

DISTRIBUTION SOLUTIONS

UniGear 500R

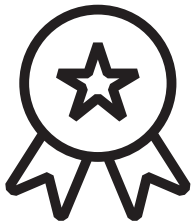
Medium-voltage air-insulated switchgear for green applications



- Ultra slim panel with 500 mm width
- Highest safety level

UniGear 500R is very space efficient solution, designed to reduce the width of the medium-voltage air-insulated switchgear. Panel design is only 500 mm wide for feeder current up to 2 000 A. Its compact design makes UniGear 500R ideal for container installation for primary distribution.

Benefits



Ultra slim panel with
500 mm width suitable
for compact substation
solutions



Highest safety level for
people and equipment



Solution with consideration
of environmental impacts
while designing

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UniGear 500R

Description

- UniGear 500R is a very space efficient solution, designed to reduce the width of the medium-voltage air-insulated switchgear
- Panel design is only 500 mm wide for feeder current up to 2000 A
- Its compact design makes UniGear 500R ideal for container installation for primary distribution
- Units can be coupled together directly with the other products of the UniGear family
- One of the main characteristics of the UniGear 500R switchgear is the isolation of the circuit-breaker from the main busbars by means of the three-position disconnecter

Characteristics of UniGear 500R

Range

- Up to 17.5 kV, ...2 000 A, ...31.5 kA
- IEC and ENA standards
- Standard and customized versions

Safety

- Fitted with safety interlocks
- Visible earthing connection (IEC version)
- Internal arc classification IAC AFLR (IEC) and IAC AFL (ENA)
- Classified as LSC-2A, PM

Flexibility

- Wide range of applications
- Traditional and IEC 61850 based protection and control solutions
- Ring core, block type instruments transformers or sensors

Quality

- ABB quality
- Large installed base
- Installed in high number of countries

Features

- 500 mm wide panel at 2 000 A load current
- Indoor wall and free-standing solution (IEC version)
- Cable testing facility (ENA version)
- Cable termination height up to 790 mm





Applications

Utilities and Power Plants

- Power generation stations
- Substations
- Main and auxiliary switchgear

Industry

- Pulp and Paper
- Cement
- Textiles
- Food
- Automotive
- Quarrying
- Petrochemical
- Oil and gas
- Metallurgy
- Rolling mills
- Mines

Transport

- Airports
- Ports
- Railways
- Underground transport

Infrastructure

- Shopping malls
- Hospitals
- Large infrastructure and civil works

UniGear 500R

Description

In order to extend the large and successful family of UniGear switchgear, ABB proudly offers UniGear 500R for medium-voltage power distribution.

The result is a very space efficient solution, designed to reduce the width of the switchgear and the panel design is 500 mm wide for up to 2000 A.

Its compact design makes the UniGear 500R ideal for container installation (IEC version).

The panel has been designed with a dedicated three-position disconnecter (connected, isolated and earthed) and with the well proven vacuum circuit-breaker Vmax in removable arrangement.

Two versions are available:

- IEC version
- ENA version

UniGear 500R has been completely tested according to IEC 62271-200 and for the United Kingdom according to ENATS 41-36.

According to the IEC standard, UniGear 500R is defined as LSC2A and Partition Metallic.

Internal arc classification for IEC version is IAC AFLR and for ENA version it is IAC AFL.

UniGear 500R is completely accessible from the front; for this reason it is a back to wall mounted solution (IEC version) and ergonomically designed for front operations of all devices.

All the compartments are accessible directly from the front and top and all the maintenance and service operations do not require rear access.

The panel is fitted with a clear label on the front part with all the operating commands and indications of the main apparatus (disconnecter, circuit-breaker, cable test cover for ENA version).

The IEC version is based on UniGear ZS1 system, which means it has internal arc proof on front, lateral and rear (IAC AFLR) and the different gas duct types are located on the top of the panel. The ENA version has been developed according to the requirements of the main UK Utilities and ENA TS specification, with internal arc proofing of up to 25 kA on the front, lateral (IAC AFL).

This version is designed with the opening flaps located on the rear part of the panel and in case of an internal arc, they will open automatically. Consequently, the accessibility of the lateral and rear part of the switchgear during service is restricted; only when the complete switchgear is out of service it is allowed to access in the lateral and rear part in a safe condition.

The ENA version requires 600 mm clearance to the rear.

The ENA version is equipped with a front cable testing device as standard feature. This ergonomic front access simplifies cable testing during maintenance.

One of the main characteristics of the UniGear 500R switchgear is the isolation of the circuit-breaker from the main busbars by means of the three-position disconnecter; this guarantees maximum personnel safety.

The panel is intrinsically safe to operate due to mechanical interlocks between the main components:

- three-position disconnecter
- circuit-breaker
- cable testing device (only for ENA version)

UniGear 500R switchgear provides maximum level of safety in the event of internal fault.

It is able to withstand over-pressures caused by arcing and is fitted with exhaust flaps to evacuate the gases generated and therefore protecting both personnel and equipment.

Vmax circuit-breaker used for UniGear 500R is the same as used for UniGear 550 panel, but a removable version.

The very high reliability of the circuit-breaker enables it to be removable without compromising service continuity.

All the main components (opening and closing coils, spring charging motor, etc.) are located on the front of the panel and their replacement only requires the removal of the front cover.

If in the unlikely event that the circuit breaker needs to be replaced, this can be carried out by trained technician in less than 90 minutes without the need of special tools.

In this case a readily- available manual earthing device must be used in order to guarantee the earthing connection on cables.

UniGear 500R in IEC version has the same overall dimensions (height and depth) and the same main busbar arrangement as UniGear ZS1 with a maximum current of 4 000 A. The result is that it

is possible to connect this panel to UniGear ZS1, 550 and MCC without the use of adaptor panel making it a very flexible solution.

UniGear 500R units are designed to be equipped with the following instrument transformers:

- Ring core type current transformer (standard)
- Block type current transformer (optional)
- Current sensor or combisensors (optional)

It is also possible to have a fixed voltage transformer with removable fuses on the cable side. On request, the UniGear 500R can also be fitted with “Fault limiting systems” in order to further limit the effects of the internal arc.



UniGear 500R

Description

Three-position disconnecter

Every UniGear 500R, except the Measurement unit, is fitted with a manually operated off-load three-position disconnecter on the main busbar side. The disconnecter allows the circuit-breaker to be separated from the main busbars.

The disconnecter has three defined positions:

- ON: circuit-breaker connected to the busbars system
- OFF: circuit-breaker isolated from the busbar and from earth
- Earth: circuit-breaker connected to earth

The disconnecter is fitted with mechanical position indicators and dedicated auxiliary switches, to provide an immediate visual indication of which of the three positions the equipment is in.

All the safety and operating interlocks between the disconnecter, circuit-breaker (and cable testing device for ENA version) are made mechanically.

The IEC version cubicle is fitted with a front inspection window to verify the correct position of the contacts of the disconnecter.

The operating command of the disconnecter is located on the front of the panel and the operations are performed in two steps:

- from ON position to OFF position
- from OFF position to earth position

The operating lever can be removed only when the movement is completed.

In the incoming/outgoing feeder the disconnecter and the circuit-breaker are used to earth the cable side.

In the bus-section unit it is possible to earth the main busbar side (busbar A and busbar B).

Normal operation conditions

The rated characteristics of the switchgear are guaranteed under the following ambient conditions:

- Minimum ambient temperature: – 5 °C
- Maximum ambient temperature: + 40 °C

For different temperature ranges, please contact your ABB sales representative.

Ambient humidity:

- maximum 24 h average of relative humidity 95% RH
- maximum 24 h average of water vapour pressure 2.2 kPa
- maximum monthly average of relative humidity 90% RH
- maximum monthly average of water vapour pressure 1.8 kPa

The normal operational altitude is up to 1 000 m above sea level. For higher altitude applications, please contact your ABB sales representative.

Presence of normal, non-corrosive and uncontaminated atmosphere.

Standards

The switchgear and main apparatus contained in it comply with the following Standards:

- IEC 62271-1 for general purposes
- IEC 62271-200 for the switchgear
- IEC 62271-102 for the earthing switch
- IEC 60071-2 for the insulation coordination
- IEC 62271-100 for the circuit-breakers
- IEC 60137 – for insulated bushings
- IEC 60529 – for degree of protections
- ENA TS 41-36 - UK Energy Network Association Technical Specification for Distribution Switchgear
- ENA TS 50-18 - Application of Ancillary Electrical Equipment

Colour of the external surfaces

RAL7035 - light grey (front doors and side sheets).
Other colours are available on request.

Degrees of protection

The degrees of protection of the switchgear conform with IEC 60529 Standards.
UniGear 500R switchgear is normally supplied with the following standard degrees of protection:

- IP4X for the enclosure of IEC version
- IP3X for the enclosure of ENA version
- IP2X for the partition between compartments

On request, the external housing can be supplied with a higher degree of protection; in this case please contact your ABB sales representative.
The electrical characteristics of the switchboard can vary for ambient conditions other than those described in the previous section and also if a higher degree of protection is used.

Electrical characteristics IEC version			
Rated voltage	[kV]	12	17.5
Rated insulation voltage	[kV]	12	17.5
Maximum service voltage	[kV]	12	15.4
Rated power frequency withstand voltage	[kV / 1 min]	28	38
Rated lightning impulse withstand voltage	[kV]	75	95
Rated frequency	[Hz]	50 / 60	50 / 60
Rated short time withstand current	[kA / 3 s]	...31.5	...31.5
Internal arc withstand current	[kA / 1 s]	...31.5	...31.5
Main busbar rated current	[A]	...4 000	...4 000
Circuit-breaker rated current	[A]	...2 000	...2 000
Internal Arc Classification		IAC AFLR	IAC AFLR

Electrical characteristics ENA version			
Rated voltage	[kV]	12	12
Rated insulation voltage	[kV]	12	12
Maximum service voltage	[kV]	12	12
Rated power frequency withstand voltage	[kV / 1 min]	28	38
Rated lightning impulse withstand voltage	[kV]	75	95
Rated frequency	[Hz]	50 / 60	50 / 60
Rated short time withstand current	[kA / 3 s]	...25	...25
Internal arc withstand current	[kA / 1 s]	...25	...25
Main busbar rated current	[A]	...4 000	...4 000
Circuit-breaker rated current	[A]	...2 000	...2 000
Internal Arc Classification		IAC AFL	IAC AFL

UniGear 500R

IEC Classification

With the release of the IEC 62271-200 standard, new definitions and classifications of medium voltage switchgear have been introduced.

One of the most significant changes is that classification of switchgear into metal-enclosed, compartmented and cubicle types has been abandoned.

The revision of switchgear classification rules has been based on the user's point of view, in particular on aspects like service and maintenance of the switchgear, according to the requirements and expectations for proper management, from installation to dismantling. In this context, Loss of Service Continuity (LSC) has been selected as a fundamental parameter for the user.

According to the IEC 62271-200, UniGear 500R switchgear can be defined as follows.

Loss of service continuity - LSC-2A

The various LSC categories describe possibility of keeping other compartments and/or panels energized while a compartment in the main circuit is opened. The defined categories are:

- LSC-1: The whole switchgear shall be put out of service for opening a main circuit compartment for normal operation and/or normal maintenance or for gaining access to any switchgear components
- LSC-2A: The same as LSC-1 with the exception that the main busbars and the functional units adjacent to the one under maintenance can remain energized
- LSC-2B: The same as LSC-2A with the exception that the cable compartment can remain energized

UniGear 500R is classified as LSC-2A because the main busbar and circuit-breaker/cable compartments are physically and electrically segregated.

This is the category for equipment that enables access to the circuit-breaker/cables compartment with the main busbars energized.

Partition Metallic - PM

With regard to the type of partitions or shutters between live parts and an open compartment, a distinction is made between two partition classes:

- Class PM (Partition made of Metal)
- Class PI (Partition made of Insulating material)

UniGear 500R is defined with PM partition class having the segregation between compartments made of metallic sheets/shutters.

Tool-based accessible compartment

This contains high-voltage parts, that may be opened, but not for normal operation and maintenance. Special procedures are required. Tools are necessary for opening.

Internal arc classification – IAC AFLR

UniGear 500R switchgear is classified IAC AFLR for IEC version and IAC AFL for ENA version. When the switchgear is specified and installed, some fundamental points must be taken into consideration:

- Level of the fault current (16...31.5 kA)
- Duration of the fault (0.1...1 s)
- Escape routes for the hot and toxic gases produced by combustion of materials
- Dimensions of the room, with special attention to the height

Please consult your ABB representatives for detailed information.





UniGear 500R

Design features

Compartments

Each switchgear unit consists of two power compartments for busbars and circuit-breaker/cables.

The closing of the circuit-breaker front cover and cables doors is done with screws.

Each unit is fitted with a low voltage compartment, where all the auxiliary instruments are housed.

Arc-proof switchgear, for the IEC version, is normally provided with a duct for evacuation of the gases produced by an arc; different types of gas ducts are available.

All the compartments are accessible from the front and top and maintenance operations can properly be carried out with the switchgear back to wall installed.

The compartments are segregated from each other by metallic partitions.

Main busbars

The busbar compartment contains the main busbar system connected to the fixed upper isolating contacts of the three-position disconnectors by means of branch connections. The main busbars are made of electrolytic copper. For ratings up to 1 250 A, the busbars are made of flat bars; while for higher currents up to 4 000 A, a special D-shape busbar is used.

The busbars are covered with insulating material at 17.5 kV.

There is a single busbar compartment along the whole length of the switchgear.

Cable connections

The circuit-breaker/cables compartment contains the branch system for connection of the power cable to the lower contacts of the circuit-breaker. The feeder connections are made of electrolytic copper and they are made with flat busbars for the whole range of currents.

For 17.5 kV they are covered with insulating material.

Earthing

The earthing of the power cables is performed by the earthing position of the disconnector and the closure of the circuit-breaker.

In addition each switchgear can be fitted with an earthing switch installed directly on the main busbar system in a dedicated compartment (busbar applications).

The earthing switch has short-circuit making capacity.

Control of the earthing switch is from the front of the switchgear with manual operation.

The position of the earthing switch can be seen from the front of the switchgear by means of a mechanical coupled indicator.

Earthing busbar

The earthing busbar is made of electrolytic copper and it runs longitudinally throughout the switchgear, thereby guaranteeing maximum personnel and installation safety.

Insulating bushings

The insulating bushings contain the contacts for connection of the circuit-breaker with the busbar compartment via the three-position disconnector.

The insulating bushing is three-pole type and is made of epoxy resin.

Cables

Single and three-core cables up to a maximum of three per phase can be used depending on the rated voltage and the cable cross section.

The switchgear can be back to wall installed as the cables are easily accessible from the front.

Gas exhaust duct (IEC version)

The gas exhaust duct is positioned above the switchgear and runs along its whole length. Each power compartment is fitted with a flap positioned on the top of it. The pressure generated by the fault opens the flap, allowing the gas to pass into the duct.

Evacuation from the room of the hot gases and incandescent particles produced by the internal arc must normally be carried out.

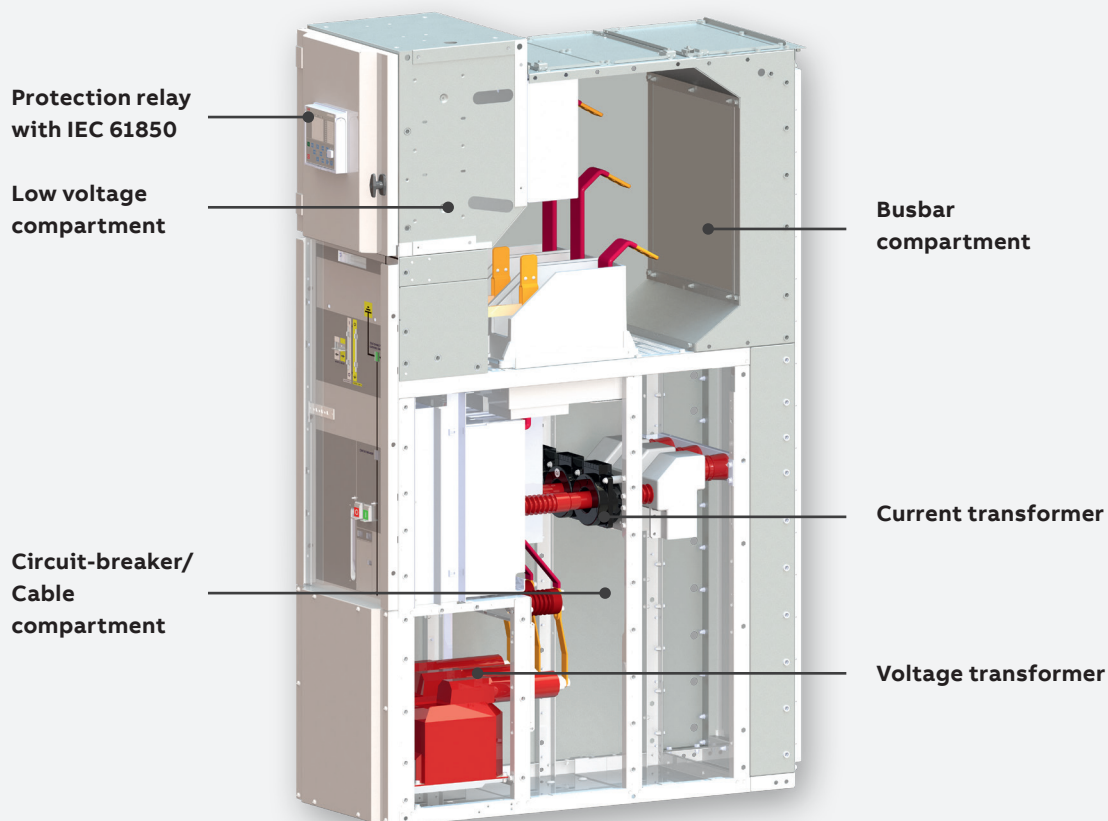
The UniGear 500R switchgear can be fitted with a complete range of solutions to meet all requirements, either where evacuation is possible directly at the end of the switchgear, or when solutions from the front or rear are requested. Some installations do not allow evacuation of the gases to the outside of the room and therefore a dedicated solution has been realised to guarantee personnel safety and conformity with the Standards, such as longitudinal evacuation chimneys.

Please contact ABB sales for more information.

Busbar applications

Each switchgear unit can optionally be fitted with an accessory busbar application:

- Voltage transformers for busbar measurements
- Busbar system earthing switch
- Top entry duct to make interconnections between different sections of switchgear



UniGear 500R

Fully type-tested

UniGear 500R switchgear has undergone all the tests required by the international (IEC) Standards and local Standards organizations as ENA for UK market.

As indicated in these standards, the tests were carried out on the switchgear units considered most sensitive to the effects of the tests and therefore the results were extended across the whole range.

Each switchgear unit is subjected to routine tests in the factory before delivery.

These tests are intended to provide a functional check of the switchgear based on the specific characteristics of each installation.

IEC type tests

- Short-time and peak withstand current
- Temperature rise
- Internal arc capability
- Dielectric test
- Making and breaking capacity of circuit-breaker
- Earthing switch making capacity
- Mechanical operations of circuit-breaker and line disconnector
- IP protection degree

IEC routine factory tests

- Visual inspection and check
- Mechanical sequence operations
- Cabling check
- Electrical sequence operations
- Power frequency withstand voltage
- Measurement of the resistance of the main circuits
- Secondary insulation test

Description of IEC type tests

Short-time and peak withstand current

The test shows that the main power and the earthing circuits resist the stresses caused by the passage of the short-circuit current without any damage.

It should also be noted that both the earthing system of the withdrawable circuit-breaker and the earthing busbar of the switchgear are subjected to the test.

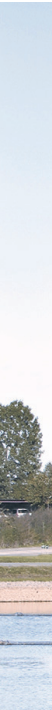
The mechanical and electrical properties of the main busbar system and of the top and bottom branch connections remain unchanged even in the case of a short-circuit.

Temperature rise

The temperature rise test is carried out at the rated current value of the switchgear unit and shows that the temperature does not become excessive in any part of the switchgear unit. During the test, both the switchgear and the circuit-breaker or contactor it may be fitted with are checked.

Internal arc capability

Please refer to chapter Safety



Dielectric test

These tests verify that the switchgear has sufficient capability to withstand the lightning impulse and the power frequency voltage. The power frequency withstand voltage test is carried out as a type test, but it is also a routine test on every switchgear unit manufactured.

Circuit-breaker making and breaking capacity

The circuit-breaker or contactor is subjected to the rated current and short-circuit current breaking tests.

Furthermore, it is also subjected to the opening and closing of capacitive and inductive loads, capacitor banks and/or cable lines.

Earthing switch making capacity

The UniGear 500R switchgear can be supplied with a dedicated earthing switch only for main busbar earthing.

This earthing switch can be closed under short-circuit. In actual fact, the earthing switch is normally interlocked to avoid being operated on circuits which are still live.

However, should this happen for any one of several reasons, safety of the personnel operating the installation would be fully safeguarded.

Mechanical operations

The mechanical endurance tests on all the operating parts ensures the reliability of the apparatus. General experience in the electrotechnical sector shows that mechanical faults are one of the most common causes of a fault in an installation.

The circuit-breaker is tested by carrying out a high number of operations - higher than those which are normally carried out by installations in the field.

Furthermore, the switchgear components are part of a quality control program and samples are regularly taken from the production lines and subjected to mechanical life tests to verify that the quality is identical to that of the components subjected to the type tests.

Partial discharge

UniGear 500R switchgear has been tested against partial discharge in order to find dielectric breakdown of a small portion of a solid electrical insulation system under high voltage stress.

IP degree and impact test

The IP protection degree is the resistance offered by UniGear 500R against penetration of solid objects and liquids. This degree of resistance is indicated by the prefix IP followed by two characters (i.e. IP4X).

The first number identifies the protection degree against the entrance of solid objects, the second one is related to liquids.



UniGear 500R

Safety

When developing modern medium voltage switchgear, personnel safety must necessarily take priority.

This is why UniGear 500R switchgear has been designed and tested to withstand an internal arc due to a short-circuit current of the same current level as the maximum short-time withstand level. The tests show that the metal housing of UniGear 500R switchgear is able to protect personnel near the switchgear in the case of a fault which evolves as far as striking an internal arc.

An internal arc is a highly unlikely fault, although it can theoretically be caused by various factors, such as:

- Insulation defects due to quality deterioration of the components. The reasons can be adverse environmental conditions and a highly polluted atmosphere.
- Overvoltages of atmospheric origin or generated by the operation of a component
- Inadequate training of the personnel in charge of the installation
- Breakage or tampering of the safety interlocks
- Overheating of the contact area, due to the presence of corrosive agents or when the connections are not sufficiently tightened
- Entry of small animals into the switchgear (i.e. through cable entrance)
- Material left behind inside the switchgear during maintenance activities

The characteristics of the UniGear 500R switchgear notably reduce the incidence of these causes for faults, but some of them may not be eliminated completely.

The energy produced by the internal arc causes the following phenomena:

- Increase in the internal pressure
- Increase in temperature
- Visual and acoustic effects
- Mechanical stresses on the switchgear structure
- Melting, decomposition and evaporation of materials

Unless suitably protected, these phenomena have very serious consequences for the personnel, such as wounds (due to the shock wave, flying parts and the doors opening) and burns (due to emission of hot gases).

The internal arc test verifies that the compartment doors remain closed and that no components are ejected from the switchgear even when subjected to very high pressures, and that no flames or incandescent gases penetrate, thereby ensuring safety of the personnel near the switchgear.

The test also ensure that no holes are produced in external accessible parts of the housing, and finally, that all the connections to the earthing circuit remain intact, hence guaranteeing the safety of personnel who may access the switchgear after the fault.

The IEC 62271-200 Standard describes the methods to be used for carrying out the test and the criteria which the switchgear must conform to.

UniGear 500R switchgear fully conforms to all the five criteria indicated by the IEC standards.

The IAC classification is proved by the test according to the following designations:

- General: classification IAC (Internal Arc Classified)
- Accessibility: A, B or C (switchgear accessible to authorized personnel only (A), to all (B), not accessible due to installation (C))
- F, L, R: access from the front (F – Front), from the sides (L – Lateral) and from the rear (R – rear)
- Test values: test current in kiloamperes (kA), and duration in seconds (s)

The parameters of each specific plant mean that evacuation of the hot gases and incandescent particles must be checked very carefully in order to ensure and maintain personnel safety.

Fault limiting systems

The structure of the UniGear 500R switchgear offers complete passive type protection against the effects of a fault due to an internal arc for a time of 1 second up to 31.5 kA for IEC version and 25 kA for ENA version.

ABB has also developed excellent active protection systems which allow very important objectives to be achieved:

- Detection and extinction of the fault, normally in less than 100 ms, which improves network stability
- Limitation of damage on the apparatus
- Limitation of outage time for the switchgear unit

For active protection against an internal arc, devices consisting of various types of sensors can be installed in the various compartments, which detect the immediate outburst of the fault and carry out tripping of the circuit-breakers. The fault limiting systems are based on sensors which use the pressure or light generated by the arc fault as trigger for fault disconnection.

ITH

The ITH sensors consist of micro-switches positioned on the top of the switchgear near the gas exhaust flaps of the three power compartments (busbars, circuit-breaker and cables).

The shock wave makes the flaps open and operate the micro-switches connected to the shunt opening release of the circuit-breaker. Total tripping time is 75 ms (15 ms ITH + 60 ms circuit-breaker).

TVOC

This system consists of an electronic monitoring device located in the low voltage compartment which is connected to optic sensors. These are distributed in the power compartments and are connected to the device by means of optic fibres. When a certain pre-set light level is exceeded, the device opens the circuit-breakers.

To prevent the system from intervening due to light occasionally generated by external phenomena (flash of a camera, reflections of external lights, etc.), current transformers can also be connected to the monitoring device.

The protection module only sends the opening command to the circuit-breaker if it receives the light and short-circuit current signal simultaneously.

Total tripping time is 62 ms (2 ms TVOC + 60 ms circuit-breaker).

REA

This system offers the same functionality as TVOC. The REA system consists of the main unit (REA 101) and optional extension units (REA 103, 105, 107) which make it possible to create customized solutions.

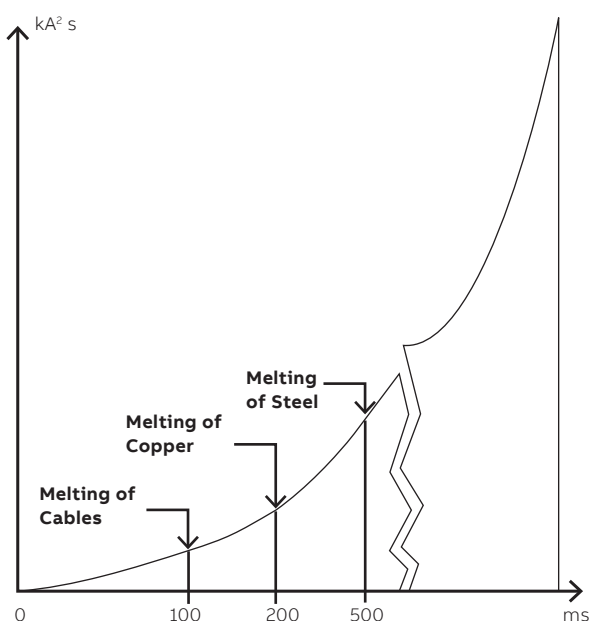
Total tripping time is 62,5 ms (2,5 ms REA + 60 ms circuit-breaker).

Arc protection in IED

615 series, 620 series and REX640 IEDs (Intelligent Electronic Device) can optionally be fitted with a fast arc flash protection. It offers a two-to three-channel arc-fault protection system for arc flash supervision of the circuit breaker, cable and busbar compartment of switchgear panels.

Total tripping time is 72 ms (12 ms IED + 60 ms circuit-breaker).

—
Arc duration and
damage caused



UniGear 500R

Safety

UniGear 500R switchgear is fitted with all the interlocks and accessories needed to guarantee the highest level of safety and reliability for both installation and personnel.

Interlocks

The safety mechanical interlocks are standard ones [1÷6], please see the dedicated table on next page.

They are set out by the IEC standards and are therefore necessary to guarantee the correct operation sequence.

ABB safety interlocks guarantees the highest level of reliability, even in the case of an accidental error, and enables highest operator safety system of interlocks.

Keys

The use of key interlocks is very important in realizing the interlocking logics between panels of the same switchgear, or of other medium-, low- and high- voltage switchgear.

The logics are realized by means of distributors or by ringing the keys.

The disconnecter can be locked in disconnected [7] or earthed position [8] and the relevant lock key can only be removed with the disconnecter in the defined positions.

When the UniGear 500R is fitted with front voltage transformers with fuses (ENA version) the cable door is interlocked [9] with the earthing position of the disconnecter; only when this apparatus is in that position it is possible access the cables side.

The closing [10] and opening [11] operations of the main busbars earthing switch can be locked by means of keys.

Padlocks

The opening and closing of the circuit-breaker can be prevented by applying the padlocks to the relevant push-buttons [12-13] on the front panel. The padlock can also be applied to the connected [14] and earthed [15] position of the disconnecter. In the ENA version the cable test cover it is interlocked with disconnecter positions and can also be padlocked [16].

UniGear 500R switchgear is preset for using padlocks with a 4 to 8 mm diameter.

Locking magnets

The locking magnets enable automatic interlocking logics without human intervention. The operation with disconnecter [17] and the circuit-breaker [18] can be prevented.

This magnet can also be applied to the earthing switch [19] of busbar applications; also in this case it can prevent operation.

The locking magnets operate with active logics and therefore the lack of auxiliary voltage leaves interlocking system active (in safety condition).

Standard safety interlocks (mandatory)

Type	Description	Condition to be met
1	Closing of the circuit-breaker	Line disconnector operating lever removed
2	Movement of the line-disconnector	Circuit-breaker in OFF position
3	Opening of the line-disconnector from EARTH position	Circuit-breaker in OFF position
4	Opening of the line-disconnector from EARTH position	Test cable door closed (ENA version only)
5	Opening of the test cable cover (ENA version only)	Line disconnector in earth position and CB in ON position
6	Opening of the earthing busbar line-disconnector	Circuit-breaker in OFF position

Keys (on request)

7	OFF position of line-disconnector
8	Earth position of line-disconnector
9	Cable door with front VTs (ENA version only)
10	Earthing switch ON lock (top busbar application)
11	Earthing switch OFF lock (top busbar application)

Padlocks

12	ON circuit-breaker push-button
13	OFF circuit-breaker push-button
14	Line-disconnector in ON position
15	Line-disconnector in earth position
16	Cable testing device (ENA version only)

Locking magnets (on request)

17	Line-disconnector operation	Magnet energized
18	Circuit-breaker operation	Magnet energized
19	Earthing switch operation (top busbar application)	Magnet energized

UniGear 500R

Vacuum circuit-breaker

Vmax removable vacuum circuit-breaker

Vmax medium voltage circuit-breakers are the synthesis of ABB technology in designing and constructing vacuum interrupters and of the excellence of design, engineering and production of the circuit-breakers. They find their ideal use in UniGear 500R.

The ratings are up to 17.5 kV, 2 000 A and 31.5 kA. Vmax circuit-breakers are used in electrical distribution for control and protection of cables, overhead lines, transformer and distribution substations, motors, transformers, generators and capacitor banks.

Insulating monobloc

The structure of Vmax is particularly innovative since instead of have three distinct separate poles, it has a single insulating monobloc where the three vacuum interrupters are housed. The monobloc and operating mechanism, of the mechanical type with a spring for operating energy storage, are fixed to a sturdy metallic frame.

The compact structure ensures the same sturdiness and mechanical reliability as a traditional circuit-breaker consisting of an operating mechanism/pole base cover and three separate poles.

The low speed of the contacts together with the reduced run of the contacts, limit the energy required for operation, resulting in extremely limited wear on the circuit-breaker. This means the circuit-breaker requires limited maintenance.

The interrupters of the Vmax medium voltage circuit-breakers are the same as those used in the VD4 and VM1 series.

The Vmax series therefore provides the same characteristics as the vacuum series mentioned above, that is, interruption of the currents without arc chopping and overvoltages and extremely rapid recovery of the dielectric properties after the interruption.

Operating mechanism

The Vmax series is fitted with a mechanical operating mechanism of simple conception and use, derived from the same mechanical operating mechanism which equips the VD4 series.

The stored energy operating mechanism with free trip allows opening and closing operations independent of the operator.

The spring system of the operating mechanism can be recharged both manually and by means of a geared motor. Opening and closing of the apparatus can take place both by means of the push-buttons located on the front of the panel, and by means of the electric releases (shunt closing, shunt opening and undervoltage).

The circuit-breaker is always fitted with a mechanical anti-pumping device to prevent repeated sequences of opening and closing operations following simultaneous and maintained opening and closing commands (local and/or remote).

Apparatus-operator interface

The front part of the circuit-breaker provides the user interface. It features the following equipment:

- ON pushbutton
- OFF pushbutton
- Operation counter
- Indicator of the circuit-breaker open and closed state
- Indicator of the charged or discharged state of the operating mechanism springs
- Manual charging device for the operating mechanism springs
- Override selector of the undervoltage release (optional)

Standards

- IEC 62271-100 for the circuit-breaker
- ENA TS 41-36 UK Energy Network Association technical specification for distribution switchgear



UniGear 500R

Instrument transformers

—
01 Current
transformer TPU
—
02 Voltage
transformer TJC
—
03 Ring core current
transformers

Selection of current transformer type must take into account the level of primary current as follows:

- 50 A - 200 A: Block type CTs or sensors
- 250 A - 1 250 A: Ring core, block type CTs or sensors
- 1 250 A - 2 000 A: Block type CTs or sensors

Ring core current transformers

The ring core current transformer can be air- or resin- insulated and is used to supply metering and protection devices.

The transformer have either a closed or split core. The ring core transformer with split core is used for detecting earth fault currents and can be easily used around the incoming cables. Air insulated ring core transformers are used for measuring the phase current and are placed over insulated CT rod.

They conform to the IEC 61869-1, IEC 61869-2 which have fully replaced previous standard IEC 60044-1 and ENA TS 41-36 Standards.

Block type current transformers

The block type current transformers are epoxy resin insulated and used to supply the measurement devices and protection instruments. These transformers have a wound core with one or more cores, with performance and accuracy classes suitable for the installation requirements.

They conform to the IEC 61869-1, IEC 61869-2 which have fully replaced previous standard IEC 60044-1 and ENA TS 41-36 Standards.

Their dimensions are in accordance with the DIN 42600 Standard, in the Medium and Long Size versions up to 2 000 A.

The current transformers can also be provided with a capacitive socket for connection to voltage signalling devices.

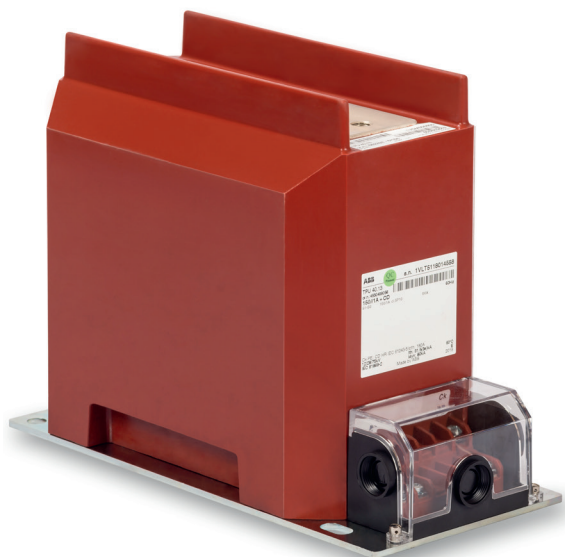
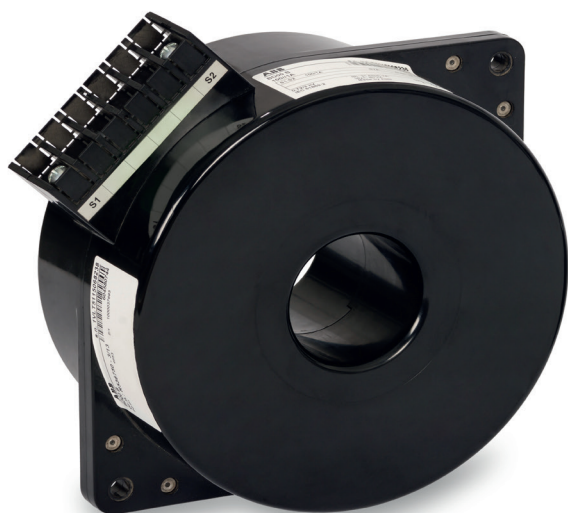
The current transformers are normally fitted on the load side of the apparatus compartment for measurement of the phase currents of the switchgear unit. The ABB range of current transformers is designated TPU.

Voltage transformers

The voltage transformer is epoxy resin insulated and used to supply metering and protection devices.

The transformer can be designed as single or double pole insulated. The single pole insulated design is available in fused solution with the fuse accessed from the front and top. They conform to the IEC 61869-1, IEC 61869-3 which have fully replaced previous standard IEC 60044-2 and ENA TS 41-36 standards and its dimensions with DIN 42600 standard.

They are available for fixed assembly (rear arrangement).

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01—
02—
03

UniGear 500R

Current and voltage sensors

The sensor technology has been used in ABB since the beginning of the 1990s and there are more than 120 000 sensors installed and operating to date.

—
01 Current sensors
KECA 250 B1
—
02 Voltage sensor
KEVA 17.5 B20

Sensors based on advanced measurement principles have been developed as successors to conventional instrument transformers in order to achieve significant reduction in dimensions, increase of safety and to provide greater rating standardization with a wider functionality range. Conventional instrument transformers with magnetic cores are based on well-known principles that have been utilized with all their advantages as well as limitations for more than 120 years. However the connected equipment (protection relays) has significantly changed during the last 20 years. New protection relays place different requirements on primary measurement equipment (instrument transformers) compared to classic electromechanical relays. These new requirements also open up the opportunity for the utilization of advanced measurement principles that offer a wide range of additional benefits. Sensors open up a way for current and voltage signals needed for the protection and monitoring of medium voltage power systems. These advantages can be fully used in connection with modern protection relays.

Sensor characteristics

ABB current and voltage sensors are designed without the use of a ferromagnetic core. The current sensor is based on the principle of Rogowski coil, voltage sensor uses the principle of resistive voltage divider. Sensor technology brings several important benefits for the user and the application.

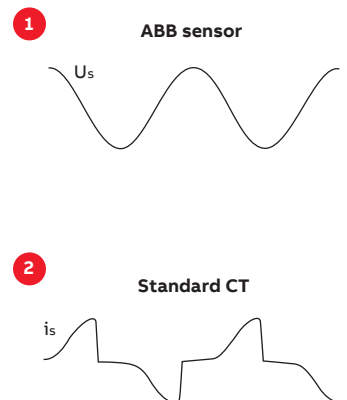
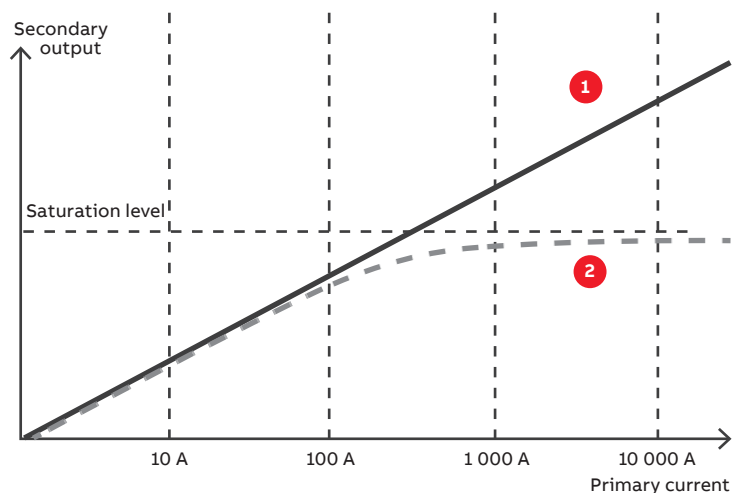
The main benefit is that the behavior of the sensor is not influenced by magnetizing curve which results in a highly accurate and linear response across a wide dynamic range of measured quantities.

The linear and highly accurate characteristic curve of the sensor across its full operating range enables several metering and protection classes to be combined in one particular winding.

Energy savings solution

The sensor technology means no transfer of power from the primary to the secondary side, which means negligible power losses. Therefore, the sensors exhibit extremely low energy consumption the value of which is just a fraction of what is converted into heat in a conventional instrument transformer.

—
Performance
comparison between
conventional current
transformer and
current sensor



This fact contributes to significant energy savings during the system's entire operating life, supporting world-wide efforts to reduce energy consumption.

Easy switchgear integration solution

Since the sensor elements are particularly small and the same elements are used for both measurement and protection, the current and voltage sensors can easily be integrated in the switchgear.

These facts enable the sensors to be designed in a highly optimal way, which contributes to a high level of switchgear simplification.

Indoor current sensors

Current measurement in KECA sensors is based on the Rogowski coil principle.

KECA 250 B1

For dynamic current measurement (protection purposes) the ABB sensors KECA 250 B1, fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current I_{th} (31.5 kA).

With KECA 250 B1 sensors, measuring class 0.5 is reached for continuous current measurement in the extended accuracy range from 5 % of the rated primary current I_{pr} not only up to 120 % of I_{pr} (as being common for conventional current transformers), but even up to the rated

continuous thermal current I_{cth} (2 000 A).

That provides the possibility to designate the corresponding accuracy class as 5P125, proving excellent linearity and accuracy measurements.

Technical parameters

- Continuous thermal current: 2 000 A
- Rated primary current: 250 A / 150 mV @ 50 Hz
- Rated primary current: 250 A / 180 mV @ 60 Hz
- Accuracy class: 0.5 / 5P125

Indoor voltage sensors

Voltage measurement in the KEVA sensor is based on the resistive divider principle.

KEVA 17.5 B20

KEVA B sensor can be used in all applications up to the voltage level 17.5 kV.

The sensor fulfills requirements of accuracy class 0.5 for measurement purposes and accuracy class 3P for protection purposes.

Technical parameters

- Rated primary voltage: 15/ $\sqrt{3}$ kV
- Rated power frequency withstand voltage: 38 (42) kV
- Rated lightning impulse withstand voltage: 95 kV
- Transformation ratio: 10 000:1
- Accuracy class: 0.5 / 3P



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01



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02

UniGear 500R

Cable terminations

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01 Cable termination
type SOT 10 with
bi-metallic cable
lug type SKSB

—
02 Cable termination
type SOT 24 with
bi-metallic cable
lug type SKSB

Terminations for polymer insulated cables 1 – 17.5 kV

It is crucial that power cables connecting the switchgear are terminated properly, and for this purpose, ABB has developed an excellent range of easy-to-use products for preparation and termination of cables.

MV power cables are normally designed with a conductor of aluminium or copper, polymer insulation, an extruded insulation screen, a metallic screen, armouring (optional) and a polymer outer jacket.

To enable safe and reliable current carrying properties, it is necessary to achieve sufficient mechanical connection between the cable conductor and the busbar. ABB offers mechanical cable lugs designed to fit the cable conductor by bolting. It is also essential to guide the electrical field of the cable correctly, and ABB offers Cold Applied terminations, made of rubber, that create an active pressure around the cable. Furthermore, if the cable is designed with another type of metallic screen than copper wires, special earthing kits must be used to achieve proper handling of possible fault currents. The armouring of the cable must have the same earth potential as the cable screen, so it might be necessary to use additional connection accessories that are also available. Detailed information can be found in separate technical information for cable accessories.

Applications and features

Depending on the cable design, it is necessary to use the correct type of cable accessory. When single core cables are designed with copper wire screen only, it is sufficient to use just a cable lug and a termination that fits the actual size of the cable.

The benefit of Cold Applied accessories is that no heat or open flame is necessary for installation (except for branch seals on 3-core cables). After the cable is prepared, the termination is simply slid on without any tools. If a three core cable is used, or a cable with copper tape screen, or aluminium foil screen, or a cable with armouring; then additional material is required.

Another very important factor is correct cable preparation and ABB also offers excellent cable preparation tools.

Recommended cable termination products

The pre-moulded cable termination type SOT can be used on any polymer cable irrespective of design or conductor size. Type SOT 10 is designed for 7.2 kV cables, while type SOT 24 covers 12 and 17.5 kV. A few variants of terminations fit a wide range of cable sizes. Extra material such as earthing kits, crutch seals for 3-core cables and screen potential material for cable armouring is also covered by the ABB range of products. Please contact your ABB Sales Representative for more information.



Designation and sizes					
Voltage level	Designation	Diameter over insulation [mm]	Conductor size [mm ²]		
[kV]			7.2 kV	12 kV	17.5 kV
1 - 7.2	SOT 101	10.5 - 15	10 - 35	-	-
1 - 7.2	SOT 102	12.9 - 25.8	50 - 150	-	-
1 - 7.2	SOT 103	21.4 - 34.9	185 - 300	-	-
12 - 17.5	SOT 241 A	11 - 15	-	10 - 35	-
12 - 17.5	SOT 241	15 - 25	-	50 - 185	50 - 150
12 - 17.5	SOT 242	24 - 39	-	240 - 500	185 - 300
12 - 17.5	SOT 242 B	38 - 54	-	630 (*)	630 (*)

(*) Can be mounted on cables with 800 and 1000 mm² by using silicone rubber tape 2342 as top seal

UniGear 500R

Distribution automation

ABB's power protection philosophy

Having delivered protection relays to more than 100 countries, ABB fully understands the need for diverse protection philosophies that meet local legislation, safety requirements and engineering practice. Therefore, ABB has developed a power protection philosophy that not only serves the specific needs and requirements of diverse power systems, but also creates confidence and peace of mind for both the power system owners and users.

The main purpose of a protection relay system is to recognize any abnormal power system condition(s), or abnormally operating system component(s). Based on the information gathered, the protection system will initiate corrective actions that return the system to its normal operating state. This provides a safe environment for all.

Protection relays are activated when something abnormal has happened in the power system; they do not prevent network faults from arising. Selecting the right protection functions and methods improves the performance and the reliability of the protection system, thus minimizing the effects of network faults and preventing the disturbance from spreading to the healthy parts of the network.

Advantages of a complete protection system

Close attention must be paid to operating speed, sensitivity, selectivity and reliability of the protection system. There is a strong correlation between the operating speed of the protection

system and the damage and danger caused by a network fault. Substation automation provides remote control and monitoring capabilities, which speed up the location of faults and the restoration of the power supply. Fast operation of the protection relays also minimizes post-fault load peaks. Together with voltage dips, post-fault load peaks increase the risk of the disturbance spreading to healthy parts of the network. The sensitivity of the protection must be adequate to detect relatively high resistance earth faults and short-circuits in the most distant parts of the network. Reliable selectivity is essential to limit the loss of power supply to as small a part of the network as possible, and to allow the faulted part of the network to be reliably located. Corrective actions can then be directed to the faulty part of the network, so that the power supply can be restored as quickly as possible.

The protection system must have a high degree of reliability. This also means that if, for example, the circuit breaker (CB) fails to operate, the back-up protection will clear the fault. Substation automation (SA) puts the operator in complete control of the substation. In addition, SA improves the power quality of the transmission and distribution network under normal operation, but especially in a disturbance situation and during substation maintenance activities. An SA or SCADA brings the full benefits of digital technology into protection and control of the networks. The protection relays are easily set-up and parameterized through easy and safe access from the operator's workplace.



UniGear 500R

Distribution automation

Relion® protection and control relays

The Relion® product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications – from generation and interconnected transmission grids over primary distribution to secondary distribution kiosks.

The Relion protection relays are deeply rooted in ABB's vast experience of developing successful protection and control relays. These relays have been developed during many years and are built on the experience gathered from wide ranging application and functionality requirements of ABB's customers globally.

To ensure interoperable and future-proof solutions, Relion products have been designed to implement the core values of the IEC 61850 standard. The genuine implementation of the IEC 61850 substation modelling and communication standard covers both vertical and horizontal information exchange between protection relays and external systems. The protection and control IED manager PCM600 provides versatile functionality throughout the life cycle of all Relion protection and control relays. PCM600 is IEC 61850 compliant, which ensures smooth engineering of the relays and enables information exchange with other IEC 61850 compliant tools.

With these products, you benefit from ABB's leading-edge technology, global application knowledge and experienced support network. The Relion technology is leading the way and setting the future trends in the field of protection and control systems.

Relion 605 series

The Relion 605 series protection relays feature basic devices that fulfill the essential protection needs in medium-voltage networks. The series is best suited for secondary distribution applications. These relays are well-known for their straight forward approach to protection.

Relion 611 series

The Relion 611 series protection relays are powerful and very easy-to-use protection devices in a compact design. The 611 series relays are delivered with a pre-configured application, which can be adapted, to a limited extent, to application-specific needs. The series offers pre-configured solutions, which are ideally suited for utility distribution and industrial applications.

Relion 615 series

The Relion 615 series protection relays can be defined as a compact and versatile solution for power distribution in utility and industrial applications. The 615 series provides standard configurations, which allows you to easily adapt and set-up your applications, still allowing you to adapt the configuration according to application-specific needs. The 615 series combines compactness and powerful features in one smart package.

Relion 620 series

The Relion 620 series protection relays increase flexibility in demanding utility and industrial applications for power distribution. They are delivered with example configurations to ease adaptation into your specific applications. The series offers customization possibilities, which supports higher levels of standardization in the applications. The 620 series extends the hardware possibilities further compared to the 615 series.

Relion 630 series

The pre-configured Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The 630 series protection relays contain pre-configured application configurations, which can be freely tailored to meet specific requirements for distribution applications.

Relion 650 series

The Relion 650 series offers ease of use from ready-to-use solutions. The 650 series protection relays provide optimum 'off-the-shelf' solutions. These relays are equipped and configured with complete protection functionality and default parameters to meet the needs of a wide range of applications within generation, transmission and sub-transmission.

Relion 670 series

The Relion 670 series protection and control relays provide versatile functionality, as well as maximum flexibility and performance to meet the highest requirements of any application in generation, transmission and sub-transmission protection systems. The 670 series relays are available as pre-configured and fully customized relays.

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>.

01 Relion protection and control product family



UniGear 500R

Distribution automation

Feeder protection

Feeder protection, or more exactly protection for overhead lines and cables, is the most used type of protection in power systems. The protection has to ensure that the power grid continues to supply energy. In the event of a fault, it has to be prevented from spreading to healthy parts of the network. The relays also have to minimize the damage to the cables and other connected equipment, as well as ensure safety for operating personnel.

ABB has a large number of feeder protection relays. There are several multifunctional protection relays for different application ranges. Among the protection relays there are some used for general feeder protection (protection against overcurrent) and as back-up protection. There are also more specialized relays, for example, for line differential protection.

The selected protection scheme has to fulfill the application specific requirements regarding sensitivity, selectivity and operating speed. The protection requirements are mainly determined by the physical structure of the network. In most cases the requirements, listed above, can be fulfilled with non-directional/directional overcurrent protection functions.

In power networks with a more complex structure, more advanced protection functions, such as, distance protection or line differential protection, may have to be introduced.

The purpose of the over and undervoltage protection system is to monitor the network's voltage level. If the voltage level deviates from the target value by more than the permitted margin for a specific time period, the voltage protection system limits the duration of the abnormal condition and the stresses caused to the power system or its components.

To prevent major outages due to frequency disturbances, sub-stations are usually equipped with underfrequency protection relays, which in turn, control various load-shedding schemes.

A specific area for applying line differential protection is emerging with feeder applications requiring an absolutely selective unit protection system. The zone-of-protection for a line differential protection system is the feeder section, defined by the location between the current measurement devices (current transformers or Rogowski coils). In certain cases there can be a power transformer within the protection zone. Unit protection guarantees exact and fast isolation of the fault and allows continued operation of the unaffected part of the power network.

These are just a few examples of the major protection functions for feeders. More details can be found in the technical documentation available online for ABB's protection and control devices.

Product offering

The recommended products for feeder protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 605 series

The Relion 605 series protection relays feature basic devices that fulfill the essential protection needs in medium-voltage networks. These relays are well-known for their straight forward approach to protection.

Relion 611 series

The Relion 611 series offers a pre-configured solution for power distribution in utility and industrial applications. The series is a suitable choice for protection and control of standard feeders. The protection relays are delivered pre-configured for easier and faster relay engineering and shorter time-to-operation.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The protection relays are delivered with a standard configuration for easier and faster relay engineering and shorter time-to-operation.

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01 Basic range:
Feeder protection REF601
and self-powered feeder
protection REJ603

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02 Medium range:
Feeder protection
and control REF611,
Feeder protection
and control REF615

—
03 High range:
Feeder protection
and control REF620,
Feeder protection
and control REF630

Relion 620 series

The Relion 620 series offers flexibility and performance for demanding power distribution in utility and industrial applications. The series offers wider application coverage in one product compared to the 615 series, which enables wider standardization of the product type in your application. The 620 series protection relays are delivered with an example configuration, which helps adaptation to user specific requirements.

Relion 630 series

The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet the specific requirements for also the most demanding distribution applications.

For more information, please refer to the following documentation:

- Feeder Protection REF601 Product Guide
- Self-Powered Feeder Protection REJ603 Product Guide
- Feeder Protection and Control REF611 Product Guide
- Line Differential Protection and Control RED615 Product Guide
- Feeder Protection and Control REF615 Product Guide
- Feeder Protection and Control REF620 Product Guide
- Feeder Protection and Control REF630 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



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03

UniGear 500R

Distribution automation

Transformer protection

The power transformer is an important component and one of the most valuable discrete units in power distribution networks. High availability of the power transformer is of particular importance for preventing disturbances in the power distribution system.

Although high-quality power transformers are very reliable, insulation breakdown faults occasionally occur. These faults appear as short circuits and/or earth faults. They tend to cause severe damage to the windings and transformer core. The damage is proportional to the fault clearing time, so the power transformer must be disconnected as quickly as possible.

For repair, the power transformer has to be transported to a workshop, which is a very time-consuming process. The operation of a power network, where the power transformer is out of service, is always cumbersome. Therefore, a power transformer fault often constitutes a more severe power system fault than a line fault, which usually can be rectified rather quickly. It is extremely important that fast and reliable protection relays are used to detect transformer faults and initiate tripping.

The size, voltage level and importance of the power transformer determine the extent and choice of monitoring and protection devices to be used to limit the damage, when a fault occurs. Compared to the total cost of the power transformer and the costs caused by a power transformer fault, the cost of the protection system is negligible.

Product offering

The recommended products for transformer protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The series covers two winding transformer application and automatic voltage regulator function in separate product types. Each protection relay is delivered with a standard configuration for easier and faster relay engineering and shorter time-to-operation.

Relion 620 series

The Relion 620 series offers flexibility and performance for demanding power distribution in utility and industrial applications. The series offers wider application coverage, including transformer application and automatic voltage regulator, in one product. Compared to the 615 series, it enables wider standardization of the product type in the application. The 620 series relays are delivered with an example configuration, which can be pre-adapted to user specific requirements.

Relion 630 series

The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet the specific requirements for also the most demanding distribution applications. In one easily scalable hardware solution, it includes extensive transformer protection and automatic voltage regulator functions.

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01 Transformer protection and control RET615, Transformer protection and control RET620 and Transformer protection and control RET630

For more information, please refer to the following documentation:

- Transformer Protection and Control RET615 Product Guide
- Voltage Protection and Control REU615 Product Guide
- Transformer Protection and Control RET620 Product Guide
- Transformer Protection and Control RET630 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



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UniGear 500R

Distribution automation

Motor protection

Motor protection is generally expected to provide overcurrent, unbalance, earth-fault and short-circuit protection of the motor. However, the fundamental issue for motors is thermal protection, as overheating is the worst threat.

Motors need to be protected not only against electrical faults, but also against any improper usage. ABB's solutions focus on advanced thermal protection that prevents improper use. Overload conditions of short duration mainly occur during start-up. Improper use of running motors does not necessarily damage the equipment, but shortens its life span. Therefore, a reliable and versatile motor protection system not only protects the motor - it also prolongs its life cycle, which contributes to improving the return of investment of your motor drive.

Product offering

The recommended products for motor protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 605 series

The Relion 605 series offers a compact solution for the protection of medium-voltage and low-voltage asynchronous motors in the manufacturing and process industry. The relays offer pre-configured functionality, which facilitates easy and fast commissioning of the switchgear. The relay can be used with both circuit-breaker and contactor-controlled motor drives.

Relion 611 series

The Relion 611 series offers a pre-configured solution for power distribution in utility and industrial applications. This series is a suitable choice for protection and control of small asynchronous motors/drives. The protection relays are delivered pre-configured for easier and faster relay engineering and shorter time-to-operation.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The series is a suitable choice for protection and control of asynchronous motors. Each protection relay is delivered with standard configuration, for easier and faster relay engineering and shorter time-to-operation.

Relion 620 series

The Relion 620 series offers flexibility and performance for demanding power distribution in utility and industrial applications. Compared to the 615 series, the 620 series offers wider application coverage in one product, which enables wider standardization of the product type in your application. The protection relay is delivered with an example configuration, which can be pre-adapted to your specific requirements.

Relion 630 series

The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet specific requirements for also the most demanding distribution applications. In one easily scalable hardware solution, it includes extensive motor protection including differential protection function.

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01 Basic range:
Motor protection and
control REM601

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02 Medium range:
Motor protection
and control REM611,
Motor protection and
control REM615

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03 High range:
Motor protection
and control REM620,
Motor protection and
control REM630

For more information, please refer to the
following documentation:

- Motor Protection and Control REM611 Product Guide
- Motor Protection and Control REM615 Product Guide
- Motor Protection and Control REM620 Product Guide
- Motor Protection and Control REM630 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



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UniGear 500R

Distribution automation

Generator protection

Generators or generating units constitute one of the most crucial parts in a power system, making it essential to use a proper protection scheme. A generator has more failure modes than any other component in the power system. It is very important that the protection system detects all faults and that it does so quickly, as they may cause injury to personnel and damage to the equipment.

It is common practice that earth faults, short circuits and other severe faults must be detected by two independent protection devices. The fault must be cleared, even if one switching device fails to operate. The generator protection system must also provide adequate backup protection for the adjacent components.

A synchronous machine is a complex device, which can operate as a generator or as a motor. The armature/stator winding is arranged in three symmetrical phase belts in slots in the stator surface. The magnetic field intensity can be controlled via the DC-current in the rotor/field winding.

The protection of synchronous generators involves the consideration of more possible faults and abnormal conditions than the protection of any other power system component. We have to consider stator faults, rotor faults, abnormal operating conditions and faults in the connected power grid.

Today there are many and varying power station configurations. This makes the use of a uniform and standardized generator protection system very challenging. Besides the varying power station configuration, the following factors influence the design of the generator protection system:

- generator circuit-breaker or not
- earthing of the generator neutral
- location of the voltage transformers
- location of the current transformers

A rotating machine provides a classic application for differential protection. The generator differential protection gives a fast and absolutely selective detection of generator stator short circuits.

Product offering

The recommended products for generator protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The protection relays are delivered with a standard configuration for easier and faster relay engineering and shorter time-to-operation.

The series offers extensive interconnection and compact generator protection for both the generator and the prime mover in various small and medium-sized power plants.

Relion 630 series

The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet specific requirements for also the most demanding distribution applications. In one easily scalable hardware solution, it includes extensive protection for generator and generator-transformer units used in various power plants.

—
01 Generator protection
and control REG615,
Generator protection
and control REG630

For more information, please refer to the following documentation:

- Generator and interconnection protection REG615 Product Guide
- Generator Protection and Control REG630 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



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01



UniGear 500R

Distribution automation

Voltage protection

Overvoltage in a network occurs either due to the transient surges in the network or due to prolonged power frequency overvoltages. The overvoltage function can be applied to power network elements, such as generators, transformers, motors, busbar and power lines, to protect the system from excessive voltages that could damage the insulation and cause insulation breakdown.

Undervoltage and low voltage conditions are caused by abnormal operation or a fault in the power system. The undervoltage protection function is used to disconnect from the network devices, for example electric motors, which are damaged when subjected to service under low voltage conditions.

Additionally synchro-check function duration mode checks that the voltages on both sides of the circuit breaker are perfectly synchronized. It is used to perform a controlled reconnection of two systems, which are divided after islanding. It is also used to perform a controlled reconnection of the system after reclosing.

The frequency protection function uses positive phasesequence voltage to measure the frequency reliably and accurately. The system frequency stability is one of the main principles in distribution and transmission network maintenance. To protect all frequency-sensitive electrical apparatus in the network, operation above/below the allowed bandwidth for a safe operation should be prevented. To guarantee network frequency stability you need to apply underfrequency, overfrequency or load-shedding schemes.

Another important and common way of regulating the voltage in the power network is using a voltage regulator on the power transformer.

Product offering

The recommended products for voltage protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 611 series

The Relion 611 series offers a pre-configured solution for power distribution in utility and industrial applications. The REU611 is designed for overvoltage and undervoltage protection and additional 2-stage frequency protection. The protection relays are delivered pre-configured for easier and faster relay engineering and shorter time-to-operation.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The series is a suitable choice for protection and control of voltage based protection. REU615 standard configuration A is the ideal choice for voltage and frequency based protection, including synchro-check and load-shedding functionality. REU615 standard configuration B offers a dedicated relay with an automatic voltage regulator function for power transformers with on-load tap changer. Each protection relay is delivered with standard configuration, for easier and faster relay engineering and shorter time-to-operation.

Relion 620 series

The Relion 620 series offers flexibility and performance for demanding power distribution in utility and industrial applications. Compared to the 615 series, RET620 offers wider application coverage in one product, including voltage and frequency based protection with automatic voltage regulator function. The relays are delivered with an example configuration, which can be pre-adapted to user requirements.

—
01 Voltage protection
and control REU611,
Voltage protection
and control REU615

—
02 Feeder protection
and control REF620,
Feeder protection
and control REF630

Relion 630 series

The Relion 630 series protection relays feature flexible and scalable functionality to adapt to different needs in power distribution networks and industrial applications. The relays contain pre-configured application configurations, which can be tailored to meet specific requirements for also the most demanding distribution applications. In one easily scalable hardware solution, you gain load-shedding with automatic voltage regulator functions.

For more information, please refer to the following documentation:

- Voltage Protection and Control REU611 Product Guide
- Voltage Protection and Control REU615 Product Guide
- Transformer Protection and Control RET620 Product Guide
- Transformer Protection and Control RET630 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



01



02



UniGear 500R

Distribution automation

01 Capacitor bank protection and control REV615

Capacitor bank protection

Capacitors form an essential part of the network and must be properly protected against overloads, overcurrents or other distortion during their connection to the network.

Capacitor banks are used for reactive power compensation in utility substations and industrial power systems. Most of the loads connected to the distribution feeders have the power factor on the inductive side, for example, motors and arc furnaces. This reactive current component does not contribute the conversion into useful power, but it stresses the network components, introducing additional voltage drops and heat losses. The most favorable approach is to compensate the reactive current as close to the consumption as possible. The compensation can be done locally, at the place where it is needed, for example, at the factory or facility. It can also be done remotely by, for example, a utility organization.

Extra charges are always applied when excess level of reactive load is taken from the network. Therefore, the utilities have to evaluate the reactive power balance within their distribution network and do the necessary compensation at the most suitable location.

Product offering

The recommended products for capacitor bank protection are part of ABB's Relion® product family. The Relion product family offers the

widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 615 series

The Relion 615 series offers a compact and versatile solution for power distribution in utility and industrial applications. The series is a suitable choice for protection and control of capacitor banks. Additionally, it can be applied to harmonic filter protection. Each protection relay is delivered with a standard configuration, for easier and faster relay engineering and shorter time-to-operation.

For more information, please refer to the following documentation:

- Capacitor Bank Protection and Control REV615 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



01



Busbar protection

The last, but not least, part in electrical power systems is defined by the busbar application. The busbar is an aluminum or copper conductor supported by insulators that interconnects the loads and the sources of electric power. For example, in metal enclosed switchgear, it is represented by copper bars in the busbar compartment. The requirements for busbar protection in respect of immunity to mal-operation are very high. For busbar protection it is essential to employ a differential protection principle.

Product offering

The recommended products for busbar protection are part of ABB's Relion® product family. The Relion product family offers the widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

Relion 611 series

The Relion 611 series offers a pre-configured solution for power distribution in utility and industrial applications. It is a suitable choice for high-impedance busbar protection. The

protection relays are delivered pre-configured for easier and faster relay engineering and shorter time-to-operation.

For more information, please refer to the following documentation:

- Busbar Protection and Control REB611 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



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Distribution automation

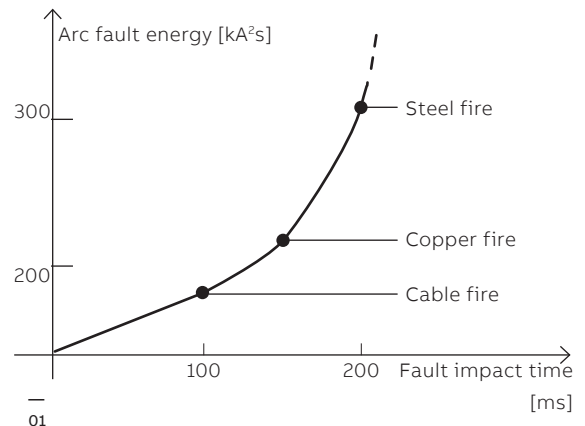
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01 Arc fault damage as
a function of the arc
fault energy and the
arc fault impact time

Arc fault protection

An electric arc short-circuit in a switchgear installation is normally caused by a foreign object entering the cubicle or by component failure. The arc causes an explosion-like heat and pressure effect, usually causing vast damage to the switchgear and in the worst-case scenario also injury to the operating personnel.

An adequate arc protection system protects your substation against arc faults via minimizing the burning time of the arc, thus preventing excessive heat and damage. It minimizes material damage and allows power distribution to be smoothly and safely restored. The system can also bring cost benefits even before an arc fault occurs. As older switchgear is more prone to arc faults, an arc protection system will effectively extend the life of your switchgear enhancing the return on your investment.

Sources of arcing may be insulation faults, mal-operating devices, defective bus or cable joints, overvoltage, corrosion, pollution, moisture, ferro-resonance (instrument transformers) and even ageing due to electrical stress. Most of these arc fault sources could be prevented by sufficient maintenance. However, regardless of precautions taken, human errors can lead to arc faults.



Time is critical when it comes to detecting and minimizing the effects of an electric arc. An arc fault lasting 500 ms may cause severe damage to the installation. If the burning time of the arc is less than 100 ms the damage is often limited, but if the arc is extinguished in less than 35 ms its effect is almost unnoticeable.

Generally applied protection relays are not fast enough to ensure safe fault clearance times at arc faults. The operation time of the overcurrent relay controlling the incoming circuit breaker may, for instance, have been delayed to hundreds of milliseconds for selectivity reasons. This delay can be avoided by installing an arc protection system. The total fault clearance time can be reduced to a maximum of 2.5 ms plus the circuit breaker's contact travel time. Further, when a cable compartment fault occurs, auto-reclosing can be eliminated by employing arc fault protection.

02 The REA system is a fast and flexible arc fault protection system for air-insulated low voltage and medium-voltage switchgear.

Product offering

The recommended products for arc fault protection is the arc fault protection system REA 101 with its extension units REA 103, REA 105 and REA 107 and protection and control relays from ABB's Relion® product family.

REA system

The REA system is a fast and flexible arc fault protection system for switchgears. This type of fast arc fault protection system is a natural constituent of modern switchgear panels, and a safety and security investment for older switchgear panels, to protect human lives and prevent or reduce material damage. The REA system can be described as the fastest operating arc fault protection system in ABB's product portfolio, with trip command time in less than 2.5 ms.

Relion 615 series and 620 series

The Relion® product family offers integrated arc fault protection in its widest range of products for the protection, control, measurement and supervision of power systems for IEC and ANSI applications.

The Relion 615 and 620 series offer integrated three channel arc fault protection – to protect human lives and prevent or reduce material damage of protected switchgear – for power distribution in utility and industrial applications. The arc fault protection function operates with high-speed outputs with operation times down to 4 ms.

For more information, please refer to the following documentation:

- Arc Fault Protection REA 101 main module Product Guide
- Arc Fault Protection REA 103 extension module Product Guide
- Arc Fault Protection REA 105 extension module Product Guide
- Arc Fault Protection REA 107 extension module Product Guide
- Feeder Protection and Control REF615 Product Guide
- Motor Protection and Control REM615 Product Guide
- Transformer Protection and Control RET615 Product Guide
- Voltage Protection and Control REU615 Product Guide
- Capacitor Bank Protection and Control REV615 Product Guide
- Feeder Protection and Control REF620 Product Guide
- Motor protection and control REM620 Product Guide
- Transformer Protection and Control RET620 Product Guide

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



UniGear 500R

Distribution automation

—
01 Substation
Management Unit
COM600S

Substation automation

ABB's protection and control relays are an integral part of substation automation systems. The substation automation system, together with the protection relays, lay the foundation for all the higher-level remote functions, such as advanced power system management and the monitoring of the condition of the equipment, when it is in service. Substation-level systems are easy to use and to adapt to customer-specific requirements.

Increased competition is driving many power providers to focus on system productivity, with the aim to reduce costs and increase customer satisfaction. To reach this goal, an upgrade of an aging infrastructure is usually involved. Updating to substation automation offers the opportunity to reduce operational and maintenance costs, increase plant productivity with the help of enhanced schemes, as well as condition monitoring for the apparatus (e.g., circuit breakers, power transformers).

Product offering

The COM600 series offers versatile substation management units. These units are deployed together with protection and control relays and other communication devices to realize smart substation and grid automation solutions in utility and industrial distribution networks. The COM600 series units perform the combined role of a user interface, a communication gateway and an automation platform in a single physical unit.

The COM600 series accommodates web technology-based functionality, which provides access to substation devices and processes via a web browser-based human machine interface (HMI). All standard substation monitoring and control aspects can be handled using the web-HMI.

The COM600 series integrates substation devices, like protection and control relays, substation controllers and meters, based on the IEC 61850 communication standard, as well as most other commonly used communication standards and legacy protocols. Seamless

connectivity can be established with gateway functionality between the substation devices and external higher-level systems such as the Network Control Center (NCC) or a process such as the Distributed Control System (DCS) using IEC 60870-5, DNP3, Modbus or OPC-based protocols.

The COM600 series hardware platform is based on ruggedized mechanics with no moving parts subject to wear and tear. The compact and robust design is well adapted to harsh environments.

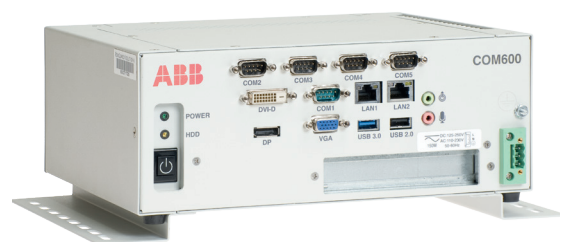
The COM600 series comprises of two products:

- COM600S for Substation Automation (for IEC and ANSI markets)
- COM600F for Feeder Automation (for ANSI markets only)

The COM600S has the capability to function as a combined substation HMI, gateway and process controller in a small to medium-sized substation automation installation. Its HMI feature enables substation monitoring and operations. It integrates various units to provide access to real-time data. It also records process data in its historian to enable access to past data. Its logic processor enables implementation of substation-level automation tasks. The gateway functionality provides a provision to communicate data from protection and control relays in the substation and COM600S itself to higher-level systems and vice versa.

For more information, please refer to the following documentation:

- COM600S Substation Management Unit Product Guide



Remote I/O concept

ABB's remote I/O concept introduces a new way of extending the I/O capabilities of protection relays. The concept is aimed at increasing the hardware functionality of the protection relays, while still maintaining the relay's compact design. This way remote I/O can be used, when it is needed. The information between the remote I/O units and the main protection relay is exchanged over the latest communication standard IEC 61850. This enables easy integration into the systems and is in line with the latest standards.

The remote I/O concept also benefits from installing the I/O units as close as possible to the place where the signals need to be digitalized, thus limiting extensive wiring within the switchgear, substation or plant. Digitalization of the signals allows users to use information wherever needed, without the need of installing additional auxiliary relays or terminals. IEC 61850 enables signals supervision, thus faster recognition of any errors and proactive operation, if these conditions happen during a critical process.



Product offering

The remote I/O unit RIO600 is designed to expand the digital and analog I/O of ABB's Relion® series protection relays and to provide I/O for the COM600 series devices using IEC 61850 communication.

RIO600 is designed using a modular architecture where the amount and type of I/O ports can be added through modules. The RIO600 modules can be stacked on a standard DIN rail to achieve the required configuration.

RIO600 is built on an industrial hardware platform, which provides the same reliability, performance and real-time functionality as ABB's protection relays, withstanding extreme temperatures, electromagnetic interference and stringent industry standards.

RIO600 provides an additional I/O within the switchgear itself by using the Ethernet-based IEC 61850 horizontal GOOSE communication. The signals can be transmitted within the switchgear and to the automation systems. Similarly, signals from the automation systems can be executed through RIO600 connected to numerical protection relays.

For more information, please refer to the following documentation:

- Remote I/O unit RIO600 Product Guide

Distribution automation

Selection table

The Relion Interactive Selection Guide (ISG), which covers the entire Relion family, is available online.

Go to: <http://abb.relionisg.com>

In the table:

x = function supported

o = function available as option

	605	605	605	605	611	611	611	611	615	615
	REF601	REJ601	REJ603	REM601	REB611 IEC	REF611 IEC	REM611 IEC	REU611 IEC	REF615 IEC	RED615 IEC
Standard										
ANSI	X	X		X						
IEC	X	X	X	X	X	X	X	X	X	X
Application										
Arc fault protection application									O	
Busbar application					X					
Back-up application	X	X			O	X			X	
Capacitor bank application										
Feeder application	X	X	X			X		X	X	X
Generator application										
Motor application				X	O		X			
Power management/load-shedding application										
Transformer application					O					X
Functionality										
Autorecloser	X	X		X		X			X	X
Circuit breaker controllability	X			X	X	X	X	X	X	X
Condition monitoring	X			X	X	X	X		X	X
Current-based protection	X	X	X	X	X	X	X		X	X
Distance protection										
Fault locator									X	X
Generator differential protection					X					
LCD display with Single Line Diagram (SLD)									X	X
Line differential protection (in-zone transformer support)										X
Load-shedding										
Motor differential protection					X					
On-load tap changer control										
Power quality									X	X
Self-powered protection relay			X							
Synchro-check									X	
Transformer differential protection					X					
Voltage based protection								X	X	X
Withdrawable release mechanism					X	X	X	X	X	X

Distribution automation

Selection table

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In the table:

x = function supported

o = function available as option

	605	605	605	605	611	611	611	611	615	615
	REF601	REJ601	REJ603	REM601	REB611 IEC	REF611 IEC	REM611 IEC	REU611 IEC	REF615 IEC	RED615 IEC
Hardware										
Analog inputs (CTs/VTs)	4/0	4/0	4/0	4/0	4/0	4/1	4/0	0/5	4/5	4/5
Analog inputs (sensor channels/CTs)	3/1	3/1		3/1					6/1	6/1
Binary inputs/outputs	4/6	4/6	0/2	4/6	4/6	10/9	4/6	4/6	18/13	18/13
RTD/mA inputs									2/1	2/1
mA outputs										
Communication protocols										
DNP 3.0									X	X
IEC 60870-5-103	X	X		X					X	X
IEC 61850					X	X	X	X	X	X
Modbus	X	X		X	X	X	X	X	X	X
Profibus									X	X
Communication media										
Ethernet (RJ-45)					X	X	X	X	X	X
Ethernet (LC)					X	X	X	X	X	X
Ethernet redundant solutions (HSR/PRP/RSTP)					X	X	X	X	X	X
Serial (RS 232/485, ST conn.)	X	X		X	X	X	X	X	X	X

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Distribution automation

Compact power management

Power management systems (PMS) are essential for a safe, efficient and reliable operation of a power system within an electrical network. The PMS functionality includes load-shedding, generator control, power sharing, network synchronization and power restoration. PMS solutions protect and optimize the stability of industrial systems against disturbances by ensuring power sharing between generators, when the industrial power system is islanded from the grid. These solutions also ensure that the generators meet the required power demand, when the network is grid-connected.

PMS solutions are suitable for industrial power networks:

- With captive power generation, islanded or grid-connected
- With substantial and critical loads
- With unstable grid connectivity
- Without grid connectivity

The PMS functionality suite is applicable to various industrial segments, for example, oil and gas, pulp and paper, metals, minerals and building automation.

Load-shedding is required, when the electrical load demand exceeds the capacity of the available power sources, subsequent to the loss of power sources or network dis-integration. The load-shedding system has to ensure availability

of electrical power to all essential and, most importantly, critical loads in the plant. This is achieved by switching off the nonessential loads in case of a lack of power in the electrical network or in parts of it (subnetwork or island). The load-shedding functionality can also be deployed in industrial power networks with sole dependency on the utility networks. The lack of electrical power can be caused by a loss of generation capacity or power grid connectivity or the tie line feeding power to the plant.

Based on the shortfall of available power in the power network, the load-shedding action initiated by the system ensures that only identified loads are shed, the system is stable after load-shedding, and the impact on the associated plant operation is minimal. The system allows flexibility to select or deselect the load feeders to be load-shed at any point in time during plant operation.

The load-shedding function must be accurate and selective. It is important that it operates only when necessary.

Load-shedding principles

There are two load-shedding system principles: (1) reactive load-shedding (reacts on measurement) and (2) active load-shedding (reacts on cause).

Reactive load-shedding is most commonly used in utility networks in primary distribution

substations. Reactive load-shedding reacts based on measuring the system frequency and/or voltage. The system as such can contain several triggering levels for these values. Each triggering level corresponds to one of the load-shedding priority classes or steps, for example, activation of the first triggering level, which sheds the loads belonging to priority class 1. Typically two or three priority classes or steps are used. Restoration of the shed feeders can take place manually or automatically, in a pre-programmed scenario. Selectivity against protection functions has to be secured, for example, the load-shedding system has to have a change to operate before the protection system is initiated.

Active load-shedding is mostly used in industrial distribution networks. Active load-shedding reacts based on measuring power, current values on supply and load feeders (key feeders included). The load-shedding system knows the present loading situation and calculates shedding priorities for different network scenarios, such as tripping or overloading of a generator or a network power source. Knowing the individual loads of feeders, only the necessary amount of load (feeders) will be shed. The reactive load-shedding system can work as a back-up for active load-shedding.

Product offering

ABB's Relion® protection relays are characterized by functional scalability and flexible configurability to perform reactive and active load-shedding.

PML630 is a power management relay that provides a comprehensive load-shedding solution for the power network in an industrial plant. It protects the plant against blackouts and power source outages due to system disturbances. This relay is a member of ABB's Relion product family and a part of its 630 series.

PML630 complies with IEC 61850 and offers seamless connectivity with Relion family protection relays, RIO600 I/O and COM600S units to realize the load-shedding functionality. The protection relays use GOOSE and MMS communication profiles for I/O data exchange with other Relion family protection relays and COM600S.

PML630 provides system level protection to small or medium-sized industrial systems from the system disturbances. PML630 supports different modes of load-shedding functions:

- Fast load-shedding (active load-shedding)
- Slow (overload or maximum demand violation-based) load-shedding (active load-shedding)
- Manual load-shedding (reactive load-shedding)

- Underfrequency load-shedding as a backup to fast and slow load-shedding (reactive load-shedding)

A network power deficit occurs when a power source such as a generator or a grid transformer trips. There could also be a power shortage, when a network becomes isolated due to trip of a bus coupler or a bus tie breaker. All load-shedding functions can be active concurrently.

For more information, please refer to the following:

- Load-shedding controller PML630 Product Guide
- Distribution automation solutions web page (<http://new.abb.com/medium-voltage/distribution-automation/distribution-automation-solutions>)

Solution offering

The Compact Power Management System (cPMS) is a load-shedding power management solution built on Relion PML630, Substation Management Unit COM600S, Remote I/O unit RIO600 and the Relion 615, 620 or 630 series feeder relays.

Relion Interactive Selection Guide

The Relion Interactive Selection Guide (ISG) helps you select the protection relay type that is the most suitable for your application. It also provides links to relevant documentation online. The Relion ISG is available at <http://abb.relionisg.com>



UniGear 500R

Distribution automation

01 C Single line diagram (SLD) of medium-voltage switchgear architecture applied, suitable for carrying out automatic and manual transfer (ATS).

Automatic transfer systems

Automatic transfer systems (ATS) are used to ensure maximum service continuity, supplying the power users uninterruptedly.

All this is possible using various systems based on different kinds of techniques. The most common of these are outlined below, with the relevant average transfer times:

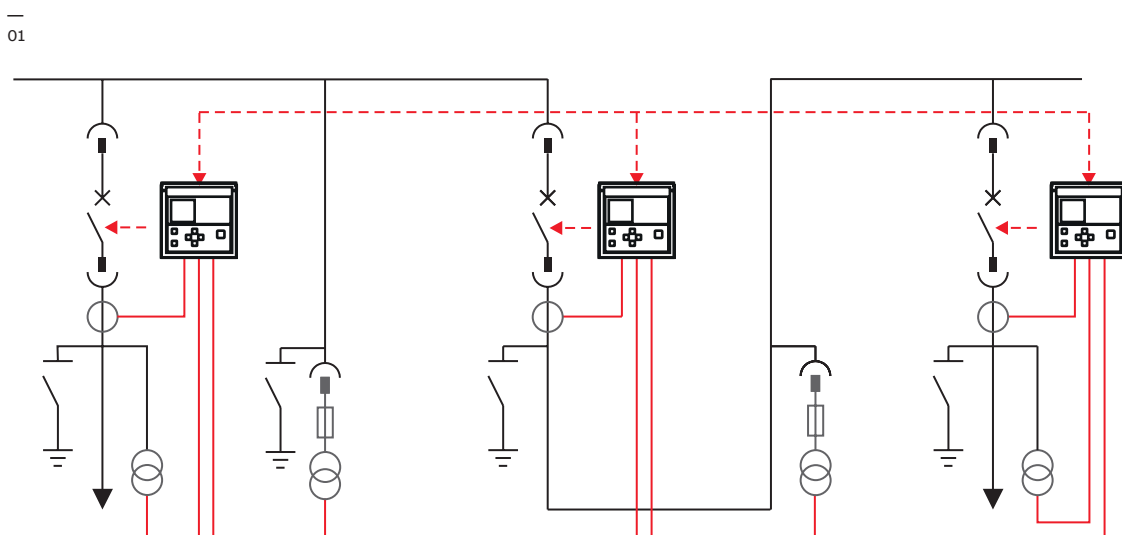
Delayed:	1500 ms
Depending on the residual voltage:	400-1200 ms
Synchronized ATS:	200-500 ms
High speed transfer device:	100 ms
High speed transfer system:	30 ms

The first two systems are the simplest and can also be achieved with conventional logics and instruments. They guarantee average transfer times and can therefore be used in installations where voltage gaps are not particularly critical. The other three systems: (1) synchronized automatic transfer system, (2) high speed transfer device and (3) high speed transfer system require microprocessor-based apparatus with high technology content. They guarantee fast transfer times. They are used in plants where the process is particularly critical, in which slow transfers would cause serious malfunction or interruption of the process itself. ABB offers all types of transfer systems, from the simplest to the most complex.

Synchronized automatic transfer system

Protection relays from Relion® product family can be used in medium-voltage switchgear to manage automatic and manual transfer between different incoming feeders. The time needed for automatic transfer carried out by means of the Relion family protection relays is between 200 to 300 ms (including the circuit breaker operating times). The time can vary within the range indicated in relation to the complexity of the software transfer logics.

Switchgear equipped with Relion protection relays, suitably configured, are complete and efficient systems able to manage transfer between one power supply system and an alternative one, or to reconfigure the network, passing from double radial distribution to a simple system, in a fully automatic way. It is also possible to carry out the same operation manually from a remote control station, or from the front of the switchgear under user supervision. Manual transfer means making the passage parallel, by means of the synchronism control function (synchro-check) implemented from the protection relay, the power supply lines are closed simultaneously with synchronization of the voltage vectors to then return to being disconnected when the transfer has taken place. The applications described do not require additional instruments.



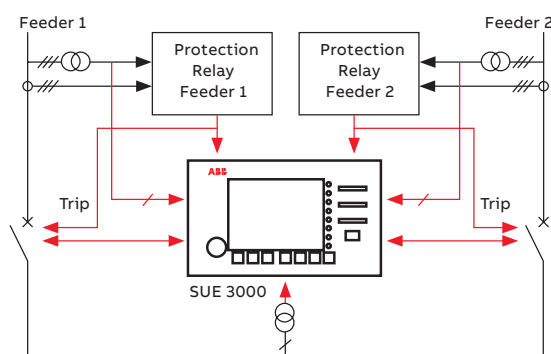
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02 An example
of a switchgear
configuration

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03 SUE 3000 High
Speed Transfer Device

SUE 3000 - High speed transfer device / High speed transfer system

Voltage decrease or complete supply interruptions represent the most crucial and critical problems for the quality of energy supply today. The SUE 3000 High Speed Transfer Device guarantees an optimal safeguarding of energy supply. The device ensures, in combination with the existing circuit breakers, the continued power supply and protects the subsidiary process from expensive stoppage time. Further, the operation of the installation is considerably simplified through the possibility of manually-initiated transfers for targeted clearings.

To achieve the fastest possible transfer time of 30 ms the High Speed Transfer System has to be used. This system is a combination of the SUE 3000 device, special trigger devices and very fast magnetic circuit breakers.



02

Application areas

The SUE 3000 High Speed Transfer Device can be used where ever a disturbance of the electrical supply would lead to a breakdown in production, which would have a significant impact on the operating costs.

Possible areas of utilization include:

- Auxiliary installations serving power stations
- Environmental technology installations
- Voltage supply to continuous industrial processes

To realize permanent availability, the load is supplied from at least two synchronized feeders, which are independent from one another and equipped with a SUE 3000 device.

SUE 3000 takes on the task of ensuring uninterrupted continuous operation of the connected devices in case of a power supply breakdown. The device takes different physical factors into account and executes the quickest possible transfer to a different feeder, which is kept on stand-by.

Corresponding to its multifaceted areas of application, the SUE 3000 is set up for different switchgear arrangements.

Permanent network comparisons

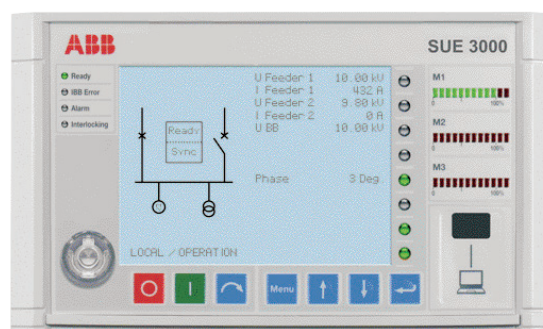
An exceptionally important characteristic, that clearly distinguishes SUE 3000 from competing concepts, is that synchronicity criteria are continuously available, as they are computed online. This is the reason that, in case of an initiation, the appropriate transfer mode is already determined and can be immediately initiated. This means that the probability of a fast transfer is considerably enhanced. Systems which wait for the instant of initiation to start the determination of the network status are not capable to perform a fast transfer with minimum interruption time.

Transfer modes and times

Four different transfer modes are available in detail: (1) fast transfer, (2) transfer at the 1st phase coincidence, (3) residual voltage transfer and (4) time-operated transfer. When a fault occurs, fast transfer is the optimal transfer mode for ensuring that only a minimum interruption of the voltage supply occurs. With fast transfer mode, the total transfer time, counting from a fault in the main feeder until the standby feeder is cut in, is less than 100 ms.

For more information, please refer to the following:

- High Speed Transfer Device SUE 3000 Product Description
- Distribution automation solutions web page (<http://new.abb.com/medium-voltage/distribution-automation/distribution-automation-solutions>)



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03

UniGear 500R

UniGear 500R Digital

With UniGear Digital you gain unprecedented flexibility for any application.

The digital solution takes full advantage of well-proven components: current and voltage sensors, protection and control relays with IEC 61850 digital communication to ensure a reliable and efficient electrical network.

UniGear Digital benefits

Safe and reliable

- Increased equipment reliability and safety in your substation
- Extended communication supervision functionality

Intelligent and ready for the future

- Implement changes easily as requirements change
- Flexibility towards varying load flows
- Late customizations and changes possible

Simple and efficient

- Minimized lifetime costs
- Saves space in your switchgear room by reducing switchgear footprint
- 30 % quicker delivery time from order to switchgear operation*

Lower environmental impact

- Lowers energy consumption up to 250 MWh** which represents saving of 23 700 EUR
- Saves up 150 tons of CO₂**, that is equal to emissions produced by mid-size European car driven for 1 250 000 km

UniGear Digital

represents an advanced switchgear solution as it meets important requirements of the future:

- Unprecedented flexibility
- Increased process efficiency
- Lower cost of operation
- Maximized integration
- Reliability and safety

With UniGear Digital you avoid many of the practical challenges you face in today's complex applications, you simply have less to worry about in your electrical network.

* compared to a conventional UniGear 500R

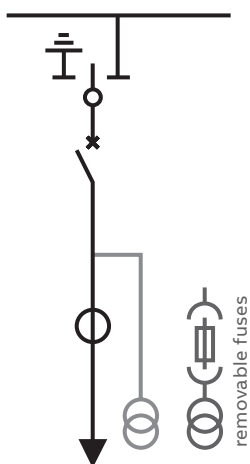
** compared to typical substation with 14 switchgear panels of UniGear 500R type over 30 years of operation



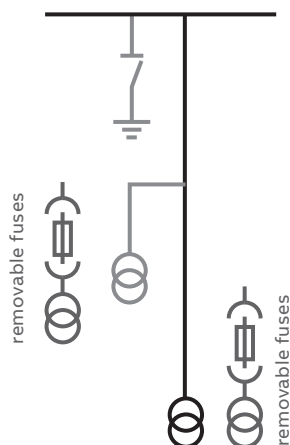
UniGear 500R

Single-line diagrams

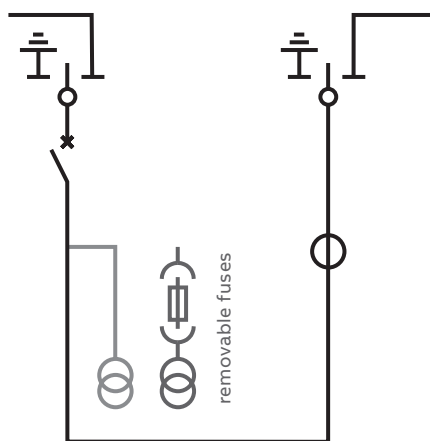
Single-line diagram of typical units



IF - Incoming/outgoing feeder



M - Measurements



BS - Bus section

Key to components

— Standard components

— Accessories

— Alternative solutions

Single-line diagram of the busbar applications



Voltage transformers



Earthing switch

Graphical symbols



Circuit-breaker



Socket and plug



Voltage transformers



Current transformers



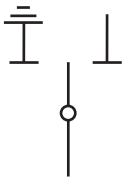
Fuse



Earth



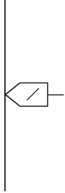
Cable entry



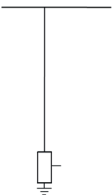
Disconnecter



Switch



Current sensor



Voltage sensor

UniGear 500R

Technical data

Units: IEC version ... 17.5 kV - ... 31.5 kA				
Width [mm]		500/1 000 ⁽¹⁾		
Height [mm]		2 200/2 595 ⁽²⁾		
Height with gas exhaust duct [mm]		2 533 ⁽³⁾		
Depth [mm]		1 320		
Rated current [A]		630	1 250	2 000
IF	Incoming/outgoing	x	x	x
M	Measurements	x		
BS	Bus Section		x	x

(1) 1 000 mm is relevant to bus-section unit

(2) The height of the unit is a function of the height of the low voltage compartment, available in the 585 and 980 mm versions

(3) Others solutions are available, please contact ABB representative

Units: ENA version ... 12 kV - ... 25 kA				
Width [mm/inch]		500/1 000 / 19.7-39.4 ⁽¹⁾		
Height [mm/inch]		2 200/2 595 / 86.5/102.2 ⁽²⁾		
Height with gas exhaust duct		⁽³⁾		
Depth [mm/inch]		1 140/44.9		
Rated current [A]		630	1 250	2 000
IF	Incoming/outgoing	x	x	x
M	Measurements	x		
BS	Bus Section		x	x

(1) 1 000 mm / 39.4 inch is relevant to bus-section unit

(2) The height of the unit is a function of the height of the low voltage compartment, available in the 585 and 980 mm versions

(3) In the ENA version on the rear part of the panel there are located the flaps; no gas duct solution is applicable

(4) Others solutions are available, please contact ABB representative



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