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# 24kV COMPACT UNIT SUBSTATION

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**MGS20-A**

## 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.01188i

**Togami Electric Mfg.Co.,Ltd.**

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## 1. Purpose

This Compact Unit Substation, hereinafter called CUS, is used and installed in the nominal circuit voltage of AC24kV underground distribution system.

## 2. Safety precautions

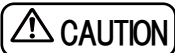
- For safe use, CUS shall be handled and operated by the personnel who have the adequate knowledge and skills.
- CUS shall be connected to the earth by the earthing terminals. Earthing of the product shall be in accordance with the regulations where the product is installed.
- Thoroughly read and understand the information contained in this instruction manual and correctly use the CUS.
- Use the CUS after acquiring proficiency in the knowledge of apparatus, safety information, and safety precautions. After reading, keep this instruction manual for future reference.
- In case a worker gets injured, after initial treatment, call an 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.

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

 <b>CAUTION</b>
<ul style="list-style-type: none"><li>■ Fall and injury hazard:<ul style="list-style-type: none"><li>• Never carry or operate CUS upside down.</li></ul></li><li>■ Electric shock and injury hazard:<ul style="list-style-type: none"><li>• Always wear rubber insulated gloves and other necessary personal protective equipment when handling and operating CUS.</li></ul></li><li>■ Electric shock, injury, and fire hazard:<ul style="list-style-type: none"><li>• Never disassemble nor modify CUS.</li></ul></li><li>■ Fire and injury hazard:<ul style="list-style-type: none"><li>• Never use when any abnormality can be identified.</li><li>• Dispose as an industrial waste.</li></ul></li></ul>

### 3. Warranty period and coverage

The warranty period of CUS 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

CUS complies the following standards.

Designation	IEC Standard
Switchgear	IEC62271-1 IEC62271-102 IEC62271-103 IEC62271-105 IEC62271-202 IEC62271-200
Circuit breaker	IEC60947-2
Contactors	IEC60947-4
Voltage transformer	IEC60044-2
Current transformer	IEC60044-1
Small item except above items	JIS, JEC, JEM
Instruments, lamp, control switch	JIS, JEC, JEM
Raw materials, wiring materials, bolts and nuts etc.	JIS, JEC, JEM

#### 4.2. Service Condition

CUS can be used in the environment indicated in the following table.

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

Site and Service conditions	
Installation site	Outdoor under direct sunlight and still air
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

<Unit substation: 500, 750 and 1,000 kVA (Common enclosure)>

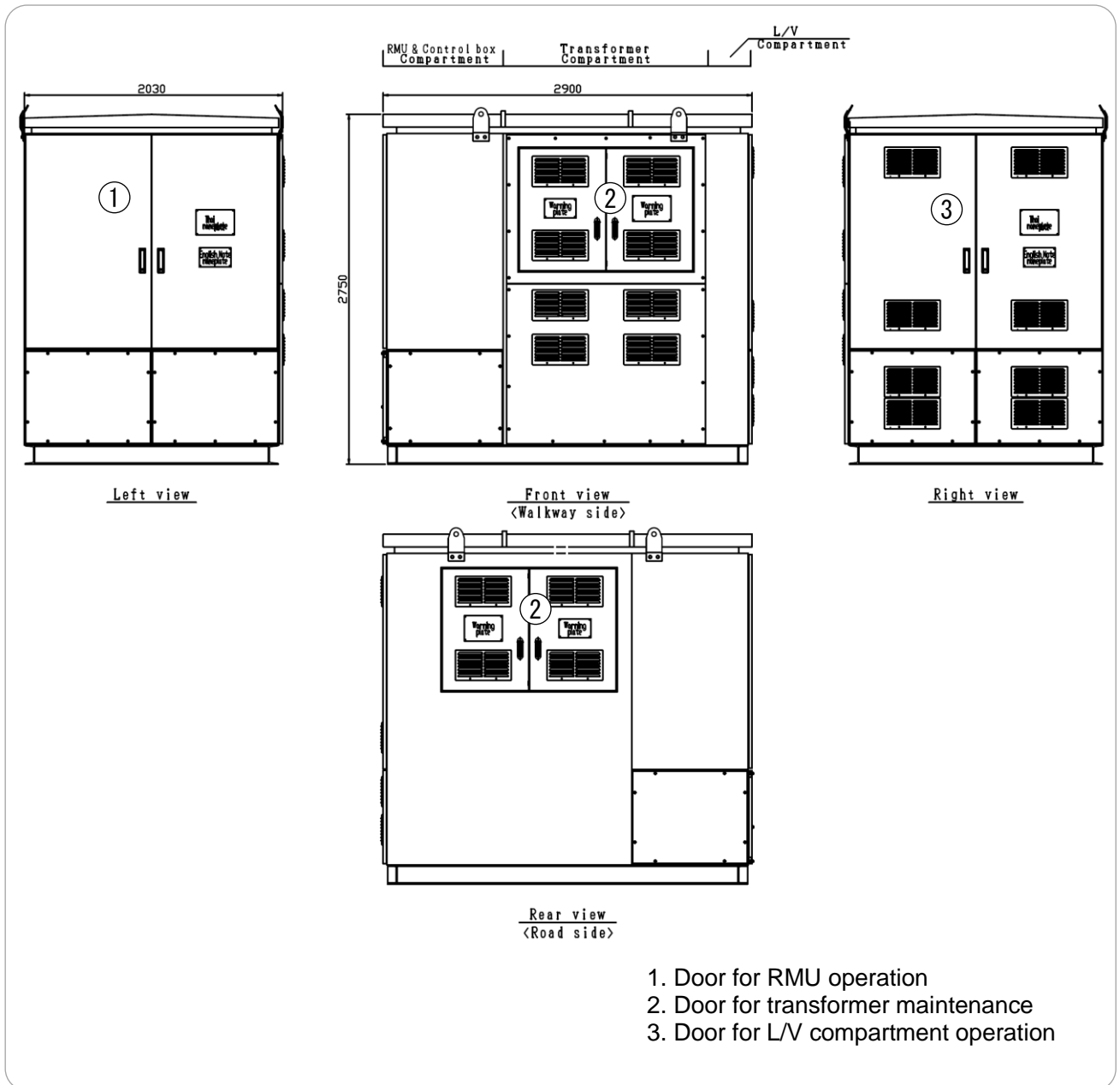
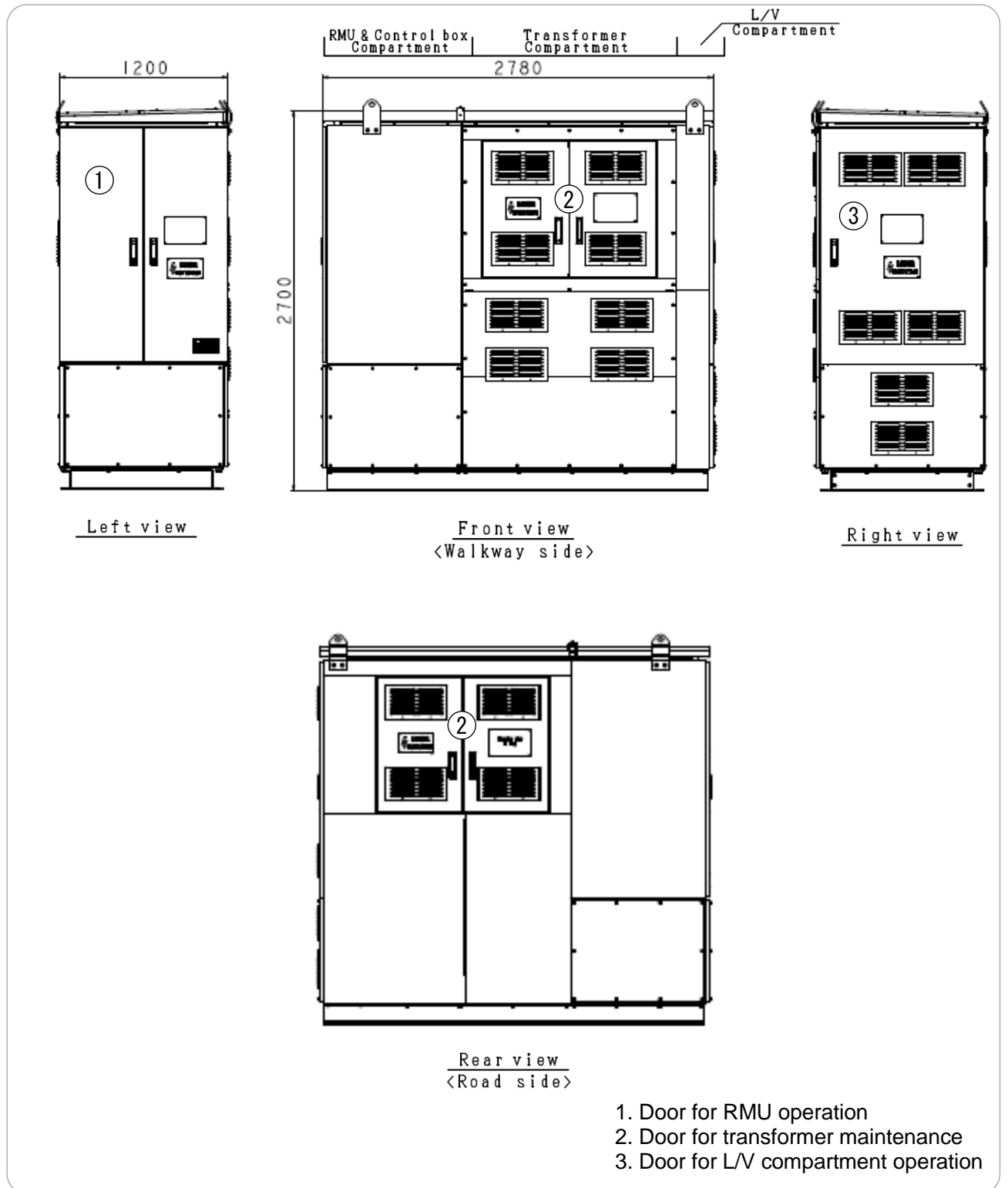


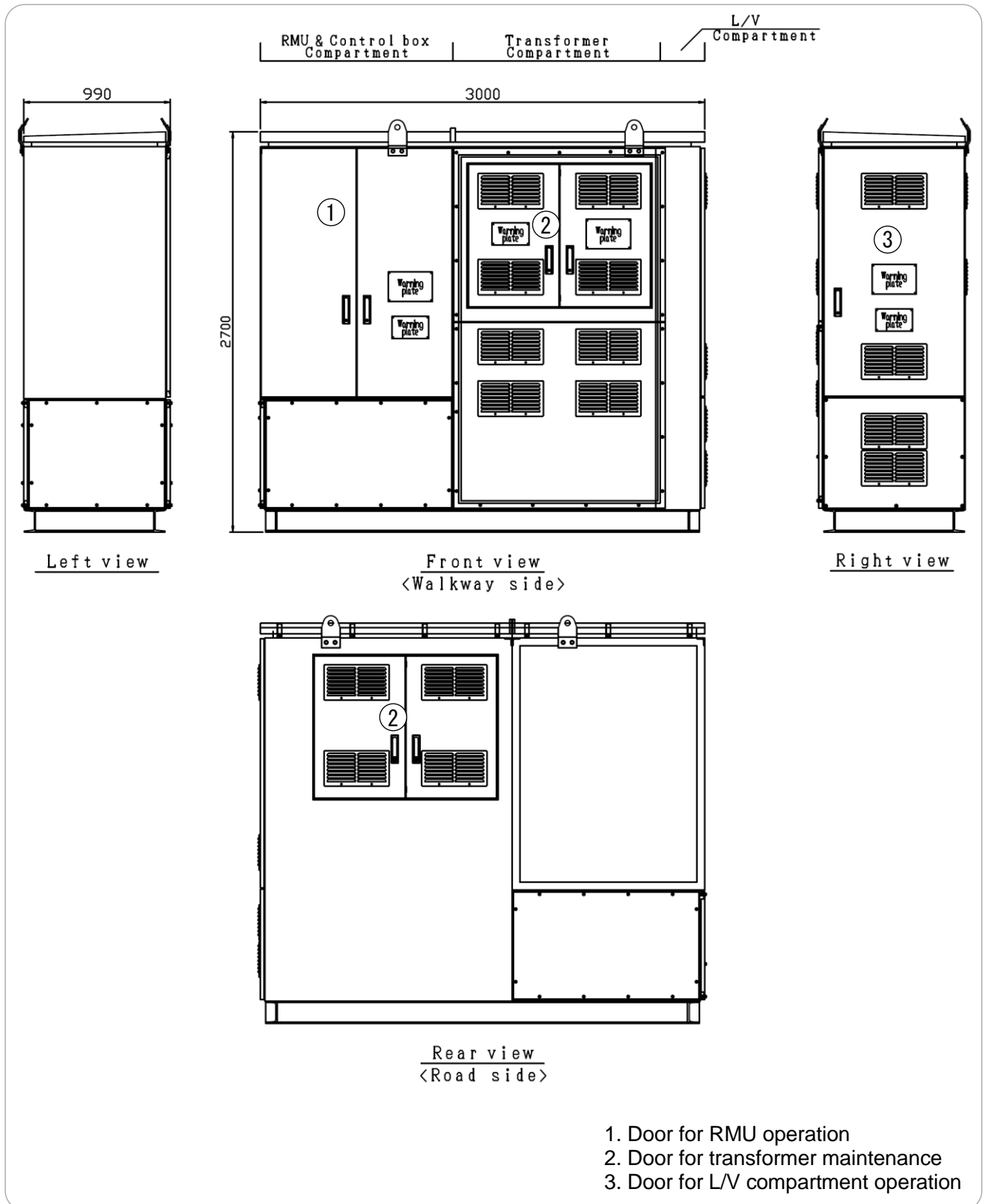
Figure 1. Part names of Unit substation

<Compact unit substation: 500 kVA>



**Figure 2. Part names of Unit substation**

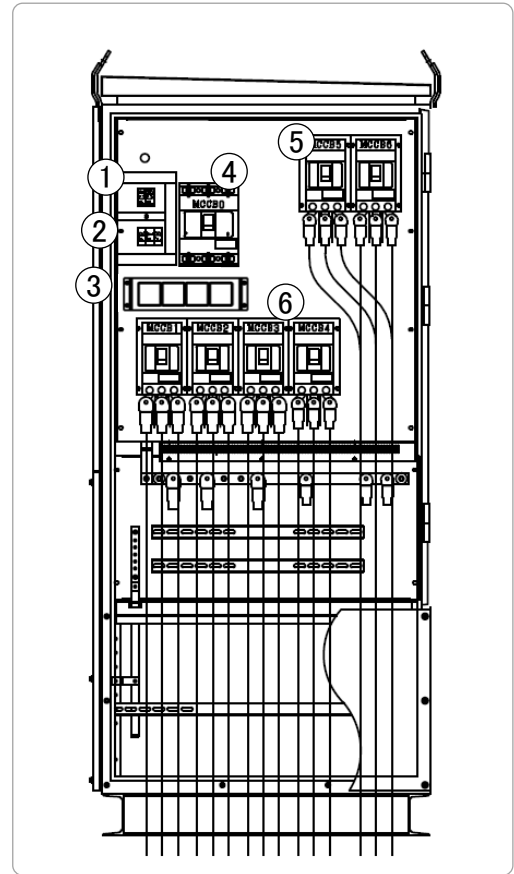
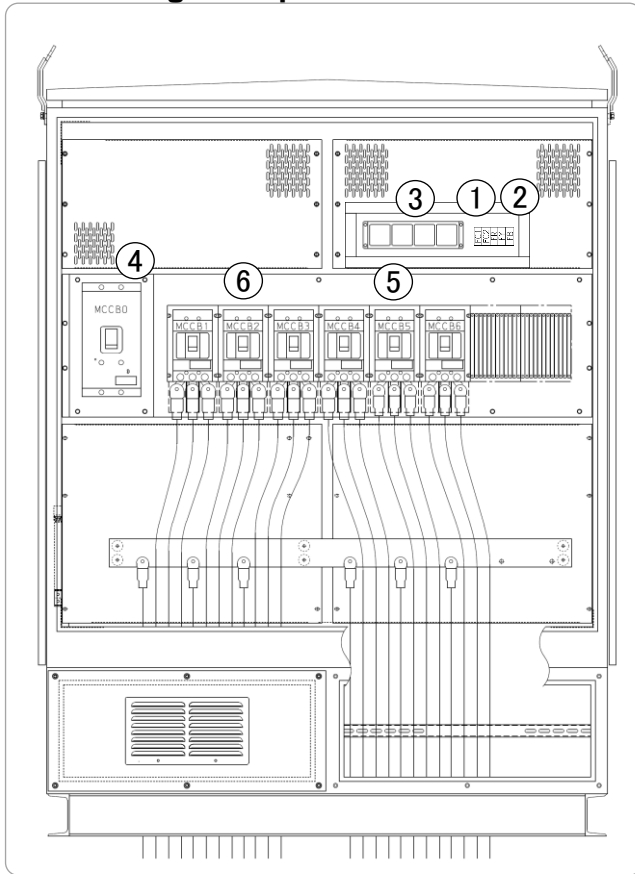
<Compact unit substation: 500 kVA (Narrower type)>



**Figure 3. Part names of Unit substation**



## 5.2. Low-voltage compartment



**Figure 4.**  
**<Unit substation: 500, 750, and 1,000kVA>**  
**(Common enclosure)**

**Figure 5.**  
**<Compact unit substation: 500kVA>**

1. Fuses for controller
2. Fuses for meter
3. Voltmeter (1 unit) and Ammeter with demand indicator (3 units)
4. MCCB Main

Figure 4. <Unit substation: 500, 750, and 1,000kVA> (Common enclosure)	1,600AT/1,600AF
Figure 5. <Compact unit substation: 500kVA>	800AT/800AF

5. MCCBs Feeder 250AT/400AF (2 units)
6. MCCBs Feeder 400AT/400AF (4 units)

### 5.3. Wiring diagram

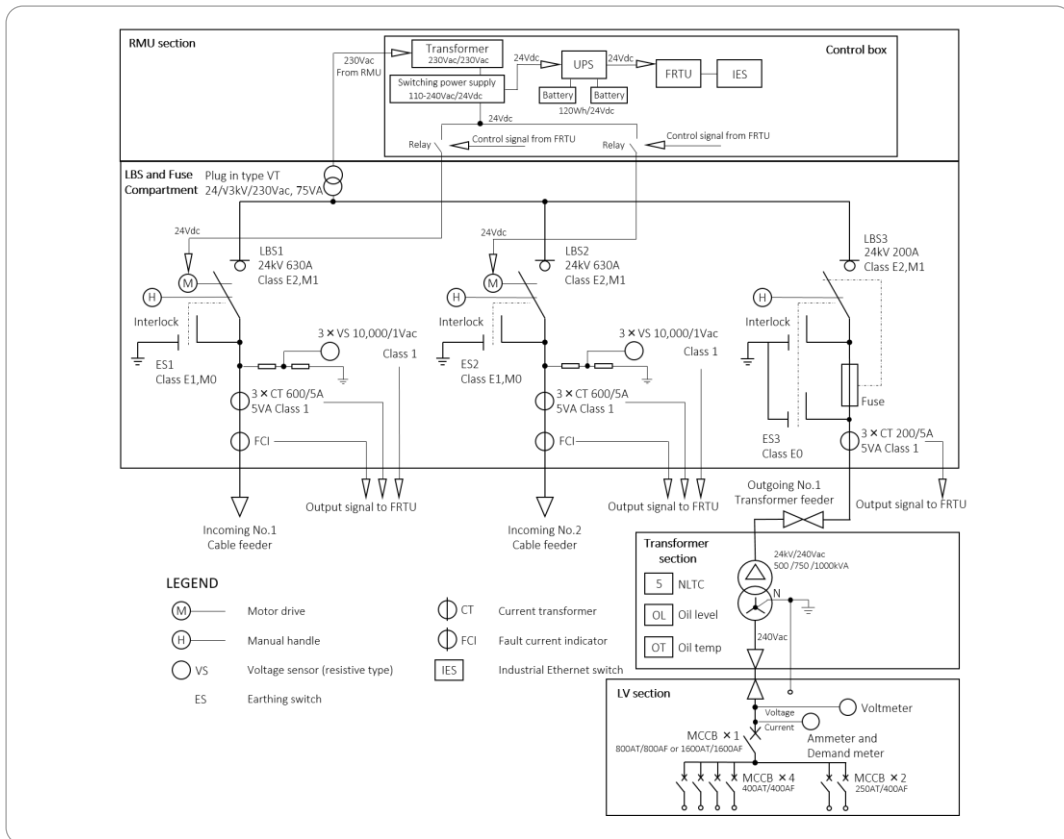


Figure 6. Single line diagram of CUS [RMU with plug in voltage transformer]

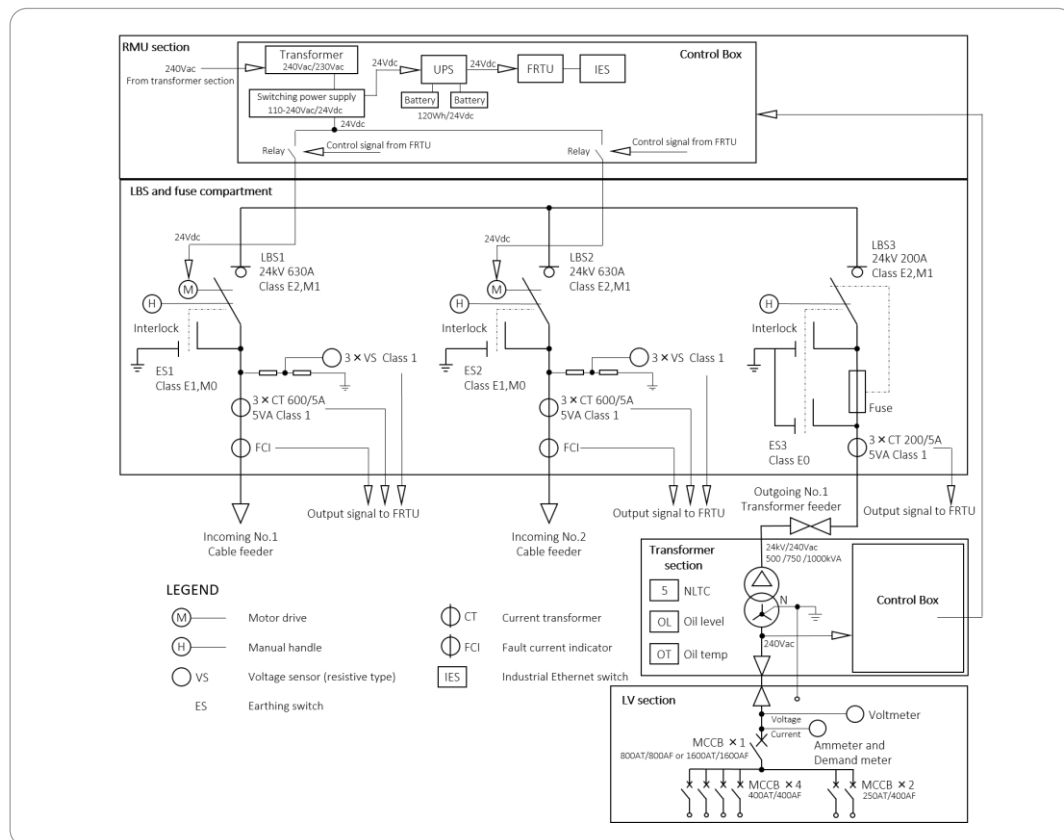


Figure 7. Single line diagram of CUS

## 6. Preparation prior to operation

### 6.1. Unloading and unpacking of CUS

Check and confirm the content of the package according to the invoice or packing list.  
 Check for any damages or sign of damages during the transportation.

### 6.2. Precautions for handling

The fragile equipment, such as meters and relays, are equipped in CUS; therefore, inappropriate operation may cause a minor damage, which may lead to a major trouble.  
 Handle CUS package with care.

### 6.3. How to lift CUS

As shown in the diagram below, hook the wire ropes to the lifting lugs at four points.  
 Operate the lifter or crane slowly and carefully so that a sudden gravity will not be applied to the wire ropes or lifting lugs.

Recommended values for lifting	Total mass (max) [kg]	Sling rope length [mm]	Allowable breaking load [kN] (Safe factor=6)	Lifting height [mm] (From the top of the enclosure)	Sling angle [°] (shall be 60° or less)
Unit substation (500, 750, 1,000kVA)	8000	3,000	117.6	2,660	56
Compact unit substation (500kVA)	5,000	3,000	108.6	2,696	51
Compact unit substation (500kVA, Narrower type)	4,500	2,000	103.2	1,803	53

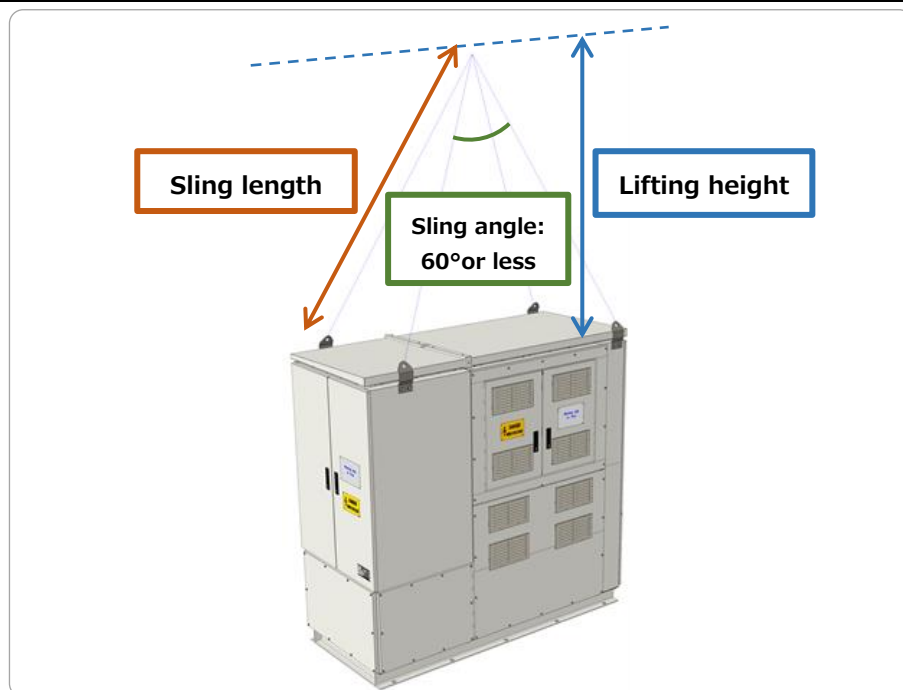


Figure 8. Recommended sling rope for CUS

### 6.4. Dust prevention

- If CUS is unpacked and left as it is for a while, cover CUS with vinyl sheets, etc. for preventing any stain or dust.
- Do not remove the cover sheets until CUS starts its operation

## 6.5. Installation

- Move CUS to place at the center of the foundation by crane.
- Confirm the level of CUS for longitudinal and side direction. If the level is not correct, adjust it with spacer, etc. Spacers are not included in the product.
- Fix CUS to the foundation securely after level adjustment.
- Use the foundation bolts which shall be M12. Refer the figure below for the location of holes.

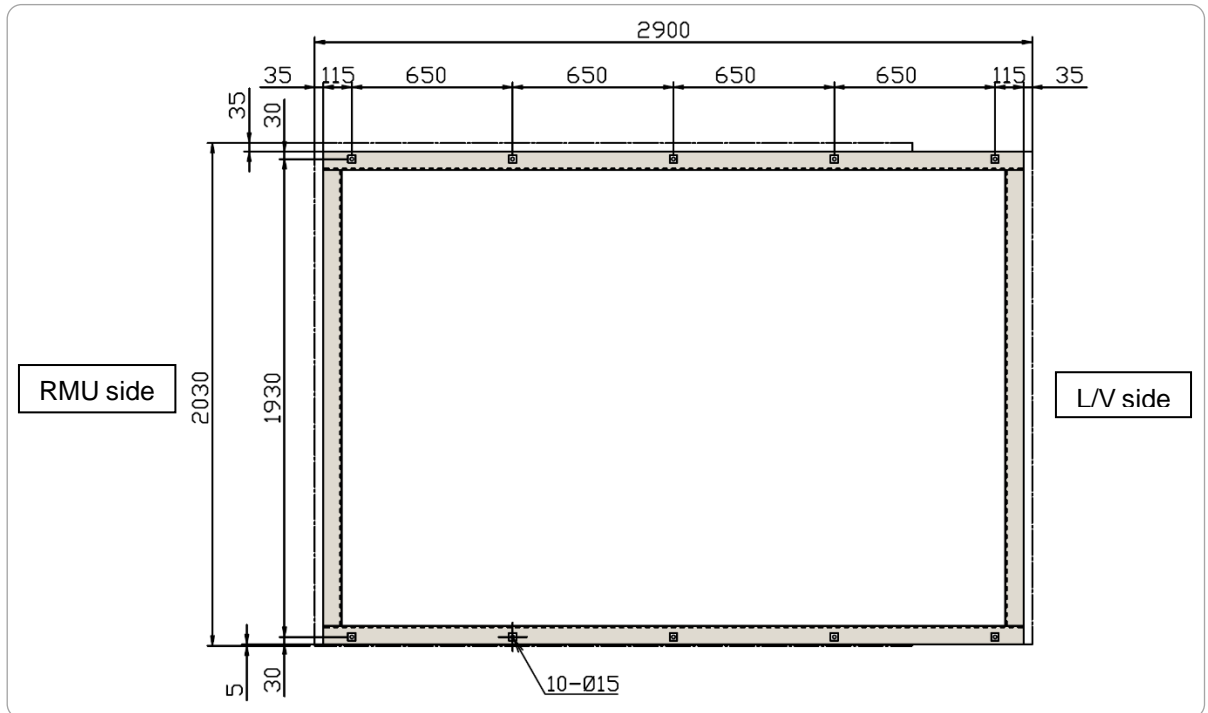


Figure 9. Unit substation: 500, 750 and 1,000 kVA (Common enclosure)

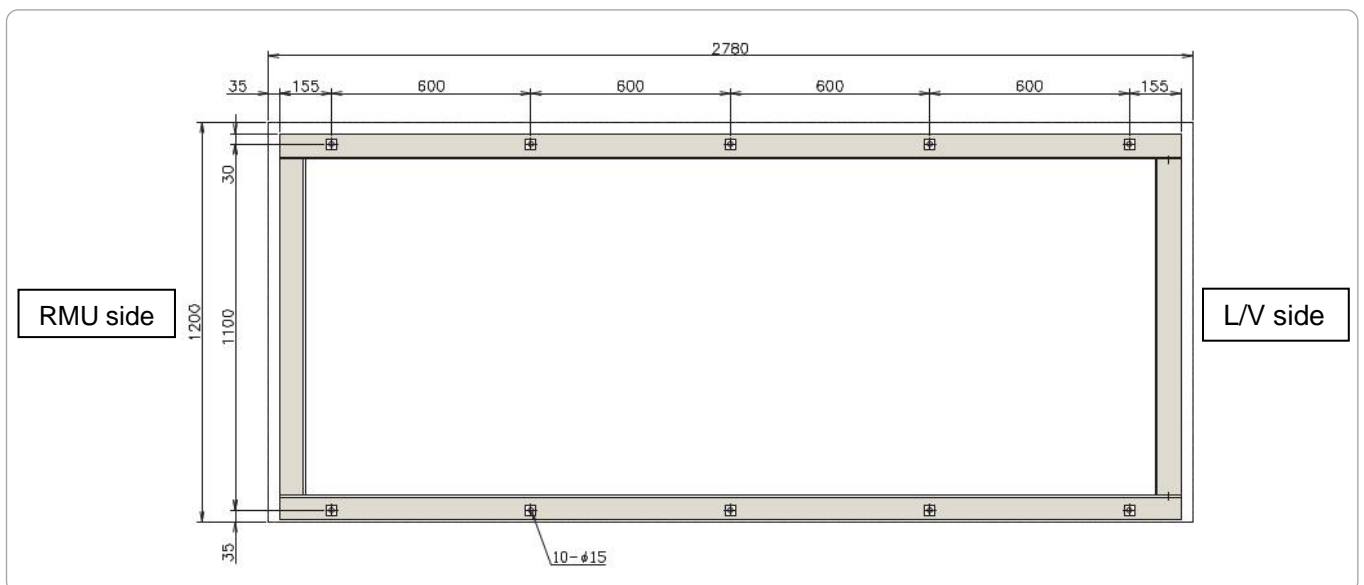
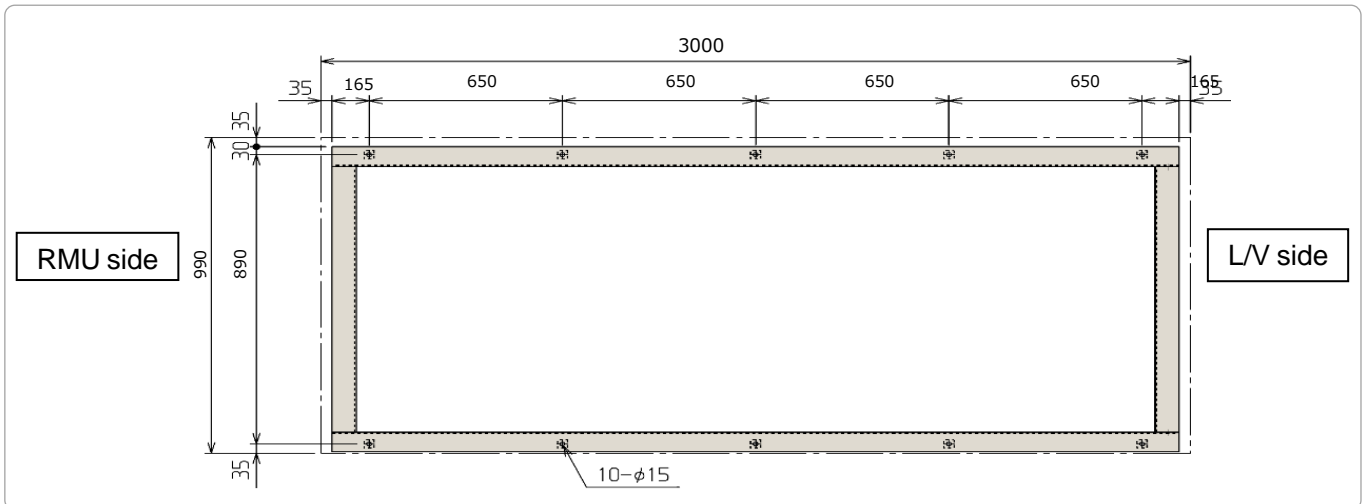


Figure 10. Compact unit substation: 500 kVA



**Figure 11. Compact unit substation: 500 kVA (Narrower type)**

- Check and confirm the damage or loose of parts during the transportation and installation. If any loose on bolts or nuts are found, fasten them by the specified torque.

(N · m)

Tightening method				M3	M3.5	M4	M5	M6	M8	M10	M12	M14	M16	M20
Male screw material	Female screw material	Lubrication	Limit											
(Stainless) Steel	(Stainless) Steel Screw thread 4 or more	None	Upper	0.98	1.47	2.16	4.41	7.55	18.2	36.2	62.9	100.6	155.4	303.6
			Standard	0.78	1.27	1.86	3.72	6.27	15.1	30.1	52.4	83.8	129.6	253.0
			Lower	0.59	0.98	1.47	2.94	5.00	12.1	24.1	41.9	67.0	103.7	202.5

## 7. Connection of external cable and earthing wire

### 7.1. Medium-voltage cable and earthing wire connection

- ① Open the doors of RMU Compartment.
- ② Remove the panel cover below the RMU door.
- ③ Open LBS1 and 2, and close the earthing switch 1 and 2.
- ④ Open and remove the cable compartment cover.
- ⑤ Connect the medium-voltage cables except LBS 3 (outgoing No. 1 transformer feeder).  
\*Refer to 7.2 for how to connect the medium-voltage cable.
- ⑥ Pass the earthing wire of the medium-voltage cable through the CT for the fault indicator and then connect it to the earthing bar inside of the cable compartment indicated in the drawing below.
- ⑦ Connect the earthing wire of voltage sensors to the earthing bar.

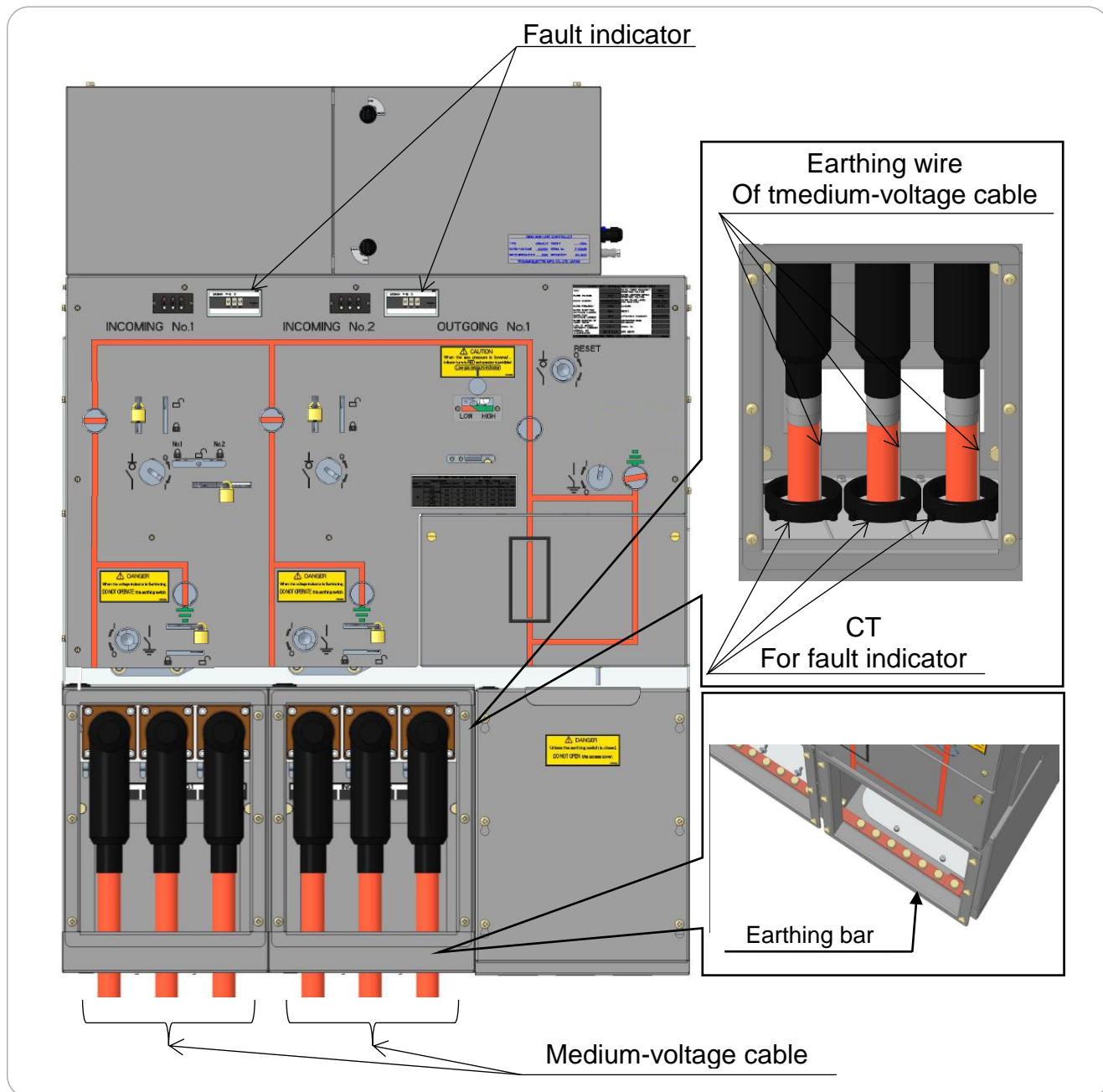


Figure 12. Connection of Medium-voltage cable and earthing wire

## 7.2. Medium-voltage cable connection

- ① Pass the cable through each CT according to the phase indication on the CT. [Figure. 13]
  - ② Cut the rubber packing according to the diameter of the cable to be used, and then attach it to the cable. [Figure. 14]
  - ③ Install the current sensors to the cables. Current sensors are numbered L1, L2, and L3, and these sensors shall be installed from phase A to C in order. [Figure. 15]
  - ④ Install the cable connector to the cable and attach it to the bushing. [Figure. 15]
  - ⑤ Install the voltage sensors. Coaxial cables are colored yellow, green, and brown. These cables shall be installed from Phase A to C in order. [Figure. 15]
  - ⑥ Install the cable clamps. [Figure. 16]
  - ⑦ Attach the plates in the bottom of cable compartments. [Figure. 15]
- \* Refer to the enclosed instruction manuals issued by Ingeteam and Horstman for the installation procedures of ③ and ⑤.

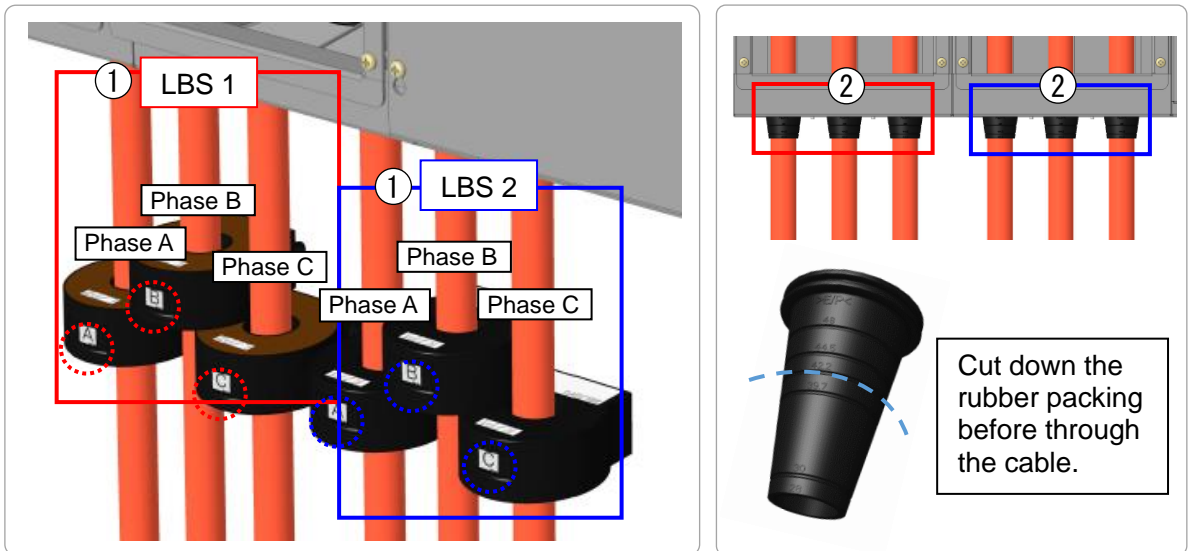


Figure 13. Installation of the CT to the cables      Figure 14. Preparation of rubber packing

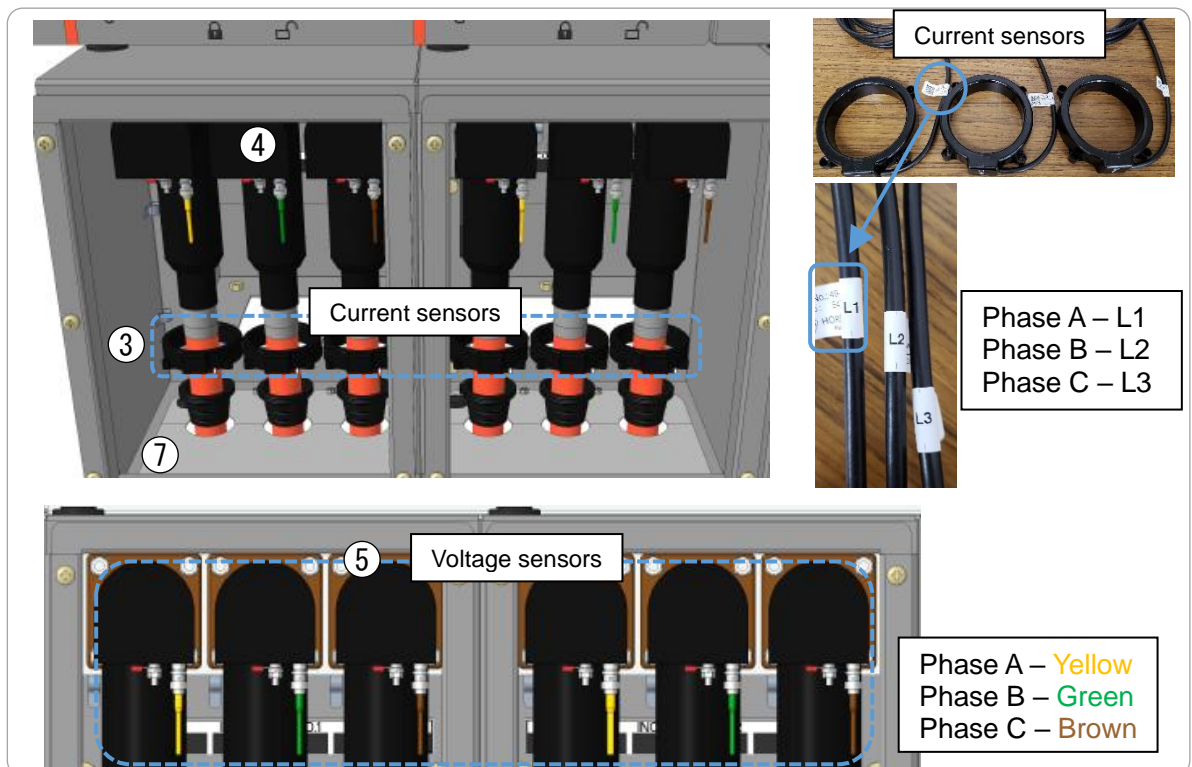


Figure 15. Installation of each part

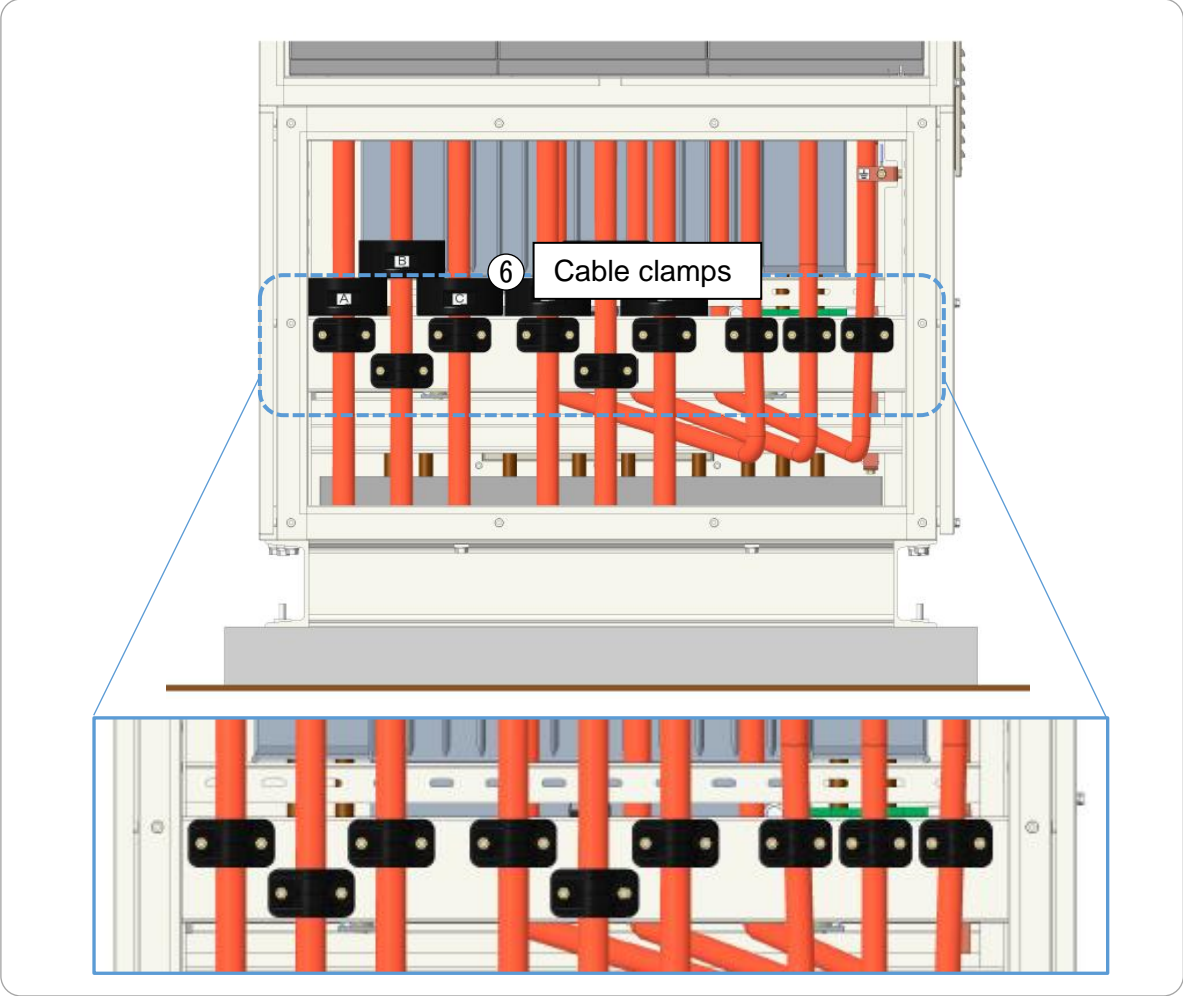


Figure 16. Installation of cable clamp



### 7.3. Low-voltage cable connection

- ① Open the door of L/V Compartment.
- ② Confirm that MCCB0 to 6 are open position.
- ③ Connect the cables to the MCCB terminals.
- ④ Make sure to connect the N-phase to the earth. (If applicable)
- ⑤ After connection, fix the cables to the cable supports with banding bands.

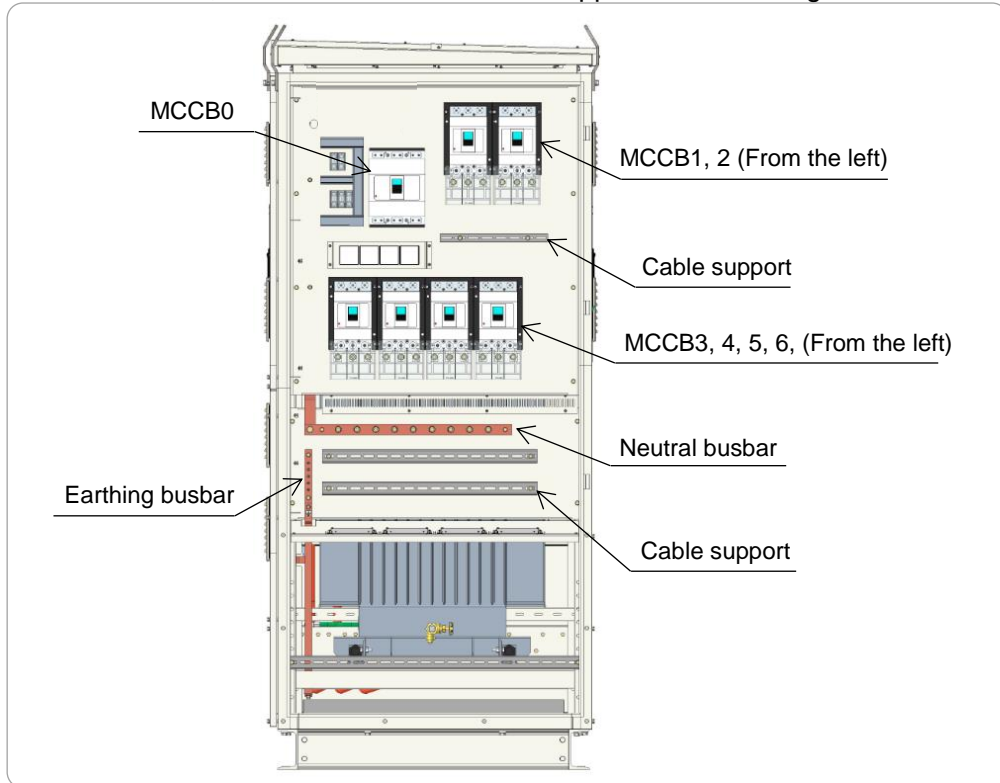


Figure 17. Connection of Low-voltage cable

## 8. Other operations

### 8.1. Low voltage fuse exchange

Use the following low voltage fuse for voltmeter and control circuit.  
 The low voltage fuse shall be complied with JIS C 8314 or IEC 269-2.

- ① Dimensions

Diameter [mm]	Length [mm]
15	50



Figure 18. Fuse appearance

- ② Fuse rating

Rated Voltage [V]	Rated normal current [A]
AC500	3
	10



• Exchange fuses after confirming that no voltage is applied to the circuit.

## 9. Earthing

### 9.1. Enclosure earthing (PE)

Enclosure of CUS shall be earthed in accordance with the regulations where the product is installed.

Earthing wire shall be connected to the earthing terminal (M8) located on the bottom of RMU compartment by using the size 60mm<sup>2</sup> or above.

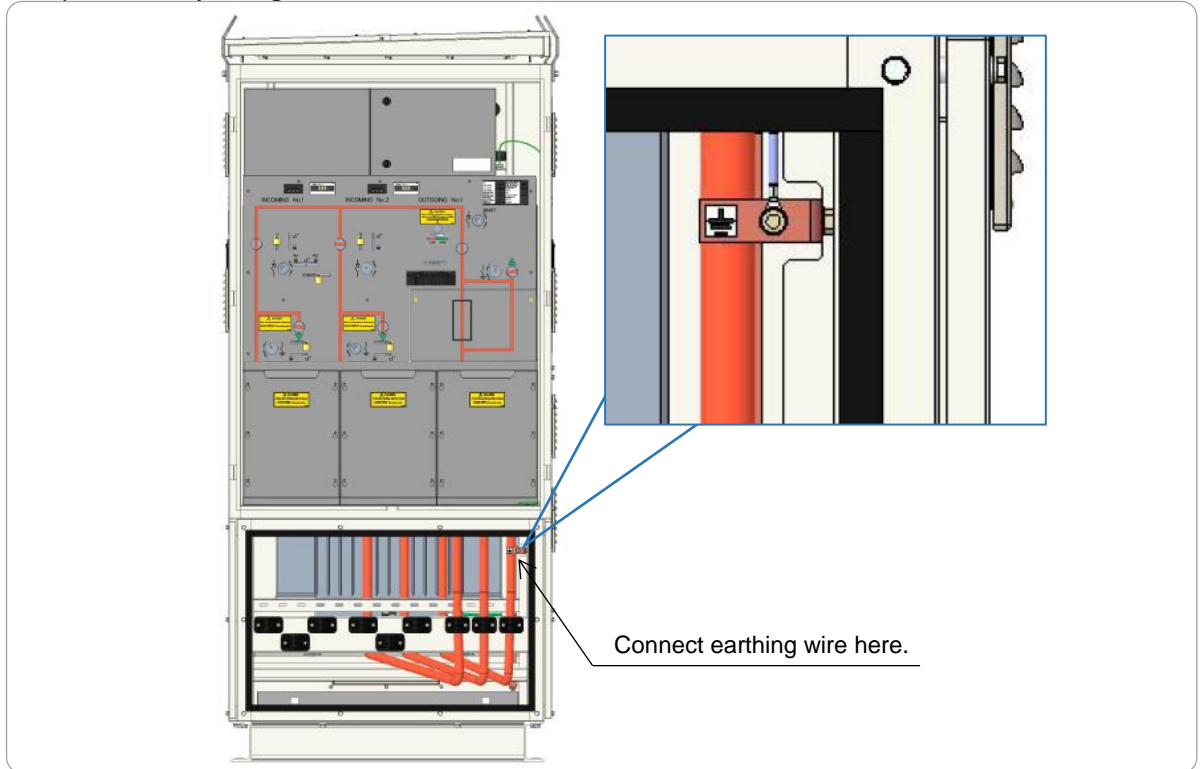


Figure 19. Connection point of earthing wire

### 9.2. Earthing of transformer secondary side N-phase (If applicable)

**N-phase of transformer secondary side is insulated from the earthing busbar (PE).**

If applicable, it shall be earthed in accordance with the regulations where the product is installed. Earthing wire shall be connected to the N-phase busbar (M12) located under the L/V MCCB.

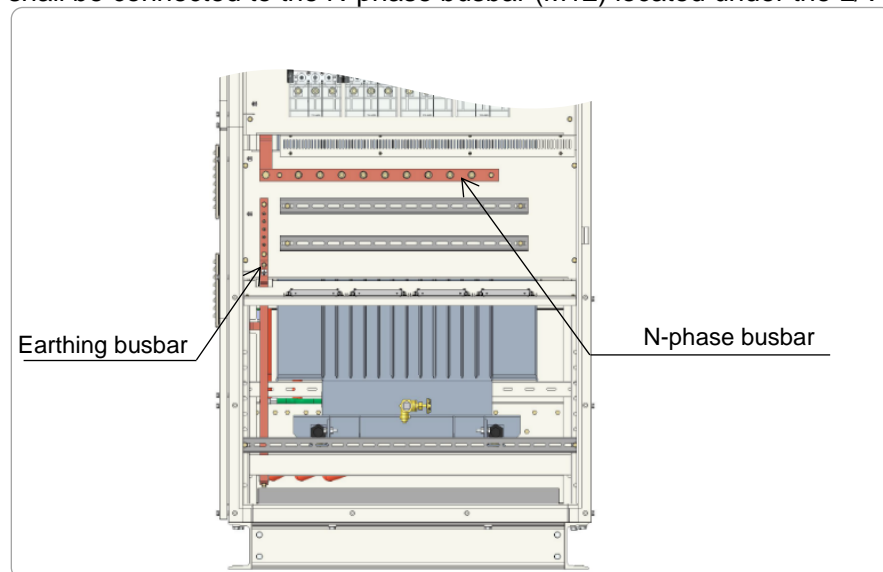


Figure 20. Position of earthing busbar and N-phase busbar

## 10. 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 check of equipment.

### 10.1. Regular check

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

Inspection point	Inspection item	Inspection timing and method	Check
		Regular check (Every year)	
Insulation resistance	1. Manual operation of equipment	Operation	
General matters	1. Check on concerned items of previous inspection	Check	
	2. Following up of modified items or fault records	Follow-up	



CAUTION

- Do not touch the medium voltage energized parts.

### 10.2. Periodic check

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

Inspection point	Inspection item	Inspection timing and method	Check
		Periodic check (Once in several years)	
L/V Busbar	1. Tightening of power supply line	Retightening in every 5 years	
	2. Tightening of busbar connection	Retightening in every 5 years	
	3. Discoloring of connections by heat or corrosion	Visual inspection in every 5 years	
	4. Tightening of insulators	Touching in every 5 years	
	5. Adhesion of dust on insulators	Visual inspection and cleaning in every 1-5 years	
	6. Contamination	Visual inspection and cleaning in every 1-5 years	
Installed equipment	1. Tightening of main circuit screws	Retightening in every 5 years	
	2. Tightening of control circuit screws	Retightening in every 5 years	
	3. Damage of equipment	Touching in every 5 years	
	4. Discoloring of equipment	Visual inspection in every 3 years	
	5. Manual operation of equipment	Operation in every 1 year	
	6. Energized operation of equipment	Operation in every 1-3 years	
	7. Characteristics test of MCCB	Operation in every 5 years	
	8. Contamination	Visual inspection and cleaning in every 1-3 years	
Insulation resistance	1. Insulation resistance of busbar (phase-to-phase, phase-to-earth)	Measuring in every 1 to 3 years	
	2. Insulation resistance of control circuit (phase-to-earth)	Measuring in every 1 to 3 years	
Enclosure appearance	1. Opening and closing operation and latching of the door	Operation in every 5 years	
	2. Operation of operation mechanism	Operation in every 5 years	
	3. Painting, deformation, and rusting of enclosure	Visual inspection in every 1 to 5 years	
General matters	1. Check on concerned items of previous inspection	Check in every 1 year	
	2. Following up of modified items or fault records	Follow-up in every 1 year	



CAUTION

- 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.

### 10.3. Measurement of insulation resistance

Confirm there is no abnormality by measuring the insulation resistance on phase-to-phase and phase-to-earth of main circuit and operation circuit.

Measuring point	Type of tester	Insulation resistance value
MV- P-to-E	1000V insulation resistance tester	2,000 MΩ or more
LV- P-to-P and P-to-E	500V insulation resistance tester	5 MΩ or more

In the case of the CUS is equipped with RMU which has a plug in transformer [Type: GST20-B-YT], the insulation resistance of (MV- phase C to E) is 0MΩ.

### 10.4. RMU fuse exchange

For fuse exchange of RMU, remove the cover of fuse compartment located on the bottom right of RMU by using an exclusive tool. Refer the enclosed instruction manual of Ring Main Unit for the detailed procedure of fuse exchange.

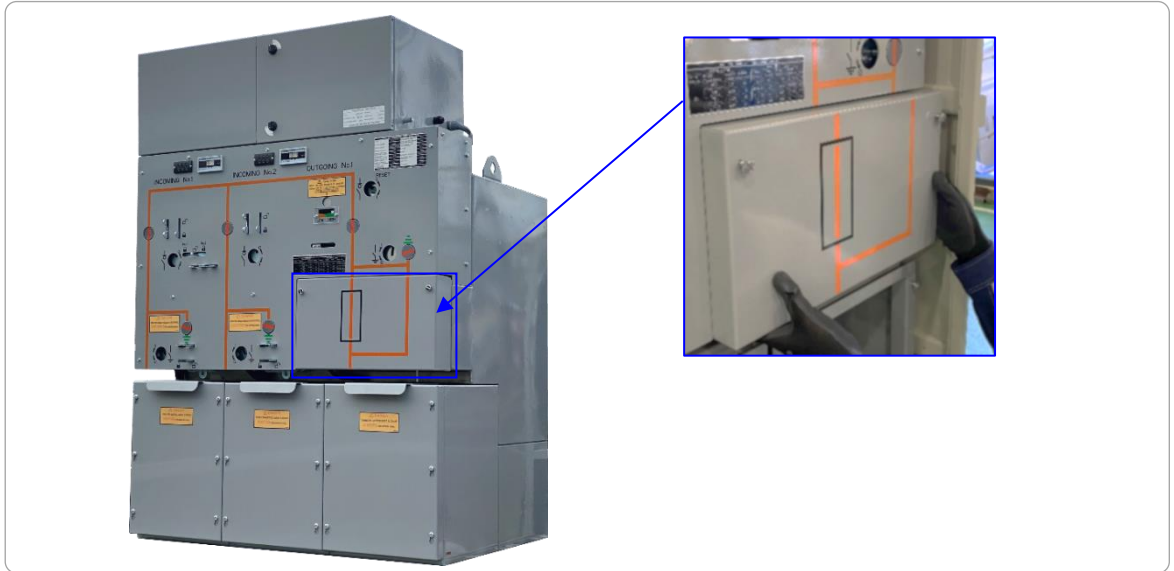


Figure 21. Position of fuse compartment

### 10.5. Inspection plan

Refer the Table 10-1 and 10-2 for practice.

### 10.6. Inspection point

Refer the Table 10-3 for practice.

Table 10-1

Inspection point	Inspection item	Inspection timing and method			
		Installation	Prior to energizing	Prior to operation	Initial phase
L/V Busbar	1. Tightening of power supply line		Retightening		Retightening
	2. Tightening of busbar connection	Retightening			Retightening
	3. Discoloring of connections by heat or corrosion				Visual inspection
	4. Interposition of insulating material at connections	Visual inspection			Visual inspection
	5. Tightening of insulators	Visual inspection			Visual inspection
	6. Adhesion of dust on insulators	Visual inspection and cleaning			Visual inspection and cleaning
	7. Contamination	Visual inspection and cleaning	Visual inspection and cleaning		Visual inspection and cleaning
Installed equipment	1. Tightening of main circuit screws		Retightening	Retightening	Retightening
	2. Tightening of control circuit screws			Touching	Touching
	3. Damage of equipment	Visual inspection		Visual inspection	Visual inspection
	4. Discoloring of equipment				Visual inspection
	5. Manual operation of equipment	Operation			Operation
	6. Energized operation of equipment			Operation	Operation
	7. Contamination	Visual inspection and cleaning	Visual inspection and cleaning		Visual inspection and cleaning

Table 10-2

Inspection point	Inspection item	Inspection timing and method			
		Installation	Prior to energizing	Prior to operation	Initial phase
Insulation resistance	1. Insulation resistance of busbar (phase-to-phase, phase-to-earth)		Measuring		
	2. Insulation resistance of control circuit (phase-to-earth)			Measuring	Measuring
Enclosure appearance	1. Opening and closing operation and latching of the door	Operation		Operation	Operation
	2. Operation of operation mechanism	Operation			
	3. Painting, deformation, and rusting of enclosure	Visual inspection			Visual inspection
General matters	1. Confirmation of temperature controller setting			Confirmation	Confirmation
	2. Check on concerned items of previous inspection	Check			Check
	3. Following up of modified items or fault records				Follow-up

Inspection criteria

- (1) Installation inspection: carried out after installation of CUS
- (2) Inspection prior to energizing: carried out before energizing CUS
- (3) Inspection prior to operation: carried out after connecting the load side cables
- (4) Initial phase inspection: carried out one year after operation started

Table 10-3

Inspection point	Inspection item			Procedure	Completed
		Good	Bad		
RMU	In accordance with RMU instruction manual			In accordance with RMU instruction manual	
Transformer	In accordance with transformer instruction manual			In accordance with transformer instruction manual	
- Power supply side terminals - Transformer primary cable - Transformer secondary cable - Load side terminals	1. No loose on screws			Retightening	
	2. No mark of heat			Exchange of terminals or , if necessary, exchange of cables	
	3. No abnormal on cable support bending on supply side			In case of abnormal condition, fixing or rewiring	
	4. No adhesion of rust			Blowing by compressed air, etc.	
Control circuit terminals	1. No loose on screws			Retightening	
	2. No abnormality on wire treatment			Retightening	
	3. No disconnection of strand on crimped terminals			Exchanging with new terminals when the strand is cut by bending forcefully for the purpose of circuit check, etc.	
	4. No adhesion of rust			Blowing by compressed air, etc.	
Busbar	1. No loose on screws			Retightening	
	2. No mark of heat on connecting points			Retightening	
	3. No adhesion of rust on busbar support			Blowing by compressed air, etc.	
	4. No damage on busbar support			Exchanging	
	5. No foreign matters is found			Removing	
Equipped device	1. No loose on measuring device and screws			Retightening	
	2. No abnormality on liquid crystal display			Exchanging	
Circuit breaker for L/V side	1. No loose on terminal screws			Retightening	
	2. No loose on installation screws			Retightening	
	3. Smooth on/off operation			Exchanging with a non-defective product	
	4. No damage on molded part			Retightening	
Others	1. No oil accumulation on oil pan			Exchanging transformer	
	2. No accumulation of water on oil pan			Flowing out water by opening the drain valve	

## 11. Withstand voltage test

In the case of conducting withstand voltage test for CUS, please follow the instructions below.

- Make sure to apply the testing voltage to all three phases at a same time.
- Make sure to connect all three phases and N-phase of transformer secondary side to the earth.
- Make sure to connect the enclosure of CUS to the earth.
- Rated withstand voltage shall be  $24/\sqrt{3}$  kV for 10 minute (phase-earth).
- Make sure to wear the protection wearing when performing the test.

In the case of the CUS is equipped with RMU which has a plug in transformer [Type: GST20-B-YT], the withstand voltage test above the rated voltage ( $24/\sqrt{3}$  kV) is prohibited due to avoid the degradation of the plug in transformer.

## 12. After service

We recommend the periodical inspection of RMU and transformer every year.  
If abnormal deposition or adhesion of dust is found, please contact the manufacturer.

For technical inquiries, please contact us at the followings:

Sales representative:  
**Thai Virawat Co., Ltd.**

86/1 Krungthongburi Road,  
Bangkok 10600, Thailand.  
TEL (662) 860-7777  
FAX (662) 860-7833

Manufacturer:  
**Precise Electric  
Manufacturing. Co., Ltd.**

103/2 Moo 6 Thambol Banmai, Amphur  
Muang, Pathumthani 12000 Thailand  
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FAX 0-2961-4500

Technical Support:  
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## **Togami Electric Mfg.Co.,Ltd.**

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