TERASAKI
Innovators in Protection Technology

TemPower2

INSTRUCTION MANUAL FOR AIR CIRCUIT BREAKERS

(With Draw-out Cradle and Type AGR-11B,21B,22B,31B Overcurrent Protective Device)

Types: AR650S, AR663S, AR663H

Notice

- Be sure to read this manual before installing, operating, servicing, or inspecting the ACB.
- Please retain this manual for future reference.
- Electrical work must be done by competent persons.
- ACB maintenance, inspection, parts replacement, OCR field tests and setting changes must be performed by competent persons.

TERASAKI ELECTRIC CO., LTD.

KRB-5417c

TABLE OF CONTENTS

1. SAFETY NOTICES 4
2. RECEIVING AND HANDLING 6
2-1. Transportation Precautions 6
2-1-1. Transporting the ACB 6
2-1-2. Transporting the breaker body 7
2-1-3. Transporting the draw-out cradle 8
2-2. Storage Precautions 9
2-3. Installation Precautions 9
3. GENERAL 13
3-1. Types and Descriptions 13
3-2. Parts and Functions 16
3-3. Circuits and Ratings 20
4. OPERATION 27
4-1. Charging and Opening operation 27
4-1-1. Charging operation 27
4-1-2. Closing operation 28
4-1-3. Opening operation 28
4-1-4. Motion of trip indication and spring charge indication switches 28
4-1-5. Motion of operation mechanisms 29
4-2. Draw-out and Insertion Operation 31
4-2-1. General 31
4-2-2. Draw-out operation 32
4-2-3. Putting the breaker body back into the draw-out cradle 33
4-2-4. Contact status of auxiliary and position switches 35
4-3. ON-OFF Button Cover Locking Procedure 35
4-4. Lock in OFF Procedure 36
4-5. Position Lock Lever Locking Procedure 36
4-6. Breaker Fixing Bolt Securing Procedure 37
4-7. OCR Cover Locking Procedure 37
5. OVERCURRENT RELEASE (OCR) 38
5-1. Specifications 38
5-2. Characteristics 40
5-2-1. L characteristic for general feeder 40
5-2-2. R characteristic for general feeder 43
5-2-3. S characteristic for generator protection 47
5-3. OCR Setting Procedure 49
5-3-1. OCR Setting Procedure (AGR-11B type) 49
5-3-2. OCR Setting Procedure (AGR-21B,22B,31B type) 50
5-3-2-1. General 50
5-3-2-2. Available screens 51
5-3-2-3. Monitor screen 53
5-3-2-3-1. Monitor screen (AGR-21B,22B) 53
5-3-2-3-2. Monitor 1 screen (AGR-31B) 54
5-3-2-3-3. Monitor 2 screen (AGR-31B) 55
5-3-2-4. Setup screen 57
5-3-2-4-1. Setup screen(AGR-21B,22B) 57
5-3-2-4-2. Setup screen(AGR-31B) 59
5-3-2-5. Reset screen 62
5-3-2-5-1. Reset screen (AGR-21B,22B) 62
5-3-2-5-2. Reset screen(AGR-31B) 63
5-3-2-6. Setting 1 screen 64
5-3-2-7. Setting 2 screen 66
5-3-2-8. Maintenance screen 69
5-4. OCR Function Check 70
5-5. Operation Indication and Indication Resetting Procedure 72
5-5-1. Operation Indication (AGR-11B type) 72
5-5-2. Operation Indication and Indication Resetting Procedure (AGR-21B,22B,31B type) 73
6. MAINTENANCE, INSPECTION AND PARTS REPLACEMENT 75
6-1. Inspection Procedures 76
7. TROUBLESHOOTING FLOWCHARTS 80

1. SAFETY NOTICES

Thank you for purchasing the TERASAKI AR-series Air Circuit Breaker (***TemPower2***).

This chapter contains important safety information.

Be sure to carefully read these safety notices, instruction in this manual, and other documents accompanying the Air Circuit Breaker (hereinafter referred to as the ACB) to familiarize yourself with safe and correct procedures or practices before installing, operating, or servicing the ACB.

In this manual, safety notices are divided into "DANGER" and "CAUTION" according to the hazard level:

⚠ DANGER : A danger notice with this symbol indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION : A caution notice with this symbol indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury and/or property damage.

Note that failure to observe a caution notice could result in serious injury/damage in some situations. Because safety notices contain important information, be sure to read and observe them.

■ Transportation Precaution

⚠ DANGER

- Never stand under the ACB that has been lifted or suspended by a lifter or lifting attachments. The weight of the ACB may cause serious injury.

■ Installation Precautions

⚠ CAUTION

- Electrical work must be done by competent persons.
- Do not place the ACB in such an area that is subject to high temperatures, high humidity, dusty air, corrosive gases, strong vibration and shock, or other unusual conditions. Mounting the ACB in such an area could cause a fire or malfunction.
- Be careful to prevent foreign objects (such as debris, concrete powder, dust, chippings, and iron powder) and oil or rainwater from entering the ACB. These materials inside the ACB could cause a fire or malfunction.
- Prior to commencing any work on the ACB, open an upstream circuit breaker or the like to isolate all sources of power/voltage. Otherwise, electric shock may result.
- Fix the draw-out cradle of the ACB firmly on a flat, level surface using mounting screws. Otherwise, the draw-out operation may cause the breaker body or the draw-out cradle to fall, resulting in damage to the ACB or personal injury.
- Take care not to deform or bend protrusions in the bottom face of the draw-out cradle when fixing the draw-out cradle with mounting screws. Deformation of the protrusions may cause a malfunction.
- Connect conductors (including screws) to the main circuit terminals in the specified area. Otherwise, a short-circuit may result.
- When terminating conductors to the ACB, tighten terminal screws to the torque specified in this manual. Otherwise, a fire could result.
- For 4-pole ACBs, be sure to connect a 3-phase, 4-wire neutral conductor to the N-phase pole (on the right end). Otherwise, an overcurrent may hinder the ACB from tripping, resulting in a fire.

■ Operation Precautions

⚠ DANGER

- Never touch live terminal parts. Doing so will result in electric shock.
- Do not leave the ACB body in the draw-out position. If the ACB body is accidentally dropped, its weight may cause serious injury.

⚠ CAUTION

- Do not force down the charging handle after completion of manual charging operation. Doing so may cause a malfunction.
- The permissible operating voltage of the spring charging motor is 85 to 110% of the rated ac voltage or 75 to 110% of the rated dc voltage. Be sure to supply a voltage within the above ranges to the motor. Otherwise, a malfunction, burnout, or fire may result.

■ Operation Precautions (continued)

⚠ CAUTION

- Repeated open/close operation by the motor charging mechanism without pause should not exceed 15 times. If repeated continuous open/close operation is inevitable, a pause of at least 20 minutes should be provided after the repetitions of 15 times. Otherwise, a spring charging motor may be burnt out.
- Do not bring your hand or face close to arc gas vent of the arc chamber while the ACB is closed. Otherwise, a burn may result from high-temperature arc gas blowing out of the arc gas vent when the ACB trips open.
- If the ACB trips open automatically, remove the cause of tripping operation before re-closing the ACB. Otherwise, a fire could result.
- If the ACB has the breaker fixing bolts, be sure to loose the fixing bolts before draw-out operation. Otherwise, damage to the ACB may result.
- Make sure the draw-out cradle is secured with mounting screws before inserting or drawing out the breaker body. Otherwise, the insertion or draw-out operation may cause the breaker body or the draw-out cradle to fall, resulting in damage to the ACB or personal injury.
- When retracting the draw-out rail into the draw-out cradle, be sure to push the rail end. Do not hold the hook pin, body stopper, or body stopper shaft. Doing so may cause your fingers to be pinched, resulting in injury.
- Do not forcedly turn the draw-out handle clockwise when the breaker body is in the “CONN.” position. Doing so may cause a malfunction.
- If the ACB has the breaker fixing bolts, make sure the bolts on both sides are securely tightened before using the ACB. Loosened fixing bolts may cause a malfunction of the ACB, in particular when it is installed in such an area that is subject to strong vibrations.

■ OCR (Overcurrent Release) Handling Precautions

⚠ CAUTION

- OCR field tests and setting changes must be performed by competent persons.
- After setting changes are made, the settings be checked with e.g., a type ANU-1 OCR checker (optional).
- After completion of OCR tests, be sure to return the settings to the original values. Failure to do so may cause a fire or burnout.
- Before changing OCR settings, open the ACB and then lock the OFF button to prevent the ACB from being closed inadvertently.
- Use a small flatblade screwdriver with a torque of not more than 0.1 N•m or a force of not more than 0.1 N when adjusting the setting switches (rotary step switches or slide switches). An excessive torque or force may cause a malfunction.
- Do not push the SET button diagonally. Doing so may cause a poor in return and malfunction.

■ Maintenance and Inspection Precautions

⚠ CAUTION

- ACB maintenance, inspection and parts replacement must be performed by competent persons.
- Do not touch ACB current carrying parts and ACB structural parts close to a current carrying part immediately after the ACB trips open. Remaining heat may cause a burn.
- Prior to commencing any work on the ACB, open an upstream circuit breaker or the like to isolate all sources of power/voltage from the main and control circuits. Otherwise, electric shock may result.
- Take care to avoid adhesion of dust to main and control circuit contacts. Dust on the contacts may result in a fire.
- Prior to commencing maintenance, inspection, or parts replacement, make sure that the closing springs are released and the ACB is open. Otherwise, unintentional open/close operation may lead to fingers or tools to be pinched by the open/close mechanism, resulting in injury.
- Retighten the terminal screws periodically to the specified torque. Otherwise, a fire could result.
- Do not perform dielectric withstand tests under other conditions than specified. Doing so may cause a malfunction.
- When replacing an auxiliary, do not damage the control wire for the auxiliary or pinch the wire between the auxiliary and the breaker body. Doing so may cause a malfunction.

2. RECEIVING AND HANDLING

Upon receipt of your ACB, check the following. If you have any question or problem, contact us at the indicated on the back cover of this manual.

- Check that the ACB received is as ordered and that the accessories are as specified.
- Check that the ACB is not damaged during shipment.

2-1. Transportation Precautions

⚠ DANGER

- Never stand under the ACB that has been lifted or suspended by a lifter or lifting attachments. If the ACB body is accidentally dropped, its weight may cause serious injury.

2-1-1. Transporting the ACB

- Before transporting the ACB, make sure the breaker body is in the CONN. position. If the ACB has breaker fixing bolts, make sure the breaker body is secured to the draw-out cradle with the fixing bolts.
- When lifting the ACB, hold it using lifting attachments or wire ropes through the lifting holes. Take care that the position switches, control circuit terminals, auxiliary switches, arc gas barrier and control terminal block cover which are shown in Fig. 1 are not damaged by the lifting rope. Lift the ACB carefully and gently. For transportation, place the ACB on a pallet and carry slowly and carefully.
- Avoid shock and vibration to the ACB during transportation.
- Do not lay the ACB during transportation.
- When transporting the ACB over great distances, crate it for protection against shock and vibration and secure the crate package with wood or ropes.
- When transporting the ACB while it is installed in a switchboard, you should fix the breaker body in the draw-out cradle with the breaker fixing bolts (optional).
- Lower the ACB onto a flat, level surface.

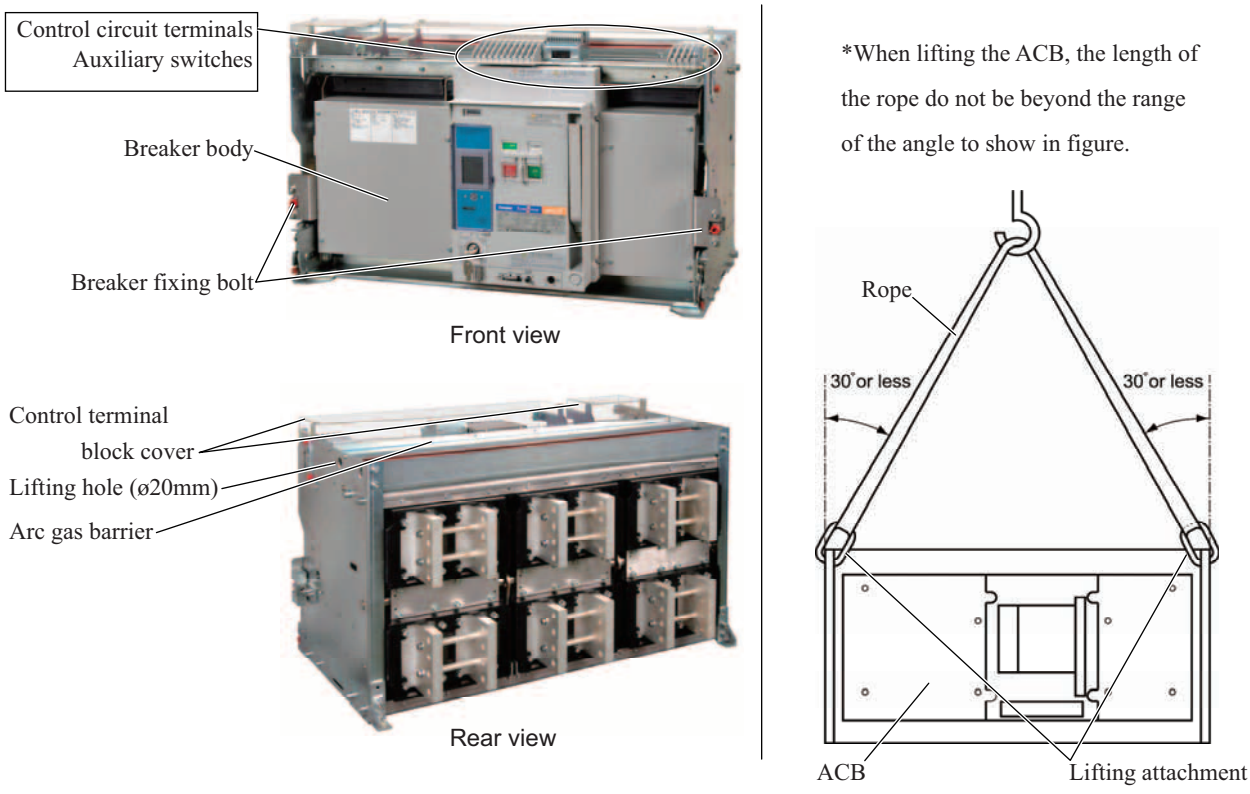
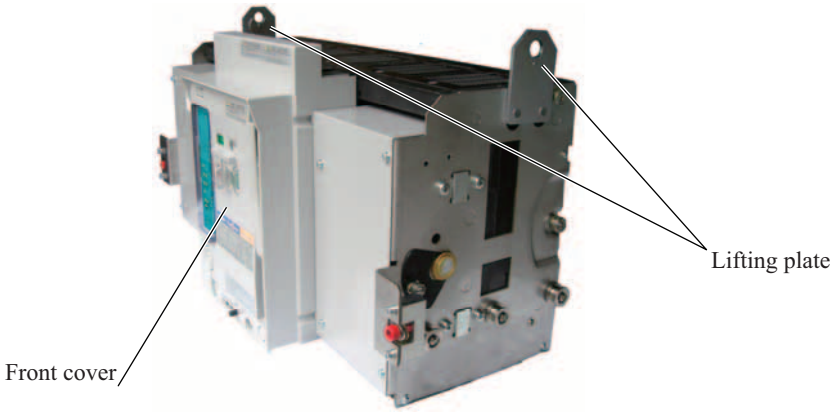


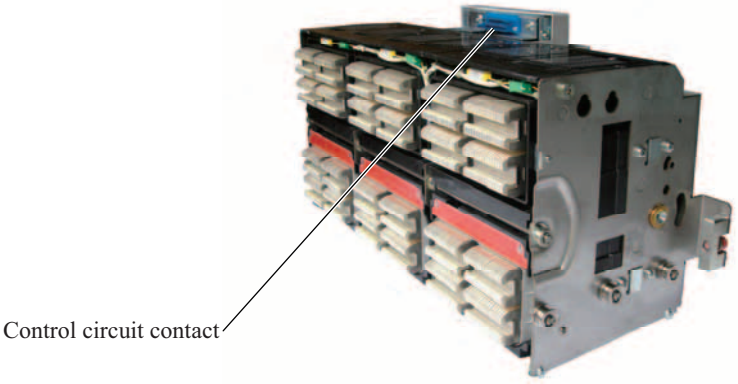
Fig. 1 Transporting the ACB

2-1-2. Transporting the breaker body

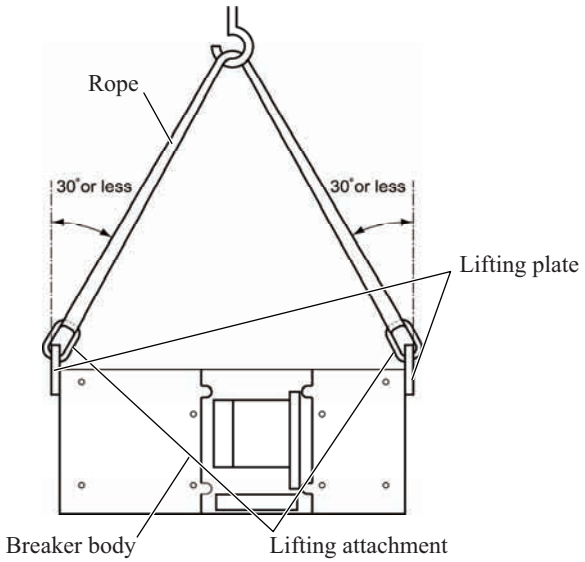
- Use an optional lifter or lifting plate to transfer the breaker body.
- When transporting the breaker body on a lifter, move the lifter with the lifter fork held at the lowest possible position.
- Take care not to exert forces on the front cover and the control circuit contacts shown in Fig. 2 . Otherwise, a deformation or damage may result.



Front view



Rear view

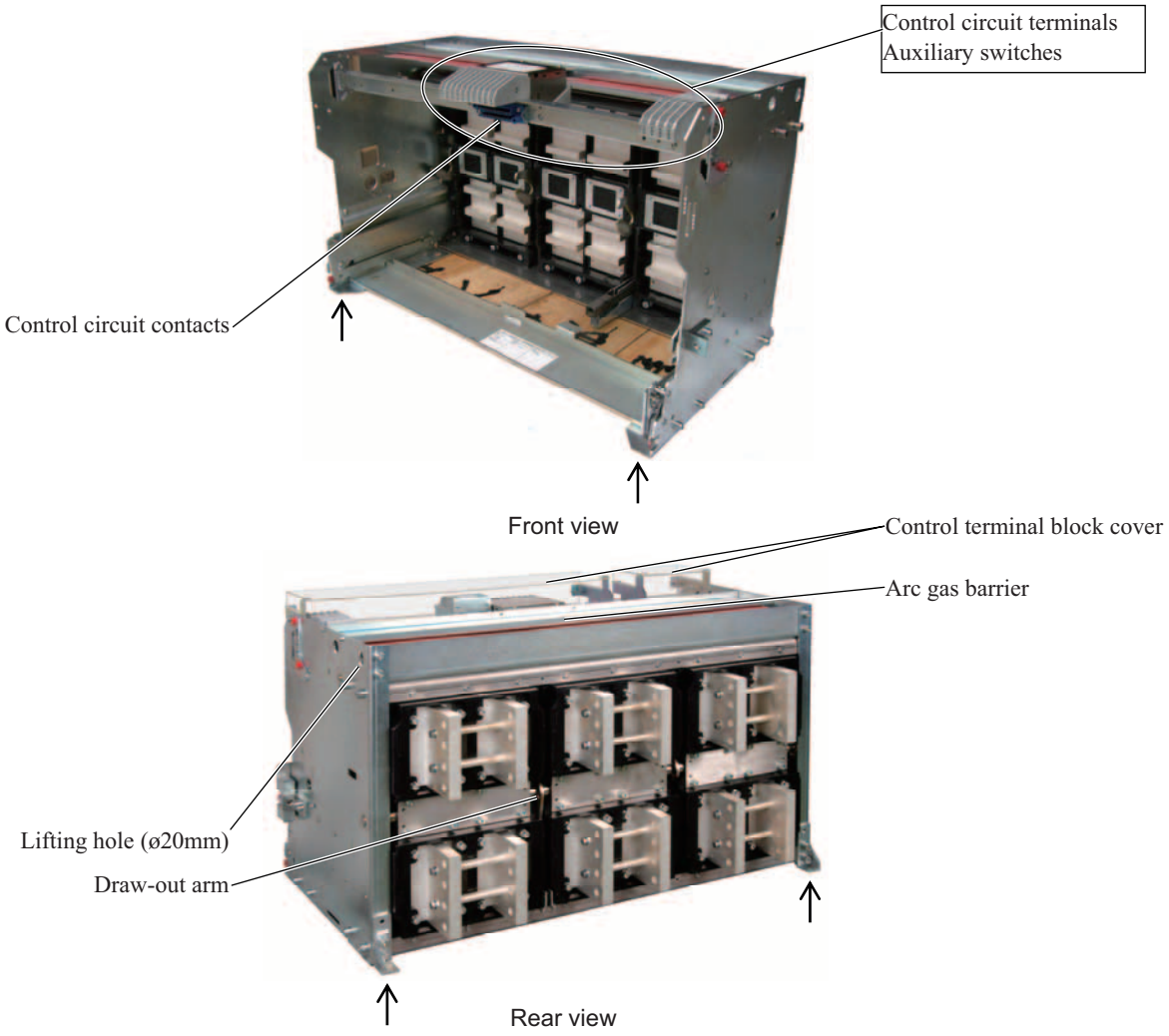


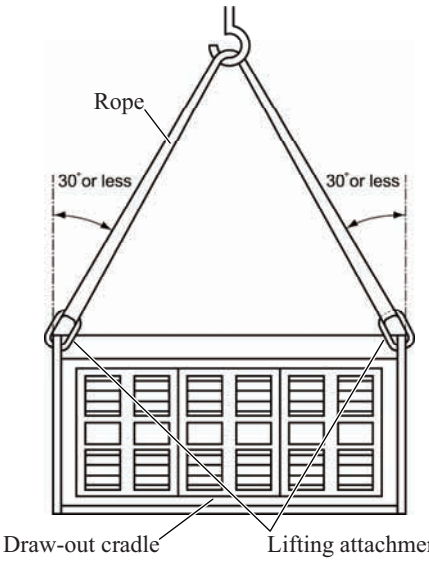
*When lifting the breaker body, the length of the rope do not be beyond the range of the angle to show in figure.

Fig. 2 Transporting the breaker body

2-1-3. Transporting the draw-out cradle

- When transporting the draw-out cradle, hold it using lifting attachments or wire ropes through the lifting holes or carry it by the portions (4 points) marked with the arrows shown in Fig 3. When carrying the draw-out cradle, take care not to exert forces on the arc gas barrier, the draw-out arm, the auxiliary switches, the control circuit terminals, the control terminal block cover, and the control circuit contacts.





*When lifting the draw-out cradle, the length of the rope do not be beyond the range of the angle to show in figure.

Fig. 3 Transporting the draw-out cradle

2-2. Storage Precautions

It is recommended that the ACB be used as soon as you have received it. If it is necessary to store the ACB, note the following:

- Store the ACB in a dry indoor location to prevent condensation due to sudden changes in ambient temperature. Condensation has a harmful effect on the ACB insulation.
- Store the ACB in a clean place free of corrosive gases and dust. In particular, exposure to a mixture of moisture and cement dust may cause corrosion damage to metal parts of the ACB.
- Place the ACB on a flat, level surface in its normal position (Do not lay the ACB).
- Do not place the ACB directly on the floor. Do not stack the ACBs during storage.

2-3. Installation Precautions

⚠ CAUTION

- Electrical work must be done by competent persons.
- Do not place the ACB in such an area that is subject to high temperatures, high humidity, dusty air, corrosive gases, strong vibration and shock, or other unusual conditions. Mounting the ACB in such an area could cause a fire or malfunction.
- Be careful to prevent foreign objects (such as debris, concrete powder, dust, chippings, and iron powder) and oil or rainwater from entering the ACB. These materials inside the ACB could cause a fire or malfunction.
- Prior to commencing any work on the ACB, open an upstream circuit breaker or the like to isolate all sources of power/voltage. Otherwise, electric shock may result.
- Fix the draw-out cradle of the ACB firmly on a flat, level surface using mounting screws. Otherwise, the draw-out operation may cause the breaker body or the draw-out cradle to fall, resulting in damage to the ACB or personal injury.
- Take care not to deform or bend protrusions in the bottom face of the draw-out cradle when fixing the draw-out cradle with mounting screws. Deformation of the protrusions may cause a malfunction. (see Fig. 4)
- Connect conductors (including screws) to the main circuit terminals in the specified area. Otherwise, a short-circuit may result.
- When terminating conductors to the ACB, tighten terminal screws to the torque specified in this manual. Otherwise, a fire could result.
- For 4-pole ACBs, be sure to connect a 3-phase, 4-wire neutral conductor to the N-phase pole (on the right end). Otherwise, an overcurrent may hinder the ACB from tripping, resulting in a fire.

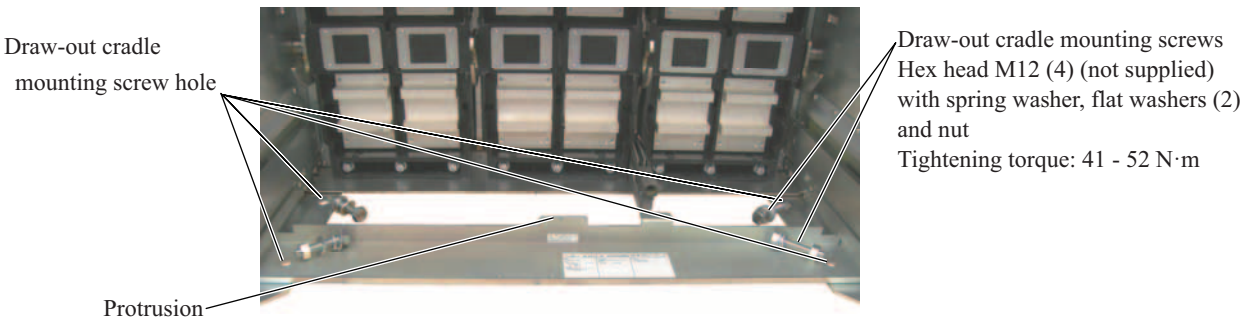


Fig. 4 Protrusion on the bottom of the draw-out cradle

- Do not install the ACB in such an area that is exposed to direct sunlight.
- Make sure that the mounting base has a sufficient capacity of bearing the weight of the ACB (see Table 3 and Table 4). The mounting base must be protected against vibration. Take appropriate measures to provide a perfect protection to the mounting base against resonance. Otherwise, open/close operation of the ACB may cause a malfunction of other devices in the switchboard or vibrations of the switchboard may cause a malfunction of the ACB.

● Use the following screws with appropriate length for the main circuit terminals.

Main circuit terminal screws: Hex head M10, with flat washers (2), spring washer (1) and nut (1) per screw

Tightening torque: 22.5 - 37.2 N·m

Table 1 Number of main circuit terminal screws required

ACB type		AR650S, AR663S, AR663H
Number of main circuit terminal screws (3/4-pole)	Vertical terminals	48/64
	Horizontal terminals*	36/48

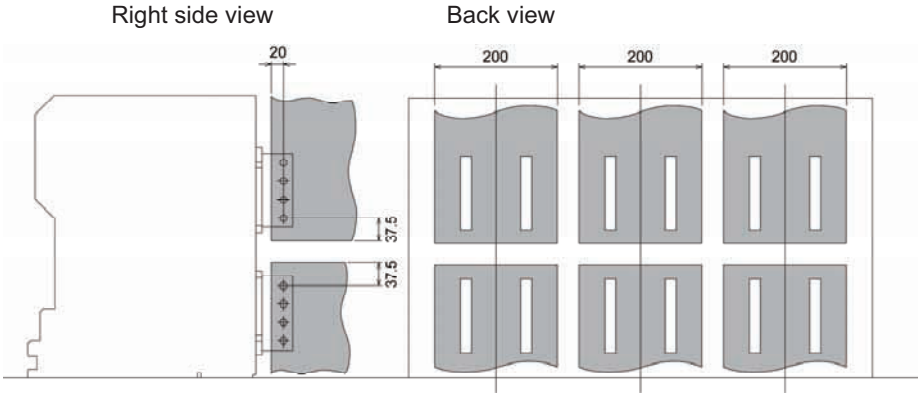
● Use the following screw for the ground terminal. The screw must have a length that allows it to be inserted 4 - 9 mm into the ground terminal M8 tapped hole.

Ground terminal screw: M8 (1) with spring washer and flat washer

Tightening torque: 11.8 - 14.7 N·m

● Connect conductors to the main circuit terminals in the conductor connection area as shown in Fig. 5.

●Vertical terminals, 3 Poles



●Vertical terminals, 4 Poles

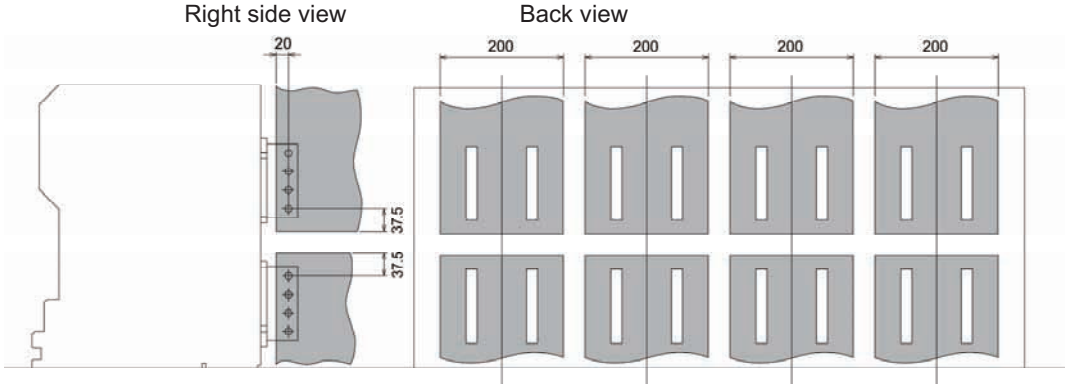


Fig. 5 Conductor (include screw) connection area

● Use a support to hold conductors securely at distance L as shown in Fig. 6 and Table 2. Such a support will help preventing the conductors and main circuit terminals from being deformed or damaged due to a large electromagnetic force caused by any fault current. Use a high-quality insulating material for a support and secure enough insulation distance.

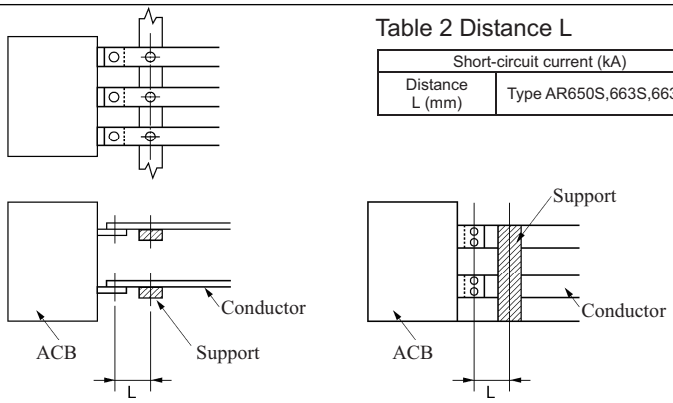


Table 2 Distance L

Short-circuit current (kA)		30	50	65	80	100	120	135
Distance L (mm)	Type AR650S,663S,663H	350	300	250	150	150	150	150

Fig. 6 Support mounting

● The following procedure makes it easy to make connections with screw terminals of position switches, control circuit terminals, and auxiliary switches.

(1) Draw out the breaker body to the removed position, and remove it using an optional lifter or lifting plate. Refer to sections 4-2-2 and 2-1-2.

(2) If the ACB is equipped with the control terminal block cover, loosen both the cover fixing screws and remove the cover.

(3) Remove the control circuit terminals fixing screws shown in Fig. 7.

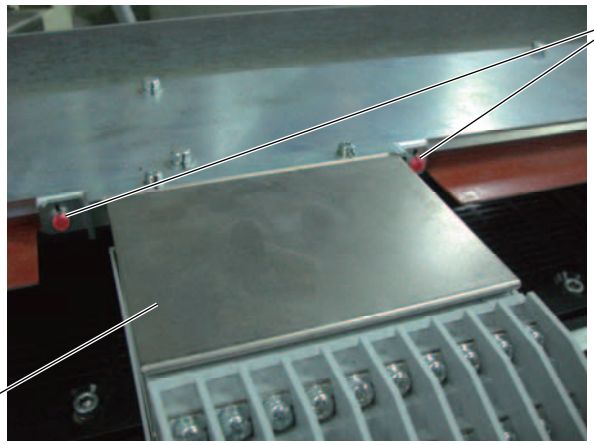


Fig. 7 Terminal block fixing screws

(4) Remove the terminal block fixing screws shown in Fig. 8.

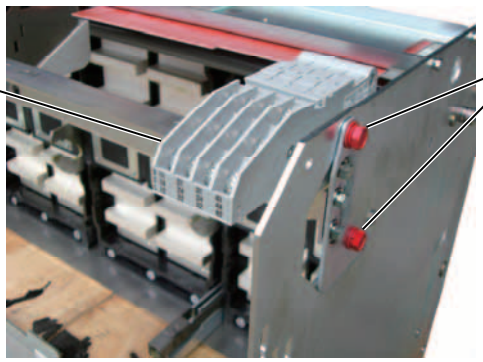


Fig. 8 Terminal block fixing screws

(5) Tilt the terminal block down as shown in Fig. 9. After connecting wires, tilt the terminal block up again and fix it with the terminal block fixing screws.

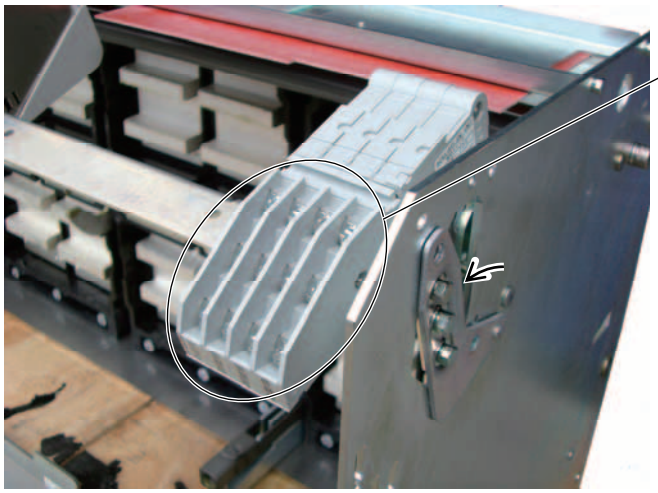


Fig. 9 Terminal block tilted down

● Connect the control wire to a com. terminal as shown in Fig. 10.

Small flat-blade screwdriver

* If the gap above the com. terminal is too small to insert the screwdriver, unscrew the two communication terminal block mounting screws (pan head M4 × 8, red, with spring and flat washers), remove the terminal block, connect the control wire and reinstall the terminal block. The tightening torque of the mounting screws is 1.3 – 1.7 N·m.

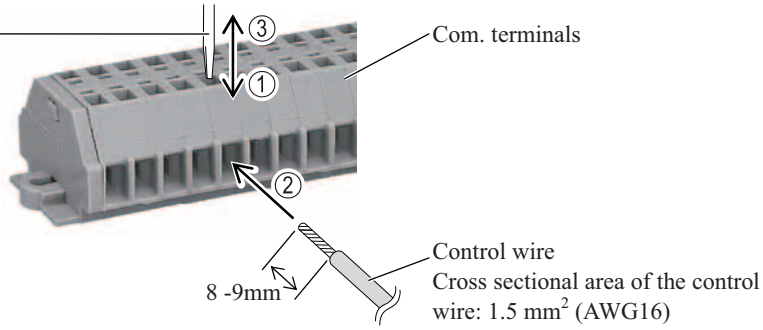


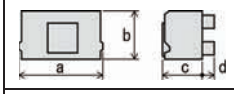
Fig. 10 Com terminal connection

● If any work is done near the ACB that have been installed, protect the openings of the ACB with appropriate covers to prevent spatters, metal chips, wire cuttings or other foreign objects from entering the ACB.

3. GENERAL
3-1. Types and Descriptions

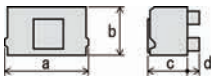
TemPower2 is available in types shown in Tables 3 and 4.

Table 3 Standard types

Frame size (A)			5000		6300	
Type			AR650S		AR663S	
Max. rated current [I_n] (A) *1	IEC, EN, AS		5000		6300	
	Marine use				6300	
N-phase rated current (A)			5000		6300	
Number of poles *2, *3			3	4	3	4
Dielectric withstand voltage [U_i] (50/60Hz)			1000		1000	
Operating voltage [U_e] (50/60Hz)			690		690	
Rated breaking/making current [kA sym rms/kA peak]						
IEC ,EN, AS [$I_{CS} = I_{CU}$] JIS C 8201-2-1 Ann.1 Ann.2	AC 690V *5		85/187			
	AC 500V		120/264			
	AC 440V					
NK *4	AC 690V		85/201			
	AC 450V		120/287			
For DC	DC 600V *6		40/40			
	DC 250V					
Rated short-time current [I_{CW}] [kA rms]	1 sec.		120			
	3 sec.		85			
Rated latching current (kA)			120			
Endurance in number of ON-OFF cycles *7	Mechanical	With maintenance	10000			
		Without maintenance	5000			
	Electrical	Without maintenance AC 460V	1000			
		AC 690V	500			
Installation			Draw-out type			
Mass (kg)			200	260	220	285
External dimensions (mm)						
		a	799	1034	799	1034
		b	460			
		c	380			
		d	60			
Connection method		Line side	Vertical terminals			
		Load side	Vertical terminals			
Control circuit terminal type			screw terminals			
Spring charging method			Manual or motor charging			
Overcurrent release (OCR)			No OCR, L-characteristic for general feeder protection, R-characteristic for general feeder protection or S-characteristic for generator protection			
Operation indication			Individual indication			
Tripping device		Tripping coil (TC)	Standard equipment for OCR-equipped ACB			
		Shunt trip device (SHT)	Optional			
		undervoltage trip device (UVT)	Optional			
Auxiliary switches		Number of switches	4C (standard), 7C or 10C; available for general feeder or microload			
		Terminal type	screw terminals			
Operation power*8		Rated voltage	AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V			

*1: Ambient temperature: 40°C (45°C for marine used)
*2: For 2-pole applications, use two poles at both ends.
*3: 4-pole ACBs are not applicable to power distribution IT systems unless N-phase protection is provided.
*4: Applicable to 3-pole ACBs
*5: For applicability to power distribution IT systems, consult us
*6: Applicable under 3-pole serial connection scheme.
*7: Expected service life based on endurance test. The service life of ACB depends on the working and environmental conditions. Refer to chapter 6 "Maintenance, Inspection and Parts Replacement".
*8: For more information, please refer to page 22.

Table 4 High-performance types

Frame size (A)				6300	
Type				AR663H	
Max. rated current [I_n] (A) *1		IEC, EN, AS		6300	
		Marine use		6300	
N-phase rated current (A)				6300	
Number of poles *2, *3				3	4
Dielectric withstand voltage [U_i] (50/60Hz)				1000	
Operating voltage [U_e] (50/60Hz)				690	
Rated breaking/making current [kA sym rms/kA peak] *4					
IEC ,EN, AS [$I_{CS} = I_{CU}$] JIS C 8201-2-1 Ann.1 Ann.2		AC 690V *6		85/187	
		AC 500V		135/297	
		AC 440V			
NK *5		AC 690V		85/201	
		AC 450V		138/322	
For DC		DC 600V *7		40/40	
		DC 250V			
Rated short-time current [I_{CW}] [kA rms]			1 sec.	135	
			3 sec.	85	
Rated latching current (kA)				120	
Endurance in number of ON-OFF cycles *8	Mechanical	With maintenance		10000	
		Without maintenance		5000	
	Electrical	Without maintenance	AC 460V	1000	
			AC 690V	500	
Installation				Draw-out type	
Mass (kg) for draw-out type				220	285
External dimensions (mm)					
		a		799	1034
		b		460	
		c		380	
		d		60	
Connection method		Line side		Vertical terminals	
		Load side		Vertical terminals	
Control circuit terminal type				screw terminals	
Spring charging method				Manual or motor charging	
Overcurrent release (OCR)				No OCR, L-characteristic for general feeder protection, R-characteristic for general feeder protection or S-characteristic for generator protection	
Operation indication				Individual indication	
Tripping device		Tripping coil (TC)		Standard equipment for OCR-equipped ACB	
		Shunt trip device (SHT)		Optional	
		Undervoltage trip device (UVT)		Optional	
Auxiliary switches		Number of switches		4C (standard), 7C or 10C; available for general feeder or microload	
		Terminal type		screw terminals	
Operation power*9		Rated voltage		AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V	

*1: Ambient temperature: 40°C (45°C for marine used)
*2: For 2-pole applications, use two poles at both ends.
*3: 4-pole ACBs are not applicable to power distribution IT systems unless N-phase protection is provided.
*4: Setting the instantaneous trip function to NON reduces the rated breaking current to the rated latching current.
*5: Applicable to 3-pole ACBs
*6: For applicability to power distribution IT systems, consult us
*7: Applicable under 3-pole serial connection scheme.
*8: Expected service life based on endurance test. The service life of ACB depends on the working and environmental conditions. Refer to chapter 6 "Maintenance, Inspection and Parts Replacement".
*9: For more information, please refer to page 22.

Use the ACBs in the environmental conditions specified in Table 5.

Table 5 Operating environment

Standard environment (Standard equipped ACBs)	Altitude	2000 m max.
	Ambient temperature	-5°C to +40°C The average temperature for 24 hours must not exceed 35°C
	Humidity	45 to 85% rel. max.
	Vibration and shock	Free from abnormal vibration and shock.
	Atmosphere	No excessive water vapor, oil vapor, dust, or corrosive gases. No sudden change in temperature and no condensation. Ammonia (NH_3): 0.5 ppm max, Hydrogen sulfide (H_2S)/sulfur dioxide (SO_2)/hydrogen chloride (HCl): 0.1 ppm max., Chlorine (Cl_2): 0.05 ppm max.
Special environment (Optional)	Tropical environment package	Different from standard ACBs in that Ambient temperature: 60°C max. and Humidity: 95% rel. max. (no condensation)
	Cold environment package	Different from standard ACBs in that Ambient temperature: -25°C min. for use and -40°C min. for storage (no condensation)
	Corrosion-resistant package	Different from standard ACBs in that NH_3: 50 ppm max, H_2S: 10 ppm max., SO_2/HCl: 5 ppm max., and Cl_2 : 1 ppm max.

Table 6 shows the dielectric withstand voltage and the insulation resistance of the ACBs.

⚠ CAUTION

- Do not perform dielectric withstand/insulation resistance tests under other conditions than specified. Doing so may cause a malfunction.

Table 6 Dielectric withstand voltage and insulation resistance

Circuit			Dielectric withstand voltage (50/60Hz)			Impulse withstand voltage U_{imp}	Insulation resistance (DC500V Megger used)
Main circuit			Between poles, and terminal group and ground	AC3500V	1 minute	12kV	300MΩ
Control circuit	Auxiliary switches	For general feeder	Between terminal group and ground	AC2500V	1 minute	6kV	100MΩ
		For microload	Between terminal group and ground	AC2000V	1 minute	4kV	100MΩ
	Position switches		Between terminal group and ground	AC2000V	1 minute	4kV	100MΩ
	Overcurrent release		Between terminal group and ground	AC2000V	1 minute	4kV	100MΩ
	Undervoltage trip device, Reverse power trip device		Between terminal group and ground	AC2500V	1 minute	6kV	100MΩ
Other accessories			Between terminal group and ground	AC2000V	1 minute	4kV	100MΩ

The above data applies to new ACBs. Device terminals within ACBs are not covered. Use a DC500V Megger to measure the insulation resistance.

Table 7 shows the internal resistance and power consumption of the ACBs.

Table 7 Internal resistance and power consumption

Type	AR650S	AR663S	AR663H
Frame size (A)	5000	6300	6300
DC internal resistance (mΩ) (for 1-pole ACB)	0.012	0.010	0.010
AC power consumption (W) (for 3-pole ACB)	1620	1910	1910

Table 8 shows applicable current of the ACBs. The applicable current varies depending on the ambient temperatures.

Table 8 Dependence of applicable current on ambient temperature

Type		AR650S	AR663S	AR663H
Standard	Conductor size / Ambient temperature (°C)	3 × 200 × 10t	4 × 200 × 10t	4 × 200 × 10t
IEC60947-2 EN60947-2 AS3947-2 JIS C8201-2-1 Ann.1 Ann.2	40 (standard ambient temperature)	5000	6300	6300
	45	5000	6300	6300
	50	4950	6000	6000
	55	4710	5680	5680
	60	4450	5370	5370
NEMA,SG-3 ANSI C37.13	40 (standard ambient temperature)	4700	5680	5680
	45	4450	5370	5370
	50	4180	5050	5050
	55	3900	4710	4710
	60	3610	4350	4350
JEC-160	40 (standard ambient temperature)	4300	5000	5000
	45	4120	4750	4750
	50	3940	4530	4530
	55	3750	4310	4310
	60	3540	4080	4080

Notes: The above values may vary depending on the switchboard configuration.

3-2. Parts and Functions

Fig. 11 provides a general views of the ACB.

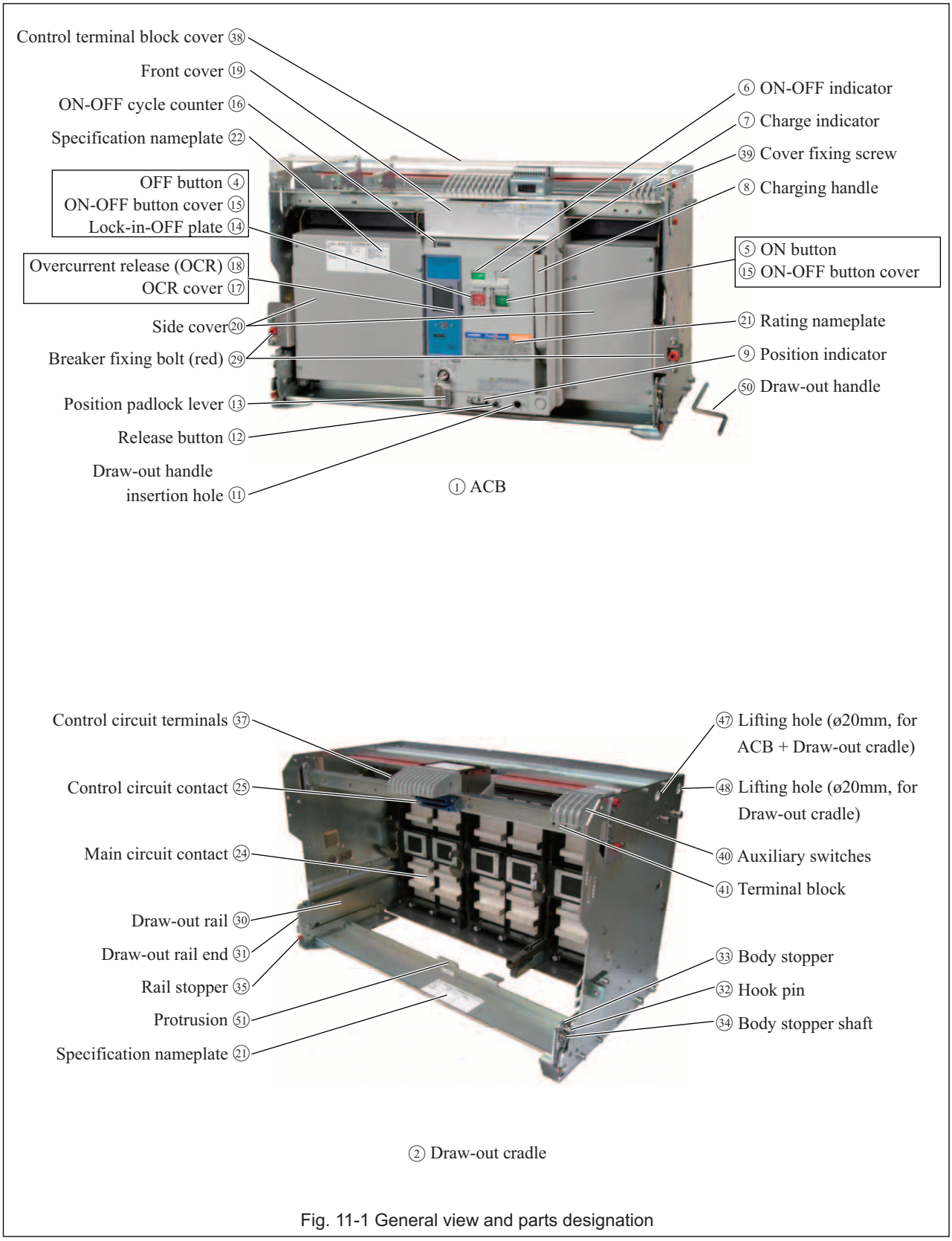
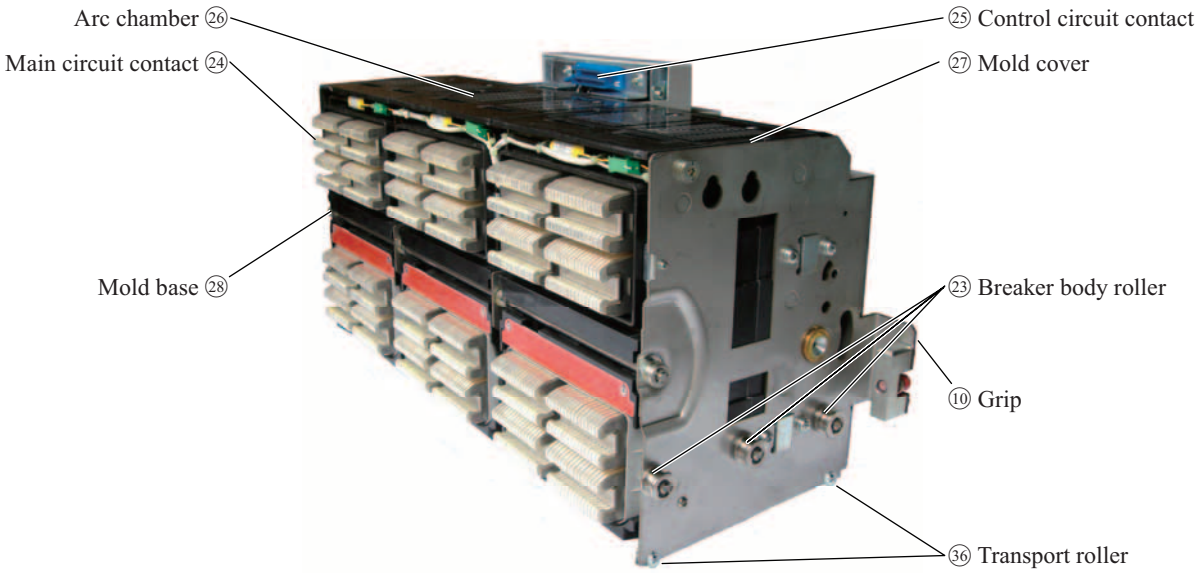
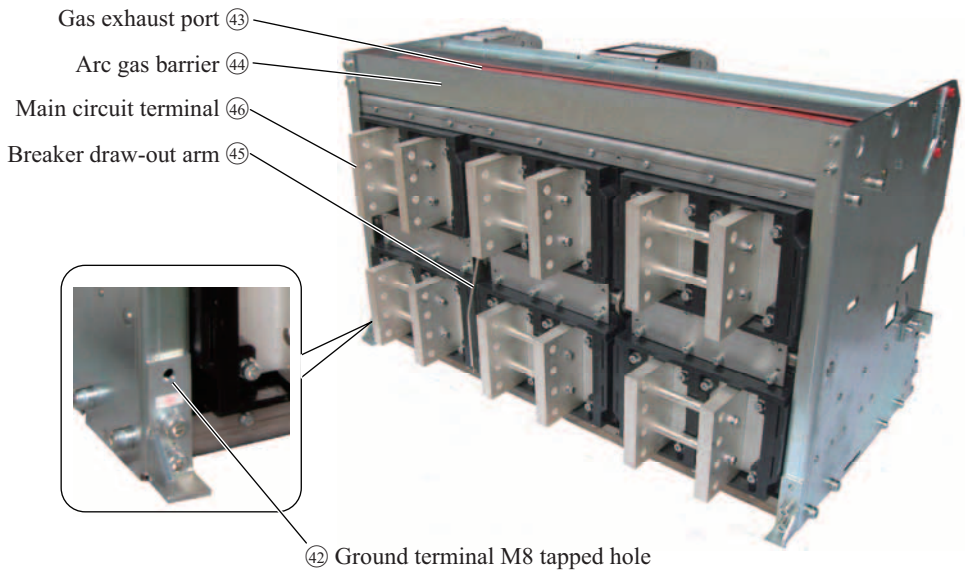


Fig. 11-1 General view and parts designation



③ Breaker body (rear view)



② Draw-out cradle (rear view)

Fig. 11-2 General view and parts designation (rear view)

①	ACB	Consists of breaker body ③ and draw-out cradle ②.
②	Draw-out cradle	Comes with main circuit terminals ㊽, control circuit terminals ㊳, auxiliary switches ㊶.
③	Breaker body	Contains the ON-OFF mechanism, the closing coil, the tripping device, and overcurrent release ⑲.
④	OFF button	Push to open the ACB.
⑤	ON button	Push to close the ACB.
⑥	ON-OFF indicator	Shows “OFF” when the ACB is open and “ON” when it is closed.
⑦	Charge indicator	Shows “CHARGED” when the closing springs are charged and “DISCHARGED” when it is released.
⑧	Charging handle	Pump to charge the closing springs.
⑨	Position indicator	Indicates the present breaker body position: CONN., TEST, or ISOLATED.
⑩	Grip	Hold to draw out the breaker body.
⑪	Draw-out handle insertion hole	Insert the draw-out handle into this hole to move the breaker body.
⑫	Release button	Push to move the breaker body from the TEST position.
⑬	Position padlock lever (optional)	Accommodates up to three padlocks to lock the breaker body in the CONN., TEST or ISOLATED position. (Padlocks are not supplied. Use padlocks with a 6 mm-diameter shackle.)
⑭	Lock-in-OFF plate (optional)	Padlocking this plate allows the ACB to be locked in the open (OFF) state. (Padlocks are not supplied. Use padlocks with a 6 mm-diameter shackle.)
⑮	ON-OFF button cover	Provides protection against inadvertent button operation and can be padlocked. (Padlocks are not supplied. Use padlocks with a 6 mm-diameter shackle.) Up to three padlocks can be installed.
⑯	ON-OFF cycle counter (optional)	Reads the number of ON-OFF cycles. It counts a series of operations from close to open as one cycle.
⑰	OCR cover	Padlocking this plate prevents settings of overcurrent release ⑱ to be inadvertently changed. (Padlocks are not supplied. Use padlocks with a 6 mm-diameter shackle.)
⑱	Overcurrent release (OCR)	This protective device is supplied power via the power CT installed in the ACB main circuit. When the current sensor detects an overcurrent in the main circuit, the OCR instructs the magnet hold trigger (MHT) to trip open the ACB.
⑲	Front cover	A plastic cover of the breaker body front panel.
⑳	Side cover	A metal cover of the breaker body front panel
㉑	Rating nameplate	Indicates the type, applicable standards and rated breaking capacity of the ACB.
㉒	Specification nameplate	Indicates the number of poles, operation method, accessories, and serial number of the ACB.
㉓	Breaker body roller	Allows breaker body ③ to be moved on draw-out rail ㉛.
㉔	Main circuit contact	Closes when the breaker body is in the CONN. position.
㉕	Control circuit contact	Closes when the breaker body is in the CONN. or TEST position.
㉖	Arc chamber	Extinguishes the arc that occurs in the breaking operation. Two arc chambers are fitted per pole. See 6-2-2. "Arc chambers".
㉗	Mold cover	A plastic cover of the breaker body side face.
㉘	Mold base	A plastic cover of the breaker body rear face.
㉙	Breaker fixing bolt (red) (optional)	Allows the breaker body to be locked in the CONN. position even if the ACB is subject to strong vibrations.
㉚	Draw-out rail	Use to draw out the breaker body from the draw-out cradle.
㉛	Draw-out rail end	Refer to chapter 1 “Operation Precautions”.
㉜	Hook pin	Refer to chapter 1 “Operation Precautions”.
㉝	Body stopper	Prevents the breaker body from falling when the body is drawn out from the draw-out cradle.
㉞	Body stopper shaft	Refer to chapter 1 “Operation Precautions”.
㉟	Rail stopper (red)	Allows the draw-out rail to be locked in the drawn-out or retracted state.
㊱	Transport roller	Allows breaker body ③ to be moved on horizontal surface. Breaker body moves to front and back.

㊲	Control circuit terminals	Allow connections of external control wire to the control circuits. Wire connections are made through M4 screw terminals. Fig. 12 shows the control circuit terminals.

Fig. 12 Control circuit terminals

㊳	Control terminal block cover (optional)	Protects the position switches, the control circuit terminals and the auxiliary switches from damage.
㊴	Cover fixing screw	Secures the control terminal block cover.
㊵	Auxiliary switches (optional)	Indicate the state of the ACB (ON or OFF). The auxiliary switches are available in 4C configuration (standard), or 7C or 10C configuration (optional). Connections to the switches are made through M4 screw terminals.
㊶	Terminal block	Contains position switches ㊱, control circuit terminals ㊲, and auxiliary switches ㊳.
㊷	Ground terminal M8 tapped hole	Allows connection of a ground terminal.
㊸	Gas exhaust port	Allows the arc gas to be discharged from arc chamber ㉕ in a horizontal direction when the ACB trips open.
㊹	Arc gas barrier	Prevents the arc gas from being discharged upwards from arc chamber ㉕ when the ACB trips open.
㊺	Breaker draw-out arm	Is retracted in the draw-out cradle when the breaker body is in the CONN. position.
㊻	Main circuit terminals	Allow connections of external conductors.
㊼	Lifting hole (ø20mm, for ACB + Draw-out cradle)	Allows lifting attachments or wire ropes to be used for lifting the ACB.
㊽	Lifting hole (ø20mm, for Draw-out cradle)	Allows lifting attachments or wire ropes to be used for lifting the Draw-out cradle.
㊾	Protrusion	Refer to section 2-3. “Installation Precautions”.
㊿	Draw-out handle (removable)	Use to draw out /insert the breaker body from/into the draw-out cradle.

3-3. Circuits and Ratings

Fig. 13 shows an ACB(AGR-11B) circuit diagram and Table 9 and Fig. 14 show the function of each terminal and the meaning of each sign in the diagram.

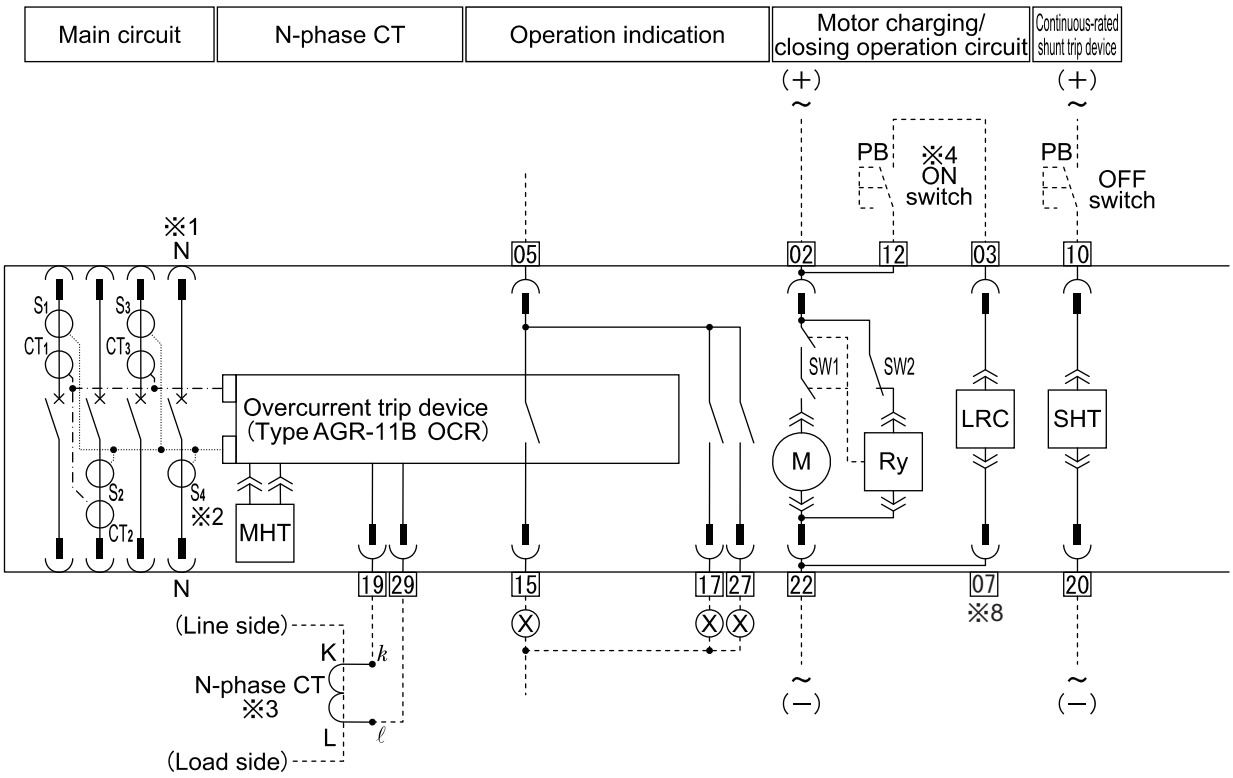


Fig. 13-1 Breaker circuits 1

Table 9-1 Terminal functions and circuit symbols 1 (Applicable to both 50 and 60Hz for AC. ⊕ and ⊖ mean the polarity for DC)

Terminal No.	Function	
02 ⊕ 22 ⊖	AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V (To be stated when ordering)	Operation power input terminals
03, 12	ON switch	Operation switch terminals
05, 15	Group indication	Operation indication contact output terminals
05, 17	Trip indication	
05, 27	Spring charged indication	
10, 20	AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V (To be stated when ordering)	Shunt trip device power input terminals
08, 09, 18, 28	AC100V, AC200V or AC400V unit (To be stated when ordering) Connect the unit to the applicable terminal Nos.	Undervoltage trip device power input terminals

Terminal No.	AC100V unit	AC200V unit	AC400V unit
08, 09	AC100V	AC200V	AC380V
18, 09	AC110V	AC220V	AC415V
28, 09	AC120V	AC240V	AC440V

24, 30	OFF switch	Undervoltage trip
19, 29	Polarity: 19 - k, 29 - ℓ	N-phase CT connection terminals *3
01 04 06 07 11 13 14 16 21 23 25 26	—	(Reserved)

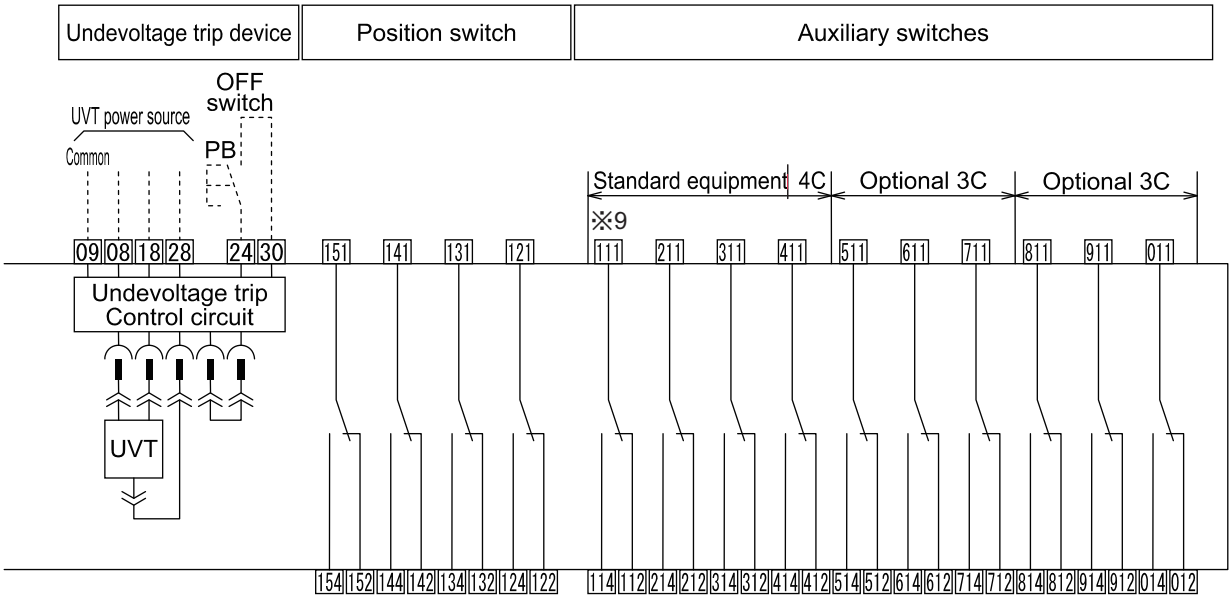


Fig. 13-2 Breaker circuits 2

Table 9-2 Terminal functions and circuit symbols 2

Symbol	Meaning	Symbol	Meaning
S_1 - S_4	Current sensors *5	LRC	Latch release coil
CT_1 - CT_3	Power supply CT *6	SHT	Shunt trip device
MHT	Magnet hold trigger	UVT	Undervoltage trip device
M	Spring charging motor	—●—	Main/control circuit contact
Ry	Control relay	—≪—	Hand connector
SW1	Control relay a contact	- - - - -	User wiring
SW2	Spring charged “OFF” switch	-⊗-	Relay or LED

*1: For 4-pole ACBs.
*2: For 4-pole ACBs equipped with N-phase protection and/or ground fault trip functions.
*3: Used for 3-pole ACBs with ground fault trip functions to be installed in a 3-phase, 4-wire circuit.
*4: Do not connect the ON switch with auxiliary switch b-contact in series. Doing so may cause pumping.
*5: Conversion ratio: CT rated primary current I_{CT} (A)/150 mV
*6: Provide power to the overcurrent trip device.
*7: When you close in LRC after cut the signal of SHT, please open the interval more than 200ms.
*8: For motor split circuit, terminals, 02, 22 and 03, 07 are used for charging and closing operation respectively.
*9: Do not use these terminals for other circuits when both instantaneously rated shunt trip and UVT are fitted. These terminals are used by Terasaki as the anti-burnout SW for the instantaneously rated shunt trip.
*10: Permissible voltage range of latch release coil and shunt trip device are the operation of the standard ambient temperature, which is defined as a standard (please see table 5.).
If it is used in environments other than unregulated environment, or it is used at all times energized purposes need not be in interlocking etc., it is recommended to install a self-switching switch to block excitation in conjunction with the operation of the circuit breaker.

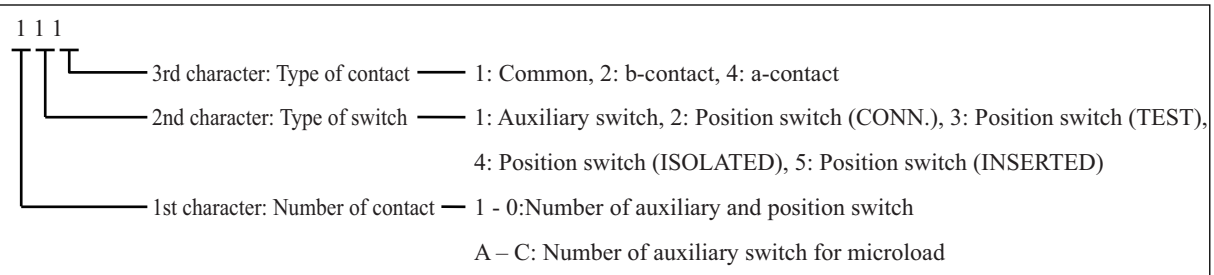


Fig. 14 Terminal number and function of auxiliary and position switches

Fig. 15 shows an ACB(AGR-21B,22B,31B) circuit diagram and Table 10 and Fig. 16 show the function of each terminal and the meaning of each sign in the diagram.

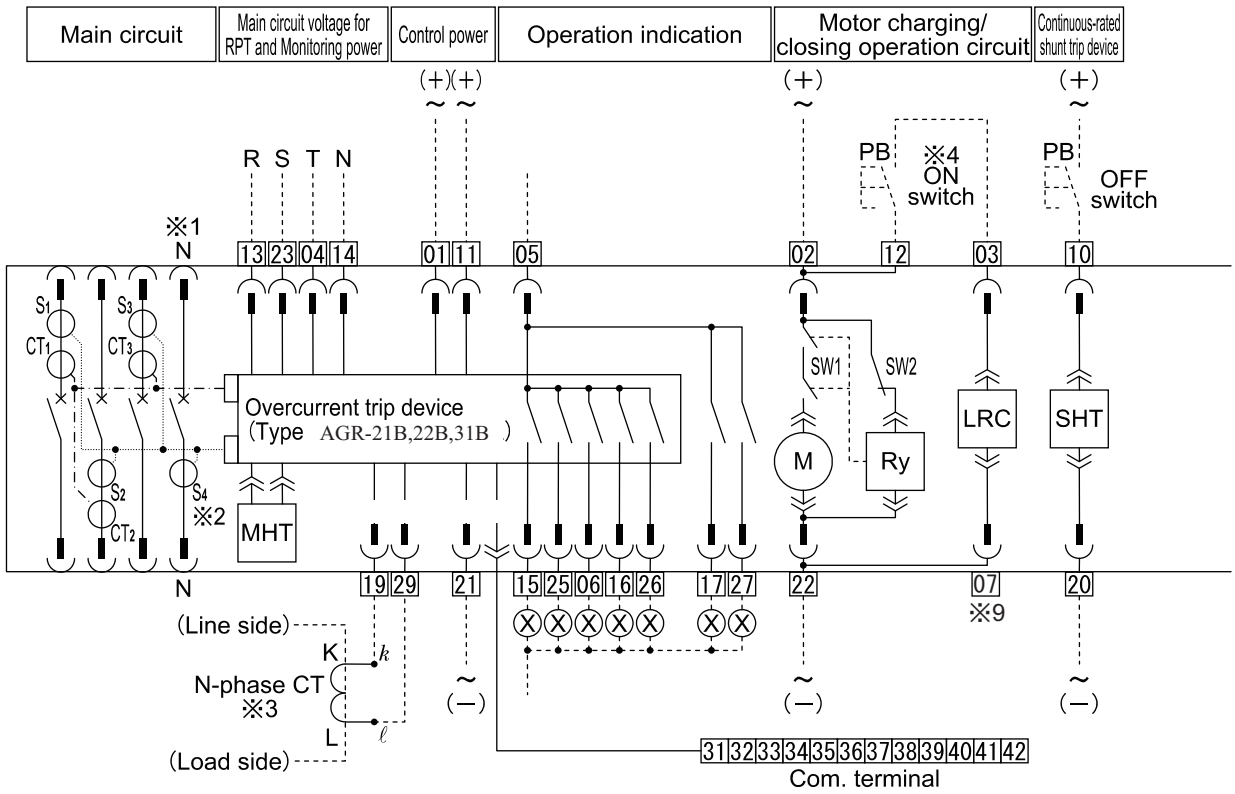


Fig. 15-1 Breaker circuits 1

Table 10-1 Terminal functions and circuit symbols 1 (Applicable to both 50 and 60Hz for AC. ⊕ and ⊖ mean the polarity for DC)

Function	Terminal No.	Remarks				
		Connect the unit to the applicable terminal Nos.	Terminal No.	Circuit voltage		
				When compatible with both AC100 - 120V and AC200 - 240V power *5	When compatible with both DC100 -125V and DC200 - 250V power *5	When compatible with both DC24V and DC48V power *5
Control power supply	01, 11, 21		01 - 11	AC100 - 120V	NA	NA
			11 ⊕ 21 ⊖	NA	DC100 - 125V	DC24V
			01 ⊕ 21 ⊖	AC200 - 240V	DC200 - 250V	DC48V
Operation power	02 ⊕ - 22 ⊖	AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V *5				
ON switch	03 - 12					
Undervoltage trip device power	08, 09, 18, 28	Connect the unit to the applicable terminal Nos.	Terminal No.	Circuit voltage		
				AC100V compatible *5	AC200V compatible *5	AC400V compatible *5
			08 - 09	AC100V	AC200V	AC380V
			09 - 18	AC110V	AC220V	AC415V
			09 - 28	AC120V	AC240V	AC440V
OFF switch	24 - 30	Available for ACBs equipped with undervoltage trip device				
Continuous-rated shunt trip device power and OFF switch	10 - 20	AC100V, AC110V, AC120V, AC200V, AC220V, AC240V, DC24V, DC48V, DC100V, DC110V, DC125V, DC200V or DC220V *5				
Operation indication	05 - 15	Long time delay trip (LT)				
	05 - 25	Short time delay (ST) and instantaneous trip (INST/MCR)				
	05 - 06	Pretrip alarm (PTA)				
	05 - 16	Ground fault trip (GF) or reverse power trip (RPT) *5				
	05 - 26	System alarm				
	05 - 17	Line side ground fault (REF), negative-phase sequence protection (NS), contact overheat monitoring (OH) or tripping operation *5				
	05 - 27	Pretrip alarm 2 (PTA2), undervoltage alarm (UV) or spring charge operation *5				
Main circuit input voltage	13, 23, 04, 14	R-phase - 13, S-phase - 23, T-phase - 04, N-phase - 14				
Separate N-phase CT	19 - 29	Polarity: 19 (31) - k, 29 (32) - ℓ *3				
Line side ground fault protection (REF) CT	35 - 36	Polarity: 35 - k, 36 - ℓ				
Zone interlock control power	33 ⊕ - 34 ⊖	DC24V				
Zone interlock signal I/O	37, 38, 39, 40	See Fig. 19.				
Communication signal I/O	41 ⊖ - 42 ⊕					
Communication signal Common	32					
(Reserved)	07	-				

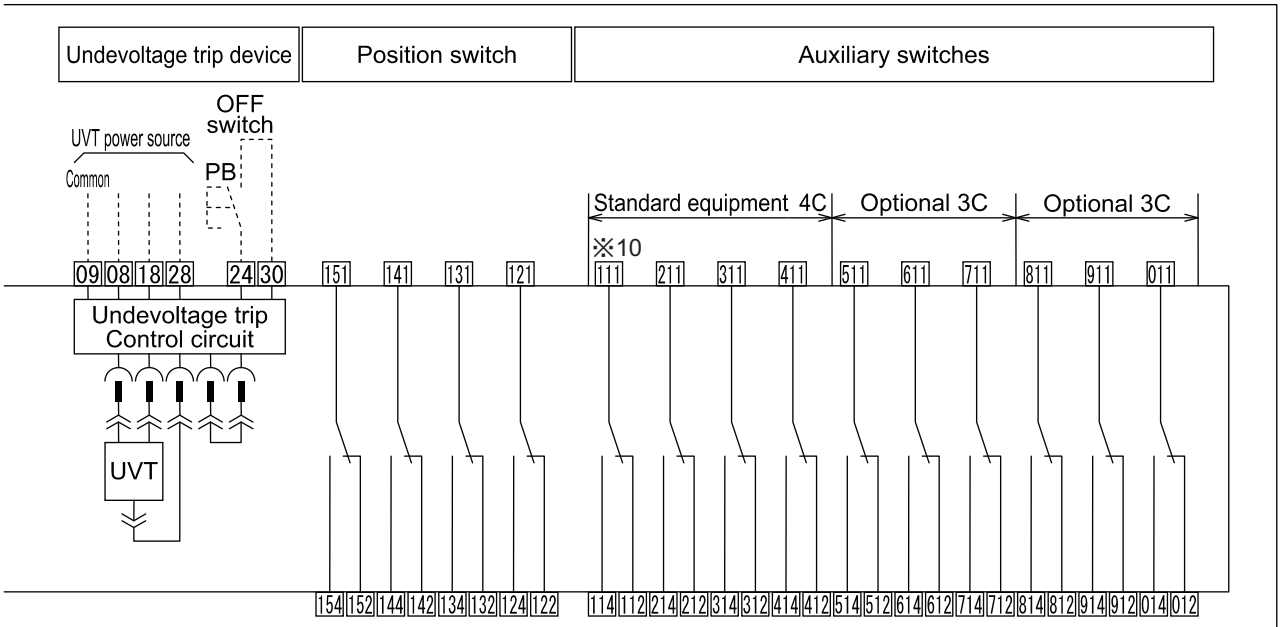


Fig. 15-2 Breaker circuits 2

Table 10-2 Terminal functions and circuit symbols 2

Symbol	Meaning	Symbol	Meaning
S_1 - S_4	Current sensors *6	LRC	Latch release coil
CT_1 - CT_3	Power supply CT *7	SHT	Shunt trip device
MHT	Magnet hold trigger	UVT	Undervoltage trip device
M	Spring charging motor	—⊶—	Main/control circuit contact
Ry	Control relay	—≪—	Hand connector
SW1	Control relay a contact	- - - - -	User wiring
SW2	Spring charged “OFF” switch	-⊗-	Relay or LED

*1 For 4-pole ACBs.
*2 For 4-pole ACBs equipped with N-phase protection and/or ground fault trip functions.
*3 Used for 3-pole ACBs with ground fault trip functions to be installed in a 3-phase, 4-wire circuit.
*4 Do not connect the ON switch with auxiliary switch b-contact in series. Doing so may cause pumping.
*5 To be stated when ordering
*6 Conversion ratio: CT rated primary current I_{CT} (A)/150 mV
*7 Provide power to the overcurrent trip device when control power is lost.
*8: When you close in LRC after cut the signal of SHT, please open the interval more than 200ms.
*9: For motor split circuit, terminals, 02, 22 and 03, 07 are used for charging and closing operation respectively.
*10: Do not use these terminals for other circuits when both instantaneously rated shunt trip and UVT are fitted. These terminals are used by Terasaki as the anti-burnout SW for the instantaneously rated shunt trip.
*11: Permissible voltage range of latch release coil and shunt trip device are the operation of the standard ambient temperature, which is defined as a standard (please see table 5.).
If it is used in environments other than unregulated environment, or it is used at all times energized purposes need not be in interlocking etc., it is recommended to install a self-switching switch to block excitation in conjunction with the operation of the circuit breaker.

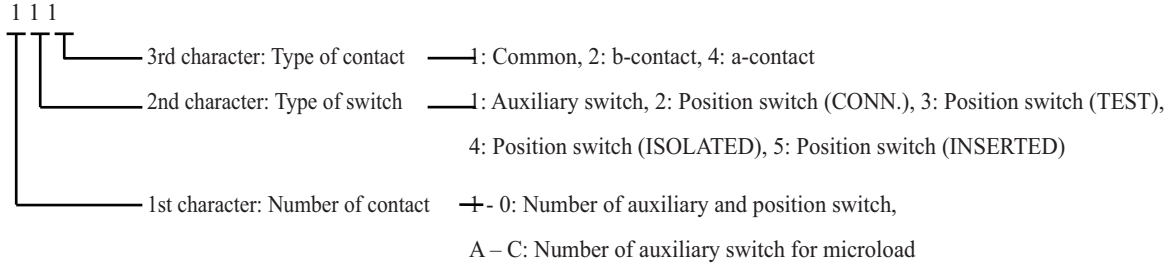


Fig. 16 Terminal number and function of auxiliary and position switches

Fig. 17 provides the terminal arrangement of the ACB.

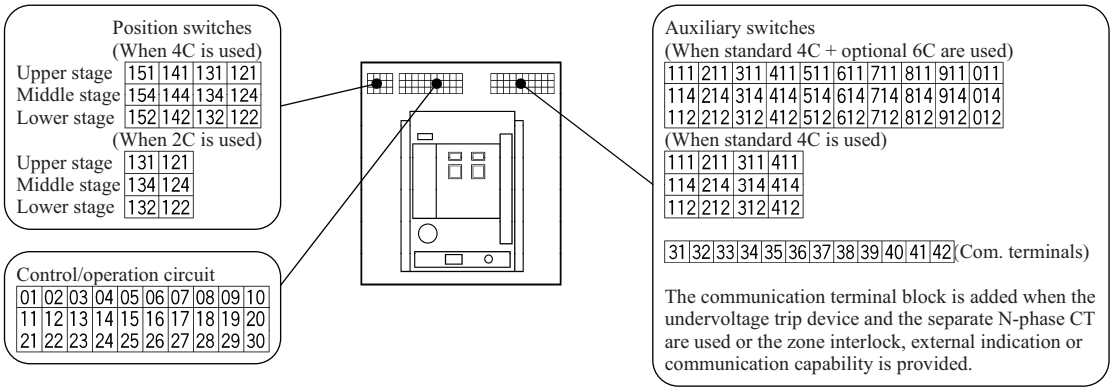


Fig. 17 Terminal arrangement

Fig. 18 shows how to connect the line side ground fault protection (REF) CT when the overcurrent release (OCR) is provided with the REF capability. See Fig. 15 for other circuits than that of the line side ground fault protection CT.

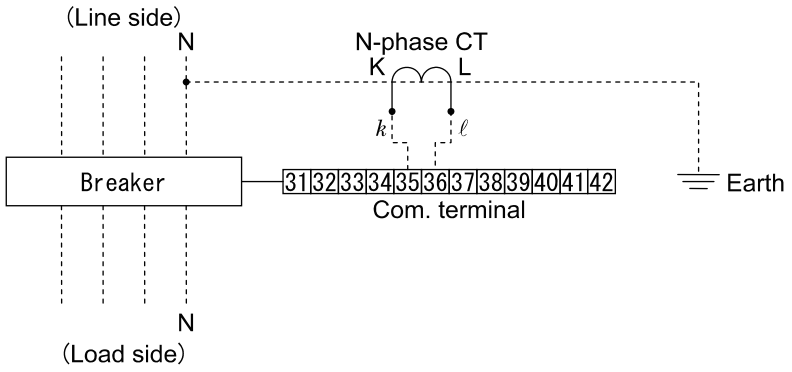
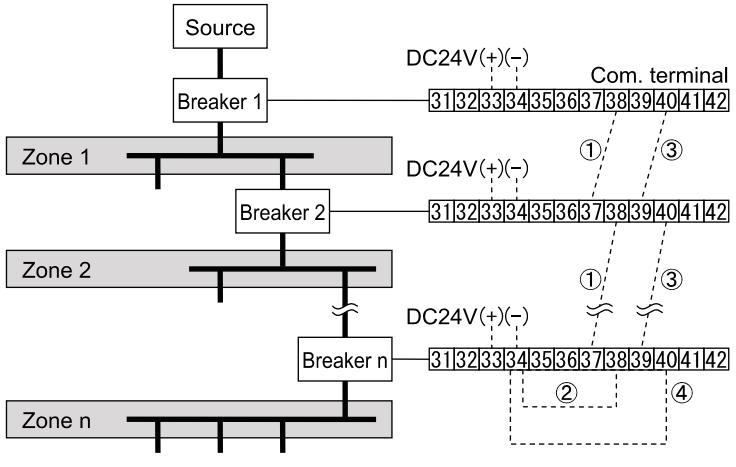


Fig. 18 Connection of the line side ground fault protection (REF) CT

Fig. 19 shows how to connect ACBs when the overcurrent release (OCR) is provided with the zone interlock (Z) capability. See Fig. 15 for other circuits than that of the zone interlock.



*1 Zone interlock requires control power (DC24V) between 33 and 34.

*2 Zone interlock capabilities for shot time delay trip and for ground fault can be combined.

*3 The zone interlock system allows selective discrimination that, when a fault current higher than the short time delay trip or ground fault trip pickup current is detected at a point in the power distribution system, operates the upstream ACB nearest to the point to shut off power within 50 ms even if the instantaneous trip function is set to NON, thus minimizing thermal and mechanical damage to the power distribution system. (The zone interlock system uses breaker 1, 2, …n to shut off power when a fault current is detected in zone 1, 2, …n within 50 ms.)

*4 Up to eight ACBs can be connected in the zone interlock system. Connect the uppermost ACB as ACB 1 and the lowermost ACB as ACB n, assuming the number of ACBs is n.

*5 The zone interlock cable should be of four-core, twisted pair shield type (Showa LW222S or equivalent).

*6 Max. length pf cables ① and ③: 300 m

① Zone interlock connection between ACBs for short time delay trip
② Zone interlock connection of the lowermost ACB for short time delay trip
③ Zone interlock connection between ACBs for ground fault trip
④Zone interlock connection of the lowermost ACB for ground fault trip

Fig. 19 Zone interlock (Z) connections

Tables 11 - 16 show the ratings of the operation power supply, the shunt trip device (SHT), the undervoltage trip device (UVT), auxiliary switches, position switches, operation indication contacts, and the N-phase CT.

Table 11 Ratings of operation power supply

Rated voltage (V)	Permissible charging/closing voltage range	Ratings of operation power supply			
		Peak motor starting current (A)	Steady-state motor current (A)	Peak making current (A)	Latch release coil (LRC) resistance (ohm) *
AC100	85 - 110	7	1.1	0.29	300-380
AC110	94 - 121	7	1.1	0.25	350-440
AC120	102 - 132	7	1.1	0.22	440-540
AC200	170 - 220	4	0.7	0.15	1130-1390
AC220	187 - 242	4	0.7	0.13	1410-1740
AC240	204 - 264	4	0.7	0.11	1710-2090
DC24	18 - 26	14	4	1.04	20-26
DC48	36 - 53	10	1.6	0.51	85-105
DC100	75 - 110	6	0.8	0.25	350-440
DC110	82 - 121	6	0.8	0.22	440-540
DC125	93 - 138	6	0.8	0.21	540-680
DC200	150 - 220	4	0.5	0.13	1410-1740
DC220	165 - 242	4	0.5	0.12	1710-2090

* Ambient temperature: 20°C

Table 12 Ratings of shunt trip device (SHT)

Rated voltage (V)	Permissible voltage range (V)	Peak exciting current (max.) (A)	Coil resistance (ohm) *	Max. contact parting time (ms)
AC100	70-110	0.29	300-380	50
AC110	77-121	0.25	350-440	
AC120	84-132	0.22	440-540	
AC200	140-220	0.15	1130-1390	
AC220	154-242	0.13	1410-1740	
AC240	168-264	0.11	1710-2090	
DC24	16.8-26.4	1.04	20-26	
DC48	33.6-52.8	0.51	85-105	
DC100	70-110	0.25	350-440	
DC110	77-121	0.22	440-540	
DC125	87.5-137.5	0.21	540-680	
DC200	140-220	0.13	1410-1740	
DC220	154-242	0.12	1710-2090	

* Ambient temperature: 20°C

Table 13 Ratings of undervoltage trip device (UVT)

Rated voltage (V)	Opening voltage range (V)	Attraction voltage (V)	Coil exciting current (A)	Power consumption (VA)		Coil resistance (ohm) *
				Normal	Attraction	
AC100	35 - 70	85	0.1	8	10	Holding coil: 410 – 510 Attraction coil: 5.6-6.8
AC110	38.5 - 77	93.5				
AC120	42 - 84	102				
AC200	70 - 140	170				
AC220	77 - 154	187				
AC240	84 - 168	204				
AC380	133 - 266	323				
AC415	145 - 290	352				
AC440	154 - 308	374				
DC24	8.4-16.8	20.4				
DC48	16.8-33.6	40.8				
DC100	35-70	85				

* Ambient temperature: 20°C

Table 14 Ratings of auxiliary and position switches

Voltage (V)	Auxiliary switches *1 *2				Position switches	
	For general feeder		For microload *3			
	Resistive load (A)	Inductive load (A) *4	Resistive load (A)	Inductive load (A) *5	Resistive load (A)	Inductive load (A) *5
AC100 - 250	5	5	0.1	0.1	11	6
AC251 - 500	5	5	-	-	-	-
DC8	-	-	-	-	10	6
DC30	1	1	0.1	0.1	6	5
DC125	-	-	-	-	0.6	0.6
DC250	-	-	-	-	0.3	0.3
DC125 - 250	1	1	-	-	-	-

*1 Using b-contact results in contact chatter of 20 ms or less when the ACB opens or closes.
*2 Do not apply different voltages to contacts of a switch.
*3 Min. applicable load: DC5V/1 mA
*4 AC cosø ≥ 0.3, DC L/R ≤ 0.01
*5 AC cosø ≥ 0.6, DC L/R ≤ 0.007

Table 15-1 Ratings of operation indication contacts (In case of AGR-11B)

Voltage (V)	Rated contact current (A)			
	Group indication		Spring charging/tripping operation	
	Resistive load (A)	Inductive load (A) *1 *3	Resistive load (A)	Inductive load (A) *2 *3
AC250	3	3	3	3
DC30	3	3	3	2
DC125	0.5	0.25	0.5	0.5
DC250	0.3	0.15	0.1	0.1

*1: AC cosø ≥ 0.3, DC L/R ≤ 0.007
*2: AC cosø ≥ 0.6, DC L/R ≤ 0.007
*3: Min. applicable load: DC5V/1 mA

Table 15-2 Ratings of operation indication contacts (In case of AGR-21B, 22B, 31B)

Voltage (V)	Rated contact current (A)			
	Individual indication Long-time delay trip, short-time delay trip, instantaneous trip, pretrip alarm, ground fault trip, system alarm		Spring charging/tripping operation	
	Resistive load (A)	Inductive load (A) *1	Resistive load (A)	Inductive load (A) *1
AC250	0.5	0.2	3	3
DC30	2	0.7	3	2
DC125	0.5	0.2	0.5	0.5
DC250	0.27	0.04	0.1	0.1

*1 AC cosø ≥ 0.6, DC L/R ≤ 0.007

Table 16 Ratings of N-phase CT

Type of ACB	Type of N-phase CT	Ratings (A)		
AR650S, AR663S, AR663H	EC160-40LS	5000/5A	6300/5A	

4. OPERATION

4-1. Charging and Opening operation

⚠ DANGER

- Never touch live terminal parts. Otherwise, electric shock may result.

⚠ CAUTION

- Do not force down the charging handle after completion of manual charging operation. Doing so may cause a malfunction.
- The permissible operating voltage of the spring charging motor is 85 to 110% of the rated ac voltage or 75 to 110% of the rated dc voltage. Be sure to supply a voltage within the above ranges to the motor. Otherwise, burnout may result.
- Repeated open/close operation by the motor charging mechanism without pause should not exceed 15 times. If repeated continuous open/close operation is inevitable, a pause of at least 20 minutes should be provided after the repetitions of 15 times. Otherwise, a spring charging motor may be burnt out.
- Do not bring your hand or face close to arc gas vent of the arc chamber while the ACB is energized. Otherwise, a burn may result from high-temperature arc gas blowing out of the arc gas vent when the ACB trips open.
- If the ACB trips open automatically, remove the cause of tripping operation before re-closing the ACB. Otherwise, a fire could result.
- If the ACB has the breaker fixing bolts, make sure the bolts on both sides are securely tightened before using the ACB. Loosened fixing bolts may cause a malfunction of the ACB, in particular when it is installed in such an area that is subject to strong vibrations.

The ACBs are available in two types in terms of the closing spring charging method and the remote operation capability: a manual charging type and a motor charging type. The manual charging type requires the charging and ON-OFF (close/open) operation to be done manually while the motor charging type allows the operation to be done either manually or by using a motor.

4-1-1. Charging operation

The ACB can be closed only when the closing springs have been charged. Be sure to charge the closing springs before closing the ACB. The charging operation is permitted, regardless of whether the ACB is ON (closed) or OFF (open). The procedure for charging the closing springs is as follows:

- Manual charging

Pump the charging handle (Fig. 20 ②) until the charge indicator (Fig. 20 ①) shows “CHARGED” Pumping the handle with the full stroke 10 - 13 times will fully charge the closing springs.

Fig. 20 Charging and opening operation

● Motor charging

When the charge indicator (Fig. 20 ①) changes to “DISCHARGED” while the specified operation voltage is applied to the control circuit terminals 02 and 22, the charging motor is activated to start charging the closing springs. Upon completion of the charging operation, the charge indicator shows “CHARGED” and the charging motor is automatically deactivated. The time required for the motor charging operation depends on the operation voltage or the ACB types, but does not exceed 10 seconds.

4-1-2. Closing operation

The ACB closing operation is not permitted unless all of the following conditions are met.

1) The charge indicator (Fig. 20 ①) shows "CHARGED".
2) The position indicator (Fig. 20 ③) shows "CONN.", "TEST" or "ISOLATED" (a halfway position not permitted).
3) The draw-out handle is not inserted in the draw-out handle insertion hole(Fig. 20 ⑤) .
4) The OFF button (Fig. 20 ⑥) is not locked with the lock-in-OFF plate (Fig. 20 ⑦).
5) The specified voltage is supplied to the undervoltage trip device .

The control power of the overcurrent release (OCR) must be supplied before closing operation in order that the internal program can be started. If the OCR trips open directly after the control power is supplied to the OCR, operation indication may be incorrect.

● Manual closing

Open the ON-OFF button cover (Fig. 20 ⑧) and press the ON button (Fig. 20 ⑨). The ACB will be closed with a sound. The ON-OFF indicator (Fig. 20 ⑩) shows "ON" and the charge indicator (Fig. 20 ①) shows "DISCHARGED".

● Electrical closing

Press the ON switch shown in Fig. 13,15. The latch release coil (LRC) (Fig. 13,15) will be excited and the ACB is closed with a sound. The ON-OFF indicator (Fig. 20 ⑩) shows "ON", the charge indicator (Fig. 20 ①) shows "DISCHARGED", and the charging motor starts charging the closing springs.

4-1-3. Opening operation

● Manual opening

Open the ON-OFF button cover (Fig. 20 ⑧) and press the OFF button (Fig. 20 ⑯). The ACB will trip open with a sound. The ON-OFF indicator (Fig. 20 ⑩) shows "OFF".

● Electrical opening

Press the OFF switch shown in Fig. 13,15. The shunt trip device (SHT) or the fixed type undervoltage trip device (Fig. 13,15) will be excited so that the ACB trips open with a sound. The ON-OFF indicator (Fig. 20 ⑩) shows "OFF".

4-1-4. Motion of trip indication and spring charge indication switches

The trip indication and spring charge indication switches provide the breaker status as shown in Table 17.

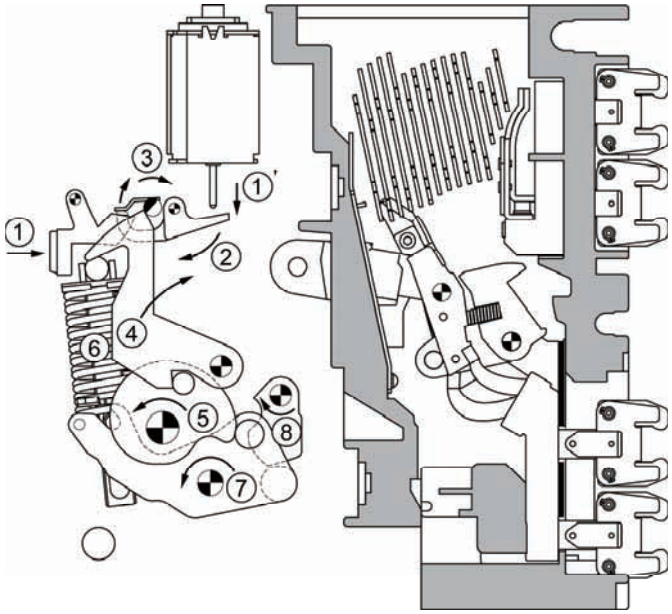
Table 17 Motion of trip indication and spring charge indication switches

Type of OCR	Operation	Contact output						
		Terminal No. See Fig. 13	State					
			Closing spring		ACB closed	ACB open		
			Charged	Discharged		Not ready to close *	Ready to close *	
All	Trip	05, 17	No change	No change	OFF	ON	OFF	
	Spring charge	05, 27	ON	OFF	No change	No change	No change	

* “Ready to close” means that all of the following conditions are met:
1. The closing springs are charged.
2. Opening operation is complete (At least 40 ms has elapsed after trip signal was produced).
3. The OFF button is released.
4. The specified voltage is applied to the undervoltage trip device (if equipped).

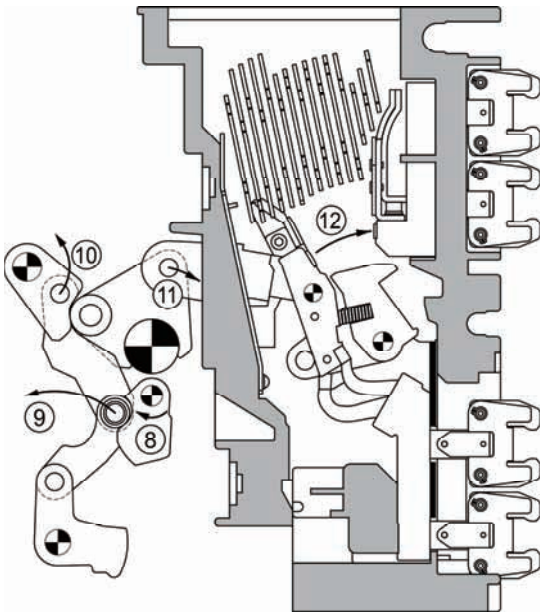
4-1-5. Motion of operation mechanisms

Figs. 21 - 24 illustrate the motion of the charging and ON-OFF mechanisms.



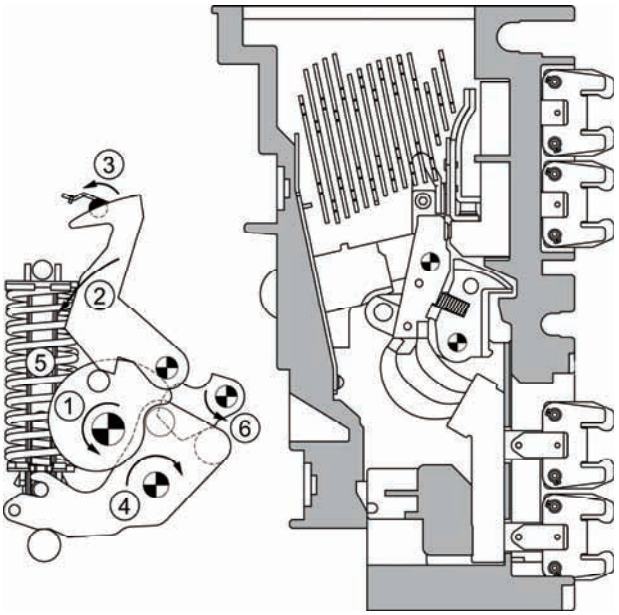
For manual closing operation, ON button ① rotates counterclockwise. For electrical closing operation, push rod ①' protrudes downward from the latch release coil (LRC) and charge latch trigger ② rotates clockwise. This rotates closing trigger shaft ③ clockwise and closing release lever ④ disengages from a semicircular pawl and rotates clockwise. And charging cam ⑤ rotates counterclockwise, so that charging lever ⑦ disengages from closing spring ⑥ and rotates counterclockwise. Closing cam ⑧ is pushed up by charging lever ⑦ and rotates clockwise. At this time, each component is positioned as shown in Fig. 23. Continued to Fig. 22.

Fig. 21 Closing motion 1 (discharge motion)



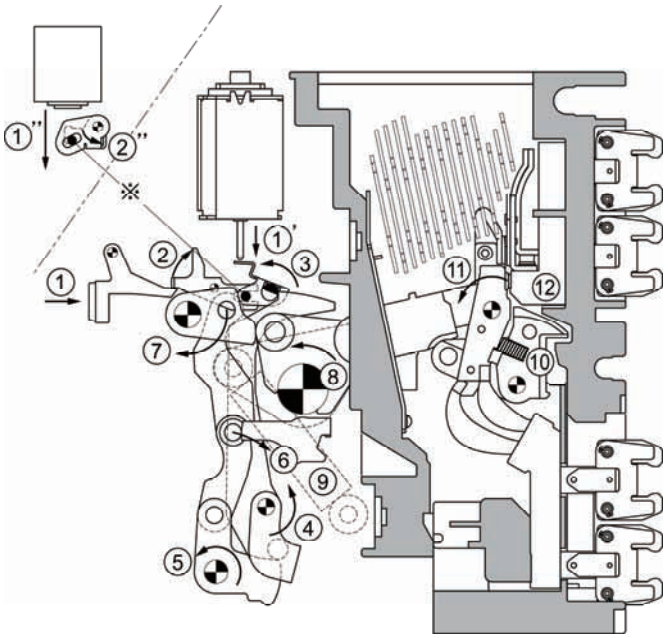
Closing cam ⑧ rotating clockwise causes closing link and top link ⑨ to be pushed straight. This rotates closing toggle cam ⑩ connected with closing link ⑨ counterclockwise, so that crossbar ⑪ rotates clockwise and thus moving contact ⑫ comes in contact with stationary contact ⑬. At this time, each component is positioned as shown in Fig. 24.

Fig. 22 Closing motion 2



The charging handle or the charging motor provides a counterclockwise rotation to charging cam ①. This rotates closing release lever ② and closing tripper lever ③ counterclockwise and a semicircular pawl engages with closing release lever ②. And charging lever ④ rotates clockwise so that closing spring ⑤ is compressed and closing cam 5 rotates counterclockwise. At this time, each component is positioned as shown in Fig. 21.

Fig. 23 Charging motion



For manual opening operation, OFF button ① rotates counterclockwise and trip linkage ② rotates clockwise. For electrical opening operation, push rod ① protrudes downward from the shunt trip device (SHT) or the undervoltage trip device (UVT). For tripping operation by the overcurrent release (OCR), moving core ① protrudes downward from the magnet hold trigger (MHT) and trip linkage ② rotates counterclockwise. (Parts marked with an asterisk (*) are trip pins. To avoid superposition in the figure, magnet hold trigger related parts are drawn in positions that are different from actual positions. This rotates trip trigger shaft ③ counterclockwise and trip lever B ④ disengages from a semicircular pawl and rotates counterclockwise. And trip lever A ⑤ rotates counterclockwise, trip link ⑥ moves to a lower right direction and closing toggle cam ⑦ rotates clockwise. The force of closing spring ⑨ and contact spring ⑩ rotates crossbar ⑧ counterclockwise, so that moving contact ⑪ is parted from stationary contact ⑫. At this time, each component is positioned as shown in Fig. 22.

Fig. 24 Opening motion

4-2. Draw-out and Insertion Operation

4-2-1. General

The draw-out type ACB consists of the breaker body and the draw-out cradle. The main and control circuit terminals are installed on the draw-out cradle, which permits you to draw out and inspect or service the breaker body without the need for removing wiring from the terminals.

The draw-out mechanism allows you to move the breaker body to any of the four positions as shown in Fig. 25. The switchboard panel door can be shut with the breaker body drawn out to the CONN., TEST or ISOLATED position.

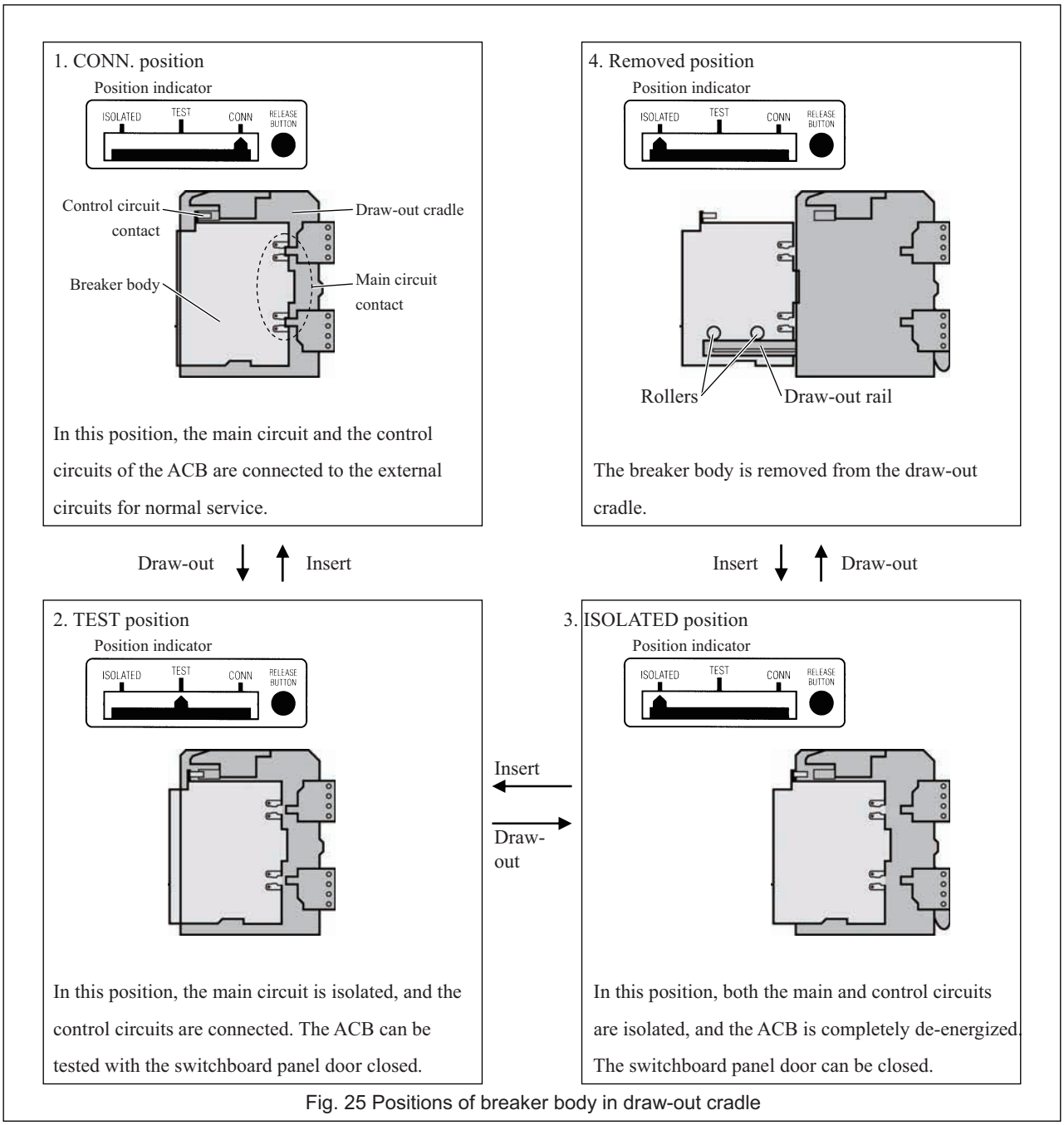


Fig. 25 Positions of breaker body in draw-out cradle

- Operation Durability

The AR series ACBs are designed to ensure the operation durability of 100 draw-out and insertion cycles in conformance to IEC 60947-1 and JIS C8201-2 (one cycle means that the breaker body is drawn out from the CONN. position to the Removed position and inserted back to the CONN. position). Draw-out and insertion operation of more than 100 cycles could abrade the main circuit contacts, resulting in an overheat of the contacts during energization.

4-2-2. Draw-out operation

⚠ DANGER

- Never touch live terminal parts. Otherwise, electric shock may result.
- Do not leave the ACB body in the removed position. The weight of the ACB may cause serious injury.

⚠ CAUTION

- If the ACB has the breaker fixing bolts, be sure to loosen the bolts on both sides before draw-out operation. Otherwise, damage to the ACB may result.
- Make sure the draw-out cradle is secured with mounting screws before drawing out the breaker body. Otherwise, the draw-out operation may cause the breaker body or the draw-out cradle to fall, resulting in damage to the ACB or personal injury.
- When retracting the draw-out rail into the draw-out cradle, be sure to push the rail end. Do not hold the hook pin, body stopper, or body stopper shaft. Doing so may cause your fingers to be pinched, resulting in injury.

Use the separate draw-out handle to draw-out the breaker body.

4-2-2-1. Moving the breaker body from the CONN. position to the TEST position

1) Open the ACB. (If the ACB remains closed, the draw-out handle (Fig. 26 ①) cannot be inserted).
2) Loosen the breaker fixing bolts (Fig. 26 ②), if used, to unlock the breaker body (Fig. 26 ③).
3) Unlock the position lock lever (Fig. 26 ⑭) if locked. See section 4-5.
4) Insert the draw-out handle into the draw-out handle insertion hole (Fig. 26 ④). And slowly turn counterclockwise until the handle cannot be turned. The position indicator (Fig. 26 ⑤) shows “TEST”.

- When the main circuit is disconnected at the disconnect contacts, the breaker body will be slightly pushed forward by the spring action of the main circuit disconnect contacts. At this moment, a bang sound will be heard. This sound does not mean a malfunction.
- The ACB cannot be closed as long as the draw-out handle is in the draw-out handle insertion hole. To close the ACB e.g., for ON-OFF testing, remove the draw-out handle.

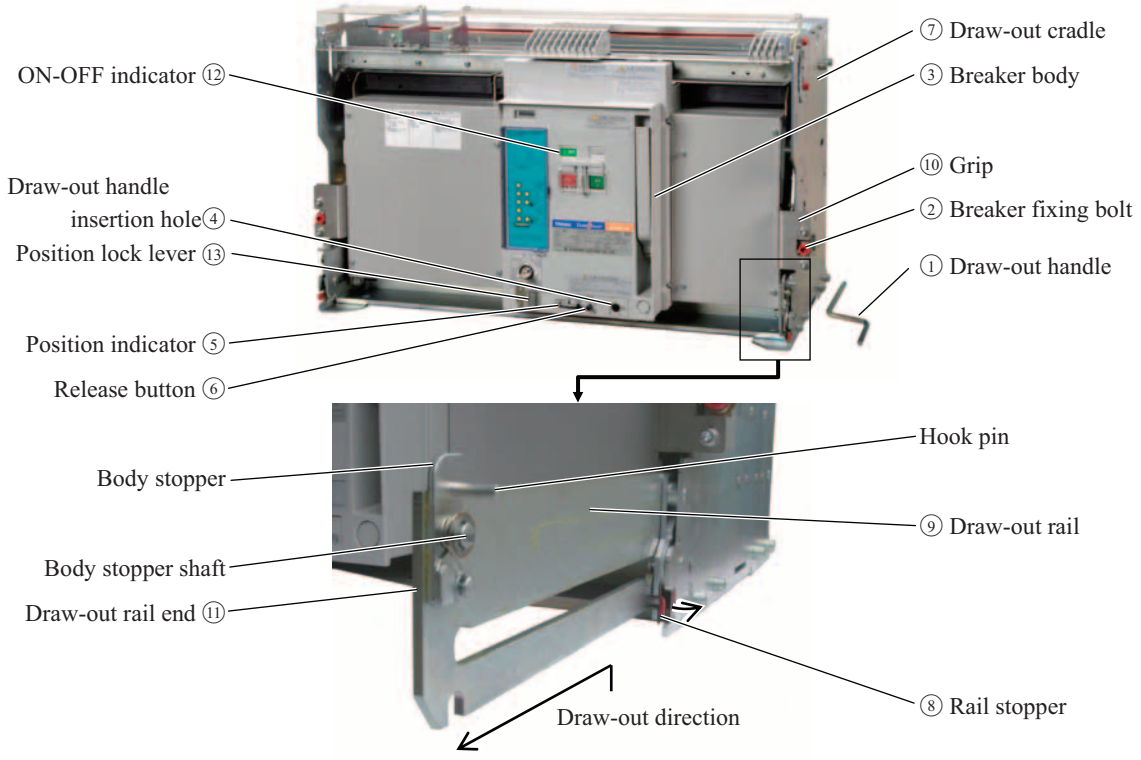


Fig. 26 Draw-out and insertion operation

4-2-2-2. Moving the breaker body from the TEST position to the ISOLATED position

1) Open the ACB. (If the ACB remains closed, the draw-out handle (Fig. 26 ①) cannot be inserted).
2) Press the release button (Fig. 26 ⑥). The release button will be locked depressed.
3) Unlock the position lock lever (Fig. 26 ⑭) if locked. See section 4-5.
4) Insert the draw-out handle into the draw-out handle insertion hole (Fig. 26 ④). And slowly turn counterclockwise until a freewheeling sound is heard. The position indicator (Fig. 26 ⑤) shows "ISOLATED". Turning the draw-out handle will unlock the release button.
5) Remove the draw-out handle.

4-2-2-3. Moving the breaker body from the ISOLATED position to the removed position

1) Make sure the draw-out cradle (Fig. 26 ⑦) is secured with mounting screws.
2) Unlock the position lock lever (Fig. 26 ⑭) if locked. See section 4-5.
3) Push the rail stoppers (Fig. 26 ⑧) outward on both sides of the draw-out cradle to unlock the draw-out rail (Fig. 26 ⑨), and then uphold and pull out the rail until it stops. The draw-out rail will be locked again by the stoppers. (The breaker body cannot be drawn out unless the rail is locked).
4) Holding both the grips (Fig. 26 ⑩), draw out the breaker body until it stops.

- If the ACB is equipped with the communication terminal block, pull out the hand connector (Fig. 26 ⑮) from the communication terminal block while drawing out the breaker body. Make sure the hand connector and control wire of the ACB are not snagged when drawing out the breaker body again.
- If the ACB is equipped with an optional auto-discharging device (Fig. 26 ⑪), the closing springs of the ACB will be automatically discharged with a mechanical sound. This sound does not mean a malfunction.
- Do not leave the ACB body on the draw-out rail pulled out.

5) Use an optional lifter or lifting plate to transfer the breaker body (Fig. 26 ③) to a safe place. Refer to section 2-1-2.

4-2-3. Putting the breaker body back into the draw-out cradle

⚠ DANGER

- Never touch live terminal parts. Otherwise, electric shock may result.
- Do not leave the ACB body in the removed position. The weight of the ACB may cause serious injury.

⚠ CAUTION

- Make sure the draw-out cradle is secured with mounting screws before inserting the breaker body into the draw-out cradle. Otherwise, the insertion operation may cause the breaker body or the draw-out cradle to fall, resulting in damage to the ACB or personal injury.
- When retracting the draw-out rail into the draw-out cradle, be sure to push the rail end. Do not hold the hook pin, body stopper, or body stopper shaft. Doing so may cause your fingers to be pinched, resulting in injury.
- Do not forcedly turn the draw-out handle clockwise when the breaker body is in the CONN. Position. Doing so may cause a malfunction.
- If the ACB has the breaker fixing bolts, make sure the bolts on both sides are securely tightened before using the ACB. Loosened fixing bolts may cause a malfunction of the ACB, in particular when it is installed in such an area that is subject to strong vibrations.

Use the separate draw-out handle to insert the breaker body.

4-2-3-1. Putting the breaker body back to the ISOLATED position

1) Make sure the draw-out cradle (Fig. 26 ⑦) is secured with mounting screws.
2) Push the rail stoppers (Fig. 26 ⑧) outward on both sides of the draw-out cradle to unlock the draw-out rail (Fig. 26 ⑨), and then uphold and pull out the rail until it stops. The draw-out rail will be locked again by the stoppers. (The breaker body (Fig. 26 ③) cannot be inserted unless the rail is locked).
3) Use an optional lifter or lifting plate to place the breaker body rollers (Fig. 27) on the draw-out rail (Fig. 27).

- Do not leave the ACB body on the draw-out rail pulled out.

4) Make sure the breaker fixing bolts (Fig. 26 ②), if fitted, are loosened and not arrest the breaker body.
5) Make sure the hand connector (Fig. 26 ⑮) of the communication terminal block, if fitted, is so positioned that it does not get caught between the breaker body and the draw-out cradle.
6) If the ACB has the breaker fixing bolts (Fig. 26 ②), make sure the bolts are loosened and, holding both the grips (Fig. 26 ⑩), firmly push the breaker body into the draw-out cradle.
   - If the ACB body is pushed out of position, it may not be inserted smoothly.
   - If the ACB is equipped with the communication terminal block, plug the hand connector (Fig. 26 ⑮) into the communication terminal block while pushing the breaker body. Into the draw-out cradle. Make sure the hand connector and control wire of the ACB are not snagged when pushing the breaker body into the draw-out cradle.
7) Push the rail stoppers (Fig. 26 ⑧) outward on both sides of the draw-out cradle (Fig. 26 ⑫) to unlock the draw-out rail, and then push the rail ends to insert the rail until it stops. The draw-out rail will be locked again by the stoppers.

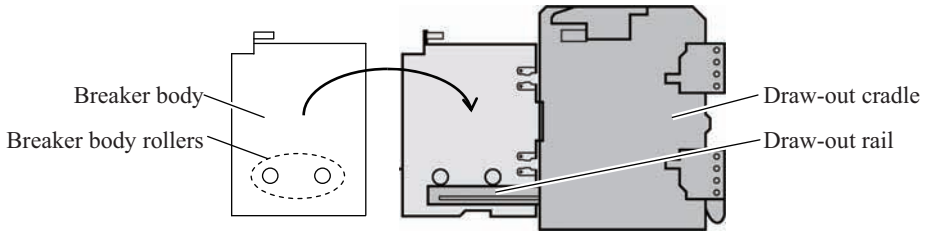


Fig. 27 Placing the breaker body on the draw-out rail

4-2-3-2. Moving the breaker body from the ISOLATED position to the TEST position

1) Make sure the ON-OFF indicator (Fig. 26 ⑬) shows “OFF”. (If the ACB remains closed, the draw-out handle (Fig. 26 ①) cannot be inserted).
2) Unlock the position lock lever (Fig. 26 ⑭) if locked. See section 4-5.
3) Insert the draw-out handle into the draw-out handle insertion hole (Fig. 26 ④). And slowly turn clockwise until the handle cannot be turned. The position indicator (Fig. 26 ⑤) shows “TEST”. When you turn the draw-out handle clockwise, you can insert the body smoothly by using a hand for holding ACB body until it moves.
   - The ACB cannot be closed as long as the draw-out handle is in the draw-out handle insertion hole. To close the ACB e.g., for ON-OFF testing, remove the draw-out handle.

4-2-3-3. Moving the breaker body from the TEST position to the CONN. position

1) Open the ACB. (If the ACB remains closed, the draw-out handle (Fig. 26 ①) cannot be inserted).
2) Unlock the position lock lever (Fig. 26 ⑭) if locked. See section 4-5.
3) Press the release button (Fig. 26 ⑥). The release button will be locked depressed.
   - If it's heavy when you push the release button or insert the main body of breaker, turn the draw-out handle a little in left and right and shake it.
4) Insert the draw-out handle into the draw-out handle insertion hole (Fig. 26 ④). And turn clockwise until the handle cannot be turned with its max. operating torque (14.7 N-m). The position indicator (Fig. 26 ⑤) shows “CONN.” Turning the draw-out handle will unlock the release button.
   - When the main contact starts engaging, the force required to turn the handle will increase as shown in Fig. 28. This symptom does not mean a malfunction. Continue to turn the handle. Rotating the handle more 13 or 14 turns moves the breaker body to the CONN. position, where the handle cannot be turned with its max. operating torque.
5) Remove the draw-out handle.
6) Tighten the breaker fixing bolts (Fig. 26 ②), if used, to lock the breaker body.

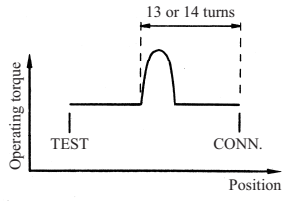


Fig. 28 Handle operating torque

4-2-4. Contact status of auxiliary and position switches

Tables 18 and 19 show the contact status of auxiliary switches and position switches respectively.

Table 18-1 Contact status of auxiliary switches

ACB state / Breaker body position	ON	OFF	Status of a-contact	Status of b-contact
CONN.			ON	OFF
			OFF	ON
TEST			ON	OFF
			OFF	ON
ISOLATED			ON	OFF
			OFF	ON
Removed			ON	OFF
			OFF	ON

Table 18-2 Contact status of auxiliary switches (When pursuant to ship classification society rules)

ACB state / Breaker body position	ON	OFF	Status of a-contact	Status of b-contact
CONN.			ON	OFF
			OFF	ON
TEST			ON	OFF
			OFF	ON
ISOLATED			ON	OFF
			OFF	ON
Removed			ON	OFF
			OFF	ON

Table 19 Contact statues of position switches

Position indication / Switch	ISOLATED	TEST	CONN.	Status of a-contact	Status of b-contact
CONN. position indication				ON	OFF
				OFF	ON
TEST position indication				ON	OFF
				OFF	ON
ISOLATED position indication				ON	OFF
				OFF	ON
Inserted position indication *				ON	OFF
				OFF	ON

* "Inserted" means that the breaker body is in the CONN., TEST, or ISOLATED position.

4-3. ON-OFF Button Cover Locking Procedure

Lock the button cover using a padlock with ø6 shackle (up to 3 padlocks can be used) as shown in Fig. 29. The ON-OFF button cover is locked and the ON and OFF buttons cannot be operated.

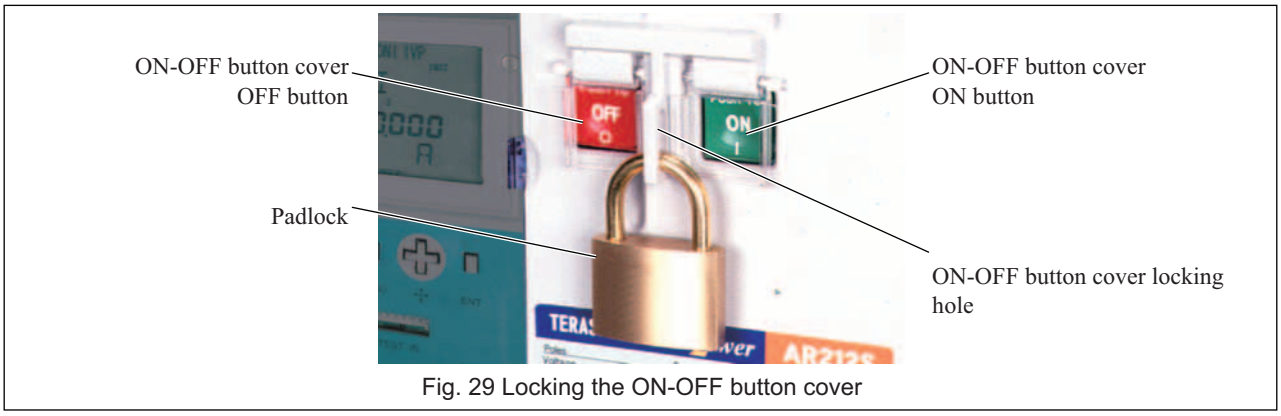


Fig. 29 Locking the ON-OFF button cover

4-4. Lock in OFF Procedure

1) Open the OFF button cover shown in Fig. 30.
2) Raise the OFF-lock tab and close the button cover.
3) Lock the button cover using a padlock with ø6 shackle (up to 3 padlocks can be used) as shown in Fig. 30. The OFF button is locked depressed, which disables the ON button.

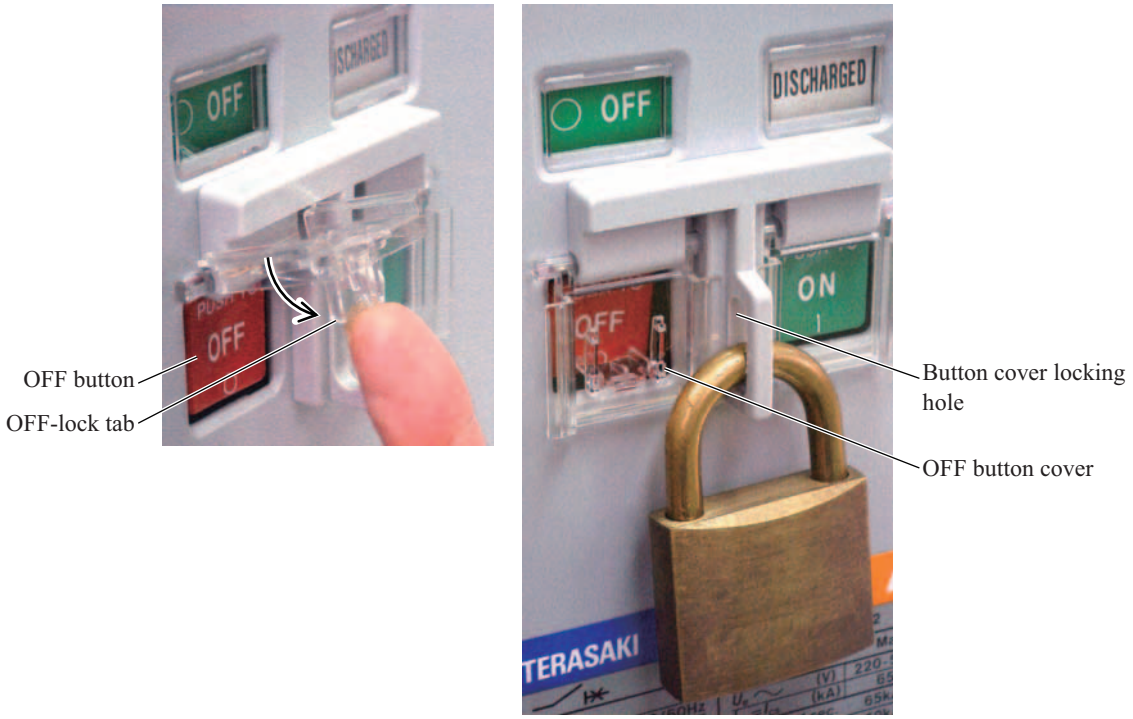


Fig. 30 Locking the OFF button

4-5. Position Lock Lever Locking Procedure

1) Move the breaker body to the desired position (CONN, TEST or ISOLATED).
2) Pull out the position lock lever shown in Fig. 31.
3) Lock the position padlock lever using a padlock with ø6 shackle (up to 3 padlocks can be used) as shown in Fig. 31. This prevents the draw-out handle from being inserted into the draw-out handle insertion hole, i.e., the breaker position cannot be changed.

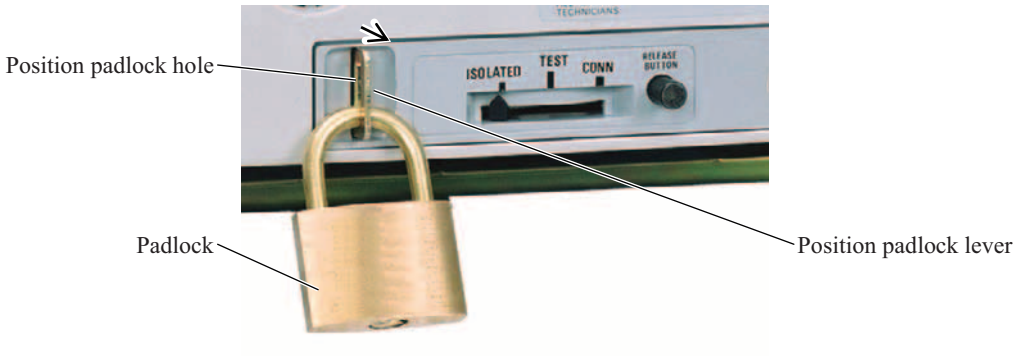


Fig. 31 Locking the position padlock lever

4-6. Breaker Fixing Bolt Securing Procedure

1) Move the breaker body to the CONN. position.

2) Tighten the breaker fixing bolt using the draw-out handle. This procedure is required for both the sides of the ACB.

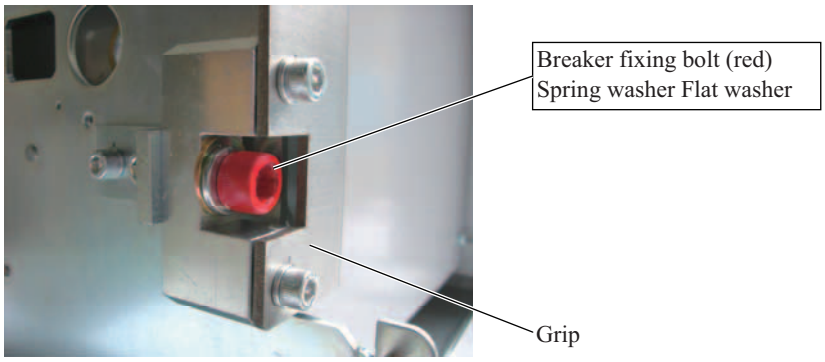


Fig. 32 Securing the breaker fixing bolts

4-7. OCR Cover Locking Procedure

Lock the OCR cover using a padlock with ø6 shackle as shown in Fig. 33. The OCR cover cannot be opened, which prevents OCR settings from being changed.

Fig. 33 Padlocking the OCR cover

5. OVERCURRENT RELEASE (OCR)

Options available for the type AR ACBs include a highly reliable, multi-functional overcurrent release (OCR) with a built-in 16-bit microprocessor.

This OCR is supplied with power through a CT and main circuit current signals from current sensors. When the OCR detects a fault, it sends a trip signal to the magnet hold trigger (MHT) or provides a trip indication or an alarm depending on the type of the fault.

The OCR uses the root mean square sensing for the long time delay (LT), pre-trip alarm (PTA, PTA2), and N-phase protection (NP) functions. (When six times the CT rated primary current is exceeded.) If a harmonic current flows through the ACB continuously, the root mean square sensing allows the ACB to operate normally.

The OCR is available in the type that follows:

- AGR-11BL,21BL,31BL L characteristic for general feeder (for works and transformer protection)
- AGR-21BR,31BR R characteristic for general feeder (3 characteristics conforming to IEC60255)
- AGR-21BS,22BS,31BS S characteristic for generator protection

5-1. Specifications

Specifications of the OCR are shown in Table 20,21.

Table 20 Specifications of type AGR-11B OCR (●: Standard, ○: Optional, –: Not applicable)

Application		For general feeder		Reference section
Characteristic		L		
Type designation		AGR-11BL-AL	AGR-11BL-GL	
Protective function	Long time delay trip (LT) Short time delay trip (ST) Instantaneous trip (INST)	●	●	5-2-1.
	Ground fault trip (GF)	–	●	
	N-phase protection	○	○	
Protection characteristic	I^2t ON/OFF (ST)	●	●	
	I^2t ON/OFF (GF)	–	●	
Trip indication	Group indication LED and contact output	●	●	5-5-1.
Test function		–	–	–
Control power supply		Not required	Not required	3-3.

Table 21 Specifications of type AGR-21B, 22B, 31B OCR (●: Standard, ○: Optional, –: Not applicable)

Application		For general feeder								For generator protection				Reference section
Characteristic		L				R				S				
Type designation		AGR-21BL-XX		AGR-31BL-XX		AGR-21BR-XX		AGR-31BR-XX		AGR- XXXX -XX		AGR-31BS-XX		
Suffix (XX or XXXX) of type designation		PS	PG	PS	PG	PS	PG	PS	PG	21BS-PS	22BS-PR	PS	PR	
Protective function	Long time delay trip (LT), short time delay trip (ST) and Instantaneous trip (INST/MCR) ①	●	●	●	●	●	●	●	●	●	●	●	●	5-2., 5-3-2-6.
	Ground fault trip (GF) ②③	–	●	–	●	–	●	–	●	–	–	–	–	5-2., 5-3-2-7.
	Reverse power trip (RPT) ②④⑤	–	–	–	–	–	–	–	–	–	●	–	●	
	N-phase protection (NP) ①⑥	○	○	○	○	○	○	○	○	–	–	–	–	5-2., 5-3-2-6.
	Negative-phase sequence protection (NS) ②⑦	○	○	○	○	○	○	○	○	–	–	–	–	5-2., 5-3-2-7.
	Line side ground fault protection (REF) ②③⑧⑨	–	○	–	○	–	○	–	○	–	–	–	–	
	Contact overheat monitoring (OH) ②⑨⑩	–	–	○	○	–	–	○	○	–	○	○	○	
	Zone interlock (Z) ⑨⑪	–	–	○	○	–	–	○	○	–	○	○	○	3-3.
Alarm function	Pretrip alarm (PTA) ⑨⑫⑬	●	●	●	●	●	●	●	●	●	●	●	●	5-2., 5-3-2-7.
	Pretrip alarm 2 (PTA2) ⑨⑫⑬	–	–	–	–	–	–	–	–	–	○	○	○	
	Undervoltage alarm (UV) ⑤⑨⑫⑭	–	–	○	○	–	–	○	○	–	○	○	○	
Protection characteristic	COLD/HOT (LT) ⑮	●	●	●	●	—	—	—	—	—	—	—	—	5-2., 5-3-2-6.
	I^2t ON/OFF (ST) ⑯	●	●	●	●	●	●	●	●	●	●	●	●	
	INST/MCR (Instantaneous trip) ⑰	●	●	●	●	●	●	●	●	●	●	●	●	
	$I^{0.02}t/It/I^2T/I^3t/I^4t$ (LT) ⑱	–	–	–	–	●	●	●	●	–	–	–	–	
	I^2t ON/OFF (FG) ⑯	–	●	–	●	–	●	–	●	–	–	–	–	5-2., 5-3-2-7.
	Polarity NOR/REV (RPT) ⑲	–	–	●	●	–	–	●	●	–	●	●	●	5-3-2-4.
Operation indication	Indication on LCD and contact output (individual indication) ⑨	●	●	●	●	●	●	●	●	●	●	●	●	5-5-2.
Measurement /event indication	Present current (switchable between respective phase current phase max. and current) ⑨	●	●	–	–	●	●	–	–	●	●	–	–	5-3-2-3.
	Present current /voltage/electrical energy/frequency(switchable between respective phase current phase max. and current) ⑨	–	–	●	●	–	–	●	●	–	–	●	●	
	Max. current (max. phase current) ⑨	●	●	–	–	●	●	–	–	●	●	–	–	
	Max. current /demanded power(max. phase current) ⑨	–	–	●	●	–	–	●	●	–	–	●	●	
	Trip event log (last trip event) ⑨⑳	●	●	●	●	●	●	●	●	●	●	●	●	5-3-2-8.
	Alarm event log (last alarm event) ⑨⑳	●	●	●	●	●	●	●	●	●	●	●	●	
Communication Functions		○	○	○	○	○	○	○	○	○	○	○	○	3-3.
External indicator		–	–	○	○	–	–	○	○	–	○	○	○	-
Test function⑨㉑		●	●	●	●	●	●	●	●	●	●	●	●	5-4.
Control power supply ㉒		Required												3-3.

① Two modes are available; one where the ACB is tripped open and operation indication is provided and the other where the ACB is not tripped and no operation indication is provided. Fail-safe against failure in setup (see 5-2).
② Three modes are available; the first where the ACB is tripped open and operation indication is provided, the second where the ACB is not tripped and only operation indication is provided, and the third where the ACB is not tripped open and no operation indication is provided.
③ Residual current sensing. When a 3-pole ACB applies to a 3-phase, 4-wire circuit, be sure to use the separate N-phase protection CT (see 3-3).
④ Allows 3-phase generators operated in parallel to be protected against reverse power.
⑤ If the main circuit voltage exceeds AC250V, a step-down PT (potential transformer) is needed.
⑥ Provides protection to the neural conductor in a 3-phase, 4-wire circuit against overcurrent. This function applies to a 4-pole ACB.
⑦ Provides protection to ACBs against negative-phase current caused by phase loss or reverse phase, preventing damage to loads.
⑧ The line side ground fault protection capability allows the ACB to trip open when transformer windings or cables on the line side suffers a ground fault in TN-C or TN-S power distribution systems where the line side neutral is grounded.
⑨ Control power supply is required. Disabled when control power is lost.
⑩ Protects the breaker main contact against overheat, preventing troubles caused by thermal damage of the contact. Helpful for preventive maintenance.
⑪ Zone selective interlock implemented between ACBs in a hierarchical system allows the upstream ACB nearest a fault point to trip open in a minimum time, irrespective of short time delay trip or ground fault trip pickup timing, thereby minimizing thermal or mechanical damage to loads. This stands for selective discrimination with zero timing.
⑫ Two modes are available; one where operation indication is provided and the other where no operation indication is provided.
⑬ The pretrip alarm capability provides an alarm on the LCD and delivers contact output when it is detected that the current value exceeds the current setting for longer than the time setting, thereby preventing the ACB from tripping due to a gradual increase in load current. Pretrip alarm 2 allows two different timings to be set and helps regulate loads depending on their importance.
⑭ Provides an alarm on the LCD and delivers contact output when the voltage of the main circuit becomes low.
⑮ In HOT mode, the OCR is actuated in shorter time than in COLD mode when an overload occurs after a certain degree of load is maintained for a certain time of period. This mode helps protect heat sensitive loads.
⑯ I^2t ON avoids intersection of characteristic curves of the ACB and e.g., a downstream fuse. This will improve selective discrimination flexibility.
⑰ INST is enabled, the OCR trips open the ACB when the trip pickup current is reached or exceeded, irrespective of the ACB status. When MCR is enabled, the OCR trips open the ACB when the ACB making current setting is reached or exceeded, and after tripping operation, it locks the ACB in the open state. MCR provides the INST function if the control power is lost.
⑱ Helpful for protection in coordination with fuses or the like. (IEC 60255-3)
⑲ Allows selection of the power supply terminal position between upstream and downstream of the breaker.
⑳ Logs the latest trip event and alarm event and allows displaying the cause, fault current value and operating time of the events.
㉑ Allows simplified field testing where simulation signals from/to the OCR are used to check for normal long time delay, short time delay, instantaneous and ground fault trip functions.
㉒ If the control power is lost, the long time delay trip, short time delay trip, instantaneous trip, ground fault trip, reverse power trip, N-phase protection and negative-phase sequence protection functions are alive.

5-2. Characteristics

5-2-1. L characteristic for general feeder

A general view, characteristic settings, and characteristic curves of the type AGR-11BL OCR (with L characteristic) are shown in Fig. 34, Table 22, and Fig. 37 respectively.

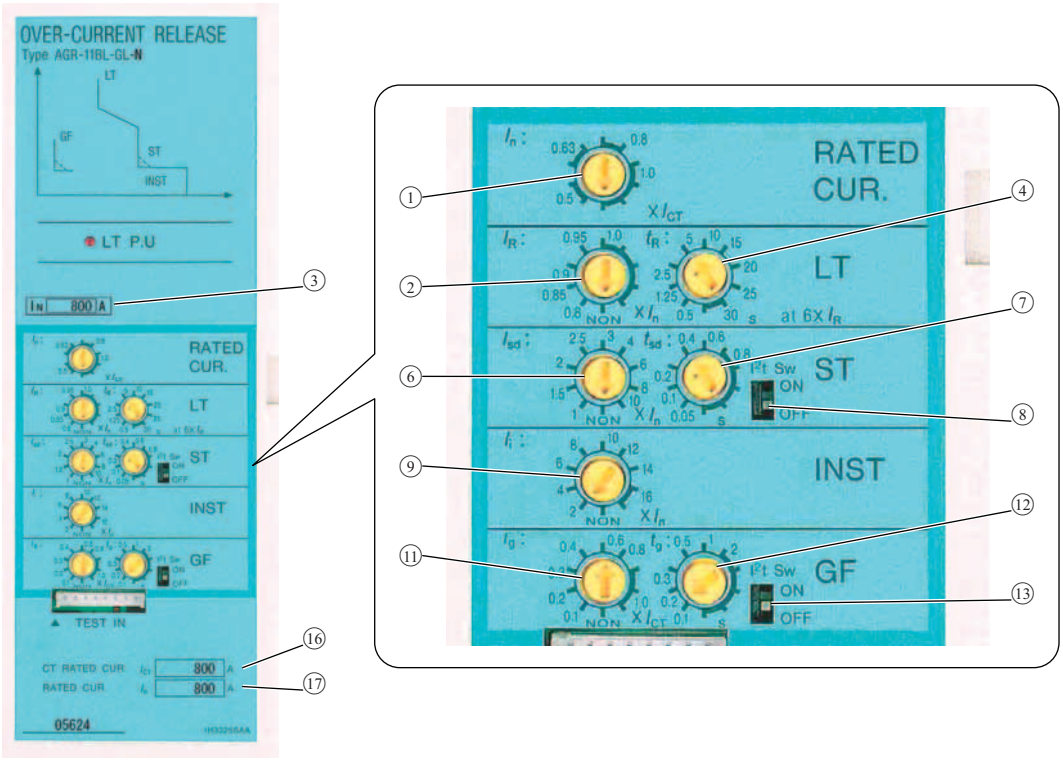


Fig. 34 General view of type AGR-11BL OCR (with L characteristic)

Table 22 Settings of type AGR-11BL OCR (with L characteristic)

No.	Setting item	Symbol	Setting range					
①	Rated current*1	I_n	CT rated primary current [I_{CT}] × (0.5-0.63-0.8-1.0) (A)					
			Applied [I_{CT}] (A)		5000		6300	
			Rated current [I_n] (A)	[I_{CT}] × 0.5	2500		3200	
				[I_{CT}] × 0.63	3200		4000	
				[I_{CT}] × 0.8	4000		5000	
				[I_{CT}] × 1.0	5000		6300	
②	Long time delay trip pickup current (continuous)	I_R	[I_n] × (0.8-0.85-0.9-0.95-1.0-NON) (A) • Non tripping at not more than [I_R] x 1.05, Tripping at more than [I_R × 1.05 and not more than [I_R] × 1.2					
③	N-phase protection trip pickup current (continuous)	I_N	[I_{CT}] × (0.4-0.5-0.63-0.8-1.0): Fixed to a single point • Non tripping at not more than [I_N] × 1.05, Tripping at more than [I_N] x 1.05 and not more than [I_R] × 1.2					
④	Long time delay/N-phase protection trip timing	t_R	Long time delay: (0.5-1.25-2.5-5-10-15-20-25-30) (s) at 600% of [I_R], Tolerance: ±15%, +0.15s –0s N-phase protection: (0.5-1.25-2.5-5-10-15-20-25-30) (s) at 600% of [I_N], Tolerance: ±15%, +0.15s –0s					
⑥	Short time delay trip pickup current	I_{sd}	[I_n] × (1-1.5-2-2.5-3-4-6-8-10-NON) (A), Tolerance: ±15%					
⑦	Short time delay trip timing	t_{sd}	Relaying time (ms.)	50	100	200	400	600	800
			Resettable time (ms.)	25	75	175	375	575	775
			Max. total clearing time (ms.)	120	170	270	470	670	870
⑧	Short time delay trip I^2t mode	I^2t t_{sd}	ON/OFF					
⑨	Instantaneous trip pickup current	I_i	[I_n] × (2-4-6-8-10-12-14-16-NON) (A), Tolerance: ±20%					
⑪	Ground fault trip pickup current *2	I_g	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A), Tolerance: ±20%					
⑫	Ground fault trip timing	t_g	Relaying time (ms.)	100	200	300	500	1000	2000
			Resettable time (ms.)	75	175	275	475	975	1975
			Max. total clearing time (ms.)	170	270	370	570	1070	2070
⑬	Ground fault trip I^2t mode	I^2t t_g	ON/OFF					
⑯	CT rated primary current display-only field							
⑰	Factory-set rated current display-only field							

- Underlined values are default settings.
- NON setting disables protective functions. If the short time delay trip function and the instantaneous trip function are set to NON, however, the fail-safe operates so that:
  • The instantaneous trip function is activated at [I_n] × 16 or more if the short time delay trip function and the instantaneous trip function are set to NON.
- A pickup current means the threshold by which the OCR determines whether or not an overcurrent occurs. When the current flowing through the OCR exceeds the pickup current setting provided that [I_R] x 1.05 < pickup current setting ≤ [I_R × 1.2, the OCR starts counting the time for tripping. Once the current flowing through the OCR reduces to less than the pickup current setting, time count is reset.

*1: A change in rated current setting results in changes in long time delay, short time delay, and instantaneous current settings accordingly.
*2: The ground fault trip pickup current setting should not exceed 1200A.

Characteristic settings and characteristic curves of the type AGR-21,31BL OCR (with L characteristic) are shown in Table 23 and Fig. 35-37 respectively.

Table 23 Settings of type AGR-21BL,31BL OCR (with L characteristic)

Setting item		Symbol	Setting range ①						
Rated current ②		I_n	CT rated primary current [I_{CT}] × (0.5-0.63-0.8-1.0) (A)						
			Applied [I_{CT}] (A)		5000	6300			
			Rated current [I_n] (A)	[I_{CT}] × 0.5	2500	3200			
				[I_{CT}] × 0.63	3200	4000			
				[I_{CT}] × 0.8	4000	5000			
				[I_{CT}] × 1.0	5000	6300			
Long time delay trip (LT) ③⑦	pickup current (continuous)	I_R	[I_n] × (0.8-0.85-0.9-0.95-1.0-NON) (A) ④ • Non tripping at not more than [I_R] × 1.05, Tripping at more than [I_R] × 1.05 and not more than [I_R] × 1.2 ⑤						
	trip timing	t_R	(0.5-1.25-2.5-5-10-15-20-25-30) (s) at 600% of [I_R], Tolerance: ±15%, +0.15s –0s						
	COLD/HOT	—	COLD/HOT ⑥						
Short time delay trip (ST) ⑦	pickup current	I_{sd}	[I_n] × (1-1.5-2-2.5-3-4-6-8-10-NON) (A), Tolerance: ±15% ④						
	trip timing⑧	t_{sd}	Relaying time (ms.)	50	100	200	400	600	800
			Resettable time (ms.)	25	75	175	375	575	775
			Max. total clearing time (ms.)	120	170	270	470	670	870
	I^2t mode	I^2t t_{sd}	OFF/ON ⑨						
Instantaneous trip (INST/MCR)	pickup current	I_i	[I_n] × (2-4-6-8-10-12-14-16-NON) (A), Tolerance: ±20% ④						
	INST/MCR	—	INST/MCR						
Ground fault trip (GF)	pickup current ⑩	I_g	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A), Tolerance: ±20% ④						
	trip timing	t_g	Relaying time (ms.)	100	200	300	500	1000	2000
			Resettable time (ms.)	75	175	275	475	975	1975
			Max. total clearing time (ms.)	170	270	370	570	1070	2070
	I^2t mode	I^2t t_g	OFF/ON ⑨						
	Mode	—	TRIP/AL/OFF ⑪						
N-phase protection trip (NP) ③⑦	pickup current (continuous)	I_N	[I_{CT}] × (0.4-0.5-0.63-0.8-1.0) • Non tripping at not more than [I_N] × 1.05, Tripping at more than [I_N] × 1.05 and not more than [I_N] × 1.2 ⑤						
	trip timing	t_R	Depends on the long time delay trip pickup timing. Activated at 600% of [I_N].						
	COLD/HOT	—	Depends on the long time delay trip mode (COLD/HOT). ⑥						
Negative-phase sequence protection (NS) ⑫	Current setting	I_{NS}	[I_n] × (0.2-0.3-0.4-0.5-0.6-0.7-0.8-0.9-1.0) (A), Tolerance: ±10%						
	Time setting	t_{NS}	(0.4-0.8-1.2-1.6-2-2.4-2.8-3.2-3.6-4) (s) at 150% of [I_{NS}], Tolerance: ±20%, +0.15 s –0 s						
	Mode	—	TRIP/AL/OFF ⑪						
Line side ground fault protection (REF)	Current setting	I_{REF}	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A), Tolerance: ±20% ④						
	Time setting	—	Instantaneous						
	Mode	—	TRIP/AL/OFF⑪						
Contact overheat monitoring (OH)	Temperature setting	–	155°C						
	Time setting	–	Instantaneous						
	Mode	–	TRIP/AL/OFF ⑪						
Zone interlock (Z) ⑬	Current setting	–	Interlock with short time delay trip pickup current						
	Time setting	–	50 ms. or less						
Pretrip alarm (PTA)	Current setting	I_{P1}	[I_n] × (0.75-0.8-0.85-0.9-0.95-1.0) (A), Tolerance: ±7.5%						
	Time setting	t_{P1}	(5-10-15-20-40-60-80-120-160-200) (s) at not less than [I_{P1}], Tolerance: ±15%, +0.1s –0 s						
	Mode	—	AL/OFF ⑭						
Undervoltage alarm ⑮⑯	Voltage setting	–	[V_n] × (0.4-0.6-0.8) (V), Tolerance: ±5%						
	Time setting	–	(0.1-0.5-1-2-5-10-15-20-30-36) (s) at voltage setting or less, Tolerance: ±15%, +0.1s –0s						
	Recovery voltage setting ⑰	–	[V_n] × (0.8-0.85-0.9-0.95) (V), Tolerance: ±5%						
	Mode	–	AL/OFF ⑭						

① Underlined values are default settings.
② A change in rated current setting results in changes in long time delay trip, short time delay trip, instantaneous strip, pretrip alarm and negative-phase sequence protection trip pickup current settings accordingly.
③ The operating time (t) at a long time delay (or N-phase protection) trip pickup current setting is given by

$t = -27.94 \times t_R \times \log_e \{1 - (1.125 I_R / i)^2\} \pm 15\% +0.15 -0$ [s]
(I_R : Long time delay or N-phase protection trip pickup current setting, i: Overcurrent value, t_R: Time setting)

④ NON setting disables protective functions. If the short time delay trip function and the instantaneous trip (or MCR) function are both attempted to be set to NON, however, the fail-safe operates so that:
• When the short time delay trip function has been set to NON, the instantaneous trip function cannot be set to NON or MCR.
• When the instantaneous trip function is set to NON or MCR, the short time delay trip function cannot be set to NON.
⑤ A pickup current means the threshold by which the OCR determines whether or not an overcurrent occurs. When the current flowing through the OCR exceeds the pickup current setting provided that [I_R] × 1.05 < pickup current setting ≤ [I_R × 1.2, the OCR starts counting the time for tripping. Once the current flowing through the OCR reduces to less than the pickup current setting, time count is reset.
⑥ In HOT mode, the OCR is actuated in shorter time than in COLD mode when an overload occurs after a certain degree of load is maintained for a certain time of period. The OCR is factory se to COLD mode. See 5-3-2-6 for how to set the OCR to HOT mode. If the control power is lost, load data stored in HOT mode is cleared. Fig. 35 shows the operating time in COLD and HOT modes.
⑦ The short time delay trip function has precedence over the long time delay trip function. The OCR operates at the short time delay trip timing even in those current ranges in which the long time delay trip time setting is shorter than the short time delay time setting.
⑧ If DC24V zone interlock power is not provided between 33 and 34, the zone interlock is inoperative and the short time delay trip function works with a total clearing time of 50 ms or less when a fault current is detected.
⑨ Fig. 36 shows the operating characteristic at I^2t ON and I^2t OFF. When I^2t is ON, the OCR operates at fixed trip pickup current of 1000% of [I_n]. (100% of [I_{CT}] for ground fault trip)
⑩ The ground fault trip pickup current setting should not exceed 1200A.
⑪ "TRIP" means the breaker is tripped open and operation indication is provided, "AL" means the breaker is not tripped and only operation indication is provided, and "OFF" means the breaker is not tripped open and no operation indication is provided.
⑫ The operating time (t) at a negative-phase sequence protection trip pickup current setting is given by

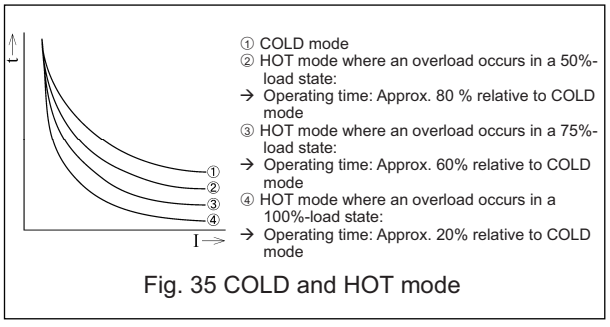


Fig. 35 COLD and HOT mode

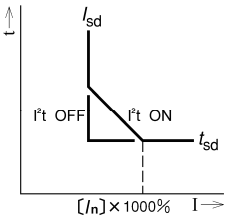
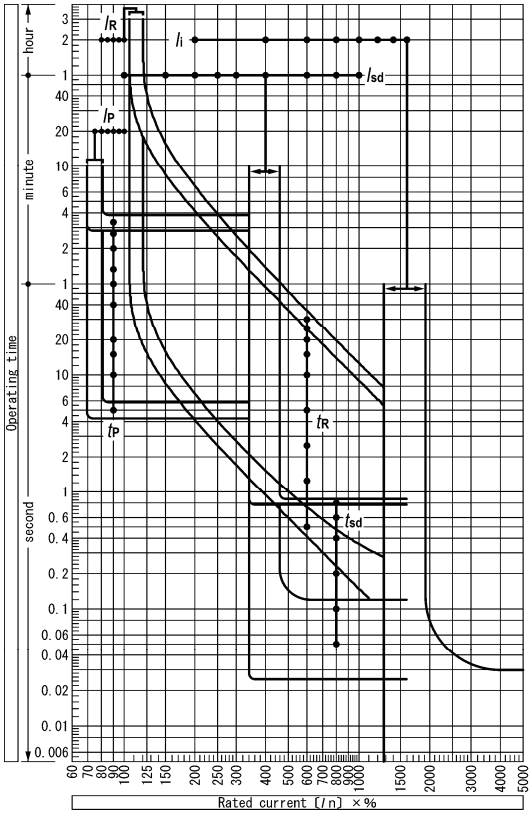


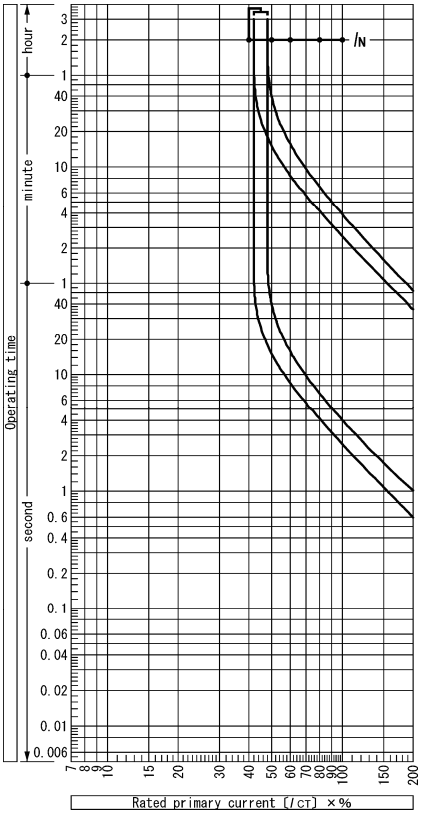
Fig. 36 I^2t characteristic

$t = 1.5 \times t_{NS} \times I_{NS} / i \pm 20\% + 0.15 -0$ [s]
(I_{NS} : Negative-phase sequence protection trip pickup current setting, i: Overcurrent value, t_{NS}: Time setting)
(i is fixed to 3 × I_{NS} when i > 3 × I_{NS})

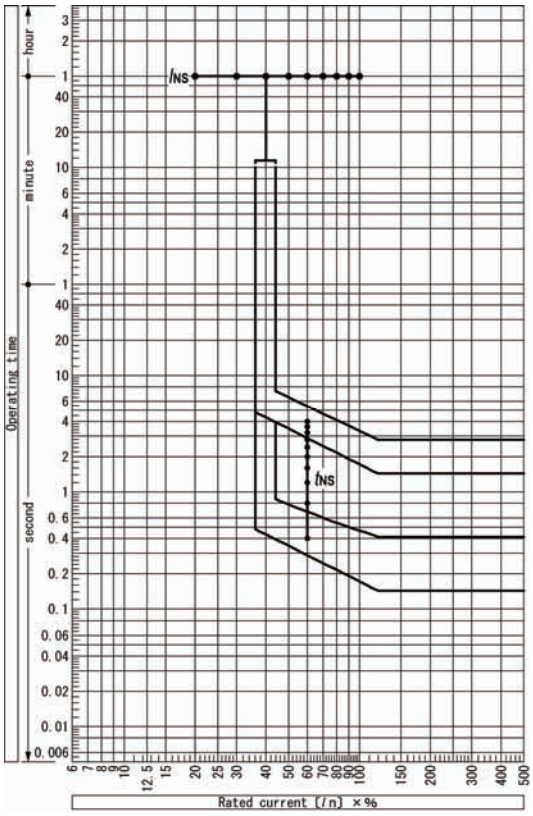
⑬ Activated only when the fault point is within the zone covered by the breaker.
⑭ "AL" means operation indication is provided and "OFF" means no operation indication is provided.
⑮ Provides an alarm and delivers contact output when the voltage of the main circuit decreases to the voltage setting or lower for longer than the time setting. The alarm ceases when the main circuit voltage returns to the recovery voltage or higher.
⑯ When this capability is used in conjunction with the undervoltage trip device (UVT), an alarm may be provided after tripping operation of the breaker depending on the voltage setting.
⑰ The undervoltage alarm capability does not work if the main circuit voltage is originally under the recovery voltage.



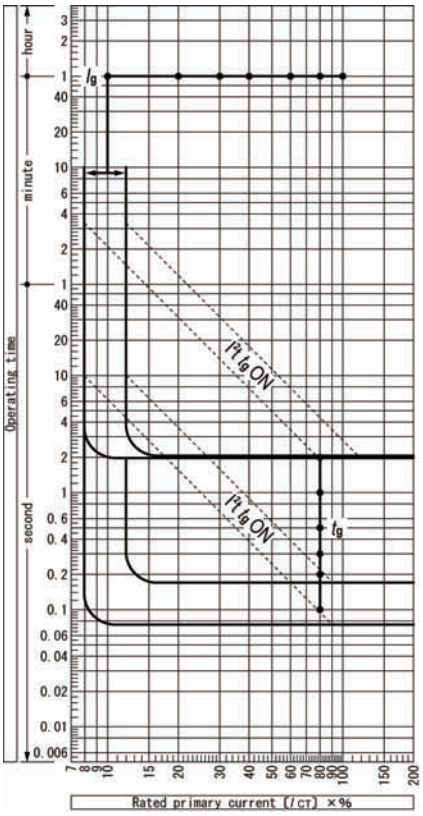
Long time delay trip, Short time delay trip, Instantaneous trip and Pre-trip alarm



N-phase protection trip



Negative-phase sequence protection



Ground fault trip

Fig. 37 Characteristic curves of type AGR-11BL,21BL,31BL OCR (with L characteristic)

5-2-2. R characteristic for general feeder

Characteristic settings and characteristic curves of the type AGR-21BR,31BR OCR (with R characteristic) are shown in Table 24 and Figs. 38 - 44 respectively.

Table. 24 Characteristic settings of type AGR-21BR,31BR OCR (with R characteristic)

Setting item		Symbol	Setting range①					
Rated current ②		I_n	CT rated primary current [I_{CT}] × (0.5-0.63-0.8-1.0) (A)					
			Applied [I_{CT}] (A)		5000		6300	
			Rated current [I_n] (A)	[I_{CT}] × 0.5	2500		3200	
				[I_{CT}] × 0.63	3200		4000	
				[I_{CT}] × 0.8	4000		5000	
				[I_{CT}] × 1.0	5000		6300	
Long time delay trip (LT) ③⑤	Current setting (continuous energization)	I_R	[I_n] × (0.8-0.85-0.9-0.95-1.0-NON) (A), Tolerance: ±5% ④					
	Time setting	t_R	(1-2-3-4-5-6.3-6.8-10) (s) at 300% of [I_R], Tolerance: ±20%, +0.15 s –0 s					
	Protection type	–	SIT: $I^{0.02}$ t, VIT: I t, EIT: I^2 t, 3IT: I^3 t, 4IT: I^4 t					
Short time delay trip (ST) ⑤	Current setting	I_{sd}	[I_n] × (1-1.5-2-2.5-3-4-6-8-10-NON) (A), Tolerance: ±15% ④					
	Time setting ⑥	t_{sd}	Relaying time (ms.)	50	100	200	400	600	800
			Resettable time (ms.)	25	75	175	375	575	775
			Max. total clearing time (ms.)	120	170	270	470	670	870
	I^2t protection type	I^2t t_{sd}	OFF/ON ⑦					
Instantaneous trip (INST/MCR)	Current setting	I_I	[I_n] × (2-4-6-8-10-12-14-16-NON) (A), Tolerance: ±20% ④					
	INST/MCR	–	INST/MCR					
Ground fault trip (GF)	Current setting ⑧	I_g	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A), Tolerance: ±20% ④					
	Time setting	t_g	Relaying time (ms.)	100	200	300	500	1000	2000
			Resettable time (ms.)	75	175	275	475	975	1975
			Max. total clearing time (ms.)	170	270	370	570	1070	2070
	I^2t protection type	I^2t t_g	OFF/ON ⑦					
	Mode	–	TRIP/AL/OFF ⑨					
N-phase protection (NP) ③⑤	Current setting (continuous energization)	I_N	[I_{CT}] × (0.4-0.5-0.63-0.8-1.0-NON) (A), Tolerance: ±5%					
	Time setting	t_R	Depends on the long time delay trip pickup timing. Activated at 300% of [I_N].					
Negative-phase sequence protection (NS) ⑩	Current setting	I_{NS}	[I_n] × (0.2-0.3-0.4-0.5-0.6-0.7-0.8-0.9-1.0) (A), Tolerance: ±10%					
	Time setting	t_{NS}	(0.4-0.8-1.2-1.6-2-2.4-2.8-3.2-3.6-4) (s) at 150% of [I_{NS}], Tolerance: ±20%, +0.15 s –0 s					
	Mode	–	TRIP/AL/OFF ⑨					
Line side ground fault protection (REF)	Current setting	I_{REF}	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A), Tolerance: ±20% ④					
	Line side ground fault protection bias current	I_{REF2}	[I_{CT}] × (0.1-0.2-0.3-0.5-0.7-0.9-1.1-1.3-1.5) (A), Tolerance: ±20%					
	Time setting	–	Instantaneous					
	Mode	–	TRIP/AL/OFF ⑨					
Contact overheat monitoring (OH)	Temperature setting	–	155°C					
	Time setting	–	Instantaneous					
	Mode	–	TRIP/AL/OFF ⑨					
Zone interlock (Z) ⑪	Current setting	–	Interlock with short time delay trip pickup current					
	Time setting	–	50 ms. or less					
Pretrip alarm (PTA)	Current setting	I_{P1}	[I_n] × (0.75-0.8-0.85-0.9-0.95-1.0) (A), Tolerance: ±7.5%					
	Time setting	t_{P1}	(5-10-15-20-40-60-80-120-160-200) (s) at not less than [I_{P1}], Tolerance: ±15%, +0.1s –0 s					
	Mode	–	AL/OFF ⑫					
Undervoltage alarm ⑬⑭	Voltage setting	–	[V_n] × (0.4-0.6-0.8) (V), Tolerance: ±5%					
	Time setting	–	(0.1-0.5-1-2-5-10-15-20-30-36) (s) at voltage setting or less, Tolerance: ±15%, +0.1s –0s					
	Recovery voltage setting ⑮	–	[V_n] × (0.8-0.85-0.9-0.95) (V), Tolerance: ±5%					
	Mode	–	AL/OFF ⑫					

① Underlined values are default settings.
② A change in rated current setting results in changes in long time delay trip, short time delay trip, instantaneous strip, pretrip alarm and negative-phase sequence protection trip pickup current settings accordingly.
③ The operating time (t) at a long time delay (or N-phase protection) trip pickup current setting is given by

$t = 0.0222 \times t_R / \{ (i/I_R)^{0.02} - 1 \}$ ±20% +0.15 –0 [s] ($I^{0.02}$t protection type)
$t = 2 \times t_R / \{ (i/I_R) - 1 \}$ ±20% +0.15 –0 [s] (It protection type)
$t = 8 \times t_R / \{ (i/I_R)^2 - 1 \}$ ±20% +0.15 –0 [s] (I^2t protection type)
$t = 26 \times t_R / \{ (i/I_R)^3 - 1 \}$ ±20% +0.15 –0 [s] (I^3t protection type)
$t = 80 \times t_R / \{ (i/I_R)^4 - 1 \}$ ±20% +0.15 –0 [s] (I^4t protection type)

(I_R : Long time delay or N-phase protection trip pickup current setting, i: Overcurrent value, t_R: Time setting)

④ NON setting disables protective functions. If the short time delay trip function and the instantaneous trip (or MCR) function are both attempted to be set to NON, however, the fail-safe operates so that:
• When the short time delay trip function has been set to NON, the instantaneous trip function cannot be set to NON or MCR.
• When the instantaneous trip function has been set to NON or MCR, the short time delay trip function cannot be set to NON.
⑤ The short time delay trip function has precedence over the long time delay trip function. The OCR operates at the short time delay trip timing even in those current ranges in which the long time delay trip time setting is shorter than the short time delay time setting.
⑥ If DC24V zone interlock power is not provided between 33 and 34, the zone interlock is inoperative and the short time delay trip function works with a total clearing time of 50 ms or less when a fault current is detected.
⑦ Fig. 38 shows the operating characteristic at I^2 ON and I^2 OFF. When I^2t is ON, the OCR operates at fixed trip pickup current of 1000% of [I_n]. (100% of [I_{CT}] for ground fault trip)
⑧ The ground fault trip pickup current setting should not exceed 1200A.
⑨ "TRIP" means the breaker is tripped open and operation indication is provided, "AL" means the breaker is not tripped and only operation indication is provided, and "OFF" means the breaker is not tripped open and no operation indication is provided.
⑩ The operating time (t) at a negative-phase sequence protection trip pickup current setting is given by

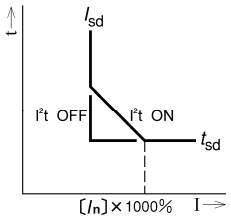
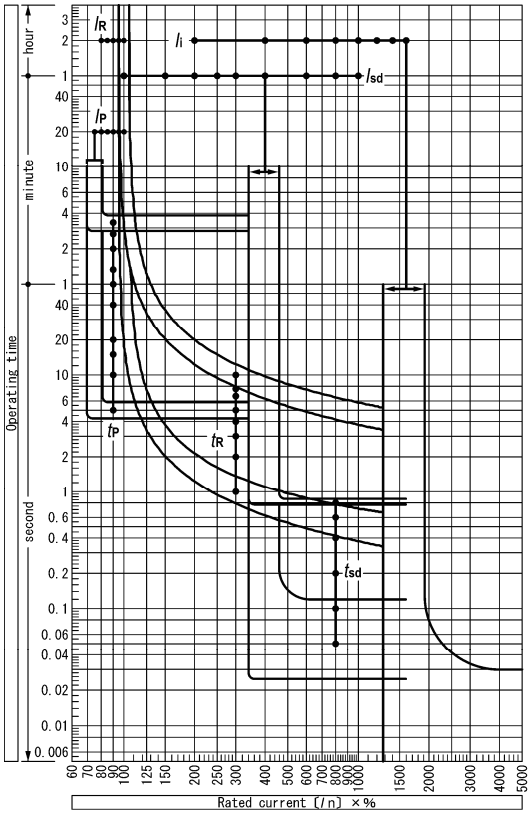


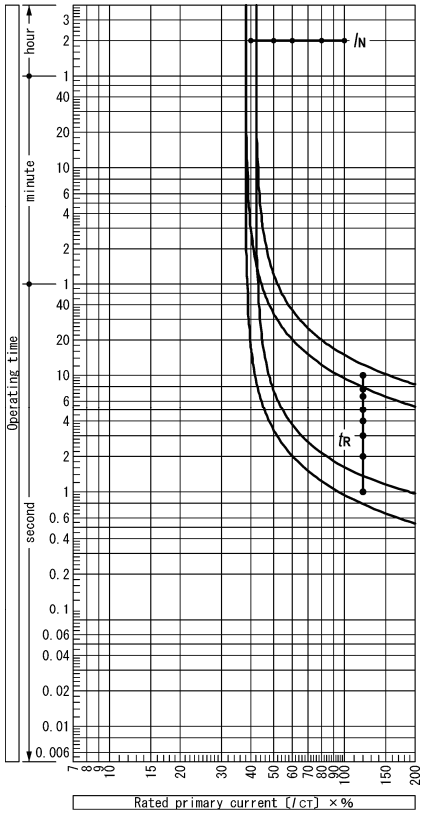
Fig. 38 I^2t characteristic

$t = 1.5 \times t_{NS} \times I_{NS}/i$ ±20% +0.15 –0 [s]

(I_{NS} : Negative-phase sequence protection trip pickup current setting, i: Overcurrent value, t_{NS}: Time setting)
(i is fixed to 3 × I_{NS} when i > 3 × I_{NS})

⑪ Activated only when the fault point is within the zone covered by the breaker.
⑫ "AL" means operation indication is provided and "OFF" means no operation indication is provided.
⑬ Provides an alarm and delivers contact output when the voltage of the main circuit decreases to the voltage setting or lower for longer than the time setting. The alarm ceases when the main circuit voltage returns to the recovery voltage or higher.
⑭ When this capability is used in conjunction with the undervoltage trip device (UVT), an alarm may be provided after tripping operation of the breaker depending on the voltage setting.
⑮ The undervoltage alarm capability does not work if the main circuit voltage is originally under the recovery voltage.

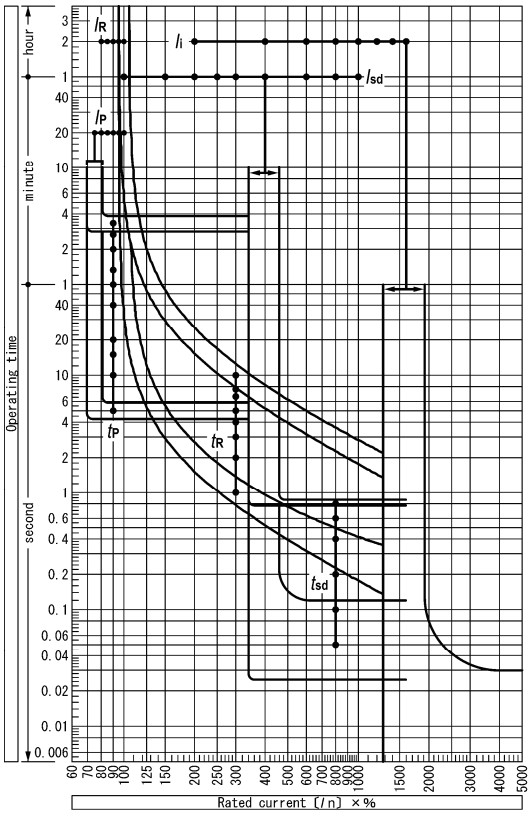


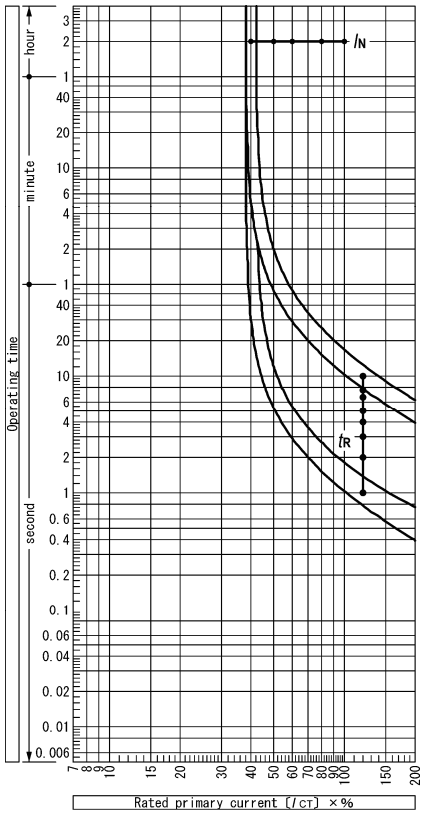


Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm

N-phase protection

Fig. 39 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of $I^{0.02}t$ protection type)

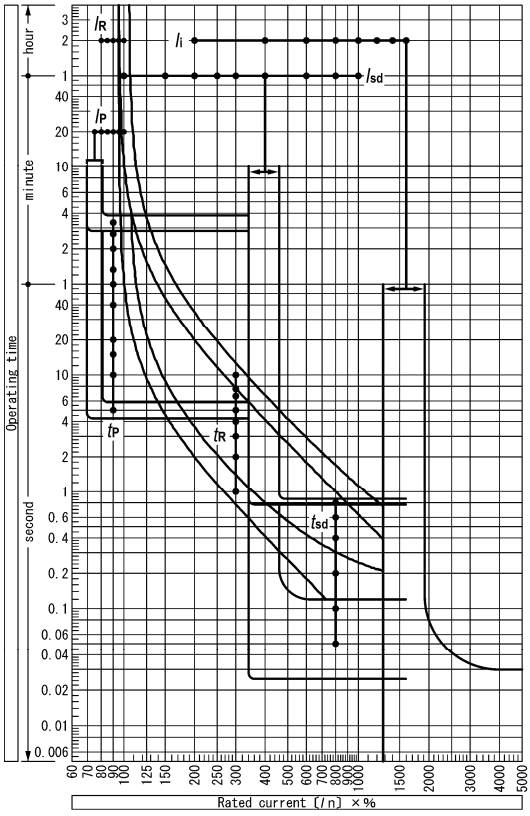




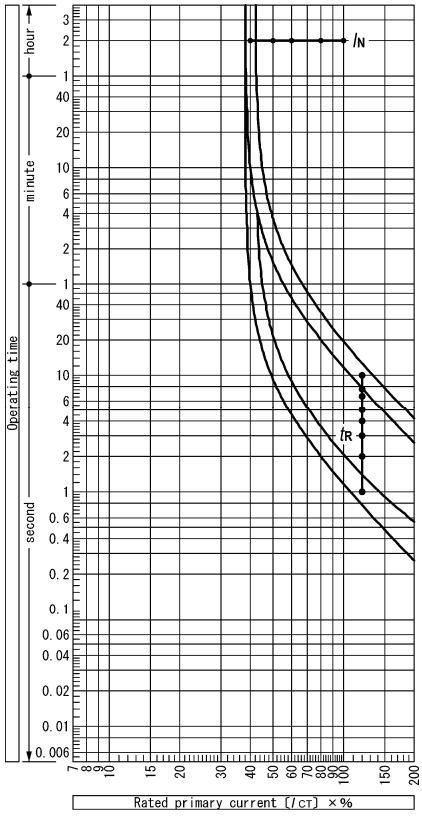
Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm

N-phase protection

Fig. 40 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of It protection type)

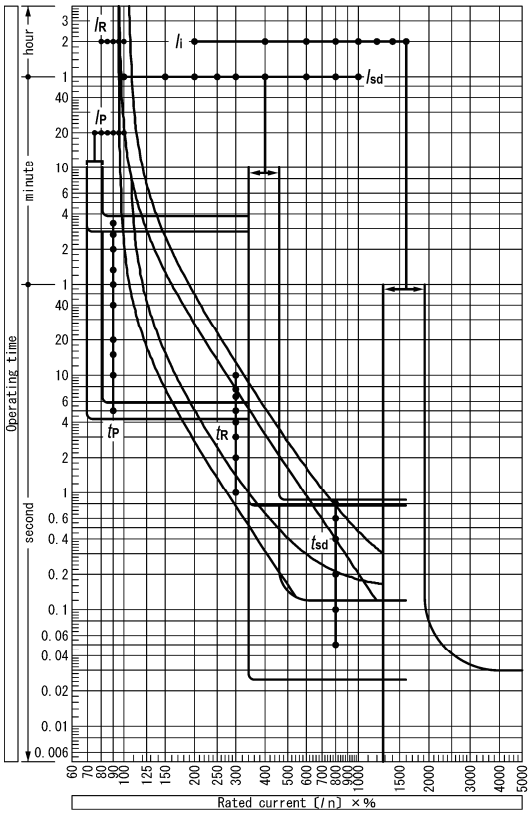


Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm

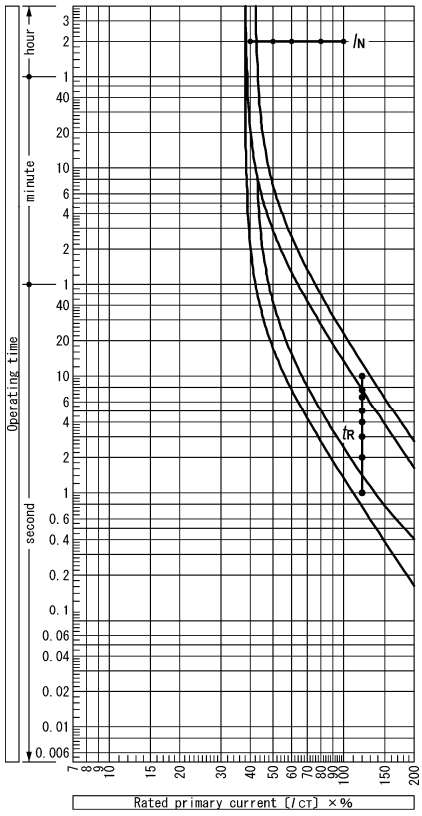


N-phase protection

Fig. 41 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of I^2t protection type)

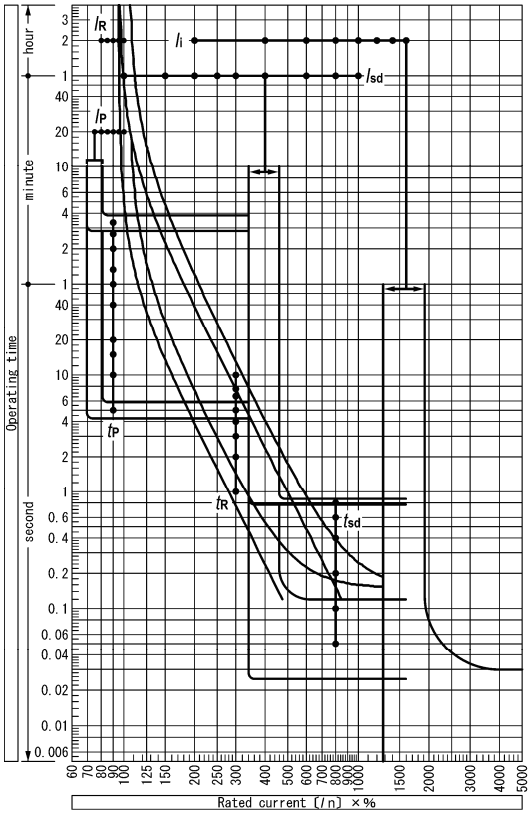


Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm

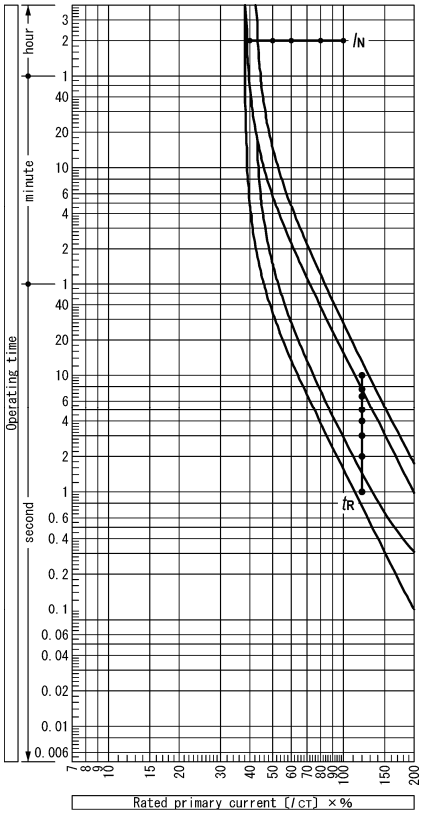


N-phase protection

Fig. 42 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of I^3t protection type)

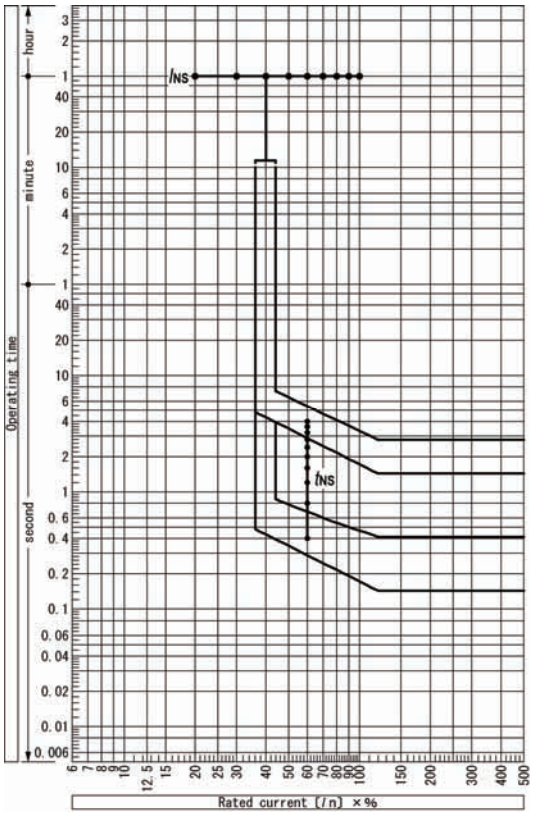


Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm

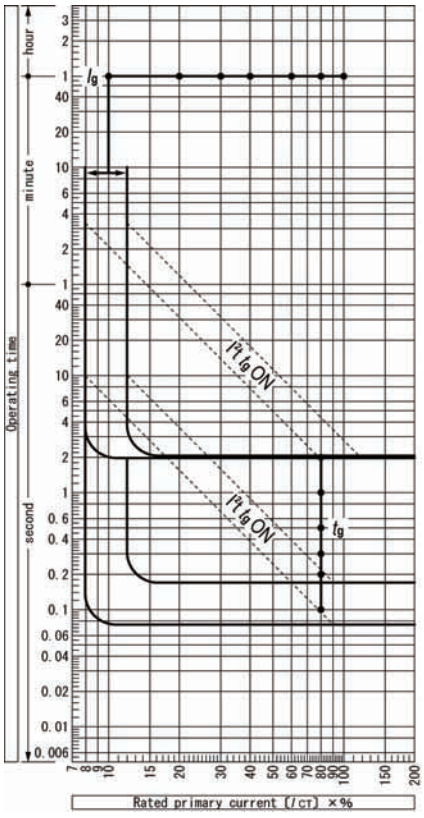


N-phase protection

Fig. 43 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of I^4t protection type)



Negative-phase sequence protection



Ground fault trip

Fig. 44 Characteristic curves of type AGR-21BR,31BR OCR (with R characteristic of common protection type)

5-2-3. S characteristic for generator protection

Characteristic settings and characteristic curves of the type AGR-21BS/22BS/31BS OCR (with S characteristic) are shown in Table 25 and Figs. 45 and 46 respectively.

Table. 25 Characteristic settings of type AGR-21BS,22BS,31BS OCR (with S characteristic)

Setting item		Symbol	Setting range ①						
Rated current ②		I_n	CT rated primary current [I_{CT}] × (0.5 to 1.0) (A): Fixed to a single point						
Long time delay trip (LT) ③	Current setting (continuous energization)	I_R	[I_n] × (0.8-1.0-1.05-1.1-<u>1.15</u>-NON) (A), Tolerance: ±5% ④						
	Time setting	t_R	(15-<u>20</u>-25-30-40-50-60) (s) at 120% of [I_R], Tolerance: ±15%, +0.15 s –0 s						
Short time delay trip (ST) ⑤	Current setting	I_{sd}	[I_n] x (<u>2</u>-2.5-2.7-3-3.5-4-4.5-5-NON) (A), Tolerance: ±10% ④						
	Time setting ⑥	t_{sd}	Relaying time (ms.)	100	<u>200</u>	300	400	600	800
		–	Resettable time (ms.)	75	175	275	375	575	775
			Max. total clearing time (ms.)	170	270	370	470	670	870
	I^2t protection type	I^2t t_{sd}	<u>OFF</u>/ON ⑦						
Instantaneous trip (INST/MCR)	Current setting	I_i	[I_n] × (2-4-6-8-10-12-14-<u>16</u>-NON) (A), Tolerance: ±20% ④						
	INST/MCR		<u>INST</u>/MCR						
Reverse power trip (RPT) ⑧	Power setting	P_R	[P_n] × (<u>0.04</u>-0.05-0.06-0.07-0.08-0.09-0.1-NON) (kW), Tolerance: +0% -20% ④						
	Time setting	–	(2.5-<u>5</u>-7.5-10-12.5-15-17.5-20) (s) at 100% of [P_R], Tolerance: ±20% +0.15s –0 s						
	Polarity	–	<u>NOR</u>/REV ⑨						
	Mode	–	<u>TRIP</u>/AL/OFF ⑩						
Contact overheat monitoring (OH)	Temperature setting	–	155°C						
	Time setting	–	Instantaneous						
	Mode	–	<u>TRIP</u>/AL/OFF ⑩						
Zone interlock (Z) ⑪	Current setting	–	Short time delay trip and/or ground fault trip pickup current						
	Time setting	–	50 ms. or less						
Pretrip alarm (PTA)	Current setting	I_{P1}	[I_n] × (0.75-0.8-0.85-0.9-<u>0.95</u>-1.0-1.05) (A) , Tolerance: ±5%						
	Time setting	t_{P1}	(10-15-20-25-<u>30</u>) (s) at 120% of [I_{P1}], Tolerance: ±15%, +0.1s –0 s						
	Mode	–	<u>AL</u>/OFF ⑫						
Pretrip alarm (PTA2)	Current setting	I_{P2}	[I_n] × (0.75-0.8-0.85-0.9-<u>0.95</u>-1.0-1.05) (A), Tolerance: ±5%						
	Time setting	t_{P2}	(1.5 x t_{P1}) (s) at 120% of [I_{P2}], Tolerance: ±15%, +0.1s –0 s						
	Mode	–	<u>AL</u>/OFF ⑫						
Undervoltage alarm ⑬⑭	Voltage setting	–	[V_n] × (0.4-<u>0.6</u>-0.8) (V), Tolerance: ±5%						
	Time setting	–	(0.1-0.5-<u>1</u>-2-5-10-15-20-30-36) (s) at voltage setting or less, Tolerance: ±15%, +0.1s –0s						
	Recovery voltage setting ⑮	–	[V_n] x (0.8-<u>0.85</u>-0.9-0.95) (V), Tolerance: ±5%						
	Mode	–	<u>AL</u>/OFF ⑫						

① Underlined values are default settings.
② Cannot be changed by the user.
③ The operating time (t) at a long time delay trip (or pretrip alarm) pickup current setting is given by

$t = 1.44 \times t_R \times (I_R/i)^2$ ±15% +0.15 –0 [s]
(I_R : Long time delay trip or pretrip alarm pickup current setting, i: Overcurrent value, t_R: Time setting)

④ NON setting disables protective functions. If the short time delay trip function and the instantaneous trip (or MCR) function are both attempted to be set to NON, however, the fail-safe operates so that:
- When the short time delay trip function has been set to NON, the instantaneous trip function cannot be set to NON or MCR.
- When the instantaneous trip function has been set to NON or MCR, the short time delay trip function cannot be set to NON.

⑤ The short time delay trip function has precedence over the long time delay trip function. The OCR operates at the short time delay trip timing even in those current ranges in which the long time delay trip time setting is shorter than the short time delay time setting.
⑥ If DC24V zone interlock power is not provided between 33 and 34, the zone interlock is inoperative and the short time delay trip function works with a total clearing time of 50 ms or less when a fault current is detected.
⑦ Fig. 45 shows the operating characteristic at I^2t ON and I^2t OFF. When I^2t is ON, the OCR operates at fixed trip pickup current of 500% of [I_n].
⑧ The operating time (t) at a reverse power trip pickup current setting is given by

$t = 0.429 \times t_{RP} / \{ (P/0.7P_R) -1 \}$ ±20% [s]
(P_R: Reverse power trip pickup current setting, P: Reverse power value, t_{RP}: Time setting)

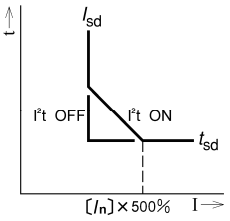
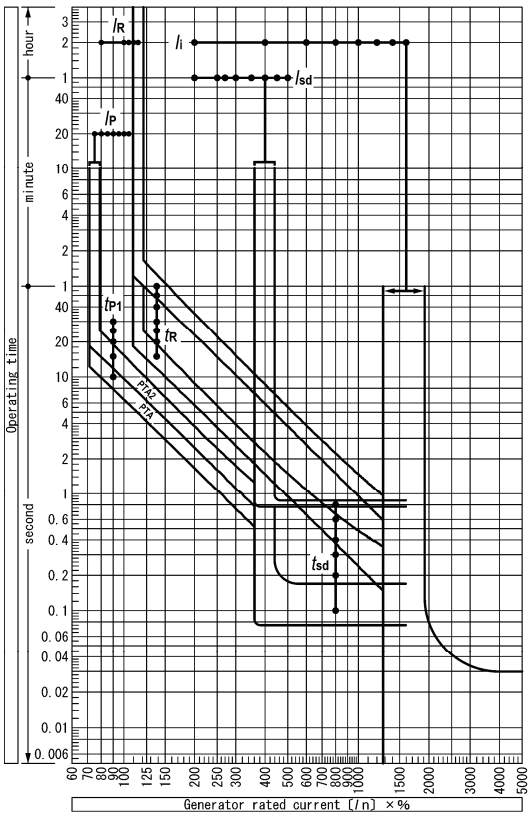
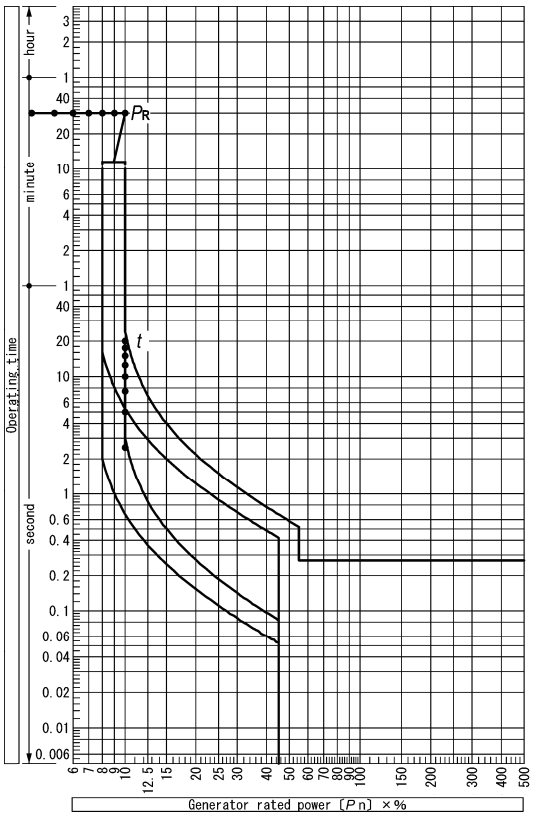


Fig. 45 I^2t characteristic

⑨ Select NOR when the power supply of the load is upstream of the breaker and REV when it is downstream of the breaker. (See 5-3-2-4).
⑩ "TRIP" means the breaker is tripped open and operation indication is provided, "AL" means the breaker is not tripped and only operation indication is provided, and "OFF" means the breaker is not tripped open and no operation indication is provided.
⑪ Activated only when the fault point is within the zone covered by the breaker.
⑫ "AL" means operation indication is provided and "OFF" means no operation indication is provided.
⑬ Provides an alarm and delivers contact output when the voltage of the main circuit decreases to the voltage setting or lower for longer than the time setting. The alarm ceases when the main circuit voltage returns to the recovery voltage or higher.
⑭ When this capability is used in conjunction with the undervoltage trip device (UVT), an alarm may be provided after tripping operation of the breaker depending on the voltage setting.
⑮ The undervoltage alarm capability does not work if the main circuit voltage is originally under the recovery voltage.



Long time delay trip, short time delay trip, instantaneous trip and pretrip alarm



Reverse power trip

Fig. 46 Characteristic settings of type AGR-21BS/22BS/31BS OCR (with S characteristic)

5-3. OCR Setting Procedure

5-3-1. OCR Setting Procedure (AGR-11B type)

⚠ CAUTION

- OCR field tests and setting changes must be performed by competent persons.
- After setting changes are made, the settings be checked with e.g., a type ANU-1 OCR checker (optional).
- After completion of OCR tests, be sure to return the settings to the original values. Failure to do so may cause a fire or burnout.
- Before changing OCR settings, open the ACB and then lock the OFF button to prevent the ACB from being closed inadvertently.
- Use a small flatblade screwdriver with a torque of not more than 0.1 N•m or a force of not more than 0.1 N when adjusting the setting switches (rotary step switches or slide switches). An excessive torque or force may cause a malfunction.

The following describes how to set the OCR.

1) Open the ACB.

2) Push the right end of the OCR cover to the left at the hollow on the front cover to unlatch and open the OCR cover. See Fig. 47. If the OCR cover is padlocked, first remove the padlock.

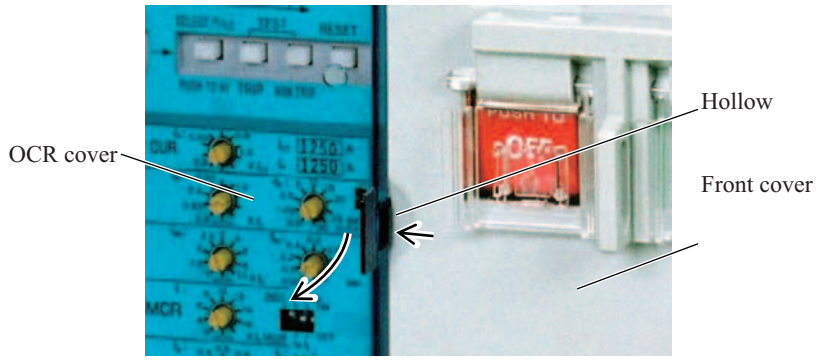


Fig. 47 OCR cover

3) Use rotary step switches and slide switches to set the OCR. See Fig. 48.

- Rotary step switches must be adjusted with a small flatblade screwdriver. Turn switch knobs stepwise and do not stop the knobs halfway between calibration markings. A bold line on a switch dial means the same settings.
- Slide switches must also be adjusted with a small flatblade screwdriver. Do not stop switch knobs halfway.

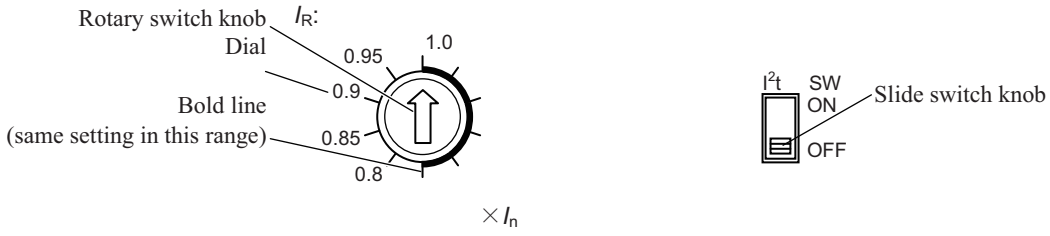


Fig. 48 OCR characteristic setting switches

4) Close the OCR cover.

5) After setting changes are made, it is recommended that the settings be checked with e.g., a type ANU-1 OCR checker (optional).

5-3-2. OCR Setting Procedure (AGR-21B,22B,31B type)

⚠ CAUTION

- OCR field tests and setting changes must be performed by competent persons.
- After setting changes are made, the settings be checked with e.g., a type ANU-1 OCR checker (optional).
- After completion of OCR tests, be sure to return the settings to the original values. Failure to do so may cause a fire or burnout.
- Before changing OCR settings, open the ACB and then lock the OFF button to prevent the ACB from being closed inadvertently.
- Do not push the SET button diagonally. Doing so may cause a poor in return and malfunction.

The following describes how to display measurements and make settings of the OCR.

5-3-2-1. General

1) Push the right end of the OCR cover to the left at the hollow on the front cover to unlatch and open the OCR cover. See Fig. 49. If the OCR cover is padlocked, first remove the padlock.

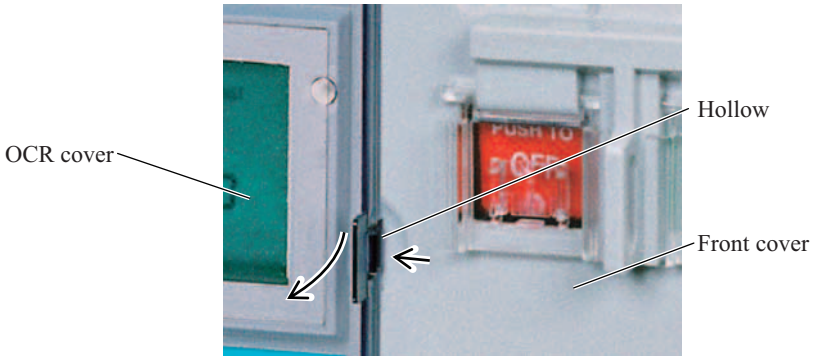
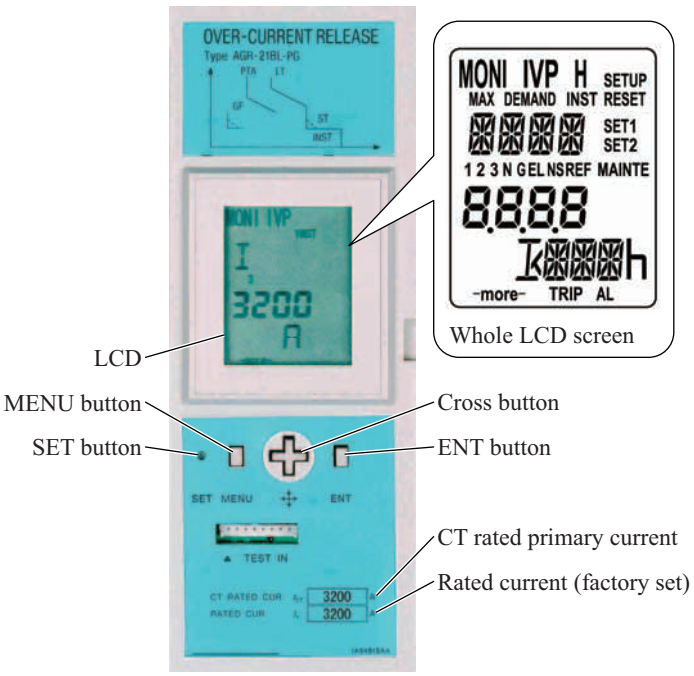


Fig. 49 OCR cover

2) Make sure that control power is supplied. Control power supply is required to display measurements.

3) The MENU, SET, cross and ENT buttons are used to navigate the LCD screen. Fig. 50 provides the general view of the OCR.



Button symbols and their meanings

Ⓢ: Press the SET button using a pointed tool such as the tip of a pen.
Ⓜ: Press the MENU button.
▲: Press the up key of the cross button.
▼: Press the down key of the cross button.
▶: Press the right key of the cross button.
◀: Press the left key of the cross button.
Ⓔ: Press the ENT button.

The button symbols are used in Figs. 51 – 64.

Fig. 50 OCR general view

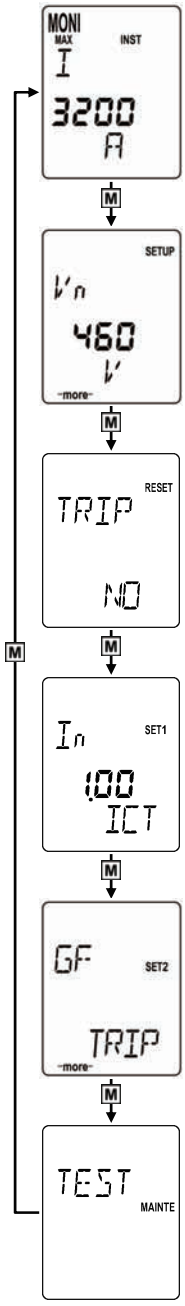
4) Before changing OCR settings, open the ACB and then lock the OFF button to prevent the ACB from being closed inadvertently. Unlock the OFF button after changing OCR settings.

5) Close the OCR cover after viewing measurements or changing settings.

6) After setting changes are made, it is recommended that the settings be checked with e.g., a type ANU-1 OCR checker (optional).

5-3-2-2. Available screens

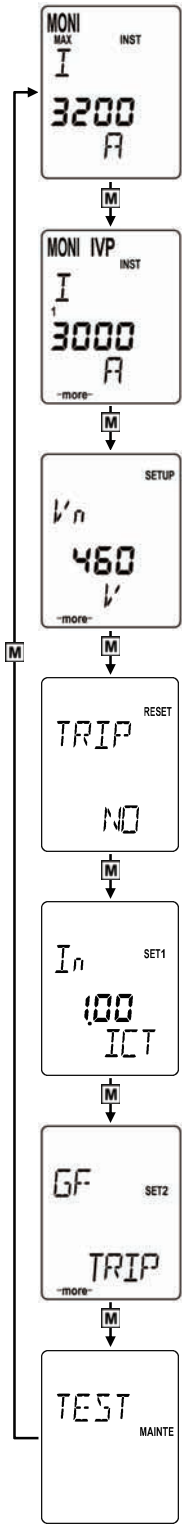
The type AGR-21B/22B OCR has six screens available as shown in Fig. 51 below. Press the MENU button to go to the next screen.



- Monitor screen (MONI): See 5-3-2-3-1.
  This is the initial screen that appears when control power is turned on. Various current values can be viewed on this screen.
- Setup screen (SETUP): See 5-3-2-4-1.
  This screen allows reviewing the rated voltage, CT rated primary current or other specifications and changing settings.
- Reset screen (RESET): See 5-3-2-5-1.
  This screen allows clearing the measured max. current and the trip/alarm event log and resetting trip/alarm operation indication.
- Setting 1 screen (SET1): See 5-3-2-6.
  This screen allows viewing settings relating to long time delay, short time delay, instantaneous and ground fault trip capabilities and changing these settings.
- Setting 2 screen (SET2): See 5-3-2-7.
  This screen allows viewing settings relating to other capabilities than described above and changing these settings.
- Maintenance screen (MAINTE): See 5-3-2-8.
  This screen allows viewing the trip/alarm event log.
- Test screen (MAINTE): See 5-4.
  This screen allows testing the long time delay, short time delay, instantaneous and ground fault trip functions.

Fig. 51 Available screens

The type AGR-31B OCR has seven screens available as shown in Fig. 52 below. Press the MENU button to go to the next screen.



- Monitor 1 screen (MONI): See 5-3-2-3-2

  This is the initial screen that appears when control power is turned on. Various current values can be viewed on this screen.

- Monitor 2 screen (MONI IVP): See 5-3-2-3-3.

  Various current values, line voltage, phase voltage, power, demanded power, electrical energy, power factor and frequency can be viewed on this screen.

- Setup screen (SETUP): See 5-3-2-4-2.

  This screen allows reviewing the rated voltage, CT rated primary current or other specifications and changing settings.

- Reset screen (RESET): See 5-3-2-5-2.

  This screen allows clearing the measured max. current and the trip/alarm event log and resetting trip/alarm operation indication.

- Setting 1 screen (SET1): See 5-3-2-6.

  This screen allows viewing settings relating to long time delay, short time delay, instantaneous and ground fault trip capabilities and changing these settings.

- Setting 2 screen (SET2): See 5-3-2-7.

  This screen allows viewing settings relating to other capabilities than described above and changing these settings.

- Maintenance screen (MAINTE): See 5-3-2-8.

  This screen allows viewing the trip/alarm event log.

- Test screen (MAINTE): See 5-4.

  This screen allows testing the long time delay, short time delay, instantaneous and ground fault trip functions.

Fig. 52 Available screens

5-3-2-3. Monitor screen

5-3-2-3-1. Monitor screen (AGR-21B,22B)

Fig. 53 shows how to navigate the monitor screen and Table 26 lists the items that can be viewed on this screen.

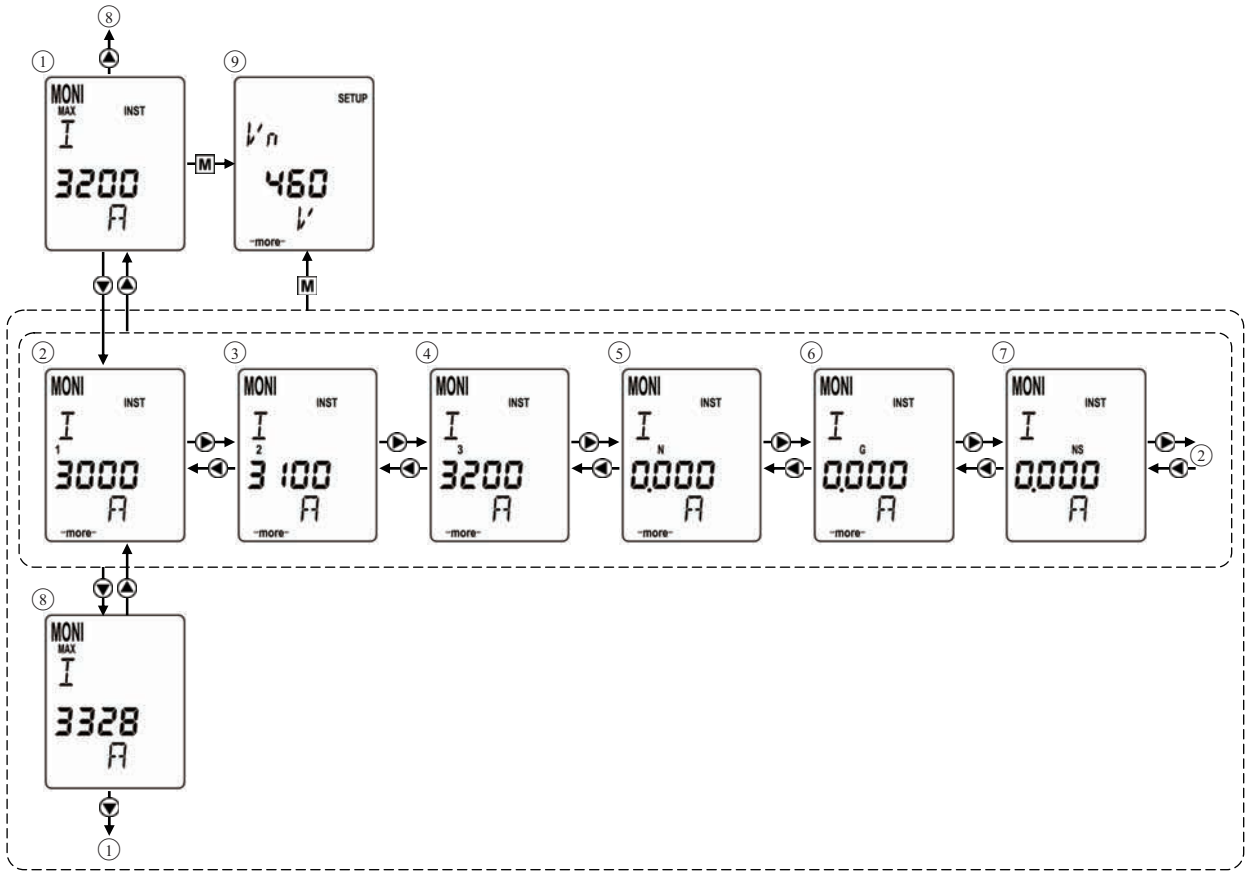


Fig. 53 Monitor screen navigation

Table 26 Monitor subscreens

No.	Subscreen item *1	Description	Tolerance
①	Max. phase current (present value)	Initial display	For type AGR-21B OCR: ±2.5% of CT rated primary current [I_{CT}] Reading will be "0" when < 5% of CT rated primary current [I_{CT}]. For type AGR-22B OCR: ±1.5% of CT rated primary current [I_{CT}] Reading will be "0" when < 1.5% of CT rated primary current [I_{CT}].
②	First phase (R/A-phase) current (present value)	–	
③	Second phase (S/B-phase) current (present value)	–	
④	Third phase (T/C-phase) current (present value)	–	
⑤	Neutral (N-phase) current (present value)	Displayed when THE ACB is of 4-pole type	
⑥	Ground fault current (present value)	Displayed only when THE ACB is equipped with the ground fault trip function	
⑦	Negative-phase current (present value)	Displayed only when THE ACB is equipped with the negative-phase sequence protective function	
⑧	Max. phase current	–	
⑨	(Setup screen)	See 5-3-2-4-1.	–

*1 If no value is found for an item, the corresponding subscreen is skipped.

5-3-2-3-2. Monitor 1 screen (AGR-31B)

Fig. 54 shows how to navigate the monitor 1 screen and Table 27 lists the items that can be viewed on this screen.

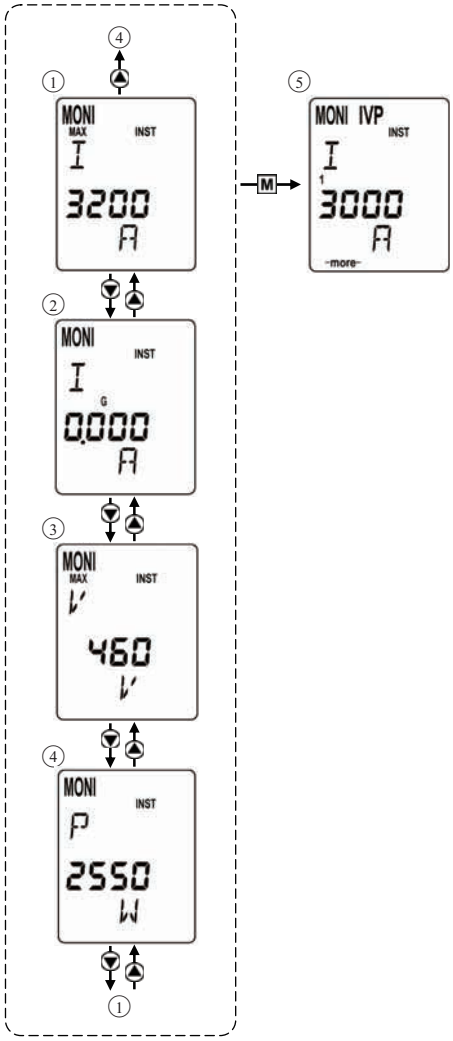


Fig. 54 Monitor 1 screen navigation

Table 27 Monitor 1 subscreens

No.	Subscreen item *1	Description	Tolerance
①	Max. phase current (present value)	Initial display	±1.5% of CT rated primary current [I_{CT}] Reading will be "0" when < 1.5% of CT rated primary current [I_{CT}].
②	Ground fault current (present value)	Displayed only when THE ACB is equipped with the ground fault trip function	
③	Max. phase current	–	
④	Power (present value)	—	
⑤	(Monitor 2 screen)	See 5-3-2-3-3.	

*1: If no value is found for an item, the corresponding subscreen is skipped.

5-3-2-3-3. Monitor 2 screen (AGR-31B)

Fig. 55 shows how to navigate the monitor 2 screen and Table 28 lists the items that can be viewed on this screen.

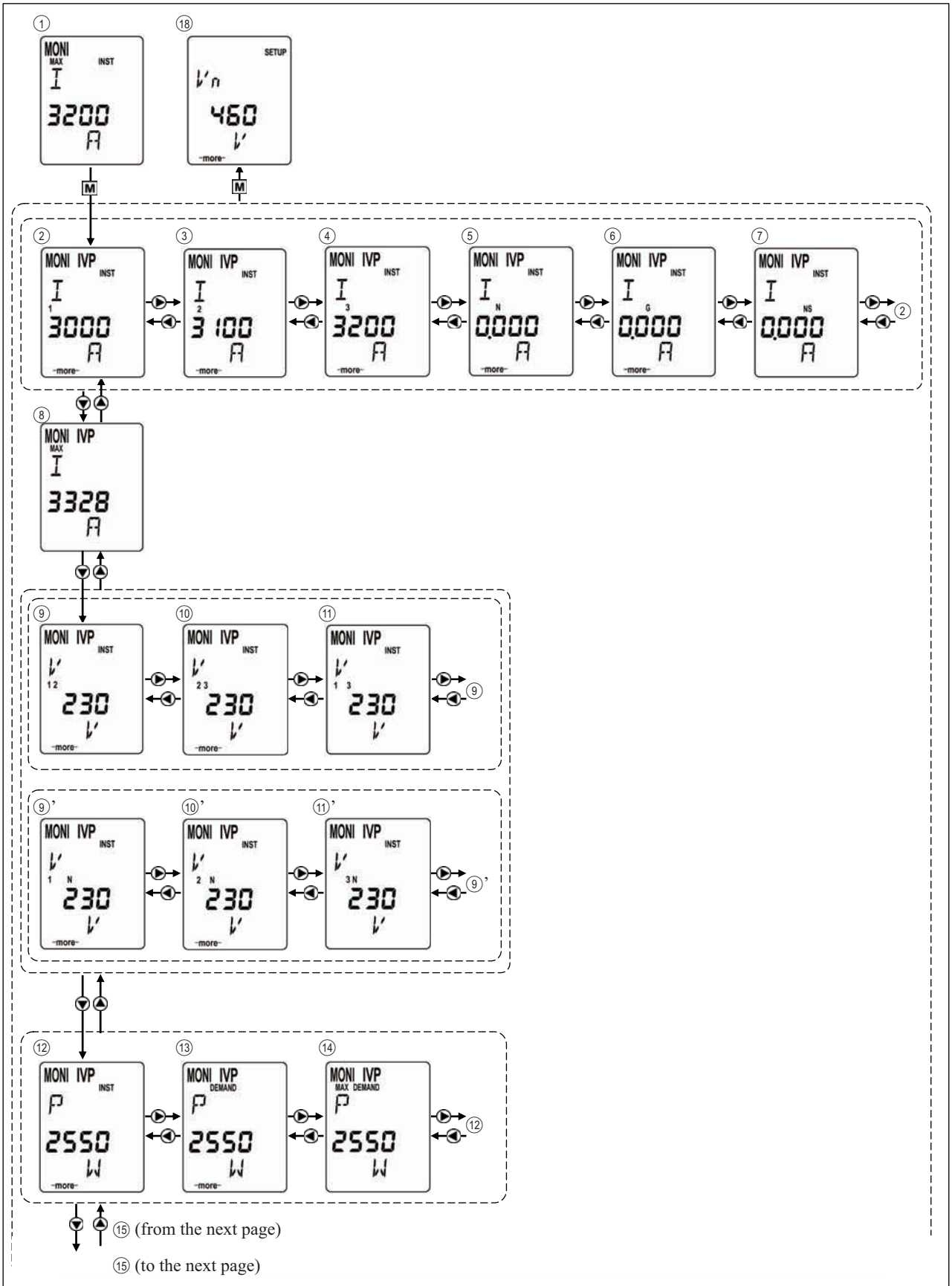


Fig. 55-1 Monitor 2 screen navigation

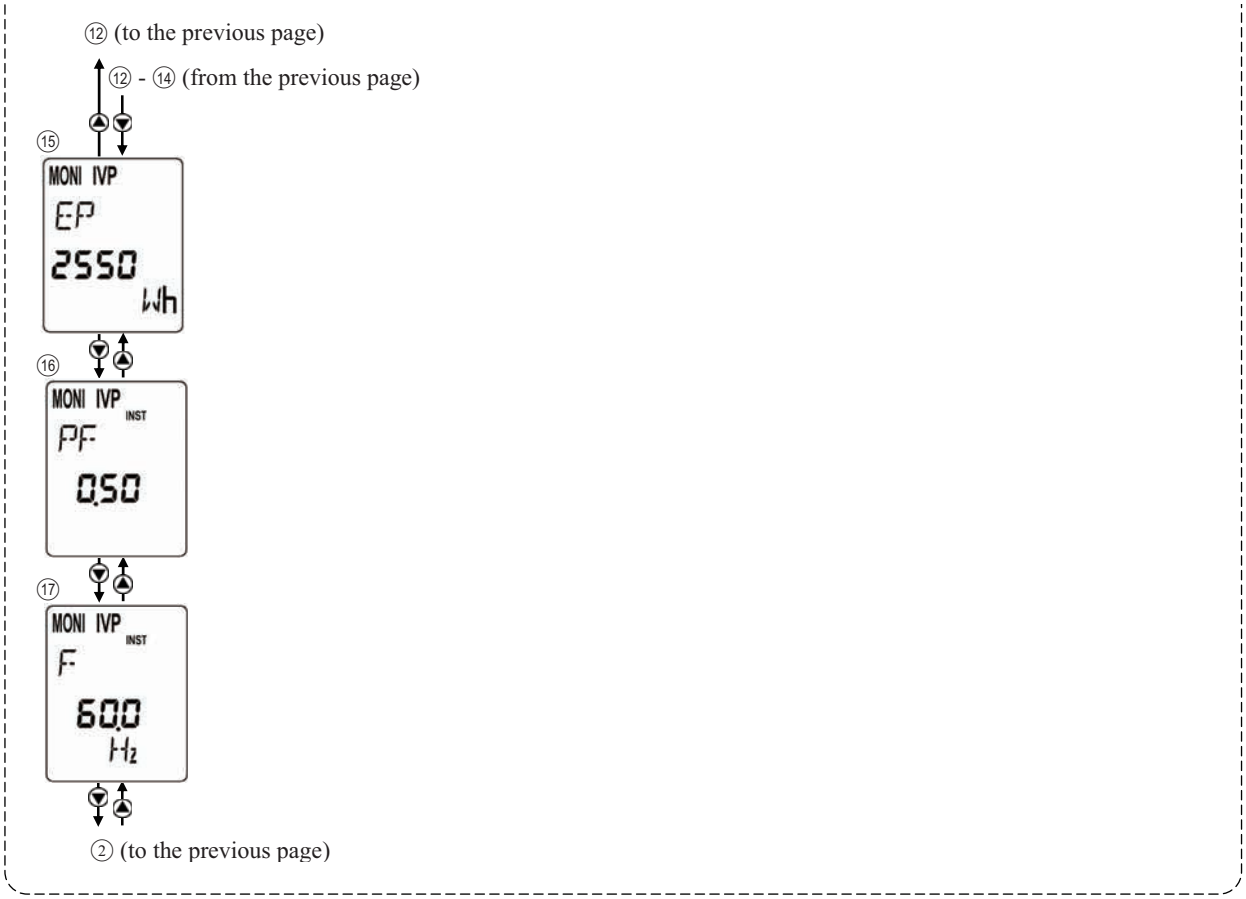


Fig. 55-2 Monitor 2 screen navigation

Table 28 Monitor 2 subscreens

No.	Subscreen item *1	Description	Tolerance
①	(Monitor 1 screen)	See 5-3-2-3-2.	±1.5% of CT rated primary current [I_{CT}] Reading will be "0" when < 1.5% of CT rated primary current [I_{CT}].
②	First phase (R/A-phase) current (present value)	–	
③	Second phase (S/B-phase) current (present value)	–	
④	Third phase (T/C-phase) current (present value)	–	
⑤	Neutral (N-phase) current (present value)	Displayed when the ACB is of 4-pole type	
⑥	Ground fault current (present value)	Displayed only when the ACB is equipped with the ground fault trip function	
⑦	Negative-phase current (present value)	Displayed only when the ACB is equipped with the negative-phase sequence protective function	
⑧	Max. phase current	–	
⑨	Line voltage between first and second phases (R and S-phases, A and B-phases)	Displayed when the ACB is of single phase 3-wire or 3-phase 3/4-wire type capable of line voltage indication	
⑩	Line voltage between second and third phases (S and T-phases, B and C-phases)		
⑪	Line voltage between thrid and first phases (T and R-phases, C and A-phases)		
⑨'	Phase voltage between first (R/A) and neutral (N) phases	Displayed when ACB is of 3-pahse 4-wire type capable of phase voltage indication	
⑩'	Phase voltage between second (S/B) and neutral (N) phases		
⑪'	Phase voltage between third (T/C) and neutral (N) phases		
⑫	Power	–	
⑬	Demanded power	–	
⑭	Max. demanded power	–	
⑮	Electrical energy	–	
⑯	Power factor	–	
⑰	Frequency	–	
⑱	(Setup screen)	See 5-3-2-4-2.	

*1: If no value is found for an item, the corresponding subscreen is skipped.

5-3-2-4. Setup screen

5-3-2-4-1. Setup screen (AGR-21B,22B)

Fig. 56 shows how to navigate the setup screen and Table 29 lists the items that can be viewed on this screen.

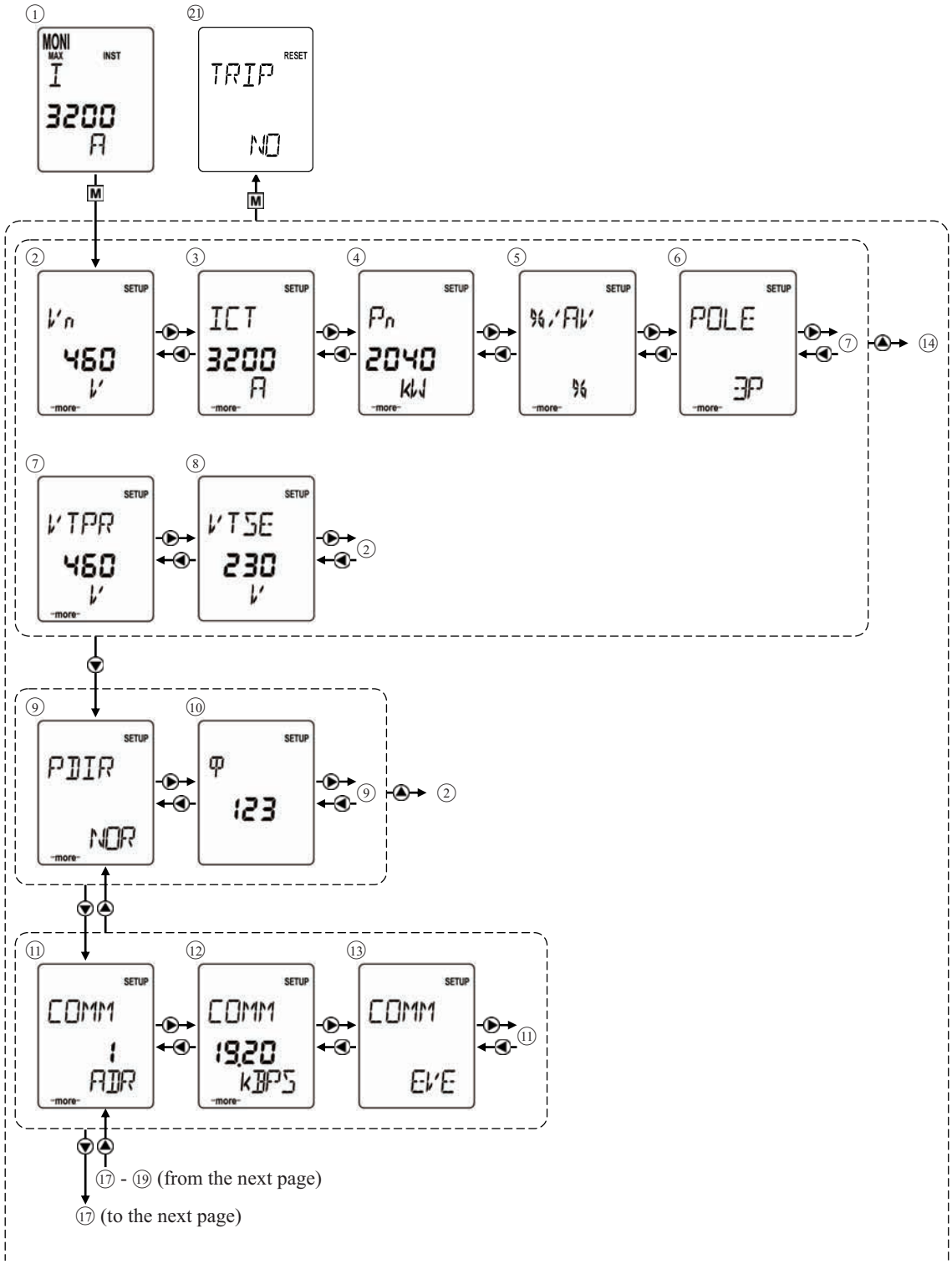


Fig. 56-1 Setup screen navigation

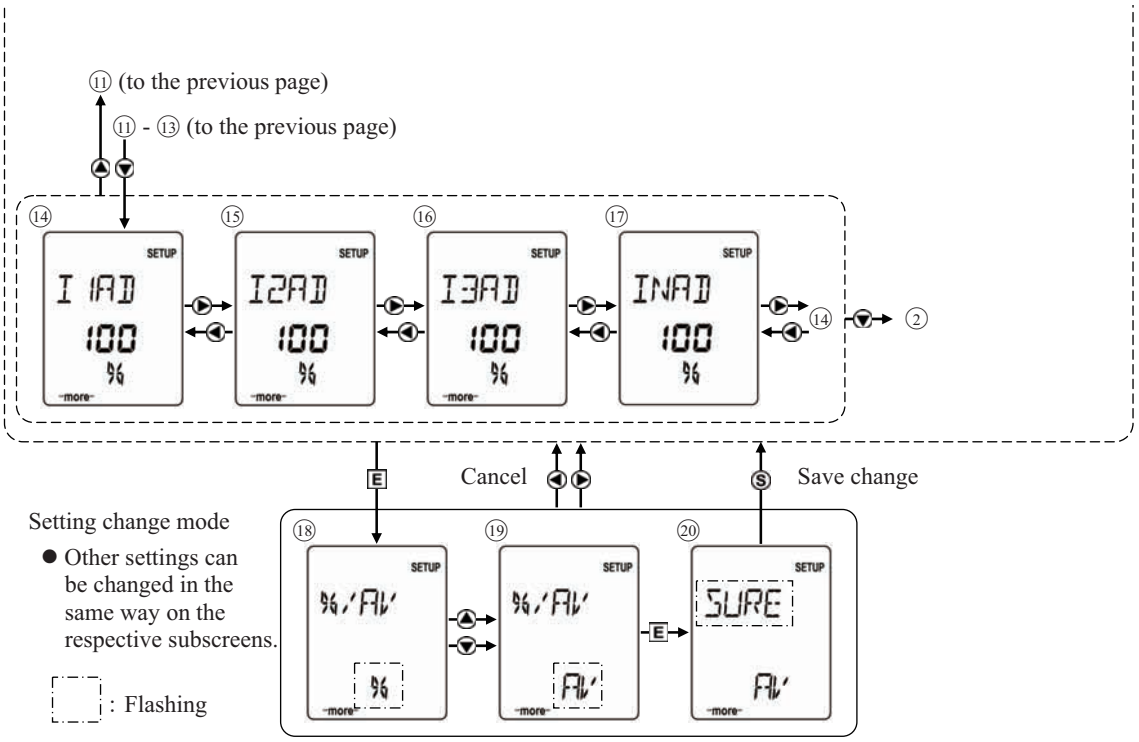


Fig. 56-2 Setup screen navigation

Table 29 Setup subscreens

No.	Subscreen item *1	Setting change	Setting range/Remarks *2
①	(Monitor screen)	–	See 5-3-2-3-1.
②	Main circuit rated voltage	Disabled	Fixed *3
③	CT rated primary current	Disabled	Fixed *3
④	Main circuit rated power	Disabled	Fixed *3 *8
⑤	Trip/alarm pickup settings	Enabled	% - AV (%: Percentage of setting reference, AV: Actual current (A.kA)/voltage (V)/power (W / kW) value)
⑥	Number of poles	Disabled	Fixed *3
⑦	PT (potential transformer) primary current	Disabled	Fixed (displayed only when THE ACB is equipped with the reverse power trip function and the main circuit voltage exceeds 250V) *3
⑧	PT (potential transformer) secondary current	Disabled	Fixed (displayed only when THE ACB is equipped with the reverse power trip function and the main circuit voltage exceeds 250V) *3
⑨	Polarity	Enabled	NOR-REV (NOR: Normal connection, REV: Reverse connection) Select NOR when the power supply of the load is upstream of the breaker and REV when it is downstream of the breaker. *8
⑩	Phase sequence	Enabled	123-321 (123 means RST (ABC) and 321 does TSR (CBA) from left to right, as seen from the front of the ACB)
⑪	Transmission address	Enabled	01-02-…-31 (31 addresses) *4 *5
⑫	Transmission rate	Enabled	4800/9600/19200 baud
⑬	Parity	Enabled	EVE-ODD-NON
⑭	Current adjustment, 1st phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑮	Current adjustment, 2nd phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑯	Current adjustment, 3rd phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑰	Current adjustment, Nth phase	Enabled	97-98-99-100-101-102-103 (%) (Equipped on 4-pole ACBs) *6 *7
⑱	Setting change mode "Start"	–	Press ENTER to enter this subscreen from a setup subscreen. The value that can be changed will flash. To exit this subscreen, press the right or left key of the cross button.
⑲	Setting change mode "Setting change"	–	Press the up or down key of the cross button to change the setting. To exit this subscreen with no change in setting, press the right or left key of the cross button.
⑳	Setting change mode "Save change"	–	Press ENTER to enter this subscreen from subscreen ⑲. "SURE" will be flashing. To save the change, press SET. The subscreen will exit to the Reset screen. To exit this subscreen while no change is saved, press the right or left key of the cross button.
㉑	(Reset screen)	–	See 5-3-2-5-1.

*1 If no value is found for an item, the corresponding subscreen is skipped.
*2 Underlined values are default settings.
*3 Factory set according to your request.
*4 The setting procedure is somewhat different from ⑱ – ⑳. Press ENT while subscreen ⑪ is displayed. The ten's digit of the communication address will flash. Use the up or down key of the cross button to change the digit. After changing the ten's digit, press ENT again. The unit's digit of the communication address will flash. Use the up or down key of the cross button to change the digit. After changing the unit's digit, press ENT. "SURE" will start flashing. See the description of subscreen ⑳.
*5 If a communication address other than 01 to 31 is entered and SET is pressed, the address setting will not change; the ten's digit of the communication address will flash, then the OCR returns to setting change mode.
*6 Factory set before delivery.
*7 These subscreens are for making corrections to avoid variation in measurement. Settings on the subscreens have no influence upon trip/alarm pickup current values.
*8 Only for the AGR-22BS-PR,this item is indicated.

5-3-2-4-2. Setup screen(AGR-31B)

Fig. 57 shows how to navigate the setup screen and Table 30 lists the items that can be viewed on this screen.

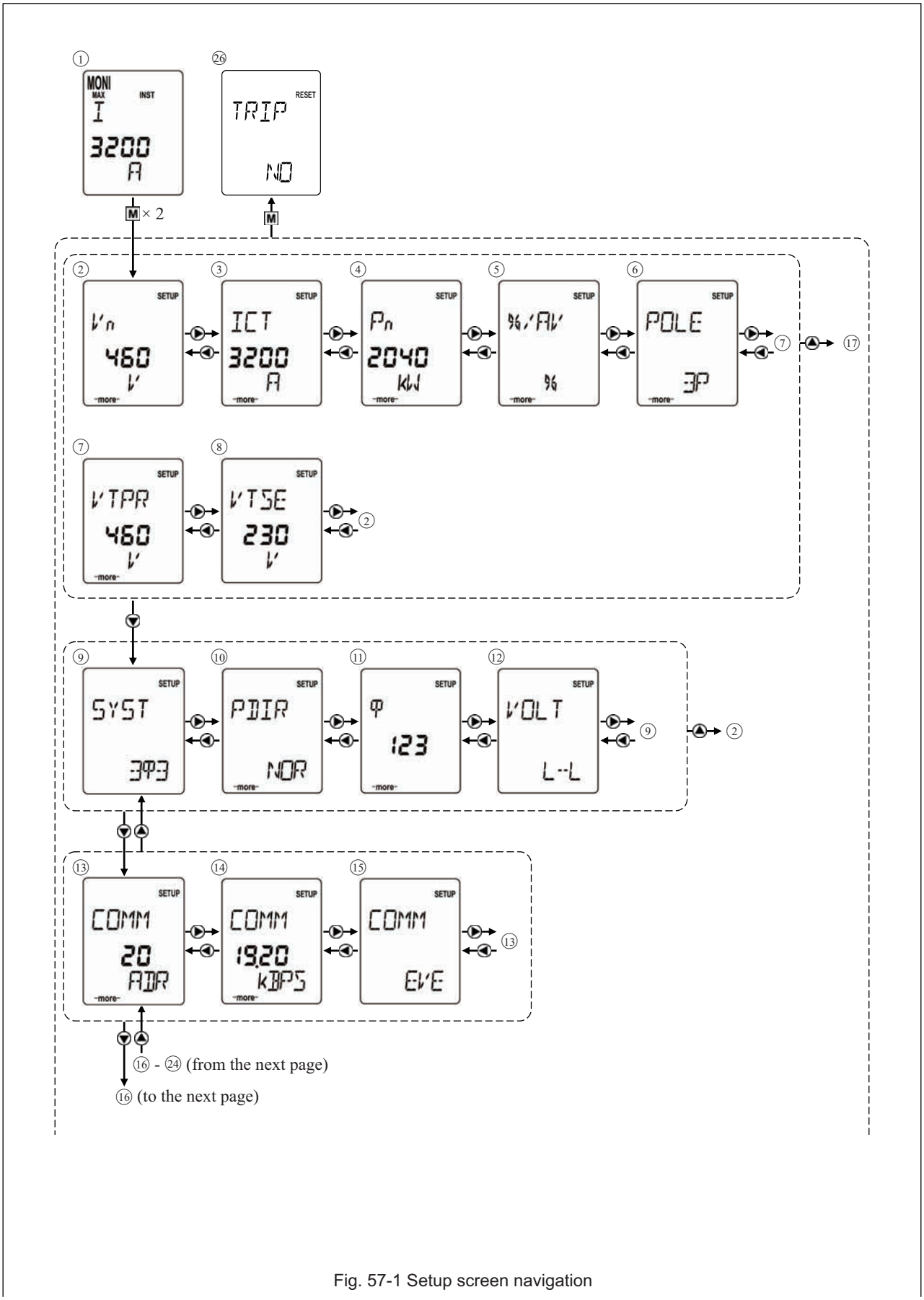


Fig. 57-1 Setup screen navigation

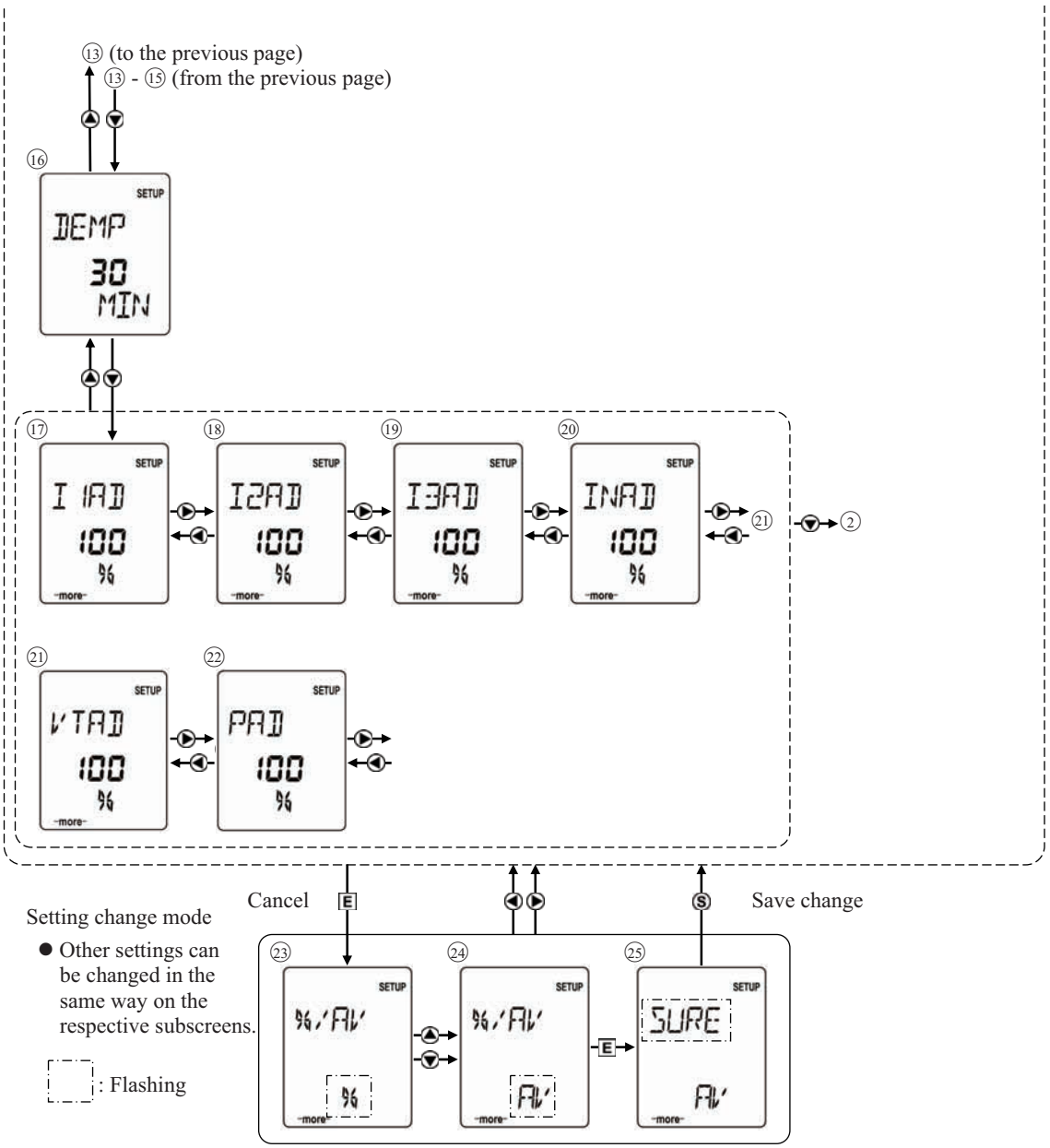


Fig. 57-2 Setup screen navigation

Table 30 Setup subscreens

No.	Subscreen item *1	Setting change	Setting range/Remarks *2
①	(Monitor 1 screen)	–	See 5-3-2-3-2.
②	Main circuit rated voltage	Disabled	Fixed *3
③	CT rated primary current	Disabled	Fixed *3
④	Main circuit rated power	Disabled	Determined (calculated with main circuit rated voltage and rated current [*In*]) Fixed *3 (for OCR type AGR-31BS-PR)
⑤	Trip/alarm pickup settings	Enabled	% - AV (%: Percentage of setting reference, AV: Actual current (A/kA)/voltage (V)/power (W / kW) value)
⑥	Number of poles	Disabled	Fixed *3
⑦	PT (potential transformer) primary current	Disabled	Fixed (displayed only when THE ACB is equipped with the reverse power trip function and the main circuit voltage exceeds 250V) *3
⑧	PT (potential transformer) secondary current	Disabled	Fixed (displayed only when THE ACB is equipped with the reverse power trip function and the main circuit voltage exceeds 250V) *3
⑨	Phase wiring scheme	Enabled	1φ3-3φ3-3φ4
⑩	Polarity	Enabled	NOR-REV (NOR: Normal connection, REV: Reverse connection) Select NOR when the power supply of the load is upstream of the breaker and REV when it is downstream of the breaker. (for OCR type AGR-31B)
⑪	Phase sequence	Enabled	123-321 (123 means RST (ABC) and 321 does TSR (CBA) from left to right, as seen from the front of the ACB)
⑫	Voltage indication	Enabled	L-N-L-L
⑬	Transmission address	Enabled	01-02-…-31 (31 addresses) *4 *5
⑭	Transmission rate	Enabled	4800/9600/19200 baud
⑮	Parity	Enabled	EVE-ODD-NON
⑯	Demand interval	Enabled	5-30-60 (MIN)
⑰	Current adjustment, 1st phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑱	Current adjustment, 2nd phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑲	Current adjustment, 3rd phase	Enabled	97-98-99-100-101-102-103(%) *6 *7
⑳	Current adjustment, Nth phase	Enabled	97-98-99-100-101-102-103 (%) (Equipped on 4-pole ACBs) *6 *7
㉑	Voltge ratio adjustment	Enabled	97-98-99-100-101-102-103 (%) *6 *7
㉒	Power adjustment	Enabled	97-98-99-100-101-102-103 (%) *6 *7
㉓	Setting change mode "Start"	–	Press ENTER to enter this subscreen from a setup subscreen. The value that can be changed will flash. To exit this subscreen, press the right or left key of the cross button.
㉔	Setting change mode "Setting change"	–	Press the up or down key of the cross button to change the setting. To exit this subscreen with no change in setting, press the right or left key of the cross button.
㉕	Setting change mode "Save change"	–	Press ENTER to enter this subscreen from subscreen ⑲. "SURE" will be flashing. To save the change, press SET. The subscreen will exit to the Reset screen. To exit this subscreen while no change is saved, press the right or left key of the cross button.
㉖	(Reset screen)	–	See 5-3-2-5-2.

*1: If no value is found for an item, the corresponding subscreen is skipped.
*2: Underlined values are default settings.
*3: Factory set according to your request.
*4: The setting procedure is somewhat different from ㉓ – ㉕. Press ENT while subscreen ⑬ is displayed. The ten's digit of the communication address will flash. Use the up or down key of the cross button to change the digit. After changing the ten's digit, press ENT again. The unit's digit of the communication address will flash. Use the up or down key of the cross button to change the digit. After changing the unit's digit, press ENT. "SURE" will start flashing. See the description of subscreen ㉕. If SET is pressed when the ten's digit is flashing, "SURE" will start flashing, indicating that the current subscreen has exited to subscreen ㉕.
*5: If a communication address other than 01 to 31 is entered and SET is pressed, the address setting will not change; the ten's digit of the communication address will flash, then the OCR returns to setting change mode.
*6: Factory set before delivery.
*7: These subscreens are for making corrections to avoid variation in measurement. Settings on the subscreens have no influence upon trip/alarm pickup current values.

5-3-2-5. Reset screen

5-3-2-5-1. Reset screen (AGR-21B,22B)

Fig. 58 shows how to navigate the reset screen and Table 31 lists the items that can be cleared on this screen. When an item is cleared while its contact output is on, the contact output turns off.

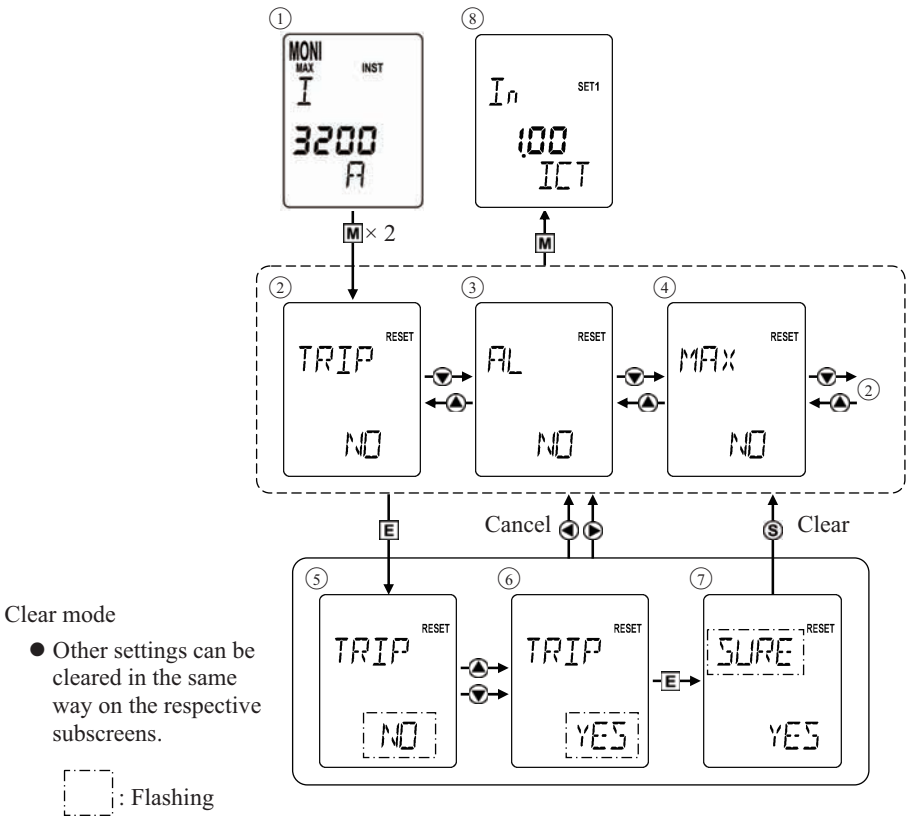


Fig. 58 Reset screen navigation

Table 31 Reset subscreens

No.	Subscreen item	Description
①	(Monitor screen)	See 5-3-2-3-1.
②	Trip event log	Allows clearing the trip event log (trip cause, fault current value and operating time).
③	Alarm event log	Allows clearing the alarm event log (alarm cause, fault current value and operating time).
④	Max. phase current	Allows clearing the max. phase current (see Fig. 58 ⑧).
⑤	Clear mode "Start"	Press ENTER to enter this subscreen from a reset subscreen. "NO" will flash. To exit this subscreen, press the right or left key of the cross button.
⑥	Clear mode "YES"	Press the up or down key of the cross button. "YES" will appear. To exit this subscreen without clearing the item, press the right or left key of the cross button.
⑦	Clear mode "Clear"	This subscreen appears when ENTER is pressed while "YES" is appearing. "SURE" will flash. To clear the item, press SET. The subscreen will exit to the Setting 1 screen. When an items is cleared while its contact output is on, the contact output turns off. To exit this subscreen without clearing the item, press the right or left key of the cross button.
⑧	(Setting 1 screen)	See 5-3-2-6.

5-3-2-5-2. Reset screen(AGR-31B)

Fig. 59 shows how to navigate the reset screen and Table 32 lists the items that can be cleared on this screen. When an item is cleared while its contact output is on, the contact output turns off.

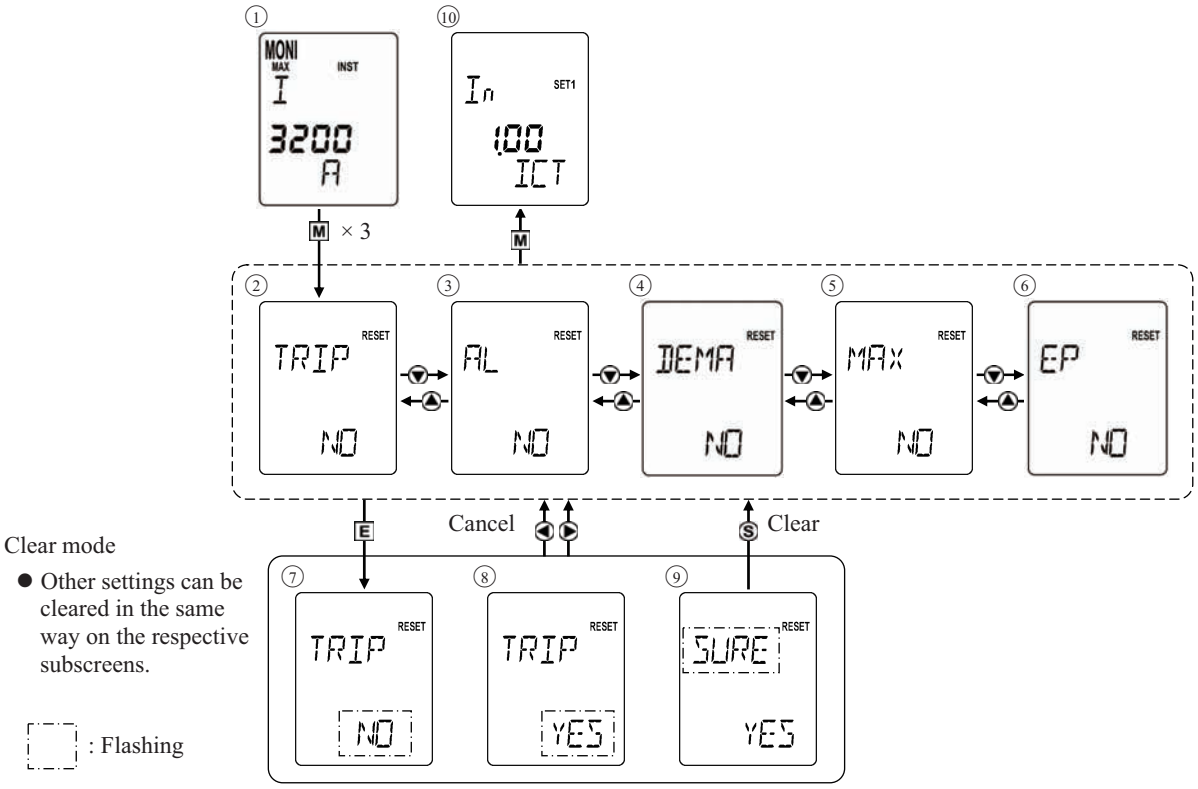


Fig. 59 Reset screen navigation

Table 32 Reset subscreens

No.	Subscreen item	Description
①	(Monitor screen)	See 5-3-2-3-2.
②	Trip event log	Allows clearing the trip event log (trip cause, fault current value and operating time).
③	Alarm event log	Allows clearing the alarm event log (alarm cause, fault current value and operating time).
④	Max. demanded power	Allows clearing the max. demanded power (see Fig. 59 ⑰)
⑤	Max. phase current	Allows clearing the max. phase current (see Fig. 59 ⑨).
⑥	Integrated demand	Allows clearing the integrated demand.
⑦	Clear mode "Start"	Press ENTER to enter this subscreen from a reset subscreen. "NO" will flash. To exit this subscreen, press the right or left key of the cross button.
⑧	Clear mode "YES"	Press the up or down key of the cross button. "YES" will appear. To exit this subscreen without clearing the item, press the right or left key of the cross button.
⑨	Clear mode "Clear"	This subscreen appears when ENTER is pressed while "YES" is appearing. "SURE" will flash. To clear the item, press SET. The subscreen will exit to the Setting 1 screen. To exit this subscreen without clearing the item, press the right or left key of the cross button.
⑩	(Setting 1 screen)	See 5-3-2-6.

5-3-2-6. Setting 1 screen

Fig. 60 shows how to navigate the Setting 1 screen and Table 33 lists the items that can be viewed or changed on this screen.

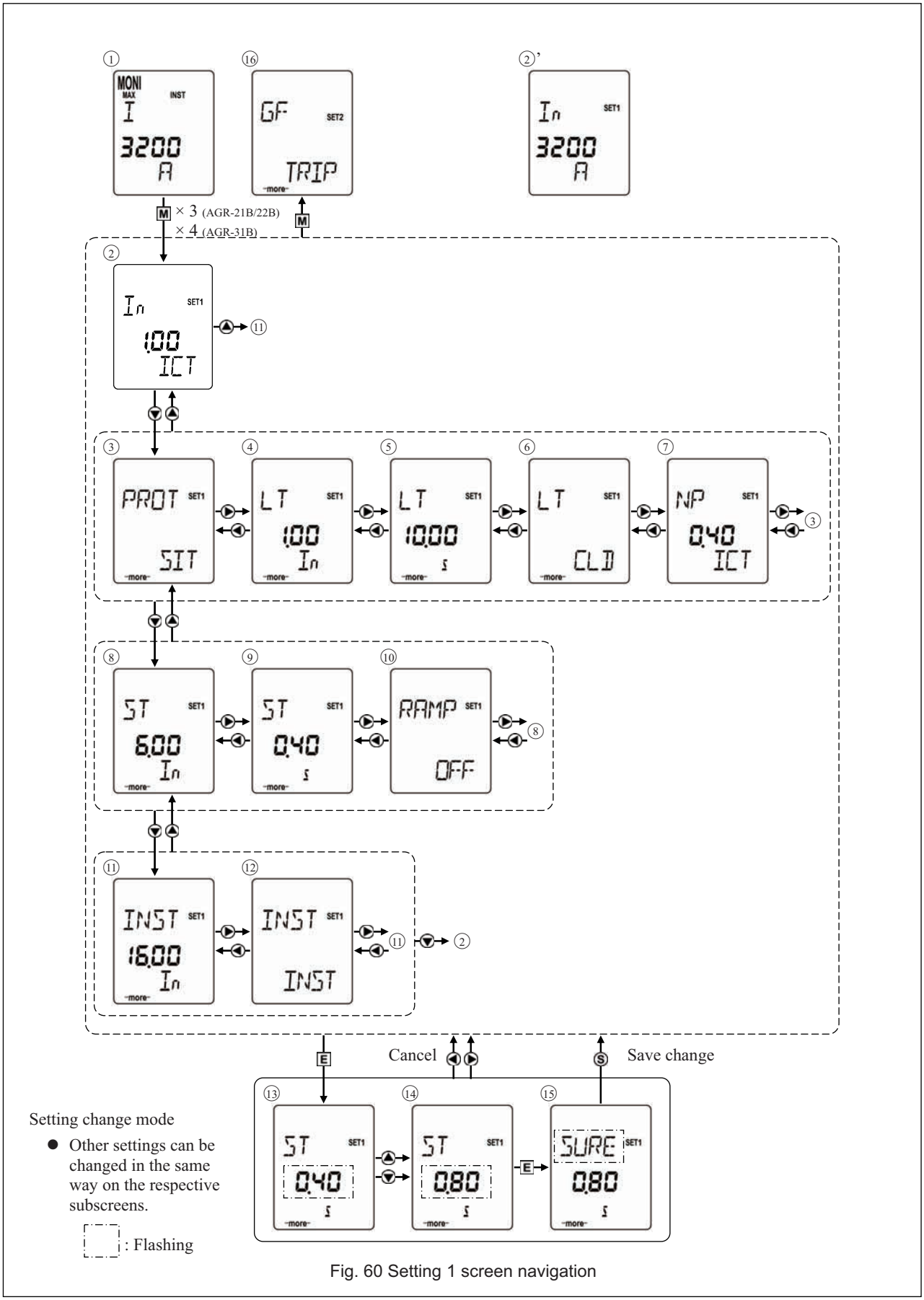


Fig. 60 Setting 1 screen navigation

Table 33 Setting 1 subscreens

No.	Subscreen item *1	Setting range/Remarks *2 *3
①	(Monitor screen)	See 5-3-2-3.
②	Rated current (L/R characteristic)	[I_{CT}] × (0.5-0.63-0.8-<u>1.0</u>) (A)
②'	Rated current (S characteristic)	[I_{CT}] × (0.5 to 1.0) (A): Fixed to a single point in increments of 1A
③	Long time delay trip characteristic (R characteristic)	SIT-VIT-EIT-3IT-4IT (SIT: $I^{0.02}$ t, VIT: I t, EIT: I^2 t, 3IT: I^3 t, 4IT: I^4 t) *4
④	Long time delay trip pickup current	L/R characteristic: [I_n] × (0.8-0.85-0.9-0.95-<u>1.0</u>-NON) (A) S characteristic: [I_n] × (0.8-1.05-1.1-<u>1.15</u>-NON) (A)
⑤	Long time delay trip pickup time	L characteristic: 0.5-1.25-2.5-5-<u>10</u>-15-20-25-30 (s) R characteristic: 1-2-3-4-<u>5</u>-6.3-6.8-10 (s) S characteristic: 15-<u>20</u>-25-30-40-50-60 (s)
⑥	Long time delay trip mode HOT/COLD	<u>COLD</u>/HOT
⑦	N-phase protection trip pickup current	[I_{CT}] × (<u>0.4</u>-0.5-0.63-0.8-1.0) (A)
⑧	Short time delay trip pickup current	L/R characteristic: [I_n] x (1-1.5-2-2.5-3-4-<u>6</u>-8-10-NON) (A) S characteristic: [I_n] x (<u>2</u>-2.5-2.7-3-3.5-4-4.5-5-NON) (A)
⑨	Short time delay trip pickup time	L/R characteristic: 0.05-0.1-0.2-<u>0.4</u>-0.6-0.8 (s) S characteristic: 0.1-<u>0.2</u>-0.3-0.4-0.6-0.8 (s)
⑩	Short time delay trip I^2t protection type	<u>OFF</u>/ON
⑪	Instantaneous trip pickup current	[I_n] x (2-4-6-8-10-12-14-<u>16</u>-NON) (A)
⑫	Instantaneous trip INST/MCR	<u>INST</u>/MCR
⑬	Setting change mode "Start"	Press ENTER to enter this subscreen from a setting 1 subscreen. The value that can be changed will flash. To exit this subscreen, press the right or left key of the cross button.
⑭	Setting change mode "Setting change"	Press the up or down key of the cross button to change the setting. To exit this subscreen with no change in setting, press the right or left key of the cross button.
⑮	Setting change mode "Save change"	Press ENTER to enter this subscreen while subscreen ⑭ is displayed. "SURE" will flash. To save the change, press SET. The subscreen will exit to the Setting 2 screen. To exit this subscreen while no change is saved, press the right or left key of the cross button.
⑯	(Setting 2 screen)	See 5-3-2-7.

*1 If no value is found for an item, the corresponding subscreen is skipped.
*2 Underlined values are default settings.
*3 This table shows percent representations of settings. For AV representations (see 5-3-2-4), current values are indicated in A (Amperage).
*4 Factory set according to your request.

5-3-2-7. Setting 2 screen

Fig. 61 shows how to navigate the Setting 2 screen and Table 34 lists the items that can be viewed or changed on this screen.

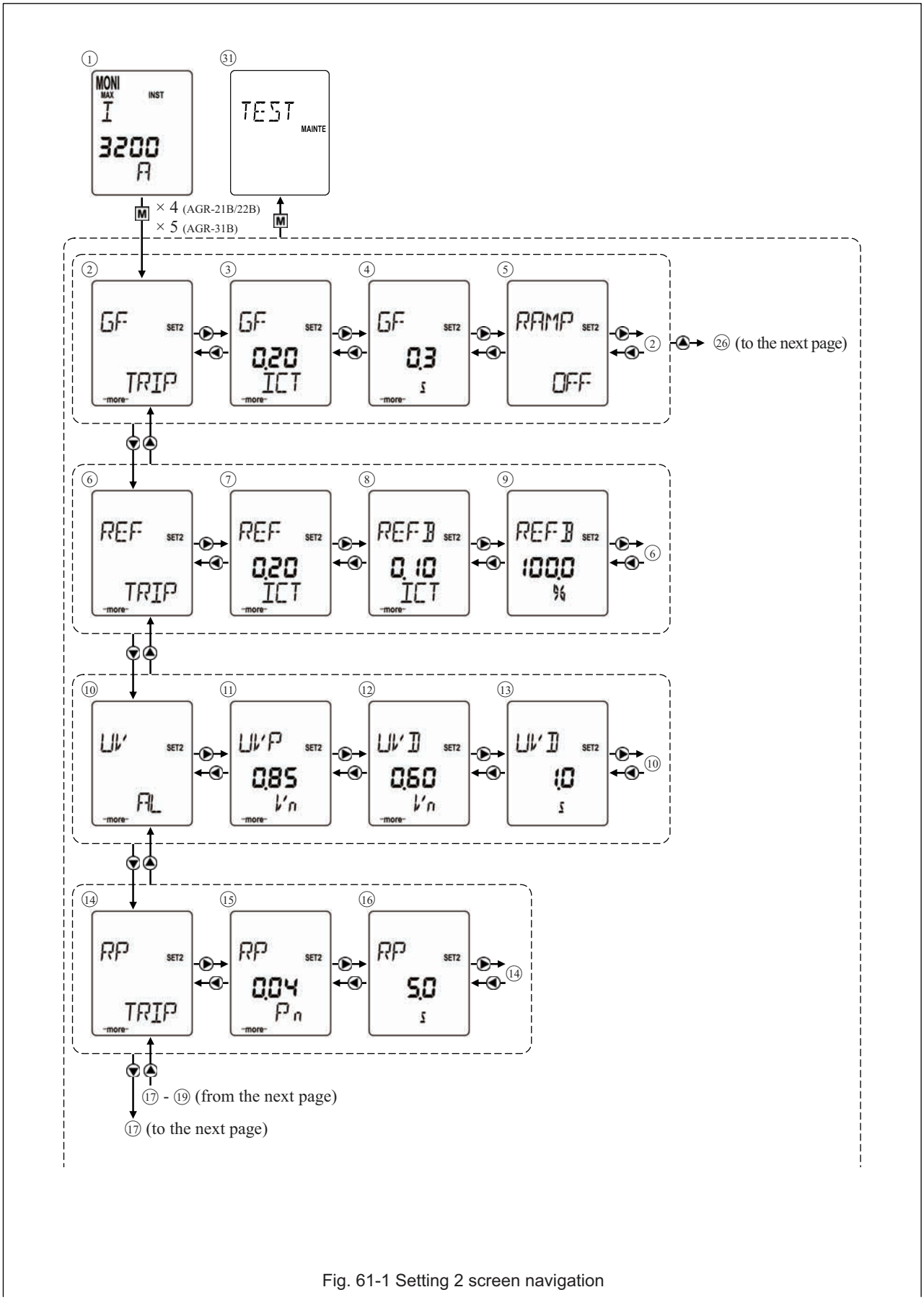


Fig. 61-1 Setting 2 screen navigation

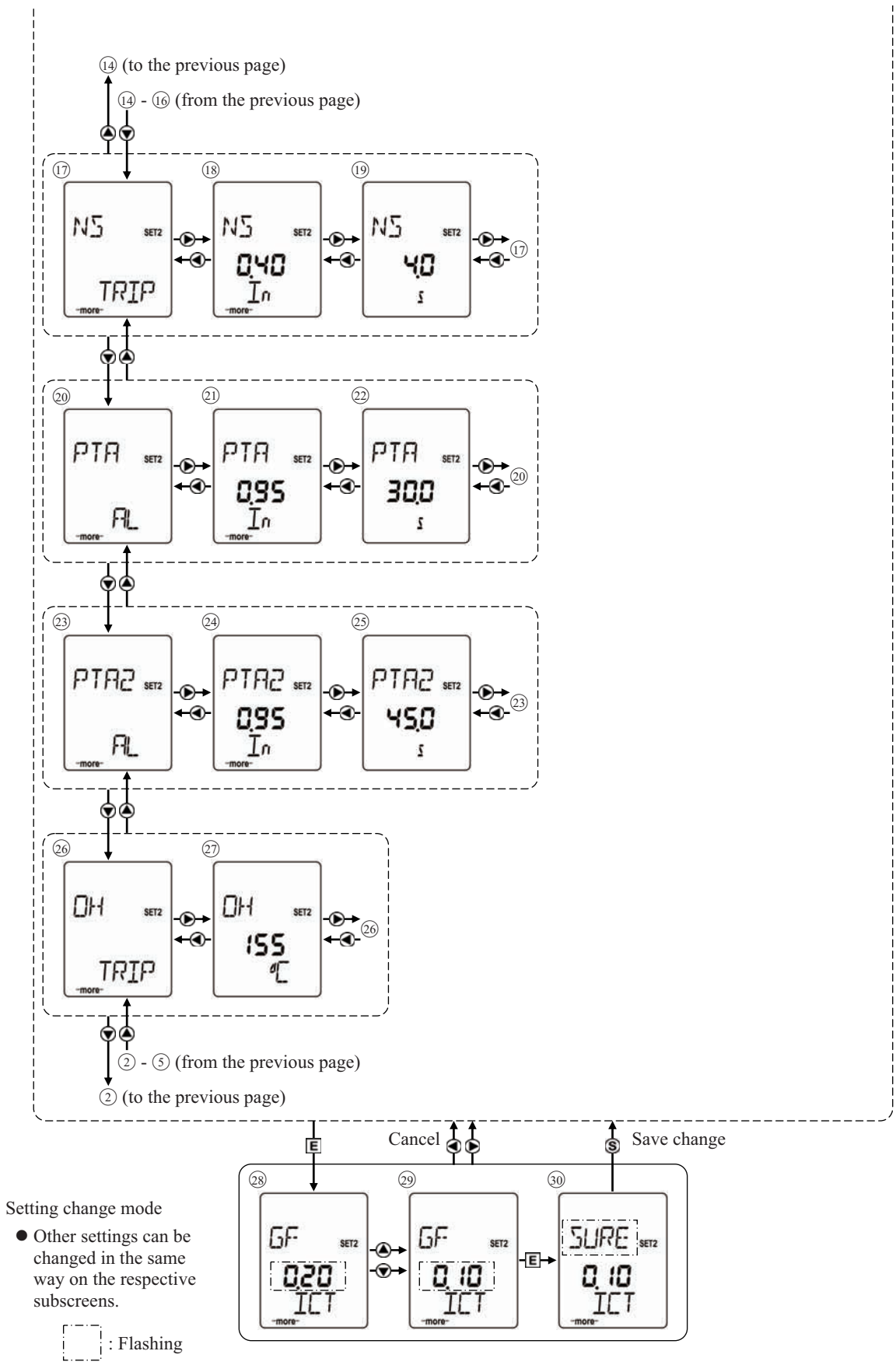


Fig. 61-2 Setting 2 screen navigation

Table 34 Setting 2 subscreens

No.	Subscreen item *1	Setting range/Remarks *2 *3
①	(Monitor screen)	See 5-3-2-3.
②	Ground fault trip mode	TRIP/AL/OFF
③	Ground fault trip pickup current	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A)
④	Ground fault trip pickup time	0.1-0.2-0.3-0.5-1-2 (s)
⑤	Ground fault trip I^2t protection type	OFF/ON
⑥	Line side ground fault protection mode	TRIP/AL/OFF
⑦	Line side ground fault protection trip pickup current	[I_{CT}] × (0.1-0.2-0.3-0.4-0.6-0.8-1.0-NON) (A)
⑧	Line side ground fault protection bias current	[I_{CT}] × (0.1-0.3-0.5-0.7-0.9-1.1-1.3-1.5) (A) *4
⑨	Line side ground fault protection bias limit	100% (fixed) *4
⑩	undervoltage alarm mode	AL/OFF
⑪	Undervoltage alarm recovery voltage	[V_n] × (0.8-0.85-0.9-0.95) (V)
⑫	Undervoltage alarm pickup voltage	[V_n] × (0.4-0.6-0.8) (V)
⑬	Undervoltage alarm pickup time	0.1-0.5-1-2-5-10-15-20-30-36 (s)
⑭	Reverse power trip mode	TRIP/AL/OFF
⑮	Reverse power trip pickup power	[P_n] × (0.04-0.05-0.06-0.07-0.08-0.09-0.1-NON) (kW)
⑯	Reverse power trip pickup time	2.5-5-7.5-10-12.5-15-17.5-20 (s)
⑰	Negative-phase sequence protection mode	TRIP/AL/OFF
⑱	Negative-phase sequence protection trip pickup current	[I_n] × (0.2-0.3-0.4-0.5-0.6-0.7-0.8-0.9-1.0) (A)
⑲	Negative-phase sequence protection trip pickup time	0.4-0.8-1.2-1.6-2-2.4-2.8-3.2-3.6-4 (s)
⑳	Pretrip alarm mode	AL/OFF
㉑	Pretrip alarm pickup current	L/R characteristic: [I_n] × (0.75-0.8-0.85-0.9-0.95-1.0) (A) S characteristic: [I_n] × (0.75-0.8-0.85-0.9-0.95-1.0-1.05) (A)
㉒	Pretrip alarm pickup time	L/R characteristic: 5-10-15-20-40-60-80-120-160-200) (s) S characteristic: 10-15-20-25-30 (s)
㉓	Pretrip alarm 2 mode	AL/OFF
㉔	Pretrip alarm 2 pickup current	[I_n] × (0.75-0.8-0.85-0.9-0.95-1.0-1.05) (A)
㉕	Pretrip alarm 2 pickup time	1.5× t_{P1} (s) (determined by auto calculation)
㉖	Contact overheat monitor mode	TRIP/AL/OFF
㉗	Contact overheat alarm pickup temperature	155°C (fixed)
㉘	Setting change mode "Start"	Press ENTER to enter this subscreen from a setting 2 subscreen. The value that can be changed will flash. To exit this subscreen, press the right or left key of the cross button.
㉙	Setting change mode "Setting change"	Press the up or down key of the cross button to change the setting. To exit this subscreen with no change in setting, press the right or left key of the cross button.
㉚	Setting change mode "Save change"	Press ENTER to enter this subscreen from subscreen ㉙. "SURE" will flash. To save the change, press SET. The subscreen will exit to the Setting 2 screen. To exit this subscreen while no change is saved, press the right or left key of the cross button.
㉛	(Maintenance screen)	See 5-3-2-8 and 5-4.

*1 If no value is found for an item, the corresponding subscreen is skipped.
*2 Underlined values are default settings.
*3 This table shows percent representations of settings. For AV representations (see 5-3-2-4), current values are indicated in A (Amperage), V (voltage),or kW (kilowatt).
*4 The line side ground fault protection bias current and bias limit are coefficients for strain. Because the line side ground fault protection function performs an arithmetic operation using the difference between CTs with different characteristics, errors in measured line side ground fault current become significant when a large current flows through the ACB. "Strain" is to increase the line side ground fault trip pickup current with increasing current flowing through the ACB, thus preventing malfunctions caused by such an error. The following shows the relationship between the current flowing through the ACB and the line side ground fault protection trip pickup current under "strained" conditions:

When (i + i_{REFCT}) / 2 ≤ I_{REF2};
I_{REFNOW} = I_{REF}
When (i + i_{REFCT}) / 2 > I_{REF2};
I_{REFNOW} = I_{REF} [1 + a { (i + i_{REFCT}) / 2 I_{REF2} - 1 }]
(I_{REF}: Line side ground fault protection trip pickup current, I_{REF2}: Line side ground fault protection bias current, a: Line side ground fault protection bias limit, i: Max. phase current (present value), i_{REFCT}: Line side ground fault current, I_{REFNOW}: Line side ground fault protection pickup current calculated using strain coefficients)

Ex.: When (i + i_{REF}) / 2 = 5 × I_{REF2} and other settings remain default;
I_{REFNOW} = I_{REF} [1 + 1 × { 5 × I_{REF2} / I_{REF2} - 1 }] = I_{REF} [1 + 1× { 5 - 1 }] = 5 × I_{REF}

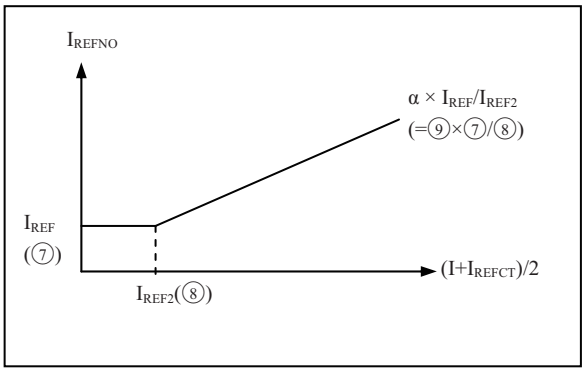


Fig. 62 Relationship between the current flowing through the ACB and the line side ground fault protection trip pickup current under "strained" conditions

5-3-2-8. Maintenance screen

Fig. 63 shows how to navigate the maintenance screen and Table 35 lists the items that can be viewed on this screen.

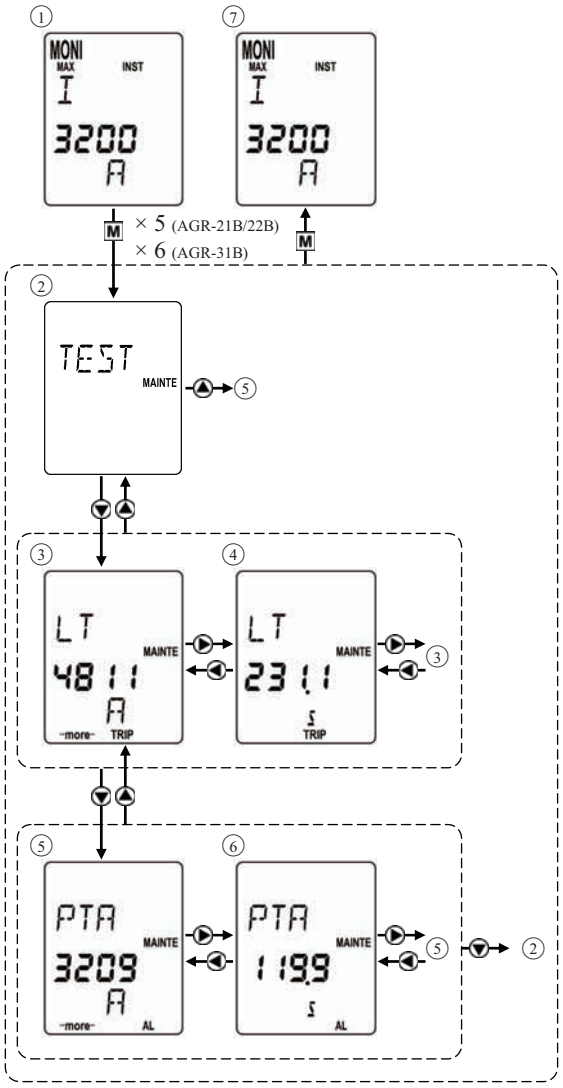


Fig. 63 Maintenance screen

Table 35 Maintenance subscreens

No.	Subscreen item *1	Description
①	(Monitor screen)	See 5-3-2-3.
②	(Maintenance screen)	–
③	Trip event log (fault current value)	Trip cause and fault current value
④	Trip event log (operating time)	Trip cause and operating time
⑤	Alarm event log (fault current value)	Alarm cause and fault current value
⑥	Alarm event log (operating time)	Alarm cause and operating time
⑦	(Monitor screen)	See 5-3-2-3.

*1 If no value is found for an item, the corresponding subscreen is skipped.

5-4. OCR Function Check

⚠ CAUTION

- OCR function check and setting changes must be performed by competent persons.
- After completion of OCR tests, be sure to return the settings to the original values. Failure to do so may cause a fire or burnout.

Use the following procedure to perform OCR function check.

1) Open the ACB and draw out the breaker body to the TEST position.

2) Change settings according to the test as shown in Table 36.

Table 36 OCR setting changes

Test *1	Output signal value	Setting to be changed
Long time delay trip	L characteristic: [I_R] × 6	Non
	R characteristic: [I_R] × 3	Non
	S characteristic: [I_R] × 1.2	Non
Short time delay trip	[I_{sd}] × 1.2	[I_i] >[I_{sd}] × 1.5, Short time delay trip I^2t protection: OFF
Instantaneous trip	[I_i] × 1.2	Mode: INST
MCR		Mode: MCR
Ground fault trip	[I_g] × 1.5	Ground fault trip I^2t protection: OFF

*1 Setting an item to NON and OFF disables the test for the item.

3) To check the ACB along with the OCR, close the ACB before applying a test signal. When checking the MCR function, close the ACB within 0.3 s. after applying a test signal.

4) Follow the procedure described in Fig. 64 and Table 37 to check the OCR for normal operation. (In NTR mode, the ACB does not operate, a trip/alarm event is not saved in the log and operation indication contact output is not provided).

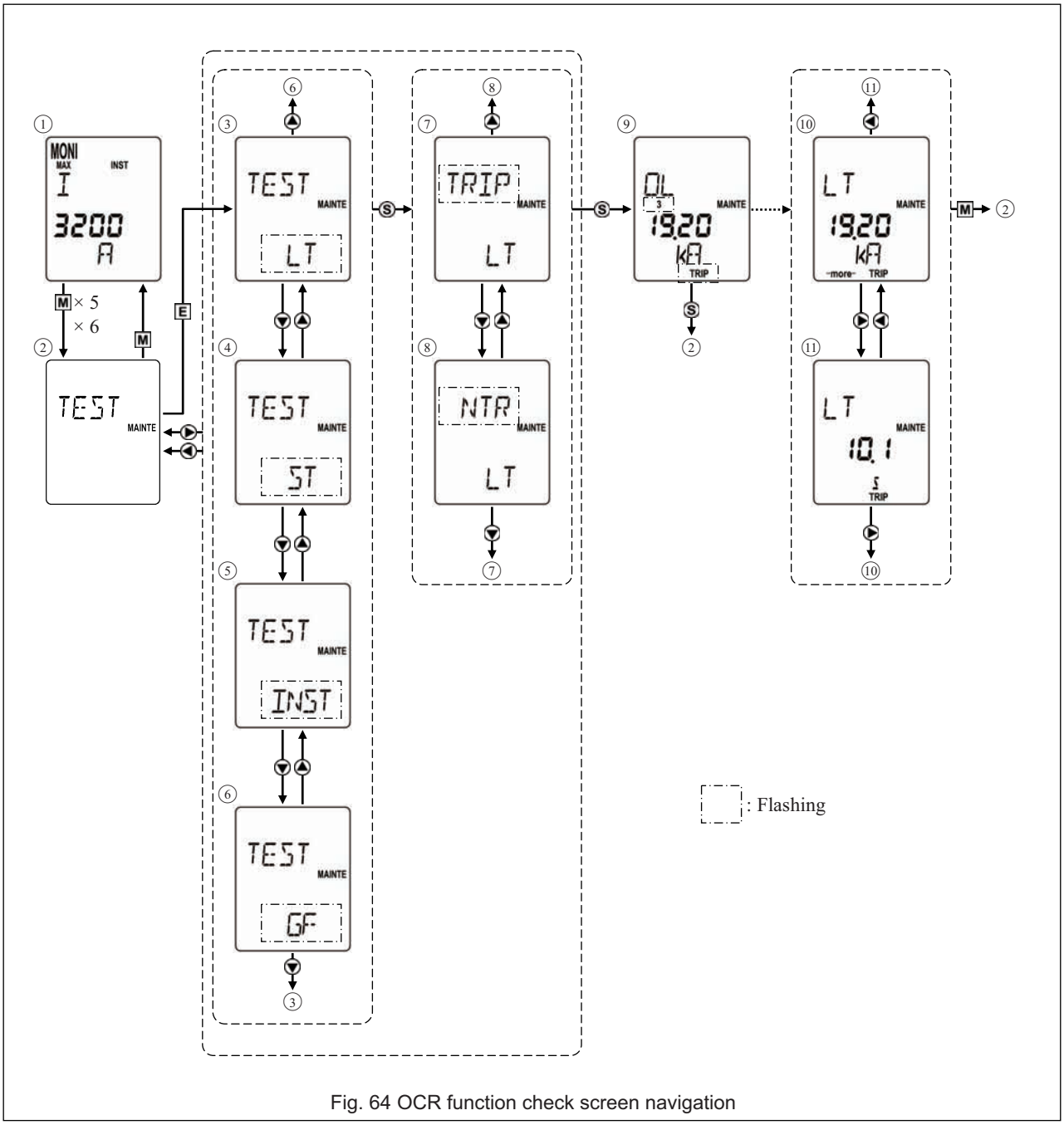


Fig. 64 OCR function check screen navigation

Table 37 OCR function check subscreens

No.	Subscreen item *1	Description
①	(Monitor screen)	See 5-3-2-3.
②	(Function check start subscreen)	–
③	Long time delay trip	"LT" flashes. *2 *3
④	Short time delay trip	"ST" flashes.
⑤	Instantaneous trip	"INST" flashes.
⑥	Ground fault trip	"GF" flashes.
⑦	OCR + ACB operation	"TRIP" flashes.
⑧	OCR operation only	"NTR" flashes.
⑨	Indication during testing *4	Pressing SET while subscreen ⑦ or ⑧ opens causes a test signal to be applied.
⑩	Trip event log (fault current value)	The trip cause and fault current value are indicated.
⑪	Trip event log (operating time)	The trip cause and operating time are indicated.

*1 If no log is found, the corresponding subscreen is skipped.
*2 When the long time delay trip function is selected, the short time delay trip and instantaneous trip functions are locked inoperative and cannot be used. The pretrip alarm function can be used.
*3 Even when the HOT mode is selected, the test is carried out in COLD mode (Accumulated current value before testing is reset to zero before the test starts).
*4 Only when the long time delay trip function is checked. The number of the signal source and "TRIP" are flashing. For other function checks, subscreen ⑦ or ⑧ will continue.

5-5. Operation Indication and Indication Resetting Procedure

5-5-1. Operation Indication (AGR-11B type)

The OCR has LEDs on the front panel to provide operation indications as shown in Fig. 65 and Table 38. It also outputs operation signals to contacts.

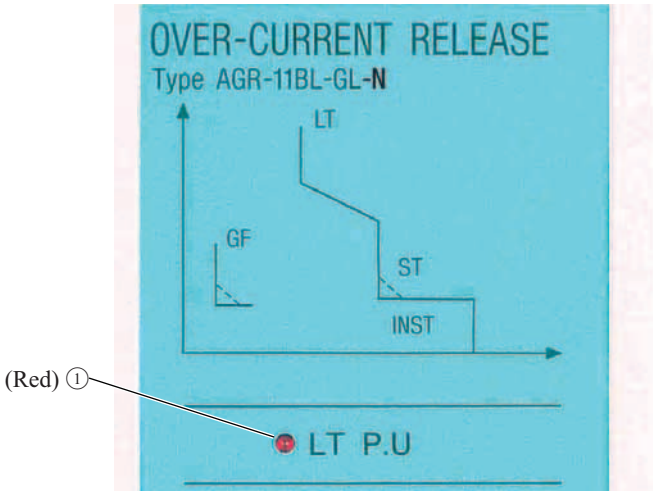


Fig. 65 LEDs

Table 38 Operation indication

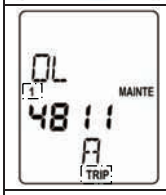
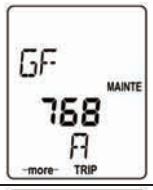
Type of OCR	Control power supply	Operation	LED				Contact output		
			Position	State			Terminal No. See Fig. 13	State	
				Normal	pickup	Trip/Alarm		Normal	Trip/Alarm
AGR-11BL-AL AGR-11BL-GL	Not required	Long time delay trip (LT) N-phase protection (NP)	①	OFF	Flash	OFF	05, 15	OFF	Turn OFF automatically after ON for 40 ms or more *1
		Short time delay trip (ST) Ground fault trip (GF)							
		Instantaneous trip (INST)			OFF				

*1: A self-hold circuit is required.

5-5-2. Operation Indication and Indication Resetting Procedure (AGR-21B,22B,31B type)

The OCR indicates a trip/alarm event on the LCD and provides contact output as shown in Table 39. Pressing the right or left key of the cross button changes the display from "trip/alarm cause" / "fault current/voltage/power" to "operating time" (if applicable). Pressing the MENU button returns the display to the previous screen. (Events saved in the event log can always be displayed on the maintenance screen. See 5.3.2.8). To reset contact output while retaining the event log, turn off the control power (Fig. 15 01, 11, 21) at least 1 s. To delete the event log and reset contact output on the LCD, follow the procedure shown in 5.3.2.5 "Reset screen".

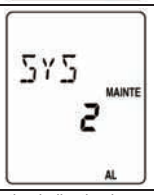
Table 39-1 Operation indication 1

Operation	LCD State: Normal operation	LCD State: When picked up	LCD State: When activated (Use the right or left key of the cross button for screen navigation)	LCD State: After control power is off for at least 1 s.	Contact output: Terminal No. See Fig. 15	Contact output State: Normal operation	Contact output State: When activated	Contact output State: After control power is off for at least 1 s.	Control power supply
Long time delay trip (LT) N-phase protection (NP)	Normal indication			Normal indication ①	05 – 15	OFF	ON ②	OFF	Required
									
Short time delay trip (ST)		–			05 – 25		ON ②		
Instantaneous trip (INST/MCR)		–	③						
Ground fault trip (GF)		–			05 – 16		ON		
Reverse power trip (RPT)					05 – 16		ON ②		
Negative-phase sequence protection (NS)					05 – 17		ON		

- The ACB can be opened, closed or tripped, irrespective of whether or not the operation indication is reset.
- The operation indication is updated when a protective function is activated.
- ▯ means flashing.

① The event log is not cleared.
② For S characteristic, the delay is as short as 500 ms or more.
③ "- - - - (kA)" is indicated when the short time delay or instantaneous trip function is activated and [I_{ST}] × 17 is exceeded.

Table 39-2 Operation indication 2

Operation	LCD State: Normal operation	LCD State: When picked up	LCD State: When activated	LCD State: After control power is off for at least 1 s.	Contact output: Terminal No. See Fig. 15	Contact output State: Normal operation	Contact output State: When activated	Contact output State: After control power is off for at least 1 s.	Control power supply
Line side ground fault protection (REF)	Normal indication	–		Normal indication ①	05 – 17	OFF	ON	OFF	Required
Contact overheat monitoring (OH)		–			05 – 17		ON		
Pretrip alarm (PTA)				Normal indication ①②	05 – 06		ON ②	OFF	
Pretrip alarm 2 (PTA2)				Normal indication ①②	05 – 27		ON ②		
Undervoltage alarm (UV)		–		Normal indication ①②	05 – 27		ON ②		
System alarm		–		Normal indication ①	05 – 26		ON ③	OFF ④	

- The ACB can be opened, closed or tripped, irrespective of whether or not the operation indication is reset.
- The operation indication is updated when a protective function is activated.
- ⌜ ⌟ means flashing

① The event log is not cleared.
② The alarm is self-recovered when the fault current decreases to less than the setting.
③ "SYS1" means disconnection of the magnet hold trigger (MHT) and "SYS2" does a tripping failure (incorrect operating time, mechanical malfunction etc).
④ The OCR has a self-monitoring feature that monitors the OCR internal circuit, the magnet hold tripper (MHT) circuit, and the ACB state. An alarm caused by transient noise can be cleared or deleted. If such an alarm cannot be cleared, check the ACB. See chapter 7.

6. MAINTENANCE, INSPECTION AND PARTS REPLACEMENT

This chapter describes the maintenance and inspection procedure for the AR series ACBs.

The service life of the ACB depends on the working and environmental conditions. The ACB is exposed to mechanical and electrical stresses and thus suffers gradual degradation during use, which will increase the possibility of malfunctions. Preventive maintenance and periodical inspection are very important to avoid any functional degradation, prevent malfunctions, extend the service life, and ensure safe operation.

The appropriate frequency of maintenance and inspection of the ACB varies depending on the installation conditions, the number of tripping operations, the magnitude of breaking current, and other factors that are to be considered empirically. As a guideline, Table 40 shows the recommended inspection frequency. See section 6-1 for detailed maintenance and inspection procedures.

Table 40 Frequency of maintenance and inspection

Category	Working and environmental conditions	Inspection level	Frequency in interval or number of open/close cycles				
			Interval	Number of open/close cycles			
Normal	• Not so dusty, • Not so much corrosive gases, • Ambient temperature: 35°C or lower • Not so humid, • Number of open/close cycles per day: 2 or less Ex. Switchboards in electric installation rooms, Control rooms, Building installation	Normal/ Detailed	• Every year or 2 years • Every year after 3 years since installation • Every half year after 6 years since installation	Open/close condition	800AF or less	1250AF - 2500AF	3200AF or more
				Nearly no current level	Every 1000 cycles		
				Rated current level	Every 1000 cycles	Every 500 cycles	Every 100 cycles
		Thorough	• Every 5 or 6 years • Every 4 years after 6 years since installation • Every year or 2 years after 10 years since installation	Every 4000 cycles			
		Overhaul	When abnormality is found during normal or through inspection				
Harsh	• Highly dusty, • Much corrosive gases, • Ambient temperature: 45°C or higher, • Highly humid, • Number of open/close cycles per day: 4 or more, • Always exposed to vibrations Ex. Iron or chemical plants Engine rooms (without ventilation), Cogeneration installation, Ferryboats	Normal/ Detailed	• Every year • Every half year after 2 years since installation	Open/close condition	800AF or less	1250AF - 2500AF	3200AF or more
				Nearly no current level	• Every 1000 cycles • Every 500 cycles after 1000 cycles		
				Rated current level	• Every 1000 cycles • Every 500 cycles after 1000 cycles	• Every 500 cycles • Every 250 cycles after 500 cycles	• Every 100 cycles • Every 50 cycles after 100 cycles
		Thorough	• Every 2 or 3 years • Every 2 years after 6 years since installation • Every year after 10 years since installation	• Every 2500 - 3000 cycles • Every 2000 cycles after 3000 cycles			
		Overhaul	When abnormality is found during normal or through inspection				
Abnormal	• Open/close operation due to overload, • Tripping due to shortcircuit, • Accidentally submerged	Thorough	When abnormality occurs	Open/close condition	800AF or less	1250AF - 2500AF	3200AF or more
				Overcurrent level (approx. 6 times the rated current)	Every 25 cycles	Every 25 cycles	Every 25 cycles
				Level exceeding overcurrent level	Every time	Every time	Every time
		Overhaul	When ACB is deemed to be repairable at through inspection				

- Normal inspection can be performed by the user. Terasaki also provides normal inspection service.
- Detailed inspection includes inspection, actions, and parts replacement that will be done to prevent functional degradation caused by aging or the like when abnormality is found during normal inspection.
  You are recommended to use Terasaki's detailed inspection service.
- Thorough inspection must be left to Terasaki. Overhaul will be done in a Terasaki's factory.

● About the service life

The expected service life of AR series ACBs is shown in the "Endurance in number of ON-OFF cycles" rows in Tables 3 and 4. "With maintenance" in the tables means that appropriate inspection, maintenance, repair, and parts replacement are performed according to the instructions in this chapter. But, when an ACB performs three times of tripping operation nearly at the rated breaking current (three standard operating duty cycles), it is at the end of its safe service life even if thorough inspection is done every time it trips open. Such an ACB will be apt to suffer malfunctions and should be replaced without delay to avoid frequent inspection and parts replacement. See section 6-2 for detailed parts replacement procedures.

6-1. Inspection Procedures

⚠ CAUTION

- ACB maintenance, inspection and parts replacement must be performed by competent persons.
- Do not touch ACB current carrying parts and ACB structural parts close to a current carrying part immediately after the ACB trips open. Remaining heat may cause a burn.
- Prior to commencing any work on the ACB, open an upstream circuit breaker or the like to isolate all sources of power/voltage from the main and control circuits. Otherwise, electric shock may result.
- Take care to avoid adhesion of dust to main and control circuit contacts. Dust on the contacts may result in a fire.
- Prior to commencing maintenance, inspection, or parts replacement, make sure that the closing springs are released and the ACB is open. Otherwise, unintentional open/close operation may lead to fingers or tools to be pinched by the open/close mechanism, resulting in injury.
- Retighten the terminal screws periodically to the specified torque. Otherwise, a fire could result.
- Do not perform dielectric withstand/insulation resistance tests under other conditions than specified. Doing so may cause a malfunction.
- Be sure to reinstall the arc chamber if removed. Failure to do so or incorrect installation of the arc chamber may result in a fire or burn.
- When charging the closing springs or performing open/close operation of the ACB with the arc chamber, front cover and/or side covers removed during maintenance or inspection work, do not touch parts other than those required for the above operation (charging handle, ON/OFF buttons, moving core and the like). Doing so may cause fingers or tools to be pinched, resulting in injury.
- When replacing an auxiliary, do not damage the control wire for the auxiliary or pinch the wire between the auxiliary and the breaker body. Doing so may cause a malfunction.

To ensure safety, be sure to perform the preparation work described in section 6-2-1 unless otherwise specified in the inspection procedures. The normal inspection procedure and the detailed inspection procedure are shown in Tables 42 and 43 respectively.

● Information you are requested to state

If you want us to take action against an abnormality, contact us while providing us the information shown in Table 41 below. Our contact is shown at the end of this manual.

Table 41 Information you are requested to state

Item	Description	Reference
Type	AR_____ __ __ poles with draw-out cradle	Rating nameplate
Serial No.	_____ – _____	
Main circuit rated current	☐ AC ☐ DC _____V	Product Specifications
Rated voltage	_____A	I_n
Spring charging method	☐ Manual charging ☐ Motor charging Rated operation voltage: ☐ AC ☐ DC _____V	CLOSING section on specification nameplate
Overcurrent release	☐ Non ☐ Equipped Type: AGR-____ – _____ Rated control voltage: ☐ AC ☐ DC _____V	OCR section on specification nameplate
Electrical tripping device	☐ Shunt trip device (SHT) Rated voltage: ☐ AC ☐ DC _____V ☐ Undervoltage trip device (UVT) Rated voltage: ☐ AC ☐ DC _____V	TRIPPING section on specification nameplate
Special specification	SR: _____ SS: _____ SO: _____	OTHERS section on specification nameplate
Working conditions (Voltage, current, environment)		-
Symptom of abnormality (in detail): When, How, Where, etc.)		-
Inspection done/actions taken (if any)		6-1.
Status quo and schedule	Permissible power cut date and time: _____ Place where you want us to take action: _____	-

- The contents of the nameplate should be provided in detail.
- Related documents such as product specifications and inspection reports should be provided.
- If you have a desired inspection and maintenance schedule, let us know the schedule at your earliest convenience. Our service representative could not meet your last minute requirement.

Table 42 Normal inspection procedure

Check point	No.	Check item	Description
General (*1)	1	Discoloration of conductors	Check connection conductors, main circuit terminals, and current carrying parts for heat discoloration. If such a symptom is found, contact us.
	2	Parts missing	Check that screws, bolts, nuts, washers, springs, retainers and the like are not missing. If any parts are missing, contact us.
	3	Damage to parts	Check for deformation, cracks, chips, rust, or other damage of parts. If damage is found, contact us.
	4	Dust accumulation	Check that no dust is accumulated in ACB. If dust has accumulated, wipe it off with a dry, clean cloth.
Main/control circuit terminals See 2-3.	5	Connections	Check main circuit terminal screws, ground terminal screw, auxiliary switch terminal screws, control circuit terminal screws, and position switch terminal screws for looseness. If loose, tighten to specified torque.
Main/control circuit See 4-2.	6	Surface condition	Draw out the breaker body from draw-out cradle and check that contacts have no dust accumulation and discoloration. If dust has accumulated and discolored, wipe it off with a dry, clean cloth. If surface is discolored badly, contact us. ● Blackening of contacts is caused by oxidation or sulfuration and has no harmful effect except in extreme cases. If heat discoloration, arc marks, roughness, or peeling of plating layer is found, contact us.
Main circuit	7	Insulation resistance	Close ACB and, using DC500V Megger, check that insulation resistance between main circuit terminals, between main circuit terminal group and ground exceeds 100M ohm. If resistance does not exceed 100M ohm, contact us.
Control circuit	8	Wiring	Check that control wiring is properly connected, and not disconnected nor damaged. If incorrect connection is found, connect correctly. If disconnection or damage is found, contact us.
Operating mechanism	9	Internal mechanism	Check for missing parts, deformation, cracks, chips, foreign matter or dust accumulation, breakage of springs, and rust. If foreign matter or dust has accumulated, wipe the foreign matter or dust off with a dry, clean cloth. If any parts are missing or damaged or springs are broken, contact us.
Auxiliary switches	10	Operation	Check that auxiliary switches operate properly. If not so, replace switches.
	11	Looseness of screws	Check screws of auxiliary switches for looseness. If loose, retighten.
Operation related mechanism See 4-1 and 4-2.	12	Draw-out/insertion mechanism	Draw in and out the body to confirm that the position indicator provides correct indication, the indication of the release button is correct, and no abnormal sound is heard. If abnormality is found, contact us.
	13	UVT	Move the breaker body to the ISOLATED position. Charge closing springs manually, and attempt closing the ACB to make sure the ACB cannot be closed. If the ACB can be closed, contact us.
	14	Operation mechanism, LRC, SHT and UVT	Move the breaker body to the TEST position. Supply voltage to operation mechanism, SHT and UVT, and perform closing spring charging operation and manual and electrical open/close operation several times each to check that the charge indicator, ON-OFF indicator, and ON-OFF cycle counter provide correction indication and no abnormal sound is heard. If abnormality is found, contact us.
OCR and MHT	15	System alarm	Move the breaker body to the TEST position. Supply voltage to the control circuit to confirm that no system alarm appears on the OCR. If a system alarm appears, reset it. If the alarm cannot be reset, contact us. (*2)

*1 Always check the "General" items during the inspection procedure shown in Table 42 above.
*2 Please note that this does not apply to some models

Table 43 Detailed inspection procedure (1/2)

Check point	No.	Check item	Description
Undervoltage trip device (UVT)	1	Coil resistance	Disconnect the red connector to measure coil resistance at the connector on the coil side. If it is out of tolerance, replace it.
	2	Operation	Remove UVT and press in plunger, and make sure releasing plunger causes plunger to be smoothly restored. If not so, replace UVT.
	3	Connector	Check that the red connector is connected correctly. If incorrect , connect correctly.
	4	Looseness of screws	Check UVT mounting screws for looseness. If loose, retighten.
	5	Electrical operation	Reassemble the side cover and front cover and move the breaker body to the TEST position. When the closing springs are charged and attraction voltage is applied to the UVT, and the ACB opening voltage when the UVT power voltage is decreased from the closed state is within the defined breaking voltage range.
Main/control circuit contacts See 4-2.	6	Surface condition	Draw out the breaker body from draw-out cradle and check that contacts have no dust accumulation and discoloration. If dust has accumulated and discolored, wipe it off with a dry, clean cloth. For main circuit contacts, apply contact grease to contact surface after cleaning. ● Excessive grease may foster dust accumulation. Grease should be applied lightly.
Arc chamber	7	Dust accumulation /Damage	Remove arc chamber and check it for foreign object or dust accumulation, deformation, cracks, chips and other damage. If foreign matter or dust has accumulated, wipe the foreign matter or dust off with a dry, clean cloth. If arc chamber has molten material stuck and unable to be removed, or if it suffers damage, replace the arc chamber.
Contacts	8	Surface condition	Remove arc chamber and check contact circumference, contacts, and contact tips for dust accumulation, discoloration, roughness, deformation, cracks, chips and other damage. If dust has accumulated or discolored, wipe it off with a dry, clean cloth. If contact tips are badly discolored or roughened, polish it with nylon scrubber. ● If damage is found, replace the contact tips. ● Blackening of contact tips is caused by oxidation or sulfuration and will be removed during closing operation. It has no harmful effect except in extreme causes.
	9	Parting distance	Remove the arc chamber and measure the distance between moving and stationary contact tips using a compass and a vernier caliper. If it is out of the specified range, replace both moving and stationary contacts.
Current sensors	10	Looseness of screws	Check current sensor mounting screws for looseness. If loose, retighten.
Latch release coil (LRC)	11	Coil resistance	Disconnect the green connector that is closer to coil than the other and, measure coil resistance between terminals. If it is out of the specified range, replace LRC.
	12	Connector	Check that the green connector is connected correctly. If incorrect , connect correctly.
	13	Looseness of screws	Check LRC mounting screws for looseness. If loose, retighten.
	14	Mechanical motion	With closing springs charged, check that pushing moving core results in ACB being closed, and releasing moving core slowly results in the core being restored smoothly. If not so, replace LRC.
	15	Electrical operation	Reassemble the side cover and front cover and move the breaker body to the TEST position. Supply ACB with operation power, and carry out closing operation to confirm that the ACB works correctly.

● Always check the "General" items in Table 42 during the inspection procedure shown in Table 43 above.

Table 43 Detailed inspection procedure (2/2)

Check point	No.	Check item	Description
Shunt trip device (SHT)	16	Coil resistance	Disconnect black connector that is closer to coil than the other and, measure coil resistance between terminals. If it is out of the specified range, replace SHT.
	17	Connector	Check that the black connector is connected correctly. If incorrect , connect correctly.
	18	Looseness of screws	Check SHT mounting screws for looseness. If loose, retighten.
	19	Mechanical motion	With ACB closed, check that pushing the moving core results in the ACB being opened, and releasing moving core slowly results in the core being restored smoothly. If not so, replace SHT. After inspection, discharge closing springs.
	20	Electrical operation	Reassemble the side cover and front cover. Place the circuit breaker body in the TEST position for draw-out type, and make sure that no current is flowing through the main circuit for fixed type. Charge closing springs, supply SHT with power, and attempt to perform electrical opening operation to make sure ACB open. (*1)
Magnet hold trigger (MHT)	21	Coil resistance	Disconnect the red connector to measure coil resistance at the connector on the coil side. If it is out of tolerance, replace it.
	22	Operation	Remove MHT and pull out moving core slowly, and make sure pushing moving core allows core to be smoothly retracted and attracted If not so, replace MHT.
	23	Connector	Check that the red connector is connected correctly. If incorrect , connect correctly.
	24	Looseness of screws	Check MHT mounting screws for looseness. If loose, retighten.
OCR and MHT	25	Electrical operation	Reassemble the side cover and front cover. Carry out the functional tests using the ANU-1 OCR checker to verify that the ACB works correctly.
Charging motor	26	Connector	Check that the green connector is connected correctly. If incorrect , connect correctly.
	27	Electrical operation	Reassemble the side cover and front cover. Place the circuit breaker body in the TEST position for draw-out type, and make sure that no current is flowing through the main circuit for fixed type. Supply ACB with operation power, and attempt to perform motor charging with max and min. voltages within permissible charging voltage range to make sure ACB operates normally.
	28	Looseness of screws	Check motor unit mounting screws for looseness. If loose, retighten.
Mechanism	29	Mechanical motion	Check lubrication and screws for looseness. (*2)

● Always check the "General" items in Table 42 during the inspection procedure shown in Table 43 above.

*1 Please contact in advance.

*2 Before doing lubrication, be sure to read “Lubrication Guidelines for Air Circuit Breakers”(KRG-5351)

7. TROUBLESHOOTING FLOWCHARTS

Figs. 95 - 99 are troubleshooting flowcharts where typical troubles and remedial actions are shown.

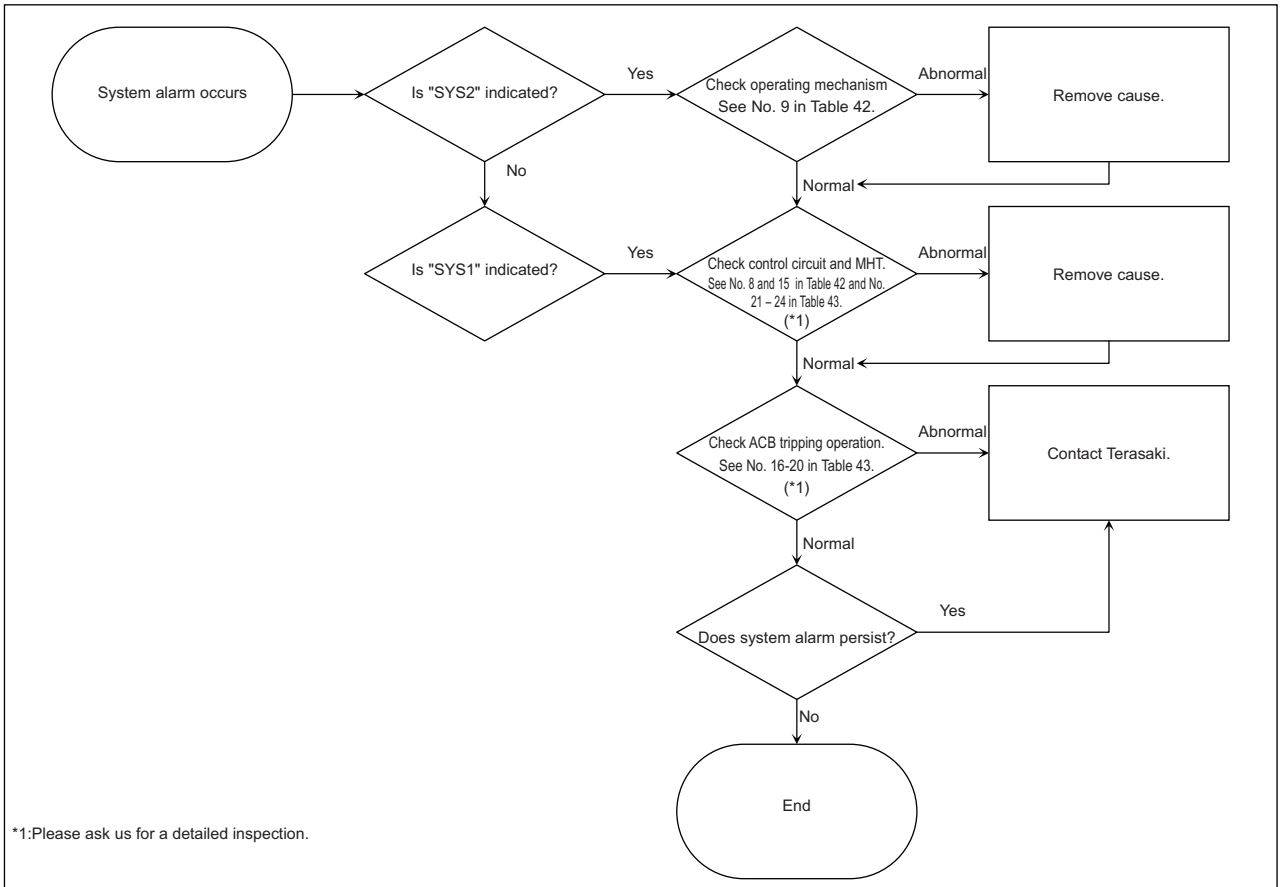


Fig. 95 Remedial actions against a system alarm(AGR-21B/22B/31B)

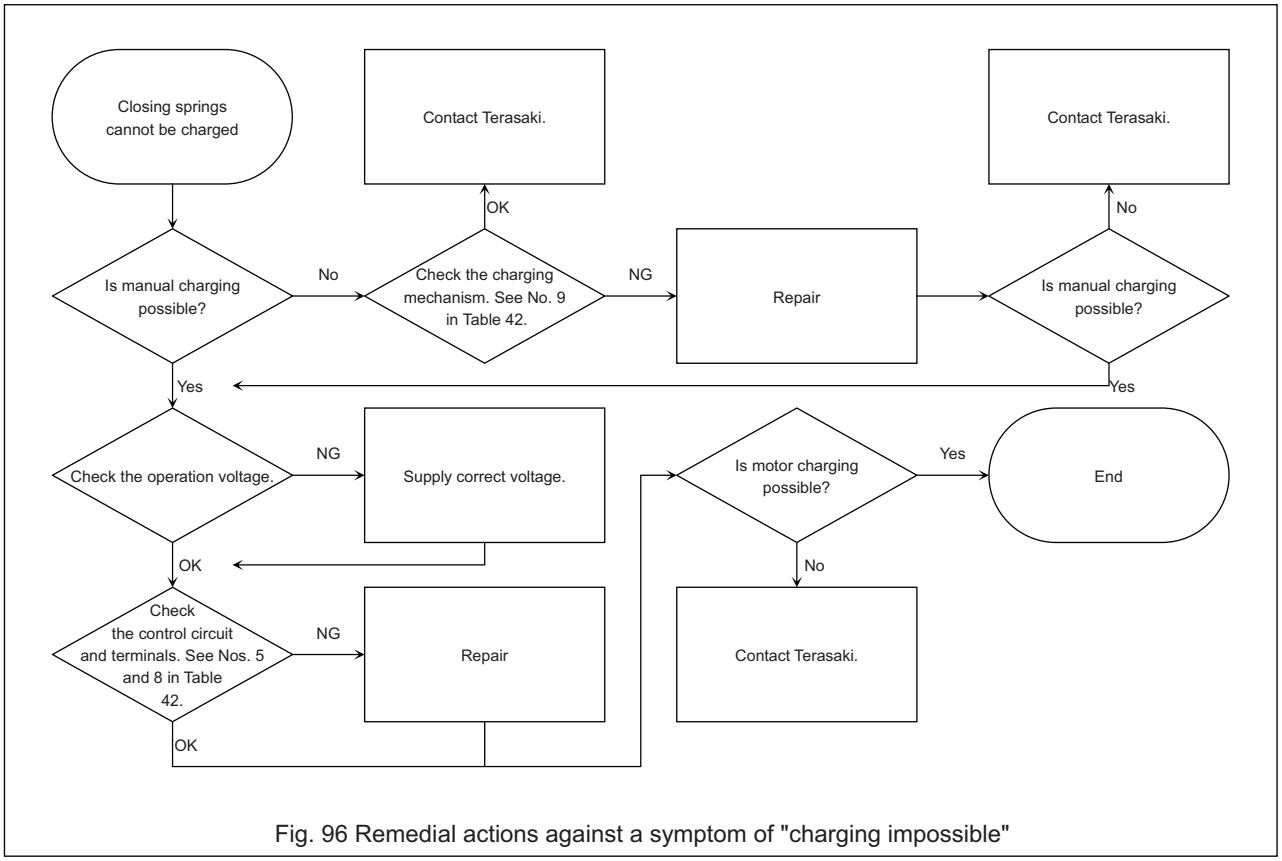


Fig. 96 Remedial actions against a symptom of "charging impossible"

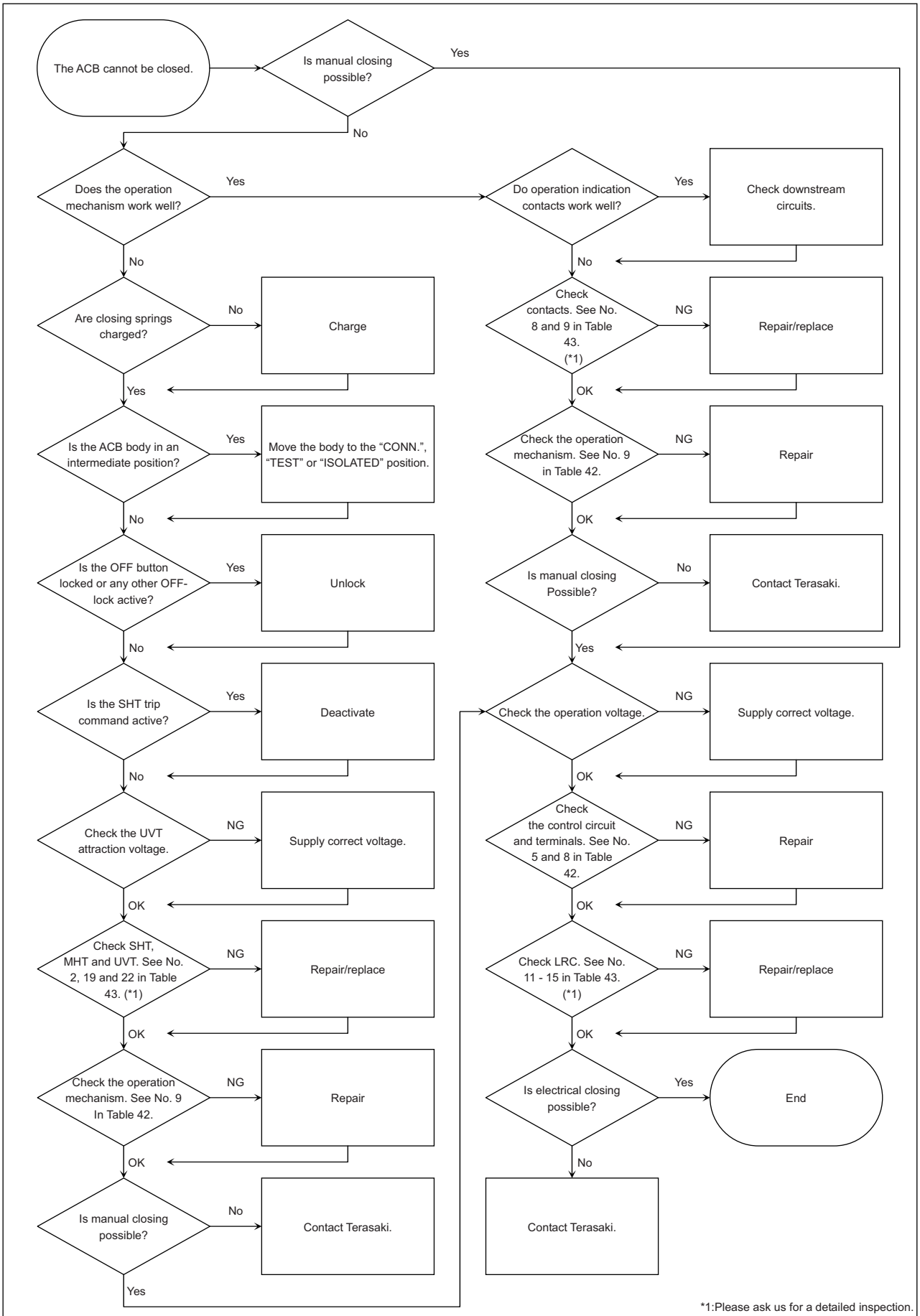


Fig. 97 Remedial actions against a symptom of "closing impossible"

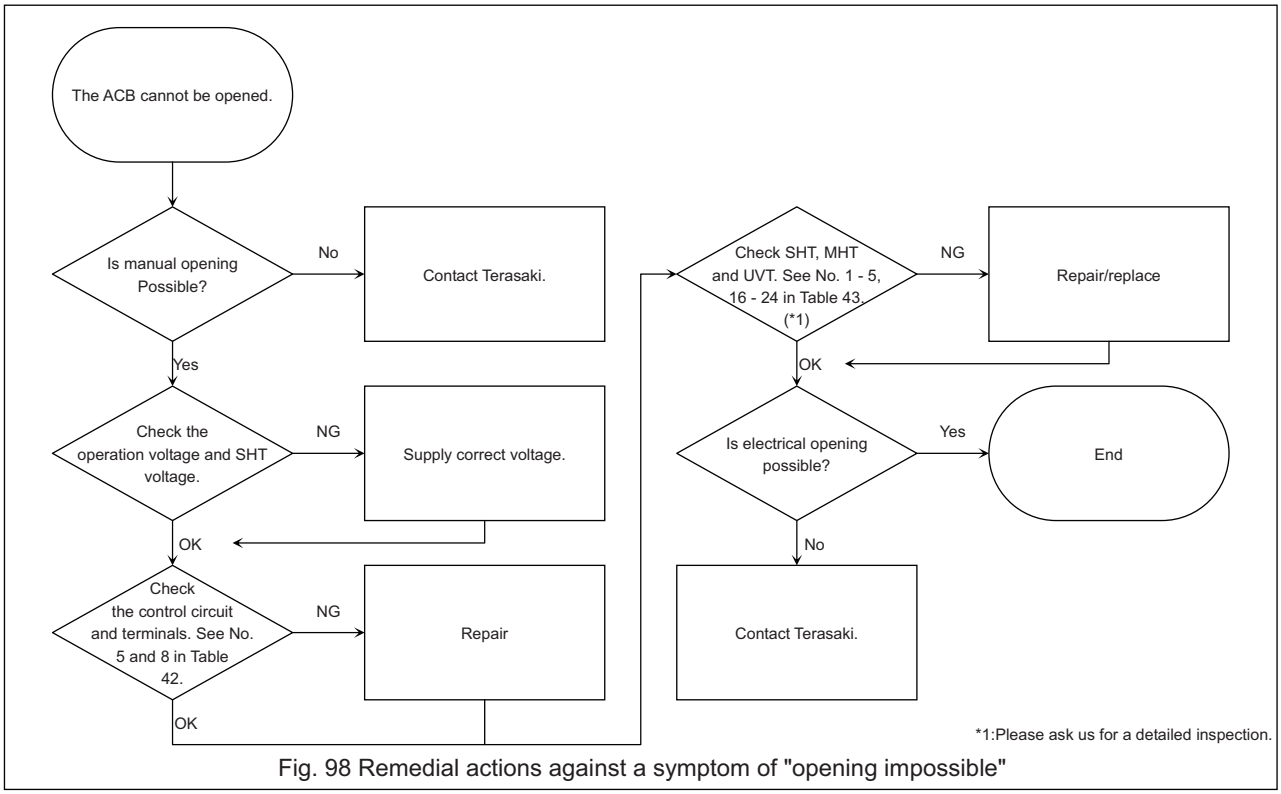


Fig. 98 Remedial actions against a symptom of "opening impossible"

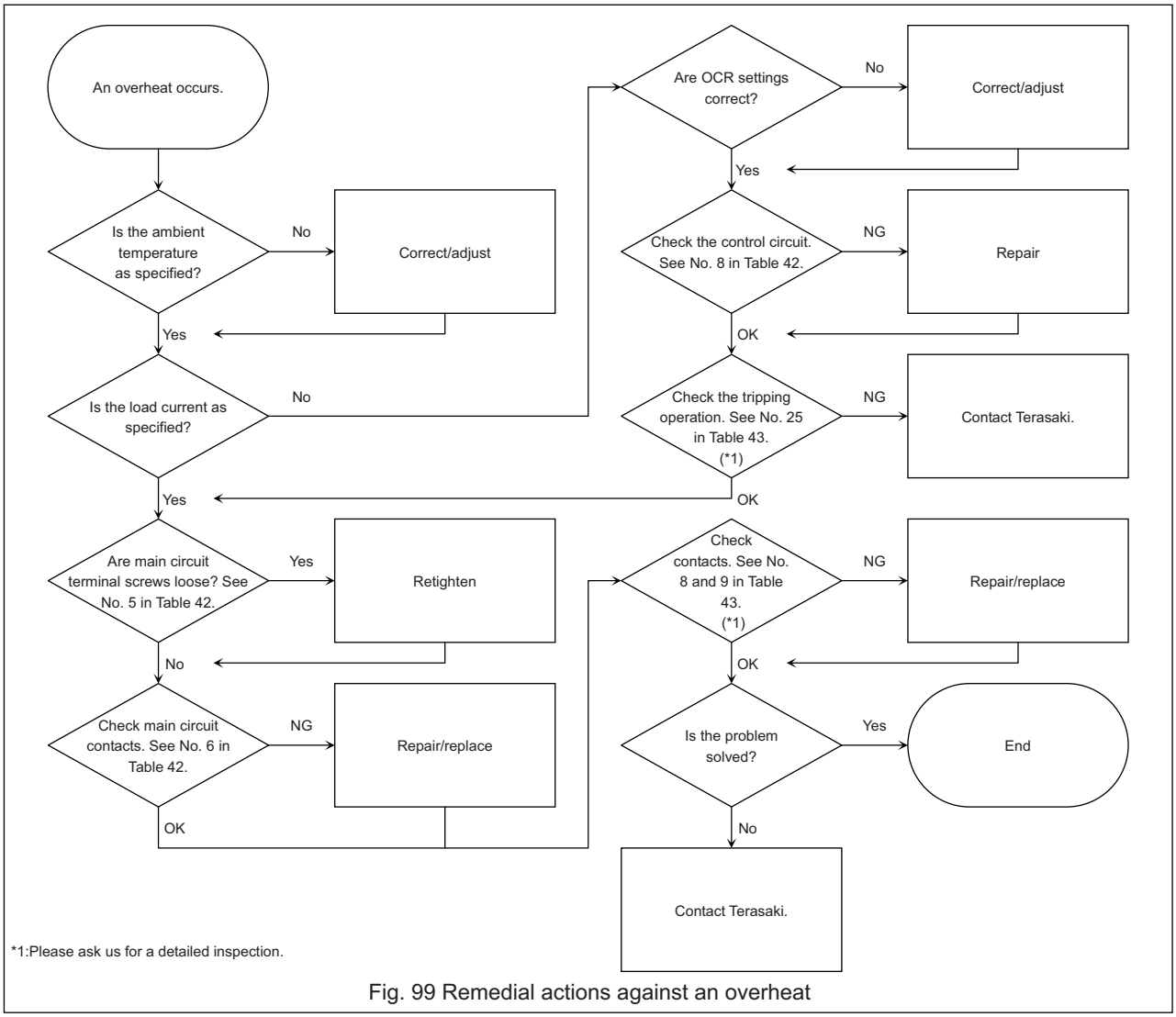


Fig. 99 Remedial actions against an overheat

⚠ CAUTION

■ SAFETY:

Be sure and read all instructions and associated documents accompanying the product thoroughly to familiarise yourself with the product handling, safety information, and all other safety precautions.

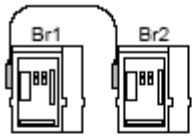
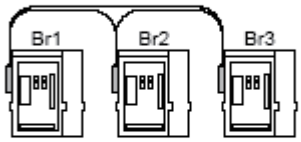
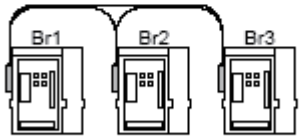
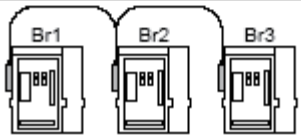
■ Installation Precautions:

- Installation work of the interlock must only be carried out by qualified and authorised personnel.
- Do not use the interlock in areas that are subject to high temperatures, high humidity, dusty air, corrosive gasses, strong vibration and shock. Using the interlock in these conditions may cause a malfunction.
- Care should be taken to prevent foreign objects (such as debris, concrete powder, dust, chippings), oil and rainwater from entering the interlock. Using the interlock in these conditions may cause a malfunction.
- If the ACBs are draw-out types, do not insert the bodies into the chassis until the installation of the interlock system has been complete. If the ACBs are fixed insure the ACBs are locked off during installation Failure to do so may result in damage to the interlock or personal injury.
- Do not bend the interlock cables at the radius of less than 200mm. Doing this may result in damage to the interlock cables causing the interlock to fail.
- Insert the interlock wire until it stops at the grove end of the lever. Insufficient insertion of the wire could result in damage to the interlock.
- Be sure to adjust the distance between the support and the lever. Failure to do this can result in damage to the interlock.
- If the ACBs are draw-out types, ensure the ACBs are off while racking them into the chassis. Failure to do this can result in damage to the interlock.

■ Operation & Maintenance

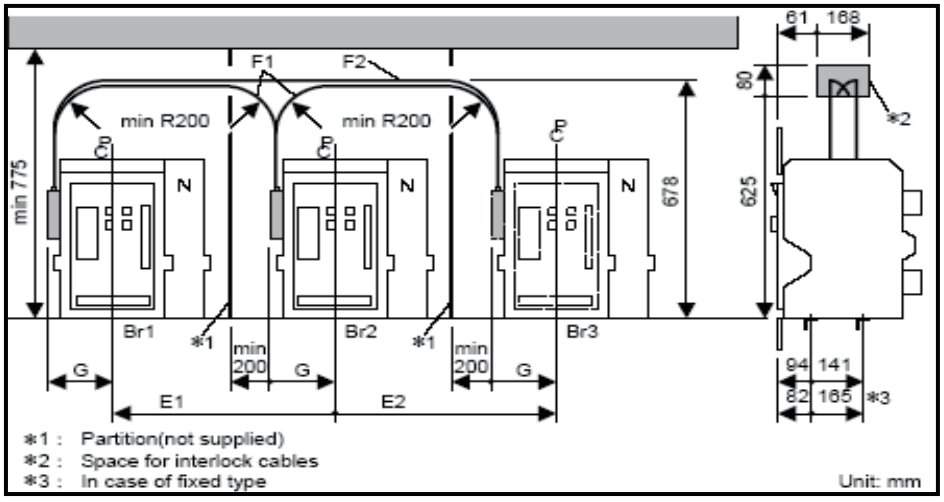
- Do not touch the interlock during operation. Doing so may result in personal injury.
- Maintenance and/or inspection of the interlock system must only be carried out by qualified and authorized personnel.
- Before commencing maintenance work, remove the ACB bodies from the chassis or lock off the ACBs. Failure to do so may result in damage to the interlock or personal injury.
- If the ACBs are draw-out types, ensure the ACBs are off while racking them into the chassis. Failure to do this can result in damage to the interlock.

■ Types & Operations

	Type	Operation Br1	Br2	Br3	Remark
TYPE C.		ON	OFF		One of two breakers can be turned on.
		OFF	ON		
		OFF	OFF		
TYPE B.		ON	ON	OFF	One or two of three breakers can be turned on.
		ON	OFF	ON	
		OFF	ON	ON	
		ON	OFF	OFF	
		OFF	ON	OFF	
		OFF	OFF	ON	
		OFF	OFF	OFF	
TYPE D.		ON	OFF	OFF	One of three breakers can be turned on.
		OFF	ON	OFF	
		OFF	OFF	ON	
		OFF	OFF	OFF	
TYPE A.		ON	OFF	ON	Br2 is interlocked with both Br1 and Br3.
		ON	OFF	OFF	
		OFF	ON	OFF	
		OFF	OFF	ON	
		OFF	OFF	OFF	

- The interlock is enabled in the connected position. When the ACB is in the TEST, ISOLATED or DRAW-OUT Position the interlock is disabled.
- If all the ACBs in the interlock system are open and receive a close (on) signal, none will turn on. However, if this occurs there will be momentary continuity between the main circuit and the auxiliary switch A-contact in all the ACBs.
- The body of the other ACB(s), as long as they are off (open) can be drawn out or inserted, irrespective of the state of the other ACB(s). NOTE: Do not draw out or insert an ACB body during cable installation, adjustment or operation check.

■ Specifications



℄ ACB front cover centre line.

There should be a minimum of 200mm-gap left between the interlock mechanism and the cabinet wall, this is to enable cable installation, adjustment or operation check.

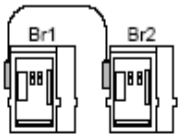
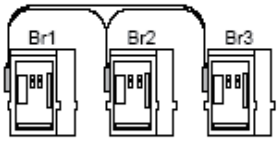
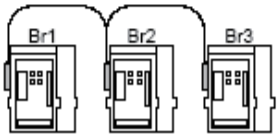
■ Mounting the ACBs

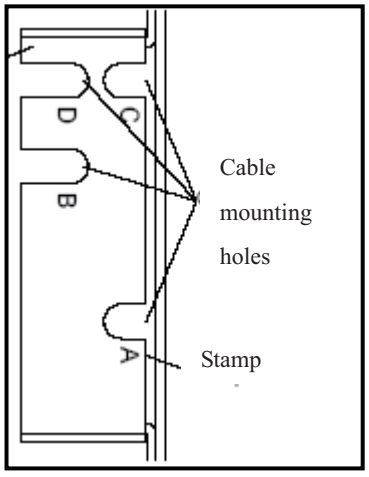
- Before mounting the ACBs check the type of interlock, number and length of the cables to ensure they are as ordered.
- Install the ACBs (for fixed type) or chassis (for draw-out type) in the switchboard (see specifications section aforementioned for dimensions).
- When installing the ACBs, be sure to locate each ACB as you have specified (i.e. middle, left or right) when ordering. A different arrangement does not permit correct installation of the interlock cables.
- If the ACBs are draw-out types, do not insert the bodies into the chassis until the installation of the interlock system has been complete. If the ACBs are fixed insure the ACBs are locked off during installation.

■ Cable Connections

The following illustration shows he connections between the ACBs.

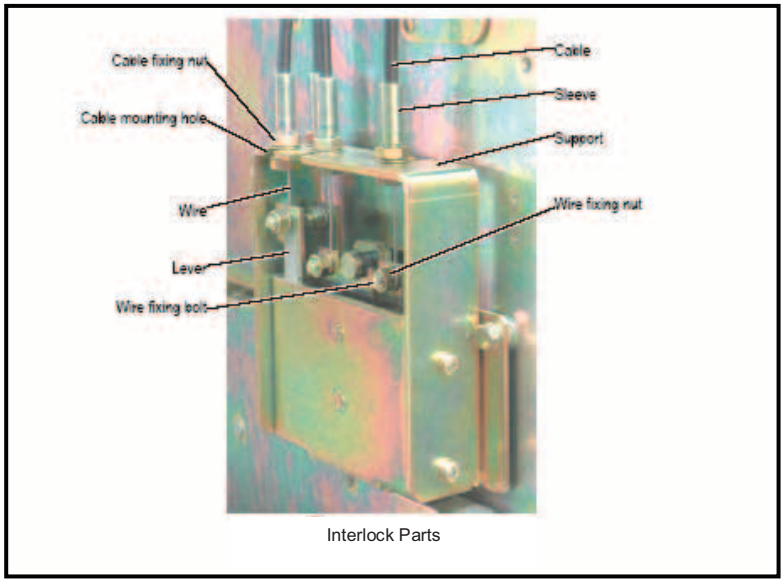
CABLE CONNECTION

	Type	Cable	Connection Br1	Connection Br2	Connection Br3	Priority
TYPE C.		F1 2pcs	A	D		-
			D	A		
TYPE B.		F1 4pcs	A	D		2
			C	A		
TYPE D.				B	C	1
				C	B	
		F2 2pcs	B		D	2
			D		A	
TYPE A.		F1 4pcs	A	D		2
			D	A		
				B	D	
				C	A	1



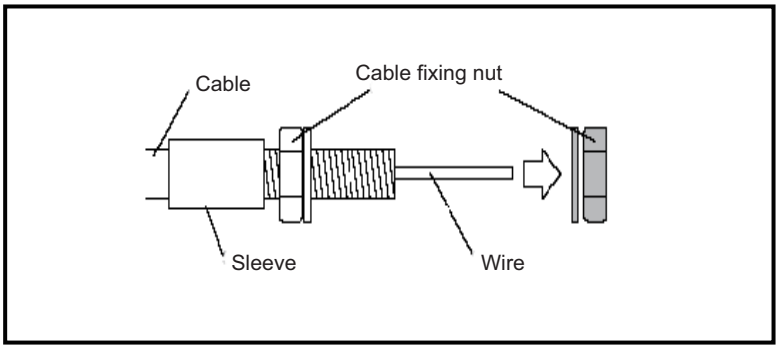
■ Mounting the Cables

- When installing the interlock cables, first perform the priority 1 connections and then priorty 2 in cable connections chart above. Then follow the steps 1 to 10.

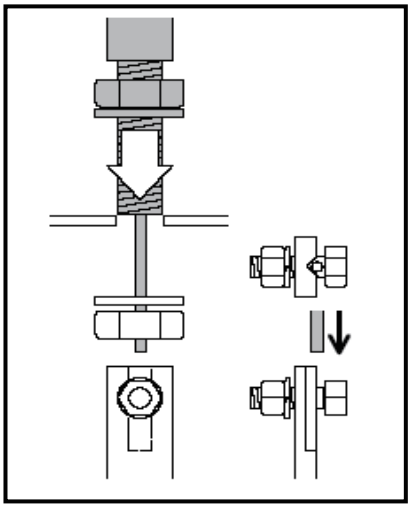


Interlock Parts

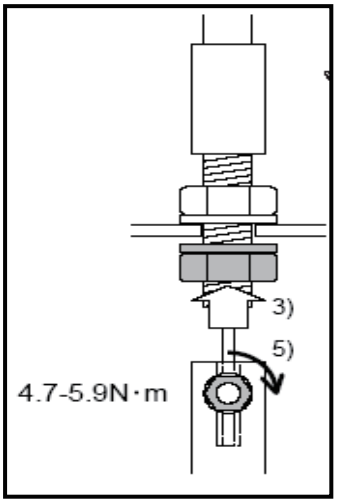
1 Loosen the cable fixing nut and the wire fixing nut.



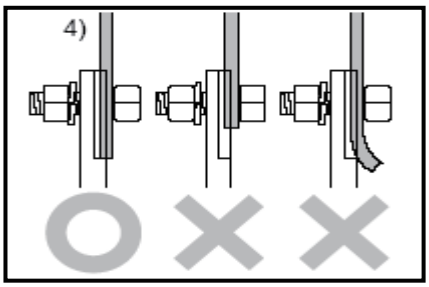
2 Attach the cable in the cable mounting Hole and insert the wire into the wire Insertion hole of the wire fixing bolt.



3 Temporarily tighten the cable fixing nut.



4 Push in and hold the wire until It stops against the groove end of the level.

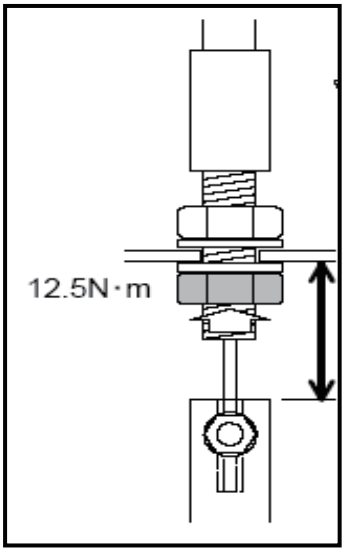


5 Holding the wire, tighten the Wire fixing nut to a torque of 4.7 to 5.9 N.m.

Unit: mm

Cable mounting hole	Distance
A,B	38.5±0.5
C,D	22±0.5

6 Repeat steps 1 to 5 for the wire on the other end of the cable.



7 Make sure the distance between the support and the lever is as specfied and then tighten the cable fixing nut to a torque of 12.5N.m. If the distance is out of the specfied range, proceed to step 8 to adjust the distance.

8 If the distance is too small, turn the cable-fixing nut counter clockwise to lower the sleeve and the lever, increasing the distance until it falls within the specified range. If the distance is too large, turn the cable-fixing nut clockwise to raise the sleeve and the lever

9 If the ACBs are of a draw-out type, insert the ACB bodies into the chassis to the connected position. Do not turn the ACB(s) on until it is in the connected position. If the ACB is a fixed typed, unlock the ACB.

10 After making sure the main circuit is not energised, check the operation of the ACB(s). Do not touch the interlock during operation.

■ Inspection & Maintenance

- If the ACBs are draw-out types, remove the ACB bodies from their chassis. If the ACBs are fixed ensure the ACBs are locked off.
- Check the wire fixing nut and cable fixing nut for tightness. If loose, retighten to the specified torque.
- Make sure the distance between the support and the lever is as specified. If the distance is out of the specified range, readjust it.
- If the ACBs are of a draw-out type, insert the ACB bodies into the chassis to the connected position. Do not turn the ACB(s) on until it is in the connected position. If the ACB is a fixed type, unlock the ACB.
- After making sure the main circuit is not energised, check the operation of the ACB(s). Do not touch the interlock during operation.

Published in March 2009.
Last updated: April 2021.
The contents of this manual may be subject to change without notice.
Recycle paper used.

TERASAKI ELECTRIC CO., LTD.

Head Office: 6-13-47 Kamihigashi, Hirano-ku, Osaka 547-0002, Japan
Circuit Breaker Division: 6-13-47 Kamihigashi, Hirano-ku,
Osaka 547-0002, Japan

TEL +81-6-6791-2763
FAX +81-6-6791-2732
int-sales@terasaki.co.jp
https://www.terasaki.co.jp/

TERASAKI ELECTRIC (M) SDN, BHD.

Lot 3, Jalan 16/13D, 40000 Shah Alam, Selangor Darul Ehsan, Malaysia

TEL +60-3-5549-3820
FAX +60-3-5549-3960
terasaki@terasaki.com.my

TERASAKI ELECTRIC TRADING & SERVICES (M) SDN. BHD.

No. 20 & 22, Jalan Rajawali 2, Bandar Puchong Jaya, Jalan Puchong, 47100 Selangor Darul Ehsan, Malaysia

TEL +60-3-8070-2486, +60-3-8075-1542
FAX +60-3-8070-2481
sales@terasaki.com.my

TERASAKI DO BRASIL LTDA.

Rua Olof Palme, No. 765,
Barra da Tijuca - Rio de Janeiro, Brazil

TEL +55-21-3301-9898
FAX +55-21-3301-9861
terasaki@terasaki.com.br
http://www.terasaki.com.br

TERASAKI ELECTRIC (CHINA) LTD.

72 Pacific Industrial Park, Xin Tang Zengcheng, Guangzhou 511340, China

TEL +86-20-8270-8556
FAX +86-20-8270-8586
terasaki@public.guangzhou.gd.cn

TERASAKI ELECTRIC GROUP SHANGHAI REPRESENTATIVE OFFICE

Room No. 1405-6, Tomson Commercial Building
710 Dong Fang Road, Pudong, Shanghai, 200122, China

TEL +86-21-58201611
FAX +86-21-58201621
terasaki@vip.163.com

TERASAKI ELECTRIC (EUROPE) LTD.

80 Beardmore Way, Clydebank Industrial Estate
Clydebank, Glasgow, G81 4HT, Scotland (UK)

TEL +44-141-941-1940
FAX +44-141-952-9246
marketing@terasaki.co.uk
http://www.terasaki.com/

TERASAKI ELECTRIC (EUROPE) LTD. FILIALE ITALIA

Via Ambrosoli, 4A-20090 Rodano, Milano, Italy

TEL +39-02-92278300
FAX +39-02-92278320
terasaki@terasaki.it
https://www.terasaki.it/

TERASAKI ELECTRIC (EUROPE) LTD. SUCURSAL EN ESPAÑA

Pol. Ind. Coll de la Manya, C/Cal Ros dels Ocells 5-7,
08403 Granollers, Barcelona, Spain

TEL +34-93-879-60-50
FAX +34-93-870-39-05
terasaki@terasaki.es
http://www.terasaki.es/

TERASAKI ELECTRIC (EUROPE) LTD. FILIAL SVERIGE

Box 2082 SE-128 22 Skarpnäck Sweden

TEL +46-8-556-282-30
FAX +46-8-556-282-39
info@terasaki.se
https://www.terasaki.se/

TERASAKI CIRCUIT BREAKERS (S) PTE. LTD.

17 Tuas Street Singapore 638454

TEL +65-6744-9752
FAX +65-6748-7592
tecs@tecs.com.sg

Ratings and specifications in this manual may be subject to change without notice.
Latest data can download by matrix code.

NOV. 2021 Ref No. KRB-5417c