Building a better future
Global Leader

Air Circuit Breaker

Instruction Manual

ACB

Air

Circuit

Breaker

Applicable Air Circuit Breaker

- HiAN type : HiAN06, HiAN08, HiAN10, HiAN12, HiAN16, HiAN20, HiAN25, HiAN32, HiAN40, HiAN50, HiAN63
- HiAH type : HiAH32
- HiAS type : HiAS06, HiAS08, HiAS10, HiAS12, HiAS16, HiAS20, HiAS25, HiAS32

Notice

- Please read this instruction manual first before using Air Circuit Breaker.
- Contact the head office or branch office listed on the back if you have any inquiries or technical problems.
- Keep this instruction handy at all times.
- Changing to this instruction manual may be made without previous notice due to quality improvement.
- Refer to our catalog for the rating items on our products.

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

For Operational Safety of Air Circuit Breakers

Safety Notices

We appreciate your kind selection for HYUNDAI Air Circuit Breaker. Following notices are important information regarding safety. Therefore, please be sure to read this instruction manual throughout, so you can be familiarized with transportation, storage, operation, and maintenance before working on the product.

The safety notices are divided into "DANGER" and "CAUTION" according to the hazard level:

⚠ DANGER	This symbol is the danger notice indicating that neglecting the suggested procedure and practice could result in fatal personal injury and property damage.

⚠ CAUTION	This symbol is the caution notice indicating that neglecting the suggested procedure and practice could result in moderate personal injury and property damage. Please note that neglecting caution notices [caution] could result in serious injury and damage in particular circumstances.

Transportation Precaution

⚠ CAUTION	Nothing shall be under the Air Circuit Breaker, such as person, animal, and any subject, when it is lifted or suspended during transportation. The ACB might drop down suddenly. **The ACB is heavy equipment, so being in such an area could cause serious injury and property damage.**

Installation Precautions

⚠ CAUTION	• Installation work must be performed by competent persons. • Prior to commencing any installation work, open an upstream circuit breaker or the like to isolate all sources of power/voltage. **Otherwise, electric shock may occur.** • Tighten terminal screws securely to the specified torque. **Otherwise, a fire may occur.** • Fix the ACB (draw-out cradle) firmly on a flat lever surface using mounting screws. **Otherwise, draw-out operation may cause the ACB to fall.** • Avoid blocking the arc gas vents of the ACB to ensure adequate arc space (insulation distance). **Blocking the vents could result in failure of ACB tripping.** • Do not place the ACB in such an area that is subject to high temperature, high humidity, dusty air, corrosive gas, strong vibration and shock, or other unusual conditions. **Mounting in such areas could cause a fire, non-tripping, or malfunction.** • Be careful to prevent foreign objects (debris, concrete powder, iron powder, etc.) and rainwater from entering the ACB. **These materials inside the ACB could cause a fire or non-tripping.** • For the ACB with four poles, connect the neutral wire of a 3-phase, 4-wire cable to the N-phase pole (on the right end). **Otherwise, an overcurrent may cause non-tripping and a fire.**

Operation Precautions

DANGER

- Never touch live terminal parts.
  Otherwise, electric shock may occur.
- Do not leave the ACB in the draw-out position.
  The ACB is heavy. Dropping the ACB could cause serious injury.

CAUTION

- If the ACB trips open automatically, remove the cause before closing the ACB.
  Otherwise, a fire could occur.
- For the ACB with the fixing block, be sure to loosen the block screws before drawing out the ACB.
  Otherwise, damage to the ACB may occur.

APR Field Test Precautions

CAUTION

- APR field test must be performed by competent persons.
- Never touch live terminal parts.
  Otherwise, electric shock may occur.

Maintenance and Inspection Precautions

CAUTION

- ACB maintenance, inspection and/or parts replacement must be performed by competent persons.
- Prior to commencing any work on the ACB, open an upstream breaker or the like to isolate all sources of power/voltage from both the primary and the auxiliary circuits.
  Otherwise, electric shock may occur.
- Prior to commencing ACB internal inspection, make sure that the ACB is open and the closing spring is released.
  Otherwise, fingers or tools could be pinched in the internal mechanism, causing an injury.
- Retighten the terminal screws periodically to the specified torque.
  Otherwise, a fire could occur.
- Retighten the arcing contact mounting screws periodically to the specified torque.
  Otherwise, a fire or malfunction could occur.
- Be sure to reinstall the arc chute if removed.
  Failure to do so or incorrect installation of the arc chute may result in a fire and cause burns.
- Do not touch ACB live parts (contacts in particular), or structural parts close to a live part, immediately after opening the ACB to stop supplying power.
  Otherwise, remaining heat may cause burns.
- Do not bring your hand or face close to the arc gas vent of the arc chute while the ACB is closed or open.
  Otherwise, burns may result from high-temperature arc gas blowing out of the arc gas vent.

Contents

Upon receipt of your breaker, check the following.
If you have any questions or any problems, contact our agent nearest you.
HYUNDAI Air Circuit Breakers are completely assembled, inspected and tested both electrically and mechanically at the factory, then shipped in fully guaranteed conditions in construction and operation.

1.1 Storage

While it is recommended that the breaker be used as soon as you have received it, you find it is necessary to store the breaker for some time before its installation. If so, please note the followings for proper storage:

1) Store the breaker in a dry indoor location to prevent condensation due to a sudden change in temperature, which is quite harmful to the breaker insulation.
2) Store the breaker in a clean place free of corrosive gases, dirt and dust.
   In particular, a mixture of cement dust and moisture can cause corrosion in the various metal parts of the breaker. Fully protect the breaker from such mixtures.
3) Place the breaker on a flat, level surface in its normal position.
4) Do not place the breaker directly on the floor.

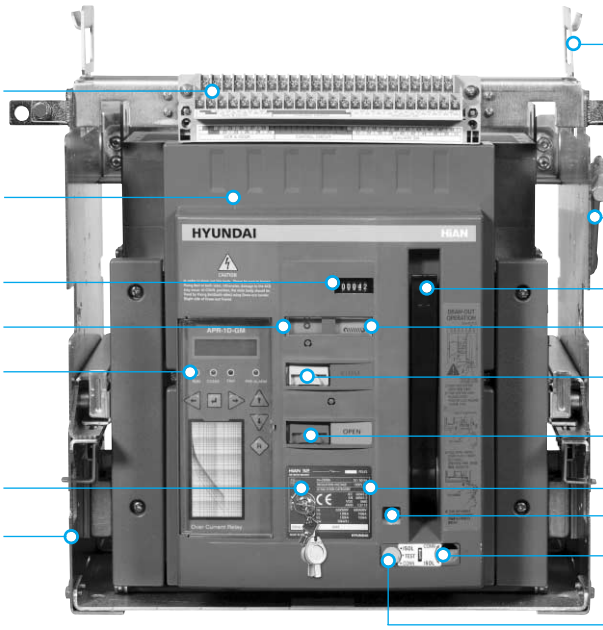
1.2 Directions for Transportation

When transporting the breaker from one place to another, note the following:

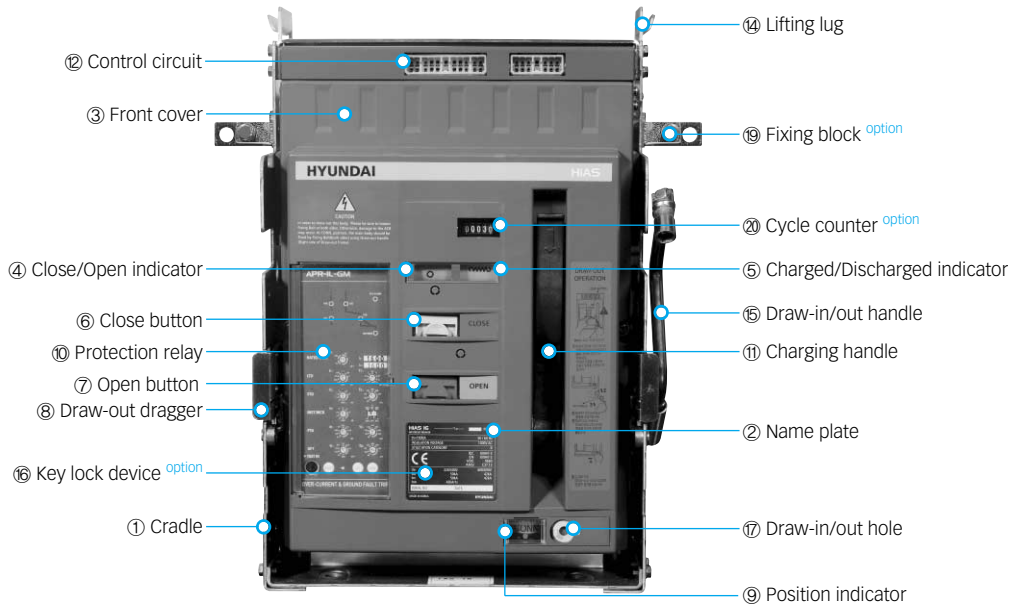
1) When lifting up the breaker, apply wire ropes to the lifting lugs (Fig.1. ⑭).
   Take necessary care to ensure that the tightened wire ropes may not touch the arc chambers and protection relay (Fig.1. ⑩).
   When lifting up the breaker, be sure to lift it up slowly.
2) Lower the breaker onto a flat, level surface.
3) Avoid impacts and shocks to the breaker during transportation.

Fig. 1

HiAN & HiAH type



HiAS Type



HYUNDAI Air Circuit Breakers are available either in manual charging type or in motor charging type.

3.1 Manual Charging Type

In the manual charging type, charging the closing springs and open-close control of the breaker are all done manually. The breaker is able to close only when the closing springs are charged.

> **CAUTION** Do not force down the charging handle after completion of charging.
> **Doing so may cause a malfunction.**

1) Spring charging operation

Follow the procedure given below to charge the closing springs.

- Pump the charging handle (about 4~5 cycles)(Fig. 2).
- When the closing springs are fully charged, a metallic "click" will be heard and no further pumping of the charging handle will be possible. When the charging handle is pumped with its maximum stroke (approx. 105°), about four pumping cycles will complete the charging. Check that the charged/discharged indicator (Fig. 3. ⑤) now shows "CHARGED" or "⊢".

2) Closing operation

Before closing the breaker, check the following items:

- Closing springs should be charged.
- The shutter of the draw-out handle insertion hole (Fig. 3. ⑰) should be completely closed.
- Specified voltage should be applied to the undervoltage trip device (option).
  See the description of the undervoltage trip device foe the procedure in detail.

Upon satisfactory confirmation of the above items, press the CLOSE button (Fig. 3. ⑥).
The breaker is closed. The close/open indicator (Fig. 3. ④) shows "CLOSE", and the charged/discharged indicator (Fig. 3. ⑤) shows "DISCHARGED" or "⊣".

3) Opening operation

Press the OPEN button (Fig. 3. ⑦) this opens the breaker, and the close/open indicator (Fig. 3. ④) shows "OPEN".

Fig. 2

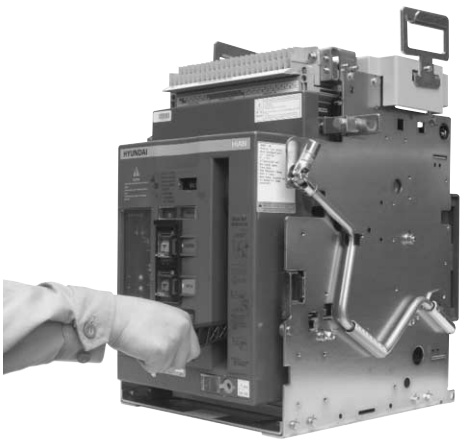
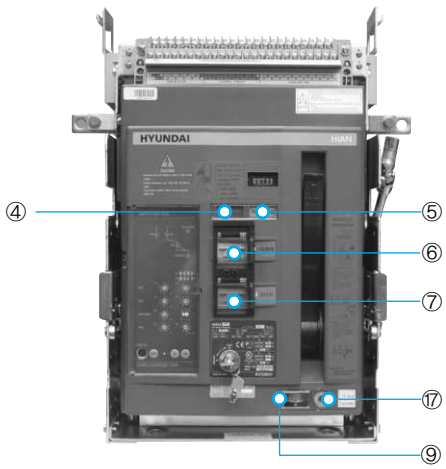


Fig. 3. Front view of breaker



④ Close/Open indicator
⑤ Charged/Discharged indicator
⑥ Close button
⑦ Open button
⑨ Position indicator
⑰ Draw-in/out hole

3.2 Motor Charging Type

In this type, a motor-operated mechanism automatically charges the closing springs.
Means for remote electrical close-open control of the breaker are also fitted.
Complete manual operations are also possible for the same procedures described in above manual charging type section.

1) Spring charging operation

- Supply the specified control power voltage to the charging motor circuit.
- In case of AC motor, check whether the UVT is applied to specified voltage.
- As soon as the closing springs are discharged, the charging motor is turned on to charge the closing springs.
- The charging motor is automatically stopped when the closing springs are fully charged, and the charged/discharged indicator (Fig. 3. ⑤) shows "CHARGED" or "⊢".
  While the charging time varies depending on the rated control voltage and the type of breaker, it is normally within a range of 3 to 10 seconds.

> **CAUTION**
> - The permissible control voltage range foe the charging motor is 85 to 110% of the rated voltage. It is strongly recommended to supply the control power at the rated voltage.
> - When dielectric withstand voltage test is carried out, the dielectric withstand voltage of motor for DC, AC110 and 220 V is 1500 V but for DC24 and 48 V is 500 V.

2) Closing operation

Before closing the breaker, check the following items:

- Closing springs are charged.
- The shutter of the draw-out handle insertion hole (Fig. 3. ⑰) is completely closed.
- Specified voltage is applied to the undervoltage trip device (option).

Upon satisfactory confirmation of the above items, press the CLOSE button.
This enegizes the latch release coil, which, in turn, releases the charged closing springs and the breaker is immediately closed.
The spring charged indicator (Fig. 3. ⑤) shows "DISCHARGED" or "⊣".
With the closing springs discharged the charging motor is immediately turned to charge the closing spring.

> **CAUTION**
> Even when item 2) is not satisfied, the breaker will not be placed in a closed state.
> Be sure to perform closing operation according item 2).

3) Opening operation

The shunt trip device (SHT) or undervoltage trip device (UVT) is used for remote electrical opening operation.
Press the OPEN button. This opens the breaker via the SHT or UVT.

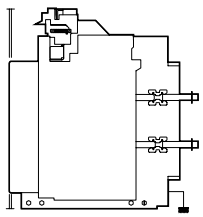
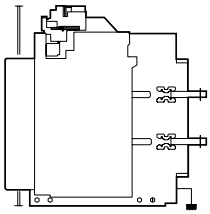
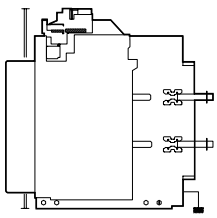
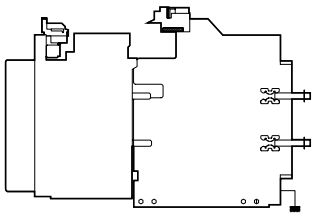
> **CAUTION**
> When close-open operations are repeated with the charging motor ON, limit the number of successive close-open cycles to 10 times. If the open-close cycle is repeated more than 10 times, allow a cooling period of at least 10 minutes between the 10th cycle and the 11th cycle.

The draw-out mechanism permits one to draw out and remove the breaker body from the draw-out cradle and to put the breaker body back into the cradle, which facilitates the inspection and parts replacement.
The draw-out mechanism permits one to move the breaker body to any of the following three positions in the draw-out cradle.
The switchboard panel door can be shut with the breaker body drawn out to the TEST or ISOLATED position.
The auxiliary switch assembly mounted on the body works in the CONNECTED, TEST and ISOLATED position.

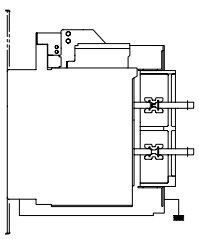
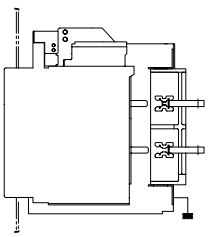
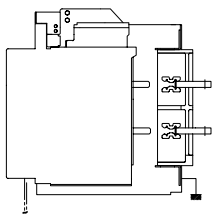
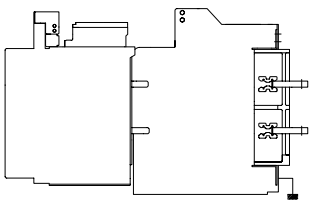
➡ Operational precautions

- Open the breaker before working with the draw-out mechanism.
- Be sure to loosen the screws of the fixing blocks (Fig. 1.⑲) before drawing out the breaker body.
  If provided otherwise, a malfunction may occur.
- When you try to move the breaker body to the CONNECTED position, the operating force, will increase.
  Further rotate the draw-out handle to move the breaker body to the CONNECTED position.
  Typical operating force is about 25kgf.
- When the breaker is in connect position, stop turning the draw-out handle.
  Otherwise, a malfunction may occur.
- Make sure the draw-in/out hole (Fig. 1.⑰) is closed after the draw-out handle is removed.
  Only at the exact position (ISOLATED, TEST, CONNECTED) the draw-in/out hole (Fig. 1.⑰) can be closed.

HiAN & HiAH type

➡ CONNECTED position	➡ TEST position	➡ ISOLATED position	➡ REMOVED position
			
Both the main and control circuit are connected for normal service.	The main circuit is disconnected and the control circuit is connected. This position permits operation tests without the opening of the switchboard panel door.	Both the main and control circuit are disconnected. The switchboard panel door can be closed.	The breaker body is competely removed from draw-out cradle.

HiAS type

➡ CONNECTED position	➡ TEST position	➡ ISOLATED position	➡ REMOVED position
			
The main circuit is connected and the control circuit is disconnected. After the connection of control circuit, electrical operation is possible.	Both the main and control circuit are disconnected. After the connection of control circuit, electrical operation tests without the opening of the switchboard panel door are possible.	Both the main and control circuit are disconnected. After the connection of control circuit, electrical operation is possible.	The breaker body is competely removed from draw-out cradle.

4.1 Moving the Breaker Body Within Draw-out Cradle (HiAN & HiAS06-32 Type)

The draw-out handle (Fig. 4. ⑮) is used to move the breaker body to one of the three positions (CONNECTED, TEST and ISOLATED) in the draw-out cradle. Attached draw-out handle (installed externally to the breaker) is to be used.

CAUTION

When the fixing blocks (optional) are fitted, be sure to loosen the right and left screws of the fixing blocks before drawing out the breaker body.
Otherwise, a malfunction may occur.

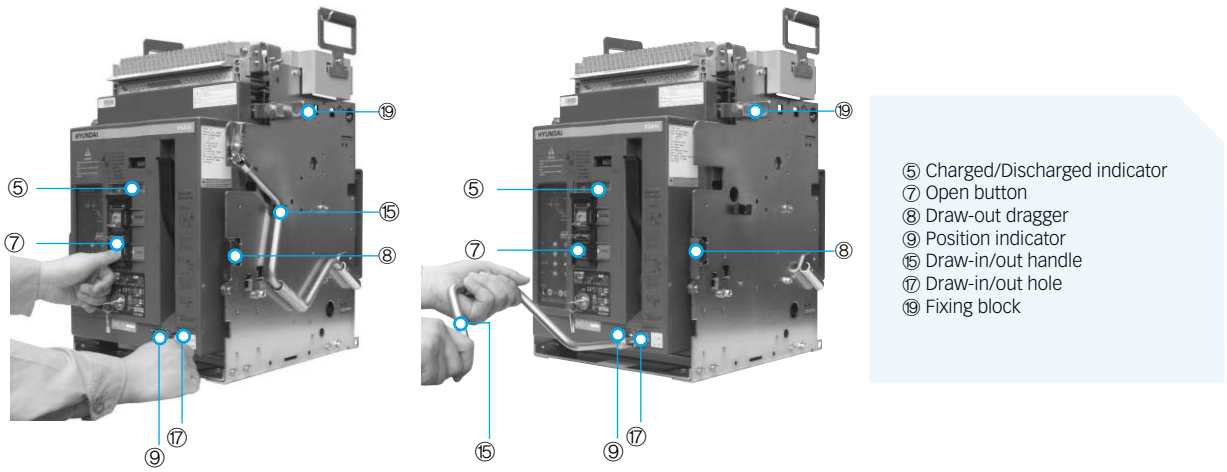
1) Moving to TEST position

- When the fixing blocks are fitted, loosen and free the right and left screws.
- Check that the breaker is OPEN. If it is CLOSED, press the OPEN button (Fig. 4. ⑦) to open the breaker.

CAUTION

When the main circuit is seperated for drawing out, the breaker is occured to be pushed forward the front due to operating spring of the main circuit contacts.
A metallic "Click" will be heard, it varies the type of breaker. The breaker performance is not related the hoise.

Fig. 4



- Press the OPEN button (Fig. 4. ⑦) and open the shutter of the draw-out handle insertion hole (Fig. 4. ⑰) at the same time.
- Engage the draw-out handle to the draw-out handle insertion hole and turn the handle counterclockwise to move the breaker body. The position indicator moves to the test position.

CAUTION

When the draw-out handle is inserted in the draw-out mechanism shaft, the breaker is prevented from being closed.
For close-open test, remove the draw-out handle and close the shutter of the draw-out handle insertion hole (Fig. 4.⑰).
If the shutter of insertion hole is not closed, it means ACB is on wrong position.
The shutter of insertion hole should be closed by draw-out handle after correct position readjustment.

DANGER

Injured human life.
Keep the circuit breaker in the OPEN position when ACB insert to connect position.

2) Moving to ISOLATED position

• The draw-out handle (Fig. 4. ⑮) turns counterclockwise to move from TEST to ISOLATED position.

⚠ CAUTION	Do not force down when the draw-out handle can not be further turned. It is caused damage of draw-out mechanism.

3) Further withdrawal and removal of breaker body from ISOLATED position

The breaker body may be further drawn out from the ISOLATED position to remove it from the draw-out cradle for inspection, maintenance or parts replacement purposes.

If the breaker is in charged condition, perform close-open operation once, and release the closing spring.

• Slowly draw out the breaker body from the draw-out cradle until the draw-out dragger stops (Fig. 4. ⑧)

⚠ CAUTION	Do not leave the breaker body as it is. When the above operation is made in as-received condition to separate the breaker body from the cradle, take necessary measures to prevent the possible turnover due to a change in the center of gravity.

• Lift the breaker body's front part to release stopper and pull out again.

⚠ CAUTION	• Never enter under the breaker. The breaker weight will cause serious injuries in the event that it drops. • This process should be performed slowly. • At this process, be sure to install crane or rope to breaker's body.

4.2 Putting the Breaker Body Back into Draw-out Cradle (HiAN & HiAS06-32 Type)

Follow the procedure given below to put the removed breaker body back into the draw-out cradle.

• Check that the breaker is OPEN, then check that the position indicator (Fig. 4. ⑨) showing " ISOLATED".

• Check that the charged indicator (Fig. 4. ⑤) shows "DISCHARGED" or "⌇⌇⌇" indicating the closing springs are discharged.

• Lift up the breaker body or use a special lifter. Attach the body extention rail to roller of the cradle and push in the breaker body slightly, as this time the body coil be stopped by stopper.

⚠ CAUTION	Never enter under the breaker. The breaker weight will cause serious injuries in the event that it drops. Do not force down the breaker body. It is caused damage of the breaker.

• To release the stopper, lift up the body's front part and push in again until the extention rails are locked.
This position is "ISOLATED".

• Press the OPEN button and to open the shutter of the draw-out handle insertion hole at the same time, and engage the draw-out handle to draw-out handle insertion hole (Fig. 4. ⑰).

• Turn the draw-out handle clockwise to send the breaker body into the draw-out cradle.
The position indicator (Fig. 4. ⑨) now shows "TEST".
Turn the draw-out handle clockwise to send the breaker into the CONNECTED position.

Mating of the primary disconnect device starts just before the CONNECTED position, and the draw-out handle will become heavy, but continue to turn the handle. When the breaker is sent into the CONNECTED position, further turning effort on the draw-out handle will be stopped.
The position indicator now shows "CONNECTED". Remove the draw-out handle (Fig. 4. ⑮).

• When the fixing blocks (Fig. 4. ⑲) are fitted, fully tighten the right and left fixing screws using the draw-out handle.

Fig. 5

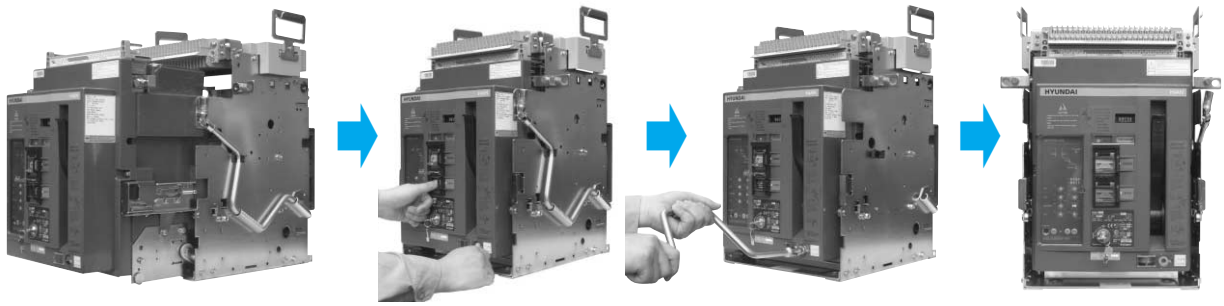
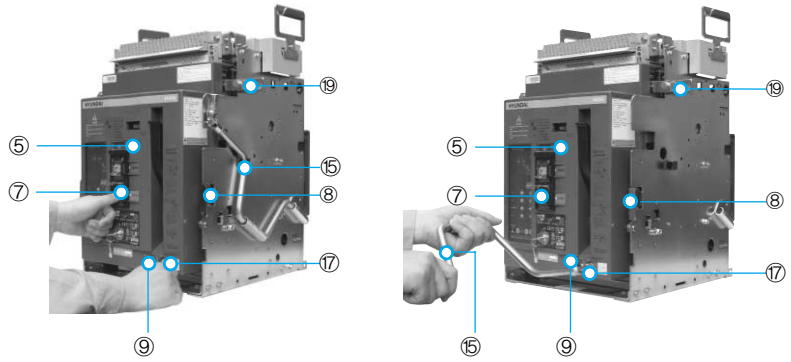


Fig. 6



⑤ Charged/Discharged indicator
⑦ Open button
⑧ Draw-out dragger
⑨ Position indicator
⑮ Draw-in/out handle
⑰ Draw-in/out hole
⑲ Fixing block

4.3 Operation of Draw-in/out Mechanism (HiAN40-63 & HiAH32 Type)

The draw-out mechanism permits one to draw out and remove the breaker body from the draw-out cradle and to put the breaker body back into the cradle, which facilitates the inspection and parts replacement. The draw-out mechanism permits one to move the breaker body to any of the following three positions in the draw-out cradle. The switchboard panel door can be shut with the breaker body drawn out to the CONNECTED or TEST or ISOLATED positions.

Operation precautions

- Open the breaker before working with the draw out mechanism.
- Be sure to loosen the screws of the fixing blocks if provided otherwise, a malfunction may occur.
- Please insert the draw-out handle (Fig. 9. ③) after the cover plate of handle insertion hole (Fig. 8. ②) comes down.
- When you try to move the breaker body to the CONNECTED position, the operating force will increase. Further rotate the draw-out handle to move the breaker body to the CONNECTED position. Typical operating force is about 25kgf.
- Be sure to close the handle cover plate, when the draw-out handle is drawn out.
  - Incomplete position of the breaker body in the cradle shall make the breaker unclosed.

CONNECTED Position	In this position, the main circuit and control circuits (of the breaker) are connected to the external circuits for normal service.
TEST Position	In this position, the main circuit is isolated, and the control circuits are connected. This position permits closed-open test, control circuit connected. This position permits closed-open test, control circuit.
ISOLATED Position	In this position, the main circuit and control circuits are isolated. The breaker is completely de-energized in this position.

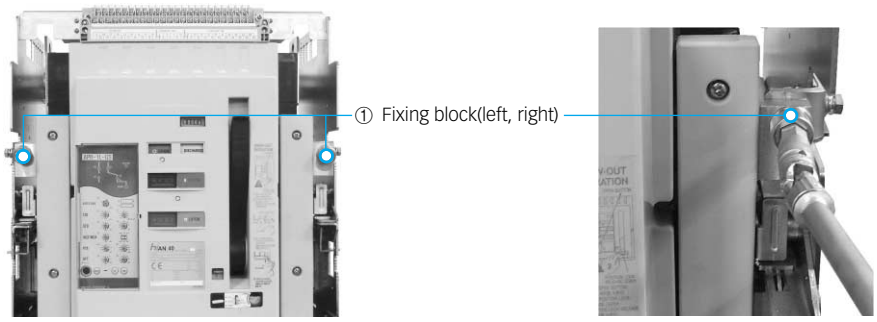
4.4 Draw-out Operation of ACB Body (HiAN40-63 & HiAH32 Type)

The draw-out handle (Fig. 9. ③) is used to change the breaker position in the draw-out cradle.

1) Moving to TEST position

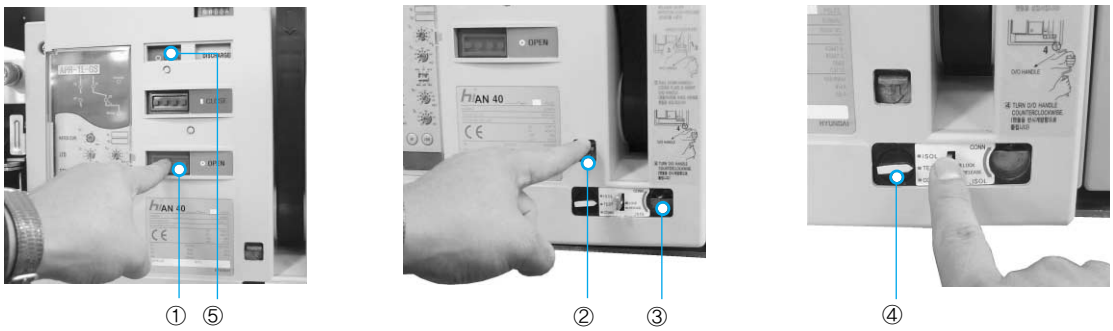
• (Fig. 7. ①) When the fixing blocks are fitted, loosen and free right and left screw.

Fig. 7



• Check that the breaker is open, press the OPEN button (Fig. 8. ①) to open the breaker.

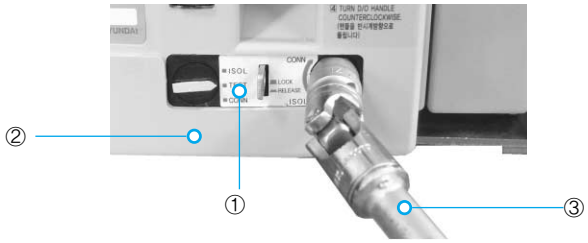
Fig. 8



① Open button
② Handle cover plate
③ Draw-in/out hole
④ Position indicator
⑤ Close/Open indicator

• Please insert the draw-out handle (Fig. 9. ③) after the cover plate of handle insertion hole (Fig. 8. ⑬) comes down.
• Turn the draw-out handle (Fig. 9. ③) counterclockwise to change CONNECTED position to TEST position after the connection with draw out mechanism shaft in draw-out hole (Fig. 8. ③).
  - When the breaker is on TEST position, the position indicator (Fig. 9. ③) points TEST.

Fig. 9



① Position indicator
② Front cover
③ Draw-in/out handle

CAUTION	When the main circuit is seperated for drawing out, the breaker is occured to be pushed forward the front due to operating spring of the main circuit contacts. A metallic "click" will be heard, it varies the type of breaker. The breaker performance is not related the noise. A metallic sound will be heard when the breaker draws out to TEST position, it means the breaker is locked TEST position. The breaker can not move even if the handle is further turned. The position indicator (Fig. 9.①) shows now TEST position. Turning the handle by further force is caused damage in the breaker.

CAUTION	The breaker is not closed when the draw-out handle is inserted. Remove the draw-out handle when the operation test is carried out.

2) Moving to isolated position

• Turn counterclockwise the draw-out handle (Fig. 9. ③) to move from TEST to ISOLATE position.

CAUTION	When the breaker is drawn out to ISOLATED position, a metallic "click" will be heard. And do not turn the handle by further force, it means the breaker is locked at ISOLATED position. Turning the handle by further force is caused damage in the breaker.

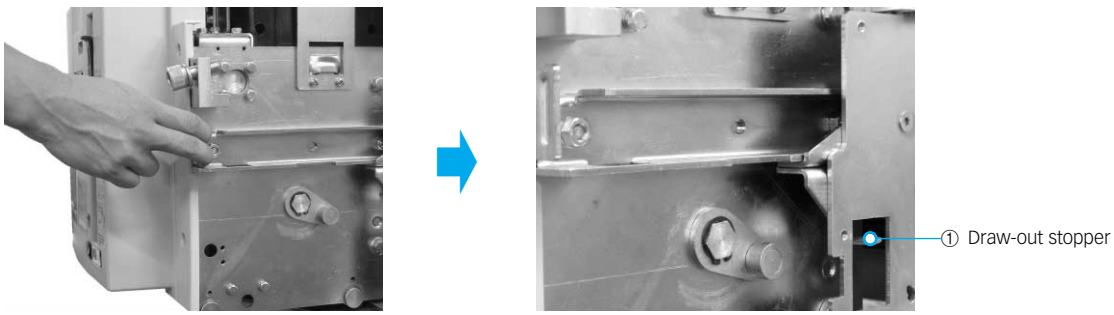
- When located in the ISOLATED position, the position indicator (Fig. 9. ①) points ISOLATED.

3) Further withdrawal and removal of breaker body from ISOLATED position

The breaker body may be further drawn out from the ISOLATED position to remove it from the draw-out cradle for inspection, maintenance or parts replacement purpose.
If the breaker is in charged condition, perform close-open operation once, and release the closing spring.

• Pull down the right-left draw-out stopper (Fig. 10. ①) to release lock, draw out the breaker until the stopper (Fig. 10. ①) is located lock slowly.

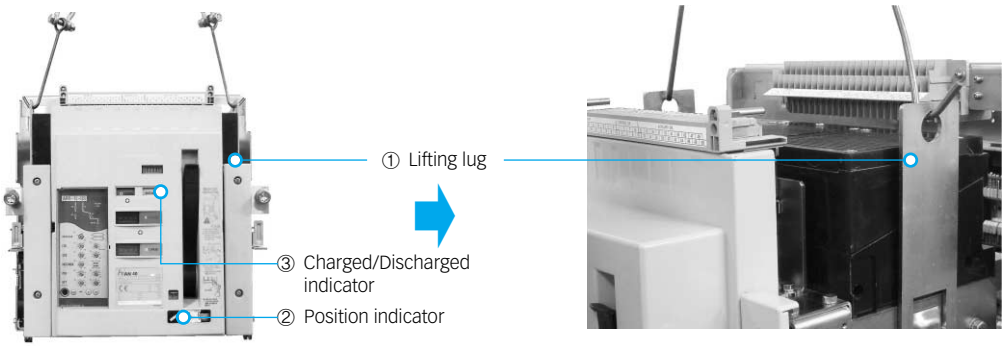
Fig. 10



CAUTION	Do not leave the breaker body as it is. When the breaker is drawn out, the draw-out cradle should be fixed to PNL due to a change in the center of gravity.

• After lifting lug (Fig. 11. ①) hangs with the wire lope, pull down the right-left draw out stopper (Fig. 10. ①) to release lock, lift up the breaker body or use a special lifting lug to separate from the cladle.

Fig. 11



CAUTION

Never enter under the breaker.
The breaker weight will cause serious injuries in the event that it drops.

CAUTION

Do not turn the draw out handle from it is located lock position.
Turning the handle by further force is caused damage in the breaker.
Draw out the handle when open and shut test is performed.

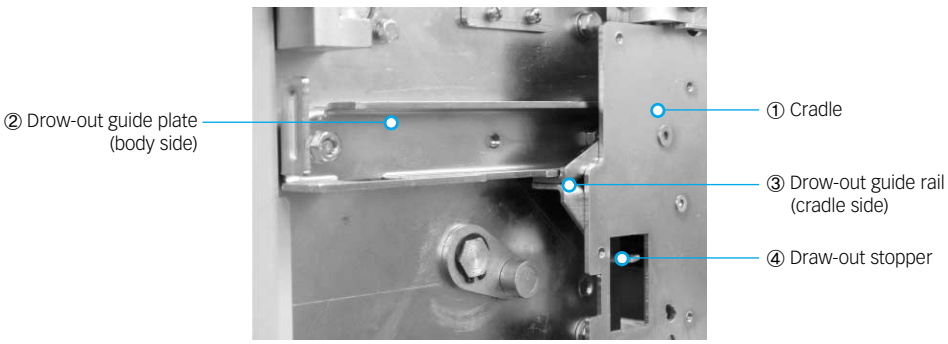
4.5 Draw-in Operation of ACB Body (HiAN40-63 & HiAH32 Type)

1) Open the breaker before working with the draw out mechanism check the position indicator (Fig. 11. ②) shows ISOLATED position.
2) Check the indicator (Fig. 11. ③) to be released the closing spring.
   The indicator shows "DISCHARGED" or "".
3) Lift up the breaker body or use a special lifter, push the breaker body into the cradle, inserting body's draw-out guide plate (Fig. 12. ②) into the draw-out guide rail (Fig. 12. ③) exactly.

CAUTION

Never enter under the breaker.
The breaker weight will cause serious injuries in the event that it drops.

Fig. 12



4) Push the breaker in until the right-left draw-out stopper (Fig. 12. ④) is locked.

It is the ISOLATED position that draw out stopper (Fig. 12. ④) is locked automatically.

5) Insert the draw-out handle (Fig. 9. ③) after the cover plate of handle insertion hole (Fig. 8. ⑬) pulled down.

6) Turn the draw-out handle (Fig. 9. ③) clockwise to push the breaker body toward draw-out cradle until connected position.

When draw-out position indicator shows TEST, turn the draw-out handle (Fig. 8. ③) clockwise to move the breaker to the connected position.

The connection of main circuit begins before the connected position, at this position, at this point draw-out handle is workable. If the breaker comes to the connected position by keeping the handle turning, the breaker is locked and draw-out position indicator (Fig. 11. ②) shows CONN, remove draw-out handle (Fig. 9. ③) and fix it on the right of draw-out cradle.

8) When the fixing block (Fig. 7. ①) is mounted, tighten left and right fixing screws.

⚠ CAUTION	Not screwing the fixing block in vibration state, it is caused damage of the breaker.
⚠ CAUTION	Do not turn the draw-out handle when it is locked. Turning the handle by further force is caused damage in the breaker.
⚠ CAUTION	Operating handle feels hard but it means the contact of main circuit part begins so the inserted load is about to increase. There is no trouble in connected position approximately, turning the handle 2 to 2.5 times with force, it changes to the CONNECTED position from the test position.
⚠ CAUTION	The mechanical noise (crack) which is one of the way to confirm the draw out position could not be heard because of surrounded environment. In this case, focus on the change of operating force. If the handle is not movable to the left or the right, that's the completed position. Turning the handle by further force at it's locked position causes damage in the breaker.
⚠ CAUTION	The breaker does not operate when it is between TEST and CONNECTED postion. Check the indicator, the cover plate of handle insertion hole (Fig. 8.②) closes automatically between TEST and CONNECTED postion.
⚠ CAUTION	The breaker never operate properly when the cover plate of handle insertion hole (Fig. 8.②) is open (between TEST and CONNECTED position).

Frequency of periodic inspection

It is the most appropriate that user works out his or her own inspection plan for breakers according to the switching frequency, the values of normal making and breaking currents, the magnitude of fault current interrupted, service conditions and environmental conditions.
Otherwise it is recommended to perform a simplified inspection once every 6 months and full inspection once a year.
Be sure to draw out the breaker to the ISOLATED position or to remove the breaker body from the draw-out cradle for inspection or parts replacement purposes.

Mechanical durability of the breaker

The following table shows the mechanical durability of the breaker in terms of the number of swithcing cycles. When the breaker switching cycles exceed those shown in the table, the possibillity of failure may increase.
For renewal or thorought inspection of the breaker, contact HHI.

Frame size	2500 AF or smaller	3200 AF or smaller
NO. of switching cycles	Over 5000	Over 3000

Frequency of periodic inspection

While it is the most appropriate that user works out his or her own inspection plan for the breakers according to the swithching frequency, the values of normal making and breaking currents, the magnitude of fault current interrupted, service conditions and environmental conditions, it is recommended to perform a simplified inspection once every 6 months and full inspection once a year.

Swithcing conditions of ACB	Inspection interval based on swithcing cycles		
	Below 630 frame (A)	1250~2500 frame (A)	Over 3200 (A)
Switching operation in the state of nearly no-carrying current	1000	1000	1000
Switching operation in the rated current region	500	500	100
Swithcing operation in overload region (about 2-3 times the rated current)	25	25	10
Switching operation in current interruption region	Each time	Each time	Each time

CAUTION

Be sure to draw out the breaker to the ISOLATED position or to remove the breaker body from the draw-out cradle for inspection or parts replacement purposes.
Make sure that live parts have cooled down before performing inspection work.

5.1 Arc Chamber

Check each arc chamber during the periodic inspection and also after a fault current was interrupted.
A cracked arc chamber cover or deionized grid side plate, or a heavy, hard-to-remove molten contact or deionized grid pieces inside of the arc chamber, requires replacement of the arc chamber unit.

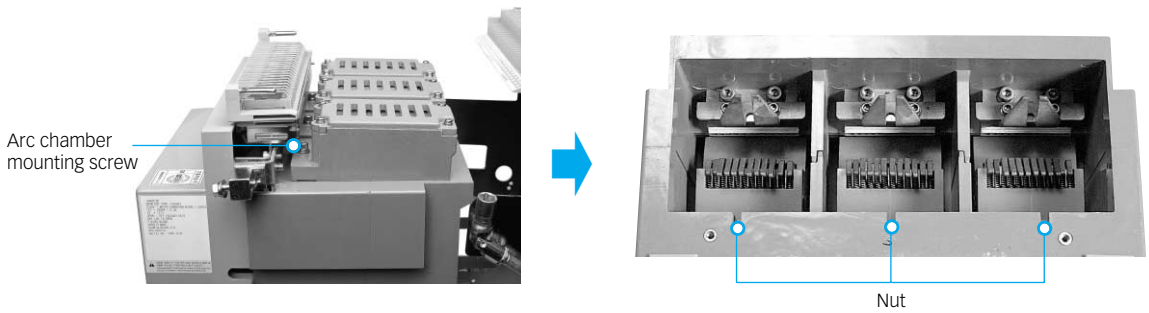
1) Periodic inspection

Inspection item	Method / Criteria
Dirt, Dust, Forenign matter	Check visually. Inside must be clean, free of foreign matter and dust. Blow off foreign matter and dust with a jet of compressed air.
Cracks	Check visually. There should be no cracks or other damage. Replace arc chamber if cracked or damaged.

2) Removal and mounting

Loosen the one-mounting screws captivated on an arc chamber until they are free, then remove the arc chamber & nut. To mount the arc chamber, set nut & arc chamber in position and tighten the one-mounting screws.

Fig. 13



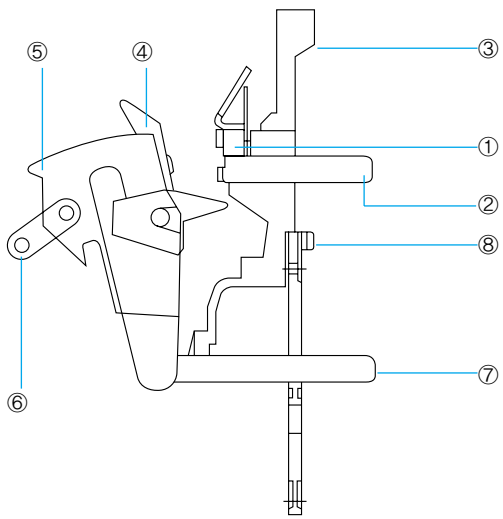
CAUTION

Do not perform on-off operation with the nut installed after removing the arc chamber.
Otherwise the nut will slip into the contact unit.

5.2 Contacts

The pole contact assemblies are visible and accessible when the arc chutes are removed.
Check them during a periodic inspection and after a short-circuit fault current was interrupted.

Fig. 14



① Stationary arcing contact
② Stationary main contact
③ Co-mold
④ Moving contact
⑤ Moving contact fixed base
⑥ Crossbar link
⑦ Low terminal
⑧ Terminal cover

1) Periodic inspection

(1) Arcing contacts

Inspection items	Methods / Criteria
Contact tip surfaces	• Check visually. • Blackening of contact tip surfaces is due to oxidation and subformation. and will not lead to any problems since it is wiped off in closing operation. • Remove dirt, dust, grease, etc. • Dress roughened surfaces with fine emery paper (# 200). If thickness of contact tip is reduced to of original value after a number of dressing operations, replace both the moving and stationary arcing contacts.
Mounting conditions	• Check each moving arcing contact for loosenting of mounting bolts (Fig. 15. ③). • Check each contact tip pair for proper alignment in the closed position.

(2) Main contacts

It the main contacts were toughened wear, clean their surfaces at the time of a periodic inspection.

CAUTION When contact tips, be careful not to let dust fall into the breaker mechanism. After cleaning, be sure to wipe and clean the tips.

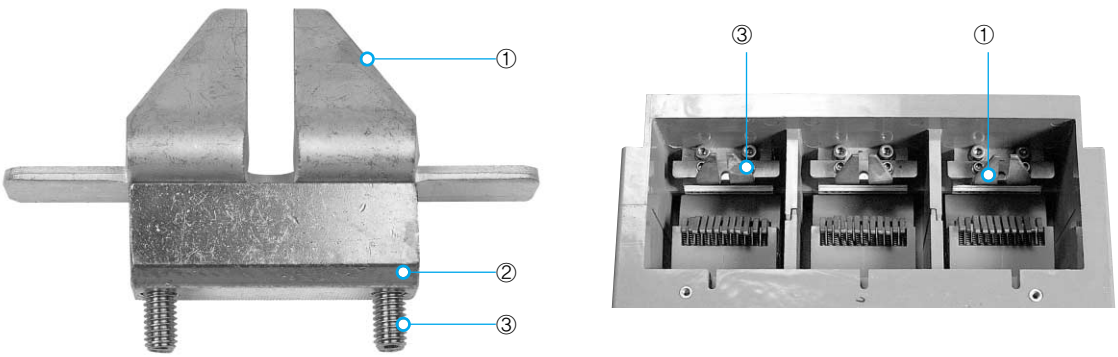
2) Replacement

(1) Stationary arcing contact (see Fig.14)

- Remove the two mounting screws (Fig. 15. ③) and remove the stationary arcing contact (Fig. 15. ②).
- Set a new stationary arcing contact in position and firmly tighten the two mounting screws.

CAUTION At the time of removing or mounting, must not drop any washer into pole inside.

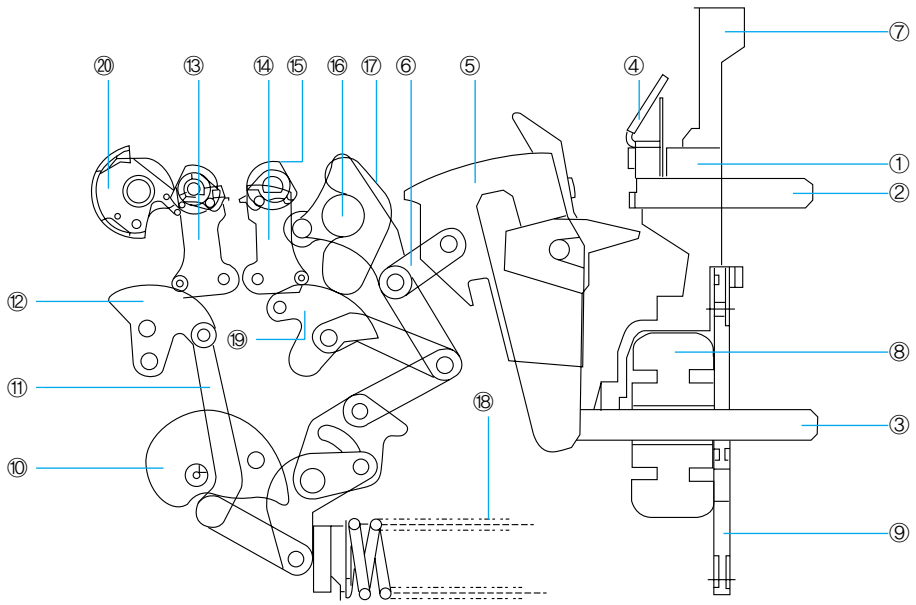
Fig. 15



① Fixed arc chute
② Stationary arcing contact
③ Below 1600 A, over 2000 A 2-M6

5.3 Operating Mechanism

Fig. 16



① Terminal spacer
② Up terminal
③ Low terminal
④ Fixed arc chute
⑤ Move cintact fix base
⑥ Crossbar link
⑦ Co-mold
⑧ CT
⑨ Terminal cover
⑩ Closing cam
⑪ Close link unit
⑫ Closing latch
⑬ Co-trip latch unit
⑭ Co-trip latch unit
⑮ Close/Open latch lever
⑯ Crossbar unit
⑰ Crossbar support
⑱ Closing spring
⑲ Co-latch
⑳ Charged/ Discharged indicator

1) Periodic maintenance

Check the operating mechanism in detail to a possible extent. If there are detail parts that seem to require a check but are hard to check, please contact HHI.

Inspection items	Methods / Criteria / Dispositions
Operation	• Open and close the breaker through manual control to check the mechanical parts for normal operation.
Lubrication	• Add a small amount of grease to each of the pins, shafts and their bearings. Avoid excessive oiling as such will result in accumulation of dirt and dust.
Screws, bolts and springs	• Check screws and bolts on each part for signs of loosening. Tighten them if loose. • Check each spring for proper engagement and damage. Correct problem by repair or replacement.
Dirt and dust	• Latching parts should be free of dirt and dust. Wipe them with a clean cloth.

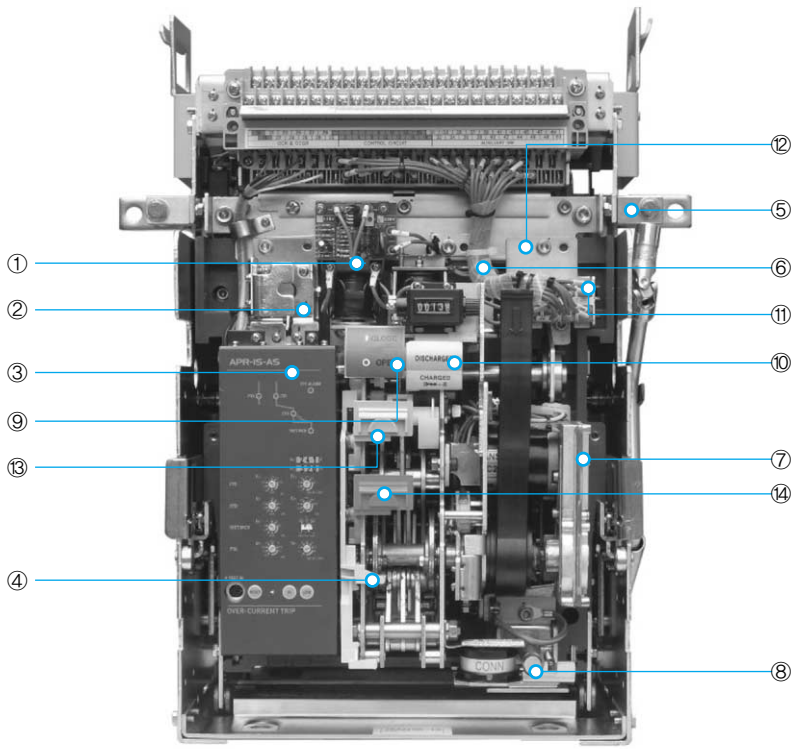
5.4 Internal Accessories

Remove the front cover (Fig. 1. ③) to gain access to the internal accessories.
To remove the front panel, remove the two front panel mounting screws.

CAUTION

Safety precautions:
1) Do not place your finger or a tool in the gap between the CLOSE button and the close/open indicator (Fig.17. ⑨, ⑬) since this gap is closed when the breaker is closed.
2) Never attempt to put your hand or a tool into the breaker when the closing springs are charged. Be sure to discharge the closing springs prior to internal inspection.

Fig. 17. Location of internal accessories (motor charging type)



① LRC (Latch Release Coil)
② MHT (Magnetic Hold Trigger)
③ ACB protection relay
④ Open lever for draw-out type
⑤ Fixing blocks
⑥ Shunt trip coil
⑦ Charging motor
⑧ Draw-out shaft
⑨ Close/Open indicator
⑩ Charged/Discharged indicator
⑪ Auxiliary switch unit
⑫ Auxiliary switch fixing bolt
⑬ Close button
⑭ Open button

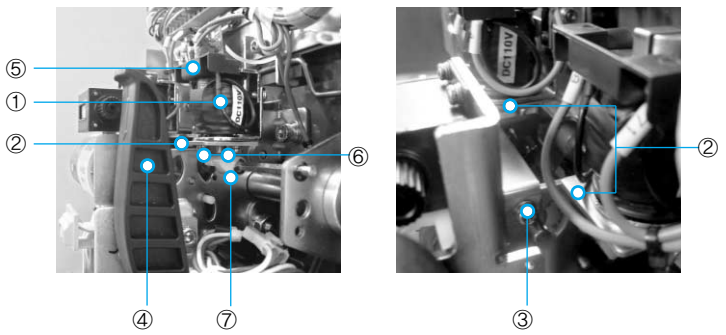
1) Shunt trip device (SHT)

Rated voltage (V)		Coil resistance (Ω)	
		HiAN & HiAS06-32	HiAN40-63 & HiAH32
AC	421 – 480	472	240
	380 – 420	352	195
	180 – 250	101	72
	100 – 150	25	28
DC	150 – 230	161	290
	90 – 125	36	75
	48	9.7	17
	24	2.7	3.4

(1) Periodic inspection (see Fig.18)

Inspection items	Methods / Criteria / Dispositions
Operation	• Push the moving core of SHT with a pointed tool, such as screwdriver tip, then slowly release the core. The result is acceptable if the core returns lightly. • Slowly push in the moving core after closing the breaker. The result is acceptable if breaker trips open. • If the breaker trips open ar less than 70% of the rated voltage after closing the breaker, the result is acceptable.
Coil	• Measure the coil resistance with an ohmmeter. If it is much lower than the value shown in table or there is no continuity, replace the SHT.
Terminals and mounting screws	• Check terminals and mounting screws for loosening. Tighten them if loose.

Fig. 18. Shunt trip device



① Shunt trip coil (SHT)
② SHT support (common for LRC, UVT)
③ R/H screw M4 for SHT support
④ Chrging handle
⑤ SHT terminal
⑥ Dish screw M5 for SHT
⑦ Trip-rod

(2) Replacement of SHT

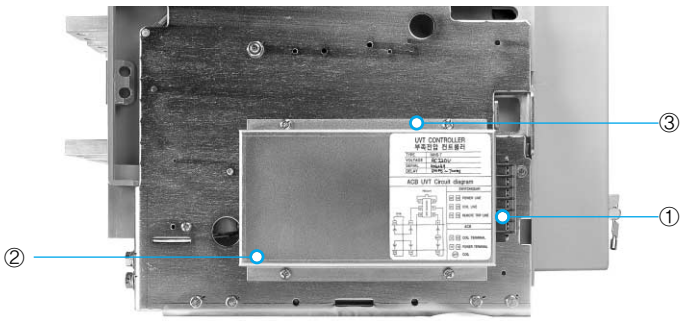
- Remove the two wires from the SHT terminals (Fig. 18. ⑤).
- Remove the one of M4 screw (Fig. 18. ③) and take out the SHT support (Fig. 18. ③).
- Remove the two mount screw (Fig. 18. ⑥).
- After checking the light movement of the moving core of new SHT, mount it in the breaker as it was. At mounting, be sure to confirm the trip lever (Fig. 18. ⑦) as it was.
- Connect the two wires to the SHT terminals. Test the SHT both electrically and mechanically for normal operation.

2) Undervoltage trip device (UVT)

- The coil of undervoltage trip device (UVT) uses only DC rating.
- This undervoltage trip device includes instantaneous trip type IANS-U and time delay trip type IANS-T having 500 ms and 1 sec time delay characteristics.

(1) General view of undervoltage trip device

Fig. 19. UVT Control device



① UVT wire terminals (fasten terminal)
② UVT controller
③ M6 bolt (4EA)

(2) Periodic inspection

Inspection items	Methods / Criteria / Dispositions		
Operation	• The breaker is trip-free when the UVT is de-energized. Because of this, when the PUSH TO CLOSE button is depressed, the closing springs are discharged, but if the breaker is not closed, the result is acceptable. • If the breaker can be closed at more than 85% of the rated voltage, the result is acceptable. • If the breaker can be tripped at 70 to 35% of the rated voltage after closing breaker, the result is acceptable.		
Coil resistance	• Measure the coil resistance with an ohmmeter. If the measured resistance is much lower than the value shown in the right or there is no continuity, replace the UVT.	Rated voltage (V)	Coil resistance (Ω)
		AC 100-470 V AC 100-200 V	160±16
Terminals and mounting screws	• Check terminals and mounting screws for loosening. Retighten them if loose.		

(3) Replacement of UVT

When it is necessary to replace the UVT, replace the whole UVT unit.

- Remove the UVT coil and the wire terminal (Fig. 19. ①).
- Remove two UVT control device mounting bolt (Fig. 19. ③ 3-M6 x 10). Take out the UVT controller.
- Install UVT control device as it was on the breaker with UVT mounting screws.
- Connect the wire terminals with fasten terminals at the same time.
- Test the UVT both electrically and mechanically for normal operation in the same manner.

CAUTION NEVER APPLY VOLTAGE TO THE UVT TERMINALS NOS."9" AND "10". WHEN THE UVT FUNCTION IS LOCKED. DOING SO MAY CAUSE BURN-OUT OF THE EQUIPMENT.

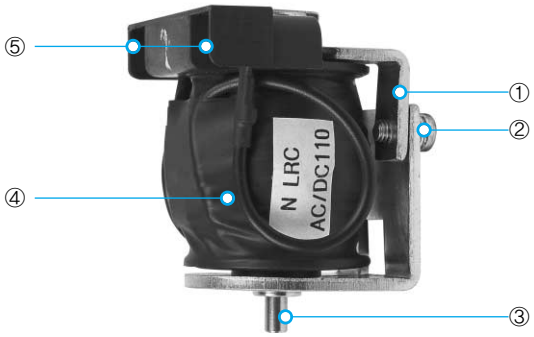
CAUTION Never loosen nor tighten the ADJ nut. Doing so may cause a malfunction.

3) Latch release coil (LRC)

Coil resistance is the same as SHT

(1) General view of latch release device

Fig. 20



① Yoke
② Yoke mounting screw
③ Moving core
④ Coil
⑤ Terminal

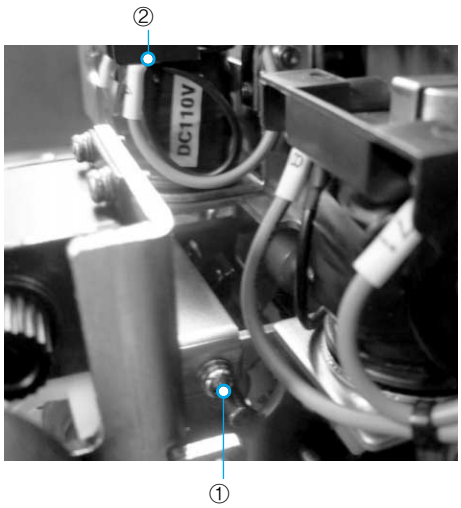
(2) Periodic inspection

Inspection items	Methods / Criteria / Dispositions
Operation	• Push the moving core with a pointed tool, such as screwdriver tip, then slowly release the core. The result is acceptable if the core returns lightly. • Charge the closing springs and push the moving core. The result is acceptable if the closing springs are discharged. • If the breaker can be closed at 85% of the rated voltage, the result is acceptable.
Coil resistance	• Measure the coil resistance with an ohmmeter. If it were much lower than the value shown in table 1 or there is no continuity, replace the LRC.
Terminals and mounting screws	• Check terminals and mounting screws for loosening. Tighten them if they are loose.

(3) Replacement of LRC

- Remove the wires from the LRC terminals (Fig. 21. ②).
- Remove one M4 screw (Fig. 21. ①), and take out the LRC support from the breaker body.
- Remove LRC coil from LRC unit.
- After checking the light movement of the new LRC moving core (Fig. 20. ③), mount it in the breaker as it was.
- Connect the wires to the LRC terminals (Fig. 21. ②).
- Test the device both electrically and mechanically for normal operation in the same manner described in periodic inspection tabel.

Fig. 21



① LRC mounting bolt
② Terminal

4) Auxiliary switch unit

(1) General view of auxiliary switch, design of connection circuit

Fig. 22. Auxiliary switch unit

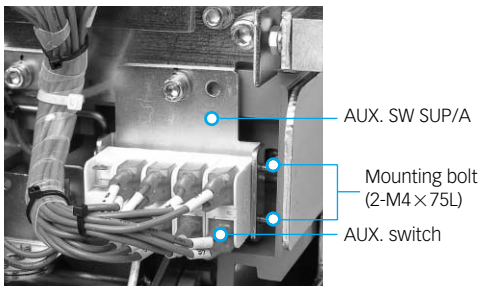
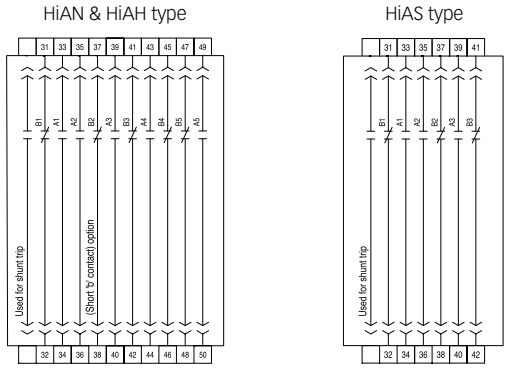


Fig. 23. Aux. SW connection diagram



(2) Periodic inspection

Inspection items	Methods / Criteria / Disposition
Operation	• Take the breaker body out of the draw-out cradle. • Connect the ohmmeter or alarm (buzzer) to each switch element. • Check that a-contact is ON and b-contact is OFF when breaker is CLOSED, and that a-contact is OFF and b-contact is ON when breaker is OPEN.
Coil resistance	• Check each contact for surface roughness (removing lamminated phenolics plate from unit permits a visual check of contacts). • If contact is excessively worn or rough, replace whole switch unit.
Terminals and mounting screws	• Check terminals and mounting screws for loosening. Tighten them if loose.

(3) Replacement of auxiliary switch unit (see Fig. 17, 22)

The auxiliary switch unit is an assembly of 8 switch elements (4 a-contacts and 4 b-contacts). Replace the whole switch unit even if a defect is partial.

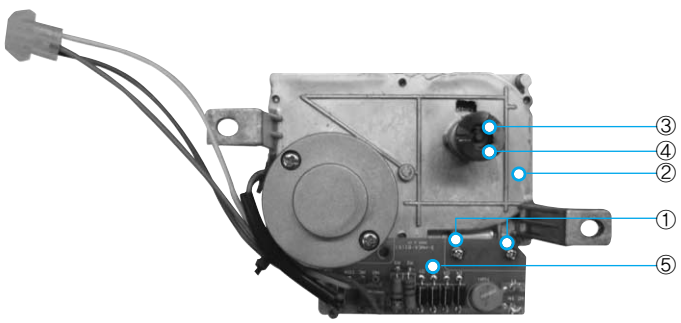
- Remove the bolt (1-M6 wrench bolt) for assembly auxiliary switch (Fig.17. ⑫).
- Connect wires which taken out the terminal lug and terminal of new auxiliary switch unit.
- Fix it again as it was.
- Check the switch movement.

CAUTION Check the replaced terminal numberl has been connected correctly, if provided otherwise a malfunction may occur.

5) Motor unit

(1) General view of motor unit

Fig. 24



① Motor control unit mounting bolt
② Charging motor
③ Motor ratchet / M
④ Motor ratchet spring
⑤ Motor control unit

(2) Operation check

Open and close the breaker through electrical control to check the relay for normal operation. Do this in the following procedure.

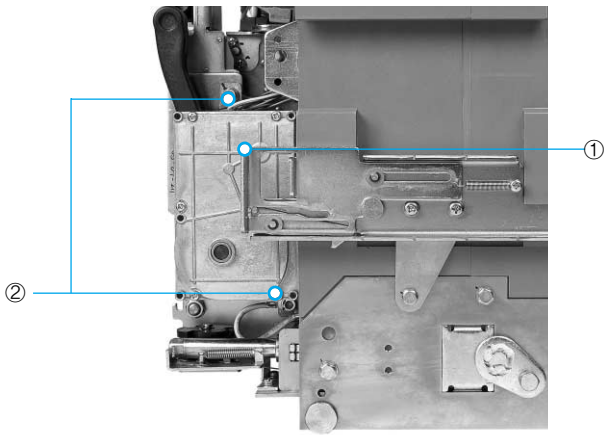
- With the push-button switch ON, close the breaker.
- Immediately place the closed breaker in open condition. Even when the closing springs are "CHARGED". if the breaker is not placed in re-closed condition, the result is acceptable. For resetting, turn the push-button switch OFF.

(3) Replacement of motor control unit

- Open the ACB.
- Draw-out the body until isolated position.
- Release two mounting bolt (Fig. 25. ②).
- Take out motor unit.
- Release motor control unit mounting screws (Fig. 24. ①).
- Replace with new motor control unti and assemble it in reverse order.
- Check the operation by the (2) clause.

CAUTION Check the wires of terminal has been connected correctly, if provided otherwise a malfunction may occur.

Fig. 25



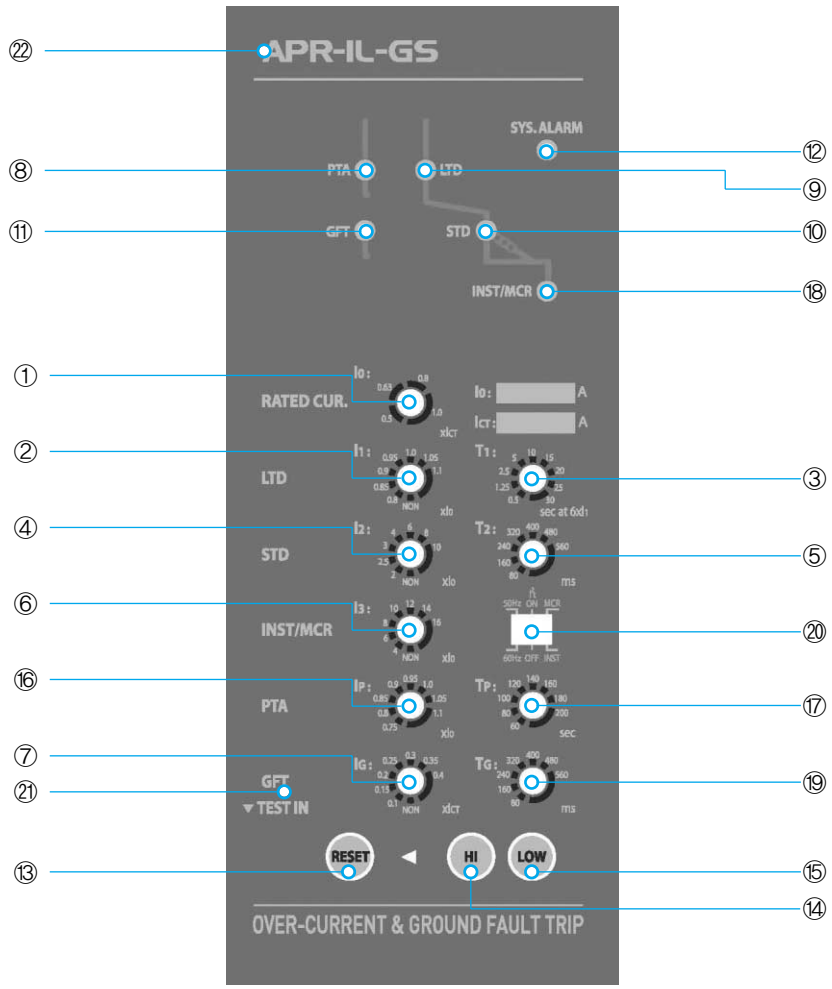
① Motor unit
② Mounting bolts

6) Direction of ACB position padlock device

- Object : Position padlock device is designed for the process of locking position of ACB (Isolated, Test or Connection position) by using shackle.
- Usage : At any position, after shutting the draw-out hole (Fig. 1. ⑰), lock the shutter with shackle (Not offered).

CAUTION Do not operate the draw-out handle during the running time.
Since main circuit is alive, draw-out operation will cause fatal accident.

Fig. 26. APR (ACB protection relay)



① Base current select dial
② Long time delay trip pick-up current setting dial
③ Long time delay setting dial
④ Short time delay trip pick-up current setting dial
⑤ Short time delay setting dial
⑥ Instantaneous trip pick-up current setting dial
⑦ Ground fault trip pick-up current setting dial
⑧ Pre-trip alarm pick-up indicator light (LED)
⑨ Long time delay tripped indicator light (LED)
⑩ Short time delay / tripped indicator light (LED)
⑪ Ground fault Tripped indicator light (LED)
⑫ CPU malfunction indicator light (LED)
⑬ Reset button
⑭ Test switch (for short time delay and instantaneous)
⑮ Test switch (for long time delay)
⑯ Pre-trip alarm current setting dial
⑰ Pre-trip alarm time delay setting dial
⑱ INST / MCR tripped indicator light (LED)
⑲ Ground fault trip time delay setting dial
⑳ INST / MCR select switch
㉑ Test jack
㉒ APR type

APR is high-realiable multi function protection relay of Hyundai Air Circuit Breaker.
7 Types of APR are available: 5 types for general feeder protection, and 2 types for generator protection.
Each APR has different protection and indication functions, so that customers can select the proper one in consideration of the system and load charasteristics.

Application	Type	Order code	Protection function				Indication function						Filed test[2]	Individual control power[3]	AMS[4]
			AL, AS, AI	AP	AG	MCR	IU	IUt	CP/I	Fault LED[1]	Event memory	LCD display			
General feeder	APR-1L-GL	23	●		●		●								
	APR-1L-GS	24	●	●	●	●			●	●			●	●	
	APR-1L-GM	27	●	●	●	●		●		●			●	●	
	APR-2L-GS	25	●	●	●	●			●	●		●	●	●	
	APR-1D-GM	26	●	●	●				●	●	●	●	●	●	●
Generator	APR-1S-AL	28	●				●								
	APR-1S-AS	29	●	●		●			●	●			●	●	

※ 1) LED makes signal when protection function operates.
2) AL, AS and AI function can be tested by APR itself or APR checker.
3) Individual control power for APR is required.
4) APR 1D-GM type APR has the RS-485 communication port. Through the interface unit or coordination with SCADA(supervisory control and data acquisition) system, APR monitoring system(AMS) controls ACB and monitors system as well as operates.

Protective function

AL Adjustable Long Time Delay Trip

AS Adjustable Short Time Delay Trip

AI Adjustable Instantaneous Trip

AP Adjustable Pre-trip Alarm :
When the current reaches to the setting value, pre-trip alarm operates.

AG Adjustable Ground Fault Trip

MCR Making Current Release :
MCR is one kind of instantaneous trip device, it trips the ACB when the current exceeds pick-up current (I_P) only during the closing operation. After the ACB is completely closed, MCR function dose not work. AI function is default, and MCR function can work by switching the INST/MCR knob.

Indication function

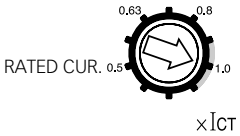
IU Integrated Instantaneous Indication Contact :
1a contact makes the signal for 80ms after a protection function operates.

IUt Integrated Continuous Indication Contact :
When any protection function operates, contacts make the signal through LED or LCD until the APR is reset.

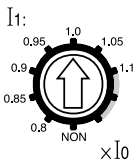
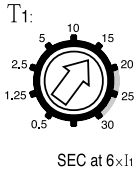
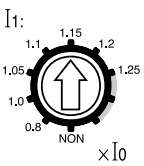
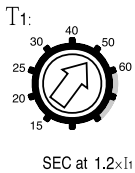
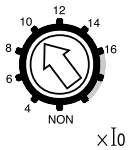
CP/I Individual Continuous Indication Contact :
When each protection function operates, contacts make the signal through LED or LCD until the APR is reset.

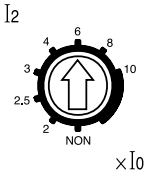
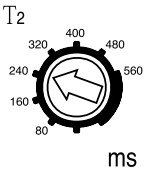
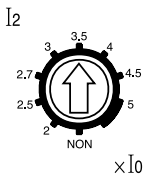
※ - Insulation level from earth to terminal is 1500V.
- Signal for AP is automatically off when the current drops below the pick-up current (I_P).
- CPU is also monitored (system alarm function).

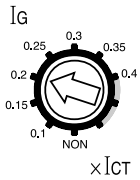
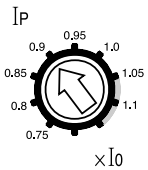
6.1 Base Current [I_0] of APR

	Base current [I_0]
APR-1L type for general feeder circuits	- Base current [I_0]can be adjusted to 50%, 63%, 80% and 100% of the rated primary CT current [I_{CT}]. - On the APR I_0 nameplate, the following is marked : BASE CUR.I_0:_____A. - Base current [I_0] can be selected by sliding the base current setting select switch, which can be set to the predetermined scale. 
APR-1S type for generator protection	- A proper CT is selected according to the rated current [I_{GEN}] of generator. And then, base current [I_0] is adjusted so as to be equal to the rated current value [I_{GEN}] of generator according to the input match inside APR-1S. Accordingly, the rated current value [I_{GEN}] of generator corresponds to base current [I_0]. On the APR the following is marked: BASE CUR.I_0:_____A.

6.2 Protective Functions and Setting Ranges of APR

Inspection items		Current setting range		Time setting range	
LTD (I_1, T_1)	APR-1L		- Setting dial is scaled in multiples of [I_0]. - There are eight discrete setting positions: NON, 0.8, 0.85, 0.9, 0.95, 1.0, 1.05 and 1.1 times I_0. - When [I_0] is set at NON the protective function does not operate. - The breaker is not tripped at less than 105%, and tripped at more than 120% of [I_1] setting.		- The setting dial is scaled in seconds, which is the operating time at 600% of [I_1] setting. There are nine discrete setting positions: 0.5, 1.25, 2.5, 5, 10, 15, 20, 25 and 30 seconds. - The breaker is tripped at the range from 95% to 105% [T_1] setting. When [I_{CT}] is less than 160 A, the breaker is tripped at the range from 90% to 110% [I_1] setting.
	APR-1S		- Setting dial is scaled in multiples of [I_0]. There are seven discrete setting positions NON, 0.8, 1.0, 1.05, 1.1, 1.15, 1.2 and 1.25 of [I_0] setting. - When [I_1] is set at NON, the protective function does not operate.		- The setting dial is scaled in seconds. which is the operating time at current flow at 120% of [I_1] setting. - There are seven discrete positions: 15, 20, 25, 30, 40, 50 and 60 seconds.
INST (I_3)	APR-1L		- Settin dial is scaled in multiples of [I_0]. - There are eight discrete setting positions: NON, 4, 6, 8, 10, 12, 14 and 16 times [I_0]. - When [I_3] is set at NON, the protective function does not operate.	- Time setting is unnecessary.	
	APR-1S		- Setting dial is scaled in multiples of [I_0]. - There are eight discrete setting positions: NON, 4, 6, 8, 10, 12, 14 and 16 times [I_0]. - When [I_3] is set at NON, the protective.		

Inspection item		Current setting range		Time setting range	
STD (I_2, T_2)	APR-1L		- Setting dial is scaled in multiples of [I_o]. There are eight discrete setting positions: NON, 2, 2.5, 3, 4, 6, 8, 10 times [I_o]. When [I_2] and [I_3]are set at NON, the device is operated at 1000% of [I_o] setting as a fail-safe function by [T_2] setting.		- Setting dial is scaled in milliseconds, which is the operating time at current flow higher than [I_2] x 110% setting. There are seven discrete 80, 160, 240, 320, 400, 480, 560 milliseconds.
	APR-1S		- Setting dial is scaled in multiples of [I_o]. There are nine discrete setting positions: NON, 2, 2.5, 2.7, 3, 3.5, 4 and 4.5, 5 times [I_o]. - When [I_2] is set at NON, the device is operated at 500% of [I_o] setting as a fail-safe function.		- Setting dial is scaled in milliseconds, which is the operating time at current flow higher than [I_2] x 110% setting. - There are seven discrete setting positions: 80, 160, 240, 320, 400, 480, 560 milliseconds.

Inspection items		Current setting range		Time setting range
GFT (I_G)	APR-1L		- Setting dial is scaled in multiples of OCR rated primarycurrent [I_{CT}]. - Setting dial is scaled in multiples of [I_{CT}].There are eight discrete setting positions: NON, 0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4 times [I_{CT}].	- Setting dial is scaled in milliseconds, which is the operating time at current flow higher than [I_G] x 120% setting. - There are seven discrete 80, 160, 240, 320, 400, 480, 560 milliseconds.
Pre-alam (I_P)	APR-1L		- Setting dial is scaled in multiples of [I_o]. - There are eight discrete positions: NON, 0.75, 0.8, 0.85, 0.9, 0.95, 1.0, 1.05, and 1.1 times [I_o].	- Setting dial is scaled in second which is the operating time at current flow higher than [I_P] setting. - There are eight discrete 60, 80, 100, 120, 140, 160, 180, 200 seconds (definite time delay).
	APR-1S		- Setting dial is scaled in multiples of [I_o]. - There are eight discrete positions: 0.75, 0.8, 0.85, 0.9, 0.95, 1.0, 1.05, and 1.1 times [I_o].	- There are nine discrete position at current flow 120% of [I_P]: 5, 10, 15, 20, 25, 30, 35, 40, 45 seconds.

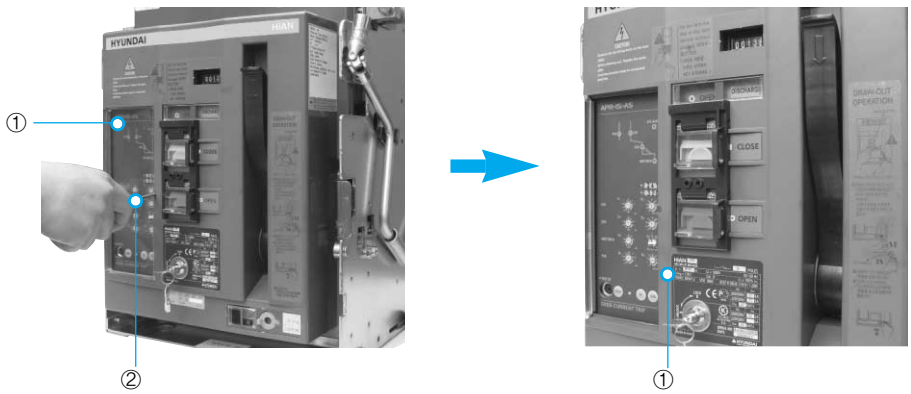
1) Method of changing protective function settings

The settings of APR can be changed easily by dial operation.
This section describes the basic procedures for setting the protective device.
For setting details of individual protective functions see section 2.

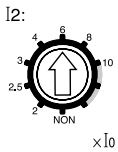
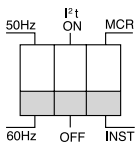
(1) Basic procedures

- Press the side center of the transparent front cover to the left or right to release the latch, and remove the cover from the breaker front cover.
- Using a small flat-head screwdriver, adjust the setting switches as appropriate. The APR has two types of setting switches: rotary step switches and slide switches.

➡ Fig. 27



① APR transparent cover
② ⊖ Screwdriver

	**Rotary step switches** Rotate the dial until the arrow points to the desired position. The setting is the same within the scale range denoted by a bold line.
	**Slide switches** Slide the switch knob up/down to turn ON/OFF.

- After adjustment, check the APR for proper setting by using a filed tester.

CAUTION Do not apply excessive force to the switches. The switches should lightly be turned or slid with the screwdriver.

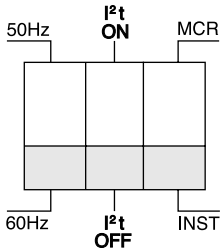
- Return the transparent cover (Fig. 27. ①) to its original position.

(2) The setting of SLIDE switch

• Frequency setting (50 Hz/60 Hz)
The frequency can change between 50 Hz and 60 Hz depending on power system. In case of APR set at 60 Hz in 50 Hz system, the tolerance of APR increases ±20% more than the exact setting.

• I²t ON/OFF
The STD trip timing can be changed between ramp (I²t = C: inverse-time) mode and definite-time mode.

➡ I²t ON/OFF



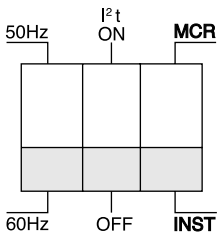
I²t ON : Inverse
I²t value becomes constant at 800% of setting current.
Setting current tolerance is ± 30%

I²t OFF : Definite

• INST/MCR
Using the INST/MCR mode select switch enables the tripping mode to be changed between INST and MCR.
When changing the tripping mode to MCR, be sure to observe the following condition:
Estimated short-circuit fault current ≦ Rated breaking capacity of the breaker (without INST).

※ MCR is a protective function which instantaneously trips open the breaker only when a fault current exceeding I_3 is applied at making operation of the breaker.
After making operation, MCR locks the INST trip function.

➡ INST/MCR



6.3 Functions of APR Operating Indication

The function of operating indication includes IU contact for tripped indication (whole indication) and CP/I LED light and contact for tripped indication.

1) IU contact for tripped indication (APR-1L-GL, APR-1S-AL)

• The contact output is one contact operating even when any one of LTD, STD, INST and GFT operates.
• The contact output is transmitted between the terminals ㉒ and ㉓ of disconnecting device for control circuit (Fig. 1. ⑬).
• Rating of contact for tripped indication.

Rated voltage	AC 250 V	DC 30 V	DC 125 V	DC 250 V
Rated current (resistive load)	8 A	5 A	0.5 A	0.3 A
Rated current (inductive load)	3 A	3 A	0.25 A	0.15 A

2) CP/I LED light and contact for tripped indication (APR-1L-GM, APR-1L-GS, APR-1D-GM, APR-2L-GS, APR-1S-AS)

- Control Power is required for tripped indication.
  Supply the following power between terminals ⑲ and ⑳ of control circuit disconnecting device (Fig. 1. ⑫).
  - AC 100 V to AC 125 V/5 VA or AC 200 V to AC 250 V/5 VA.
  - DC 100 V to AC 125 V/5 W or DC 200 V to DC 250 V/5 W or DC 240 V/5 W.
- When LTD, STD or GFT operates, the LED lights for tripped indication (Fig. 26. ⑨, ⑩, ⑱, ⑪) light up individually.
- At the same time, the contact signal ON is outputted individually between terminals ㉕~㉖ of control circuit disconnecting device (Fig. 1. ⑫).

Operating indication terminal	
㉒-㉔ : Pre-alarm terminal	㉕-㉖ : LTD/STD/INST terminal
㉗-㉘ : GFT terminal	

- The LTD, STD and GFT tripped indications remain ON until the reset button (Fig. 26.⑬) is depressed or the control power is turned OFF. Press the reset button or turn the control power OFF for more than one second resets the ON state.
- LED light and contacts for pre-trip alarm operation indication.
  - The LTD pickup indication LED light (Fig. 26.⑧) flickers at more than pickup current value [I_P].
    At the same time, the contact signal ON is outputted between terminals ㉒~㉔ of control circuit disconnecting device (Fig. 1.⑫).
  - The operation indication is automatically reset if the current of less than [I_P] is reached.
- CPU malfunction indicating LED lights and contact .
  When the analog circuit is abnormal, CPU malfunction indicating LED light (Fig. 26.⑫) lights up.
  If CPU malfunction indicating LED light lights up, the breaker in service is not effected directly.
  But take the following measures at earlier stages and eliminate the trouble.

※ Press the reset button (Fig. 26.⑬)
If the abnormality is temporary, such as noise, the LED will go off, At that time, the control function returns to normal.
If the LED does not go off even by pushing the reset button, some abnormality may occur. In this case, immediately contact with HHI.

- Rating of contact for trip indication.

Rated voltage	AC 250 V	DC 220 V
Rated current (resistive load)	125 VA (max. 2 A)	60 W (max. 2 A)
Rated current (inductive load)	20 VA (max. 2 A)	10 W (max. 2 A)

6.4 Field Test Method of APR Multifunction Protective Device Type

1) Function check method

- A simple check of operation for APR multifunction protective devices type can be made with a test switch.

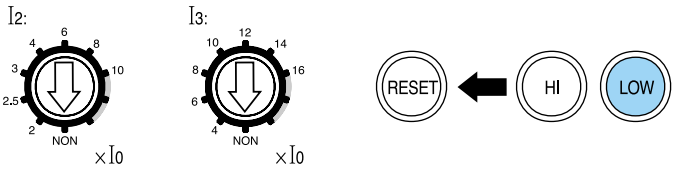
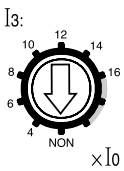
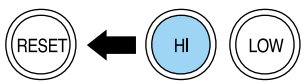
> **CAUTION** For function check of each protective function, draw out the breaker to the ISOLATED position, or take it out from the draw-out cradle. If making function check in the TEST position, confirm that there is no influence on the sequence.

- Function check of the ground fault trip function is not possible (But APR checker can check the ground fault trip function).

2) Control power and fitting for checking function

- Timer: a stopwatch.
- ⊖ screwdriver.
- Control power.

3) Function check method of each protective function

Protective function	APR-1L (for general feeder circuit) / APR-1S (for generator protection)
Long time delay trip function check	1. Close the breaker. 2. In case of APR-1L type, if the setting current of STD/INST pick-up less than 6 times of base current, set the dial I_2, I_3 to the NON position with a ⊖ screwdriver.  3. Push the test switch (Fig. 26. ⑮) "LOW" (current flow of 6 times the base current [I_o] in type APR-1L, and 1.5 times the base current in type APR-1S), and at the same time, start the tripping time measurement with a watch. Also hold the test switch until the breaker is tripped. 4. After tripping, release the test switch. It is reset to OFF (neutral) automatically. 5. Read the tripped time. If it is nearly equal to the operation time at the current flow of 6 times [I_o] for type APR 1L and 1.5 times [I_o] for type APR-1S, it is normal. 6. Return the INST pick-up current setting dial to the original set value with a ⊖ screwdriver.
Short time delay trip function check	1. Close the breaker. 2. Set the INST pickup current setting dial to NON, using a ⊖ screwdriver.  3. Push the test switch (Fig. 26. ⑭) to "HI" current flow of more than 16 times the base current [I_o]. If the breaker is tripped with time delay setting, it is normal.  4. After tripping, release the test switch. 5. Return the INST pickup current setting dial to the original set value with a ⊖ screwdriver.
Instataneous time delay trip function check	1. Close the breaker. 2. Push the test switch (Fig. 26. ⑭) to "HI" current flow of more than 16 times the base current [I_o]. If the breaker is tripped momentarily, it is normal. 3. After tripping, release the test switch. It is reset to OFF (neutral) automatically.

4) Method of characteristic check

• The rated secondary current of CT is 0.2 A, the rating of CT shows Ict: 0000A on the type APR multi protective device.

• Test current = $(I/I_{CT}) \times 0.2$

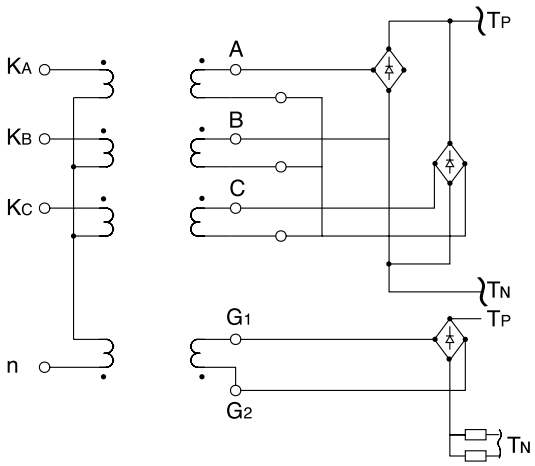
I : a setting value. ($[I_1]$, $[I_2]$, $[I_3]$, $[I_P]$, $[I_G]$)

I_{CT} : the rated primary current.

0.2 : the rated secondary current of CT.

ex) I : I_1 = 900 A I_{CT} = 1250 A Test current = (900/1250) x 0.2=0.14 A.

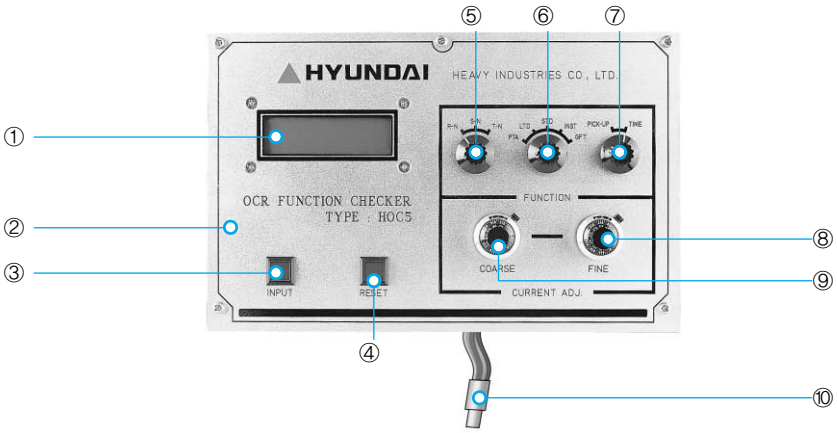
Fig. 28



6.5 APR Function Check Method by APR Checker

1) Configuration and specifications of APR checker

Fig. 29



Item	Rate or indication
Control voltage	AC 220 V±10 V
Usable temperature	0℃~45℃
Test range of operation time	0 ms~999.999 sec
Test current range	0~3400 mA
Dimension (mm)	W 220 x H 90 x D 150

2) Manual

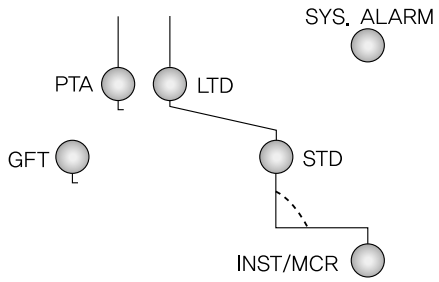
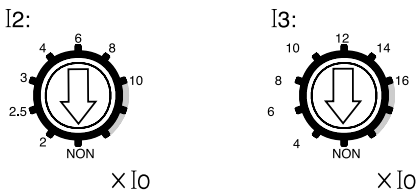
• Caution and preparation for every test
- Connect the jack ⑩ to the test terminal of the APR before the test.
- Select the test phase with the switch ⑤.
- Select the pick-up or the TIME function with the switch ⑦.
- Select the test item of the APR with the switch ⑥.
- Turn on the power switch ②.
- Set the test current in the left side of the checker with the switch ⑧, ⑨.
- The LCD ① will display the current as 2000 mA in the first line and the time as 999.999 sec in the second line. The current can be 0~3400 mA according to test current, and the time can be 0~999.999 sec according to operation time.

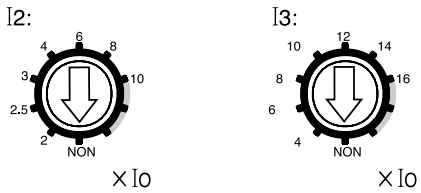
• Pre-alarm pick-up
- Select the pick-up function with the switch ⑦.
- Select the PTA function with the switch ⑥.
- Push the INPUT button ③.
- Check the pre-alarm condition of the APR during adjusting the current with the switch ⑧, ⑨.

• Pre-alarm time
- Select the TIME function with the switch ⑦.
- Select the PAT function with the switch ⑥.
- Set the test current by adjusting the switch ⑧, ⑨, while the current is (being) varied with the VR ⑧, ⑨.
- Push the INPUT button ③.
- When the pre-alam of the APR works, the operation time will stop.
- Push the RESET button ④ after the test.

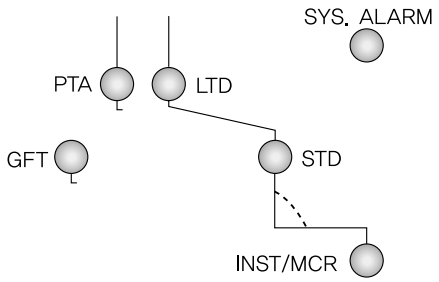
• LTD pick-up
  - Select the pick-up function with the switch ⑦.
  - Select the LTD function with the switch ⑥.
  - Push the INPUT button ③.
  - Check the LTD pick-up condition of the APR during adjusting the current with the switch ⑧, ⑨.
• LTD time delay
  - Select the TIME function with the switch ⑦.
  - Select the LTD function with the switch ⑥.
  - Set the test current by adjusting the switch ⑧, ⑨.
  - Push the INPUT button ③.
  - When the APR is tripped, the operation time will stop.
  - Push the RESET button ④ after the test.
• STD pick-up
  - Select the pick-up function with the switch ⑦.
  - Select the STD function with the switch ⑥.
  - Push the INPUT button ③.
  - Check ths STD pick-up condition of the APR during adjusting the current with the switch ⑧, ⑨.
• STD time delay
  - Select the TIME function with the switch ⑦.
  - Select the STD function with the switch ⑥.
  - Set the test current by adjusting the current with the switch ⑧, ⑨.
  - Push the INPUT button ③.
  - When the APR is tripped, the operation time will stop.
  - Push the RESET button ④ after the test.
• INST pick-up
  - Select the pick-up function with the switch ⑦.
  - Select the INST function with the switch ⑥.
  - Push the INPUT button ③.
  - Check ths INST pick-up condition of the APR during adjusting the current with the switch ⑧, ⑨.
• Ground fault pick-up
  - Select the pick-up function with the switch ⑦.
  - Select the GFT function with the switch ⑥.
  - Push the INPUT button ③.
  - Check ths GFT pick-up condition of the APR during adjusting the current with the switch ⑧, ⑨.
• Ground fault time delay
  - Select the TIME function with the switch ⑦.
  - Select the GFT function with the switch ⑥.
  - Set the test current by adjusting the current with the switch ⑧, ⑨.
  - Push the INPUT button ③.
  - When the APR is tripped, the operation time will stop.
  - Push the RESET button ④ after the test.

3) Function check method of each protective function

Protective function		APR-1L type (for general feeder circuit), APR-1S type (for generator protection)
LTD	Pick-up current	1. Close the breaker. 2. When you increase the test current from zero, the pre-trip alarm indicator (PTA, Fig. 26. ⑧) will flicker around the LTD pick-up setting current. 3. Increase the test current slowly until the long time delay tripped indicator (LTD, Fig. 26. ⑫) turns to steady lighting; if the current value at the time is within the range of 1.05 to 1.2 times of secondary current value in this position, the current value should be in the range of 1.05 to 1.2 times of the secondary current value converted.  4. Reduce the test current output to zero.
	Trip time	1. Close the breaker. 2. In case of APR-1L type, if the setting current of STD/INST pick-up less than 6 times of the base current, set the dial I_2, I_3 to the NON position with a ⊖ screwdriver.  3. Supply 6 times current of I_1 setting current for APR-1L type and 1.2 times for APR-1S type, and start to measure the trip time delay. 4. The breaker should be tripped within ±15% of long time delay set time T_1. 5. Reduce the test current output to zero. 6. After the test, reset STD/INST pick-up current setting dial I_2, I_3 of the original set value for using.

<table>
<tr><td colspan="2">Protective function</td><td>APR-1L type (for general feeder circuit), APR-1S type (for generator protection)</td></tr>
<tr><td rowspan="2">STD</td><td>Pick-up current</td><td>1. Close the breaker.
2. Set the LTD/INST pick-up current setting dial I_2, I_3 to NON position with a ⊖ screwdriver.
 

3. Promptly supply ±15% of secondary current converted from the setting current value I_2 for APR-1L type, and ±10% for APR-1S type. Under this condition, the breaker should be tripped.
4. Reduce the test current output to zero.</td></tr>
<tr><td>Trip time</td><td>1. Close the breaker.
2. Set the test equipment output to 1.2 times of the secondary current converted from the setting current value I_2.
3. Supply the test current, and start to measure the trip time delay.
4. When the breaker is tripped, reduce the test equipment output to zero.
5. The trip time value should be between resettable time (ms) and maximum total clearing time (ms) shown in the below;
<table><tr><td>Time setting T_2 (ms)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>7-step system</td><td>80</td><td>160</td><td>240</td><td>320</td><td>400</td><td>480</td><td>560</td></tr><tr><td>Resettable time (ms)</td><td>55</td><td>120</td><td>190</td><td>260</td><td>330</td><td>400</td><td>460</td></tr><tr><td>Max. total clearing time (ms)</td><td>150</td><td>240</td><td>335</td><td>425</td><td>520</td><td>610</td><td>700</td></tr></table>6. After the test, reset STD/INST pick-up current setting dial I_2, I_3 to the original set value for using.</td></tr>
<tr><td>INST</td><td>Pick-up current</td><td>1. Close the breaker.
2. When you supply -20% of the secondary current converted from the setting current value I_3, the breaker should not be tripped. And the breaker should be tripped under the supply +20% of the secondary current.</td></tr>
</table>

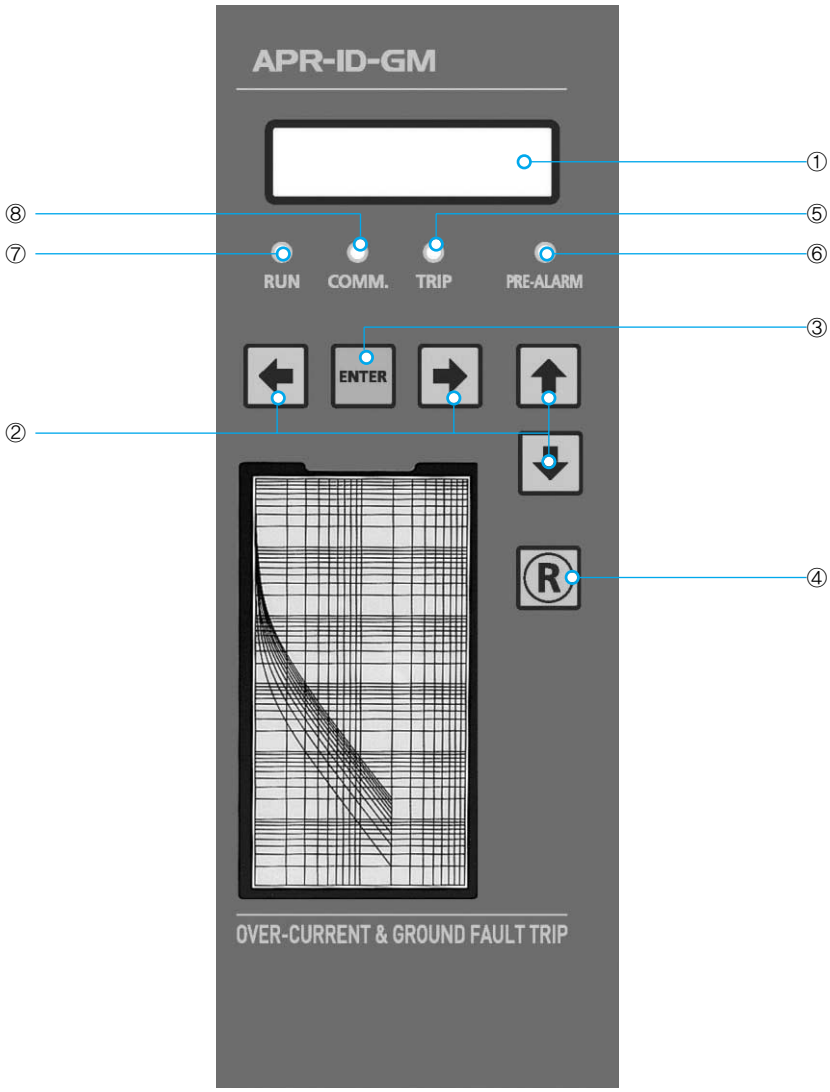
<table>
<tr><th colspan="2">Protective function</th><th>APR-1L type (for general feeder circuit), APR-1S type (for generator protection)</th></tr>
<tr><td rowspan="2">Pre trip alarm</td><td>Pick-up current</td><td>1. Close the breaker.
2. Increase the test current until the pre-trip alarm pick-up indicator (PTA, Fig. 26. ⑧) flickers: In this position the current value should be in the range of ±7.5% of secondary current value converted from the setting current value I_P for APR-1L type and ±5% for APR-1S type.
 

3. Reduce the test current output to zero.</td></tr>
<tr><td>Trip time</td><td>1. Supply the specified control power.
2. Supply 1.1 times of the secondary current converted from the setting current value I_P for APR-1L type, and 1.2 times for APR-1S type, and start to measure the pre-trip alarm time. The time balance between Ac and Ap terminal should be in the range of ±20% of the setting time value T_P for APR-1S type and ±15% for APR-1S type.
3. Reduce the test current output to zero.</td></tr>
<tr><td rowspan="2">GFT</td><td>Trip current</td><td>1. Close the breaker.
2. When you supply of ±20% of secondary current converted from the setting current [I_G], the breaker should be tripped.
3. Reduce the test current output to zero.</td></tr>
<tr><td>Trip time</td><td>1. Close the breaker.
2. Set the test equipment output to 1.20% of the secondary current converted from the setting current value I_G.
3. Supply the test current, and start to measure the trip time. At the same time, start the trip time measurement with a watch.
4. When the breaker is tripped, reduce the test equiment output to zero.
5. The trip time value should be between resettable time (ms) and maximum total clearing time (ms) shown the below;
<table><tr><td>Time setting T_G (ms)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>7-step system</td><td>80</td><td>160</td><td>240</td><td>320</td><td>400</td><td>480</td><td>560</td></tr><tr><td>Resettable time (ms)</td><td>55</td><td>120</td><td>190</td><td>260</td><td>330</td><td>400</td><td>460</td></tr><tr><td>Max. total clearing time (ms)</td><td>150</td><td>240</td><td>335</td><td>425</td><td>520</td><td>610</td><td>700</td></tr></table></td></tr>
</table>

6.6 Operating Manual for APR-1D-GM

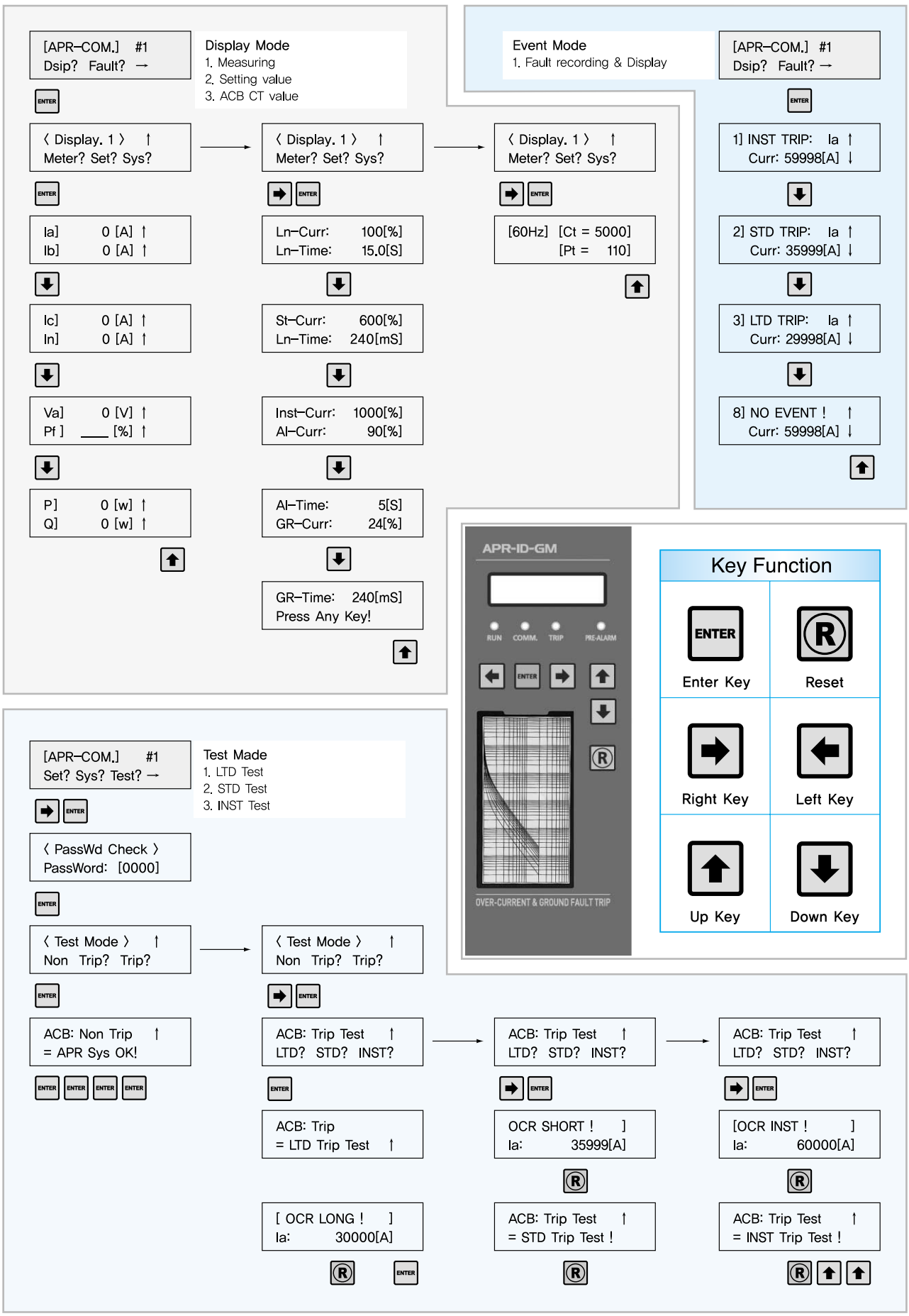
1) Front view

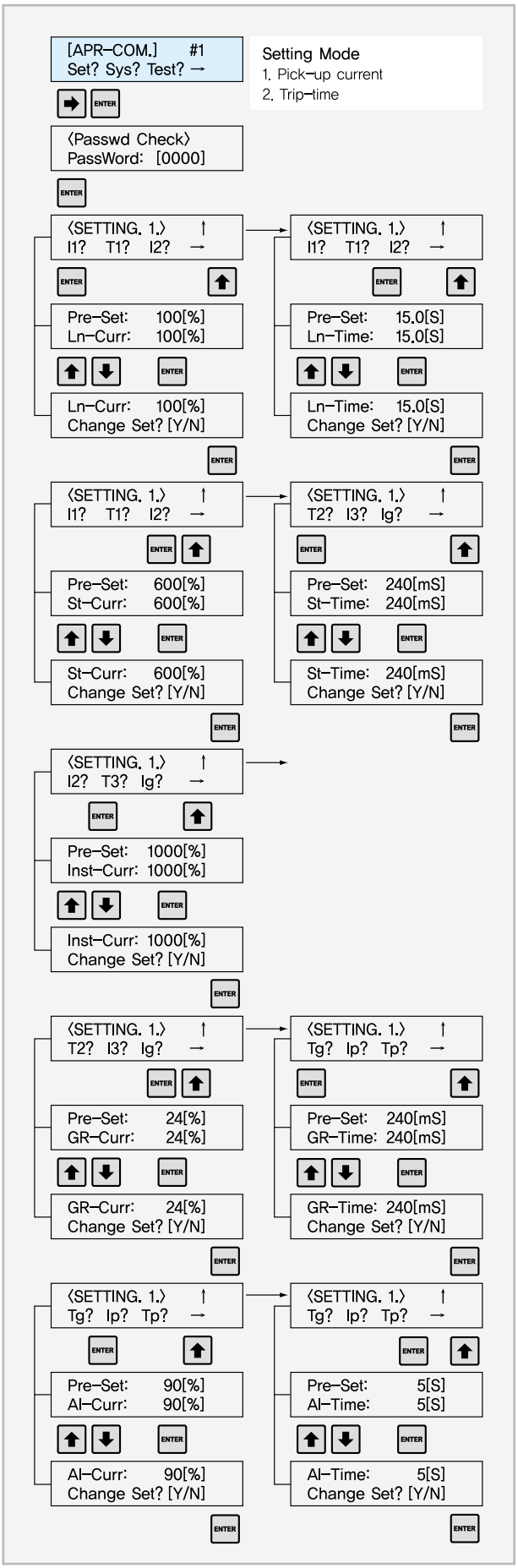
Fig. 30

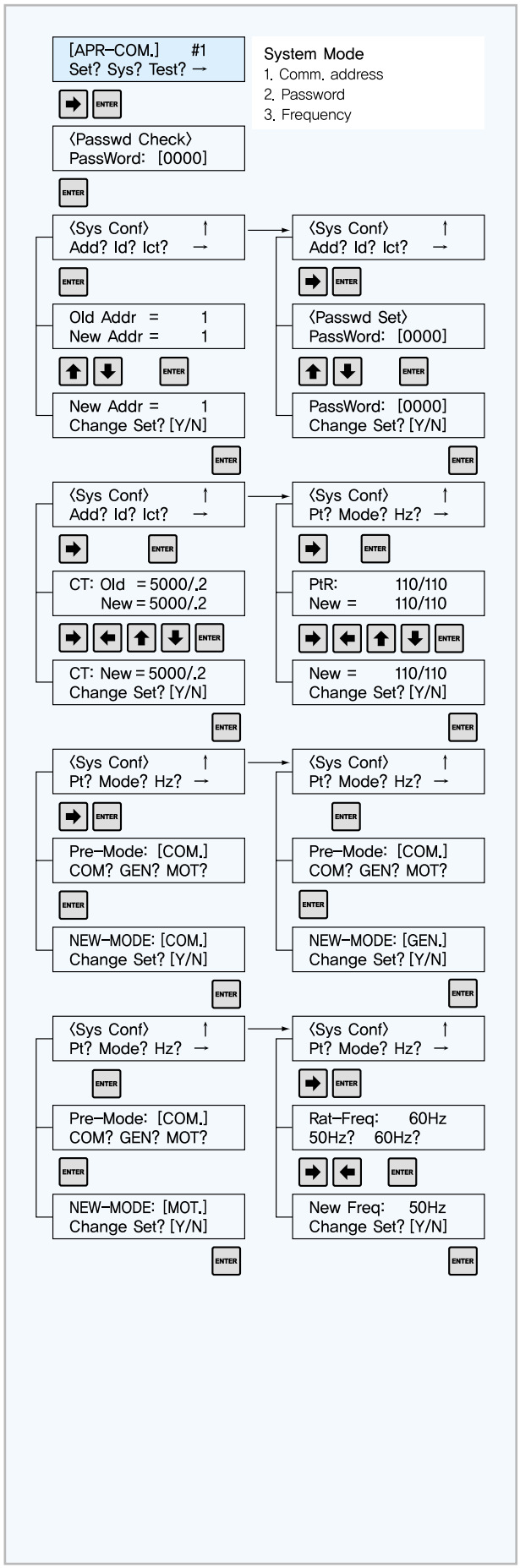


① LCD display
② Setting & function select key
③ Enter key
④ Reset key
⑤ Fault trip lamp
⑥ Pre-trip alarm lamp
⑦ Operating lamp
⑧ Communication protocol lamp

■ APR-1D-GM Menual

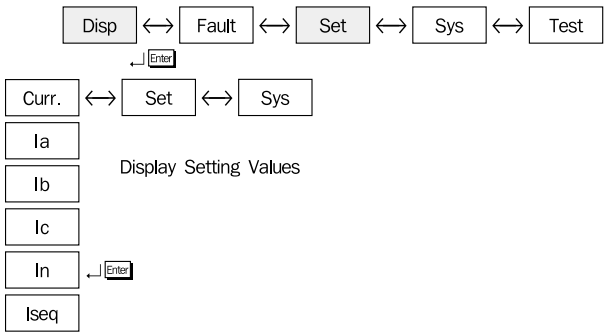



[APR-COM.] #1
Set? Sys? Test? →
ENTER
〈Passwd Check〉
PassWord: [0000]
ENTER
Setting Mode
1. Pick-up current
2. Trip-time
〈SETTING. 1.〉 ↑
I1? T1? I2? →
ENTER
Pre-Set: 100[%]
Ln-Curr: 100[%]
ENTER
Ln-Curr: 100[%]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
I1? T1? I2? →
ENTER
Pre-Set: 15.0[S]
Ln-Time: 15.0[S]
ENTER
Ln-Time: 15.0[S]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
I1? T1? I2? →
ENTER
Pre-Set: 600[%]
St-Curr: 600[%]
ENTER
St-Curr: 600[%]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
T2? I3? Ig? →
ENTER
Pre-Set: 240[mS]
St-Time: 240[mS]
ENTER
St-Time: 240[mS]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
I2? T3? Ig? →
ENTER
Pre-Set: 1000[%]
Inst-Curr: 1000[%]
ENTER
Inst-Curr: 1000[%]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
T2? I3? Ig? →
ENTER
Pre-Set: 24[%]
GR-Curr: 24[%]
ENTER
GR-Curr: 24[%]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
Tg? Ip? Tp? →
ENTER
Pre-Set: 240[mS]
GR-Time: 240[mS]
ENTER
GR-Time: 240[mS]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
Tg? Ip? Tp? →
ENTER
Pre-Set: 90[%]
AI-Curr: 90[%]
ENTER
AI-Curr: 90[%]
Change Set? [Y/N]
ENTER
〈SETTING. 1.〉 ↑
Tg? Ip? Tp? →
ENTER
Pre-Set: 5[S]
AI-Time: 5[S]
ENTER
AI-Time: 5[S]
Change Set? [Y/N]
ENTER

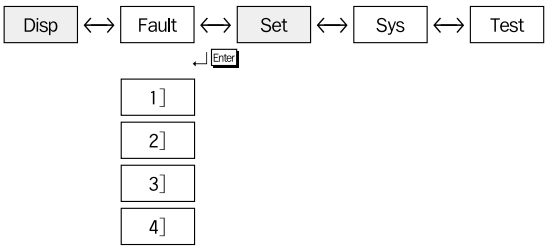

[APR-COM.] #1
Set? Sys? Test? →
ENTER
〈Passwd Check〉
PassWord: [0000]
ENTER
System Mode
1. Comm. address
2. Password
3. Frequency
〈Sys Conf〉 ↑
Add? Id? Ict? →
ENTER
Old Addr = 1
New Addr = 1
ENTER
New Addr = 1
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Add? Id? Ict? →
ENTER
〈Passwd Set〉
PassWord: [0000]
ENTER
PassWord: [0000]
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Add? Id? Ict? →
ENTER
CT: Old = 5000/.2
New = 5000/.2
ENTER
CT: New = 5000/.2
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Pt? Mode? Hz? →
ENTER
PtR: 110/110
New = 110/110
ENTER
New = 110/110
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Pt? Mode? Hz? →
ENTER
Pre-Mode: [COM.]
COM? GEN? MOT?
ENTER
NEW-MODE: [COM.]
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Pt? Mode? Hz? →
ENTER
Pre-Mode: [COM.]
COM? GEN? MOT?
ENTER
NEW-MODE: [GEN.]
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Pt? Mode? Hz? →
ENTER
Pre-Mode: [COM.]
COM? GEN? MOT?
ENTER
NEW-MODE: [MOT.]
Change Set? [Y/N]
ENTER
〈Sys Conf〉 ↑
Pt? Mode? Hz? →
ENTER
Rat-Freq: 60Hz
50Hz? 60Hz?
ENTER
New Freq: 50Hz
Change Set? [Y/N]
ENTER

2) Key menu structure

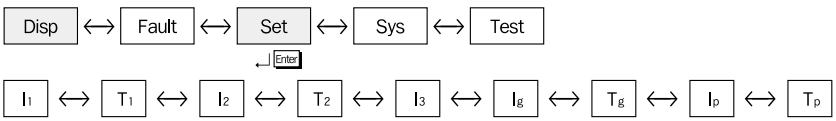
Display screen



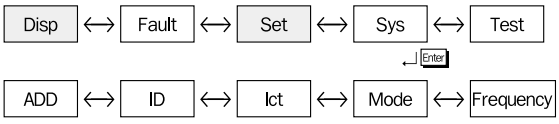
Fault



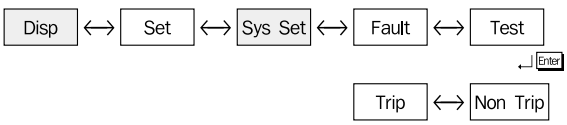
Set screen



Sys

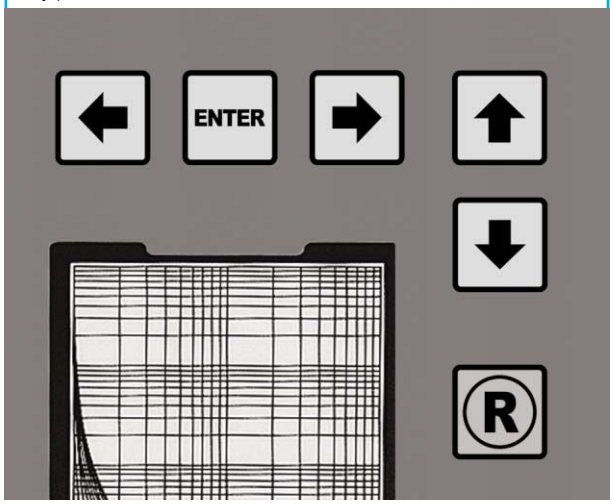


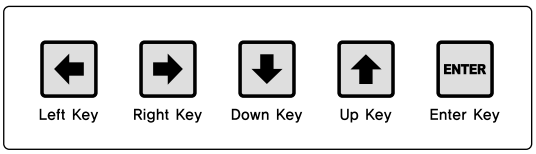
Test



3) Key operation manual and LCD status

Key pad of APR-1D-GM





■ Main menu

<[APR-COM]> Shows five main menu: Display, Fault, Setting, System and Test.
You can push ← key to move to next menu,
push ↑ key to view upper menu, in all menu windows.

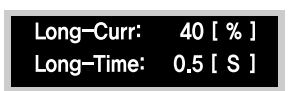
■ Display menu

In the main menu window, select Disp? by using ← →, and push ENTER key for display menu.
The display menu shows load current, setting values and system setting values.

- Load current

In the display menu window, select Curr? by using ← → key and push ENTER key.
Press ↓ key to see Ia, Ib, Ic, In, Vab, Vbc, Pf, W.

- Setting information



In the display menu window, select Set? by using ← → key and push ENTER key for setting information. Press ENTER continuously to see next setting information.

- System information

In the display menu window, select Sys? by using ← → key and push ENTER key for system information.

■ **Fault menu**

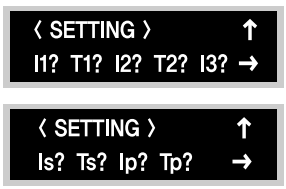
In the main menu window, select Fault? by using ← → key, and push ENTER key for trip information.

Press ↓ key to see fault trip history.

■ **Setting menu**

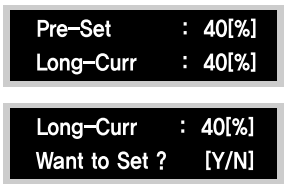
In the main menu window, select Set? by using ← → key and push ENTER for setting menu.
Through the pass word check, you can approach setting menu.

※ Pass word check method if password is 1234, change the flicker "O" into "4" by using ENTER key.
You can move to next "O" by using ← key, and set the other digits.



In the setting menu window, each item has follow meaning.
LTD curr: I_1, LTD time: T_1
STD curr: I_2, STD time: T_2, INST curr: I_3, GFT curr:Ig, GFT time: Tg,
PRE-ALARM Curr: Ip, PRE-ALARM time: Tp

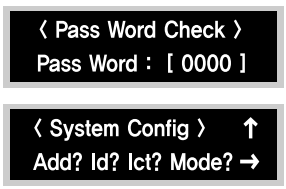
If you want to set I_1=40%, select I_1 by using ← → key and push ENTER key, you can see the below window.



Move cursor to the figure required modification by using ← → key. Set "4" and "O" by using ↑ ↓ key, and push ENTER key. Then, the below screen will appear.

You can select "Y" to finish the setting or "N" to cancel the setting, and push ENTER key.
Set the other values with same method.

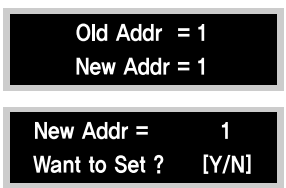
■ **System menu**



In the system menu window, user can set the communication port, password, CT ratio, Hz, load type and the characteristic curve of overload.

In the main menu window, select Sys? by using ← → key and push ENTER key.
Through the password check, you can approach system menu.

If you want to set communication address, select Add? by using ↑ ↓ key, and push ENTER key, and you can see below window.



Make new figure by using ↑ ↓ key, and push ENTER key, the below screen will appear. Select "Y" or "N" and push ENTER key.

Set other values with same method.

■ **Test menu**

〈 Pass Word Check 〉 Pass Word : [0000]

In the main menu window select Test? by using ◀ ▶ key, and push ENTER key.
Through the pass word check, you can approach test menu.

〈 Test Mode 〉 ↑ Non Trip? Trip?

In case of non-trip function, APR simulates LTD, STD & INST trip like a real fault, but the breaker will not operate. In case of trip function, APR simulates LTD, STD & INST trip and gives a trip signal to the breaker, then the breaker operates trip mechanism.

For the test under the trip function, select Trip? by using ◀ ▶ key, and push ENTER key.

ACB : Trip Test ↑ LTD? STD? INST?

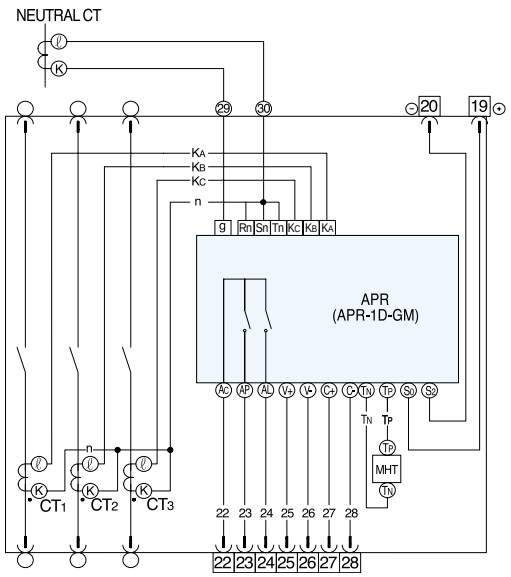
If you select LTD, and push ENTER key, APR simulates according to setting value: fault trip and pre-alarm trip lamp is lighted, and the breaker is tripped.
Push ENTER key to reset.

ACB : Trip Test ↑ = LTD Trip Test !

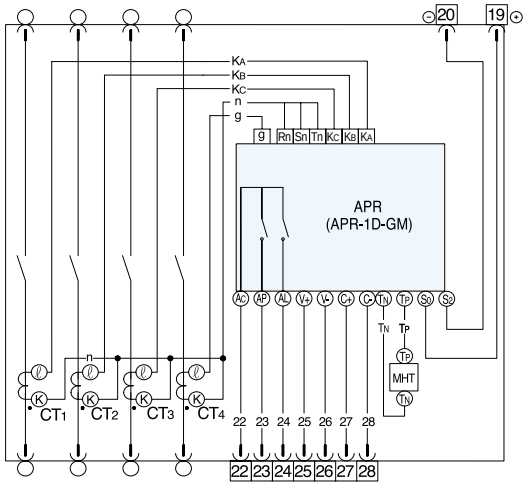
[OCR LONG TRIP !] [Fault Phase : Ia]

4) Wiring diagram of APR-1D-GM type

Wiring diagram of APR-1D-GM type



(3 pole)



(4 pole)

19	20	APR control power terminal
22	23	Pre-trip alarm contact
22	24	LTD, STD, INST, GFT contact
25	26	Voltage supply terminal (user wiring) (phase voltage AC 110 V)
27	28	Communication port (user wiring)

5) General directions for the current test of main circuit

When a single-phase current source is used to test the breaker, observe the following directions.

- Temperature test

  If a single-phase test current equal to the rated current is applied to a breaker with its three poles connected in series for temperature test, the breaker will be tripped. All function (LTD, STD, INST, GFT) of APR set "NON" for a single phase test.

- Over current trip test

  When a trip test is performed on a breaker with a test current supplied to its main circuit, in the same manner as in the temperature test, do this for each pole so that 2 out of the three poles are not in the same direction (not allowed when ground fault trip is provided) or with 2 poles.

Insulation Resistance Test and Dielectric Withstand Test

The insulation resistance test and dielectric withstand test of main and control circuit are performed as follows:

7.1 Main Circuit

- Dielectric withstand voltage test: AC 3500 V for one minute.
- Insulation resistance test: DC 500 V insulation resistance tester (megger).

7.2 Control Circuit (to earth)

- Dielectric withstand voltage test: AC 1500 V for one minute.

  For DC 24 V rating of motor charging and closing operation circuits, use AC 500 V for one minute.
  (Control circuit terminals ①, ②, ③, ④)
  For following control circuits, dielectric withstand test is impossible.

  - UVT control circuit terminal ⑨, ⑩ in case of DC rating.
  - Control power terminal ⑲, ⑳ in both AC and DC rating.

- Insulation resistance test: DC 500 V insulation resistance tester (megger).

8.1 Trouble & Troubleshooting

NO.	Trouble	Causes	Troubleshooting
1	The breaker cannot be closed	1. Roughness of contact's surface. 2. Discharged spring. 3. Cut of closing coil. 4. Defect in control circuit. 5. Abnormal UVT. - Abnormal control source. - Cut or short of coil. - Defect in control device of UVT. 6. Abnormal SHT. - Abnormal position of moving core. - Change in moving core stroke. 7. Roughness of moving parts caused by insufficient grease. 8. Abnormal position of open padlock lever.	1. Grinding the contact surface or replace the contact. 2. Charge the spring. 3. Replace the closing coil. 4. Check the connection, operation status of the control circuit and correct it to the normal position. 5. - Supply the proper source voltage. - Replace the UVT. - Repair or replace the UVT. 6. - Check the core surface, and remove the external material. - Replace the SHT. 7. - Remove dust and inject grease. - Check the abrasion degree of ratch, roller and shaft. If any trouble happens, refer to HHI. 8. Check the open padlock lever, and return it to normal position.
2	Overheat	1. Loosed terminal screws. 2. Contact. - Lack of compression force. - Roughness of compression surface. - Contamination of compression surface. 3. Rise of ambient temperature.	1. Tighten the terminal screws. 2. - Refer to HHI for the compression force adjustment. - Grind the contact surface or replace the contact. - Clean the contact. 3. Install the ventilation equipment.
3	The breaker cannot be charged	1. Sliding between feed lever and ratchet. 2. Defect of charging motor. - Abnormal control source. - Abnormal operation of control circuit. - Defect in motor pinion or gear. - Damage of motor.	1. Check the return spring, feed lever and ratchet, if any damage or abrasion is found, please them. 2. - Supply the proper source voltage. - Check the connection, operation status of the control circuit and correct it to the normal position. - Change the unit.
4	The breaker cannot be tripped	1. Abnormal UVT. - Lack of trip force - Residual magnetism. 2. Abnormal SHT. - Cut or short of coil. - Decrease in source voltage. - Lack of moving core stroke. - Abnormal operation of control circuit. 3. Abnormal APR. - Detect of APR. - Cut of CT coil. 4. Roughness of moving parts caused by insufficient grease.	1. - Check the state of spring, it any damage is detected, repair it. - Check the moving operation of moving part. If any damage is detected, repair it or refer to HHI. - If any external material is found, remove it. 2. - Change the coil. - Supply the proper source voltage. - Refer to HHI for the stroke adjustment. - Check the connection, operation status of the control circuit and correct it to the normal position. 3. Refer to HHI for the APR replacement. 4. - Remove dust and inject grease. - Check the abrasion degree of ratch, roller and shaft. If any trouble happens, refer to HHI.

9.1 Neutral CT and APR Connection Method

When using a 3-pole ACB with the ground fault protection to protect a 3-phase, 4-wire system against ground fault, it is required to install an appropriate current transformer (CT) to the neutral line of the system.

1) Neutral CT rating and specification

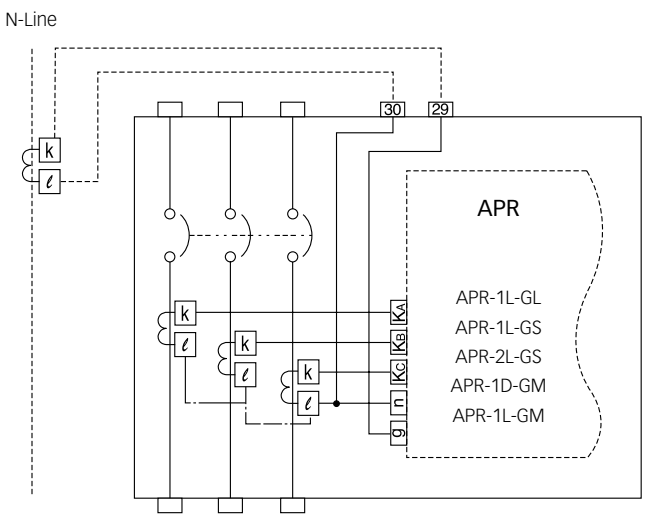
Circuit breaker	CT rating (A)
HiAN06, HiAS06 HiAN08, HiAS08 HiAN10, HiAS10 HiAN12, HiAS12 HiAN16, HiAS16	320/0.2 630/0.2 800/0.2 1000/0.2 1200/0.2 1600/0.2
HiAN20, HiAS20 HiAN25, HiAS25 HiAN32, HiAH32, HiAS32	2000/0.2 2500/0.2 3200/0.2
HiAN40 HiAN50 HiAN63	4000/0.2 5000/0.2 6300/0.2

※ The neutral CT : class 1.0

2) Connection of CT and APR

Connect the CT with correct polarity.

Fig. 34. Connection diagram for neutral CT of 3-pole ACB



CAUTION When the CT polarity is connected reversely, ground fault protection function may cause a malfunction. (ACB is set with K polarity, please attach it with K polarity when attached neutral CT)

9.2 Method of Ground Fault Protection

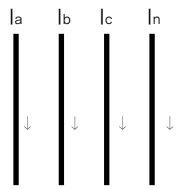
1) Y-Y connected transformer which grounded neutral

(1) When using 3 pole ACB at the 3 phase, 4 wire system.
The neutral CT connects to 29, 30 neutral terminal.
When the residual current of CT exceeds the setting point, ACB will be tripped GFT.
The more sensitive the ground current is, the more low the neutral CT ratio is.

AG	At I_{CT} x 0.1~0.4, continuous adjustment I_{CT} x (0.1-0.15-0.2-0.25-0.3-0.35-0.4, NON) 8 step
Peak-up current adjustment	Step-type adjustment by I_{CT} x 0.1~0.4
Tolerance	±20%
Tirp time	80-160-240-320-400-480-560 msec

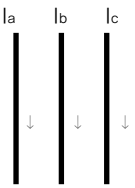
(2) When using 4 pole ACB at the 3 phase, 4 wire system
There is CT inside of the neutral pole in 4 pole ACB and it is not the neutral CT but the residual current which is generated by vector sum of 4 CT, which senses fault.

Ia + Ib + Ic + In = 0, NON Trip
Ia + Ib + Ic + In ≠ 0, Trip



(3) When using 3 pole ACB at the 3 phase, 4 wire system, the principle is the same (1).

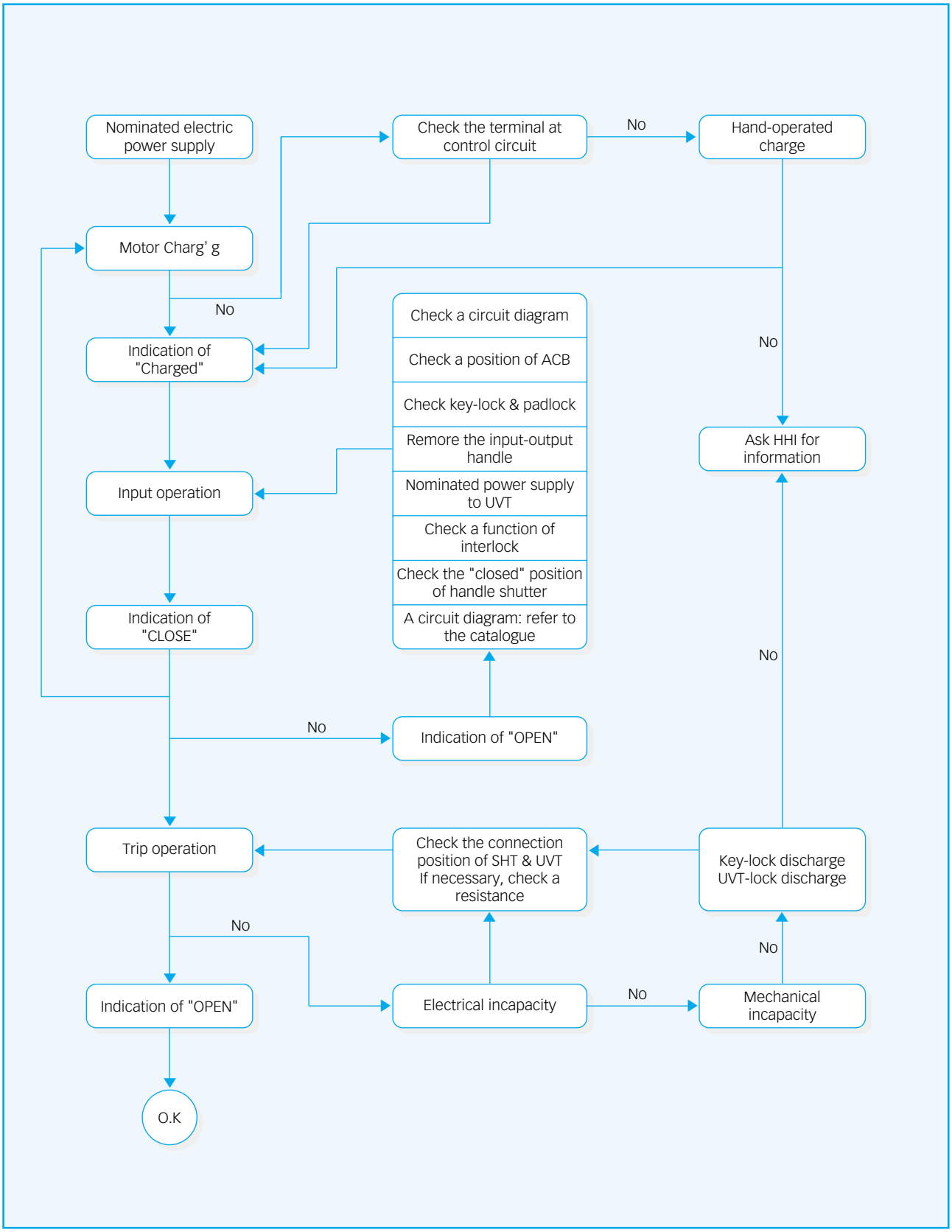
Ia + Ib + Ic + In = 0, NON Trip
Ia + Ib + Ic + In ≠ 0, Trip



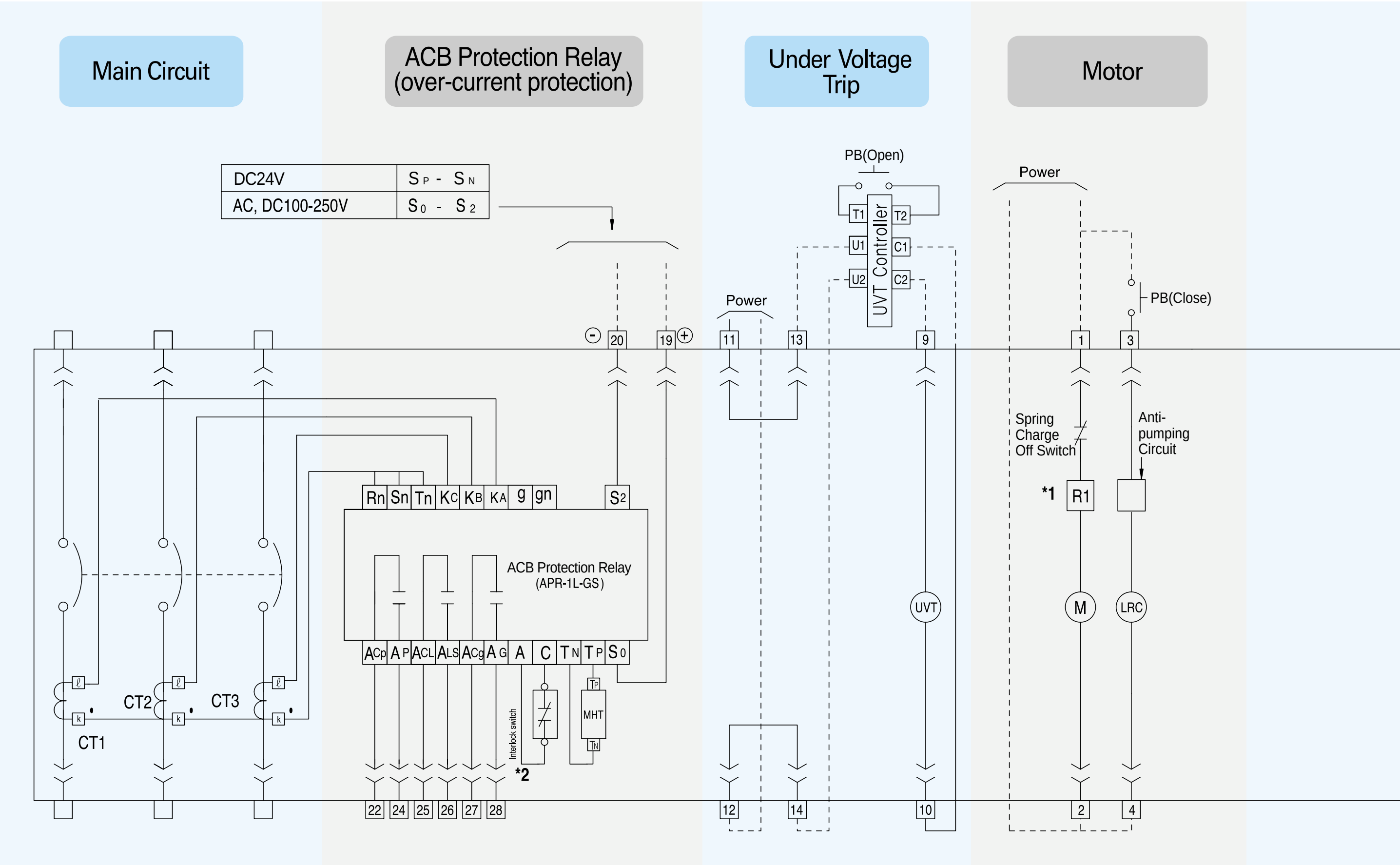
2) Y-Y connected transformer which ungrounded neutral

It damages os less to the instrument which is grounded owing to very small amount of short current in ungrounded system. So this system does not apply to HYUNDAI ACB APR because it can detect very small amount of short current.
If you need short function, please set up seperately ZCT and OCGR relay in panel.

9.3 Closing and Trip Operation Cycle



9.4 HiAN & HiAH Draw-out Type Circuit Diagram / APR-1L-GS



*1: Attach at rated voltage DC125V *2: Option (MCR)

Control Circuit Lay-out

◆ Draw-out type

APR & UVT						Control Circuit							Aux. Switch									
19	21	23	25	27	29	1	3	7	9	11	13	15	31	33	35	37	39	41	43	45	47	49
20	22	24	26	28	30	2	4	8	10	12	14	16	32	34	36	38	40	42	44	46	48	50

◆ Fixed type

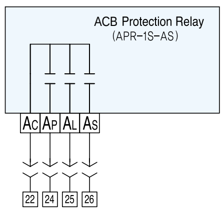
Control Circuit

30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	4	3	2	1

Aux. Switch

B1		A1		A2		B2		A3		B3		A4		B4	
31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46

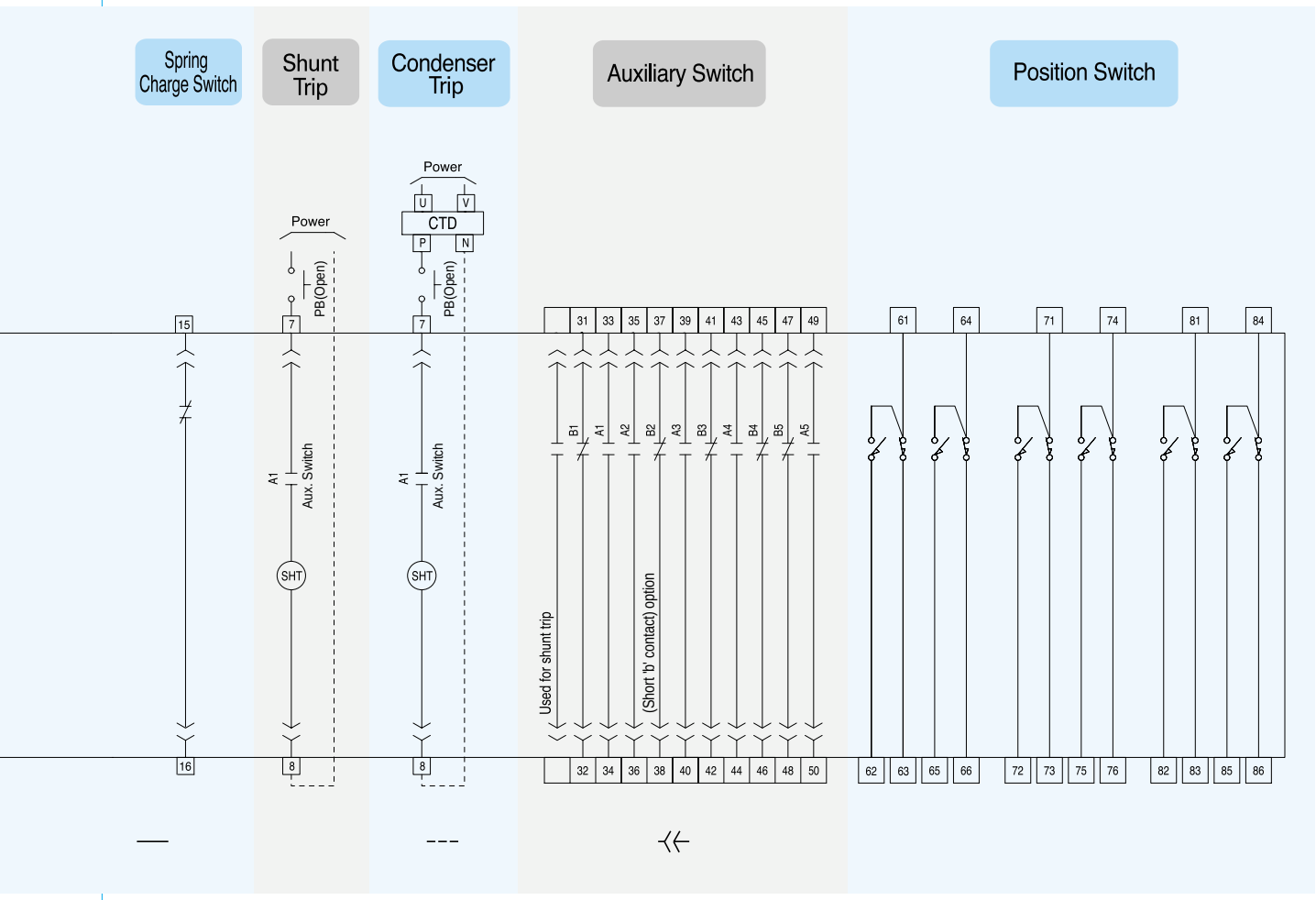
APR-1S-AS type APR



22 24 AP Indication Terminal

22 25 AL Indication Terminal

22 26 AS AI Indication Terminal



Main circuit

CT: Current Transformer for APR

APR Protection Relay / APR-1L-GS (over-current protection)

19 20	Control Power Terminal (CP/I)
22 24	AP Indication Terminal
25 26	AL AS AI Indication Terminal
27 28	AG Indication Terminal
MHT	Magnetic Hold Trigger

※ For other type APR, please refer to page 58, 59.

Under Voltage Trip (UVT)

11 12	Control Power Terminal
T1 T2	Remote Trip Terminal
UVT	Under Voltage Trip Coil

Spring Charge Switch

15 16	Spring Charge Switch Terminal

Motor Charging/Closing Circuits

1 2	Charging Power Terminal
3 4	Closing Power Terminal
M	Charging Motor
LRC	Latch Release Coil
R1	Resistances

Shunt Trip (SHT)

7 8	Control Power Terminal
SHT	Shunt Trip Coil

Condenser Trip (CTD)

U V	Control Power Terminal
P N	Remote Trip Terminal
CTD	Condensor Trip Device

Auxiliary Switch

31 – 46	Auxiliary Contact Terminal
47 – 50	Extensional Auxiliary Contact (1a1b)

※ - In case that you use shunt trip in combination with under voltage trip, 1a contact (33, 34) shall be used in the circuit of under voltage trip.
- Extensional auxiliary contact 1a1b is not applicable to HiAN40-63 and HiAH32.

Position Switch

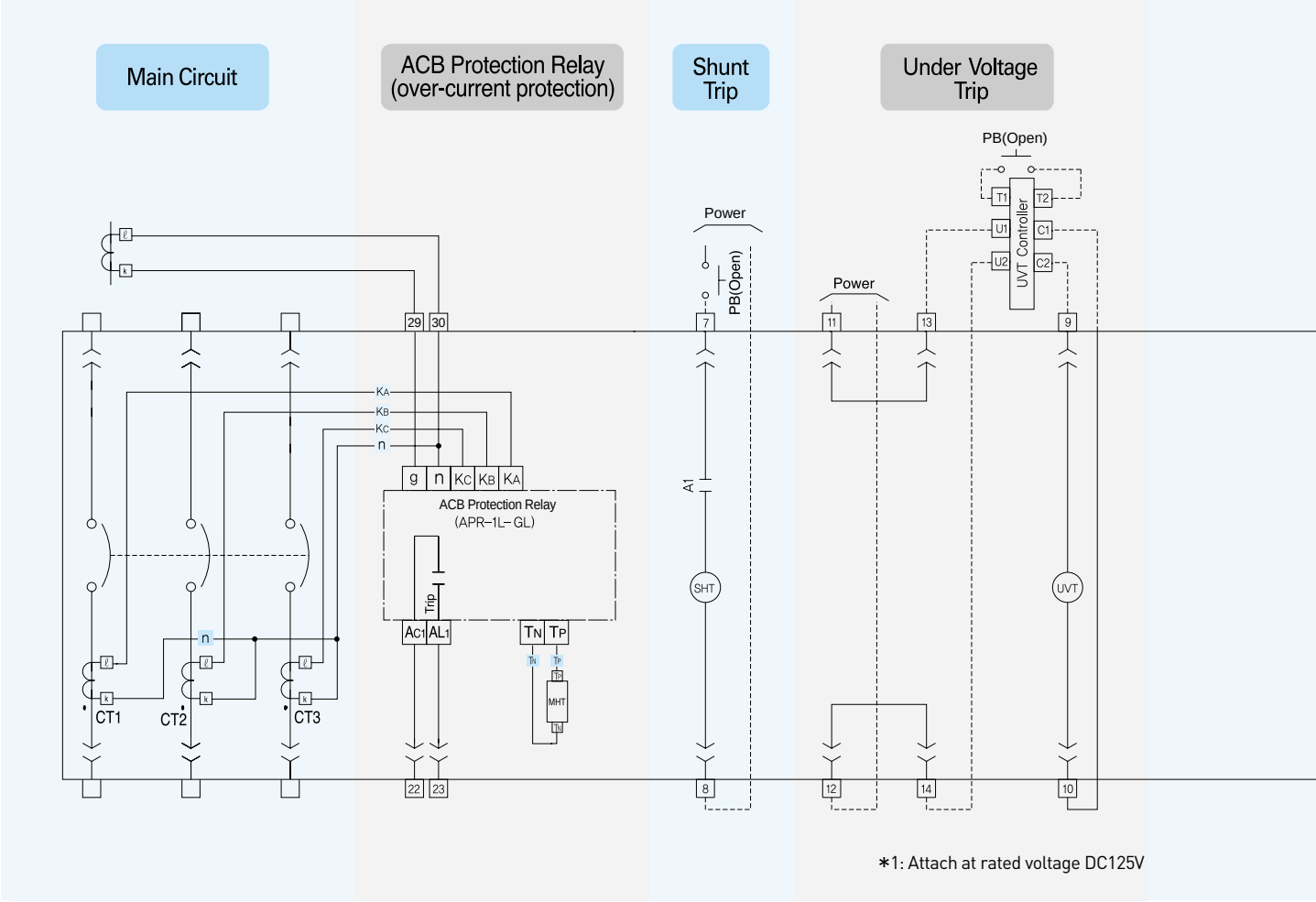
TEST position
61-62 ON
61-63 OFF
64-65 ON
64-66 OFF

CONNECTED position
71-72 ON
71-73 OFF
74-75 ON
74-76 OFF

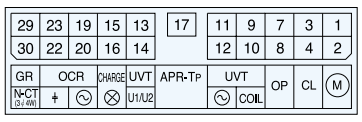
ISOLATED position
81-82 ON
81-83 OFF

INSERTED position
84-85 ON
84-86 OFF

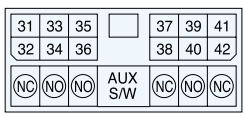
9.5 HiAS Type Circuit Diagram / APR-1L-GL



Control Circuit Lay-out

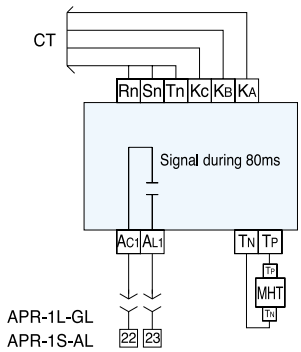


Control circuit

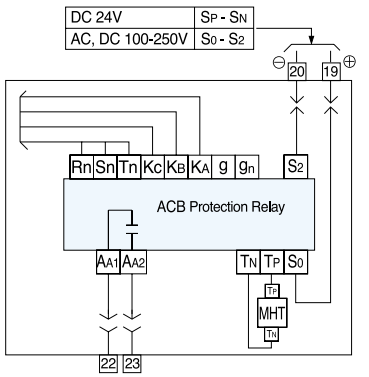


Aux. Switch

APR-1L-GL, APR-1S-AL type APR

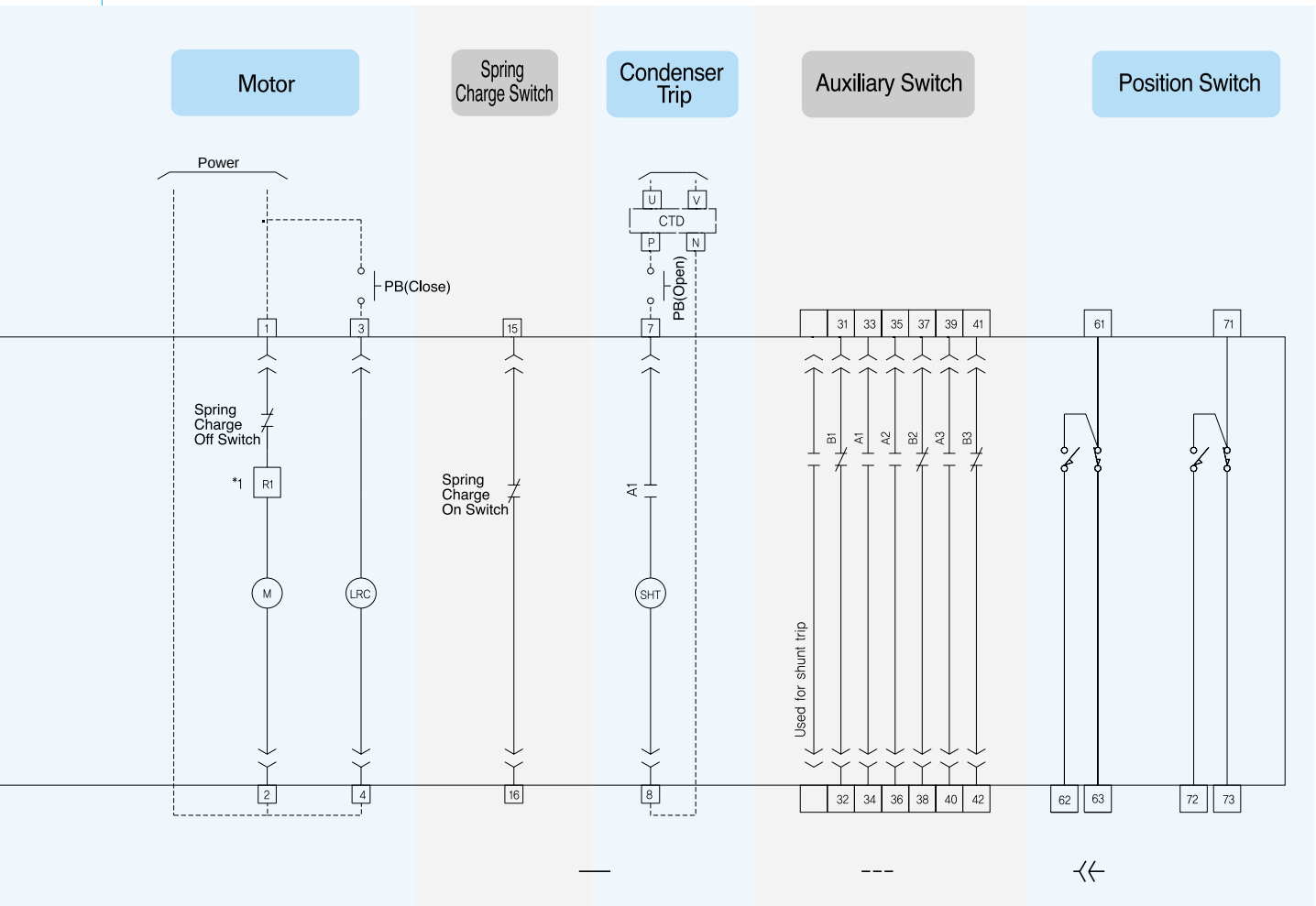


APR-1L-GM type APR



19 20 Control Power Terminal (CP/I)

22 23 AL AS AI AG Indication Terminal



Main circuit

CT: Current Transformer for APR

APR Protection Relay / APR-1L-GL (over-current protection)

19	20				Control Power Terminal (CP/I)
22	25	AL	AS	AI	Indication Terminal
26	27	AL	AS	AI	Indication Terminal

(MHT) Magnetic Hold Trigger

※ For other type APR, please refer to page 56.

Under Voltage Trip (UVT)

9	10	Control Power Terminal
T1	T2	Remote Trip Terminal

(UVT) Under Voltage Trip Coil

Spring Charge Switch

15	16	Spring Charge Switch Terminal

Motor Charging/Closing

1	2	Charging Power Terminal
3	4	Closing Power Terminal

(M) Charging Motor

(LRC) Latch Release Coil

R1 Resistance

Shunt Trip (SHT)

7	8	Control Power Terminal

(SHT) Shunt Trip Coil

Capacitor Trip (CTD)

U	V	Control Power Terminal
P	N	Remote Trip Terminal
CTD		Condensor Trip Device

Auxiliary Switch

31	42	Auxiliary Contact Terminal

Position Switch

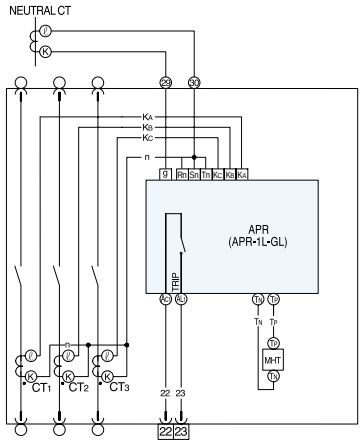
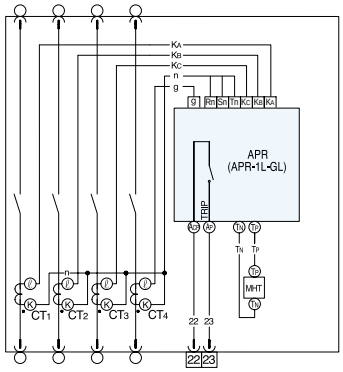
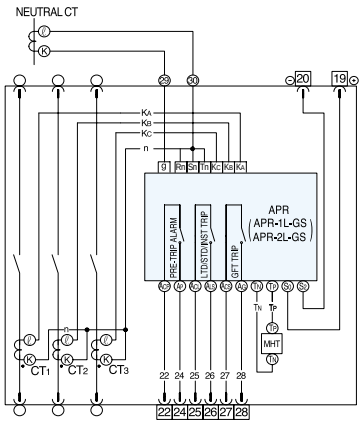
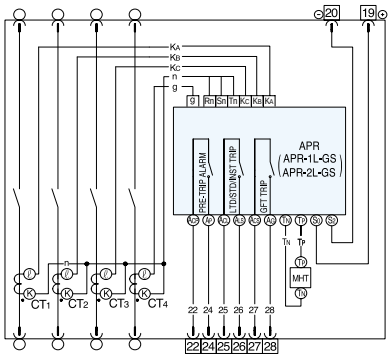
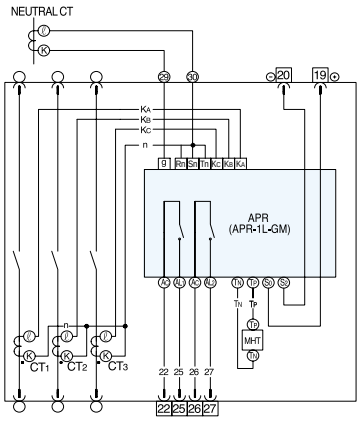
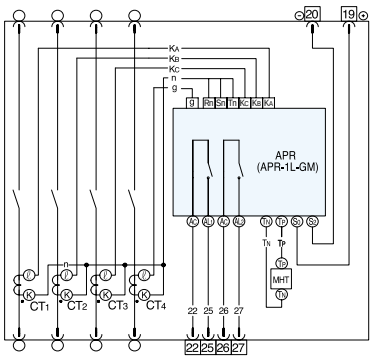
TEST position

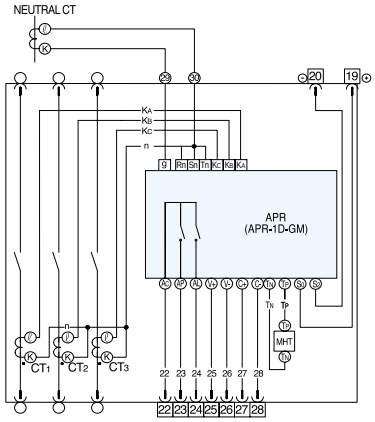
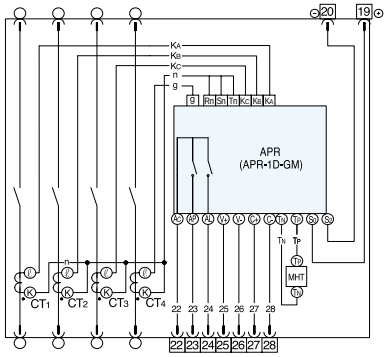
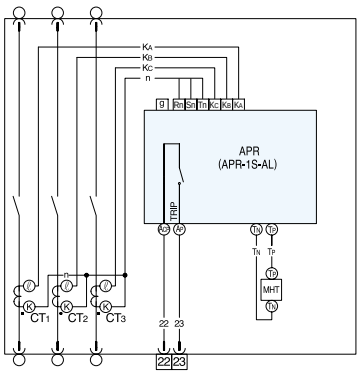
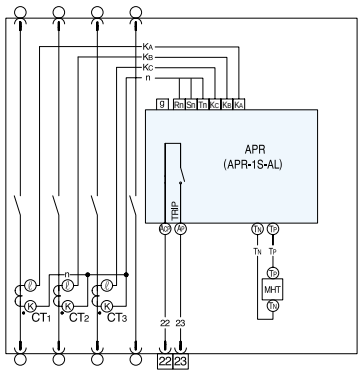
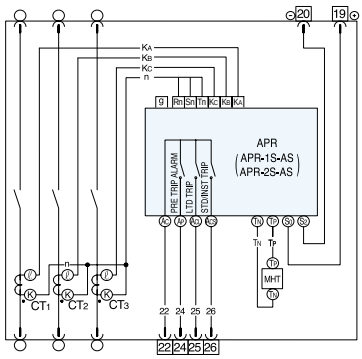
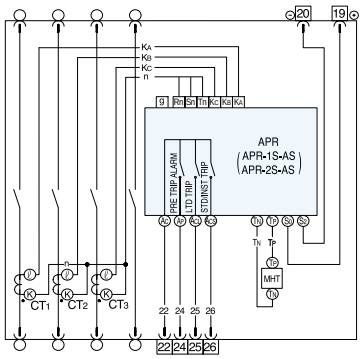
61-62 ON
61-63 OFF
64-65 ON
64-66 OFF

CONNECTED position

71-72 ON
71-73 OFF
74-75 ON
74-76 OFF

9.6 APR Wiring Diagrams

Type	3 pole	4 pole
APR-1L-GL		
APR-1L-GS APR-2L-GS		
APR-1L-GM		

Type	3 pole	4 pole
APR-1D-GM		
APR-1S-AL		
APR-1S-AS APR-2S-AS		

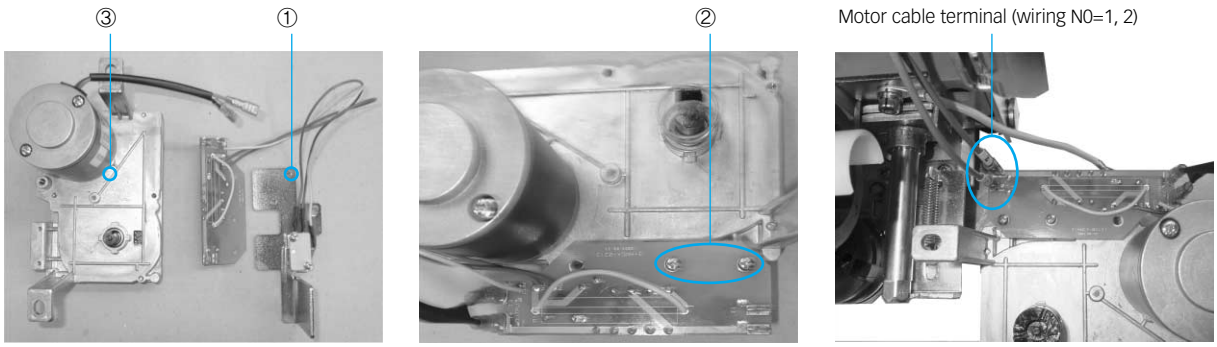
9.7 Motor Unit Assembly Manual

1) Open the ACB front cover.

2) Check the associated parts (motor, motor control unit, screws).

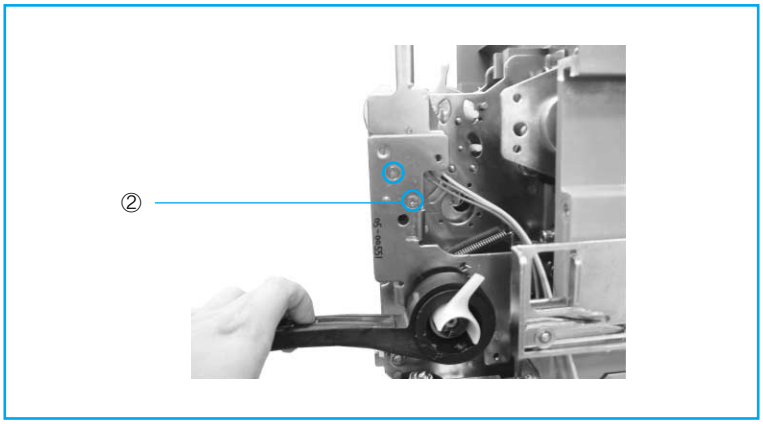
3) Attach the motor control unit to motor control unit using R/H screw.

① Motor control unit ··· 1EA
② R/H screw (M3×10, with S/W) ··· 2EA
③ Motor unit ··· 1EA (110 V or 220 V).



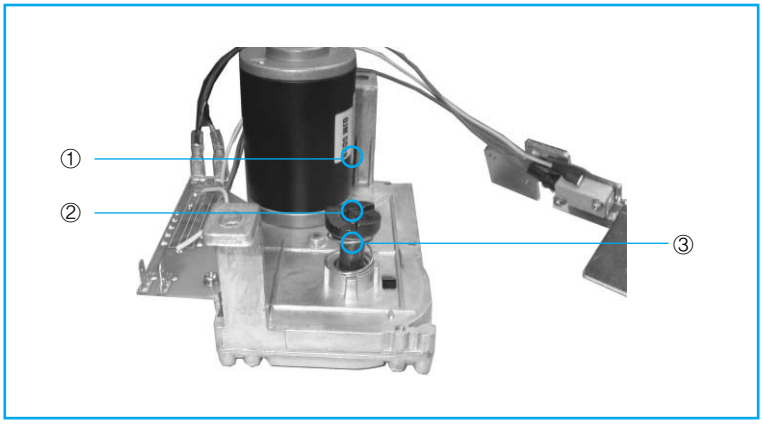
4) Joint a D/H screws with motor control unit (after paste the loc-tite).

① Motor control unit ··· 1EA
② D/H screw (M3×10) ··· 2EA

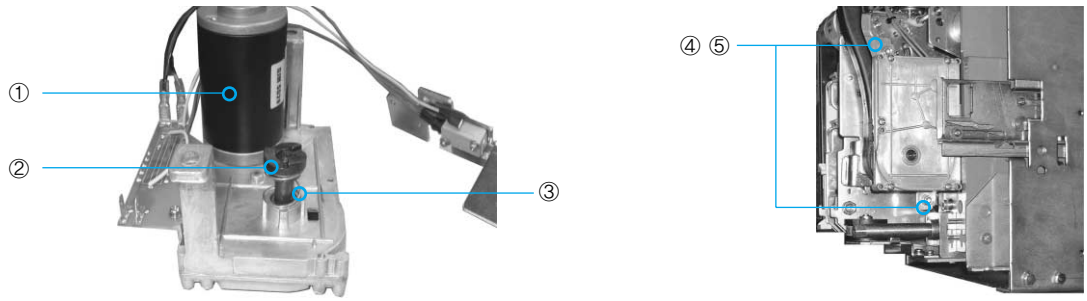


5) After greasing motor shaft assemble motor ratchet/M and motor ratchet spring.

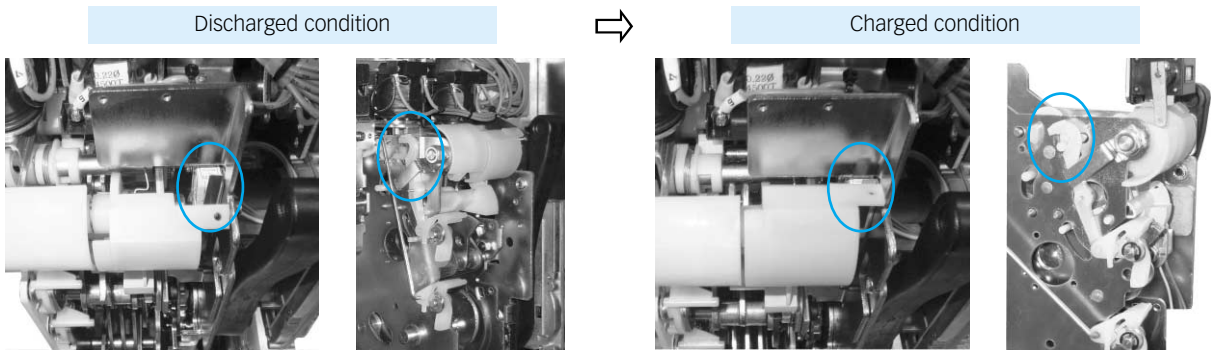
① Motor unit
② Motor ratchet/M ··· 1EA
③ Motor ratchet spring ··· 1EA
④ Hex wrench bolt (M6×12) ··· 2EA
⑤ S/washer (M6) ··· 2EA



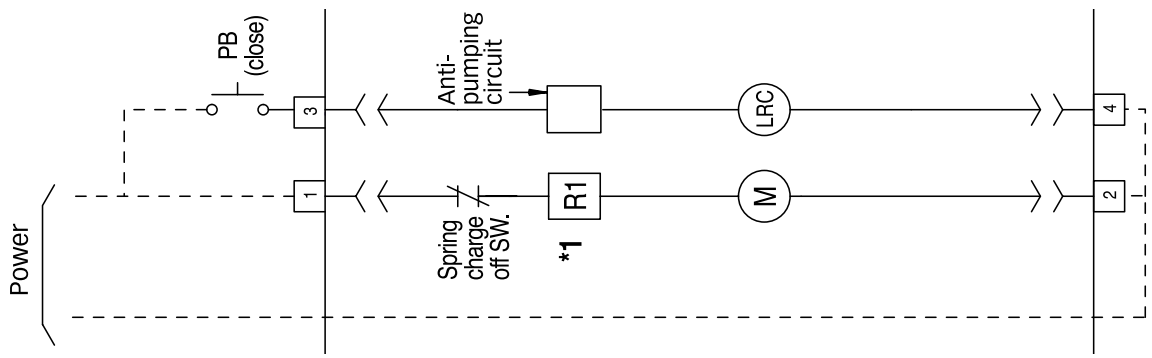
6) Push down charging handle and assemble above ⑤ sub assembly using M6 x 12 with s/washer.



7) Limit switch which is assembled on counter support should be switchable by Charged/Discharged Indicator.



8) Wiring should be doen according to below schematic diagram.



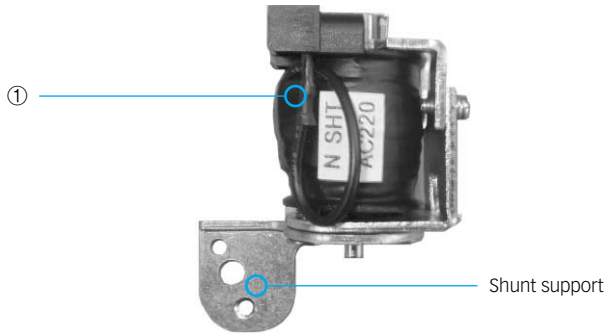
9) Attach the front cover.

9.8 Shunt Unit Assembly Manual

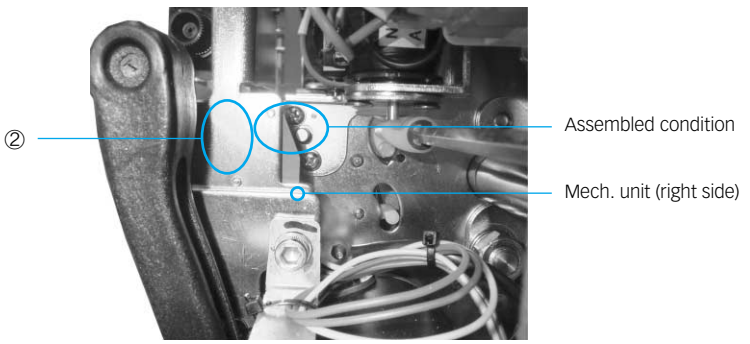
1) Open the ACB front cover.

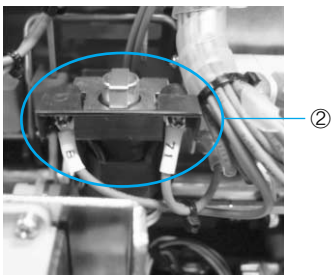
2) Check the associated parts (shunt, shunt support, screws).

① Shunt unit ··· 1EA
② R/H screw (M4×10, with S/W) ··· 2EA

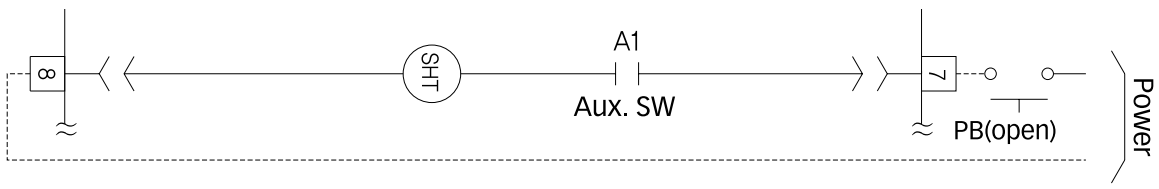


3) Attach the shunt unit to mechanism unit using R/H screw.





4) Wiring should be doen according to below schematic diagram.



5) Attach the front cover.

6) Shunt trip unit spec.

No	Rating voltage	Coil resistance(Ω)	Resistance tolerance	No	Rating voltage	Coil resistance(Ω)	Resistance tolerance
1	AC 110 V	25 Ω	±10 %	5	DC 24 V	2.7 Ω	±10 %
2	AC 110 V	101 Ω		6	DC 48 V	9.7 Ω	
3	AC 380 V	352 Ω		7	DC 110 V	36 Ω	
4	AC 440 V	472 Ω		8	DC 220 V	161 Ω	

Repair and Inspection Contents

Date	Contents	Expenses	A place of repair	Name of engineer	Signature

※ Please be sure to obtain the appropriate signatures after service.
Please keep this table for management, maintenance, and after-sales service.

HHIS-WZ-LE-013-05, 2012. 02 Designed by ADPARK

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