SF$_6$-insulated, metal-enclosed Ring Main Unit
with circuit-breaker in the outgoing panel
Type GA 2K1LSF (-C)
for rated voltages of up to 24 kV
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1 Panel nameplate
2 Actuating shaft
   (Load-break switch)
3 Short-circuit indicator
4 Actuating shaft
   (Earthing switch)
5 Gas leakage indicator
6 Switch position indicator
7 Actuating shaft
   (circuit-breaker)
8 Front panel
9 Shrouds (voltage indication ledge)
10 Rating plate
11 Front cover interlock
12 Fastener
13 Relay niche (optional)
14 Bushing-type current transformer
15 Cable connection compartment
16 Front cover
17 Front cover handle
18 Cable fixing iron
19 Strengthening plate for cable fixing irons (optional)
20 Pedestal
21 Earthing busbar
22 SF₆ gas tank
23 T-connector for VPE-cable
24 Bushing
25 Drive mechanism housing
1 General

1.1 Liability and warranty

All information and notes concerning operation and maintenance of the Ring Main Unit are provided under due consideration of our present experience and to the best of our knowledge. This manual describes the standard Ring Main Unit.

All technical information and data contained in these operating instructions are up to date at the day of printing. We reserve the right for technical changes in the course of further development without changing these instructions.

Therefore, no claims can be made based on the information and descriptions in these instructions.

We will not assume liability for damage or malfunctions resulting from operating errors, failure to observe these operating instructions or incorrect repairs.

Genuine spare parts from Ormazabal have been specially designed and tested for Ormazabal Ring Main Units.

It is highly recommended to purchase spare parts and accessories only from Ormazabal. We would like to make explicitly clear, that any spare parts and accessories not supplied by us require the approval by Ormazabal.

The assembly and use of other products may have a negative effect on design specific characteristics of the switchgear and thereby impair the safety for man, switchgear or other property.

For damage resulting from the use of spare parts and accessories not approved by Ormazabal any liability by Ormazabal is excluded.

Any unauthorized conversions and changes to the switchgears are prohibited for safety reasons and cause the exclusion of any liability by Ormazabal for any damage resulting from this.

1.2 Service information

For any technical information on Ormazabal switchgears the customer service department of Ormazabal is always available.

Should you encounter any difficulties with our equipment, please contact the plant where it was manufactured. The address can be found on the last page of these operating instructions.
2 Safety regulations

2.1 Intended use

The SF₆-insulated, metal-enclosed Ring Main Unit GA is a prefabricated, type-tested indoor switchgear.

The Ring Main Unit is available with a height of 1400 mm (type GA…) and a height of 1050 mm (type GA…-C) for accessible and non-accessible switchgear rooms and compact stations.

The Ring Main Unit can be used with alternating current of up to 630 A (rated normal current) at rated voltages of up to 24 kV.

The switchgear is used for e. g.:
- secondary substations
- industrial plants
- consumer’s installations
- wind turbine generators

The Ring Main Unit is used as:
- outgoing panel in front of bigger size distributor transformers with ratings of up to approx. 10 MVA at 20 kV
- bus sectionalizer panel in consumer’s installations with a tapping power of up to approx. 10 MVA at 20 kV.

The Ring Main Unit must only be serviced and repaired by authorized persons, who have been instructed or trained accordingly.

These operating instructions must be read before the installation and commissioning of the Ring Main Unit. All measures and notes mentioned in the operating instructions must be fully complied with during installation, commissioning and during operation.

Each person involved in the installation, commissioning, operation, maintenance and repair of the unit must have read and understood these operating instructions, especially the chapter on safety regulations and any other notes on safety.

We recommend that the user/owner obtains written confirmation of compliance with this requirement.

Only the exact knowledge of these operating instructions helps to avoid operating errors and ensures trouble-free operation.

The general safety and accident prevention instructions issued by the legislator and possible regulations of the insurer, which may be different from country to country, must be strictly observed when operating and servicing the switchgear.

These operating instructions are part of the Ring Main Unit. When passing on the Ring Main Unit (relocation, selling or similar) the operating instructions must also be handed over.

2.2 Explanation of symbols and notes

Observe these instructions and exercise extreme care in such cases. Hand out all notes on health and safety also to all persons who are involved in work on the equipment. Besides the notes in these operating instructions you must also comply with the generally valid safety and accident prevention instructions (e. g. DIN EN 50110, VDE 0105 part 100, BGV A3).

Health and safety symbols

In these operating instructions you will meet these symbols with all notes on health and safety which highlight possible dangers for the health and life of persons.

Warning about risk of electric voltage

This special health and safety symbol warns against dangers due to the risk of electric voltage.

Attention!

Cautionary instruction

In these operating instructions this highlights all subjects needing particular attention in order to comply with guidelines, instructions and the correct work sequence, thereby avoiding damage and destruction of the the Ring Main Unit.
2.3 General health and safety instructions

Ring Main Units from Ormazabal are designed to the latest technical standard and under due consideration of all relevant safety instructions.

However, dangers for persons and property may arise from these Ring Main Units if they are used incorrectly by untrained personnel or for purposes they are not intended for, if they are manipulated or if the safety regulations are disregarded. Each person involved in the installation, commissioning, operation or servicing of the Ring Main Unit must therefore have read and understood these instructions.

2.3.1 Operation

When operating the Ring Main Unit the responsibilities must be clearly specified and complied with, so that no unclear competences regarding safety will arise.

Before taking the Ring Main Unit into operation and after service work or modifications the Ring Main Unit must be inspected by qualified personnel to ensure a safe working condition.

Before starting operation all persons within the danger zone around the Ring Main Unit must be warned and asked to leave this area. There must not be any objects blocking the access to the controls.

The user must operate the Ring Main Unit only in perfect condition.

Any changes that degrade safety must be reported immediately to the supervisor.

Changes to the Ring Main Unit must strictly be coordinated with Ormazabal and should only be performed under the supervision of expert personnel.

Experts are persons who, due to their professional education and experience, have sufficient knowledge in the field of electro technology and are acquainted with the relevant accident prevention instructions, guidelines (BGV A3), and the generally accepted technical rules and regulations (e. g. VDE-regulations, DIN-standards).

2.3.2 Safety features

Safety features must not be altered, dismantled or rendered ineffective. Unprotected parts of the system can cause fatal injuries.

All safety installations, e. g. shrouds, must always be fully functional and correctly in place.

Operation of the Ring Main Unit with faulty safety installations is not permitted.

2.3.3 Auxiliary device for operation, maintenance and repair

If any auxiliary devices are required for operation, maintenance or repair of the Ring Main Unit (tools or similar), these must be in safe condition and should be used in a safe way.

Any unnecessary and endangering use of auxiliary devices of any kind on the Ring Main Unit is not permitted.

2.3.4 Statutory health and safety regulations

Apart from these notes on prevention of accidents and the notes attached to the switchgear, the locally valid accident prevention instructions must also be observed.
3 Transport and installation

3.1 Safety notes for transport

1. Lifting tackle must only be used at points intended for this purpose.
2. Ropes, chains or other lifting tackle must be fitted with safety hooks.
3. Do not use any torn or worn ropes.
4. Ropes and chains must not be knotted.
5. Ropes and chains must not touch any sharp edges.
6. Use only ropes and chains of sufficient load bearing capacity. (for weight of GA Ring Main Unit see Table 1)
7. Use only lifting gear of sufficient loading capacity. (for weight of GA Ring Main Unit see Table 1)
8. Do not lift loads over persons.

When unloading observe the safety instructions (see 3.1) and the applicable accident prevention regulations.

Unloading is only allowed to be performed by experienced persons who are fully familiar with the lifting gear.

Observe the permissible hoisting weight of lifting tackle and lifting gear (forklift truck, crane).

3.2 Transport and unloading

The equipment is delivered fully packed standing upright on a pallet. It is strapped to the pallet with tightening straps (Fig. 2).

For transportation or intermediate storage you should always use the original packaging and secure the Ring Main Unit with tightening straps (tightening belts), in the same way as for delivery.

When attaching the tightening straps make sure to attach these as shown in Fig. 2, as otherwise the cable connection compartment may be damaged.

During transport comply with the warning and safety notes on Ring Main Unit and packaging!

Table 1

<table>
<thead>
<tr>
<th>Types</th>
<th>Weight Ring Main Unit (with pressure absorber channel) [kg]</th>
<th>Weight Accessories [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Depth 740 mm (Depth 925 mm)</td>
<td>Depth 800 mm (Depth 985 mm)</td>
</tr>
<tr>
<td>GA 2K1LSF</td>
<td>330 (420)</td>
<td>345 (435)</td>
</tr>
<tr>
<td>GA 2K1LSF-C</td>
<td>272 (–)</td>
<td>287 (–)</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 1 Weight of the various Ring Main Unit types

Fig. 2
3.3 Arrival and unpacking

Upon arrival check the Ring Main Unit immediately for any signs of transport damage:

- **Externally visible damage** must be confirmed by the driver on the freight documents. For insurance reasons, damage must be reported in writing to the delivering freight carrier within a period of 3 days(!).

- **Hidden damage** can only be detected after removing the packaging material. Claims for transport damage found at a later date can only be accepted by us **within one week**.

- Remove the tightening straps – the Ring Main Unit is now unsecured. Due to the design of the Ring Main Unit the centre of gravity is located in the middle of the unit.

⚠️ The Ring Main Unit may only be attached using the transport brackets provided. The transport bracket screw connections (Fig. 4) must be checked for tightness before lifting the Ring Main Unit (tightening torque see chapter 8, Table 13).

⚠️ When handling the Ring Main Unit in unsecured condition the unit may tip over!

This is of particular importance when transporting the Ring Main Unit to its final place of installation. No lever must be used to transport the Ring Main Unit its final destination. This action could cause damage to the enclosure.

As a measure to avoid damage the Ring Main Unit can be transported with a cross-bar (vertical stop) or a 2-rope (Fig. 3 and Fig. 4).

The length of the ropes must allow an angle between the ropes of max. 60°. If this angle is exceeded damage to the Ring Main Unit cannot be ruled out.
After transporting the Ring Main Unit to the place of installation remove the transport brackets and close the fastening threads for the brackets with the hexagon screws.

For a possible later transport of the Ring Main Unit store the transport brackets in a suitable place.

In order to ensure a tight fit of the screws in case of a later installation of the transport brackets, the screws must be tightened with the tightening torque according to chapter 8, Table 13.

Due to the flux of force the correct assembly direction of the transport angles is of utmost importance (Fig. 4).

- Check the delivery for completeness.

The serial number on the delivery note must conform with the serial number mentioned on the rating plate (Fig. 5) of the Ring Main Unit.

### 3.4 Storage

In the factory the Ring Main Unit is packed ready for transport and storage. It is only to be stored in dry, clean rooms and is to be protected against excessive soiling.

The environmental conditions must comply with IEC 62271-1 / DIN EN 62271-1 and VDE 0670 Part 1000, ambient temperature class "minus 5 indoor".

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**Fig. 5 Rating plate (example)**

1. Serial number
2. Technical data
3. Standards applied
4. Document numbers of the corresponding operating instructions (German/English)
5. Type of unit
6. Manufacturing date: month/year
3.5 Installation and assembly

For installation of the Ring Main Unit follow the corresponding installation plan. In order to assure secure standing of the Ring Main Unit use all fastening bores provided.

In order to assure the extensibility of all possible unit/panel combinations within the GA/GEA product ranges, the foundation projection must be drawn at a distance of 200 mm from the wall! On the variant with pressure absorber channel the minimum distance is 100 mm.

⚠️ The areas for the floor openings must not be reduced in size, so that, in case of an internal arc fault, the hot gases can be safely discharged.

A straight and level floor surface is a prerequisite for the stress-free installation of the Ring Main Unit. Pay attention to the information in DIN 43661. In particular the tolerance on the evenness (maximum 1 mm over a measured length of 1 m) and the tolerance on the straightness (maximum 1 mm per metre and maximum 2 mm over the entire length of the foundation rail) are to be observed.

The fastening material is not included in the items supplied.

To anchor the Ring Main Unit to a raised floor, we recommend the following fastening material:

- Hexagon screw M10 (minimum M8, strength class 5.6) DIN EN ISO 4017
- Washers DIN EN ISO 7093 (switch panel side)
- Washers DIN EN ISO 7089/7090 (raised floor side) or tapered washers for anchoring to U-sections
- Spring lock ring DIN 127 / DIN 128
- Hexagon nut M10 DIN EN ISO 4032

In the case of installation on concrete with a strength of ≥ 25 N/mm², we recommend the following fastening material:

- Fischer plastic dowels of type S12
- Wood screw DIN 571-10x80-St
- Washer DIN 125 A10

Remove front covers and cable fixing irons inside the cable connection compartment in order to gain access to the fastening bores (see Chapter 5).
3.6 Planning of installation

3.6.1 Floor fastening measurements

Fig. 6 and Table 2 show the floor fastening and floor opening dimensions for the Ring Main Unit for pressure relief as per variant 1 and variant 2 (see Chapter 3.6.3 “Possible installations”).

<table>
<thead>
<tr>
<th>Equipment installation depth</th>
<th>A [mm]</th>
<th>B [mm]</th>
<th>C [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>740 mm</td>
<td>635</td>
<td>351</td>
<td>530</td>
</tr>
<tr>
<td>800 mm</td>
<td>695</td>
<td>413</td>
<td>596</td>
</tr>
</tbody>
</table>

Table 2

Fig. 7 and Table 3 show the floor fastening and floor opening dimensions for the Ring Main Unit for pressure relief as per variant 3 (see Chapter 3.6.3 “Possible installations”).

<table>
<thead>
<tr>
<th>Equipment installation depth</th>
<th>A [mm]</th>
<th>B [mm]</th>
<th>C [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>740 mm</td>
<td>635</td>
<td>351</td>
<td>255</td>
</tr>
<tr>
<td>800 mm</td>
<td>695</td>
<td>413</td>
<td>321</td>
</tr>
</tbody>
</table>

Table 3
Fig. 8 and Table 4 show the base fixing and floor opening dimensions for the Ring Main Unit for pressure relief as per variant 4 (see Chapter 3.6.3 "Possible installations").

<table>
<thead>
<tr>
<th>Equipment installation depth</th>
<th>A [mm]</th>
<th>B [mm]</th>
<th>C [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>925 mm</td>
<td>894</td>
<td>351</td>
<td>255</td>
</tr>
<tr>
<td>985 mm</td>
<td>954</td>
<td>413</td>
<td>321</td>
</tr>
</tbody>
</table>

Table 4

Fig. 8 (Dimensions in mm)
3.6.2 Dimensions of Ring Main Units

Fig. 9 GA 2K1LSF with current transformers (□) on the outgoing cables (equipment depth 740 mm), (all dimensions are nominal dimensions [mm])

Fig. 10 GA 2K1LSF-C current transformers (□) on the outgoing cables (equipment depth 740 mm), (all dimensions are nominal dimensions [mm])
Fig. 11 GA 2K1LSF with bushing-type current transformers ( ) (equipment depth 800 mm), (all dimensions are nominal dimensions [mm])

Metal cooling stretch arrangement (optional)

Fig. 12 GA 2K1LSF-C with bushing-type current transformers ( ) (equipment depth 800 mm), (all dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional
Fig. 13  GA 2K1LSF with pressure absorber channel and current transformers (□) on the outgoing cables (equipment depth 925 mm), (all dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional

Fig. 14  GA 2K1LSF with pressure absorber channel and bushing-type current transformers (□) (equipment depth 985 mm), (all dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional
3.6.3 Possible installations

**Attention!**
During installation make sure not to damage the burst protection in the bottom of the gas tank.

This diaphragm opens in case of an internal arc fault. The gases emerging must be discharged as shown in Fig. 15.

**Variant 1**
- Panel bottom open
- Pressure relief into the cable trench/raised floor

**Variant 2**
- Panel bottom open
- Pressure relief via rear metal cooling stretch arrangement into the room behind as well as into the cable cellar

**Variant 3**
- Panel bottom closed
- Pressure relief via metal absorber and rear metal cooling stretch arrangement into the switchgear room

**Variant 4**
- Panel bottom closed
- Pressure relief via metal absorber and rear pressure absorber channel into the switchgear room

The cable trench must have a defined minimum cross-section. For the pressure relief of the cable trench the following rule of thumb must be applied:
- up to 3 panels: 1 Metal cooling stretch arrangement (400x600 mm)
- from 4 panels: 1 second metal cooling stretch arrangement of the same size.

The metal cooling stretch arrangement provided by the customer must be arranged in a way that the cable trench is evenly divided.

In order to enhance the stability the rear wall of the Ring Main Unit can be fastened with two steel angles (not included in the scope of delivery). For this purpose use the screw connections from the transport device. Please ask for our assistance in the planning and installation of the station.

**Fig. 15**

The construction of the building and the switchgear room must withstand the expected mechanical loads and the internal pressure caused by a short-circuit arc.

Appropriate calculations for these purposes are recommended. Switchgear related pressure calculations can be requested as part of the services provided by the sales department at Ormazabal GmbH.
3.7 Installation of the supply line for supply voltage

When routing the supply line for the supply voltage to the motor drive (Fig. 16) as well as for the auxiliary and control circuits the following installation work must be performed:

**Note!**

On Ring Main Units with fitted relay cabinet the cable leadin is effected through the roof or the side wall of the relay cabinet. In this case the following assembly steps are not required.

⚠️ When working on the open drive of the circuit-breaker panel the stored-energy mechanism must be in relieved condition. Accidental triggering of the drive can cause severe injury!

- Unscrew the hexagon screws (2x) from the covering sheet.
- Unscrew all self-tapping screws (6x) from the upper section of the front panel (Fig. 16-1).
- Pull the front panel a few millimetres forward (Fig. 16-2).
- Lift the covering sheet up from behind the front panel (Fig. 16-3).
- Pull the covering sheet out of the clip-on clamps (Fig. 16-4).

The side wall of the cover frame is fitted with flexible plugs, which enable a cable bushing protected against dust and moisture. For matching the cable diameter use the separating lines of the plugs.

- Assembly of cover plate and front panel is performed in reverse order.

3.7.1 Terminal connection diagrams for the individual extension groups

Fig. 17 shows the arrangement of auxiliary switches for the circuit-breaker and the earthing switch on the drive carrier.
Fig. 18..20 show the connection diagrams for the individual attachment groups.

Additional relevant information for the wiring of the switchgear can be found in the enclosed circuitry documentation.

Fig. 18 Terminal connection diagram circuit-breaker / earthing switch

Fig. 19 Remote contact Short-circuit indicator ALPHA M type

Fig. 20 Terminal connection diagram cable switch (K-panel)
3.8 Connection of the power cables

Please proceed as follows to connect the power cables:

- Remove the front cover (see Chapter 5, "Operation").

- Dismantle the Z profile.

- Only on variants with bottom plates: Remove the front bottom plate and the rubber cable grommets. Push the rubber cable grommets onto the power cables to be connected.

- Route the power cables through the floor opening, cut to length, put in place and mount the male cable connector or cable adapter by following the instructions of the respective manufacturer.

- Only on variants with bottom plates: Insert the power cables with the rubber cable grommets into the cut-outs in the rear bottom plate.

- Connect power cables to the panel.

- Fix power cables to the cable fixing iron using the cable clamps so they are free of strain.

- Connect the earthing cables to the earthing terminals of the cable fixing iron.

- Only on variants with bottom plates: Re-fit the front bottom plate. During this process ensure the rubber cable grommet is correctly inserted between the bottom plates.

- Re-fit Z profile.
3.9 Earthing

The earthing of the Ring Main Unit should be carried out according to DIN VDE 0141/101. The Ring Main Unit is furnished with an earthing bus running over the entire length of the Ring Main Unit (Fig. 22, left hand cable panel).

As a measure to ensure an electrically conductive connection of the metal enclosure, earthing bus and enclosure are bolted with contact washers.

This makes sure that, in case of a ground leak or a double ground leak, the fault currents are safely discharged to the earth connection.

In each panel area the earthing bar is equipped with a screw terminal (M12) for the connection of an earthing lead to establish earthing of the unit.

In order to ease assembly of the earthing lead the earthing terminals of the earthing bus and the cable fixing irons are fitted with insert nuts. On the cable fixing irons the cable lugs of the cable shields are fastened to the earthing terminals (M12). The cable fixing irons are designed with freely assignable earthing terminals.

Fig. 22
4 Technical description

4.1 Description of the switchgear

The SF₆-gas-insulated Ring Main Unit type GA 2K1LSF is characterised by the following features:

Primary switchgear and busbar are installed in a common gas tank. Sulphur hexafluoride (SF₆) is used as an insulation and extinguishing medium. The switchgear can be used up to a rated voltage of 24 kV with a rated normal current of 630 A.

The Ring Main Unit is:
- metal-enclosed,
- almost low maintenance,
- suitable for severe climatic conditions,
- type-tested.

Connection to the distribution network is accomplished via load-break switches in the cable panels. The outgoing panel or the sectionalizer panel is equipped with a circuit-breaker.

The switchgear complies with the specifications of the applicable standards and regulations as well as the statutory regulations. During manufacturing the switchgears are subjected to the quality guidelines of ISO 9001.

Circuit-breaker

The circuit-breaker is characterized by the following main components:
- three-position switch
- integrated switch-on resistant earthing switch
- circuit-breaker
- no additional isolating gap generator required
- the isolating gap is bridged without insulating material
- arc extinction by quenching coil principle
- SF₆ as insulating and quenching gas
- low maintenance drive not capable of automatic reclosing (force storing mechanism only for switching off)

Load-break switch

The load-break switches differ from the circuit-breaker by the following components:
- load-break switch
- arc extinction by quenching coil principle
- maintenance-free drive without force storing mechanism

Protection technology

The circuit-breaker requires a protection technology for the monitoring of the connected working equipment. Tripping may be accomplished via a shunt trip release and/or a low energy transformer-operated trip. All commercially available relays may be used as protection relays. Depending on the relay type, a corresponding transformer must be a window-type current transformer in the outgoing. It is possible to mount the transformer on the bushing. This ensures that the sealing end is inside the protection range of the protection relay. The protection relay is mounted inside a relay cabinet on the drive housing. Alternatively the protection relay can be installed in a metal enclosed relay niche. The relay niche is located behind the front cover of the outgoing panel.

The system components, such as drive mechanism housing with drives, cable connection compartment and pedestal are attached to the gas tank in modular mode.

The cable connection compartment is of pressure resistant design and sectionized by metal walls. This design enables work in the terminal area of an earthed panel, while the adjacent panels are life.

For enhanced personnel protection, the switchgear can optionally be built in an arc-fault proof design.

Protection sheets as a protection against internal faults.

In case of an internal fault the pressure increase inside the gas tank is limited by the bursting plate (in the bottom of the gas tank). The burst protection, a clamped metal foil of low mass, opens at a gas overpressure of 200 kPa. The opening created by the pressed out metal foil controls the directed pressure relief of the hot gases into the compartment under the SF₆-gas tank and from there as described in Chapter 3.6.3 “Possible installations”.

The front covers close the cable connection compartment of the individual sections pressure tight. The front cover is plugged onto pan-head screws on the lateral panel walls, they are then pushed vertically down and thereby locked in the cable connection compartment.

Front covers can be additionally provided with inspection windows.

The cable connection compartment with front cover gives a high level of safety for personal protection.
For safety reasons the individual panels of the switchgear are fitted with various interlocking facilities as standard.

Switching interlock:
An interlock against an unauthorized operating sequence between the actuating shafts of a panel.

Front cover interlock:
An interlock against unauthorised removal of the front cover during operation.

Anti-reverse interlock (optional)
Interlock against unauthorized switching-on of the load-break switch when the front cover is removed.

For further details please refer to chapter 4.5.

All active parts are located in the gas tank filled with SF₆-insulating gas. The supply or discharge of energy is routed through cast resin bushings in accordance with DIN EN 50181. The operator shall use T-connection kits for bushings acc. to DIN EN 50181 connection type C (630 A) with outside taper and screw contact M16 at his own discretion (see also chapter 8.6).

All control and indication elements of the switchgear are clearly arranged on the front panel. Switch position indicators and actuating shafts are integrated in the mimic diagram. The front panel is provided with padlocking facilities and panel nameplates as standard. Both the capacitive voltage detecting system and the short-circuit indicator (optional for cable panels) are arranged in the operating range of the individual panels. On the front panel all symbols of relevance for the earthing circuit appear in red, whereas the symbols for the current path are printed in black. With the coloration of the front panel background all elements are clearly assigned to the respective switchgear panel.

### 4.2 Ring Main Unit versions

The Ring Main Unit is available with a height of 1400 mm (type GA…) and a height of 1050 mm (type GA…-C) for accessible and non-accessible switchgear rooms and compact stations. The Ring Main Unit is designed with two cable panels and with one circuit-breaker panel. The circuit-breaker panel is arranged on the right side of the switchgear.

**Designation of the types:**
- GA 2K1LSF
- GA 2K1LSF-C

**Different panel types:**

<table>
<thead>
<tr>
<th>K</th>
<th>Cable outgoing panel with load-break and earthing switch drive (load-break switch without trip-free release)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSF</td>
<td>circuit-breaker outgoing panel with circuit-breaker, earthing switch drive (circuit-breaker drive with trip-free release via manual trip, shunt release or transformer operated trip).</td>
</tr>
</tbody>
</table>

The switchgear depth determines the transformer design to be used. The switchgear with the installation depth of 800 mm is provided with extended bushings in the circuit-breaker panel for the use of bushing type current transformers, the version with an installation depth of 740 mm for window-type current transformers. Window-type/bushing-type current transformers are available on request. With both designs the protection relay can be installed in the cable connection compartment of the circuit-breaker. For this purpose a metal-encapsulated relay cabinet with lockable front flap can be installed above the bushings. If the switchgear is fitted with large-volume protection relays (specification of power supply company), with extensive control or with motor drives, a relay cabinet for the installation of the secondary equipment may be installed on top of the drive housing.

With the exception of the switchgear with pressure absorber channels and switchgear of type C (height = 1050 mm), as an option all GA Ring Main Units can be equipped with a metal cooling stretch arrangement in the rear wall of the pedestal. The various possible installations are described in Chapter 3.6.3 "Possible installations".
The equipment of the relay cabinet is customized acc. to order and may differ from the described design:

- terminal strip
- remote control relay for ON or OFF to control the load-break switches / circuit-breakers
- circuit-breakers to protect motors and the control circuit
- changeover switch for local remote control
- Push-buttons to switch the load-break switch/circuit-breaker on/off by the motor drive
- complete wiring to the electric components of the switchgear, such as: motor, auxiliary contact, shunt release, tripping signal contact, short circuit indicator
- secondary net protection features with UMZ/AMZ relay, current transformer connection, test sockets, measuring technology.
- electrical switch position indicators

The following may be optionally installed:

- anti-reverse interlock
- short-circuit indicator
- arc-fault resistant lining of the cable connection compartment
- remote tripping in the circuit-breaker panel
- signal contact
- motor drives for remote activation and deactivation
- relay niche in cable connection compartment
- relay cabinet on the drive housing for installation of secondary technology

4.3 Three-position switch (K/LSF-panel)

The circuit-breaker/load-break switch is designed as a three-position switch. The switching positions ON-OFF-EARTHED can be switched with only one switching element (switch blade).

Fig. 24 shows a schematic representation of the three-position switch.

The technical design of the three-position switch (blade switch) is simple and reliable. In each phase a pair of switch blades, vertically arranged above each other in the gas tank, which slides onto the contact elements, is effective.

Contact elements and switch blades are coated with a non-welding and wear-resistant material. This results in a long lifetime of the switch elements. The lifetime of the circuit-breaker/load-break switch depends on the extend and number of short circuit breaks (see chapter "Technical Data").

The fixed contact elements of the individual switchgear units are connected with the busbar.

The switch blades are connected with the bushings. The unit earthing contact/actuating shaft is triggered via the drive and transmits the rotary movement via the coupling rod to the switch blades.
**Circuit-breaker**

Function:
The circuit-breaker is switched off by an over-current or a short circuit current.

The essential components of the protection system are:
- current transformer
- protection relay
- tripping coil

The current transformers measure overcurrent and short-circuit current. The protection relay assess the measured current.

If the adjusted limit values are exceeded, the protection relay will send a tripping pulse to the transformer-operated trip. The transformer-operated trip unlocks the stored-energy drive by means of the tripping shaft and switches the circuit-breaker to OFF position.

(Adjust the accurate relay position as specified by the relay manufacturer. See also chapter 4.11).

For the circuit-breaker a quenching coil is used as an extinguishing device. When the switching blade leaves the contact piece an arc is created between switching blade and contact piece. After a short while the arc root commutes from the contact piece to the metal core of the quenching coil, creating a magnetic field, which causes rotation of the arc in the coil.

Due to this rotation the arc is cooled in the SF₆-gas and goes out in case of current zero. The circuit-breaker has switched off.

**Load-break switch**

For the load-break switch a quenching coil is used as an quenching facility. During the breaking action of the switch blade from switching position ON to OFF the quenching facility ensures that the arc generated when separating the contacts is cooled and interrupted. The interruption of current therefore takes place after a short quenching period.

The quenching coil is designed to meet the switching capacity of the load-break switch (see chapter "Technical Data").

In OFF-position of the load-break switch/circuit-breaker the isolating gap is generated without bridging by insulating agent.
4.4 Drive mechanism

The switchgear is designed with cable panels and a circuit-breaker in the outgoing panel as standard. All parts of the drive susceptible to corrosion are galvanically zinc coated. The cable panels are equipped with a spring drive (cable panel drive), the circuit-breaker panel is fitted with a spring drive with power accumulator (LSF-drive). The cable panel drive switches the load-break switch and the earthing switch of the cable panel to ON and OFF position. The LSF-drive switches the circuit-breaker and the earthing switch of the circuit-breaker panel to ON and OFF position. The power accumulator of the LSF-drive switches the circuit-breaker from switch position ON to OFF. The function of the actuating shafts and their arrangement is shown in the mimic diagram on the front panel.

4.4.1 Cable panel drive

For the cable panels a spring drive (cable panel drive) with a combined acting compression spring is used. The drive is installed on a U-shaped drive carrier; the actuating shafts for load-break switch (right) and earthing switch (left) are mounted in plain bearings in the webs of the drive carrier. Between these two actuating shafts the compression spring works on a pin guide, which is rotably mounted on each actuating shaft by two welded tongues. Both actuating shafts are hollow shafts with integrated blade inhibitors, which prevent swinging of the switch blade to the opposite contact of the three-position switch when switching off.

These interlocks are unlocked when the switching levers are inserted (against spring pressure) into the actuating shaft. The transfer of the rotary movement of the actuating shafts to the switching shaft vertically arranged in the gas tank is accomplished by toggle links. On the actuating shafts the toggle links are fastened to lugs with actuating cams and rotably mounted by means of bolt connections.

The operating lever, which is horizontally mounted on the switching shaft, has the function of a counter bearing for the two toggle links. The drivers fastened with pins to the ends of the toggle links are designed with a freewheel, so that they can decouple each other during the switching process. The operating lever controls the switch position indicator mounted to the drive carrier.

![Diagram of cable panel drive](image-url)
4.4.2 LSF-drive

General
Circuit-breaker panels are delivered with spring drive with accumulator (LSF-drive), (Fig. 26) as standard. The accumulator of the drive is activated by the protection system via the transformer-operated trip (or optionally push button, shunt trip release). The switch position indicator of the circuit-breaker shows the message TRIPPED for this drive. The LSF-drive switches the circuit-breaker and the earthing switch of the circuit-breaker panel to ON and OFF position. The power accumulator of the LSF-drive switches the circuit-breaker from switch position ON to OFF. Tripping of the power accumulator is accomplished by push button or shunt trip release. The function of the actuating shafts and their arrangement is shown in the mimic diagram on the front panel. All parts of the drive susceptible to corrosion are galvanically zinc coated.

Design and function
The drive is installed on a U-shaped drive carrier, whereby the actuating shafts for circuit-breaker (right) and earthing switch (left) are resting in plain bearings in the webs of the drive carrier. Between these two actuating shafts one compression spring each works on a pin guide, which is rotably mounted on each actuating shaft by two welded tongues. Both actuating shafts are hollow shafts. The blade inhibitor for the earthing switch is integrated in the accumulator. They prevent back-swinging of the switch blades to the opposite contact of the three-position switch when switching off. The accumulator is a unit that is freely rotating on the actuating shaft of the circuit-breaker. It consists mainly of tripping lever, accumulator tension spring and toggle link.

The transfer of the rotary movement of the actuating shafts to the switching shaft vertically arranged in the gas tank is accomplished by toggle links.

On the actuating shafts the toggle links are fastened to lugs with actuating cams and rotably mounted by means of bolt connections. The operating lever, which is horizontally mounted on the switching shaft, has the function of a counter bearing for the two toggle links.

The dogs fastened with pins to the ends of the toggle links are of freewheeling design, so that they can decouple each other during the switching process. The operating lever controls the switch position indicator mounted to the drive carrier.

Fig. 26
1 Earthing switch actuating shaft
2 Switch position indicator - slide
3 Tripping lever
4 Accumulator tension spring
5 Circuit-breaker actuating shaft
6 Blade inhibitor for earthing switch
7 Tripping roller
8 Linkage for front cover interlock
9 Toggle link
10 Switching shaft
11 Operating lever
12 Drive carrier
13 Toggle link for earthing switch
14 Compression spring for earthing switch
15 Compression spring for circuit-breaker
While tensioning the compression spring (left hand turn) the tripping roller, rotably mounted on the pressure spring unit, locks at the front face of the tripping latch. When turning the actuating shaft for the circuit-breaker clockwise the compression spring is relieved and the accumulator tensioning spring is tensioned. The accumulator is relieved by excitation of the transformer-operated trip via the protection relay. The stroke rod of the transformer operated trip (lift magnet) swivels the angle contact face to the side. This overrides the locking of the tripping shaft and releases the tripping lever (see Fig. 27).

With the help of a control cam the tripping lever presses the tripping roller out of its locked position on the accumulator. The accumulator is relieved, the circuit-breaker is switched to OFF position.

The push button in the front panel swivels the angle contact face to the side via a linkage and triggers the accumulator in the same way as the transformer-operated trip.

A shunt trip release (lift magnet) can be optionally installed above the transformer-operated trip, which will, when excited, relieve the accumulator in the same way as the transformer operated trip.

In case of manual deactivation with the switching lever the tripping roller is pressed out of its lock by a lever system, in order to relieve the accumulator.

Fig. 27

1 Linkage
2 Push button
3 Lift magnet blade inhibitor
4 Shunt release
5 Transformer-operated trip
6 Angle contact face
7 Tripping shaft
8 Anti-reverse interlock (optional)
4.4.3 Motor drive (optional)

A motor drive system (Fig. 28) can optionally be retrofitted to all drive types - even subsequently. This complies with all standard direct and alternating voltages. For details see “Motor drive system for SF6-insulated switchgear systems of type GA/GAE Load-break switch panels K, TS circuit-breaker panels LSF”, article no. 12265423.
4.5 Switch panel interlocks

The switchgear panels are equipped with the following interlocks as standard.

Switching interlock
- In the cable panel: between load-break switch and earthing switch
- In the circuit-breaker panel: between circuit-breaker and earthing switch

Front cover interlock
- between earthing switch and front cover.

Anti-reverse interlock (optional)
- Between fastener and load break switch (cable panel)
- between fastener and circuit-breaker (circuit-breaker panel)

Switching interlock and front cover interlock are activated or deactivated during the switching process via lever and rod drives.

4.5.1 Switching interlock (Fig. 29)

The interlock between load-break and earthing switch in the cable panel (between circuit-breaker and earthing switch in the circuit-breaker panel) or earthing/circuit-breaker is accomplished by the position indicator plate, whereby a downward extended plate tongue slides laterally into the horizontal recess in the actuating shaft (earthing/load-break switch or earthing/circuit-breaker). During this process always the opposite plug-in opening for the switching lever (actuating shaft), which is switched to ON-position, is closed. When the actuating shaft for earthing is switched to ON-position, the actuating shaft for the load-break switch / circuit-breaker of this panel is closed (and vice versa). When switching both actuating shafts to OFF-position the plugging openings for both actuating shafts are open.

4.5.2 Front cover interlock (Fig. 30)

On the front cover interlock a bolt is inserted into a recess on the front cover. Controlled via the drive the pin is only retracted from the front cover when the earthing switch is switched to ON-position. The front cover can be removed.

Fig. 29

Fig. 30
4.5.3 Anti-reverse interlock (optional) (Fig. 31)

The anti-reverse interlock is switched on or off with the fastener key and the fastener in the front cover via a link drive. When closing/opening the front cover the anti-reverse interlock is activated/deactivated at the same time.

A sheet metal tongue (in front of the switch position indicator plate) turns sideways into the horizontal recess in the actuating shaft and closes the plugging opening for the switching lever.

With the fastener opened on the load-break switch / circuit-breaker panel the sheet metal tongue closes the actuating shaft and prevents activation of the load-break switch / circuit-breaker after the front cover has been removed. For cable tests the earthing switch can be deactivated even if the front cover has been removed.

Function of fastener:

- Turn the fastener clockwise to the end stop!
  The front cover is locked, the sheet metal tongue does not cover the plugging opening for the actuating shaft.

- Turn the fastener anti-clockwise to the end stop!
  The front cover is unlocked, the sheet metal tongue covers the plug-in opening for the actuating shaft (Fig. 31).
4.6 Gas tank

The power cable is connected to the cable panels/circuit-breaker panel using cast resin bushings with outer taper (acc. to DIN EN 50181), which are individually tested for compliance with the maximum permissible partial-discharged value. Copper bars connect the three-position switch to the cable bushings. Inside the gas tank three copper busbars are mounted along the rear wall and connect the individual phases of all panels among each other. The guarantee for safe functioning of the sealed pressure system requires optimal mechanical processing of all mechanical components and an strict leak tightness of the tank. The gas tank is made of stainless steel. Bushings, sealing flange for actuating shaft and bursting plate are sealed towards the tank by means of sealing rings. The rotating stainless steel switching shaft of the three-position switch are sealed towards the tank by a double pair of radial seals.

After the evacuation process each item of switchgear is filled with dry SF$_6$-gas, in accordance with IEC 60376. The additional installation of a molecular sieve absorbs smallest amounts of moisture and permanently regenerates the SF$_6$. The performance of a leak test according to IEC 62771-200 is proof that the permissible leak rate (10$^{-7}$ mbar l/s) of the hermetically welded tank is not exceeded.

4.7 Gas leakage indicator

The gas pressure is indicated by an aneroid diaphragm pressure gauge, which is connected to the tank via a check valve. The pressure gauge is corrosion-resistant against normal environmental influences. The indication range (Fig. 32) is divided into two measuring ranges.

![Fig. 32](image)

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 bar</td>
<td>Red: Not ready for switching!</td>
</tr>
<tr>
<td>1.0 bar</td>
<td>Green: Ready for switching</td>
</tr>
</tbody>
</table>

Before each switching process the gas leakage indicator and therefore the gasfilling inside the tank must be checked.

4.8 Density monitor (optional)

For remote monitoring the switchgear can optionally be equipped with a temperature-compensated density monitor, which works as a normally closed contact in the auxiliary circuit.

The bottom switching point of the density monitor is 138 kPa abs. If the pressure in the gas tank drops to 138 kPa abs., the density monitor will report this pressure drop.

The density monitor is fastened to the non-return valve, together with the gas leakage indicator.

The density monitor is equipped with an auxiliary switch.
4.9 Capacitive voltage indicator

For the detection of the de-energized state a measuring bar (capacitive coupling part) is integrated in each panel section.

It is a HR-system acc. to VDE 0682, part 415 and IEC 61243-5.

The measuring bar consists of a plastic housing with all electronic components cast in.

Corrosion resistant sockets enable the connection of conventional display units.

The coupling electrode in each bushing connected in series with the sub-capacitor has the function of a capacitive voltage divider.

The coupling part must be subjected a requalification test at regular intervals (approx. every 6 years).

This test must be performed under operating voltage and by using appropriate testing equipment or adapters.

Captive shrouds protect the test sockets against dirt, dust and moisture (Fig. 33).

For voltage testing they must be swivelled by 90°. The test can be performed with an appropriate voltage tester (Table 5).

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For voltage testing they must be swivelled by 90°. The test can be performed with an appropriate voltage tester (Table 5).

<table>
<thead>
<tr>
<th>Pfisterer</th>
<th>Type DSA-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horstmann</td>
<td>Type HO-ST-1</td>
</tr>
<tr>
<td>ELSIC</td>
<td>Type HO-SA</td>
</tr>
<tr>
<td>Jordan</td>
<td>Type KSP HR</td>
</tr>
<tr>
<td>Dehn</td>
<td>Type DEHN cap/P-HR</td>
</tr>
</tbody>
</table>

Table 5

With a flashing indicator these units indicate that voltage is applied to the testing point of the bushing.

During every switch procedure (connection to or disconnection from the mains) the function of the capacitive voltage testing system must be checked, if a de-energised state is detected (see Chapter 6.2). Always check all phases L1, L2, L3!
4.10 Short-circuit indicator (optional)

In the cable panels the Ring Main Unit can be optionally equipped with short-circuit indicators. Two different designs can be installed.

**Short-circuit indicator mounted to the single-conductor cables (Fig. 35).**

These design types can vary.
- Short-circuit indicator with rotor system.
  In this case the rotary mounted rotor must be manually reset after it has tripped.
- Short-circuit indicator with liquid.
  The red particles whirled up after tripping remain suspended for 4-8 hours; after this time the indicator is clear again (automatic reset).
- Short-circuit indicator with fluid (automatic reset) and micro-fleeting contact.
  The contact closes for the duration of the short-circuit and therefore makes possible remote signalling.

When installing the short-circuit indicators the earthing strand of the sealing end must be routed through the installation ring of the short-circuit indicator and connected to the earthing screw on the cable fixing iron.

For the use of these short-circuit indication systems the front covers are provided with inspection windows (optional).

**Fig. 35**

**Short-circuit indicator for installation in front panel (Fig. 36).**

The indicator unit is integrated in a control panel plug-in housing acc. to DIN 43700 and is installed in the front panel of the Ring Main Unit next to the actuating shaft for the load-break switch for the assigned panel. In the factory three sensors are mounted to the bushing, electrically connected to the indicator unit and tested.

The following types are used:
- **Short-circuit indicator ALPHA M type** (manual release).
  The indicator unit contains an electronic circuit with rotary knob generator and three rectangular flags, one for each phase in the panel. The indication is maintained until it is manually reset by turning the rotary head quickly in an anti-clockwise direction. The function test on the short-circuit indicator is performed by turning the rotary knob quickly in the clockwise direction.

- **Short-circuit indicator ALPHA/E type** (automatic release).
  The indicator unit is fitted with an electronic control, a test/reset push button and three rectangular indicating flags, one for each phase of the field.
  The indication is maintained until it is automatically reset after two or four hours (factory setting). Premature resetting is possible by means of remote resetting or via the push button on the unit.
  The function test on the short-circuit indicator is performed by pressing the push-button.
  The energy for temporal resetting and function test is taken from a lithium cell (lifetime > 15 years). The energy required for the excitation of the indicating flags and for the remote contact is taken from the short-circuit current.

On customer request, other types of short-circuit indicators can also be fitted.
4.11 Protection technology

4.11.1 Transformer protection with transformer current dependent relay

For protection of a transformer we recommend the use of a dependent overcurrent time-lag relay with transformer-operated trip. This is especially suitable for medium-voltage switchgear in transformer or distributor substations without substation battery.

The protection system is characterized by the following features:

- the system consists of an AMZ-relay, transformer and a low energy breaking trip
- no auxiliary voltage required
- tripping pulse repetition, until the primary current is interrupted
- each protection system factory tested
- a wide selection of characteristic curves
- selectivity between medium voltage and low voltage
- fully encapsulated, therefore independent from climatic conditions
- complies with requirements acc. to VDE 0345 part 303, IEC 255

![Diagram of protection characteristics](image-url)

**Fig. 37**

1 = Inrush current of transformer (peak value)
2 = NH-characteristic curve
3 = tripping characteristic with tolerance band
4.11.2 Line protection with transformer current dependent relay

For the protection of a line or transformer branch we recommend a two-stage independent overcurrent time-lag relay with transformer-operated trip. This is especially suitable for medium voltage switchgear in distributor substations without substation battery.

The protection system is characterized by the following features:

- the system consists of a UMZ relay, transformer and a low energy breaking trip
- no auxiliary voltage required
- tripping pulse repetition, until the primary current is interrupted
- each protection system factory tested
- no intervention in the protection system during installation of the switchgear
- separately adjustable overcurrent and short-circuit current stage
- fully encapsulated, therefore independent from climatic conditions
- complies with requirements acc. to VDE 0345 part 303, IEC 255

Further protection relay systems on request. The installation of customer owned protection systems needs our approval.

Fig. 38
5 Operation

5.1 Switching accessories

For operation of the switchgear the following accessories are needed:

1. Switching lever for load-break switch / circuit-breaker (bare shaft)
   (optional for load-break switch/circuit-breaker and earthing switch (only in conjunction with 1-lever drive)).

2. Switching lever for earthing switch (red shaft)
   (only in conjunction with 2-lever drive).

3. Square socket key for front cover fastener (controls the anti-reverse interlock).

The switching levers used to switch the Ring Main Unit are fitted with a torque reducing safety feature, which avoids damage to the drives.

When trying to continue a switching operation in a switch position (ON/OFF) by application of force, the knob of the switching lever will bend.

**Attention!**

Never leave the switching lever inserted in the actuating shaft, because operation of the other actuating shaft will damage the switching interlock of the panel.
5.2 Padlocking facility

The Ring Main Unit is fitted with padlocking facilities as standard (Fig. 40). The padlocking facility is opened by pressing the thumb against the locking resistance of the locking cover in clockwise direction. The padlocking facility stops in end position by means of an integrated stop, so that also the adjacent padlocking facility can be opened. The access to the actuating shafts can be secured with a maximum of three locks.

Note!

In the description of the switching operations in chapters 5.3 and 5.4 the padlocking facilities are not shown, for the purpose of a clearer representation of switch position indicators and actuating shafts.

Fig. 40
5.3 Delivery condition of Ring Main Unit

Upon delivery the Ring Main Unit is in the following switch position:

**Note!**

For reasons of clarity the drawings in chapters 5.3 and 5.4 do not show any padlocking facilities.

**Cable panel (K-panel)**

Earthing switch activated. Load-break switch deactivated and locked by switching interlock.

**Circuit-breaker panel (LSF-panel)**

Earthing switch activated. Circuit-breaker deactivated and locked by switching interlock.

---

**Fig. 41**

Fastener closed (Anti-reverse interlock optional).

**Fig. 42**

Earthing switch activated. Load-break switch deactivated and locked by switching interlock.

**Fig. 43**

Earthing switch activated. Circuit-breaker deactivated and locked by switching interlock.
5.3.1 Remove the front cover

⚠️ Before removing the front cover, the particular panel has to be switched off and earthed (see chapter Chapter 5.4).

---

**Cable panel (K-panel)**

- **Fastener opened** (Anti-reverse interlock optional).

**Circuit-breaker panel (LSF-panel)**

- **Earthing switch activated.**
- **Load-break switch deactivated.**
- **Load-break switch locked by switching interlock and anti-reverse interlock (optional).**
- **The plate of the switching interlock is located behind the plate of the anti-reverse interlock.**

---

In the switch position described the front covers are removable, because the pin of the front cover interlock has been pulled out of the front cover Fig. 48).

**Remove front cover:**

- Lift the front cover up against the stop (Fig. 47/1).
- Pull the front cover off to the front (Fig. 47/2)
5.4 Switching the switchgear

⚠ Check the gas leakage indicator before switching the switchgear.

In case of a red indication the switchgear must not be switched!
In such a case inform the customer service of Ormazabal.

![Fig. 49](image1)
Gas overpressure correct
– Unit may be switched.

![Fig. 50](image2)
Gas overpressure not correct
– Unit may not be switched.

Before switching the load-break switch and the circuit-breaker the front covers must be inserted. The fastener must be closed with the fastener key. For this purpose turn the fastener key clockwise to the end stop (Fig. 51).

The switch positions of earthing and load-break switches as well as of the circuit-breaker can be read from the indicating device in the mimic diagram of the system (Fig. 52).

⚠ Note!
Load-break switches / circuit-breakers and associated earthing switches are mechanically locked with each other.

If the earthing switch is switched ON the plugin opening on the switching shaft of the corresponding load-break switch/ circuit-breaker is closed by a locking plate.

⚠ If the switching procedure includes safety disconnection and earthing/short-circuiting, the integral voltage detecting systems and suitable voltage testers should in any case be used in compliance with VDE 0105 Part 100.
5.4.1 Switching the cable panel on

1 Switch position with deactivated load-break switch and activated earthing switch.

2 Switch off the earthing switch. Hold the switching lever (red shaft) depressed to the end stop against spring pressure and turn it anti-clockwise.

3 Switch position with deactivated load-break switch and deactivated earthing switch.

4 Switch the load-break switch on. Hold the switching lever (bare shaft) depressed to the end stop against spring pressure and turn it clockwise.

5 Switch position with activated load-break switch and deactivated earthing switch.
5.4.2 Switching off and earthing the cable panel

1. Switch position with activated load-break switch and deactivated earthing switch.

2. Switch off the load-break switch. Hold the switching lever (bare shaft) depressed to the end stop against spring pressure and turn it anti-clockwise.

3. Switch position with deactivated load-break switch and deactivated earthing switch.

⚠️ Verify safe isolation from supply acc. to VDE 0105 part 1 (if earthing is required). Always check all phases L1, L2, L3!

4. Switch on the earthing switches. Hold the switching lever (red shaft) depressed to the end stop against spring pressure and turn it clockwise.

5. Switch position with deactivated load-break switch and activated earthing switch.
5.4.3 Switching on the circuit-breaker panel

1. Switch position with deactivated circuit-breaker, tripped message and activated earthing switch.

Note!
The side plate "TRIPPED" of the switch position indicator is only displayed when the circuit-breaker is switched off by the push button, the shunt trip release (optional) or the transformer-operated trip.

2. Switch off the earthing switch. Hold the switching lever (red shaft) depressed to the end stop against spring pressure and turn it anti-clockwise.

3. Switch position with deactivated earthing switch and deactivated loadbreak switch.

4. Tension the circuit-breaker.

Note!
No counter spring pressure on circuit-breaker. Insert switching lever (bare shaft) and turn it anti-clockwise against the stop.

5. Switching position after tensioning the closing spring. The tripped signal in the switch position indicator is no longer visible.
Switch on the circuit-breaker. Turn the switching lever (bare shaft) clockwise.

Switch position with switched on circuit-breaker and switched off earthing switch.
5.4.4 Switching off and earthing the circuit-breaker

1. Switch position with switched on circuit-breaker and switched off earthing switch.

2. Switch off the circuit-breaker. Press the push button.

3. Switch position after deactivating the circuit-breaker.

4. Switch on earthing switch. Hold the switching lever (red shaft) depressed to the end stop against spring pressure and turn it clockwise.

5. Switch position with deactivated circuit-breaker and activated earthing switch.

⚠️ Verify safe isolation from supply acc. to VDE 0105 part 100 (if earthing is required). Always check all phases L1, L2, L3!
6 Commissioning

For commissioning the correct function of the Ring Main Unit must be assured by checking the following points:

- Please compare the data of rating plate, delivery note and order documents.
- Check the wiring of the secondary equipment by following carefully the specifications in the circuit documentation provided for the respective equipment configuration.
- Check all screwed connections (cable connections, equipment joints, system earthing, fuse installation) for tight fit (torque) and proper fastening.
- Check the available service pressure on the gas leakage indicator (the pointer must be in the green sector).
- In case of an installed density monitor check the reading on the pressure gauge when the voltage supply is switched on.
- After the installation of the Ring Main Unit perform a function test of the switches.

6.1 Switching (manually by means of switching lever)

**Cable panel (K-panel)**

**SWITCHING ON**
- Switch off the earthing switch.
- Switch on the load-break switch.

**SWITCHING OFF**
- Switch off the load-break switch.
- Switch on earthing switch.

**Circuit-breaker panel (LSF-panel)**

**SWITCHING ON**
- Switch off the earthing switch.
- Tension the circuit-breaker (spring accumulator).
- Switch on the circuit-breaker.

**SWITCHING OFF**
- Switch off the circuit-breaker/push button.
- Switch on earthing switch.

**Switching of the circuit-breaker panel via the shunt trip release (option)**

- Switch on the circuit-breaker panel with the switching levers.
- For switching tests of the shunt release activate the voltage supply.
- Actuate the push button or the respective control transmitter on the remote trip until the circuit-breaker panel is deactivated and the switch position indicator shows “TRIPPED”.

---

**Note!**

The Ring Main Unit is delivered with closed front covers and in earthed switch position (see Chapter 5.3).
6.2 Verifying the safe isolation from supply

Before switching off and earthing an operating Ring Main Unit, use the capacitive voltage detecting system to check the de-energized state of the panels.

⚠️ Attention!
Tests must always be performed in triplepole mode!
Compliance with VDE 0105 part 1 is mandatory!

When checking the cable/circuit-breaker panel the following steps must be performed:

- With the Ring Main Unit switched on open the capacitive measuring points by turning the shrouds.
- Plug 3 voltage testers (see Table 5, Chapter 4.9) into the measuring sockets in the corresponding switchgear panel (Fig. 77).

The voltage testers must flash.

- Switch the load-break switch / circuit-breaker to “OFF”.
- Isolate also the second cable end.

The voltage testers must no longer flash!

- Switch the earthing switch to "ON".

The outgoing cable is now electrically isolated.

- Upon completion of the test remove the voltage testers and close the shrouds.

Fig. 77
6.3 Phase comparison

A phase comparison between two outgoings can of course be performed at the insulated test sockets (e.g. Manuf. Horstmann: type ORION, manuf. Pfisterer: type EPV, Manuf. ELSIC: type HO-PV). The correct function of the phase comparison device must be checked in compliance with the instructions of the manufacturer (Fig. 78).

6.4 Cable test

The cable test is performed on the appropriately equipped cable set. Fig. 79 shows the male cable connector of type AB 24-630 with assembled testing adapter type PAK 630. The testing adapter PAK 630 can also be used for male cable connector CB 24-630.

For the execution of a cable test the following steps must be performed:

– Open the plugs for the capacitive measuring points by turning.
– Insert 3 voltage testers into the measuring sockets.

The voltage testers must flash.

– Switch the switch of the switchgear panel to be tested/measure to "OFF". In case of A-panels the adjacent panels must be switched off.
– Safely disconnect and earth the second cable end.

The voltage testers must no longer flash!

– Switch the earthing switch of the switchgear panel to be measured to "ON".
– Remove the front cover.
– Unscrew the threaded insert from the male cable adapter.
– Screw the test adapter onto the threaded pin of the male cable adapter (observe the tightening torque).
– Switch the earthing switch to "OFF".

Perform measurement/test. The cable panel can be tested with a maximum direct voltage of $8U_0 = 96$ kV. The circuit-breaker panel can be tested with a maximum direct voltage of $6U_0 = 72$ kV. The busbars may conduct an operating voltage of maximum 24 kV!

After completion of the cable test:

– Switch the earthing switch to "ON".
– Unscrew the testing adapter.
– Screw the threaded insert into the male cable adapter (observe the tightening torque).
– Insert the front cover.

The switchgear panel can be activated.
7 Maintenance

Maintenance and repair work as well as subsequent modifications must only be performed by skilled personnel and in compliance with the operating instructions, the accident prevention instructions and the regulations of the liability associations.

7.1 Inspection

Depending on the operating and local conditions an inspection of the switchgear should be performed every 4 years in order to check the condition of the unit.

Test switching of the circuit-breaker panel should be performed every 10 years.

This should include a check of the function of the accumulator in the LSF-drive by:

- switching off with the push button (Fig. 80)
- manual tripping with the switching lever.

Fig. 80

The tripping shaft mechanically releases the TRIPPED message, which is displayed in the switch position indicator of the circuit-breaker switch.

The function of the shunt release (optional) shall also be checked by tripping (electrically).

Protective equipment should be inspected locally at regular intervals. The duration of the inspection interval depends, amongst other things, on the type of the relay used and the specific operating conditions of the switchgear.

During the relay test all relay functions, including the adjustment values and tripping characteristics and tripping times must be checked.

If the protection transformers include a testing coil, this should be used for the relay test.

In case of operation under severe environmental conditions (temperature, dirt, gases) shorter inspection intervals may be necessary.

The operating pressure of the SF₆-gas tank should be checked for pressure loss during this process. As long as the pointer in the gas leakage indicator is in the green sector the pressure is sufficient.

The switching station should be subjected to a general visual examination. Check the switchgear for any peculiarities such as dirt deposits or changes caused by other environmental influences.

7.2 Maintenance

The drives and the switches themselves are maintenance-free.

The gas tank is welded gas-tight and all components inside are maintenance-free.

The SF₆-gas is resistant to ageing and is not consumed during the switching operations.

Under normal conditions the SF₆-gas does not need to be refilled during the lifetime of the switchgear.
7.3 Cleaning

**Attention!**
Before starting cleaning work the switchgear must be isolated.

As a measure to avoid impermissible switching processes the auxiliary voltage supply must be switched off.

- The switchgear must be isolated as specified in the chapter on operation.
- Open the fasteners and remove the front covers (if required).

Carefully clean off all dirt, especially from the surfaces of insulating materials. Clean off strongly adhesive, e.g. greasy, dirt with a lint-free cloth soaked in a commercial detergent, then wipe off with clear water and dry.

**Attention!**
Do not use any aggressive solvents!

7.4 Return of switchgear

For Ormazabal switchgear at least a 30-year operating time is assumed. The "hermetically sealed pressure system" acc. to IEC does not require refilling of the SF₆ gas over the entire operating time.

Due to the high reliability of the switchgear arc faults are almost completely ruled out. The handling and implementation of safety measures for switchgear, that has failed or has been taken out of operation because of such incidents, is described in the brochure SF₆-systems, issued by the liability association for precision engineering and electrical engineering.

In 1993 the plant in Krefeld was certified acc. to DIN EN ISO 9001 for its quality system and in 1998 acc. to DIN EN ISO 14001 for its environment management system. As a competent partner Ormazabal offers you the return of your switchgear after the expiration of the above mentioned operating time. The costs involved depend on the legal requirements applicable at the time of return.

This switchgear contains the fluorinated greenhouse gas SF₆ covered by the Kyoto Protocol and with a global warming potential (GWP) 22200. SF₆ shall be recovered and not released into the atmosphere.

For further information on use and handling of SF₆ please refer to IEC 62271-303: High-voltage switchgear and controlgear – Part 303 Use and handling of sulphur hexafluoride (SF₆).

All other materials of this switchgear should also be recycled.
## 8 Technical data

### 8.1 General data

<table>
<thead>
<tr>
<th>Description</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated filling pressure of insulating gas at 20 °C and 101.3 kPa</td>
<td>150 kPa (50 kPa overpressure)</td>
</tr>
<tr>
<td>Minimum service pressure of insulating gas at 20 °C and 101.3 kPa</td>
<td>140 kPa</td>
</tr>
<tr>
<td>Insulating gas</td>
<td>SF₆</td>
</tr>
<tr>
<td>SF₆-filling capacity at 20 °C and 101.3 kPa</td>
<td>2.16 kg</td>
</tr>
<tr>
<td>Rated density of insulating gas</td>
<td>9.1 kg/m³</td>
</tr>
<tr>
<td>Ambient temperature T with secondary equipment</td>
<td>–5 to +40 °C ¹</td>
</tr>
<tr>
<td>with reduced rated currents</td>
<td>over +40 °C</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>maximum 95 % (indoor conditions)</td>
</tr>
<tr>
<td>Enclosure of HV compartment</td>
<td>sealed pressure system</td>
</tr>
<tr>
<td>in accordance with IEC, IP65</td>
<td></td>
</tr>
<tr>
<td>Enclosure of the drive housing</td>
<td>IP 44</td>
</tr>
<tr>
<td>Enclosure of cable connection compartment</td>
<td>IP 44</td>
</tr>
<tr>
<td>Internal arc classification according to VDE 0671 part 200 or IEC 62271-200</td>
<td>IAC AFL 20 kA 1 s for HV compartment and connection compartment</td>
</tr>
<tr>
<td>Coloration of equipment</td>
<td>RAL 7035 (light grey)</td>
</tr>
<tr>
<td>Loss of service continuity category</td>
<td>LSC 2A</td>
</tr>
<tr>
<td>Partition class</td>
<td>PM</td>
</tr>
<tr>
<td>Weight</td>
<td>see page 9, Table 1</td>
</tr>
</tbody>
</table>

Table 6

¹) Usage at lower temperatures on request
8.2 Technical data GA Ring Main Unit

<table>
<thead>
<tr>
<th></th>
<th>Cable panel K</th>
<th></th>
<th>Feeder panel LSF</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Load-break</td>
<td>Earthing</td>
<td>Circuit-breaker</td>
<td>Earthing</td>
</tr>
<tr>
<td></td>
<td>switch</td>
<td>switch</td>
<td>switch</td>
<td>switch</td>
</tr>
<tr>
<td>Rated frequency</td>
<td>f</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
<td>50/60 Hz</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>U</td>
<td>12 kV</td>
<td>24 kV</td>
<td>12 kV</td>
</tr>
<tr>
<td>Rated normal current</td>
<td>I</td>
<td>630 A</td>
<td>–</td>
<td>250 A / 630 A</td>
</tr>
<tr>
<td>Rated short-duration power-frequency withstand voltage 1 min.</td>
<td>U</td>
<td>28 kV</td>
<td>50 kV</td>
<td>28 kV</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage</td>
<td>U</td>
<td>75 kV</td>
<td>125 kV</td>
<td>75 kV</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage of the air gap</td>
<td>U</td>
<td>85 kV</td>
<td>145 kV</td>
<td>85 kV</td>
</tr>
<tr>
<td>Rated mainly active load breaking current</td>
<td>I</td>
<td>630 A</td>
<td>–</td>
<td>250 A / 630 A</td>
</tr>
<tr>
<td>Rated short-circuit-breaking current</td>
<td>I</td>
<td>–</td>
<td>–</td>
<td>20 kA</td>
</tr>
<tr>
<td>Rated cable-charging breaking current</td>
<td>I</td>
<td>50 A</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rated earth fault breaking current</td>
<td>I</td>
<td>160 A</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rated cable and line-charging breaking current under earth fault conditions</td>
<td>I</td>
<td>100 A</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Rated peak withstand current</td>
<td>I</td>
<td>50 kA</td>
<td>40 kA</td>
<td>50 kA</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>I</td>
<td>20 kA</td>
<td>16 kA</td>
<td>20 kA</td>
</tr>
<tr>
<td>Rated duration of short circuit</td>
<td>t</td>
<td>1 s (3 s)</td>
<td>1 s (3 s)</td>
<td>1 s (3 s)</td>
</tr>
<tr>
<td>Rated short-circuit making current</td>
<td>I</td>
<td>50 kA</td>
<td>40 kA</td>
<td>50 kA</td>
</tr>
<tr>
<td>Number of switching operations at rated short-circuit-breaking current</td>
<td>n</td>
<td>–</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>Number of switching operations at rated short-circuit making current</td>
<td>n</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Number of mechanical switching operations</td>
<td>n</td>
<td>1000</td>
<td>1000</td>
<td>2000</td>
</tr>
<tr>
<td>Number of operating cycles with mainly active load</td>
<td>n</td>
<td>100</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Class</td>
<td>–</td>
<td>E3 M1</td>
<td>E2</td>
<td>E2 M1</td>
</tr>
</tbody>
</table>

Table 7

8.3 Processing time guide values for circuit-breaker

|                              | –             | CO               |
| Mechanical switching delay of motor operator | s | 6               |
| Opening time                 | ms            | Approx. 44       |
| Arcing time                  | ms            | Approx. 17       |
| Total opening time           | ms            | Approx. 61       |
| Nominal switching sequence   | –             | O - 3 min - CO - 3 min - CO |

Table 8
8.4 Shunt trip release and transformer-operated trip

Electromagnet shunt release (optional)

<table>
<thead>
<tr>
<th>Nominal voltage (V)</th>
<th>Nominal power (W/VA)</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>147</td>
<td>6</td>
</tr>
<tr>
<td>48</td>
<td>238</td>
<td>6</td>
</tr>
<tr>
<td>60</td>
<td>323</td>
<td>6</td>
</tr>
<tr>
<td>110</td>
<td>37</td>
<td>6</td>
</tr>
<tr>
<td>220</td>
<td>132</td>
<td>6</td>
</tr>
<tr>
<td>Alternating current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>35</td>
<td>6</td>
</tr>
<tr>
<td>230</td>
<td>131</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 9

<table>
<thead>
<tr>
<th>Nominal voltage (V)</th>
<th>Nominal power (W/VA)</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>32</td>
<td>14</td>
</tr>
</tbody>
</table>

Table 10

8.5 Density monitor

8.5.1 Density monitor GMD1 (optional)

<table>
<thead>
<tr>
<th>Pressure range</th>
<th>Switchpoint</th>
<th>Make-break capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1000 hPa</td>
<td>380 hPa</td>
<td>250 V / 5 A 1)</td>
</tr>
</tbody>
</table>

Table 11 1) Further tripping data on request

8.5.2 Auxiliary switch

Load-break switch (Q0) and earthing switch (Q8)
Switching duty 250 V / 10 A

8.6 T-connection kits

T-connection kits are to be used at the discretion of the operator. To be connected to bushings acc. to DIN EN 50181 connection type C (630 A) with outside taper and screw contact (M16). On uncontrolled systems the installation instructions of the manufacturer must be strictly observed.

Installation possibilities for cable connection kits:

<table>
<thead>
<tr>
<th>NKT</th>
<th>Südkabel</th>
<th>tyco Electronics</th>
<th>Euromold/Nexans</th>
<th>Prysmian</th>
<th>Celpack</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 kV</td>
<td>20 kV</td>
<td>10 kV</td>
<td>20 kV</td>
<td>10 kV</td>
<td>20 kV</td>
</tr>
<tr>
<td>XLPE-Cable</td>
<td>SET12</td>
<td>SET24</td>
<td>RSTI</td>
<td>RSTI</td>
<td>K400TB</td>
</tr>
<tr>
<td>CC12</td>
<td>CC24</td>
<td>SEHD13</td>
<td>SEHD23</td>
<td>RICS...</td>
<td>RICS...</td>
</tr>
<tr>
<td>CB36</td>
<td>CB36</td>
<td>SEHDT13.1</td>
<td>SEHDT23.1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AB12</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>AC12</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

Table 12

Note!

Information on further connection possibilities is available from our application information GA as well as on request.
8.7 Tightening torques

<table>
<thead>
<tr>
<th>Thread nominal diameter</th>
<th>Screw connections strength class 8.8</th>
<th>Welded studs</th>
</tr>
</thead>
<tbody>
<tr>
<td>M5</td>
<td>6 Nm</td>
<td>–</td>
</tr>
<tr>
<td>M6</td>
<td>10 Nm</td>
<td>5.9 Nm</td>
</tr>
<tr>
<td>M8</td>
<td>25 Nm</td>
<td>14.7 / -0.2 Nm</td>
</tr>
<tr>
<td>M10</td>
<td>49 Nm</td>
<td>–</td>
</tr>
<tr>
<td>M12</td>
<td>86 Nm</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 13

8.8 Switching forces with manual operation

<table>
<thead>
<tr>
<th>Drive type/Actuating shaft</th>
<th>Switching position</th>
<th>Torque actuating shaft (Nm)</th>
<th>Force to be applied (N) (manual)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable panel drive earthing switch</td>
<td>Making / breaking</td>
<td>55</td>
<td>130</td>
</tr>
<tr>
<td>Cable panel drive load-break switch</td>
<td>Making / breaking</td>
<td>55</td>
<td>130</td>
</tr>
<tr>
<td>LSF-drive earthing switch</td>
<td>Making / breaking</td>
<td>85</td>
<td>200</td>
</tr>
<tr>
<td>LSF-drive circuit-breaker</td>
<td>Tensioning</td>
<td>110</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Making</td>
<td>70</td>
<td>165</td>
</tr>
<tr>
<td></td>
<td>Breaking</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 14

8.9 Materials

<table>
<thead>
<tr>
<th>Metals</th>
<th>Steel, copper, aluminium, zinc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic materials</td>
<td>PC, PA, EPDM, NBR, EP; POM, Q, (PF/ MF, PBT, GFK optional)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Aluminium oxide, lubricants, SF₆ gas</td>
</tr>
</tbody>
</table>

Table 15
8.10 Permissible number of operating cycles for the load-break switch

![Graph](image)

Fig. 81

8.11 Permissible number of operating cycles for the circuit-breaker

![Graph](image)

Fig. 82
8.12 Regulations and standards

8.12.1 Test specifications

The Ring Main Unit complies with the following standards or publications:

IEC 60265-1 (62271-103)\(^1\) / VDE 0670 Part 301 (VDE 0671 Part 103)\(^1\)
IEC 60529 / VDE 0470 part 1
IEC 61243-5 / VDE 0682 part 415
IEC 62271-1 (60694)\(^2\) / VDE 0670 Part 1000 (VDE 0671 Part 1)\(^1\)
IEC 62271-100 / VDE 0671 part 100
IEC 62271-102 / VDE 0671 part 102
IEC 62271-200 (60298)\(^2\) / VDE 0671 part 200 (VDE 0670 part 6)\(^2\)
IEC 62271-303\(^1\) / VDE 0671 part 303\(^1\)

BlmSchV Federal Gazette 1996, part 1 no. 66 dated 20/12/1996
\(^1\) Future
\(^2\) Former

8.12.2 Female connector (bushing)

Design of terminal components acc. to DIN EN 50181 connection type C (630 A) with external taper and screw contact M16.