GAS INSULATED RING MAIN UNIT
SFA-RM up to 36kV

www.alfanar.com
PARTNERSHIP

SAFETY

DURABILITY
1- Introduction to SFA-RM

A - SFA-RM Solution

SFA-RM units are designed to supply reliable energy and protect electrical equipment in secondary distribution networks up to 36 kV. SFA-RM units are the best solution for indoor/outdoor distribution substations as their compact design makes them suitable for various network applications such as transformer substations, wind power plants, industrial zones, etc. SFA-RM SF6 gas insulated units offer the following features.

B. Key Features.
- Compact design and type tested.
- High-level operator safety, high-level operation reliability.
- Lower filling SF6 gas pressure (1.1 bar, abs.), lower minimum operating SF6 gas pressure (1.05 bar. abs.)
- Hermetically sealed pressure system, leakage rate less than 0.1 per year.
- Resistant to pollution, insensitive to humidity and altitude.
- Modular and compact type (extensible and non-extensible).
- Lower maintenance cost.
- Suitable for remote control and monitoring.
- Comply with relevant IEC and EN standards.
- Compact type RMU’s can be manufactured to be extensible for either both sides or for only the left/right side.

C. Safety.
- The durable design withstands internal arc, providing protection against thermal and dynamic effects.
- Ability to visually check the position of the Earthing Switch (Close or Open) through the front pane surveillance window.
- Consecutive interlocking systems prevent incorrect operation.
- Access to the cable compartment and fuse compartment is only possible if the related earthing Earthing Switch/Switches is in the earthed position.
2- SFA-RM in Power Grids
3- Applications

SFA-RM units are widely used in the following applications:

**A - Infrastructure and buildings:** ports, railway stations, airports, hospitals, schools, hotels, malls, commercial centers, holiday resorts, etc.

**B - Industries:** water, iron and steel, automotive, oil and gas, etc.

**C - Energy:** wind power plants, solar power plants, hydro power plants, secondary distribution networks, transformer substations, etc.

**D - Special applications:** high air pollution areas, high humidity areas, etc.
4- Operating Conditions and Standards

- SFA-RM has an embedded hermetically-sealed gas tank filled with SF6 gas having a lower filling SF6 gas pressure (1,1 bar, abs.) and lower minimum operating SF6 gas pressure (1,05 bar. abs.).

- The expected lifetime of the product is more than 30 years with a leakage rate of less than 0.1 % per year.

- No maintenance or gas refilling is required during the lifetime of the SFA-RM.

- The main busbar and switching compartment has an IP 67 protection degree rating whereas the other sections of indoor products are rated at IP 41 and the outdoor products are rated IP 54.

Operating conditions:
- Ambient temperature range from -25 °C to 55 °C
- Altitude range of (0-1000 m)*
- Maximum relative humidity of 100%

SFA-RM fully complies with the following IEC Standards used under general operating conditions.

<table>
<thead>
<tr>
<th>STANDARDS</th>
<th>CLASSIFICATION</th>
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</thead>
<tbody>
<tr>
<td>SFA-RM 36</td>
<td>IEC 62271-200</td>
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<tr>
<td></td>
<td>Partition</td>
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<tr>
<td></td>
<td>PM</td>
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<tr>
<td>Loss of Service Contunity</td>
<td>LSC 2</td>
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<tr>
<td>Internal arc</td>
<td>A (FLR) 25 ka-1 s</td>
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<tr>
<td>SWITCH-DISCONNECTOR</td>
<td>IEC 62271-103</td>
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<tr>
<td></td>
<td>General purpose, M2, E3</td>
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<tr>
<td>CIRCUIT BREAKER</td>
<td>IEC 62271-100</td>
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<tr>
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<td>M2, E2 (for cable network)</td>
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<tr>
<td>DISCONNECTOR</td>
<td>IEC 62271-102</td>
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<td>M1, E0</td>
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<tr>
<td>EARTHING SWITCH</td>
<td>IEC 62271-102</td>
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<td>E2</td>
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<tr>
<td>VOLTAGE DETECTION SYSTEM</td>
<td>IEC 61243-5</td>
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<td></td>
<td>Voltage Presence Indicating System (VPIS)</td>
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<tr>
<td>PLUG-IN BUSHINGS</td>
<td>IEC 50181</td>
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<td></td>
<td>Outer cone plug-in bushing</td>
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</tbody>
</table>

*: For 1000+ m please contact alfanar
5- SFA–RM Ranges and Dimensions

- SFA–RM–SSB 25kA(EXTENSIBLE INDOOR)
SFA-RM-SSB_25kA(EXTENSIBLE OUTDOOR)
SFA-RM-SSB_25kA (NON EXTENSIBLE INDOOR)
- SFA-RM-SSB_25kA (NON EXTENSIBLE OUTDOOR)
### Electrical characteristics

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>alfanar Electrical Systems</th>
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<tbody>
<tr>
<td>Type</td>
<td>SFA-RM</td>
</tr>
<tr>
<td>Voltage (Ur)</td>
<td>36 kV</td>
</tr>
<tr>
<td>Insulation level</td>
<td></td>
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<tr>
<td>- power frequency withstand voltage (Ud) – common value</td>
<td>70 kVRms</td>
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<tr>
<td>- power frequency withstand voltage (Ud) – across the isolating distance</td>
<td>80 kVRms</td>
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<tr>
<td>- lightning impulse withstand voltage (Up) – common value</td>
<td>170 kVpeak</td>
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<tr>
<td>- lightning impulse withstand voltage (Up) – across the isolating distance</td>
<td>200 kVpeak</td>
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<td>Frequency (fr)</td>
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<td>Normal current (Ir)</td>
<td>630 A</td>
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<td>Short-time withstand current for main (Ik) and earthing circuits (Ike)</td>
<td>25 kA</td>
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<tr>
<td>Peak withstand current for main (Ip) and earthing circuits (Ipe)</td>
<td>65 kA</td>
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<tr>
<td>Duration of short-circuit (tk – tke)</td>
<td>1 s</td>
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<tr>
<td>Internal arc classification (IAC) (type of accessibility and classified sides)</td>
<td>AFLR</td>
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<tr>
<td>Arc fault current (IA)</td>
<td>25 kA</td>
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<tr>
<td>Arc fault duration (tA)</td>
<td>1 s</td>
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<td>PM</td>
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<td>Loss of Service Continuity category</td>
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<tr>
<td>Degree of protection</td>
<td>IP54</td>
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<tr>
<td>Type of application</td>
<td>indoor/outdoor</td>
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<tr>
<td>Rated supply voltage of auxiliary and control circuits (Ua)</td>
<td>DC 24 V</td>
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<tr>
<td>Type of neutral earthing</td>
<td>Solidly earthed neutral</td>
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</table>
Compact SFA-RM units are an excellent solution for secondary distribution networks. The units cover all medium voltage functions such as connection, supply and protection of MV equipment for different applications.

**Standard Equipments**

- **2 (two) feeders with Switch-disconnector:**
  - Switch-disconnector (three-positioned, open-closed-earthed)
  - Integrated capacitive Voltage Presence Indicator System.
  - Operating mechanism
  - Interface C bushings

- **1 (one) pc feeder with Vacuum Circuit Breaker:**
  - Vacuum Circuit Breaker
  - Disconnector with earthing switch
  - Over current and earth fault relay
  - Current transformer
  - Integrated capacitive Voltage Presence Indicator System
  - Operating mechanism
  - Interface C bushings

- **SF6 Gas Pressure Manometer**
- **Main Busbar, Earthing Bar**
- **Operating Handle**
- **Pad-locking facility**

**Optional Equipments**

- SF6 Gas Pressure Manometer (hermetic and double contact)
- Remote OPENING and CLOSING operation with cable
- Motor + Gear Box

**For Extensible Type Compacts RMU’s**

- Extension Boots
- Extension Bar
- Screened Plug
7 - Main Components

7.1 SWITCH-DISCONNECTOR (with earthing switch)

- Applied Standard: IEC 62271-103
- Three-phase, three positioned (OPEN-CLOSE-EARTHED)
- Load current is quenching in the SF6
- Electrical Endurance Class: E3
- Electrical Endurance Class: E2 (for earthing switch)
- Mechanical Endurance Class: M2

OPERATING MECHANISM OF THE SWITCH-DISCONNECTOR

- Stored energy operation
- Standard mechanism: Type M018
- Optional mechanism: Type M019
- Independent of the operator operation
- Comply to motor specifications

M018 Type Mechanism

- Opening and Closing operation takes place at one stage. The position of the switch (closing, opening and earthing operation) is performed manually using the Operating Handle. For motorized types, mentioned operation is performed via geared motor.

M019 Type Mechanism

- Energy storage is performed by the operator using the Operating Handle or via geared motor (for motorized mechanism)
- Releasing of the energy is performed:
  - By operator using push button (mechanically)
  - By shunt coils (electrically)
7- Main Components

7.2 VACUUM CIRCUIT BREAKER+DISCONNECTOR WITH EARTHING SWITCH UNIT

Vacuum Circuit Breaker.
- Applied Standard: IEC 62271-100
- Electrical Endurance Class: E2
- Mechanical Endurance Class: M1

Disconnected.
- Applied Standard: IEC 62271-102
- Three-phase, three positioned (OPEN-CLOSED-EARTHED)
- Mechanical Endurance Class: M2

Earthing Switch.
- Applied Standard: IEC 62271-102
- Electrical Endurance Class: E2

Operating Mechanism of the Vacuum Circuit Breaker

- Operating mechanism is based on stored energy within a spring. Storing of energy is provided with either a geared motor (electrically) or with an operating handle (manually). Releasing of energy is conducted using either the push button on the front panel (manually) or using a shunt coil (electrically)
- During the Breaker closing operation, the closing spring charges both of the spring of opening and the spring of trip-coil
- Suitable for rapid re-closing
- Suitable for self-powered relay application

Auxiliary Service Voltages

<table>
<thead>
<tr>
<th>VOLTAGE*</th>
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</thead>
<tbody>
<tr>
<td>Motor</td>
</tr>
<tr>
<td>Coil</td>
</tr>
</tbody>
</table>

*Contact alfaran if different service voltage is required.
7- Main Components

7.3 – Gas Pressure Indicator

Gas density is an important operating parameter for SF6 insulated MV equipment. If the required gas density is not sufficient, safe operation cannot be guaranteed. On SFA-RM units, a gas pressure indicator is fitted to the tank to provide a reliable warning indication against low gas levels. The gas pressure indicator shows the minimum pressure for safe operation.

7.4 – Voltage Presence Indication System

All SFA-RM units are integrated with a voltage presence indication system. A voltage signal comes from the VPIS through the voltage divider positioned in the cable entrance of bushings.

The VPIS can be used to check whether a voltage is present across the cables.
7 - Main Components

7.5 - Protection Relay

Overcurrent Protection.

1- 50P/50N Function: Phase/Neutral Instantaneous Overcurrent

Time of operation is independent from the current of operation flowing through the relay, hence if the phase current increases more than its determined value for an equal or greater amount of time than the specified value, then protection function activates (trips) and does not reset itself till the value of the phase drops below the point of current pick-up.

The function activates at 100% of the preset input, and deactivates at 95%, where the reset is instantaneous.

The accuracy of the operating time is equal to the present time plus a maximum of 30 ms.

2- 51P/51N Function: Phase/Neutral Time Overcurrent Protection

A - Definite Time O/C Protection

If the option “Definite time” is selected for the curve setting, the unit operating time is set by the parameter “Operating time” so as to trip the fault after a preset specific time setting.

If the unit operates with defined time, the function is activated at 100% of the set tap value, and it deactivates at 95%. If the unit operates with a curve, the function is activated at 110% of the set pick-up value, and it deactivates at 100%. The reset is instantaneous in both cases. The activation time is accurate to ±5% or ±30 ms, whichever is greater, of the theoretical activation time. The curves used are IEC 60255-151.

B - Inverse Time O/C Protection (IDMT)

If a curve (e.g. inverse, very inverse or extremely inverse) is selected for the curve setting, the operating time principally depends on the current value which is set through the curve type, and dial and tap settings.
8- Accessories

8.1 - Operating Handles

In SFA-RM units, there are two operating handles; the first one is for the operation of the load break switch and the second is for charging the spring of vacuum circuit breaker. The design of the operating handles enables a safe and easy operation for the user.

![Switch Disconnector & Disconnector Operating Handle](image1)

![Circuit Breaker Spring Charging Handle](image2)

8.2 - IR / PD Windows

The SFA-RMU can be optionally equipped with IR & PD windows, a new feature that complies with the new requirements of the Saudi Electric Company.

The inclusion of an infrared inspection window is considered a very effective method for maintenance personnel to identify any possible problems with loose electrical terminations without the need to shut down the RMU. The window consists of polymer and mesh optics to allow thermal infrared inspection by employing broadband media.

The inclusion of a partial discharge window is to facilitate the ability to measure partial discharge of a live RMU and estimate the expected life of insulation components.

8.3 - Motorization Kit (LBS / VCB)

Motors with gearboxes can easily be installed to load break switch and circuit breaker mechanisms either in the factory or on-site. A built-in electrical interlocking system prevents any unintentional operations.

When the unit is installed with the motor mechanism, it can be used with intelligent systems such as SCADA, DAS, etc. With the help of a selector switch, SFA-RM units can be controlled remotely by choosing the remote control option.

![Motor with Gearbox](image3)
8- Accessories

8.4- Earth Fault Indicator (EFI)
EFI can also be implemented in SFA-RM units. EFIs help the operator to easily find the fault location in medium voltage ring networks.

Earth fault is indicated with a LED flashlight and a flag when asymmetrical currents are detected in three phase cables.

EFI is fed via either auxiliary supply with internal batteries or a core balance current transformer.

8.5- Operation Counter for Load Break Switch Mechanism
In SFA-RM units, implementation of an operation counter for mechanical operation of load break switches is available as an option.

8.6 - CVI Auxiliary Contacts
To automate voltage indication in SFA-RM units auxiliary contacts could be integrated with CVI units. This feature makes it suitable for SFA-RM to accommodate

Absence of voltage applications
- Automation on voltage loss
- Alarms on voltage loss
- Automatic transfer systems

Presence of voltage applications
- Earth locking on presence on voltage
- Alarms on voltage presence

8.7 - Gas Pressure Indicator with Contacts
As an optional feature a gas pressure indicator with electrical switch contacts can be implemented.

The gas pressure indicator warns the operator when the gas density drops below the defined “alarm” level, and can block the operation.
9- Control Panels

9.1 FOR CUBICLE WITH SWITCH-DISCONNECTOR

1. Position indicator for switch-disconnector
2. Operating Handle Slot for switch-disconnector
3. Operating Handle Slot for earthing switch
4. Push Button for closing operation of switch disconnecter (mechanically)
5. Push Button for opening operation of switch disconnecter (mechanically)
6. “Spring Charged” or “Spring Discharged” indicator for switch-disconnector
7. Pad-locking
8. Position indicator for earthing switch
9. Surviallance window (for earthing switch contact position)

9.2 FOR CUBICLE WITH VACUUM CIRCUITBREAKER

1. Position indicator for circuit breaker
2. Operating handle shaft for charging spring
3. Operating handle shaft for disconnector
4. Operating handle shaft for earthing switch
5. Thump knot for OPENING and CLOSING
6. “Spring Charged” or “Spring Discharged” indicator for switch-disconnector
7. SF6 Gas Manometer
8. Padlocking
9. Position indicator for earthing switch
10. Surviallance window (for earthing switch contact position)
11. Voltage Presence Indicator
12. Position indicator for disconnector
10- MV Cables Connections

Cables Connections of the SFA-RM.36 is done in the Cables Connections Compartment which is located at the front of the cubicle using Separable Cable Connectors.

Separable Connector Type “L”
Contact Type: Bolted
Rated Current: 630 A
Interface: C

Separable Connector Type “T”
Contact Type: Bolted
Rated Current: 630 A
Interface: C

WARNING!

1. Separable Connectors should have type test reports/certificates according to the related standards.
2. Manufacturer’s installation instructions must be followed.
3. Metal screen of the HV cable should be connected to the earthing bar of the cubicle.
11- Side Extensions

Alfanar SFA-RM can be extended from both ends through extension boots. The extensions can be done by the enduser without affecting the SF6 gas insulation.

**Extension kit equipment:**
- Extension Boots
- Extension Bar
- Screened Plug

The extension kit withstands the rated voltage and rated short-time withstand current of the cubicles.
Stainless steel tank, filled with SF6 gas, is sealed to the atmosphere using the “Sealed Pressure” method. A gas tightness test is performed on every unit as a routine test. Helium is used as a tracer gas during the leakage test. Leakage test and SF6 gas filling are fulfilled inside the vacuum chamber. SFA-RM RMU’s have an expected life of more than 30 years.

Welding robots are used to weld the stainless steel tanks. Using this method, production flaws caused by human error are minimized.
13– Quality Management

SFA-RM units are produced with an integrated quality system carefully defined for all departments. During each stage of the manufacturing process we ensure that the SFA-RM units are built perfectly and comply with the highest adherence standards. The SFA quality system is ISO 9001:2015 Certified.

Routine Test

Every SFA-RM unit undergoes routine quality tests and intensive related IEC Standards checks to ensure the highest quality product. These tests are:

1- Sealing check  
2- Gas filling pressure check  
3- Opening/Closing speed check  
4- Tightness test  
5- Rotational torque measurement  
6- Partial discharge test  
7- Dielectric test  
8- Conformity with drawings and diagrams check  
9- Resistance measurement

The Quality Control Department prepares a test quality certificate for each unit and records the results for future accessibility and quality assurance.
SFA - RM has undergone all the tests required by the international (IEC) Standards in a CESI lab. The tests were carried out on SFA - RM units considered most sensitive to the effects of the tests and therefore the results were extended across the whole range.

1. Impulse withstand-voltage tests
2. Power frequency withstand-voltage tests
3. Temperature-rise tests
4. Short time current tests
5. Verification of making and breaking capacity
6. Mechanical endurance/operation tests
7. Verification of degrees of protection for persons against contact with live and moving parts
8. Internal arc tests
15.1-Overview

New SFA RM is designed for supplying sustainable energy, protecting electrical equipment in secondary distribution networks up to 36 kV.

<table>
<thead>
<tr>
<th>Rated Short Time Withstand Current</th>
<th>25 kA / 1 Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Arc Classification</td>
<td>A (FLR) 25kA / 1 Sec (indoor &amp; outdoor)</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>100%</td>
</tr>
<tr>
<td>IP Class (Gas Tank / Indoor / Outdoor)</td>
<td>IP 67/ IP41 / IP54</td>
</tr>
</tbody>
</table>

Applied Standard

- IEC 62271-100
- IEC 62271-200
- IEC 62271-103
- IEC 62271-102
- IEC 62271-1

15.2-Features

- Self-power RMU
- 3G/4G Communication, VPN Security “IPsec”
- IEC60870-5-104/101 and DNP3
- Accurate measurements for voltage and current in all switching elements
- Switching units sealed in SF6 gas filled stainless steel tank
- High level of operator safety and operating reliability
- Maintenance free unit offering life expectation of over 30 years
- Smart interlocking with padlocking system for maximum operator safety
- Different feeder combinations with switch disconnecter and vacuum circuit breaker
- High resistance to pollution and humidity
- Compact design up to 36 kV
- CESI type tested
b) Power supply and batteries:
The proposed Smart RMU a self-powered unit, the supplied power comes from the CPT (Control Power Transformer) connected directly to the live bus and provides the LV circuit with 220VAC. All the equipment such as aux relays, RTU, modem, and trip close motor coils are operated by a 24VDC which comes from a AC/DC converter capable of providing sufficient power. This unit has a battery system to ensure sustainability of the power supply.

c) ZIV-IRS (Self-Powered Overcurrent Protection)
Where a dependable auxiliary power source is not available, the IRS Relay can be energized either directly from Main Current Transformers, AC/DC Auxiliary Voltage or through the USB Front Port.
## 16- Ordering

<table>
<thead>
<tr>
<th>Unit Configuration</th>
<th>Voltage System</th>
<th>Extensibility</th>
<th>Ingress Protection</th>
<th>Load Break Switch</th>
<th>Circuit Breaker</th>
<th>Motor Kit</th>
<th>Tee-off Load Rating 1</th>
<th>Tee-off Load Rating 2</th>
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