

DISTRIBUTION SOLUTIONS

UniGear 550

Medium-voltage air-insulated switchgear up to 17.5 kV



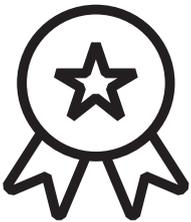
- Compact switchgear panel with 550 mm width
- Highest safety level
- High customization and adaptation level

UniGear 550 is an air-insulated medium-voltage switchgear for primary distribution.

The innovative feature of this panel is its size. In fact, it only measures 550 mm in width which makes it a very compact and versatile product that is ideal for applications where space is restricted.

It is suitable for indoor installations and it offers a wide range of units and functions.

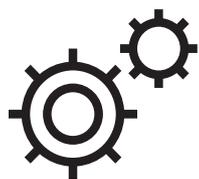
Benefits



Compact switchgear panel with 550 mm width suitable for compact substation solutions



Highest safety level for people and equipment



Customization and easy adaptation while integrating into existing or new installation

Table of contents

UniGear 550

006–009	Description
010–011	IEC Classification
012–013	Design features
014–015	Fully type-tested
016–019	Safety
020	Vacuum circuit-breaker
021	Earthing switch
022–023	Instrument transformers
024–025	Current and voltage sensors
026–027	Cable terminations
028–055	Distribution automation
060–061	UniGear 550 Digital
062–063	Single-line diagrams
064	Technical data

UniGear 550

Description

- Each UniGear 550 panel consists of a single unit which can be equipped with a vacuum circuit-breaker as well as with all the accessories available for conventional switchgear units
- Approved to be used for special applications such as marine, navy and type tested for IEC, GB/DL and GOST standards
- The panel incorporates a cubicle in its upper level to house auxiliary instrumentation
- Units can be coupled together directly with the other products of the UniGear family
- The switchgear does not require rear access for installation or maintenance, all the operations are carried out from the front

Characteristics of UniGear 550

Range

- Up to 12-17.5 kV, ...1 250 A, ...31.5 kA
- Standard IEC
- GOST and GB/DL Standards
- Highly customized versions

Safety

- Fitted with safety interlocks
- Internal arc classification IAC AFLR
- Classified LSC-2B, PM
- CB racking with closed door

Flexibility

- Wide range of applications
- Vacuum circuit-breaker
- Ring core, block type instruments transformers or sensors
- Wall and free-standing solution

Quality

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

Design includes

- Protection and control
- Earthing switch
- Integrated capacitor banks
- Bay computer





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

Marine

- Drilling platforms
- Off-shore oil rigs
- Cruise ships
- Container ships
- Tankers
- Cable ships
- Ferries

Transport

- Airports
- Ports
- Railways
- Underground transport

Infrastructure

- Shopping malls
- Hospitals
- Large infrastructure and civil works

UniGear 550

Description

UniGear 550 is medium voltage switchgear with a metal enclosure, suitable for indoor installations. Metal partitions segregate the compartments from each other and the live parts are air-insulated.

The innovative feature of this panel is its size. In fact, it only measures 550 mm in width which makes it a very compact and versatile product that is ideal for applications where space is restricted.

UniGear 550 is designed so that it can be connected directly to the other versions of UniGear, such as ZS1, 500R and MCC.

UniGear 550 has the same overall dimensions (height and depth) and the same main busbars arrangement as UniGear ZS1 with a maximum current of 4 000 A.

For this panel, positioning against the wall is possible. In fact, the switchgear does not require access from the rear for installation or maintenance. All the service operations are carried out from the front.

UniGear 550 has undergone all the tests required by the International Standards (IEC) and local standards organizations (for example the Chinese GB/DL and Russian GOST standards).

In addition, UniGear 550 has completed the series of certifications required by the regulations of the major shipping registers (LR, DNV, RINA, BV and GL) for use of the switchgear in Marine and Navy installations.

The UniGear 550 reflects all the construction characteristics of the UniGear ZS1.

As a standard solution, it is possible to connect up to three single-core cables per phase (maximum cross-section of 185 mm²), or two cables per phase (maximum cross-section of 300 mm²). The connection height of the cables in relation to the floor is 600 mm.

The circuit-breaker is the vacuum type Vmax/L in a withdrawable version.

UniGear 550 uses ring core current transformers as the standard solution, which are fixed onto "CT Rods".

As an optional solution, block type current transformers are available.

The panel is designed to allow the insertion of fixed voltage transformers, positioned at the rear of the panel itself and also to allow the use of a withdrawable VT truck.

The capacitive signal for indicating voltage presence is connected directly to the insulators which support the busbars on the cable sides. The surge arresters can also be inserted in the cable area.

The UniGear 550 switchgear is fitted with all the interlocks and accessories needed to guarantee a high level of safety for equipment and personnel, as well as reliable operation.

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 62271-100 for the circuit-breakers
- IEC 60071-2 for the insulation coordination
- IEC 60529 for degree of protections

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 550 switchgear is normally supplied with the following standard degrees of protection:

- IP4X for the enclosure
- 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				
Rated voltage	[kV]	12	12	17.5
Rated insulation voltage	[kV]	12	12	17.5
Rated power frequency withstand voltage	[kV / 1 min]	28	38	38
Rated lightning impulse withstand voltage	[kV]	75	95	95
Rated frequency	[Hz]	50 / 60	50 / 60	50 / 60
Rated short time withstand current	[kA / 3 s]	...31.5	...31.5	...31.5
Internal arc withstand current	[kA / 1 s]	...31.5	...31.5	...31.5
Main busbar rated current	[A]	...4 000	...4 000	...4 000
Circuit-breaker rated current	[A]	...1 250	...1 250	...1 250

GB/DL version is available with higher request in dielectric characteristics (42 kV) and short time withstand current (4 s)



UniGear 550

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 550 switchgear can be defined as follows.

Loss of service continuity - LSC-2B

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 550 is classified as LSC-2B because the busbar, circuit-breaker and cable compartments are physically and electrically segregated. This is the category that defines the possibility of accessing the circuit-breaker compartment with the busbars and cables 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 550 is defined with PM partition class having the segregation between compartments made of metallic sheets/shutters.

Interlock-controlled accessible compartment

The front side of UniGear 550 is classified interlock-controlled because the access of the compartments containing high-voltage parts, intended to be opened for normal operation and/or normal maintenance, is controlled by the integral design of the switchgear.

Tool-based accessible compartment

The rear part of the UniGear 550 is classified tool-based because it is possible to open the compartment containing high-voltage parts, that may be opened, but not for normal operation and maintenance, only using a tool. Special procedures are required.

Internal arc classification – IAC AFLR

UniGear 550 switchgear is classified IAC AFLR. 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 550

Design features

Compartments

Each switchgear unit consists of three power compartments: circuit-breaker, busbars and cables; please refer to figure on next page. Each unit is fitted with a low voltage compartment, where all the auxiliary instruments are housed.

Arc-proof switchgear 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 maintenance operations can correctly be carried out with the switchgear installed up against a wall.

The compartments are segregated from each other by metallic partitions.

Main busbars

The busbar compartment contains the main busbar system connected to the upper isolating contacts of the circuit-breaker by means of branch connections.

The main busbars are made of electrolytic copper. For ratings up to 2500 A, the busbars are flat bars; while for currents between 3150 A and 4000 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, which optionally can be divided into compartments.

Cable connections

The cable compartment contains the branch system for connection of the power cables to the lower contacts of the circuit-breaker.

The feeder connections are made of electrolytic copper and they are flat bars for the whole range of currents.

For 17.5 kV they are covered with insulating material.

Earthing switch

Cable compartment can be fitted with an earthing switch for cable earthing.

The same device can also be used to earth the busbar system (measurements and bus-tie units). It can also be 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 and from the front window.

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 and shutters

The insulating bushings in the circuit-breaker compartment contain the contacts for connection of the circuit-breaker with the busbar compartment and cable compartment respectively.

The insulating bushings are of single-pole type and are made of epoxy resin.

The shutters are metallic and are activated automatically during movement of the circuit-breaker from the racked-out position to the operation position and vice versa.

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

The gas exhaust duct is positioned above the switchgear and runs along its whole length. Each power compartment is fitted with a flap on its top surface. The pressure generated by the fault makes it open, 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.

UniGear 550 switchgear can be fitted with a complete range of solutions to satisfy all requirements, either in the case where evacuation is possible directly at the end of the switchgear, or when solutions from the front or rear are requested.

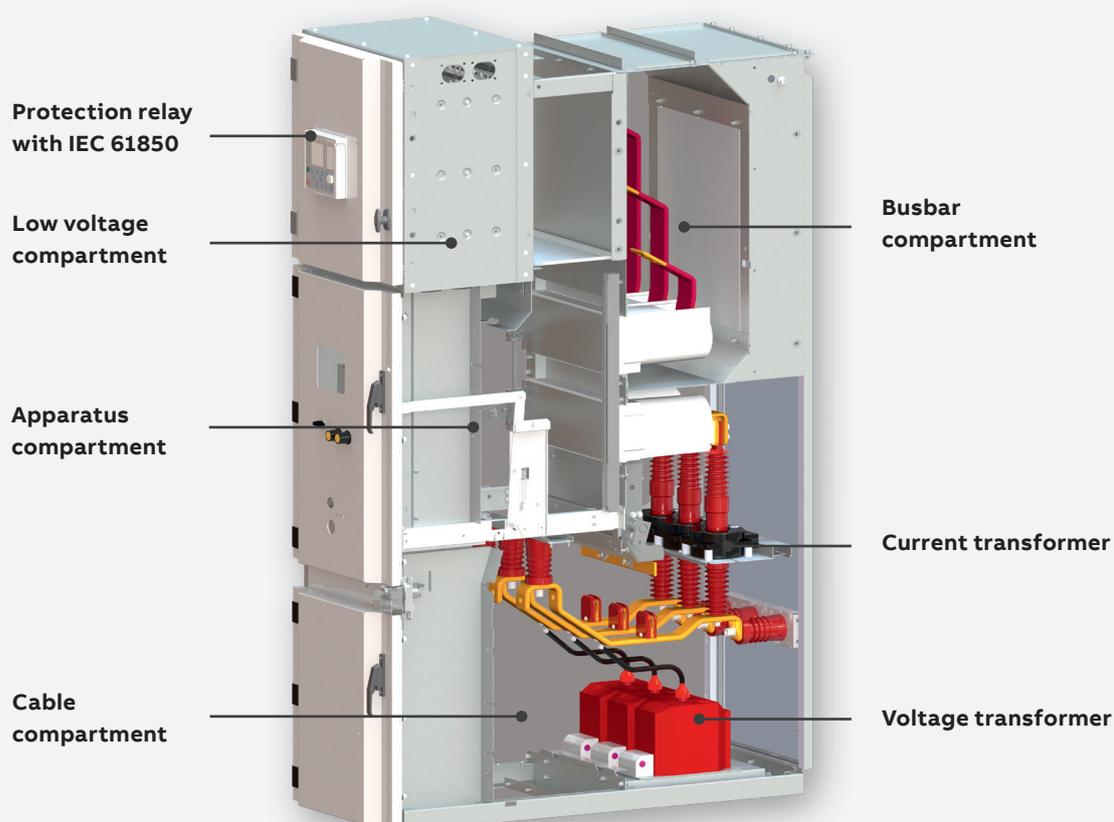
Some installations, such as marine applications, do not allow evacuation of the gases to the outside of the room and therefore a dedicated solution has been developed to guarantee personnel safety and conformity with the Standards, such as longitudinal evacuation chimneys.

Please contact your ABB sales representative for more information.

Busbar applications

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

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



UniGear 550

Fully type-tested

UniGear 550 switchgear has undergone all the tests required by the international (IEC) Standards and local Standards organizations (for example, the Chinese GB/DL and Russian GOST standards).

In addition, the tests required by the main shipping registers (LR, DNV, RINA, BV and GL) have been carried out for use of the switchgear in marine installations.

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 earthing switch
- 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

Special type tests required by shipping registers for marine application

- High ambient temperatures (+ 45°C)
- Inclination
- Vibration

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 earthing switch of the UniGear 550 switchgear can be closed under short-circuit. Although, 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, personnel safety 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 electro-technical 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.

IP protection degree

The IP protection degree is the resistance offered by the UniGear 550 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 degree of protection against the entrance of solid objects, the second one is related to liquids.

Type tests required by the shipping registers

High ambient temperature

The service conditions for the electrical apparatus in marine installations are generally more severe than those in normal land applications.

Temperature is a main factor and for this reason the shipping register regulations require the switchgear to be able to operate at higher ambient temperatures (45 °C or higher) than those stated in the IEC Standards (40 °C).

Inclination

The test is carried out by inclining the switchgear for a defined time up to 25° alternately on all four sides and operating the apparatus.

The test proves that the switchgear is able to resist these extreme service conditions and that all the apparatus it contains can be operated without any problems and without being damaged.

Vibration

The reliability and sturdiness of the UniGear 550 switchgear has been definitively proved by the result of the withstand test to mechanical stresses due to vibration. The service conditions on shipping installations and marine platforms require the switchgear to work in environments strongly affected by vibrations, such as those caused by the motors on large cruise ships or the drilling plants of oil rigs.

- 1 mm amplitude in the frequency range between 2 and 13.2 Hz
- 0.7 g acceleration amplitude in the frequency range between 13.2 and 100 Hz



UniGear 550

Safety

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

This is why the UniGear 550 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 550 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 550 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.

The UniGear 550 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 550 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.

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.

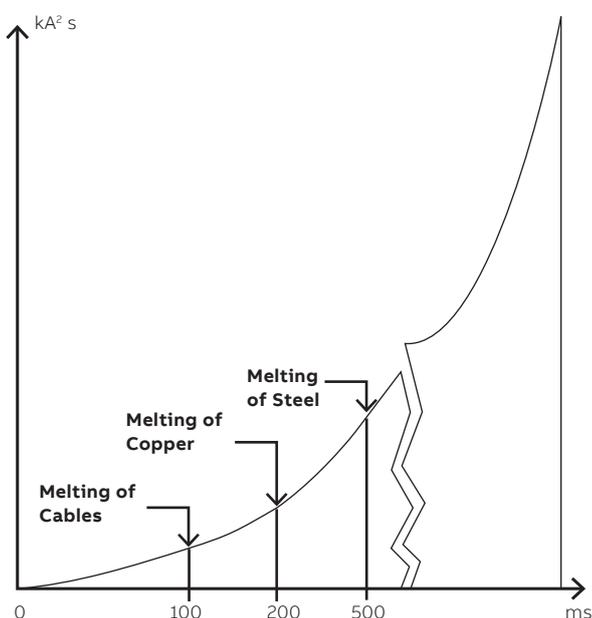
Total tripping time is 62,5 ms (2,5 ms REA + 60 ms circuit-breaker).

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 550

Safety

The UniGear 550 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+5], 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 realising the interlocking logics between panels of the same switchgear, or of other medium, low and high voltage switchgear. The logics are realised by means of distributors or by ringing the keys.

The apparatus truck [6] can be locked in the racked-out position and the relevant lock key can only be removed with the apparatus in this position.

The earthing switch closing [7] and opening [8] operations can be locked by means of keys, key logic is explained in the table on next page.

The circuit-breaker racking-in/out operations [9] and earthing switch opening/closing [10] can be prevented by means of key locks, which prevent insertion of the relevant operating levers.

The key lock can also be applied to the earthing switch of busbar applications. The keys can always be removed.

Padlocks

The circuit-breaker [11] and cables [12] compartment doors can be locked in the closed position by means of padlocks. These can be applied to both door closing versions –with central handle (standard) or screws (optional). The operations for apparatus racking-in/out [13] and earthing switch opening/closing [14] can be prevented by applying the padlocks to the insertion slots of the relevant operating levers.

The padlock can also be applied to the earthing switch of busbar applications.

The metallic segregation shutters [15] between circuit-breaker, busbars and cables compartments can be locked by means of two independent padlocks in both the open and closed positions.

Padlocks from 5 to 8 mm diameter can be accommodated.

Locking magnets

The locking magnets enable automatic interlocking logics without human intervention. The circuit-breaker racking-in/out [16] and the earthing switch closing/opening [17] operations can be interlocked.

This magnet can also be applied to the earthing switch of busbar applications.

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

Standard safety interlocks (mandatory)

Type	Description	Condition to be met
1	A Apparatus racking-in/out	Apparatus in open position
	B Apparatus closing	Defined truck position
2	A Apparatus racking-in	Apparatus multi-contact plug plugged
	B Apparatus multi-contact plug unplugging	Truck in test position
3	A Earthing switch closing	Truck in test position
	B Apparatus racking-in	Earthing switch in open position
4	A Apparatus compartment door opening	Truck in test position
	B Apparatus racking-in	Apparatus compartment door closed
5	A Cable compartment door opening	Earthing switch in ON position
	B Earthing switch opening	Cable compartment door closed

Note: Apparatus is circuit-breaker

Keys (on request)

6	Apparatus racking-in lock	Can only be removed with the truck in the racked-out position
7	Earthing switch closing lock	Can only be removed with the earthing switch open
8	Earthing switch opening lock	Can only be removed with the earthing closed
9	Insertion of the apparatus raking-in/out crank lever	Can always be removed
10	Insertion of the earthing switch operating lever	Can always be removed

Padlocks

11	Apparatus compartment door opening
12	Cable compartment door opening
13	Insertion of the apparatus raking-in/out crank lever
14	Insertion of the earthing switch operating lever
15	Shutters opening or closing

Locking magnets (on request)

16	Apparatus racking-in/out	Magnet energized
17	Earthing switch ON/OFF	Magnet energized

Accessory devices

20	Shutters fail-safe	The device locks the shutters in the closed position when the apparatus is removed from the compartment. The operator cannot open the shutters manually. The shutters can only be operated by the apparatus truck or the service trucks.
21	Apparatus-switchgear unit compatibility matrix	The apparatus multi-contact plug and relative switchgear unit socket are equipped with a mechanical matrix, that disables apparatus racking-in into a switchgear unit with an inappropriate rated current.
22	Circuit-breaker mechanical operating mechanism	The apparatus compartment is equipped with a mechanical device, that enables circuit-breaker closing and/or opening directly by means of the front operating mechanism pushbuttons, keeping the door closed. The controls can be operated with the circuit-breakers in the operation and racked-out position.

UniGear 550

Vacuum circuit-breaker

Vmax circuit-breaker

Vmax medium voltage circuit-breakers combine ABB's state-of-the-art technology in designing and constructing vacuum interrupters with its excellence in the design, engineering and production of the circuit-breakers. They find their ideal use in UniGear 550.

The ratings are up to 17.5 kV, 1 250 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 mass container, limits the energy required for the operation and therefore guarantees extremely limited wear on the circuit-breaker.

This means the circuit-breaker requires limited maintenance.

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

The Vmax series guarantees the same characteristics as the vacuum series mentioned above, i.e. 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 simple mechanical operating mechanism, derived from the same mechanical operating mechanism used on 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 antipumping device to prevent repeated sequences of opening and closing operations following simultaneous and maintained opening and closing commands (both 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

UniGear 550

Earthing switch

ST-UG Earthing switch

UniGear 550 panel is equipped with the ST-UG type earthing switch. This device is a patented switch with rectilinear movement. It is fitted with a snap action operating mechanism for positive high speed closing and it is dimensioned to conduct the rated short circuit making current when closed under load.

The speed of the snap action closing operation is independent of the controls.

The switch is equipped with an earthing blade which connects the three phases via the earthing pins mounted on the copper bars of the cable connecting system.

The earthing bar is electrically connected to earth by a stranded copper conductor.

The snap action closing mechanism of the earthing switch functions independently of the rotation of the drive shaft.

The switching speed and torque achieved are independent of the action of the operating mechanism.

A manual operating lever is provided for operation of the switch.

Earthing switch has been tested for two closing operations at 100% of the rated short-circuit making current.

Device is provided with auxiliary switches for signalling the open and closed positions, operated by the rod mechanism.

The following are available on request:

- Locking magnet
- Key locks for open and closed positions
- Padlock

Rated voltage	[kV]	12.5	17.5
Rated lightning impulse withstand voltage	[kV]	75	95
Rated short-time withstand current	[kA]	31.5	31.5
Short-circuit duration	[s]	1	1
Short-circuit making current	[kA]	80	80

UniGear 550

Instrument transformers

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

Ring core current transformer

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

The transformer can feature either a closed or split core. The ring core transformer with split core is used for detecting earth fault currents and can be easily mounted around the incoming cables. An air insulated ring core transformer is used for measuring the phase current and it is placed over the insulated CT rod.

They conform to the IEC 61869-1, IEC 61869-2 which have fully replaced previous standard IEC 60044-1.

The CT rods are designed to be equipped with a maximum of two current transformers per phase (metering and protection) and with the following dimensional requirements:

From 50 A to 200 A:

- Minimum internal diameter: 59 mm
- Maximum external diameter: 200 mm
- Maximum height: 100 mm

From 250 A to 1 250 A:

- Minimum internal diameter: 69 mm
- Maximum external diameter: 147 mm
- Maximum height: 75 mm

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.

Their dimensions are in accordance with the DIN 42600 Standard, in the Medium and Long Size versions up to 1 250 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. Fitting on the supply side of the apparatus compartment is also possible (busbar applications) for measuring the busbar currents or for realising particular protection schemes. The ABB range of current transformers is designated TPU.

Bushing type current transformer

As an another alternative, UniGear 550 can also be furnished with bushing type current transformers, making this switchgear suitable for markets influenced by British Standards (BS).

Voltage transformers

The voltage transformers are of the epoxy resin insulated type and are used to supply measurement and protection devices.

They are available for fixed assembly or for installation on removable and withdrawable trucks.

They conform to the IEC 61869-1, IEC 61869-3 which have fully replaced previous standard IEC 60044-2.

Their dimensions are in accordance with the DIN 42600 Standard.

These transformers can have one or two poles, with performance and precision classes suited to the functional requirements of the instruments connected to them.

When they are installed on removable or withdrawable trucks they are fitted with medium voltage protection fuses.

The withdrawable trucks also allow replacement of the fuses with the switchgear in service. Truck racking-out with the door closed automatically operates closure of a metallic segregation shutter between the live parts of the switchgear and the instrument compartment.

Fixed voltage transformers can be installed directly on the main busbar system in a dedicated compartment (busbar applications).

The ABB range of voltage transformers is designated TJC, TDC, TJP.

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UniGear 550

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.

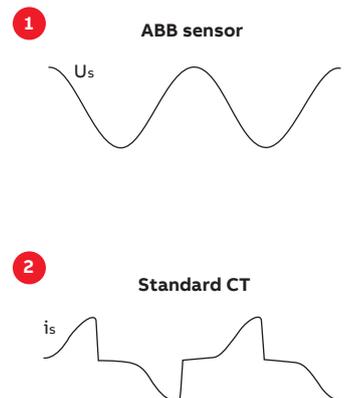
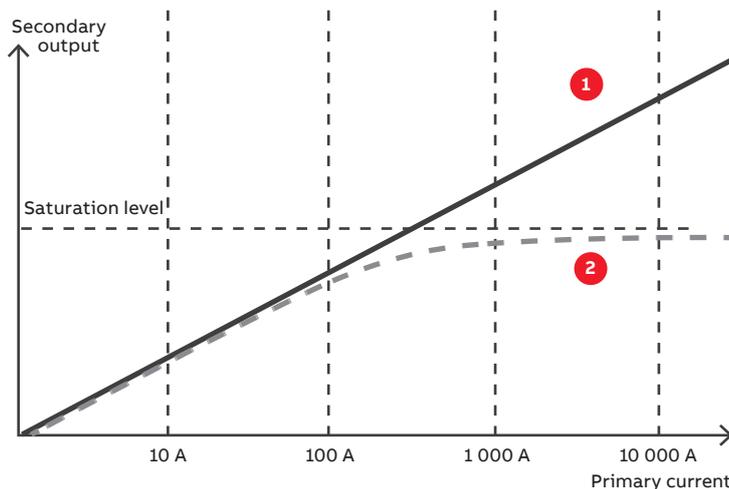
Sensor characteristics

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

Combined sensors

Current & voltage measurements and voltage indication integrated in the same compact cast resin part.

KEVCD

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

With KEVCD 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} .

That provides the possibility to designate the corresponding accuracy class as 5P630, proving excellent linearity and accuracy measurements.

Technical parameters

- Rated primary current of application: 80 A up to 1 250 A
- Rated primary voltage of application: $6/\sqrt{3}$ kV up to $24/\sqrt{3}$ kV



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UniGear 550

Cable terminations

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

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02 ABB Kabeldon 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

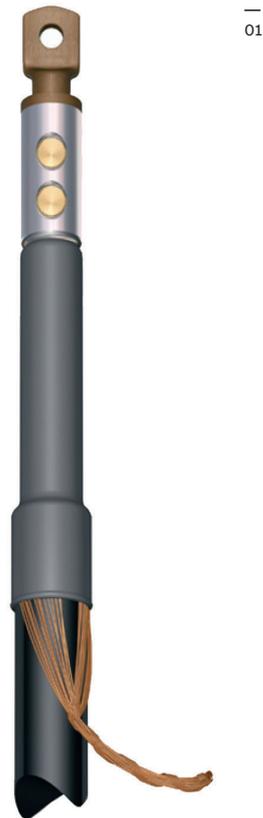
Depending on the cable design, it is necessary to use the correct type of cable accessory. When single core cables are designed with copper wire screen only, it is sufficient to use just a cable lug and a termination that fits the actual size of the cable.

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 Kabeldon 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.

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Designation and sizes

Voltage level [kV]	Designation Kabeldon	Diameter over insulation [mm]	Conductor size [mm ²]		
			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 550

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 550

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 640

REX640 makes protecting all your assets in advanced power generation and distribution applications easy. The fully modular design allows unequalled customization and modification flexibility, and easy adaptation to changing protection requirements throughout the relay life cycle. This is asset management at its best. Please see dedicated chapter on page 64.

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.



UniGear 550

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
—

04 Multiapplication
Protection and
Control REX640
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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.

Relion 640

The base functionality in REX640 can be enhanced with additional application packages for feeder protection, such as fault locator, line differential protection and line distance protection.

Please see dedicated chapter on page 64.

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
- Multiapplication Protection and Control REX640 Product Guide

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UniGear 550

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.

Relion 640

The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The relay can be used for two and three-winding transformer applications. The base functionality is enhanced with power transformer application packages. With the packages also on-load tap changer control can be managed. Please see dedicated chapter on page 64.

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

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02 Multiapplication Protection and Control REX640

For more information, please refer to the following documentation:

- Transformer Protection and Control RET615 Product Guide
- Transformer Protection and Control RET620 and Transformer protection and control RET630 Product Guide
- Voltage Protection and Control REU615 Product Guide
- Transformer Protection and Control RET620 Product Guide
- Transformer Protection and Control RET630 Product Guide
- Multiapplication Protection and Control REX640 Product Guide

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UniGear 550

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.

Relion 640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. For motor protection the base functionality in REX640 can be enhanced with motor application packages. The packages support both synchronous and asynchronous motors.

Please see dedicated chapter on page 64.

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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

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04 Multiapplication
Protection and Control REX640

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
- Multiapplication Protection and Control REX640 Product Guide

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04



UniGear 550

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.

Relion 640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. In addition to conventional protection, control, measurement and supervision duties REX640 can also perform both generator and non-generator circuit breaker synchronizing. REX640 includes extensive protection for generator and generator-transformer units used in various power plants.

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

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02 Multiapplication Protection and Control REX640

Please see dedicated chapter on page 64.

For more information, please refer to the following documentation:

- Generator and interconnection protection

REG615 Product Guide

- Generator Protection and Control REG630 Product Guide

- Multiapplication Protection and Control REX640 Product Guide

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02



UniGear 550

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.

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.

- 01 Voltage protection and control REU611, Voltage protection and control REU615
- 02 Feeder protection and control REF620, Feeder protection and control REF630
- 03 Multiapplication Protection and Control REX640

Relion 640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The base package includes most of the standard protection functions needed for voltage protection. Please see dedicated chapter on page 64.

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
- Multiapplication Protection and Control REX640 Product Guide

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03



UniGear 550

Distribution automation

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.

Relion 640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The base functionality in REX640 can be enhanced with a special application package for shunt capacitor protection.

Please see dedicated chapter on page 64.

For more information, please refer to the following documentation:

- Capacitor Bank Protection and Control REV615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide

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02 Busbar protection and control REB611

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01 Capacitor bank protection and control REV615

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03 Multiapplication Protection and Control REX640

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.

Relion 640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The base functionality in REX640 can be enhanced with a special application package for busbar high-impedance protection. Please see dedicated chapter on page 64.

For more information, please refer to the following documentation:

- Busbar Protection and Control REB611 Product Guide
- Multiapplication Protection and Control REX640 Product Guide

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UniGear 550

Distribution automation

Protection and control REX640

REX640 makes protecting all your assets in advanced power generation and distribution applications easy. The fully modular design allows unequalled customization and modification flexibility, and easy adaptation to changing protection requirements throughout the relay life cycle. This is asset management at its best.

Complete application coverage with one device for optimal cost-effectiveness

REX640 is the outcome of a long-standing evolution, building on ABB's strong heritage of freely configurable multifunctional relays. The ability to cover the full range of utility and industrial applications and manage multiple applications simultaneously, with the same device, guarantees flexible, versatile and cost-efficient protection solutions.

REX640 has been designed to support the increasing digitalization of substations. REX640 thereby supports a variety of digital switchgear solutions and is suitable for both single and double-busbar applications. REX640 offers as many as 20 current and voltage measurement channels in total, supporting both conventional instrument transformers and sensors, not to mention the ability to receive four streams of sampled measured values (SMV) via IEC 61850-9-2 LE-based process bus communication. As the newest member of ABB's Relion® protection and control family of relays, REX640 further reinforces Relion's position as the range of relays to rely on.

New application package concept for maximum convenience and flexibility

REX640 introduces an entirely new application package concept, by offering a variety of ready-made application packages to choose from. The application packages include various protection and control functions, which can be flexibly combined to create protection solutions that meet your unique protection requirements.

The available packages support the following applications:

- Feeder protection
 - Line differential protection
 - Line distance protection
 - Interconnection protection
 - Fault locator
- Power transformer protection
 - Two and three-winding differential protection
 - On-load tap-changer control
- Machine protection
 - Asynchronous machines
 - Synchronous machines
- Shunt capacitor protection
- Busbar protection
- Automatic synchronization
 - Generator circuit breaker
 - Non-generator circuit breaker
- Petersen coil control
- Arc protection with supervised sensors
 - Loop and lens-type sensors

Fully modular hardware and software for maximum flexibility for the entire relay lifetime

The modularity and scalability of both software and hardware allow you to create your own, unique relay for your specific protection requirements. The ready-made application packages make ordering your relay smooth and easy.

When requirements change, so will REX640. Adapting to changing protection requirements is flexible and easy – the software and hardware can be modified anytime. In addition, new software and hardware developments will be continuously and easily accessible – throughout the relay's entire life cycle.

- 01 Protection and control REX640
- 02 Phasor diagram of a three winding power transformer on the LHMI
- 03 New application package concept

Intuitive human-machine interface for enhanced user experience

A novel, application-driven approach to the local human-machine interface (LHMI) allows support for entirely new applications. The unique, 7-inch color touch screen visualizes power distribution process information in an entirely new way. This results in increased situational awareness and maximum usability.

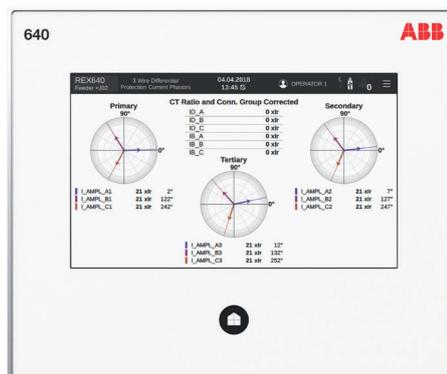
Ready-made application-based pages minimize the need for graphical engineering, which saves both time and efforts. The LHMI pages can also be customized, if necessary, for optimum freedom.

REX640 – innovative, flexible and easy to use

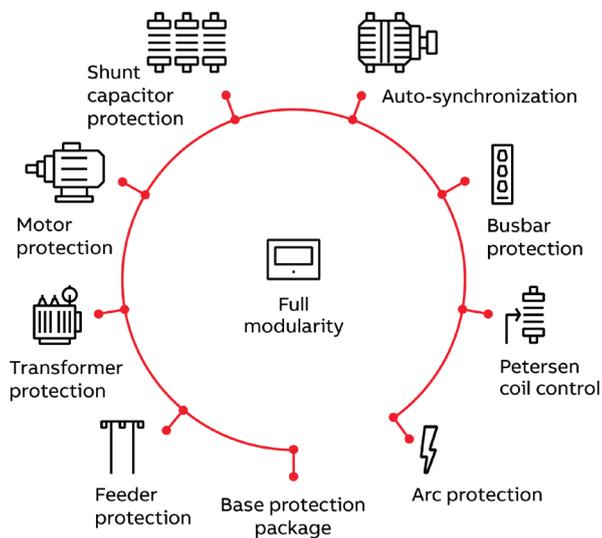
- Complete application coverage with one device for optimal flexibility and cost-effectiveness
- Ready-made application packages for convenient and smooth ordering
- Customization freedom with modular and scalable design
- Fully modular hardware and software for maximum flexibility throughout the entire relay life cycle
- Easy adaption to changing protection requirements
- Continuous access to the latest software and hardware developments
- Ready-made application-based LHMI pages – saving both time and efforts
- Increased situational awareness and optimal usability with application-driven LHMI
- Designed to support the increasing digitalization of substations

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UniGear 550

Distribution automation

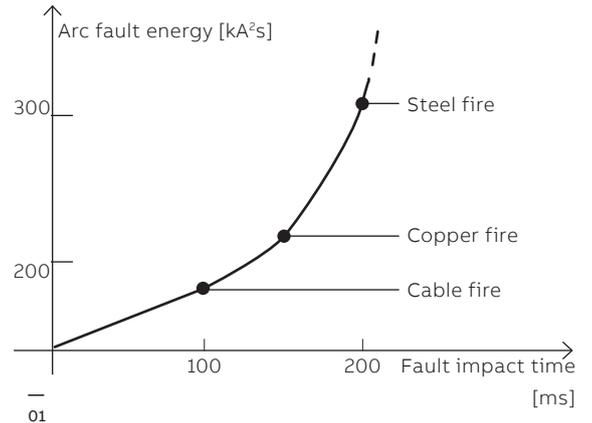
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01 Arc fault damage as a function of the arc fault energy and the arc fault impact time

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.

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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.

Relion 640

REX640 protection relays are equipped with arc flash sensor card, that supports either loop or lens sensors or a combination thereof, and includes supervision of the sensors. By using suitable sensor combinations for different bays, a selective arc flash protection scheme can be build up for the complete switchgear.

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
- Multiapplication Protection and Control REX640 Product Guide



UniGear 550

Distribution automation

—
Smart Substation Control
and Protection SSC600

—
Substation Merging
Unit SMU615

—
01 Example of centralized
protection and control

Centralized protection and control

Advances in communication systems, including time synchronization, their integration to substation applications and the standardization of protocols have facilitated the operation and the diagnosis of failures in complex grids and have enabled new possibilities for protection and control schemes. These advances have opened space for the implementation of the centralized protection and control system.

The centralized protection and control concept is based on the concentration of substation protection and control in a single device and the utilization of communication networks to converse between different components, bays, substations and the related operators. The most substantial protection philosophy change in the system is the total or partial shift of functions from the bay level, i.e., from the relays, to the station level in the substation.

Product offering

ABB Ability™ Smart Substation Control and Protection for electrical systems SSC600 is a smart substation device designed for protection, control, measurement and supervision of utility substations and industrial switchgear and equipment. The design of the device has been guided by the IEC 61850 standard for communication and interoperability of substation automation devices. It is fully integrable with Relion series IEDs for creating a complete solution. Optional functionality is available at the time of order for both software and hardware, for example, special application packages and additional communication modules.

Depending on the chosen product options, the device is adapted for:

- Protection for overhead line and cable feeder in isolated neutral, resistance earthed, compensated and solidly earthed networks.
- Protection, control, measurement and supervision of asynchronous motors in manufacturing and process industry.
- Transformer protection and control for power transformers, unit and step-up transformers including power generator-transformer blocks in utility and industry power distribution systems.

Substation Merging Unit SMU615

SMU615 is a dedicated substation merging unit intended for measuring current and voltage signals from the instrument transformers and merging them into the standard digital output format that other devices can further use for various power system protection application purposes. SMU615 itself includes no protection functionality but it offers the physical interface into the switchgear primary equipment, that is, circuit breaker, disconnecter and earthing switch. SMU615 is a member of ABB's Relion® product family and is characterized by the compactness, simplicity and withdrawable-unit design.

For more information, please refer to the following documentation:

- Smart Substation Control and Protection SSC600 Product Guide
- Substation Merging Unit SMU615 Product Guide

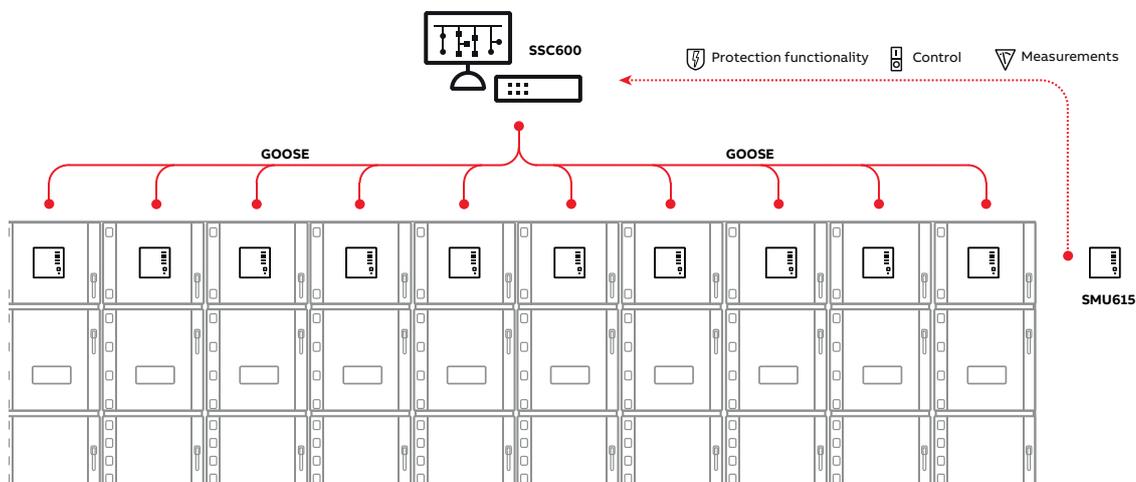
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UniGear 550

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

615	615	615	615	615	615	620	620	620	620	620	620	630	630	630	630	640	SSC	615
REU615 IEC	REV615 IEC	REF615 ANSI	REF615R ANSI	REM615 ANSI	RET615 ANSI	REF620 IEC	REM620 IEC	RET620 IEC	REF620 ANSI	REM620 ANSI	RET620 ANSI	REF630 IEC	REM630 IEC	RET630 IEC	REG630 IEC	REX640	SSC600	SMU615
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UniGear 550

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, marine, 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 550

Distribution automation

01 CSingle 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.

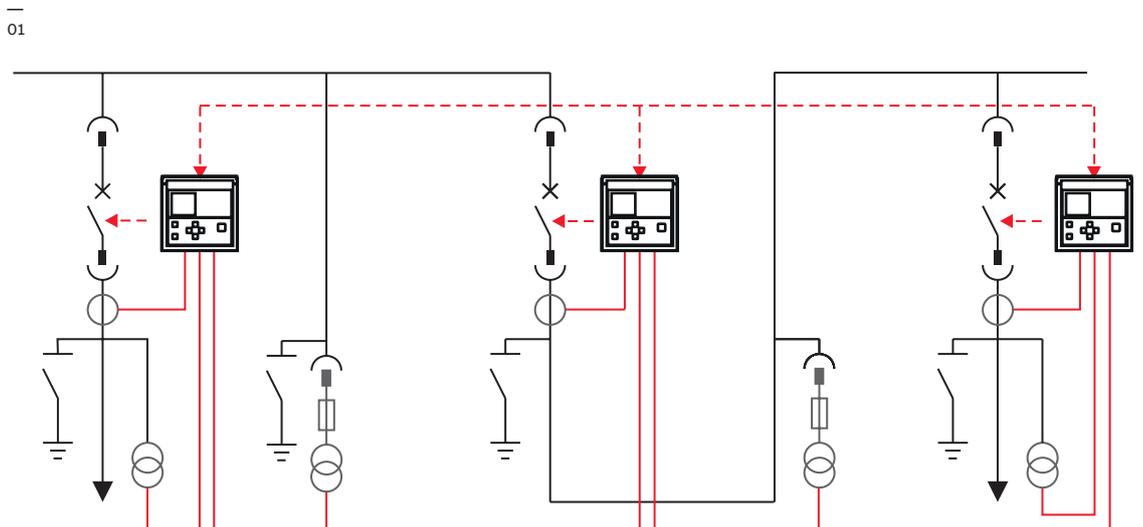
ABB offers all types of transfer systems, from the simplest to the most complex.

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.



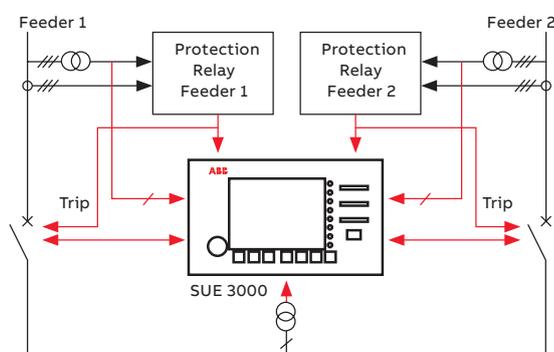
—
02 An example
of a switchgear
configuration

—
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.



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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

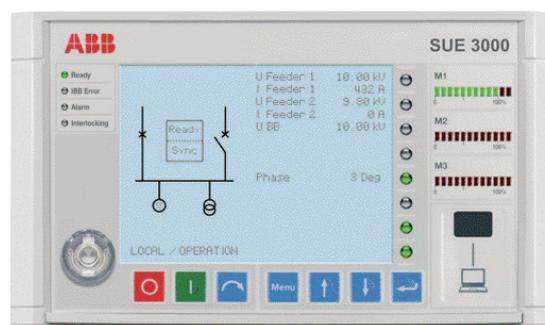
An exceptionally important characteristic, that clearly distinguishes SUE 3000 from competing concepts, is that synchronicity criteria are continuously available, as they are computed online. This is the reason that, in case of an initiation, the appropriate transfer mode is already determined and can 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 550

UniGear 550 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:

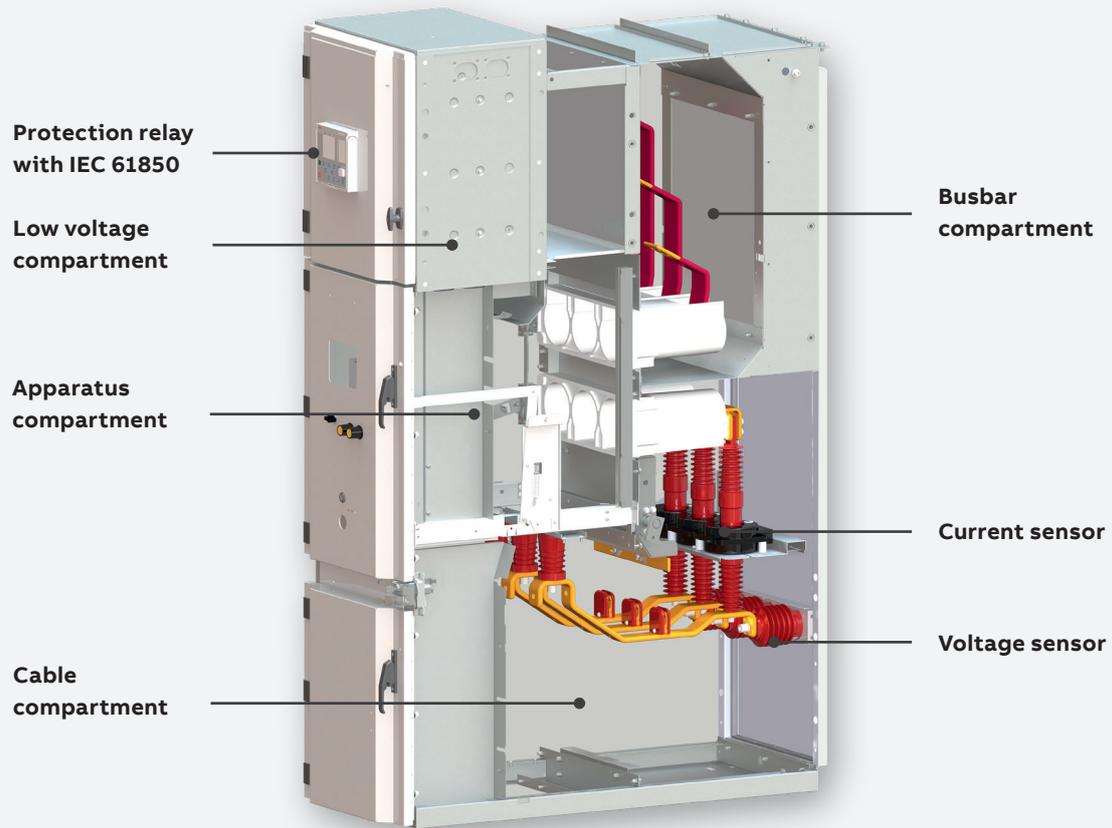
- Unprecedented flexibility
- Increased process efficiency
- Lower cost of operation
- Maximized integration
- Reliability and safety

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.

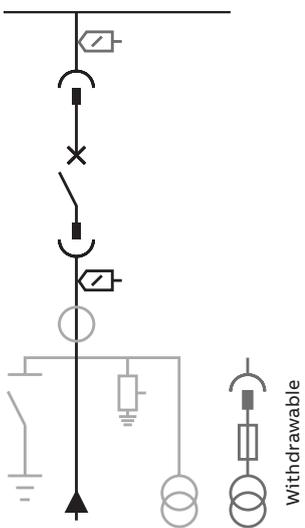
* compared to a conventional UniGear 550

** compared to typical substation with 14 switchgear panels of UniGear 550 type over 30 years of operation

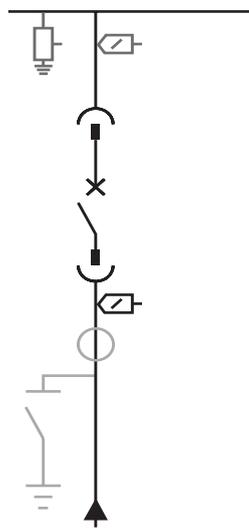




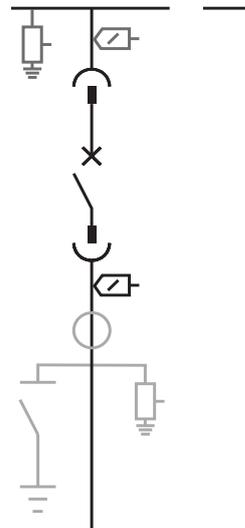
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Single-line diagram
of typical units



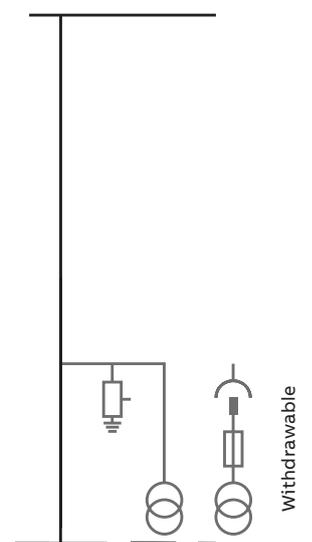
IF - Incoming/outgoing feeder



OFM - Outgoing with BB
measurement



BT - Bus-tie

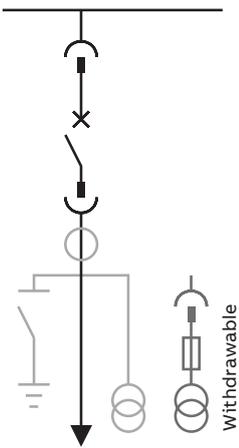


R - Riser

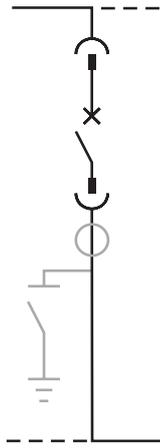
UniGear 550

Single-line diagrams

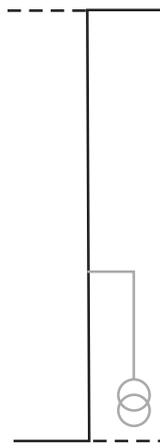
Single-line diagram of typical units



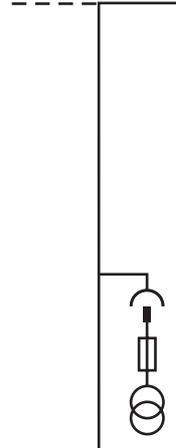
IF - Incoming/outgoing feeder



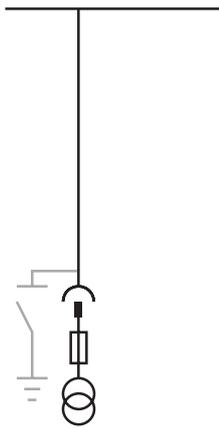
BT - Bus-tie



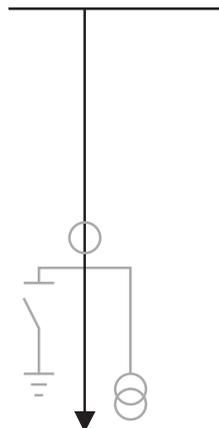
R - Riser



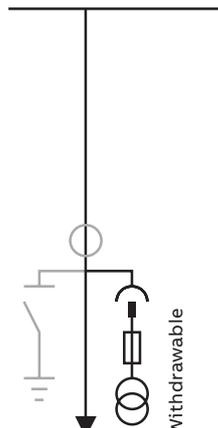
RM - Riser with measurements



M - Measurements



IFD - Direct incoming/outgoing feeder



IFDM - Direct incoming/ outgoing feeder with measurements

Key to components

— Standard components

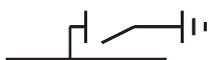
— Accessories

— 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



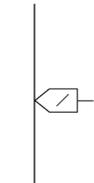
Earth



Cable entry



Busbar entry



Current sensor



Voltage sensor

UniGear 550

Technical data

Units: ... 12 kV - 17.5 kV - ... 31.5 kA			
Width [mm]	550		
Height [mm]	2 200/2 595 ⁽¹⁾		
Height with gas exhaust duct [mm]	2 533 ⁽²⁾		
Depth [mm]	1 340		
Rated current [A]	-	630	1 250
IF Incoming/outgoing		x	x
BT Bus-tie		x	x
R Riser		x	x
RM Riser with measurements			
M Measurements	x		
IFD Direct incoming/outgoing		x	x
IFDM Direct incoming/outgoing with measurement			

(1) The height of the unit is a function of the height of the low voltage compartment, available in the 665 and 1 060 mm versions.

(2) Others solutions are available, please contact ABB representative.

Additional information

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ABB Ltd.

Distribution Solutions

Electrification

P.O. Box 8131

CH-8050 Zurich

Switzerland

abb.com/mediumvoltage

abb.com/contactcenters