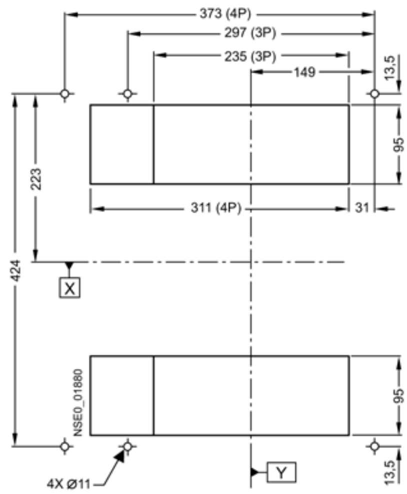


(1)	Connected position	(4)	Mounting level
(2)	Masking frame for door cutout	(5)	Disconnected position
(3)	External surface of cabinet door		

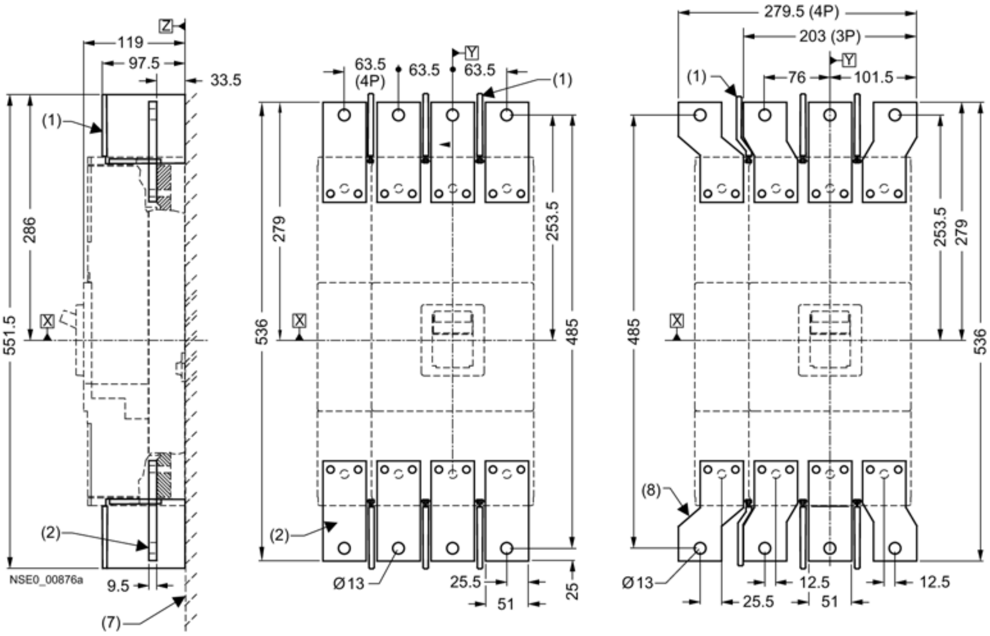
Withdrawable version with extended escutcheon (without masking frame), insert position and remove position



(1)	Connected position	(4)	Mounting level
(2)	Masking frame for door cutout	(5)	Disconnected position
(3)	External surface of cabinet door		

Withdrawable version	Drilling template and cutout for withdrawable modules with flat connecting bars on rear
 	

12.4.4 Connections and phase barriers



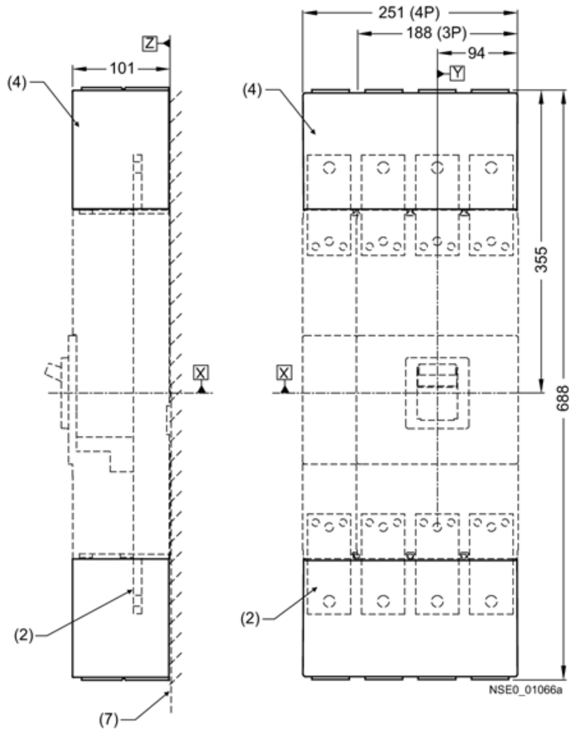
(1) Interphase barrier

(2) Front connecting bars

(7) Mounting level

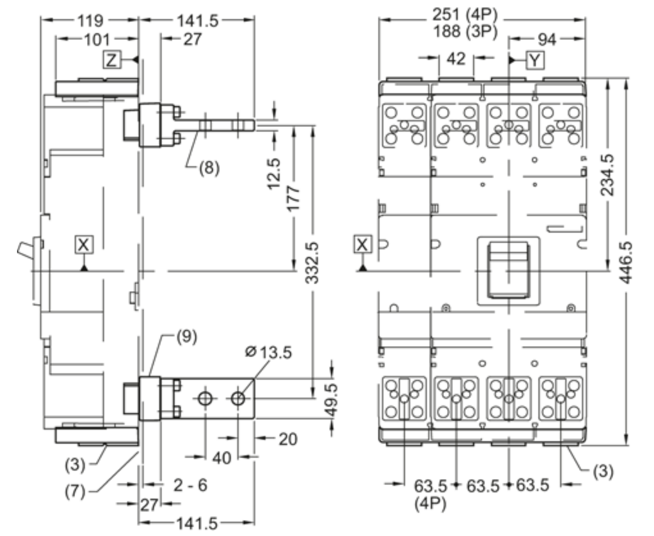
(8) Front connecting bars for increased pole spacing

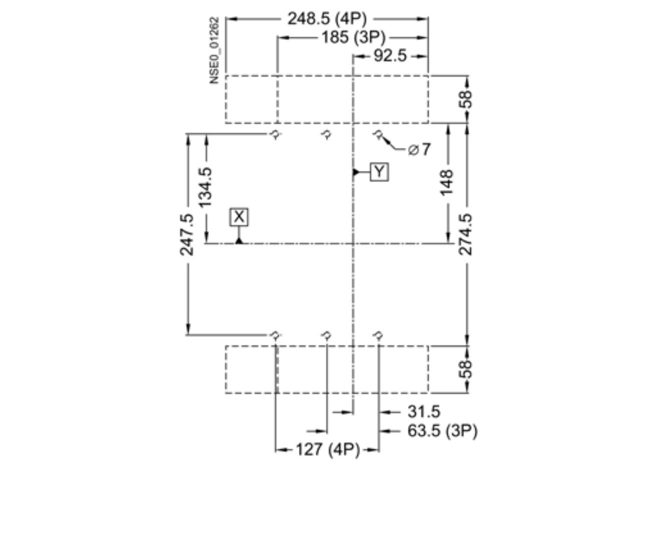
12.4.5 Terminal covers



(2)	Front connecting bars	(7)	Mounting level
(4)	Terminal covers (extended)		

Table 12- 10





(3) Terminal covers (standard)

(7) Mounting level

(8) Rear connection (horizontal mounting)

(9) Rear connection (vertical mounting)

12.4.6 Locking and locking device for toggle lever

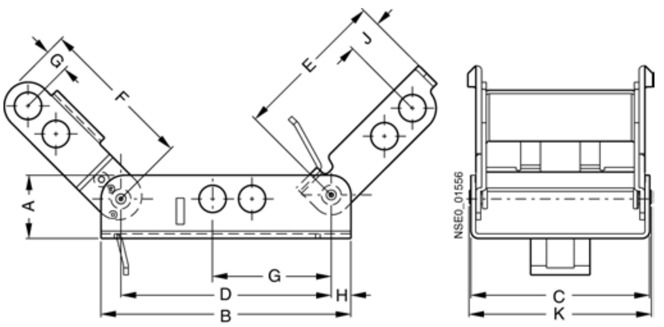


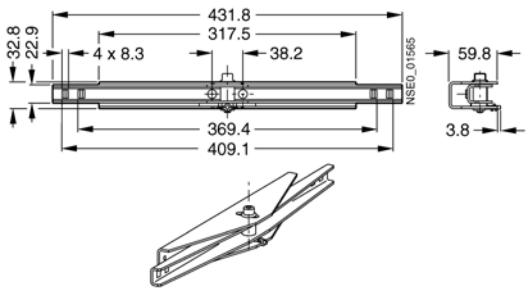
Table 12- 11

Type	A	B	C	D	E	F	G	H	I	K
3VL9 4	20,3	80,3	57,4	52,8	49,3	49,8	6,35	6,3	11,2	58,5
3VL9 6	21,6	79,8	71,1	62,0	50,4	46,5	12,9	8,9	8,6	72,2
3VL9 8	21,6	110,5	88,9	96,5	77,2	69,1	11,7	5,1	24,8	90,0

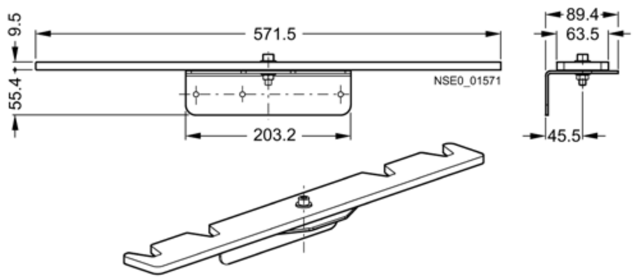
12.4.7 Rear interlocking module

Rear interlocking module 3-pole molded case circuit breaker

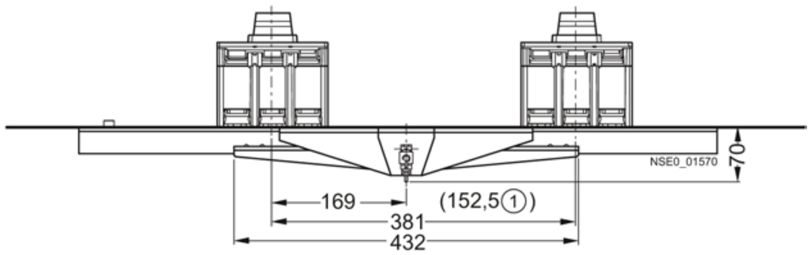
For other detailed dimension drawings, please refer to the mounting instructions for the rear interlocking module.



Rear interlocking module 4-pole molded case circuit breaker



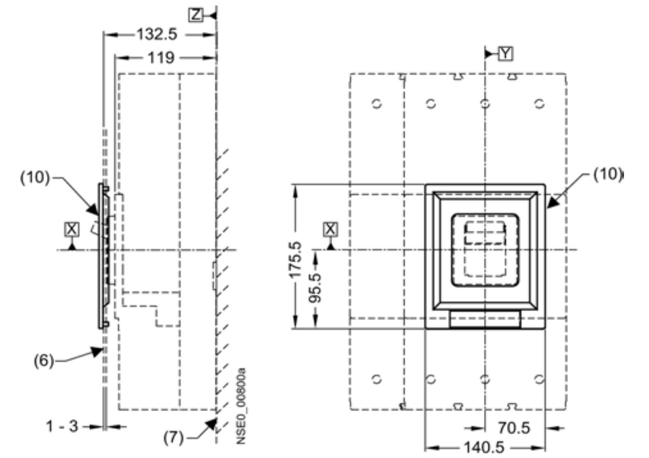
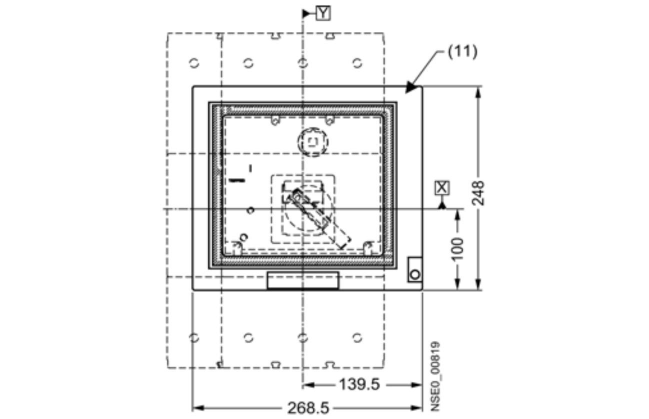
Rear interlocking module



(1) For withdrawable module

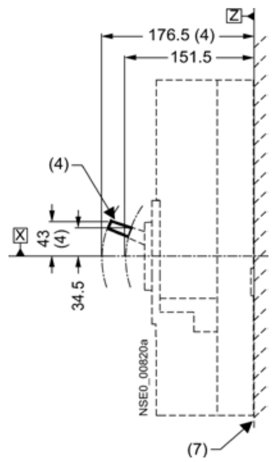
12.4.8 Accessories

Masking frame for door cutout

<table>
<tr><th>Masking frame for door cutout for molded case circuit breakers with toggle lever</th><th>Masking frame for door cutout for molded case circuit breakers with operating mechanism</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

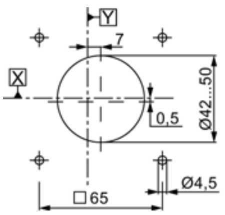
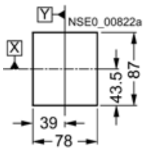
(6) External surface of cabinet door
(7) Mounting level
(10) Masking frame for door cutout (for molded case circuit breakers with toggle lever)
(11) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

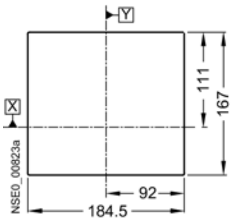
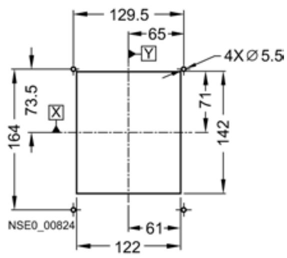
Toggle lever extension



(4) Toggle lever extension
(7) Mounting level

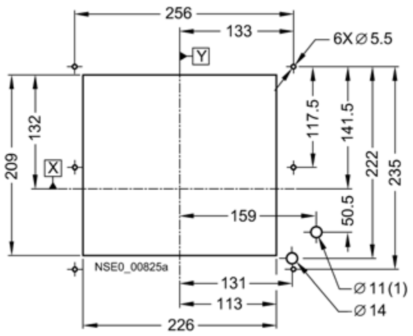
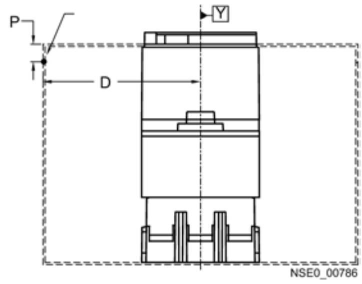
12.4.9 Door cutouts

<table>
<tr><th>Door cutout
Door coupling rotary operating mechanism</th><th>Door cutout toggle lever
(without masking frame)</th></tr>
<tr><td></td><td></td></tr>
</table>

<table>
<tr><th>Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon (without masking frame)</th><th>Door cutout toggle lever
(with masking frame)</th></tr>
<tr><td></td><td></td></tr>
</table>

Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

<table>
<tr><th>Door cutout front-operated rotary operating mechanism, motorized operating mechanism with stored energy mechanism and extended escutcheon
(with masking frame)</th><th>Door hinge point (see arrow)</th></tr>
<tr><td>
</td><td>

D > A from table + (P x 5)</td></tr>
</table>

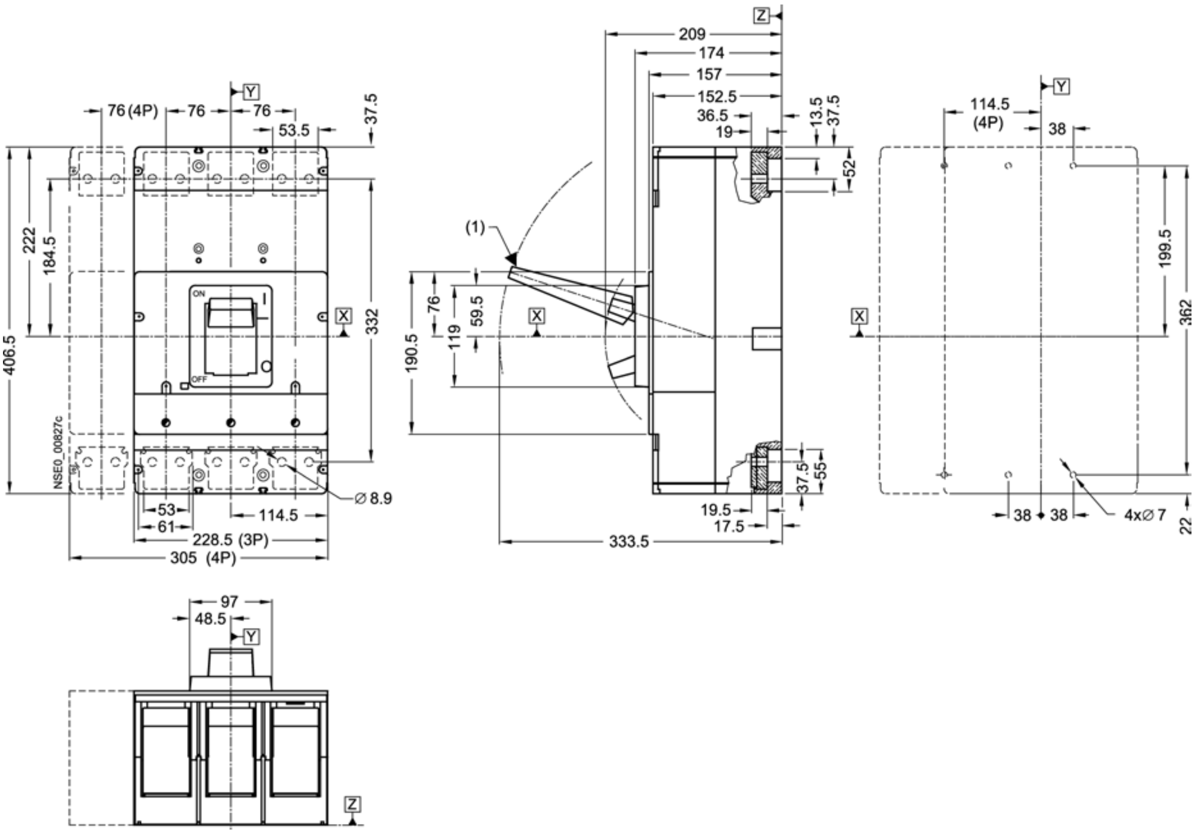
(1) Withdrawable version only

Combination	A
Molded case circuit breaker only	150
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	150
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

12.5 VL1250 (3VL7) and VL1600 (3VL8), 3- and 4-pole, up to 1600 A

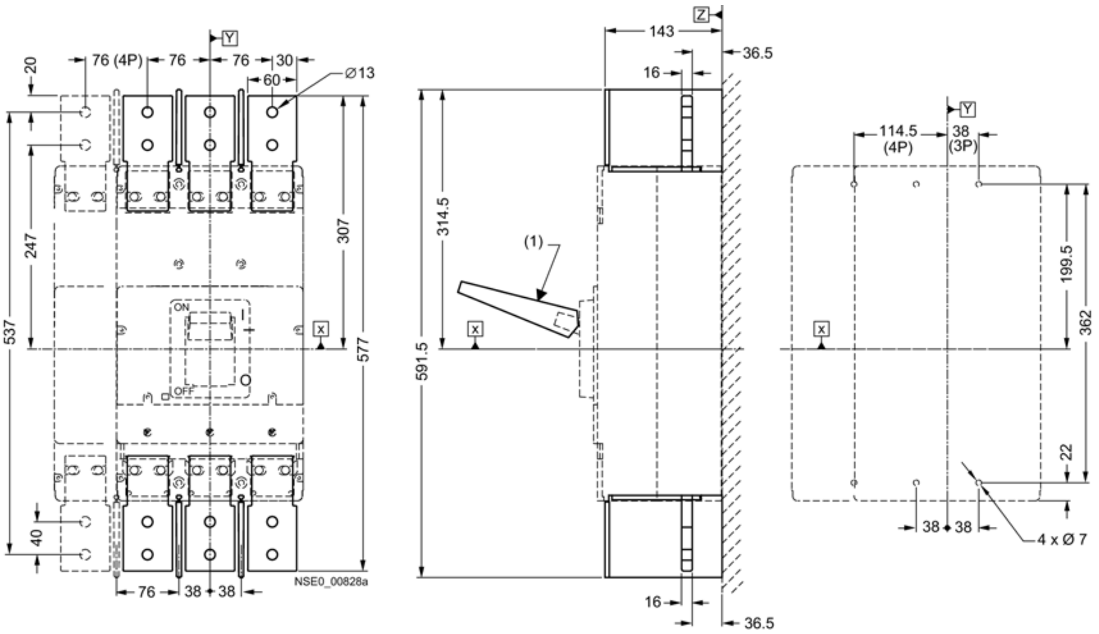
12.5.1 Molded case circuit breakers

VL1250 (3VL7) molded case circuit breaker



(1) Toggle lever extension

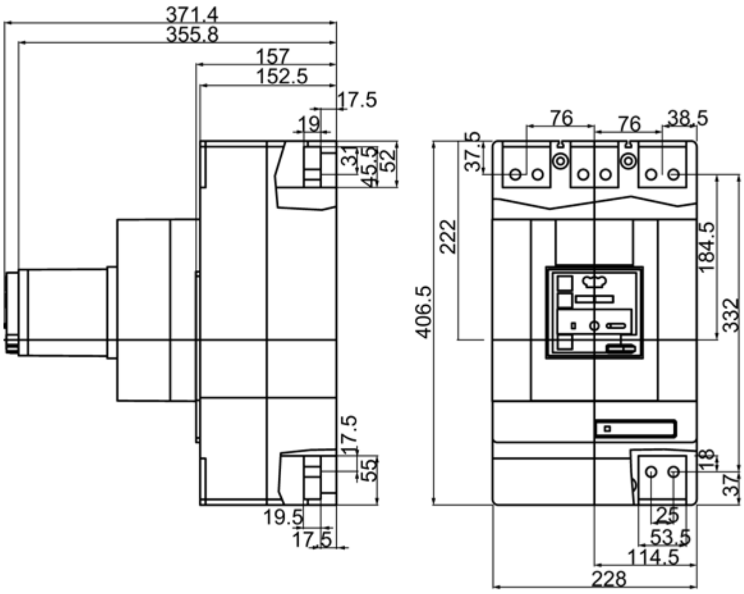
VL1600 (3VL8) molded case circuit breaker



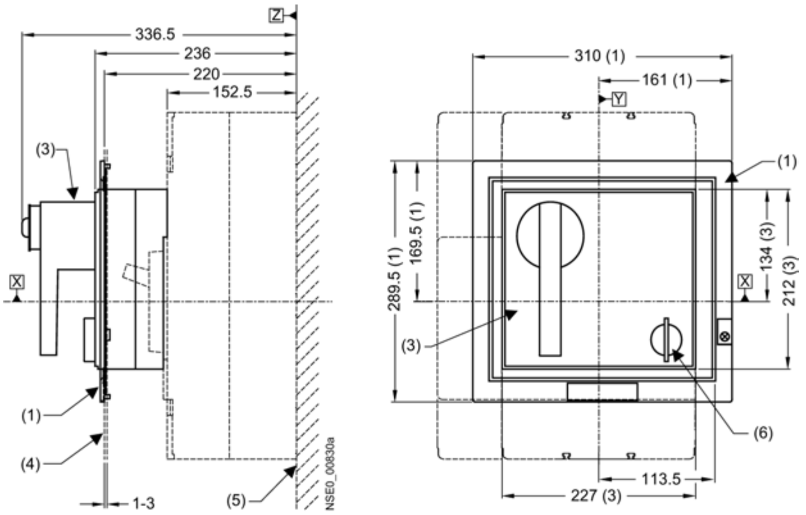
(1) Toggle lever extension

12.5.2 Operating mechanisms

Motorized operating mechanism (MO)

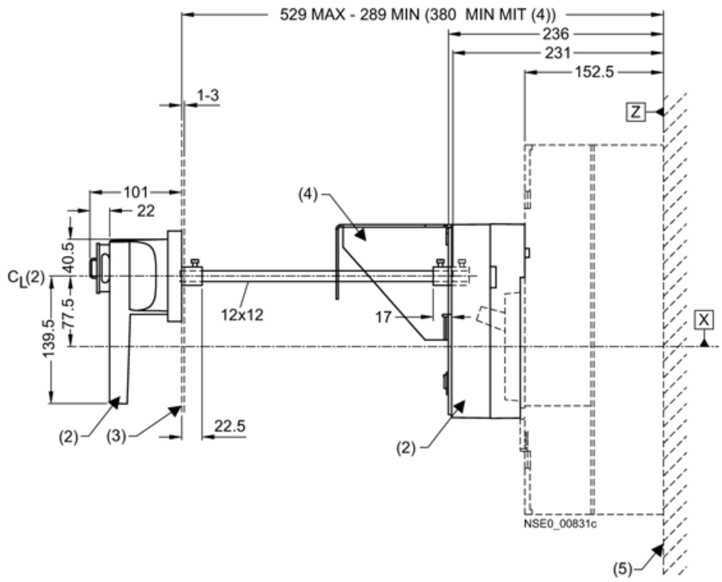


Front-operated rotary operating mechanism



(1)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)	(4)	External surface of cabinet door
(2)	Motorized operating mechanism	(5)	Mounting level
(3)	Front-operated rotary operating mechanism	(6)	Safety lock

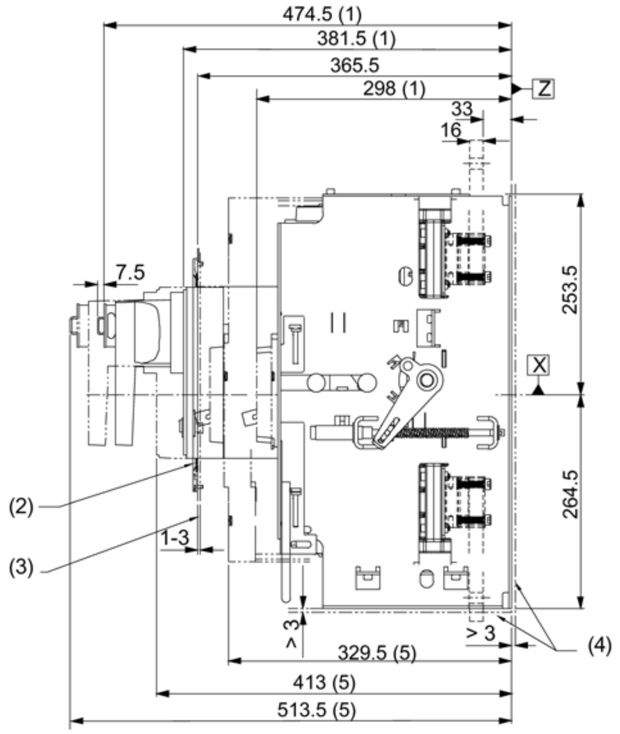
Molded case circuit breaker with door-coupling rotary operating mechanism



(2) Door-coupling rotary operating mechanism
(3) External surface of cabinet door
(4) Supporting bracket
(5) Mounting level

12.5.3 Withdrawable version

Withdrawable version with front-operated rotary operating mechanism, insert position and remove position



(1) Connected position

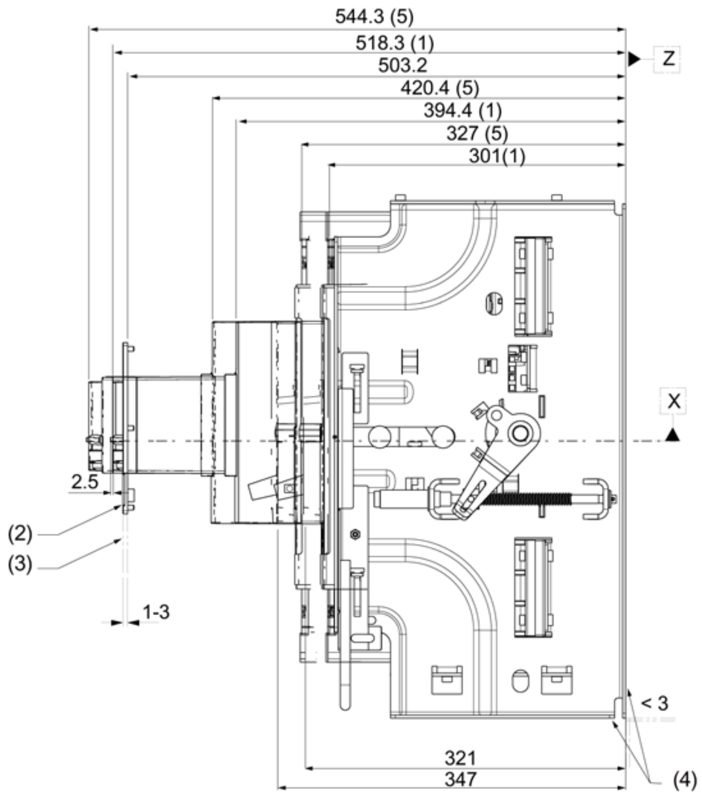
(2) Masking frame for door cutout

(3) External surface of cabinet door

(4) Mounting level

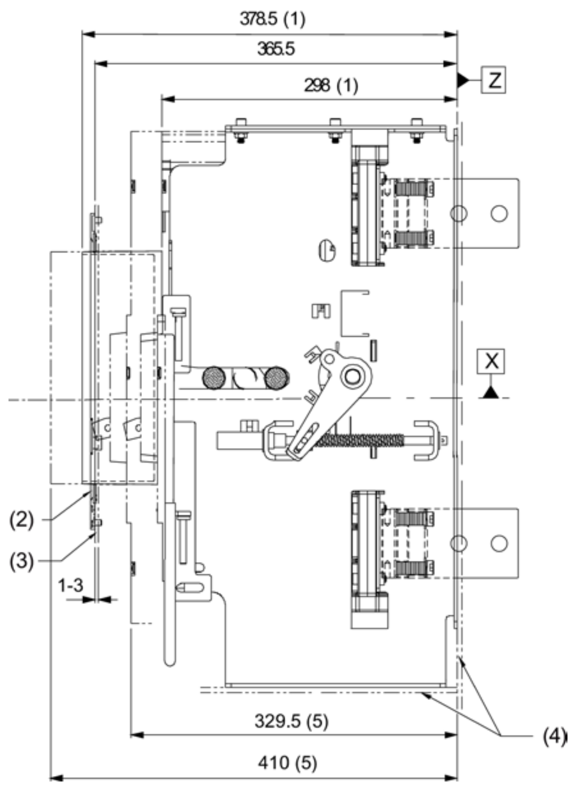
(5) Disconnected position

Withdrawable version motorized operating mechanism, insert position and remove position



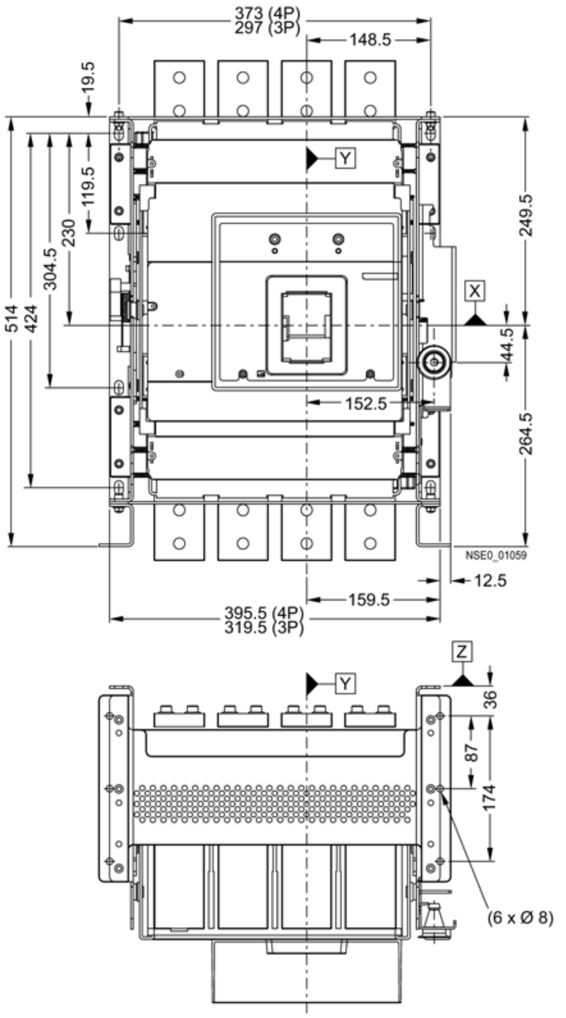
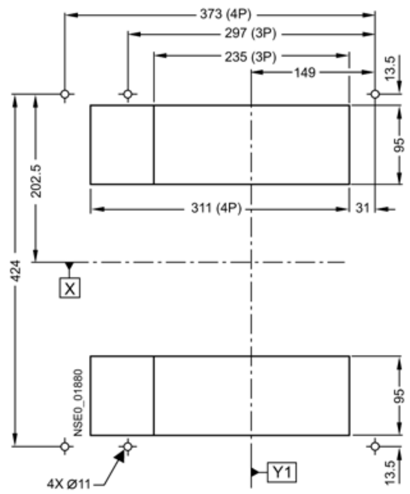
(1) Connected position
(2) Masking frame for door cutout
(3) External surface of cabinet door
(4) Mounting level
(5) Disconnected position

Withdrawable version with extended escutcheon (without masking frame), insert position and remove position

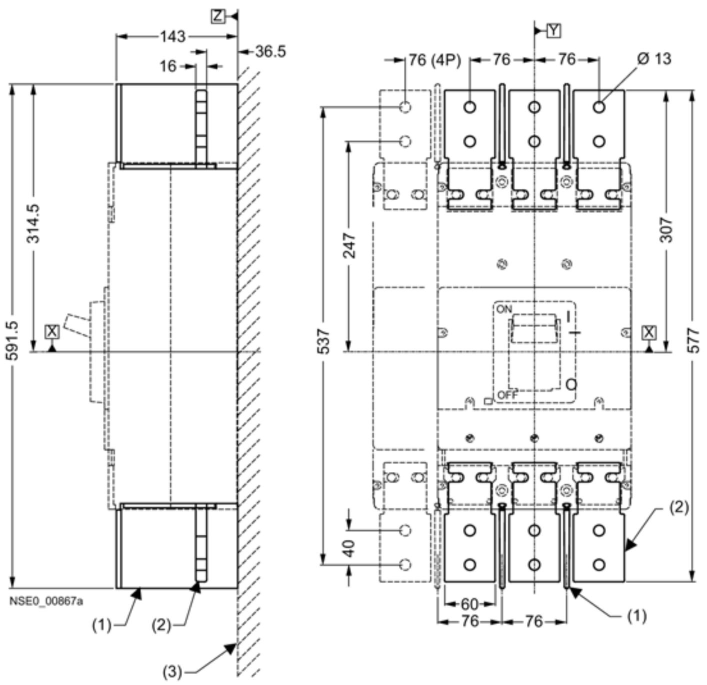


(1) Connected position
(2) Masking frame for door cutout
(3) External surface of cabinet door
(4) Mounting level
(5) Disconnected position

Table 12- 12

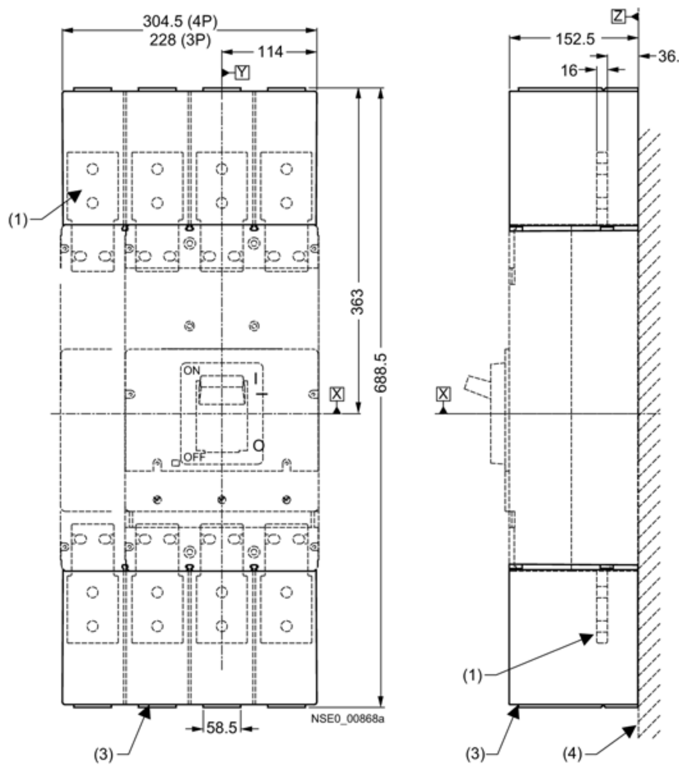
Withdrawable version	Drilling template and cutout for withdrawable modules with flat connecting bars on rear
	

12.5.4 Connections and phase barriers



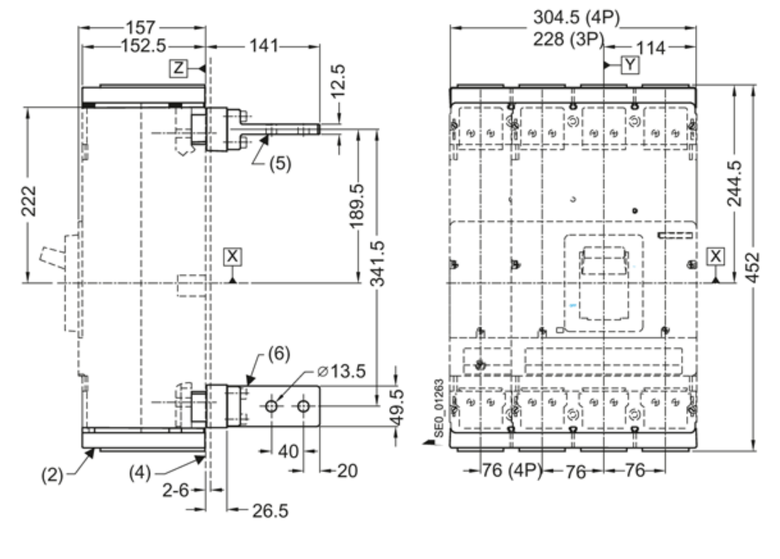
(1)	Interphase barrier
(2)	Front connecting bars
(3)	Mounting level

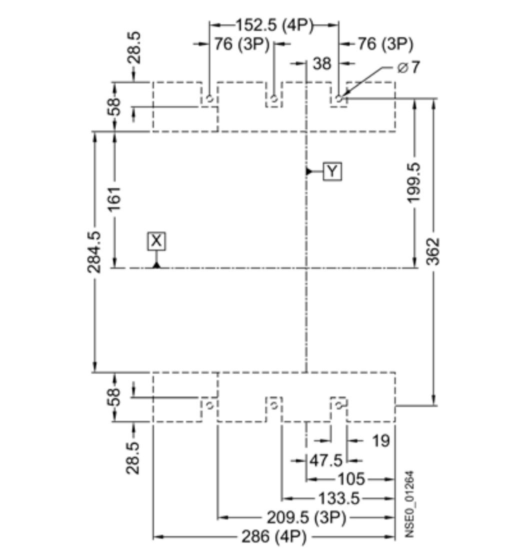
12.5.5 Terminal covers



(1) Front connecting bars
(3) Terminal covers (extended)
(4) Mounting level

VL1250 (3VL7) molded case circuit breakers only





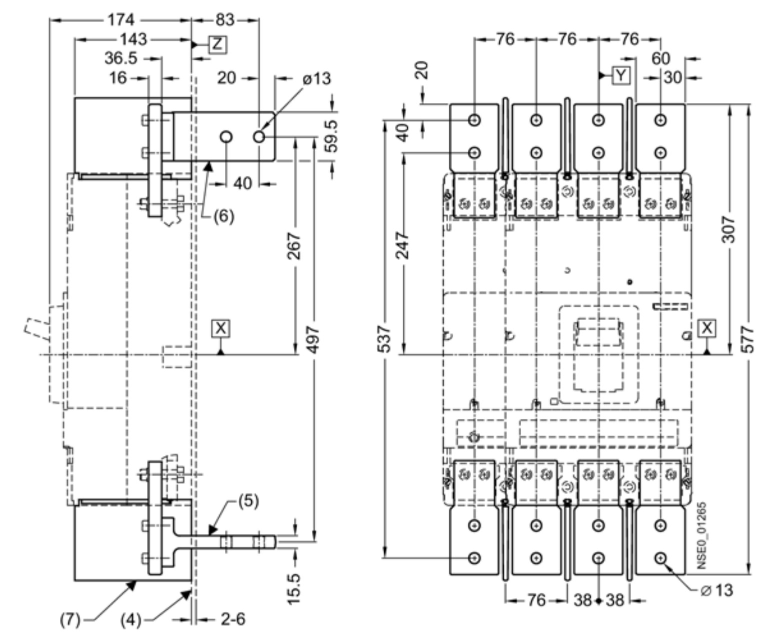
(2) Terminal covers (short) – for VL1250 (3VL7) molded case circuit breakers only

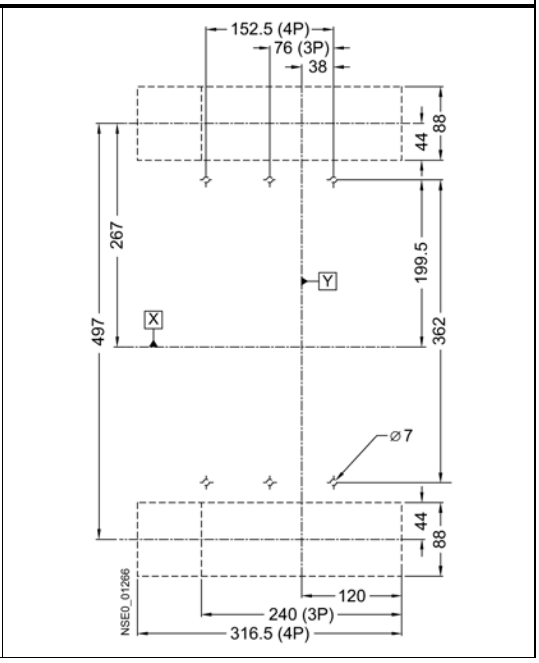
(4) Mounting level

(5) Rear connection (horizontal mounting)

(6) Rear connection (vertical mounting)

VL1600 (3VL8) molded case circuit breakers only





(1) Front connecting bars

(2) Terminal covers (short) – for VL1250 (3VL7) molded case circuit breakers only

(3) Terminal covers (extended)

(4) Mounting level

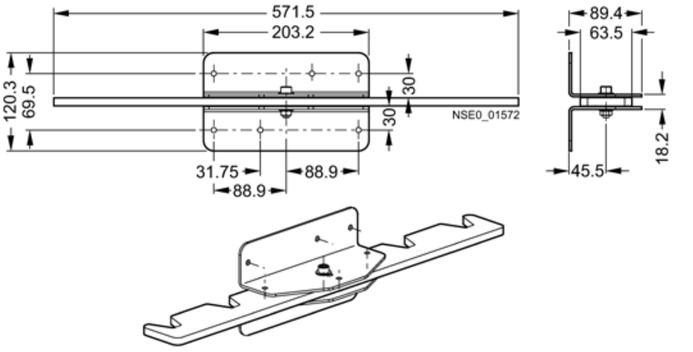
(5) Rear connection (horizontal mounting)

(6) Rear connection (vertical mounting)

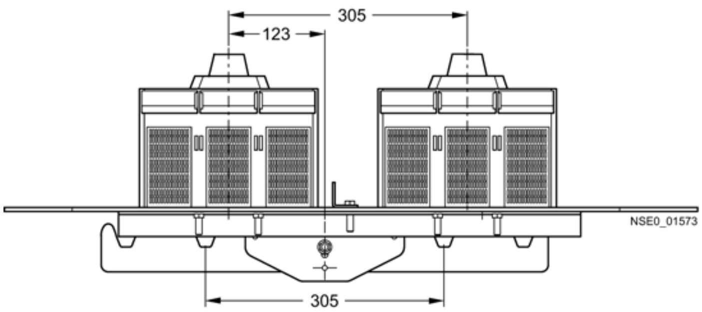
(7) Phase barriers

12.5.6 Rear interlocking module

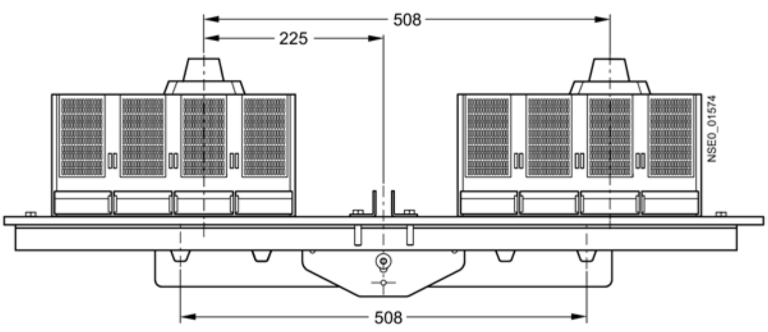
For other detailed dimension drawings, please refer to the mounting instructions for the rear interlocking module.



3-pole version



4-pole version



12.5.7 Locking and locking device for toggle lever

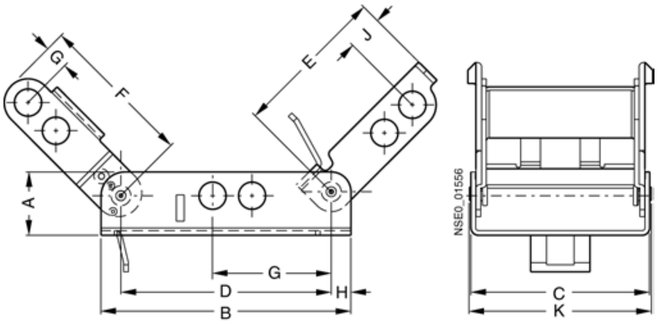
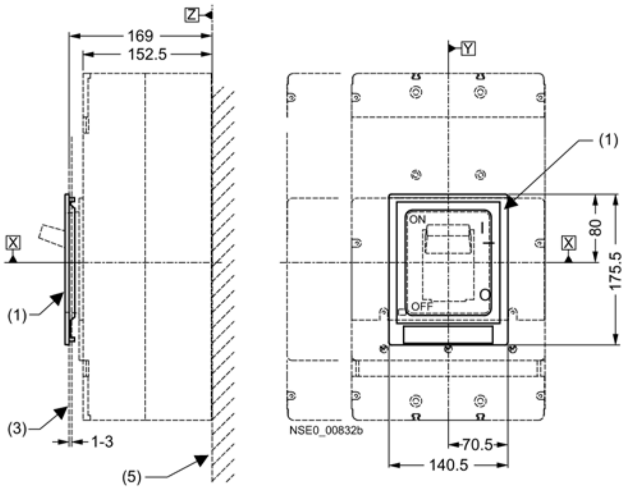


Table 12- 13

Type	A	B	C	D	E	F	G	H	I	K
3VL9 4	20,3	80,3	57,4	52,8	49,3	49,8	6,35	6,3	11,2	58,5
3VL9 6	21,6	79,8	71,1	62,0	50,4	46,5	12,9	8,9	8,6	72,2
3VL9 8	21,6	110,5	88,9	96,5	77,2	69,1	11,7	5,1	24,8	90,0

12.5.8 Accessories

Masking frame for door cutout for molded case circuit breakers with toggle lever



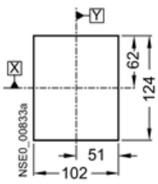
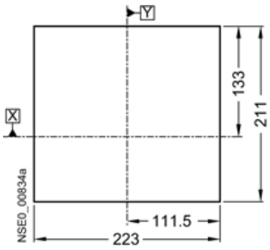
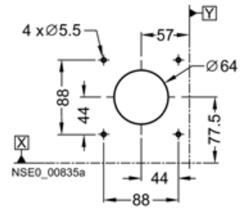
(1) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

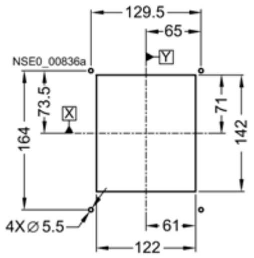
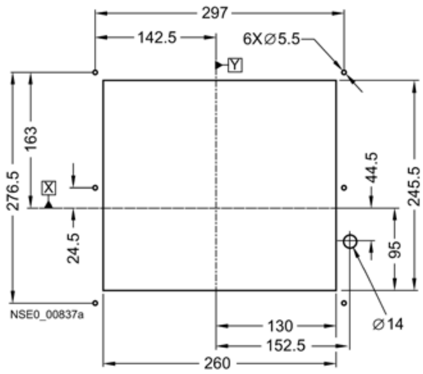
(3) External surface of cabinet door

(5) Mounting level

12.5.9 Door cutouts

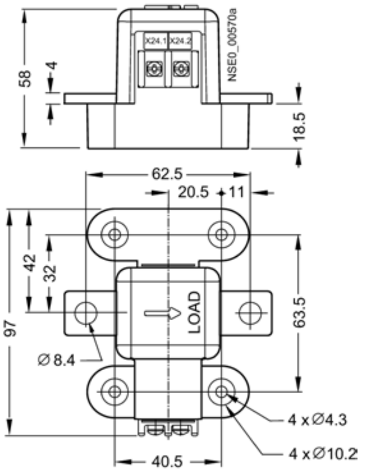
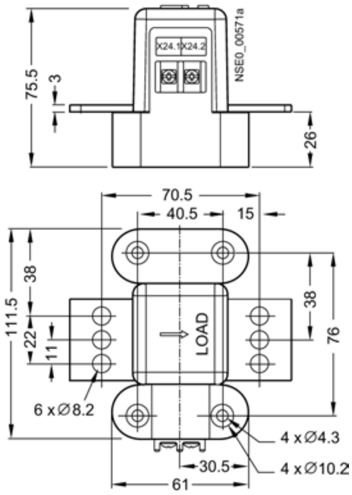
Table 12- 14

<table>
<tr><th>Door cutout toggle lever
(without masking frame)</th><th>Door cutout front-operated rotary operating mechanism and motorized operating mechanism (without masking frame)</th><th>Door cutout
Door coupling rotary operating mechanism</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

<table>
<tr><th>Door cutout toggle lever
(with masking frame)</th><th>Door cutout front-operated rotary operating mechanism, motorized operating mechanism and extended escutcheon (with masking frame)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

12.5.10 Current transformer

Table 12- 15

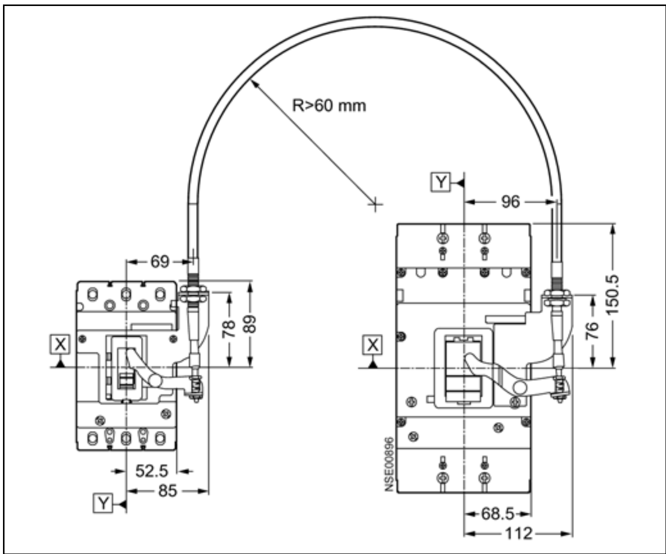
<table>
<tr><th>Current transformer for neutral conductor for ground-fault protection in 4-conductor three-phase systems for VL160 (3VL2)/VL250 (3VL3) molded case circuit breakers</th><th>Current transformer for neutral conductor for ground-fault protection in 4-conductor three-phase systems for VL630 (3VL5)/VL800 (3VL6) molded case circuit breakers</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

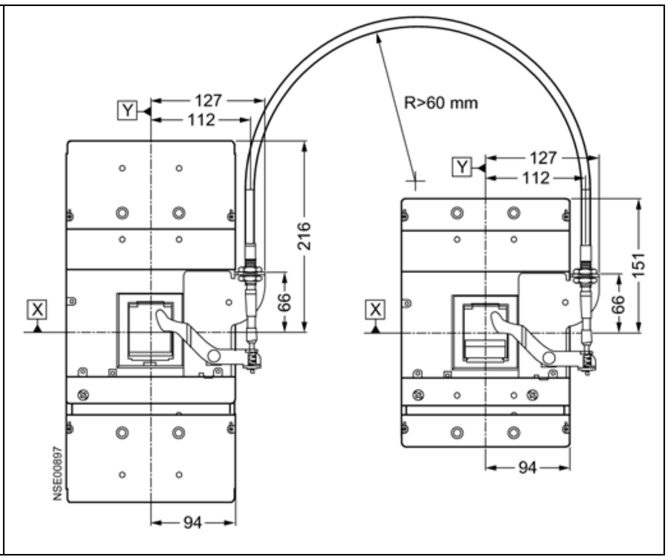
For other dimension drawings (for current transformers for 3VL4, 3VL7, 3VL8), please refer to the mounting instructions for current transformers.

12.6 Interlocks for VL160X (3VL1) to VL800 (3VL6), 3- and 4-pole, up to 800 A

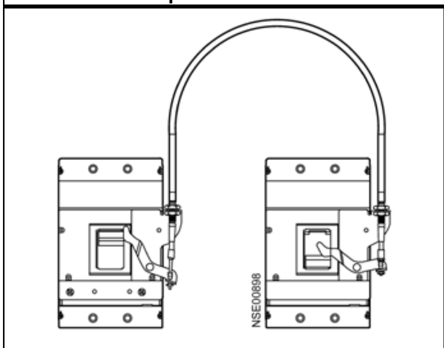
12.6.1 Locking with bowden wire

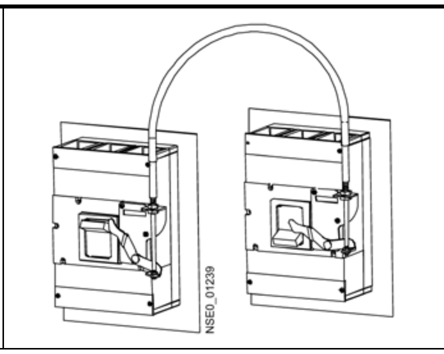
Table 12- 16

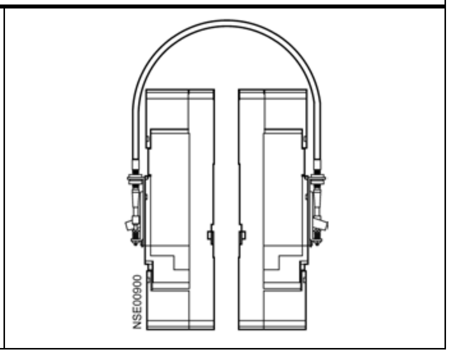




Combination options





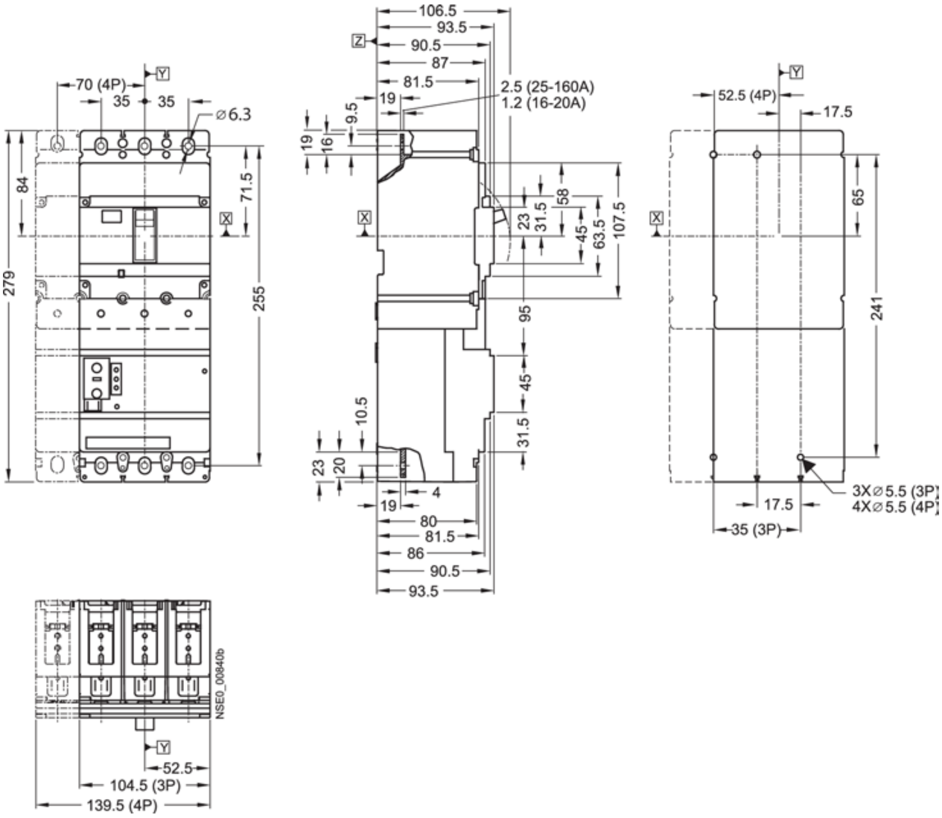


	3VL93008LA00	3VL94008LA00	3VL96008LA00	3VL98008LA00
3VL93008LA00	OK	OK	OK	-
3VL94008LA00	OK	OK	OK	-
3VL96008LA00	OK	OK	OK	OK
3VL98008LA00	-	-	OK	OK

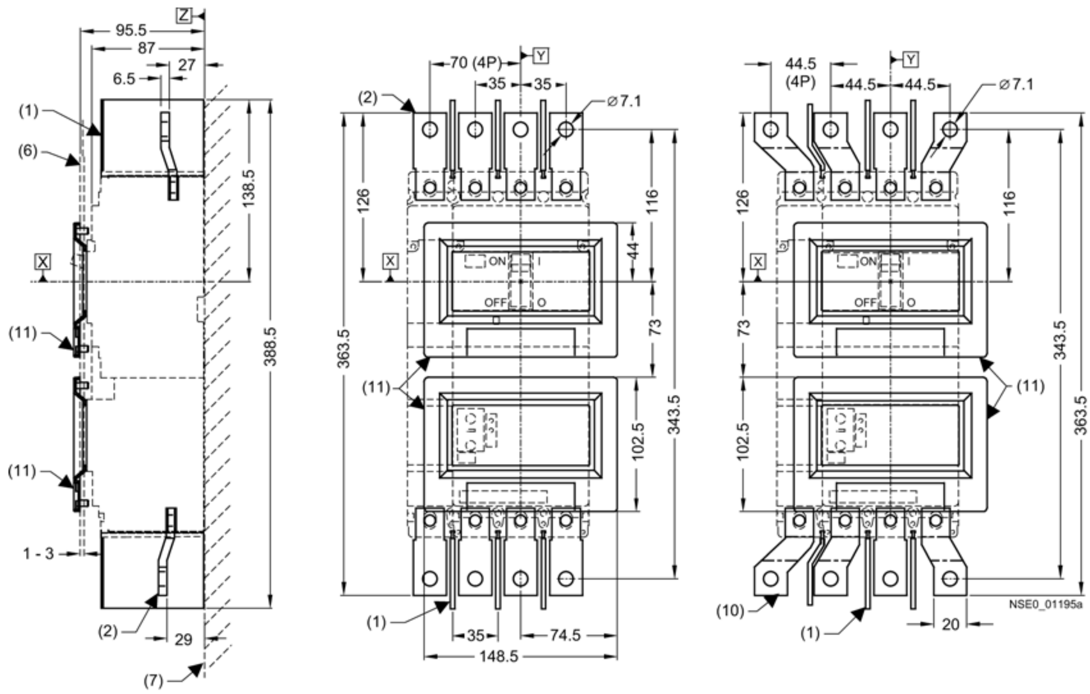
12.7 VL160X (3VL1) with RCD block, 3- and 4-pole, up to 160 A

12.7.1 Molded case circuit breakers

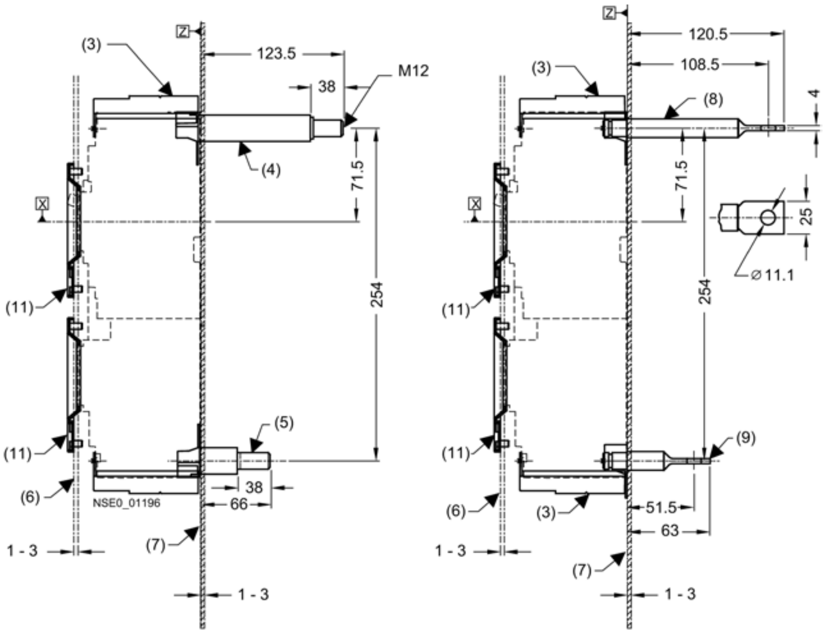
VL160X (3VL1) molded case circuit breakers with RCD module



12.7.2 Connections and phase barriers

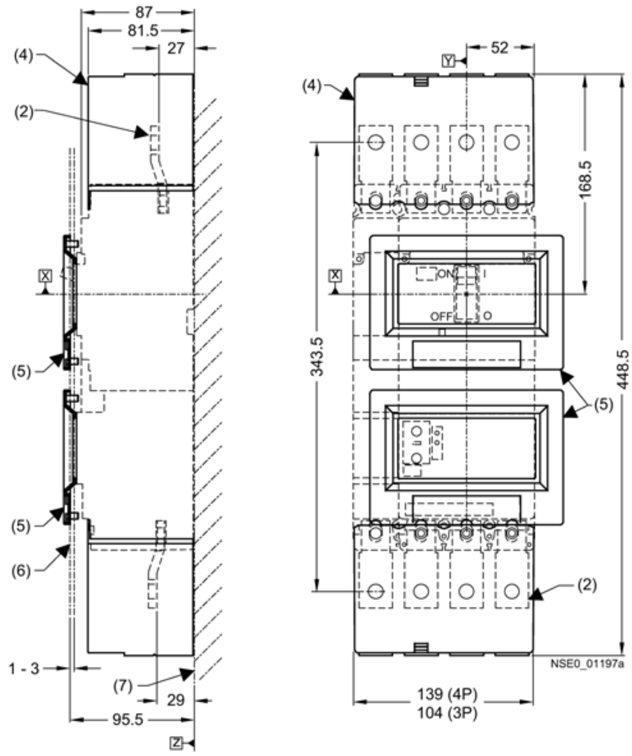


(1)	Interphase barrier
(2)	Front connecting bars
(6)	External surface of cabinet door
(7)	Mounting level
(10)	Front connecting bars for increased pole spacing
(11)	Masking frame for door cutout (for molded case circuit breakers with RCD module)

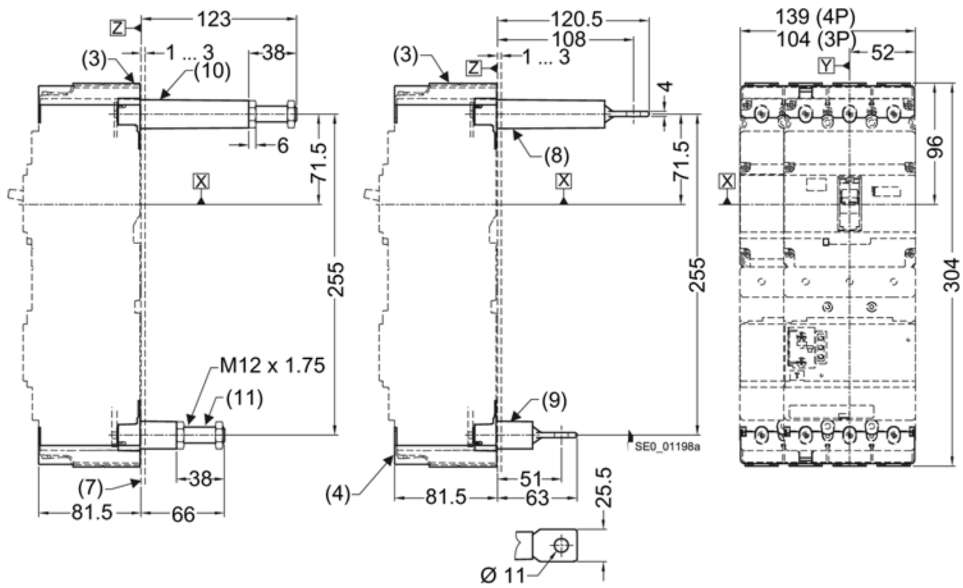


(3)	Terminal covers (standard)
(4)	Rear connection threaded bolt (long)
(5)	Rear connection threaded bolt (short)
(6)	External surface of cabinet door
(7)	Mounting level
(8)	Rear connection, long flat terminals
(9)	Rear connection, short flat terminals
(11)	Masking frame for door cutout (for molded case circuit breakers with RCD module)

12.7.3 Terminal covers



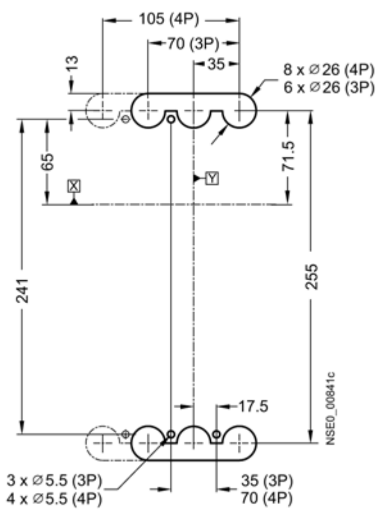
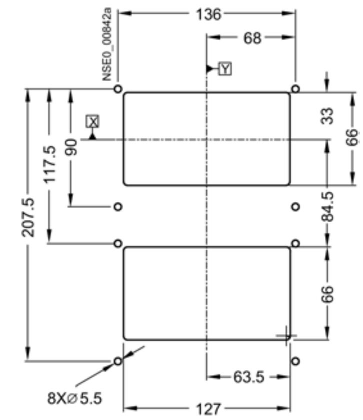
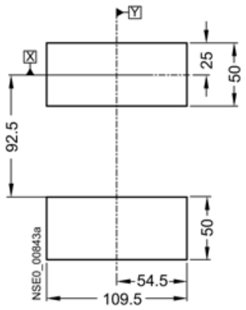
(2)	Front connecting bars	(6)	External surface of cabinet door
(4)	Terminal covers (extended)	(7)	Mounting level
(5)	Masking frame for door cutout (for molded case circuit breakers with RCD module)		



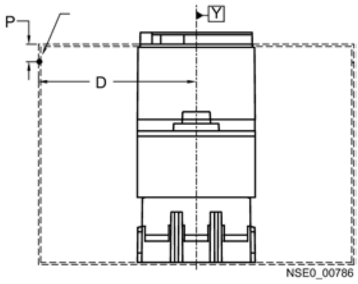
(3)	Terminal covers (standard)	(9)	Rear connection, short flat terminals
(4)	Terminal covers (extended)	(10)	Rear connection, long
(7)	Mounting level	(11)	Rear connection, short
(8)	Rear connection, long flat terminals		

12.7.4 Door cutouts

Table 12- 17

Drilling template for rear connection	Door cutout toggle lever (with masking frame)	Door cutout toggle lever (without masking frame)
		

Door hinge point (see arrow)



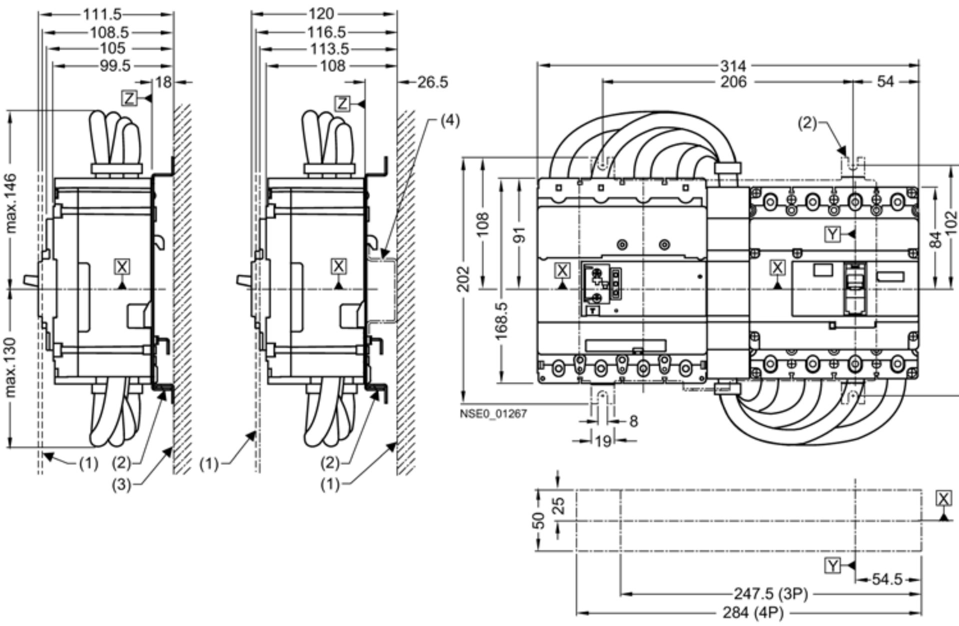
D > A from table + (P × 5)

Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

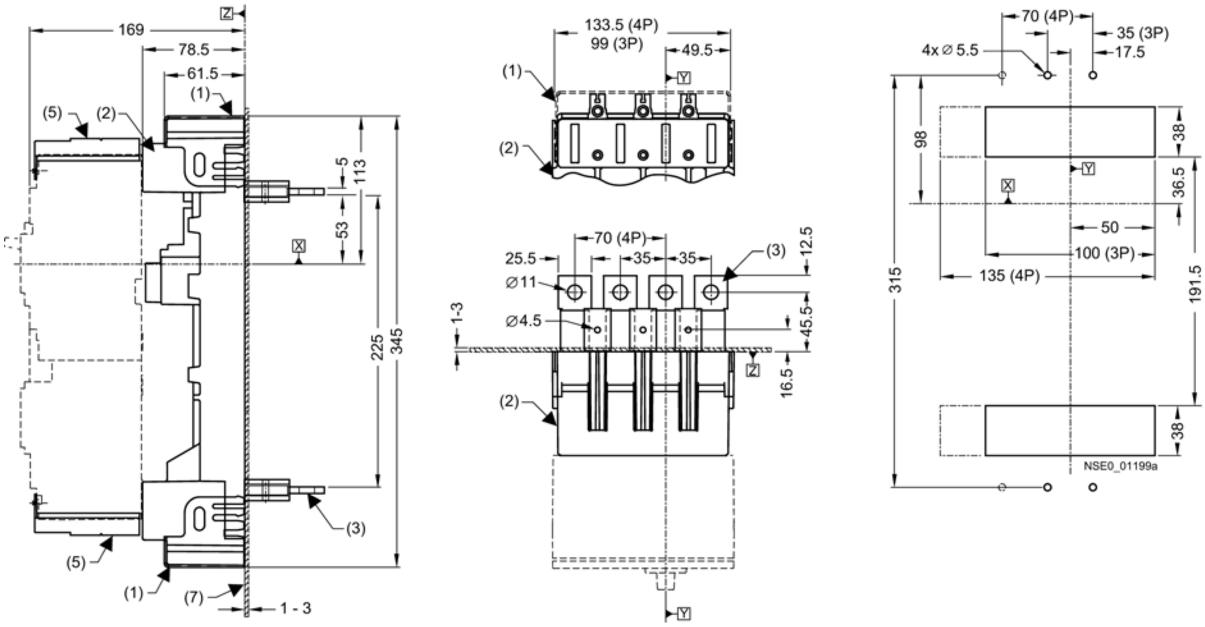
Combination	A
Molded case circuit breaker only	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	100
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200

Molded case circuit breaker with RCD module mounted on side

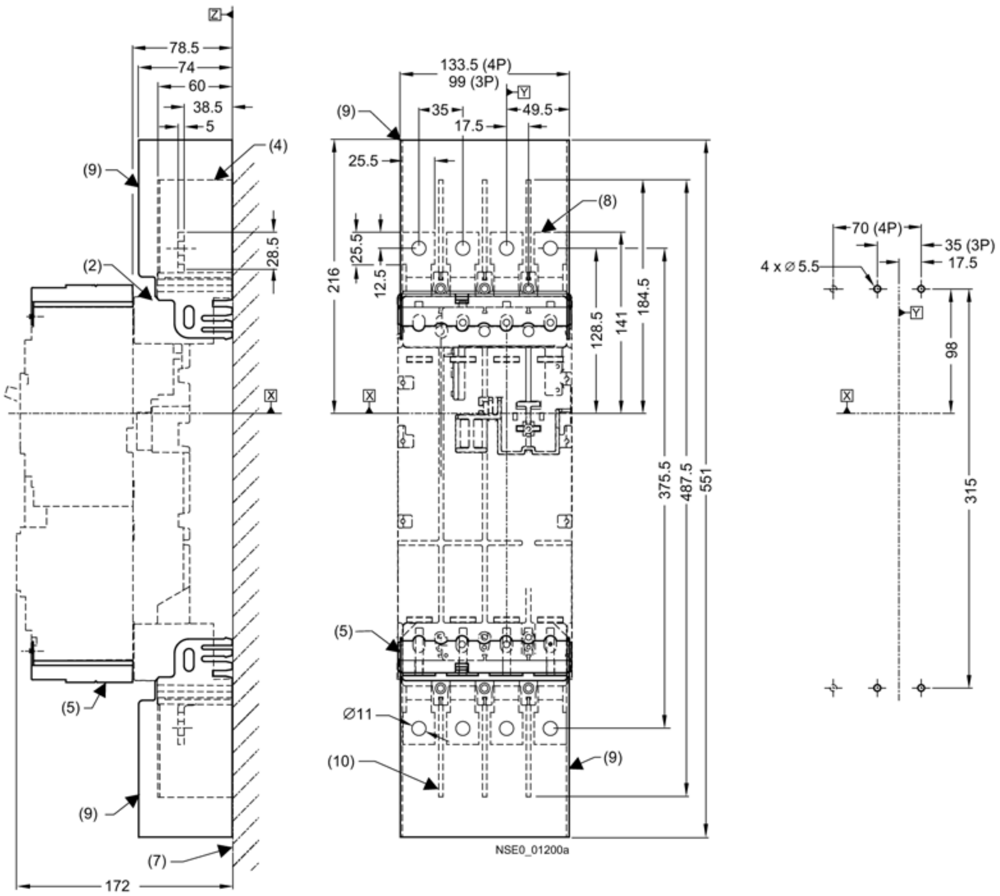


(1) External surface of cabinet door
(2) Fastening bracket
(3) Mounting level
(4) Mounting rail TH 75 in accordance with DIN EN 60715 (to be provided by the customer)

12.7.5 Plug-in base and accessories



(1) Plug-in base with rear terminal covers
(2) Plug-in base for molded case circuit breaker with RCD module
(3) Plug-in base with flat rear terminals
(5) Terminal cover (standard)
(7) Mounting level



(2) Plug-in base for molded case circuit breaker with RCD module

(4) Masking frame for door cutout (for molded case circuit breakers with RCD module)

(5) Terminal cover (standard)

(7) Mounting level

(8) Plug-in base with front connecting bars

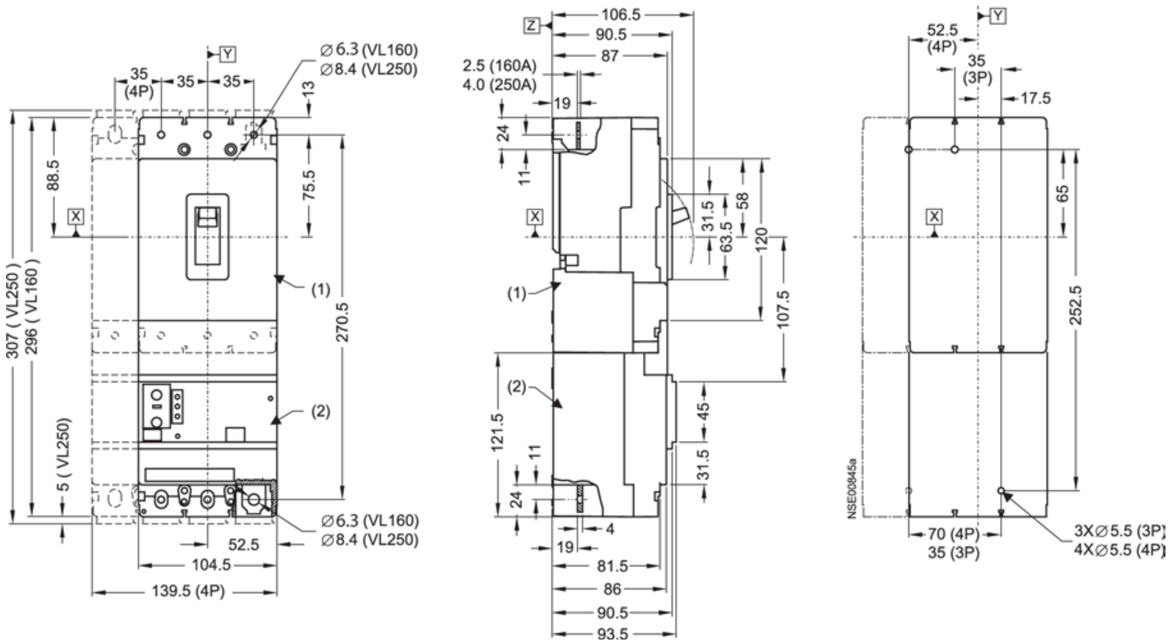
(9) Plug-in base with terminal covers on the front

(10) Interphase barrier

12.8 VL160 (3VL2) and VL250 (3VL3) with RCD module, 3- and 4-pole, to 250 A

12.8.1 Molded case circuit breakers

VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module



(1) Molded case circuit breakers

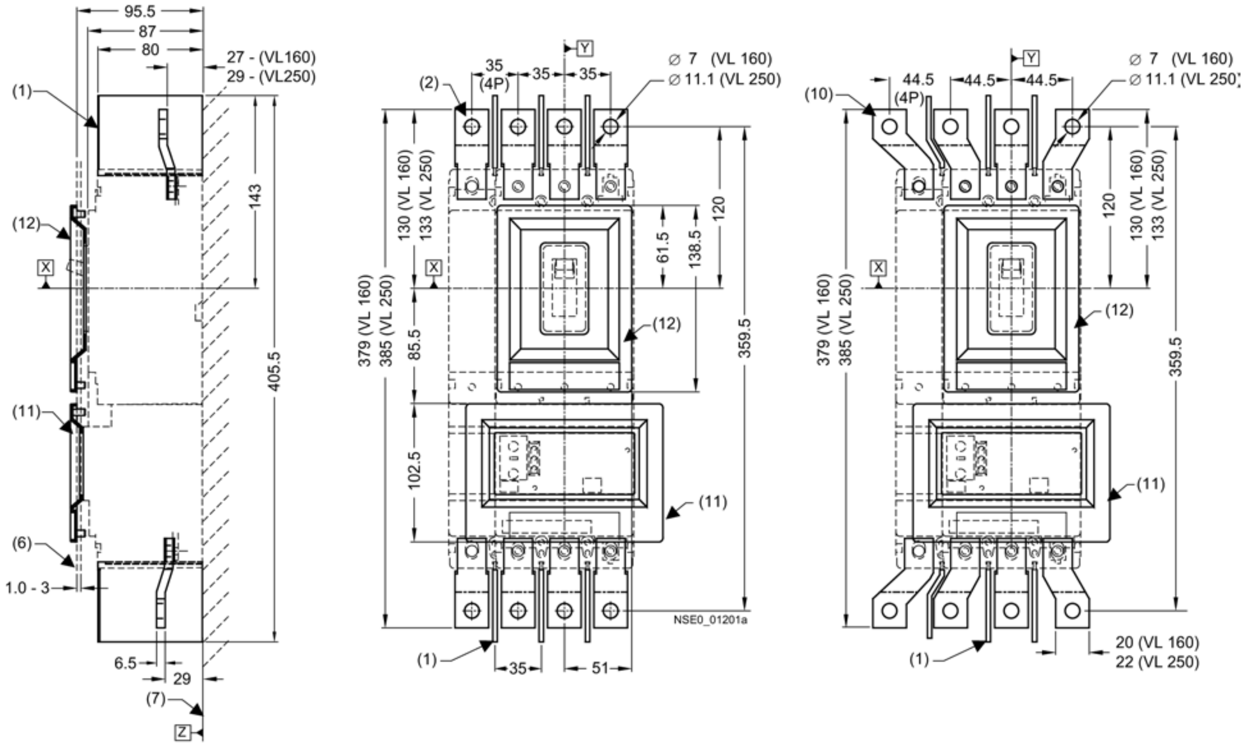
(2) RCD module

Note

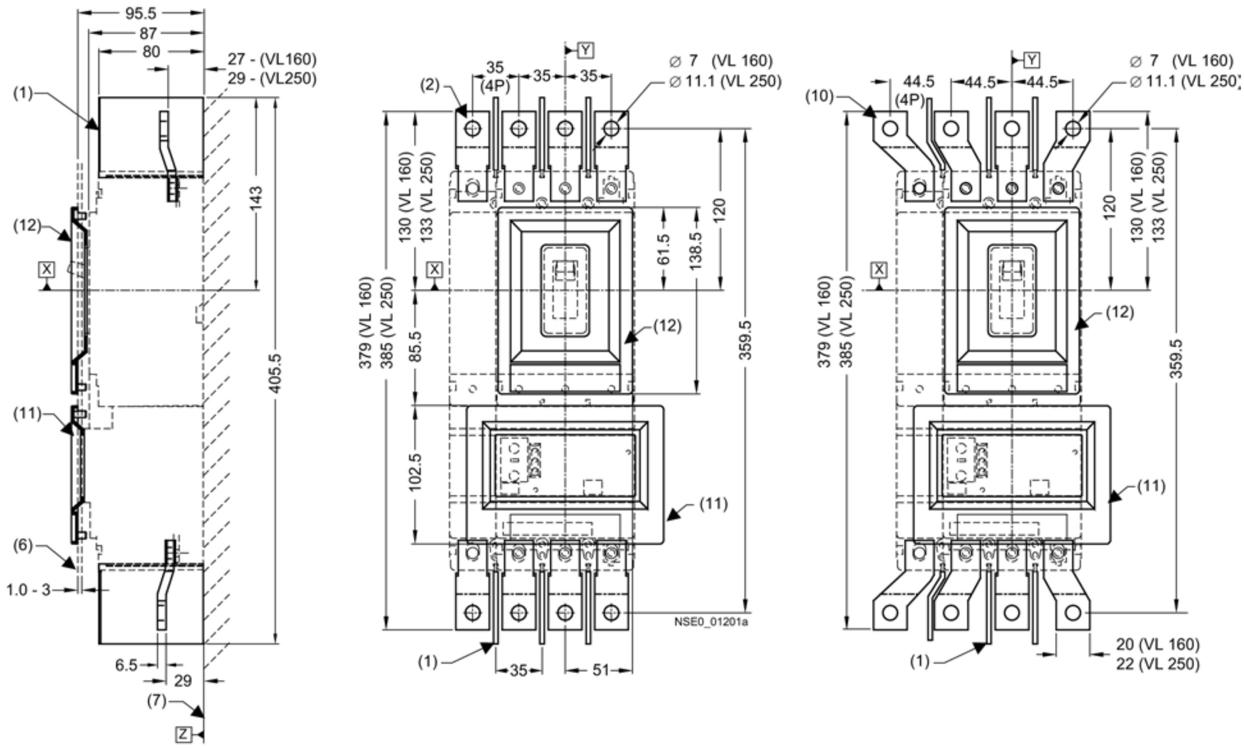
VL250 (3VL3) molded case circuit breakers:

The 5-mm extension (total height 307 mm) at each end is only significant when box terminals and circular conductor terminals are used.

12.8.2 Connections and phase barriers



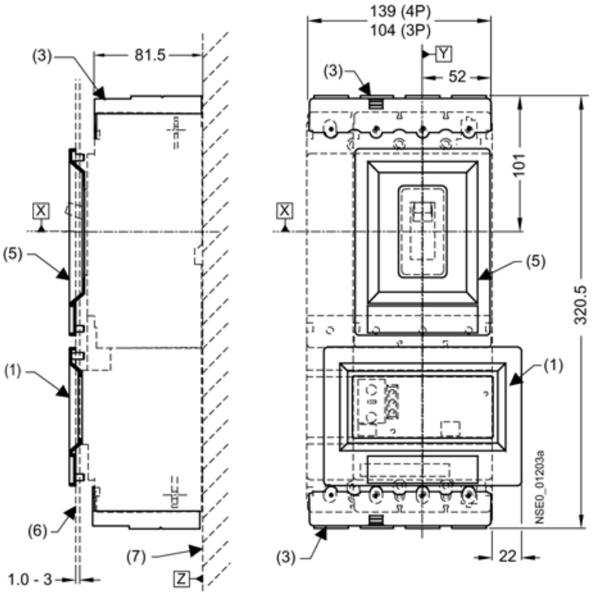
(1) Interphase barrier
(2) Front connecting bars
(6) External surface of cabinet door
(7) Mounting level
(10) Front connecting bars for increased pole spacing
(11) Masking frame for door cutout (for molded case circuit breakers with RCD module)
(12) Masking frame for door cutout (for molded case circuit breakers with toggle lever)



(1) Interphase barrier
(2) Front connecting bars
(3) Terminal covers (standard)
(4) Rear connections (long)
(5) Rear connections (short)
(6) External surface of cabinet door
(7) Mounting level
(8) Rear flat terminals (long)
(9) Rear flat terminals (short)
(10) Front connecting bars for increased pole spacing
(11) Masking frame for door cutout (for molded case circuit breakers with RCD module)
(12) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

12.8.3 Terminal covers

Dimensions of lower cover frame "VL160X (3VL1) with RCD block, 3- and 4-pole, up to 160 A", Terminal covers (Page 256).



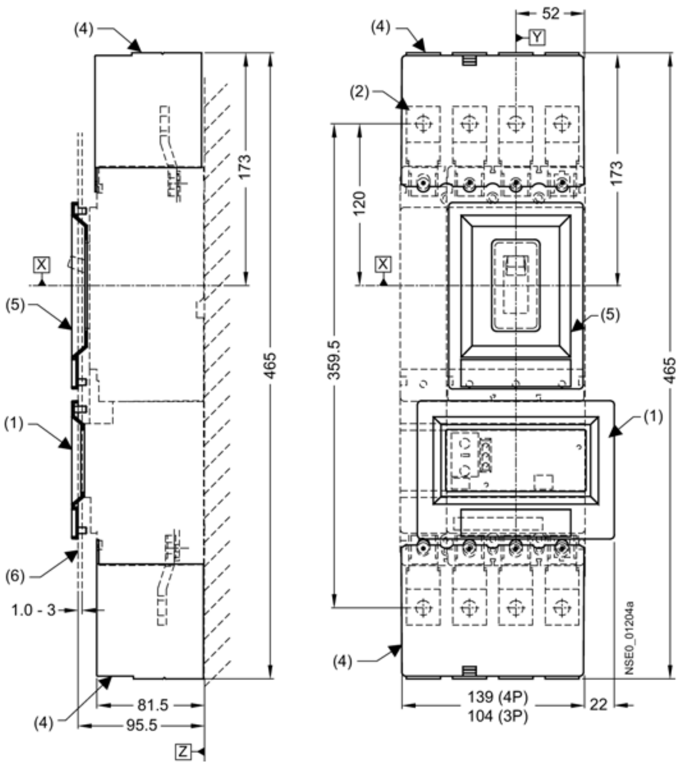
(1) Masking frame for door cutout (for molded case circuit breakers with RCD module)

(3) Terminal covers (standard)

(5) Masking frame for door cutout (for molded case circuit breakers with toggle lever)

(6) External surface of cabinet door

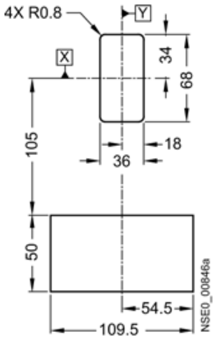
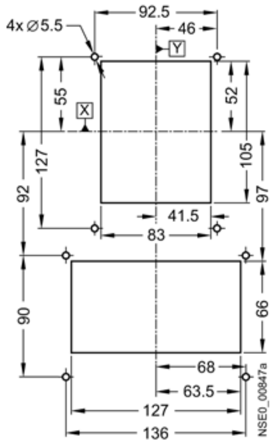
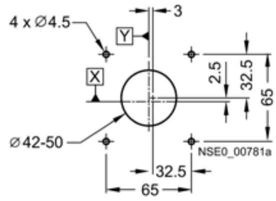
(7) Mounting level

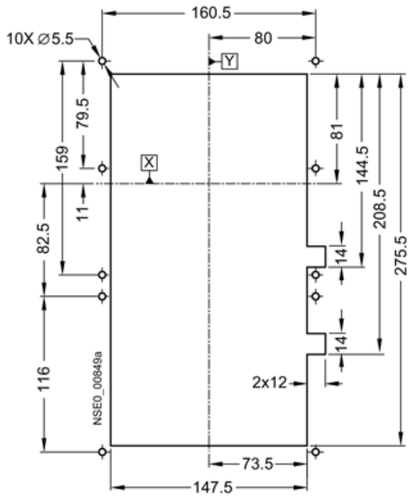
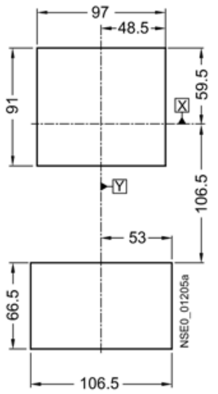
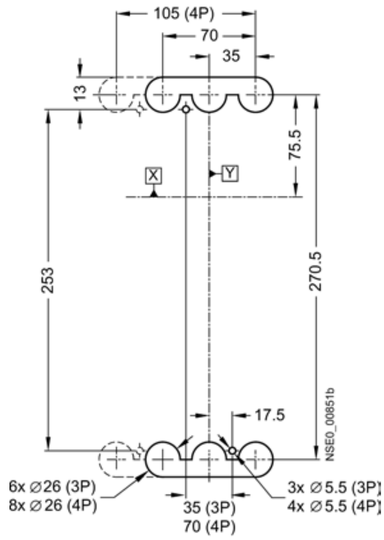


(1) Masking frame for door cutout (for molded case circuit breakers with RCD module)
(2) Front connecting bars
(4) Terminal covers (extended)
(5) Masking frame for door cutout (for molded case circuit breakers with toggle lever)
(6) External surface of cabinet door

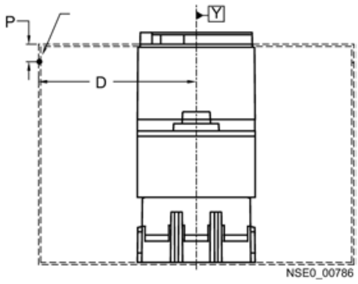
12.8.4 Door cutouts

Table 12- 18

<table>
<tr><th>Door cutout toggle lever
(without masking frame)</th><th>Door cutout toggle lever
(with masking frame)</th><th>Door cutout
Door coupling rotary operating mechanism</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

<table>
<tr><th>Door cutout front-operated rotary operating mechanism and motorized operating mechanism with stored energy mechanism
(with masking frame)</th><th>Door cutout front-operated rotary operating mechanism
(without masking frame)</th><th>Drilling template for cutout rear connection bolts</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

Door hinge point (see arrow)



D > A from table + (P × 5)

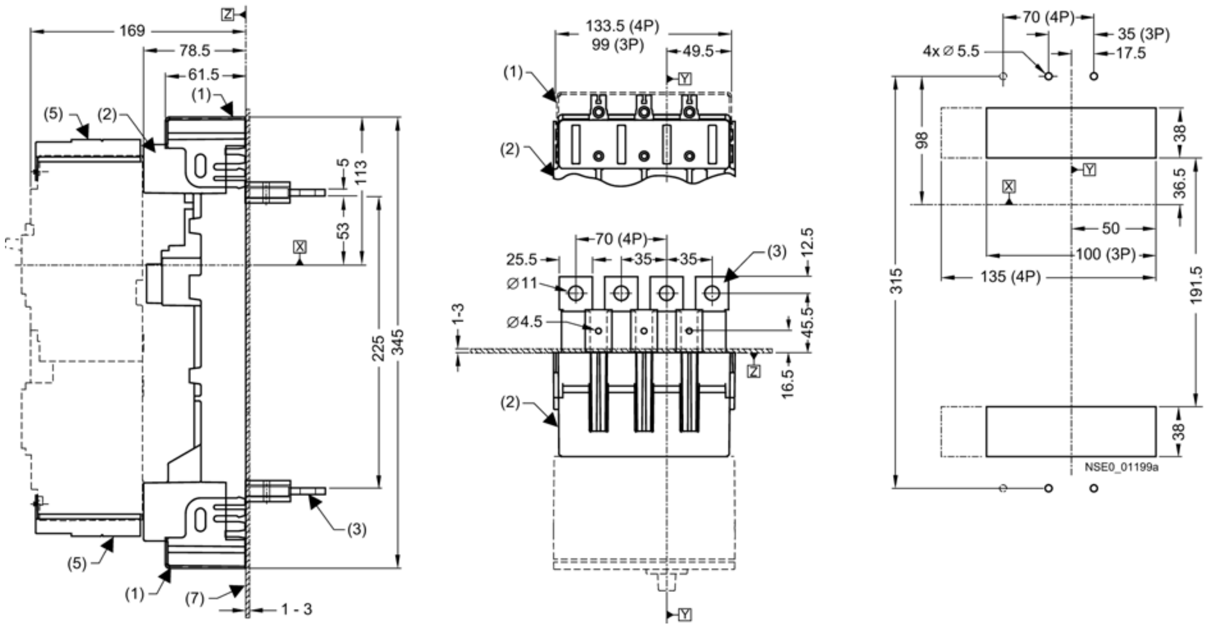
Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

Combination	A
Molded case circuit breaker only	100
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	100
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

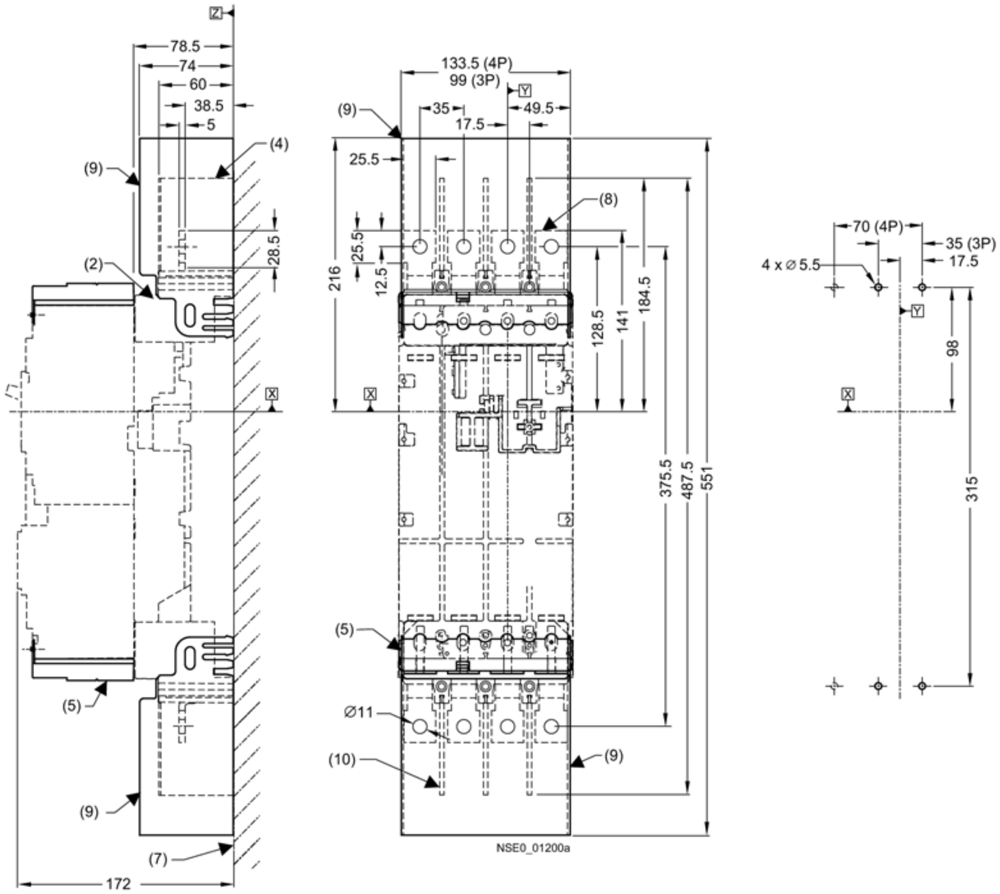
12.8.5 Plug-in base and accessories

Plug-in base and accessories with drilling template and cutout for plug-in base with flat connecting bars on rear



(1) Plug-in base with rear terminal covers
(2) Plug-in base for molded case circuit breaker with RCD module
(3) Plug-in base with flat rear terminals
(5) Terminal cover (standard)
(7) Mounting level

Drilling template and cutout for plug-in base with flat connecting bars on rear with plug-in base and accessories



(2) Plug-in base for molded case circuit breaker with RCD module

(4) Masking frame for door cutout (for molded case circuit breakers with RCD module)

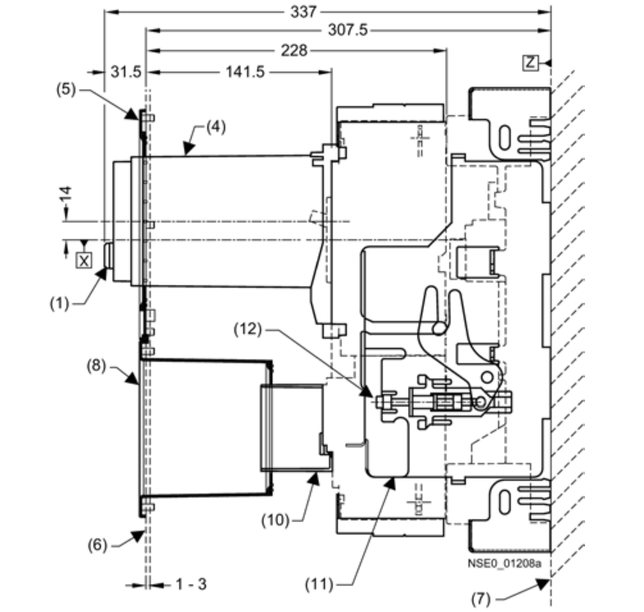
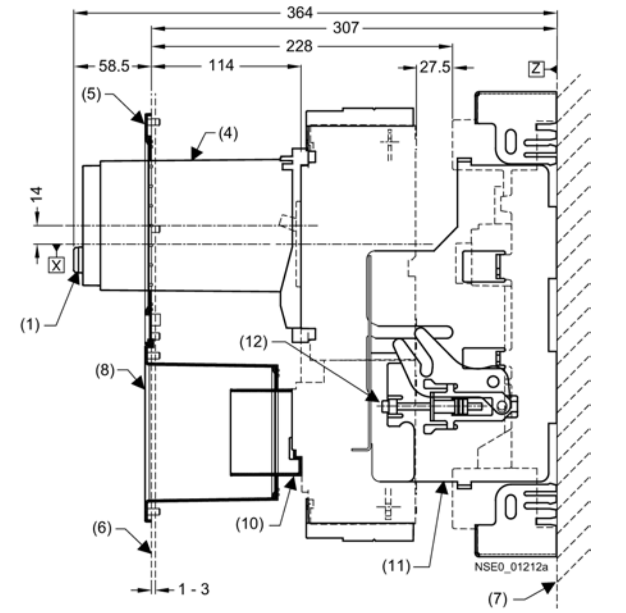
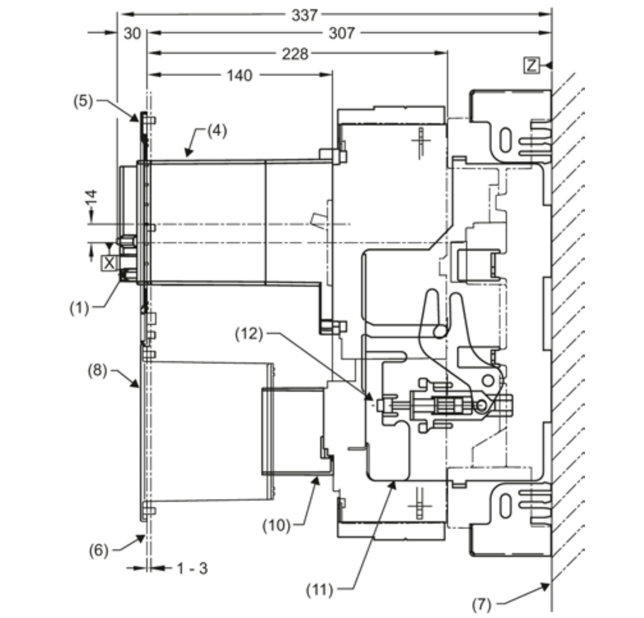
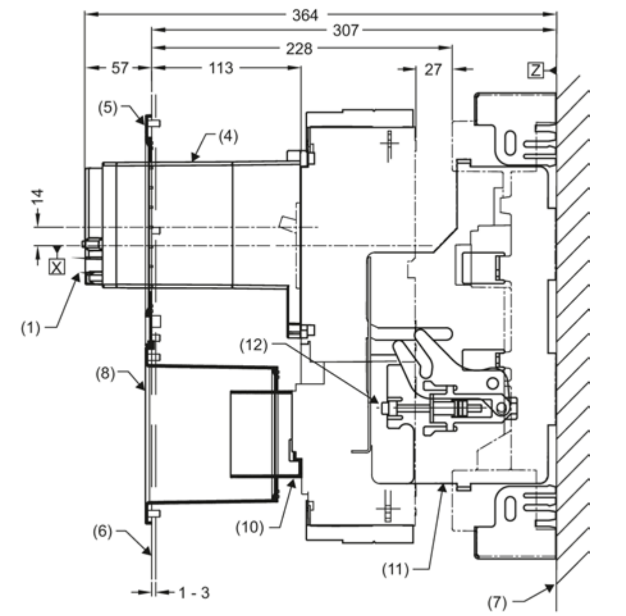
(5) Terminal cover (standard)

(7) Mounting level

(8) Plug-in base with front connecting bars

(9) Plug-in base with terminal covers on the front

(10) Interphase barrier

VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and motorized operating mechanism with stored energy mechanism (connected position)	VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and motorized operating mechanism with stored energy mechanism (disconnected position)
	
VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and motorized operating mechanism (connected position)	**VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and motorized operating mechanism (disconnected position)**
	

(1) Safety lock

(4) Motorized operating mechanism with stored energy mechanism

(5) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(6) External surface of cabinet door

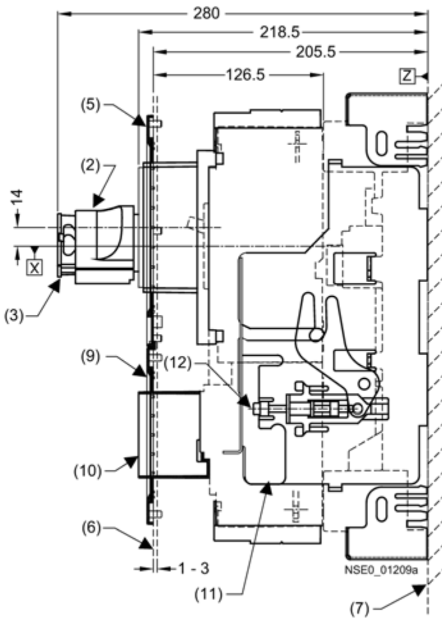
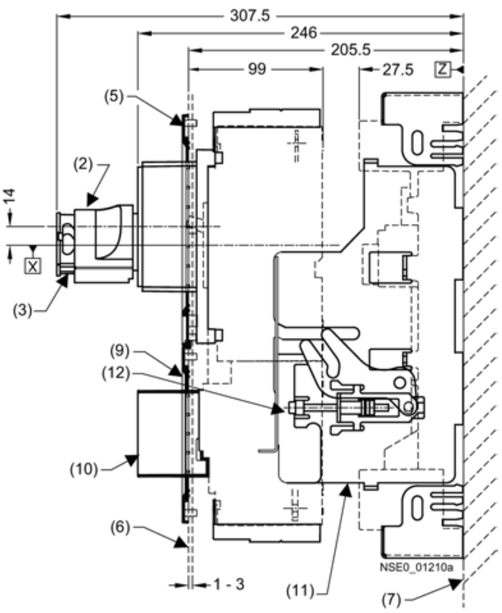
(7) Mounting level

(8) Masking frame for door cutout
(for molded case circuit breakers with RCD module)

(10) RCD extended escutcheon

(11) Locking device for the racking mechanism

(12) Racking mechanism

<table>
<tr><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and front-operated rotary operating mechanism (connected position)</th><th>VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and front-operated rotary operating mechanism (disconnected position)</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

(2) Front-operated rotary operating mechanism

(3) Padlock barrier

(5) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(7) Mounting level

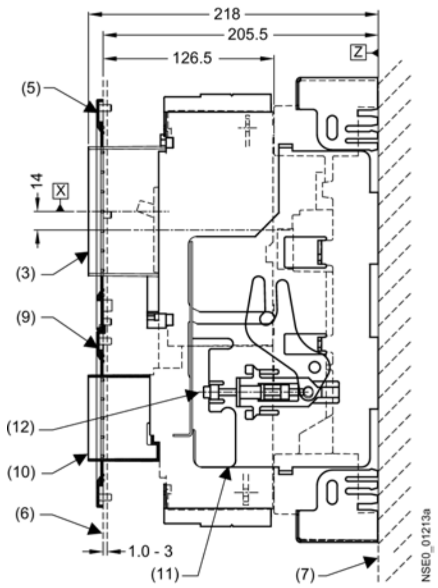
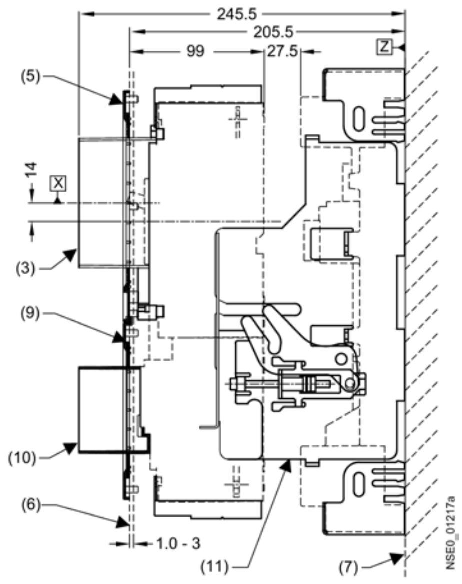
(9) Masking frame for door cutout
(for molded case circuit breakers with RCD module, toggle lever/rotary operating mechanism)

(10) RCD extended escutcheon

(11) Locking device for the racking mechanism

(12) Racking mechanism

Table 12- 19

VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and extended escutcheon (connected position)	**VL160 (3VL2) and VL250 (3VL3) molded case circuit breakers with RCD module and extended escutcheon (disconnected position)**
	

(3) Molded case circuit breaker extended escutcheon

(5) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(6) External surface of cabinet door

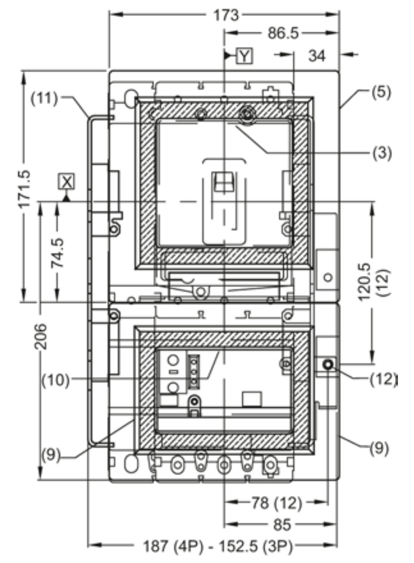
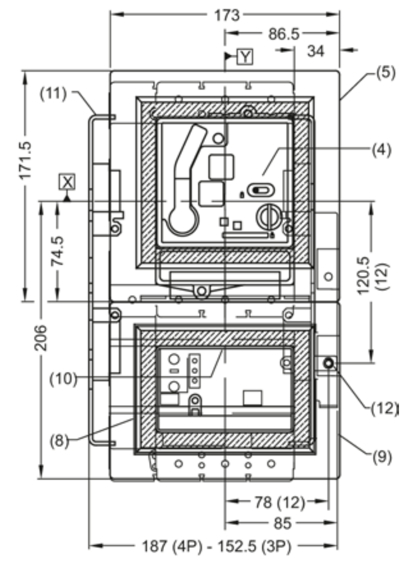
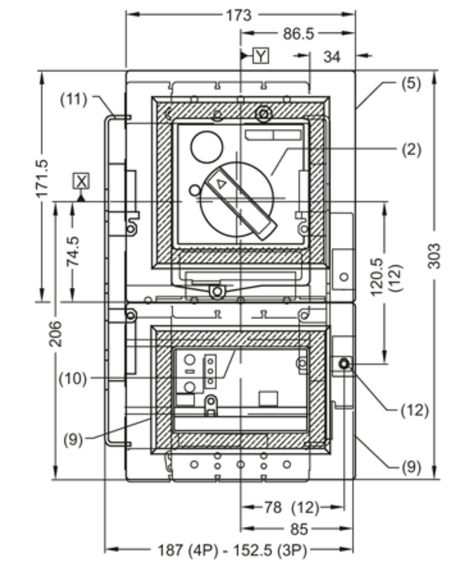
(7) Mounting level

(9) Masking frame for door cutout
(for molded case circuit breakers with RCD module, toggle lever/rotary operating mechanism)

(10) RCD extended escutcheon

(11) Locking device for the racking mechanism

(12) Racking mechanism

Withdrawable version	Withdrawable version	Withdrawable version
		

(2) Front-operated rotary operating mechanism

(3) Molded case circuit breaker extended escutcheon

(4) Motorized operating mechanism with stored energy mechanism

(5) Masking frame for door cutout (for molded case circuit breakers with operating mechanism)

(8) Masking frame for door cutout
(for molded case circuit breakers with RCD module)

(9) Masking frame for door cutout
(for molded case circuit breakers with RCD module, toggle lever/rotary operating mechanism)

(10) RCD extended escutcheon

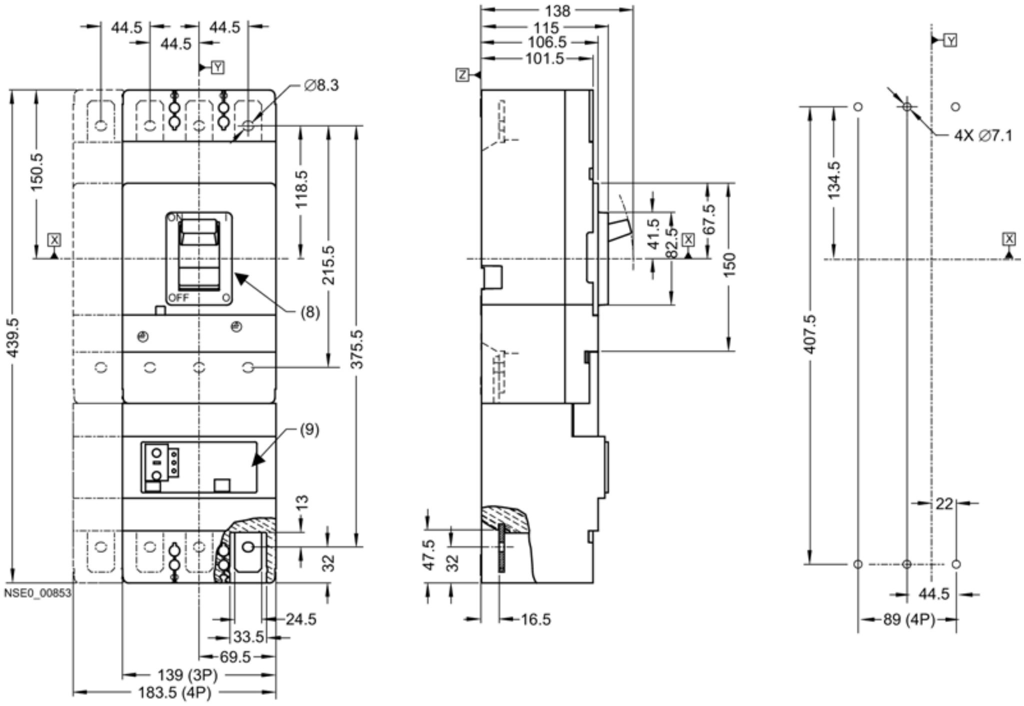
(11) Locking device for the racking mechanism

(12) Racking mechanism

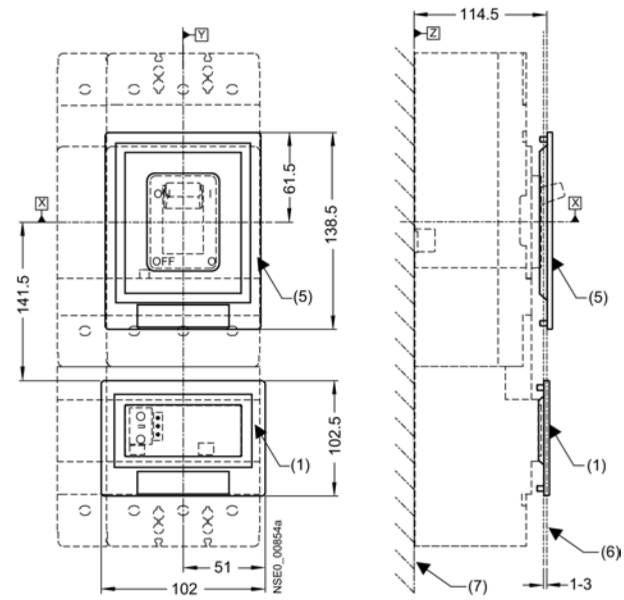
12.9 VL400 (3VL4) with RCD module, 3- and 4-pole, up to 400 A

12.9.1 Molded case circuit breakers

VL400 (3VL4) molded case circuit breaker with RCD module

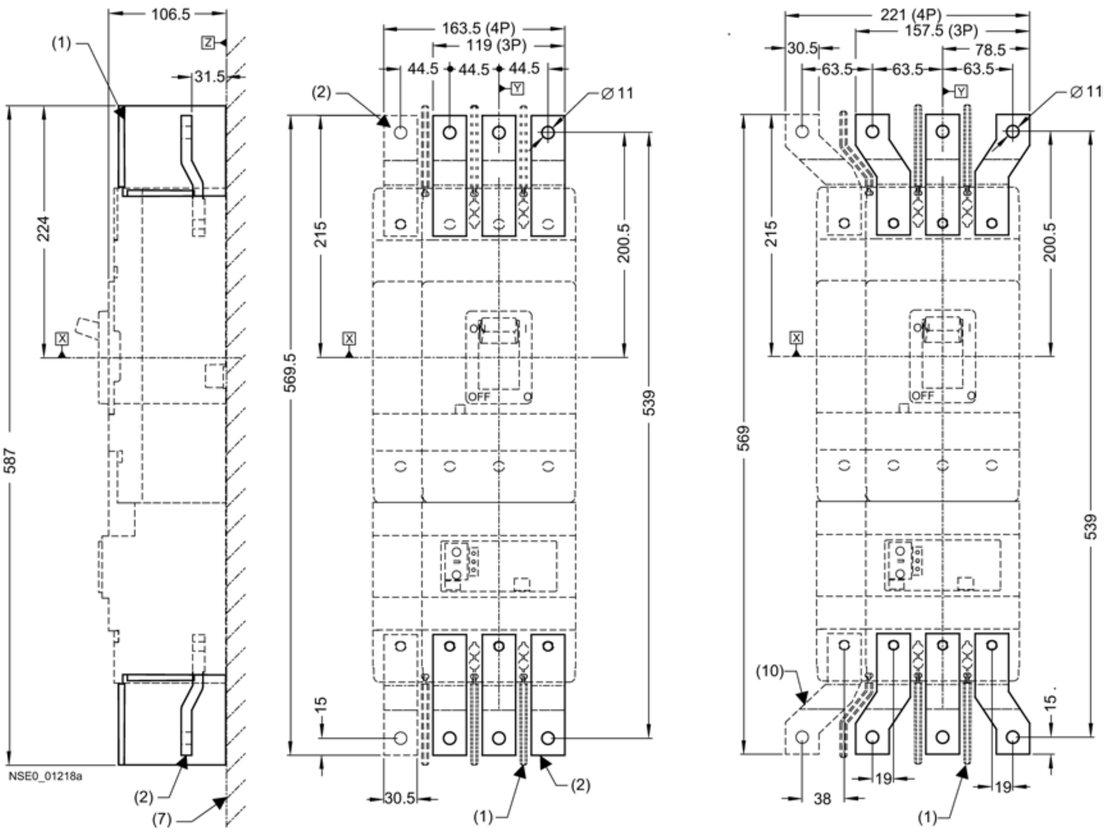


(8) Molded case circuit breakers (9) RCD module



(1)	Masking frame for door cutout (for molded case circuit breakers with RCD module)	(6)	External surface of cabinet door
(5)	Masking frame for door cutout (for molded case circuit breakers with toggle lever)	(7)	Mounting level

12.9.2 VL400 (3VL4) molded case circuit breaker with RCD front connection bar (connections and interphase barriers)

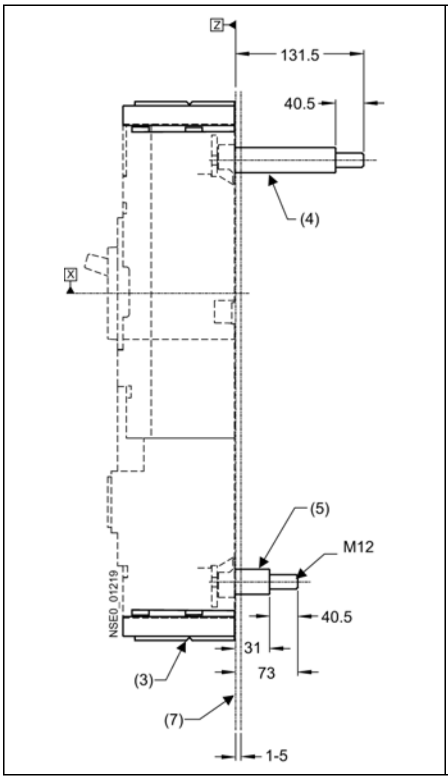


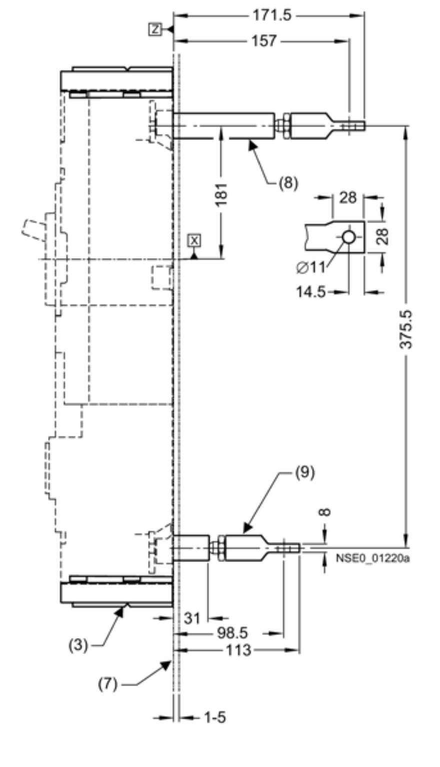
(1) Interphase barrier

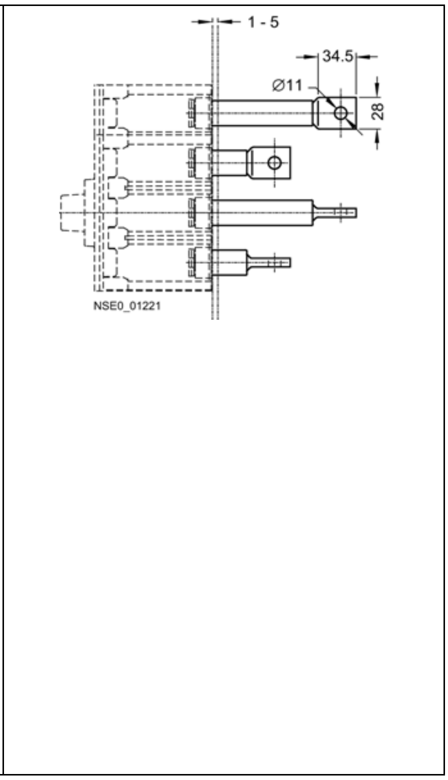
(2) Front connecting bars

(7) Mounting level

(10) Front connecting bars for increased pole spacing

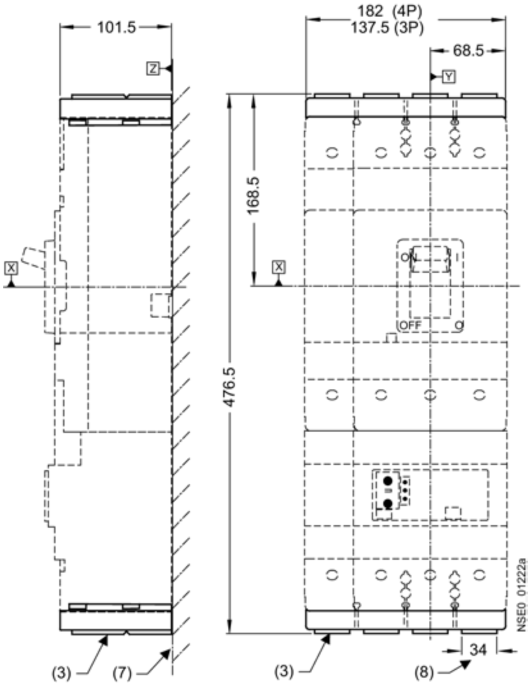






(3)	Terminal covers (standard)
(4)	Rear connections (long)
(5)	Rear connections (short)
(7)	Mounting level
(8)	Rear flat terminals (long)
(9)	Rear flat terminals (short)

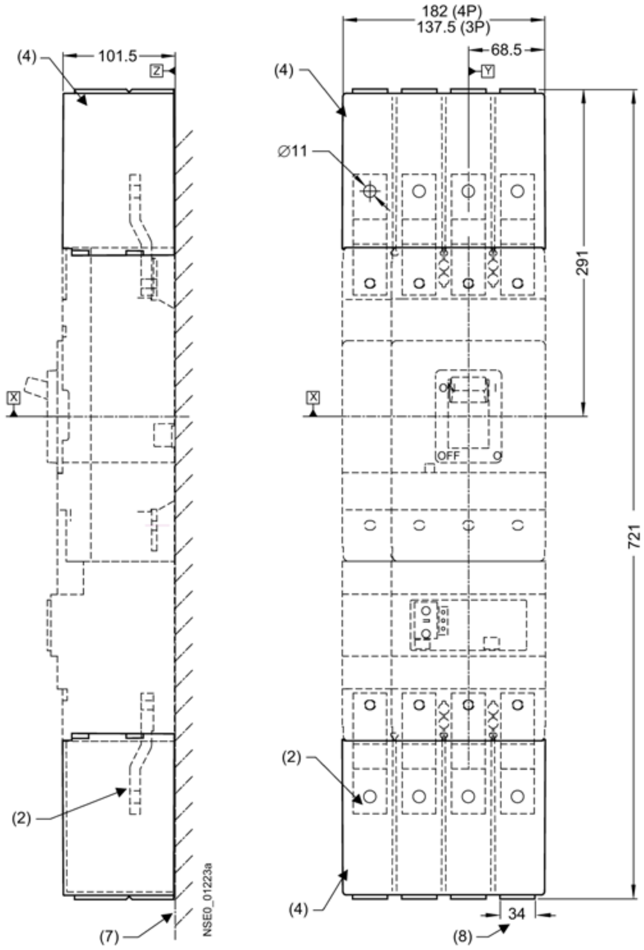
12.9.3 Terminal covers



(3) Terminal covers (standard)

(7) Mounting level

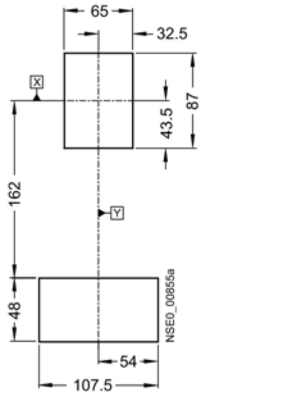
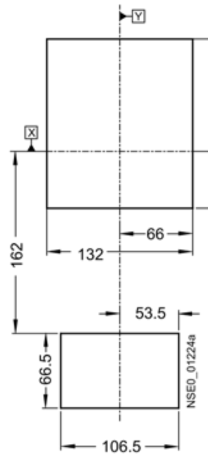
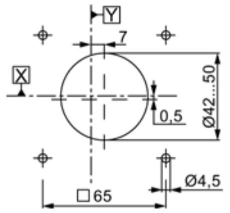
(8) Cutout



(2) Front connecting bars
(4) Terminal covers (extended)
(7) Mounting level
(8) Cutout

12.9.4 Door cutouts

Table 12- 20

<table>
<tr><th>Door cutout toggle lever
(with masking frame)</th><th>Door cutout front-operated rotary operating mechanism
(without masking frame)</th><th>Door cutout
Door coupling rotary operating mechanism</th></tr>
<tr><td>
</td><td>
</td><td>
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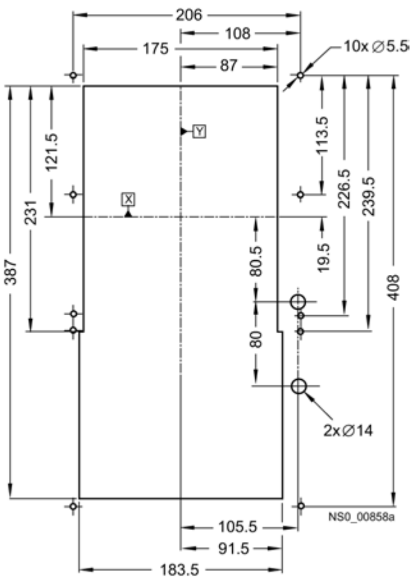
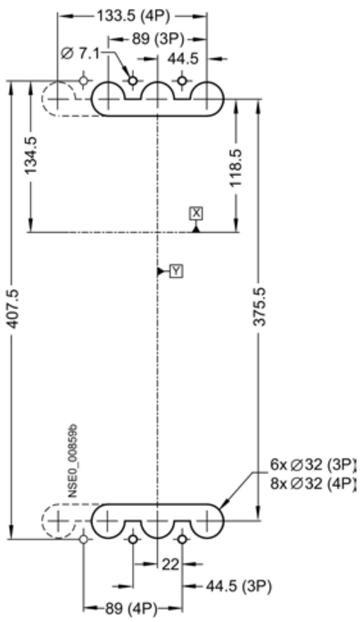
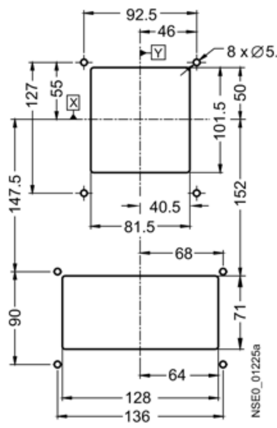
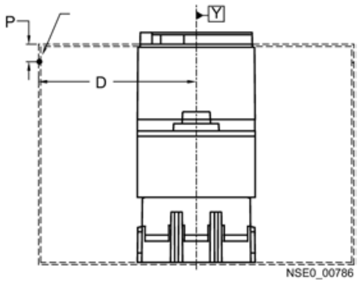
</table>

<table>
<tr><th>Door cutout toggle lever
(with masking frame)</th><th>Door cutout front-operated rotary operating mechanism
(without masking frame)</th><th>Door cutout
Door coupling rotary operating mechanism</th></tr>
<tr><td>
</td><td>
</td><td>
</td></tr>
</table>

Door hinge point (see arrow)



D > A from table + (P × 5)

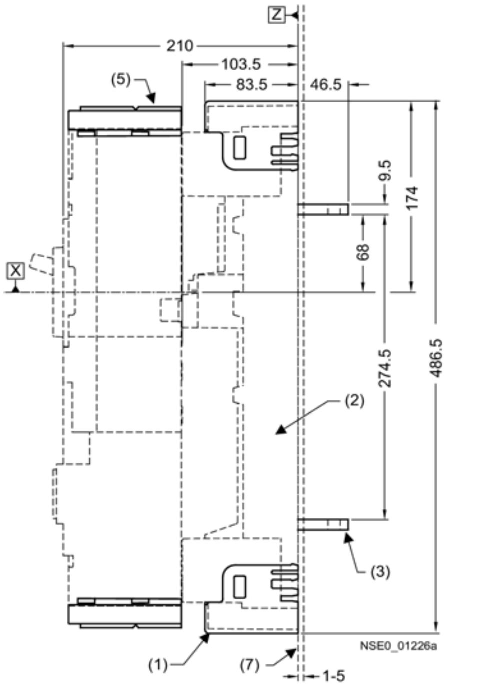
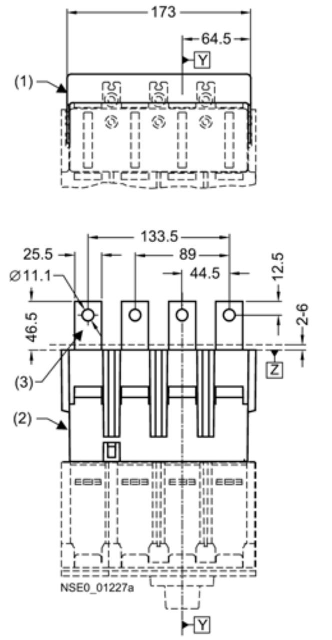
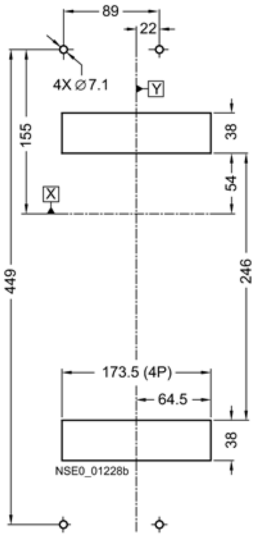
Note

Door cutouts require a minimum clearance between reference point Y and the door hinge.

Combination	A
Molded case circuit breaker only	150
Molded case circuit breaker + door-coupling rotary operating mechanism	100
Molded case circuit breaker + plug-in base + motorized operating mechanism with stored energy mechanism	150
Molded case circuit breaker + plug-in base + front-operated rotary operating mechanism	200
Molded case circuit breaker + withdrawable version	200

12.9.5 Plug-in base and accessories

Table 12- 21

		 Drilling template and cutout for plug-in base for rear flat busbar connection

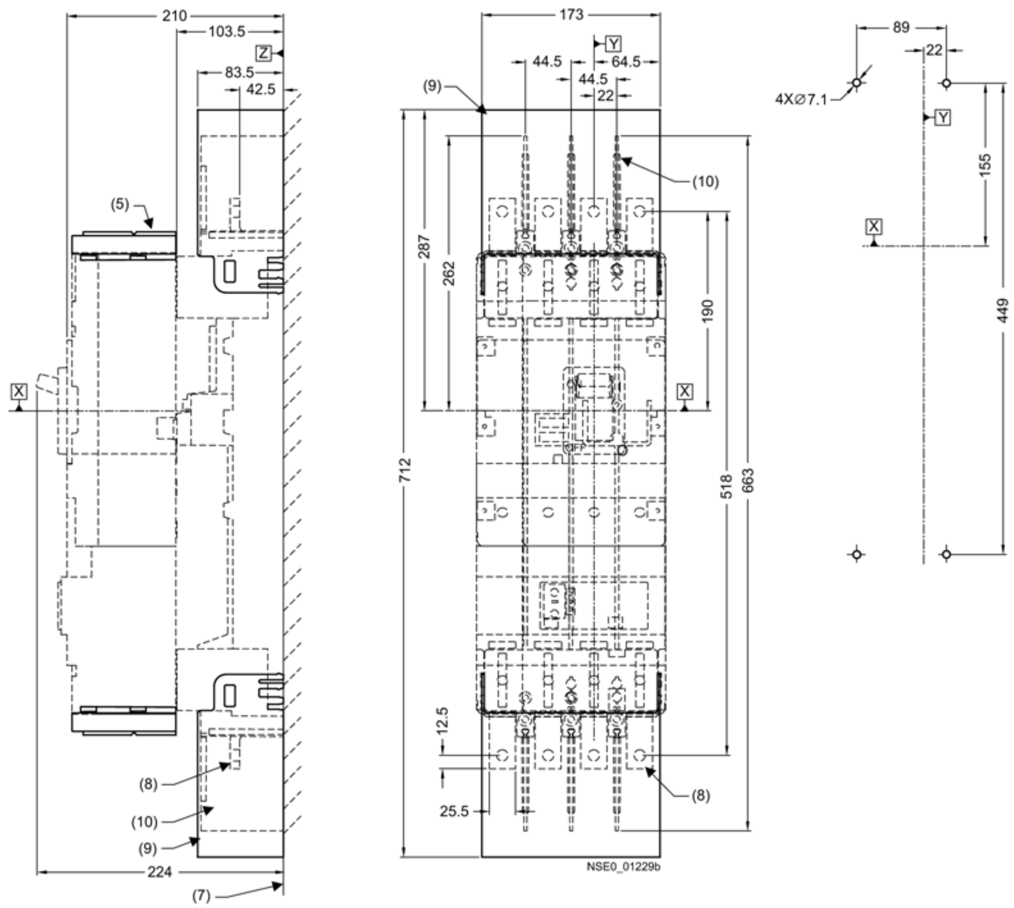
(1) Plug-in base with terminal covers

(2) Plug-in base

(3) Plug-in base with flat rear terminals

(5) Terminal covers (standard)

(7) Mounting level



(5) Terminal covers (standard)

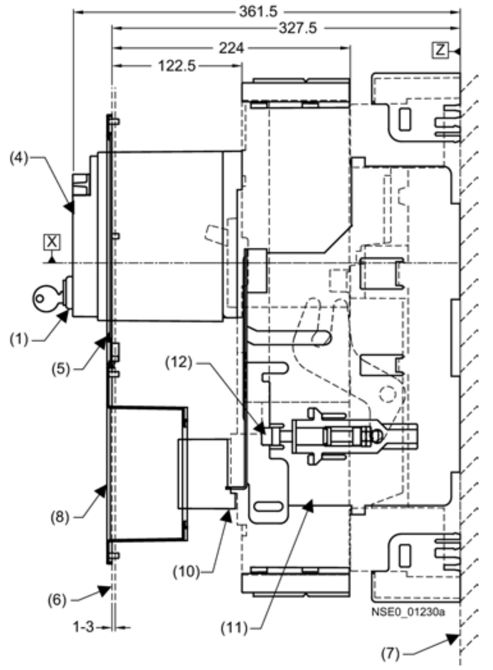
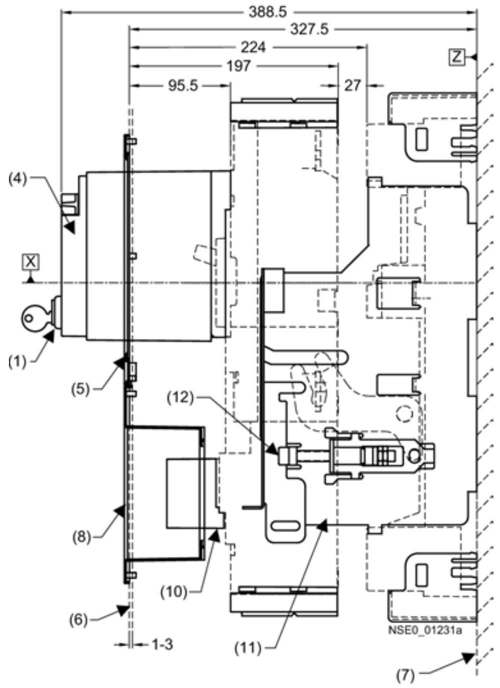
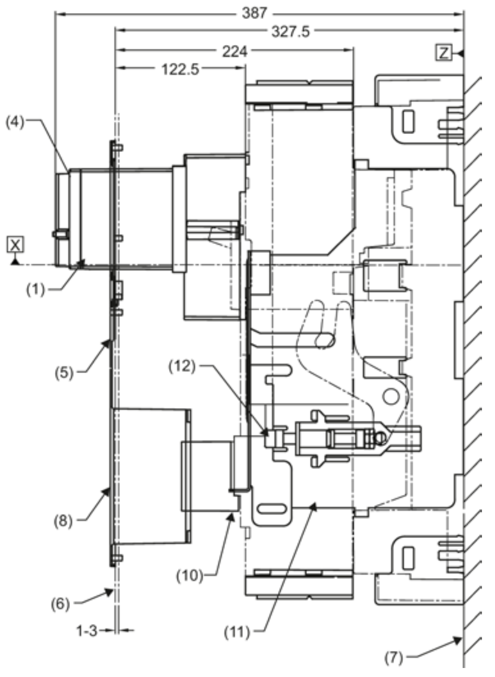
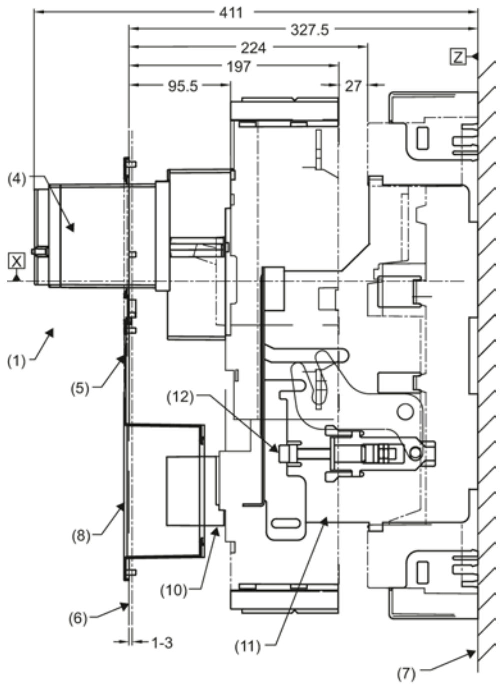
(7) Mounting level

(8) Plug-in base with front connecting bars

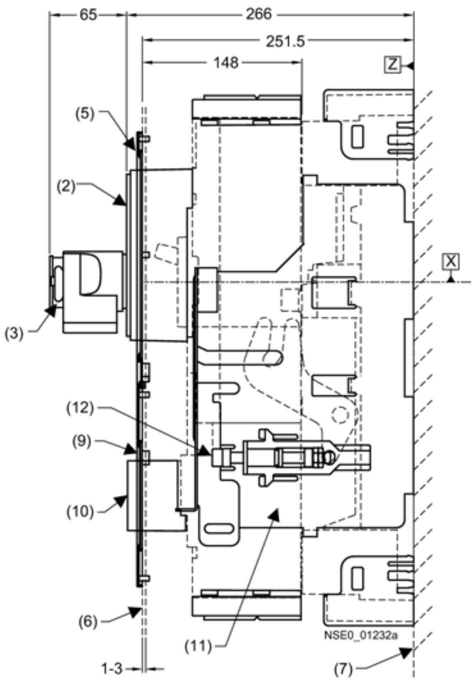
(9) Plug-in base with terminal covers on the front

(10) Interphase barrier

Table 12- 22

VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with motorized operating mechanism with stored energy mechanism (connected position)	VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with motorized operating mechanism with stored energy mechanism (disconnected position)
	
VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with motorized operating mechanism (connected position)	**VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with motorized operating mechanism (disconnected position)**
	

(1)	Safety lock
(4)	Motorized operating mechanism with stored energy mechanism
(5)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(6)	External surface of cabinet door
(7)	Mounting level
(8)	Masking frame for door cutout (for molded case circuit breakers with RCD module)
(10)	RCD extended escutcheon
(11)	Locking device for the racking mechanism
(12)	Racking mechanism

<table>
<tr>
<th>VL400 (3VL4) molded case circuit breaker with RCD module, plug-in, with front-operated rotary operating mechanism (connected position)</th>
<th>VL400 (3VL4) molded case circuit breaker with RCD module, plug-in, with front-operated rotary operating mechanism (disconnected position)</th>
</tr>
<tr>
<td>


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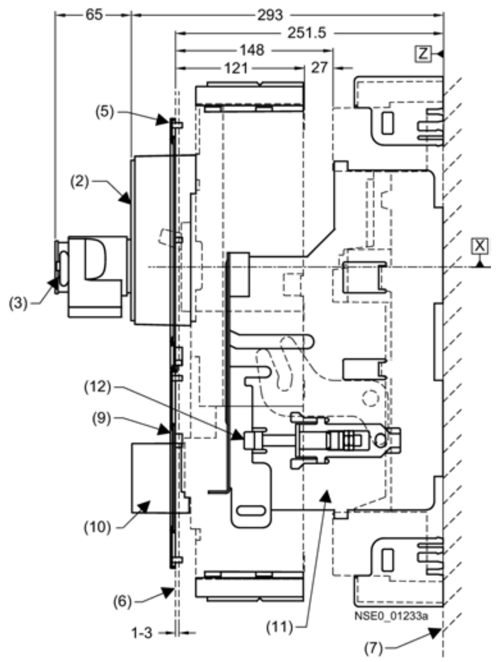
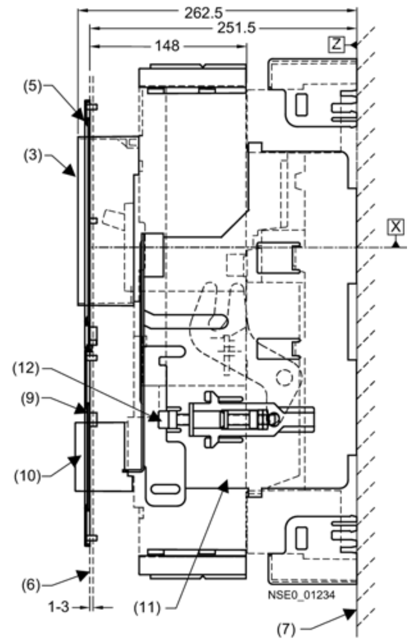
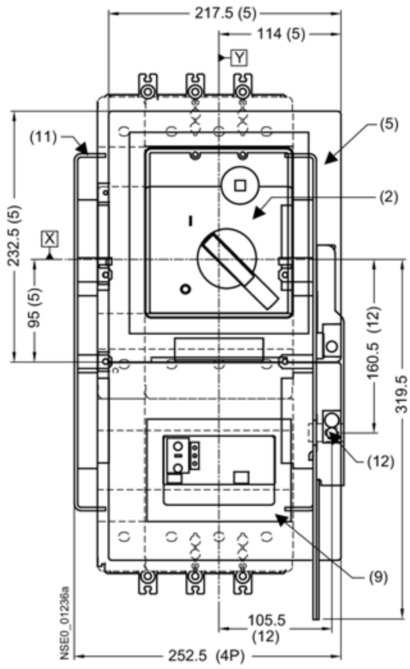


</td>
</tr>
</table>

(2)	Front-operated rotary operating mechanism
(3)	Padlock barrier
(5)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(6)	External surface of cabinet door
(7)	Mounting level
(9)	Masking frame for door cutout (for molded case circuit breakers with RCD module, toggle lever/rotary operating mechanism)
(10)	RCD extended escutcheon
(11)	Locking device for the racking mechanism
(12)	Racking mechanism

<table>
<tr><th>VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with extended escutcheon (connected position)</th><th>VL400 (3VL4) molded case circuit breaker with RCD module, withdrawable module, with extended escutcheon (disconnected position)</th></tr>
<tr><td>




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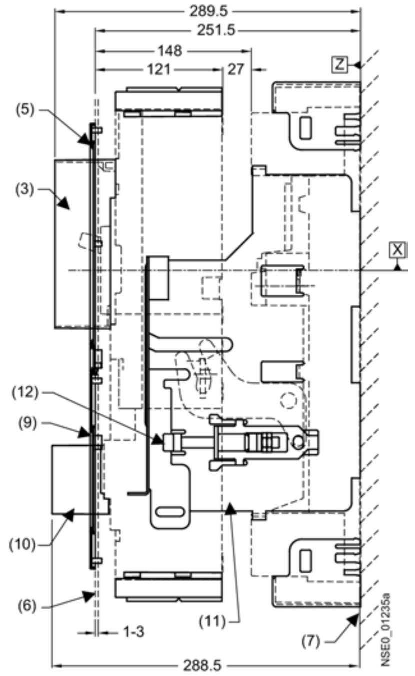


</td></tr>
</table>

(2)	Front-operated rotary operating mechanism
(3)	Molded case circuit breaker extended escutcheon
(5)	Masking frame for door cutout (for molded case circuit breakers with operating mechanism)
(6)	External surface of cabinet door

(7) Mounting level

(9) Masking frame for door cutout
(for molded case circuit breakers with RCD module, toggle lever/rotary operating mechanism)

(10) RCD extended escutcheon

(11) Locking device for the racking mechanism

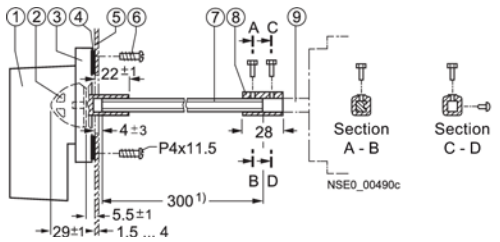
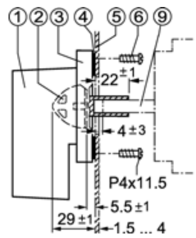
(12) Racking mechanism

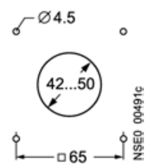
(1)	Safety lock
(4)	Motorized operating mechanism with stored energy mechanism
(8)	Masking frame for door cutout (for molded case circuit breakers with RCD module)

12.10 Door-coupling rotary operating mechanisms 8UC

Door-coupling rotary operating mechanisms 8UC71 and 8UC72, sizes 1 and 2

Table 12- 23

<table>
<tr><th>with extension shaft</th><th>without extension shaft</th><th>Door cutout with fixing holes</th></tr>
<tr><td>
</td><td colspan="2">


</td></tr>
</table>

(1) Knob

(2) Coupling driver

(3) Cover frame

(4) Seal

(5) Door

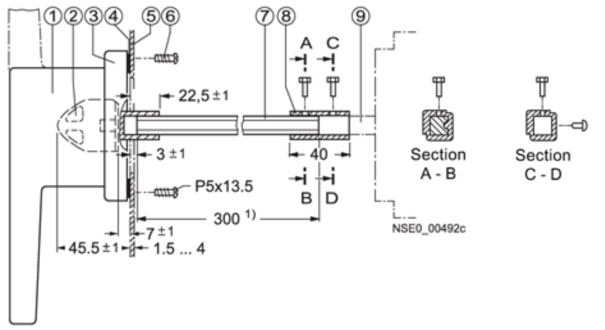
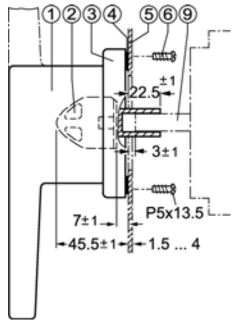
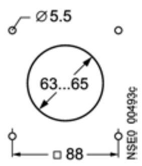
(6) Fastening screws, Qty. 4

(7) Extension shaft

(8) Spacer

(9) Actuating shaft of the circuit breaker

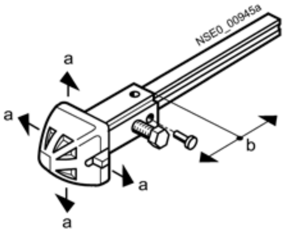
Door-coupling rotary operating mechanisms 8UC73, size 3

with extension shaft	without extension shaft	Door cutout with fixing holes
		

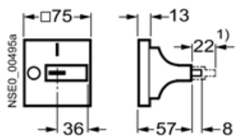
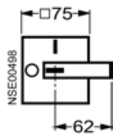
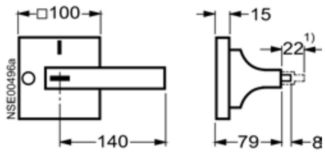
1) Adjust the length of the extension shaft by reducing the installation depth. Extension shaft also available in 600 mm length.

(1)	Handle or double handle
(2)	Coupling driver
(3)	Cover frame
(4)	Seal
(5)	Door
(6)	Fastening screws, Qty. 4
(7)	Extension shaft
(8)	Spacer
(9)	Actuating shaft of the circuit breaker

Coupling driver 8UC60/8UC70



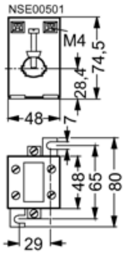
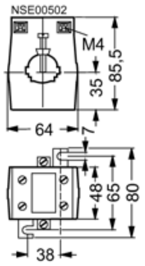
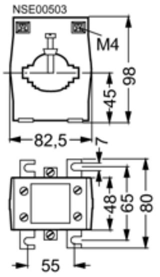
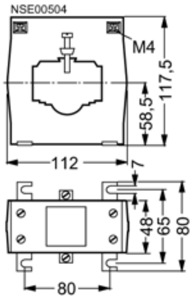
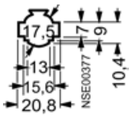
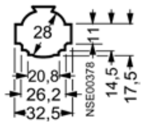
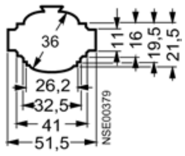
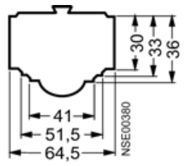
Coupling driver	a	b	Wavelength
with tolerance compensation	+ 5	±5	x
without tolerance compensation	+ 1,5	±2,5	x+23.5

Size 1	Size 2	Size 3
		
Handles with cover frame, sizes 1 to 3		

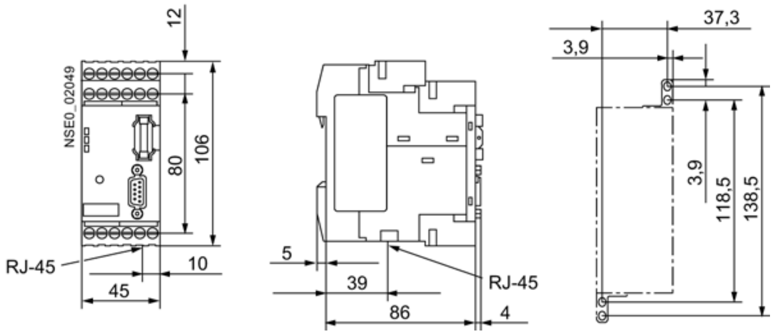
1) Lock holder of the handle when extended.

12.11 4NC current transformers for measuring purposes

Table 12- 24

	4NC51	4NC52		4NC53		4NC54		
4NC current transformers for measuring purposes								
Window openings								
For busbars								
Number	1	1	2	1	2	1	2	3
Width × thickness mm	12 × 5 12 × 10 20 × 5	20 × 5 20 × 10 25 × 5 30 × 5 30 × 10	20 × 5 25 ×	25 × 5 30 × 5 30 × 10 40 × 5 40 × 10 50 × 5 50 × 10	25 × 5 30 × 5 40 × 5	40 × 10 50 × 5 50 × 10 60 × 5 60 × 10	40 × 5 40 × 10 50 × 5 50 × 10 60 × 5 60 × 10	40 × 5 50 × 5 60 × 5
For round conductors								
max. mm	17,5 ∅	28 ∅		36 ∅		45 ∅		

12.12 COM20/COM21 (communication module for SENTRON 3VL)

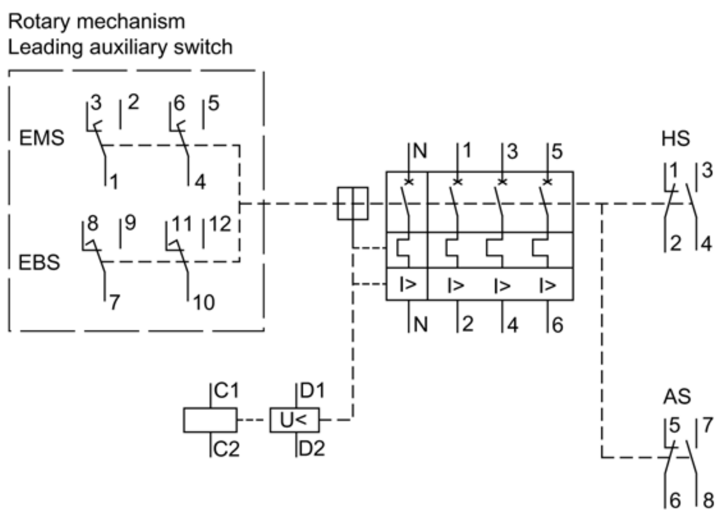


13 Circuit diagrams

The circuit diagram examples below show the most frequent uses of the 3VL molded case circuit breaker:

It is not possible to show combinations here. For versions that differ from those shown, the diagrams must be modified appropriately.

Circuit diagrams are only provided where they are required for improved understanding of the operation of the device.



HS Auxiliary switches

AS Alarm switches

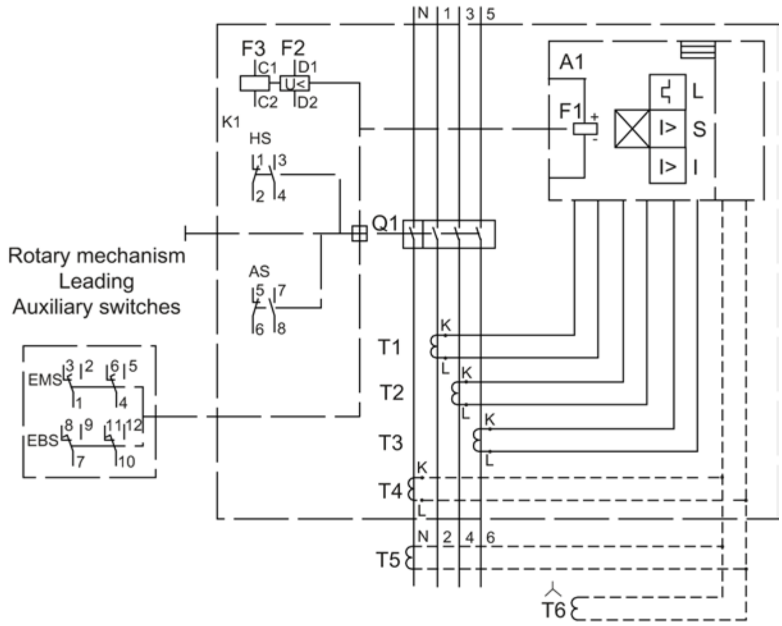
Figure 13-1 Connection diagram for 3- and 4-pole VL160X-VL630 molded case circuit breakers for system protection with thermal-magnetic overcurrent releases

Terminal assignments for rotary operating mechanism, leading auxiliary switch

Q1	Main contacts	T1 ... T4	Current transformer
F1	Tripping solenoid for A1	A1	Electronic trip unit
F3	Shunt release	F2	Undervoltage release
AS	Alarm switches	HS	Auxiliary switches

EBS Leading auxiliary switch OFF (integrated into the rotary operating mechanism)

EMS Leading auxiliary switch ON (integrated into the rotary operating mechanism)



HS Auxiliary switches

AS Alarm switches

Figure 13-2 Internal circuit diagram for 3- and 4-pole molded case circuit breakers for system and motor protection with electronic trip units

Circuit diagrams VL1 ... 8 motorized operating mechanism (MO)

You can see the circuit diagrams for the motorized operating mechanism (MO) without stored energy mechanism below.
The functions of the motorized operating mechanisms are described in the following chapter:
Motorized operating mechanisms (optional) (Page 32)

The isolated contact S3 (terminals 6, 7, 8) is used for scanning the contact position of the mode selector (switching capacity in accordance with UL 1054: 16 A / 250 V AC; 0.4 A / 125 V DC; 0.2 A / 250 V DC).

With this changeover contact S3, two states of the mode selector can be scanned:

1. Local operation -> "MANUAL" or "LOCAL" position
2. Remote operation -> "AUTO" position

Manual operation with Allen key

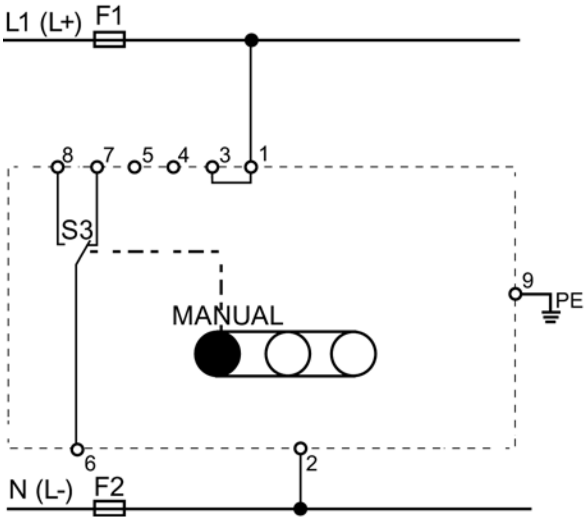
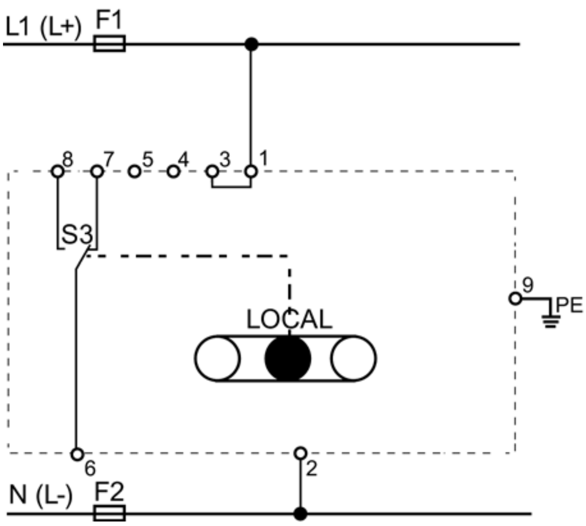
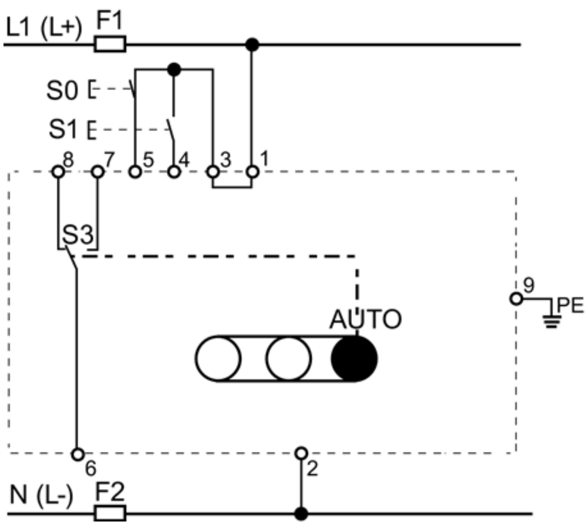


Figure 13-3 Motorized operating mechanism (MO) without stored energy mechanism for VL160X to VL1600.

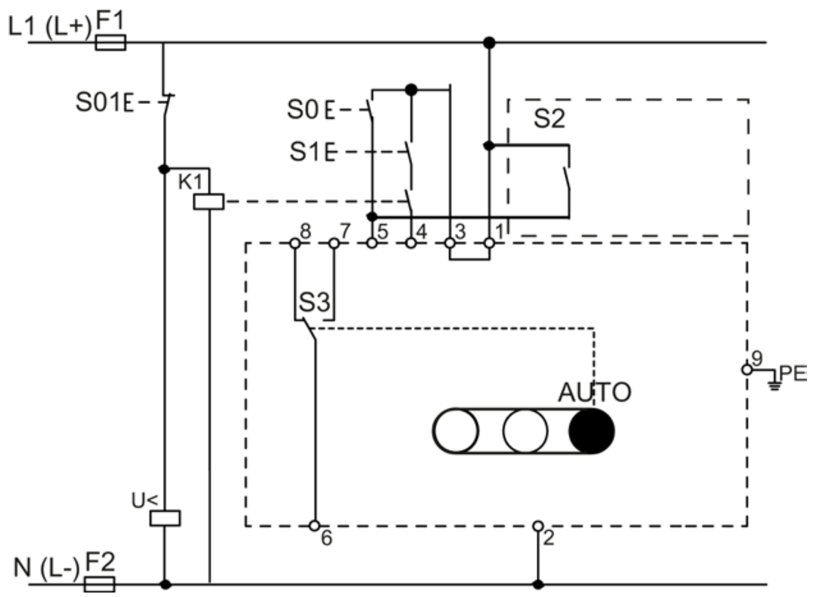
Manual operation with pushbutton on motorized operating mechanism



Control via control cable



Control with undervoltage release



S0	OFF (to be provided by customer)
S01	Remote command (to be provided by customer)
S2	Alarm switch (to be provided by customer)
K1	Auxiliary contactor (to be provided by customer)
PE	Protective grounding
S1	ON (to be provided by customer)
-F1	Fuse in the control circuit
-F2	Fuse in the control circuit
U<	Undervoltage release

Figure 13-4 Motorized operating mechanism without stored energy mechanism for VL160X to VL1600 with undervoltage release

Note

Switching the circuit breaker off automatically

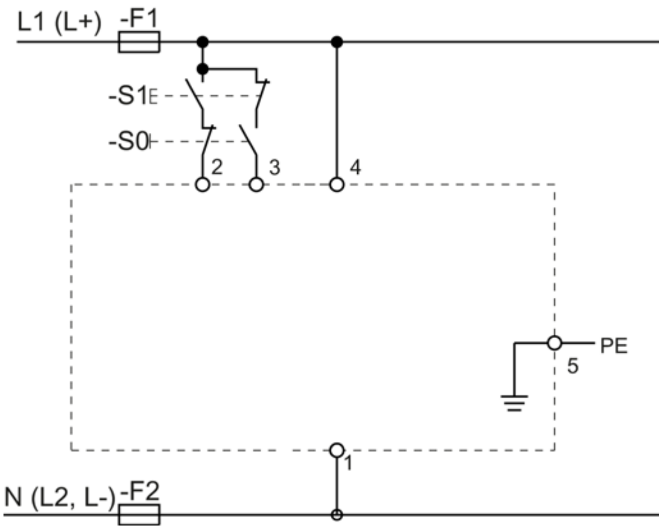
A separate alarm switch contact (7-8) can be connected for switching off the circuit breaker automatically. Automatic switching on of the molded case circuit breaker must be prevented, otherwise after a tripping event it may automatically switch to short-circuit.

The contact of auxiliary contactor K1 prevents no-load operation of the molded case circuit breaker when the undervoltage release "U<" is without power. No-load operations represent a high level of stress for the molded case circuit breaker. If the undervoltage release is without power, auxiliary contactor K1 has not picked up. The contact in the ON circuit (control circuit) of the motorized operating mechanism is thus not closed, that is, the molded case circuit breaker cannot be switched.

This auxiliary contactor is not necessary in principle when the undervoltage release is supplied uninterrupted (e.g. pushbutton S01) from the same source as the motorized operating mechanism itself (e.g. contact 1).

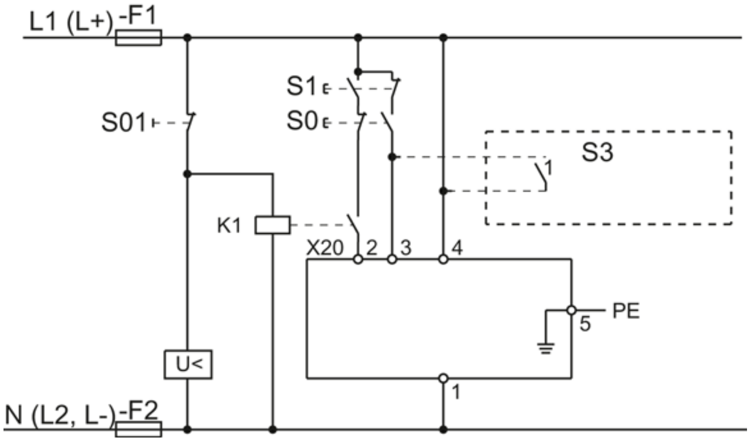
Circuit diagrams VL1 ... 6, motorized operating mechanism with stored energy mechanism, with or without undervoltage release

Below are the circuit diagrams for the motorized operating mechanism with stored energy mechanism for the circuit breakers VL160X, VL160, VL250, VL400, VL630 and VL800. The functions of the motorized operating mechanisms are described in the following chapter:
Motorized operating mechanisms (optional) (Page 32)



S0	AUS	S1	ON
-F1	Fuse in the control circuit	PE	Protective grounding
-F2	Fuse in the control circuit		

Figure 13-5 Motorized operating mechanism with stored energy mechanism for VL160X, VL160, VL250, VL400, VL630 and VL800, without undervoltage release



S0	OFF (to be provided by customer)	S1	ON (to be provided by customer)
S01	Remote command (to be provided by customer)	S3	Alarm switch (to be provided by customer)
-F1	Fuse in the control circuit	-F2	Fuse in the control circuit
K1	Auxiliary contactor (to be provided by customer)	PE	Protective grounding
U<	Undervoltage release		

Figure 13-6 Motorized operating mechanism with stored energy mechanism for VL160X, VL160, VL250, VL400, VL630 and VL800 with undervoltage release

---

Note

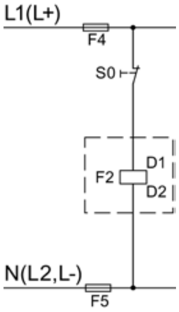
Automatic charging/close

A separate alarm switch contact (7-8) can be connected for automatic charging after tripping. Automatic switching on of the molded case circuit breaker must be prevented, otherwise after a tripping event it may automatically switch to short-circuit.

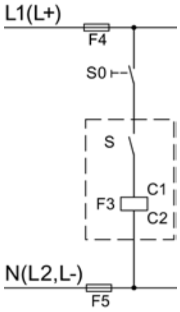
The contact of auxiliary contactor K1 or K3 prevents no-load operation of the molded case circuit breaker when the undervoltage release "U<" is without power. No-load operations represent a high level of stress for the molded case circuit breaker. If the undervoltage release is without power, auxiliary contactor K1 or K3 has not picked up. The contact in the ON circuit (control circuit) of the motorized operating mechanism is thus not closed, that is, the molded case circuit breaker cannot be switched.

This auxiliary contactor is not necessary in principle when the undervoltage release is supplied uninterrupted (e.g. pushbutton S01) from the same source as the motorized operating mechanism itself (e.g. contact 4).

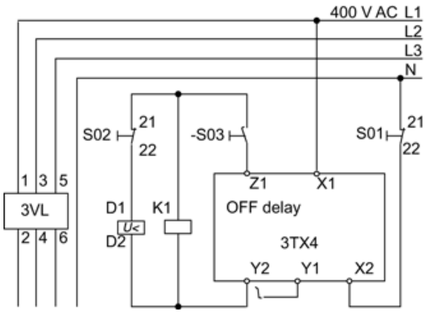
Circuit diagrams, undervoltage release and shunt release



"S contat" integrated into shunt release



Undervoltage release and shunt release for VL160X to VL1600



S01 Delayed release

S02 Instantaneous release for EMERGENCY-OFF loop (if required)

S03 Leading auxiliary contact, e.g. 3VL9300-3AS10 "OFF to ON" in the front-operated rotary operating mechanism of the molded case circuit breaker (if required)

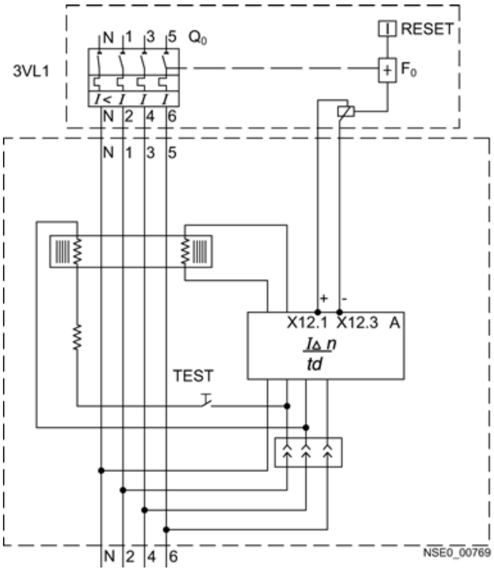
K1 Auxiliary contactor 3RH11 (if required)

Figure 13-7 Time-delay device (3TX4701-0A) for undervoltage release for VL160X to VL1600

Protective circuit with UVR (220 V to 250 V DC)	Tripping time UVR
Y2 only	Approx. 3 seconds
Y2 and Y1 bridged	Approx. 6 seconds

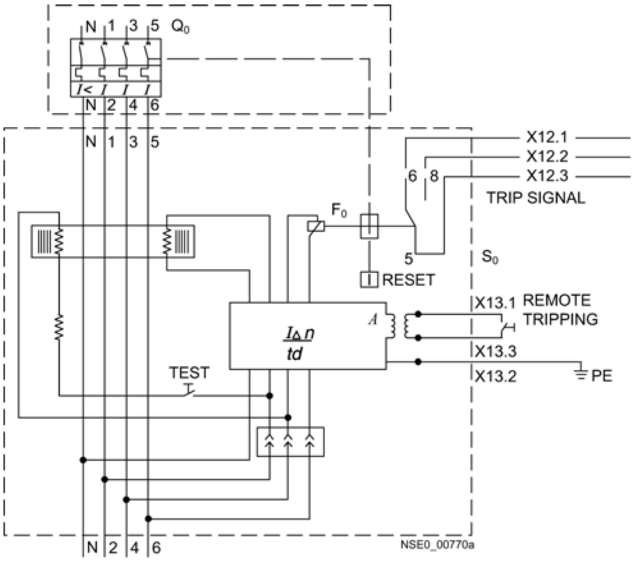
Protective circuit with UVR and contactor	Tripping time UVR	Drop-out time contactor
Y2 only	0.8 s	Approx. 2 s
Y2 and Y1 bridged	1.2 s	Approx. 4 s

Circuit diagrams 3VL plus RCD module



Q_0	Molded case circuit breakers
A	Evaluation electronics
F_0	Closing solenoid with local trip indication and reset
TEST	Test button

Figure 13-8 4-pole 3VL1 with RCD module (3-pole version corresponds, but without N pole)



Q_0	Molded case circuit breakers
A	Evaluation electronics
F_0	Closing solenoid with local trip indication and reset
TEST	Test button
S_0	Remote trip (to be provided by customer)

Figure 13-9 4-pole molded case circuit breaker for 3VL2, 3VL3 and 3VL4 molded case circuit breakers with remote trip unit and RCD alarm switch (3-pole version corresponds, but without N pole)

14 Spare parts/accessories

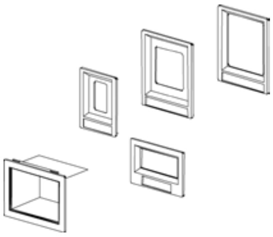
14.1 Installation

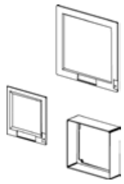
The following safety accessory parts are available for installing in the 3VL molded case circuit breaker:

- Masking frames for door cutouts
- Terminal covers / phase barriers
- Phase barriers
- Toggle lever extension

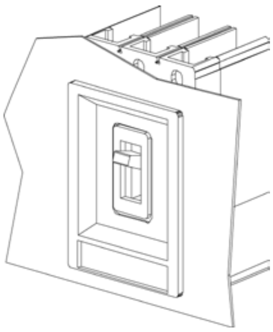
Masking frames for door cutouts:

Masking frames for door cutouts are used to increase the IP degree of protection of the molded case circuit breakers and to better adapt them to the control cabinets. Masking frames for door cutouts are available for fixed-mounted, plug-in and withdrawable molded case circuit breakers with rotary operating mechanisms, motorized operating mechanisms and RCD modules. The masking frames for door cutouts are attached to the door with 4 fixing elements.

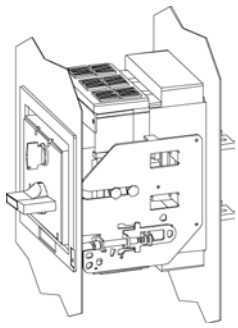




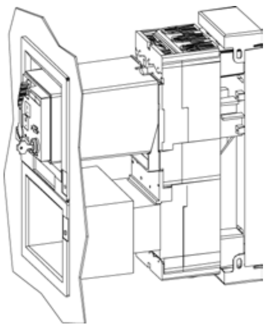
Masking frames for door cutouts



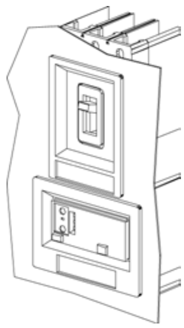
3VL9300-8BC00 (front)



3VL9300-8BG00



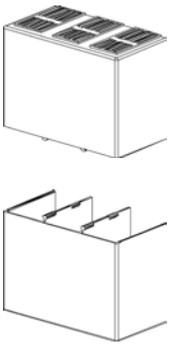
3VL9300-8BC00



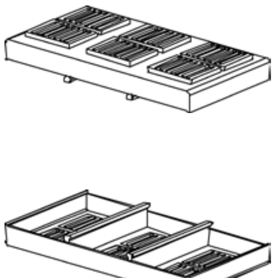
3VL9300-8BJ00 / 3VL9300-8BD00

Terminal covers/phase barriers:

Sealable terminal covers can be installed on the input and output side of the 3VL molded case circuit breakers. They offer degree of protection IP30 for fixed-mounted or withdrawal molded case circuit breakers in the connected position. In addition, extended terminal covers provide separation between the phases if uninsulated busbars or cables are used



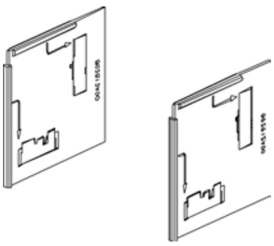
Extended terminal cover



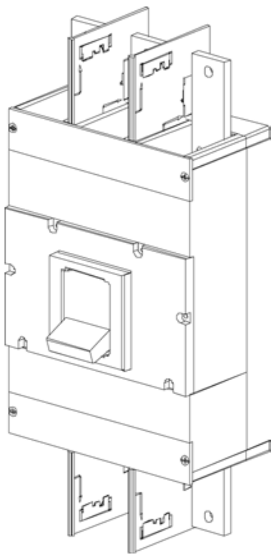
Standard terminal cover

Phase barriers

Phase barriers provide insulation on the input and output side of the molded case circuit breakers. They can be mounted in the specially formed slots on the input and output sides of the molded case circuit breakers. They can be used in conjunction with other connection accessories (except terminal covers). The phase barriers can be used with fixed-mounted, plug-in and withdrawable molded case circuit breakers. Terminal covers must be used if the molded case circuit breakers are mounted immediately next to each other (see the section Mounting and safety clearances).



Phase barriers



Use of phase barriers

Appendix A

A.1 Table of abbreviations

Explanation of the abbreviations

Abbreviation	Explanation
line	for line protection
motor	for motor protection
starter	for starter combinations
insulation circuit breaker	Switch disconnectors
I_R	Current value of the overload release
I_{sd}	Current value of the short-time delayed short-circuit release
t_{sd}	Delay time of the short-time delayed short-circuit release
I_i	Current value of the instantaneous short-circuit release
I_{cn}	Rated short-circuit breaking capacity
TM	Thermal-magnetic release
ETU	Electronic trip unit
Settings of the LI and LSI releases of the upstream and downstream protective devices for calculating the selectivity limits:	
I_R	1 x I_r
I_{sd}	max.
t_{sd}	100 ms
I_i	max.

A.2 Standards and specifications

3VL molded case circuit breakers comply with:

- IEC 60947-2 / DIN EN 60947-2 (VDE 0660-101)
- IEC 60947-1 / DIN EN 60947-1 (VDE 0660-100)

Disconnector properties in accordance with:

- IEC 60947-2 / DIN EN 60947-2 (VDE 0660-101)

Please contact SIEMENS for additional standards.

The overcurrent releases of the circuit breakers for motor protection additionally fulfill:

- IEC 60947-4-1 / DIN EN 60947-4-1 (VDE 0660-102)

Network disconnecting device (used to be called "main switch" in accordance with:

- IEC 60204-1 / DIN EN 60204-1 (VDE 0113-1)
  Network disconnecting device for stopping and shutting down in an emergency (previously called "EMERGENCY-OFF switch")

Table A- 1 The following certificates are available on request

Symbol	Name of the certificate
	CE certificate of conformity
	Type examination certificate IEC 60947
	Type examination certificate CCC (China)
	Gost
	Valid from July 2014
	C-Tick certification for Australia
	Shipbuilding approvals (GL, LRS, DNV, ABS, BV)
	KTL certificate
	Fire Safety certificate
	Certificate of origin
	Halogen-free
	PVC-free

VL160X–VL400 molded case circuit breakers that are equipped with a SENTRON VL RCD module correspond to IEC 60947-2 Annex B.

The RCD module SENTRON VL corresponds to IEC 61000-4-2 to 61000-4-6, IEC 61000-4-11 and EN 55011, Class B (tested in accordance with CISPR 11) with regard to electromagnetic compatibility.

The reference temperature for the RCD modules and the 3VL molded case circuit breakers is 40 °C. The suitability of the SENTRON VL RCD module for mounting on the 3VL molded case circuit breakers has no effect on the characteristic key data of the molded case circuit breaker, such as:

- Rated voltage (50 / 60 Hz), switching capacity
- Electrical and mechanical service life
- Connections
- Operating mechanisms (VL160, VL250, VL400)
- Auxiliary switches and trip units

Rated current, see "Use in unusual environments".

In accordance with DIN 40713, the graphical symbols that the internal circuit diagrams contain only provide information on the type, connection and mode of operation of devices, but not on their type of construction.

Shock resistance

All 3VL molded case circuit breakers have shock resistance in accordance with the test procedures defined in IEC 68 Part 2.

A.3 Comprehensive support from A to Z

For more information, please see the following links:

Useful links

Table A- 2 Product information

Website	The website provides rapid and targeted information on our pioneering products and systems.	Link (http://www.siemens.com/lowvoltage)
Newsletter	Constantly updated information on the subject of low-voltage power distribution.	Link (http://www.siemens.com/lowvoltage/newsletter)

Table A- 3 Product information / product and system selection

Information and Download Center	• Current catalogs • Customer magazines • Brochures • Demonstration software • Promotion packages	Link (http://www.siemens.com/lowvoltage/infomaterial)

Table A- 4 Product and system selection

Industry Mall	Platform for e-business and product information. 24/7 access to a comprehensive information and ordering platform for our complete low-voltage controls and distribution portfolio, including: • Selection tools • Product and system configurators • Availability check • Order tracking	Link (http://www.siemens.com/lowvoltage/mall)

Table A- 5 Product documentation

Service & Support Portal	Comprehensive technical information from the planning phase through configuration to operation. Around the clock. 365 days a year. • Product data sheets • Manuals / operating instructions • Certificates • Characteristic curves • Downloads • FAQs	Link (http://www.siemens.com/lowvoltage/support)
CAx DVD	Configuration-relevant CAx data on SENTRON is available on DVD: • Commercial and technical product master data • 2D dimension drawings • Isometric illustrations • 3D models • Product data sheets • Tender specifications	Link (http://www.siemens.com/lowvoltage/mall) Order number: E86060-D1000-A207-A6-6300
Image Database	Free downloads in several different versions are available from the image database: • All current product photos • 2D dimension drawings • Isometric illustrations • 3D models • Device circuit diagrams • Symbols	Link (http://www.siemens.com/lowvoltage/picturedb)

Table A- 6 Product training

SITRAIN Portal	Comprehensive training program to expand your knowledge about our products, systems, and engineering tools	Link (http://www.siemens.com/lowvoltage/training)

Index

F

G

I

L

M

O

P

R

S

T

U

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