

DISTRIBUTION SOLUTIONS

VD4/R

MV vacuum circuit breakers
for secondary distribution



VD4/R medium voltage vacuum circuit breakers feature the separate pole construction technique. Each pole houses a vacuum interrupter which is embedded in the resin when the cylinder is moulded thanks to a special manufacturing process. This construction method protects the vacuum interrupter from shock, pollution and condensation. VD4/R circuit breakers can be used in all medium voltage secondary distribution systems and MV/LV transformer substations, in factories, industrial workshops and in the services-providing sector.



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VD4/R:

its strengths, your benefits



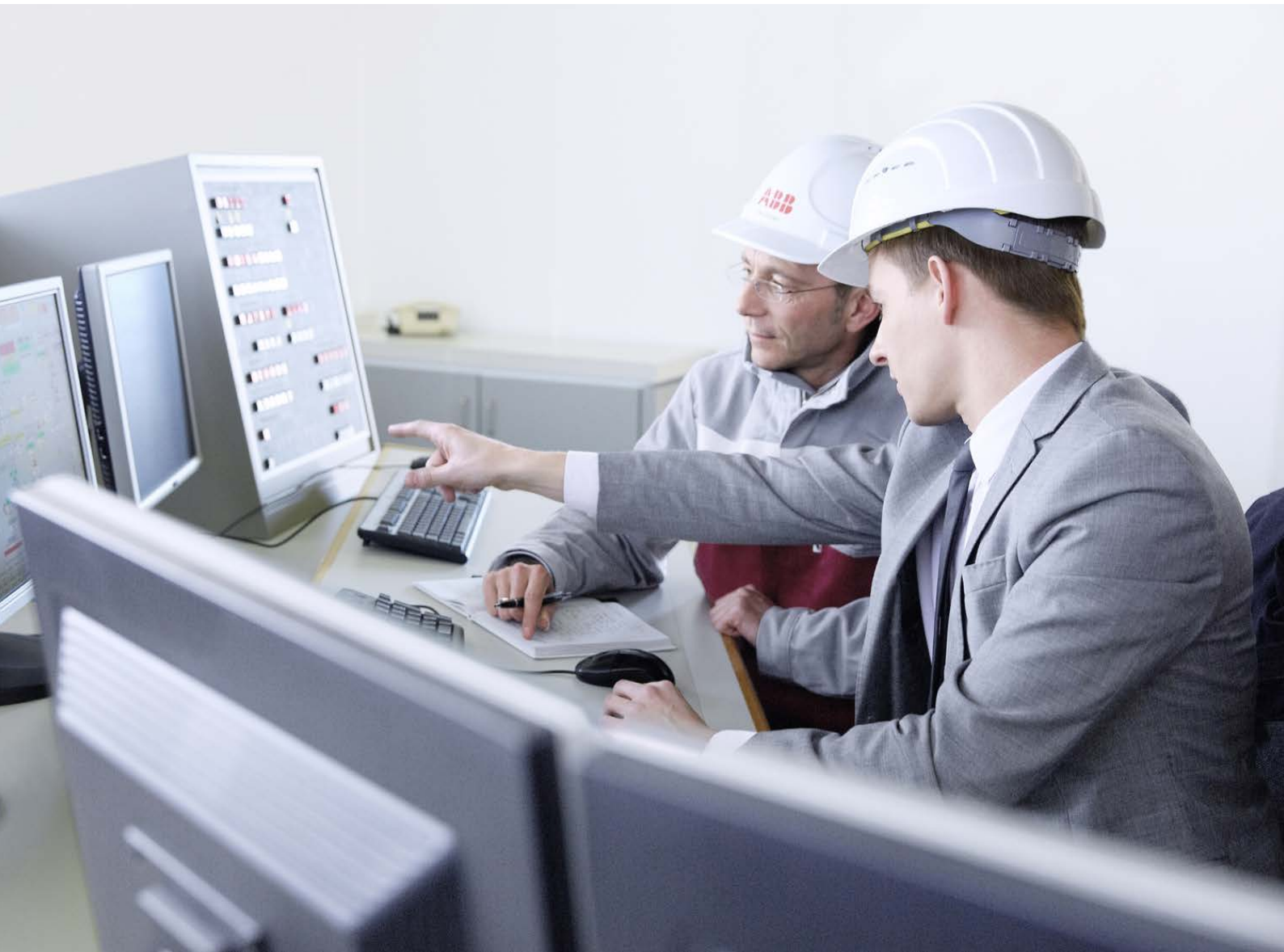
Productivity



Reliability



Efficiency



— Productivity

Maximizing your output



Continuous operation

- Reduced spares and maintenance
 - 10.000 mechanical close-open operations assured (M2 class)
 - Long electrical life (E2 class)



Easy to installing

- Satisfy different customer needs in a simple fast way
 - Version with on board protection relay and current sensors available
 - Full range of plug and play accessories
 - Same accessories available for all the circuit breaker series



Services and training

- Rely on programs enabling to produce their your solution taking advantage of ABB products and know how
 - Technical cooperation / license based on a modular concept of support allowing the OEM to choose in a flexible way the level of added value which better fits its individual needs

Reliability

Protecting your assets



Safety and protection

- Proven reliability
 - Same operating mechanism (“EL” family) of the VD4/R front operated
 - High number of operations and long electrical and mechanical life (E2 and M2 class)
- Hazardous situations prevented
 - Integrated mechanical anti-pumping system to prevent accidental reclosing



Reliable in extreme conditions

- Good performance in harsh environment
 - Vacuum interrupters embedded in the resin poles, protecting VIs against impacts, condensation and polluted environments
 - Self-supplied overcurrent on board relay available, making VD4/R CBs suitable for use in unmanned MV/LV transformer substations without auxiliary power supply



Global availability

- ABB by your side
 - Count on a worldwide presence for any support you may need



Efficiency

Optimizing your investments



Affordable Range

- Technical / License cooperation agreement
 - Rely on ABB technical support for new panel development based on ABB proven design



Description



- Interchangeable with VD4/R and HD4/R circuit breakers
- Stored-energy mechanical control able to make a complete O-C-O cycle without reloading the springs
- EL type control common to the VD4/R series with front operating mechanism
- High number of operations and long electrical and mechanical life (class E2 and M2 - 10.000 operations)
- Suitable for installation in prefabricated substations and switchgear
- Easy to customize thanks to the full range of accessories

- Vacuum interrupters built into the pole cylinders to protect against impact, condensation and polluted environments
- Maintenance-free
- Application (on request) of current sensors and protection device REF 601 (in accordance with IEC Standards or CEI 0-16), or self-supplied protection device PR521, with fully tested actuation chain for facilitated installation

Note: the fast delivery option can be requested for VD4/R series circuit breakers.

General information

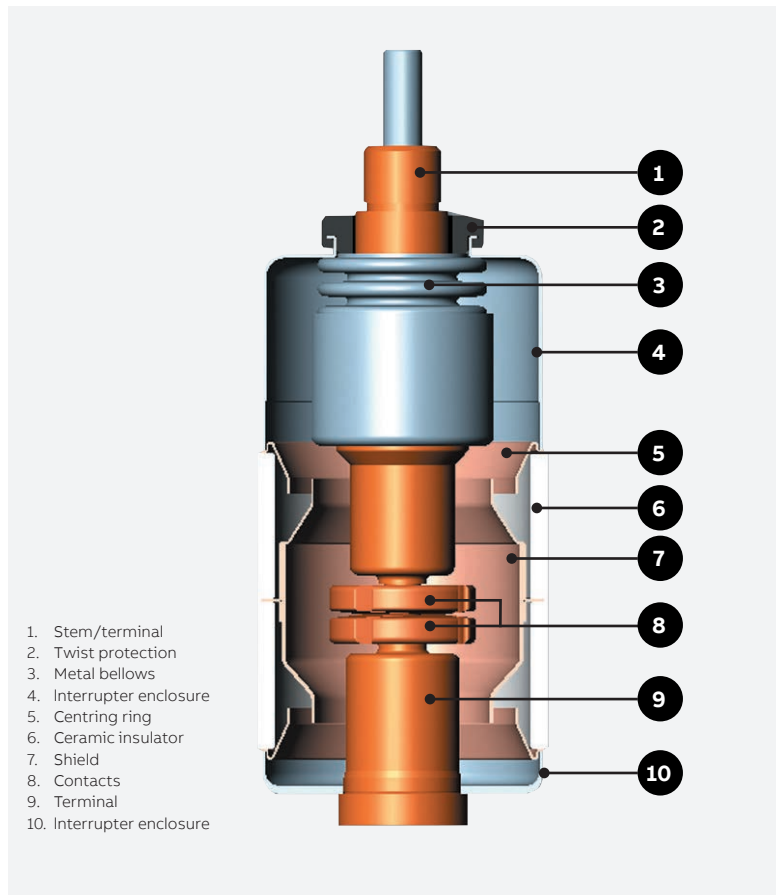
VD4/R series medium voltage vacuum circuit breakers with lateral operating mechanism feature the separate pole construction technique. Each pole houses a vacuum interrupter which is encased in the resin when the cylinder is moulded thanks to a special manufacturing process. This construction method protects the vacuum interrupter from shock, pollution and condensation.

The operating mechanism is the EL trip-free stored energy type with independent opening and closing regardless of the operator's action. The EL operating mechanism is widely used in all VD4/R series circuit breakers with frontal control. The circuit breaker can be remote controlled when fitted with dedicated electrical accessories (gearmotor, opening and closing release).

The operating mechanism, the three poles and the current sensors (if installed) are assembled on a metal frame without wheels. The construction is extremely compact, strongly built and low in weight.

VD4/R series circuit breakers with lateral operating mechanisms are life-long sealed pressure devices (Standards IEC 62271-100 and CEI EN 62271-100).

Additionally, VD4/R series circuit breakers have been type tested for low temperature and marine applications (Germanischer Lloyd).



Vacuum interrupter

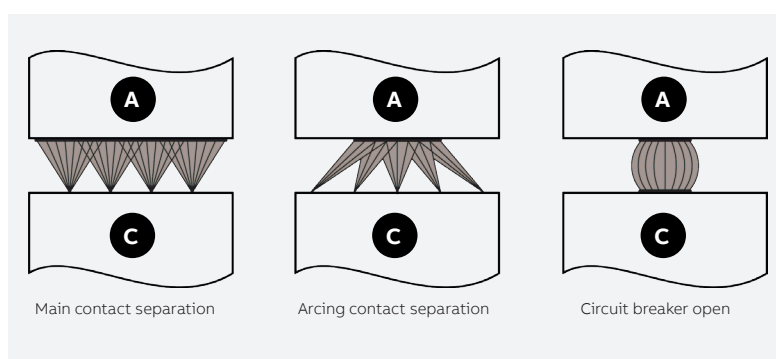


Diagram of transition from diffuse arc to constricted arc in a vacuum interrupter

Breaking principle of ABB interrupters

In a vacuum interrupter, the electric arc begins the instant in which the contacts separate. It persists until zero current is reached and can be influenced by the magnetic field.

Diffuse or constricted vacuum arc

Individual points of fusion form on the surface of the cathode following separation of the contacts. This leads to the formation of metallic vapours that support the arc itself.

The diffuse arc is characterized by expansion on the surface of the contact itself, and by evenly distributed thermal stress.

At the interrupter's rated current value, the electric arc is always the diffuse type. The contact is only eroded very slightly and there are a very high number of interruptions.

As the value of the interrupted current increases (beyond rated value), the electric arc tends to change from diffuse to constricted owing to the Hall effect.

Starting out from the anode, the arc constricts and tends to concentrate as the current increases.

There is a temperature increase on a level with the affected area, and the contact is consequently subjected to thermal stress.

To prevent the contacts from overheating and becoming eroded, the arc is made to rotate. By turning, the arc resembles a moving conductor through which current passes.

Description

The spiral shape of the contacts of ABB vacuum interrupters

The special spiral shape of the contacts generates a radial magnetic field in all parts of the arc column, concentrated around the circumferences of the contacts.

The electromagnetic force that self-generates, acts tangentially and causes the arc to spin rapidly around the axis of the contacts.

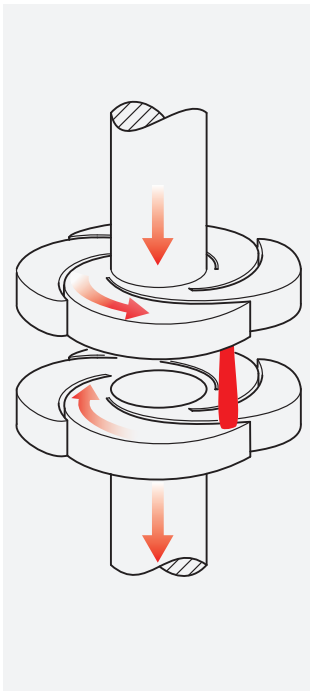
This forces the arc to turn and affect a larger area than that of a fixed constricted arc.

Besides limiting the thermal stress to which the contacts are subjected, all this ensures that these latter are only eroded to a negligible extent and, above all, allows the interruption process to be controlled even with very high short-circuit current values.

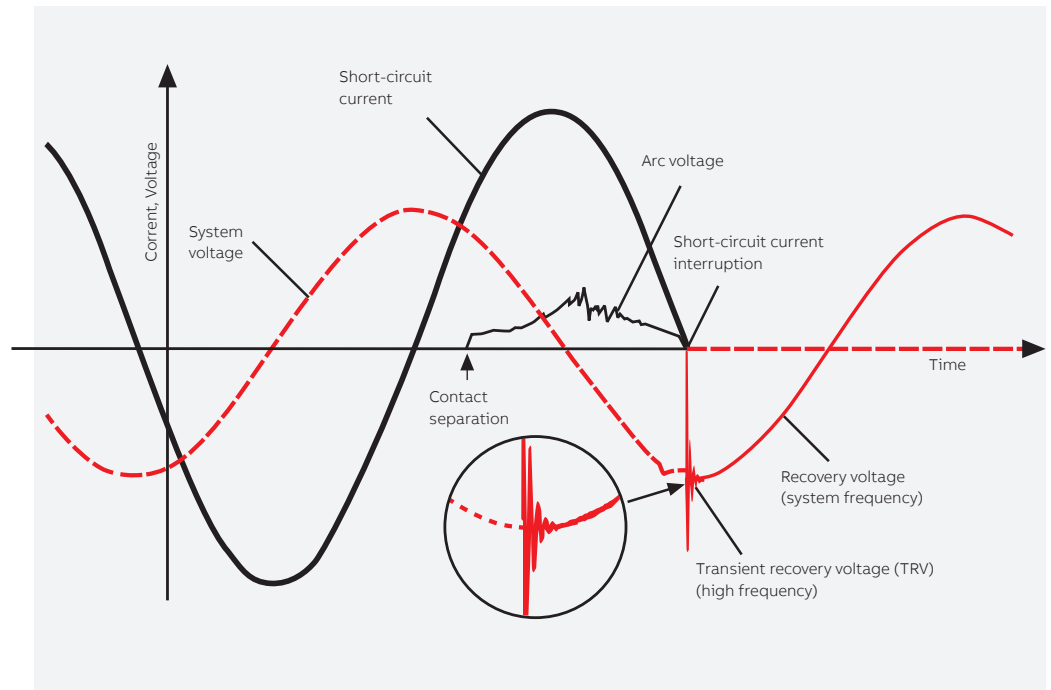
ABB vacuum interrupters interrupt at the natural passage of the current through zero, thereby preventing the arc from restriking after this has occurred.

Rapid reduction in current density and rapid condensation of the metallic vapours at the same time as the zero current instant allow maximum dielectric strength to be re-established between the interrupter's contacts within a few thousandths of a second.

In addition, radial magnetic field technology allows the current to flow straight from the interrupter contacts via the connecting stem, thus reducing power loss when the circuitbreaker is closed.



Geometry of radial magnetic field contact with a rotating vacuum arc

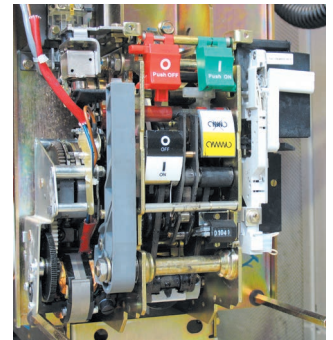
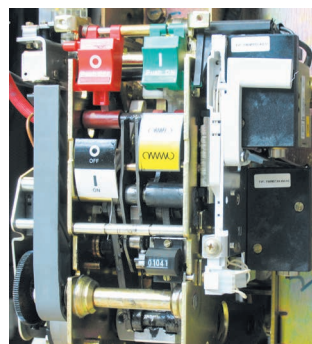


Current and voltage trend evolution in a single phase during vacuum interruption



EL operating mechanism

- The same one is used for the entire series.
- The same accessories are available for all types of circuit breaker.
- Fixed strikers make the accessories easy to assemble or replace.
- Accessories wired with sockets and plugs.
- Suitable for the rapid 0-0.3s-CO-15s-CO reclosing cycle.
- Integrated spring loading lever.
- Integrated mechanical anti-pumping system to prevent accidental reclosing.
- Available with Low Smoke Zero Halogen (LSOH) cabling with V0 quenching degree.



- 01 Current sensors.
- 02 Electrical accessories for simplified assembly.
- 03 Plate with circuit breaker specifications fixed to side of operating mechanism enclosure.
- 04 Self-supplied PR521 relay (on request) coordinated with circuit breaker and with current sensors.
- 05 Mechanical anti-pumping device.

01

04

05

Description

Anti-pumping device

The EL operating mechanism of VD4/R circuit breakers (in each version) is equipped with a mechanical anti-pumping device that prevents reclosing due to both electrical and mechanical operating mechanisms.

If both the closing control and any one of the opening controls (local or remote) were active at the same time, there would be a continuous succession of opening and closing controls. The anti-pumping device prevents this from occurring and ensures that each closing operation is only followed by an opening operation and by no other closing operation after this latter. The closing control must be released and then reactivated again in order to obtain a new closing operation.

Moreover, the anti-pumping device will only allow the circuitbreaker to close if the following conditions have all occurred at the same time:

- springs of the control fully loaded
- opening pushbutton and/or opening release (-MBO1/-MBO2) not activated
- circuit breaker open.

Fields of use

These VD4/R circuit breakers with lateral operating mechanism can be used in all medium voltage secondary distribution systems and MV/LV transformer substations in factories, industrial workshops and in the services-providing sector. Thanks to installation (on request) of the self-supplied PR521 overcurrent release with microprocessor, the VD4/R series circuit breakers with lateral operating mechanism are suitable for use in unmanned MV/LV transformer substations without auxiliary power supply.



PR521 Protection Device

With the exception of the version for UniSec switchgear, VD4/R series circuit breakers with lateral operating mechanism and a rated voltage of up to 24 kV can be equipped on request with the self-supplied PR521 overcurrent release with microprocessor, which is available in the following versions:

- **PR521 (50-51):** protects against overloads (51) and against instantaneous and delayed short-circuits (50);
- **PR521 (50-51-51N):** protects against overloads (51), instantaneous and delayed short-circuits (50) and against earth faults (51N).

The current sensors are available with four rated current values and cover all the circuit breaker's application ranges (consult chap. 3 for the protection ranges).

Other important features of PR521 are:

- precise interventions
- wide setting ranges
- operation also assured with single-phase power supply
- fade-free specifications and reliable operation even in places with a high degree of pollution
- single and contemporaneous adjustment of the three phases
- no limitation (due to the current sensors) to the rated breaking capacity or to the short-time withstand current of the circuit breaker.

Consult chapter 3 for further details.

REF 601 Protection Device

On request, VD4/R series circuit breakers with lateral operating mechanisms and a rated voltage of up to 24 kV can be equipped with the REF 601 protection device. The VD4/R version for UniSec switchgear can be equipped on request with the REF 601 protection device only.

Unlike PR521, which is a self-supplied relay, REF 601 requires an auxiliary power supply in order to function. The device is available in two different versions:

- **REF 601 version IEC** (time-current curves in compliance with IEC 255-3): protects against overloads (51), instantaneous and delayed short-circuits (50-51) and against instantaneous and delayed homopolar earth faults (50N and 51N). It also detects the magnetizing current of a threephase transformer, thus preventing untimely tripping when the transformer (68) connects.
- **REF 601 version CEI** (time-current curves in compliance with CEI 0-16 and thresholds that can be set in accordance with ENEL specification 3rd Ed. of CEI 0-16 2012-12): this version has been specifically designed for medium voltage user connection to the Italian electricity main. It protects against overload (51 - not required by all public utility companies), instantaneous and delayed short-circuits (50 and 51), instantaneous and delayed homopolar earth faults (50N and 51N).

The device can operate with up to 3 inputs from current sensors of the Rogowsky coil type and 4 rated current values can be entered by a keyboard: 40 - 80 - 250 - 1250 A for the IEC version, while 2 rated current values can be selected for the CEI 0-16 version, i.e. 80-250 A.

The current sensors are available in two versions: for circuit breakers with 630 A rated current and for circuit breakers with rated current values that are higher than 630 A.

Consult chap. 3 for the protection ranges.

Besides the characteristics already described for PR521, REF 601 also possesses other important features, such as:

- pushbuttons for the circuit breaker's local switching operations (opening and closing pushbutton. The lateral operation mechanism is always supplied with a shunt opening release. Application of the shunt closing release must obviously be requested to operate the closing command via REF 601).



- 5 separate indicators: “relay operating”, “relay at tripping threshold”, “relay tripped”, “relay tripped due to phase overcurrent”, “relay tripped due to earth fault overcurrent”
- HMI consisting of an LCD display and by “arrow”, “enter” and “esc” keys for user-friendly browsing amongst the “measuring”, “data recording”, “event recording”, “settings”, “configuration” and “test” menus
- three user levels with different operations allowed and two passwords
- continuous display of the current in the most loaded phase and the earth current
- recording of the values of the currents that caused the device to trip
- storage of the number of openings caused by the device
- event recording (storage of the previously described parameters in the last 5 tripping actions of the device) in a non-volatile memory
- curves “ $\beta = 1$ ” or “ $\beta = 5$ ” and curve “RI”, specifically for the Belgian market (only the IEC version of REF 601)
- circuit breaker opening by means of the undervoltage release (only the CEI 0-16 version of REF 601)
- on request, version with RS485 Full Duplex serial link - MODBUS RTU (version not available for installation on the circuit breaker)
- built-in TCS function 48-240 V
- 24...240 V a.c./d.c. multivoltage feeder, either 50 Hz or 60 Hz.

Description

Standards and approvals

The VD4/R circuit breakers with lateral operating mechanisms conform to standards IEC 62271-100, CEI 17-1 dossier 1375 and to those in force in the main industrial countries.

They have been subjected to the tests described below and guarantee that the equipment is safe and reliable for use in all types of installation.

- **Type tests:** heating, power frequency withstand and lightning impulse withstand voltage, short-time and peak withstand current, mechanical life, short-circuit current making and breaking capacity.
- **Individual tests:** power-frequency insulation of the main circuits, insulation of the auxiliary and operating circuits, main circuit resistance measurements, mechanical and electrical operation.

Safe service

Safe distribution switchgear can be created using VD4/R circuit breakers with lateral operating mechanisms thanks to the full range of mechanical and electrical locks (available on request).

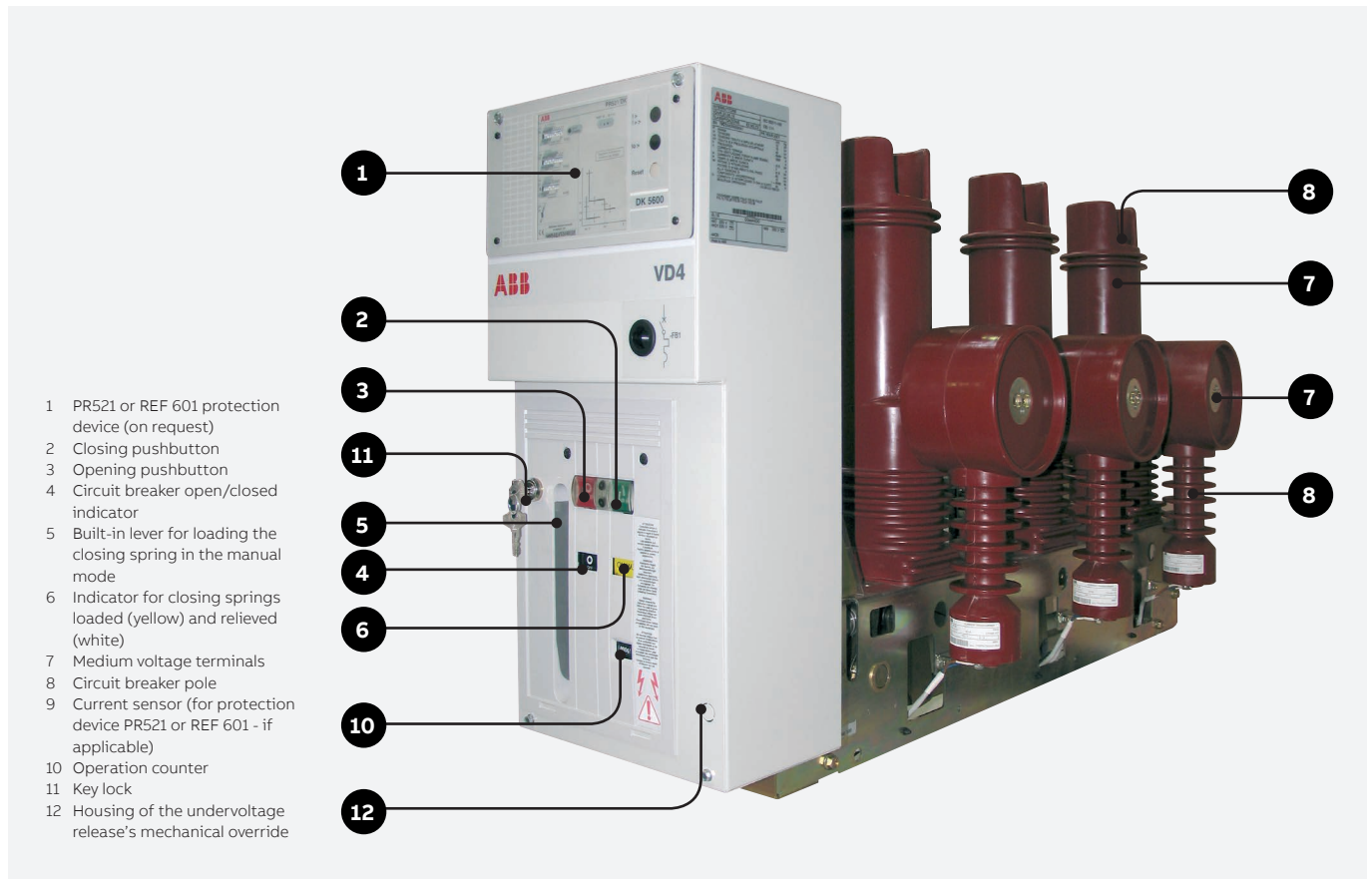
The locks have been designed to prevent incorrect manoeuvres and to allow the installations to be inspected while guaranteeing the utmost safety for the operator. All the operating, monitoring and indicating devices are installed on the front of the circuit breaker.

There is always an anti-pumping device on the actuator.

Technical literature

Order the following publications for more details about the technical aspects and applications of VD4/R circuit breakers:

- | | |
|---------------------|-----------------|
| • UniSec switchgear | Cat. 1VFM200001 |
| • REF601 IEC | Man. 1MDU072061 |
| • REF601 CEI 0-16 | Man. 1MDU072051 |



Quality System

Conforms to ISO 9001 Standards, certified by an independent third party.

Environmental Management System

Conforms to ISO 14001 Standards, certified by an independent third party.

Health and Safety Management System

Conforms to OHSAS 18001 Standards, certified by an independent third party.

Test laboratory

Conforms to UNI CEI EN ISO/IEC 17025 Standards, certified by an independent third party.

Electrical specifications

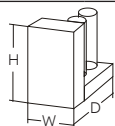
Circuit breaker		VD4/R 12	VD4/R 17	VD4/R 24
Rated voltage	[kV]	12	17.5	24
Rated thermal current	[A]	630/800/1250	630/800/1250	630/800/1250
Rated duty breaking capacity	[kA]	12.5...25	12.5...25	

How to choose and order the circuit breakers

General specifications of fixed circuit breakers
with right lateral operating mechanisms
(12 - 17.5 - 24 kV)



Circuit breaker		VD4/R 12			VD4/R 17			VD4/R 24		
Standards	IEC 62271-100	•			•			•		
	CEI EN 62271-100 (dossier 7642)	•			•			•		
Rated voltage	Ur [kV]	12			17.5			24		
Rated insulation voltage	Us [kV]	12			17.5			24		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28 ⁽⁸⁾			38			50		
Impulse withstand voltage	Up [kV]	75			95			125		
Rated frequency	fr [Hz]	50-60			50-60			50-60		
Rated normal current (40 °C)	Ir [A]	630	800	1250	630	800	1250	630	800	1250
		12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		12.5	—	—	12.5	—	—	12.5	—	—
Short-time withstand current (3s)	Ik [kA]	16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
Making capacity	Ip [kA]	20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		31.5	—	—	31.5	—	—	31.5	—	—
		40	40	40	40	40	40	40	40	40
		50	50	50	50	50	50	50	50	50
Operation sequence	[O - 0.3 s - CO - 15 s - CO]	63	63	63	63	63	63	63	63	63
		63	63	63	63	63	63	63	63	63
		63	63	63	63	63	63	63	63	63
		63	63	63	63	63	63	63	63	63
		63	63	63	63	63	63	63	63	63
Mechanical class	M2 - 10.000 CO	•			•			•		
Electrical class	E2	•			•			•		
Opening time	[ms]	40 ... 60			40 ... 60			40 ... 60		
Arcing time	[ms]	10 ... 15			10 ... 15			10 ... 15		
Total break-time	[ms]	50 ... 75			50 ... 75			50 ... 75		
Closing time	[ms]	30 ... 60			30 ... 60			30 ... 60		
Overall dimensions (maximum)	H [mm]	785			785			785		
	W [mm]	317			317			317		
	D [mm]	1029 ⁽¹⁾ / 1170 ⁽²⁾			1029 ⁽¹⁾ / 1170 ⁽²⁾			1029 ⁽¹⁾ / 1170 ⁽²⁾		
	Pole center-distance P [mm]	230 / 300			230 / 300			230 / 300		
Weight	[kg]	65 ⁽¹⁾ - 67 ⁽²⁾			65 ⁽¹⁾ - 67 ⁽²⁾			65 ⁽¹⁾ - 67 ⁽²⁾		
Application of PR521 protection device	In [A]	40-80-250-1250 ⁽⁴⁾			40-80-250-1250 ⁽⁴⁾			40-80-250-1250 ⁽⁴⁾		
Application of REF 601 protection device ⁽⁵⁾		• ⁽⁵⁾			• ⁽⁵⁾			• ⁽⁵⁾		
Standardized dimensions table		1VCD000100 ⁽¹⁾			1VCD000100 ⁽¹⁾			1VCD000100 ⁽¹⁾		
		1VCD000101 ⁽²⁾			1VCD000101 ⁽²⁾			1VCD000101 ⁽²⁾		
Wiring diagram	without protection device installed	1VCD400097			1VCD400097			1VCD400097		
	with PR521	1VCD400097			1VCD400097			1VCD400097		
	with REF 601	1VCD400115			1VCD400115			1VCD400115		
Operating temperature	[°C]	- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾		
Tropicalization	IEC: 60068-2-30, 60721-2-1	•			•			•		
Electromagnetic compatibility	IEC: 62271-1	•			•			•		



⁽¹⁾ 230 mm pole center-distance

⁽²⁾ 300 mm pole center-distance

⁽³⁾ increase the indicated weight by 20 kg for circuit breakers with PR 521 / REF 601 devices and 3 current sensors

⁽⁴⁾ rated current of the current sensors (the PR521 device and the current sensors are available on request)

⁽⁵⁾ the rated current of the REF 601 device must be set in the relay in accordance with the circuit breaker's rated current

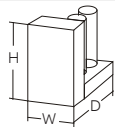
⁽⁶⁾ "IEC" or "CEI 0-16" version. If the "CEI 0-16" is required, the circuit breaker is always supplied with 3 phase current sensors (Rogowsky coils) installed on the actual circuit breaker and with a loose toroidal TA. In the "CEI 0-16" version, the REF 601 device opens the circuit breaker by means of the undervoltage release - MBU

⁽⁷⁾ for operating temperature -25 °C and storage temperature -40 °C, please ask ABB

⁽⁸⁾ 42 kV version available

General specifications of fixed circuit breakers with left lateral operating mechanisms (12 - 17.5 - 24 kV)

Circuit breaker		VD4/L 12			VD4/L 17			VD4/L 24		
Standards	IEC 62271-100	•			•			•		
	CEI EN 62271-100 (dossier 7642)	•			•			•		
Rated voltage	Ur [kV]	12			17.5			24		
Rated insulation voltage	Us [kV]	12			17.5			24		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28 ⁽⁸⁾			38			50		
Impulse withstand voltage	Up [kV]	75			95			125		
Rated frequency	fr [Hz]	50-60			50-60			50-60		
Rated normal current (40 °C)	Ir [A]	630	800	1250	630	800	1250	630	800	1250
		12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		12.5	—	—	12.5	—	—	12.5	—	—
Short-time withstand current (3s)	Ik [kA]	16	16	16	16	16	16	16	16	16
		20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		12.5	—	—	12.5	—	—	12.5	—	—
		16	16	16	16	16	16	16	16	16
Making capacity	Ip [kA]	20	20	20	20	20	20	20	20	20
		25	25	25	25	25	25	25	25	25
		31.5	—	—	31.5	—	—	31.5	—	—
		40	40	40	40	40	40	40	40	40
		50	50	50	50	50	50	50	50	50
Operation sequence	[O - 0.3 s - CO - 15 s - CO]	•			•			•		
Mechanical class	M2 - 10.000 CO	•			•			•		
Electrical class	E2	•			•			•		
Opening time	[ms]	40 ... 60			40 ... 60			40 ... 60		
Arcing time	[ms]	10 ... 15			10 ... 15			10 ... 15		
Total break-time	[ms]	50 ... 75			50 ... 75			50 ... 75		
Closing time	[ms]	30 ... 60			30 ... 60			30 ... 60		
Overall dimensions (maximum)	H [mm]	785			785			785		
	W [mm]	317			317			317		
	D [mm]	1029 ⁽¹⁾ / 1170 ⁽²⁾			1029 ⁽¹⁾ / 1170 ⁽²⁾			1029 ⁽¹⁾ / 1170 ⁽²⁾		
	Pole center-distance P [mm]	230 / 300			230 / 300			230 / 300		
Weight	[kg]	65 ⁽¹⁾ - 67 ⁽²⁾			65 ⁽¹⁾ - 67 ⁽²⁾			65 ⁽¹⁾ - 67 ⁽²⁾		
Application of PR521 protection device	In [A]	40-80-250-1250 ⁽³⁾			40-80-250-1250 ⁽³⁾			40-80-250-1250 ⁽³⁾		
Application of REF 601 protection device ⁽⁶⁾		• ⁽⁵⁾			• ⁽⁵⁾			• ⁽⁵⁾		
Standardized dimensions table		1VCD003453 ⁽¹⁾			1VCD003453 ⁽¹⁾			1VCD003453 ⁽¹⁾		
		1VCD003454 ⁽²⁾			1VCD003454 ⁽²⁾			1VCD003454 ⁽²⁾		
Wiring diagram	without protection device installed	1VCD400097			1VCD400097			1VCD400097		
	with PR521	1VCD400097			1VCD400097			1VCD400097		
	with REF 601	1VCD400115			1VCD400115			1VCD400115		
Operating temperature	[°C]	- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾		
Tropicalization	IEC: 60068-2-30, 60721-2-1	•			•			•		
Electromagnetic compatibility	IEC: 62271-1	•			•			•		



⁽¹⁾ 230 mm pole center-distance
⁽²⁾ 300 mm pole center-distance
⁽³⁾ increase the indicated weight by 20 kg for circuit breakers with PR 521 / REF 601 devices and 3 current sensors
⁽⁴⁾ rated current of the current sensors (the PR521 device and the current sensors are available on request)
⁽⁵⁾ the rated current of the REF 601 device must be set in the relay in accordance with the circuit breaker's rated current
⁽⁶⁾ "IEC" or "CEI 0-16" version. If the "CEI 0-16" is required, the circuit breaker is always supplied with 3 phase current sensors (Rogowsky coils) installed on the actual circuit breaker and with a loose toroidal TA. In the "CEI 0-16" version, the REF 601 device opens the circuit breaker by means of the undervoltage release - MBU
⁽⁷⁾ for operating temperature -25 °C and storage temperature -40 °C, please ask ABB
⁽⁸⁾ 42 kV version available

How to choose and order the circuit breakers

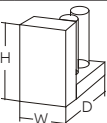
General specifications of fixed circuit breakers
with right lateral operating mechanisms for
ABB UniSec switchgear (12 - 17.5 - 24 kV)

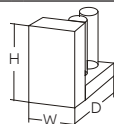
(¹) for 12.08.20 and 17.08.20, versions with withstand voltage up to 42 kV are available
(²) rated duty breaking capacity 21 kA at 17.5 kV. Rated short-time withstand current 21 kA x 3 s
(³) rated short-time withstand current 25 kA x 2 s

(⁴) increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors
(⁵) "IEC" or "CEI 0-16" version. If the "CEI 0-16" is required, the circuit breaker is always supplied with 3 phase current sensors (Rogowsky coils) installed on the actual circuitbreaker and with a loose toroidal TA. In the "CEI 0-16" version, the REF 601 device opens the circuit breaker by means of the undervoltage release - MBU

(⁶) the rated current of the REF 601 device must be set in the relay in accordance with the circuit breaker's rated current

(⁷) for 12.08.20 and 17.08.20, versions with operating temperature up to -25 °C and storage temperature up to -40 °C are available

Circuit breaker		VD4/R-SEC 12			VD4/R-SEC 17			VD4/R-SEC 24			
Standards	IEC 62271-100	•			•			•			
	CEI EN 62271-100 (dossier 7642)	•			•			•			
Rated voltage	Ur [kV]	12				17.5				24	
Rated insulation voltage	Us [kV]	12				17.5				24	
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28 (1)				38 (1)				50	
Impulse withstand voltage	Up [kV]	75				95				125	
Rated frequency	fr [Hz]	50-60				50-60				50-60	
Rated normal current (40 °C)	Ir [A]	630	800	1250	630	800	1250	630	800	1250	
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	12.5	—	12.5	12.5	—	12.5	—	—	
		16	16	—	16	16	—	16	—	—	
		20	20	—	20 (2)	20 (2)	—	20	—	—	
		25	25	—	25	—	—	25	—	—	
Short-time withstand current (3s)	Ik [kA]	12.5	12.5	—	12.5	12.5	—	12.5	—	—	
		16	16	—	16	16	—	16	—	—	
		20	20	—	20 (2)	20 (2)	—	20	—	—	
		25 (3)	25 (3)	—	25 (3)	—	—	25 (3)	—	—	
Making capacity	Ip [kA]	31.5	31.5	—	31.5	31.5	—	31.5	—	—	
		40	40	—	40	40	—	40	—	—	
		50	50	—	50	50	—	50	—	—	
		63	63	—	63	—	—	63	—	—	
Operation sequence	[O - 0.3 s - CO - 15 s - CO]	•			•			•			
Mechanical class	M2 - 10.000 CO	•			•			•			
Electrical class	E2	•			•			•			
Opening time	[ms]	40 ... 60				40 ... 60				40 ... 60	
Arcing time	[ms]	10 ... 15				10 ... 15				10 ... 15	
Total break-time	[ms]	50 ... 75				50 ... 75				50 ... 75	
Closing time	[ms]	30 ... 60				30 ... 60				30 ... 60	
Overall dimensions (maximum)		H [mm]	740				740				740
		W [mm]	315				315				315
		D [mm]	1005				1005				1005
		Pole center-distance P [mm]	230				230				230
Weight	[kg]	65				65				65	
Application of PR521 protection device (5)	In [A]	not available			not available			not available			
Application of REF 601 protection device		• (6)			• (6)			• (6)			
Standardized dimensions table		1VCD000131			1VCD000131			1VCD000131			
	without / with REF 601	1VCD000118			1VCD000118			1VCD000118			
Operating temperature	[°C]	- 5 ... + 40 (7)			- 5 ... + 40 (7)			- 5 ... + 40 (7)			
Tropicalization	IEC: 60068-2-30, 60721-2-1	•			•			•			
Electromagnetic compatibility	IEC: 62271-1	•			•			•			



General specifications of fixed circuit breakers with right lateral operating mechanisms for ABB UniSec switchgear (12 - 17.5 - 24 kV)

Circuit breaker		VD4/L-SEC 12			VD4/L-SEC 17			VD4/L-SEC 24		
Standards	IEC 62271-100	•			•			•		
	CEI EN 62271-100 (dossier 7642)	•			•			•		
Rated voltage	Ur [kV]	12			17.5			24		
Rated insulation voltage	Us [kV]	12			17.5			24		
Withstand voltage at 50 Hz	Ud (1 min) [kV]	28 ⁽¹⁾			28 ⁽¹⁾			28 ⁽¹⁾		
Impulse withstand voltage	Up [kV]	75			95			125		
Rated frequency	fr [Hz]	50-60			50-60			50-60		
Rated normal current (40 °C)	Ir [A]	630	800	1250	630	800	1250	630	800	1250
		12.5	12.5	—	12.5	12.5	—	12.5	—	—
		16	16	—	16	16	—	16	—	—
		20	20	—	20 ⁽²⁾	20 ⁽²⁾	—	20	—	—
		25	25	—	25	—	—	25	—	—
Rated duty breaking capacity (symmetrical rated short-circuit current)	Isc [kA]	12.5	12.5	—	12.5	12.5	—	12.5	—	—
		16	16	—	16	16	—	16	—	—
		20	20	—	20 ⁽²⁾	20 ⁽²⁾	—	20	—	—
		25	25	—	25	—	—	25	—	—
		25 ⁽³⁾	25 ⁽³⁾	—	25 ⁽³⁾	—	—	25 ⁽³⁾	—	—
Short-time withstand current (3s)	Ik [kA]	12.5	12.5	—	12.5	12.5	—	12.5	—	—
		16	16	—	16	16	—	16	—	—
		20	20	—	20 ⁽²⁾	20 ⁽²⁾	—	20	—	—
		25 ⁽³⁾	25 ⁽³⁾	—	25 ⁽³⁾	—	—	25 ⁽³⁾	—	—
		25 ⁽³⁾	25 ⁽³⁾	—	25 ⁽³⁾	—	—	25 ⁽³⁾	—	—
Making capacity	Ip [kA]	31.5	31.5	—	31.5	31.5	—	31.5	—	—
		40	40	—	40	40	—	40	—	—
		50	50	—	50	50	—	50	—	—
		63	63	—	63	—	—	63	—	—
		63	63	—	63	—	—	63	—	—
Operation sequence	[O - 0.3 s - CO - 15 s - CO]	•			•			•		
Mechanical class	M2 - 10.000 CO	•			•			•		
Electrical class	E2	•			•			•		
Opening time	[ms]	40 ... 60			40 ... 60			40 ... 60		
Arcing time	[ms]	10 ... 15			10 ... 15			10 ... 15		
Total break-time	[ms]	50 ... 75			50 ... 75			50 ... 75		
Closing time	[ms]	30 ... 60			30 ... 60			30 ... 60		
Overall dimensions (maximum)	H [mm]	740			740			740		
	W [mm]	315			315			315		
	D [mm]	1005			1005			1005		
	Pole center-distance P [mm]	230			230			230		
	Weight [kg]	65			65			65		
Application of PR521 protection device ⁽⁵⁾	In [A]	not available			not available			not available		
Application of REF 601 protection device	• ⁽⁶⁾	• ⁽⁶⁾			• ⁽⁶⁾			• ⁽⁶⁾		
Standardized dimensions table	without / with REF 601	1VCD000132			1VCD000132			1VCD000132		
	without / with REF 601	1VCD000118			1VCD000118			1VCD000118		
Operating temperature	[°C]	- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾			- 5 ... + 40 ⁽⁷⁾		
Tropicalization	IEC: 60068-2-30, 60721-2-1	•			•			•		
Electromagnetic compatibility	IEC: 62271-1	•			•			•		

⁽¹⁾ for 12.08.20 and 17.08.20, versions with withstand voltage up to 42 kV are available

⁽²⁾ rated duty breaking capacity 21 kA at 17.5 kV. Rated short-time withstand current 21 kA x 3 s

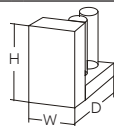
⁽³⁾ rated short-time withstand current 25 kA x 2 s

⁽⁴⁾ increase the indicated weight by 20 kg for circuit breakers with REF 601 devices and 3 current sensors

⁽⁵⁾ "IEC" or "CEI 0-16" version. If the "CEI 0-16" is required, the circuit breaker is always supplied with 3 phase current sensors (Rogowsky coils) installed on the actual circuitbreaker and with a loose toroidal TA. In the "CEI 0-16" version, the REF 601 device opens the circuit breaker by means of the undervoltage release - MBU

⁽⁶⁾ the rated current of the REF 601 device must be set in the relay in accordance with the circuit breaker's rated current

⁽⁷⁾ for 12.08.20 and 17.08.20, versions with operating temperature up to -25 °C and storage temperature up to -40 °C are available



How to choose and order the circuit breakers

Available versions

VD4/R circuit breakers with lateral operating mechanism are available in the following versions:

- fixed, with right lateral operating mechanism and 230 mm pole center-distance
- fixed, with left lateral operating mechanism and 230 mm pole center-distance
- fixed, with right lateral operating mechanism and 300 mm pole center-distance
- fixed, with left lateral operating mechanism and 300 mm pole center-distance
- removable, with right lateral operating mechanism, version for UniSec switchgear, 230 mm pole center-distance
- removable, with left lateral operating mechanism, version for UniSec switchgear, 230 mm pole center-distance.

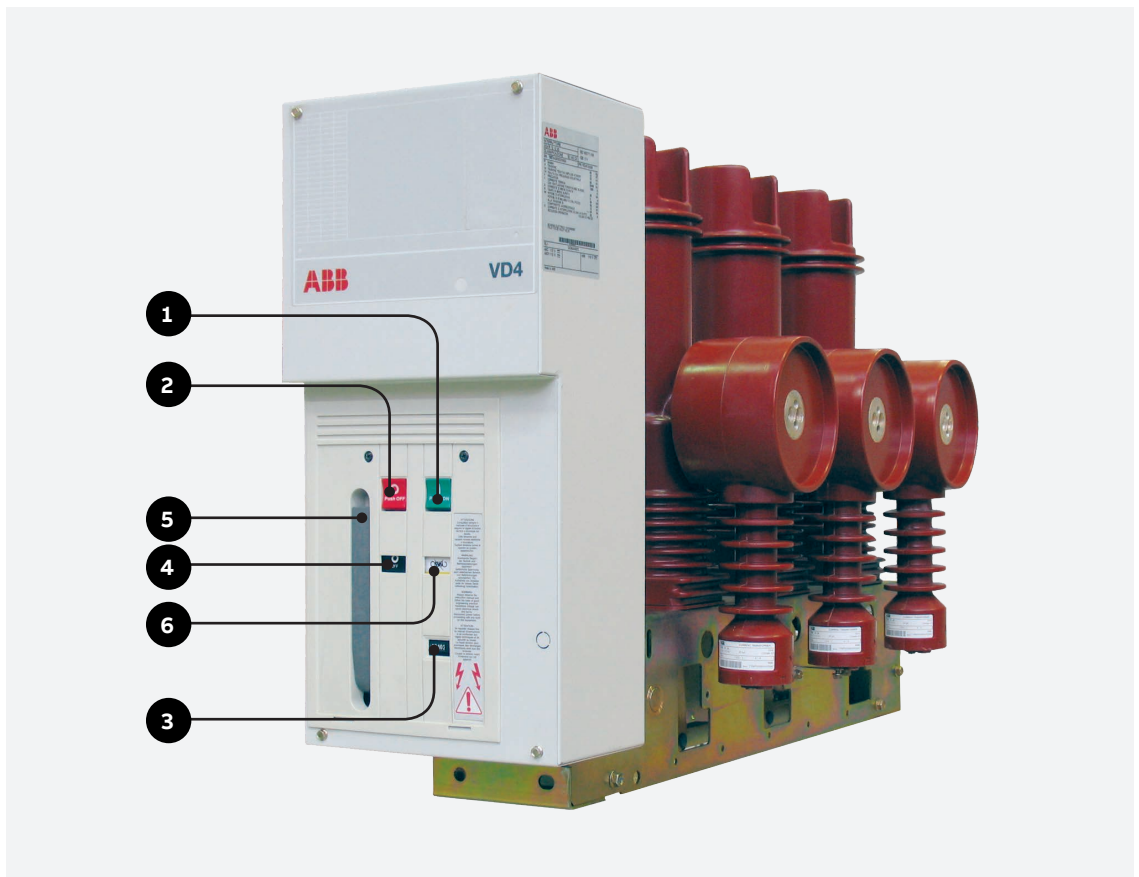
Depending on the version, they can be equipped on request with two or three current sensors and with a PR521 series or REF 601 series device for protection against overcurrents.

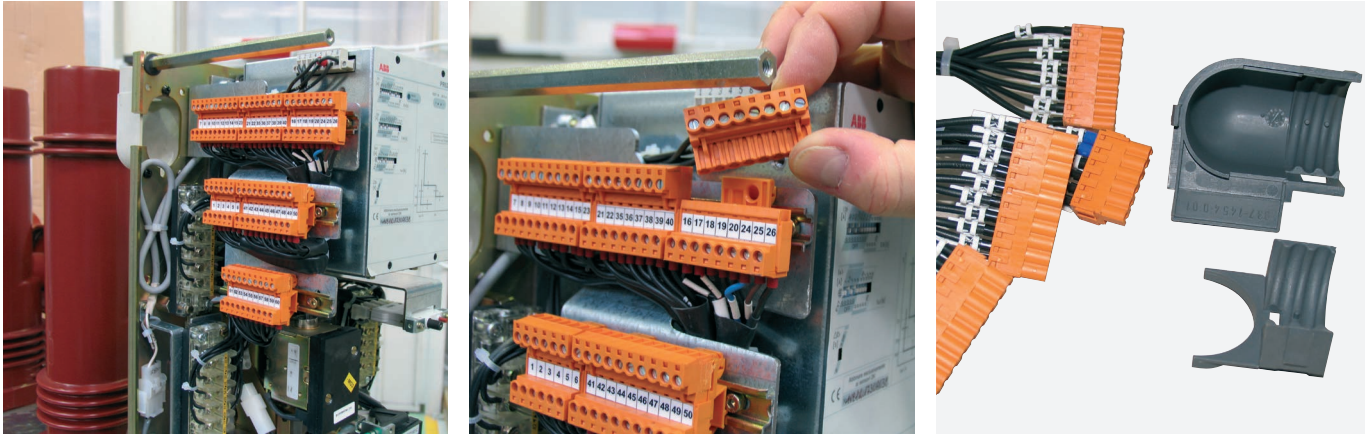
Standard equipment

1. VD4/R fixed circuit breakers with right lateral operating mechanisms and VD4/L fixed circuit breakers with left lateral operating mechanisms

The coded basic version of the fixed circuit breakers is always the three-pole type and comes equipped with:

- 1 opening pushbutton
- 2 closing pushbutton
- 3 operation counter
- 4 circuit breaker open/closed indicator
- 5 lever for loading the springs in the manual mode (built into the operating mechanism)
- 6 indicator for closing springs loaded/relieved.





The basic wiring ends in the terminal box. This latter is equipped with a withdrawable part that allows the customer to create a disconnectable connection (see picture alongside).

The basic version also includes the following accessories, which must be specified on order (see Kits 1, 2, 3 described on pages 25-26):

Kit 1 set of five opened/closed auxiliary contacts or alternatively, with a surcharge, ten or fifteen auxiliary contacts. Each shunt opening device uses an NO auxiliary contact to shut off its power supply after the circuit breaker has been opened. This means that there is one NO auxiliary contact less for every opening release installed

Kit 2 opening release

Kit 3 key lock.

2. Circuit breakers for UniSec switchgear with right or left lateral operating mechanisms (230 mm distance between centers)

The coded basic version of the circuit breakers for UniSec switchgear is the same as that of the fixed circuit breakers, with the following specific exceptions and equipment:

- the dustproof enclosure of the operating mechanism is equipped with a specific side frame for the UniSec switchgear
- the base is equipped with wheels to make the switchgear easier to move and rack-in to the compartment

- the wiring ends at the terminal box equipped with a withdrawable part and can be accessed without removing the operating mechanism's dustproof enclosure. The terminal box is actually situated at the front and projects over the upper edge of the enclosure
- the front enclosure has a transparent sliding shutter over the mechanical indicators, the operating pushbuttons and the hand lever that loads the closing spring. This protection prevents hot gas from escaping if an arc forms in the UniSec circuit breaker compartment. On request, this shutter can be equipped with a padlock to prevent it from sliding and thus inhibit the opening and closing buttons from being used
- 9 auxiliary contacts are available on request, with a surcharge, as an alternative. Since each shunt opening device uses an NO auxiliary contact to shut off its power supply after having opened the circuit breaker, there is an unavailable NO auxiliary contact for every opening release installed
- on request, this version can be supplied with just the REF 601 protection device. The PR521 protection device cannot be supplied for the VD4/R version for UniSec.

How to choose and order the circuit breakers

VD4/R 12-17-24

right lateral operating mechanism

U [kV]	In [A]	Isc [kA]	Description	Pole centre distance		Wiring diagram
				230 mm	300 mm	
				1VCD000100	1VCD000101	
12	630	12.5	VD4/R 12.06.12	•	•	without relay 1VCD400173
		16	VD4/R 12.06.16	•	•	
		20	VD4/R 12.06.20	•	•	
		25	VD4/R 12.06.25	•	•	
	800	16	VD4/R 12.08.16	•	•	
		20	VD4/R 12.08.20	•	•	
		25	VD4/R 12.08.25	•	•	
	1250	16	VD4/R 12.12.16	•	•	
		20	VD4/R 12.12.20	•	•	
		25	VD4/R 12.12.25	•	•	
17.5	630	12.5	VD4/R 17.06.12	•	•	with relay PR521 1VCD400173
		16	VD4/R 17.06.16	•	•	
		20	VD4/R 17.06.20	•	•	
		25	VD4/R 17.06.25	•	•	
	800	16	VD4/R 17.08.16	•	•	
		20	VD4/R 17.08.20	•	•	
		25	VD4/R 17.08.25	•	•	
	1250	16	VD4/R 17.12.16	•	•	
		20	VD4/R 17.12.20	•	•	
		25	VD4/R 17.12.25	•	•	
24	630	12.5	VD4/R 24.06.12	•	•	with relay REF 601 1VCD400174
		16	VD4/R 24.06.16	•	•	
		20	VD4/R 24.06.20	•	•	
	800	16	VD4/R 24.08.16	•	•	
		20	VD4/R 24.08.20	•	•	
	1250	16	VD4/R 24.12.16	•	•	
		20	VD4/R 24.12.20	•	•	

VD4/L 12-17-24

left lateral operating mechanism

U [kV]	In [A]	Isc [kA]	Description	Pole centre distance		Wiring diagram
				230 mm	300 mm	
				1VCD000100	1VCD000101	
12	630	12.5	VD4/L 12.06.12	•	•	without relay 1VCD400173
		16	VD4/L 12.06.16	•	•	
		20	VD4/L 12.06.20	•	•	
		25	VD4/L 12.06.25	•	•	
	800	16	VD4/L 12.08.16	•	•	
		20	VD4/L 12.08.20	•	•	
		25	VD4/L 12.08.25	•	•	
	1250	16	VD4/L 12.12.16	•	•	
		20	VD4/L 12.12.20	•	•	
		25	VD4/L 12.12.25	•	•	
17.5	630	12.5	VD4/L 17.06.12	•	•	with relay PR521 1VCD400173
		16	VD4/L 17.06.16	•	•	
		20	VD4/L 17.06.20	•	•	
		25	VD4/L 17.06.25	•	•	
	800	16	VD4/L 17.08.16	•	•	
		20	VD4/L 17.08.20	•	•	
		25	VD4/L 17.08.25	•	•	
	1250	16	VD4/L 17.12.16	•	•	
		20	VD4/L 17.12.20	•	•	
		25	VD4/L 17.12.25	•	•	
24	630	12.5	VD4/L 24.06.12	•	•	with relay REF 601 1VCD400174
		16	VD4/L 24.06.16	•	•	
		20	VD4/L 24.06.20	•	•	
	800	16	VD4/L 24.08.16	•	•	
		20	VD4/L 24.08.20	•	•	
	1250	16	VD4/L 24.12.16	•	•	
		20	VD4/L 24.12.20	•	•	

How to choose and order the circuit breakers

VD4/R-Sec 12-17-24

right lateral operating mechanism, version for UniSec switchgear

U [kV]	In [A]	Isc [kA]	Description	Pole centre distance	Wiring diagram (¹)
				230 mm 1VCD000131	
12	630	12.5	VD4/R-SEC 12.06.12	•	without relay 1VCD400177
		16	VD4/R-SEC 12.06.16	•	
		20	VD4/R-SEC 12.06.20	•	
		25	VD4/R-SEC 12.06.25	•	
	800	12.5	VD4/R-SEC 12.08.12	•	
		16	VD4/R-SEC 12.08.16	•	
		20	VD4/R-SEC 12.08.20	•	
		25	VD4/R-SEC 12.08.25	•	
17.5	630	12.5	VD4/R-SEC 17.06.12	•	with relay REF 601 1VCD400177
		16	VD4/R-SEC 17.06.16	•	
		20	VD4/R-SEC 17.06.20	•	
		25	VD4/R-SEC 17.06.25	•	
	800	12.5	VD4/R-SEC 17.08.12	•	
		16	VD4/R-SEC 17.08.16	•	
		20	VD4/R-SEC 17.08.20	•	
		25	VD4/R-SEC 17.08.25	•	
24	630	12.5	VD4/R-SEC 24.06.12	•	
		16	VD4/R-SEC 24.06.16	•	
		20	VD4/R-SEC 24.06.20	•	
		25	VD4/R-SEC 24.06.25	•	

(¹) this version is not available with relay PR521

VD4/L-Sec 12-17-24

left lateral operating mechanism, version for UniSec switchgear

U [kV]	In [A]	Isc [kA]	Description	Pole centre distance	Wiring diagram (¹)
				230 mm 1VCD000132	
12	630	12.5	VD4/L-SEC 12.06.12	•	without relay 1VCD400177
		16	VD4/L-SEC 12.06.16	•	
		20	VD4/L-SEC 12.06.20	•	
		25	VD4/L-SEC 12.06.25	•	
	800	12.5	VD4/L-SEC 12.08.12	•	
		16	VD4/L-SEC 12.08.16	•	
		20	VD4/L-SEC 12.08.20	•	
		25	VD4/L-SEC 12.08.25	•	
17.5	630	12.5	VD4/L-SEC 17.06.12	•	with relay REF 601 1VCD400177
		16	VD4/L-SEC 17.06.16	•	
		20	VD4/L-SEC 17.06.20	•	
		25	VD4/L-SEC 17.06.25	•	
	800	12.5	VD4/L-SEC 17.08.12	•	
		16	VD4/L-SEC 17.08.16	•	
		20	VD4/L-SEC 17.08.20	•	
		25	VD4/L-SEC 17.08.25	•	
24	630	12.5	VD4/L-SEC 24.06.12	•	
		16	VD4/L-SEC 24.06.16	•	
		20	VD4/L-SEC 24.06.20	•	
		25	VD4/L-SEC 24.06.25	•	

(¹) this version is not available with relay PR521

Accessories included in the standard equipment

KIT 1 - Open/closed signalling contacts (-BGB1)

The standard equipment includes a set of six auxiliary contacts. Other additional sets of auxiliary contacts are available on request, with a surcharge. Their number depends on the version of the device. See summary of the total quantities that can be supplied.

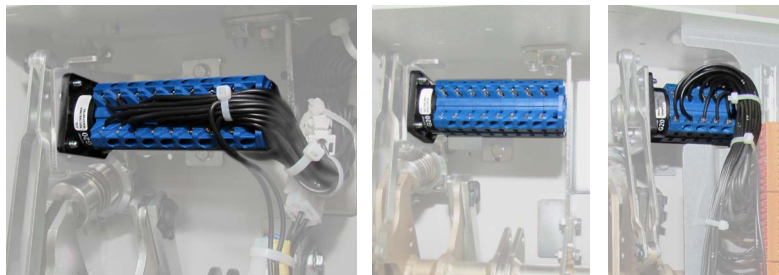
Kit Description

- | | |
|-----------|--|
| 1A | Set of 6 auxiliary contacts (standard equipment for all versions) |
| 1B | Set of 10 auxiliary contacts (versions VD4/R, VD4/L, VD4/R-SEC, VD4/L-SEC) |
| 1C | Set of 15 auxiliary contacts (versions VD4/R, VD4/L) |

Summary of the total quantity of auxiliary contacts available(*)

Total quantity	6 Contacts (3 layers) (-BGB1)	10 Contacts (5 layers) (-BGB1, -BGB2)	16 contacts (8 layers) (-BGB1, -BGB2, -BGB3)
VD4/R p230 VD4/R p300 VD4/L p230 VD4/L p300	Standard equipment	Alternative available on request. This is the obligatory minimum quantity if MBO2 (the additional opening release) is also required	Alternative available on request
VD4/R-SEC VD4/L-SEC	Standard equipment	Alternative available on request but with 8 auxiliary contacts	Alternative not available

(*) Each opening release required uses an auxiliary contact to shut off its power supply after having opened the circuit breaker. Thus the number of auxiliary contacts really available diminishes in the same way as the number of opening releases installed.



General characteristics

Insulation voltage to standard VDE 0110, Group C	660 V AC 800 V DC
Rated voltage	24 V ... 660 V
Test voltage	2 kV for 1 min
Maximum rated current	10 A - 50/60 Hz
Breaking capacity	Class 1 (IEC 62271-1)
Number of contacts	5
Groups of contacts	10 / 16
Contact travel	90°
Actuating force	0.66 Nm
Resistance	<6.5 mΩ
Storage temperature	-30 °C ... +120 °C
Operating temperature	-20 °C ... +70 °C (-30° ref. ANSI 37.09)
Contact overtemperature	10 K
Mechanical life	30.000 mechanical operations
Protection class	IP20
Cable section	1 mm²

Electrical characteristics (according to IEC 60947)

Rated current Un		Breaking capacity (10000 interruptions)
220 V AC	Cosφ = 0.70	20 A
220 V DC	Cosφ = 0.45	10 A
24 V DC	1 ms	12 A
	15 ms	9 A
	50 ms	6 A
60 V DC	1 ms	10 A
	15 ms	6 A
	50 ms	4.6 A
110 V DC	1 ms	7 A
	15 ms	4.5 A
	50 ms	3.5 A
220 V DC	1 ms	2 A
	15 ms	1.7 A
	50 ms	1.5 A
250 V DC	1 ms	2 A
	15 ms	1.4 A
	50 ms	1.2 A

Electrical characteristics (according to IEC 62271-100 class 1)

Rated current Un	Breaking capacity
24 VDC 20 ms	18.8 mA
60 VDC 20 ms	7.4 mA
110 VDC 20 ms	4.2 mA
250 VDC 20 ms	1.8 mA

How to choose and order the circuit breakers

Accessories included in the standard equipment

KIT 2 - Shunt opening release (-MBO1)

Allows the device to be opened by remote control. The release operates with both direct and alternate current. This release is suitable for both instantaneous and permanent duty. However, an auxiliary contact shuts off the power supplied to the opening release after the circuit breaker has been opened. To guarantee the release action, the current impulse must last at least 100 ms. The functionality and continuity can be monitored with the STU device (accessory 25), or with devices that integrate CCC or TCS.

Characteristics	
Un	LV: 24...30 VDC; 48...60 VDC/AC 50-60 Hz
Un	HV: 110...132 - 220...250 VDC/AC 50-60 Hz
Operating limits	65 ... 120% Un
Power on inrush (Ps)	70...100 W / VA
Inrush time	150 ms
Holding power (Pc)	1.5 W
Opening time	40...60 ms
Insulation voltage	2000 V 50 Hz (for 1 min)

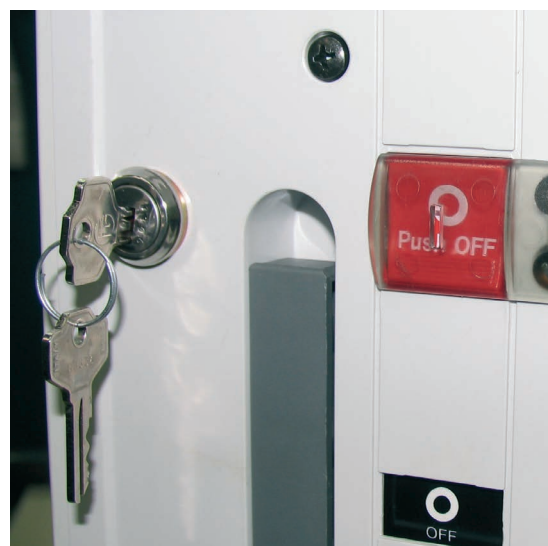
KIT 3 - Open mode key lock

This lock prevents the closing operation (local and remote) when the key has been removed. To activate the lock, open the circuit breaker, keep the opening pushbutton depressed, turn and remove the key.

Specify the type of lock required:

3A Lock with different keys

3B Lock with the same keys.



Accessories available on request

1. Spring-loading gearmotor (-MAS)

Automatically loads the closing spring of the circuit breaker's operating mechanism. The gearmotor immediately reloads the closing spring after the circuit breaker has closed.

The closing spring can still be loaded in the manual mode (using the relative lever built into the operating mechanism) in a power failure or during maintenance work.

NOTE: The 24 V d.c. gearmotor is always supplied with the protecting thermal relay (accessory 2).

Specifications	
Un	24...30 - 48...60 - 110...130 - 220...250 V~
Un	100 - 0.130 - 220 - 0.250 - 50 V~ 60 Hz
Operating limits	85...110 % Un
Power on inrush (Ps)	DC=600 W; AC=600 VA
Rated power (Pn)	DC=200 W; AC=200 VA
Inrush time	0.2 s
Loading time	6-7 s
Insulation voltage	2000 V 50 Hz (for 1 min)

2. Thermal relay for protecting the gearmotor (-FB1)

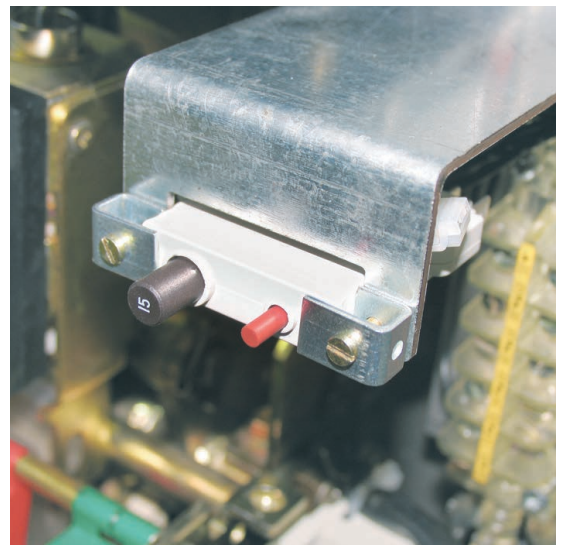
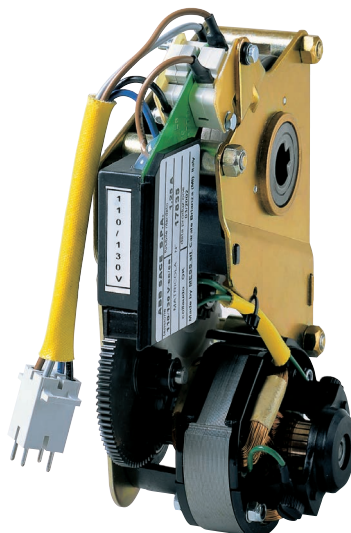
Protects the spring loading motor if an overload occurs.

It is always pre-engineered with a signalling contact.

It is available in two versions:

2A Protecting thermal relay with circuit breaker closed signalling contact

2B Protecting thermal relay with circuit breaker open signalling contact (specify the power supply voltage of the spring loading motor on order).



How to choose and order the circuit breakers

3. Supplementary opening release (-MBO2)

Similarly to opening release -MBO1, this allows the opening control of the device to be transmitted in the remote mode and can be powered by a circuit that is completely separate from release -MBO1. The release operates with both direct and alternate current.

This release is suitable for both instantaneous and permanent duty.

However, an auxiliary contact shuts off the power supplied to the opening release after the circuit breaker has been opened.

To guarantee the release action, the current impulse must last at least 100 ms.

The functionality and continuity can be monitored with devices STU (accessory 25), CCC and TCS.

Specifications	
Un	LV: 24...30 Vdc; 48...60 Vdc/ac 50-60 Hz
Un	HV: 110...132 - 220...250 Vdc/ac 50-60 Hz
Operating limits	65...120 % Un
Power on inrush (Ps)	70...100 W
Inrush time	150 ms
Holding power (Pc)	1.5 W
Opening time	40...60 ms
Insulation voltage	2000 V 50 Hz (for 1 min)

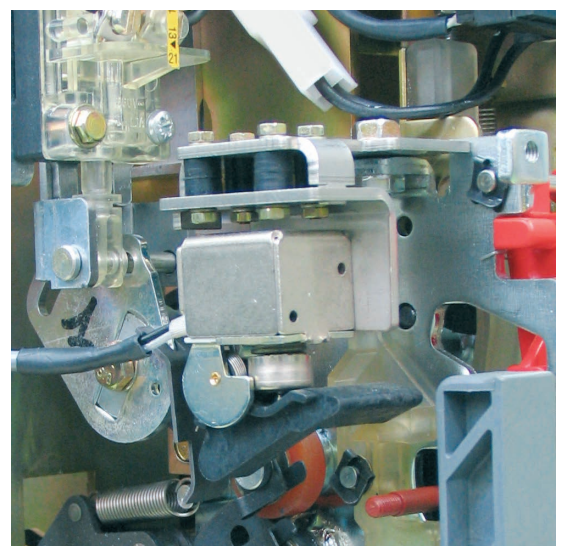
4. Opening solenoid (-MBO3)

Opening solenoid -MBO3 is a demagnetizing release that is supplied as part of the standard equipment when the PR521 series overcurrent protection device is required.

The demagnetizing release is an accessory that is not an alternative to releases -MBO1 and -MBO2.

Use of this release with undercurrent protection devices differing from the PR521 series must be checked out beforehand.

This opening solenoid cannot be used with the REF 601 series protection device.



5. Undervoltage voltage release (-MBU)

The undervoltage release opens the circuit breaker when there is a sensitive reduction or lack of the voltage that powers it.

It can be used for remote release (by means of a pushbutton of the normally closed type), for locking on closing or for monitoring the voltage in auxiliary circuits. The circuit breaker can only close when the release is energized (the closing lock is obtained mechanically).

The release operates with both direct and alternate current.

This accessory is supplied as part of the standard equipment when the CEI 0-16 version of protection device REF 601 is ordered (with the same power supply voltage as the one requested for REF 601).

Characteristics	
Un	24-30-48-60-110...132-220...250 V DC
Un	48-60-110...127-220...250 V AC 50-60 Hz
Operating limits	- circuit breaker opening: 35-70% Un - circuit breaker closing: 85-110% Un
Inrush power (Ps)	150 W / VA
Continuous power consumption (Pc)	1.55 W
Electronics self-consumption (no coil supplied); value independent of voltage applied	1.5 mA
Insulation voltage	2000 V 50 Hz (for 1 min)

6. Electronic time-lag device (-KT)

This device allows the tripping action of the undervoltage release to be delayed with preset and adjustable times.

The electronic time-lag device must be assembled externally in relation to the circuit breaker.

Use of the undervoltage release in conjunction with electronic time-lag device -KT prevents the release action from taking place when the supply line of the release is liable to be subjected to short-time voltage drops or breaks.

When it is not powered, circuit breaker closing is inhibited.

The time-lag device must be used with the undervoltage release with the same voltage as the time-lag device itself.

Characteristics of the time-delay device	
Un	24...30 - 48 - 60 - 110...127 - 220...250 V-
Un	48 - 60 - 110...127 - 220...240 - V~ 50/60 Hz
Adjustable opening time (release + time delay device): 0.5-1-1.5-2-3 sec	



How to choose and order the circuit breakers

7. Electrical signalling of undervoltage voltage trip (-BGB5)

The undervoltage release can be equipped with a contact (normally closed or open, as required) that signals when the undervoltage release is energized or de-energized, so as to signal the status of the release in the remote mode.

Specify the type of signalling required:

- 7A** Undervoltage release energized signal
- 7B** Undervoltage release de-energized signal

8. Closing release (-MBC)

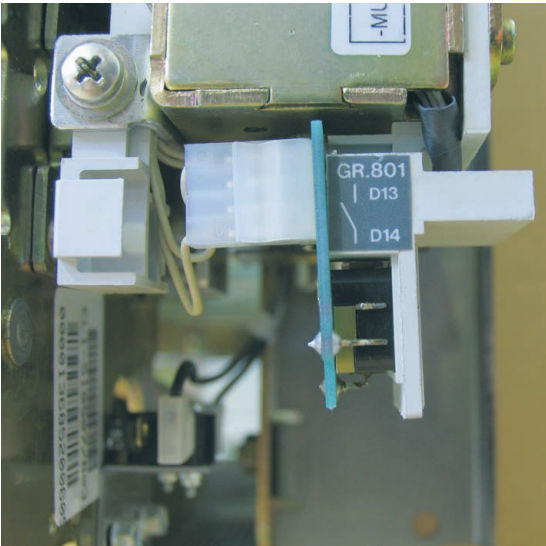
The closing release (-MBC) allows the device to be closed by remote control.

The release can function with both direct and alternate current and is fit for both instantaneous and continuous service. When permanently energized, the release provides the electric anti-pumping function.

In the case of instantaneous service, the current impulse must last at least 100 ms.

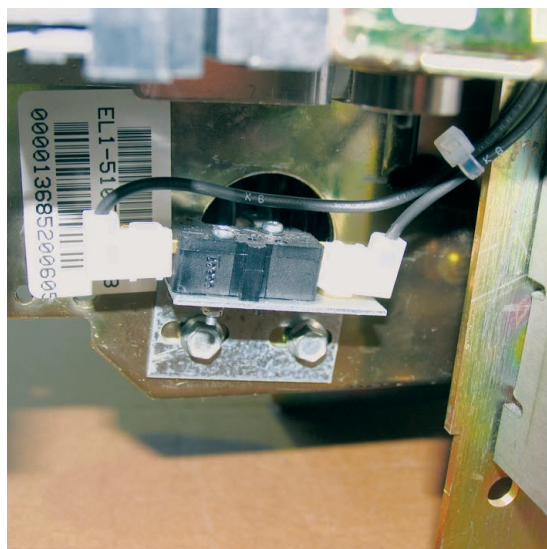
The functionality and continuity can be monitored with devices STU (accessory 25), CCC and TCS.

Specifications	
Un	LV: 24...30 VDC; 48...60 VDC/AC 50-60 Hz
Un	HV: 110...132 - 220...250 VDC/AC 50-60 Hz
Operating limits	65...120 % Un
Power on inrush (Ps)	70...100 W
Inrush time	150 ms
Holding power (Pc)	1.5 W
Opening time	30...60 ms
Insulation voltage	2000 V 50 Hz (for 1 min)



9. Closing spring loaded and unloaded signalling contacts (-BGS2)

Two pairs of contacts (one open and the other closed) allow the status of the circuit breaker's closing spring to be signalled in the remote mode. Only one contact can be wired, thus the spring loaded or spring unloaded can be signalled in the remote mode.



10. Mechanical override of the undervoltage release

This is a mechanical device that allows the operation of the undervoltage release to be de-activated.

This allows the circuit breaker to be closed even when the undervoltage release is not energized. The undervoltage release is activated / de-activated by means of a dedicated two-position selector switch installed on the front of the circuit breaker operating mechanism.

The minimum voltage override is always equipped with an electrical device for signalling when the undervoltage release is de-activated (-BGB6).

The mechanical undervoltage override cannot be supplied when the CEI 0-16 version REF 601 protection device is required.

The "Temporary mechanical override" version is available on request. This allows the action of the de-energized undervoltage release to remain de-activated for as long as the control knob on the front of the circuit breaker's operating mechanism is depressed in the manual mode.

The temporary mechanical override can be supplied when the CEI 0-16 version REF 601 protection device is required.



How to choose and order the circuit breakers

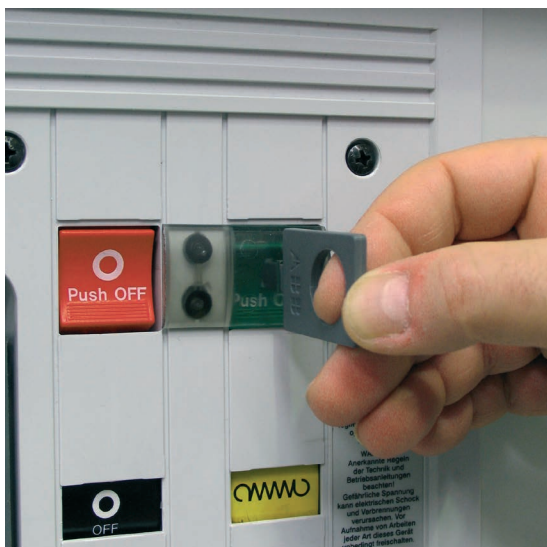
11. Opening pushbutton protection

This protection only allows the opening button to be operated with a special tool. It cannot be supplied for the VD4/R-SEC and VD4/L-SEC versions.



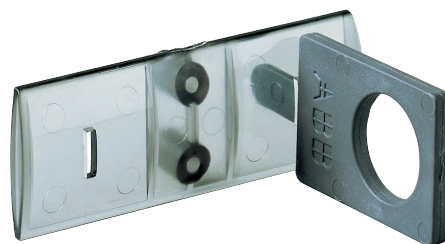
12. Closing pushbutton protection

This protection only allows the closing button to be operated with a special tool. It cannot be supplied for the VD4/R-SEC and VD4/L-SEC versions.



13. Opening and closing pushbutton protection

This protection only allows the opening and closing buttons to be operated with a special tool. It cannot be supplied for the VD4/R-SEC and VD4/L-SEC versions.



14. Padlock device for the opening and closing pushbuttons

Allows the opening and closing pushbuttons to be locked with up to three 4 mm diameter padlocks (not supplied). The padlock is not supplied. This locking mechanism is available in three versions:

- 14A** Locking of both pushbuttons without distinction
- 14B** Separate locking of the opening and/or closing pushbuttons
- 14C** Complete padlock system for VD4/R-SEC and VD4/L-SEC circuit breakers.

NOTE: Lock 14A prevents closing by remote control; lock 14B does not prevent closing by remote control.



15. PR521 protection device (-BR51)

This protection device cannot be supplied for the VD4/R-SEC and VD4/L-SEC versions.

It trips the circuit breaker owing to:

- overload (51)
- short-circuit (50)
- earth fault (51N).

It is available in the following versions:

15A PR521 self-supplied with protection 51-50

15B PR521 self-supplied with protection 51-50-51N.

Consult chapter 3 for the technical and tripping specifications and for the adjustable threshold values.

Notes:

- The transparent tamperproof protection is always supplied with protection device PR521.
- In order for the relay to function, the circuit breaker must be equipped with the opening solenoid -MBO3 (accessory 4) and two or three current sensors -BC1 ... BC3 (accessory 17).

Three sensors are required in order to perform function 51N for the vector sum of the phase currents. Just two current sensors can be installed if function 51N is performed with an external toroidal current transformer. The external toroidal transformer is available on request -BN (accessory 19). Only two current sensors can be installed (on the lateral poles) in 24 kV versions with 230 mm pole center distance.

16. REF 601 protection device (-BR51)

This protection device is an alternative to the similar PR521.

Unlike PR521, which is self-supplied, REF 601 needs auxiliary voltage in order to function. On request, it can be equipped with all the VD4/R series circuit breakers with lateral operating mechanisms. It is the only protection device that can be installed on the VD4/R-Sec and VD4/L-Sec versions.

REF 601 trips the circuit breaker owing to:

- overload (51)
- delayed and instantaneous short-circuit (50 and 51)
- delayed and instantaneous homopolar earth fault (50N and 51N)

It also detects the magnetizing current of a threephase transformer to prevent untimely tripping on switch-in (68).

It is available in the following versions:

16A REF 601 version IEC (time-current curves according to IEC 255-3 and with “ $\beta = 1$ ” or “ $\beta = 5$ ” and specific curve “RI” for the Belgian market)

16B REF 601 version IEC as 16A with RS485 serial communication, MODBUS RTU protocol

16C REF 601 version CEI 0-16 (time-current curves in compliance with CEI 0-16)(*)

16D REF 601 version CEI 0-16 as 16C with RS485 serial communication, MODBUS RTU , FULL DUPLEX protocol(*).

(*) Only supplied for installation on the door of the instrument compartment.



How to choose and order the circuit breakers

Consult chapter 3 for the technical and tripping specifications and for the adjustable threshold values.

The REF 601 protection device has pushbuttons for the circuit breaker's electrical opening and closing control. The electrical opening control is always operative because the VD4/R circuit breaker is supplied with opening release -MBO1 (kit 2) as part of the standard equipment. For the electrical closing control to function, the circuit breaker must be equipped with closing release -MBC (accessory 8).

The power supply voltage of the opening release -MBO1 (and of the closing release -MBC if required), must be the same as the power supply voltage of the REF 601 device.

Protection device REF 601 cannot operate in conjunction with the opening solenoid -MBO3 (accessory 4).

Notes:

In order for the IEC version of the REF 601 protection device to function, the circuit breaker must be equipped with two or three current sensors -BC1...-BC3 (accessory 18), which are different from those supplied for the PR521 device (accessory 17).

Three current sensors are required for protection functions 50N and 51N for the vector sum of the phase currents. Only two current sensors need be installed if functions 50N and 51N are performed with an external toroidal transformer. The external toroidal transformer -BN (accessory 19) is available on request.

The CEI 0-16 version REF 601 is a specific version for the Italian market. In order to conform to CEI 0-16, it opens the circuit breaker by means of the undervoltage release -MBU (accessory 5), which is supplied as part of the standard equipment with the CEI 0-16 version REF 601.

The power supply voltage of the undervoltage release -MBU must be the same as the power supply voltage of the REF device.

In order for the CEI 0-16 version of the REF 601 relay to function, the circuit breaker must always be equipped with three current sensors -BC1...-BC3 (accessory 18), and with the external toroidal transformer for homopolar protection -BN (accessory 19).

17. Current sensors for protection device PR521 (-BC1 ... -BC3)

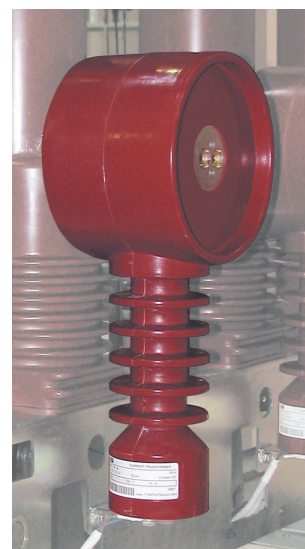
The current sensors transmit the current signal to the relay for processing and provide the energy to power the relay and opening solenoid if tripping occurs.

Sensors available for PR521:

Kit	Quantity	Rated current
17A	3 sensors	In = 40 A
17B	3 sensors	In = 40 A
17C	3 sensors	In = 80 A
17D	3 sensors	In = 80 A
17E	3 sensors	In = 250 A
17F	3 sensors	In = 250 A
17G	3 sensors	In = 1250 A
17H	3 sensors	In = 1250 A

Maximum number of current sensors for PR521 relays that can be installed on the circuit breaker, depending on the version and rated insulation voltage:

Service voltage (kV)		12 - 17.5	24
		Pole center distance (mm)	
VD4/R	VD4/L	230	2 or 3
VD4/R	VD4/L	300	2 or 3



18. Current sensors for protection device REF 601 (-BC1 ... -BC3)

The current sensors for REF 601 are Rogowsky coils encapsulated in epoxy resin.

The following sensors are available:

Kit Quantity

- 18A** 2 (three) KEVCR 24 OC2 sensors with 630 A internal feed-through
- 18B** 3 (three) KEVCR 24 OC2 sensors with 630 A internal feed-through
- 18C** 2 (two) KEVCR 24 AC2 sensors with 1250 A internal feed-through
- 18D** 3 (three) KEVCR 24 AC2 sensors with 1250 A internal feed-through.

The current sensors for the REF 601 protection device can be installed in the following ways:

- circuit breakers up to 24 kV with 230 to 300 mm pole center-distance: the sensors can be installed on each pole regardless of the circuit breaker's rated voltage
- circuit breakers up to 17.5 kV with 210 mm pole centerdistance: the sensors can be installed on each pole regardless of the circuit breaker's rated voltage
- circuit breakers up to 24 kV with 210 mm pole centerdistance: the circuit breaker can be used in conjunction with the REF 601 protection device installed in the switchgear and connected to KECA sensors on insulated medium voltage cables.

Note:

The rated current of the REF 601 protection device must be set on the device itself and does not depend on the type of sensor. The choice between the sensor with 630 A feed-through and that with 1250 A feed-through solely depends on the rated current of the circuit breaker on which the sensors will be installed.

It is always obligatory to use 3 sensors for the CEI 0-16 version of REF 601.

19. External toroidal transformer (-BN)

The external toroidal transformer is essential for detecting earth fault currents when the circuit breaker is equipped with just two current sensors. It also allows earth fault currents of less than ten or so Amperes to be detected.

It is available in the following versions (with $I_n = 50/1$ A transformer ratio):

- 19A** with closed core and 110 mm internal diameter (in the photograph)
- 19B** with openable core and 110 mm internal diameter
- 19C** with closed core and 110 mm internal diameter, CEI version with 100/1A transformer ratio (for use in conjunction with the CEI 0-16 version REF 601).

20. Test unit TT2

This is a portable device that allows the operation of "release chain" PR521 and the opening solenoid (-MBO3) to be checked.



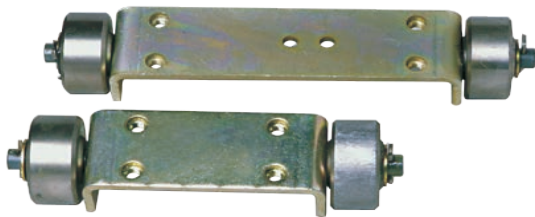
How to choose and order the circuit breakers

21. Wheels

This kit consists of the front and rear wheel unit which can be assembled instead of the fixing brackets of the VD4/R and VD4/L circuit breaker.

NOTE: Assembly is at the customer's charge.

Warning! The wheels are part of the standard equipment for VD4/R-SEC and VD4/L-SEC circuit breakers.



23. Release lever for VD4/R and VD4/L

The lever that allows the circuit breaker to be latched and locked in the cubicle so as to prevent it from moving, is available on request.

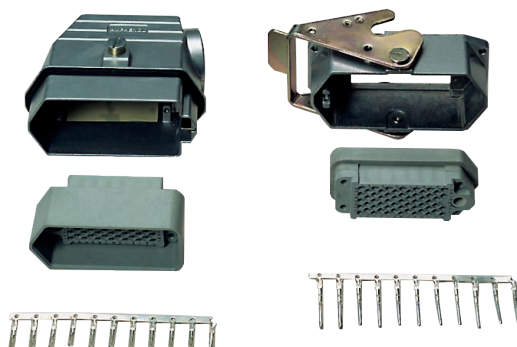
NOTE: Lever operation does not automatically open the circuit breaker.



22. Socket and plug

This kit consists of a 58-pin connector of the male (loose plug) and female (fixed socket) type, and the pins required for the wiring.

NOTE: The cables, sheath and assembly are at the customer's charge.



24. Connection terminals

Terminals for connecting to the power circuit of the fixed circuit breaker are available on request for the VD4/R and VD4/L versions. The set includes the set of upper and lower terminals available in the following versions:

24A Set of 630 A terminals

24B Set of 1250 A terminals

Connection terminals are not available for 24 kV P 230 mm versions.



25. Device for monitoring the functionality and continuity of the opening/closing releases (STU Shunt Test Unit)

The STU device can be used in conjunction with the shunt opening release (-MBO1; -MBO2) or the shunt closing release (-MBC) for functionality and continuity tests. A device is required for each release tested.

The testing/monitoring Shunt Test Unit can be used to test the continuity of releases with rated operating voltage between 24 V and 250 V (AC or DC), as well as the functionality of the release's electronic circuit.

The continuity test is performed in cycles with a 20-second interval between one test and the next.

The unit has optical LED indicators on the front.

The following information is given:

- POWER ON: power is being supplied
- -MBO/MBC TESTING: the test is being performed
- TEST FAILED: this signal is given after a test has failed or when there is no auxiliary power being supplied
- ALARM: this signal is given after three consecutive tests have failed.

There are two change-over relays on the unit that indicate these two events in the remote mode:

- test failed (resetting occurs automatically once the alarm has ceased)
- failure of three tests (resetting only occurs by means of the manual - RESET - on the front of the unit).

A manual - RESET - key is also installed on the front of the unit.

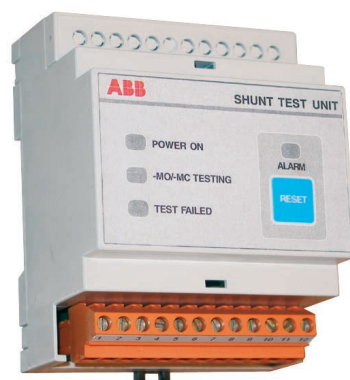
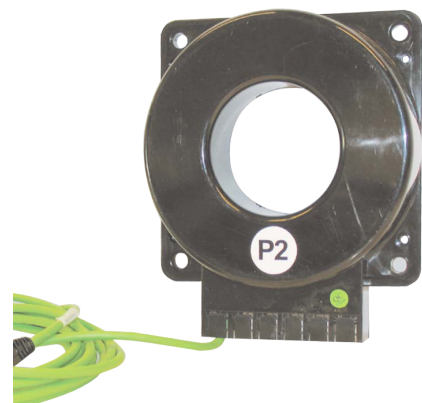
Specifications

Un	24 ... 250 V AC/DC
Interrupted overcurrent	6 A
Interrupted overvoltage	250 V AC

26. KECA current sensors for REF 601 relays only suitable for assembly on insulated MV cable

KECA sensors are used when the REF 601 relay is installed in the switchgear instead of being built into the circuit breaker.

The following Rogowsky sensors with fixed core and 70 mm internal diameter are available: KECA250B.



Specific characteristics of the product



Vibration resistance

VD4/R circuit-breakers with EL lateral operating mechanisms are not affected by mechanically or electromagnetically generated vibrations.



Tropicalization

VD4/R circuit-breakers with EL lateral operating mechanisms are made in compliance with the most stringent specifications concerning their use in hot-humid-saline climates.

All the more important metal parts are treated against the corrosive substances in the environment in question and in accordance with UNI 12500 Standards.

The galvanizing treatment is applied in compliance with Standard UNI ISO 2081, classification code Fe/Zn 12, thickness 12×10^{-6} m, protected by a conversion layer formed mainly by chromates, in accordance with Standard UNI ISO 4520.

Such characteristics ensure that the VD4/R series with EL lateral operating mechanism complies with climatogram 8 of Standards IEC 60721-2-1 and IEC 60068-2-2 (Test B: Dry Heat), IEC 60068-2-30 (Test Db: Damp Heat, cyclic).

Electromagnetic compatibility

VD4/R circuit-breakers with EL lateral operating mechanisms equipped with REF 601 and PR521 electronic protection devices with microprocessors guarantee operation without accidental tripping even in the presence of interference caused by electronic equipment, atmospheric disturbance or electrical discharge. They are also unable to create interference with other, already existing electronic equipment near the installation.

The above in accordance with Standards EN 50081-2, 50082-2, 60694 and European Directive EEC 89/336 and successive directives concerning electromagnetic compatibility (EMC), in compliance with which the releases bear CE marking.



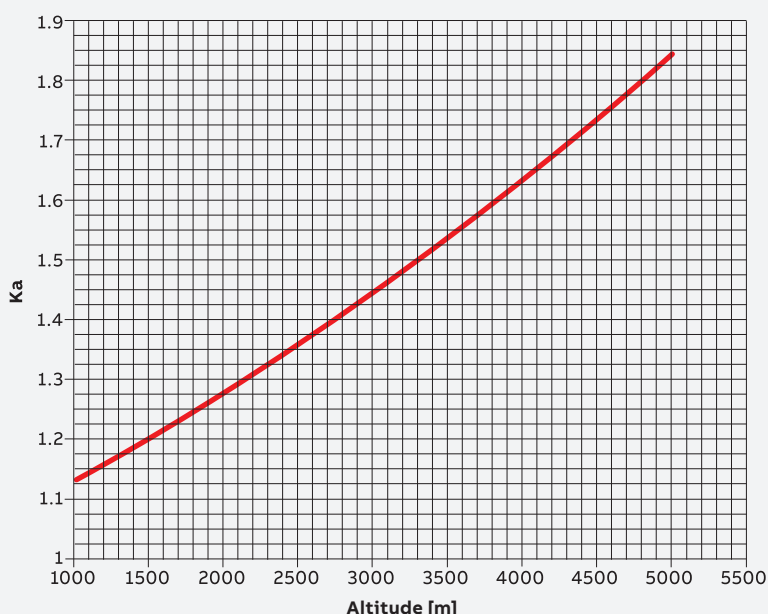
Altitude

It is known that the insulating property of air diminishes as the altitude increases.

This phenomenon must always be considered when the insulating components of equipment that must be installed at more than 1000 m above sea level are designed. In this case, one must consider a correction coefficient that can be taken from the following graph created in accordance with the indications provided by Standards IEC 62271-100.

The example below gives a clear interpretation of the indications above.

Graph for determining the Ka correction factor according to the altitude, Example (IEC):



$K_a = e^{mH/8150}$ with $m=1$

H = altitude in metres

m = value referred to industrial frequency and the atmospheric impulse withstand voltages and those between phase and phase. Defined value for $m = 1$

- Installation altitude: 2000 m
- Service at a rated voltage of 7 kV
- Withstand voltage at power frequency 20 kV rms
- Impulse withstand voltage 60 kVp
- Ka Factor = 1.28 (see graph).

Taking the above parameters into consideration, the apparatus will have to withstand the following values (under test at zero altitude i.e. at sea level):

- withstand voltage at power frequency equal to:
 $20 \times 1.28 = 25.6 \text{ kVrms}$
- impulse withstand voltage equal to:
 $60 \times 1.28 = 76.8 \text{ kVp}$.

From the above, it can be deduced that for installations at an altitude of 2000 m above sea level, with a service voltage of 12 kV, apparatus with a rated voltage of 17 kV characterized by insulation levels at power frequency of 38 kV rms and with 95 kVp impulse withstand voltage must be provided.

Specific characteristics of the product

Environmental protection program

VD4/R circuit breakers with EL lateral operating mechanisms are made in compliance with ISO 14000 standards (guidelines for environmental management).

The manufacturing processes are implemented in accordance with the environmental protection standards when it comes to reducing both energy consumption and the production of waste.

Assessment of the environmental impact during the life cycle of the product (LCA - Life Cycle Assessment) obtained by reducing the overall energy consumption and use of raw materials for the product to the minimum, is put into effect during the design engineering phase through an accurate choice of materials, processes and packaging.

Production techniques that allow the products to be easily disassembled and their components easily separated are implemented when the circuit breakers are manufactured.

This to allow the products and components to be recycled to the utmost degree at the end of their life cycle.

The Environmental Management System of the factory where the medium voltage equipment is manufactured has been certified by an independent third party.

Spare parts

- Opening spring(*)
- Closing spring(*)
- Complete pole(*)
- Basic control(*)
- Gearmotor
- Opening release
- Supplementary opening release
- Closing release
- Key lock
- Limit contact
- Opening pushbutton
- Closing pushbutton.
- Connections for VD4/R and VD4/L (specify the rated contact)

Ordering: please contact us and specify the serial number of the circuit breaker when ordering spare parts.

(*) Can only be replaced by trained personnel and/or in our repair shops.

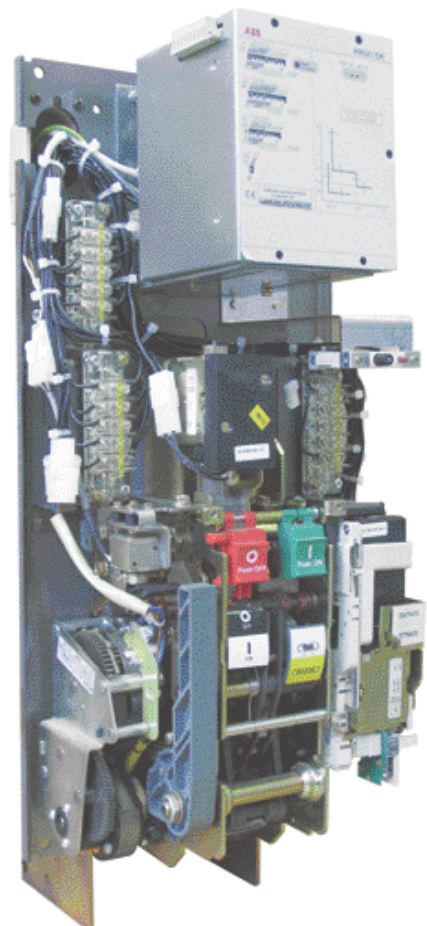
PR521 Protection Device

Unit PR521 provides the following functions:

- PR521 - LSI: two-phase or threephase overcurrent protection (code ANSI 50-51), depending on whether two or three current sensors are connected;
- PR521 - LSIG: same as PR521-LSI plus earth fault protection (code ANSI 51N) (by means of the internal vector sum of the three phase sensors or by means of the external earth fault toroid and two or three current sensors).

Besides providing the current signal, the current sensors also supply the energy required for operating the unit. The unit is self-supplied and guarantees correct operation when the current is 20% of the rated value or more on at least one of the phases equipped with current sensor ($0.2 \times I_n$). This device features digital microprocessor technology.

The unit opens the circuit breaker in which it is installed by means of an opening solenoid (-MBO3 see accessory kit N° 4), which acts straight on the operating mechanism of the device.

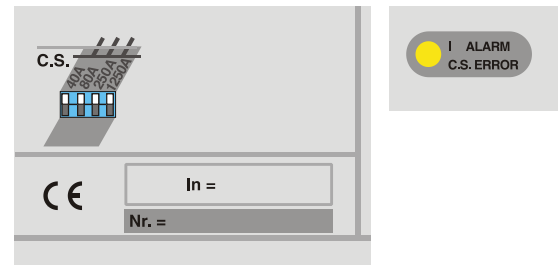


Current sensors (C.S.)

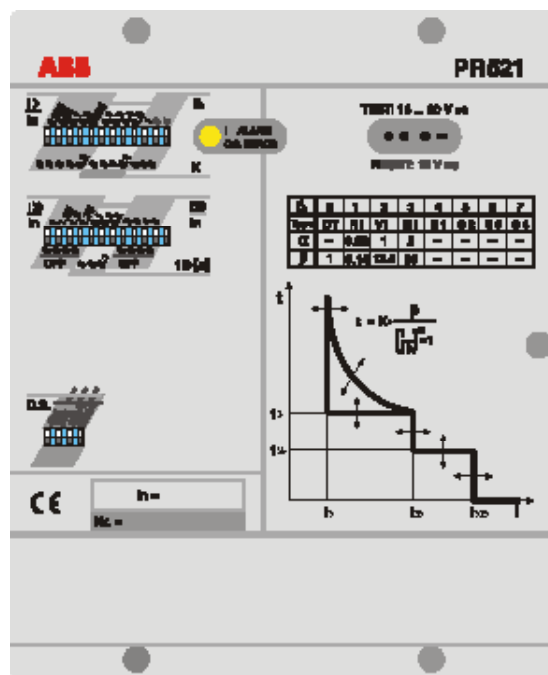
PR521 can be used with ABB current sensors possessing the following specifications:

Rated primary current	I_n	=	40 A
	I_n	=	80 A
	I_n	=	250 A
	I_n	=	1250 A
Rated secondary current	I_n	=	1 A.

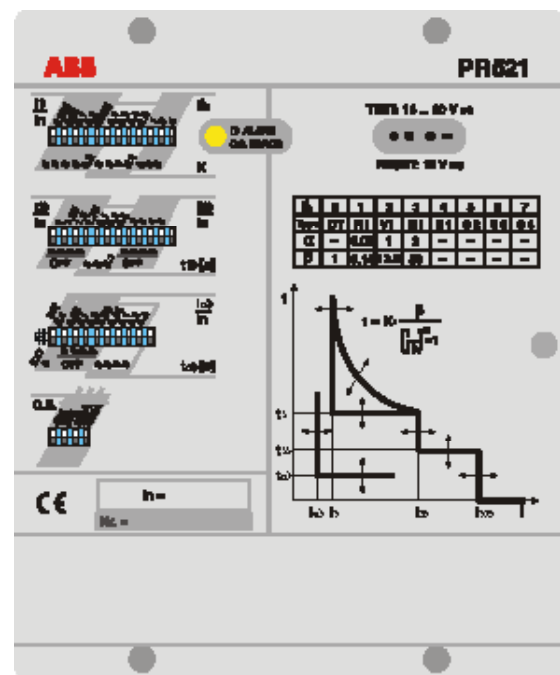
Activate the corresponding dip-switch in order to select the sensor. If more than one sensor is selected by accident, the alarm LED will flash to indicate that an error has occurred.



Selection of the primary current of the current sensors



PR521 with LSI protection functions



PR521 with LSI protection functions

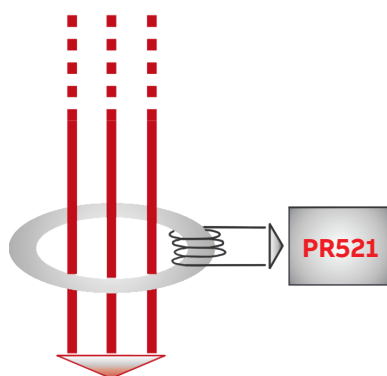
Specific characteristics of the product

External earth fault toroid

PR521 can be used with any external toroid for detecting earth fault current, so long as it possess the following specifications:

Primary rated current	any
Secondary rated current	1 A
Performance	1 VA
Accuracy class, accuracy limit factor	Cl. 3 or better

It is advisable to use the external toroids for detecting earth fault current when very low values of the 51N threshold must be regulated (less than 0.45 times the rated current - I_n - of the current sensors).



External earth fault toroid

Release actuator

The PR521 release unit releases the control by means of an opening solenoid (-MBO3 - see accessories chap. 2) when the protection functions trip.

Self-powering

PR521 operation is guaranteed by the self-powering circuit.

The minimum phase current value required for operation is $0.2 \times I_n$.

This circuit is able to withstand:

- overload: continuative $1.5 \times I_n$
- overload: $6 \times I_n$ for 200 s
- overload: 25 kA for 1 s (circuit breaker's maximum shorttime withstand current).

MTBF

A 15-year MTBF has been envisaged at an operating temperature of 40 °C.

Environmental conditions

Ambient temperature	- 5 °C ... +40 °C
Storage temperature	- 40 °C ... +90 °C
Relative humidity without condensation	90%
Protection class (assembled on circuit breaker and with front protection)	IP42

Operating frequency

From 45 Hz to 66 Hz.

Inputs

Analog inputs

- Inputs for current sensors.
The current sensors that supply the proportional signals to the current circulating in the phases and the energy required for self-powering the device, are connected to the PR521 unit by means of these three inputs.
- External earth fault toroid input.
The external earth fault toroid, the signal of which is directly proportional to the earth fault current, is connected to the PR521 unit by means of this input. This transformer does not supply electricity for relay operation in the self-powering mode. This input must be made with a twin-core screened cable, the braided wire of which must be earthed on the metal housing of the PR521 unit (refer to the wiring diagram enclosed with the circuit breaker). If there are EMC problems, the earth connection of the braided wire must be as solid and short as possible.

Binary input for the monitoring function

- Input for remote controlled circuit breaker opening command.
This input allows the circuit breaker to be opened by remote control, using the energy supplied by the current sensors if available. This input must be made with a twin-core screened cable, the braided wire of which must be earthed on the metal housing of the PR521 unit (refer to the wiring diagram enclosed with the circuit breaker).

By connecting a potential-free external contact (e.g. the contact of a Buchholz relay) to the relative input connector, circuit breaker opening can be remote controlled through the PR521 release when the primary current exceeds the value of $0.2 \times I_n$ in at least one phase without current sensor.

Outputs

Power output

This output controls the specific opening solenoid for PR521 (-MBO3 - see accessories chap. 2).

Signalling output with closing contact

There is an output obtained by means of a bistable relay (maintains the status even in a power failure and until the RESET operation) with potential-free closing contacts, through which the relay tripped signal is transmitted. After the protection has tripped and the circuit breaker has opened, this contact can be reset in two different ways:

- resetting occurs automatically when the circuit breaker recloses with a phase current of more than $0.2 \times I_n$;
- with a phase current of less than $0.2 \times I_n$ and the protection unit off (even when the circuit breaker is open), resetting occurs by means of the front bushings for the RESET function, as described in the “Test and reset function” chapter.

NOTE: The signalling contact is not activated if circuit breaker opening or the release function Test are conducted by remote control.

Function	Protection tripped
Type	Bistable
Maximum changeover power	150 W / 1250 VA (resistive load)
Maximum changeover voltage	220 V~ / 250 V~
Maximum changeover current	5 A
Breaking capacity (UL/CSA):	
– at 30 Vdc (resistive load)	5 A
– at 250 Vac (resistive load)	5 A
– at 250 Vac ($\cos\phi = 1.0$)	5 A
– at 250 Vac ($\cos\phi = 0.4$)	3 A
Mechanical life (at 180 operations/minute)	5×10^7
Electrical life	1×10^5
Insulation:	
– between open contacts	1000 Veff (50 Hz / 1 min)
– between contact and coil	3000 Veff (50 Hz / 1 min)

Protection functions

Unit PR521 provides the following protections::

- PR521 - LSI: phase overcurrent protection (instantaneous, with adjustable delay, with inverse and fixed time delay)
- PR521 - LSIG: the same as PR521-LSI, plus earth fault overcurrent protection (with adjustable delay).

The tripping times and thresholds can be selected by setting the Dip Switches on the front part of the unit.

The tripping time for the fixed time protection is given by the following relation.

$$t = K \times \beta$$

The relation between tripping time and overcurrent for the inverse time protection, is given by the following formula.

$$t = K \times \frac{\beta}{\left[\frac{I}{I>}\right]^\alpha - 1}$$

Key
 t = tripping time
 k = parameter that can be set by the user in order to select the desired tripping curve
 α, β = pair of parameters that depends on the type of protection that can be selected by the user
 I = fault current
 $I>$ = tripping threshold that can be selected by the user.

Specific characteristics of the product

Fixed time overcurrent protection

A family of protection curves known as “Fixed time with adjustable delay DT” is available (in accordance with Standard IEC 60255-3).

The following settings can be obtained:

• 32 current threshold values ($I>$) (¹)				
0.200	0.225	0.250	0.275	
0.300	0.325	0.350	0.375	
0.400	0.425	0.450	0.475	
0.500	0.525	0.550	0.575	
—	0.625	0.650	0.675	
0.700	0.725	0.750	0.775	
0.800	0.825	0.850	0.875	
0.900	0.925	0.950	0.975	
1.000	—	—	—	$\times I_n$

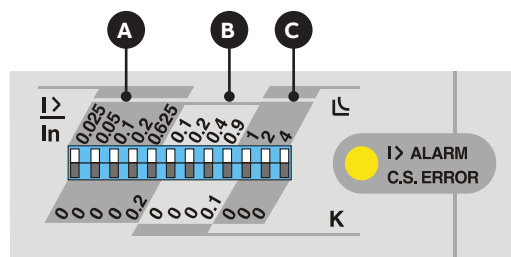
• 16 tripping times ($t>$), (with $b = 1$, $K = 0.1 \dots 1.6$ with 0.1 pitch) (²)					
0.1	0.2	0.3	0.4	0.5	—
0.6	0.7	0.8	0.9	1.0	—
1.1	1.2	1.3	1.4	1.5	1.6 s

(¹) The unit guarantees non-access to the threshold for current values of less than $1.05 \times I>$ regulated and guarantees access to the threshold for current values of more than $1.30 \times I>$ regulated.

(²) The tolerance on tripping times with threephase power is $\pm 15\%$ or ± 30 ms.

The protection **cannot be cut out**.

Protection $I>$ for the DT curve processes the peak value for the entire range $0.2 \dots 20 \times I_n$.

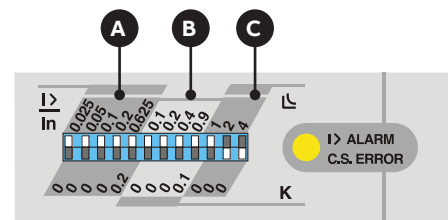


- A Dip Switch for setting the threshold value.
- B Dip Switch for setting the tripping time.
- C Position Dip Switches 1, 2 and 4 down for the fixed time protection $I>$ setting.

Inverse time overcurrent protection

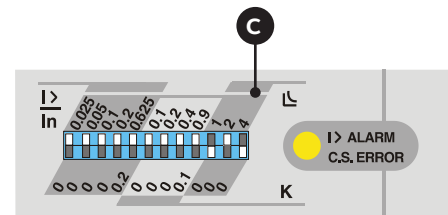
Three different families of protection curves are available (in accordance with Standard IEC 60255-3), namely:

- Normally inverse time NI
- Very inverse time VI
- Extremely inverse time VI.



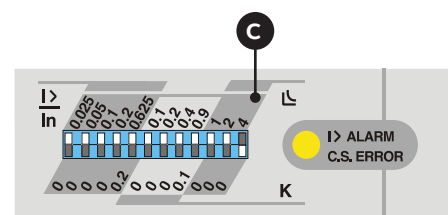
Normally inverse time curves

- A Dip Switch for setting the threshold value.
- B Dip Switch for setting the tripping curve.
- C Position Dip Switch 1 up and Dip Switches 2 and 4 down for the normally inverse time protection $I>$ setting.



Very inverse time curves

- C Position Dip Switches 1 and 4 down and Dip Switch 2 up for the very inverse time protection $I>$ setting.



Extremely inverse time curves

- C Position both Dip Switches 1 and 2 up and Dip Switch 4 down for the extremely inverse time protection $I>$ setting.

The following settings can be obtained:

• 32 current threshold values ($I>$) (¹)				
0.200	0.225	0.250	0.275	
0.300	0.325	0.350	0.375	
0.400	0.425	0.450	0.475	
0.500	0.525	0.550	0.575	
—	0.625	0.650	0.675	
0.700	0.725	0.750	0.775	
0.800	0.825	0.850	0.875	
0.900	0.925	0.950	0.975	
1.000	—	—	—	$\times I_n$

• 16 trip curves for each family, defined as follows ⁽¹⁾

- a) Normally inverse time curves
(with $\alpha = 0.02$, $\beta = 0.14$, $K = 0.1 \dots 1.6$ with 0.1 pitch)
- b) Very inverse time curves
(with $\alpha = 1$, $\beta = 13.5$, $K = 0.1 \dots 1.6$ with 0.1 pitch)
- c) Extremely inverse time curves
(with $\alpha = 2$, $\beta = 80$, $K = 0.1 \dots 1.6$ with 0.1 pitch)

⁽¹⁾ The unit guarantees non-access to the threshold for current values of less than $1.05 \times I_n$ regulated and guarantees access to the threshold for current values of more than $1.30 \times I_n$ regulated.

⁽²⁾ The tolerance on tripping times is $\pm 20\%$ or ± 150 ms.

The protection **cannot be cut out**. The tripping curves change as the current thresholds vary. Protection $I>$ for curves NI, VI and EI processes the true r.m.s. value of the phase current.

Overcurrent protection with adjustable delay

The following settings can be obtained:

• 14 current threshold values ($I>$) ⁽¹⁾

1.00	1.25	1.50	1.75
—	2.25	2.50	2.75
3.00	3.25	—	3.75
4.00	4.25	4.50	—
—	—	5.50	—
$\times I_n$			

• 8 trip times ($t>$) ⁽²⁾

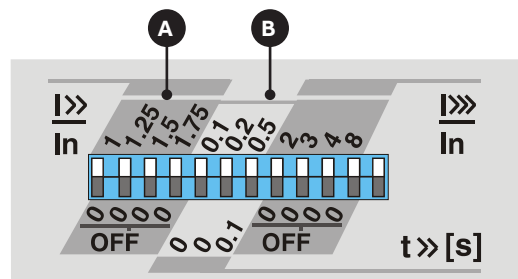
0.10	0.20	0.30	0.40
0.50	0.60	0.70	0.80 s

⁽¹⁾ The tolerance on the threshold values is $\pm 10\%$.

⁽²⁾ The tolerance on tripping times is $\pm 15\%$ or ± 30 ms.

The protection **can be excluded**.

Protection $I>>$ processes the peak value for the entire range $1 \dots 20 \times I_n$.



A Position all the Dip Switches down to cut-out the protection. The tripping threshold setting is made by positioning the Dip Switches in the appropriate way.

B Dip Switch for setting the tripping time.

Instantaneous overcurrent protection

The following settings are possible:

• 15 current threshold values ($I>>$) ⁽¹⁾

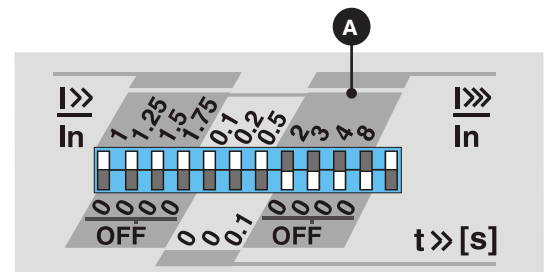
2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 17 $\times I_n$

• Instantaneous trip time not adjustable
(curve with intentional delay nil added)

⁽¹⁾ The tolerance of the threshold values is $\pm 10\%$.

The protection **can be cut out**.

Protection $I>>>$ processes the peak value for the entire range $2 \dots 20 \times I_n$.



A Position all the Dip Switches down to cut-out the protection. The tripping threshold setting is made by positioning the Dip Switches in the appropriate way.

Specific characteristics of the product

Earth fault overcurrent protection with adjustable delay (internal vector sum)

The earth fault current is calculated as the vector sum of the three phase current values, thus the device must be equipped with three current sensors.

This sum is obtained by means of an internal toroid (which processes the secondary phase currents of the correct sensors). This mode is selected by means of the front Dip Switches. The following settings can be obtained:

•14 current threshold values ($I_{o>}$) ⁽¹⁾				
0.65	0.70	0.75	0.80	
0.85	0.90	0.95	1.00	
1.05	1.10			x I_n

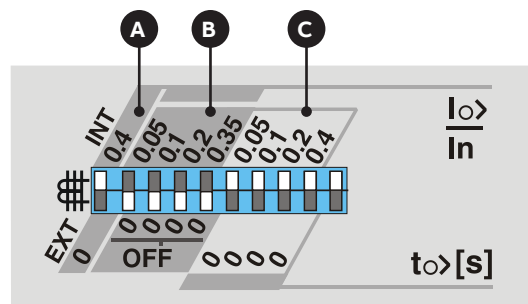
•16 trip times ($t_{o>}$) ⁽²⁾				
0.00 ⁽³⁾	0..	0.10	0.15	
0.20	0.25	0.30	0.35	
0.40	0.45	0.50	0.55	
0.60	0.65	0.70	0.75	s

⁽¹⁾ The tolerance on the threshold values is $\pm 20\%$.

⁽²⁾ The tolerance on tripping times is $\pm 20\%$ or ± 30 ms.

⁽³⁾ Curve with intentional additional null delay.

The protection **can be cut out**. Protection $I_{o>}$ processes the peak value of the earth fault current for the entire range $0...2.5 \times I_n$.



- A Position the Dip Switch up to select the internal toroid. This setting defines a tripping threshold of $0.4 + \text{the threshold setting}$ (see note B).
- B Position all the Dip Switches down to cut-out the protection. The tripping threshold setting is made by positioning the Dip Switches in the appropriate way.
- C Dip Switch for setting the tripping time.

NOTE. The $I_{o>}$ protection function is activated if the current exceeds the value of $0.2 \times I_n$ in at least two phases, or the value of $0.4 \times I_n$ in the single-phase mode, while it is automatically cut out when the phase overcurrent exceeds the value of $2.5 \times I_n$.

Earth fault overcurrent protection with adjustable delay (External Toroid)

The earth fault current is calculated as the vector sum of the three primary phase currents.

This sum is obtained by means of an external toroid (which processes the primary phase currents) installed on the power cables. Thus, only two current sensors can be installed on the device (with network with isolated neutral).

This mode is selected by means of the front Dip Switches.

The following settings can be obtained:

• 14 current threshold values ($I_{o>}$) ⁽¹⁾				
0.05	0.10	0.15	0.20	
0.25	0.50	0.35	0.40	
0.45	0.50	0.55	0.60	
1.65	0.70			x I_n

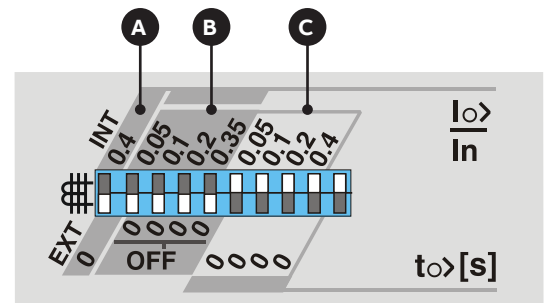
• 16 trip times ($t_{o>}$) ⁽²⁾				
0.00 ⁽³⁾	0.05	0.10	0.15	
0.20	0.25	0.30	0.35	
0.40	0.45	0.50	0.55	
0.60	0.65	0.70	0.75	s

⁽¹⁾ The tolerance on the threshold values is $\pm 15\%$.

⁽²⁾ The tolerance on tripping times is $\pm 20\%$ or ± 30 ms.

⁽³⁾ Curve with intentional additional null delay.

The protection **can be cut out**. Protection $I_{o>}$ processes the peak value of the earth fault current for the entire operating range.



- A Position the Dip Switch down to select the external toroid. This setting defines a tripping threshold of $0 + \text{the threshold setting}$ (see note B).
- B Position all the Dip Switches down to cut-out the protection. The tripping threshold setting is made by positioning the Dip Switches in the appropriate way.
- C Dip Switch for setting the tripping time.

NOTE. The $I_{o>}$ protection function is activated if the current exceeds the value of $0.2 \times I_n$ in at least two phases or the value of $0.4 \times I_n$ in the single-phase mode.

Fixed time fail-safe operation curve

We can supply a fail-safe operation curve for the electronic relay that trips with a 1 s fixed time at 20 x I_n . The fail-safe operation processes the peak value of the phase current.

No type of regulation can be made and the protection cannot be cut out. This allows fail-safe operation to be achieved for the unit when the phase current exceeds 20 x I_n without limiting the circuit breaker's breaking capacity (1 short-time current).

Rated currents for settings

Current sensor	Protection function				
I_n [A]	$I>$ (0.2...1x I_n) [A]	$I>>$ (1...5.5x I_n) [A]	$I>>>$ (2...17x I_n) [A]	$I_{o>}$ (0.05...0.7x I_n) [A]	$I_{o>}$ (0.45...1.1x I_n) [A]
				External toroid (*)	Internal toroid
40	8 ... 40	40 ... 220	80 ... 680	2.5 ... 35	18 ... 44
80	16 ... 80	80 ... 440	160 ... 1360	2.5 ... 35	36 ... 88
250	50 ... 250	250 ... 1375	500 ... 4250	2.5 ... 35	112.5 ... 275
1250	250 ... 1250	1250 ... 6875	2500 ... 21250	2.5 ... 35	562.5 ... 1375

I_n = rated current of the current sensor
 $I>$ = setting value of the overload current (5I)
 $I>>$ = setting value of the short-circuit current (50I)

$I>>>$ = setting value of the instantaneous short-circuit current (50I)
 $I_{o>}$ = setting value of the earth fault current (5IN)
 (*) = If the external toroid is used (kit N° 16) with $I_n = 50/1$ A

Optical signalling function with LED

The release is fitted with an indicator on the front (operates from 0.22 x I_n of phase onwards) that signals the events given in the table.

Current sensor setting	Protection $I>$ under timing	LED
No	No	Off
No	Yes	On
Yes	No	Flashing
Yes	Yes	Flashing

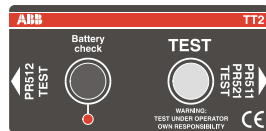
Note. A current sensor setting error is made with 2 or more models are selected at the same time.

TEST and RESET function

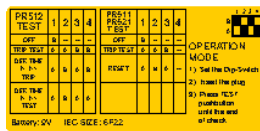
The overall TEST of the relay release function (electronic part and opening solenoid -MBO3) can be performed and the "release tripped owing to overcurrent signalling contact" RESET by means of the TT2 accessory (Test Unit supplied on request). The RESET function is only active when the protection unit is completely off.

Autoreset

The release tripped signal autoreset function occurs when the circuit breaker recloses with 0.2 x 2 primary current or more on at least one phase equipped with current sensor.



Front view of Test Unit TT2.

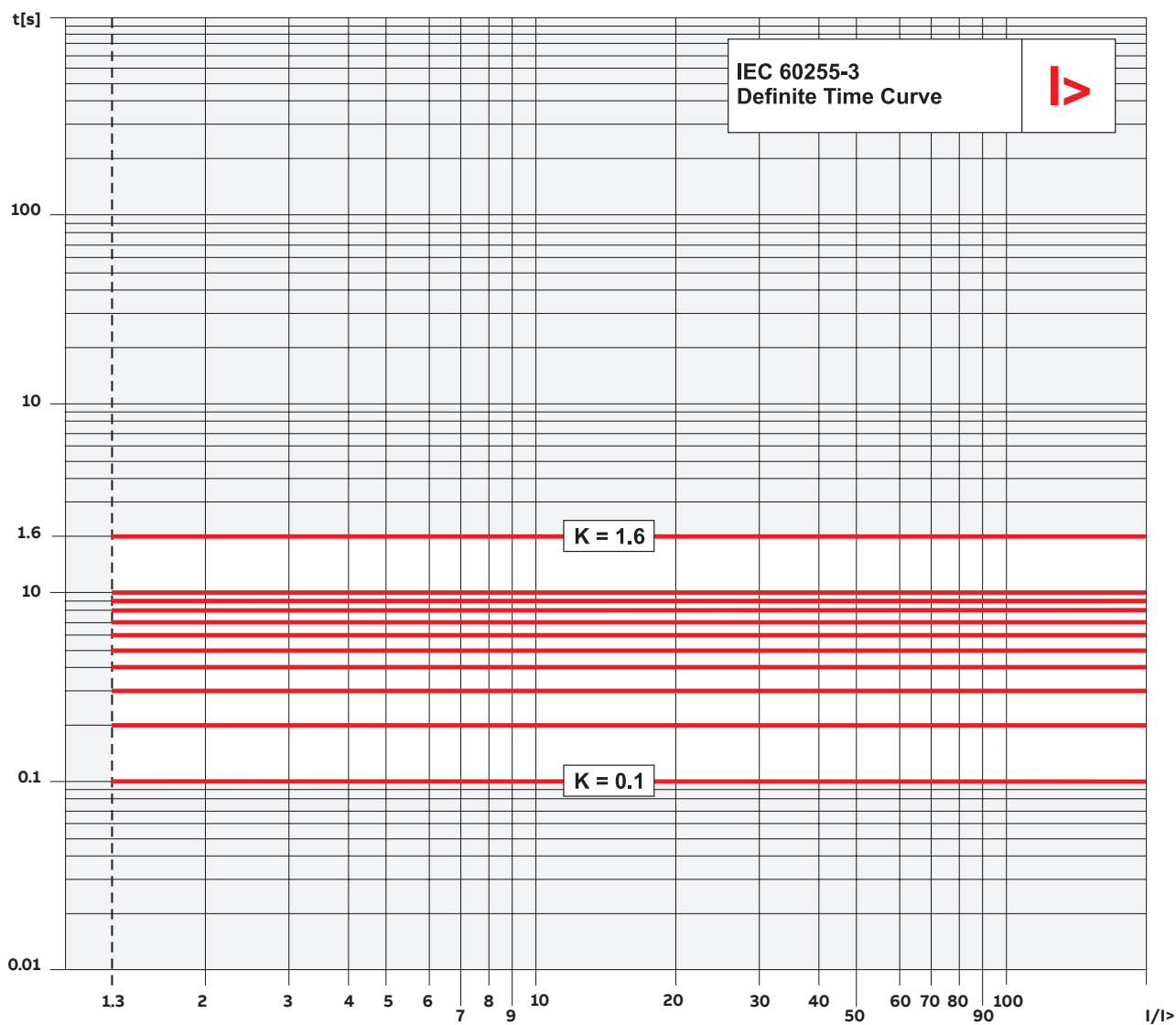


Rear view of Test Unit TT2.

- The TT2 unit activates when Dip Switch 1 is set in position A (the Battery Check can be performed).
- When Dip Switches 1 and 2 are set to position A and Dip switch 3 to position B, the TT2 unit conducts the circuit breaker opening test by means of opening solenoid -MBO3.
- When Dip Switches 1 and 3 are set to position A and Dip switch 2 to position B, the TT2 unit resets the alarm (internal signalling relay).

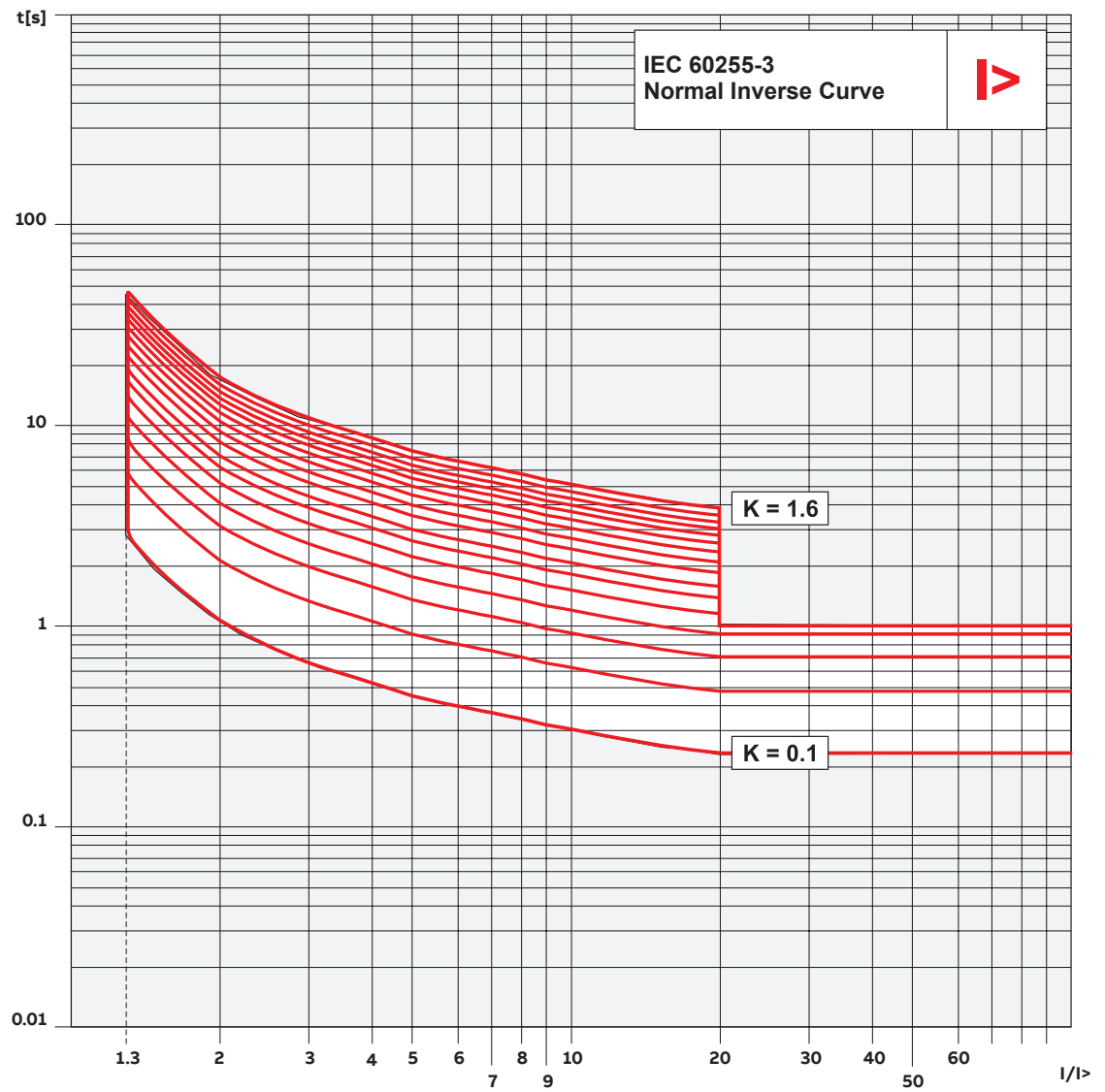
Specific characteristics of the product

PR521 - Fixed time tripping curve (DT) for overcurrent protection



$$t = K \times 1$$

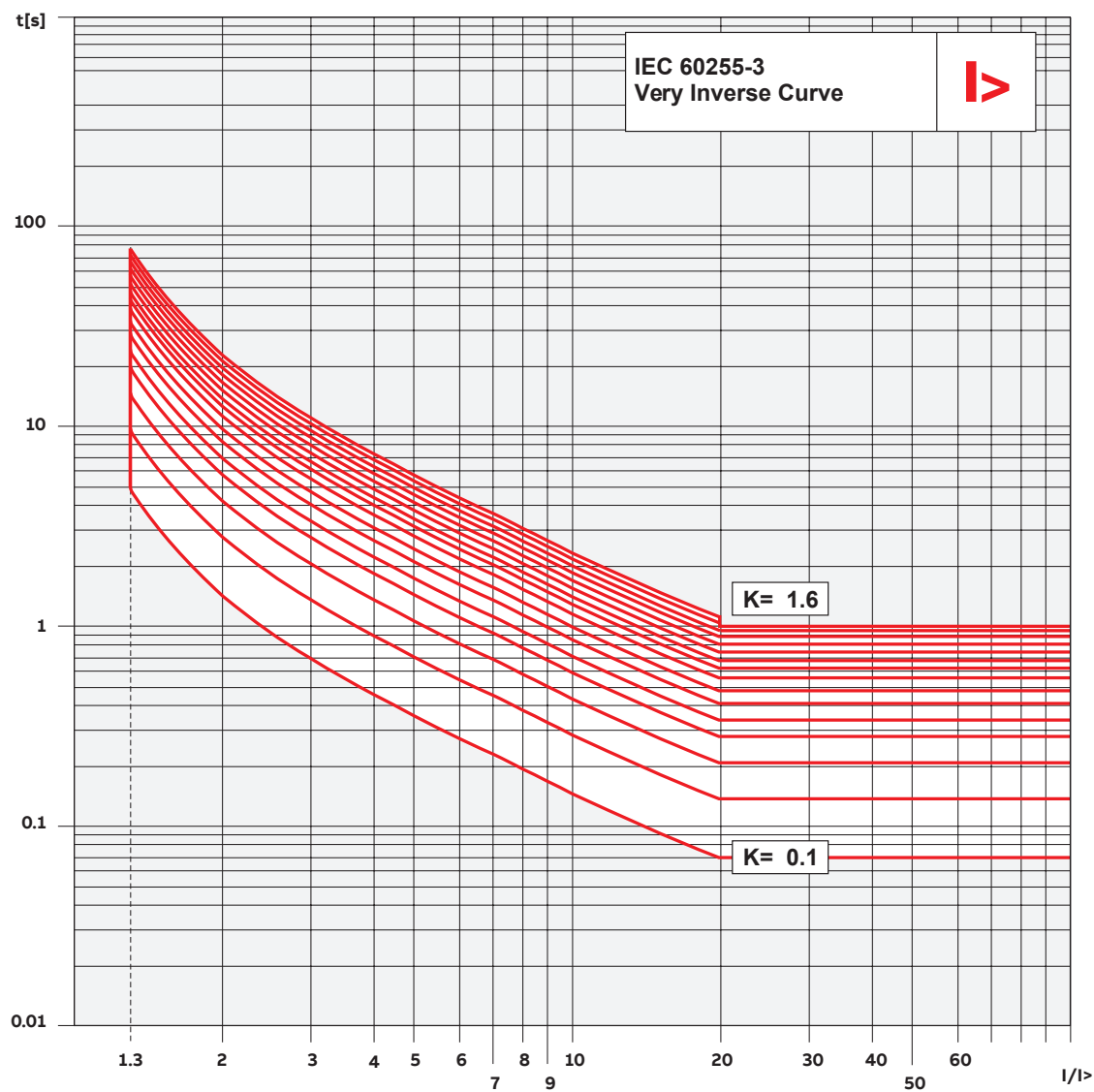
PR521 - Normally inverse time tripping curve (NI) for overcurrent protection



$$t = K \times \frac{0.14}{\left[\frac{I}{I>} \right]^{0.02} - 1}$$

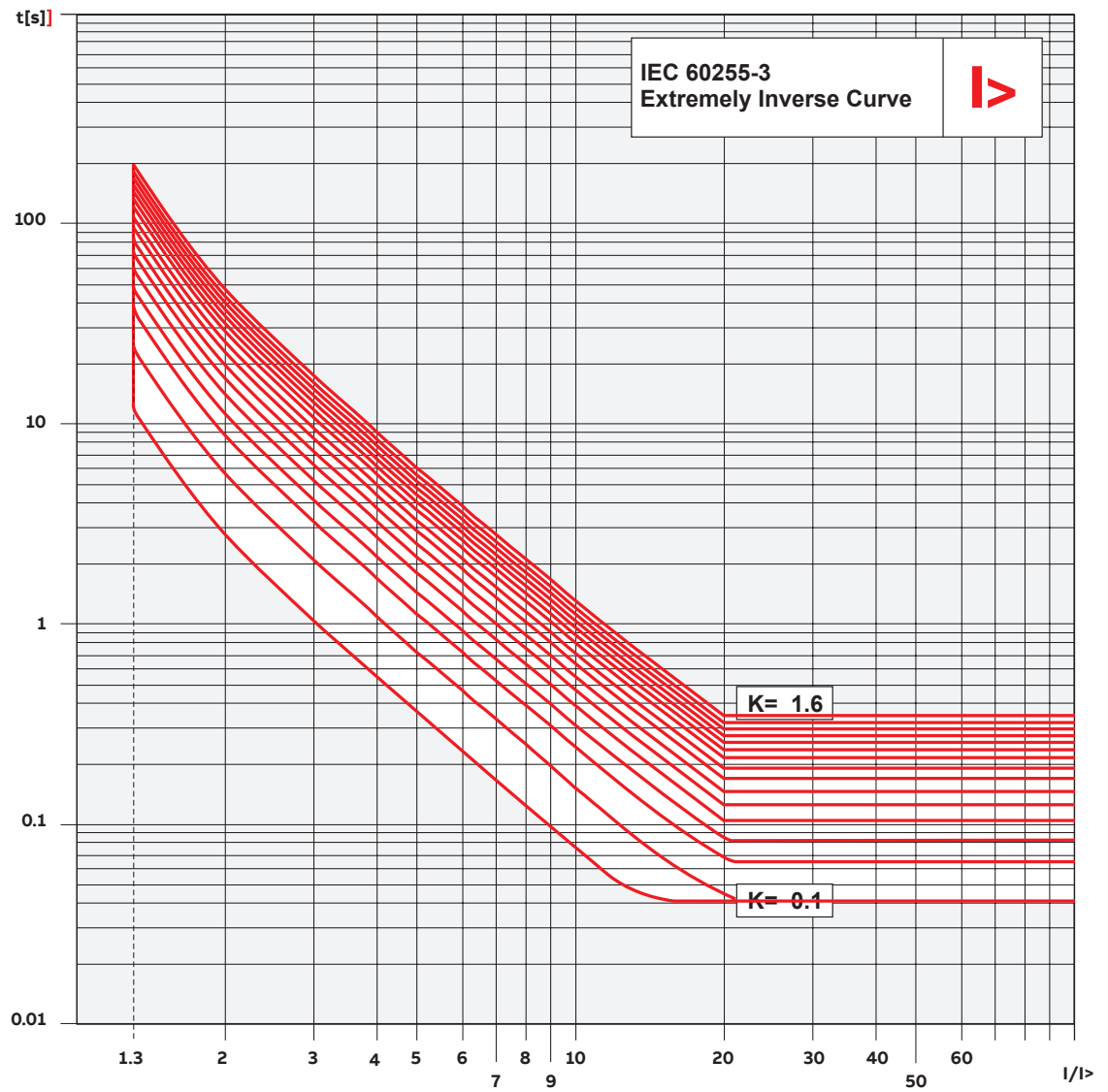
Specific characteristics of the product

PR521 - Very inverse time tripping curve (VI) for overcurrent protection



$$t = K \times \frac{13.5}{\left[\frac{I}{I>} \right]^{-1}}$$

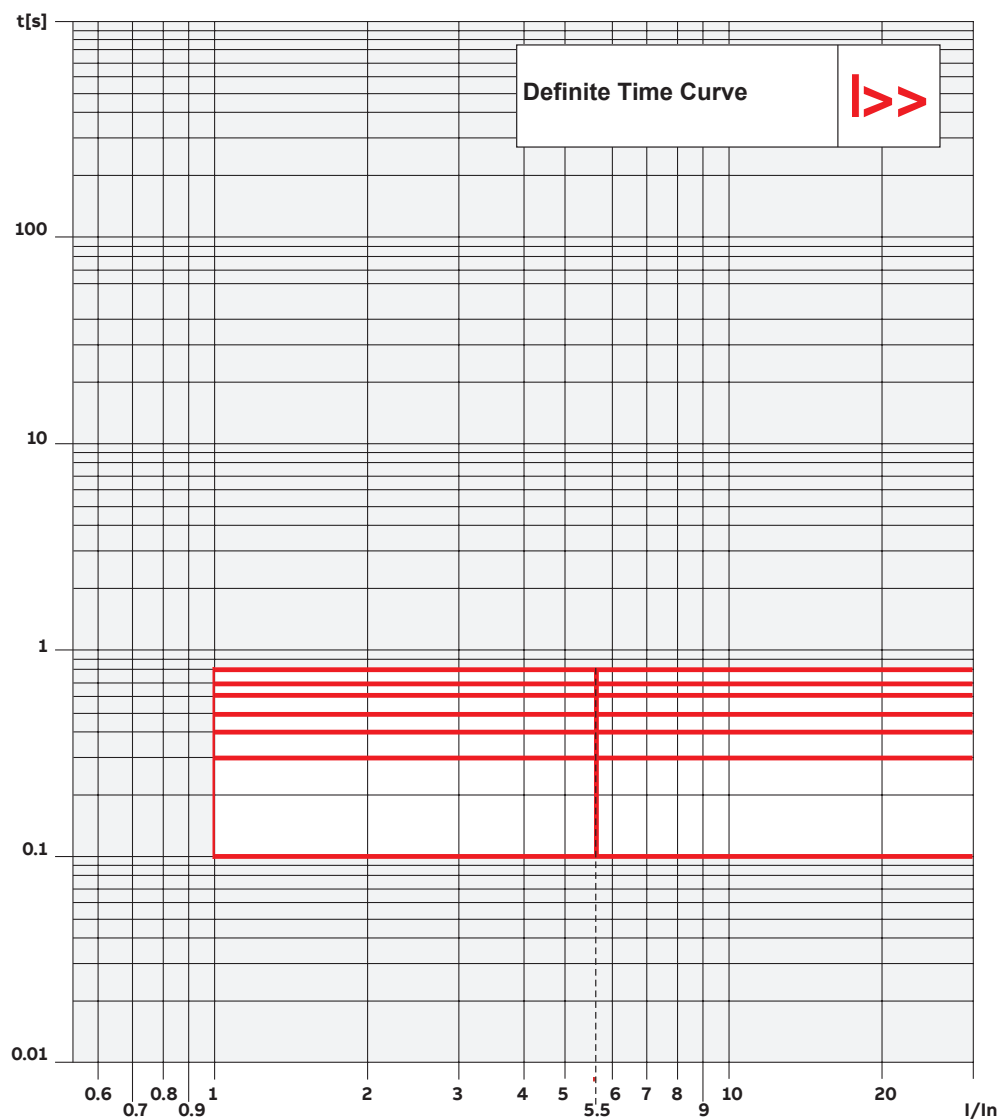
PR521 - Extremely inverse time tripping curve (EI) for overcurrent protection



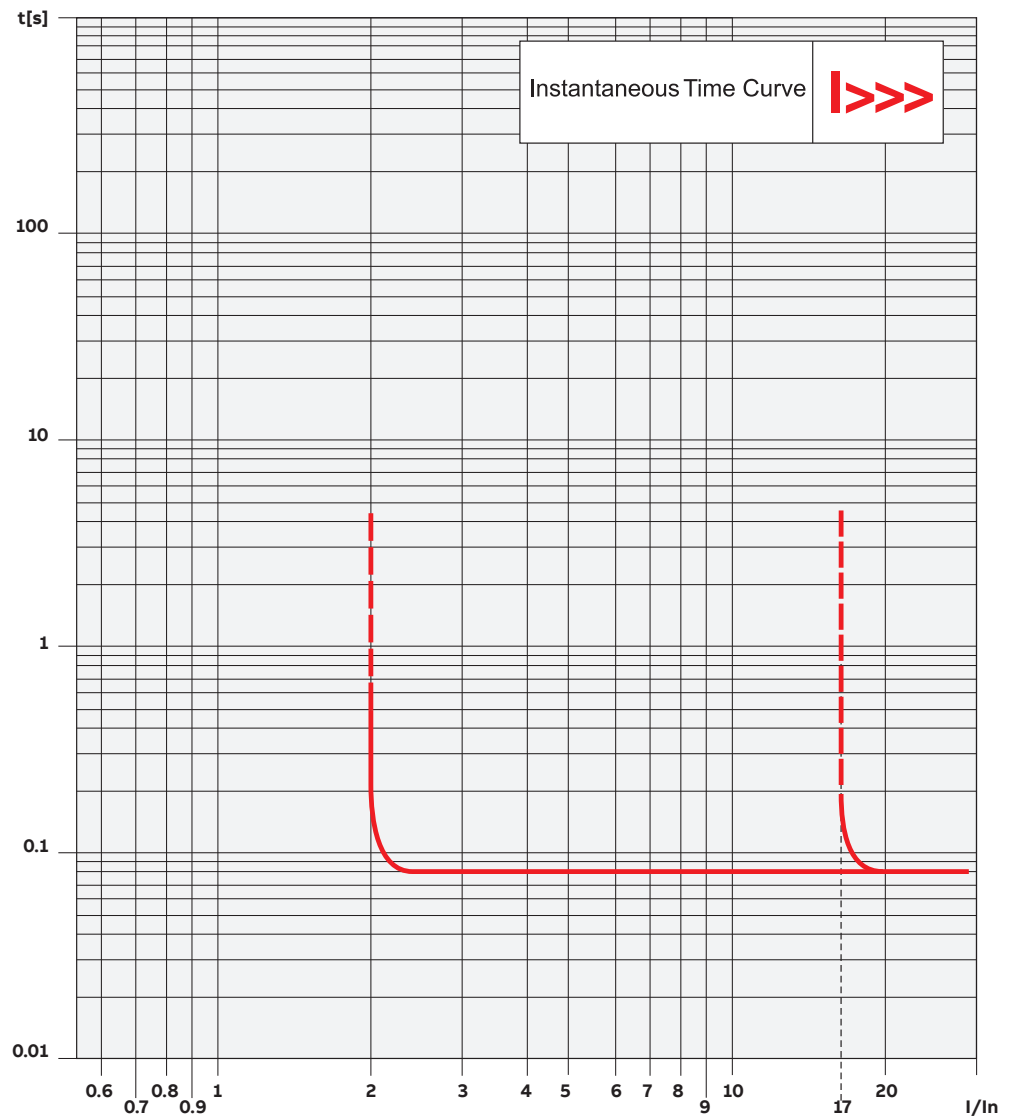
$$t = K \times \frac{80}{\left[\frac{I}{I>} \right]^2 - 1}$$

Specific characteristics of the product

PR521 - Fixed time tripping curve for short-circuit protection with adjustable delay



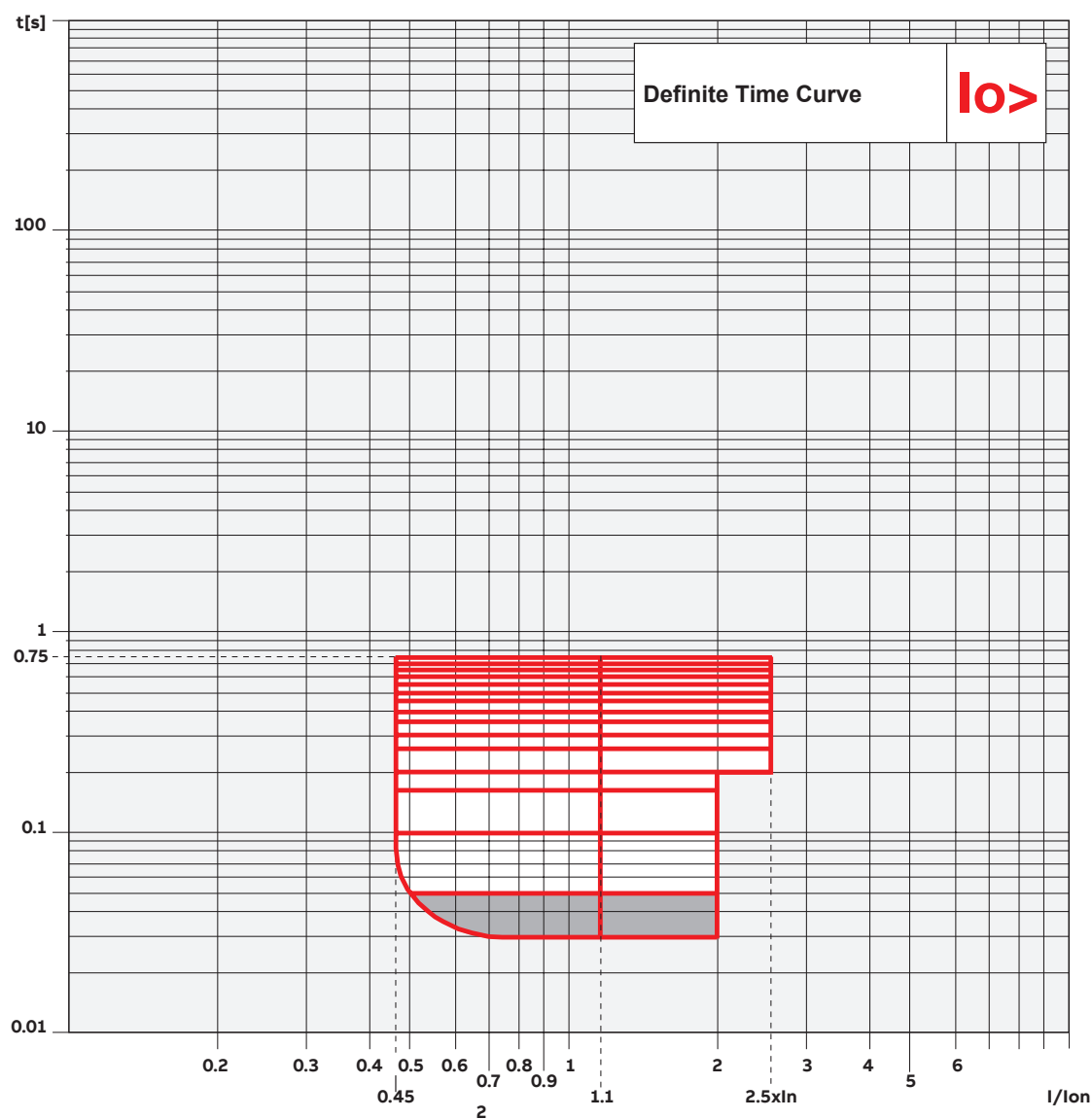
$$t = t_{>>}$$

PR521 - Tripping curve for short-circuit protection with instantaneous tripping time

$$t = t >>>$$

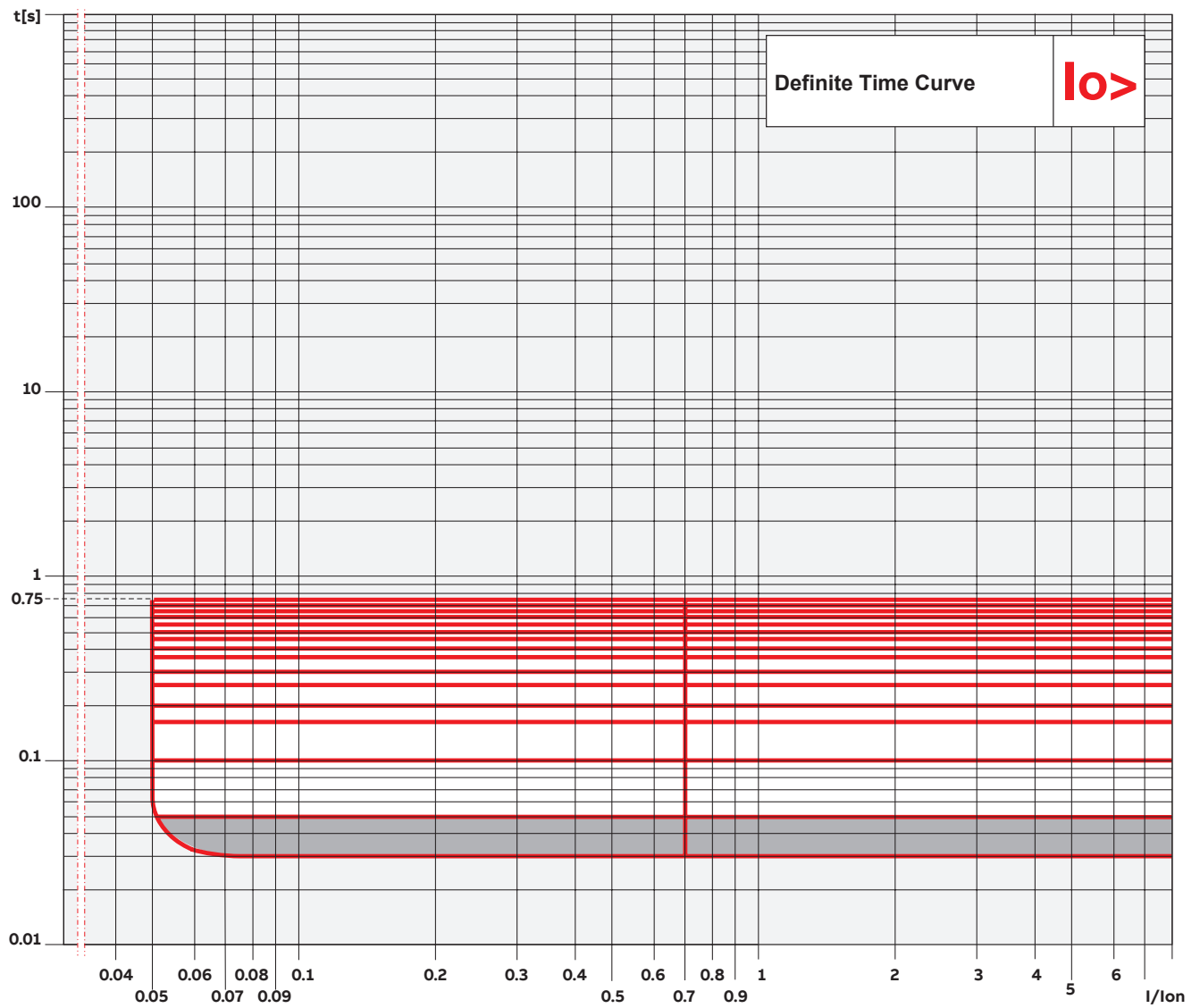
Specific characteristics of the product

PR521 - Fixed time tripping curve for earth fault protection via internal toroid



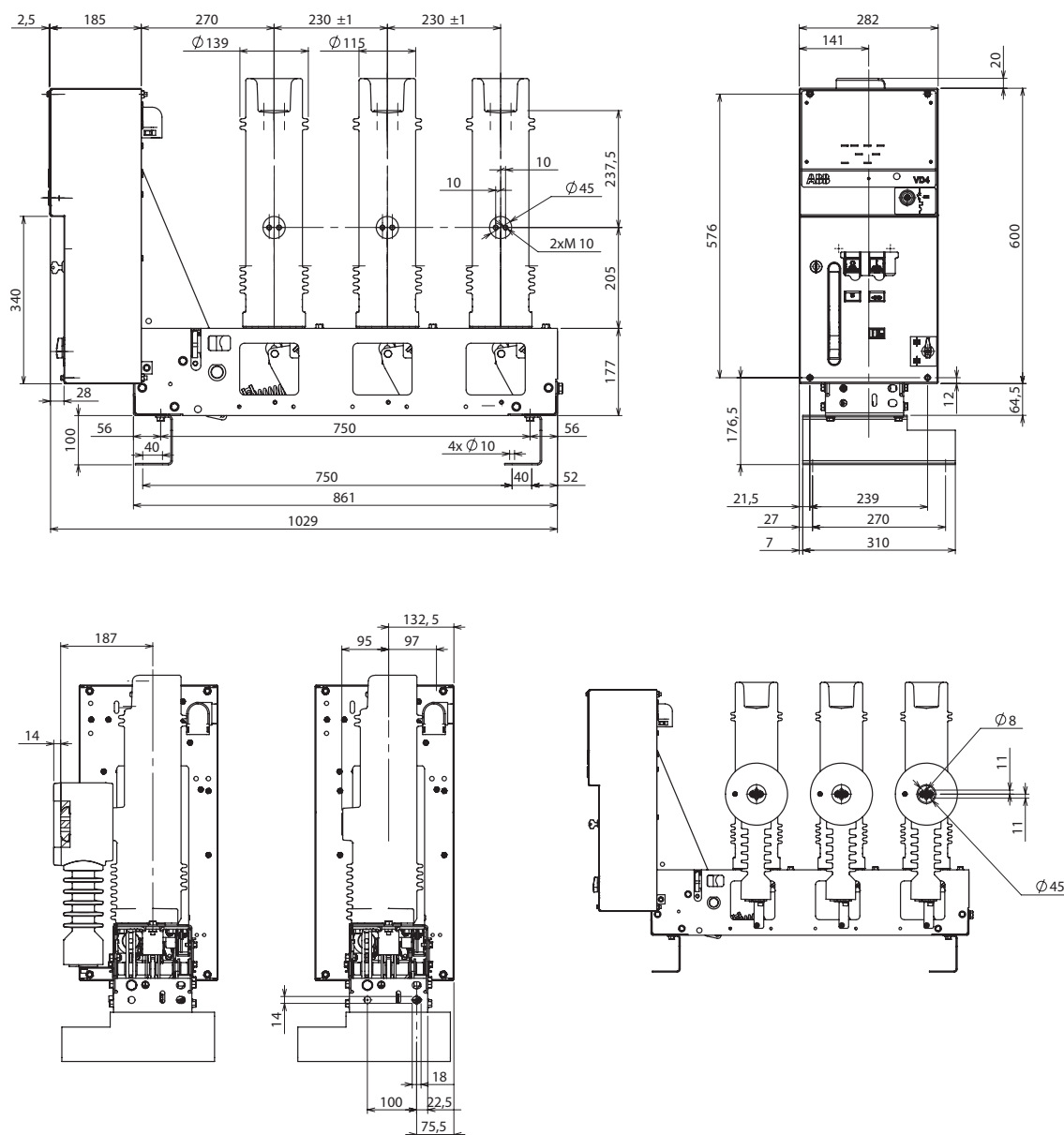
$t = t_0 >$

PR521 - Fixed time tripping curve for earth fault protection via external toroid



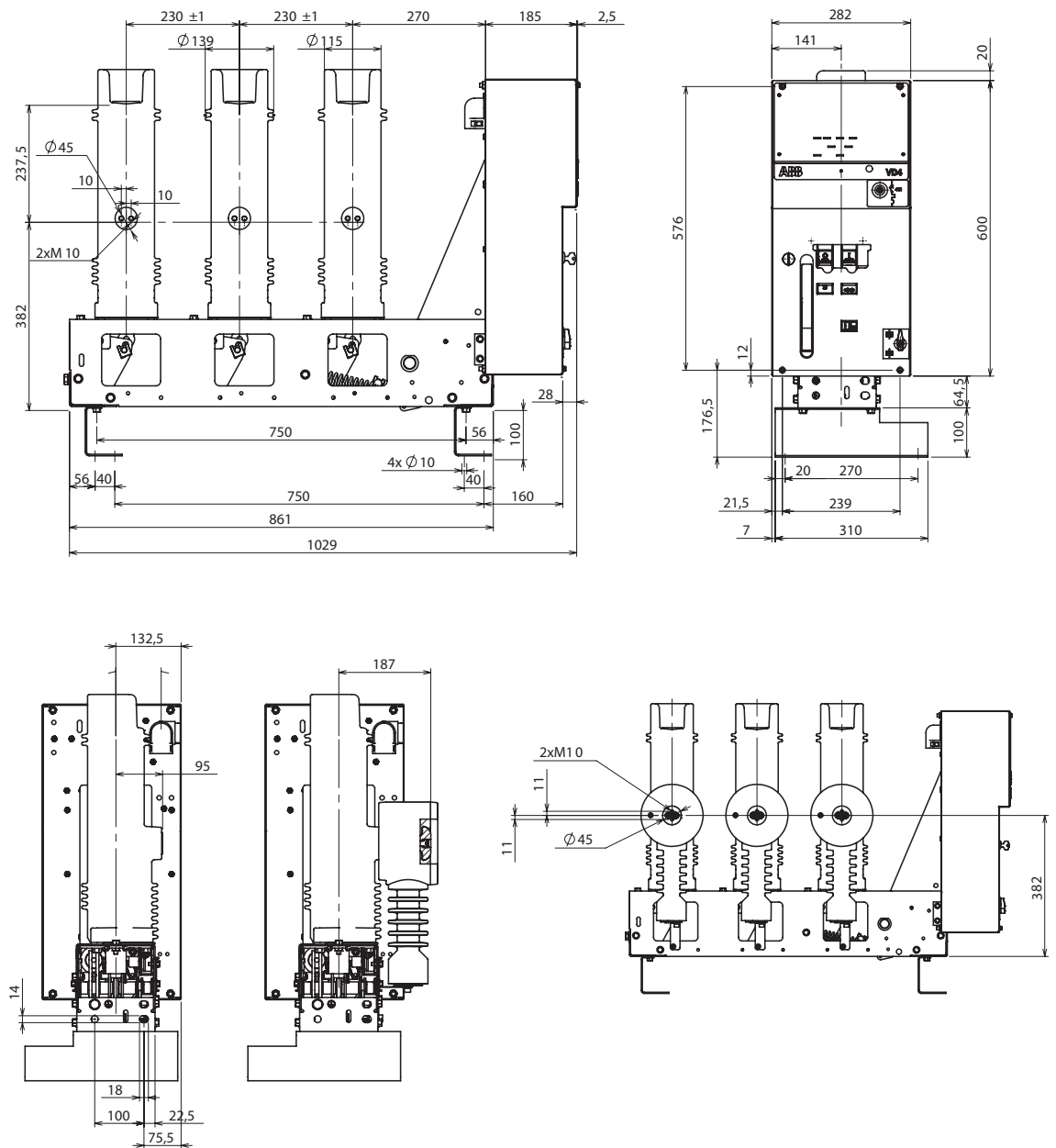
$$t = t_{0>}$$

TN 1VCD0000100

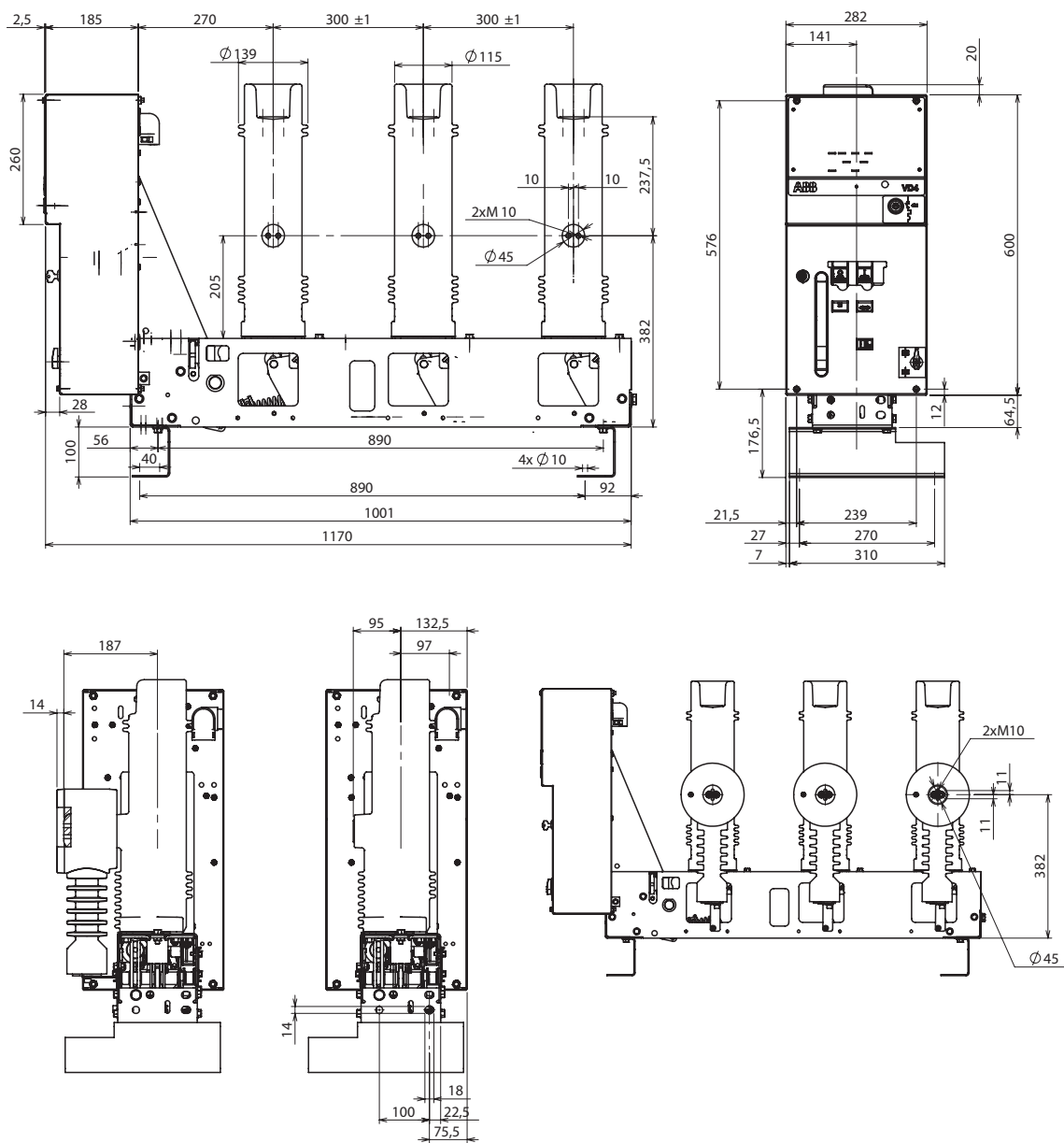


Fixed circuit breaker with left lateral operating mechanism
12-17.5-24 kV pole center-distance P = 230 mm

TN 1VCD003453

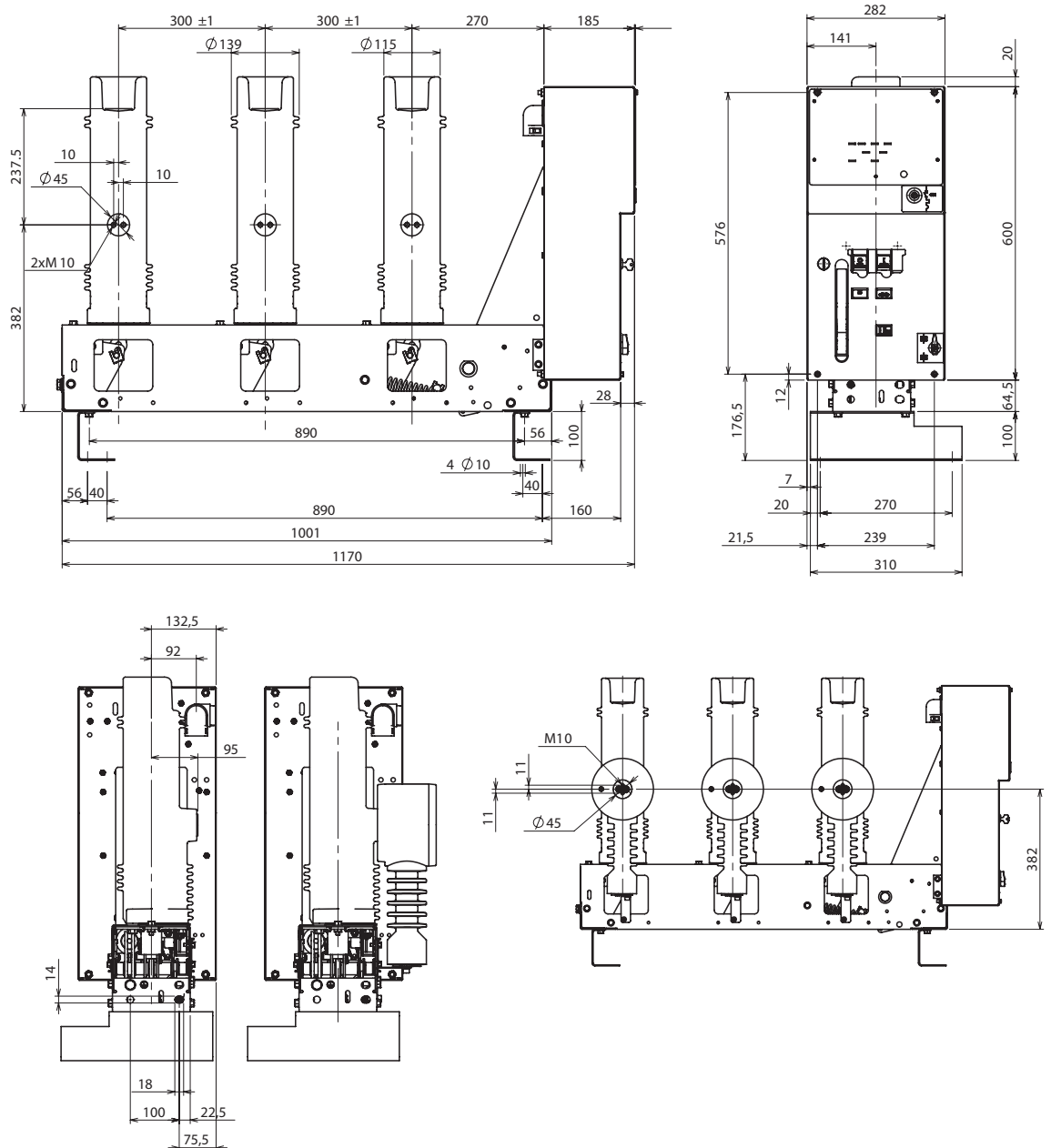


TN 1VCD000101



Fixed circuit breaker with left lateral operating mechanism
12-17.5-24 kV pole center-distance P = 300 mm

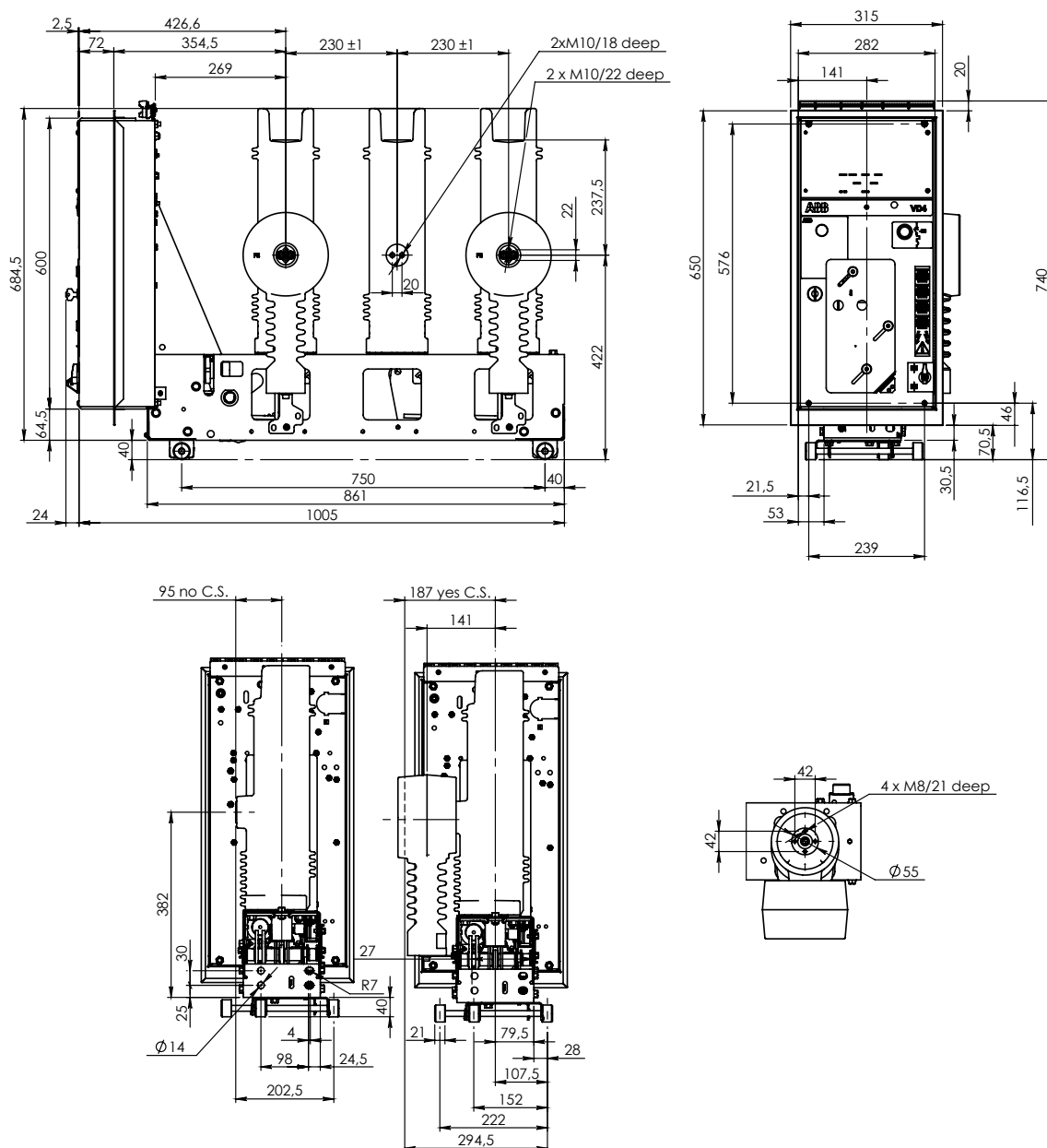
TN 1VCD003454



Overall dimensions

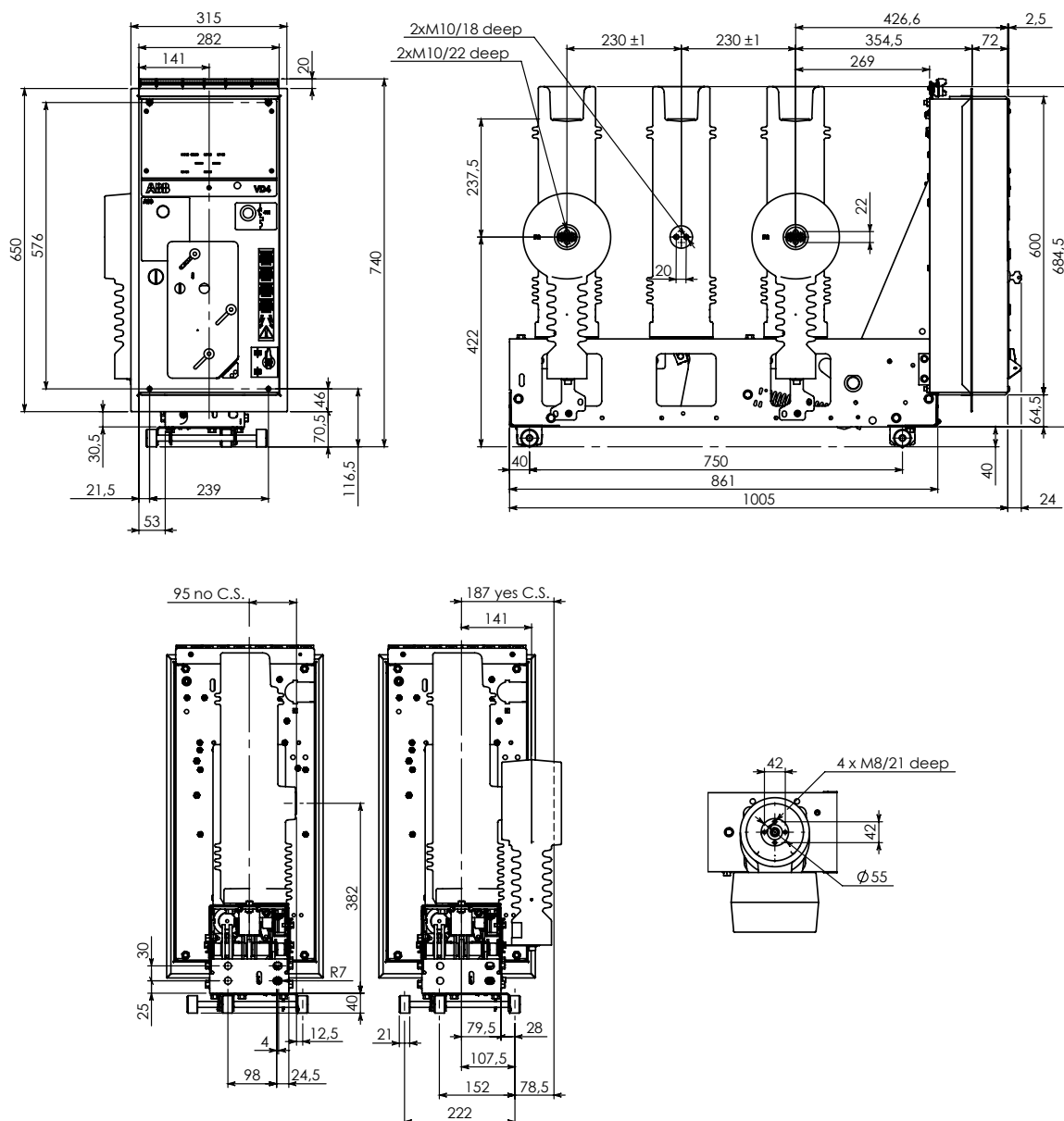
Fixed circuit breaker for UniSec switchgear - right lateral operating mechanism -
12-17.5-24 kV pole center-distance P = 230 mm

TN 1VCD000131



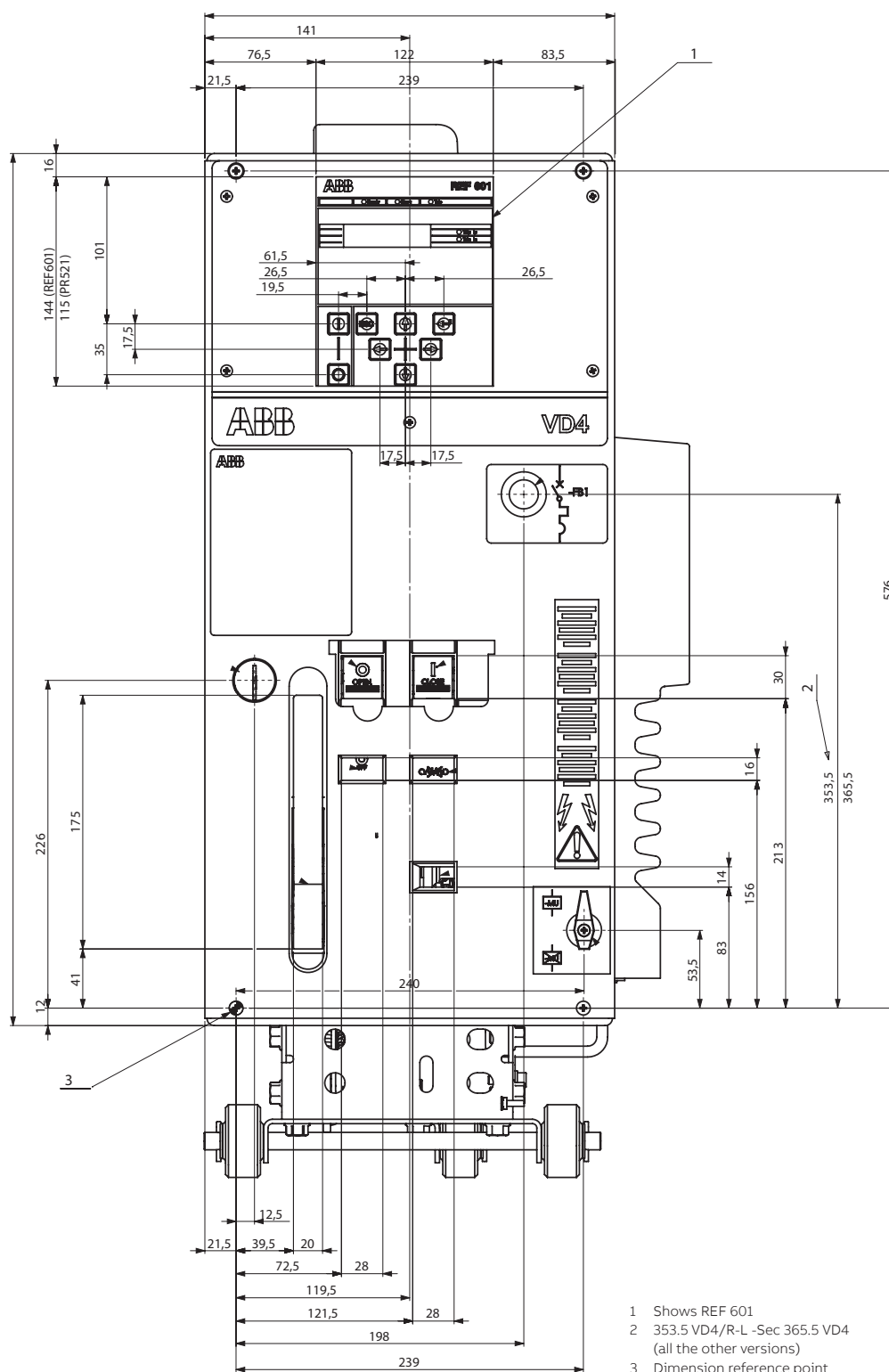
**Fixed circuit breaker for UniSec switchgear - left lateral operating mechanism -
12-17.5-24 kV pole center-distance P = 230 mm**

TN 1VCD000132



Overall dimensions

Detail of control front





For more information please contact:



More product information:

abb.com/mediumvoltage

Your contact center:

abb.com/contactcenters

More service information:

abb.com/service