Medium Voltage Switchgear and Switches

Medium Voltage Switchgear up to 24 kV, 630 A SF₆-insulated, Non-extensible Ring Main Unit

Type: GA, GA...-C
**Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C**

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Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

**General/Description**

**Advantages of SF₆-insulated switchgear in block construction**

With switchgear of Type GA and GA...-C, the Ormazabal Systems Division meets the following requirements of its customers.

- ✔ Climatic resistance
- ✔ Maintenance-free concept with SF₆-pressurised containers as a hermetically sealed pressure system
- ✔ Minimum space requirement
- ✔ Comprehensive personnel protection
- ✔ Great reliability of supply
- ✔ Conventional mode of operation
- ✔ Cable connection for cable plug system
- ✔ Great electrical and mechanical reserves
- ✔ Easy to integrate into existing networks
- ✔ Easy combination with GAE panels
- ✔ Straightforward mounting
- ✔ No plastic bridging of the isolating gap
- ✔ In the transformer feeder panel always protective earth conductor upstream and downstream of the fuse
- ✔ All switching devices, even the protective earth downstream of the fuse, are SF₆ insulated.

**Features**

Types GA and GA...-C switchgear panels are type-tested, factory-built, metal-encapsulated switchgear assemblies in block construction, for indoor installation. Switching devices built in are: load-break switches, earthing switches as well as SF₆ circuit-breakers.

**Applications**

The GA and GA...-C systems in block construction are eminently suitable for installation in:

- Any kind of switchgear room,
- Transformer substations with or without personnel access,
- Sandy or dusty regions.

They are preferred for use in:

- Compact stations,
- Distribution substations in electricity supply company and industrial networks,
- Compact transformer substations, such as with wind-powered generator systems.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

General/Description

Construction

The GA and GA...-C series are block-type systems with integrated individual panels.

Panel versions with
• two feeder circuits,
• three feeder circuits,
• four feeder circuits,
are available.

GA and GA...-C systems have five system elements.

The HV compartment

This is a gas-tight welded tank made from stainless steel, which houses all the live parts including the busbars. The incoming and outgoing power feeders, as well as the connections from the fuse compartments are led through cast-resin bushings that are individually tested for adherence to the maximum admissible partial discharge values (TE ≤ 2 pC) at 26 kV cable to earth voltage stipulated by Ormazabal Systems Division. Each HV compartment is equipped with a stainless steel bursting membrane that is specifically designed for the individual tank.

Drives

The sturdy drives, operated by spring or stored energy mechanisms, of the load-break and earthing switches and SF₆ circuit-breakers are located above the HV compartment. The spring operated drives are maintenance free, the tripping mechanism of the stored energy operated drives of transformer and circuit-breaker panels should be operated at least once after 10 years. But, due to the materials selected, there is no need for maintenance even here.

Fuse arrangement

The fuse arrangement is designed as a plug-in system. All the fuse components are coupled to the contacts via cast-resin bushings from outside of the gas tank. (→ page 20).

Cable connection compartments

These are generally provided, and are always in pressure-proof design. Arc-fault resistant compartments can also be supplied if required. They are separated from one panel to the next by sheet steel intermediate walls. Inspections or work can be carried out in this way although the cable connection zone of the neighbouring panel is live. The front covers are interlocked against the corresponding earthing switch as standard. The front cover can be opened only with the earthing switch switched On. An anti-reverse interlock system can also be provided, if required. This prevents the corresponding load-break switch from being switched onto a live busbar when the termination zone is open (front cover removed). The mechanism can be operated only with the front cover in place and the latch closed. The earthing switch at the cable outgoer is not incorporated in this interlock and is switchable even when the terminal zone is open (necessary for cable testing).

Deeper front covers are available for deeper double-cable connections (page 29).

Panel plinth

This is located below the HV compartment. The height of the plinth determines the height of the switchgear.

• GA Standard height 1 400 mm
• GA...-C Standard height 1 050 mm

Combination of GA and GAE

Due to their uniform design and dimensions, system Types GA and GAE can be combined with one another and simply installed side-by-side (→ page 12 and page 18).

The electrical link between the two types at transfer points, e.g. to adjacent metering panels, must be effected using part-insulated busbar or cable. The cablelink offers a particularly effective solution where electricity supply company and customer sections are installed in separate rooms.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

General/Description

Operation
The mechanisms must be operated via the external drive shafts that are included in the mimic diagram. They include operating lever, 1 × load-break switch or circuit-breaker, 1 × earthing switch. Conventional operability is ensured due to the clearly structured mimic diagram and the easy-to-operate rotary handles.

Cable retention brackets
These consist of galvanized pliable metal parts. Thanks to a special screwable design, they can be adjusted in height and depth enabling any of the cable terminations normally used for SF₆ systems to be applied and the cables to be fastened by means of cable clamps without difficulty.

Operational safety
This is assured by the hermetically sealed encapsulation of the primary components which makes them impervious to ambient influences such as dirt, humidity, insects. The actuating parts are maintenance free, and accessible from the outside of the HV compartment.

Arc fault protection
The HV compartments and cable connection compartments were tested to the VDE standard 0670 Part 6 / IEC 60298 resp. VDE 0671 Part 200 / IEC 62271-200 Annex A “internal arc faults” and fulfilled criteria 1 to 5. This arc fault qualification IAC (AFL) is always present in the arc-fault resistant cable compartment systems. For installation of the system, see the relevant particulars on page 30.

To cool the hot gasses that emanate in the event of an arc fault, an optional four-layer metal cooling stretch arrangement is fitted into the back plate of the panel plinth in GA... (H = 1400 mm) systems. The pressure arising in the switchgear room due to such a fault, will be reduced by this arrangement.

In the GA...-C (H = 1050 mm) system version, it is not possible to fit a metal cooling stretch arrangement into the plinth. Instead, a metal cooling stretch arrangement can be provided as part of the station building, in the lower dividing wall towards the transformer room.

A rear absorber channel is optionally available on request, which enables the installation of the switchgear in connection with metal absorbers on a closed floor.

The pressure relief will be to the rear upwards (see page 31). Also this variant fulfils the arc fault qualification IAC AFL 20 kA 1 s.

By help of this rear absorber channel the pressure data within switchgear rooms will be reduced by appr. 60%.

During a test of a GA 2K1TS within a pressure-proof test cubicle of 77 qm pressure data <15 mbar at 21 kA 1 s have been reached.

Switchgear related pressure calculations can be enquired as part of services at the sales department of Ormazabal.
Medium-Voltage Switchgear up to 24 kV, SF\textsubscript{6}-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

SF\textsubscript{6} the insulating and arc quenching medium

Sulphur hexafluoride (SF\textsubscript{6}) gas has in recent years increasingly found its way also into medium-voltage load switching systems, having been previously successfully used mainly in circuit-breakers up to highest voltage levels.

This system change is taking place worldwide, since each of the previously used insulating and arc-quenching media, such as air, oil and solid materials, have their own more or less serious disadvantages:

- Air-insulated systems take up a great deal of space and, in extreme climatic or environmental conditions, require maintenance.
- Oil-insulated systems (as still predominantly used in English-speaking countries) although on the whole well protected against external influences, pose a considerable safety risk in the event of an internal fault.
- Solids-insulated systems (e.g. by cast resin), in the final analysis, are air-insulated devices and have the same maintenance problems, but much aggravated due to their compact construction.

SF\textsubscript{6} as insulating medium has a high degree of dielectric strength thereby enabling the construction of very compact systems that furthermore are maintenance free since all the live electric assembly parts have to be encapsulated.

With the actuating mechanics also largely removed from environmental influences, the user therefore gets a product that will do long-term duty without maintenance.

SF\textsubscript{6} is a non-poisonous, inert, electronegative gas that is heavier than air. In addition to the high insulating capability already mentioned, it also has extremely effective arc-quenching properties. At the high temperatures arising in the circuit-breaking arc, SF\textsubscript{6} separates into its constituent parts. When it cools, these regenerate to restore the SF\textsubscript{6} gas. This regeneration process is supported by aluminium oxyde (Al\textsubscript{2}O\textsubscript{3}) within the system. It means that the volume of gas originally introduced remains unchanged and suffices for the entire service life of the system or mechanism. An evaluation of the advantages and potential theoretical risks has shown that at present, there are no technically and ecologically worthwhile alternatives in sight.

The high operational safety of the system (external influences such as humidity, conductive dust etc., have no effect) virtually excludes arc faults. Should such a fault nevertheless occur, then the pressure release diaphragm (bursting membrane) comes into play.

There are detailed instructions for use of such a SF\textsubscript{6} system, issued by the German official Labour association. SF\textsubscript{6} gas contained in the system shall be recycled and not released into the atmosphere. Ormazabal Systems Division will take care of the disposal for you, should you not wish to dispose of a system yourself. This offer will hold good even after the system has been in operation for 25 to 30 years for the costs then applicable.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Technical data

Switchgear panels (rated values)

<table>
<thead>
<tr>
<th>Rated voltage $U_r$</th>
<th>7.2 kV</th>
<th>12 kV</th>
<th>17.5 kV</th>
<th>24 kV(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated insulation level</td>
<td>20 kV</td>
<td>28 kV</td>
<td>38 kV</td>
<td>50 kV</td>
</tr>
<tr>
<td>Rated power-frequency withstand voltage, AC $U_d$</td>
<td>60 Hz</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage $U_p$</td>
<td>630 A</td>
<td>630 A</td>
<td>630 A</td>
<td>630 A</td>
</tr>
<tr>
<td>Rated normal current $I_n$</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
</tr>
<tr>
<td>Rated short-time current $I_s$</td>
<td>20 kA (t_k = 3) s</td>
<td>20 kA (t_k = 3) s</td>
<td>20 kA (t_k = 3) s</td>
<td>20 kA (t_k = 3) s</td>
</tr>
<tr>
<td>Rated peak withstand current $I_p$</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
<td>20 kA (t_k = 1) s</td>
</tr>
<tr>
<td>Ambient temperature $T$</td>
<td>Below -25°C</td>
<td>-25 to +40°C ((-40 to +40 on request))</td>
<td>-5 to +40°C ((-25 to +40 on request)) (^3), (^4)</td>
<td>Above +40°C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td></td>
<td></td>
<td></td>
<td>Maximally 95%</td>
</tr>
<tr>
<td>Rated filling pressure of insulating gas at 20°C and 101.3 kPa</td>
<td>130 kPa (30 kPa overpressure)/2K1LSF = 150 (50 kPa overpressure) (SF_6)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulating gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated density of insulating gas</td>
<td>7.9 kg/m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encapsulation of the HV compartment</td>
<td>Hermetically sealed tank, IP65</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encapsulation of the fuse compartment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encapsulation of the drive housing</td>
<td>IP44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enclosure of the cable connection compartment</td>
<td>IP44</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal arc qualification to VDE 0671, Part 200 resp. IEC 62271-200 (IEC 60298)</td>
<td>IAC AFL 20 kA, 1 s for HV compartments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colour of panel paint finish</td>
<td>RAL 7035 (light grey)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of service continuity category</td>
<td>LSC 2A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partition class</td>
<td>PM</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) Higher rated voltage (25 kV), on request.
2) Optional
3) When a pressure switch (optional) is being used, the operating conditions correspond to Class Minus 5, indoor installation.
4) Depending to the secondary technic.

Standards

The Type GAE switchgear installation complies with the following Standards and Regulations:

<table>
<thead>
<tr>
<th>Standard</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60265-1 (62271-103*)</td>
<td>VDE 0670 Part 301 (VDE 0671 Part 103*)</td>
</tr>
<tr>
<td>IEC 60282-1</td>
<td>VDE 0670 Part 4</td>
</tr>
<tr>
<td>IEC 62271-1 (IEC 60694**)</td>
<td>VDE 0670 Part 1000 (VDE 0671 Part 1*)</td>
</tr>
<tr>
<td>IEC 62271-100</td>
<td>VDE 0671 Part 100</td>
</tr>
<tr>
<td>IEC 62271-102</td>
<td>VDE 0671 Part 102</td>
</tr>
<tr>
<td>IEC 62271-105</td>
<td>VDE 0671 Part 105</td>
</tr>
<tr>
<td>IEC 62271-200 (60298**)</td>
<td>VDE 0671 Part 200 (VDE 0670 Part 6**)</td>
</tr>
</tbody>
</table>

\* = future  
\** = up to now
### Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

#### Technical data

##### Three-position load-break switches (rated values)

<table>
<thead>
<tr>
<th>Cable feeder panel K, Transformator feeder panel, TS</th>
<th>Rated voltage ( U_r )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.2 kV</td>
</tr>
<tr>
<td>Rated normal current for Ring cable feeder circuits</td>
<td>( I_r ) A</td>
</tr>
<tr>
<td>Transformer feeder circuits</td>
<td>( I_t ) A</td>
</tr>
<tr>
<td>Rated short-time current&lt;sup&gt;2)&lt;/sup&gt; For systems with ( t_k = 1 ) s</td>
<td>( I_k ) kA</td>
</tr>
<tr>
<td>For systems with ( t_k = 3 ) s</td>
<td>( I_k ) kA</td>
</tr>
<tr>
<td>Rated peak withstand current&lt;sup&gt;2)&lt;/sup&gt;</td>
<td>( I_p ) kA</td>
</tr>
<tr>
<td>Rated short-circuit making current for Transformer feeder circuits&lt;sup&gt;4)&lt;/sup&gt;</td>
<td>( I_{ma} ) kA</td>
</tr>
<tr>
<td>Ring cable feeder circuits</td>
<td>( I_{ma} ) kA</td>
</tr>
</tbody>
</table>

##### Switching capacity for multi-purpose load-break switches to IEC 60265-1 and VDE 0670 Part 301

<table>
<thead>
<tr>
<th>Test sequence 1</th>
<th>Rated mainly active load-breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 20 operations</td>
<td>( I_1 ) A</td>
</tr>
<tr>
<td>At 100 operations</td>
<td>( I_1 ) A</td>
</tr>
<tr>
<td>At 5 %</td>
<td>( I_1 ) A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test sequence 2a</th>
<th>Rated distribution line closed-loop breaking current, 10 ×</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_d ) A</td>
<td>630</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test sequence 4a</th>
<th>Rated cable-charging breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{oa} ) A</td>
<td>50</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test sequence 5</th>
<th>Rated short-circuit making current</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{ma} ) kA</td>
<td>50, 63&lt;sup&gt;3)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test sequence 5</th>
<th>Rated no-load transformer breaking current</th>
</tr>
</thead>
<tbody>
<tr>
<td>( I_{3} ) A</td>
<td>5&lt;sup&gt;3)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

##### Switching capacity in the event of an earth fault

| Rated earth-fault disconnect current | \( I_{6a} \) A | 160 | 160 | 160 | 160 |
|Rated cable-charging breaking current in the event of an earth fault | \( I_{6b} \) A | 100 | 100 | 100 | 100 |

##### Switching capacity to IEC 62271-105

| Rated transfer current | Device Type TS | \( I_{transfer} \) A | 1900 | 1900 | 1500 | 1500 |

##### Operations, ring cable panel,1K

| Rated mainly active load-breaking current | \( n \) | 100 × | 100 × | 100 × | 100 × |
|Rated short-circuit making current | 50/63 kA | \( n \) | 5 ×/2 × | 5 ×/2 × | 5 ×/2 × | 5 ×/2 × |
|Mechanically admissible | \( n \) | 1000 ×<sup>6)</sup> | 1000 ×<sup>6)</sup> | 1000 ×<sup>6)</sup> | 1000 ×<sup>6)</sup> |

| Class | E3/E1 M1 | E3/E1 M1 | E3/E1 M1 | E3/E1 M1 |

1) Dependent on HV fuse link size.
2) In the transformer feeder circuit, these values are limited by HV fuses.
3) Optional
4) Dependent on the HV fuse cut-off current.
5) Tested exemplary in accordance with the above Standard for 400 kVA and 1000 kVA transformers at 12 kV and 24 kV.
6) Higher values on request.
7) Higher rated voltage (25 kV) on request.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA-C

Technical data

Three-position SF₆ circuit-breaker with stored energy Off (rated values)

| SF₆ Circuit-breaker panel LSF, Switching capability acc. to IEC 62271-100, test duty \(I_{100\text{a}}\) is not required | Rated voltage \(U_r\) |
|---|---|---|---|---|
| \(I_n\) A | 7.2 kV | 12 kV | 17.5 kV | 24 kV¹ |
| For systems with \(t_k = 1\) s \(I_n\) kA | 250/630 | 250/630 | 250/630 | 250/630 |
| For systems with \(t_k = 3\) s \(I_n\) kA | 20 | 20 | 16 | 16 |
| Rated peak withstand current \(I_p\) kA | 50 | 50 | 40 | 40 |
| Rated short-circuit making current \(I_{\text{na}}\) kA | 50 | 50 | 40 | 40 |
| Rated short-circuit breaking current \(I_{\text{sc}}\) kA | 20 | 20 | 16 | 16 |
| Rated cable-charging breaking current \(I_c\) A | 50 | 50 | 50 | 50 |
| Rated switching sequence – | 0 – 3 min – C0 – 3 min – C0 |

Operations at

| Rated short-circuit making current \(n\) | 5 × | 5 × | 5 × | 5 × |
| Rated short-circuit breaking current \(n\) | 20 × | 20 × | 22 × | 22 × |
| Class | M1, E2 | M1, E2 | M1, E2 | M1, E2 |

1) Higher rated voltage (25 kV) on request

Three-position earthing switch (rated values)

| To DIN VDE 0670 Part 2 and IEC 60129 Panals K, TS, LSF | Rated voltage \(U_r\) |
|---|---|---|---|---|
| 7.2 kV | 12 kV | 17.5 kV | 24 kV² |
| Earthing function of the three-position switch \(I_{\text{na}}\) kA | 50, 63 | 50, 63 | 50, 63 | 50, 63 |
| Rated short-time current \(I_n = 1\) s \(I_n\) kA | 20, 25 | 20, 25 | 20, 25 | 20, 25 |
| \(I_n = 3\) s \(I_n\) kA | 20 | 20 | 20 | 20 |
| Earthing function downstream of HV fuse \(I_{\text{na}}\) kA | 6.3 | 6.3 | 6.3 | 6.3 |
| Rated short-time current \(I_{\text{sh}}\) kA | 2.5 | 2.5 | 2.5 | 2.5 |

Operations

| Rated short-circuit making current 50/63 kA \(n\) | 5 ×/2 × | 5 ×/2 × | 5 ×/2 × | 5 ×/2 × |
| Rated short-time current \(n\) | 1000 ×(1) | 1000 ×(1) | 1000 ×(1) | 1000 ×(1) |
| Class | E2/E1 | E2/E1 | E2/E1 | E2/E1 |

1) Higher values, on request
2) Higher rated voltage (25 kV) on request
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of two-panel systems

Systems with one transformer feeder panel and one cable connection panel with one set of connection bushings

Standard equipment for
- System,
- KS panel,
- TS panel,
- A1 panel.

→ page 19

Type GA1KS1A1 or GA1TS1A1,
Type GA1KS1A1-C or GA1TS1A1-C

Overview diagram GA1KS1A1(-C)

Overview diagram GA1KS1A2/GA1TS1A1

Overview diagram GA1K1TS-B

Accessories, optional
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Capacitive voltage indication ledges upstream of the HV fuses,
- Shunt trip release, DC or AC,
- Auxiliary contact trip indication¹,
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Fuse adapter for fuse with dimension “e” = 292 mm,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm).

Type GA1K1TS-B

1) Deep front cover in K1 panel.

GA1KS1A2/GA1TS1A1 (weight: 236 kg) (-C weight: 214 kg)

1) Deep front cover in A1 panel.

GA1K1TS-B (weight: 236 kg)
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of two-panel systems

Systems with one transformer feeder panel and one cable connection panel with two sets of connection bushings

Type GA1KS1A2 or GA1TS1A2
Type GA1K1A2-C or GA1TS1A2-C

Standard equipment for
- System,
- KS panel,
- TS panel,
- A2 panel.

→ page 19

Overview diagram: GA1KS1A2(-C)

Overview diagram: GA1TS1A2(-C)

Accessories, optional
- Short-circuit indicator,
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Capacitive voltage indication ledges upstream of the HV fuses,
- Shunt trip release, DC or AC,
- Auxiliary contact trip indication¹),
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Fuse adapter for fuse with dimension "e" = 292 mm,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm).

GA1KS1A2/GA1TS1A2 (weight: 246 kg)
Cable connection panel equipped with overvoltage arrester at the top, with plug connectors at the bottom.

GA1KS1A2-C/GA1TS1A2-C (weight: 233 kg)
Cable connection panel equipped with plug connectors, top and bottom.

¹) Deep front cover in A2 panel.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of three-panel systems

Systems with three cable feeder panels

**Type GA3K, Type GA3K-C**

Standard equipment for
- System,
- K panels.
→ page 19

**Accessories, optional**
- Short-circuit indicator,
- Auxiliary contact modules to load-break switches, max. 3 NO, 3 NC,
- Earthing switches, max. 2 NO, 2 NC,
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Arc-fault resistant cable compartments,
- Deep front cover (depth + 61 mm),
- Extra deep front cover in K-feeder panel (depth + 150 mm),
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm).

Overview diagram: GA3K(-C)

1) Deep front cover in K panel.
GA3K (weight: 265 kg)

Combination of GA3K system and GAE-1M5 bus riser metering panel, electrical link via busbar

GA3K-C (weight: 234 kg)
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of three-panel systems

Systems with two cable feeder panels and one transformer feeder panel
Type GA2K1KS or GA2K1TS
Type GA2K1KS-C or GA2K1TS-C

Standard equipment for
- System,
- K panels
- KS panel,
- TS panel.

→ page 19

Accessories, optional
- Short-circuit indicator,
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Capacitive voltage indication ledges upstream of the HV fuses,
- Shunt trip release, DC or AC,
- Auxiliary contact trip indication¹),
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Fuse adapter for fuse with dimension "e" = 292 mm,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm),
- Deep front cover (depth + 61 mm),
- Extra deep front cover in K-feeder panel (depth + 150 mm).

Overview diagram: GA2K1KS(-C)

Overview diagram: GA2K1TS(-C)

1) Deep front cover in K panel.
GA2K1KS/GA2K1TS (weight: 298 kg)

GA2K1KS-C/GA2K1TS-C (weight: 240 kg)
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C
Range of three-panel systems

Standard equipment for
• System,
• K panels,
• LSF panel.
→ page 19

Overview diagram: GA2K1LSF(-C)

Accessories, optional
• Short-circuit indicator,
• Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
• Auxiliary contact module for SF₆ circuit-breaker, max. 3 NO, 3 NC,
• Motor operator,

Additional features:
• Anti-reverse interlock,
• Cable clamps,
• Arc-fault resistant cable compartments,
• Deep cable compartment (+80 mm),
• Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm),
• Deep front cover (depth +61 mm),
• Extra deep front cover in K-feeder panel (depth +150 mm).

Optional equipment for SF₆ circuit-breaker
• Shunt trip release, DC or AC,
• Current transformer trip release for pulsed release or via auxiliary current transformer,
• Auxiliary current transformer,
• Relay and control compartment, height 300 or 600 mm,
• Short bushings in connection with split-core current transformers around the cables,
• Long bushings in connection with 3-core current transformer around the bushings.

System Type 2K1LSF250 (with relay and control compartment, height 300 mm)

1) Cable connection compartment standard.
2) Cable connection compartment deep.
GA2K1LSF250/GA2K1LSF630 (weight: 345 kg)

GA2K1LSF250-C/GA2K1LSF630-C (weight: 287 kg)
Medium-Voltage Switchgear up to 24 kV, SF6-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of four-panel systems

Systems with four cable feeder panels

Type GA4K
Type GA4K-C

Standard equipment for

- System,
- K panels.

→ page 19

Overview diagram: GA4K(-C)

Accessories, optional

- Short-circuit indicator,
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm),
- Deep front cover (depth + 61 mm),
- Extra deep front cover in K-feeder panel (depth + 150 mm).

GA4K (weight: 325 kg)

1) Deep front cover in K panel.

GA4K-C (weight: 291 kg)
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of four-panel systems

Systems with three cable feeder panels and one transformer feeder panel

Type GA3K1KS or GA3K1TS
Type GA3K1KS-C or GA3K1TS-C

Standard equipment for

- System,
- K panels,
- KS panel,
- TS panel.

→ page 19

Accessories, optional

- Short-circuit indicator,
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Capacitive voltage indication ledges upstream of the HV fuses,
- Shunt trip release, DC or AC,
- Auxiliary contact trip indication,
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Fuse adapter for fuse with dimension “e” = 292 mm,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm),
- Deep front cover (depth + 61 mm),
- Extra deep front cover in K-feeder panel (depth + 150 mm).

Overview diagram: GA3K1KS(-C)

1) Deep front cover in K panel.
GA3K1KS/GA3K1TS (weight: 366 kg)

Overview diagram: GA3K1TS(-C)

GA3K1KS-C/GA3K1TS-C (weight: 325 kg)
Medium Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of four-panel systems

**Systems with two cable feeder panels and two transformer feeder panels**

- Type GA2K2KS or GA2K2TS
- Type GA2K2KS-C or GA2K2TS-C

**Standard equipment for**

- System,
- K panels,
- KS panels,
- TS panels.

→ page 19

**Accessories, optional**

- Short-circuit indicator,
- Auxiliary contact modules for load-break switches, max. 3 NO, 3 NC, Earthing switches, max. 2 NO, 2 NC,
- Capacitive voltage indication ledges upstream of the HV fuses,
- Shunt trip release, DC or AC,
- Auxiliary contact trip indication,
- Motor operator,
- Anti-reverse interlock,
- Cable clamps,
- Fuse adapter for fuse with dimension "e" = 292 mm,
- Arc-fault resistant cable compartments,
- Rear absorber channel with metal absorbers for installation on closed floor (standard switchgear depth 915 mm),
- Deep front cover (depth + 61 mm),
- Extra deep front cover in K-feeder panel (depth + 150 mm).

---

Overview diagram: GA2K2KS(-C) 1) Deep front cover in K panel.

GA2K2KS/GA2K2TS (weight: 399 kg)

Overview diagram: GA2K2TS(-C)

GA2K2KS-C/GA2K2TS-C (weight: 341 kg)
Switching system

Three-position load-break switch, three-position SF₆ circuit-breaker

- Front gas tank
- Fixed contact, On
- Arc quenching coil
- Busbar
- Drive shaft
- Earthing contact
- Special contact rivets
- Blade contact
- Bushing

Function principle of the arc quenching coil

\[ I = \text{Current} \]
\[ B = \text{Magnetic field generated by current} \]
\[ F = \text{Force exerted on the current-carrying switching arc} \]
\[ v = \text{Speed vector of the switching arc} \]

Combination of GA2K1TS system and GAE1M1 metering panel, electrical link via insulated busbar
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Range of standard equipment

Standard equipment of GA/GA...-C systems
Depending on its type, every system essentially includes the system elements shown in the diagram on page 4:

- Electrical switching chamber (HV compartment) including the busbar compartment, gas-filled,
- Drive compartment, above the HV compartment, in air,
- Fuse arrangement in systems with KS or TS panels, in air,
- Cable compartment, cable termination area,
- Panel plinth.

Standard equipment of K panel
Cable feeder panel
- SF₆ three-position load-break and earthing switches, including interlock,
- Spring operated drives for load-break and earthing switches – On and Off –,
- Capacitive voltage indication ledges,
- Padlocking facility: Load-break switch and earthing switch drives,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.

Standard equipment of KS panel
Transformer feeder panel
- SF₆ three-position load-break switches and earthing switches, including interlock,
- Spring operated drives for load-break switches and earthing switches – On and Off –,
- 3-phase plug-on fuse arrangement,
- Earthing switch additionally downstream of the HV fuses,
- Capacitive voltage indication ledges downstream of the HV fuses,
- Set of integrated slip-on type cable terminations,
- Padlocking facility: Load-break switch and earthing switch drives,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.

Standard equipment of TS panel
Transformer feeder panel
- SF₆ three-position load-break switches and earthing switches, including interlock,
- Spring operated drive – On –,
- Spring operated drive – Off – for earthing switch,
- Spring operated drive – Off – for load-break switch,
- 3-phase line protection, version and transformer ratio by agreement,
- Tripping indication of line-protective relay,
- Capacitive voltage indication ledges,
- Padlocking facility: Load-break switch and earthing switch drives,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.

Standard equipment of LSF panel
Outgoing feeder panel with SF₆ circuit-breaker
- SF₆ three-position circuit-breaker and earthing switch including interlock,
- Spring operated drive – On –,
- Spring operated drive – Off – for earthing switch,
- Spring operated drive – Off – for load-break switch,
- 3-phase plug-on fuse arrangement,
- Earthing switch additionally downstream of the HV fuses,
- Capacitive voltage indication ledges,
- Padlocking facility: Load-break switch and earthing switch drives,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.

Standard equipment of A1 panel
Cable connection panel with one set of connection bushings
- SF₆ earthing switch,
- Spring operated drives – On and Off –,
- Padlocking facility: Drive,
- Capacitive voltage indication ledges,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.
- Bushings for cable termination – one set –.

Standard equipment of A2 panel
Cable connection panel with two sets of connection bushings
- SF₆ earthing switch,
- Spring operated drives – On and Off –,
- Padlocking facility: Drive,
- Capacitive voltage indication ledges,
- Interlock between earthing switch and front cover → page 4, section “Cable connection compartments”.
- Bushings for cable termination – two sets –.
Fuse arrangement, Fuse selection

In the GA system, the fuse arrangement is plug-fitted. All the fuse components are coupled to the contacts via cast-resin bushings from outside of the gas tank. The plug-in system consists of the upper and the lower fuse holder. The plug-in parts, made from silicone rubber, are designed to be track- as well as arc-proof. The lower fuse holder additionally functions as push-on type cable termination. Range of application: for Cu or Al cables from 25 up to 240 mm². The earthing switches in the SF₆ chamber enable the HV fuse cartridges to be earthed at both ends. The fuse arrangement is accessible only with earthing switches switched On. The individual components of the plug-in system can be separated even after years of use since the plug-in surfaces are made of a special combination of materials which prevents sticking. There is no need to lubricate these surfaces (interfaces). Fuse length: 442 mm; fuses of 292 mm length can be used with an extension adapter.

Fuse selection

Only HV back-up fuse links should be used acc. to actual fuse selection table No. 12254569 acc DIN 43625 up to 88 mm Ø for protection of distribution transformers 6, 12 and 24 kV. Other types of fuse links only to be used after reconfirmation!

Exchanging of HV fuse

1. Tensioning lever
Pull tensioning lever forward against the spring pressure, then swing it upwards, into the fuse compartment.

1. Upper fuse holder
Grasp upper fuse holder and pull it straight out of the upper bushing.

Swing upper fuse holder forward, out of the fuse compartment, then pull it out towards the top, and replace the HV fuse link. It is not necessary to grease the interface.

To insert a fuse, follow the sequence in reverse.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Front panel

Front panel with
- Mimic diagram
- Switch position indication
- Operator surface for the actuators
- Capacitive voltage indicators

Gas leakage indication
- Short-circuit indicators
- Padlocking facility
- Drive sealed against dust, sand and insects
- Housing IP44

Ring cable panel

Transformer feeder panel

Padlocking facility for drives

Pressure switch/density switch
Each gas tank can be fitted with a pressure switch resp. density switch (auxiliary contact) for remote monitoring. The lower switching point corresponds to the crossover point to the red measuring range on the gas leakage indication. The density switch can be optionally provided with auxiliary contacts for alarm and tripping function.

Phase sequence indication

Gas leakage indication
Each gas tank has a pressure display for verification of the SF₆ overpressure within, and allowing its functional safety to be inspected.

Meaning of the indication:
Green = Sufficient service pressure
Red = Insufficient service pressure.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Interlocking function

Operating lever cannot be inserted

Ring cable panel: Load-break switch blocked by switch interlocking.

Transformer feeder panel: Load-break switch blocked by switch interlocking.

Anti-reversing interlock – Option –

Fastener of the front cover is closed.
Switching processes not restricted.

Fastener of the front cover open.
Switching processes can take place only at the earthing switch in the ring cable panel.

Ring cable panel:
Fastener of the front cover is open. Load-break switch blocked by anti-reverse interlock. The switch interlock plate lies behind that of the anti-reverse interlock. Earthing switch can be operated without restriction even with the front cover removed.

Transformer feeder panel:
Fastener of the front cover is open.
Earthing switch blocked by anti-reverse interlock.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Switching processes in ring cable panels

Earthing switch Off – load-break switch On

Switch Off the earthing switch. Press the operating lever fully (up to the stop) against the spring pressure, hold and turn it to the left.

Switch On the load-break switch. Press the operating lever fully (up to the stop) against the spring pressure, hold and turn it to the right.

Switch position with load-break switch Off and earthing switch On.

Load-break switch Off – earthing switch On

Switch Off the load-break switch. Press the operating lever fully (up to the stop) against the spring pressure, hold and turn it to the left.

Switch On the earthing switch. Press the operating lever fully (up to the stop) against the spring pressure, hold and turn it to the right.

Switch position with load-break switch Off and earthing switch On.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Switching processes in transformer feeder panels

Earthing switch Off – Transformer switch On

Switch Off the earthing switch. Turn the operating lever fully (up to the stop) to the left.

Charge the transformer switch by turning the operating lever to the left.

Switch On the transformer switch. Turn the operating lever to the right.

Switch position with transformer switch On and earthing switch Off.

Transformer switch Off – earthing switch On

Switch Off the transformer switch. Turn the operating lever about 20 to 30 degrees to the left.

Switch On the earthing switch. Turn the operating lever fully (up to the stop) to the right.

Switch position with transformer switch Off and earthing switch On.

Transformer switch TRIPPED

The TRIPPED flag in the switch position indication shows only when the transformer switch has been de-energized via the HV fuse link having responded or via the shunt trip release (optional). The drive must be charged by turning it to the left, before the transformer switch can be switched On again.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Voltage indication and testing

Each system is equipped with the necessary three-phase capacitive voltage indication ledges Type KSO for voltage testing to VDE 0682 Part 415 and IEC 61243-5 with HR system (other systems on request). This enables the absence of voltage in individual phases to be verified by inserting the voltage indication plugs into the corresponding pairs of sockets. Optionally, fixed-mounted capacitive indication lamps can be provided within indication ledges Type KSG. These are activated by removing the short-circuit bridges. The voltage indication ledge circuitry is designed for rated operational voltages of 10, 15 and 20 kV. The minimum and maximum values of the Standard for these voltage ranges are adhered to in the standard system. It is not necessary therefore, to adjust them again when changing the rated operational voltage within this range. Rated operational voltage 6 kV can be implemented in a special version. The live contact sockets are protected against accidental contact.

Voltage indication ledge in sealed version

Voltage indication plug

(Picture shows Horstmann device)

The following devices may be used:

Pfisterer  Type DSA-2
Horstmann  Type H0-ST-1
ELSIC  Type H0-SA
Jordan  Type DSP-HR
Dehn  Type DEHNcap/P-HR

Indication devices are also suitable for continuous duty.

Single-line diagram of a voltage indicator

Voltage indication via capacitive voltage divider, HR system. Voltage indication plugged in. C₁ Capacitor integrated in the bushings. C₂ Capacitance of the connecting cables and the voltage indication device to earth. U₂ = Uₐ = Voltage at the capacitive interface of the system or at the voltage indication device.

Phase sequence indication Interface tester

(Picture shows Horstmann device, Type ORION 3.0)

The following devices may be used:

<table>
<thead>
<tr>
<th>Make</th>
<th>Phase sequence indication</th>
<th>Interface tester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horstmann</td>
<td>Orion</td>
<td>H-OM measuring module with Fluke ammeter Type 87 or matrix Type Mx55 (II unit IV)</td>
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<tr>
<td>ELSIC</td>
<td>Type: H0-PV</td>
<td>–</td>
</tr>
<tr>
<td>Pfisterer</td>
<td>Type: EPV</td>
<td>Type: Euro test-H0</td>
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<tr>
<td>Jordan</td>
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<td>Type: KSP-HR</td>
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<tr>
<td>Kries</td>
<td>Type: CAP-Phase</td>
<td>Type: CAP-Phase</td>
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</table>
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Short-circuit/earth-fault indicator

All ring cable panels can be equipped either with a 3-phase short-circuit or earth-fault indicator.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
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<tbody>
<tr>
<td>Horstmann</td>
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<td>IKI-20B1</td>
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</table>

Other types and products on demand.

Cable connection systems

T cable connector systems

At the customer's discretion, T cable connector systems can be used which are connected to the outer-cone bushings to DIN EN 50181 connection type C (630 A) with screw contacts (M16).

<table>
<thead>
<tr>
<th>NKT Type</th>
<th>Südkabel Type</th>
<th>Tyco Electronics</th>
<th>Euromold/Nexas Type</th>
<th>Prysmian Type</th>
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<tr>
<td>10 kV</td>
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<td>XLPe cable</td>
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<td>CC12</td>
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<td>--</td>
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</tr>
</tbody>
</table>

With unscreened systems, the assembly instructions of the manufacturer must be strictly observed.

Assembly options of cable connection systems.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Short-circuit/earth-fault indicator

Cable connection for transformer panels

Lightning arrester at the T cable connector

1. Bushing cone (lower bushing)
2. Assembling paste for fitting of termination
3. Cable lug
4. Lower fuse holder
5. Stress cone
6. ISO nuts
7. Fixing flange

The lower fuse holder additionally functions as **push-on transformer cable termination**. Range of application: for Cu or Al cables from 25 to 240 mm².

The following combinations of T cable connectors with lightning-arresters may be used:

- Messrs. NKT (picture shows combination from Messrs. NKT): Type CB T plug with lightning arrester: CSA
- Messrs. ABB: Type SEHDT T plug with lightning arrester: MUT
- Messrs. Raychem: Cable terminations: IXSU, SMOE, UHGK, IDST with RICS adapter with RDA lightning arrester

Transformer feeder panel, front cover open.
With fuse holders and transformer cable termination.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C
Short-circuit/earth-fault indicator

Ring cable panel, front cover open. With lightning arrester in phase L1.

GA2K1TS with front covers removed

GA2K1LFS with front covers removed
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Short-circuit/earth-fault indicator

Double cable connection

1: Push-on cable termination, Type: CB12 or 24-630
2: Push-on cable termination, Type: CC12 or 24-630

Double cables equipped with the above mentioned cable termination types can be connected to the standard system version without modification (maximal depth of installation 318 mm).

Deeper double-cable connections require a deep front cover (→ page 4).

Other combinations on request.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Installation possibilities in switchgear rooms

Installation possibilities for Ring Main Units type GA and GA-C
In accessible and non-accessible switchgear rooms

Installation GA and GA-C
- Without metal cooling stretch arrangement within pedestal
- Bottom open

Installation GA
- With metal cooling stretch arrangement within pedestal
- Bottom open

Installation GA
- With rear absorber channel and metal absorber
- Bottom closed

Pressure relief only into cable cellar/cable trench.
1. Metal cooling stretch arrangement to cool down hot gases generated in case of an internal arc fault.
2. Cable trench/cable cellar

Pressure relieve via metal cooling stretch arrangement into the room behind.
(Optionally also in the cable trench)
Dimension Y = 30 mm for 3-panel-units
Dimension Y = 395 mm for 4-panel units
1. Metal cooling stretch arrangement to cool down hot gases generated in case of an internal arc fault.
2. Cable trench/cable cellar

Pressure relieve via rear absorber channel.
1. Metal absorber
2. Rear absorber channel

For details see relevant operating instructions for GA- and GA...-C systems.
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Panel accessories, quality

Operating levers

Operating levers, keys for fasteners

1. Operating lever (optional) for the load-break switch actuating shaft with motor operator (for manual switching e.g. in case of loss of supply voltage).
2. Operating lever for the earthing switch (optional red shaft).
3. Key for the fastener on the front cover (controls the anti-reverse interlock).

Fuse adapter

The transformer feeder panels are designed for fuses with dimension “e” = 442 mm. An adapter is available to allow fuses with dimension “e” = 292 to be used also.

Fuse link with adapter

1. Fuse link
2. Adapter

Cable clamps

- Size I:
  - clamping range 26 to 38 mm for cables, e.g.
  - 12 kV – 35 mm² ≤ 240 mm²*
  - 24 kV – 25 mm² ≤ 185 mm²*
- Size II:
  - clamping range 36 to 52 mm for cables, e.g.
  - 12 kV – ≤ 300 mm²
  - 24 kV – ≤ 240 mm²

* Compare actual cable diameters with the clamping range.

Quality

In order to be able to guarantee and verify quality, Ormazabal Systems Division (FG) has installed a comprehensive Quality Management System.


Routine testing of panels and systems as a matter of course includes the various tests to VDE 0670/IEC 62271 as well as the testing of customer-specific device configurations.

For example:

- Function tests of devices,
- Rated AC withstand voltage test 1 min,
- Testing of all auxiliary devices such as auxiliary contacts, shunt trip releases, remote operators, protective mechanisms (relays), measuring instruments,
- Function testing of the capacitive measuring device,
- Function testing of short-circuit indicators (where present).
Medium-Voltage Switchgear up to 24 kV, SF₆-insulated, Non-extensible Ring Main Unit, Type GA and GA...-C

Protection technology

All commercially available protection relays can be installed in the type GA switchgear for the LSF circuit breaker panels. The variants range from transformer-operated protection relays to combined protection and control systems. Low energy trips 0.5 VA and 0.1 VA are available for the transformer-operated relays. In this context special relay-transformer combinations are tested.

Common protocols and interfaces, e.g. Profibus DP, Modbus, IEC 60870-5-103, IEC 60870-5-101 and IEC 61850 can be provided with related relays. Installation is in low-voltage compartment / relay niche. Optionally, the protection relay can also be installed in the related cover. It is also possible to configure the parameters for the protection relay in accordance with customer requirements. A few commercially available protection relays as examples:

Transformer supplied:

- SEG type WIC
- SEG type WIP
- Siemens type 7SJ45
- Areva type P114S

Supplied with external power:

- SEG type MRI3
- SEG type MRI...
- Siemens type FSJ60...
- Areva type P141
- **SF₆-insulated switchgear**
  - type GA
  - type GAE
  - type CPG.0
  - type CPG.1

- **Air-insulated switchgear**
  - type EA
  - type AMC

- **Air-insulated switches**
  - type NVL
  - type KLF, T, DES