ABB MV switchgears
Unigear ZS1 - air insulated switchgear for 12-17.5 and 24kV
Unigear ZS1 – the basic description
The switchgear solution

- Integrated station automation COM600
- Horizontal communication via IEC61850-8-1
- Withdrawable design
- Unigear ZS1 switchgear ready for remote control IEC62271-200 design, LSC2B-PM
Unigear ZS1 – the basic description
Design of a typical functional unit

- Low voltage compartment
- Busbar compartment – tool based access for maintenance; ready for future extensions
- LSC2B-PM
  Metal enclosed, standard class IP3XD* or IP4X
  Internal metallic partitioning IP2X
- Circuit breaker compartment – interlock-controlled access (can be combined also with procedure-based access)
- Cable compartment – interlock-controlled access (can be combined also with procedure-based access)
Unigear ZS1 – the basic description
Safety first

- System of safety mechanical interlocks preventing hazardous access to HV compartments and dangerous operation

- Additional electrical interlocks available via blocking coils (no-voltage check before the E/S operation, CB movement blocking coil, CB operation blocking coil, ...)

- Key-locking system available on request
Unigear ZS1 – the basic description
Designed and type tested as per IEC standards

Type tested as per IEC62271-200:
- Insulation level
- Temperature rise test
- Peak and short time withstand currents
- Making and breaking capacities of the switching devices
- Functional test
- Protection of persons against access to hazardous parts and entry of solid foreign objects
- Internal Arc Classification
- EMC test (on typical layout and wiring)
Service continuity ...
Service continuity

Safe only access and flexibility ...

- Especially in some industrial and petrochemical applications, the service continuity belongs to the key features
- The service continuity and conditions for accessibility are key aspects in top-down approach for switchgear selection
Unigear ZS1 – the basic description
The categories for Loss of service continuity

LSC2B - PM
- Segregated switchgear units (except for the main busbar)
- The unit can be disconnected from the main busbar (LSC-2A)
- The unit can be also disconnected from its cable compartment (LSC-2B)
Internal arc classified ...
Unigear ZS1- safety aspects
Internal arc withstand capability

An internal arc can be caused by:

- Wrong sequence of the switchgear operation
- Internal failure of a switchgear component
- Flashover caused by an internal insulation failure

Unigear ZS1 panels provides maximal protection with safety interlocking system and internal arc withstand capability
Unigear ZS1- safety aspects
Internal arc classification – IEC62271-200

Five criterions for the IAC classification:

1. Correctly secured doors and cover do not open
2. No fragmentation of the enclosure occurs within the test time
3. Arcing do not cause holes in the accessible sides, up to height of 2m
4. Indicators do not ignite due to effect of hot gases
5. The enclosure remains connected to its earthing point
Unigear ZS1- safety aspects
Arc time duration – influence on the damage level

- Internal arc duration has influence on the level of damage, generally:
  - >500ms – severe damage
  - <100ms – small damage
  - <35ms – subtle damage

- The switchgear withstand duration shall be stated by the manufacturer

- Recommended standard values for the tests are 1s, 0.5s and 0.1s (IEC62271)

- Unless stated otherwise, Unigear ZS1 panels are type tested for 1s
Unigear ZS1- safety aspects
Accessibility class IAC AFLR

- Unigear ZS1 is designed and tested for accessibility class IAC AFLR
  - A – authorized personnel only
  - F, L, R – front, lateral and rear side
- Arc proof installation shall always consider all the aspects from the overall installation point of view (switchgear room)
Unigear ZS1- safety aspects
Gas exhaust protection covers

- From safety reasons, most of the installations require use of additional protection covers above the switchgear
- The application of the covers depends on the ceiling height, rated arcing current and arc time duration
- Alongwith the protection covers, detectors for rapid fault clearance times are used with Unigear ZS1
First type are Gas exhaust channels with outlets, leading the gasses away from the switchgear room.

- The most robust solution, tested up to 50kA/1s.
- Requires to be considered in the civil works (wall openings and its direction, the outlet channels).
- Used also when a higher IP class is required (up to IP53).

Gas exhaust channels for full IAC protection.
Second type are protection covers with top chimneys, without need for outlets from the room.

- The solution is tested up to 50kA/0,5s
- In smaller rooms, pressure calculation is recommended
- Used also when a higher IP class is required (up to IP43)
Unigear ZS1- safety aspects
Detectors for rapid fault clearance – pressure switches

Option:
Application of overpressure sensors inside the panels

Basic level:
auxiliary switches on the pressure release flaps

Arc detection within 100ms plus direct CB trip (40-60ms)
Unigear ZS1- safety aspects

Detectors for rapid fault clearance – optic sensors

Advanced level: arc-protection set REA with optic sensors and relay unit

arc detection within 2.5ms plus direct CB trip (40-60ms)
Unigear ZS1- safety aspects
Internal arc caused by dangerous operations

Mechanical interlocks:

CB rack-in/out allowed with open CB only

CB rack-in/out allowed only with closed front doors

Blocked CB closing in the interposition

Remote control for CB ON/OFF,
Remote control for Rack IN/OUT (if motorized truck used)
Remote control for E/S ON/OFF (if motorized E/S used)
Unigear ZS1 production portfolio overview
Unigear ZS1
The production portfolio overview

- Unigear ZS1 (12-17,5kV and 24kV)
  - Standard single busbar version
  - Double Level
    - Double BusBar – one CB and two line disconnectors
- Unigear 550 (12-17,5kV)
- Unigear 500R (12-17,5kV)
- ZVC slim motor control centre (7,2kV)
- Is limitor (12-17,5kV and 24kV)
Unigear ZS1
MV AIS 12-17,5kV and 24kV
Back to wall installation

- Maintenance and service operations performed from the front
- Front access to all the compartments (apparatus, busbars, cables)
- Comfortable front cables access.
UniGear switchgear fixed on the skid
### Unigear ZS1
**Technical parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>12</th>
<th>17.5</th>
<th>24</th>
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<tbody>
<tr>
<td>Rated voltage</td>
<td>[kV]</td>
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<tr>
<td>Test voltage (50-60 Hz/1 min)</td>
<td>[kV]</td>
<td>28 &lt;sup&gt;1&lt;/sup&gt;</td>
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<tr>
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<td>2500</td>
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<td></td>
<td></td>
<td>4000 &lt;sup&gt;2&lt;/sup&gt;</td>
<td>4000 &lt;sup&gt;2&lt;/sup&gt;</td>
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<tr>
<td>Internal arc withstand current</td>
<td>[kA]</td>
<td>Up to 50</td>
<td>50</td>
<td>31.5</td>
</tr>
</tbody>
</table>

1. 42kV for GOST applications with insulation class B
2. With cooling fan
3. Note: the panels equipped with contactors or disconnector switches are limited by parameters of these devices
UniGears ZS1 - Single busbar system

Circuit breaker units
- W=650mm  630-1250A …31.5kA
- W=800mm  1250-2000A …50kA
- W=1000mm 2500-4000A …50kA

Fused vacuum contactor units up to 12kV
- W=650mm  400A …50kA

All units
- H=2200mm (2675mm with exhaust gas duct)
- D=1340/1390(¹)-1700(²)mm Bottom entry
- D=1650/1700(¹)mm Bottom(³) & top entry
- D=2170mm Bottom(³) & top entry

(1) 1390mm for 12/17.5kV at 3150-4000A
(2) 1700mm for 24kV
(3) With additional features
Unigear ZS1
Standard units SBB – Incomer, Outgoing

- Withdrawable circuit breaker
- Dedicated earthing switch with making capacity
- Customizable control cabinet, always fit to the application
- Available also with withdrawable cable VT, optional busbar CT and many other features ...
Unigear ZS1
Deep units SBB – Incomer, Outgoing

- Applications demanding use of 2 sets of CTs/VTs, for example with a dedicated CT for differential protection
- Applications demanding high number of cables per phase
- Applications demanding connection of the power cables from top side
- Can be combined with standard units into one switchgear
UniGear Double level system

- UniGear ZS1 double level
- UniGear ZS1 double level duplex.
UniGear ZS1 double level / double level duplex

Electrical characteristics

<table>
<thead>
<tr>
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<tr>
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<td>Rated current branch connection</td>
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<tr>
<td></td>
<td></td>
<td>1600</td>
<td>1600</td>
<td>1600</td>
</tr>
</tbody>
</table>
UniGear ZS1 double level

Circuit-breakers units
- W=750mm  630-1000A  ...31,5kA
- W=900mm  1250-1600A  ...50kA

Fused vacuum contactor units up to 12kV
- W=750mm  400A  ...50kA

All units
- H=2700mm
- D=1976mm  Bottom & top entry
UniGear ZS1 double level

Section view

- Gas duct
- Cables compartment
- Busbar compartment
- Auxiliary compartment
- Apparatus compartment
UniGear ZS1 double level / double level duplex

Compound configuration with single and double level units

Full single line diagram
Unigear ZS1
The main components used in SBB and DBB units

Unigear ZS1 panels are available complete with the latest ABB technologies

- Vacuum and SF6 circuit breakers
- Vacuum contactors
- CTs, VTs and sensors
- Protection relays
- Earthing switch
- Surge arresors
- Cable termination kits
The main components of Unigear ZS1 Apparatus – circuit breakers 12-17.5 and 24kV

- **VD4** – unique ABB vacuum technology with embedded sealed-for-life poles, spring actuator for 30,000 operations
- **VM1** – unique ABB vacuum technology with embedded sealed-for-life poles, magnetic actuator for up to 100,000 operations
- **HD4** – SF6 technology, suitable for applications sensitive to dielectric and dynamic stresses, capacitor banks etc.
The main components of Unigear ZS1 Apparatus – vacuum contactors 7, 2 and 12kV

- V-contact VSC – fused contactor with permanent-magnet actuator, single or double command version, suitable for high number of hourly operation

- V-contact V (abandoned) – contactor with electro-magnetic actuator, single command version (electrical latching) or double command version (mechanical latching)
The main components of Unigear ZS1
Measurement – Current transformers

- Cast epoxy resin, supporting type TPU 4, 5, 6 – used for currents ≤ 2500A, with optional capacitive sensor for CPI
- Cast epoxy resin, ring type KOKS – used for high currents in panels ≤ 4000A
- Optional use of types KORI and BD – LV ring CTs installed on insulated primary conductor for MV (12-17,5kV)
- Alternative installation also as busbar CT (TPU type)
The main components of Unigear ZS1
Measurement – Core balance Current transformers

- Ring types of KOLMA/KOLA family
- Reconnectable or split-types available
- Methods of the CBCT installation:
  - Separately, bellow the switchgear panel
  - Inside the cable compartment (if allowed by distances)
  - Inside in a special bottom-mounted cable box
The main components of Unigear ZS1
Measurement – Voltage transformers (cable side)

- Cast epoxy resin type TJC 4, 5, 6 – single pole, fixed without fuse (standard)
- Cast epoxy resin type TJP 4, 5, 6 – single pole with HV fuse, mounted on VT truck
- Double pole VTs can be mounted in some special cases
- Auxiliary VT for aux. power supply can be used, if needed (for Self-powered substations without DC systems)
The main components of Unigear ZS1 Measurement – Voltage transformers (busbar side)

- Cast epoxy resin type TJC 4, 5, 6 – single pole, fixed without fuse in separate top-mounted box
- Cast epoxy resin type TJP 4, 5, 6 – single pole with HV fuse, VT truck in Apparatus compartment
The main components of Unigear ZS1 Measurement – Electronic transformers (sensors)

- Replacement for conventional inductive CTs and VTs with one current sensor (Rogowski coil) and voltage detector
- KEVCD – light weight current and voltage combisensor with optional capacitive sensor for CPI
- Linear response, designed for use with ABB relays REF
- Low energy output – reduced cost of ownership!
The main components of Unigear ZS1 Measurement – Electronic transformers (sensors)

- Conventional inductive Instrument Transformers consume significant amount of energy, and thus contribute to power losses in substation in significant way
- Sensor technology dramatically reduces energy consumption of Switchgear and its total cost of ownership
The main components of Unigear ZS1 Protection relays and IEDs

- REF 542+ feeder terminals (IEDs) for protection, control, measurement and supervision, including power quality
- Interactive mimic diagram
- PLC functions for automation and sequence logic functions
- Excellent for use with ABB combisensors KEVCD
- Variety of communication standards, including IEC 61850; available as Webserver
The main components of Unigear ZS1 Protection relays and IEDs

REF 541, 543, 545
Suitable for switchgear with single busbar, double busbar and duplex systems
REM 543, 545
Machine protection terminal
RET 541, 3, 5
Transformer protection

- REF 541/3/5 feeder terminals (IEDs) for protection, control, measurement and supervision
- Interactive mimic diagram
- PLC functions for automation and sequence logic functions
- Excellent for use with ABB combisensors KEVCD
- Variety of communication standards, including IEC 61850 via SPA-ZC 400
The main components of Unigear ZS1 Protection relays and IEDs

**REX 521**
Suitable for single busbar switchgear, incoming/out-going or motor feeder

- REX 521 feeder relay for protection, measurement and supervision
- Excellent for use with ABB combisensors KEVCD
- Variety of communication standards, including IEC 61850 via SPA-ZC 400
The main components of Unigear ZS1 Protection relays and IEDs

COM 600
Station automation device, all-in-one communication gateway and user interface for utility and industrial distribution substations

- IEC 61850 gateway connectivity between substation IEDs and network-level control and management systems
- Flexible platform for substation-level automation tasks
- Web technology, access via a web browser as the human machine interface (HMI)
The main components of Unigear ZS1

Surge arrestors

- Additional protection against overvoltages in the network
- The surge arrestors are placed in cable compartment, instead of one position of the cable connections
- There are used ABB surge arrestors of type MWD in Unigear ZS1 panels
The main components of Unigear ZS1
Cable termination kits

Recommended cable terminations kits for Unigear ZS1:

- ABB type SOT 12-36kV indoor for 1-core or 3-core XLPE cables, for standard applications

- ABB type APIT 12-36kV indoor for 1-core or 3-core XLPE cables, for extremely high demands (polluted areas etc.)
Unigear 550
MV AIS 12-17,5kV
Unigear 550
Basic information

- 12-17.5kV panels available up to 1250A and STC 31.5kA
- Simple and compact panels for lower ratings, developed from and directly connectable with Unigear ZS1
- Perfectly suitable for common distribution applications as MV/LV substations, etc.
# Unigear 550
## Technical parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated voltage</td>
<td>kV</td>
<td>12</td>
<td>17.5</td>
</tr>
<tr>
<td>Test voltage (50-60 Hz/1 min)</td>
<td>kV</td>
<td>28</td>
<td>38</td>
</tr>
<tr>
<td>Impulse withstand voltage</td>
<td>kV</td>
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<td>95</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>Hz</td>
<td>50-60</td>
<td>50-60</td>
</tr>
<tr>
<td>Rated current of the main busbars</td>
<td>A</td>
<td>Up to</td>
<td>4000 1)</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>kA</td>
<td>Up to</td>
<td>31.5</td>
</tr>
<tr>
<td>Peak withstand current</td>
<td>kA</td>
<td>Up to</td>
<td>80</td>
</tr>
<tr>
<td>Rated circuit-breaker thermal current</td>
<td>A</td>
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<td>630</td>
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<tr>
<td></td>
<td></td>
<td>1250</td>
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</tr>
<tr>
<td>Internal arc withstand current</td>
<td>kA</td>
<td>Up to</td>
<td>31.5</td>
</tr>
</tbody>
</table>

1. Only in combination with Unigear ZS1 panels
Unigear 550
Standard units SBB – Incomer, Outgoing, BT, M

- Space-effective solution, 550mm wide panel with withdrawable circuit breaker
- Dedicated earthing switch with making capacity
- Customizable control cabinet
- Directly connectable with Unigear ZS1
Switchgear units produced by other ABB factories
Unigear ZVC - slim MCC up to 7,2kV

- Compact 325mm motor control unit with fused vacuum contactor, produced by ABB Australia
- Suitable as motor feeders for power plants, industry, ...
- Directly connectable with Unigear ZS1
- Up to Ir=400A and STC 50kA
- Electrical life of the contactor 100,000 operations (closing-opening)
Switchgear units produced by other ABB factories
Is Limiter panel 12-24kV

- Solution for switchgear applications with high STC ratings
  – protection by Is Limiter panel produced by ABB Germany

- Directly connectable with Unigear ZS1

- The device consists of main conductor (Ir ≤ 4000A) with
  fast switch and high rupturing capacity fuse in parallel

- Short-circuit current limited at the first rise, in less than
  1ms
Unigear ZS1 – interbay and upstream communication

Horizontal interpanel communication - GOOSE

Communication bus, IEC618650-8-1 multicast messaging, data shared across the IEDs

Faster transfer of signals between IEDs than with the conventional wiring

Flexibility - programming is independent of wiring
Unigear ZS1 – interbay and upstream communication
Step 2: Integrated station automation COM600

- Integrated station automation (industrial computer) COM600
  - station computer as control and monitoring unit
  - webserver with own IP address
  - communication gateway between the switchgear IEC 61850 and upper systems
- Compact and robust design with IP44, suitable for installation into Unigear ZS1 switchgears
Switchgear healthy monitoring systems
Unigear ZS1 – switchgear healthy monitoring systems
Continuous overheating supervision – Sensycal

ABB Sensycal unit
up to 12 IR sensor units
MODBUS output

Main busbar system

Power cables terminations
Unigear ZS1 – switchgear healthy monitoring systems
Provision for periodic thermal inspection via IR camera

Power cables terminations

Inspection windows for portable IR camera
Unigear ZS1 in switchgear rows
Busbar bridges
Busbar bridges for Unigear ZS1

Principles of usage

- Busbar ducts are an alternative solution for cases, when the connection can not be achieved by power cables

- Typical applications
  - Long switchgear as primary stations, bridges help to reduce the switchgear room size
  - Rings inside building complex
In principle, there are 2 basic ways of the interconnection:

- Direct busbar interconnection, without coupling CB
- Busbar interconnection with bus CB coupler in (at least) one of the interconnecting panels.

In the second case, additional 500mm rear-mounted box is needed in order to loop the connection back to the top.
## Busbar bridges for Unigear ZS1

### Electrical parameters

<table>
<thead>
<tr>
<th>Busbar duct type</th>
<th>A</th>
<th>B</th>
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<tbody>
<tr>
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<td>Rated power frequency withstand voltage</td>
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<td>Rated lighting impulse withstand voltage</td>
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**Panel width 650mm**

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<tr>
<th></th>
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<tbody>
<tr>
<td>Rated current of busbars</td>
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<tr>
<td>Rated dynamic current ¹)</td>
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**Panel width 800mm**

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</tr>
<tr>
<td>Rated dynamic current ¹)</td>
<td>80/125</td>
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<tr>
<td>Rated short-time withstand current 3 s ¹)</td>
<td>31.5/50</td>
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**Panel width 1000mm**

<table>
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<tr>
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<td>Rated current of busbars</td>
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<tr>
<td>Rated dynamic current ¹)</td>
<td>80/125</td>
</tr>
<tr>
<td>Rated short-time withstand current 3 s ¹)</td>
<td>31.5/50</td>
</tr>
</tbody>
</table>

### Notes:

1. For the rated dynamic and short time current, the particular busbar ducts are designed in compliance with design rules for Unigear ZS1 panels of the same parameters.

2. Busbar ducts rated 4000A requires forced ventilation.
Busbar bridges for Unigear ZS1
Standardized and customized ducts

- Classification (internal):
  - Standardized (modular) busbar ducts for applications front-to-front with an aisle width from 1800 to 3000mm
  - Customized, design-to-order for a particular project: Side-by-side, Back-to-back, special arrangements...
Busbar bridges for Unigear ZS1
Modular concept for the standardized ducts

Basic structure of the standardized modular duct:
- Two corner coupling modules bolted to the swg. frame
- Two fixed outer modules bolted to the corner modules
- One central module, put over the fixed outer modules and fixed as per the exact aisle width
Busbar bridges for Unigear ZS1
Construction of the standardized ducts

- Frame/Enclosure modules made of AlZn coated steel sheets (Ir ≤ 2500A) or as a combination of AlZn with stainless steel and aluminum sheets (influence of magnetic currents at Ir = 3150A and 4000A)

- The main busbar system is made of flat copper profiles, with single (Ir ≤ 1250 A), double (Ir ≤ 2500 A) or triple (Ir ≤ 4000 A) profile
Busbar bridges for Unigear ZS1
The aisle width

The distance is measured from the front panel **frame** edges

Even for the modular bridges, the aisle width is an important information, which shall be confirmed before the production release.
Unigear ZS1 as a switchgear pre-assembled on frame
Unigear ZS1 as a switchgear on frame
Switchgear panels supplied in pre-assembled blocks

- Pre-assembled „switchgear blocks“ of Unigear ZS1 panels on a supporting frame
- Excellent for cases when site services and labour cost are very high
- Reduced installation time, fast track energization

Two delivery options:
- Complete switchgear on common frame, typically up to 10 panels
- Pre-assembled switchgear blocks per 3-4 panels
Power and productivity for a better world™