



Medium voltage products

# PowerCube type PB/N Enclosure for V-Contact VSC



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# 1. General information

PB/N PowerCube units can be used to make metal-clad medium voltage air-insulated switchgear with the same rated current values as the enclosure. The rated current values of the enclosures refer to versions tested in ABB switchgear.

PB/N PowerCube units are available with the following characteristics:

Rated voltage (kV)	7.2	12
Rated current (A)	400	400
Main circuit duration (kA) (*)	50kA x 1s	50kA x 1s

(\*) By means of suitable protection fuses coordinated with the contactor

## Standards

PB/N PowerCube units are pre-assembled and tested in the factory and can be used to create switchgear that conforms to the following international product standards:

- IEC 62271-200,
- IEC 62271-1 (IEC 60694 where applicable)
- IEC 62271-102 (for the earthing switch)
- IEC 60529 (for the protection class)
- IEC 60470 (for the isolatable contactor)

## Loss of service continuity - LSC-2A

The various LSC classes establish whether adjacent panels can remain in service/energized when the main circuit is open. These classes are:

- LSC-1: The entire switchgear must be taken out of service before any of its components can be accessed for a normal operation or for routine and/or supplementary maintenance work.
- LSC-2A: Same as LSC-1, the only difference being that the main busbar compartment and the adjacent panels energized by the main busbars can remain energized.
- LSC-2B: Same as LSC/2A, the only difference being that the cable compartment can remain energized.

PB/N PowerCube units have been optimized for the creation of LSC\_2A classified panels since the contactor compartment and busbar compartment are segregated by metal partitions, while the contactor compartment and cable compartment are communicating.



## Metal partitions - PM

There is a distinction between the two partition classes, depending on the type of partitions or shutters between the live parts and switchgear compartments:

- PM class (separation with metal partitions)
- PI class (separation with insulating partitions).

PB/N PowerCube units are in segregation class PM since the circuit-breaker compartment is separated from the busbar side by the metal plate of the shutter (3 fig. 3).

## Protection classes

The protection classes of the PowerCube modules comply with IEC 60529 standards.

The following standard protection classes are guaranteed on the front:

- external enclosure: IP4X
- inside the cubicles: IP2X.

## Apparatus

PB/N PowerCube units can be fitted with the apparatus listed in the table.

	Standard (IEC 62271-106)		Performance of upper insulation	
	20	28	32	42
Power-frequency test voltage (kV x 1min)	20	28	32	42
PowerCube type	PB7/N	PB12/N	PB7/NG (*)	PB12/NG (*)
Contacteur type	VSC7/PN	VSC12/PN	VSC7/PNG (*)	VSC12/PNG (*)

(\*) ask ABB whether these versions are available.

All the switching operations are carried out from the front of the unit.

## Normal ambient conditions of use

PB/M PowerCube units are normally used for making panels and switchgear suitable for the normal operating conditions of equipment installed in indoor switchgear, as established by standard IEC 62271-1. The limit values given in the table are applicable.

### Ambient temperature

Maximum	+40 °C
Maximum over the 24h average	+35 °C
Minimum (according to the “- 5 indoor class”)	-5 °C

### Ambient humidity

Maximum relative humidity over the 24h average	95% RH
Maximum water vapour pressure over the 24h average	2.2 kPa
Average monthly maximum relative humidity	90% RH
Average monthly maximum water vapour pressure	1.8 kPa

The normal altitude is up to 1000 m above sea level. The ambient conditions for installation indoors include the absence of pollution, e.g. dust, smoke, corrosive or inflammable gas, vapours, salt, etc.

## Altitude

The insulating properties of the air diminish as the altitude increases. This must be taken into account when equipment that must be installed at a higher altitude than 1000 m above sea level is designed.

In this case, consider a correction coefficient that can be taken from the graph on the following page, created in accordance with the indications provided by Standards IEC 62271-1.

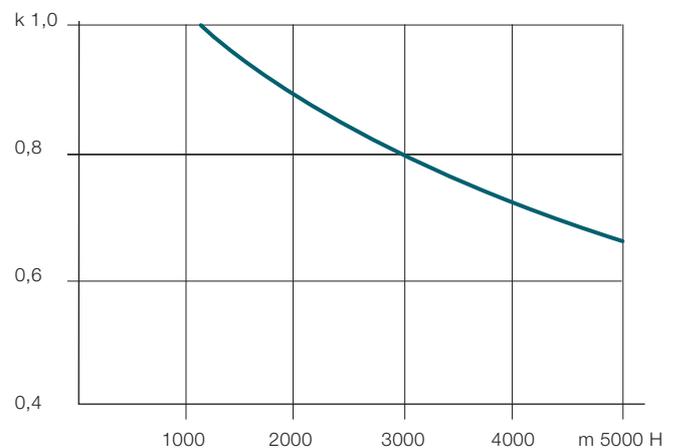


Fig. 1

## Interlocks

The PowerCube module is equipped with interlocks to prevent incorrect operations that could put the operators' safety at risk and compromise the efficiency and reliability of the actual equipment.

These interlocks inhibit the following operations:

- Contactor closing unless the connected, test isolated or disconnected positions have been reached.
- Door opening if the contactor is in the connected or test isolated position.
- Contactor connection when the compartment door is open.
- Closing of the earthing switch if the contactor is connected or halfway between the connected and test isolated positions.
- Contactor switching from the test isolated to connected position when the earthing switch is closed.

Note: some of the aforementioned interlocks are available on request or only available for certain versions.

# 1. General information



## Quality Assurance System

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

## Test laboratory

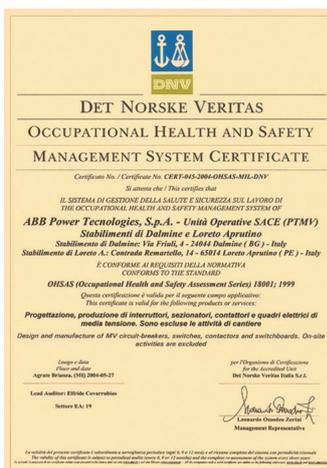
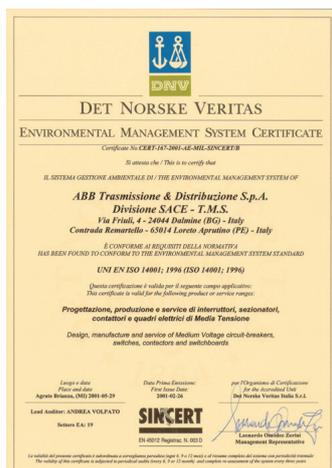
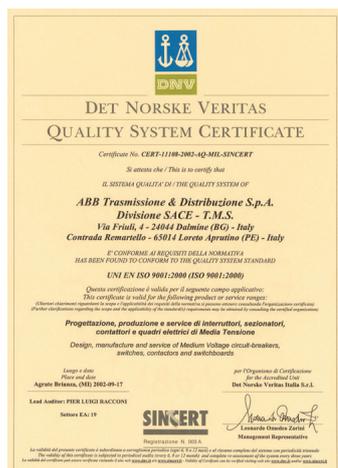
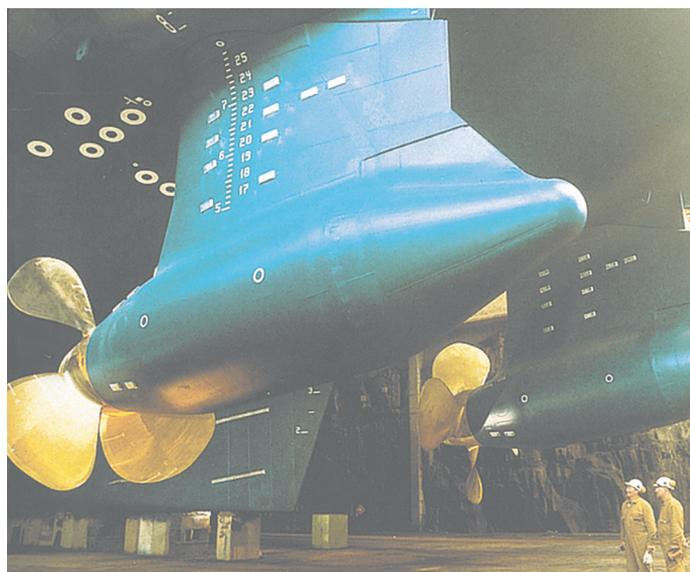
Conforms to ISO 45001 Standards, certified by an independent third party.

## 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.





### Applications

- Utilities
- Power generating stations
- Substations
- Transformer substations
- Switching stations
- Main and auxiliary switchgear

### Industry

- Paper mills
- Cement works
- Textile factories
- Chemical factories
- Food industries
- Car manufacturers
- Petrochemical industry
- Extractive industry
- Oil and gas pipelines
- Metalworks
- Rolling industry
- Mines

### Transport sector

- Airports
- Ports

### Infrastructures

- Shopping centers
- Hospitals
- Training facilities, laboratories, etc.

## 2. General characteristics

PB/N PowerCube units are designed for the development of switchgear in accordance with the latest international standards.

The structure of the enclosure is ideal for creating LSC2A panels, in compliance with standard IEC 62271-200



IEC electrical specifications		PB7/N	PB12/N	PB7/NG (*)	PB12/NG(*)
Rated voltage	kV	7.2	12	7.2	12
Withstand voltage	kV	20	28	32	42
Lightning impulse withstand voltage	kV	60	75	60	75
Rated frequency	Hz	50-60	50-60	50-60	50-60
Rated network current (40 °C)	A	...400	...400	...400	...400
Admissible rated short-time withstand current <sup>1)</sup>	kAx3s	...50	...50	...50	...50
Continuity of service level and internal arc classification obtainable with a panel based on a PB/N PowerCube		LSC 2A PM - IAC AFLR			

<sup>1)</sup> Limited by fuses.

(\*) Ask ABB whether these versions are available.

Two BS fuses can be installed on the VSC7/P and VSC7/PG contactor so as to operate a motor with 400A rated current and a panel 400 mm in width.

Use of medium voltage protection fuses notably limits the let-through energy if faults occur, thus allowing the contactor to be used in installations with high fault current values.

This characteristic also helps to safeguard the insulation level and electrical life of the cables and equipment connected.

### Earthing switches

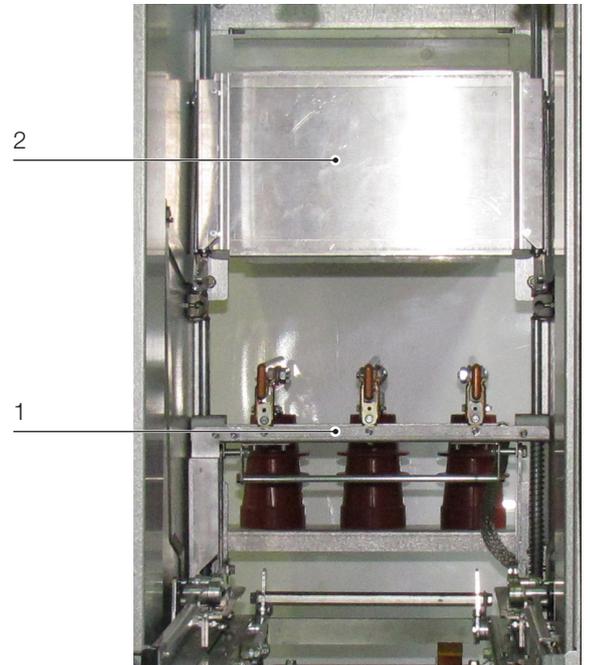
PB/N PowerCube units are equipped with an automatically closing earthing switch (1) controlled by the movement of the contactor.

The closing speed of the earthing switch is independent of the operator.

Owing to the features described above, the earthing switch on the cable side may possess a reduced short-circuit making capacity compared to the rest of the switchgear equipment, but sufficient for the fault current on the load side of the fuses (6kA corresponding to the making capacity of the contactor on the cable side).

On request, the opening and closing operations can be inhibited by means of a key lock. The earthing switch is controlled from the front of the module with an automatic operation when switching from the test isolated to the disconnected position takes place and vice versa, and is interlocked with the position of the contactor. Door opening will only be enabled when the earthing switch is closed and the contactor disconnected.

The position of the earthing switch can be inspected through the window in the lower part of the door (3).



### Compatibility with other PowerCube units

PB/N PowerCube units have been designed for connection to both 31.5kA, and 40 and 50kA PB/M PowerCube units and PB/E PowerCube units, as shown in the photos.



# 3. Accessories

## Auxiliary and/or position contacts (always supplied)

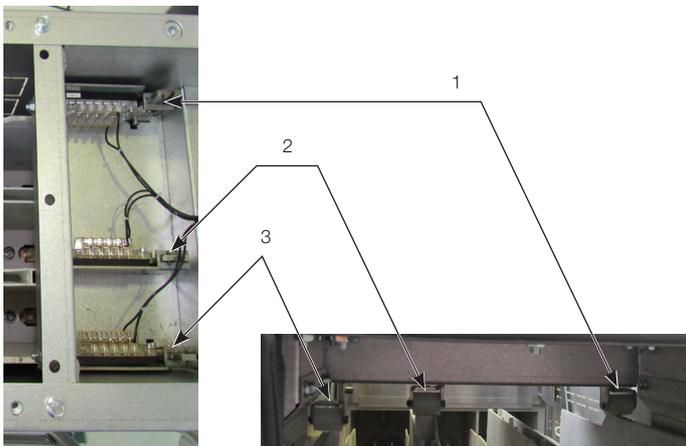
The PB/N enclosure uses auxiliary signalling contacts with linear movement and screw terminals to fasten the wiring. The characteristics of the auxiliary contacts are given below:

Un	24...250 V AC/DC			
Rated current	$I_{th^2} = 10 \text{ A}$			
Insulation voltage	2500 V 50 Hz (for 1 min)			
Electrical resistance	3 mOhm			
Rated current and breaking capacity in class AC11 and DC11				
Un	Cosφ	T	In	Icu
220 V-	0.7	–	2.5 A	25 A
24 V–	–	15 ms	10 A	12 A
60 V–	–	15 ms	6 A	8 A
110 V–	–	15 ms	4 A	5 A
220 V–	–	15 ms	1 A	2 A

The contacts in the unit are described below:

### Position contacts

Installed in the top part of the enclosure. A block of 5 normally open contacts is available for each of the three positions to which the contactor can set:

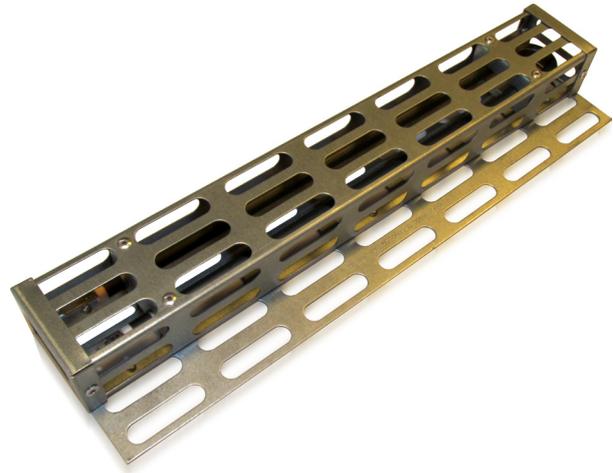


- 1 Disconnected position
- 2 Test isolated (or test) position
- 3 Connected position

### Auxiliary contacts of the earthing switch

5 contacts that change-over when the earthing switch is in the open position and 5 contacts that change-over when the earthing switch is in the closed position are available on request.

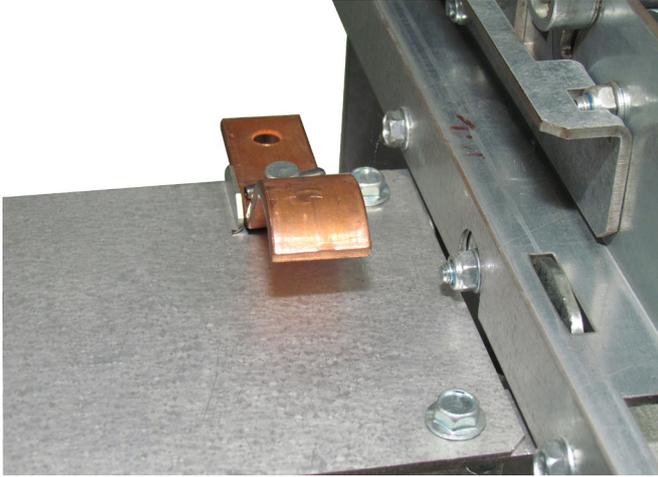
## Anti-condensation heater (accessory available on request)



Installed at the bottom of the enclosure, this device eliminates the condensation that may form if the switchgear is stored for a long period of time.

Rated voltage		
AC 50 Hz	V	110-220
AC 60 Hz	V	110-220
Rated power	W	150 ± 10

Earth connection of the apparatus (always supplied)



During the isolating/racking-in travel, the contactor is earthed by a sliding earth contact, which is always supplied on the enclosure.

Key lock with key free when earthing switch is open



When the earthing switch is open, the key can be removed to prevent the earthing switch from closing.

# 3. Accessories

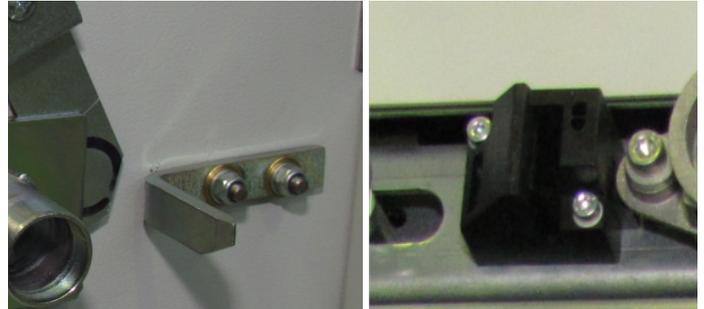
**Key lock with key free when earthing switch is closed (always supplied)**



The lock is installed on the door and locks the shutter that prevents the racking-in/racking-out lever from being inserted into the relative housing in the apparatus.

When the contactor is in the disconnected or test isolated position, the key can be removed to prevent the earthing switch from being opened, since the contactor cannot be switched from the test isolated to connected position (operation which would automatically open the earthing switch).

**Lock preventing the contactor from connecting with the door open (always supplied)**



**Lock installed on the inner side of the door**

**Matching part on apparatus**

Prevents the isolatable apparatus from being switched from the disconnected to connected position (and vice versa) with the door open. In order to function correctly, this lock requires the matching contactor.

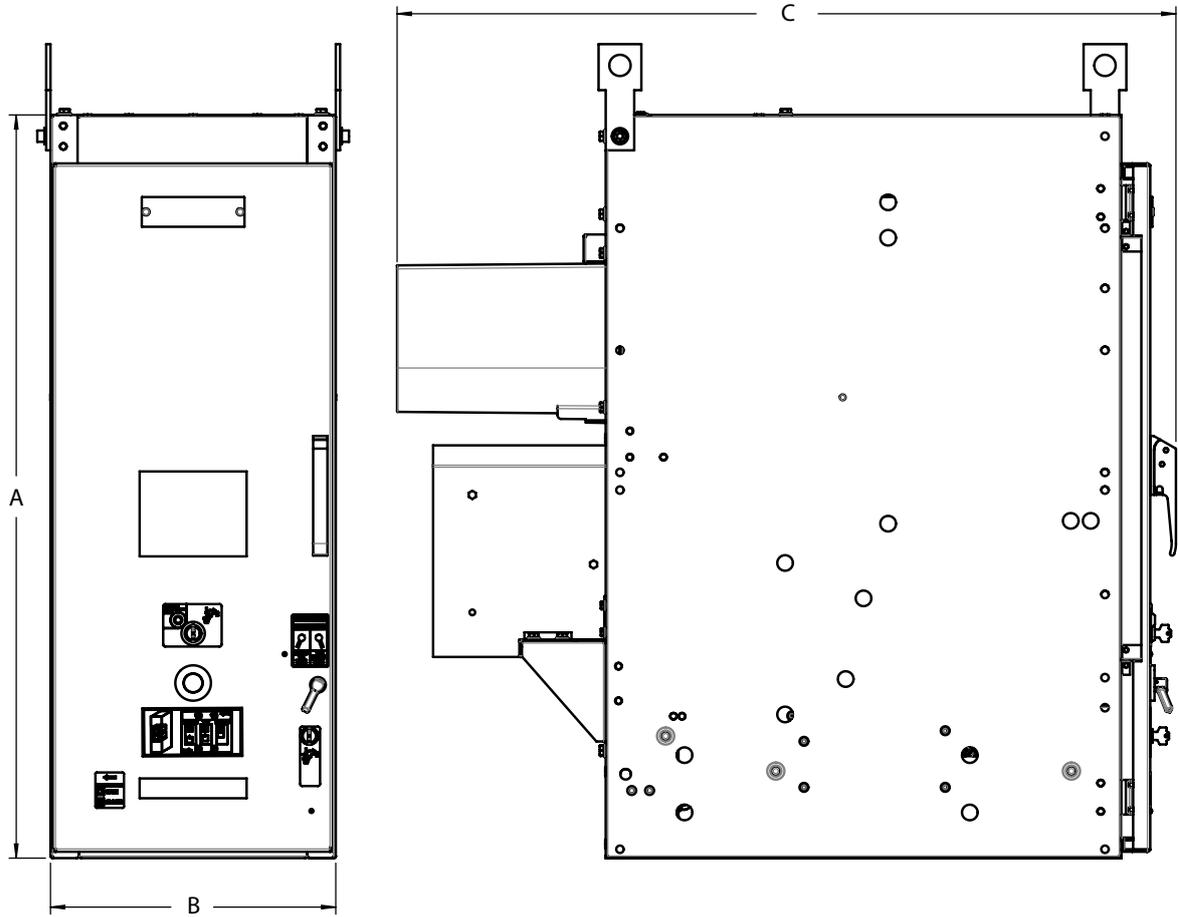
**Safety device for shutters (Fail safe, on request)**

This is a mechanical device that prevents a person from opening the shutter in the manual mode in the absence of the isolatable apparatus

**Equipment transport trolley (on request)**

Equipped with a plate allowing the apparatus to be racked into the unit.

# 4. Overall dimensions and weights



PowerCube type	Rated voltage [kV]	Rated current [A]	Isc Icw [kA]	Dimensions table	A [mm]	B [mm]	C [mm]	Weight [kg]
PB7/N	7.2	400	50 (1)	1VCD003666	1050	400	1100	XXX
PB12/N	12	400	50 (1)	1VCD003667	1050	400	1100	XXX
PB7/NG	7.2	400	50 (1)	1VCD003668	1050	400	1100	XXX
PB12/NG	12	400	50 (1)	1VCD003669	1050	400	1100	XXX

(1) Protection ensured by medium voltage fuses

# 5. Switchgear completion

Thanks to the comprehensive range of accessories available, ABB can provide accessories and devices to complete the switchgear.

## REF601 switchgear protection device

Relay REF601 is a device that protects against overcurrents, with tripping curves in compliance with standard IEC 255-3. It protects against overload (51), instantaneous and delayed short-circuits (50-51), instantaneous and delayed homopolar earth faults (50N and 51N).

It also detects the magnetizing current of a three-phase transformer to prevent untimely tripping when a transformer switches in (68). Relay REF 601 must be energized in order to function.

The REF601 relay can operate with up to 3 inputs from current sensors of the Rogowsky coil type and an input from an external toroidal current transformer. 4 rated current values can be entered via the keyboard: 40, 80, 250, 1250 A.

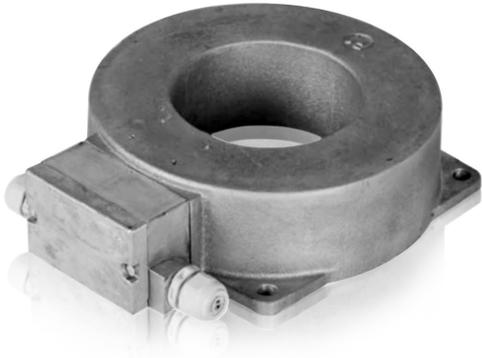
If the circuit-breaker is equipped with 3 current sensors, the 50N and 51N protection functions are accomplished with the vector sum of the phase currents. On the other hand, the external toroidal current transformer must be installed for the 50N and 51N functions if 2 current sensors are used. The external toroidal transformer can have either an openable or closed core and any transformer ratio, so long as there is 1 A secondary current. Specific features of relay REF601:

- Precision trips
- Wide setting ranges
- 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

- Local electric operating push-buttons
- 5 separate indicators: “relay operating”, “relay at tripping threshold”, “relay tripped”, “relay tripped due to phase overcurrent”, “relay tripped due to earth fault overcurrent”
- Interface consisting of an LCD display and “arrow”, “enter” and “esc” keys for user-friendly browsing amongst the “measuring”, “data recording”, “event recording”, “settings”, “configuration” and “test” menus
- Three user levels: “Operator” (display only, free access), “configurator” (same as the previous level, but with the ability to enter the protection parameters and, if applicable, the communication parameters - access limited by a password), “administrator” (same as the previous level but with the ability to enter the passwords and configure the settings to suit the device - access limited by a password)
- 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
- On request, version with RS485 serial link, 4 wires - MODBUS RTU full duplex protocol
- 24...240 V AC/DC multivoltage feeder.

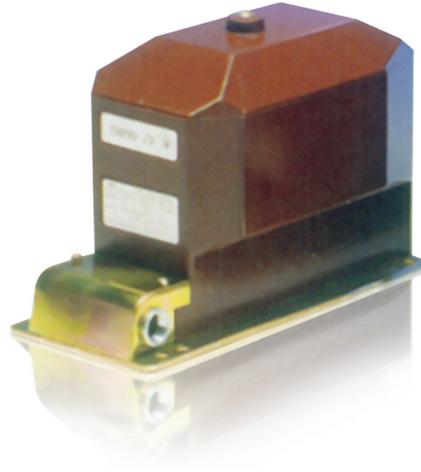
Relay REF601 is also available in a specific version, in accordance with standard IEC 0-16 (for the Italian market), with reference to the point where MV energy is delivered to the distribution user.

### Toroidal current transformer



The KODI toroidal current transformer is designed for both measuring and protection. Rated service voltage of the transformer 0.72 kV with 50-600 Hz rated frequency. In the outdoor version, the transformer can be installed on the insulator of the distribution transformers. The nominal temperature for transport and storage is -350 °C ... +400 °C. Use copper wires with 2.5 mm<sup>2</sup> section or more for connection to the secondary circuit.

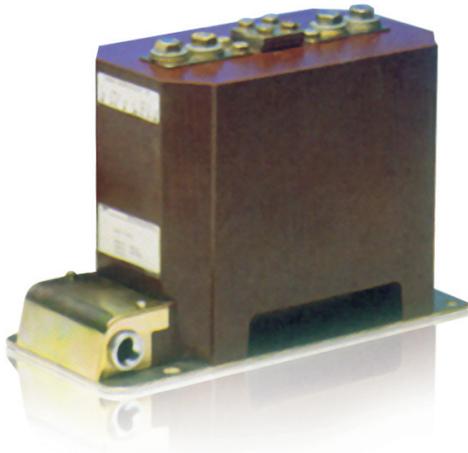
### Voltage transformers



The voltage transformers are resin-insulated and are used for energizing measuring devices and protections. They conform to standard IEC 60044-2. The dimensions normally conform to DIN 42600 standards. These transformers can have one or two poles and possess performance and precision classes that suit the functional requirements of the instruments to which they are connected.

# 5. Switchgear completion

## Current transformers



The current transformers are resin-insulated and are used for energizing measuring devices and protections. These transformers can have a wound core or bushing bar with one or more cores, and performance and precision classes that suit the requirements of the installation. They conform to standard IEC 60044-1. The dimensions normally conform to DIN 42600 standards. The current transformers can also be supplied with a capacitive socket for connection to voltage signalling lamps.

## Measuring sensors (for applications with REF542plus microprocessor protection units or similar)



Use of digital technologies for electrical protection and measuring instruments has radically modified the performance that transformers must provide. The analog input levels of the instruments have become significantly lower than those of conventional systems. This is why ABB has introduced a new range of sensors that meets the specifications of the new generation instruments in an optimal way. The switchgear can be equipped with up to 24 kV ABB KEVCD Block Type sensors. The current sensors comply with standard IEC 60044-8 (CDV), while the voltage sensors comply with standard IEC 60044-7. The dimensions normally conform to standard DIN 42600 Narrow Type. The resin casing can house current sensors and voltage sensors at the same time, or just the current sensor. A capacitive divider is also installed for connection to the voltage signalling lamps. ABB multifunction units and measuring sensors comply with accuracy class CI.1.

## Current sensor



The current sensor consists of a Rogowski coil without ferromagnetic core, thus unaffected by saturation phenomena. If a coil is formed by a uniform winding over a non-magnetic closed core with a constant section, the voltage induced in the secondary circuit will be directly proportional to the variations in the let-through current. This voltage must be integrated in order to obtain a signal proportional to the current provided. The multifunction devices accomplish this function and use the signal obtained for both measurements and protections.

### Main features of the current sensors

- Linear response over the entire measuring range;
- no saturation;
- no hysteresis;
- one single instrument for both protections and measurements;
- high accuracy class;
- high degree of immunity to electromagnetic disturbances;
- the output signal is a voltage (150 mV) proportional to the current variation over time. The current measurement is obtained by integrating the signal;
- two single coils cover the range from 0 to 3200 rated A;
- the winding can remain open even when the switchgear is under service conditions.

## Voltage sensor



The voltage sensor consists of a resistive divider through which the signal is taken. This sensor is also the non-saturable type and gives a linear response for the entire measuring range. The output signal is a voltage directly proportional to the primary voltage. The resistive element consists of a bar of ceramic material. Voltage sensors are used at the same time, for taking measurements and energizing the protections.

### Main features of the voltage sensors

- Linear response over the entire measuring range;
- no saturation;
- no ferroresonance;
- one single instrument for both protections and measurements;
- high accuracy class;
- high degree of immunity to electromagnetic disturbances;
- the output signal is a voltage directly proportional to the primary voltage;
- the division ratio is 10000/1;
- one single divider covers the range from 0 to 24 rated kV.

# 5. Switchgear completion

## Microprocessor-based REF542plus



The REF542plus unit provides all the secondary functions of a switchgear unit in a single module with watchdog function. Thanks to its flexible software, the unit is able to meet the requirements of a vast range of installations: protection, measuring, monitoring and signalling. The user interface is simple and easy to use.

## REF542plus in kits for OEM

The integrated protection and monitoring unit is based on the REF542plus platform, multifunction unit for medium voltage switchgear.

The REF542plus unit includes all the latest innovations in the microelectronics and information technology fields.

The main functions provided by the REF542plus unit are:

- protection
- control
- measuring
- monitoraggio
- energy quality
- communication.

Thanks to the exceptional flexibility and scalability of this modern unit, all the functions are integrated in a single configurable environment.

Thus dedicated and intelligent solutions can be created with a limited use of wiring in situations where a conventional approach would be costly and inefficient.

## Pre-configured solutions based on REF542plus

Some already configured solutions for protecting and monitoring the majority of the common medium voltage applications are described below.

These solutions are based on the REF542plus unit and do not need to be programmed in any way.

The REF542plus unit is supplied already programmed and ready for installation.

All that needs to be done is to enter the parameters of the protections.

The already configured REF542plus unit can only be ordered as part of the medium voltage kit.

It cannot be sold separately.

The primary part is configured as indicated in the single-line diagram alongside.

The circuit-breaker can be the fixed or withdrawable type. The earthing switch is manual. Configurations with a contactor instead of a circuit-breaker are available for motor outgoing feeders.

A certified ATEX version for explosive environments, conforming to directive 94/9/EC, is also available. Please consult ABB.

## Fuses

Fuses to DIN standards can be supplied for use in conjunction with the contactor, for protecting lines, motors, capacitors, voltage transformers for measuring functions, etc.

Consult technical catalogue 1VCP000049 for the contactor-fuse matches and coordination.



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