



24kV GAS-INSULATED RING MAIN UNIT

SF₆ GAS

24kV・630A・200A

GST20-B

INSTRUCTION MANUAL



- This instruction manual describes the operation and maintenance for the correct and safe use of this product. Please thoroughly read and understand the information contained in this instruction manual before operating.
- After reading, keep this instruction manual for future reference.

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No. 01186h

Togami Electric Mfg.Co.,Ltd.

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1. Purpose

This SF6 gas capsulated manual 24kV gas-insulated Ring Main Unit, hereafter called RMU, is used and installed in the nominal circuit voltage of AC24kV underground distribution system.

2. Safety precautions

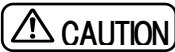
- For safe use, RMU shall be handled and operated by the personnel who have the adequate knowledge and skills.
- RMU shall be connected to the earth by the earthing terminals. Earthing shall be carried out according to the regulation in the area of installation.
- Thoroughly read and understand the information contained in this instruction manual and correctly use the RMU.
- Use the RMU after acquiring proficiency in the knowledge of apparatus, safety information, and safety precautions. After reading, keep this instruction manual for future reference.
- In case an internal arc fault occurs, RMU equips the internal pressure releasing device for the safety of workers, which may produce toxic and corrosive decomposition products.
- In case a work gets injured, after initial treatment, call ambulance.
- Safety precaution levels are classified as “DANGER” and “CAUTION”.





If operation is incorrect, a dangerous situation may occur, resulting in death or serious injury.



If operation is incorrect, a dangerous situation may occur, resulting in moderate impairment or minor injury or physical damage to the equipment.

However, items in  may cause serious consequences depending on the situation. Items in both DANGER and CAUTION are very important.

 DANGER
<ul style="list-style-type: none">■ Electric shock hazard:<ul style="list-style-type: none">• Never touch the voltage energized part.• Properly connect the RMU enclosure to the earth depending on the ground condition and regulations of installation site.• Be sure to check that no voltage is applied to low and high voltage parts prior to starting any work with RMU.

 CAUTION
<ul style="list-style-type: none">■ Fall and injury hazard:<ul style="list-style-type: none">• Never carry or operate RMU upside down.■ Electric shock and injury hazard:<ul style="list-style-type: none">• Always wear rubber insulated gloves and other necessary personal protective equipment when handling and operating RMU.■ Electric shock, injury, and fire hazard:<ul style="list-style-type: none">• Never disassemble nor modify RMU.• When operating the drive mechanism, release the stored energy by opening the switch to prevent any injury.■ Fire and injury hazard:<ul style="list-style-type: none">• Never use when any abnormality can be identified.• Dispose as an industrial waste.

3. Warranty period and coverage

The warranty period of RMU shall be one year after the date of shipment. However, if another warranty period is specified in the contract, the period of the contract shall be applied. Manufacturer will repair the product free of charge, provided that such degradation is determined to be due to defects in materials or workmanship under normal operation within the warranty period.

Warranty coverage does not apply when:

- (1) the failure is caused by user's negligence and force majeure,
- (2) the failure is caused by the modification and service by anyone other than the manufacturer or the authorized personnel,
- (3) the failure is caused by operation, connection, or assembling other than the procedures or methods mentioned in this instruction manual, and
- (4) the failure is caused by using accessories or parts other than specified by manufacturer.

This warranty is limited to the coverage of only the delivered product itself and does not extend to the compensation for consequential damage that has occurred by the supplied product.

4. Scope of application

4.1. Standards

RMU complies the following standards.

Designation	IEC Standard
Switchgear	IEC62271-1 IEC62271-103 IEC62271-200
Switch fuse combination	IEC62271-105
Earthing switch	IEC62271-102

4.2. Service Condition

RMU can be used in the environment indicated in the following table and the normal operation environment specified in IEC62271-1.

In case of using under conditions other than indicated below, please consult the manufacturer.

Site and Service conditions	
Installation site	Indoor or outdoor with metal enclosure
Minimum ambient temperature	-5°C
Maximum ambient temperature	40°C
Average ambient temperature in any one year	30°C
Average relative humidity in any one year	79%
Average maximum relative humidity in any one year	94%
Altitude	Less than 1,000m above sea level

5. Product overview

5.1. Part names

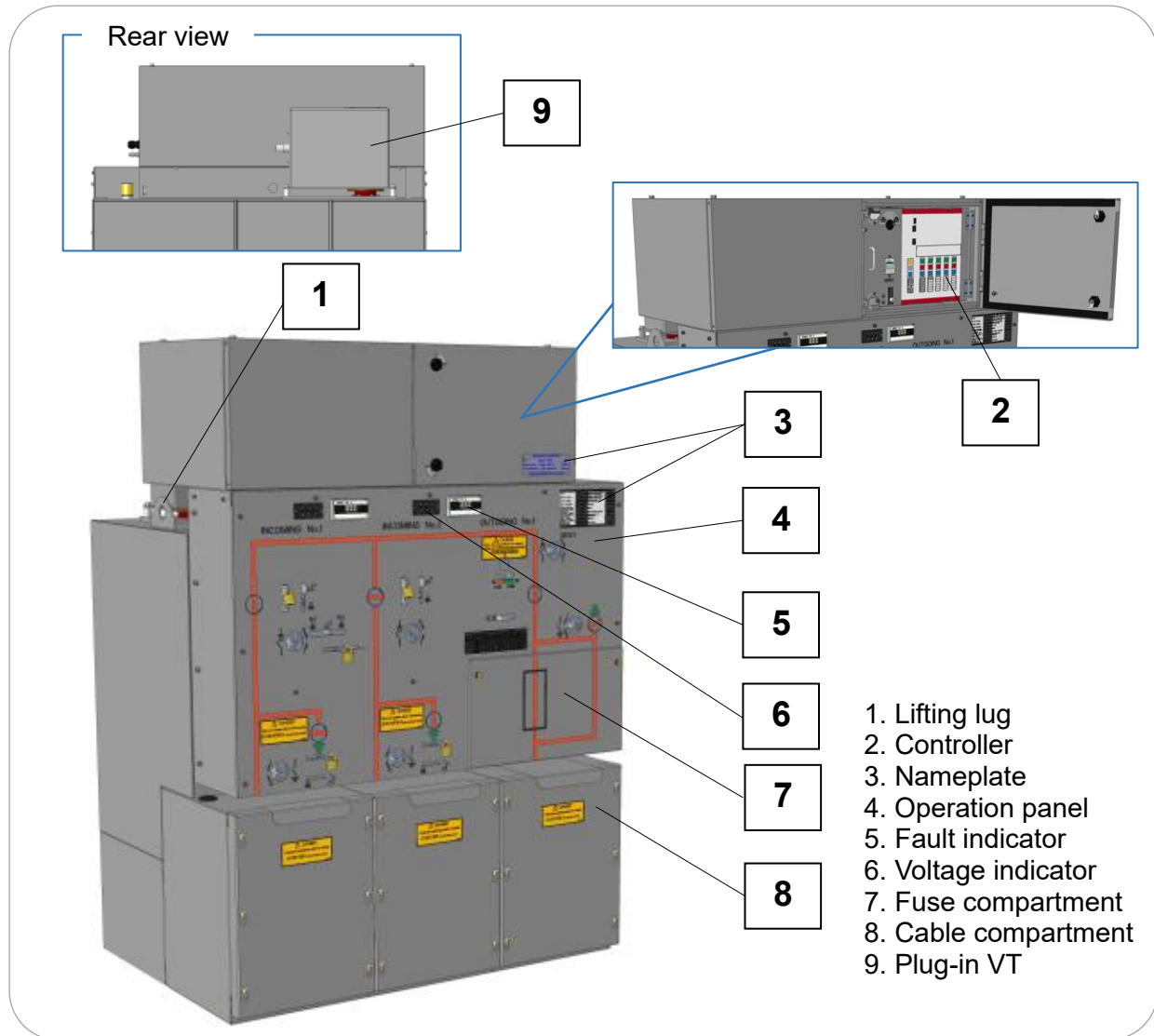


Figure 1. Part names

5.2. Specifications

Item	Ratings
Rated voltage	24kV
Rated current	630A (2-IN), 200A (1-OUT)
Rated frequency	50Hz
Number of circuits	3 circuits
Rated short time withstand current	16kA (r.m.s.) – 1sec.
Rated short circuit making current	40kA (peak)
Rated active load current	630A (LBS1,2)
Rated power frequency withstand voltage	50kV (Dry)
Lightning impulse withstand voltage	125kV
SF6 gas pressure	50kPa·G (20°C)
Fuse (See 5.4.2 Ratings of fuse)	Rated current: 31.5A, Rated breaking current: 63kA Standard: DIN 43.625 complied
Interlock function	All feeder: main circuit and earthing switch (SW) Transformer feeder: main circuit and fuse compartment cover

5.3. Circuit diagram

The diagram below shows the circuit of RMU.

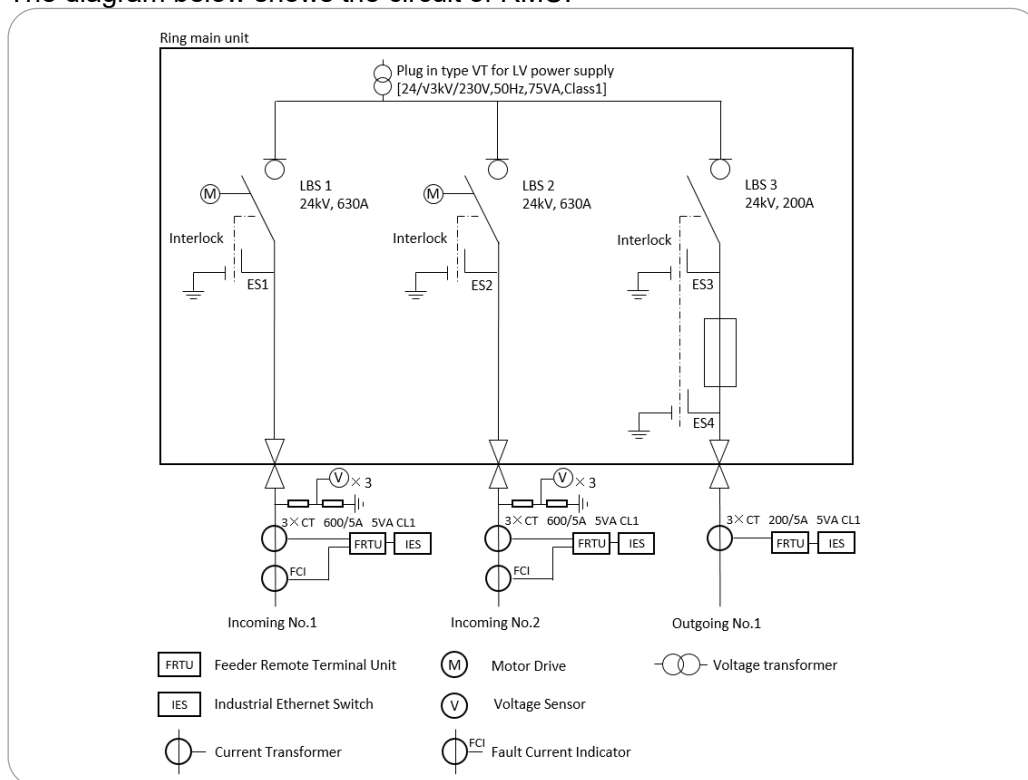


Figure 2. RMU circuit diagram

5.4. HRC fuse

Fuse shall be complied with DIN standard and equipped with striker pins.

5.4.1. Dimensions

Diameter (mm)	Length (mm)
Standard DIN43.625	442

5.4.2. Ratings of fuse

When replacing, select the fuse meeting the following ratings.

Transformer ratings				HV HRC fuse ratings			
Rated Voltage (kV)	Rated power (kVA)	Impedance Voltage (%)	Rated Current (A)	Rated voltage (kV)	Rated Current (A)	Fuse Length E (mm)	Order No. Made by SIBA
24	500 (For Type II special and Type III)	3.91	12	10 to 24	31.5	442	30 006 13.31.5
	500 (For Type I)	6.61	12	10 to 24	25	442	30 006 13.25
	750 (For Type I)	7.26	18	10 to 24	40	442	30 006 13.40
	1,000 (For Type I)	6.63	24	10 to 24	50	442	30 014 13.50

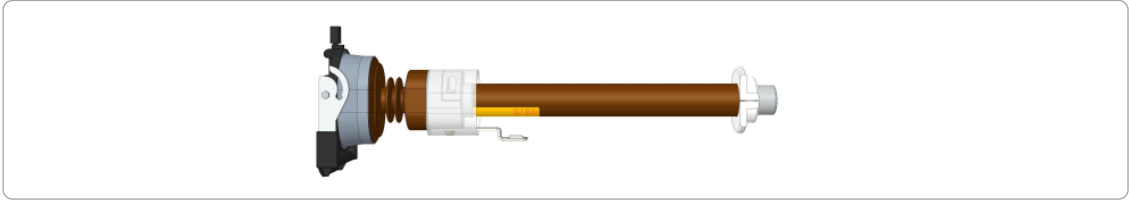


Figure 3. Fuse appearance (equipped in fuse holder)



CAUTION

- Replace all three fuses even in case of any one of fuses blows.
- Always use three fuses for three-phase system. Fuses of all three phases shall be equipped to maximize the performance of fuses. Never use only two fuses with another fuse short-circuited by copper wire.
- Never reclose RMU after any fuses blow. Make sure to replace all three fuses before closing RMU.

6. Handling

6.1. Lifting of RMU

Make sure to lift RMU at two points with the lifting lugs equipped on the top of RMU.

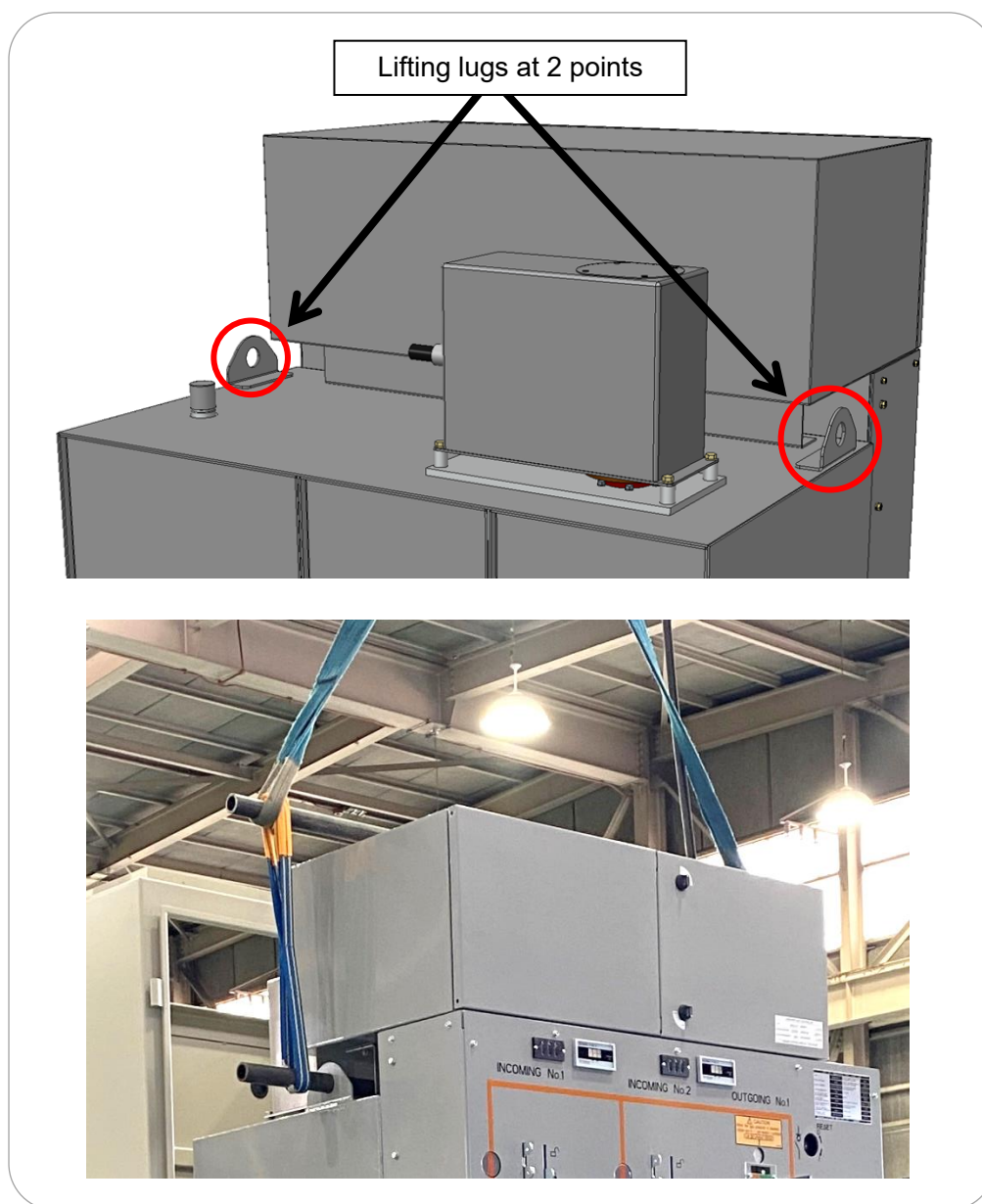


Figure 4. Lifting points and lifting image



- Make sure not to apply an excessive force to the controller and Plug-in VT.

7. Manual handle operation

The diagram below shows the locations to insert the operating handle for each operation.

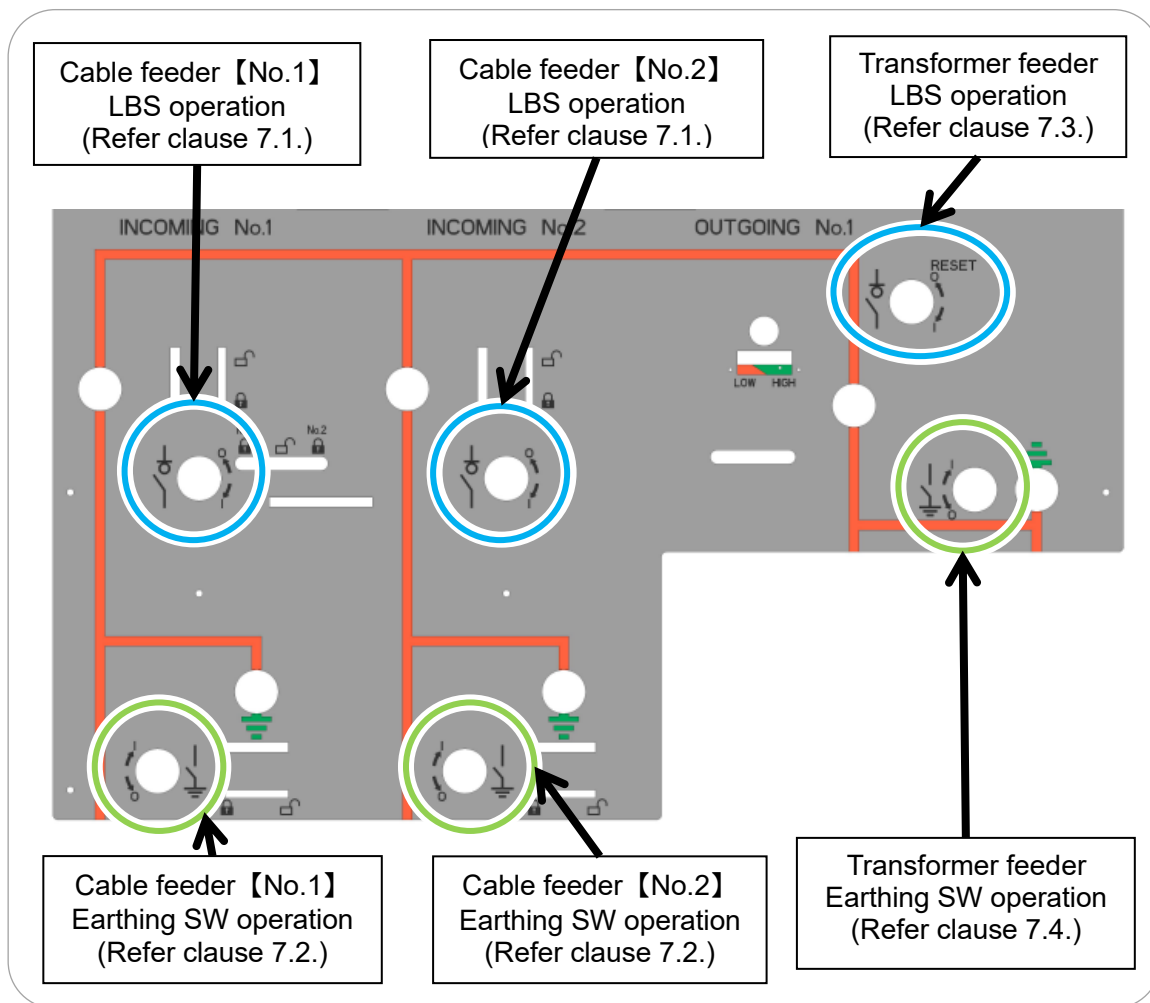


Figure 5. Location of handle insert for operation



Figure 6. Operating handle

7.1. Two incoming/cable feeder circuits [630A main circuits]

Operate with handle to CLOSE and OPEN the LBS as indicated in the diagrams below.

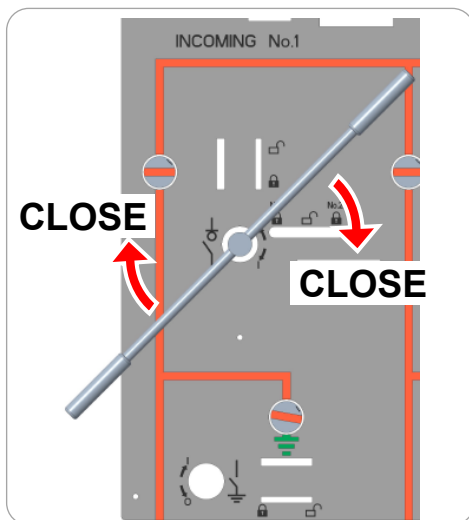


Figure 7. CLOSE operation

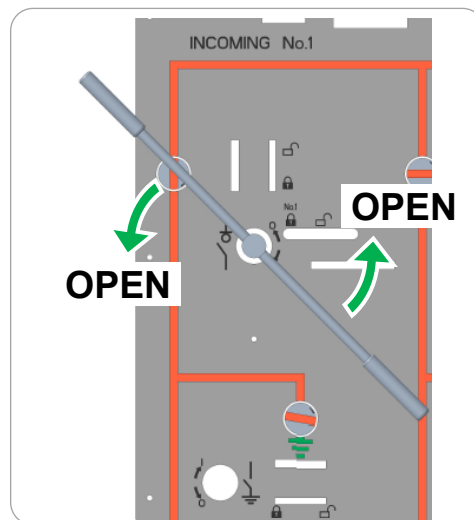


Figure 8. OPEN operation

7.2. Two incoming/cable feeder circuits [Earthing switch]

Operate with handle to CLOSE and OPEN the earthing switch as indicated in the diagram below.

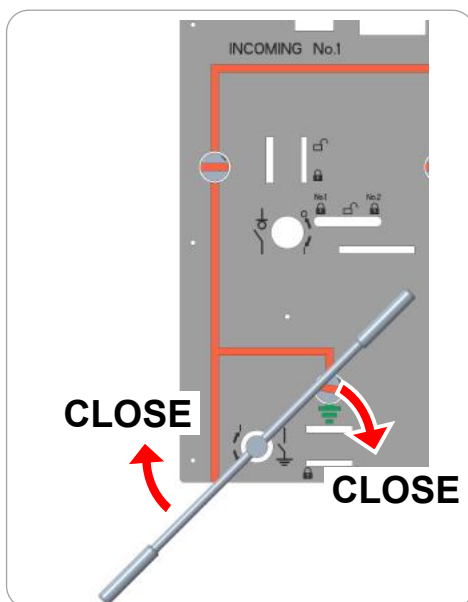


Figure 9. CLOSE/Earthing operation

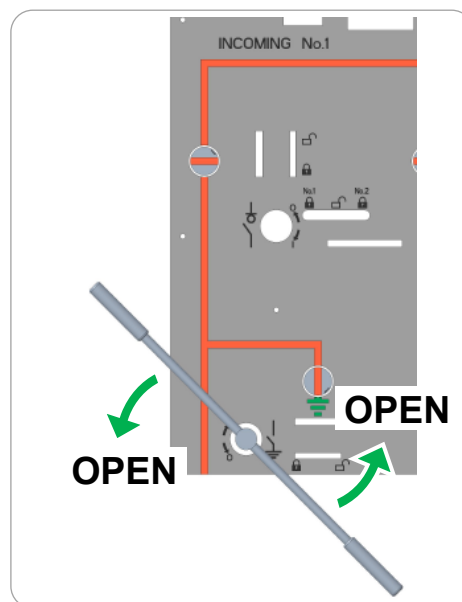


Figure 10. OPEN/Unearthing operation

7.3. One outgoing/transformer feeder circuit [200A main circuit]

1) Normal CLOSE/OPEN operation

Operate with handle to CLOSE and OPEN the LBS as indicated in the diagrams below.

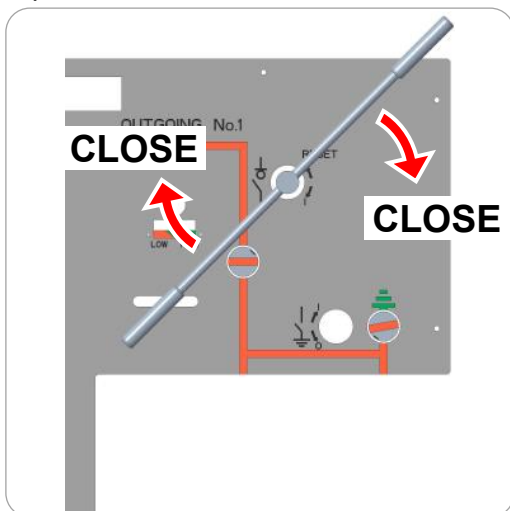


Figure 11. CLOSE operation

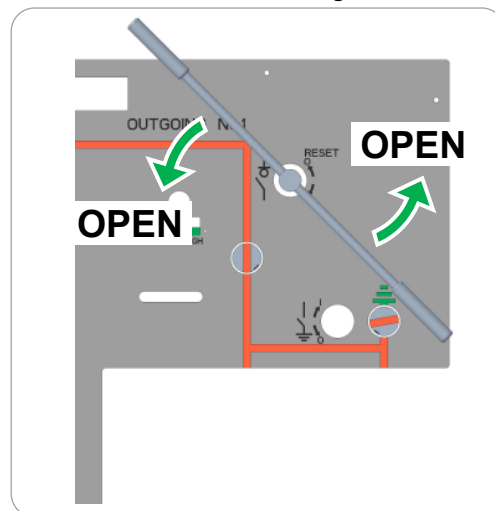


Figure 12. OPEN operation

2) Reset operation

In case of LBS of transformer feeder is tripped/opened by the striker of fuse links, Reset the status of LBS following the operations below.

- ① Replace fuses and reset the strikers.
For details of replacing fuses, refer the clause 11.1.
- ② Operate LBS to reset. [Figure 13]
- ③ The status remains as OFF/OPEN state.
- ④ After these reset operation, LBS can be normally operated following CLOSE operation.

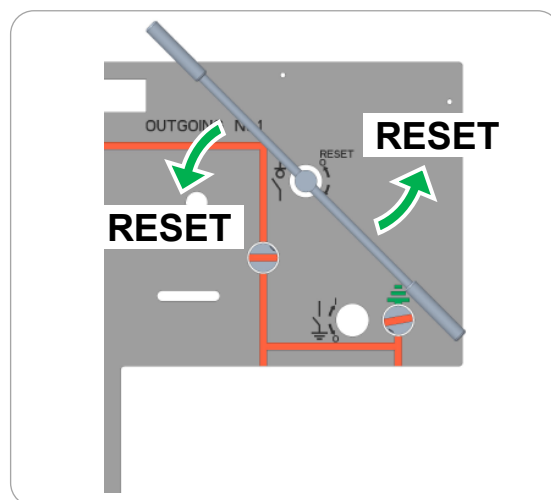


Figure 13. RESET operation

7.4. One outgoing/transformer feeder circuit [Earthing switch]

Operate with the handle as indicated in the diagram below.

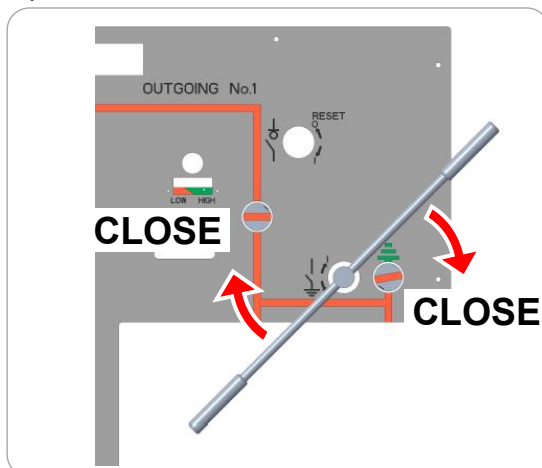


Figure 14. CLOSE operation

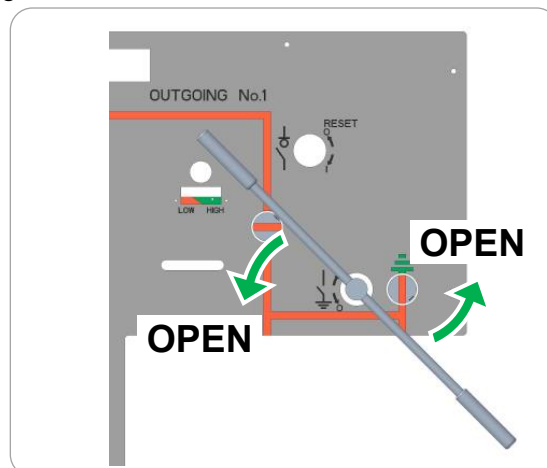


Figure 15. OPEN operation

8. Interlock

8.1. Mechanical interlock

RMU has mechanical interlock functions as indicated in the table below.

SW/ condition	State	Interlock mechanism		
		LBS	Earthing SW	Cable compartment cover
LBS 1-3	ON	—	Unable to operate	Unable to open
	OFF	—	Able to operate	Depending on the earthing SW
Earthing SW 1-3	ON (earthed)	Unable to operate	—	Able to open
	OFF	Able to operate	—	Unable to open
Gas pressure	Above guaranteed value ^{*1}	Able to operate	Able to operate	Depending on the earthing SW
	Below guaranteed value ^{*1}	Unable to operate	Unable to operate	Depending on the earthing SW
Reference clause for unlocking the interlock		—	—	8.2.1

^{*1}: Guaranteed value: 25kPa·G (20°C)

Mechanical interlock of the fuse compartment cover is as follows.

SW/ condition	State	Fuse compartment cover
LBS 3	ON	Unable to open
	OFF	Depending on the earthing SW
Earthing SW 3	ON (earthed)	Able to open
	OFF	Unable to open
Reference clause for unlocking the interlock		8.2.2

8.2. Unlocking the mechanical interlock

8.2.1. Cable compartment

When working on the cables and terminals for all feeders, such as cable connection, remove the front cover according to the following procedures.

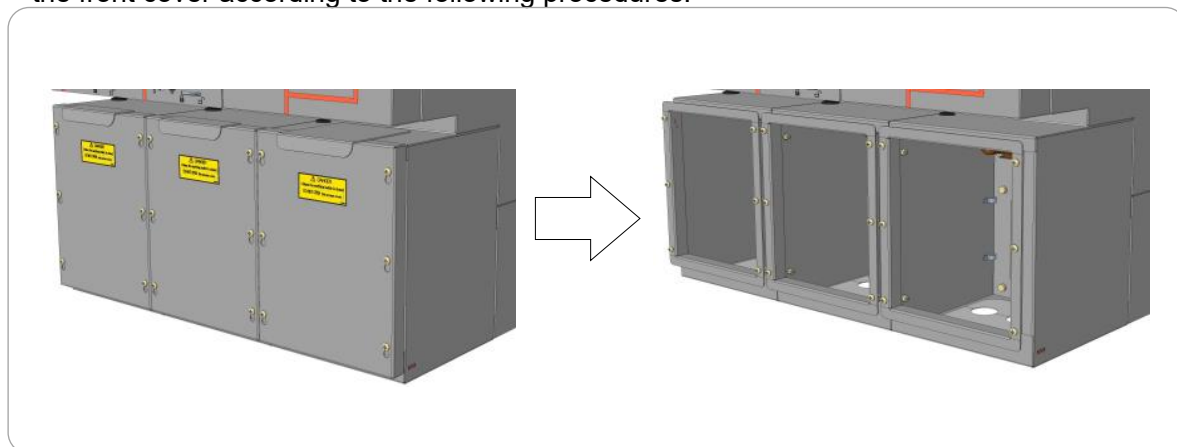


Figure 16. Opening the front cover

- ① OPEN the LBS and CLOSE the earthing SW [Figure 17 & 18] to unlock the mechanical interlocks of cable compartment covers. (for all feeders)

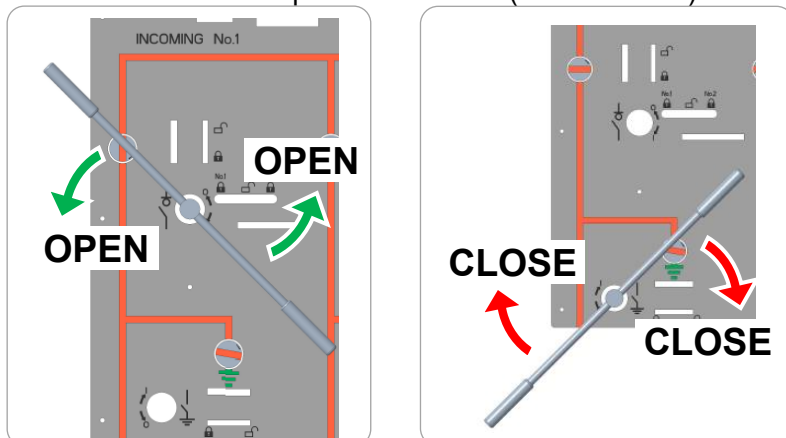


Figure 17. LBS OPEN and Earthing SW CLOSE operations of cable feeders

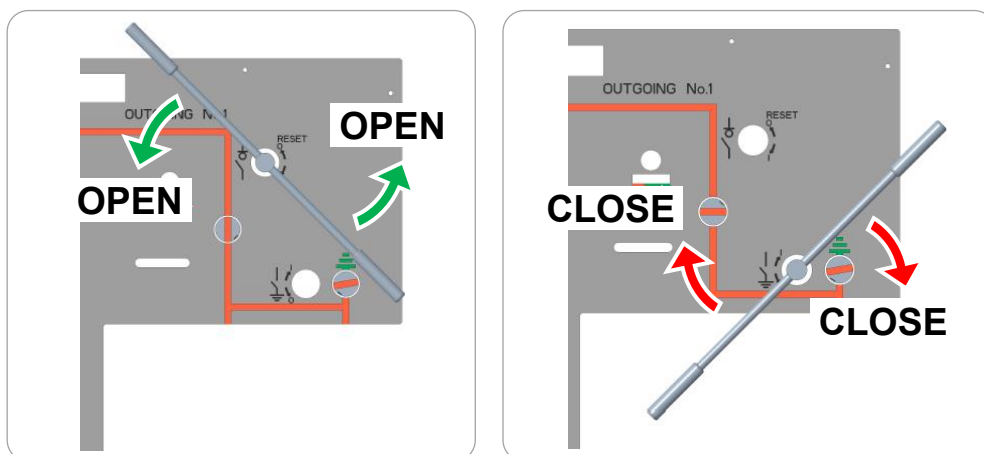


Figure 18. LBS OPEN and Earthing SW CLOSE operations of transformer feeder

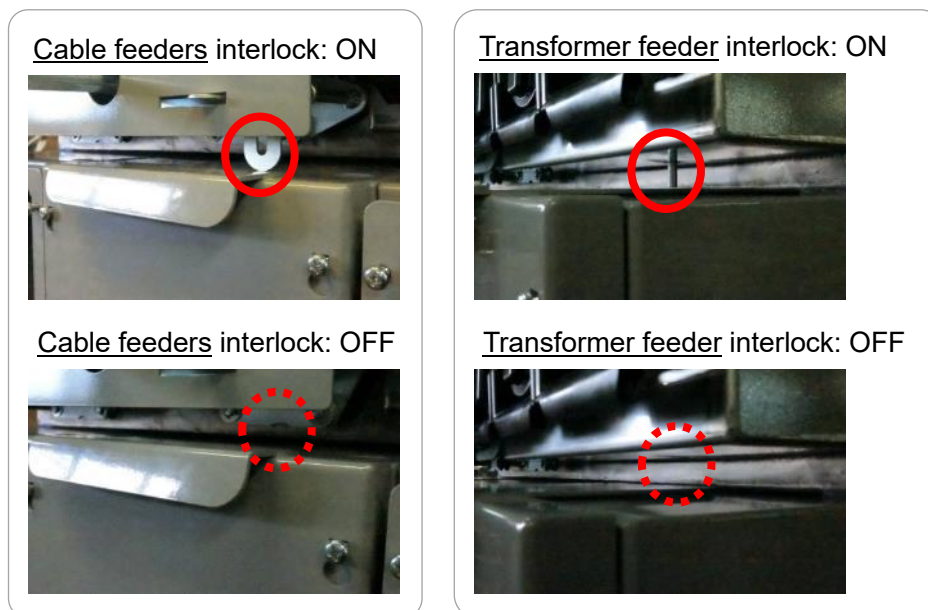


Figure 19. Unlocking the interlocks

- ② Pull up and then pull forward to remove the cover. [Figure 20]

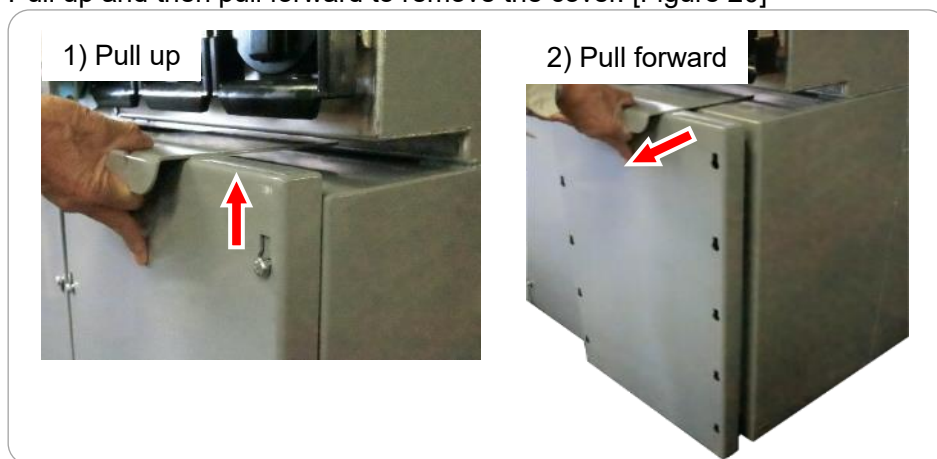


Figure 20. Removing the covers

8.2.2. Fuse compartment cover

- ① OPEN the LBS of transformer feeder [Figure 21] and CLOSE the earthing SW [Figure 22] to unlock the mechanical interlock of fuse compartment cover.
② Loosen two knurled screws, and open the cover. [Figure 23]

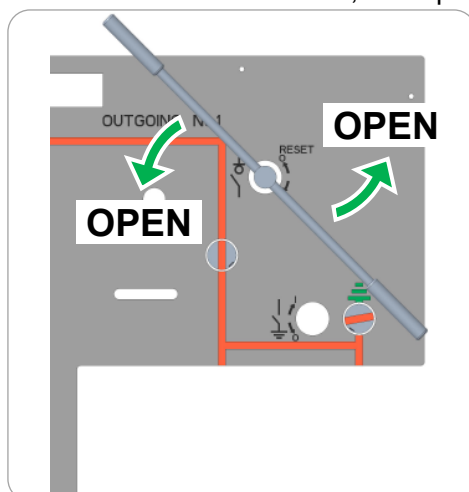


Figure 21. LBS OPEN operation

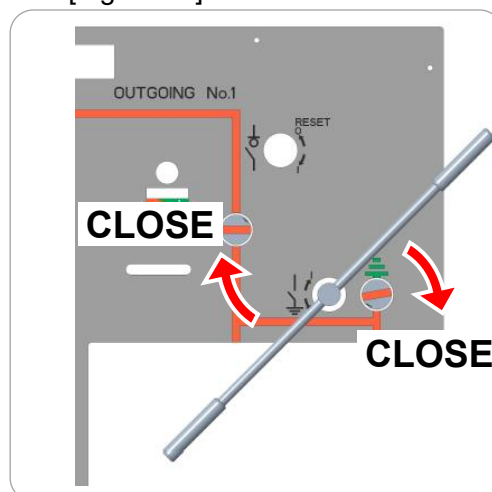


Figure 22. Earthing SW CLOSE operation

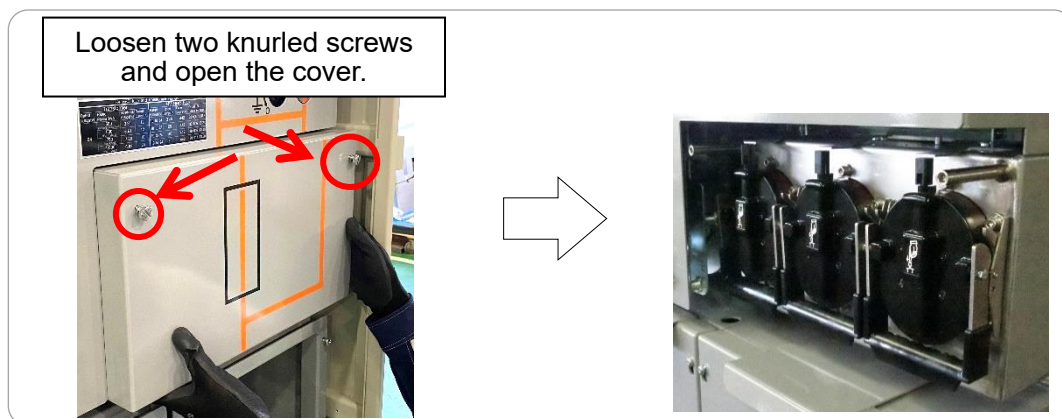


Figure 23. Opening the cover

8.3. Padlock

LBSs and earthing SWs of cable feeders can be padlocked as indicated in the following drawing and photos. [Figure 24 & 25]

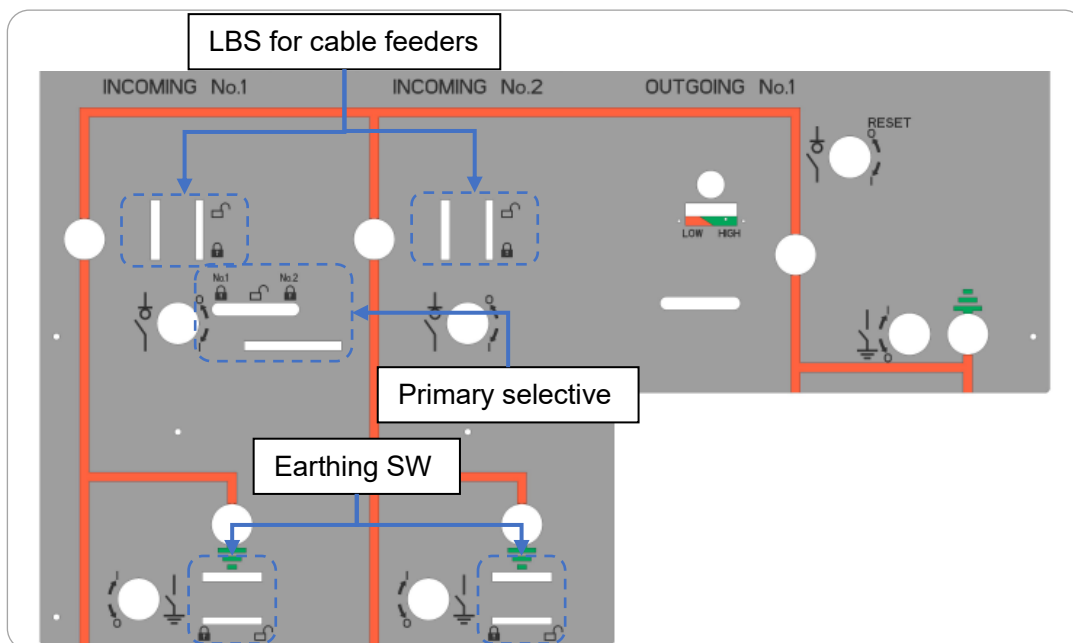


Figure 24. RMU front panel descriptions

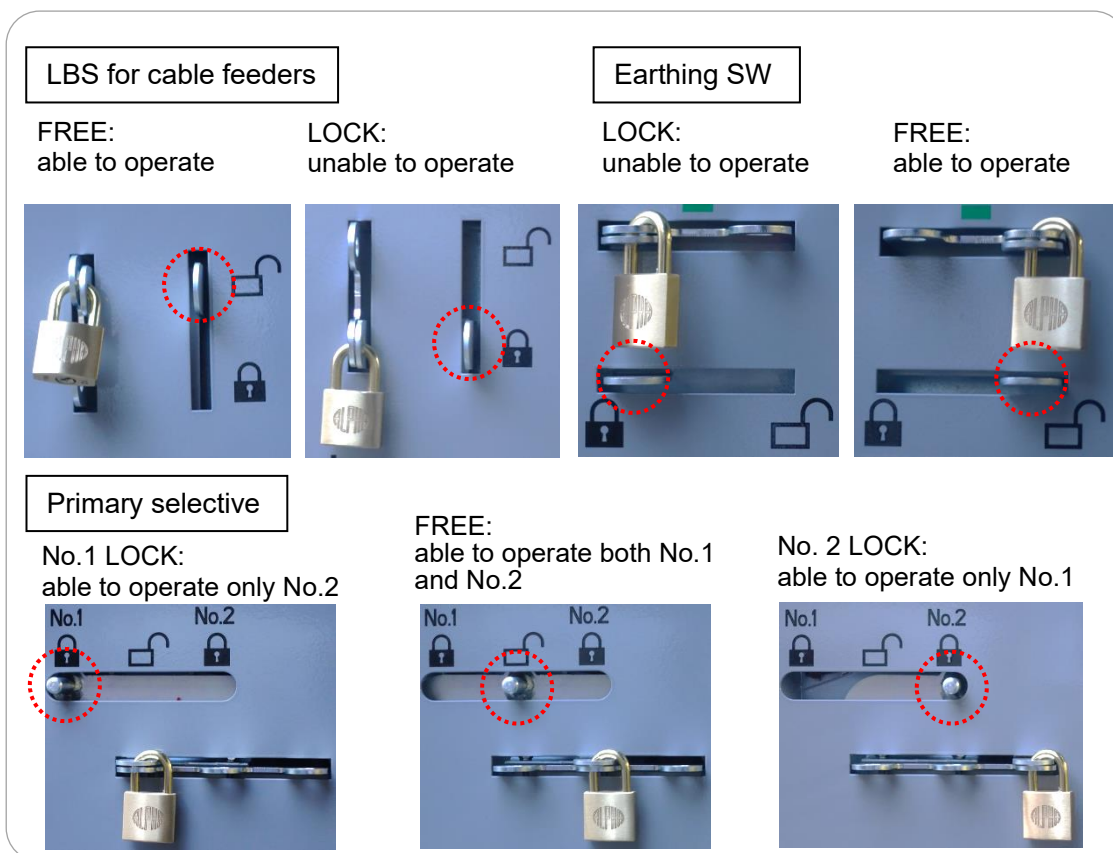
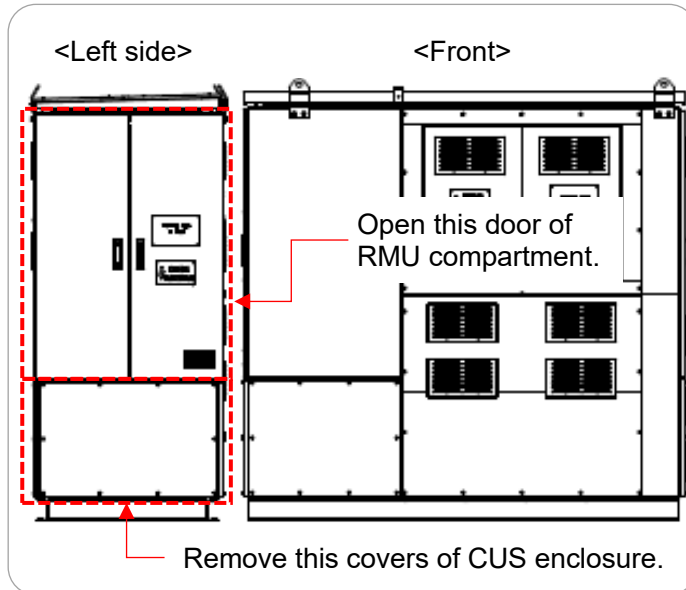


Figure 25. Padlocks at each position

9. Installation

9.1. Earthing of RMU

- ① Open the door of RMU compartment, and remove the cover below the RMU compartment door.



- ② OPEN the LBS and CLOSE the earthing SW of transformer feeder to unlock the mechanical interlock of cable compartment cover, and then open the front cover of transformer feeder cable compartment according to the clause 8.2.1.
- ③ Ground the RMU by connecting the earthing bus bars of RMU and CUS enclosure. Grounding shall be in accordance with the regulation of the installation site. [Figure 26]

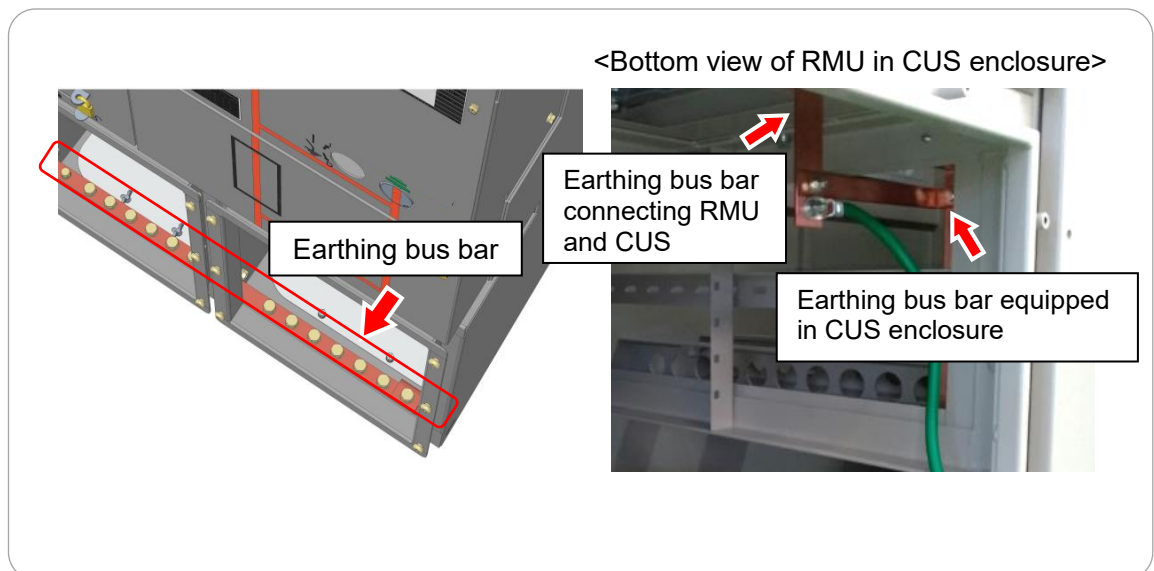


Figure 26. Earthing connection point

10. Operation

10.1. FRTU operation

[Manufacturer: Ingeteam; Type: INGE PAC DA-AUC]

Refer the instruction manual No. 01236 for the operation of RMU controller.

10.1.1. Front panel of FRTU

The diagram below shows front panel mounting and role of the buttons of FRTU.

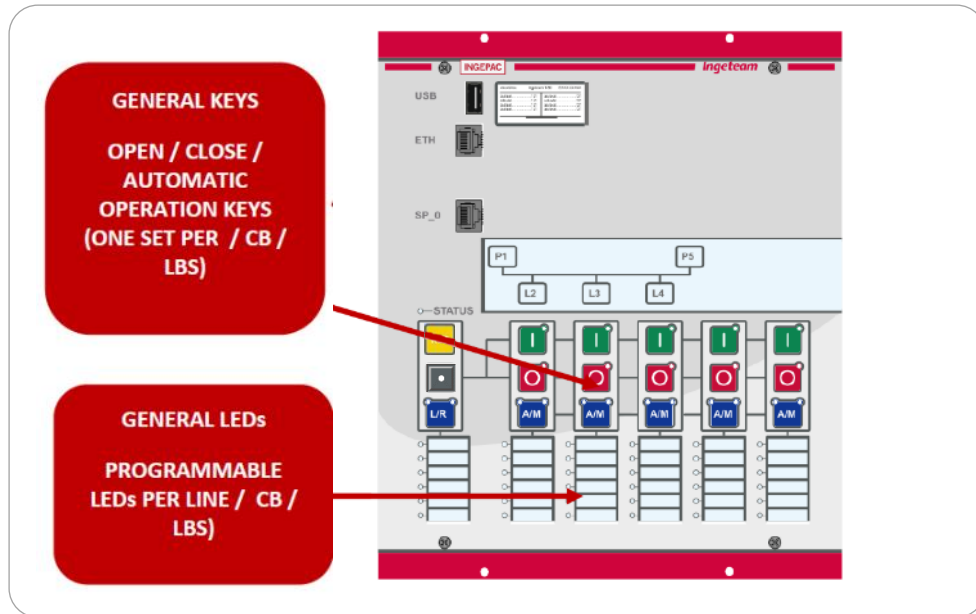







Figure 27. FRTU Front Panel

	CB / LBS Close with LED indicator; one per line
	CB / LBS Open with LED indicator; one per line
	Automatic operation enable / disable with LED indication; one per line
	Local/ Remote Control with LED indicator
	Operation permission
	Reset (Reboot FRTU)






Figure 28. Role of front panel buttons

10.1.2. Open and Close operation of LBS

1) Open operation

- ① Push  button
 - FRTU becomes local mode
 - LED on the left side : ON
- ② Push  button
 - permit open button operation
- ③ Push  button
 - open command executed
 - LED on  button: ON
 - LED on  button: OFF

2) Close operation

- ① Push  button
 - FRTU becomes local mode
 - LED on the left side: ON
- ② Push  button
 - permit open button operation
- ③ Push  button
 - open command executed
 - LED on  button: ON
 - LED on  button: OFF

Note:

For safety reasons, it is mandatory to press the operation permission button together with the desired button in order to execute a command. There is a separate set of buttons per Line / CB / LBS.

10.1.3. Configuration software

For setting of FRTU, it is possible to use **pacFactory** protection management software, which allows for the configuration and monitoring of equipment based on the IEC 61850 Standard. The controller contains a built-in webserver that allows the monitoring and control including customizable web based HMI.

The **pacFactory** application allows for the following functions:

- Installation Management
- Equipment monitoring:
 - ☐ Status
 - ☐ Statistical data
 - ☐ Measurement
 - ☐ Protection events
 - ☐ Fault reports
 - ☐ Measurements log
 - ☐ Interferences (oscillography)
- Setting configuration
- Communication configuration
 - ☐ IEC 61850 Server (MMS and GOOSE, fully configurable by user)
 - ☐ Other protocols:
IEC104, IEC101, IEC103, Modbus, DNP3,...
- Logic configuration based on IEC61131
- Front panel operation
- Irig-B and SNTP synchronization
- Firewall and cybersecurity features included

10.2. Voltage indicator

RMU equips voltage indicators to show whether the voltage is applied to the phases for two incoming/cable feeders. [Manufacturer: SHUGUANG ELECTRIC]

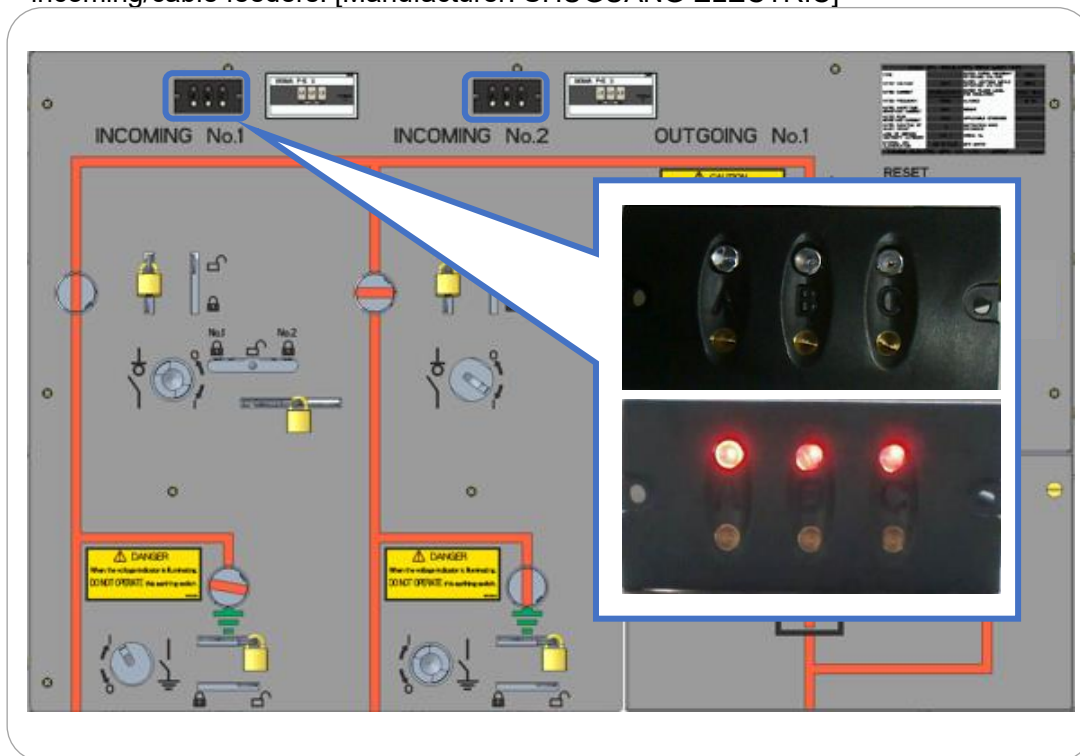


Figure 29. Voltage indicator

10.3. Fault current indicator

RMU equips fault current indicators to detect and show any earth faults or overcurrent faults for two incoming/cable feeders. [Manufacturer: HORSTMANN]

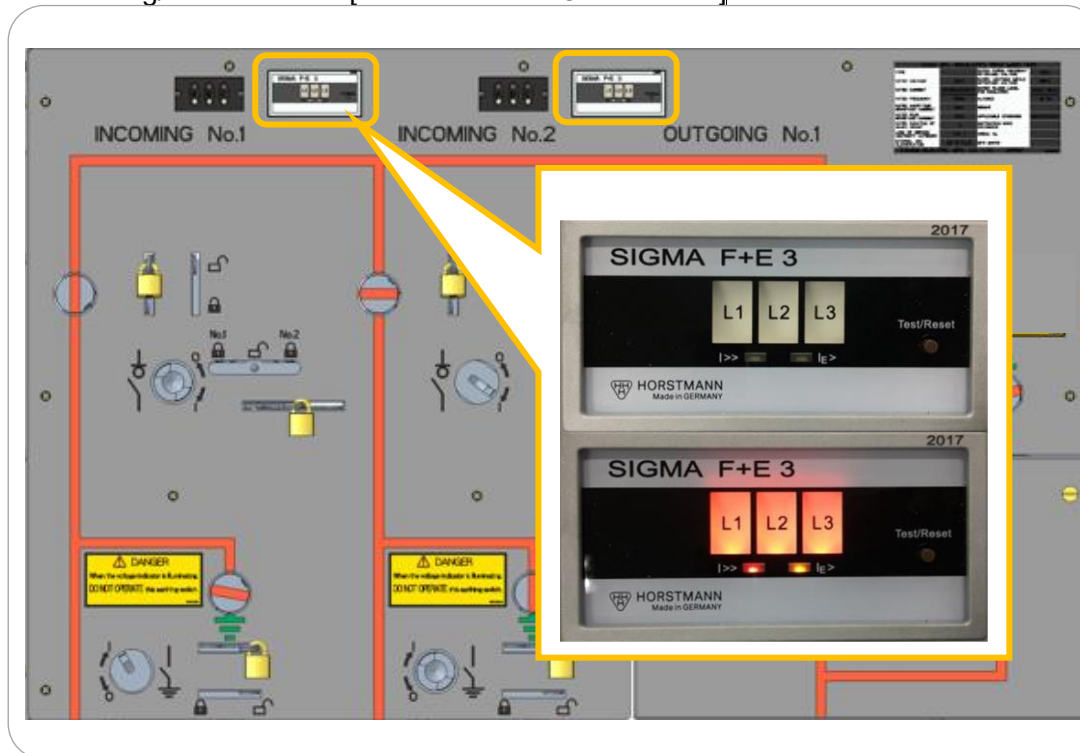


Figure 30. Fault current indicator

10.3.1. Installation of current sensors

Six (6) current sensors (three (3) for each cable feeder) are equipped in RMU with connected to the fault indicators. [Manufacturer: HORSTMANN]

These sensors are installed to the M/V cables prior to cable termination and fixing connectors to the cables.

Current sensors are numbered L1, L2, and L3, and these sensors are installed from phase A to C in order.

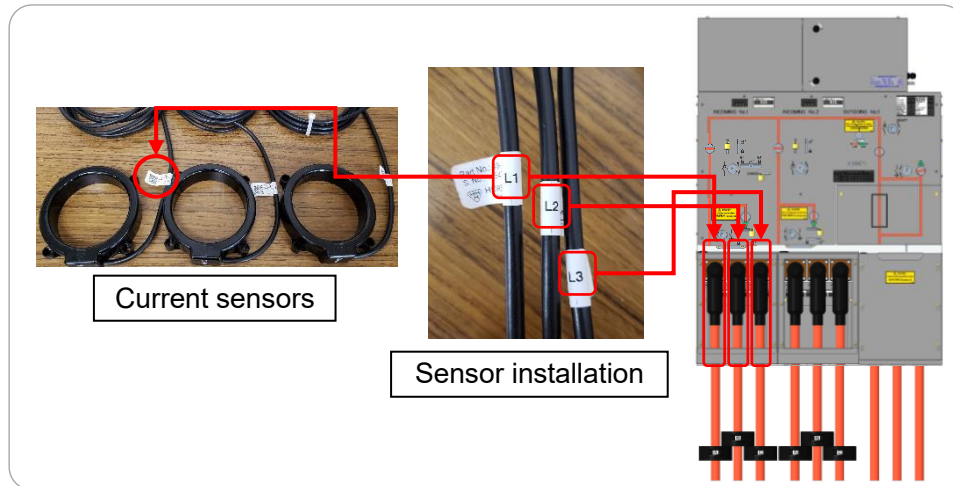


Figure 31. Current sensors

10.3.2. Usage of fault current indicator

Refer the instruction manual of Horstmann.

And, the fault current indicator settings at the time of shipment is as shown below.

• Short-circuit trip currents	Auto setting
• Short-circuit response delay setting	$\geq 80\text{msec}$
• Inrush current suppression	Off
• AR blockade time	0.1sec
• Switch-off detection trip criterion	Off
• Automatic time reset	4hours
• Contact type	Normally open
• Relay type	Permanent contact
• Earth short-circuit trip current	$> 100\text{A}$
• Earth short-circuit response delay	$\geq 200\text{msec}$
• Current reset	Inactive
• Remote signal	Phase-selective

11. Other operation

11.1. Fuse replacement

11.1.1. Fuse replacement

After opening the fuse compartment cover, replace the fuses according to the following procedures.

- ① Open the fuse compartment cover according to 8.2.2.
- ② Pull up the lever of fuse holder. [Figure 32]
- ③ Withdraw the fuse straight without rotating the fuse holder. [Figure 33]
- ④ Remove the fuse from the holder. [Figure 34]
- ⑤ Place and set the new fuse in the holder. Make sure the direction of the fuse. [Figure 35]
- ⑥ Reset the striker. [Figure 36]
- ⑦ Apply grease to the holder and insert it into the fuse box. [Figure 37]
*If the attached grease has expired, contact to Togami Electric Mfg. Co., Ltd. (HO) to procurement.
- ⑧ Push down the lever of fuse holder to the end. [Figure 38] Make sure to lock by the holder handle.

- ⑨ Replace other two fuses according to the same procedures above.
⑩ Close the front cover of fuse compartment.

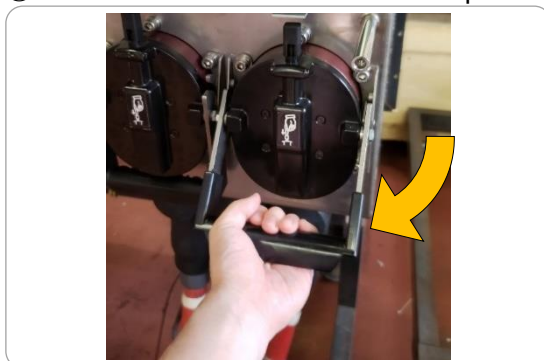


Figure 32. Lever operation (②)



Figure 33. Holder withdrawal (③)

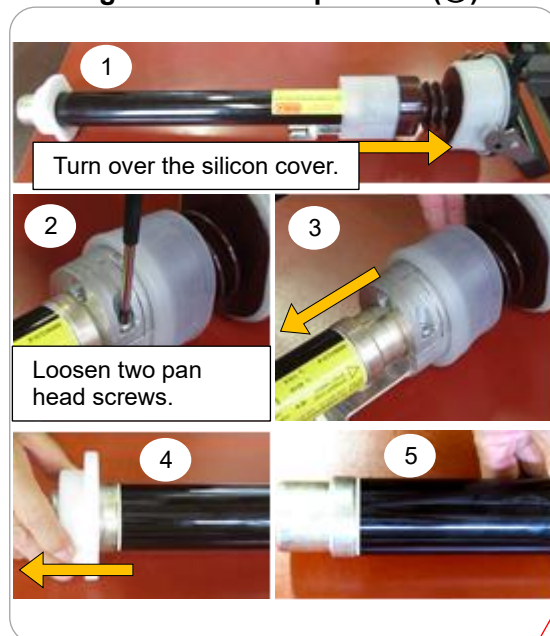


Figure 34. Fuse removal (④)

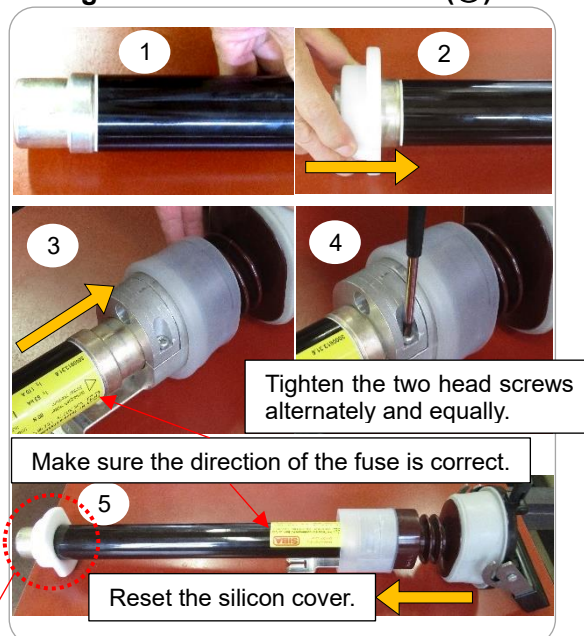
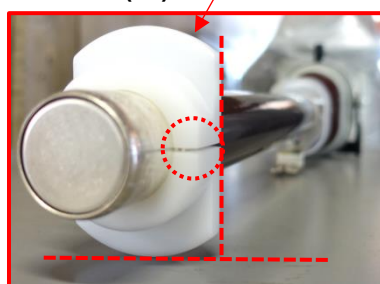


Figure 35. Fuse set (⑤)



Note:

- Set the fuse guide vertically to the ground as shown in the picture.
- Set the fuse guide so that the slit is parallel to the ground

Apply grease to silicone parts



Figure 36. Striker reset (⑥)

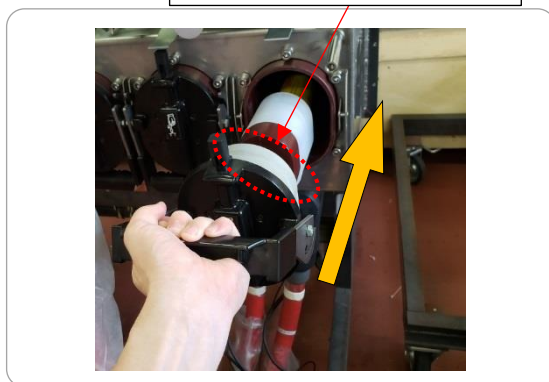


Figure 37. Holder insert (⑦)



Figure 38. Lever operation (8)



- In case of blowing any one of three fuses, replace all three fuses.
- Always wear the protective gloves because the fuse link may get hot.
- If one of the fuses blows, LBS of transformer feeder trips, and the circuit is opened.

11.2. Medium voltage terminal work

When working on the termination of 2-incoming cable feeders, cables shall be terminated by referring to the instruction of the terminals.

For the termination of medium voltage side, use Type C elbow connectors of EN50180 and EN50181. We recommend a connector of K400LB/G from Euromold.

11.3. Plug-in voltage transformer

Item	Ratings
Phase	1 phase, 1 pole (Phase C)
Rated primary voltage	24/ $\sqrt{3}$ kV
Rated secondary voltage	230 V
Rated power frequency withstand voltage	50 kV
Rated impulse withstand voltage	125 kV
Accuracy class	Class 1
Rated burden	75 VA
Thermal limiting output	350 VA _{th}
Polarity	Subtractive
Rated voltage factor	1.9 U _n / 8 hours and 1.2 U _n / continuous

The plug-in type voltage transformer for supplying a power to the controller is installed on the RMU at the time of shipment from the factory. And no special maintenance is required. However, it's recommended to clean the surface from time to time with a dry, soft cloth.

The primary and secondary neutral windings are connected to the enclosure of the RMU. Please make sure the enclosure is earthed before operation.



- Do not detach the secondary cable of the VT.
- Do not also short circuit the secondary windings.
- For cleaning never spray with water.

12. Insulation gas and tank

12.1. Insulation gas used in RMU

Sulfur hexafluoride (SF₆) gas is used according to IEC60376.

12.2. Gas tank (RMU enclosure)

RMU enclosure is designed as “hermetically-sealed pressurized system” in accordance with IEC62271-200.

Design as “hermetically-sealed pressurized system” requires no maintenance for insulated gas encapsulation. Under the normal operation environment, the expected product life of RMU enclosure will be 20 years.



- Never make any holes on the enclosure.
- Never open the gas tank/enclosure.

12.3. Designed pressure

Rated encapsulated pressure is 50kPa · G at 20°C.



- If the gas pressure gets lowered, namely below 25-30kPa · G at 20°C, the low gas pressure indicator points the orange section. If the indicator is in orange, LBS cannot be operated.
- If RMU is operated forcefully under the low gas pressure condition, RMU may get damaged, and there is a possibility to cause an accident.

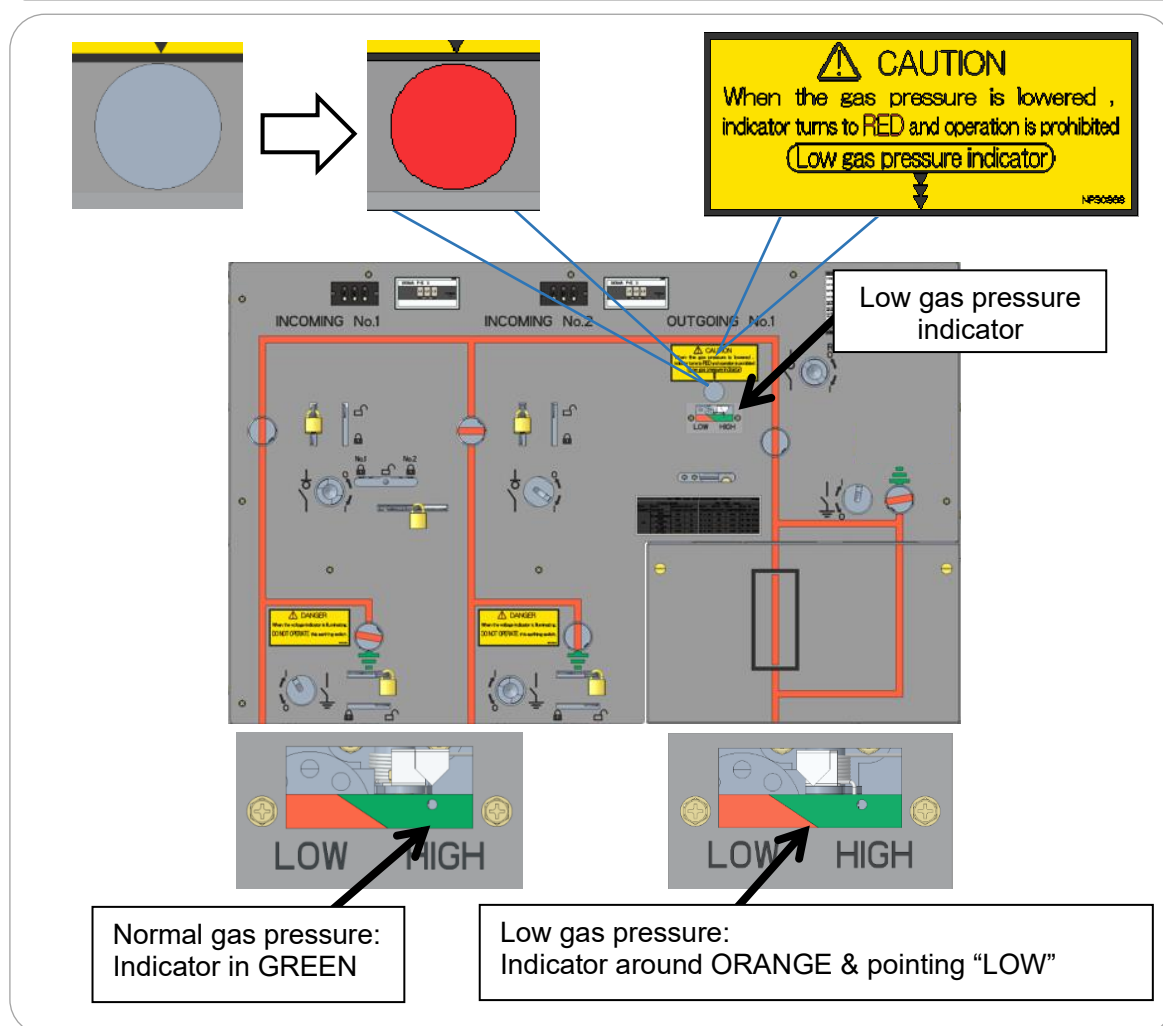


Figure 39. Low gas pressure indicator

13. Maintenance

Maintenance and checks are necessary to find any deterioration and/or failure prior to any problem. In consideration of usage environment and economic efficiency, we recommend the users to carry out a periodical checks of equipment.

13.1. Regular check

Without suspending the power supply, carry out the appearance check by visual, hearing, and smelling.

Interval of check: Once in one (1) week to a month



- Do not touch the medium voltage energized parts.

13.2. Periodic check

In addition to the appearance check, carry out the precise check by suspending the power supply.

Interval of check: Once in one (1) year



- Confirm the disconnection of all circuits from the power supply line prior to and during the work.
- Make sure to display and carry out the necessary protection to avoid any making operation of RMU by accident.

	No.	Checklist	Check
Regular check	1	No damage or deformation on the case of RMU	
	2	Secure and no loose on installation of RMU	
	3	Appropriate indication of each position indicator	
	4	No damage, such as crack and chip, on bushings	
	5	Appropriate earthing of RMU	
Periodic check	1	Smooth operation of RMU with the accessory handle	
	2	Appropriate insulation resistance on medium voltage circuits	
	3	No blown fuses	

14. Accessories

14.1. Treatment of contact surface

When connecting the terminals of two incoming cable feeders, refer the instruction of terminal manufacturer, and make sure to apply the enclosed grease.

14.2. Accessories

- 1 (one) Operating handle: for LBS and earthing SW

15. After service

We recommend the periodical inspection every year.

If abnormal deposition or adhesion of dust is found, RMU may need cleansing and switching test by our technical service personnel. In such a case please contact the manufacturer.

For technical inquiries, please contact us at the followings:

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