SF$_6$-insulated, metal-enclosed Ring Main Unit
with fuse switch disconnector in the outgoing panel
Type GA...A/K/KS/TS (-C)
for rated voltages of up to 24 kV
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System overview

1. Actuating shaft for earthing switch
2. Actuating shaft for load-break switch
3. Padlocking facility for earthing switch
4. Switch position indicator
5. Panel designation
6. Padlocking facility for load-break switch
7. Short-circuit indicator
8. Shrouds (voltage indication ledge)
9. Gas leakage indicator
10. Transport bracket
11. Front panel
12. Rating plate
13. Fuse tripping mechanism (mechanical)
14. Tensioning lever
15. Fuse diaphragm
16. Upper fuse holder
17. Fastener
18. Cable connection compartment
19. Front cover
20. Lower fuse holder
21. Bursting plate
22. Pedestal
23. Cable fixing iron
24. Strengthening plate for cable fixing irons (optional)
25. System earthing
26. SF₆-gas tank
27. T-connector for VPE-cable
28. Bushing
29. Switching blade
30. Busbars
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 to make technical changes in the course of further development without the need to change these instructions.

No claims can therefore be raised on the basis of 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 Unit.

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 Ring Main Unit and thereby impair the safety for man, plant/panel 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 Ring Main Unit are prohibited for safety reasons and cause the exclusion of any liability by Ormazabal for any damage resulting from this.

1.2 Service information

The customer service department of Ormazabal is always available for any technical information on Ormazabal Ring Main Unit.

Should you encounter any difficulties with our equipment, please contact the local manufacturing plant. The address of the local manufacturing branch 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 operating current) at rated operating voltages of up to 24 kV.

Ring Main Units are used for e. g.:
- secondary substations
- industrial plants
- consumer’s installations
- wind turbine generators etc.

With Ring Main Unit:
- transformers
- overhead lines and cables

are switched.

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 instruction 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 Ring Main Unit.

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 assembly 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 the risk of electric voltage.

Attention!

Cautionary instruction

In these operating instructions this note appears at all points which must be especially observed in order to comply with guidelines, instructions and the correct work sequence, thereby avoiding damage and destruction of 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 (BGV A3), guidelines and the generally accepted technical rules and regulations (e. g. VDE regulations, IEC-standards, DIN standards).

2.3.2 Safety features

Safety installations must not be modified, dismantled or made ineffective. Unprotected parts of the system can cause fatal injuries.

All safety installations, such as covers, must always be fully functional and correctly in place. Operation of this Ring Main Unit with faulty safety installations is not permitted.

2.3.3 Auxiliary device for operation, maintenance and repair

If any auxiliary devices (tools or similar) are required for operation, maintenance or repair of the Ring Main Unit, 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 loading 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.

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!

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

Unloading must only 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).

<table>
<thead>
<tr>
<th>Types</th>
<th>Weight Ring Main Unit</th>
<th>Weight Ring Main Unit with pressure absorber channel</th>
<th>Weight Accessories</th>
<th>SF6 filling capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>GA 1T(K)S1A1</td>
<td>236</td>
<td>326</td>
<td>11</td>
<td>1,41</td>
</tr>
<tr>
<td>GA 1T(K)S1A1-C</td>
<td>214</td>
<td>–</td>
<td>19</td>
<td>1,41</td>
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<td>GA 1T(K)S1A2</td>
<td>246</td>
<td>336</td>
<td>11</td>
<td>1,41</td>
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<td>233</td>
<td>–</td>
<td>19</td>
<td>1,41</td>
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<td>236</td>
<td>326</td>
<td>11</td>
<td>1,41</td>
</tr>
<tr>
<td>GA 1K1TS-B-C</td>
<td>214</td>
<td>–</td>
<td>19</td>
<td>1,41</td>
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<tr>
<td>GA 3K</td>
<td>265</td>
<td>355</td>
<td>5</td>
<td>1,74</td>
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<td>GA 3K-C</td>
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<td>GA 2K1T(K)S</td>
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<td>1,74</td>
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<td>GA 2K1T(K)S-C</td>
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<td>1,74</td>
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<td>GA 2K2T(K)S</td>
<td>399</td>
<td>489</td>
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<td>2,46</td>
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<tr>
<td>GA 2K2T(K)S-C</td>
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<td>–</td>
<td>30</td>
<td>2,46</td>
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<tr>
<td>GA 3K1T(K)S</td>
<td>366</td>
<td>456</td>
<td>11</td>
<td>2,46</td>
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<tr>
<td>GA 3K1T(K)S-C</td>
<td>325</td>
<td>–</td>
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<td>GA 4K</td>
<td>354</td>
<td>444</td>
<td>5</td>
<td>2,46</td>
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<tr>
<td>GA 4K-C</td>
<td>313</td>
<td>–</td>
<td>19</td>
<td>2,46</td>
</tr>
</tbody>
</table>

Table 1 Weight of the various Ring Main Unit types
3.3 Arrival and unpacking of goods

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 actuarial reasons damages must be reported in writing to the delivering forwarding agent 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 torques see chapter 8, Table 11).

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 gear 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 tackle (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.

Fig. 3

Fig. 4
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 a torque according to chapter 8, Table 11.

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”.

---

**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 (except LSF panels), the foundation projection must be drawn at a distance of 135 mm from the wall!

In the case of the installation of LSF panels, a minimum distance of 200 mm is necessary. Only the variant with pressure absorber channel the minimum distance is 100 mm.

Note!

If it is assured that with any system extension no:
- GAE -1LSF- panels
- GAE measuring panels with metal cooling stretch arrangement are installed, the distance from the wall can be reduced to 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
- Washers DIN EN ISO 7089/7090 (switch panel 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 fixing 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, 2-panel switchgear

**GA 1T(K)S1A1, GA 1K1TS-B(-C)**

Fig. 6 shows the base fixing and floor opening dimensions for the switchgear GA 1T(K)S1A1 and GA 1K1TS-B(-C) for pressure relief as per variant 1 and variant 2 (see Chapter 3.6.10 Possible installations).

**GA1T(K)S1A1-C**

Fig. 7 shows the base fixing and floor opening dimensions for the switchgear GA1T(K)S1A1-C for pressure relief as per variant 1 (see Chapter 3.6.10 Possible installations).

---

**Note!**

If no GAE-panel is installed in the line, you may install the switchgear with its base having a minimum distance to the wall of 100 mm.
** GA 1T(K)S1A2 **

Fig. 8 shows the base fixing and floor opening dimensions for the switchgear GA 1T(K)S1A2 for pressure relief as per **variant 1** and **variant 2** (see Chapter 3.6.10 Possible installations).

Fig. 8 (Dimensions in mm)

** GA 1T(K)S1A2-C **

Fig. 9 shows the base fixing and floor opening dimensions for the switchgear GA 1T(K)S1A2-C for pressure relief as per **variant 1** (see Chapter 3.6.10 Possible installations).

Fig. 9 (Dimensions in mm)

** Note! **

If no GAE-panel is installed in the line, you may install the switchgear with its base having a minimum distance to the wall of 100 mm.
3.6.2 Floor fastening measurements, 3-panel switchgear

Fig. 10 and Table 2 show the base fixing and floor opening dimensions for the 3-panel switchgear for pressure relief as per variants 1, 2 and 3 (see Chapter 3.6.10 Possible installations).

<table>
<thead>
<tr>
<th>3-panel unit</th>
<th>A [mm]</th>
<th>B [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure relief</td>
<td>Variant 1, variant 2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Variant 3</td>
<td>325</td>
</tr>
</tbody>
</table>

Table 2

3.6.3 Floor fastening measurements, 4-panel switchgear

Fig. 11 and Table 3 show the base fixing and floor opening dimensions for the 4-panel switchgear for pressure relief as per variants 1, 2 and 3 (see Chapter 3.6.10 Possible installations).

<table>
<thead>
<tr>
<th>4-panel unit</th>
<th>A [mm]</th>
<th>B [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure relief</td>
<td>Variant 1, variant 2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Variant 3</td>
<td>325</td>
</tr>
</tbody>
</table>

Table 3

** Note!

If no GAE-panel is installed in the line, you may install the switchgear with its base having a minimum distance to the wall of 100 mm.
3.6.4 Floor fastening measurements, 2-panel switchgear with pressure absorber channel

Fig. 12 shows the floor fastening and floor opening measurements for 2-panel switchgear with pressure relief as per variant 4 (see Chapter 3.6.10 Possible installations).

3.6.5 Floor fastening measurements, 3-panel switchgear with pressure absorber channel

Fig. 13 shows the floor fastening and floor opening measurements for 3-panel switchgear with pressure relief as per variant 4 (see Chapter 3.6.10 Possible installations).
3.6.6 Floor fastening measurements, 4-panel switchgear with pressure absorber channel

Fig. 14 shows the floor fastening and floor opening measurements for 4-panel switchgear with pressure relief as per variant 4 (see Chapter 3.6.10 Possible installations).
3.6.7 Floor fastening measurements, 2-panel switchgear

- Metal cooling stretch arrangement (optional)
- Pressure absorber channel (optional)

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in A1-panel (K-panel)

Ring Main Unit GA 1TS1A1 (All dimensions are nominal dimensions [mm])
(Ring Main Unit GA 1K1TS-B with identical overall dimensions, K-panel left, TS-panel right)

Fig. 15

Ring Main Unit GA 1TS1A1-C (All dimensions are nominal dimensions [mm])
(Ring Main Unit GA 1K1TS-B-C with identical overall dimensions, K-panel left, TS-panel right)

Fig. 16

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in A1-panel (K-panel)
Fig. 17  Ring Main Unit GA 1TS1A2 (All dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in A2-panel

Fig. 18  Ring Main Unit GA 1TS1A2-C (All dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in A2-panel
3.6.8 Floor fastening measurements, 3-panel switchgear

![Diagram of Ring Main Unit GA 2K1TS](image1)

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in K-panel

![Diagram of Ring Main Unit GA 2K1TS-C](image2)

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in K-panel

Fig. 19 Ring Main Unit GA 2K1TS (All dimensions are nominal dimensions [mm])

Fig. 20 Ring Main Unit GA 2K1TS-C (All dimensions are nominal dimensions [mm])
Fig. 21  Ring Main Unit GA 3K (All dimensions are nominal dimensions [mm])

- Metal cooling stretch arrangement (optional)
- Pressure absorber channel (optional)

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in K-panel

Fig. 22  Ring Main Unit GA 3K-C (All dimensions are nominal dimensions [mm])

Note: Relay cabinet (300/600/900 mm) optional
1) Deep front cover in K-panel
3.6.9 Floor fastening measurements, 4-panel switchgear

Fig. 23 Ring Main Unit GA 3K1TS (All dimensions are nominal dimensions [mm])
(Ring Main Units GA 4K and GA 2K2TS with identical overall dimensions)

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

1) Deep front cover in K-panel

Fig. 24 Ring Main Unit GA 3K1TS-C (All dimensions are nominal dimensions [mm])
(Ring Main Units GA 4K-C and GA 2K2TS-C with identical overall dimensions)

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

1) Deep front cover in K-panel
3.6.10 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. 25.

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 optional 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 switchgear 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. 25

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 enquired as part of services at the sales department of 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 as well as for the auxiliary and control circuits the following installation work must be performed:

**Note!**

On Ring Main Units with a relay cabinet fitted, the cables are laid in the roof or in 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 transformer panel the stored-energy drive 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 Phillips head screws (6x) from the upper section of the front panel (Fig. 26/1).
- Pull the front panel a few millimetres forward (Fig. 26/2).
- Lift the covering sheet up from behind the front panel (Fig. 26/3).
- Pull the covering sheet out of the clip-on clamps (Fig. 26/4).

The side wall of the cover frame is fitted with flexible plugs, which enable a cable inlet protected against dust and moisture. For adaptation to the cable diameter use the separating lines on the plugs.
3.7.1 Terminal connection diagrams for the individual extension groups

Fig. 28 shows the arrangement of auxiliary switches for the load-break switch and the earthing switch on the drive carrier. Fig. 27 and Fig. 29 to Fig. 31 show the terminal connection diagrams for the individual extension groups. Additional information of relevance for the wiring of the Ring Main Unit can be found in the enclosed circuit documentation.

* The density monitor is also available with 2 changeover contacts (2 switching points)
Fig. 30  Terminal connection diagram cable switch (K-panel)

Fig. 31  Terminal connection diagram for earthing switch (1A1/1A2-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. 33, 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 iron are fitted with insert nuts.

On the cable fixing iron the cable lugs of the cable shields are fastened to the earthing terminals (M12). The cable fixing iron is designed with freely assignable earthing terminals.

Fig. 33
4 Technical description

4.1 Description of the Ring Main Unit

The SF$_6$-insulated Ring Main Unit type GA is characterized by the following features.

Primary switchgear and busbar are installed in a common gas tank. Sulphurhexafluoride (SF$_6$) is used as insulation and extinguishing medium. The Ring Main Unit can be used up to a rated voltage of 24 kV with a rated current of 630 A.

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

The GA Ring Main Unit is designed with two cable panels and one transformer panel as standard. Connection to the distribution network is accomplished via load-break switches in the cable panels. Connection to the consumer is accomplished via the transformer panel to the main transformer.

The Ring Main Unit complies with the specifications of the applicable standards and regulations as well as the statutory regulations. During manufacturing the Ring Main Units are subjected to the quality guidelines of ISO 9001.

Load-break switch, cable panel

The load-break switch consists of the following core components:
- three-position switch / integrated switch-on resistant earthing switch
- arc extinction byquenching coil
- maintenance-free spring drive
- no additional insulating distance generator required because the break distance is not bridged by the insulating substance
- SF$_6$ as insulating and quenching gas.

Load-break switch with trip-free release transformer panel

The load-break switch with trip-free release differs from the load-break switch by the following components:
- maintenance-free stored-energy mechanism
- triggering by HRC-fuse cartridge and tripping mechanism.

The system components, such as drive mechanism housing with drives, cable connection compartment and pedestal are attached to the gas tank in modular mode (see Fig. 1).

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 an enhanced personnel protection the Ring Main Unit can be built in an arc-proof design. In this case both the outside walls and the cover of the cable connection compartment and the front covers are reinforced.

The gas tank is reinforced with burn-out 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 SF$_6$ gas tank and from there as described in Chapter 3.6.10 Possible installations.

The front covers close the cable connection compartment of the individual sections pressure tight. The front cover is plugged onto panhead rivets 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.

For safety reasons the individual panels of the Ring Main Unit are fitted with various interlocking facilities as standard.

Switching interlock:
- An interlock against an unauthorized switching sequence between the actuating shafts of a panel

Front cover interlock:
- An interlock against unauthorized removal of the frontcover during operation

Anti-reverse interlock (optional)
- An interlock against unauthorized activation of the load-break switch or deactivation of the earthing switch after removing the front cover

For further details please refer to Chapter 4.5.

All active parts are located in the gas tank filled with SF$_6$-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 type 630 A with outside taper and screw contact M16 at his own discretion (see Chapter 8.5).

All control and indication elements of the Ring Main Unit are clearly arranged on the front panel. Switch position indicators and actuating shafts are integrated in the mimic diagram. The front cover is fitted with padlocking facilities and panel nameplates as standard. Both the capacitive voltage detecting system and the short-circuit indicator (optionally 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 main 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 has 2 to 4 panels and can e.g. be delivered in one of the following panel combinations:

2-panel
- GA 1T(K)S1A1
- GA 1T(K)S1A1-C
- GA 1T(K)S1A2
- GA 1T(K)S1A2-C
- GA 1K1TS-B
- GA 1K1TS-B-C

3-panel
- GA 3K
- GA 3K-C
- GA 2K1T(K)S
- GA 2K1T(K)S-C

4-panel
- GA 2K2T(K)S
- GA 2K2T(K)S-C
- GA 3K1T(K)S
- GA 3K1T(K)S-C
- GA 4K
- GA 4K-C

Different GA types:

A1 Cable connection panel with 3 cable bushings and earthing switch device
A2 Cable connection panel with 6 cable bushings and earthing switch device
K Cable panel with load-break and earthing switch device (load-break switch without trip-free release)
KS Transformer panel with load-break and earthing switch device (load-break switch without trip-free release)
TS Transformer panel with load-break and earthing switch device (load-break switch drive with trip-free release for tripping via HRC-fuse cartridge, shunt release)

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 different possible installations are described in Chapter 3.6.10 Possible installations.

 Optionally, the drives may have motor drives for remote switching on and off. For remote tripping the transformer panels can be optionally fitted with shunt release and tripping signal contacts.

If the Ring Main Unit is equipped with motor drives, a relay cabinet for the installation of secondary equipment can be mounted on top of the drive housing. The equipment of the relay cabinets is customized acc. to order and may differ from the following description:

- terminal strip,
- remote control relay for ON or OFF to control the load-break switches
- miniature circuit-breakers to protect motors and control circuit,
- the changeover switch for local remote control,
- the push-buttons to switch the load-break switch ON/OFF by the motor drive,
- the complete wiring to the electric components of the GA-system, such as:
  - motor, auxiliary contact, shunt release, tripping signal contact, short-circuit indicator.

![Fig. 34](image1)
![Fig. 35](image2)
![Fig. 36](image3)
4.3 Three-position switch  
(K/KS/TS-panel)

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

Fig. 37 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 load-break switch depends on the extent and number of short circuit breaks (see Chapter 8 “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/switching shaft is tripped via the drive and transmits the rotary movement via the coupling rod to the switch blades.

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.

In OFF-position of the load-break switch the isolating distance is generated without bridging by insulating agent.

4.3.1 Two-position switch  
(1A1/1A2-panel)

The two-position switch is to a great extent identical with the three-position switch for the K/TS-panel. The difference is that the bushings are directly connected with the busbars via copper busbars (Fig. 38). Thus only closing of the earthing switch is possible.
4.4 Drive mechanism

4.4.1 General

The Ring Main Units are designed with cable panels and transformer panels (e.g. GA 2K1TS or GA 3K) 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 transformer output panel is fitted with a spring drive with power accumulator (transformer panel drive).

The cable panel drive switches the load-break switch and the earthing switch of the cable panel to ON and OFF position.

The transformer panel drive switches the load-break switch and the earthing switch of the transformer panel to ON and OFF position.

The power accumulator of the transformer panel drive switches the load-break switch from switch position ON to OFF. Tripping of the power accumulator is accomplished by a HRC-fuse cartridge, the switching lever or the shunt release.

The function of the actuating shafts and their arrangement is shown in the mimic diagram on the front panel.

4.4.2 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, whereby the actuating shafts for load-break switch (right) and earthing switch (left) are resting 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 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.
4.4.3 Transformer panel drive

Transformer panels have a spring drive with accumulator (transformer panel drive) as standard. The accumulator of this drive is activated by tripping of the fuse. The switch position indicator of the load-break switch shows the message TRIPPED for this drive.

The design of the transformer panel drive is identical with the design of the previously described cable panel drive. However, in this case the actuating shaft is equipped with a compression spring. The blade inhibitor for the earthing switch is integrated in the accumulator. The accumulator is a unit that is freely rotating on the actuating shaft of the load-break switch. It consists mainly of tripping lever, accumulator tension spring and toggle link.

While tensioning the compression spring (left hand turn) the tripping roller, rotably mounted on the pressure spring unit at the front face of the tripping lever, is locked. When turning the actuating shaft clockwise the compression spring is relieved and the accumulator tensioning spring is tensioned. Releasing of the accumulator is accomplished by tripping of the fuse via a HRC-fuse cartridge. During this process the tripping shaft coupled to the fuse tripping mechanism releases the tripping lever. With the help of a control cam the tripping lever presses the tripping roller out of its locked position on the accumulator. A shunt release can be optionally coupled to this tripping shaft which, when energized, will relieve the accumulator in the same way as the fuse tripping mechanism.

The accumulator is relieved, the load-break switch is switched to OFF-position. When switching off manually with the switching lever the triggering roller is forced out of its lock on the accumulator by means of another lever system.

Transformer panels can optionally also be designed without fuse tripping mechanism. In this case the panel will be fitted with the drive for cable panels (cable panel drive).
4.4.4 Motor drive (optional)

A motor drive system (Fig. 41) can optionally be added 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” order no. 12265423.

4.5 Panel interlocks

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

**Switching interlock**
- between load-break switch and earthing switch

**Front cover interlock**
- between earthing switch and front cover. On panel configuration 2A11K(T)S the front cover in the left hand A-panel has no interlock.

**Anti-reverse interlock (optional)**
- between fastener and load-break switch (cable panel)
- between fastener and earthing switch (transformer panel) (Fig. 43)

Switching interlock and front cover interlock are activated or deactivated during the switching process via lever and rod drives.
Switching interlock (Fig. 43)
The interlock between load-break switch and earthing switch is accomplished by the position indicator plate, whereby the downward extended plate tongue slides laterally into the horizontal recess in the actuating shaft (earthing/load-break switch). Hereby 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 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.

Front cover interlock (Fig. 42)
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.

Anti-reverse interlock (optional) (Fig. 43)
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 position indicator plate) turns sideways into the horizontal recess in the actuating shaft and closes the plug-in opening for the switching lever. With the fastener opened on the cable panel the sheet metal tongue closes the actuating shaft for the load-break switch and prevents activation of the load-break switch after the front cover has been removed.

With the front cover removed only the earthing switch can be switched off in order to check the cables.

With the fastener opened on the transformer panel the sheet metal tongue closes the actuating shaft for the earthing switch and prevents deactivation of the earthing switch after 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.
4.6 Gas tank

The power cables to the cable panels are connected to cast resin bushings with outer taper (acc. to DIN 50181), which are individually tested for compliance with the maximum permissible partial-discharged value. In each phase the transformer panels are fitted with a top and bottom bushing. Copper busbars connect the three-position switch with the cable bushings/bushings in the upper fuse holder. The lower fuse holder is fixed to the bottom bushing, which has the function of a second earthing. 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 Ring Main Unit is filled with dry SF$_6$ gas, in accordance with IEC 60376. The addition of Al$_2$O$_3$ absorbs very small quantities of moisture and permanently regenerates the SF$_6$. The performance of a leak test according to IEC 62271-200 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. 44) is divided into two measuring ranges.

![Fig. 44](image)

Red: Not ready for switching! Green: Ready for switching

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

4.8 Pressure switch/density monitor (optional)

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

The bottom switching point of the pressure switch or temperature-compensated density monior is 106 kPa abs. If the pressure in the gas tank drops to 106 kPa abs., the pressure switch or temperature compensated density monior will report this pressure drop.

The bottom switching point of the pressure switch / density monitor corresponds with the transition to the red measuring range on the scale of the gas leakage indicator.

The pressure switch or temperature-compensated density monitor is fastened to the non-return valve, together with the gas leakage indicator.
4.9 Capacitive voltage detecting system

For detection of the de-energised state each panel section is fitted with a capacitive coupling element (voltage indication ledge, Fig. 45) in the front panel, which is wired with the switchgear panel.

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

The voltage indication ledge consists of an insulated housing with all electronic assembly parts encapsulated.

The test sockets in the voltage indication ledge enable the plugging in of conventional voltage testers.

The coupling electrode in each bushing in series connection 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 at the operational voltage using appropriate test units or adapters.

Captive shrouds protect the test sockets against dirt, dust and moisture (Fig. 45).

For voltage testing they must be swivelled by 90°. The test can be performed with an appropriate voltage tester (Table 4) (Fig. 46).

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

Table 4

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

In the standard version transformer panels are equipped with a voltage indication ledge for measurements after the fuse (bottom bushing). Transformer panels can be optionally equipped with an additional voltage indication ledge before the fuse (top bushing) (Fig. 113).

Pfisterer   Type DSA-2
Horstmann   Type HO-ST-1
ELSIC       Type HO-SA
Jordan      Type DSP-HR
Dehn        Type DEHN cap/P-HR

Always check all phases L1, L2, L3!

During each switching process (connection to or disconnection from the mains) the function of the capacitive voltage detecting system must be checked, if a de-energised state is detected (see Chapter 6.2).
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 on the single-conductor cables (Fig. 47)

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).

Short-circuit indicator for installation in front panel (Fig. 48).

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 conversion sensors are mounted to the bushing, electrically connected to the indicator unit and tested.

The following types are used:

- **Short-circuit indicator type ALPHA M** (manual reset)
  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 retained until it is manually reset by turning the rotary knob quickly in the counter 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 type ALPHA/E** type (automatic reset)
  The indicator unit is fitted with an electronic control, a test-reset push button and three square wave annunciators, one for each phase of the panel.
  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 of 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 excitement of the annunciators 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 Fuse base in transformer (cable)-panels

4.11.1 Design and function

The fuse base on GA Ring Main Units is designed as a plug-in system.

All components of the fuse base are coupled to the current path outside the gas tank via cast resin bushings. The plug system consists of the upper and lower fuse holder. The components inside the plugged enclosure are protected against water and dust. The plug parts made of silicon rubber is of track-proof and arc-root free design.

In its functionality the lower fuse holder is additionally designed as a slide-on transformer cable sealing end.

The range of application for copper or aluminium cables reaches from 25 to 240 mm².

Each HRC-fuse cartridge is earthed on both sides by means of two earthing electrodes switching in SF₆. Changing of a HRC-fuse cartridge can therefore be performed without any risk, because the fuse base is only accessible with the earthing electrodes inserted.

All plug-in surfaces (changing of a HRC-fuse cartridge) are made of special material pairs, which prevent inseparable bonding.

The individual components of the plug-in system can be easily separated, even after years.

The fuse base has been designed for HRC-fuse cartridges acc. to DIN 43625 with a pitch measurement of 442 mm and a maximum outside diameter of 88 mm. HRC-fuse cartridges with a pitch measurement of 292 mm can only be used in connection with an extension adapter (optional).

As standard the fuse base of each TS-panel is fitted with a fuse tripping mechanism in combination with a accumulator drive.
In case one of the three HRC-fuse cartridges in a transformer panel trips the TS-panel is switched off in triple-phase mode, in contrast to a KS-panel. The striker pin of the HRC-fuse cartridge presses the flexible diaphragm of the top fuse holder against the releasing lever of the fuse tripping mechanism, which then responds and causes a triple-phase shut-down of the transformer outgoing panel via the accumulator drive (transformer panel drive). A red indicator with the inscription TRIPPED in the switch position indicator for the load-break switch indicates triggering of the drive (Fig. 50).

All components of the fuse base (except HRC-fuse cartridges and extension adapters) belong to the scope of delivery. For the assembly of the fuse base please follow the: assembly instructions “HRC-fuse base”, order no. 21015575.

4.11.2 Design of the HRC-fuse cartridges

All HRC-fuse cartridges acc. to DIN 43625 with a pitch measurement of e = 442 mm (24 kV) can be used.

For HRC-fuse cartridges with the pitch dimensione = 292 mm (12 kV) an extension adapter must be used.

Note!

The appropriate HRC-e-fuse cartridge must be selected by following the “HRC-fuse selection table”, order no. 12254569.
4.11.3 Replacement of HRC fuse cartridges

**Note!**
Since the top and bottom bushings of the fuse compartment are earthed, the following steps of changing the fuse cartridge can be performed manually without any insulated tools.

If one of the three HRC-fuse cartridges of the transformer panel has tripped and the panel is fitted with a load-break switch of **Type TS** a triple-phase shutdown of the panel will occur.

Please remember: If fuse cartridges without thermal protection are used for partial areas, all HRC-fuse cartridges should be replaced, even if only one of the HRC-fuse cartridges has tripped, because the fusing conductors of the other HRC-fuse cartridges may already be damaged.

When engaging the earthing switch both the top and bottom contact caps of the HRC-fuse cartridge in the transformer panel are earthed.

Before starting work the transformer must be protected against inverse voltage by disconnecting **it from the mains and earthing!**

- Check the de-energised state of the transformer panel (see also Chapter 6.2)
- Switch the earthing switch ON with the red earthing switch lever (see mimic diagram).
- Open the fastener of the front cover by turning the square key anti-clockwise.
- Remove the front cover by lifting it up and pulling it forward out of the lateral locks of the adapter housing.

**Note!**
On TS-panels with motor drive the motor reloads the drive immediately. The tripped signal can therefore only be recognized by remote enquiry via the auxiliary switch.

At the same time the switch position indicator in the shut down panel is tripped by the tripping technology. A red decal with the inscription TRIPPED informs the viewer that the panel has been switched off (Fig. 50).

**Fig. 51**

The before mentioned HRC-fuse cartridge can be recognized by the upwards expanded diaphragm at the upper fuse holder. Perform the following steps to change the HRC-fuse cartridge:

Pull the tensioning lever forward against spring pressure, then lift it up into the attachment box. Due to the spring mechanism the tensioning lever remains in end position.

**Fig. 52**

Grip the upper fuse holder (Fig. 52) and pull it straight out of the top bushing.
For easier handling the upper fuse holder may be pulled to an inclined position, because the contact element of the lower fuse holder is rotably mounted.

Pull the upper fuse holder upwards (Fig. 53) out of the lower fuse holder.

Lay the upper fuse holder on a clean base, as shown in Fig. 54.

Remove all dirt with a lint-free cloth.

**Attention!**

The fuses may still be hot.

Pull the loosened HRC-fuse cartridge out of the lower fuse holder and insert the new HRC-fuse cartridge.

**Attention!**

In case of a burst HRC-fuse cartridge all coarse particles that have dropped into the lower fuse holder can be removed by hand, whereas the fine quenching sand particles can be removed by using e.g. a battery powered vacuum cleaner.

**Attention!**

The striker pin of the HRC-fuse cartridge must always point up (Fig. 55).

*An incorrect installation position disables the fuse tripping mechanism.*

**Attention!**

If HRC-fuse cartridges with a pitch measurement of $e = 292$ mm are to be installed, the Ormazabal fuse adapter must be used.

This extends the pitch measurement for the HRC-fuse cartridge to 442 mm (Fig. 54).
Avoid any accumulation of dirt on the inserting taper and in the slide-on area for the insulating tube of the top fuse holder (Fig. 56).

The surfaces of the parts to be fitted must be free of any foreign particles! Guide the upper fuse holder over the HRC-fuse cartridge until the contact cap of the HRC-fuse cartridge has entered into the contact element of the upper fuse holder. For easier handling the HRC-fuse cartridge may be pulled forward to an inclined position (Fig. 56), because the contact element of the lower fuse holder has a rotating mounting.

Check: Once the end of the insulating tube of the upper fuse holder rests against the collar of the lower fuse holder (Fig. 56), the HRC-fuse cartridge has been properly inserted.

Swivel the taper of the upper fuse holder into the top bushing against the stop (Fig. 57).

**Attention!**
The use of force may cause damage!

Pull the tensioning lever against spring pressure forward and swing it down over the lock for the upper fuse holder.

Reinstall the front cover to the adapter housing in reverse order (to the previous description).

The transformer panel can be activated again.

For further information refer to the assembly instructions “Fuse base” no. 21015575.

**Note!**
Brief instructions for changing HRC-fuse cartridge are attached to the inside of the front cover on the transformer panel.
5  Operation

5.1  Switching accessories

For operation of the Ring Main Unit the following accessories are needed:

1  Switching lever for load-break switch (bare shaft)
   (optional for load-break switch 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  Key for front cover fastener
   (controls the anti-reverse interlock).

The switching levers used to switch the Ring Main Unit are fitted with a non-positive lock, 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. 59). 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.

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. 59
5.3 Delivery condition of Ring Main Unit

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

Cable panel (K-panel)
- Earthing switch activated.
- Load-break switch deactivated and locked by switching interlock.

Transformer panel (TS-panel)
- Earthing switch activated.
- Load-break switch deactivated and locked by switching interlock.

Cable connection panel (1A1/1A2)
- Cable connection panel switched off (earthed).

Note!
- The panels 1A1 and 1A2 are not equipped with anti-reverse 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)

- Turn the fastener anti-clockwise with the fastener key to the end stop.
- Fastener opened (Anti-reverse interlock optional).

Transformer panel (TS-panel)

Earthing switch activated and locked by anti-reverse interlock (optional).
Load-break switch deactivated and locked by switching interlock.

In the switch position described the front covers are removable, because the pin of the front cover interlock (see Chapter 4.5 Panel interlocks) has been pulled out of the front cover (Fig. 68).

Remove the front cover:
- Lift the front cover up against the stop (Fig. 67/1)
- Pull the front cover off to the front (Fig. 67/2)
5.4 Switching the Ring Main Unit

Check the gas leakage indicator before switching the Ring Main Unit.

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

![Fig. 69](image1.png)
Fig. 69 Gas overpressure correct - system may be operated.

![Fig. 70](image2.png)
Fig. 70 Gas overpressure not correct – switchgear must not be operated.

Before switching the load-break switch and the transformer switch 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. 71).

The switch positions of earthing and load-break switches can be read from the indicating device in the mimic diagram of the system (Fig. 72).

Note!

Load-break switches and associated earthing switches are mechanically locked with each other.

If the earthing switch is switched ON the plug-in opening on the switching shaft of the corresponding load-break switch 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 100 (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 transformer panel

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

**Note!**
The side plate "TRIPPED" of the switch position indicator is only displayed if the transformer switch is switched off by a tripped HRC-fuse cartridge or the shunt release (option).

2 Switch off the earthing switch. Turn the switching lever (red shaft) anti-clockwise against the stop. (no pressure from counter spring).

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

4 Tension the transformer switch (see also Fig. 50).

5 Switch position after tensioning the closing spring. The tripped signal in the switch position indicator is no longer visible.

**Note!**
No counter spring pressure on transformer switch. Insert the switching lever (bare shaft) and turn anti-clockwise.
6. Switch on the transformer switch. Turn the switching lever (bare shaft) clockwise.

7. Switch position with activated transformer switch and deactivated earthing switch.
5.4.4 Switching off and earthing a transformer panel

1. Switch position with activated transformer switch and deactivated earthing switch.

2. Switch off the transformer switch. Turn the switching lever (bare shaft) approx. 20...30 degrees to the left.

3. Switch position with deactivated transformer switch and deactivated earthing switch.
   
   ☻ Verify safe isolation from supply acc. to VDE 0105 part 100 (if earthing is required). Always check all phases L1, L2, L3!

4. Switch on the earthing switches. Turn the switching lever (red shaft) clockwise against the end stop (no spring pressure).

5. Switch position with deactivated transformer switch and activated earthing switch.
5.4.5 Switching on a transformer panel (KS-panel)

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.
5.4.6 Switching off and earthing a transformer panel (KS-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 100 (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.**
5.4.7 De-earthing a cable connection panel (1A1/1A2-panel)

1 Switch position with 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 anticlockwise.

3 Switch position with deactivated earthing switch.

5.4.8 Earthing a cable connection panel (1A1/1A2-panel)

1 Switch position with deactivated earthing switch.

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

3 Switch position with activated earthing switch.

⚠️ Verify safe isolation from supply acc. to VDE 0105 part 1. 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 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 operating pressure on the gas pressure gauge (the pointer must be in the green sector).
- In case of an installed pressure switch or density monitor check the reading on the indicator via the remote indicator when the voltage supply is switched on.
- After the installation of the Ring Main Unit perform a function test of the switches.

### Note!

The switchgear panel is delivered with front covers earthed (see Chapter 5.3).

#### 6.1 Switching (manually by means of switching lever)

**Cable panels (K-panels)/transformer panel (KS-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.

**Transformer panels (TS-panels)**

SWITCHING ON
- Switch off the earthing switch.
- Tension the load-break switch (trip-free release).
- Switch on the load-break switch.

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

**Cable connection panels (1A1/1A2-panels)**

SWITCHING ON
- Switch off the earthing switch.

SWITCHING OFF
- Switch on earthing switch.

Switching the transformer panel (TS-panel) via the shunt release (option)

- Activate the transformer 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 transformer panel is switched off and the position indicator shows “TRIPPED”.

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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 panels for safe isolation from supply.

**Attention!**

Tests must always be performed in triple-phase mode! Compliance with VDE 0105 part 100 is mandatory!

When checking a cable panel the following steps must be performed:

1. With the Ring Main Unit switched on remove the plugs from the capacitive measuring points by turning.

2. Plug 3 voltage testers (see, Table 4, Chapter 4.9) into the measuring sockets in the corresponding switchgear panel (Fig. 112).

   The voltage testers must flash.

3. Switch the load-break switch to "OFF".

4. Safely disconnect earth the second cable end.

   The voltage testers must no longer flash!

5. Switch the earthing switch to "ON".

   The outgoing cable is now electrically isolated.

6. Upon completion of the test remove the voltage testers and reinsert the plugs.
When checking the transformer panel the following steps must be performed:

1. With the Ring Main Unit switched on remove the plugs from the capacitive measuring points in the transformer panel by turning.

2. Plug 3 voltage testers (see, Table 4, Chapter 4.9) into the measuring sockets. In case of transformer panels of panel version with top and bottom measuring bar plug 6 voltage testers into the measuring sockets (Fig. 113).

The voltage testers must flash.

3. Switch the load-break switch of the transformer panel to be checked to "OFF".

4. Isolate and earth also the low voltage transformer supply.

The voltage testers must no longer flash.

5. Switch the earthing switch to "ON".

The fuse base is now safely isolated (before and after the fuse).

6. Upon completion of the test remove the voltage testers and reinsert the plugs.

6.3 Phase comparison

On the insulated test sockets a phase comparison can obviously also be performed between two outgoing circuits (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. 114).
6.4 Cable test

Cable testing with connected cables is only possible on K-panels.

The cable test is performed on the appropriately equipped cable set.

Fig. 115 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:

1. Open the plugs for the capacitive measuring points by turning.
2. Insert 3 voltage testers into the measuring sockets. The voltage testers must flash.
3. Switch the switch of the switchgear panel to be tested/measured to "OFF". In case of 1A1/1A2-panels the adjacent panels must be switched off.
4. Safely disconnect and earth the second cable end. The voltage testers must no longer flash!
5. Switch the earthing switch of the switchgear panel to measured to "ON".
6. Remove the front cover.
7. Unscrew the threaded insert from the male cable adapter.
8. Screw the test adapter onto the threaded pin of the male cable adapter (observe the tightening torque).
9. Switch the earthing switch to "OFF".
10. Perform measurement/test. The panel can be tested with a maximum direct voltage of $8 \times U_0 = 96$ kV, whereby the busbars may be applied to a rated voltage of maximum 24 kV!

After completion of the cable test:
11. Switch the earthing switch to "ON".
12. Unscrew the testing adapter.
13. Screw the threaded insert into the male cable adapter (observe the tightening torque).
14. 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 Ring Main Unit should be performed every 4 years in order to check the condition of the unit.

Test activation of the transformer panel with trip-free release (if present) should be performed approx. every 10 years. The function of the fuse tripping mechanism is tested by lifting the fuse tripping mechanism (Fig. 116) a few millimetres towards the roof of the cable connection compartment.

![Fig. 116](image)

The tripping shaft mechanically releases the TRIPPED message, which is displayed in the switch position indicator of the transformer load-break switch. The function of the shunt release (optional) shall also be checked by tripping (electrically).

On Ring Main Units equipped with anti-reverse interlock the function test of the fuse tripping mechanism must be performed with a test fuse with time delay. The anti-reverse interlock does not permit activation of the load-break switch in the transformer panel when the front cover is open.

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 thereby be checked for pressure losses. As long as the pointer in the gas leakage indicator is in the green sector the pressure is sufficient.

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

7.2 Maintenance

The drives (with/without trip-free release) and the switches themselves are maintenance free.

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

Under normal conditions, the SF₆-gas filling does not need to be replaced during the lifetime of the Ring Main Unit.

7.3 Cleaning

**Attention!**

Before starting cleaning work the Ring Main Unit 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 a 30-year operating time is assumed. The “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 Cable panel and transformer output panel

<table>
<thead>
<tr>
<th></th>
<th>Cable panel K</th>
<th>Transformer panel TS / KS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outgoing cable panel</td>
<td>before the fuse</td>
</tr>
<tr>
<td></td>
<td>1A1/1A2</td>
<td>after the fuse</td>
</tr>
<tr>
<td>Switch</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Earthing electrode</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Switch</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Earthing electrode</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rated frequency (f_r)</td>
<td>50 / 60 Hz</td>
<td>50 / 60 Hz</td>
</tr>
<tr>
<td>Rated voltage (U_r)</td>
<td>12 kV 24 kV</td>
<td>12 kV 24 kV</td>
</tr>
<tr>
<td>Rated operating current (I_r)</td>
<td>630 A - 200 A</td>
<td>630 A - 200 A</td>
</tr>
<tr>
<td>Rated power-frequency withstand voltage (U_{p_{1\ min}})</td>
<td>28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV</td>
<td>28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV 28 kV 50 kV</td>
</tr>
<tr>
<td>Rated lightning impulse withstand voltage of the air gap (U_{p_{2\ min}})</td>
<td>85 kV 145 kV - 85 kV 145 kV - -</td>
<td>85 kV 145 kV - 85 kV 145 kV - -</td>
</tr>
<tr>
<td>Rated mainly active load breaking current (I_{l_{1\ max}})</td>
<td>20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA</td>
<td>20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA 20 kA 16 / 20 kA</td>
</tr>
<tr>
<td>Rated cable-charging breaking current (I_{l_{1\ max}})</td>
<td>50 A (^1) - 50 A (^1) - -</td>
<td>50 A (^1) - 50 A (^1) - -</td>
</tr>
<tr>
<td>Rated transformer off-load breaking current (I_{l_{1\ max}})</td>
<td>160 A (^1) - 160 A (^1) - -</td>
<td>160 A (^1) - 160 A (^1) - -</td>
</tr>
<tr>
<td>Rated Earth fault breaking current (I_{l_{1\ max}})</td>
<td>100 A (^1) - 100 A (^1) - -</td>
<td>100 A (^1) - 100 A (^1) - -</td>
</tr>
<tr>
<td>Rated cable and line-charging breaking current under earth fault conditions (I_{l_{1\ max}})</td>
<td>1(3) s - 1(3) s - -</td>
<td>1(3) s - 1(3) s - -</td>
</tr>
<tr>
<td>Rated short-time withstand current (I_{l_{1\ max}}) 1 s</td>
<td>50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA</td>
<td>50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA</td>
</tr>
<tr>
<td>Rated peak withstand current (I_{l_{1\ max}})</td>
<td>63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5)</td>
<td>63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5)</td>
</tr>
<tr>
<td>Rated surge current (I_{l_{1\ max}}) (optional)</td>
<td>50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA</td>
<td>50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA 50 kA 40 / 50 kA</td>
</tr>
<tr>
<td>Rated short-circuit making current (I_{l_{1\ max}}) (n_{5/2})</td>
<td>63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5)</td>
<td>63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5) 63 kA (^5)</td>
</tr>
<tr>
<td>Rated short-circuit making current (I_{l_{1\ max}}) (n_{5/2}) (optional)</td>
<td>125 A 100 A</td>
<td>125 A 100 A</td>
</tr>
<tr>
<td>Largest rated current with fuse (I_{l_{1\ max}}) (n_{5/2})</td>
<td>1(3) s - 1(3) s - -</td>
<td>1(3) s - 1(3) s - -</td>
</tr>
<tr>
<td>HRC-fuse cartridges (manuf. SIBA) (I_{l_{1\ max}})</td>
<td>- 300/1243 300/2243</td>
<td>- 300/1243 300/2243</td>
</tr>
<tr>
<td>Fuse striker pin (I_{l_{1\ max}})</td>
<td>- medium -</td>
<td>- medium -</td>
</tr>
<tr>
<td>Rated take-over current (I_{l_{1\ max}}) (n_{5/2})</td>
<td>- 1900 A 1500 A</td>
<td>- 1900 A 1500 A</td>
</tr>
<tr>
<td>Switch opening time in case of striker pin actuation (I_{l_{1\ max}})</td>
<td>- 54 ms -</td>
<td>- 54 ms -</td>
</tr>
<tr>
<td>Number of switching events at Rated mainly active load breaking current (I_{l_{1\ max}})</td>
<td>n 100 - 10 -</td>
<td>n 100 - 10 -</td>
</tr>
<tr>
<td>Number of switching events at Rated short circuit making current (I_{l_{1\ max}})</td>
<td>n 5/2 (^5) 2 2 2</td>
<td>n 5/2 (^5) 2 2 2</td>
</tr>
<tr>
<td>Number of mechanical switching cycles (I_{l_{1\ max}})</td>
<td>n 1000 1000 1000 1000 1000</td>
<td>n 1000 1000 1000 1000 1000</td>
</tr>
<tr>
<td>Class</td>
<td>E3/E1 (^5) M1 E2/E1 (^5) E1/M1 - E1</td>
<td>E3/E1 (^5) M1 E2/E1 (^5) E1/M1 - E1</td>
</tr>
</tbody>
</table>

1) Higher values on request.
2) These values are limited by the HRC-fuses.
3) Value \(I_{l_{1\ max}}\) for KS-drive, depending on fuse, because trip-free release of the load-break switch drive is not applicable.
4) Checked for example acc. IEC 60265-1 and VDE 0670 part 301 for 400 kVA and 1000 kVA transformers of 12 kV and 24 kV.
5) Optional.
8.2 General data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal filling pressure of insulating gas at 20 °C and 101.3 kPa</td>
<td>130 kPa (30 kPa overpressure)</td>
</tr>
<tr>
<td>Insulating gas</td>
<td>SF₆</td>
</tr>
<tr>
<td>Rated density of the insulating gas</td>
<td>7.9 kg/m³</td>
</tr>
<tr>
<td>Ambient temperature T</td>
<td>without secondary equipment: –25 to +40 °C</td>
</tr>
<tr>
<td></td>
<td>with secondary equipment: –5 to +40 °C (–25 to +40 °C on request)</td>
</tr>
<tr>
<td></td>
<td>with reduced rated currents: above +40 °C</td>
</tr>
<tr>
<td>Relative humidity (indoor conditions)</td>
<td>max. 95%</td>
</tr>
<tr>
<td>Enclosure of HV compartment</td>
<td>sealed pressure system acc. to IEC, IP 65</td>
</tr>
<tr>
<td>Enclosure of the fuse compartment</td>
<td>single pole cathode-point free enclosure and 3-phase metal enclosure, IP44</td>
</tr>
<tr>
<td>Enclosure of the drive housing</td>
<td>IP 44</td>
</tr>
<tr>
<td>Enclosure of the drive housing</td>
<td>IP 44</td>
</tr>
<tr>
<td>Internal arc classification according to VDE 0671 part 200 or IEC 62271-</td>
<td>IAC AFL 20 kA 1 s</td>
</tr>
<tr>
<td>200 respectively</td>
<td></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  
When using a pressure switch (optional) the operating conditions comply with class minus 5 for indoor use  
2) Depending on secondary equipment used

8.3 Shunt release

Electromagnet for open-circuit shunt release (optional)

<table>
<thead>
<tr>
<th>Nominal voltage (V)</th>
<th>Nominal power (W / VA)</th>
<th>ED %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>225</td>
<td>5</td>
</tr>
<tr>
<td>48</td>
<td>285</td>
<td>5</td>
</tr>
<tr>
<td>60</td>
<td>250</td>
<td>5</td>
</tr>
<tr>
<td>110</td>
<td>272</td>
<td>5</td>
</tr>
<tr>
<td>230</td>
<td>256</td>
<td>5</td>
</tr>
<tr>
<td>Alternating current</td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>652</td>
<td>5</td>
</tr>
<tr>
<td>230</td>
<td>608</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 7

8.4 Pressure switch/density monitor

8.4.1 Pressure switch 1) (optional)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>60-400 hPa</td>
</tr>
<tr>
<td>Lower switch point</td>
<td>60 hPa</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>20-30 hPa</td>
</tr>
<tr>
<td>Make-break capacity</td>
<td>250 V / 1 A</td>
</tr>
</tbody>
</table>

Table 8  
1) when using the pressure switch (optional) the operating conditions comply with class minus 5 indoor.

8.4.2 Density monitor GMD1  
(optional)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure range</td>
<td>0-1000 hPa</td>
</tr>
<tr>
<td>Lower switch point</td>
<td>60 hPa</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>50 hPa</td>
</tr>
<tr>
<td>Make-break capacity</td>
<td>250 V / 5 A</td>
</tr>
</tbody>
</table>

Table 9  
1) further tripping data on request

8.4.3 Auxiliary switch

Load-break switch (Q0) and earthing switch (Q8)

– Switching duty 250 V / 10 A

Auxiliary switch tripped signal S12

– Switching duty 250 V / 16 A
8.5 T-connection kits

T-connection kits are to be used on 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></th>
<th>NKT</th>
<th>Südskabel</th>
<th>tyco Electronics</th>
<th>Euromold/Nexans</th>
<th>Prysman</th>
<th>Cellpack</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 kV</td>
<td>10 kV</td>
<td>10 kV</td>
<td>10 kV</td>
<td>10 kV</td>
<td>10 kV</td>
</tr>
<tr>
<td>XLPE-Cable</td>
<td>CB12</td>
<td>CB24</td>
<td>SET12</td>
<td>RSTI</td>
<td>K400TB</td>
<td>FMCTS400</td>
</tr>
<tr>
<td></td>
<td>CC12</td>
<td>CC24</td>
<td>SEHDT13</td>
<td>RICS...</td>
<td>K430TB</td>
<td>FMCTJ400</td>
</tr>
<tr>
<td></td>
<td>CB36</td>
<td>SEHDT23.1</td>
<td>SEHDT23.1</td>
<td></td>
<td>K440TB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AB12</td>
<td>AGT10/630</td>
<td>AGTL10/630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AC12</td>
<td>AGT20/630</td>
<td>AGTL20/630</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 10

**Note!**

Information on further connection possibilities is available from our user information GA.

8.6 Tightening torques

<table>
<thead>
<tr>
<th>Thread nominal diameter</th>
<th>Screw joints strength class 8.8</th>
<th>Welded stud</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 11

**Note!**

The table values do not apply for tightening torques specially mentioned in the documents!

8.7 Switching forces with manual operation

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Switch position</th>
<th>Torque acting 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>Transformer panel drive earthing switch</td>
<td>Making / breaking</td>
<td>60</td>
<td>140</td>
</tr>
<tr>
<td>Transformer panel drive load-break switch</td>
<td>Tensioning</td>
<td>75</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td>Making</td>
<td>45</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>Breaking</td>
<td>5</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 12
8.8 Materials

Materials used on the Ring Main Unit:

<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, PPS (PF/ MF, PBT, GFK-optional)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Aluminium oxide, lubricants, SF$_{6}$/gas</td>
</tr>
</tbody>
</table>

Table 13

8.9 Permissible switching operations for the load-break switch

![Fig. 117](image)

8.10 Regulations and standards

8.10.1 Test specifications

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

- IEC 60265-1 (62271-103) / VDE 0670 part 301 (VDE 0671 part 103) ¹)
- IEC 60282-1 / VDE 0670 part 4
- IEC 60529 / VDE 0470 part 1
- IEC 61243-5 / VDE 0682 part 415
- IEC 62271-1 (60694) / VDE 0670 part 1000 (VDE 0671 part 1) ¹)
- IEC 62271-102 / VDE 0671 part 102
- IEC 62271-105 / VDE 0671 part 105
- IEC 62271-200 (60298) / VDE 0671 part 200 (VDE 0670 part 6) ²)
- IEC 62271-303 / VDE 0671 part 303 ³)

BlmSchV Federal Gazette 1996, part 1 no. 66 dated 20/12/1996

¹) Future
²) Former
8.10.2 Female connector (bushing)

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