

DISTRIBUTION SOLUTIONS

UniGear ZS1

Medium-voltage air-insulated switchgear up to 24 kV



- Well-established global product
- Highest safety level
- High customization and adaptation level

UniGear ZS1 is the ABB mainline switchgear for primary distribution up to 24 kV, 4 000 A, 63 kA.

The switchgear is manufactured worldwide and there are more than 500 000 panels currently installed. UniGear ZS1 is used to distribute electric power in a variety of demanding applications such as on off-shore platforms, in container or cruise ships, in mines as well as in utility substations, power plants or chemical plants.

Panels are available as a single busbar, double busbar, back-to-back or double level solution.

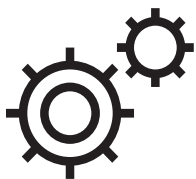
Benefits



Well-established global product with more than 500 000 panels produced and installed in more than 100 countries



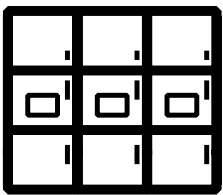
Highest safety level for people and equipment



High customization and adaptation level while integrating into existing or new installation



Approved to be used for special applications such as marine, seismic, nuclear and type tested for IEC, GB/DL, GOST and CSA standards



Compatible with other panel types from UniGear family



Solution with consideration of environmental impacts while designing

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UniGear ZS1

Description

- UniGear ZS1 is the ABB mainline global switchgear up to 24 kV, 4000 A, 63 kA and is produced close to you in all the six continents
- More than 500 000 panels produced and installed in more than 100 countries
- Each UniGear ZS1 panel consists of a single unit which can be equipped with a circuit-breaker, contactor or switch-disconnector, as well as with all the accessories available for conventional switchgear units
- Approved to be used for special applications such marine, seismic, nuclear and type tested for IEC, GB/DL, GOST and CSA standards
- 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 ZS1

Range

- Up to 12-17.5 kV, ...4000 A, ...63 kA
- Up to 24 kV, ...3150 A, ...31.5 kA
- Standard IEC
- Highly customized versions

Safety

- Fitted with safety interlocks
- Internal arc classification IAC AFLR
- Classified as LSC2B, PM *
- CB racking with closed door

Flexibility

- Wide applications
- Vacuum and SF6 circuit-breaker
- Vacuum contactor
- Switch-disconnector
- Traditional CT/VT and 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
- Ultra fast earthing switch
- IS Limiter
- Integrated capacitor banks
- Bay control and protection unit

* UniGear ZS1 panel variants have the most common classification LSC2B, PM. Check other panel variants and their LSC classification in this catalogue.





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 ZS1

Description

UniGear ZS1 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.

Since the switchgear is highly modular type, this make simple selection of components required by any application.

The functional units of the switchgear are guaranteed arc proof in accordance with the IEC 62271-200 Standards, appendix AA, class A accessibility, criteria 1 to 5.

All the installation, operation and maintenance operations can be carried out from the front of the unit.

The switchgear and the earthing switches are operated from the front with the door closed. The switchgear can be back to wall installed.

Apparatus

The range of apparatus available for UniGear ZS1 switchgear is the most complete on the market, including:

- Withdrawable vacuum circuit-breakers with mechanical or magnetic actuator
- Withdrawable gas circuit-breakers
- Withdrawable vacuum contactors with fuses
- Fixed version of switch-disconnectors

This makes it possible to offer a single switchgear-user interface, with the same operational and maintenance procedures. The switchgear can be fitted with instrument transformers or sensors for current and voltage measurement and protection and any type of protection and control unit.

Switchgear, busbar configuration

In the completion of the traditional functional units in single level-single busbar arrangement, the UniGear ZS1 switchgear platform is fitted with:

- Double-level
- Compact units equipped with contactors with fuses
- Double Busbar Systems

The use of these units allows extremely efficient use of space. In addition UniGear ZS1 single busbar is possible to combine to other members of UniGear family like:

- UniGear 550
- UniGear 500R
- UniGear MCC

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 62271-106 for the contactors
- IEC 62271-103 for the switch-disconnectors
- 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 ZS1 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] | 7.2 | 12 | 17.5 | 24 |
| Rated insulation voltage | [kV] | 7.2 | 12 | 17.5 | 24 |
| Rated power frequency withstand voltage | [kV / 1min] | 20 | 28 | 38* | 50 |
| Rated lightning impulse withstand voltage | [kV] | 60 | 75 | 95 | 125 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 | 50 / 60 | 50 / 60 |
| Rated short time withstand current | [kA / 3 s] | ...50 | ...50 | ...50 | ...31.5 |
| Rated short time withstand current | [kA / 1 s] | 63 | 63 | 63 | |
| Peak current | [kA] | ...164 | ...164 | ...164 | ...80 |
| Internal arc withstand current | [kA / 1 s] | ...50 | ...50 | ...50 | ...31.5 |
| Internal arc withstand current | [kA / 0.5 s] | 63 | 63 | 63 | |
| Main busbar rated current | [A] | ...4 000 | ...4 000 | ...4 000 | ...3 150 |
| | | 630 | 630 | 630 | 630 |
| | | 1 250 | 1 250 | 1 250 | 1 250 |
| Circuit-breaker rated current | [A] | 1 600 | 1 600 | 1 600 | 1 600 |
| | | 2 000 | 2 000 | 2 000 | 2 000 |
| | | 2 500 | 2 500 | 2 500 | 2 300 |
| | | 3 150 | 3 150 | 3 150 | 2 500 |
| | | 3 600 | 3 600 | 3 600 | 2 500 |
| Circuit-breaker rated current with forced ventilation | [A] | 4 000 | 4 000 | 4 000 | 3 150 |

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

The values indicated are valid for both vacuum and SF6 circuit-breaker

For panel with contactor the rated current value is 400 A

CSA version is available up to 27.6 kV

1 250 A - 40 kA available at 650 mm panel

* 42 kV (63 kA version)

UniGear ZS1

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 ZS1 switchgear can be defined as follows.

Loss of service continuity

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:

- LSC1: 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
- LSC2A: The same as LSC1 with the exception that the main busbars and the functional units adjacent to the one under maintenance can remain energized
- LSC2B: The same as LSC2A with the exception that the cable compartment can remain energized

UniGear ZS1 panel variants have the most common classification LSC2B, PM. For detailed information please see tables on next page.

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 ZS1 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 ZS1 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 ZS1 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 ZS1 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...63 kA)
- Duration of the fault (0.1...1s)
- 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.

LSC Classification for each UniGear ZS1 single busbar panel type

| Units: ... 12 kV - 17.5 kV - ... 31.5 kA | | |
|--|---|--------------------|
| Panel type | | LSC Classification |
| IF | Incoming/outgoing | LSC2B |
| BT | Bus-tie | LSC2B |
| R | Riser | LSC1 |
| RM | Riser with measurement | LSC2 |
| M | Measurement | LSC2 |
| IFD | Direct incoming/outgoing | LSC1 |
| IFDM | Direct incoming/outgoing with measurement | LSC2 |
| DF | Switch-disconnector unit | LSC2A |
| IFC | Contactor panel | LSC2B |

| Units: ... 12 kV - 17.5 kV - 40 / 50 kA | | |
|---|---|--------------------|
| Panel type | | LSC Classification |
| IF | Incoming/outgoing | LSC2B |
| BT | Bus-tie | LSC2B |
| R | Riser | LSC1 |
| RM | Riser with measurement | LSC2 |
| M | Measurement | LSC2 |
| IFD | Direct incoming/outgoing | LSC1 |
| IFDM | Direct incoming/outgoing with measurement | LSC2 |
| IFC | Contactor panel | LSC2B |

| Units: ... 12 kV - 17.5 kV - 63 kA | | |
|------------------------------------|------------------------|--------------------|
| Panel type | | LSC Classification |
| IF | Incoming/outgoing | LSC2B |
| BT | Bus-tie | LSC2B |
| R | Riser | LSC1 |
| RM | Riser with measurement | LSC2 |
| M | Measurement | LSC2 |

| Units: ... 24 kV - ... 31.5 kA | | |
|--------------------------------|---|--------------------|
| Panel type | | LSC Classification |
| IF | Incoming/outgoing | LSC2B |
| BT | Bus-tie | LSC2B |
| R | Riser | LSC1 |
| RM | Riser with measurement | LSC2 |
| M | Measurement | LSC2 |
| IFD | Direct incoming/outgoing | LSC1 |
| IFDM | Direct incoming/outgoing with measurement | LSC2 |

Note: All panel variants defined with PM partition class

UniGear ZS1

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 2 500 A, the busbars are flat bars; while for currents between 3 150 A and 4 000 A, a special D-shape busbar is used. The busbars are covered with insulating material. There is a single busbar compartment along the whole length of the switchgear up to 31.5 kA, which optionally can be divided into compartments. For 40/50 kA these bushings are a standard feature.

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 busbars for the whole range of currents.

For 17.5 and 24 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, and optionally, can also be motor operated.

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

Earthing busbar

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

Insulating bushings 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 twelve per phase can be used depending on the rated voltage, the unit dimensions 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.

The UniGear ZS1 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

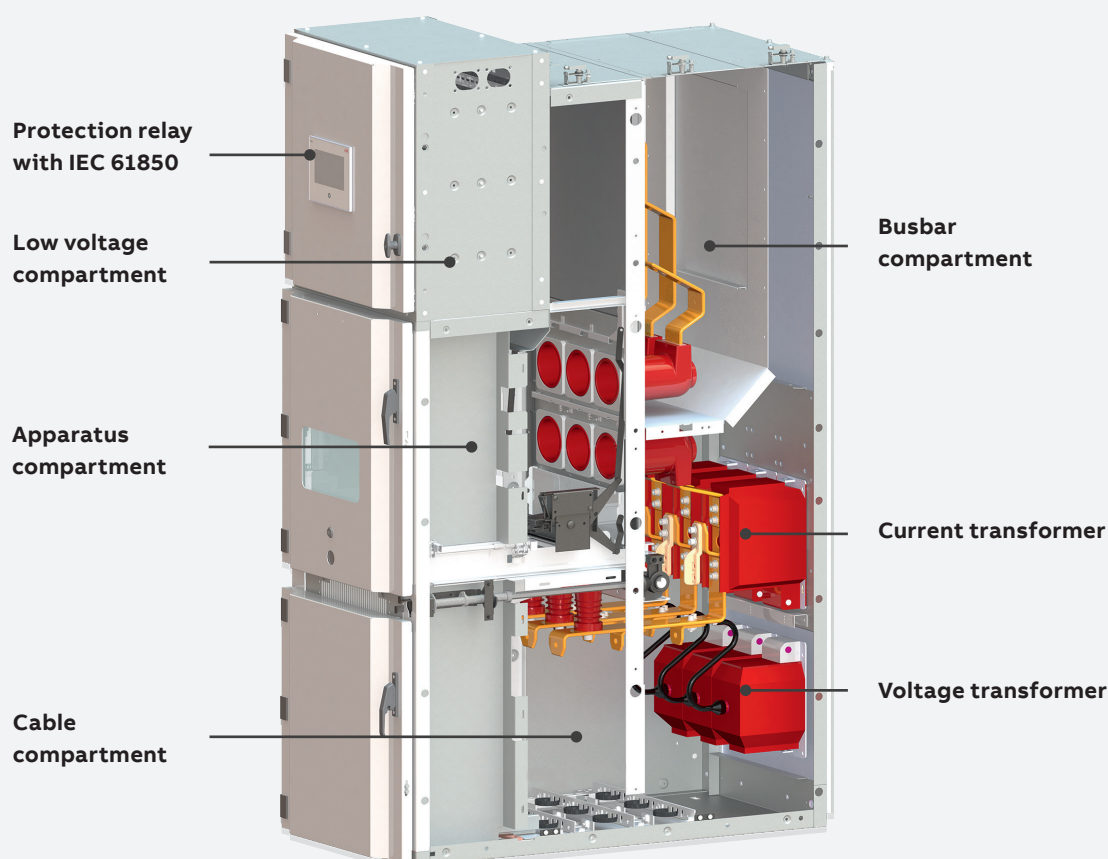
Each switchgear unit can optionally be fitted with an accessory busbar application:

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

Note:

According to IEC 62271-200 and IEC 50110 to ensure personnel protection during maintenance work, all of high-voltage conductive parts to which access is required or provided shall be capable of being earthed prior to becoming accessible. This does not apply to removable parts which become accessible after separated from the switchgear and controlgear.

Each switchgear panel must have its own earthing switch or earthing truck. This requirement also applies to busbars, where earthing can be done either by an earthing switch mounted in top-housing box or by using an earthing truck. Where none of these is available, the switchgear panel shall have connection points for applying earthing kit.



UniGear ZS1

Fully type-tested

The UniGear ZS1 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 and contactors
- 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 ZS1 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 ZS1 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 ZS1 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 ZS1

Safety

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

This is why the UniGear ZS1 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 ZS1 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 ZS1 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 ZS1 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 ZS1 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 50 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

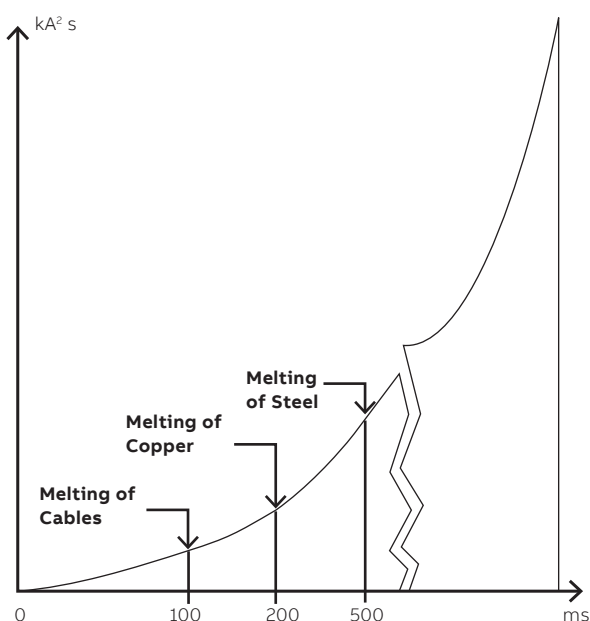
615 series, 620 series and REX640 IEDs (Intelligent Electronic Device) can optionally be fitted with a fast arc flash protection. It offers a two-to three-channel arc-fault protection system for arc flash supervision of the circuit breaker, cable and busbar compartment of switchgear panels.

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

UFES (ultra fast earthing switch)

The UFES is an innovative design of an extremely fast-acting earthing switch, grounding all 3 phases within < 4 ms after detection of an internal arc fault.

—
Arc duration and
damage caused



UniGear ZS1

Safety

The UniGear ZS1 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.

These locks can also be applied to the earthing switch of busbar applications.

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 are circuit-breakers and contactors

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 racking-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 racking-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

| | | |
|----|--|---|
| 18 | 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. |
| 19 | 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. |
| 20 | 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 ZS1

Vacuum circuit-breaker

UniGear ZS1 switchgear can be fitted with the widest range of apparatus available on the market today, and of these the vacuum circuit-breaker now occupies a position of prime importance in all sectors of primary distribution. Vacuum circuit-breakers cover the whole range of switchgear parameters and therefore the whole range of applications.

Many years of experience gained in developing and using vacuum interrupters is today reflected in the range of ABB circuit-breakers, which stand out for their exceptional electrical and mechanical characteristics, extremely long life, low maintenance, compactness and the use of highly innovative construction techniques.

ABB develops and produces a complete range of interrupters for use in circuit-breakers and contactors and for all medium voltage applications.

VD4 circuit-breaker

The VD4 medium voltage circuit-breaker interrupters use vacuum to extinguish the electric arc and as the insulating medium. Thanks to the unequalled properties of vacuum and the breaking technique used, current interruption takes place without arc chopping and without overvoltages. Restoration of the dielectric properties following interruption is extremely rapid.

The VD4 circuit-breakers are used for protection of cables, overhead lines, motors, transformers, generators and capacitor banks.

Poles

The VD4 medium voltage circuit-breakers use vacuum interrupters embedded in poles (circuit-breakers up to 17.5 kV - 1 250 A - 40 kA are made off polyamide poles).

Embedding the interrupter in the pole makes the circuit-breaker particularly sturdy and protects the interrupter itself against shocks, deposits of dust and humidity.

The vacuum interrupter houses the contacts and provides the interruption chamber.

ABB circuit-breakers use the most advanced vacuum-breaking techniques: with radial magnetic flow for circuit-breakers with medium-low ratings and with axialmagnetic flow for those with high breaking capacity.

Both techniques guarantee even distribution of the arc roots over the whole surface of the contacts, allowing optimum performance at all current values.

The structure of a vacuum interrupter is relatively simple. The housing is made up of a ceramic insulator closed at the ends by stainless steel covers. The contacts are made of pure copper and sintered chrome and are welded to the copper terminals. A metallic bellows allows movement of the moving contact-terminal group, at the same time guaranteeing that the vacuum is maintained in the interrupter. The interrupter components are welded in an environment under a very strong vacuum to guarantee a vacuum of less than 10^{-5} Pa in the interrupter.

This means that the interrupter does not any ionisable material. In any case, on detachment of the contacts, an electric arc is generated which only consists of the melted and vaporised material of the contact.

A metallic shield is integrated inside the interrupter to capture the metallic vapours given off during interruption, as well as for controlling the electric field. The particular shape of the contacts generates a magnetic field which forces the arc to rotate and to involve a much wider surface than that of a fixed contact arc.

Apart from limiting the thermal stress on the contacts, this makes contact erosion negligible and, above all, allows the interruption process to be controlled even with very high short-circuit currents.

The electric arc remains supported by the external energy until the current passes through its natural zero.

The ABB vacuum interrupters are zero current interrupters and are free of any re-striking phenomena.

The rapid reduction of the current density and fast

condensation of the metallic vapours, that happens at the at the instant that the current passes through zero, allow the maximum dielectric strength between the interrupter contacts to be re-established within a few milliseconds. Supervision of the vacuum level is not necessary as the circuit-breaker poles are sealed-for-life and do not require any maintenance.

Operating mechanism

The VD4 circuit-breaker is fitted with a mechanical stored energy type operating mechanism.

The trip free mechanism allows opening and closing operations independent of the operator. The operating mechanism spring system can be recharged either manually or by means of a geared motor. The apparatus can be opened and closed by means of the pushbuttons on the front of the operating mechanism or by means of electric releases (shunt closing, shunt opening and undervoltage).

The circuit-breakers are always fitted with an anti-pumping device to eliminate the possibility of simultaneous opening and closing commands, closing commands with springs discharged or with the main contacts not yet in their run-end position.

Truck

The poles and operating mechanism are fixed onto a metal support and handling truck.

The truck is provided with a wheel system which makes the operations for racking the apparatus into and out of the switchgear unit possible with the door closed. The truck allows efficient earthing of the circuit-breaker by means of the metallic structure of the switchgear unit.

The vacuum circuit-breaker truck can be motor-operated.

The racking-out and racking-in operations can be carried out by means of electrical controls, either locally by the operator or by a remote system.

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)

UniGear ZS1

Vacuum circuit-breaker

—
01 VD4 circuit-breaker
with mechanical
actuator
—
02 VM1 circuit-breaker
with magnetic actuator
—
03 VD4G circuit-breakers

VM1 circuit-breaker

The conventional mechanical stored energy type of operating mechanism used on the VD4 circuit-breakers can be replaced with an operating mechanism with magnetic actuator, creating the VM1 series of circuit-breakers.

All the characteristics of the circuit-breakers described in this chapter remain unchanged except for the operating mechanism.

The operating mechanism is based on a greatly reduced number of components:

- Actuator with permanent magnets. The heart of the operating mechanism consists of the magnetic actuator which carries out the closing and opening operations, and keeps the main contacts in their positions taken up after the operation. The magnet transmits the operating mechanism to the interrupters by means of a single transmission lever.
- Electronic control device. All the functions (trip, operation, energy charging and watchdog) are carried out by the integrated electronic controller. The circuit-breaker is fitted with a multivoltage direct and alternating current feeder.
- Capacitors. The energy required to switch the operating mechanism is provided by an incorporated capacitor bank. The stored energy guarantees the complete O-C-O reclosing sequence.
- Position sensors. The position of the circuit-breaker contacts is detected by means of electronic proximity sensors.

Standards

- IEC 62271-100 for the circuit-breaker



01



02



03



UniGear ZS1

VD4G – Vacuum circuit-breaker for generator switching applications

The worldwide increasing energy demand is covered more and more by decentralized power plants and renewable resources of small unit size. As the generated energy is fed into the grid by step-up transformers and MV distribution boards, VD4G offers a reliable and economical solution to protect the power plants assets.

VD4G is the upgraded version of VD4 vacuum circuit-breaker for generator (GCB) applications. VD4G is suitable for the small power plants as well as for industrial, oil and gas applications in which generators are connected to the MV distribution of the plant.

Protection

- Suitability analysis using grid calculation tool
- Optional system study for additional circuit-breakers in grid
- System-fed faults tested up to 63 kA and generator-fed faults tested up to 50 kA
- Special design allows ultra-demanding breaking current switching without any additional opening
- Completely type-tested in accordance to the latest IEEE/IEC 62271-37-013 standards covering also IEEE C37.013

Availability

- Severe TRV withstand capability
- Special design allows ultra-demanding breaking current switching without any additional opening
- More reliable synchronization
- More reliable supply for unit auxiliaries

Flexibility

- Only one circuit-breaker shall be operated during the starting-up or shutting-down of generator
- Maintenance-free solution
- Compact solution

Possible applications

- Renewable energy power plants
- Small energy power plants
- Networks with emergency power generator
- Process industry with own power generation
- Retrofit solutions

Special requirements for suitability analysis with grid calculation tool

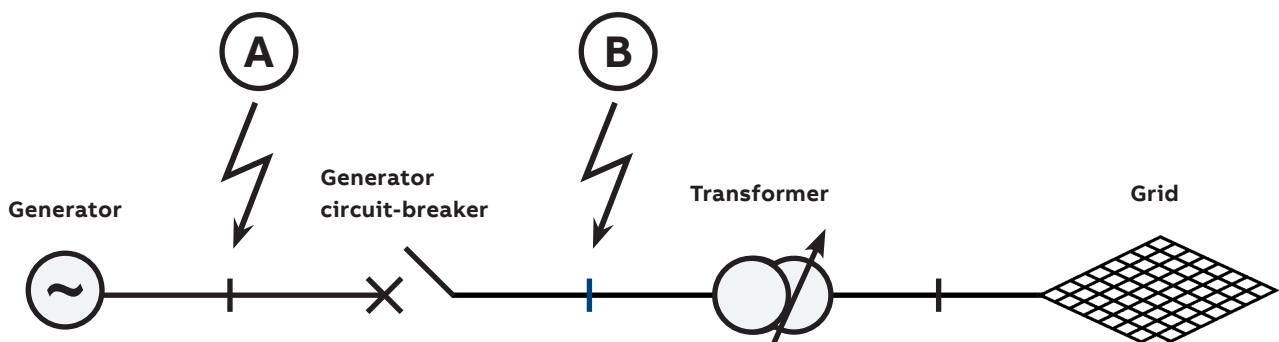
ABB can provide you with adequate support for the suitability analysis and proper selection of GCB by providing the following information:

- Single Line Diagram
- Technical data sheet of generator, transformer and other grid equipment

Technical data

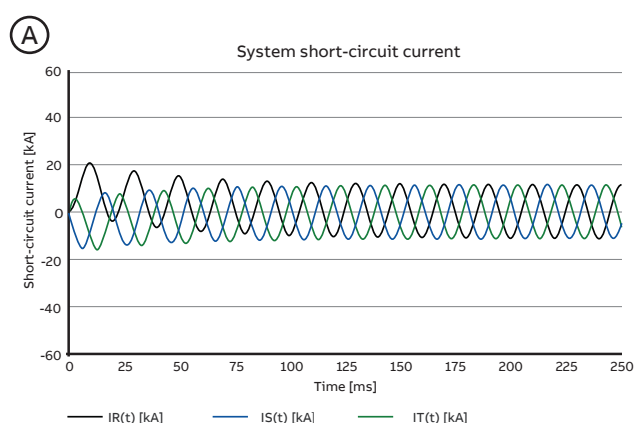
- System-fed faults tested up to 63 kA and generator-fed faults tested up to 50 kA
- Severe TRV withstand capability
- Suitable for switching under delayed current zero conditions
- Completely type tested according to Dual Logo IEC/IEEE 62271-37-013 covering also IEEE C37.013

Typical schematic of generator circuit-breaker application

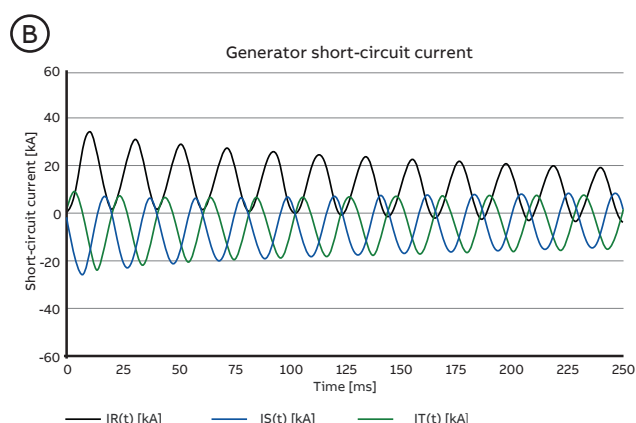


The challenge to protect the grid as well as the generator against failures makes generator circuit-breakers essential. Each generator has specific technical characteristics. A suitability analysis of the generator circuit-breaker application is indispensable.

The system-fed fault (A) and the generator-fed fault (B) of a grid need to be reliably interrupted by the generator circuit-breaker.



Failure location A: System-fed fault
Fast decaying DC component



Failure location B: Generator-fed fault
Slowly decaying and raised DC component results in delayed current zero

Electrical characteristics according to IEC 62271-200 and IEC/IEEE 62271-37-013

| Switchgear | | UniGear ZS1 with VD4G-25 | UniGear ZS1 with VD4G-40 | UniGear ZS1 with VD4G-50 | UniGear ZS1 with VD4G-63 |
|---|--------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| Rated voltage | [kV] | | 15* | | |
| Maximum service voltage | [kV] | | 15 | | |
| Test voltage (50/60 Hz) | [kV / 1 min] | | 38 | | |
| Impulse withstand voltage | [kV] | | 95 | | |
| Rated frequency | [Hz] | | 50 / 60 | | |
| Rated short-time withstand current | | 25 kA / 3 s | 40 kA / 3 s | 50 kA / 3 s | 63 kA / 1 s |
| Symmetrical short-circuit current I _{scg} Class G1 | [kA] | 16 | 25 | 50 | 50 |
| Symmetrical short-circuit current I _{scg} Class G2 | [kA] | 16 | 25 | 37 | 37 |
| Peak withstand current | [kA] | 68.5 | 115 | 137 | 173 |
| Internal arc withstand current | | 25 kA / 1 s | 40 kA / 1 s | 50 kA / 1 s | 63 kA / 0.5 s |
| Rated current of the main busbars | [A] | ...4 000 | ...4 000 | ...4 000 | ...4 000 |
| | [A] | 1 250 | 1 250 | | |
| Feeders rated current with natural ventilation | [A] | | 1 600 | | |
| | [A] | | 2 000 | | |
| Feeders rated current with forced ventilation | [A] | | 3 150 | 3 150 | 3 150 |
| | [A] | | 4 000 | 4 000 | 4 000 |

UniGear ZS1 panel with VD4G circuit-breaker can be coupled with standard UniGear ZS1 panel with VD4/P circuit-breaker

* Contact ABB for higher values

UniGear ZS1

Gas circuit-breaker

UniGear ZS1 switchgear can also be fitted with SF6 gas circuit-breakers.

The ABB vacuum and gas series of circuit-breakers are mechanically interchangeable and the same switchgear unit can therefore take either type of apparatus. Only ABB can offer apparatus representing both techniques for the whole range of applications, voltage levels (12-17.5-24 kV), rated current (630...4 000 A) and breaking capacity (16...50 kA).

This makes it possible to specify the optimum solution for the installation characteristics and the feeders to be switched and protected. ABB's long practical experience shows that the two types of circuit-breakers are equally valid and complementary.

HD4 circuit-breaker

The HD4 medium voltage circuit-breakers use sulphurhexafluoride gas (SF6) to extinguish the electric arc and as the insulating medium. Thanks to the excellent properties of SF6 gas, interruption of the currents takes place without arc chopping and overvoltages. There is no restriking phenomenon after interruption and the dielectric properties following interruption are recovered extremely rapidly.

Gas circuit-breakers are available for all electric power distribution applications. They are particularly recommended for use on capacitor banks, motors, transformers insulated in oil and in installations where components which are particularly sensitive to dielectric and dynamic stresses are installed (for example, old cables or transformers).

Poles

The HD4 circuit-breaker poles use the autopuffer breaking system, combining the compression and self-blast techniques in a single solution. The autopuffer system is the most innovative technique in the field of gas circuit-breakers and originates from high voltage apparatus. The combination of the compression and self-blast techniques allows the best performance to

be obtained at all current values. Both techniques are always present, but whereas the former operates optimally in switching low currents, the latter acts effectively during operation at higher current values. The autopuffer technique allows the use of a smaller quantity of gas than that required by circuit-breakers based on other techniques. For the same reason, the gas pressure is also considerably reduced. The autopuffer technique guarantees the insulating withstand voltage and the breaking capacity up to 30% of the rated value, even with zero relative pressure. The whole range of HD4 circuit-breakers uses the same gas pressure for all rated voltage levels (12-17.5-24 kV). SF6 gas pressure level monitoring is not necessary, since the circuit-breaker poles are sealed-for-life pressure systems and are maintenance-free.

They are fitted with a pressure control device for checking that the characteristics are not altered due to transport or incorrect operations.

Operating mechanism

The HD4 circuit-breaker is fitted with a mechanical stored energy operating mechanism. This is trip free and therefore allows opening and closing operations independent of the operator. The operating mechanism spring system can be recharged either manually or by means of a geared motor. The operating mechanism is of the same type for the whole series and has a standardised range of accessories and spare parts.

All the accessory components can easily be replaced by means of plug-socket connectors. Opening and the closing of the apparatus can be carried out by pushbuttons on the front of the operating mechanism or by electric releases (shunt closing, shunt opening and undervoltage). The circuit-breakers are always fitted with an anti-pumping device to eliminate the possibility of simultaneous opening and closing commands, closing commands with springs discharged or with the main contacts not yet in their run-end position.

Truck

The poles and operating mechanism are fixed onto a metal support and handling truck.

The truck is provided with a wheel system which makes the operations for racking the apparatus out of and into the switchgear unit possible with the door closed.

The truck allows effective earthing of the circuit-breaker by means of the metallic structure of the switchgear unit.

Apparatus-operator interface

The front panel 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 and discharged state of the operating mechanism springs
- Manual charging device for the operating mechanism springs
- Override selector of the undervoltage release (optional)
- LED gas pressure indicator (optional)

HD4-HXA circuit-breaker for high unidirectional components

The range of HD4 circuit-breakers is extended by the HD4-HXA version.

This series of circuit-breakers maintains all the features

described in this chapter, but is notable for its ability to switch loads with strong unidirectional components.

For breaking capacities of 40 kA or lower, HD4-HXA circuit-breakers are able to switch loads with unidirectional components IDC = 100%, up to service voltage 13.8 kV; at 50 kA the unidirectional component percentage IDC is reduced to 50%. They can be used in all installations affected by strong unidirectional components, but their natural field of application is found in switching and protecting transformers of the auxiliary circuits in power generating stations.

Standards

- IEC 62271-100 for the circuit-breaker
- IEC 60376 for the SF₆ gas

HD4 circuit-breaker



UniGear ZS1

ConVac vacuum contactor

The medium voltage ConVac contactor operates in alternating current and is normally used to control devices requiring a high number of hourly operating sequences.

The ConVac contactor has a linear electromagnetic actuator that moves in line with the moving contact of the vacuum interrupters to guarantee the best performance and long, reliable mechanical life. They are ideal for controlling motors, transformers, capacitor banks, switching systems, etc. Fitted with fuses, they can be used in circuits with up to 50 kA fault levels. ConVac contactors are suitable for AC4 category according IEC 62271-106.

ConVac contactor

ConVac contactors are available in the following ratings:

- ConVac 7/P: for voltages up to 7.2 kV
- ConVac 12/P: for voltages up to 12 kV

Main technical characteristics are:

- Extremely low chopping current value: < 0.7 A
- Plug and play concept for majority of accessories (interchangeable between 7.2 kV and 12 kV version)
- High mechanical and electrical life:
 - Mechanical life: 2 000 000 operations (electrical latching)
 - Electrical life: 100 000 cycles in AC3 category
- Multi-voltage feeder
- up to 6NO+6NC positively driven auxiliary contacts in class 1 according IEC 62271-1
- Position contacts on the truck
- Motor operated truck (on request)
- Fuse protected self supply control power transformer on board the withdrawable truck:
 - Dedicated winding for self-supply purposes
 - Separate winding on request (50 VA class 1) for customer use
- Fuse presence indicators
- Fuse intervened indicator

ConVac contactors are available with two different type of actuating system:

- Electrical latching: closing takes place by supplying auxiliary power to the multi-voltage feeder. On the other hand, opening occurs when the auxiliary power is interrupted either intentionally (by means of a command) or unintentionally (due to lack of auxiliary power in the installation).
- Mechanical latching: the contactor closes as in the electrical latching version but when the apparatus reaches the closed position, this is maintained by a mechanical device. Opening takes place when the opening coil is supplied. This releases the mechanical lock and allows the opening springs to operate.

Mechanical latching is achieved only by assembling on the electrically latched version a kit, called RiMe. In the same way, removing the kit from a mechanically latched unit, is possible to switch to electrical latching. This activity can be done directly by the customer as there is no adjustments required.

Auxiliary contacts

The contactor is equipped with positively driven, class 1 (according IEC 62271-1) auxiliary contacts. Three options are available:

1. Two normally open plus two normally closed (3a)
2. Four normally open plus four normally closed (3b)
3. Six normally open plus six normally closed (3c)

As RiMe kit, they are replaceable by the customer.

Fuses

ConVac/P is fitted with medium voltage fuses to protect the users and devices downstream the fuses. Fuse coordination with ABB fuses is tested in damage class C according IEC 62271-106 Standard.

ConVac/P fuse-holder is suitable to accept, for each phase, one single body DIN type fuse, or BS

type fuse (to be defined at order stage), with average dimensions and striker according DIN 43625 Standard. Fuses shall be according IEC 60282-1 with maximum cartridge length 442 mm or BS 2692 (1975) with maximum cartridge length L=454 mm.

ABB fuses type CMF-BS cannot be installed on ConVac/P contactors.

| ConVac electrical characteristics | | 7.2 kV | 12 kV |
|---|--------------|------------------------|------------------------|
| Rated voltage | [kV] | 7.2 | 12 |
| Rated insulation voltage | [kV] | 7.2 | 12 |
| Rated power frequency withstand voltage | [kV / 1 min] | 20 (32) ⁽³⁾ | 28 (42) ⁽³⁾ |
| Rated lightning impulse withstand voltage | [kV] | 60 | 75 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 |
| Rated short-time withstand current ⁽¹⁾ | [kA] | 6 (50) | 6 (50) |
| Internal arc withstand current ⁽²⁾ | [kA / 1s] | ...50 | ...50 |
| Maximum contactor rated current without fuses | [A] | 400 | 400 |
| Maximum contactor rated current with fuses | [A] | 250 | 160 |

(1) Limited by the fuses

(2) The internal arc withstand values are guaranteed in the compartments on the supply side of the fuses (busbars and apparatus) by the structure of the switchgear and on the load side (feeder) by the limiting properties of the fuses

(3) Available on request

—
ConVac



UniGear ZS1

Switch-disconnector

UniGear panels can be fitted with ABB NAL type switch-disconnectors. These units are used to switch and protect feeders and transformers or the auxiliary services transformers in sub and power station.

NAL-NALF switch-disconnector

The NAL switch-disconnectors are medium voltage air-insulated apparatus consisting of a fixed support to which the post insulators are applied (top and bottom), the system of contacts (fixed and moving) and latching pliers (of the fuses or of the insulating bars).

The switch-disconnector is fitted with two systems of moving blade contacts, the main one (through which the load current passes with the switch in the closed position) and the arc-breaking one (through which the current passes during the opening and closing operations). This solution means the main contacts are not stressed and therefore keeps the electrical characteristics of the apparatus unchanged. During switch-disconnector opening air is compressed by the pistons contained in the top insulator cylinders. At the moment of opening and separation of the contacts, a blast of compressed air is emitted through special nozzles, so the arc is cooled and deionised. This leads to a gradual increase in the arc resistance which causes its extinction. The movement of the pistons is synchronised with the arc-breaking contacts of the switch-disconnector -this guarantees the highest inflow of air at the moment of separation of the contacts and there by ensures reliable arc extinction.

The unit can be fitted with insulating bars (NAL switch-disconnector unit) or with medium voltage fuses (NALFswitch-disconnector unit with fuses).

The NALF switch-disconnector is fitted with an automatic release mechanism for fuse tripping and uses fuses in accordance with DIN 43625 Standards. The ABB range of fuses for transformer protection is CEF. Each unit is fitted with an earthing switch with making capacity 16 kA for earthing the cables.

Switch-disconnector control, like that of the earthing switch, is carried out manually from the switchgear front panel.

The position of both items of apparatus can be seen directly from the front of the switchgear through an inspection window.

The switchgear panel can be fitted with a set of three current transformers or with measurement sensors.

The Disconnecter Feeder unit (DF) consists of two power compartments: busbars and switch-disconnector/cables. The latter contains both the switch-disconnector and the connection terminals of the power cables.

Segregation between the power compartments takes place automatically with earthing switch closure. An insulating shutter creates complete separation between the fixed contacts of the switch-disconnector, making the top ones inaccessible to the operators. This makes maintenance operations on the cables and fuses possible, keeping the remainder of the switchgear in operation.

UniGear ZS1 panel with fixed switch-disconnector is classified LSC-2A because the cable and apparatus compartments are not physically segregated.

The switch-disconnector, earthing switch and access door to the cables compartment are interlocked with each other to guarantee maximum safety for the personnel and correct operation.

Each switchgear panel is fitted with an auxiliary compartment, where the instruments and auxiliary cabling are housed.

All the switchgear panels are accessible from the front and maintenance and service operations can therefore be carried out even when the switchgear is wall-mounted.

Standards

- IEC 62271-103 for the switch-disconnector
- IEC 60282-1 for the fuses

| | | | | |
|--|--------------|-------|-------|-------|
| Rated voltage | [kV] | 12 | 17.5 | 24 |
| Rated insulation voltage | [kV] | 12 | 17.5 | 24 |
| Rated power frequency withstand voltage ⁽¹⁾ | [kV / 1 min] | 28 | 38 | 50 |
| Rated lightning impulse withstand voltage | [kV] | 75 | 95 | 125 |
| Rated frequency | [Hz] | 50/60 | 50/60 | 50/60 |

(1) GB/DL version is available with higher request in dielectric characteristics

| NALF switch-disconnector unit with fuses | | | | |
|--|------------|-------|-------|-------|
| Rated short-time withstand current of switch-disconnector ⁽¹⁾ | [kA / 1 s] | ...25 | ...25 | ...25 |
| Peak current | [kA] | ...63 | ...63 | ...63 |
| Maximum rated current of the fuses | [A] | 100 | 63 | 63 |
| Internal arc withstand current ⁽²⁾ | [kA / 1 s] | ...25 | ...25 | ...25 |

(1) Limited by the fuses

(2) The internal arc withstand values are guaranteed in the compartment on the supply side of the fuses (busbars) by the structure of the switchgear and on the load side (cables) by the limiting properties of the fuses

Selection table of the fuses for protection transformers

| Transformer rated voltage [kV] | Transformer rated output [kVA] | | | | | | | | | | | | | | | | | Fuse rated voltage [kV] |
|--------------------------------------|--------------------------------|----|----|-----|-----|-----|-----|-----|------|-----|-----|------|-----|------|------|------|------|-------------------------------|
| | 25 | 50 | 75 | 100 | 125 | 160 | 200 | 250 | 315 | 400 | 500 | 630 | 800 | 1000 | 1250 | 1600 | 2000 | |
| | CEF Fuse-link In [A] | | | | | | | | | | | | | | | | | |
| 3 | 16 | 25 | 25 | 40 | 40 | 50 | 63 | 80 | 100 | 125 | | | | | | | | 3.6/7.2 |
| 5 | 10 | 16 | 25 | 25 | 25 | 40 | 40 | 50 | 63 | 80 | 100 | 125 | | | | | | |
| 6 | 6 | 16 | 16 | 25 | 25 | 25 | 40 | 40 | 50 | 63 | 80 | 100 | 125 | | | | | |
| 10 | 6 | 10 | 16 | 16 | 16 | 20 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | 100 | 125 | | | 12 |
| 12 | 6 | 6 | 10 | 16 | 16 | 16 | 20 | 20 | 25 | 40 | 40 | 50 | 63 | 80 | 100 | 125 | | 17.5 |
| 15 | 6 | 6 | 10 | 10 | 16 | 16 | 16 | 20 | 20 | 25 | 40 | 40 | 50 | 63 | 80 | 100 | 125 | |
| 20 | 6 | 6 | 6 | 10 | 10 | 16 | 16 | 16 | 20 | 20 | 25 | 31.5 | 40 | 50 | 63 | 80 | | 24 |
| 24 | 6 | 6 | 6 | 6 | 10 | 10 | 16 | 16 | 16 | 20 | 20 | 25 | 40 | 40 | 50 | 63 | 80 | |

The table was calculated according to standards IEC 60787 and IEC 62271-105 (for operating voltages up to 24 kV).

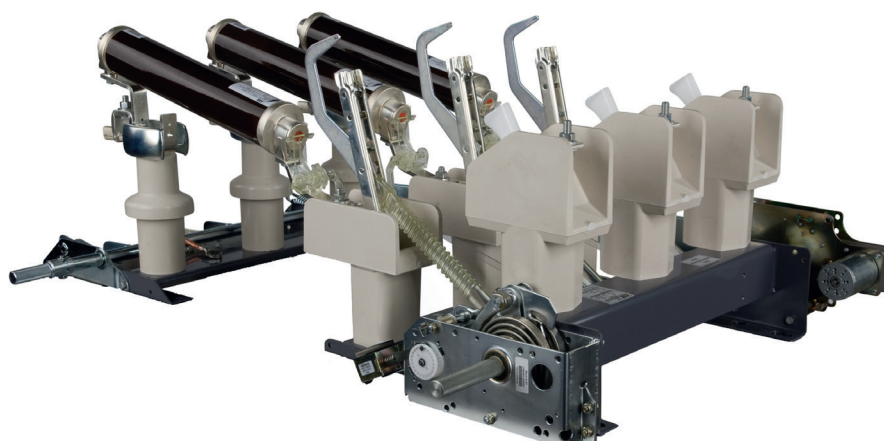
The following transformer work conditions were assumed:

- Maximum long-lasting overload – 150%
- Magnetizing inrush current – $12 \times I_n$ during 100 ms
- Transformer short-circuit voltage according to IEC 60076-5
- Standard ambient working conditions of fuses

The table above details the rated current of a particular fuse link for a given line voltage and transformer rating. For different criteria, the fuse selection must be recalculated.

The given limits of the rated current of fuse are not mandatory for use in the NALF disconnector / NAL without fuse tripping system. Rated current values of the corresponding fuses for these applications are given in the ABB catalogue "FUSES".

—
NALF switch-disconnector



UniGear ZS1

Service trucks

The UniGear ZS1 range is equipped with all the service trucks needed for service maintenance activities.

The trucks are divided into three different types:

- Earthing without making capacity
- Earthing with making capacity
- Isolation

Earthing truck without making capacity

These trucks carry out the same function as the earthing switches without making capacity. They therefore have no capacity to earth live circuits in fault conditions.

They are used to ensure an additional fixed earth, as is required by certain installation service and maintenance procedures, as a further safety guarantee for personnel.

The use of these trucks require the removal of the apparatus (circuit-breaker or contactor) from the switchgear and its replacement with the truck.

The switchgear panels preset for use of the earthing trucks must be provided with a key lock which, when activated, prevents their racking-in. This truck is available in two versions:

- Earthing of the main busbar system
- Earthing of the power cables

The earthing truck of the main busbars, during the racking-in phase, only lifts the top shutter and earths the contacts connected to the top branch connections (and therefore to the main busbar system) by means of the switchgear structure.

The earthing truck of the power cables, during the racking-in phase, only activates the bottom shutter and earths the contacts connected to the bottom branch connections (and therefore to the power cables) by means of the switchgear structure.

These trucks can also be used in the bus-tie unit. In this case, they earth one of the two sides of the main busbar system.

Earthing truck with making capacity

These trucks carry out the same function as the earthing switches with making capacity.

They consist of circuit-breakers provided with top (earthing of the main busbars) or bottom (earthing of the power cables) terminals only. The contacts without terminals are short-circuited by means of a copper bar and connected to earth by means of the apparatus truck.

They keep all the characteristics of the circuit-breakers, such as full making and breaking capacity on live circuits under fault conditions.

They are used to ensure extremely effective earthing on circuits stressed by a fault. They allow opening and closing operations to be carried out rapidly with electric remote control.

The use of these trucks require the removal of the apparatus (circuit-breaker or contactor) from the switchgear and its replacement with the truck.

The switchgear panels preset for use of the earthing trucks must be provided with a key lock which, when activated, prevents their being racked-in.

This truck is available in two versions:

- Earthing of the main busbar system
- Earthing of the power cables

The earthing truck of the main busbars, during the racking-in phase, only lifts the top shutter and presets the contacts connected to the top branch connections (and therefore to the main busbar system) for closing to earth by means of operating mechanism.

The earthing truck of the power cables, during the racking-in phase, only activates the bottom shutter and presets the contacts connected to the bottom branch connections (and therefore to the power cables) for closing to earth by means of operating mechanism.

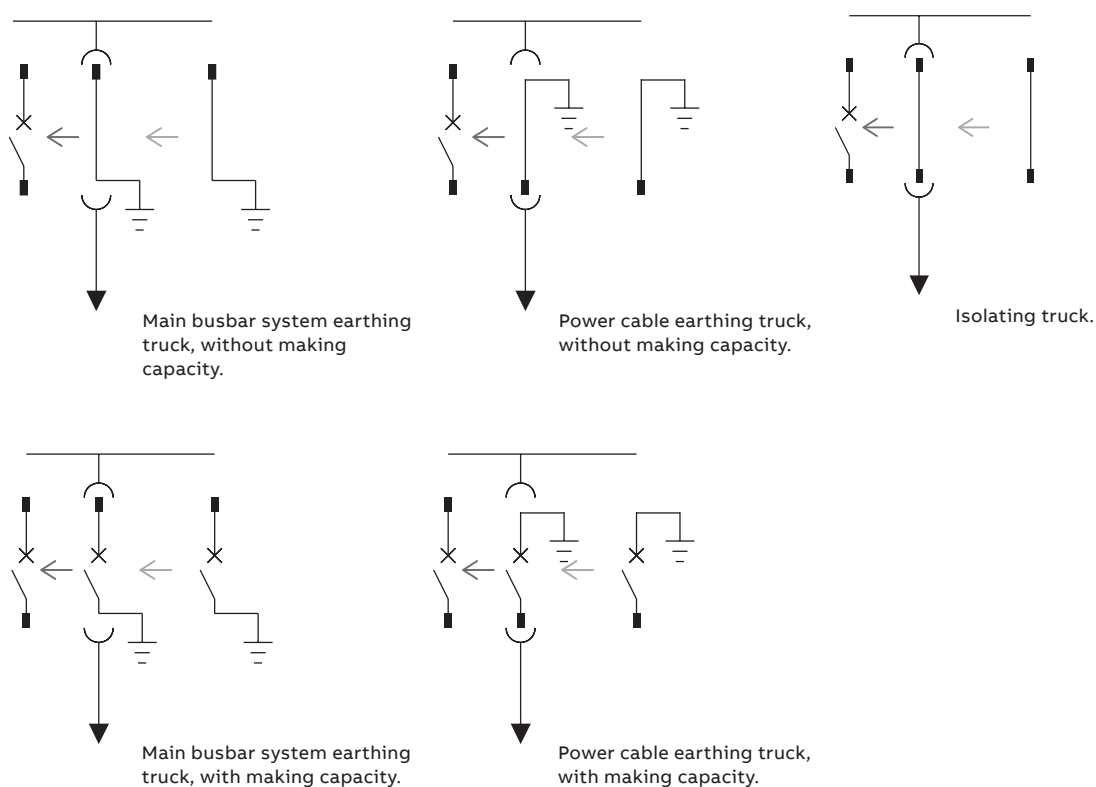
These trucks can also be used in the bus-tie unit. In this case, they earth one of the two sides of the main busbar system.

Isolating truck

The isolating truck allows the top switchgear contacts to be connected directly to the bottom ones. Connection is made extremely safe by using the poles of the circuit-breakers to insulate the connection busbars from the external environment. In the incoming/outgoing feeder units it connects the main busbar system to the power cables, whereas in the bus-tie, to the two sides of the busbar system.

This truck has its application in UniGear switchgear for making incoming/outgoing feeders without a circuit-breaker in radial networks, for making cable connections between two items of switchgear placed in front of each other, in making interconnection units and in creating the bus-tie riser configuration with double insulation (in this case, both the units are made up of bus-ties, the former fitted with a circuit-breaker and the latter with an isolating truck).

The switchgear panels preset for use of the isolating trucks must be fitted with a key lock which, when activated, prevents their being racked-in.



UniGear ZS1

Ultra Fast Earthing Switch

The Ultra-Fast Earthing Switch (UFES) is an innovative design of an active arc protection device which effectively mitigates the severe mechanical and thermal impacts caused by internal arc faults.

The UFES is a combination of devices consisting of an electronic unit and the corresponding primary switching elements which initiate a three-phase earthing in the event of an arc fault. With operating times of less than 4 ms after detection UFES clears an internal arc fault almost immediately after it arises. Thus arc impacts are reduced to an absolute minimum and safety standards raised to a whole new level.

The UFES is available to fulfil a variety of applications in the UniGear ZS1 switchgear e.g.:

- Busbar installation with top-housing box
- Cable compartment installation

Unbeatable advantages in case of an arc fault event:

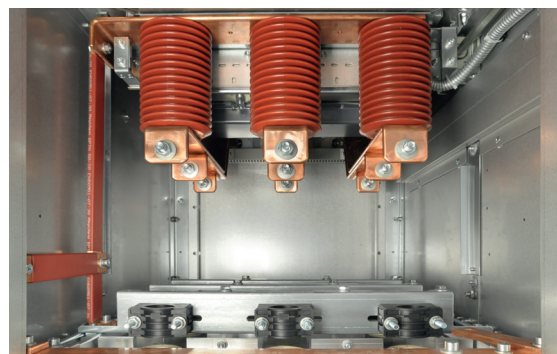
- Drastic reduction of repair costs: no damages on the switchgear equipment to be expected. No exchange of the faulty panel.
- Greatly increased system availability: after inspection and elimination of the fault reason the switchgear can be taken into service again within shortest possible time.
- Greatly increased operator safety for human mal-operation under maintenance conditions
- Minimized secondary effects like light/sound emission or the release of toxic gases
- Solution for pressure sensitive environment with limited pressure relief options

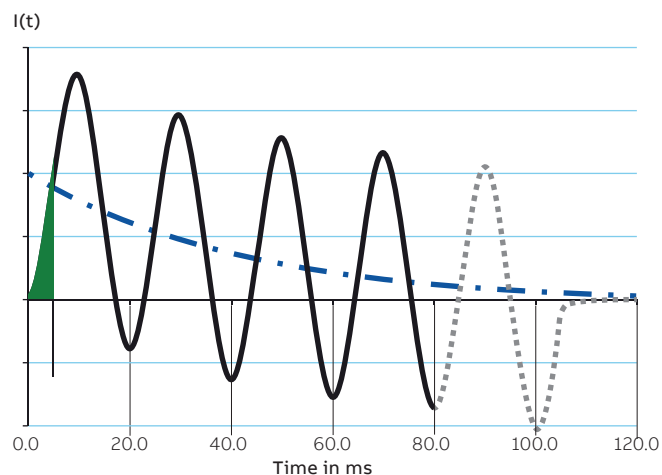
Electrical maximum characteristics in UniGear ZS1

| | | | | |
|---|------|---------|---------|---------|
| Rated insulation voltage (rms) ⁽¹⁾ | [kV] | 12 | 17.5 | 24 |
| Rated power frequency withstand voltage (rms) | [kV] | 28 | 38 | 50 |
| Rated lightning impulse withstand voltage (peak) | [kV] | 75 | 95 | 125 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 | 50 / 60 |
| Rated short-time withstand current (rms) ⁽¹⁾ | [kA] | 50 | 50 | 31.5 |
| Rated short-circuit making current | [kA] | 125 | 125 | 80 |
| Rated duration of short-circuit | [s] | 3 | 3 | 3 |

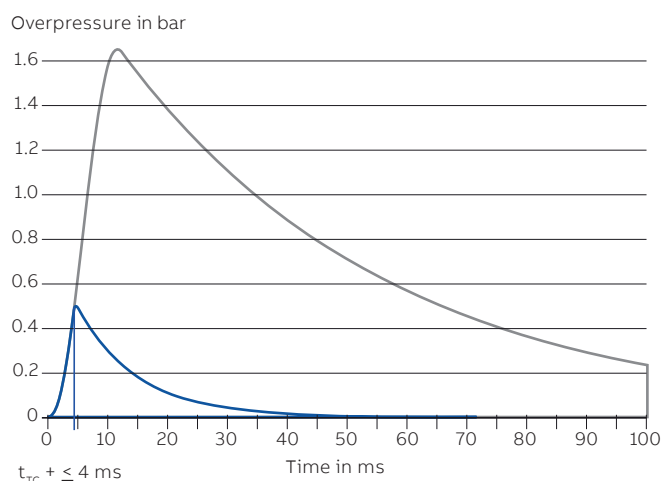
⁽¹⁾ GB/DL version is available with higher request in dielectric characteristics (42 kV) and short-time withstand current (4 s)

UFES kit; Primary switching element installed in the cable compartment





— Short-circuit current I_n
 - - - DC component
 ■ Arcing time with UFES
 . . . Final clearing of fault current by upstream circuit-breaker - 80 ms + time_x
 t_{TC} Reaching time for tripping criteria

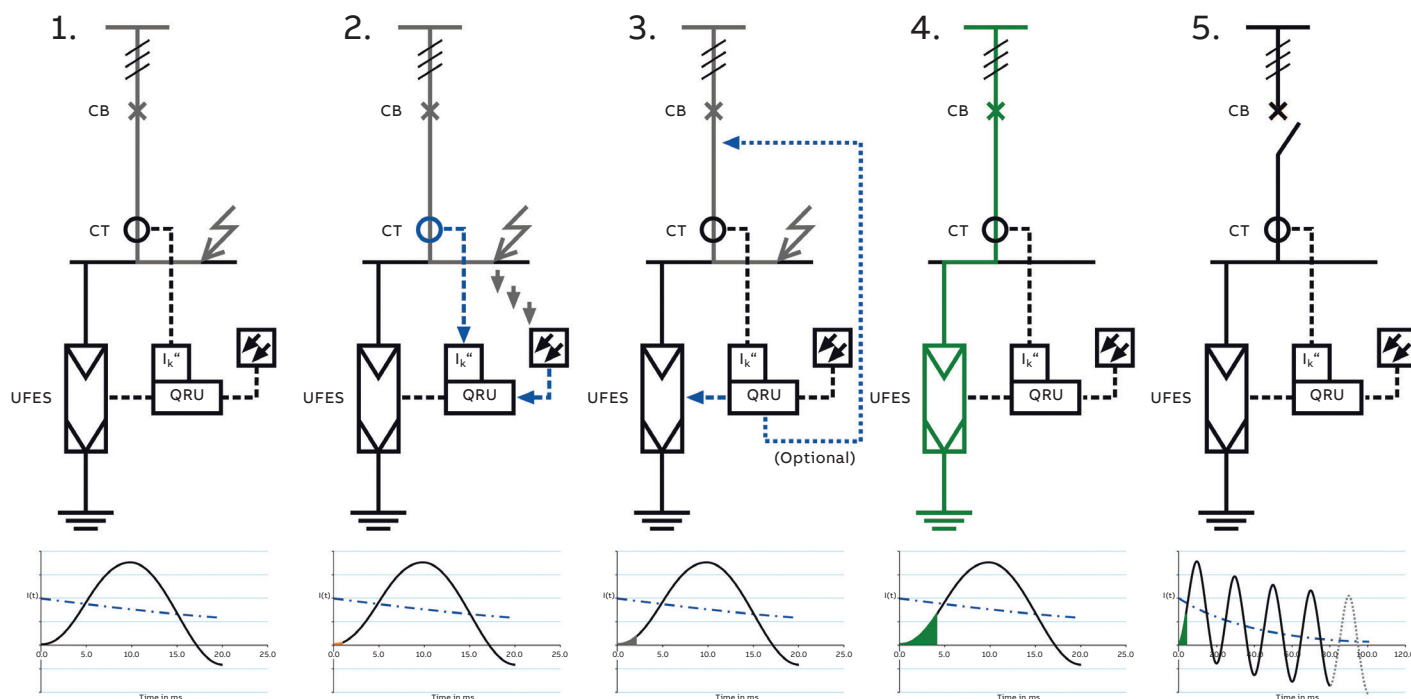


— Pressure curve with UFES (4 ms) — Pressure curve without UFES
 t_{TC} Reaching time for tripping criteria

In rare cases, failure inside a switchgear cubicle due either to a defect, an exceptional service condition or mainly by human mal-operation may initiate an internal arc. The faster the arc will be interrupted, the less destruction on the switchgear equipment will occur.

Avoidance of the severe effects of an internal arc fault, such as ...

- Rapid temperature rise (up to 20,000 °C)
 - Rapid pressure rise (see figure)
 - Burning of materials
- ... by fastest possible extinction.



Event sequence description

1. Internal arc formation
2. Arc detection by the electronic device (light and current)
3. ~ 1-2 ms after detection: Tripping signal to the UFES primary switching elements
4. ~ 3-4 ms after detection: Bolted 3-phase earthing by operation of the UFES primary switching elements
 - Interruption of the arc voltage: Immediate extinction of the arc
 - Controlled fault current flow via UFES primary switching elements to earth potential
5. Final clearing of the fault current by the upstream circuit-breaker

UniGear ZS1

I_s -limiter: fault-current limitation

Short-circuit currents too high?

The I_s -limiter, a switching device with extremely short operating time, solves the problem.

The rising global demand for energy requires more powerful or additional transformers and generators, and an increasing interconnection of the individual supply networks.

This can lead to the permissible short-circuit currents for the equipment being exceeded causing severe dynamic or thermal damage or even complete destruction.

The replacement of existing switchgear and cable connections by new equipment with a higher short-circuit strength is often technically impossible or uneconomical for the user.

The use of I_s -limiters reduces the short-circuit current in both new systems and expansions of existing systems, thus saving cost.

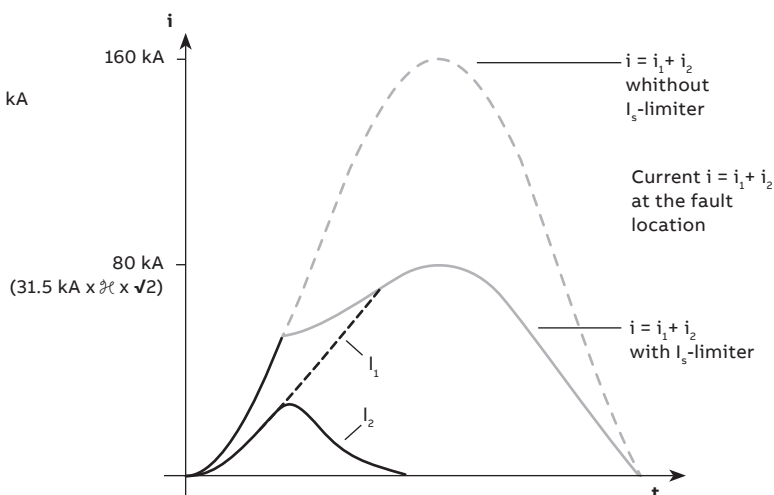
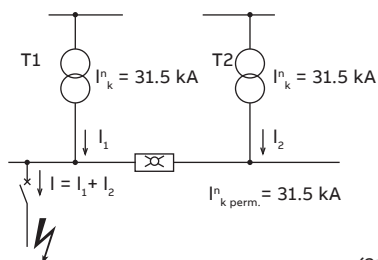
A short-circuit downstream from an outgoing feeder breaker is assumed. The oscillogram shown below indicates the course of the short-circuit currents in the first half wave.

A short-circuit current of 31.5 kA can flow to the fault location through each transformer. This would result in a total short-circuit current of 63 kA, which is twice as much as the switchgear capability.

The course of the current through the I_s -limiter in such an event is shown below as current i_2 . It can be seen that the I_s -limiter operates so rapidly, that there is no contribution via the transformer T2 to the total peak short-circuit current ($i_1 + i_2$). Therefore, a switchgear with a rating of 31.5 kA is suitable for this application.

| Technical Data | | | | |
|----------------------|----------------------|---|---|---|
| Rated voltage | [kV] | 12.0 | 17.5 | 24.0 |
| Rated current | [A] | 1 250 / 2 000 / 2 500 / 3 000 / 4 000 ¹⁾ | 1 250 / 2 000 / 2 500 / 3 000 / 4 000 ¹⁾ | 1 250 / 1 600 / 2 000 / 2 500 ¹⁾ / 3 000 ¹⁾ |
| Interrupting current | [kA _{RMS}] | Up to 210 | Up to 210 | Up to 140 |
| 1) with cooling fan | | | | |

Single line diagram of a bus tie for a system with $I_n = 31.5$ kA and with an I_s -limiter; I_s -limiter application diagram



Potential applications

Such a fast switching device caters for a variety of applications which cannot be fulfilled by conventional switches. The most important of these are presented below.

Advantages of all I_s -limiter applications:

- Reduction of short-circuit currents at the fault location
- No upgrading of the existing switchgear

Option A

Coupling-parallel operation of two systems.

Advantages:

- Improving power quality
- Increasing the reliability of the system
- Reduction of the network-impedance
- Optimal load flow

Option B

I_s -limiter in the generator feeder to protect the high voltage system.

Advantages:

- Generator can be connected independent of the short-circuit capability of the system
- Existing busbar system does not need to be changed
- No need for expensive generator breaker

Option C

I_s -limiter and reactor connected in parallel.

Advantages:

- Avoid copper losses of the reactor
- Avoid voltage drop over the reactor
- No electro-magnetic field of the reactor

Option D

Station service supply and public network.

Advantages:

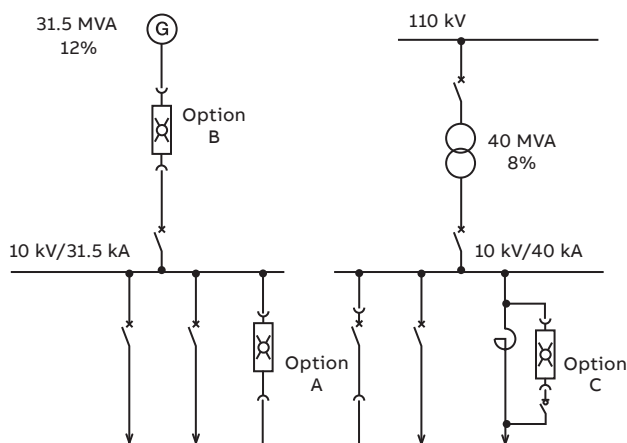
- Private/industrial generator feeder can be connected to the (fully loaded) grid
- Selective tripping of the I_s -limiter (I_s -limiter will operate only for short-circuit faults in the grid)

Option E

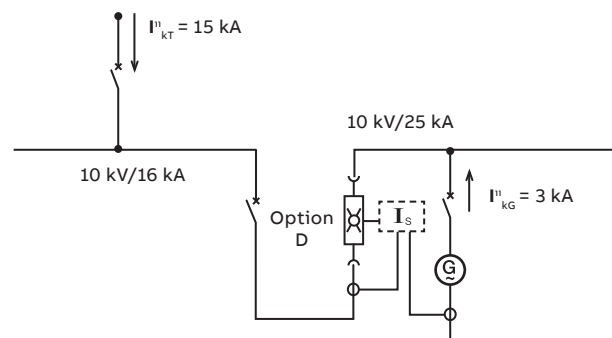
If in the case of two I_s -limiters being installed in a switch-board selective tripping is required, a measurement of the total current becomes necessary.

Advantage: The I_s -limiter trips as follows:

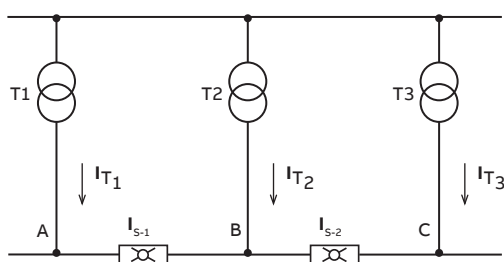
- Short-circuit in section A: Only I_s -limiter no. 1 trips
- Short-circuit in section B: I_s -limiter no. 1 and no. 2 trip
- Short-circuit in section C: Only I_s -limiter no. 2 trips



Three possible applications of I_s -limiters in one figure (Option A, B, C)



I_s -limiter in connecting point with a public supply network (Option D)



Use of more than one I_s -limiter with selectivity (Option E)

UniGear ZS1

Instrument transformers

—
01 Current
transformer TPU
—
02 Voltage
transformer TJC
—
03 Current and voltage
transformers

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 can have a wound core or a bushing bar 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 2 500 A, where they are of the toroidal type in the range of currents from 3 150 A to 4 000 A (KOKS type). 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.

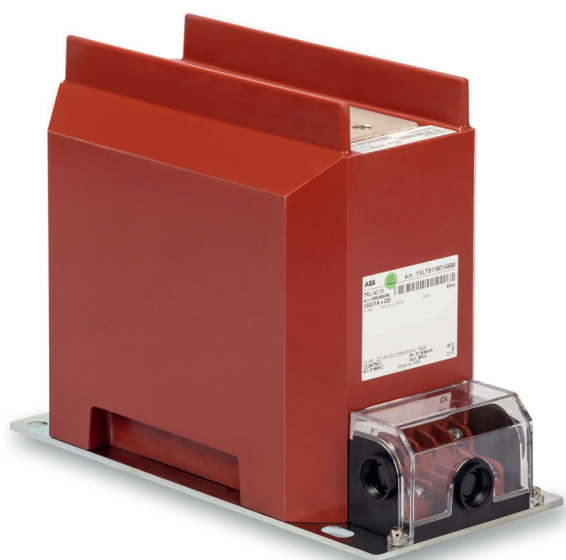
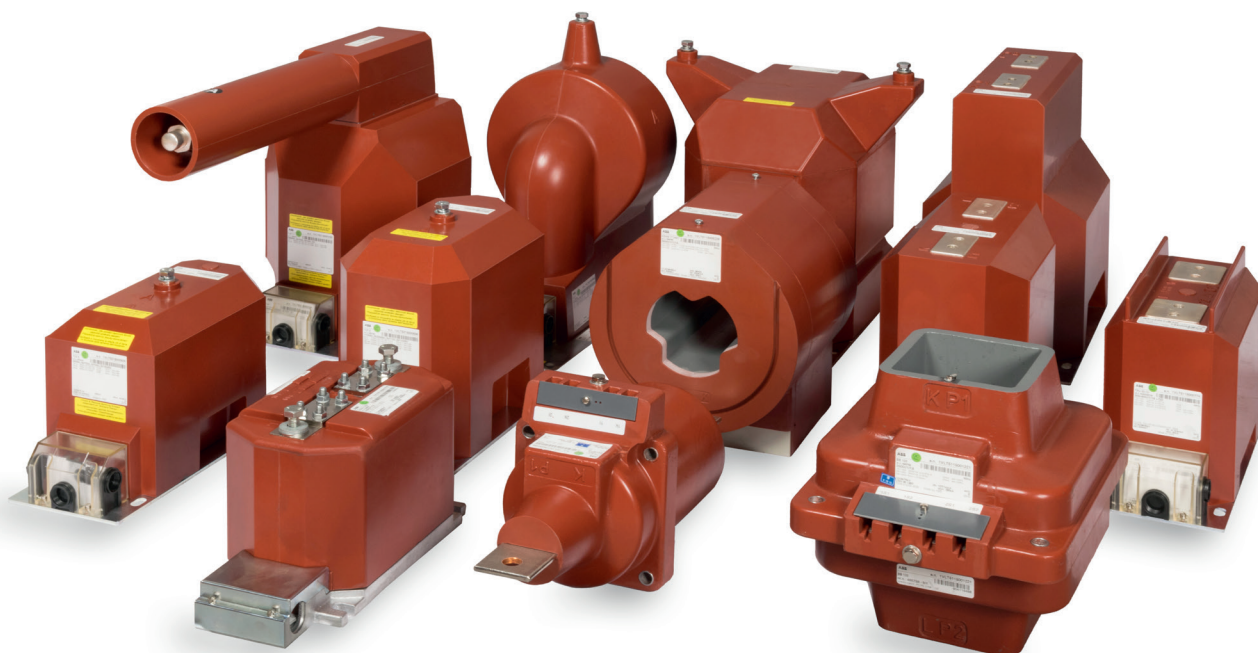
Ring core current transformers

The toroidal transformers are of the epoxy resin insulated type and are used to supply measurement and protection devices. These transformers can feature either a closed or openable core. They can be used both for measuring phase currents or for detecting the earth fault current. They conform to the IEC 61869-1, IEC 61869-2 which have fully replaced previous standard IEC 60044-1.

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.

—
01—
02—
03

UniGear ZS1

Current and voltage sensors

The sensor technology has been used in ABB since the beginning of the 1990s and there are more than 400 000 sensors installed and operating to date.

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.

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 80 C104 / KECA 80 C125 / KECA 80 C165

For dynamic current measurement (protection purposes) the ABB sensors KECA 80 C104, KECA 80 C125 (for 500 mm wide panel) and KECA 80 C165, fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current I_{th} (31.5 kA or 50 kA). With KECA 80 C104 and KECA 80 C165 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} (1 250 A or 4 000 A).

That provides the possibility to designate the corresponding accuracy class as 5P400, 5P 85kA and 5P630, proving excellent linearity and accuracy measurements.

Technical parameters

- Continuous thermal current: 1 250 / 4 000 A
- Rated primary current: 80 A / 150 mV @ 50 Hz
- Rated primary current: 80 A / 180 mV @ 60 Hz
- Accuracy class: 0.5 / 5P400; 0.5-A2 / 5P 85kA; 0.5 / 5P630

KECA 80 C184 / KECA 80 C216

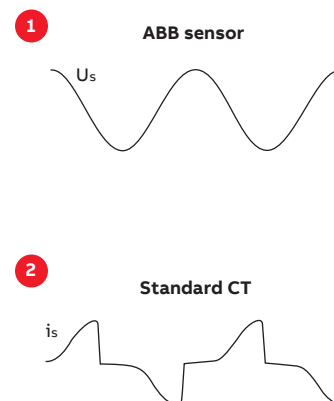
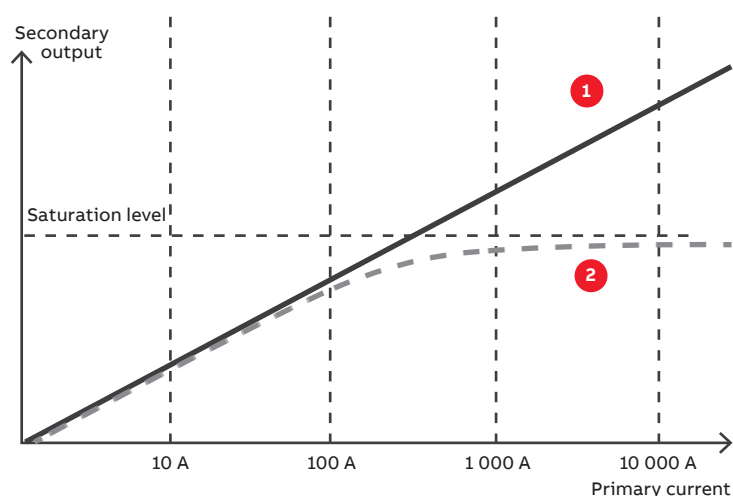
For dynamic current measurement (protection purposes) the ABB sensors KECA 80 C184, and KECA 80 C216, fulfill requirements of protection class 5P up to an impressive value reaching the rated short-time thermal current I_{th} (31.5 kA). With KECA 80 C184 and KECA 80 C216 sensors, measuring class 0.5 is 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} (1 250 A or 3 150 A).

That provides the possibility to designate the corresponding accuracy class as 5P400, proving excellent linearity and accuracy measurements.

Technical parameters

- Continuous thermal current: 1 250 / 3 150 A
- Rated primary current: 80 A / 150 mV @ 50 Hz
- Rated primary current: 80 A / 180 mV @ 60 Hz
- Accuracy class: 0.5 / 5P400

—
Performance
comparison between
conventional current
transformer and
current sensor



UniGear ZS1

Current and voltage sensors

—
01 Current sensors KECA
80 C104 / KECA 80 C165

—
02 Voltage sensor
KEVA 17.5 B20

—
03 Combined
sensors KEVCD

—
04 Current sensor
KECA 80 C125 for
500 mm wide panel

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

KEVA 24 B20

KEVA B sensor can be used in all applications up to the voltage level 24 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: 22/ $\sqrt{3}$ kV
- Rated power frequency withstand voltage: 50 kV
- Rated lightning impulse withstand voltage: 125 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

The combined sensors type KEVCD are intended for use in current and voltage measurements in air insulated switchgear. KEVCD are block type sensors designed according to the DIN 42600 size requirements.

Technical parameters KEVCD A

- Continuous thermal current: 1 250 A
- Rated primary current: 80 A / 150 mV @ 50 Hz
- Rated primary current: 80 A / 180 mV @ 60 Hz
- Current accuracy class: 0.5 / 5P630
- Voltage accuracy class: 0.5 / 3P

Technical parameters KEVCD B

- Continuous thermal current: 3 200 A
- Rated primary current: 1 600 A / 150 mV @ 50 Hz
- Rated primary current: 1 600 A / 180 mV @ 60 Hz
- Current accuracy class: 1
- Voltage accuracy class: 1 / 3P

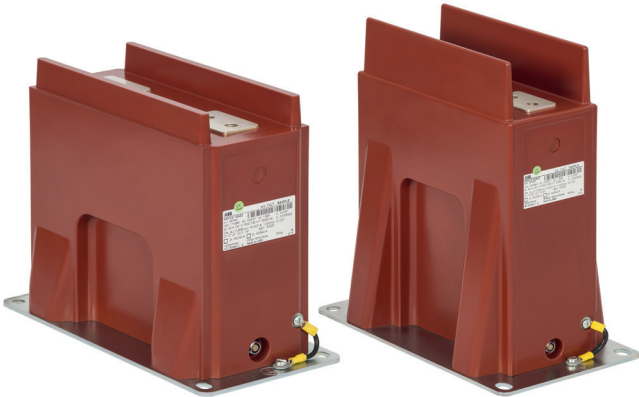
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01



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02



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04



UniGear ZS1

Cable terminations

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

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

Terminations for polymer insulated cables 1 – 24 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, an insulation of polymer material, an extruded insulation screen, a metallic screen, armouring (optional) and a polymeric outer jacket.

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

Applications and features

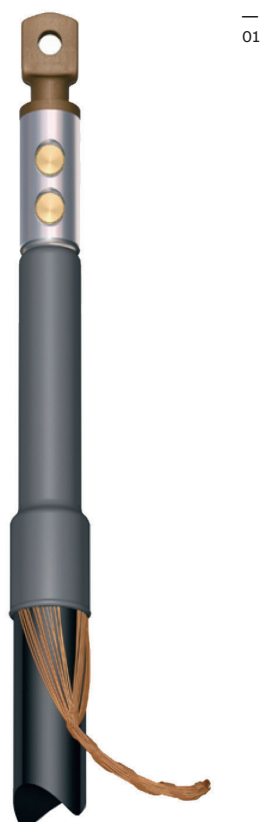
Depending on the cable design, it is necessary to use the correct type of cable accessory. When single core cables are designed with copper wire screen only, it is sufficient to use just a cable lug and a termination that fits the actual size of the cable.

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

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

Recommended cable termination products

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



| Designation and sizes | | | | | | |
|-----------------------|-------------|--------------------------|-----------------------------------|-----------|-----------|---------------|
| Voltage level | Designation | Diameter over insulation | Conductor size [mm ²] | | | |
| [kV] | | [mm] | 7.2 kV | 12 kV | 17.5 kV | 24 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 - 28 | - | 50 - 185 | 50 - 150 | - |
| 12 - 17.5 | SOT 242 | 24 - 39 | - | 240 - 500 | 185 - 300 | - |
| 24 | - | - | - | - | - | - |
| 12 - 17.5 | SOT 242 B | 38 - 54 | - | 630 (*) | 630 (*) | - |
| 24 | SOT 241 A | 11 - 15 | - | - | - | 10 |
| 24 | SOT 241 | 15 - 28 | - | - | - | 25 - 120 |
| 24 | SOT 242 | 24 - 39 | - | - | - | 150 - 400 |
| 24 | SOT 242 B | 38 - 54 | - | - | - | 500 - 630 (*) |

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

UniGear ZS1

Distribution automation

ABB has delivered protection relays and solutions to more than 100 countries and 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 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 is activated when something abnormal happens in the power system. 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 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. Protection relays are easily set-up and parameterized through easy and safe access from the operator's workplace.



UniGear ZS1

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 grids over primary distribution to secondary distribution kiosks. ABB's 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 from ABB's customers globally.

To ensure interoperable and future-proof solutions, the 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.

The Relion product family includes:

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 REX610

REX610 covers the full range of basic utility and industrial applications. The modular and scalable design makes creating unique protection solutions easy, whereas the extensive range of default functionality, including communication, allows easy alterations with no additional costs nor hardware changes. This makes REX610 not only flexible but also a very cost-effective choice.

Relion REX615

REX615 is a freely configurable all in-one protection relay for power generation and distribution applications, representing the next step for ABB's 615 and 620 series relays. Multiapplication coverage combined with a fully modular and scalable hardware and software ensures maximum flexibility and optimal cost-effectivity throughout the relay life cycle.

—
01 ABB Relion
protection and control
product family

Relion REX640

REX640 makes protecting all 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.

Smart substation control and protection SSC600

SSC600 offers centralized protection and control for distribution substations. It builds on ABB's solid and proven technological foundation manifested in the renowned Relion product family.

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UniGear ZS1

Distribution automation

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's wide offering for feeder protection suits different requirements. The offering ranges from protection relays for general feeder protection (protection against overcurrent) and products for back-up protection purposes, on to multifunctional relays for different applications and products for centralized protection and control. The offering also includes specialized applications, such as line differential protection and line distance 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 many cases the requirements can be fulfilled with non-directional/directional over-current 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, substations 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 for ABB's protection and control devices.

Product offering

The recommended products for feeder protection are:

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 straightforward approach to protection.

Relion REX610

REX610 is a freely configurable all-in-one protection relay that covers the full range of basic power distribution applications, without forgoing simplicity. The small number of variants translates into easy ordering, set up, use and maintenance. Rich in functionality, with a fully modular hardware unlocking all available functionality, REX610 represents both a flexible and cost-effective choice.

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

—
02 Medium range:
Protection and control
REX610, Protection
and control REX615
standard and wide

—
03 High range:
Multiapplication
Protection and Control
REX640 and Smart
Substation Control and
Protection SSC600

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The base functionality offers possibility to use REX615 as a measurement and control device or merging unit without protection functions. The REX615 with base functionality can be enhanced with application packages for feeder protection, fault location, line differential protection and interconnection feeder protection.

Relion REX640

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.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level.

For more information, please refer to the following documentation:

- Feeder Protection REF601 Product Guide
- Self-Powered Feeder Protection REJ603
- Protection and Control REX610 Product Guide
- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide

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UniGear ZS1

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 is 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:

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 offers extensive protection functionality for transformer protection, including two-winding transformer protection, on-load tap-changer control and automatic voltage regulator functionality, in one device.

Relion REX640

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.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level.

For more information, please refer to the following documentation:

- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide

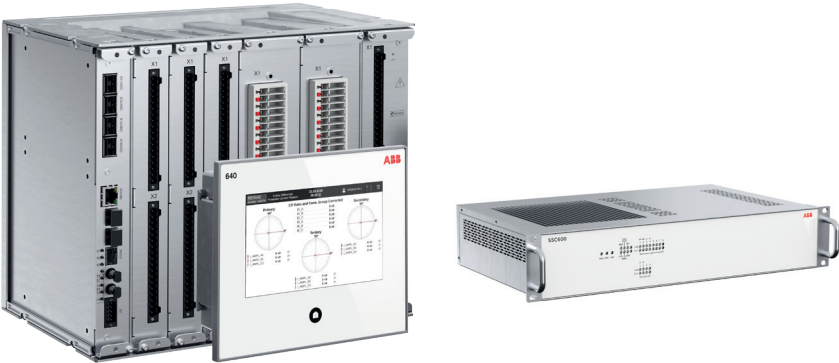
01 Protection and control
REX615 standard and wide

02 Multiapplication
Protection and Control
REX640 and Smart
Substation Control and
Protection SSC600

01



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UniGear ZS1

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:

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 REX610

REX610 is a freely configurable all-in-one protection relay that covers the full range of basic power distribution applications, without forgoing simplicity. The small number of variants translates into easy ordering, set up, use and maintenance. Rich in functionality, with a fully modular hardware unlocking all available functionality, REX610 represents both a flexible and cost-effective choice.

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 offers extensive protection functionality for motor protection. When the machine protection package has been selected, REX615 can be enhanced with an add-on package for either machine differential protection or synchronous machine protection.

Relion REX640

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.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level.

For more information, please refer to the following documentation.

- Protection and Control REX610 Product Guide
- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide

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01 Basic range:
Motor protection and
control REM601

—
02 Medium range:
Protection and control
REX610, Protection
and control REX615
standard and wide

—
03 High range:
Multiapplication
Protection and Control
REX640 and Smart
Substation Control and
Protection SSC600

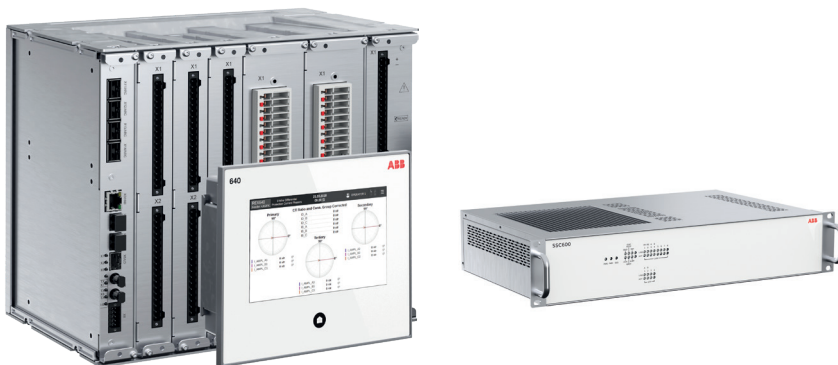
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UniGear ZS1

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:

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 offers extensive protection for generator and generator-transformer units used in various small and medium-sized power plants.

Relion REX640

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.

For more information, please refer to the following documentation:

- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide

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01 Protection and
control REX615
standard and wide,
Multiapplication
Protection and
Control REX640

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UniGear ZS1

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 the 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:

Relion REX610

REX610 is a freely configurable all-in-one protection relay that covers the full range of basic power distribution applications, without forgoing simplicity. The small number of variants translates into easy ordering, set up, use and maintenance. Rich in functionality, with a fully modular hardware unlocking all available functionality, REX610 represents both a flexible and cost-effective choice.

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 can be easily customized for conventional voltage protection applications by selecting hardware with voltage inputs and a voltage protection application package, which offers an extensive range of voltage and frequency-based functions.

Relion REX640

The fully modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. The base package includes the standard protection functions needed for voltage protection.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level.

For more information, please refer to the following documentation:

- Protection and Control REX610
- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide

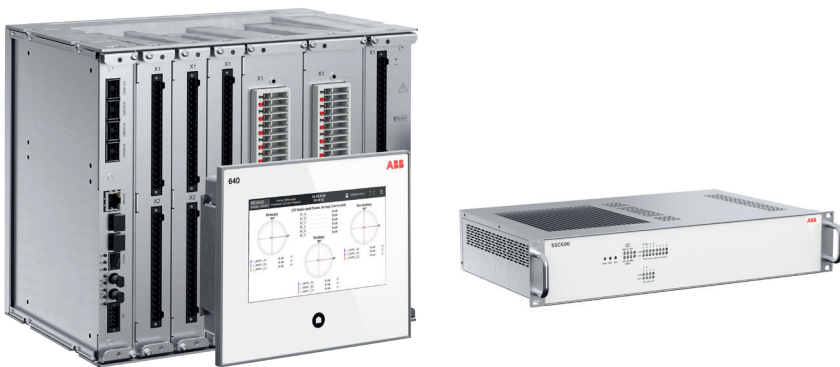
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01 Protection and control
REX610, Protection
and control REX615
standard and wide

—
02 Multiapplication
Protection and Control
REX640 and Smart
Substation Control and
Protection SSC600

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UniGear ZS1

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 electrical 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 to 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 grid operator.

Extra charges are always applied when an 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:

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 can be enhanced with an application package for shunt capacitor protection.

Relion REX640

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.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level.

For more information, please refer to the following documentation:

- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide

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01 Protection and control
REX615 standard and
wide, Multiapplication
Protection and Control
REX640 and Smart
Substation Control and
Protection SSC600

Busbar protection

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:

Relion REX615

REX615 offers flexibility and performance for power distribution in utility and industrial applications. The modular design allows customization and modification flexibility, and easy adaptation to changing protection requirements. REX615 can be enhanced with an application package for high-impedance based busbar protection.

Relion REX640

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.

Smart Substation Control and Protection SSC600

SSC600 represents a new approach to protection and control in distribution networks – centralizing all protection and control functionality in one single device on the substation level. SSC600 can be enhanced with a special application package for busbar low-impedance protection.

For more information, please refer to the following documentation:

- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide



UniGear ZS1

Distribution automation

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

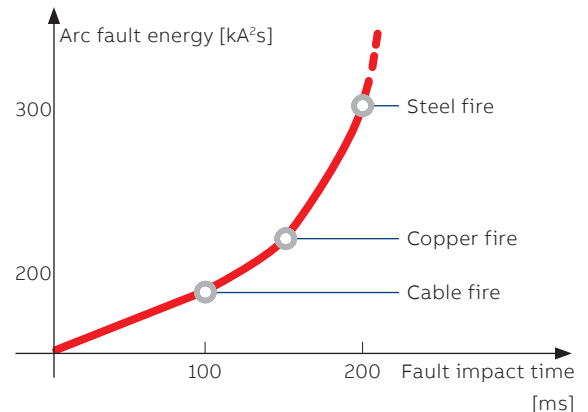
02 The REA system is a fast and flexible arc fault protection system for low- and medium-voltage switchgear

An electric arc short-circuit in a switchgear installation is normally caused by a foreign object entering the switchgear panel 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 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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03 A redundant and selective arc fault protection system, with a single-busbar, two section switchgear, which is fed from two power transformers. Each Relion REX615 protection relay with integrated arc fault protection is supervising compartments of the metal-enclosed switchgear panels. The selectivity of tripping between the REX615 protection relays is achieved via utilizing IEC 61850 GOOSE communication. The REA 101 main unit is used as the redundant arc protection system for the switchgear bus sections.

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 ABB's Relion protection relays.

REA system

The REA system is a fast and flexible arc fault protection system for switchgear. 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.

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

Relion REX610

The arc-fault protection sensor interface in the REX610 relay is available on an optional communication module. The module supports connection up to 3 lens sensors.

Relion REX615

The arc-fault protection sensor interface in the REX615 relay is available on the optional communication module. The module supports connection up to 3 lens sensors. Fast tripping increases staff safety and limits material damage, therefore it is recommended to use high-speed outputs (HSO) instead of normal power outputs (PO). This typically decreases the total operating time with 4..6 ms compared to the normal power outputs.

Relion REX640

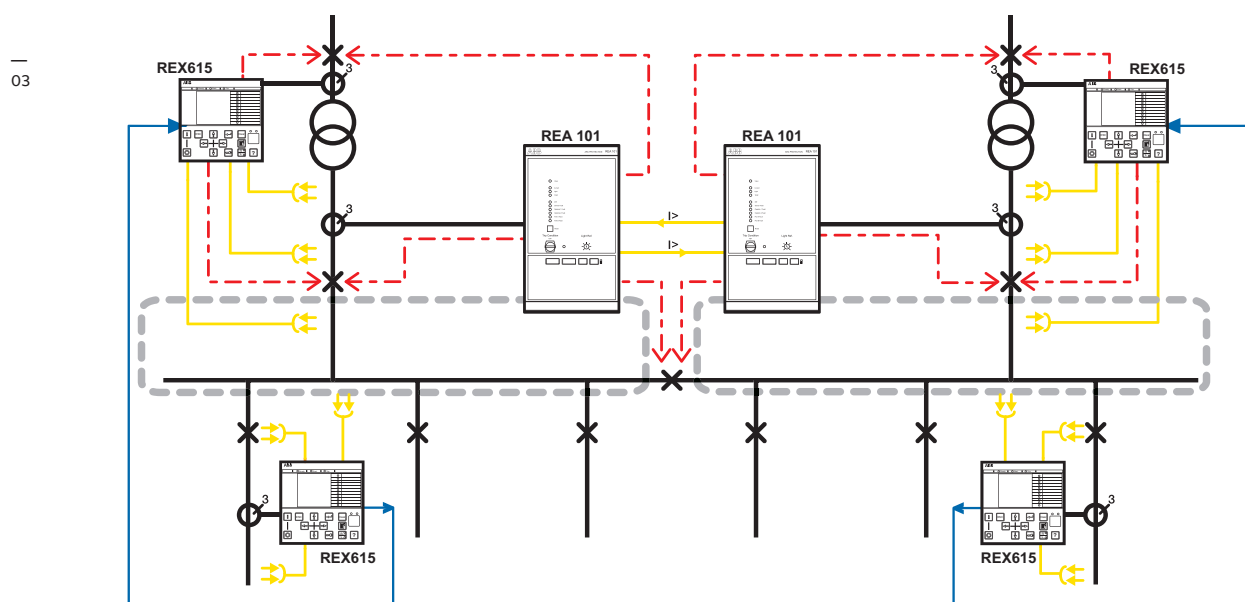
REX640 protection relays are equipped with arc flash sensor card, that supports either loop or lens sensors or a combination thereof, and includes supervision of the sensors. By using suitable sensor combinations for different bays, a selective arc flash protection scheme can be build up for the complete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

Smart Substation Control and Protection SSC600

The arc protection in SSC600 is a station-wide arc protection, processing current measurements and light indications received from several bay level relays or merging units.

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
- Protection and Control REX615 Product Guide
- Multiapplication Protection and Control REX640 Product Guide
- Smart Substation Control and Protection SSC600 Product Guide



UniGear ZS1

Distribution automation

—
01 Smart Substation
Control and
Protection SSC600

—
02 Substation Merging
Unit SMU615

—
03 Example of centralized
protection and control

Centralized protection and control

With a centralized protection and control (P&C) approach, all P&C functionality is centralized into one single device on the substation level.

With this approach, you gain the ability to protect and control a wide variety of utility and industrial applications from a single device, resulting in convenient station-wide visibility, minimal engineering, and easy and cost-efficient process management.

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.

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.

Product offering

Smart Substation Control and Protection SSC600

SSC600 offers protection, control, measurement and supervision of a wide variety of applications. As an IEC 61850 standard-compliant solution, SSC600 offers unprecedented flexibility throughout the substation's entire lifetime. Fully modular software allows the flexibility to change with the evolving grid and meet the challenge of increasing digitalization. Up to 15 percent savings in substation life cycle costs can be achieved as SSC600 can handle new network functionalities as required.

Customizable, cost-effective turnkey P&C solutions can be made combining SSC600 with ABB's merging units.

SSC600 offers:

- Protection for overhead line and cable feeders 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.
- Busbar differential protection to ensure uninterrupted power supply - protecting the busbar from critical harm.
- Protection for shunt capacitor banks
- Arc flash protection to guard the switchgear from damage and personnel from injury in case of an arc flash incident.

Smart Substation Control and Protection SSC600 SW

SSC600 functionality is also available as a virtualized product, SSC600 SW, which enables you to use the hardware of your choice and gain access to the same proven protection and control functionality as with the turnkey solution.

Substation Merging Unit SMU615

SMU615 is a dedicated substation merging unit intended for measuring current and voltage signals from the instrument transformers and sensors 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, disconnect and earthing switch. SMU615 is a member of ABB's Relion product family and is characterized by the compactness, simplicity and withdrawable-unit design.

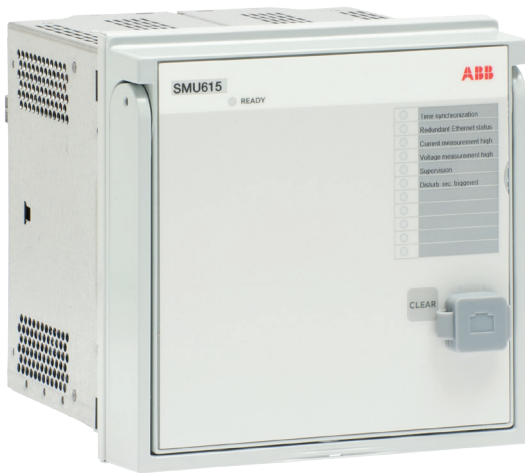
For more information, please refer to the following documentation:

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

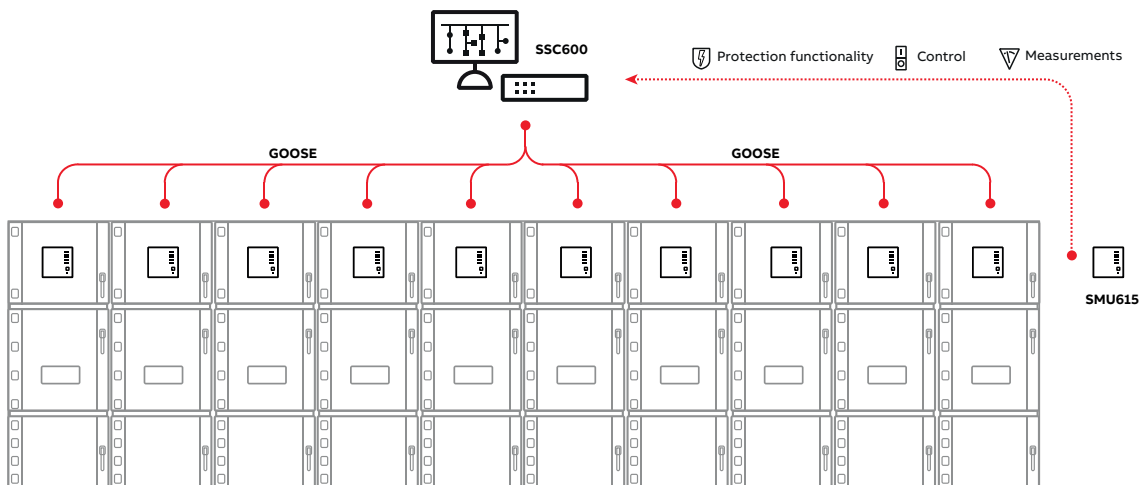
01



02



03



Distribution automation

Selection table

| | 605 | 605 | 605 | 605 | 610 | 615 | 640 | SSC | 615 |
|--|--------|--------|--------|--------|--------|----------------|----------------|--------|--------|
| | REF601 | REJ601 | REJ603 | REM601 | REX610 | REX615 | REX640 | SSC600 | SMU615 |
| Standard | | | | | | | | | |
| ANSI | X | X | | X | X | X | X | X | X |
| IEC | X | X | X | X | X | X | X | X | X |
| Application | | | | | | | | | |
| Arc fault protection application | | | | | O | O | O | O | O |
| Busbar application | | | | | | X | O | O | |
| Back-up application | X | X | | | X | X | X | X | |
| Capacitor bank application | | | | | | X | O | O | |
| Feeder application | X | X | X | | X | X | X | O | |
| Generator application | | | | | | X | O | | |
| Motor application | | | | X | X | X | O | O | |
| Petersen coil protection | | | | | | | X | | |
| Transformer application | | | | | | X | O | O | |
| Functionality | | | | | | | | | |
| Autorecloser | X | X | | X | X | X | X | X | |
| Circuit breaker (CB) controllability | X | | | X | X | X | X | X | |
| Condition monitoring | X | | | X | X | X | X | X | X |
| Current-based protection | X | X | X | X | X | O | X | X | |
| Distance protection | | | | | | | O | O | |
| Fault locator | | | | | | O | O | O | |
| Generator differential protection | | | | | | O | O | | |
| Display with Single Line Diagram (SLD) | | | | | | X | O ¹ | | |
| Line differential protection (in-zone transf. support) | | | | | | O | O | | |
| Load-shedding | | | | | | O | X | O | |
| Motor differential protection | | | | | | O | O | | |
| On-load tap changer control | | | | | | O | O | O | |
| Power quality | | | | | | X | X | O | |
| Self-powered protection relay | | | X | | | | | | |
| Synchro-check | | | | | | O | X | O | |
| Generator/non-generator CB synchronizing | | | | | | | X | | |
| Transformer differential protection | | | | | | O | O | O | |
| Voltage based protection | | | | | X | O | X | X | |
| Withdrawable release mechanism | | | | | X | X | | | |
| Hardware | | | | | | | | | |
| Analog inputs (CTs/VTs) | 4/0 | 4/0 | 4/0 | 4/0 | 4/4 | 7/8 8/8 | 12/10 | | 4/3 |
| Analog inputs (sensor channels/CTs) | 3/1 | 3/1 | | 3/1 | | 6/1 6/1 | 6/2 | | 6/1 |
| Binary inputs/outputs | 4/6 | 4/6 | 0/2 | 4/6 | 6/6 | 18/13 32/21 | 56/42 | | 8/9 |
| RTD/mA inputs | | | | | | 6/2 14/5 | 20/4 | | |
| mA outputs | | | | | | | 4 | | |
| Communication protocols | | | | | | | | | |
| DNP 3.0 | | | | | | X | X | | |
| IEC 60870-5-103 | X | X | | X | | X | X | | |
| IEC 60870-5-104 | | | | | | O | O | O | |
| IEC 61850 | | | | | X | X | X | X | X |
| Modbus | X | X | | X | X | X | X | | |
| Profibus | | | | | | O | O | | |
| Communication media | | | | | | | | | |
| Ethernet (RJ-45) | | | | | X | X | X | X | X |
| Ethernet (LC) | | | | | | X | X | O | O |
| Ethernet redundant solutions (HSR/PRP/RSTP) | | | | | | X | X | X | O |
| Serial (RS 232/485, ST conn.) | X | X | | X | X | X | X | | |

¹ Color touch screen

x Function supported

o Function available as option



UniGear ZS1

Distribution automation

Fleet management

ADAM offers fleet management of protection and control devices. Easy-to-use, cybersecure and cloud-based, ADAM provides you with the full view of your devices, complete visibility of your data, and easy device management.

ADAM is a digital solution and it is fully hosted in a cloud environment. Secure communication from the site to the cloud can be flexibly chosen depending on the installation. One possibility for secure wireless communication over mobile network is ABB's Arctic family of wireless communication products.

ADAM can be used in combination with Smart Substation Control and Protection SSC600 and the standalone software version, SSC600 SW, today. ABB will gradually increase support for also other protection and control devices in upcoming releases.

Rich in features and easy to use

Because ADAM is hosted in the cloud, it's always accessible – from anywhere. Any device with internet connectivity and a web browser can be used to get an up-to-date status of all the connected devices and an overall status of substations.

Available features include:

Fleet status

- Versions, variants
- Firmware updates

Fault analysis

- Events
- Disturbance recordings
- Internal logs

Cyber security

- Role-based access control
- Secured communication
- Activity monitoring

Easy configurability

- Configured directly from the relay engineering tool PCM600

Device status information

- Alarm status
- Configuration status with online monitoring
- Measurements

Efficient management of substations

With ADAM customers benefit from improved device management with a full view of substation devices and complete visibility and control of data. Connection from cloud to substation is effective, it's easy to modify and update devices. Taking ADAM into use is straightforward, end users simply have to login to the cloud service to get started.

Better decisions with comprehensive data

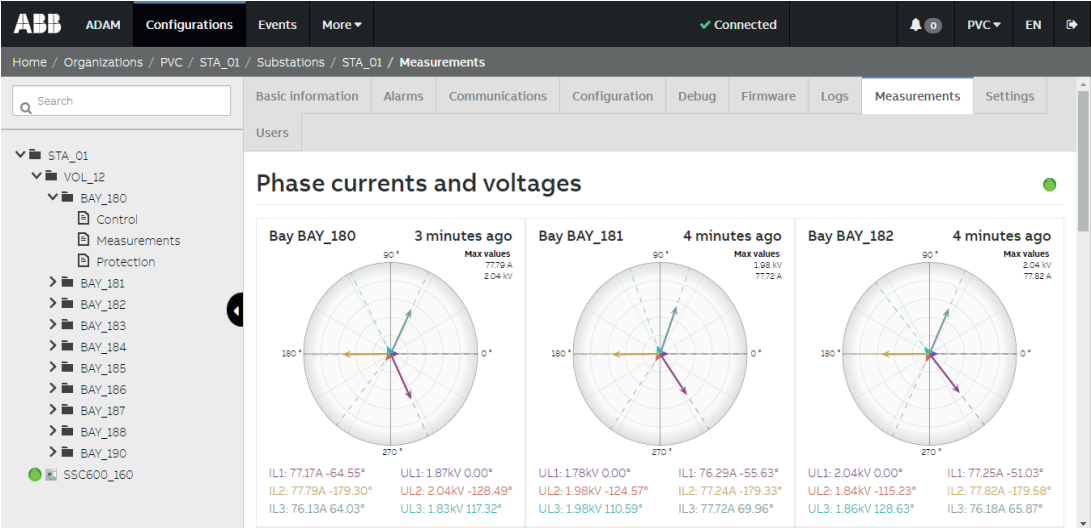
With fleet management disturbance recordings and fault records are gathered automatically. This means it will always be possible to do post-fault analysis. With full visibility of the substation's status comes also the possibility for fault analysis of the whole installation, providing data to support decision-making. The complete electric grid related process data for a complete substation is available with a single access point from the SSC600.

Unlocking fleet management benefits

- Cost-efficient management of protection and control devices
- Full visibility of substation status and available data
- Easy for end-users to use - just login to the cloud service
- Unique possibility for fault analysis covering the complete installation
- Cybersecure end-to-end ABB solution
- Reliable storage for configurations and logs
- Ensure that protection and control devices are updated with the latest firmware

ADAM

01 Phase currents and voltages view



01



UniGear ZS1

Distribution automation

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

Automatic transfer systems

Automatic transfer systems (ATS) are used to ensure maximum service continuity, supplying the power without interruption.

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 |

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 systems, synchronized automatic transfer system and high speed transfer device, 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.

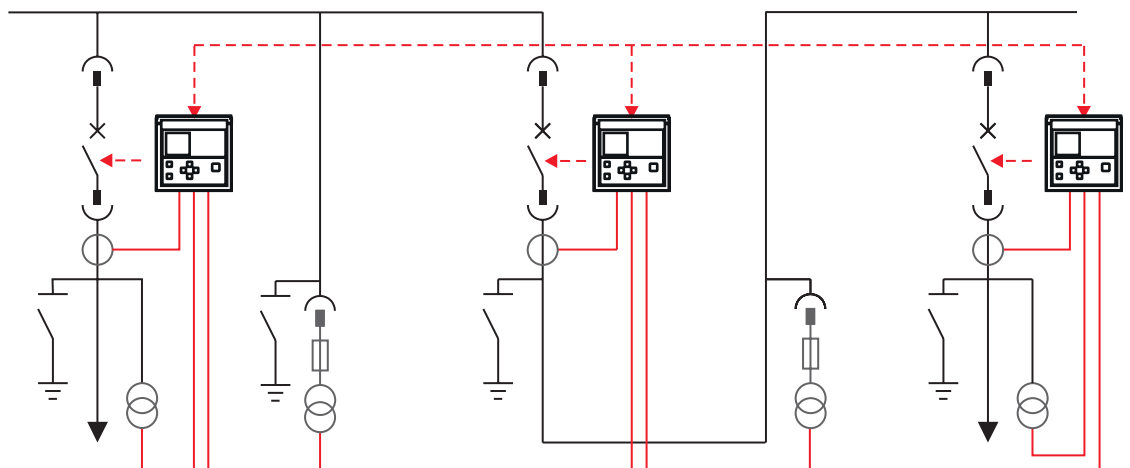
Synchronized automatic transfer system

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 protection relays is between 200 to 300 ms (including the circuit breaker operating times). The time can vary within the range indicated in relation to the complexity of the software transfer logics.

Switchgear equipped with Relion protection relays, suitably configured, are complete and efficient systems able to manage transfer between one power supply system and an alternative one, or to reconfigure the network, passing from double radial distribution to a simple system, in a fully automatic way.

It is also possible to carry out the same operation manually from a remote control station, or from the front of the switchgear under user supervision. Manual transfer means making the passage parallel, by means of the synchronism control function (synchro-check) implemented from the protection relay, the power supply lines are closed simultaneously with synchronization of the voltage vectors to then return to being disconnected when the transfer has taken place. The applications described do not require additional instruments.

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01

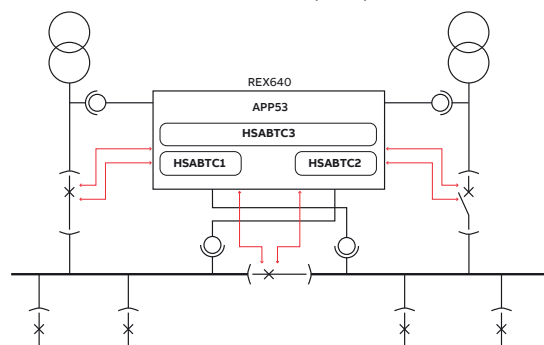


Relion REX640

Voltage decrease or complete supply interruptions represent the most crucial and critical problems for the quality of energy supply today. ABB's Relion REX640 guarantees an optimal safeguarding of energy supply. The protection relay 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.

Application areas

REX640 can perform automatic high-speed transfer functionality. In the industry the functionality is also referred as high-speed busbar transfer (HSBT), motor bus transfer (MBT), high-speed motor bus transfer (HSMBT) and automatic bus transfer (ABT).



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02

The high-speed transfer is typically required in processes where the electrical supply for the critical system parts must be secured by connecting alternative (stand-by) feeder online. Such processes are typically found in petrochemical, pharmaceutical, semiconductor manufacturing industries and in electrical power generation plants. Common feature for these examples is that there are motors fed by the switchgear, these motors will back-feed the busbar once the grid connection is lost. The declining busbar voltage and frequency must be considered carefully to determine the correct closing moment for the alternative feeder.

To ensure optimal utilization of the REX640 as a high-speed transfer device, the following prerequisites should be fulfilled:

- Existence of at least two synchronous feeders, which are independent of one another during normal operation
- Circuit breakers with less than 100ms operating time
- Switchgear assembly and load suitable for network transfers
- Fast protection relays to initiate transfer externally, if used
- Rotating loads (motors) back feeding the busbar during the transfer sequence

Transfer modes and times

Four different transfer modes are available in detail: (1) fast transfer, (2) transfer at the first 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:

- Multiapplication Protection and Control REX640 Product guide



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03

UniGear ZS1

Distribution automation

—
01 Remote I/O
unit RIO600
—
02 Urban environment
—
03 Control center

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 IEC 61850 standard for communication. This enables easy integration into the system.

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 the need to install 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 protection relays 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 (Generic Object Oriented Substation Event) 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



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02



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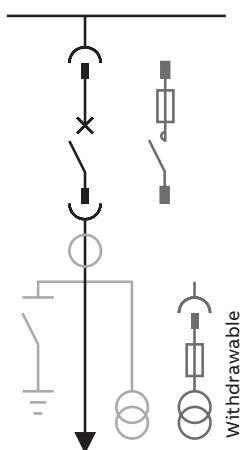
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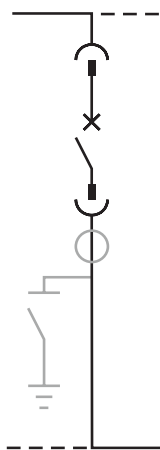
UniGear ZS1

Single-line diagrams

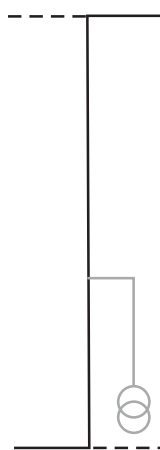
Single-line diagram of typical units



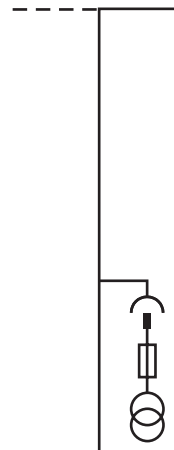
IF - Incoming/outgoing feeder



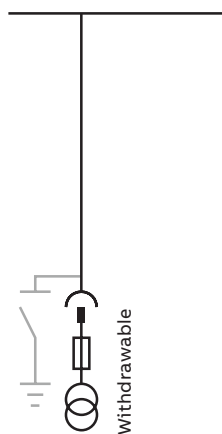
BT - Bus-tie



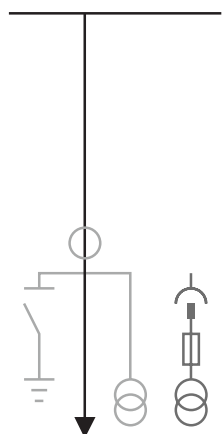
R - Riser



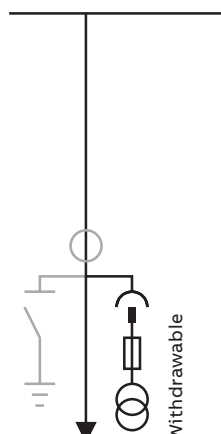
RM - Riser with measurement



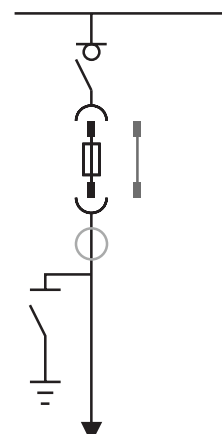
M - Measurement



IFD - Direct incoming/outgoing feeder



IFDM - Direct incoming/ outgoing feeder with measurement



DF - Switch-disconnector unit

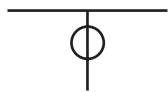
Key to components

— Standard components

— Accessories

— Alternative solutions

Single-line diagram of the busbar applications



Current transformers



Voltage transformers



Duct entry



Earthing switch

Graphical symbols



Circuit-breaker



Contactor



Switch-disconnector



Disconnecter



Isolating bar



Socket and plug



Voltage transformers



Current transformers



Fuse



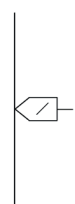
Earth



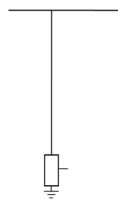
Cable entry



Busbar entry



Current sensor



Voltage sensor

UniGear ZS1

Technical data

| | | |
|-----------------------------------|---|----------------------------|
| Units: ... 12 kV - ... 31.5 kA | | |
| Width [mm] | | 500 |
| Height [mm] | | 2 200/2 595 ⁽¹⁾ |
| Height with gas exhaust duct [mm] | | 2 700 ⁽⁴⁾ |
| Depth [mm] | | 1 312 |
| Rated current [A] | | 1 250 |
| IF | Incoming/outgoing | x |
| IFD | Direct incoming/outgoing | x |
| IFDM | Direct incoming/outgoing with measurement | x |
| BT | Bus-tie | x |
| R | Riser | x |
| RM | Riser with measurement | x |
| M | Measurement | x |
| ME | Measurement with earthing switch | x |

| | | | | | | | | | | | | | | | | | |
|--|---|---------------------------|--|--|--|--------------------------|--|--|--|--------------------------|--|----------------|--|----------------|--|------|--|
| Units: ... 12 kV - 17.5 kV - ... 31.5 kA | | | | | | | | | | | | | | | | | |
| Width [mm] | | 650 | | | | 800 | | | | 1000 | | | | | | | |
| Height [mm] | | 2200/2595 ⁽¹⁾ | | | | 2200/2595 ⁽¹⁾ | | | | 2200/2595 ⁽¹⁾ | | | | | | | |
| Height with gas exhaust duct [mm] | | 2533 ⁽⁴⁾ | | | | 2533 ⁽⁴⁾ | | | | 2533 ⁽⁴⁾ | | | | | | | |
| Depth [mm] | | 1340 | | | | 1340 | | | | 1390 | | 1340 | | 1390 | | 1405 | |
| Rated current [A] | | 630 1250 1600 2000 2500 | | | | 630 1250 1600 2000 2500 | | | | 3150 3600 4000 | | 1600 2000 2500 | | 3150 3600 4000 | | | |
| IF | Incoming/outgoing | x ⁽²⁾ x | | | | x x x | | | | | | x x x | | x x x | | x | |
| BT | Bus-tie | x | | | | x x x | | | | | | x | | x x x | | x | |
| R | Riser | x x x x | | | | | | | | x x x | | | | | | | |
| RM | Riser with measurement | x x x x | | | | | | | | x x x | | | | | | | |
| M | Measurement | x | | | | | | | | | | | | | | | |
| IFD | Direct incoming/outgoing | x | | | | | | | | x | | | | | | x x | |
| IFDM | Direct incoming/outgoing with measurement | x | | | | | | | | x | | | | | | x x | |
| DF | Switch-disconnector unit | | | | | x ⁽³⁾ | | | | | | | | | | | |
| IFC | Contactor panel | x ^{(2), (6)} x x | | | | | | | | | | | | | | | |

| Units: ... 12 kV - 17.5 kV - 40 / 50 kA | | | | | | | | | | | | | | | | | |
|---|--|--------------------------|------|--------------------------|------|------|------|------|------|------|------|--------------------------|-------|------|------|------|-------|
| Width [mm] | | 650 | | 800 | | | | | | | | 1000 | | | | | |
| Height [mm] | | 2200/2595 ⁽¹⁾ | | 2200/2595 ⁽¹⁾ | | | | | | | | 2200/2595 ⁽¹⁾ | | | | | |
| Height with gas exhaust duct [mm] | | 2 696 ⁽⁴⁾ | | 2 696 ⁽⁴⁾ | | | | | | | | 2 696 ⁽⁴⁾ | | | | | |
| Depth [mm] | | 1 390 | | 1 390 | | | | | | | | 1 455 | 1 390 | | | | 1 455 |
| Rated current [A] | | 630 | 1250 | 630 | 1250 | 1600 | 2000 | 2500 | 3150 | 3600 | 4000 | 2000 | 2500 | 3150 | 3600 | 4000 | |
| IF | Incoming/outgoing | x ⁽⁷⁾ | | x | x | x | | | | | | x | x | x | x | x | |
| BT | Bus-tie | | | x | x | x | | | | | | | x | x | x | x | |
| R | Riser | | | x | x | x | x | x | x | x | | | | | | | |
| RM | Riser with measurement | | | x | x | x | x | x | x | x | | | | | | | |
| M | Measurement | x ⁽⁷⁾ | | x | | | | | | | | | | | | | |
| IFD | Direct incoming/ outgoing | | | x | | | | | | | | | x | | | | x |
| IFDM | Direct incoming/ outgoing with measurement | x ⁽⁷⁾ | | x | | | | | | | | | x | | | | x |
| IFC | Contacting panel | x ^{(2), (6)} | | | | | | | | | | | | | | | |

| Units: ... 12 kV - 17.5 kV - 63 kA | | | | | | | | |
|------------------------------------|------------------------|----------------------------|-------|-------|-------|-------|-------|-------|
| Width [mm] | | 1 000 | | | | | | |
| Height [mm] | | 2 200/2 595 ⁽¹⁾ | | | | | | |
| Height with gas exhaust duct [mm] | | 2 700 ⁽⁴⁾ | | | | | | |
| Depth [mm] | | 2 089 | | | 2 139 | | 2 154 | |
| Rated current [A] | | 1 250 | 1 600 | 2 000 | 2 500 | 3 150 | 3 600 | 4 000 |
| IF | Incoming/outgoing | x | x | x | x | x | x | x |
| BT | Bus-tie | x | x | x | x | x | x | x |
| R | Riser | x | x | x | x | x | x | x |
| RM | Riser with measurement | x | x | x | x | x | x | x |
| M | Measurement | | | | | | | |

| Units: ... 24 kV - ... 31.5 kA | | | | | | | | | | | | |
|-----------------------------------|---|----------------------------|------|------|------|------|----------------------------|------|------|------|------|------|
| Width [mm] | | 800 | | | | | 1 000 | | | | | |
| Height [mm] | | 2 325/2 720 ⁽¹⁾ | | | | | 2 325/2 720 ⁽¹⁾ | | | | | |
| Height with gas exhaust duct [mm] | | 2 733 ⁽⁴⁾ | | | | | 2 733 ⁽⁴⁾ | | | | | |
| Depth [mm] | | 1 700 ⁽⁵⁾ | | | | | 1 700 ⁽⁵⁾ | | | | | |
| Rated current [A] | | 630 | 1250 | 1600 | 2000 | 2500 | 630 | 1250 | 1600 | 2000 | 2500 | 3150 |
| IF | Incoming/outgoing | x | x | | | | x | x | x | x | x | x |
| BT | Bus-tie | | x | | | | | x | x | x | x | x |
| R | Riser | | x | x | x | x | | x | x | x | x | x |
| RM | Riser with measurement | | x | x | x | x | | | | | x | |
| M | Measurement | x | | | | | x | | | | | |
| IFD | Direct incoming/outgoing | | x | x | x | x | | | | | x | |
| IFDM | Direct incoming/outgoing with measurement | | x | x | x | x | | | | | x | |

(1) The height of the unit is a function of the height of the low voltage compartment, available in the 705 and 1100 mm versions.

(2) For the characteristics of the unit equipped with contactor refer to page 30.

(3) For the characteristics of the unit equipped with switch-disconnector refer to page 32.

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


(5) For short-time current up to 25 kA a 1560 mm depth version is available.

(6) Rated current, short current and internal arc are restricted by coordinated fuses.

(7) Available at 40 kA

The newest and narrowest panel of the UniGear family has been designed with the customers in mind: a reduced footprint and improved sustainability based on the well-known quality and reliability of the ZS1 switchgear product line.

Safer




Combined with an innovative design and material mix, the narrow panel allows for a shorter overall switchgear length and reduced weight. It maintains the same level of safety and reliability as the UniGear ZS1 family and can be combined with other panel widths.

Smarter



UniGear ZS1 smart solutions enable condition monitoring and diagnostic systems, including current and voltage sensors and IEC 61850 communication and more. With secure access to condition and operational data, it is ready for cloud connectivity, enabling further data analysis, such as predictive maintenance to optimize maintenance costs and operations.

More sustainable



We care about the overall environmental impact of our products. That is why our latest switchgear has been further enhanced with new thermoplastic components that reduce the use of traditional non-recyclable composite insulation materials.

We have taken a real project where UniGear ZS1 is combined with UniGear 550. The parameters of the substation are: nominal voltage is 11 kV, nominal current is 1 250 A, short-circuit current is 20 kA. And the new 500 mm wide UniGear ZS1 version fulfills all these basic parameters of this substation, which consists of two incoming feeders (IF), one bus coupler (BT) with bus riser (BR) and ten outgoing feeders (OF).

2xIF, 1xBT, 1xBR and 10x 550 OF



10x UG ZS1 in 500 mm
Length 7,6 m / 9 395 kg

- 2 175 kg

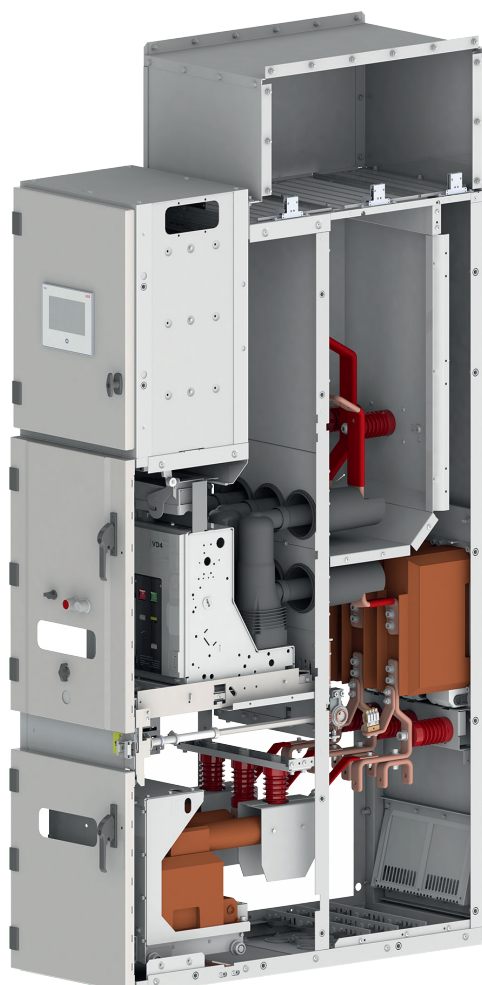
- 2 175 kg
18% reduction in weight

- 874,8 kg

| | |
|-------------------------|---|
| - 2 175 kg | - 874,8 kg |
| 18% reduction in weight | Line-up length reduced by 0,5m, which represents 6% reduction in CAPEX cost |

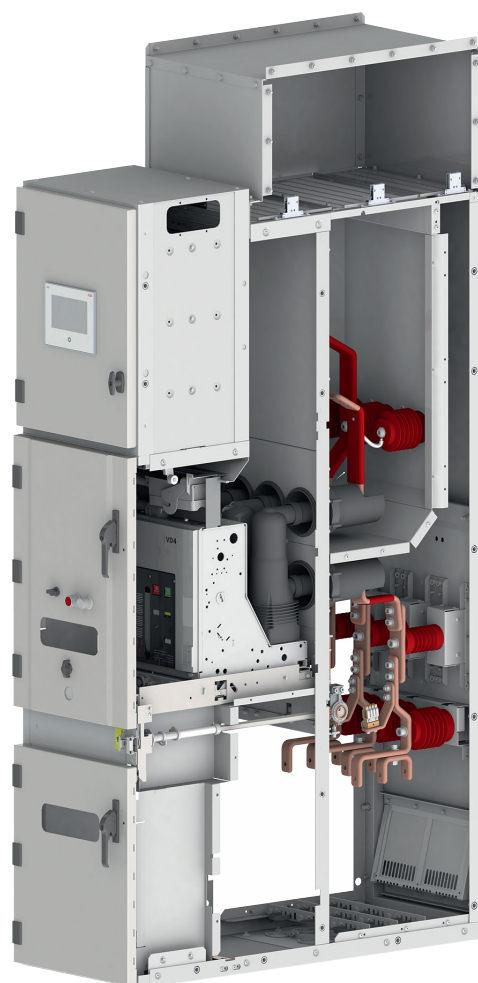
- **In 1 year:** 8,56 MWh reduction in energy losses
7,36 t CO₂-eq/kg
- **In 30 years:** 256,9 MWh reduction in energy losses
220,93 t CO₂-eq/kg

- **In 30 years:** 256,9 MWh reduction in energy losses **220,93 t CO₂-eq/kg**



500 mm wide UniGear ZS1 standard panel with instrument transformers

- Current transformers – TPU type, same as in 650 mm wide UniGear ZS1 (short or long version)
- Voltage transformers - fixed or removable (on trolley) located in the front of the cable compartment for voltage measurement
- Ring core current transformers for I_o measurement
- Thermoplastic spouts
- Earthing switch EK7
- Max 3 cable connections per phase



500 mm wide UniGear ZS1 panel with Rogowski coils and voltage dividers

- Current sensors – new KECA type to fit thermoplastic spouts, up to 2 sets, Rogowski coil principle
- Voltage sensors – existing KEVA 17,5 B20 type for cable or busbar voltage measurement, 2 sets
- Ring core current transformers for I_o measurement
- Thermoplastic spouts
- Earthing switch EK7
- Max 3 cable connections per phase
- Panel offers flexibility to accommodate also instrument transformers technology in parallel if needed

UniGear ZS1

Smart Solutions

Reduce costs and environmental impact with UniGear with current and voltage sensors and IEC 61850, the next generation of switchgear.

UniGear with Smart solutions delivers unprecedented flexibility for any application, while lowering your operating costs and minimizing your environmental footprint.

The advantages of UniGear, equipped with current and voltage sensors and integrated with IEC 61850, include:

Safety and reliability

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

Intelligence and future-readiness

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

Simplicity and efficiency

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

Improved sustainability

- Lowers energy consumption up to 250 MWh** which represents saving of 13 000 EUR
- Saves up 150 tons of CO₂**, that is equal to emissions produced by mid-size European car driven for 1 250 000 km

Global solution

- Available for projects according to IEC, GOST and CSA standards

UniGear with current and voltage sensors and IEC 61850

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

By utilising UniGear equipped with current and voltage sensors, along with IEC 61850, you mitigate numerous practical challenges encountered in today's complex applications, thus reducing concerns within your electrical network.

* Compared to UniGear ZS1 with instrument current and voltage transformers

** Compared to typical substation with 14 switchgear panels of UniGear ZS1 over 30 years of operation

Protection and control
relay from Relion® family
with IEC 61850

Low voltage
compartment

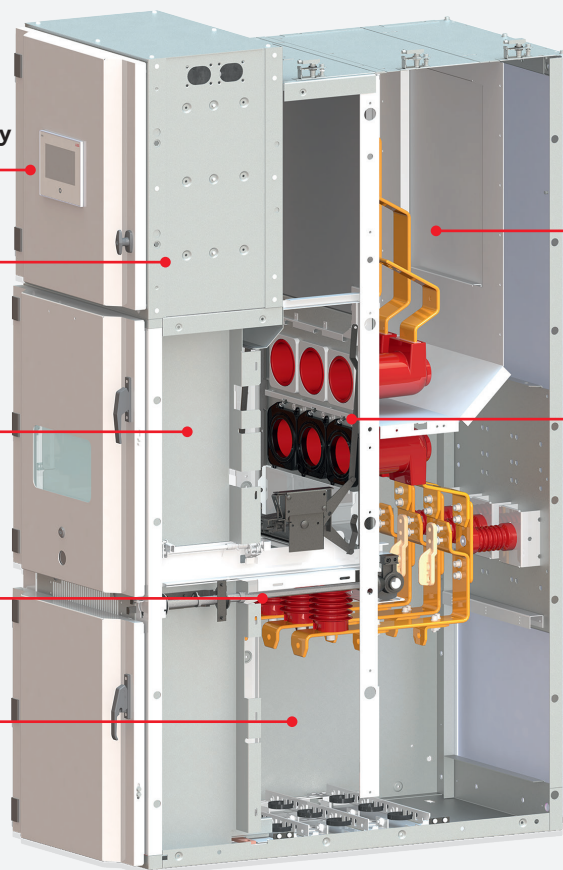
Apparatus
compartment

Voltage sensor

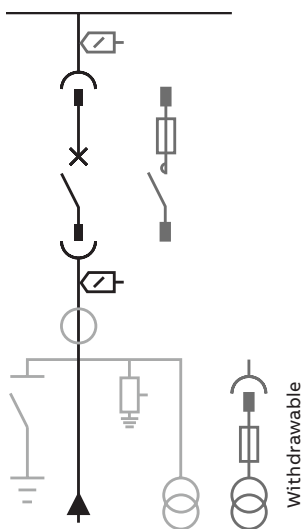
Cable
compartment

Busbar
compartment

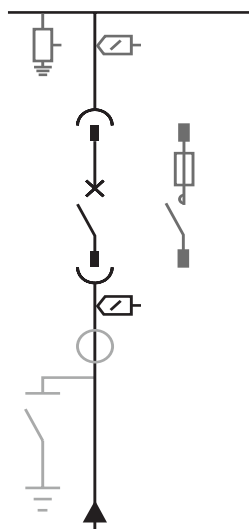
Current sensor



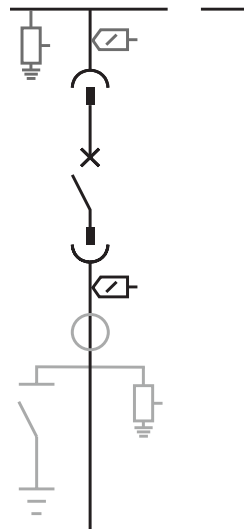
Single-line diagram
of typical units



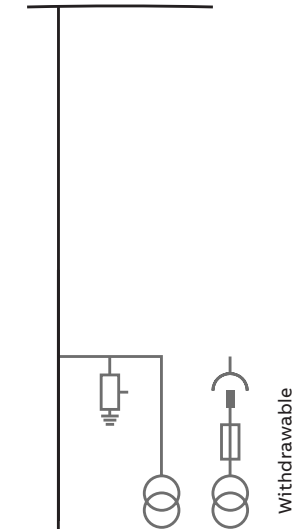
IF - Incoming/outgoing feeder



OFM - Outgoing with BB
measurement



BT - Bus-tie



R - Riser

UniGear ZS1

Monitoring and Diagnostics

Medium-voltage primary air insulated switchgear is an important component of power distribution systems, and condition monitoring systems are essential to ensure the reliable and safe operation of the switchgear.

By using partial discharge monitoring, temperature monitoring, and circuit breaker monitoring or environmental monitoring, end users can improve the reliability and longevity of their switchgear, reduce maintenance costs, and increase overall system performance.

UniGear takes full advantage of new technologies such as online condition monitoring and diagnostics to provide a new way of working for the electrical system.

The condition monitoring system provides secure access to many customizable widgets that help you monitor your assets, apply data analysis, subscribe to alerts, plan maintenance schedules, generate custom reports and more.



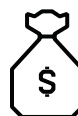
Make better, data-driven decisions

Real-time operational data from equipment, predictive analytics and insights that help customers make timely decisions.



Maximize Up-time

Reduce potential unplanned downtime to a minimum, that directly impacts revenue generation.



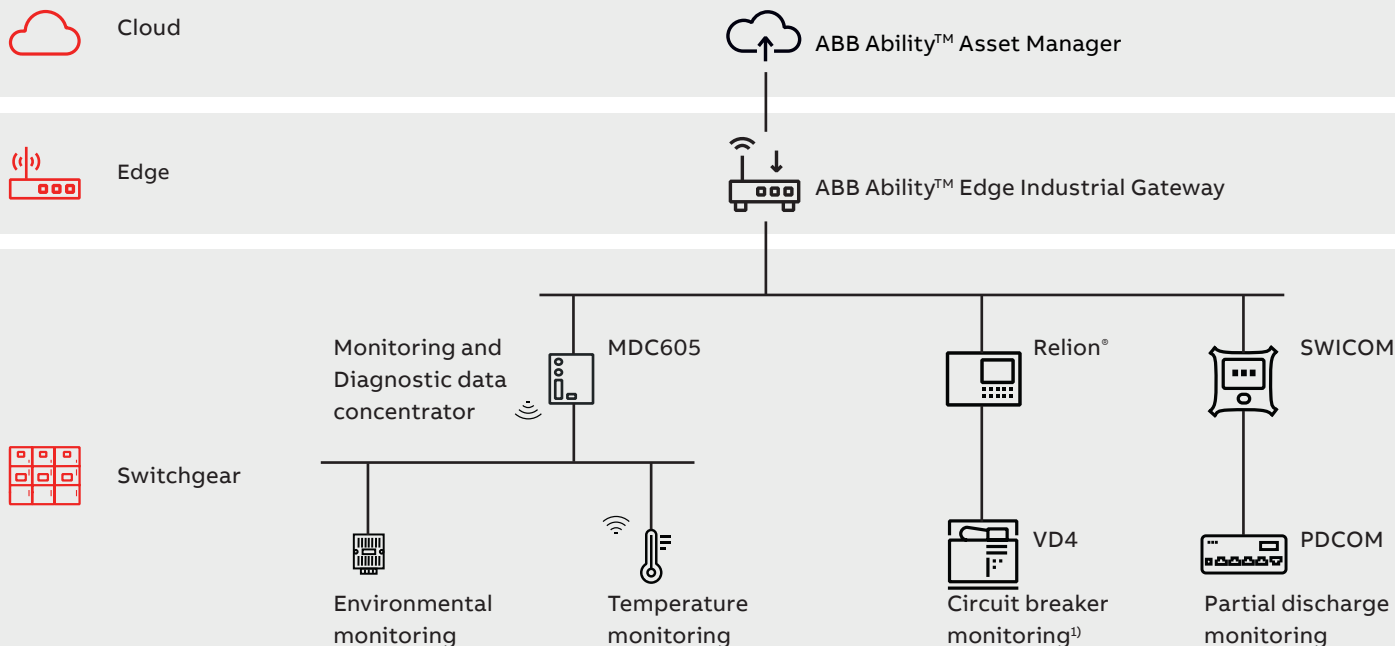
Reduce total cost of ownership

Reduce site visits, optimize maintenance schedules and increase workforce efficiency.



Increase safety and sustainability

Deploy field service engineers only when needed, optimizing resources and extending asset life while maintaining safety.



¹⁾ VD4 evo availability to be clarified with UniGear factory before ordering

Environmental monitoring

- Ambient room condition (temperature and humidity)
- Environmental condition in cable (or other) compartments in assembly (temperature and humidity)

Understanding the ambient condition, a switchgear is operated in provides further insights of maintenance needs i.e., whether the switchgear is operated within its design limits. Exceeding those limits may lead to additional maintenance.

Understanding room condition also helps to prevent incidents i.e., by detecting open doors or windows.

Temperature monitoring

- Up to 12 temperature measurement points at critical joints such as cable connection, busbar or circuit breaker connection
- Thresholds are applied to absolute temperatures as well as rise values

Temperature rise indicates the quality of primary connections within the panel, such as busbar connections, circuit breaker connections and cable connections. Online monitoring of temperature increases safety and provides a reliable way to identify such risks with early alerts.

Circuit breaker monitoring

- Monitoring the mechanical condition of the VD4 circuit-breaker using the Relion® protection relay function
- Advanced monitoring of the mechanical condition of the VD4 evo¹⁾ circuit-breaker and integrated sensors

Monitoring the condition of mechanical parts of a circuit breaker or its accessories such as spring charge motor over its operational life provides a much better information than periodical offline testing.

Every time a breaker is operated parameters such as opening/closing time etc. is monitored and with dedicated diagnosis functions mechanical and electrical wearing can be estimated and informed.

¹⁾ VD4 evo availability to be clarified with UniGear factory before ordering

Partial Discharge monitoring

- ABB's PDCOM monitors changes in partial discharge levels over time
- Partial discharge can be shown or communicated upstream via the SWICOM device

Insulation performance is the most critical aspect when designing and operating a switchgear. Due to complicate operational condition or harsh environment, insulation can be subject to accelerated aging.

The online monitoring of partial discharge changes provides an effective manner to capture such deterioration of insulation as early as possible to avoid disruptive failures.

Monitoring and Diagnostic data concentrator

- ABB's MDC605 series data concentrator connects to sensors in a single switchgear panel or across multiple panels
- Wireless connectivity to thermal sensors to reduce wiring effort
- Powerful data concentrator with built-in storage, analytics and local web server for data visualization

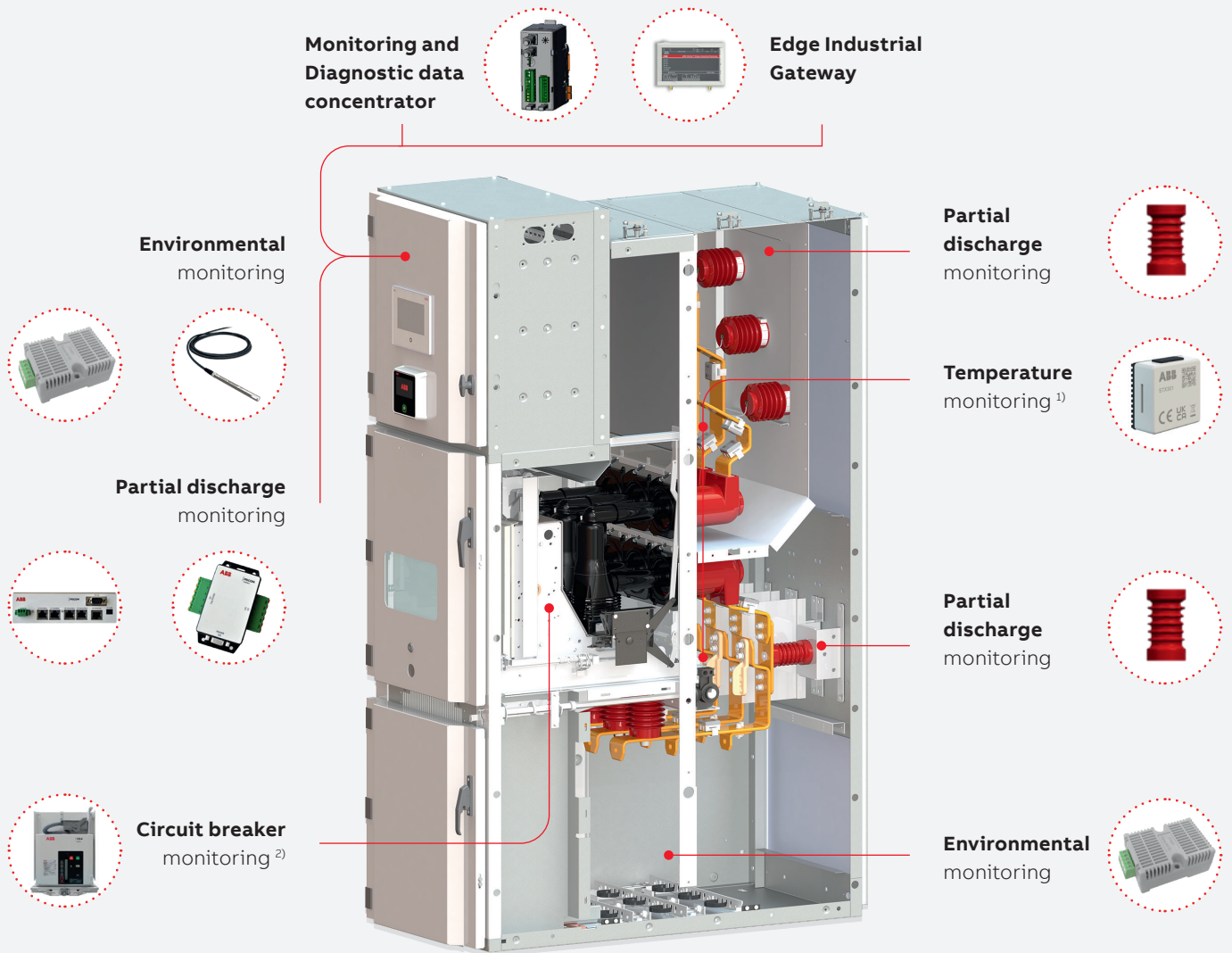
Asset Manager

- ABB Ability™ Asset Manager is a cloud solution that integrates energy and asset management into a single intuitive dashboard

| Product type | Temperature monitoring | Environmental monitoring | Partial discharge monitoring |
|---------------------------|------------------------|--------------------------|------------------------------|
| UniGear ZS1 up to 12 kV | • | • | • |
| UniGear ZS1 up to 17.5 kV | • | • | • |
| UniGear ZS1 up to 24 kV | • | • | • |
| UniGear MCC | • | • | • |

UniGear ZS1

Monitoring and Diagnostics



Note: The picture shows various options, while actual implementation depends on the selected features

1) Rear access to panel needed for temperature monitoring of circuit breaker / panel connection

2) Monitoring of mechanical condition of VD4 circuit breaker through Relion® protection relay function

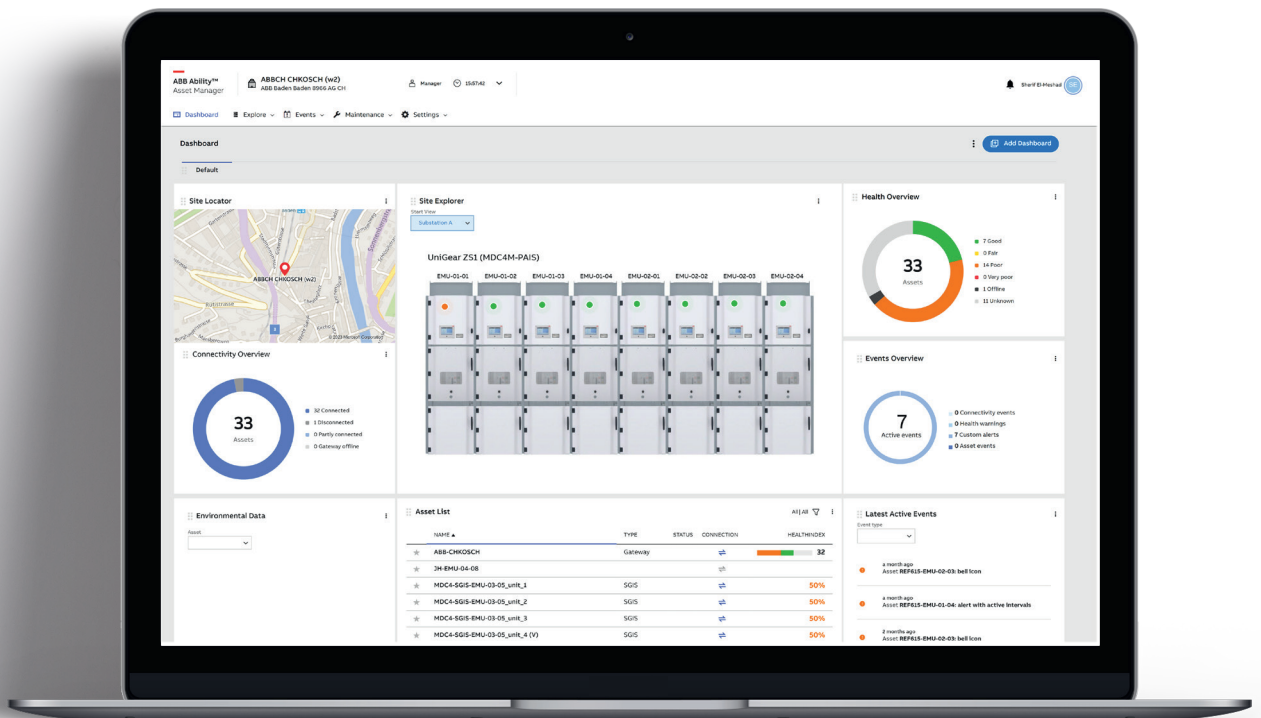
Advanced circuit breaker condition monitoring available with VD4 evo

Data visualisation

- Monitoring and Diagnostic data concentrator (MDC605)



- Asset Manager







UniGear ZS1 - Double Busbar System

Description

When ABB developed UniGear ZS1, the double busbar system was included since the beginning.

The users of UniGear ZS1 double busbar system are mainly power utility companies, main substations and heavy industries. In any case the using of this product is highly recommended where there is the request to increase the service continuity.

The use of UniGear ZS1 double busbar switchgear is necessary when some of the following features are required:

- Load shedding of outgoing feeders with a different level of importance during emergency conditions
- Isolation of particular outgoing feeders from the normal network
- Outgoing feeders balancing on two busbar systems during normal operating condition
- Flexibility during inspection and maintenance procedures without switchgear load interruption
- Extension of switchgear without shutdown *
- Motor operated line-disconnector that permit fast switching between the two busbar systems during emergency situations (only possible with Bus-tie transversal closed)
- Free access to one busbar system during maintenance operations while the other is in operation and the considered unit is out of operation
- Incoming feeders and the most important outgoing feeders can be equipped with two circuit-breakers in order to allow apparatus redundancy
- Circuit-breaker maintenance and testing without feeder shutdown
- Fewer number of components and less switching apparatus

UniGear ZS1 double busbar systems are based on two different panel types:

- Two busbar systems, two busbar-disconnectors and one circuit-breaker (up to 2500 A - 12-17.5 kV and 2000 A -24 kV)
- Two busbar systems, two circuit-breakers compartments with one or two circuit breakers, this version is called duplex system (up to 4000 A -12-17.5 kV and 3150 A-24 kV)

Both types provide full busbar system redundancy (physical isolation between source busbar systems) and allow uninterrupted and reliable service conditions.

Thanks to the numerous standard units available, the switchgear can be suitably configured to satisfy all configuration requirements. Each switchgear panel can be equipped with circuit-breakers.

All the significant components and accessories are identical to those used for UniGear ZS1 single level and double level units and therefore the same operation and maintenance procedures are guaranteed.

ABB double busbar system can be provided with single section or two or more sections in order to satisfy the most demanding customer request. For examples refer to the two sections:

- One section of double busbar
- Two sections of double busbar

* Contact ABB representative for specific details to enable extension on site.

IEC electrical characteristics

| | | | | |
|--|--------------|-------------------|-------------------|----------|
| Rated voltage | [kV] | 12 | 17.5 | 24 |
| Test voltage | [kV / 1 min] | 28 ⁽¹⁾ | 38 ⁽¹⁾ | 50 |
| Impulse withstand voltage | [kV] | 75 | 95 | 125 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 | 50 / 60 |
| Rated short-time withstand current ⁽²⁾ | [kA / 3 s] | ...31.5 | ...31.5 | ...25 |
| Peak withstand current | [kA] | ...80 | ...80 | ...63 |
| Internal arc withstand current ⁽²⁾ | [kA / 1 s] | ...31.5 | ...31.5 | ...25 |
| Rated current of the main busbars | [A] | ...4 000 | ...4 000 | ...2 500 |
| Rated circuit-breaker thermal current | [A] | ...4 000 | ...4 000 | ...2 500 |
| Double busbar-disconnector feeders rated current | [A] | ...2 500 | ...2 500 | ...2 000 |
| Duplex feeder rated current | [A] | 3 150 | 3 150 | - |
| Duplex feeders rated current with forced ventilation | [A] | 3 600 | 3 600 | 2 500 |
| | | 4 000 | 4 000 | - |

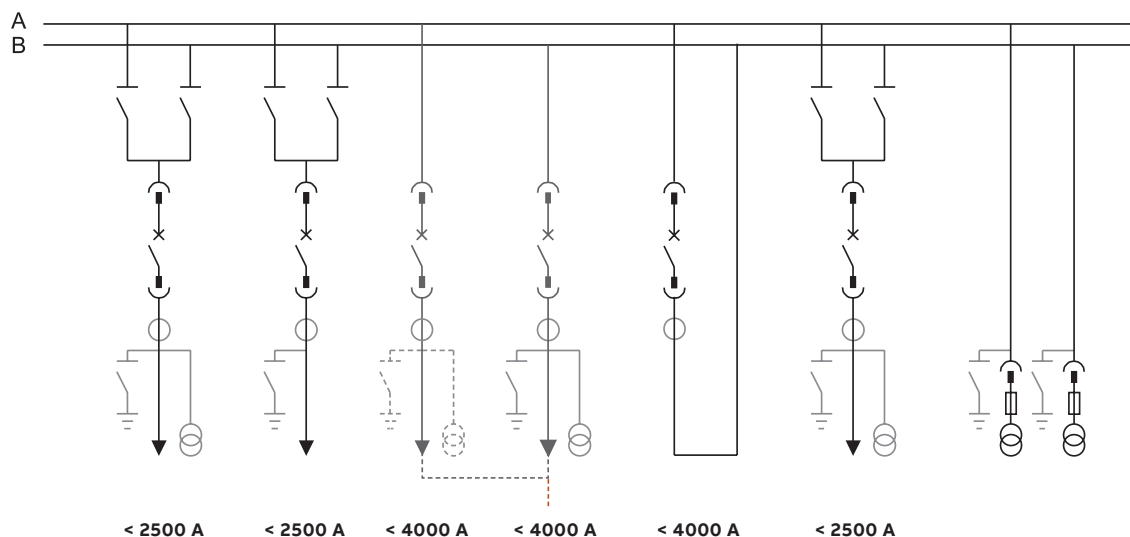
The values indicated are valid for both vacuum and SF6 circuit-breaker

For panel with contactor the rated current value is 400 A

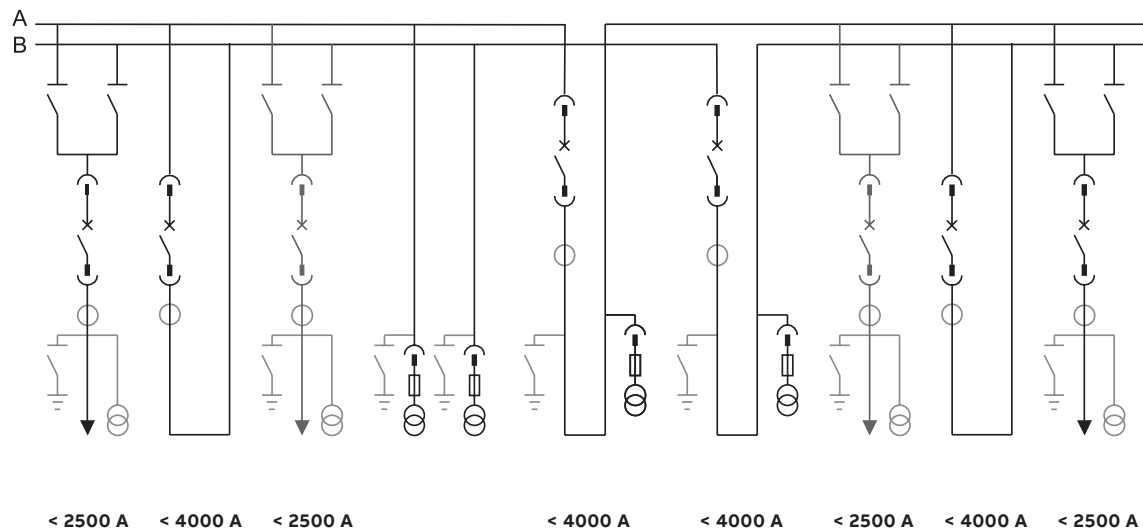
(1) 42 kV (GB/DL)

(2) A duplex back to back configuration can be used to cover applications at 40/50 kA - please contact the factory for further details

—
Example of one section
of UniGear ZS1 double
busbar system



—
Example of two sections
of UniGear ZS1 double
busbar system



UniGear ZS1 - Double Busbar System

Characteristics

Compartments

Each panel is made up of four independent power compartments: apparatus, busbar 1, busbar 2 and cable.

There is a metallic segregation between all the compartments. In its front/top part the panel is fitted with a compartment to take the auxiliary instruments.

UniGear ZS1 double busbar system is arc-proof version and supplied with a duct for the evacuation of the gases produced by an arc. Each compartment of the unit is fitted with a flap on the top surface. The pressure generated by the fault makes this open, allowing the gas to pass into the duct.

The apparatus compartment is accessible from the front. Door closing of these compartments is available in two versions, with screws or central handle.

Removal of the apparatus from the switchgear (circuit-breakers and contactors) and from its relative compartments takes place by means of a single dedicated truck.

The busbar and cable compartment are accessible from the rear of the switchgear by means of removable panels.

All the normal service operations are carried out from the front, whereas maintenance and start-up operations also require access from the rear of the switchgear.

Busbar disconnectors

IF unit busbar-disconnectors are designed to act as two position switches - open and closed positions - and operation is manual (e.g. without springs assistance).

The opening and closing operation of the busbar-disconnector is operated from the front of the panel.

The position of the busbar-disconnector is indicated on the front of the panel with mechanical coupled indicators.

The busbar-disconnectors are clearly separated and the relevant busbar compartments are segregated from each other in order to achieve the following:

- It should be possible to carry out maintenance and also extend the switchgear with additional units, keeping one of the two busbars systems energised
- A fault generated in one compartment (e.g. insulation discharge) will not generate any damage to the others or require the shutdown of the unit

Busbar-disconnectors are provided with limit switches for the detection of operating position and they can be operated manually or, as an option, motor operated.

The busbar-disconnectors are provided with the necessary interlocking facilities.

The interlocks between the two line disconnectors and the circuit breaker are implemented by means of locking magnets.

The busbar-disconnector consists of a moveable copper tube housed inside an epoxy insulator. Electrical contact is guaranteed by two or four connection springs (depending on the rating of the disconnector).

Additional protective insulating caps are mounted on both sides of the insulator, thus providing the device with a high level of reliability.

| Units: ... 12 kV - 17.5 kV - ... 31.5 kA | | | | | | | | | | | | | | | | |
|--|--|----------------------------|------|------|------|------|----------------------------|------|------|------|------|----------------------------|------|------|------|------|
| Depth (mm) | | 2 021 | | | | | 2 021 | | | | | 2 021 | | | | |
| Height (mm) | | 2 200/2 595 ⁽¹⁾ | | | | | 2 200/2 595 ⁽¹⁾ | | | | | 2 200/2 595 ⁽¹⁾ | | | | |
| Height with gas exhaust duct (mm) | | 2 700 ⁽²⁾ | | | | | 2 700 ⁽²⁾ | | | | | 2 700 ⁽²⁾ | | | | |
| Width (mm) | | 650 | | | | | 800 | | | | | 1 000 | | | | |
| Rated current (A) | | 630 | 1250 | 1600 | 2000 | 2500 | 1600 | 2000 | 2500 | 3150 | 3500 | 4000 | 2500 | 3150 | 3500 | 4000 |
| IF | Incoming/outgoing | x | x | | | | x | x | | | | | x | | | |
| IF | Incoming/outgoing duplex feeder | | | | | | | | | | | | | x | x | x |
| IFM | Incoming/outgoing duplex feeder with measurement | | | | | | | | | | | | | x | x | x |
| BTT | Transverse bus-tie | | x | | | | x | | | | | | x | x | x | x |
| M | Measurement | x | | | | | | | | | | | | | | |
| BTL | Longitudinal bus-tie | | x | | | | x | x | | | | | x | x | x | x |
| RL | Longitudinal riser | | x | x | x | | | | | x | x | x | x | | | |
| RML | Longitudinal riser with measurement | | x | x | x | | | | | x | x | x | x | | | |

| Units: ... 24 kV - ... 25 kA | | | | | | | | | | |
|-----------------------------------|--|----------------------------|------|------|------|------|----------------------------|------|------|--|
| Depth (mm) | | 2 570 | | | | | 2 570 | | | |
| Height (mm) | | 2 400/2 720 ⁽¹⁾ | | | | | 2 400/2 720 ⁽¹⁾ | | | |
| Height with gas exhaust duct (mm) | | 3 000 ⁽²⁾ | | | | | 3 000 ⁽²⁾ | | | |
| Width (mm) | | 800 | | | | | 1 000 | | | |
| Rated current (A) | | 630 | 1250 | 1600 | 2000 | 2500 | 1600 | 2000 | 2500 | |
| IF | Incoming/outgoing | x | x | | | | x | x | | |
| IF | Incoming/outgoing duplex feeder | x | x | | | | | | x | |
| IFM | Incoming/outgoing duplex feeder with measurement | x | x | | | | | | x | |
| BTT | Transverse bus-tie | | x | | | | x | x | x | |
| M | Measurement | x | | | | | | | | |
| BTL | Longitudinal bus-tie | | x | | | | x | x | x | |
| RL | Longitudinal riser | | | | x | x | x | | | |
| RLM | Longitudinal riser with measurement | | | | x | x | x | | | |

IF and IFM duplex feeder, M, BTL, RL and RLM are available for both A and B busbar system connections

1) The height of the unit is a function of the height of the low voltage compartment, available in the 705 and 1100 mm versions

2) Other solutions are available, please contact ABB representative

LSC Classification for each UniGear ZS1 double busbar panel type

| Units: ... 12 kV - 17.5 kV - ... 31.5 kA | | |
|---|--------------------|--|
| Panel type | LSC Classification | |
| IF Incoming/outgoing | LSC2B | |
| IF Incoming/outgoing duplex feeder | LSC2B | |
| IFM Incoming/outgoing duplex feeder with measurement | LSC2B | |
| BTT Transverse bus-tie | No LSC | |
| M Measurement (A, B) | LSC1 | |
| M Measurement (A), Measurement (B) | LSC2 | |
| BTL Longitudinal bus-tie | LSC2B | |
| RL Longitudinal riser | LSC1 | |
| RLM Longitudinal riser with measurement | LSC2 | |

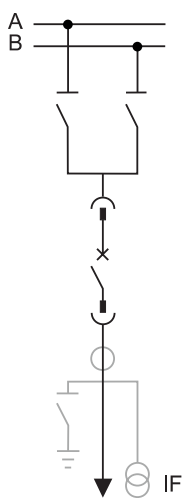
| Units: ... 24 kV - ... 25 kA | | |
|---|--------------------|--|
| Panel type | LSC Classification | |
| IF Incoming/outgoing | LSC2B | |
| IF Incoming/outgoing duplex feeder | LSC2B | |
| IFM Incoming/outgoing duplex feeder with measurement | LSC2B | |
| BTT Transverse bus-tie | No LSC | |
| M Measurement (A, B) | LSC1 | |
| M Measurement (A), Measurement (B) | LSC2 | |
| BTL Longitudinal bus-tie | LSC2B | |
| RL Longitudinal riser | LSC1 | |
| RLM Longitudinal riser with measurement | LSC2 | |

Note: All panel variants defined with PM partition class

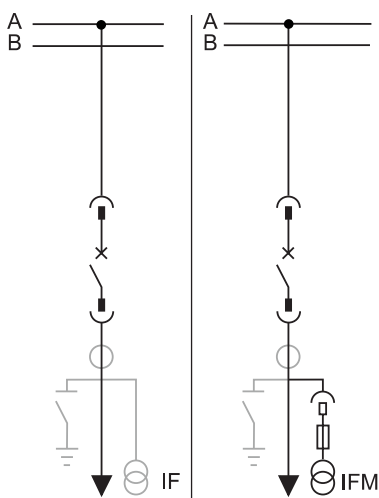
UniGear ZS1 - Double Busbar System

Single-line diagrams

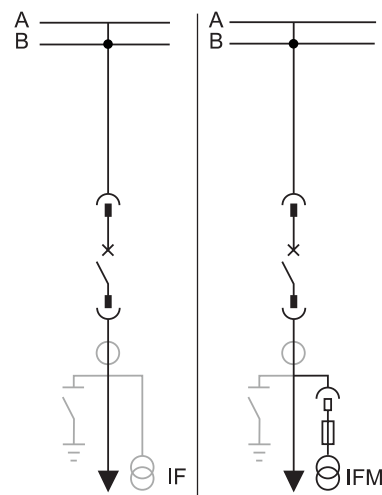
Single-line diagram of typical units



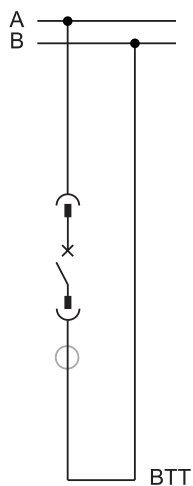
IF - Incoming/Outgoing



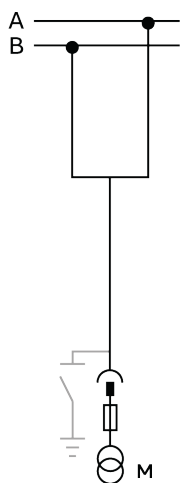
IF and IFM - Busbar A Duplex



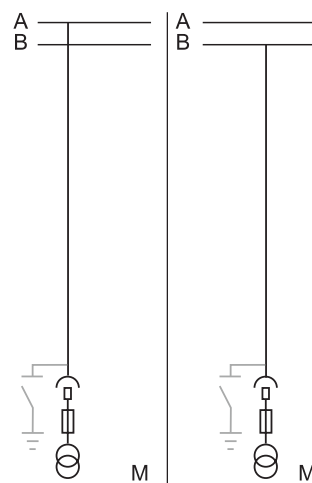
IF and IFM - Busbar B Duplex



BTT - Transv. Bus Tie



M - Measurement (A, B)



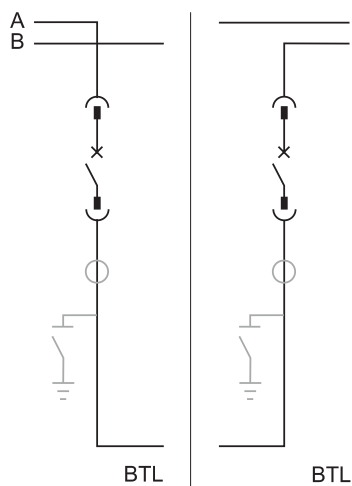
M - Measurement (A), Measurement (B)

Key to components

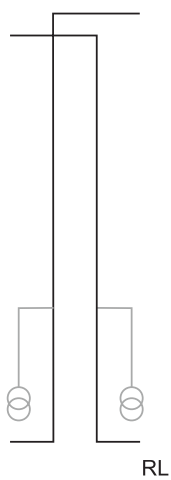
— Standard components

— Accessories

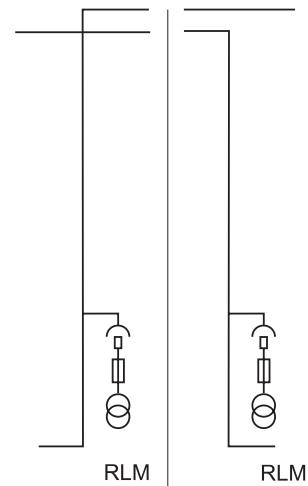
— Alternative solutions



BTL - Longitudinal Bus Tie

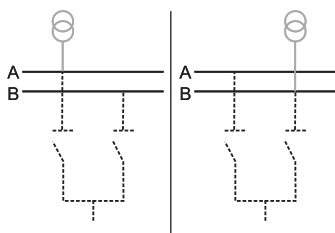


RL - Bus Riser Longitudinal

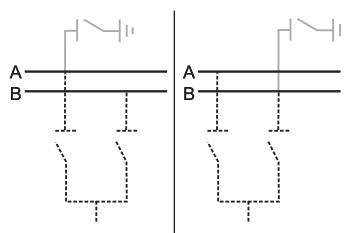


RLM - Bus Riser Longitudinal with Measurement

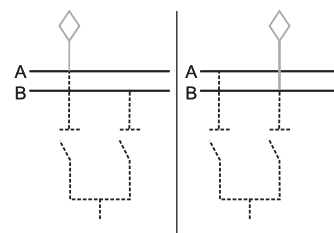
Single-line diagram of the busbar applications



Top-mounted VTs



Top-mounted earthing switch



Top entry duct

Graphical symbols



Circuit-breaker



Disconnect



Isolating bar



Socket and plug



Voltage transformers



Current transformers



Fuse



Earth



Cable entry



Busbar entry





Marine applications

Description

The Marine Market is divided into four different segments:

- Passenger vessels (cruise ships and ferries)
- Industrial vessels (shuttle tankers, drill ships, oil carriers, cargo vessels, etc.)
- Rigs (drill and oil rigs)
- Navy

In this type of application the temperature range, vibrations and variable inclination are particularly severe conditions that impact the functional requirements of on-board components such as the switchgear.

ABB is the leading manufacturer of air-insulated switchgear

for marine applications, installed by all main shipyards (Brazil, China, Denmark, Finland, France, Germany, Japan, Korea, Italy, Norway, Singapore, Spain, UK and USA).

The switchgear suitable for marine applications is UniGear ZS1 in single and double level arrangement up to 7.2-12 kV rated voltage (with the option for 17.5 kV), with the need for many dedicated features and some special typical units.

Over 10,000 ABB panels are in service in the world on board all kind of ships.

Registers and end-customers (shipyards or ship owners) require switchgear manufactured to comply with Shipping Register test requirements for on-board apparatus.

For this purpose, tests have been performed in compliance with the main Shipping Register regulations; DNV, LR, RINA, BV, GL, ABS, KR and Russian regulations.

In order to guarantee the necessary comfort and facilities, high power generation plants and control systems must be concentrated in significantly reduced overall dimensions.

UniGear ZS1 can be offered in single level with the possibility to be coupled with double level; it offers a wide range of apparatus and control units to satisfy marine installation requirements.

UniGear ZS1 switchgear provides the ideal technical solutions for marine applications:

- Arc-proof construction, mechanical safety interlocks, automatic segregation shutters and apparatus control with the door closed guarantee personnel safety during installation, operation and maintenance;
- High degree of protection (up to IP43) on the external enclosure;
- Metallic partitions between each compartment and earthing of all components accessible to personnel: apparatus, shutters, doors and the whole switchgear frame;
- High fire resistance thanks to minimal use of plastic and resins: the auxiliary equipment and wiring are highly self-extinguishing.

Shore connection

Ships generate emissions while docked in port by running their auxiliary engines to create onboard electric power.

In ports with heavy ship traffic, this practice creates emissions and negative health and environmental impact to the local surrounding communities.

As global trade steadily expands, ship emissions represent an ever-increasing environmental concern.

Sustainability is today a key area of focus in the shipping industry, where strong measures are being taken on several fronts to dramatically reduce ship emissions.

One such measure is shore-to-ship electric power supply, which eliminates pollution problems and particle discharge as well as noise and vibration from ships in port.

UniGear ZS1 Shore Connection panel is delivered as a finished cabinet solution with both a power module and a control module. Depending on the system configuration and onboard requirements, the cabinet may be supplied with cable connectors located in the front of the cabinet or with openings for cable entry through the cabinet floor.

All equipment is constructed and factory tested according to international standards and classification society rules.

Ambient conditions for classification of on-board apparatus

- Ambient temperature from 0°C to + 45°C
- Inclination up to 25° permanent

Vibration in the frequency range of 2 ... 100 Hz at the following motion width

- 1 mm amplitude in the frequency range of 2...13.2 Hz
- 0.7 g acceleration amplitude in the frequency range of 13.2...100 Hz

Fully type tested

The UniGear ZS1 switchgear has undergone all the tests required by the international (IEC), in addition, the tests required by the main shipping registers (LR, DNV, RINA, BV, GL, KR and Russian) have been carried out for use of the switchgear in marine installations.

| IEC electrical characteristics | | | |
|---|--------------|---------------|---------------|
| Rated voltage | [kV] | 7.2 | 12 |
| Rated insulation voltage | [kV] | 7.2 | 12 |
| Rated power frequency withstand voltage | [kV / 1 min] | 20 | 28 |
| Rated lightning impulse withstand voltage | [kV] | 60 | 75 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 |
| Rated short-time withstand current | [kA / 3 s] | ...50 | ...50 |
| Peak current | [kA] | ...125 | ...125 |
| Internal arc withstand current | [kA / 1 s] | ...40 | ...40 |
| | [kA / 0.5 s] | ...50 | ...50 |
| Main busbar rated current | [A] | ... 4 000 | ... 4 000 |
| Circuit-breaker rated current | [A] | ... 3 150 | ... 3 150 |
| Circuit-breaker rated current with forced ventilation | [A] | 3 600 - 4 000 | 3 600 - 4 000 |

The values indicated are valid for both vacuum and SF6 circuit-breaker
For panel with contactor the rated current value is 400 A

Marine applications

Characteristics

The features required for marine application, which are not part of the standard design, are described here below.

Degree of Protection

On request, the external housing of UniGear ZS1 can be supplied with different degrees of protection, the standard one requested for marine application is IP42 or IP43; where:

- IP42: protection against foreign bodies with diameter 1 mm and against water ingress at 15° maximum inclination
- IP43: protection against foreign bodies with diameter 1 mm and against water ingress at 60° maximum inclination

Duct for secondary wirings

On the top of the switchgear and exactly above the low voltage compartment as an option can be supplied the wiring duct.

Into this duct there are positioned the terminal boards related to the interpanel wiring between panels.

Gas duct

UniGear ZS1 is arc-proof version and supplied with a duct for the evacuation of the gases produced by an arc.

The duct is fixed on the top of the auxiliary compartment.

In marine plants, the exhaust gases cannot normally be evacuated out of the room and therefore the gas duct must always be closed on both the end-sides and equipped with top chimneys.

If there are cases where it is possible to evacuate hot gases out of the room, the gas duct with outlet can be supplied.

Doors

The door of the apparatus compartment and the rear panel is always supplied with handrails.

In addition, all the doors (low voltage, apparatus and cable compartments) are equipped with an appropriate stop to fix them in the open position.

Cables

UniGear ZS1 single level

Single level IF and IFM units are usually delivered in the deeper version (1650-1700 mm). This design will allow the following targets to be achieved:

- Bottom and top cable entry
- Appropriate cable terminal distance (minimum requirements):
 - 700 mm in case of bottom entry
 - 1 000 mm in case of top entry

Standard depth IF units (1 340-1 390 mm) are also used as an alternative in case of problems with space.

This feeder version will only allow bottom cable entry and a cable terminal distance in the range of 440...535 mm, depending on the rated current.

UniGear ZS1 double level

All the described recommendations for single level units must be applied to double level units. The cable terminal distance of IF units is 600 mm for all the following configurations:

- Bottom entry (both feeders)
- Top entry (both feeders)
- Bottom and top entry (one feeder from top, one feeder from bottom)

Thermo-graphic inspection

Thermographic inspection is normally required on power cable terminations and sometimes on main busbar systems.

Customers are normally much more sensitive to the former, because cable termination faults represent a considerable percentage of all the faults in switchgear, whereas faults in main busbar systems are quite rare.

Thermo-graphic inspection and supervision can be done in two ways:

- Temporary inspection by means of an IR camera through an appropriate inspection window
- Continuous supervision by means of IR sensors located inside the switchgear

The first system (temporary inspection) requires an IR camera and an inspection window for each compartment to be supervised.

The second system (continuous supervision) requires the continuous thermal monitoring.

This is a non-touch temperature monitoring system based on IR temperature probes connected to a central unit (up to 8 sensors can be plugged in to each central unit).

Due to the switchgear design constraints, the main busbar Thermo-graphic inspection can only be carried out using the continuous thermal monitoring system.

The power cables can be supervised with both solutions.

With regard to UniGear ZS1 double Level, we can point out that due to the switchgear design constraints, both the main busbar and the power cables thermo-graphic inspection can only be carried out using the continuous thermal monitoring system.



Marine applications

Typical units

The required units, which are not part of the standard design, are described here below.

Earthing transformer units

From the electrical point of view, marine plants are based on isolated networks (isolated neutral point).

The main consequences are as follows:

- The network can be operated with single-phase earth fault
- Earth fault detection is very difficult, due to the very low earth fault current

In order to increase this and therefore allow releases to operate on single-phase earth faults, two solutions can be used:

- Connecting the secondary winding of the generator to ground by means of a resistor
- Installing an earthing transformer in the network

For this reason, the UniGear ZS1 range must be enhanced with two addition typical units:

- ME: Busbar metering unit with earthing transformer feeder
- RE: Rise with earthing transformer feeder

In the case of switchgear with a single busbar section, ME can be used for this purpose; in the case of switchgear equipped with two busbar sections, both ME and RE units must be used, in order to cover all the schemes.

Additional features of Measurement and Riser units

Out of choice, M and R units should be equipped with fixed Voltage Transformers instead of withdrawable VT's with fuses.

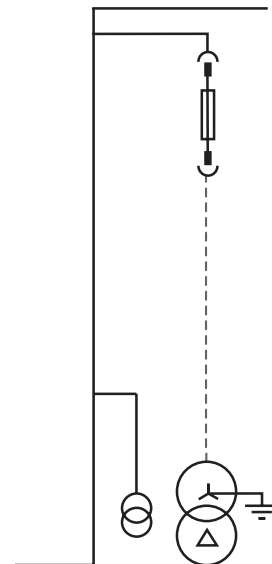
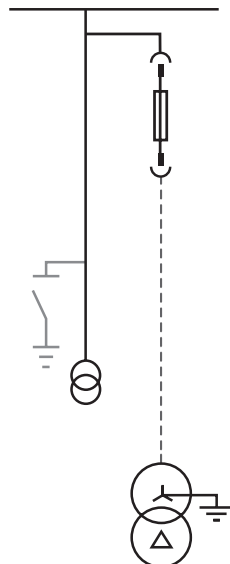
In this configuration the "apparatus compartment", where is placed the VT's truck, will be used as an additional auxiliary compartment. It is fully segregated from the power compartments with metallic partitions and designed as a low voltage compartment with respect to the safety rules.

The inside rear and side walls of the compartment is fitted with the grid plate for fixing the auxiliary equipment.

This will be equipped with the relevant left-hand side duct for wiring entry from the bottom and exit to the top-mounted Low voltage compartment.

ME – Metering with earthing transformer

RE – Bus Riser with metering and earthing transformer



| Units: 7.2 - 12 kV - ... 31.5 kA | | | | | |
|---|------------------|------|------|------|------|
| Unit width [mm] | 650 | | | | |
| Unit depth [mm] | 1650 | | | | |
| Rated current [A] | 630 | 1250 | 1600 | 2000 | 2500 |
| IF Incoming/outgoing feeder ⁽¹⁾ | x ⁽³⁾ | x | | | |
| IFM Incoming/outgoing feeder with measurement ⁽¹⁾ | x ⁽³⁾ | x | | | |
| | | | | | |
| Unit width [mm] | 650 | | | | |
| Unit depth [mm] | 1340 | | | | |
| Rated current [A] | 630 | 1250 | 1600 | 2000 | 2500 |
| IF Incoming/outgoing feeder ⁽²⁾ | x ⁽³⁾ | x | | | |
| BT Bus-tie | | | | | |
| R Riser | | x | | | x |
| RE Riser with earthing transformer | | x | | | x |
| RM Riser with measurement | | x | | | x |
| M Measurement | x | | | | |
| ME Measurement with earthing transformer | x | | | | |

| Units: 7.2 - 12 kV - ... 40-50 kA | | | | | | | | | | | | | |
|--|------------------|-------|------|------|------|-------|------|-------|------|------|------|-------|-----------|
| Unit width (mm) | 650 | 800 | | | | | | 1 000 | | | | | |
| Unit depth (mm) | 1 650 | 1 650 | | | | 1 700 | | 1 650 | | | | 1 700 | |
| Rated current (A) | 400 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 630 | 1250 | 1600 | 2000 | 2500 | 3150 4000 |
| IF Incoming/outgoing feeder ⁽¹⁾ | x ⁽³⁾ | x | x | x | | | | | | | x | x | x |
| IFM Incoming/outgoing with measurement ⁽¹⁾ | x ⁽³⁾ | x | x | x | | | | | | | x | x | x |
| | | | | | | | | | | | | | |
| Unit width (mm) | 650 | 800 | | | | | | 1 000 | | | | | |
| Unit depth (mm) | 1 340 | 1 340 | | | | 1 390 | | 1 340 | | | | 1 390 | |
| Rated current (A) | 400 | 1250 | 1600 | 2000 | 2500 | 3150 | 4000 | 630 | 1250 | 1600 | 2000 | 2500 | 3150 4000 |
| IF Incoming/outgoing feeder ⁽²⁾ | x ⁽³⁾ | x | x | x | | | | | | | x | x | x |
| BT Bus-tie | | x | x | x | | | | | | | x | x | x |
| R Riser | | x | x | x | x | x | x | | | | | | |
| RE Riser with earthing transformer | | x | | | x | x | x | | | | | | |
| RM Riser with measurement | | x | | | x | x | x | | | | | | |
| M Measurement | x | | | | | | | | | | | | |
| ME Measurement with earthing transformer | x | | | | | | | | | | | | |

(1) Bottom and top cable entry

(2) Bottom cable entry

(3) Up to 50 kA with vacuum contactor

LSC Classification for each UniGear ZS1 marine single busbar panel type

| Units: 7.2 - 12 kV - ... 31.5 kA | | |
|--|--------------------|--|
| Panel type | LSC Classification | |
| IF Incoming/outgoing feeder | LSC2B | |
| IFM Incoming/outgoing feeder with measurement | LSC2B | |
| BT Bus-tie | LSC2B | |
| R Riser | LSC1 | |
| RE Riser with earthing transformer | LSC1 | |
| RM Riser with measurement | LSC2 | |
| M Measurement | LSC2 | |
| ME Measurement with earthing transformer | LSC2 | |

| Units: 7.2 - 12 kV - ... 40-50 kA | | |
|--|--------------------|--|
| Panel type | LSC Classification | |
| IF Incoming/outgoing feeder | LSC2B | |
| IFM Incoming/outgoing feeder with measurement | LSC2B | |
| BT Bus-tie | LSC2B | |
| R Riser | LSC1 | |
| RE Riser with earthing transformer | LSC1 | |
| RM Riser with measurement | LSC2 | |
| M Measurement | LSC2 | |
| ME Measurement with earthing transformer | LSC2 | |

Note: All panel variants defined with PM partition class

Marine applications

UniGear ZS1 Double Level

UniGear ZS1 is also available as single busbar system in the double level configuration. Each panel consists of two completely independent superimposed units and is functionally identical to two single-level units placed side by side. Thanks to the numerous standard units available, the switchgear can be suitably configured to satisfy all installation requirements. Each unit can be equipped with circuit-breakers or contactors, as well as with all the accessories available for UniGear ZS1 single level units.

All the significant components are identical to those used for the single-level units and therefore the same service and maintenance procedures are guaranteed.

The UniGear ZS1 double level switchgear is mainly distinguished by its efficient use of space. All the configurations allow a drastic reduction in the space occupied, with special regard to the width of the switchgear (30...40% less in typical configurations).

Its use is recommended in installations with a high number of feeders, fitted with either circuit-breakers or contactors.

It can be used as a motor control center for applications up to 12 kV.

All the electrical characteristics of the double and single level units are identical.

The overall rated current of the busbar system is given by the sum of the currents of the two top and bottom half-busbars. The double-level units can be coupled directly to single-level units, with the possibility of extension on both sides of the switchgear. *

The switchgear requires access from the rear for the installation and maintenance procedures, while all the service operations are carried out from the front.

The UniGear ZS1 double level switchgear can be used in two typical configurations:

- Complete with double-level
- Compound with simple and double-level

The complete solution only uses double level panels to realise all the standard units: incoming feeders, bus-tie, riser, busbar measurement and outgoing units.

The compound solution in contrast, uses both the simple and double level solution: the former for the incoming feeders, bus-tie and riser compartments, the latter for the busbar measurement and outgoing units.

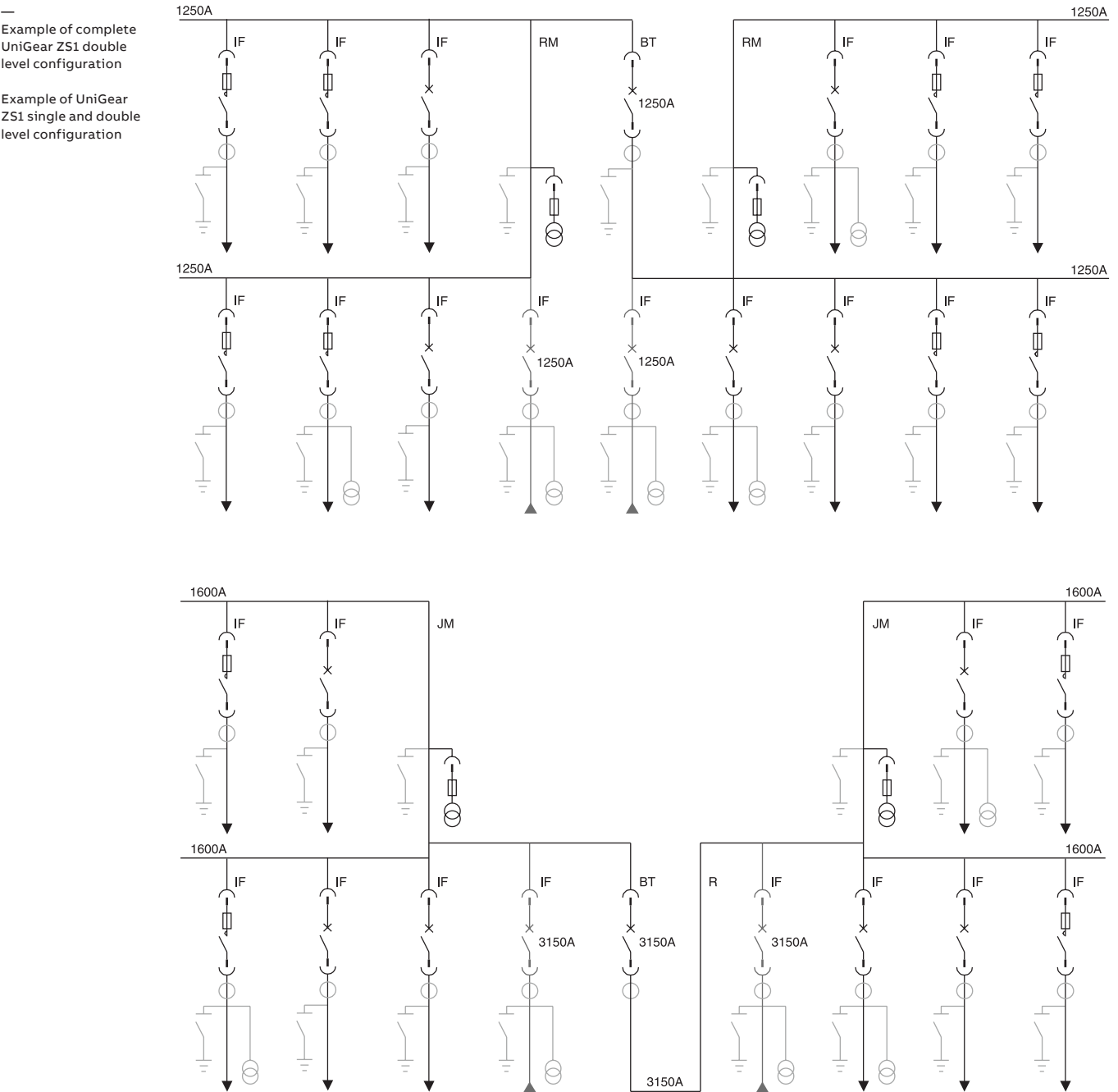
The complete double level solution makes it possible to achieve the maximum reduction in installed dimensions and can be used for relatively limited rated currents (1600 A maximum current of the incoming feeders). It is normally used to construct local distribution switchgear, with a limited number of outgoing feeders.

The field of application of the compound solution is aimed at main distribution switchgear, with high rated currents (3150 A maximum current of the incoming feeders) and numerous outgoing feeders.

* Contact ABB representative for specific details to enable extension on site.

| IEC electrical characteristics | | | | |
|---|--------------|-----------|-----------|----------|
| Rated voltage | [kV] | 7.2 | 12 | 17.5 |
| Rated insulation voltage | [kV] | 7.2 | 12 | 17.5 |
| Rated power frequency withstand voltage | [kV / 1 min] | 20 | 28 | 38 |
| Rated lightning impulse withstand voltage | [kV] | 60 | 75 | 95 |
| Rated frequency | [Hz] | 50 / 60 | 50 / 60 | 50 / 60 |
| Rated short-time withstand current | [kA / 3 s] | ...50 | ...50 | ...40 |
| Peak current | [kA] | ...125 | ...125 | ...105 |
| Internal arc withstand current | [kA / 1 s] | ...40 | ...40 | ...40 |
| | [kA / 0.5 s] | ...50 | ...50 | ...50 |
| Main busbar rated current | [A] | ... 1 600 | ... 1 600 | ...1 600 |
| Circuit-breaker rated current | [A] | ... 1 600 | ... 1 600 | ...1 600 |

GB/DL version is available with higher request in dielectric characteristics (42 kV) and short time withstand current (4 s).
The values indicated are valid for both vacuum and SF6 circuit-breaker.
For panel with contactor the rated current value is 400 A.



Marine applications

UniGear ZS1 Double Level

Compartments

Each panel consists of two superimposed units [1st level and 2nd level] and each unit is therefore made up of three independent power compartments: apparatus, busbar and cable. There is metallic segregation between all the compartments.

In its middle part, the panel is fitted with a compartment to accommodate the auxiliary instruments of both the units.

This solution means the apparatus interfacing with the user is at a convenient height. In the top part of the panel, an additional compartment is available to house any further instruments provided.

The arc-proof switchgear is normally fitted with a duct for evacuation of the gases produced by an arc.

Each compartment of the unit placed on the 2nd level is fitted with a flap on the top surface. The pressure generated by the fault makes this open, allowing the gas to pass into the duct. The gases produced by faults generated in the power compartments of the unit placed on the 1st level are evacuated towards the main duct by means of a dedicated duct placed laterally to the switchgear. Each compartment of the switchgear panel placed on the 1st level is fitted with a flap positioned on the side of the switchgear. The pressure generated by the fault makes this open, allowing the gas to pass into the duct. This solution means the units placed on the 2nd level are not affected by this fault.

The apparatus compartments are accessible from the front.

Door closing of these compartments is available in two versions, with screws or central handle.

Removal of the apparatus from the switchgear (circuit-breakers, contactors and measurement truck) placed on the two levels and from its relative compartments, takes place by means of a single dedicated fork-lift truck. This truck can also be used for the same procedures for the single level units.

The busbar and cable compartments are accessible from the rear of the switchgear by means of removable panels.

All the normal service operations are carried out

from the front, whereas maintenance and start-up operations also require access from the rear of the switchgear.

The characteristics of the busbar system, branch connections, earthing busbar, earthing switch, insulator bushings and shutters are the same as those for the single level units.

A maximum of six single or three-core cables per phase can be used depending on the rated voltage, on the switchgear panel dimensions and on the cross-section of the cables.

Configurations

The typical switchgear panels available allow the most suitable configurations for the installation requirements.

The incoming/outgoing feeder panel [IF] is the most widely used: both switchgear levels consist of units of this type and can be used both as incoming and outgoing feeders.

The bus-tie [BT] and riser [R] units are used to arrange complete double-level switchgear configuration.

These units are positioned on the 2nd level, whereas the incoming/outgoing feeder units are included in the 1st level.

The bus-tie units can be fitted with current transformers on the load side of the circuit-breaker for busbar measurement.

Installation of the current transformers on the supply side is also possible to realise special protection schemes. The riser compartment is also available in the version with withdrawable instrument truck with voltage transformers with fuses [RM].

The mixed configuration with single and double level requires connection between the two sections of switchgear by means of the connection unit. This unit makes all the connections between the two types of switchgear (busbars, earthing busbar, gas exhaust duct, ducts for connection of the auxiliary circuits) and can integrate the earthing switch of the busbars [J] and also the withdrawable instrument truck with voltage transformers with fuses [JM]. These units are positioned on the 2nd level, whereas the incoming/outgoing feeder units are included on the first level.

| Units: ... 12 kV - ... 50 kA | | | | | | LSC Classification | |
|-----------------------------------|-----|-----------------------------|----------------------|----------|--------|--------------------|--------|
| Depth (mm) | | | 1 976 | | | | |
| Height (mm) | | | 2 700 ⁽¹⁾ | | | | |
| Height with gas exhaust duct (mm) | | | 2 700 ⁽¹⁾ | | | | |
| Width (mm) | | | 750 | 750 | 900 | 900 | |
| Rated short-time current (kA) | | | ... 31.5 | ... 31.5 | ... 50 | ... 50 | |
| Rated current (A) | | | 630 | 1 000 | 1 250 | 1 600 | |
| 2 nd | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | B T | Bus-tie | | x | x | x | No LSC |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | R | Riser | | x | x | x | LSC1 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | R M | Riser with measurement | | x | x | x | LSC2 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | J | Connection | | 1 250 A | x | x | LSC1 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | J M | Connection with measurement | | 1 250 A | x | x | LSC2 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |

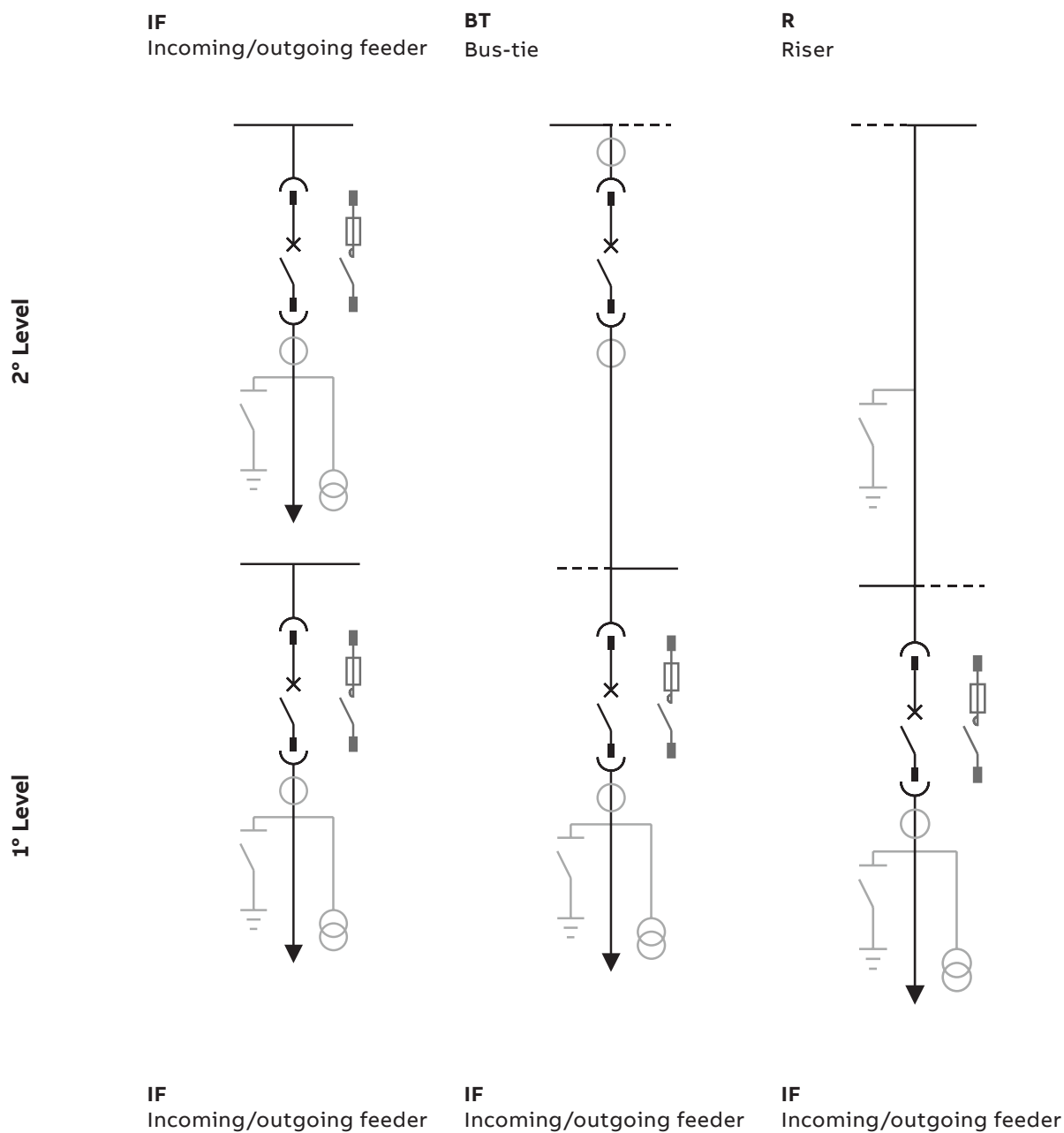
| Units: ... 17.5 kV - ... 40 kA | | | | | | LSC Classification | |
|-----------------------------------|-----|-----------------------------|----------------------|----------|--------|--------------------|--------|
| Depth (mm) | | | 1 976 | | | | |
| Height (mm) | | | 2 700 ⁽¹⁾ | | | | |
| Height with gas exhaust duct (mm) | | | 2 700 ⁽¹⁾ | | | | |
| Width (mm) | | | 750 | 750 | 900 | 900 | |
| Rated short-time current (kA) | | | ... 31.5 | ... 31.5 | ... 40 | ... 40 | |
| Rated current (A) | | | 630 | 1 000 | 1 250 | 1 600 | |
| 2 nd | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | B T | Bus-tie | | x | x | x | No LSC |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | R | Riser | | x | x | x | LSC1 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | R M | Riser with measurement | | x | x | x | LSC2 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | J | Connection | | 1 250 A | x | x | LSC1 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |
| | | | | | | | |
| 2 nd | J M | Connection with measurement | | 1 250 A | x | x | LSC2 |
| 1 st | IF | Incoming/outgoing | x | x | x | x | LSC2B |

(1) The height of the switchgear in the mixed configuration with single and double level is the same as that of the double level unit

Note: All panel variants defined with PM partition class

Marine applications

UniGear ZS1 Double Level



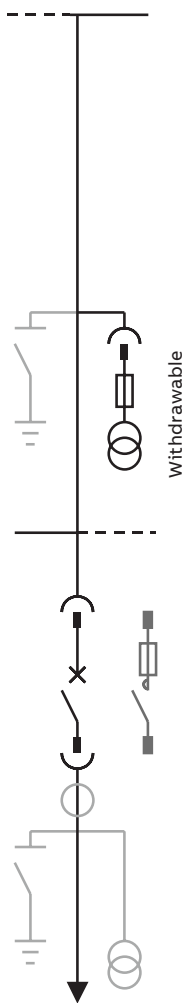
Key to components

— Standard components

— Accessories

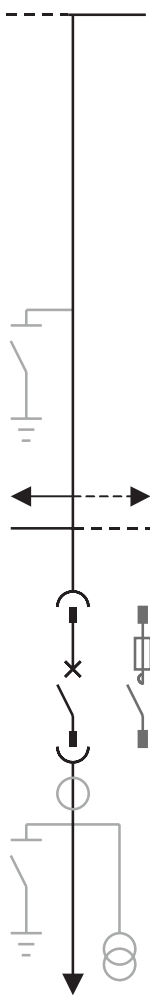
— Alternative solutions

RM
Riser with measurement



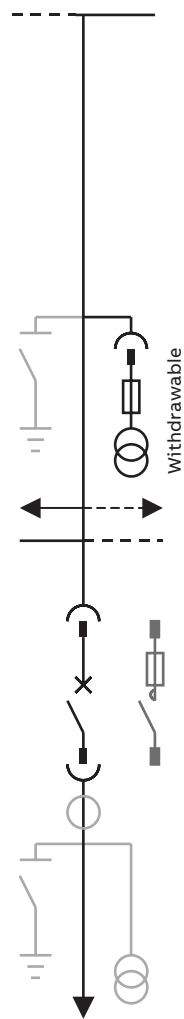
IF
Incoming/outgoing feeder

J
Connection unit



IF
Incoming/outgoing feeder

JM
Connection unit with measurement



IF
Incoming/outgoing feeder



—

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