

Hybrid Hydraulic System
[Super Unit]
SUT10D80L21-10-F
SUT16D80L21-10-F

Operation Manual



DAIKIN INDUSTRIES, LTD.

Oil Hydraulics Division

<Safety Precautions>

■ Before using this product

- Give consideration to make users thoroughly understand the contents of this operation manual.
- Please incorporate the contents of this operation manual in operation manuals for your machine using this product.
- To ensure proper operation of this unit, be sure to read this operation manual and all other attached documents carefully, to have a thorough understanding of the equipment, safety information and all other precautions before installation, operation and maintenance/inspection of this unit.
- Be sure to keep this operation manual, attached documents and delivery specifications in place, so that you can read them whenever required.
- For detailed explanation of the unit, all figures and photographs included in this manual show the unit without covers or safety shields. To operate this unit, be sure to mount the covers and shields in the specified manner, and observe the operating procedures described in this manual.
- The contents of this operation manual are subject to change appropriately for product improvement, specification change or easier operations.

The latest version of this manual is available through DAIKIN Oil Hydraulics Division Internet Service (DHCnet HomePage) ([http:// www.dhcnet.daikin.co.jp:8100/](http://www.dhcnet.daikin.co.jp:8100/)).

- This operation manual should be used as a reference that provides safety instructions for DAIKIN Hydraulic Unit. In addition to this manual, please prepare safety references for your machine to ensure safe operations and maintenance in accordance with various standards and norms.

■ Conventions of safety instructions in this manual

- In this manual, safety instructions are classified into three categories: "▲ DANGER", "▲ WARNING" and "▲ CAUTION".

▲ DANGER: Improper handling regardless of this indication causes an urgently hazardous condition that may result in death or serious injury.

▲ WARNING: Improper handling regardless of this indication causes a potentially hazardous condition that may result in death or serious injury.

▲ CAUTION: Improper handling regardless of this indication causes a potentially hazardous condition that may result in medium or slight injury, or property damage.

Even an item indicated as "CAUTION" may result in a serious accident depending on the situation. All instructions given in this manual include important information. Be sure to observe all of them.

■ Safety precautions

◆ General precautions

▲ DANGER

- Transportation, installation, piping, wiring, operations, maintenance and inspections must be conducted by qualified personnel.
- During the above work, wear protective gear required for safe work (work clothes, safety band, helmet, safety shoes, gloves and so on).
- Do not use this unit under conditions other than those specified in the catalog or delivery specifications.

▲ CAUTION

- Be sure to conduct daily inspections (described in this manual or attached documents).
- Do not apply external force to this unit. (Do not step on, or pound on this unit.) Otherwise, you may suffer from injury, or the unit may be damaged.

<Escape Clauses>

- DAIKIN shall not be responsible for any damage attributable to a fire, earthquake, third party's action and other accidents, as well as customer's intention, misuse or use under abnormal conditions.
- DAIKIN shall not be responsible for any damage incidental to use of this product or impossibility to use this product (loss of business profit, discontinuation of business).
- DAIKIN shall not be responsible for any accident or damage attributable to negligence in observing the instructions given in the operation manual or delivery specifications.
- DAIKIN shall not be responsible for any damage attributable to malfunction caused by combinations of this unit and external equipment.

<Limitations on Applications>

- If a failure or malfunction of this unit may directly threaten human life, or this unit is used for equipment that may cause injury to the human body, such an application must be considered depending on the case.
- This unit has been manufactured under strict quality control. However, when it is used for important equipment, the equipment must be provided with a safety device to prevent malfunction of this unit from resulting in serious accident or damage.

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[1. Introduction]

Thank you for selecting IPM Motor Drive Hydraulic Unit <Super Unit>.

Using the oil hydraulic technology and energy-saving IPM motor drive system that DAIKIN originally developed, the IPM Motor Drive Hydraulic Unit <Super Unit> provides overwhelmingly excellent energy conservation performance and advanced functions.

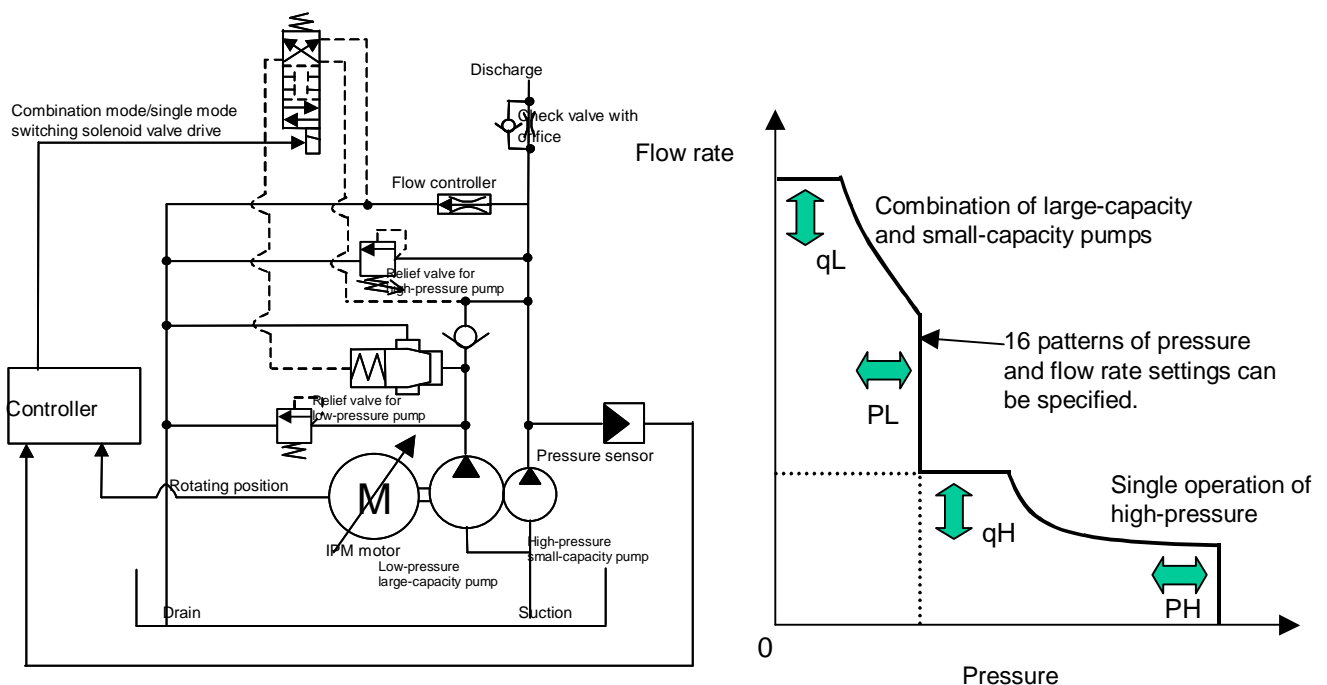
Before using the SUT Series <Super Unit>, please read this manual thoroughly, and handle and maintain this unit properly, so that this unit can retain excellent performance for a long period.

The components of this unit may be modified for the purpose of quality/performance improvement or other reasons. In such a case, some parts of this product may be different from those described in this manual.

[2. Features and Structure]

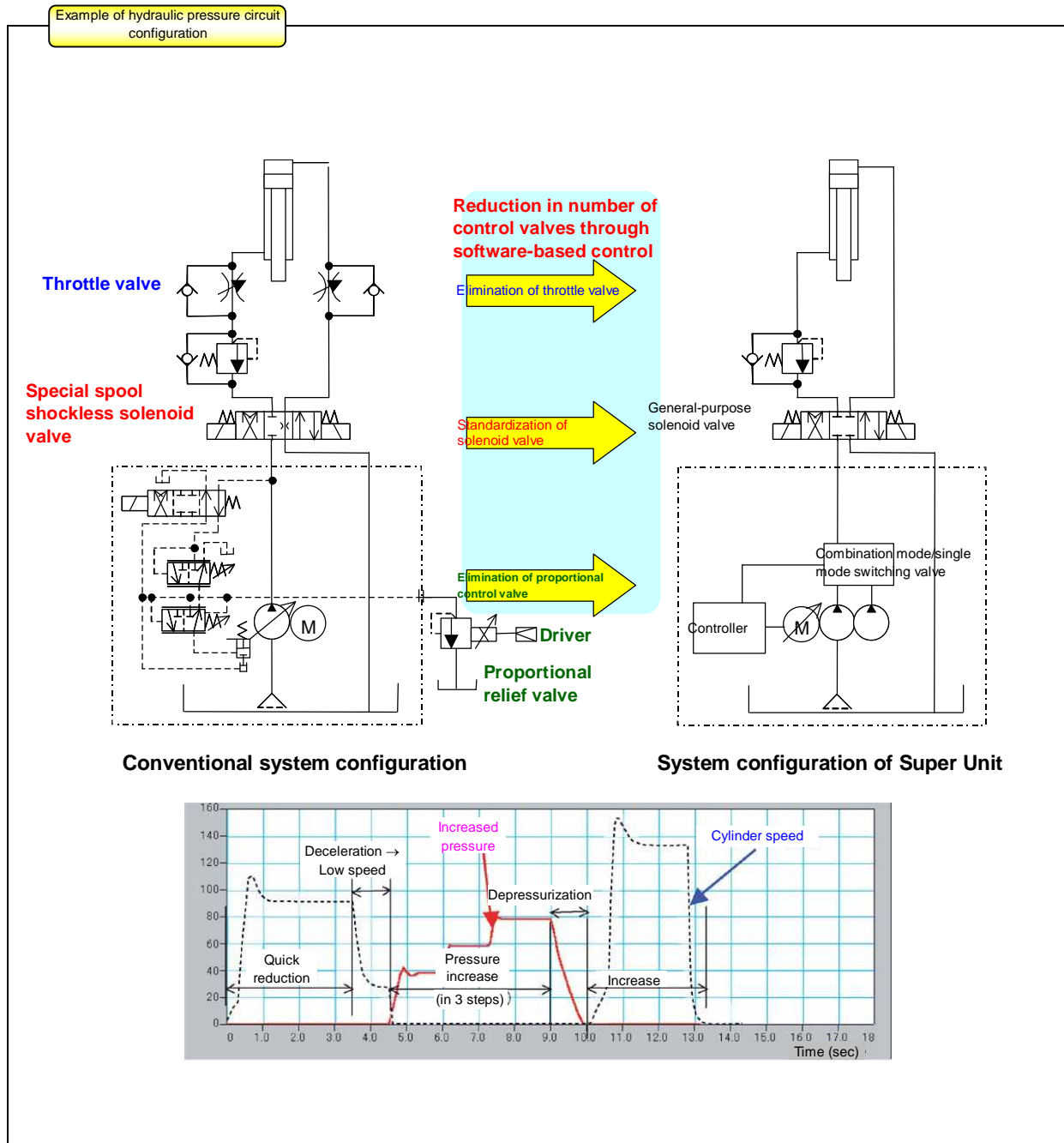
(1) Energy conservation

- Since the motor unit uses the highly efficient IPM motor drive system that DAIKIN originally developed, the Super Unit provides extremely high energy efficiency.
 - The Super Unit uses the autonomously-switching dual pump system that enables autonomous control of combination mode/single mode switching according to load pressure by using the dual fixed-capacity pumps (small-capacity and large-capacity pumps) and the switching valve.
- When a large flow rate is required, the dual fixed-capacity pumps (small-capacity and high-capacity pumps) are operated together at a high rpm. When a large flow rate is not required (during a pressure holding period), only the small-capacity pump is operated at a low rpm. Thus, the Super Unit can remarkably reduce energy consumption.



(2) Multi-stage speed control/Multi-stage pressure control, and shockless control functions

- The Super Unit enables multi-stage pressure control/flow rate control by selecting 16 patterns of P-Q characteristics that have been registered in the controller from the master machine (via a contact input).
- The Super Unit enables shockless control by setting or adjusting the rising/falling time during changeover of P-Q characteristics.
- Since the conventional valve-controlled functions are controlled with the pumps, the Super Unit can simplify the system configuration and reduce the cost for switching between high-speed and low-speed operations and multi-stage pressure control of presses.



[3. Description on Model Identification Code]

(a)	(b)	(c)	(d)		(e)		(f)		(g)		(h)
SUT	**	D	80	L	21	-	**	-	F	-	*****

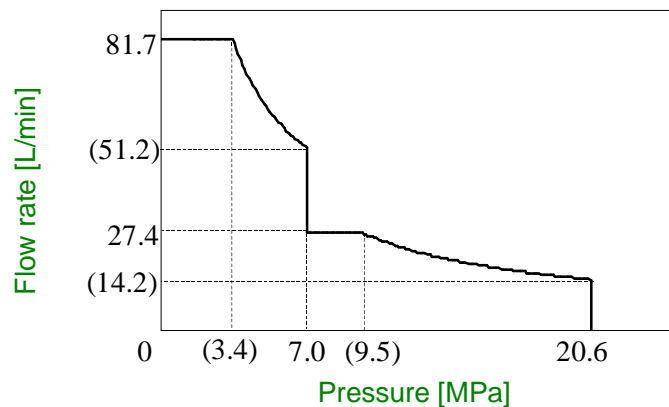
- (a) Series name
 - SUT: SUT series
- (b) Tank capacity
 - 10: 100 L
 - 16: 160 L
- (c) Pump type
 - D: Dual gear pump
- (d) Maximum pump discharge rate
 - 80: 83.0 L/min
- (e) Maximum operating pressure
 - 21: 20.6 MPa
- (f) Design No.
 - Advances according to model change.
- (g) Optional function
 - F: 16-pattern P-Q function and noise filter are used.
- (h) Non-standard control No.
 - Item without a symbol: Standard item

MFG. No

(i)	(j)	(k)		(l)
*	*	**	-	**_*****

- (i) Hardware revision history
- (j) Software revision history
- (k) Serial No.

<PQ represent characteristic chart>



- * The above charts show the typical characteristics at an oil temperature of 40°C.
- * Above PQ characteristics show the usable range by actual flow rate.

[4. Specifications and Operating Conditions]

■ Major specifications

		SUT10D80L21	SUT16D80L21
Maximum operating pressure (MPa)		20.6	
Maximum discharge rate ^(Note 1) (L/min)		83.0	
Operating pressure adjusting range	Low-pressure (combination) mode	1.5 to 7.0	
	High-pressure (single) mode	1.5 to 20.6	
Operating discharge rate adjusting range ^(Note 1) (L/min)	Low-pressure (combination) mode	11.6 to 83.0	
	High-pressure (single) mode	4.1 to 28.7	
Power supply ^(Note 2)		3φ 200 V/50 Hz, 200 V/60 Hz, 220 V/60 Hz	
External input signal (5ch)		Photo-coupler insulation, 24 VDC (27 VDC max.) 5 mA/ch	
External output signal	Contact output (1ch)	Relay output Contact capacity: 30 VDC, 0.5 A (Resistance load) 1c contact	
	Digital output (2ch)	Photo-coupler insulation, open-collector output, 24 VDC, 50 mA max./ch	
Standard paint color		Ivory white (Munsell code 5Y7.5/1)	

- ^(Note 1)
- Before shipment from the factory, the unit has been set to the maximum flow rate. (The maximum flow rate is a theoretical value, not a guaranteed value.)
 - For other specifications, see the delivery specification drawing (model drawing).
 - The maximum pressure/flow rate can be set at values higher than the adjustable range above; for daily use, however, be sure to observe the above pressure range/flow rate range.
 - This hydraulic unit incorporates a safety valve, which has been set to work at the maximum operating pressure + 1.0 MPa.

However, if the surge pressure during actuator operation must be minimized, adjust the pressure setting according to “Attachment: High-pressure Safety Valve Adjustment Procedure”.

- ^(Note 2)
- Power supply voltage fluctuation tolerance range is (10%. Even if the power supply voltage fluctuations are within the tolerance range, when the power supply voltage fluctuates in the positive direction, the regenerative overload (alarm stop) may occur in response, depending on the master machine operating conditions and load conditions.

■ Operating conditions

Hydraulic oil ^(Note 3)	Dedicated mineral hydraulic oil / Wear-resistant hydraulic oil (For recommended brands, see DAIKIN "Hydraulic Equipment General Catalog (HK196)"). <ul style="list-style-type: none"> • Viscosity grade: ISO VG 32 to 68 • Viscosity range: 15 to 400 mm²/s • Pollution degree: NAS Class 9 or lower level
Tank oil temperature	0 to 60°C (Recommended operating temperature range: 15 to 50°C) ^(Note 4)
Operating ambient temperature	0 to 35°C
Storing ambient temperature	-20 to 60°C
Humidity	80% RH or less (No condensation)
Height above the sea level	1,000 m or less
Installation place	Indoor (Be sure to fasten the unit with bolts.)
Others	<ul style="list-style-type: none"> • Be sure to mount a no-fuse breaker (three-pole) and a ground fault interrupter. • Make sure that the electric wiring conforms to European Norm EN60204-1. • If you frequently turn ON/OFF the power supply for this unit, the controller service life will be remarkably deteriorated. . If you intend to start and stop the unit at intervals of eight minutes or less, use the start/stop signal function of this unit. • Be sure to connect the ground terminal.

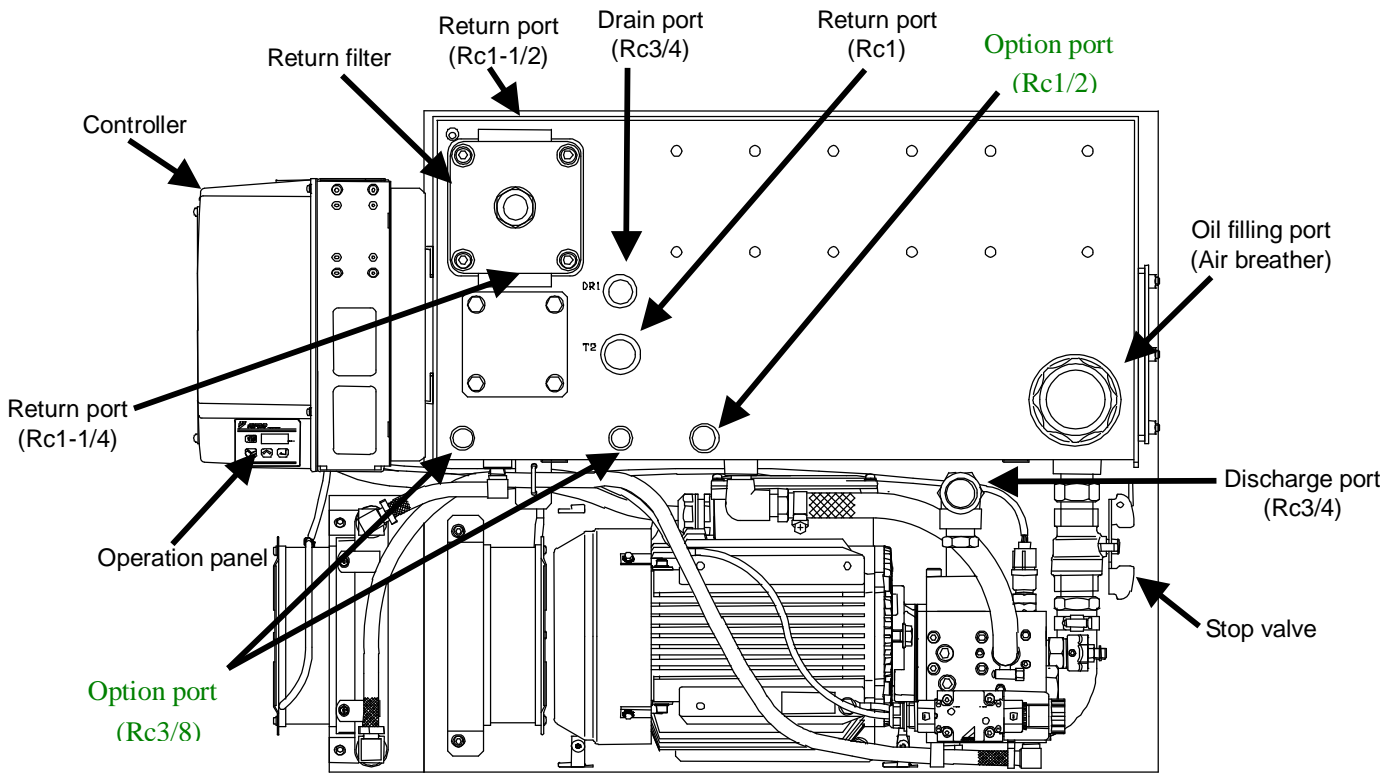
- ^(Note 3)
- This unit can use only mineral hydraulic oil. (Water-containing or synthetic oil such as water-glycol cannot be used.)

- ^(Note 4)
- When the tank oil temperature exceeds the recommended operating temperature range, pressure pulsation may be increased, or the discharge rate may be decreased. However, such phenomena do not indicate abnormality.

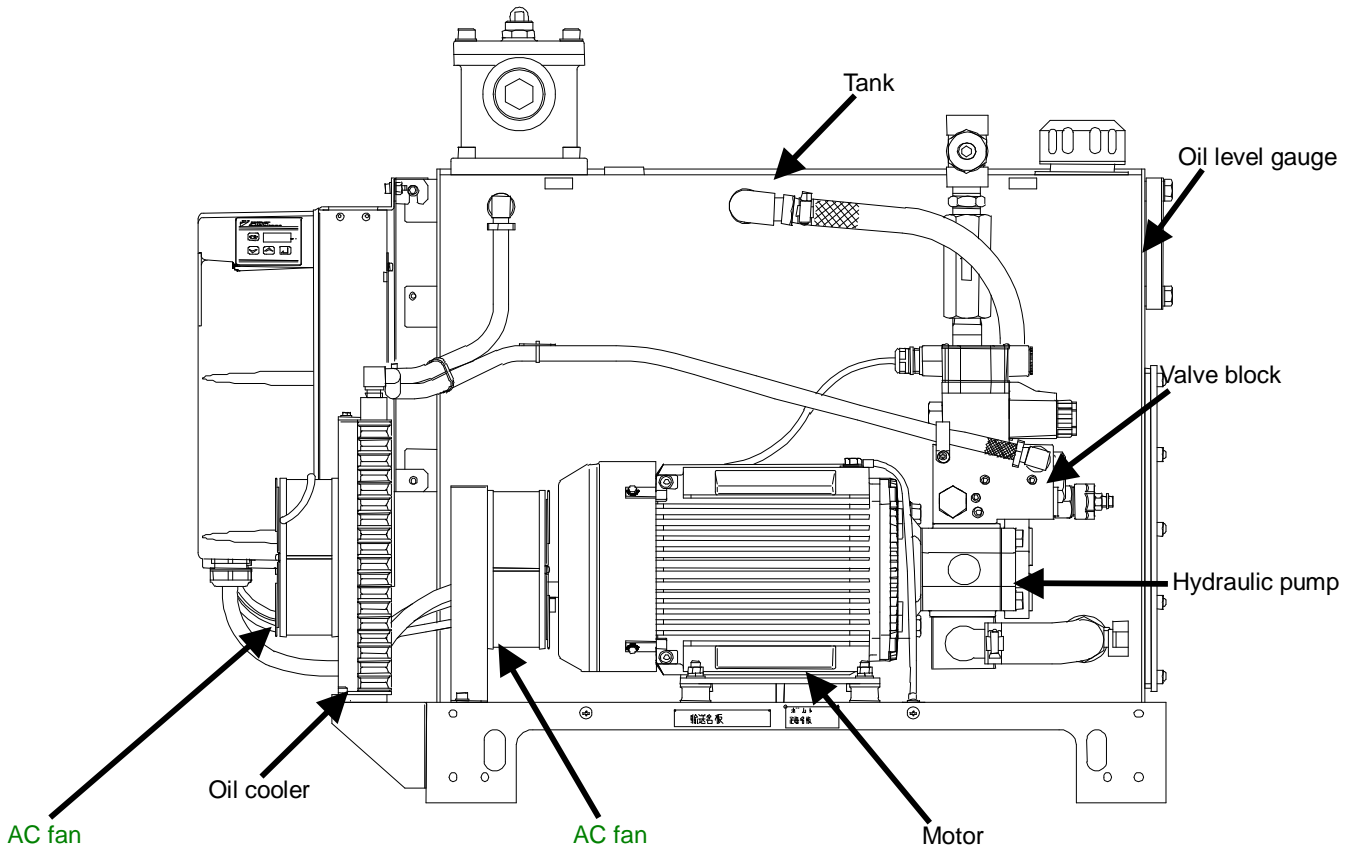
[5. Precautions for Use]

- (1) To provide excellent energy-saving performance, this hydraulic unit provides the solenoid valve that switches the dual pump operation between the combination mode and the single mode. If the machine operating point is close to the solenoid valve switching point, the pump operation may become unstable. In this case, it is necessary to adjust the flow rate setting (qH) or the pressure setting (PL) to a value below the solenoid valve switching point. Furthermore, adjusting the dead zone provided around this switching point (see page 37 on p29,p30.) allows you to stabilize operation.
- (2) In this hydraulic unit, the motor pump unit is equipped with vibration suppressing rubber to prevent vibration of the motor pump unit from being conveyed to the whole unit. For this purpose, the discharge pipe provides a large degree of freedom. Therefore, when connecting the discharge pipe, be careful that the discharge pipe will not touch the cover even if the pipe shakes with reaction force of the hose.
The piping to the unit should be connected with a hose, so that vibration of the motor pump unit will not be conveyed to the machine.
- (3) This hydraulic unit is equipped with an AC fan for cooling of hydraulic oil and motor.
To ensure spaces for air intake and exhaust, do not place an obstacle at 10 cm or shorter distance from the fan motor air intake and exhaust planes.
- (4) Frequently turning ON/OFF the power supply causes the controller service life to be remarkably shortened. If you start and stop the hydraulic unit repeatedly by turning ON/OFF the power supply at intervals of 8 minutes or less, use the “start/stop” function using the start/stop signal. (See page 24)
When the hydraulic unit is started/stopped with the start/stop signal, the time interval to restart the unit after stop command input should be at least 0.5 sec.
- (5) This hydraulic unit incorporates a check valve that provides an orifice in the discharge line. If high response is required for machine pressure release or other purpose, the machine must be provided with an additional pressure release circuit.
If the load volume is large, you may hear a fluid flow sound from this orifice when the unit is stopped. However, this phenomenon does not indicate abnormality.
- (6) This hydraulic unit uses an IPM motor, which generates counter-electromotive force during changeover (regenerative operation). If the motor is frequently turned ON/OFF in the operating condition that easily generate counter-electromotive force (a large load volume causes a large load reaction force accordingly), it causes regenerative overload, resulting in unit stop.
- (7) This hydraulic unit is equipped with a safety valve.
This safety valve has been set to a specified pressure before shipment. However, the set pressure of the safety valve may decrease while the machine is repeatedly used for a long period, or due to contaminants in the hydraulic oil.
If this unit is continuously used with the safety valve activated, it may output an alarm due to a temperature rise and so on.
In this case, re-adjust the high pressure safety valve pressure setting according to “Attachment: High-pressure Safety Valve Adjustment Procedure”
- (8) Continuous operations with maximum pressure is only allowable when operating flow rate is 14.0L/min.

[6. Names of Unit Components]



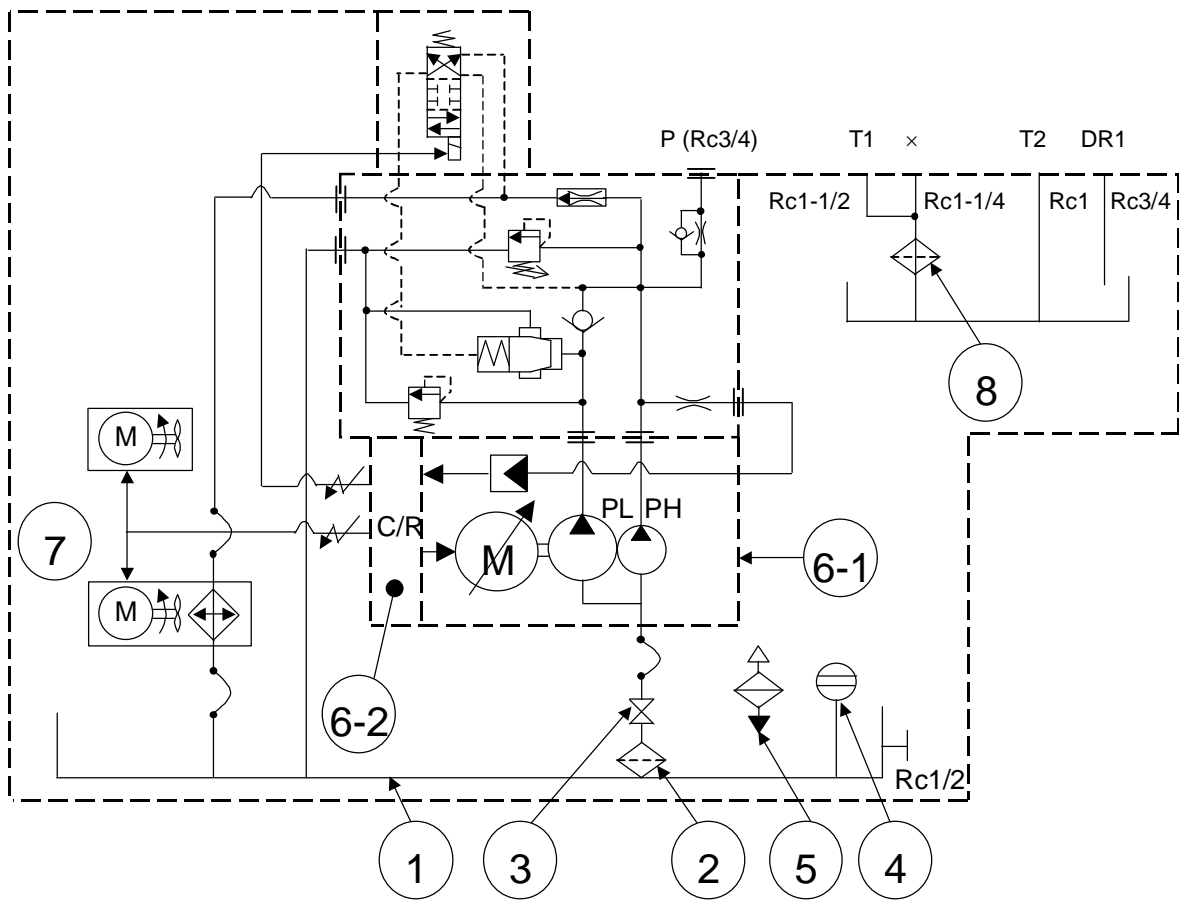
<Unit top view (When the full cover is removed)>



<Unit front view (When the full cover is removed)>

[7. Hydraulic Circuit]

■ Hydraulic circuit diagram



■ Components

Part No.	Name
1	Tank
2	Suction strainer
3	Stop valve
4	Oil level gauge
5	Oil filling port (Air breather)
6-1	Inverter drive pump
6-2	Controller
7	Oil cooler
8	Return filter

■ Piping

This hydraulic unit is equipped with one return port (submerged in the oil), one drain port (above the oil surface), and one discharge port, in addition to the return filter. Connect pipes with these ports as required. Each piping port has been covered with tapered cap (vinyl cap) before shipment.]

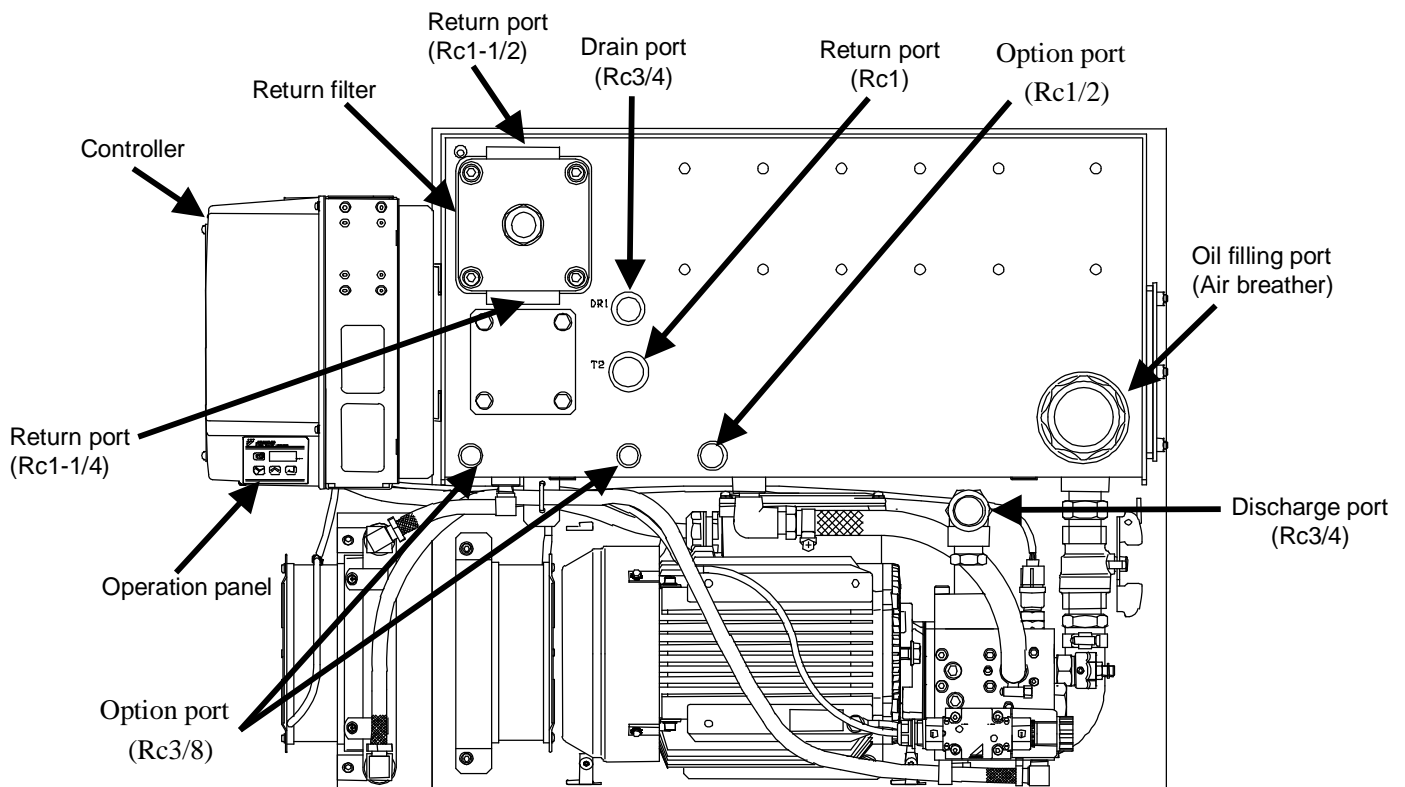
In this hydraulic unit, the motor pump unit is equipped with vibration suppressing rubber to prevent vibration of the motor pump unit from being conveyed to the whole unit. For this purpose, the discharge pipe provides a large degree of freedom. Therefore, when connecting the discharge pipe, be careful that the discharge pipe will not touch the cover even if the pipe shakes with reaction force of the hose.

The piping to the unit should be connected with a hose, so that vibration of the motor pump unit will not be conveyed to the machine.

Note) The return filter provides two ports. One port is covered with a plug (Rc3/4), and another port is covered with a taper plug (vinyl cap) (Rc1).

Note) For details of the pipe positions, refer to the model drawing on a separate sheet.

Note) Tighten each pipe connection by winding seal tape.



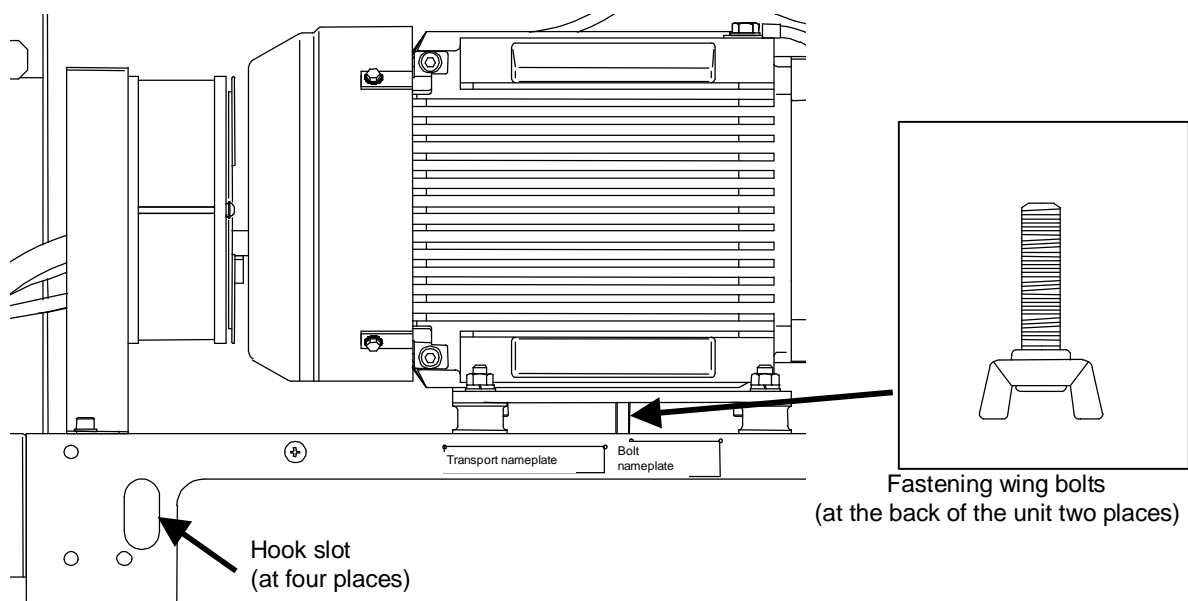
<Unit top view (When the full cover is removed)>

▲ CAUTION

- This hydraulic unit incorporates a check valve. If an additional inline check valve is mounted to the discharge port, resonance occurs, which may have bad influence on the master machine. Therefore, do not use an inline check valve.

[8. Precautions for Operation, Transportation and Installation]

- In order to suppress vibration and noise, vibration suppressing rubber is attached to each mounting leg. Before shipment, it is fastened with fastening wing bolts (M8 × L30: at two places) in order to suppress transport vibration.
- Precautions for operation
 - Before operation, remove the fastening wing bolts (M8 × L30: at two places). Operating the unit without removing the wing bolts may increase vibration and noise.
- Precautions for transportation
 - During transportation, be sure to mount the motor base to the base with the fastening wing bolts (M8 × L30: at two places) to fasten it securely in order to protect the vibration suppressing rubber. (See the figure below)



▲ DANGER

- If the hydraulic unit is lifted by any parts (e.g. pump pipes) other than the hook slots, the unit may fall or turn over.
- Check the weight of the hydraulic unit, and make sure that it does not exceed the rated load capacity of each lifting sling.

▲ WARNING

- During transportation, make sure that the unit can be evenly lifted by the hook slots at four places.
- During transportation using lifting slings, never come close to the unit. If the unit falls or turns over, you may suffer from injury.

▲ CAUTION

- Avoid transporting the hydraulic unit with hydraulic oil contained in the tank. (This may cause oil leak, or malfunction due to air intrusion.)
- During transportation, hold the hydraulic unit securely so that it will not be moved by vibration or external force.

<Weight table> (Hydraulic oil is not included)

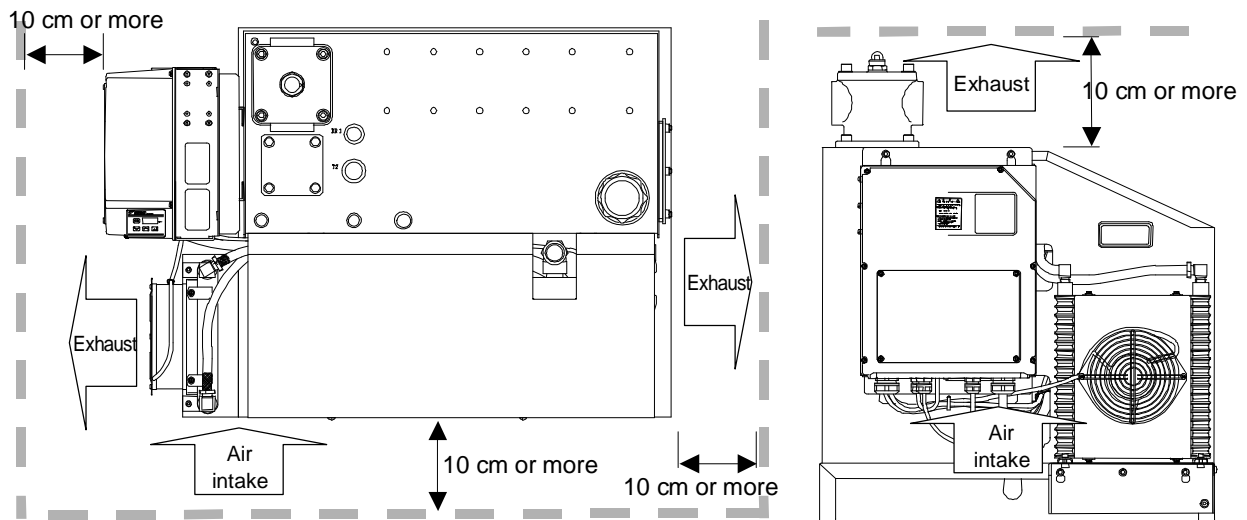
Model	SUT10D80L07	SUT16D80L21
Tank capacity	100 L	160 L
Weight	135 kg	145 kg

■ Precautions for installation

◆ Securing air intake/exhaust space

Do not place an obstacle that blocks the oil cooler's air intake or air exhaust within 10 cm from the unit end surface.

Install the unit in a well-ventilated place to prevent the area around the unit from being stuffed with hot air. Make sure that the intake air temperature does not exceed the specified ambient temperature range (35°C or lower temperature).



▲ WARNING

- If the hydraulic unit is used in a place without an air intake/exhaust space, or a place stuffed with hot air, the oil cooler/AC fan heat exchanging function will deteriorate, causing the hydraulic oil and equipment to become extremely hot.
- If you accidentally touch the hot parts, you may get burns.

▲ CAUTION

- If the hydraulic unit is used in a place without an air intake/exhaust space, or where hot air is stuffed around the unit, the motor and controller become hot, causing the equipment service life to be remarkably shortened.
- When the motor or controller becomes hot, the temperature protection function is activated to stop operation.
(When the motor or controller becomes extremely hot, the alarm/warning signal will be output.)
- If the hydraulic unit is continuously used at a high temperature, the hydraulic equipment (pump, valves, etc.) will have defects or shortened service life, as well as the electric components described above.
- Using the hydraulic unit at a high temperature accelerates deterioration of the hydraulic oil, resulting in shortened service life.

◆ Fastening onto a level plane

- Install the hydraulic unit on a level base or level floor.
- Fasten the hydraulic unit securely so that it will not shake.
- For attaching the base fixing bracket (separately sold), see the delivery specification drawing (model drawing).

▲ WARNING

- Unless the hydraulic unit is fastened with bolts, it may be turned over or moved by reaction force under the oil pressure in the pipe.

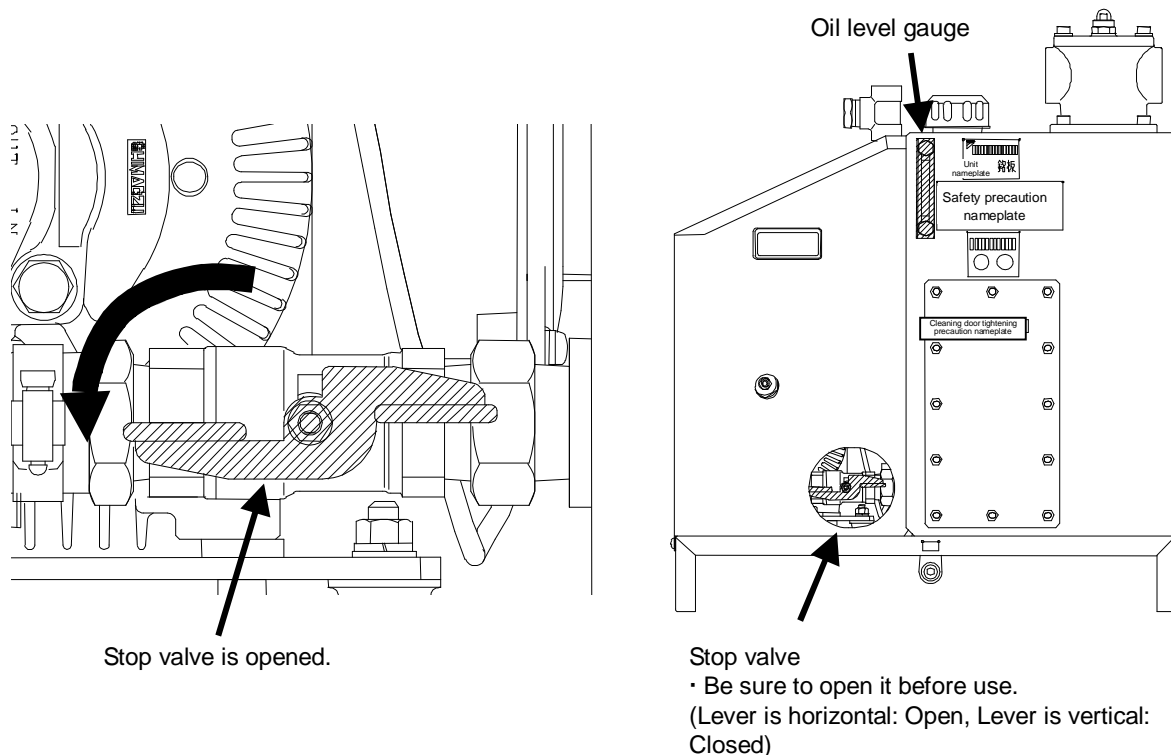
▲ CAUTION

- If the hydraulic unit is installed on an inclined plane, oil leak or air intrusion occurs, resulting in abnormal sound or shortened service life of the equipment. Be sure to install the unit on a level plane.

[9. Preparations for Operation]

■ Filling hydraulic oil

- Remove the cap of the oil filling port (air breather) by turning it counterclockwise, and fill clean hydraulic oil (pollution degree: NAS Class 9 or lower level) into the tank. Set the oil level so that the float of the level gauge is between the red and yellow lines.
- Use the hydraulic oil conforming to the specifications on p. 8.
- Make sure that the stop valve is opened.



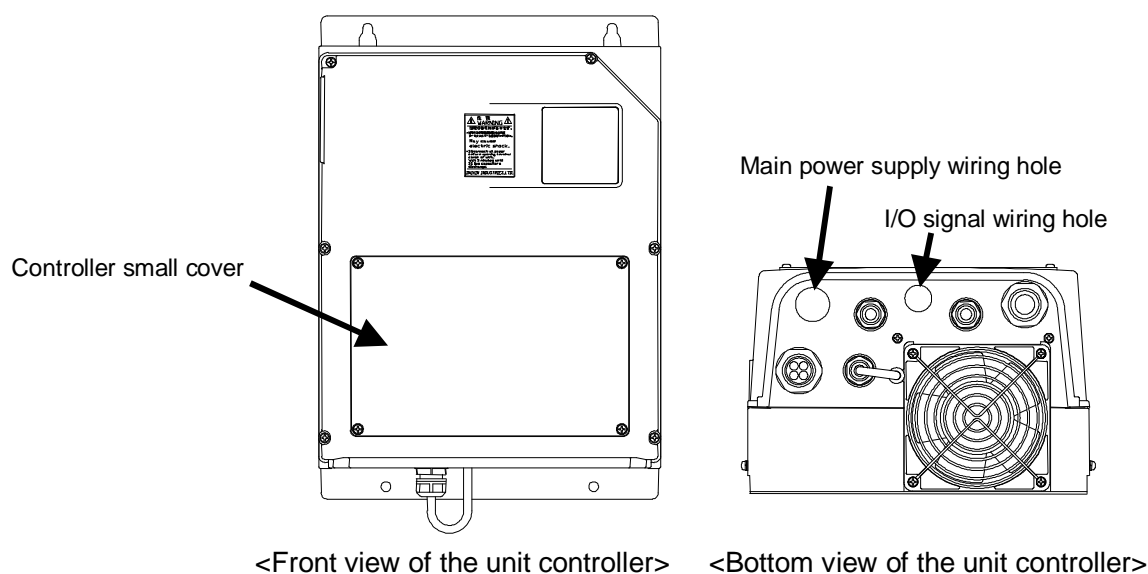
Tank capacity (L)	Oil level setting range	
	Yellow line (upper limit)	Red line (lower limit)
100	100 L	85 L
160	165 L	141 L

▲ CAUTION

- [1] Operating the hydraulic unit with no oil in the tank causes pump seizure or wear, which may result in pump damage.
- [2] Make sure that the stop valve is opened. If the stop valve is not opened, the oil cannot be supplied into the pump. This causes pump seizure or wear, which may result in pump damage.
- [3] During initial operation of the machine, oil will be supplied into the hydraulic circuit of the machine. Be careful about a decrease in oil level in the tank.
- [4] The oil level in the tank may largely fluctuate depending on the machine hydraulic circuit. This may result in oil leak from the tank, or decrease in oil level.

■ Electric wiring

- This hydraulic unit needs connections of a main power cable and I/O signal cables as required. (For recommended cables, see the table below.)
- Connect the main power cable and I/O signal cables through the specified wiring holes.
- In order to protect the electric circuit against short-circuiting and overcurrent and prevent electric shocks, the hydraulic unit main power supply must be equipped with a safety device (no-fuse breaker, earth leakage breaker, etc.) conforming to European Norm EN60947-2. (For the capacity of each device, see the table below.)
- For the power supply connection device, use a switch that provides 3 mm or longer contact distance for three electrodes in the OFF status.



Item	Cable size	Recommended cable	Recommended crimp terminal	Recommended cable clamp
Power supply cable	6.0 mm ² or more (AWG10 or larger size)	CE362 6.0 mm ² × 4 cores (manufactured by KURAMO)	RBV5. 5-5 (manufactured by NICHIFU)	OA-W2219 (manufactured by OHM ELECTRIC)

Item	Cable size compatible with the terminal block	Recommended cable	Recommended cable clamp
I/O signal cable	0.3 - 1.0 mm ² (AWG22 - 16)	KCV-36SB 0.3 - 0.5 mm ² (manufactured by KURAMO)	OA-W1611 (manufactured by OHM ELECTRIC) Applicable cable outer diameter: φ9 - φ11

[Rated current and breaker setting]

Model	Power supply voltage and frequency			Breaker setting
	3φ 200 V 50 Hz	3φ 200 V 60 Hz	3φ 220 V 60 Hz	
SUT10D80L21/SUT16D80L21	25.5A	24.8A	22.7A	50A

▲ DANGER

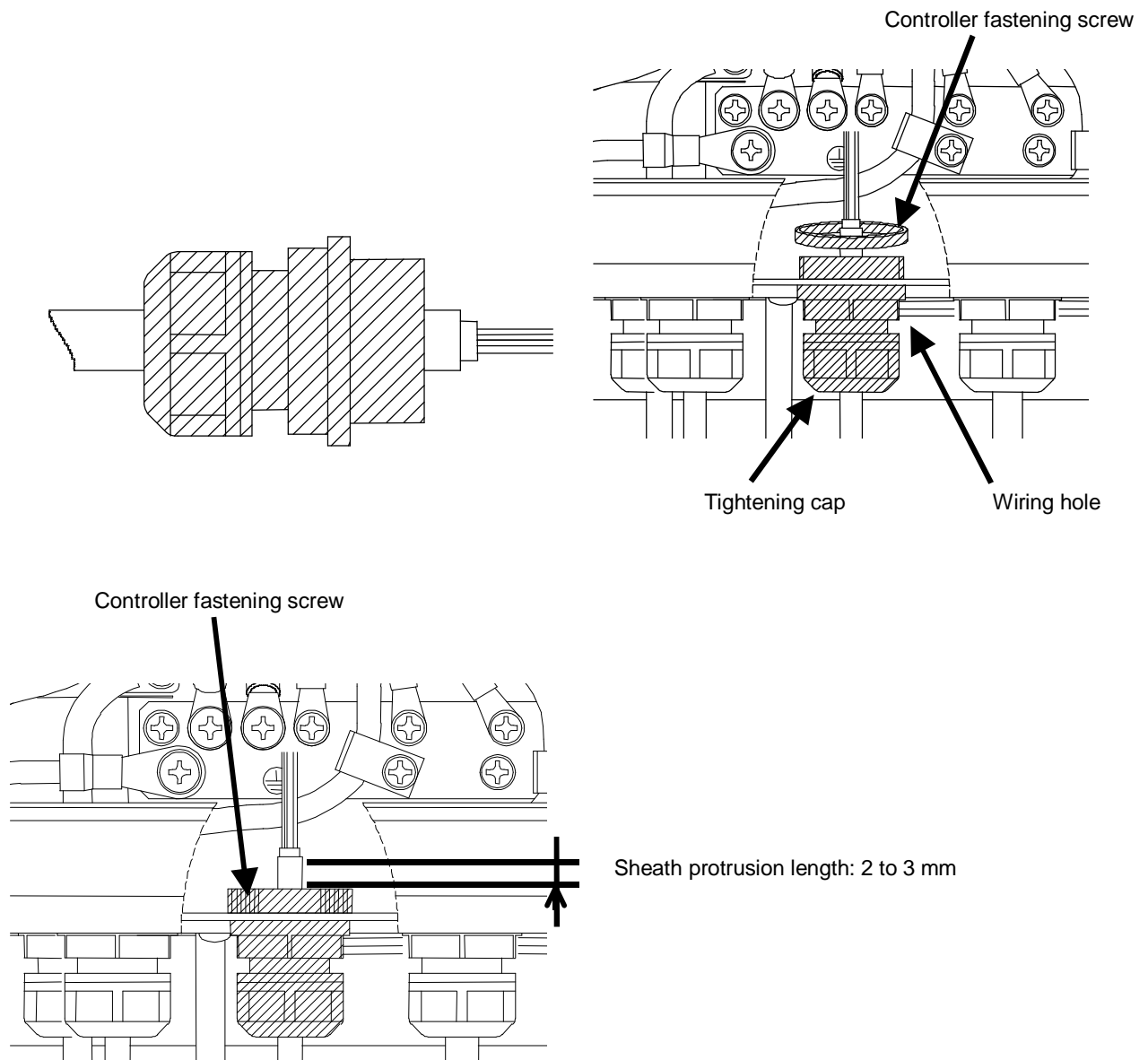
- For connection of the ground terminal, ensure Class D (former Class 3) or higher grounding condition. (Connect the ground terminal directly without using a breaker.)
- Be sure to complete installation of the hydraulic unit before connecting the cables.
- Before connecting the cables, be sure to turn OFF the main power supply breaker, and make sure that the power is interrupted.
- Be sure not to connect the power supply cable to the I/O signal terminals.
- Do not apply an excessive power supply voltage higher than the power supply rating of the hydraulic unit.

▲ CAUTION

- The hydraulic unit incorporates an overcurrent protection function. Therefore, it does not need an overcurrent protection thermal relay. If a thermal relay is used, the hydraulic unit may malfunction due to influence of inverter switching.

<How to use the cable clamp>

1. Loosen the tightening cap, and pass the cable through the clamp. Before this step, remove the controller fastening screw in advance.
2. Insert the cable into the controller through the controller's wiring hole.
3. Tighten the controller fastening screw to fasten the cable clamp to the controller.
4. Tighten the tightening cap to fasten the cable. The cable sheath protrusion length should be approx. 2 to 3 mm.



◆ Wiring procedure

To connect the main power supply and I/O signal cables, remove the small cover of the controller. Remove the controller small cover by loosening the cross recessed head machine screws (four M4 screws, Tightening torque: 1.0 N·m).

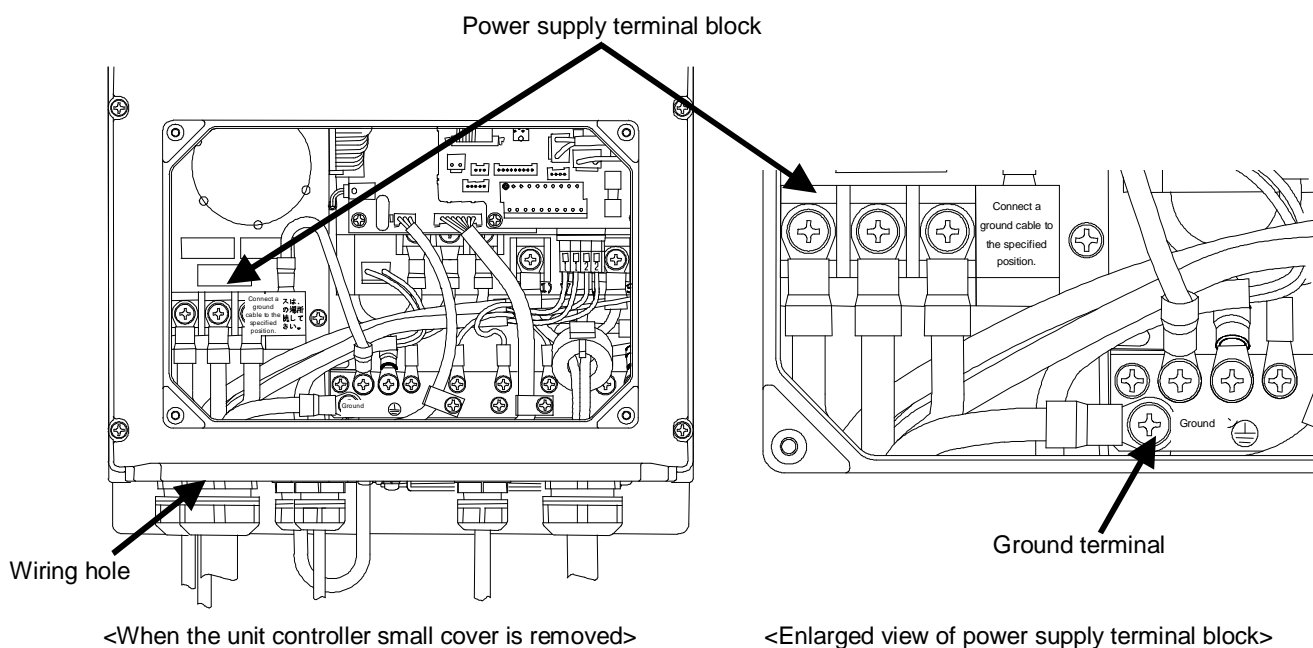
● Connecting the main power supply cable

(1) Connect the main power supply cable to the controller through the controller's wiring hole. Use a cable clamp suitable for the wiring hole, whose protection rating should be IP54 or higher level. (Wiring hole diameter: $\phi 28$ mm)

[1] Connect the ground cable to the controller's ground terminal.

[2] Connect the power supply cable to individual terminals on the power supply terminal block.

(Tightening torque: 2.4 N·m)



▲ DANGER

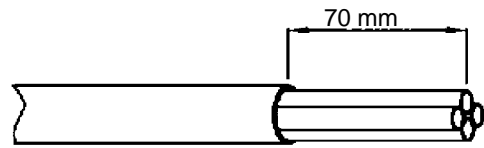
- Use an AC power supply conforming to the power supply specifications of this product.
- Use a power supply cable conforming to the power supply capacity. (See the table below.)
- Do not connect the power supply cable to the ground terminal.
- The ground terminal is connected with the motor frame. Ensure Class D (former Class 3) or higher grounding condition.
- When unsheathing the cable, be careful not to damage the conductors.
- Be careful that the cable conductors do not protrude from the terminal block.

▲ CAUTION

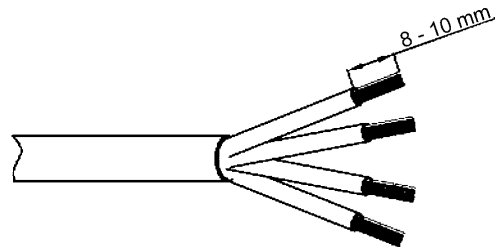
- For connection of the power supply cable, attach a crimp terminal to the tip of the cable.
- The cable inserted into the cable clamp should be a multi-core cable as those recommended below. If two or more cables are inserted into the clamp, the cable clamp does not conform to the specified protection rating because of a gap between the cables and the cable clamp.
- When connecting the cable, be careful not to drop a screw into the housing.

<Power supply cable connecting procedure>

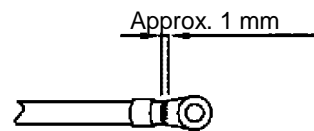
- [1] Unsheathe the cable by approx. 70 mm.



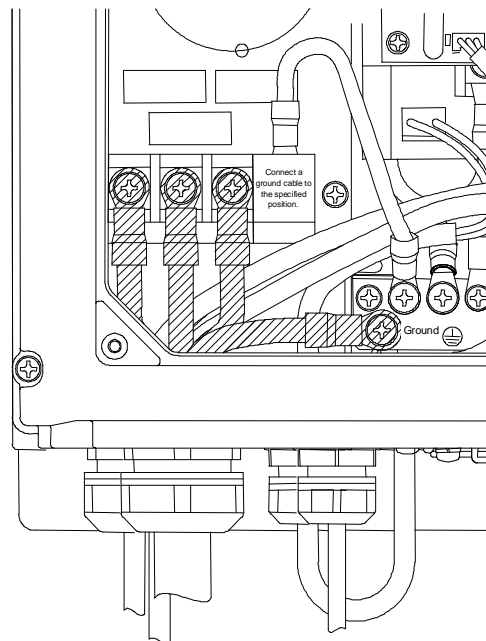
- [2] Remove the inner sheath so that the core wires are exposed by 8 to 10 mm.



- [3] As shown on the right, crimp the round crimp terminal with insulation sheath by using a dedicated tool.



- [4] After looping each cable connect it to the terminal block.

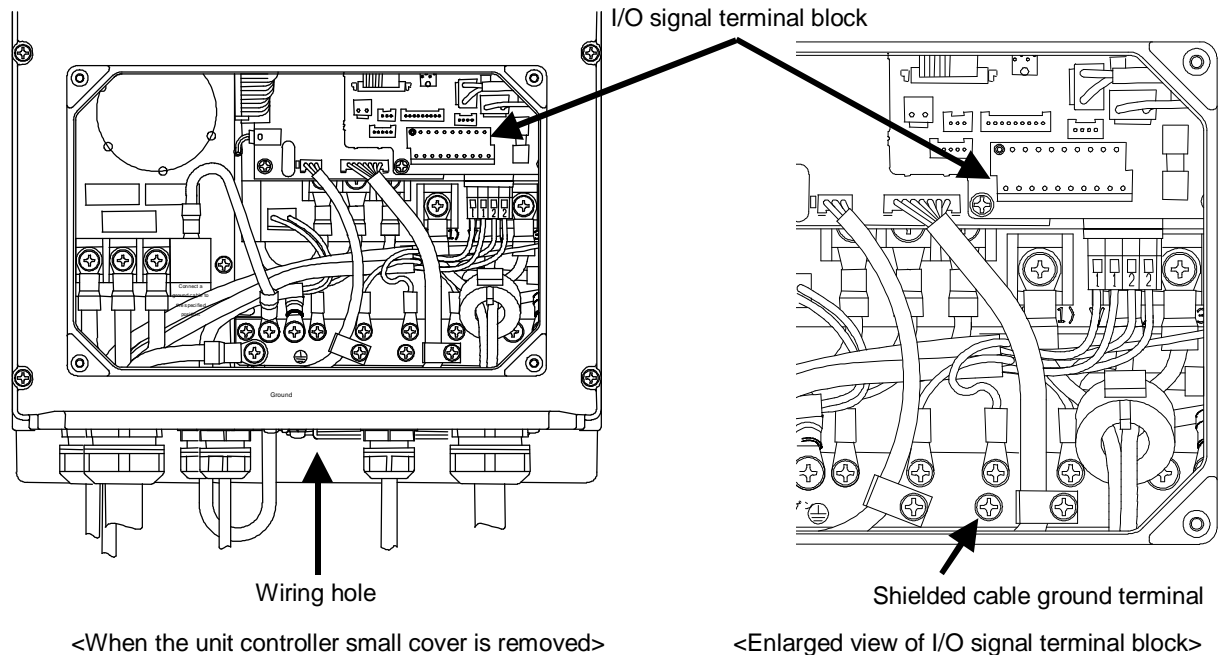


▲ CAUTION

- If the crimp tool is not suitable for the crimp terminal, the cable will come off the terminal due to a crimp failure during operation. This results in short-circuiting or burnout of the circuit caused by abnormal heating.

● Connecting the I/O signal cable

- (1) Connect the main power supply cable to the controller through the controller's wiring hole. Use a cable clamp suitable for the wiring hole, which should provide IP54 or higher protection rating. (Wiring hole diameter: $\phi 22$ mm)
- (2) Check the specifications of individual signal lines (see p. 24), and connect the cable to the I/O signal terminal block.

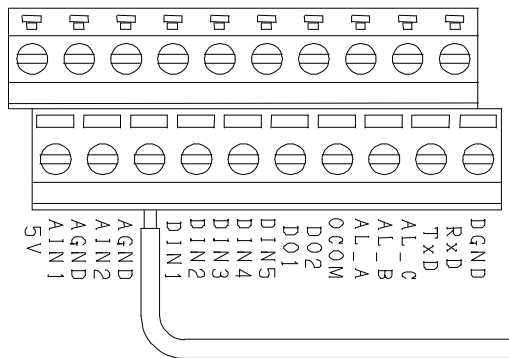


▲ DANGER

- Do not connect the I/O signal cable to the power supply terminal block.
- When unsheathing the cable, be careful not to damage the conductors.
- Be careful that the cable conductors do not protrude from the terminal block.

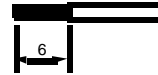
▲ CAUTION

- After checking the specifications of individual signal lines (see p. 24), connect the cable to the I/O signal terminal block.
- The cable inserted into the cable clamp should be a multi-core cable as those recommended below. If two or more cables are inserted into the clamp, the cable clamp does not conform to the specified protection rating because of a gap between the cables and the cable clamp.
- Terminate the shielded cable securely, and connect it to the shielded cable connection terminal.
- If noise cannot be eliminated by connecting the shielded cable to the ground terminal, the user's equipment should be directly grounded. (Disconnect the ground cable of this unit.)



- [1] Loosen the screw with a screwdriver.
- [2] Check the unsheathed length of the cable, and insert it all the way into the terminal so that the conductors will not become loose.
- [3] Tighten the screw with a screwdriver.
- [4] Pull the cable lightly to make sure that it is securely connected.

Unsheathed length of the cable: 6 mm



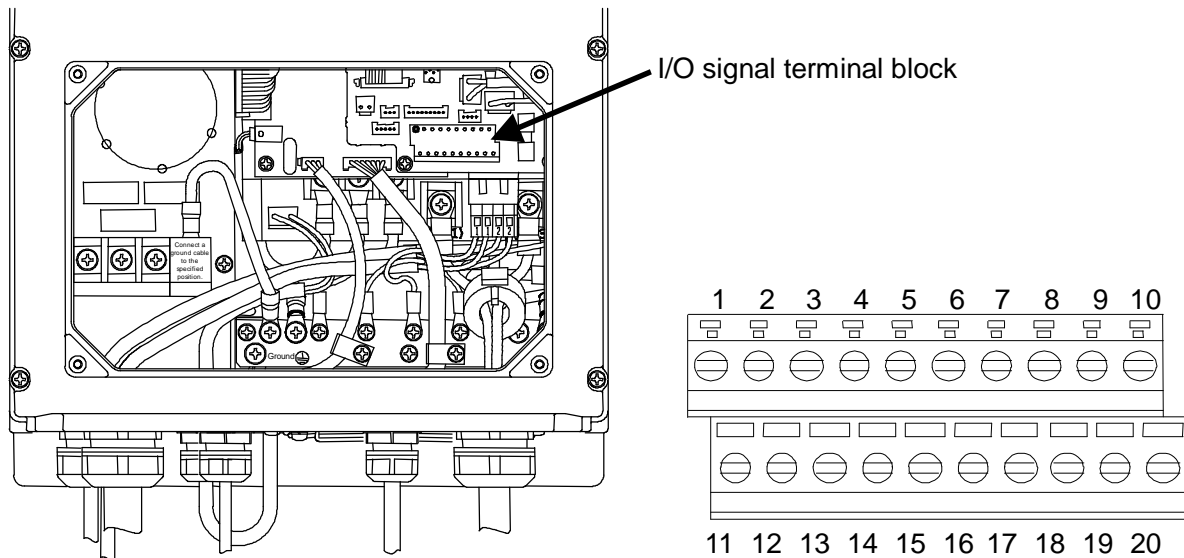
Procedure for connecting the cable to the terminal block

■ I/O signal cable specifications

Specifications of the external interface I/O signal cables are listed below.

For detailed specifications of each signal cable, refer to the following pages.

Terminal No.	Type	Name	Function of terminal	Remarks	
I/O signal terminal block	1			These terminals are not open to users. Do not use these terminals.	
	11				
	2	No connection			
	12				
	3				
	13	Digital I/O terminal	ICOM	Digital input common	Both plus common and minus common are allowable.
	4		DIN1	Digital input 1	Used for start/stop control. Operation at the signal input can be changed by the start/stop signal switching command in the setting mode.
	14		DIN2	Digital input 2	P-Q selection patterns (0 to 15) can be changed depending on the combination of input signals.
	5		DIN3	Digital input 3	
	15		DIN4	Digital input 4	
	6		DIN5	Digital input 5	
	16	Digital/contact output terminal	DO1	Digital output 1	Output the alarm state of the unit.
	7		DO2	Digital output 2	
	17		OCOM	Digital output common	
	8		AL_A	Contact output a	
	18		AL_B	Contact output b	
	9	AL_C	Contact output common		
	19				
	10	No connection			These terminals are not open to users. Do not use these terminals.
	20				



<When the unit controller small cover is removed>

<I/O signal terminal block>

◆ Digital input

These terminals are used for sequence input signals that control the unit operations from external equipment. Connect these terminals as required, with reference to the table below.

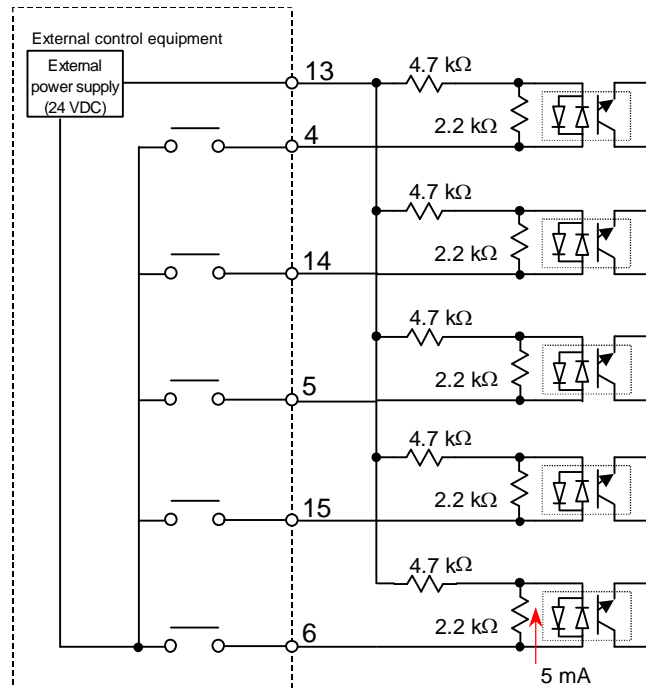
Terminal No. (Symbol of switchboard wiring diagram)	Signal name	Remarks
13 (ICOM)	Digital input common	Both positive and negative signals are acceptable.
4 (ICOM1)	Digital input 1	Used for start/stop control. With the start/stop signal switching parameter (Setting mode: [P00]), you can change the operation at signal input. (See p. 37) P-Q selection Nos. 0 to 15 can be selected depending on the combination of digital input status. (For P-Q selection setting, see p. 37.)
14 (ICOM2)	Digital input 2	
5 (ICOM3)	Digital input 3	
15 (ICOM4)	Digital input 4	
6 (ICOM5)	Digital input 5	

Note) While the unit is stopped by digital input, the panel shows " **SEP** ".

Note) Set the time between unit stop and unit start at 0.5 seconds or more.

Combination of digital inputs for P-Q selection

P-Q selection No.	Digital input 2	Digital input 3	Digital input 4	Digital input 5
0	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF
2	OFF	ON	OFF	OFF
3	ON	ON	OFF	OFF
4	OFF	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	OFF	ON	ON	OFF
7	ON	ON	ON	OFF
8	OFF	OFF	OFF	ON
9	ON	OFF	OFF	ON
10	OFF	ON	OFF	ON
11	ON	ON	OFF	ON
12	OFF	OFF	ON	ON
13	ON	OFF	ON	ON
14	OFF	ON	ON	ON
15	ON	ON	ON	ON



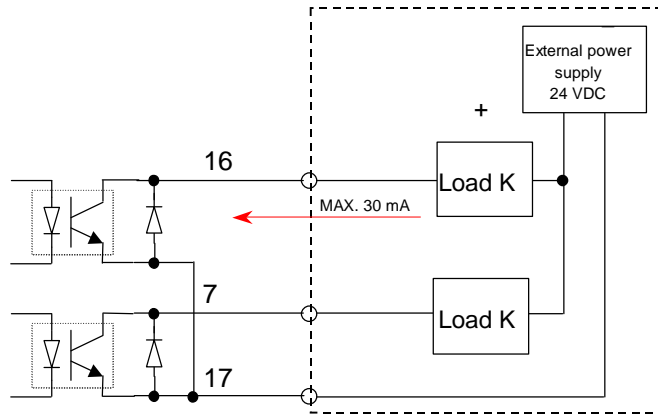
▲ CAUTION

- For the external power supply, use a power supply with 24 VDC \pm 1 V, 0.5 A or higher capacity.
- Power cannot be supplied from this controller to external equipment.
- Terminals for input signals are available for contact relay and non-contact transistor output.
- The current flowing through each input circuit is 5 mA (typical). To configure a circuit with a contact, be careful about the minimum current of the contact.

◆ Digital output/Contact output

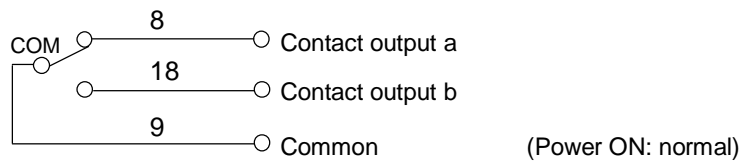
These terminals are used for digital/contact output signals that output alarm status of this unit. Connect these terminals as required, with reference to the table below. For description on the outputs, see p. 39.

Terminal No. (Terminal name)	Signal name	Remarks
16 (DO1)	Digital output 1	Outputs the. Digital output 0
7 (DO2)	Digital output 2	Outputs the. Digital output 1
17 (OCOM)	Digital output common	Negative common



▲ CAUTION		
<ul style="list-style-type: none"> As the external power supply, prepare a 24 VDC ±1 V, 0.5 A power supply. Power cannot be supplied from this controller to external equipment. This controller's output circuit serves as negative common. Not capable for positive common. The maximum output current of an output circuit is 30 mA (resistance load). If you attempt to drive load higher than the allowable current, the circuit may be damaged. Pay attention to the maximum allowable current. To drive induction load, take surge preventive measures. 		

Terminal No. (Terminal name)	Signal name	Remarks
8 (AL_A)	Contact output a	Continuity with "Common" exists when the pressure switch is normal.
18 (AL_B)	Contact output a	Continuity with "Common" exists when the Signal output
9 (AL_B)	Contact output common	Common



▲ CAUTION

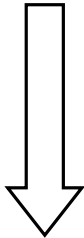
- The contact output switching capacity is 30 VDC/0.5 A (resistance load). If you attempt to drive load higher than the allowable current, the contact may be damaged. Pay attention to the maximum allowable current.
- The minimum allowable load of the contact output is 10 mVDC/10 μ A. However, it is an approximate lower limit that enables the contact to be opened/closed under minute load. This value varies depending on switching frequency and environmental conditions. We recommend you to check the minimum allowable load in actual conditions.
- To drive induction load, take surge preventive measures.

[10. Test Run]

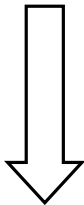
Supply hydraulic oil into the tank to the specified level, and conduct a test run after piping and electric wiring are completed.

(Before turning ON the power supply, re-check if the ground cable and power supply cable are securely connected.)

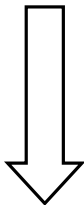
◆ **Start check**



◆ **Flushing**



◆ **Oil replacement**



◆ **Air vent**

- Turn ON the switch on the machine control panel.

- [1] Check the pump operation sound, and confirm that a pressure indicated on the display panel increases.
- [2] Confirm that the oil cooler AC fan motor is running.

NOTE) This hydraulic unit takes a warm-up time of approx. three seconds until it starts operation after power-ON.

(The pressure rising time varies depending on the pipe volume.)

Furthermore, the hydraulic unit takes a time to increase the circuit pressure above the set pressure of the pressure switch. During this period, the pressure switch signal may be output depending on the pipe condition (pipe volume). In such a case, set up the master machine so that it does not receive the alarm output.

- After completion of the start check, loop all pipes (except for the actuator), and execute flushing operation for approx. two hours while running hydraulic oil through the filter.

- To conduct flushing operation, loop all pipes, and run the oil through a filter.
- Before flushing operation, check all pipe connections for looseness and oil leak.

- After completion of the flushing operation, check the return filter indicator. If the filter is clogged, replace the filter element, and drain all hydraulic oil from the tank through the oil drain port of the tank.

- Fill new hydraulic oil through the oil filling port (air breather) to the specified level.

(Use new clean hydraulic oil with pollution degree of NAS Class 9 or lower level.)

- Evacuate air from the hydraulic circuit completely. If air is not completely evacuated, the following phenomena may occur.

- [1] Abnormal operation of cylinder actuator
- [2] Abnormal sound of pump and valve

NOTE: Specifications of the return filter element are subjected to change.

When replacing the element, check the type of the return filter incorporated in the unit, and order the specified type of element.





▲ DANGER

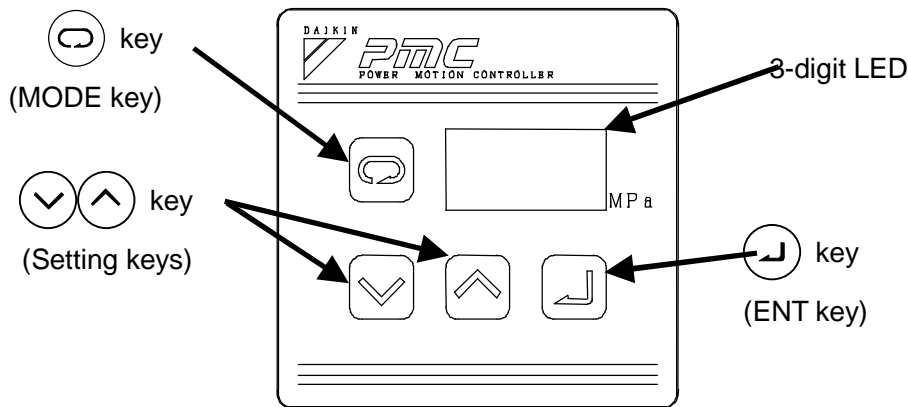
- When evacuating air, high-pressure and high-temperature oil may spout out. Pay attention to oil splash.

[11. Operation Panel Operating Procedure]

This hydraulic unit enables you to monitor or change pressure, flow rate or other parameter settings by operating the controller key switches.

■ Outline of functions

The operation panel is comprised of the 3-digit LED **8.8.8**, mode key , setting keys   and ENT key . Normally, the panel shows an actual pressure value. It can be switched between the monitor display mode and set value display mode through key operations.

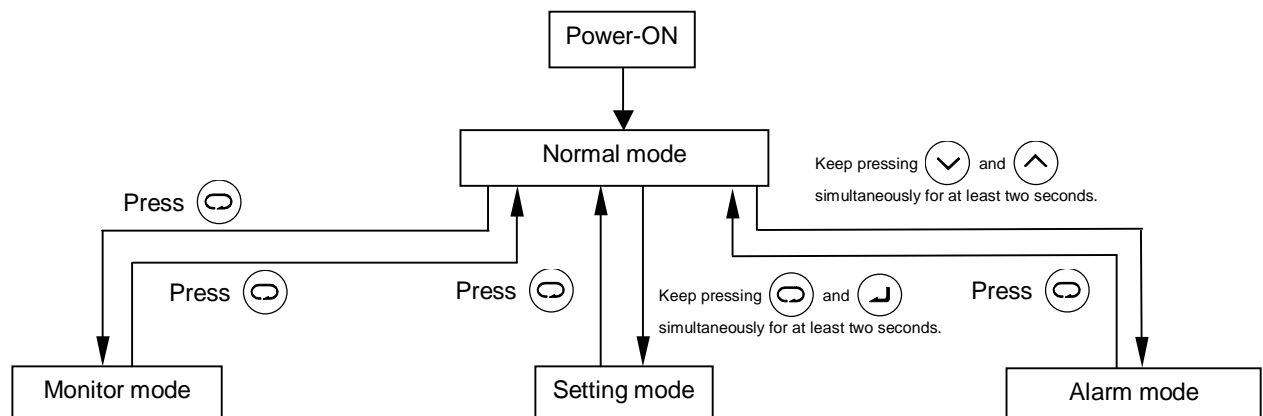


■ Description on individual modes

- Normal mode: Displays an actual pressure value or alarm code.
- Monitor mode: Displays a pressure switch set value, pressure set value, flow rate set value, actual flow rate, and actual rpm.
- Setting mode: Used to set or change a parameter such as pressure and flow rate.
- Alarm mode: Alarm records can be checked.

■ Shift between individual modes

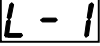
Key switch operations for shift between individual modes are shown below:



■ Operating procedure for each mode

a) Monitor mode


The monitor mode allows you to monitor a parameter by selecting a desired item from the following table.

Parameter No.	Name	Description
n00	Pressure switch setting	(MPa) [When PSI unit is selected, x 10PSI] Displays a pressure switch setting.
n01 ^{Note 1}	Pressure setting	(MPa) [When PSI unit is selected, x 10PSI] Alternately displays pressure settings of the high-pressure and low-pressure pumps for the current P-Q selection number.
n02	flow rate setting	(L/min) Alternately displays discharge flow rate settings of the small-capacity and large-capacity pumps for the current P-Q selection number.
n03	flow rate	(L/min) Displays the current discharge rate.
n04 ^{Note 2}	Latest alarm code	Displays the latest alarm code.
n05	rpm	($\times 10\text{min}^{-1}$) Displays the current rpm.
n06	Operating status	Displays the current switching status of the solenoid valve (combined or single operation), and the current P-Q selection No. <Example>  low-pressure pump (combination mode) P-Q selection number 1
n07	Reverse rpm at power-OFF	Displays a motor reverse rpm due to counter-flow from the load when the unit power supply is turned OFF. This parameter is used to estimate the machine load volume.
n08	Regenerative load integration ratio	Displays the load integration ratio of the current regenerative braking resistance.
n10	Motor thermistor temperature	Displays the temperature detected by the thermistor in the motor.
n11	Fin thermistor temperature	Displays the temperature detected by the thermistor in the controller.
n12	Main circuit voltage	Displays the controller's internal voltage. The voltage value is indicated as power supply voltage multiplied by $\sqrt{2}$. Although the voltage value may instantaneously exceed 350 V due to regenerative current during deceleration, it is not a fault.

^{Note 1} With the factory setting, "MPa" is the standard unit. When it is changed to the PSI unit, attach a label to indicate the PSI display mode.











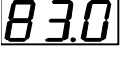

However, if the PSI unit is used in Japan, you will be punished under the Measuring and Weighing Law. The indication label should be prepared by the user.

^{Note 2} For details on the alarm codes, refer to description on the alarm display mode.

You can check the current power-ON count by pressing the  key when an alarm code is displayed.

An example of monitor mode operation is shown below.

<Example> Monitoring current flow rate

Operating procedure	Key operation	3-digit LED	Remarks
<ul style="list-style-type: none"> • Power-ON ↓ (Startup, Run) 			
<ul style="list-style-type: none"> • Actual pressure display 			
<ul style="list-style-type: none"> • Shift to monitor mode ↓ 			
<ul style="list-style-type: none"> • Parameter No. selection ↓ 			
<ul style="list-style-type: none"> • Monitor display ↓ 			Press the  key three times.
<ul style="list-style-type: none"> • Monitor display ↓ 			Blinking
<ul style="list-style-type: none"> • Return to actual pressure display mode ↓ 			Flow rate (theoretical value) 83.0 L/min
<ul style="list-style-type: none"> • Return to actual pressure display mode 			

To monitor other parameter, return to the actual pressure display mode once, and then select a desired item.

b) Setting mode

The setting mode allows you to set or change a parameter such as pressure and flow rate on the operation panel. For the parameters that can be specified or changed in the setting mode and their adjusting ranges, see the list of setting ranges on p. 36.

For the initial values and adjusting ranges of non-standard models or custom-made models, see the delivery specifications on separate sheets.

NOTE:

- [1] The above flow rate set value is a theoretical value (the product of theoretical displacement volume by rpm). It is slightly different from the actual flow rate.
- [2] For the pressure/flow rate setting parameters ([P13] through [P28]), the following settings are not allowed.
 - a) If [PH.*] is set lower than [PL.*], [PL.*] automatically becomes equal to [PH.*].
 - b) [PL.*] cannot be set higher than [PH.*].
 - c) If [qL.*] is set lower than [qH.*], [qH.*] automatically becomes equal to [qL.*].
 - d) [qH.*] cannot be set higher than [qL.*].

Wherein, [PH.*] is a high-pressure pump pressure setting, and [qH.*] is a small flow rate setting.
[PL.*] is a low-pressure pump pressure setting, and [qL.*] is a large flow rate setting.

Example) If the [PH.0] setting is changed to "5.5 MPa" when [PL.0] is set at "6.0 MPa", the [PL.0] setting is automatically changed to "5.5 MPa".

- Flow rate setting changing procedure

An example of flow rate setting changing operation is shown below.

<Example> Changing flow rate for P-Q selection 1 from 83.0 L/min to 32.8 L/min.

When the PQ selection is not changed over, do not change the item number, but select P00 and set PQ selection at 0.

Operating procedure	Key operation	3-digit LED	Remarks
• Power-ON			
• Actual pressure display			
• Setting mode	Keep pressing two keys simultaneously for at least two seconds.		After two seconds
• Parameter No. selection	or		P-Q selection 1
• Set value display		 ↓↑ 	Displays pressure setting of high-pressure pump for P-Q selection 1.
• P-Q selection	Press three times. "PH.1", "qH.1", "PL.1", "qL.1", "Ut.1" and "dt.1" are alternately displayed in this order.	 ↓↑ 	Displays flow rate setting of low-pressure pump for P-Q selection 1.
• Changing set value	or		
• Writing set value			Displays acceleration time setting after writing flow rate setting.
• Return to actual pressure display mode			

CAUTION: The flow rate setting can be arbitrarily specified in steps of 0.1 L/min.










Model	Theoretical pump displacement volume (cc/rev)	
	Pump capacity (Low-pressure mode)	Pump capacity (High-pressure mode)
SUT10D80L21/SUT16D80L21	19.3	6.68

• Pressure setting changing procedure

An example of pressure setting changing operation is shown below.

<Example> Changing pressure for P-Q selection 1 from 7.0 MPa to 6.0 MPa

When the PQ selection is not changed over, do not change the item number, but select P00 and set PQ selection at 0.

Operating procedure	Key operation	3-digit LED	Remarks
<ul style="list-style-type: none"> • Power-ON 			
<ul style="list-style-type: none"> • Actual pressure display 		20.6	
<ul style="list-style-type: none"> • Setting mode 			After two seconds
	<ul style="list-style-type: none"> Keep pressing two keys simultaneously for at least two seconds. 	P00	
<ul style="list-style-type: none"> • Parameter No. selection 	 or 	P01	P-Q selection 1
<ul style="list-style-type: none"> • Set value display 		PH.1	Displays pressure setting of high-pressure pump for P-Q selection 1.
		↓ ↑ 20.6	
<ul style="list-style-type: none"> • P-Q selection 	<ul style="list-style-type: none"> Press  two times. "PH.1", "qH.1", "PL.1", "qL.1", "Ut.1" and "dt.1" are alternately displayed in this order. 	PL.1	Displays flow rate setting of low-pressure pump for P-Q selection 1.
		↓ ↑ 7.0	
<ul style="list-style-type: none"> • Changing set value 	 or 	6.0	
<ul style="list-style-type: none"> • Writing set value 		9L.1	Displays flow rate setting of low-pressure pump after writing low-pressure pump pressure setting.
		↓ ↑ 32.8	
<ul style="list-style-type: none"> • Return to actual pressure display mode 		20.6	

The setting range

Parameter No.	Name	Initial setting	Operating range	unit	Description
P00	Start/stop signal switching	1	0:Run at signal ON	-	Specify whether to run or stop the unit at signal input.
			1:Run at signal ON		
P01	Pressure switch	0	0to35.0 (0: Disabled)	MPa	Specify whether to enable or disable the pressure switch function, and the pressure to activate the pressure switch.
			0to507	× 10PSI	
			0to150 (0: Disabled)	%	
P02	Pressure switch output delay time	0.00	0.00to9.99	sec	Specify the delay time until alarm output after the pressure falls below the pressure switch activating pressure.
P03	Pressure switch display hold setting	0	0:Disabled	-	Specify the function that indicates that the pressure switch is activated. For details on this function, see "Alarm codes and classification table" on p. 41.
			1:Holds display during pressure switch activation		
			2:Display and memory during pressure switch activation		
P04	Pressure unit selection setting	0	0:MPa	-	Used to change the unit of the normal pressure display mode ("MPa" or "x10 PSI").
			1:PSI		
P05	Regenerative load command ratio	50	30to100	%	Adjust the regenerative load when it is too much increased at normal pressure response (FF → DH).
P06	Deceleration load command ratio	30	20to100	%	Limits the torque command ratio if the command changes by more than 1/2 of the maximum flow rate when a change is made in the PQ selection.
P07	Warning output level setting	0	0:No output	%	Specify a warning output level.
			1:Warning output		
			2:Alarm equivalent output		
P08	Alarm output combination	1	0:Individual output	-	Specify whether the contact outputs (alarm, warning and pressure switch outputs) are individually activated, or integrally activated as a single output, or specify expansion of the pressure switch function.
			1:Integrated output		
			2:Pressure switch function extension See Attachment.		
			3:disabled		
P09	Reset to factory setting	0	0:Retains current settings	-	If the power supply is turned OFF and then turned ON again, the parameter settings will be reset to the factory-set conditions.
			1:Reset to factory settings		
			2:Return to the status at shipment		
P10	Response gain	30	10to999	-	Adjust a control response value. (A smaller value makes quicker response.)
P11	Acceleration response gain	200	0to500	-	Adjust an acceleration response value. (A larger setting makes quicker acceleration response. However, it easily causes vibration during deceleration.)
P12	Solenoid valve response delay time	0.00	0.00to9.99	sec	Specify a solenoid valve response delay time so that a P-Q selection is synchronized with motion of the operating axis.

Parameter No.	Name	Initial setting	Operating range	unit	Description
P13 ~ P28	P-Q selection 0 to 15 Pressure, flow rate, acceleration time and deceleration time settings				<p>This mode is used to set a pressure, flow rate, acceleration time and deceleration time for each P-Q selection No. Set the following items in this order:</p> <p>PH <Pressure setting of high-pressure pump (single mode)> qH <Flow rate setting of high-pressure pump (single mode)> PL <Pressure setting of low-pressure pump (combination mode)> qL <Flow rate setting of low-pressure pump (combination mode)> Ut <Acceleration time setting> : Increases in both pressure and speed (flow rate) are simultaneously specified. dt <Deceleration time setting> : Decreases in both pressure and speed (flow rate) are simultaneously specified.</p> <p>* For parameters [P23] through [P28], P-Q selection Nos. are expressed by hexadecimal numbers. Example) When P-Q selection No. is "11": PH.b, qH.b, PL.b, qL.b, Ut.b, dt.b</p>
	PH.0toPH.F: High pressure side pressure setting	3.5 50	1.5to20.6 22to298	MPa × 10 PSI	
	qH.0toqH.F: High pressure side flow rate setting	15.0	4.1to30.0	L/min	
	PL.0toPL.F: Low pressure side pressure setting	1.5 50	1.5to7.0 22to101	MPa × 10 PSI	
	qL.0toqL.F: Low pressure side flow rate setting	83.0	11.6to83.0	L/min	
	Ut.0toUt.F: Acceleration time setting	0.10	0.01to99.99	sec/MPa	
	dt.0todt.F: Deceleration time setting	0.10	0.01to99.99	sec/1000 min ⁻¹	
P29	High/Low switching response time	0.30	0.05to1.00	sec	Used to adjust the minimum response time for switching the solenoid valve when the pump operation is unstable because the operating point is close to the high pressure/low pressure switching point (solenoid valve switching point).
P30	Single mode switching rpm dead zone	400	0to999	min ⁻¹	Used to adjust the dead zone of the solenoid valve switching rpm when the pump operation is unstable because the operating point is close to the high pressure/low pressure switching point (solenoid valve switching point).
P31	Pressure sensor rated value	35	1 to 35	MPa	Specify the rated pressure detectable with the pressure sensor.
P32	Motor startup time	0.50	0.01 to 9.99	sec	Specify a starting time during motor startup.
P33	Motor startup initial response gain	10	1 to 999	-	Specify an initial response gain during motor startup.
P34	Motor startup error judgment time	2.00	0.01 to 9.99	sec	Specify an alarm judgment time during motor startup.
P35	Dry operation judgment pressure	0.50	0.00 to 2.00	MPa	Specify a pressure threshold level for judgment of dry operation.
		72	0 to 290	PSI	
P36	Dry operation judgment time	3.00	0.01 to 9.99	sec	Specify a time for judgment of dry operation.
P37	Combined operation judgment rate when the same pressure is set	80	0 to 100	%	Specify the pressure for judgment of switching to combined operation, when the same pressure is set for the high-pressure pump during operation with double pumps.
P38	Pressure switch output dead zone	0.50	0.00 to 1.00	MPa	Specify a dead zone for switching the pressure switch function.
		72	0 to 145	PSI	

P39	Digital output selection (See the next page.)	0	0: Completion output 1: Motor operation output 2: High-pressure pump operation output	-	Specify the signal to be output from digital output terminal 0.
P40	Pump operation selection	0	0: Autonomous switching operation 1: High-pressure, small-capacity pump operation	-	You can specify operation of the high-pressure, small-capacity pump only.

- Normally, the P05, P10 and P11 settings need not to be changed. However, if a special circuit condition (large load volume, etc.) is expected, these settings must be changed.
- This hydraulic unit allows 16 patterns from PQ selection numbers 0 to 15 to be set; when using a single pattern only, however, select “PQ selection 0.”

The pressure and flow rate can be set larger than the operating ranges specified in the above table. However, the hydraulic unit must be operated at pressure and flow rate within the above pressure ranges.

*** [P08] 2: Expansion of pressure switch function**

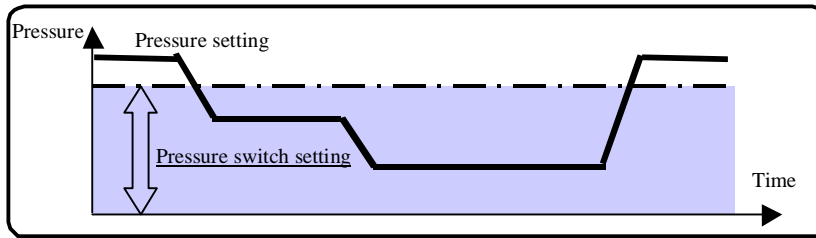
Expansion of pressure switch function is enabled when the [P18] (alarm output combination setting) parameter in the setting mode is set to “2”.

Normally, the [P01] (pressure switch setting) parameter specifies the pressure that activates the pressure switch. In this case, the pressure that activates the pressure switch is constant, regardless of the current P-Q selection.

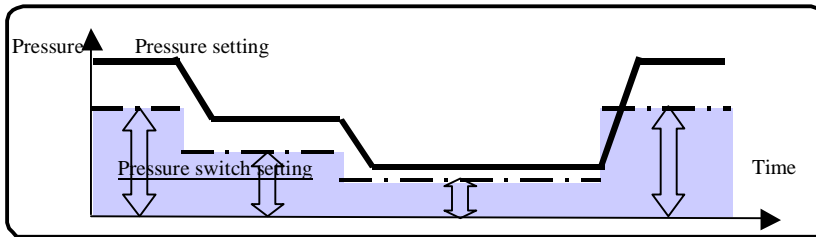
On the other hand, the “expansion of pressure switch function” parameter specifies a ratio to the pressure setting for each P-Q selection. Therefore, the pressure that activates the pressure switch varies depending on the pressure setting for the P-Q selection. The setting range is 0 to 150 [%].

If “expansion of pressure switch function” is enabled, the alarm output is set to “individual alarm output”.

**P08 = 0 (Individual alarm output), or
P08 = 1 (Integrated alarm output)**



P08 = 2 (Expansion of pressure switch function)



*** [P39] Digital output selection**

Digital output selection is available by changing parameter P18 and P39 as shown below;

[P08] setting	[P07] setting	[P39] setting	Digital output 1	Digital output 2	Contact output	
0 or 2	0	0	Completion output	Alarm output	Pressure switch output	
		1	Motor operation output			
		2	High-pressure pump operation output			
	1	1	0	Completion output		Alarm output or warning output
			1	Motor operation output		
			2	High-pressure pump operation output		
	2	2	0	Completion output		
			1	Motor operation output		
			2	High-pressure pump operation output		
1	0	0	Completion output	No output	Alarm output or Pressure switch output	
		1	Motor operation output			
		2	High-pressure pump operation output			
	1	1	0		Completion output	
			1		Motor operation output	
			2		High-pressure pump operation output	
	2	2	0		Completion output	
			1		Motor operation output	
			2		High-pressure pump operation output	
					Alarm output or Pressure switch output or warning output	









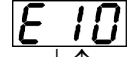
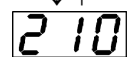

c) Alarm mode

The alarm mode allows you to check alarm conditions listed below by selecting any item between A00 and A09.

Alarm No.	Description	Remarks
A00 to A09	Alarm code indicating alarm condition (For each code, see the attached table.)	A smaller No. indicates a later alarm.

An example of alarm mode operation is shown below.

<Example> Checking an alarm condition (E10: IPM alarm) of an alarm before the latest one (A01)

Operating procedure	Key operation	3-digit LED	Remarks
<ul style="list-style-type: none"> • Power-ON <li style="text-align: center;">↓ • Actual pressure display <li style="text-align: center;">↓ • Alarm mode <li style="text-align: center;">↓ • Selecting alarm No. <li style="text-align: center;">↓ • Displays alarm condition <li style="text-align: center;">↓ • Return to actual pressure display mode 	<p style="text-align: center;">   </p> <p style="text-align: center;">Keep pressing two keys simultaneously for at least two seconds.</p> <p style="text-align: center;">Press  once.</p> <p style="text-align: center;">  </p> <p style="text-align: center;">  </p>	<p style="text-align: center;"></p> <p style="text-align: center;"></p> <p style="text-align: center;">After two seconds (Displays the latest alarm)</p> <p style="text-align: center;"></p> <p style="text-align: center;">Displays an alarm before the latest one</p> <p style="text-align: center;">   </p> <p style="text-align: center;"></p>	<p style="text-align: center;">After two seconds</p> <p style="text-align: center;">Alarm code and power-ON count are alternately displayed at a second interval.</p>

■ Alarm code display list

The hydraulic unit incorporates alarm detecting functions that are classified as follows:

◆ Panel display, unit operation and external output signal at occurrence of trouble

Unit status	Error condition	Panel display	Unit operation	External output signal
Normal operation	[1]	Alarm No. display	Operation stop	See the table on the next page.
Power-ON (during initialization)	[2]	Alarm No. and erroneous parameter No. are alternately displayed.		
Normal operation	[3]	Warning No. and actual pressure value are alternately displayed.	Operation continued	
Normal operation	[4]	Warning No. display		

◆ Alarm codes and classification table

(Individual alarm output: When the alarm output combination setting [P08] is "0")

(Integrated alarm output: When the alarm output combination setting [P08] is "1")

Classification	Description	Panel indication	External output status				
			○: There is continuity in the circuit. ×: There is no continuity in the circuit. -: The status immediately before alarm activation is retained.				
			Individual alarm output		Integrated alarm output		
			Relay output		Alarm/ Warning	Relay output	
A contact	B contact	A contact	B contact				
Power OFF		-	×	○	×	×	○
Power ON: Normal		Actual pressure display	○	×	○	○	×
[1]	Output device error	E10	-	-	×	×	○
	Instantaneous overcurrent	E11	-	-	×	×	○
	Overspeed	E12	-	-	×	×	○
	Regenerative brake overcurrent	E13	-	-	×	×	○
	Regenerative brake overload	E14	-	-	×	×	○
	Undervoltage	E15	-	-	×	×	○
	Overvoltage	E16	-	-	×	×	○
	Electronic thermal	E17	-	-	×	×	○
	Magnetic pole detection error	E18	-	-	×	×	○
	Encoder cable break	E20	-	-	×	×	○
	Motor cable break	E21	-	-	×	×	○
	Power supply open phase	E24	-	-	×	×	○
	Pressure sensor error	E30	-	-	×	×	○
	Motor start error	E31	-	-	×	×	○
	Motor thermistor cable break	E40	-	-	×	×	○
	Motor temperature abnormal rise	E41	-	-	×	×	○
	Radiator fin thermistor cable break	E42	-	-	×	×	○
	Fin temperature abnormal rise	E43	-	-	×	×	○
Drying operation error	E64	-	-	×	×	○	
CPU runaway (watchdog)	E91	-	-	×	×	○	
[2]	EEPROM data error (1)	E93	×	○	×	×	○
	EEPROM data error (2)	E94	×	○	×	×	○
	Motor temperature abnormal warning	L44	○	×	*	×	○
[3]	Fin temperature abnormal warning	L45	○	×	*	×	○
	Power supply voltage drop warning	L50	○	×	*	×	○
	Pressure deviation abnormal warning	L60	○	×	*	×	○
[4]	Pressure switch activation ^{Note 1}	L63	×	○	○	×	○


During activation of an alarm of Classification [1], the system records the alarm, and holds the alarm code on the display.

During activation of an alarm of Classification [1], the pressure switch does not work. The system retains the status immediately before activation of the alarm.

When alarm output combination setting [P08] is "1" (integrated alarm output is selected), the alarm signal is output even if the warning/pressure switch is activated.

^{Note 1} The pressure switch activation alarm code ("L63" of Classification [4]) is displayed only with the a) or b) setting below:

- When the pressure switch display hold setting (Setting mode [P03]) is "1" or "2".
- When the pressure switch setting [P01] is enabled (When any number other than "0" is entered)

When the pressure switch display hold setting [P03] is "1" or "2", the display hold status cannot be reset until the  key is pressed.

When the pressure switch display hold setting [P03] is "2", the alarm is stored in the alarm record if the pressure falls below the value of the pressure switch setting [P01].

- * The alarm/warning output of the individual alarm output of Classification [3], and the relay output B contact of the integrated alarm output vary depending on the warning output level setting [P07]. See "Attachment: Power-ON External I/O Signal Timing Chart".

● Causes of alarms and measures to be taken

Classification	Description	Indication	Cause of alarm output	Measure to be taken
[1]	Output device error	E10	The self-holding function of the power device is activated.	If the event is repeated when the power supply is reclosed, contact DAIKIN.
	Instantaneous overcurrent	E11	The current control section senses instantaneous overcurrent.	If the event is repeated when the power supply is reclosed, contact DAIKIN.
	Overspeed	E12	The motor runs at a speed faster than the allowable speed (including reverse rotation).	Make sure that no problems exist in the hydraulic circuit, and contact DAIKIN.
	Regenerative brake overcurrent	E13	Overcurrent is sensed in the regenerative brake circuit.	If the event is repeated when the power supply is reclosed, contact DAIKIN.
	Regenerative brake overload	E14	Motor regenerative current causes the alarm to be outputted when regeneration overloading occurs.	Check the regenerative load integration ratio with the monitor mode set at [n08], and alleviate the load condition of the process in which the integration ratio increases.
	Undervoltage	E15	The main circuit voltage drops below 190 VDC (134 VAC).	Check the power supply voltage. If the event is repeated, contact DAIKIN.
	Overvoltage	E16	The main circuit voltage increases beyond 400 VDC.	Check the power supply voltage. If the event is repeated, contact DAIKIN.
	Motor Electronic thermal error	E17	Overloading is detected via the status of the current output. (60 seconds at 110%)	The motor output is larger than the normal output. If the event is repeated, contact DAIKIN.
	Magnetic pole detection error	E18	Faulty detection of the initial position of the motor	If the event is repeated, contact DAIKIN.
	Encoder cable break	E20	Alarm outputted as a result of a break in the encoder	Parts should be replaced; contact DAIKIN.
	Motor cable break	E21	Alarm outputted as a result of a break in the motor	If the event is repeated, contact DAIKIN.
	Power supply open phase	E24	Alarm outputted as a result of an open phase in the power supply	If the event is repeated, contact DAIKIN.
	Pressure sensor error	E30	Alarm outputted as a result of an abnormal feedback value from the pressure sensor	If the event is repeated, contact DAIKIN.
	Motor start error	E31	Alarm outputted when the command differs from the actual rotation in polarity	If the event is repeated, contact DAIKIN.
	Motor thermistor cable break	E40	Alarm outputted when a break in the motor thermistor is detected	Parts should be replaced; contact DAIKIN.
	Motor temperature abnormal rise	E41	The motor is forcefully stopped when the temperature reaches the specified temperature (85°C) under the L44 condition.	The event can be caused as a result of a decrease in the heat radiation and cooling performance of the motor. Carry out servicing.
	Radiator fin thermistor cable break	E42	Alarm outputted when a break in the fin thermistor is detected	Parts should be replaced; contact DAIKIN.
Fin temperature abnormal rise	E43	The motor is forcefully stopped when the temperature reaches the specified temperature (80°C) under the L45 condition.	The event can be caused as a result of a decrease in the heat radiation and cooling performance of the controller. Carry out servicing.	
Drying operation error	E64	Alarm outputted when an increase in the rotational speed is not accompanied by an increase in pressure	The event can be caused as a result of a closed stop valve or a decrease in the oil in the tank. Open the stop valve and check the oil quantity.	
CPU runaway (watchdog)	E91	Alarm outputted when the CPU runs away	If the event is repeated, contact DAIKIN.	

Classification	Description	Indication	Cause of alarm output	Measure to be taken
[2]	EEPROM data error (1)	E93	Alarm outputted when data in EEPROM is abnormal	If the event is repeated, contact DAIKIN.
	EEPROM data error (2)	E94	Alarm outputted when data in EEPROM is abnormal	If the event is repeated, contact DAIKIN.
[3]	Motor temperature abnormal warning	L44	Alarm outputted when the motor thermistor temperature exceeds the threshold (83°C)	The event can be caused as a result of a decrease in the heat radiation and cooling performance of the motor. Carry out servicing.
	Fin temperature abnormal warning	L45	Alarm outputted when the fin thermistor temperature exceeds the threshold (78°C)	The event can be caused as a result of a decrease in the heat radiation and cooling performance of the controller. Carry out servicing.
	Power supply voltage drop warning	L50	Alarm outputted when the power supply voltage falls below 180 V	Check the power supply voltage. If the event is repeated, contact DAIKIN.
	Pressure deviation abnormal warning	L60	Alarm outputted when the command is in saturated condition for five seconds or more	The motor output is higher than the normal output. If the event is repeated, contact DAIKIN.
[4]	Pressure switch activation	L63	The indication appears when the pressure switch is activated (to be selected using the parameter).	

[12.Maintenance]

To keep the motor pump performance in good conditions for a long period, conduct periodic maintenance on the following items. If there is a problem, repair or replace defective parts.

Standard inspection cycles are listed below. However, these cycles considerably vary depending on the operating conditions and environment.

■ Periodic inspection

Item	Inspection cycle	Method
<ul style="list-style-type: none"> ● Oil tank <ul style="list-style-type: none"> • Oil level check • Oil temperature check • Oil color check 	Daily, Occasionally Daily, Occasionally Semiannually	Make sure that the float of the oil level gauge is between the red and yellow lines. Check the hydraulic oil for whitish muddiness and air bubbles. Make sure that the oil temperature is 60°C or less. (Normally, use the oil at 15 to 50°C.) Deterioration of hydraulic oil can be checked by color. If the hydraulic oil turns brownish (ASTM L4 level: bright yellow), replace it.
<ul style="list-style-type: none"> ● Return filter 	Daily, Occasionally	Check the indicator for clogging of the return filter. If the return filter is clogged, replace the filter element.
<ul style="list-style-type: none"> ● Oil cooler <ul style="list-style-type: none"> • AC fan rotation • Clogging of the core 	Daily, Occasionally Semiannually	Make sure that the AC fan is rotating. Visually check the core for clogging. If the AC fan rotation is stopped, or the core is clogged, <ol style="list-style-type: none"> [1] the oil cooler cooling capacity remarkably deteriorates. This causes the hydraulic oil or the unit to become hot, resulting in burns. Also, this accelerates deterioration of the hydraulic oil, causing the unit service life to be shortened. [2] the motor becomes hot, causing the motor service life to be shortened. [3] the controller heat radiation performance deteriorates, causing the electric component service life to be shortened.
<ul style="list-style-type: none"> ● Pressure display <ul style="list-style-type: none"> • Operation check • Pressure display check 	Daily, Occasionally Daily, Occasionally	Check if the indicated value changes according to load condition changes. Make sure that the pressure display for D.H. conforms to the preset value.
<ul style="list-style-type: none"> ● Sound and vibration 	Daily, Occasionally	Check for abnormal sound and vibration.
<ul style="list-style-type: none"> ● Electric wiring 	Semiannually	<ol style="list-style-type: none"> [1] Check the cable sheathing for cracks or fracture. [2] Measure the insulation resistance, and check for a decrease in insulation resistance. [3] Make sure that the ground cable is securely connected.
<ul style="list-style-type: none"> ● Hose 	Yearly	Check the hose for cracks, fracture or flaws.
<ul style="list-style-type: none"> ● Screws and pipes 	Daily, Occasionally	Check screws and pipes for looseness and oil leak.

■ Cleaning and replacement

Item	Operation cycle	Method
● Replacement of oil tank and oil	Yearly	Replace hydraulic oil periodically. If the oil is used without replacement for a long period, it has bad influences on operation and service life of the hydraulic unit.
● Cleaning of oil cooler and core	Yearly	Disassemble and clean the oil cooler and the core according to "Maintenance Procedure" on p. 46 and p. 48.
● Cleaning of AC fan	Yearly	Disassemble and clean the AC fan (air breather) according to "Maintenance Procedure" on p. 49.
● Oil filling port (Air breather)	Yearly	Disassemble and clean the oil filling port (air breather) according to "Maintenance Procedure" on p. 50.
● Suction strainer	Yearly	Disassemble and clean the suction strainer according to "Maintenance Procedure" on p. 50.
● Return filter ^{*1}	If the indicator shows filter clog, replace the filter element.	Replace the filter element according to the maintenance procedure on p. 51.

*1 The type of the return filter is MAR10-10P-S, manufactured by Masuda Mfg.
The type of the filter element is AR10-010P.

▲ DANGER

- [1] Do not access or touch rotating parts.
- [2] If you touch internal components of the controller, observe the following procedure to prevent electric shock.
 - i) Turn OFF the hydraulic unit main power supply.
(Turn OFF the power supply circuit breaker.)
To prevent erroneous operation during work, post an "Operation Prohibited (During Work)" sign on the power supply circuit breaker.
 - ii) Remove the controller cover after elapse of at least five minutes.
The controller uses a large-capacitance capacitor. If you work with the capacitor charged, you may get electric shock. Before removing the controller cover, be sure to leave the controller for at least five minutes to discharge electricity from the capacitor.
- [3] Before turning ON the power supply to start operation, mount all covers to the controller.

■ Oil cooler maintenance procedure

▲ WARNING

- [1] Before maintenance work, stop operation, and turn OFF the main power supply.
- [2] During work, wear protective goggles and gloves.
 - i) The core fin has a sharp edge. Be careful not to hurt yourself.
 - ii) During air blow, be careful that foreign bodies will not touch your eyes.

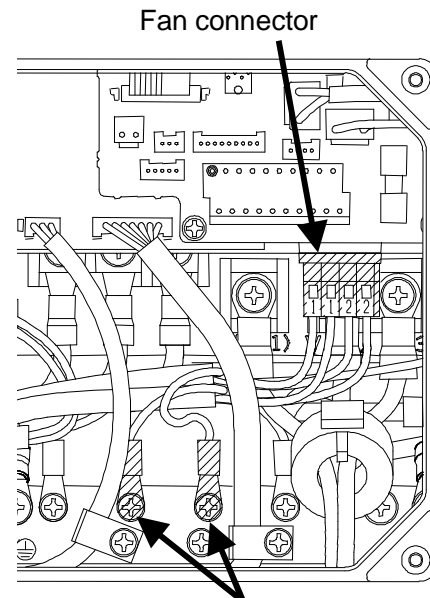
▲ CAUTION

- [1] Be careful that strong force will not be applied to the AC fan power supply cable and connector during work.
- [2] During disassembly process, oil will flow out of the pipes and oil cooler.

1. Dismounting the oil cooler

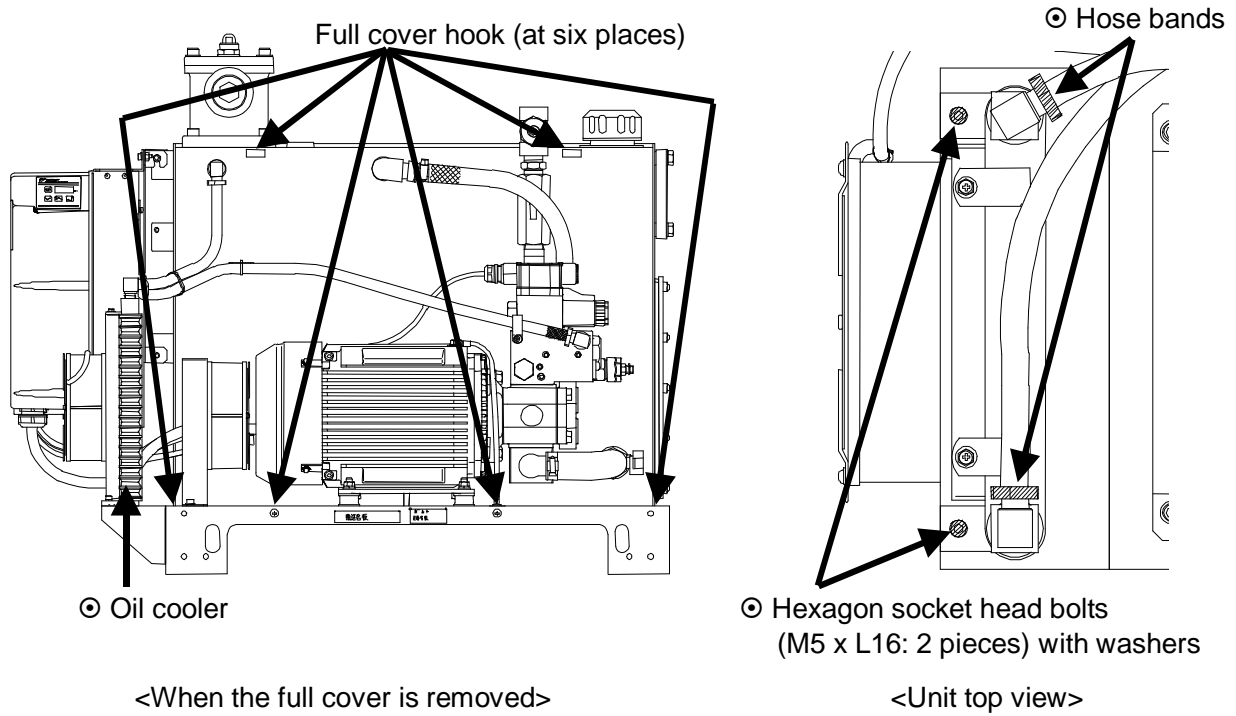
- [1] Loosen the cross recessed truss head machine screws (M5 × L14, two pieces) in the full cover, and remove the full cover.
 - The full cover has been fastened to the unit body with the claws (at six places in total: two at the front of the unit, one on each side, and two at the top of the unit). Lift the cover vertically from the unit.
- [2] Open the controller small cover, and remove the fan connector and the fan ground cable.
- [3] Cut the binding strap that ties the fan harness.
- [4] Cut the binding strap that ties the hoses.
- [5] Remove the hose bands (at two places), and disconnect the hoses (two pieces) at the top of the oil cooler.

Note) In this step, oil may leak due to backward oil flow from the tank. Before conducting this step, attach a blind plug to each hose.
- [6] Remove the hexagon socket head bolts (M5 × L16: 2 pieces) with washers, and dismount the oil cooler.



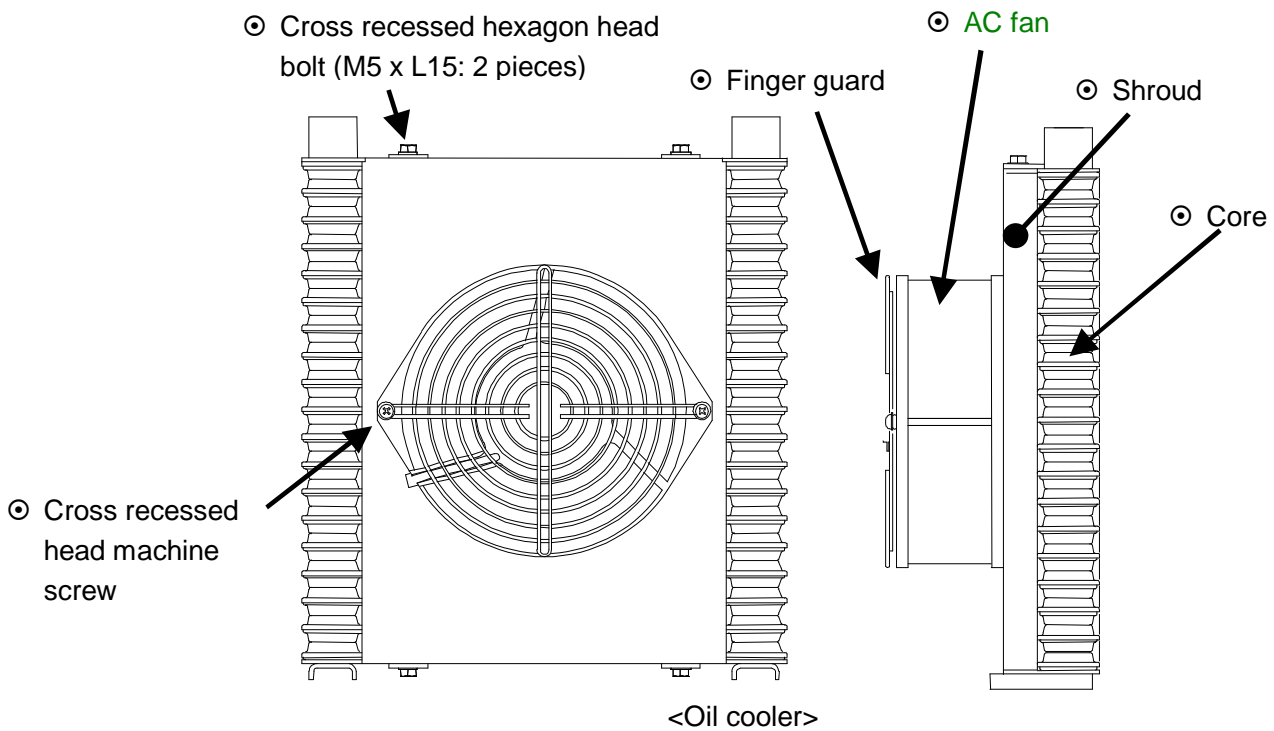
Fan ground cable

<When the controller small cover is removed>



2. Disassembling the oil cooler

- [1] Remove the cross recessed hexagon head bolts (M5 x L12: 4 pieces), and separate the shroud from the core.
- [2] Remove the cross recessed head machine screws (M4 x L70: 2 pieces), and separate the AC fan and finger guard from the shroud.



3. Cleaning the core

Blow air or steam onto the core, and clean the fins by blowing off dust accumulated on/adhering to the fins. When cleaning the fins, be careful that the dust blown away will not enter the core.

4. Cleaning the AC fan

Clean the clearance between the blade periphery and the casing, as well as the blades and the casing, by using a cloth.

▲ CAUTION

[1] Prohibition of steam/air blow

- Never attempt to blow steam or air onto the fan motor. Steam/air blow causes foreign bodies to be blown into the motor.

5. Reassembling the oil cooler

After cleaning is completed, reassemble the oil cooler.

After reassembling is completed, conduct the test run procedure described on p. 29 to make sure that the hydraulic unit normally operates.

Check if the oil cooler air intake/exhaust direction is correct. (See p. 15)

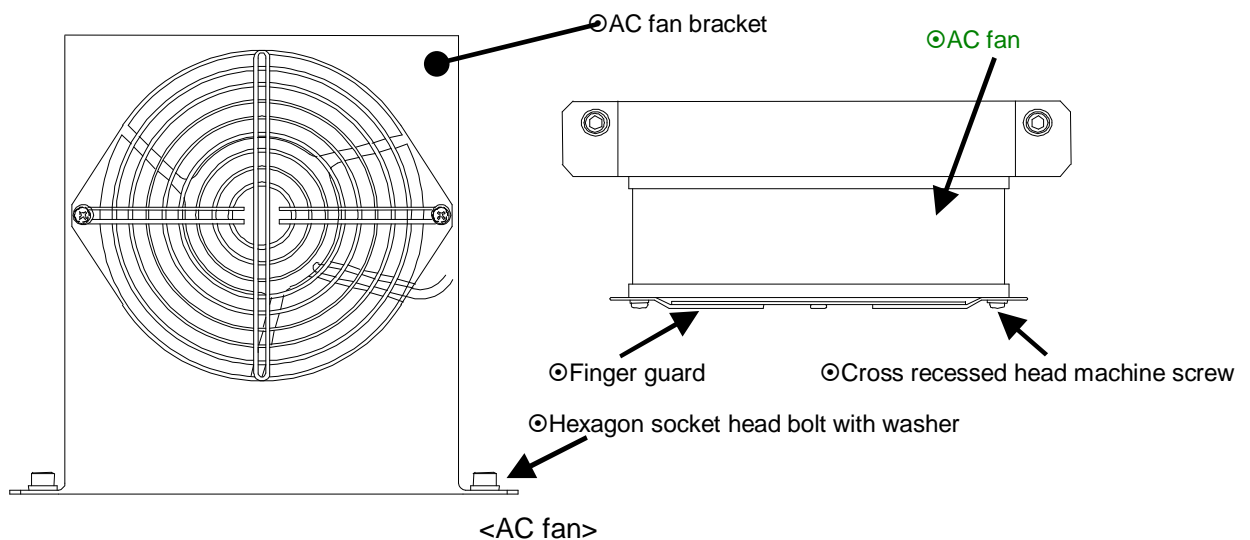
■ AC fan maintenance procedure

1. Removing the AC fan

- 1) Remove the full cover. (See p. 44)
- 2) Open the controller small cover, and remove the fan connector and the fan ground cable. (See p. 44)
- 3) Cut the binding strap that ties the fan harness.
- 4) Remove the hexagon socket head bolts with washers (M6 × L15: two pieces), and remove the AC fan bracket.

2. Cleaning the AC fan bracket

Remove the cross recessed head machine screws (M4 × L70: two pieces), and separate the AC fan bracket from the fan motor and the fan guard.



3. Cleaning the AC fan bracket

Blow steam or air onto the AC fan bracket to eliminate dust or contamination accumulated on/adhering to the bracket.

4. Cleaning the AC fan

Clean the clearance between the blade periphery and the casing, as well as the fan blades and the casing, by using a cloth.

▲ CAUTION

[1] Prohibition of steam/air blow

- Never attempt to blow steam or air onto the fan motor. Steam/air blow causes foreign bodies to be blown into the motor.

5. Re-assembling the AC fan

After cleaning the AC fan, re-assemble it.

After reassembling is completed, make sure that the fan normally operates according to the test run procedure described on p. 29.

(Check if the AC fan air intake/exhaust direction is correct. (See p. 15))

■ Oil filling port (air breather) maintenance procedure

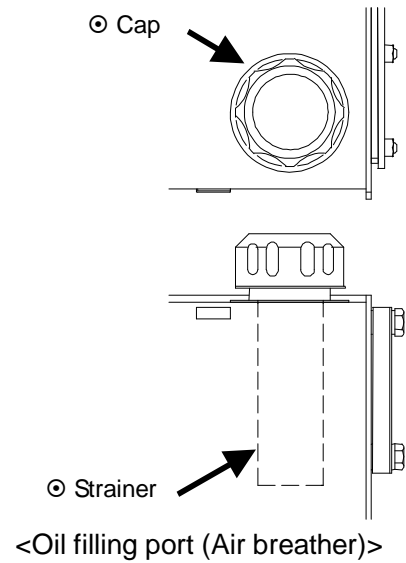
1. Removing procedure

The cap can be easily removed by turning it counterclockwise by hand.

2. Cleaning procedure

Blow air onto the filter to blow off dust accumulated on/adhering to the filter.

Remove dust from inside of the strainer cylinder.



3. Mounting direction

Mount the cap by turning it clockwise by hand until it stops.

▲ WARNING
<ul style="list-style-type: none"> • During air blow, wear protective goggles to prevent accumulated substances or dust from touching your eyes.

■ Suction strainer maintenance procedure

1. Removing procedure

[1] After draining hydraulic oil completely, remove the nuts (M8: 12 pieces; Tightening torque: 9 to 10 N·m) from the cleaning door cover, and remove the cover from the cleaning door.

* When the Super Unit uses the 160 L tank, there are 14 nuts for the cleaning door.

[2] You can see the suction strainer. Loosen the strainer, and remove it.
(Hexagon nut, Width across flats: 41 mm)

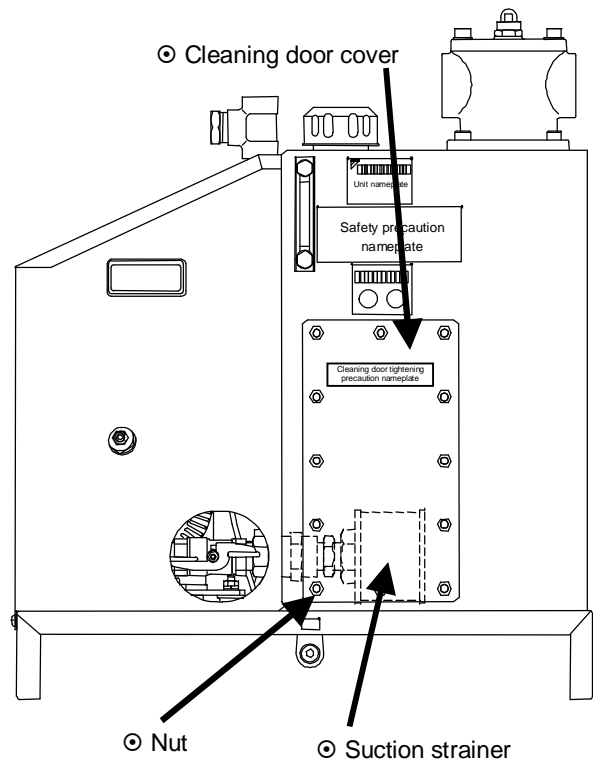
2. Cleaning procedure

Blow air onto the filter to blow off dust accumulated on/adhering to the filter.

Remove dust from inside of the strainer cylinder.

3. Reassembling the strainer

After cleaning is completed, reassemble the suction strainer. Follow the removing procedure in reverse. After reassembling is completed, conduct the test run procedure described on p. 29 to make sure that the hydraulic unit normally operates.

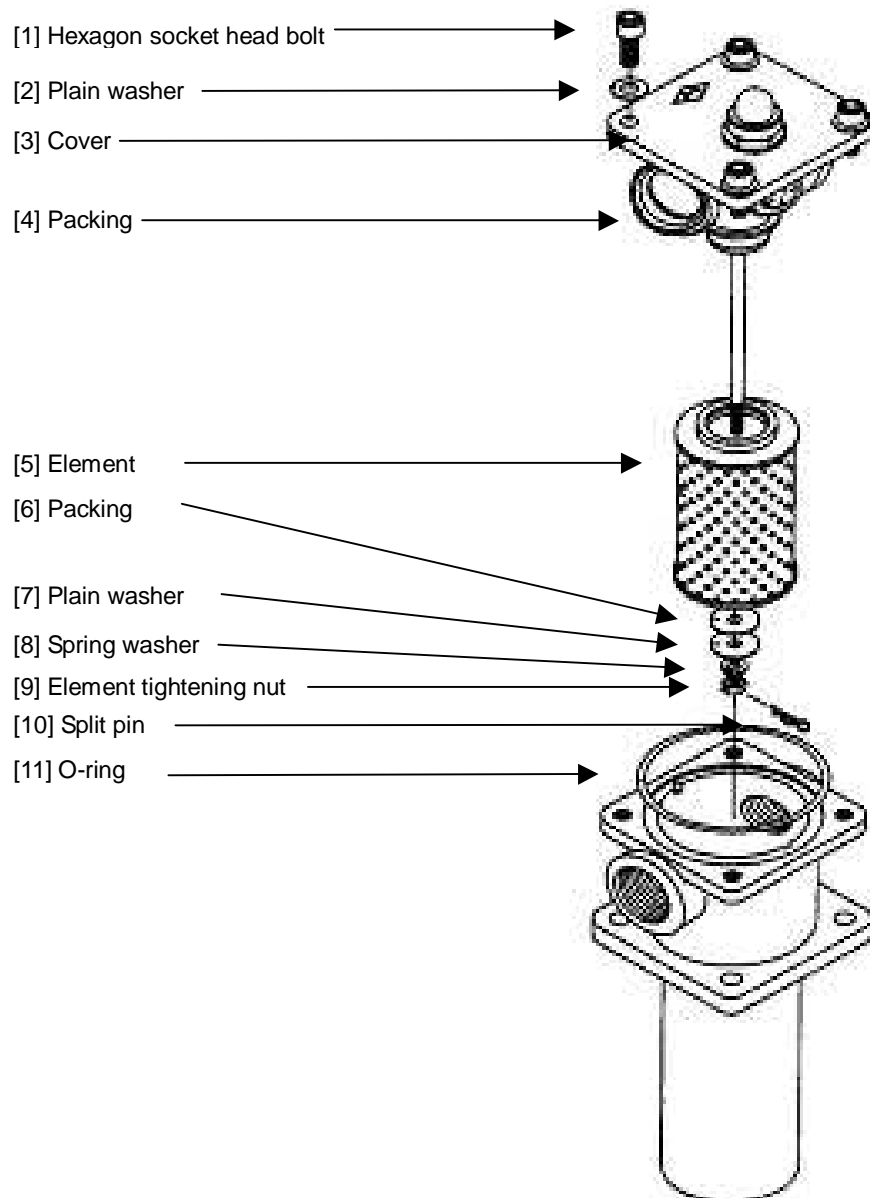


▲ WARNING
<ul style="list-style-type: none"> • During air blow, wear protective goggles to prevent accumulated substances or dust from touching your eyes.

■ Return filter element replacement procedure

When the detector indicates clogging of the filter (the indicator ring floats up, and the green area of the indicator column is completely hidden), replace the filter element according to the following procedure:

1. Loosen the hexagon socket head bolts [1] that fasten the cover [3], and pull up the cover. Then, the element [5] can be removed.
2. Pull out the split pin [10] from the element, loosen the element tightening nut [9], and remove the parts [6] to [8].
3. Replace the element with a new one, and re-mount it by following the above procedure in reverse.
4. Tighten the hexagon socket head bolts [1] securely in the diagonal order.



[Attachment: High-pressure Safety Valve Adjustment Procedure]

With this hydraulic unit, it is not necessary to change the high-pressure safety valve settings in detail, even in the case of pressure setting adjustment. This hydraulic unit uses the IPM motor, resulting in drastic improvement of the motor drive system. Thus, it ensures stable performance without necessity of high-pressure safety valve setting adjustment.

In any of the following three cases, adjust the safety valve with reference to "Safety Valve Adjusting Procedure".

1. When safety valve setting adjustment is required:

Even if the hydraulic unit is used with the maximum pressure setting, the safety valve will not be activated under normal pressure control (except for the transient period when the circuit is blocked due to stop of the master machine hydraulic actuator). However, the safety valve set pressure will be lowered due to long-term repeated operations and contaminants in the hydraulic oil. If the safety valve is activated even with normal conditions, safety valve adjustment is required.

[Judgment criteria]

- The hydraulic oil temperature rising time is shorter than before.
- When the safety valve adjusting screw is turned in the tightening direction, the rpm indication in the pressure hold status is lowered.

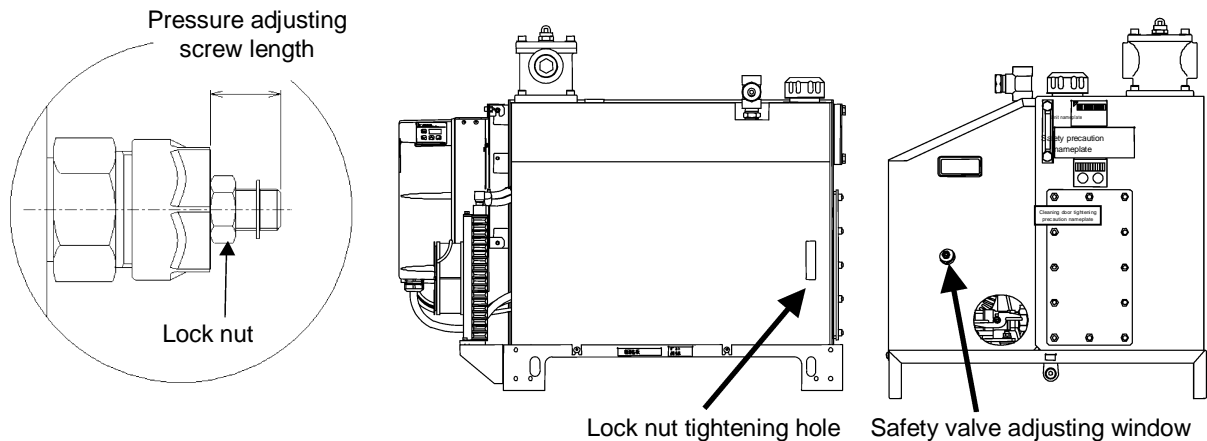
2. To minimize surge pressure that much exceeds a set pressure, safety valve adjustment is required in consideration of the withstand pressure of the hoses being used.

3. When the pressure set value is changed from the factory setting:

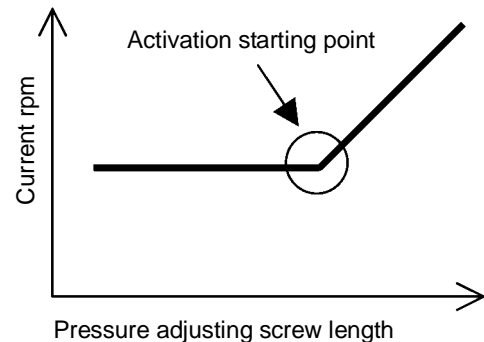
In order to suppress surge pressure to protect the master machine peripheral equipment (actuator, pressure gauge, etc.), it is recommended that the safety valve set pressure should be set "pressure of the unit + 1.0 MPa".

<High-pressure Safety Valve Adjustment Procedure>

- [1] Referring to the enlarged view of the high-pressure safety valve shown below, loosen the lock nut. (M10 lock nut, Width across flats: 14 mm)
- [2] According to the pressure adjusting screw length reference chart, determine the screw length corresponding to a desired control pressure setting.
 - * Tip of adjusting screw: Hexagon socket head, Width across flats: 5 mm
 - * One turn of the adjusting screw changes the pressure by approx. 7.7 MPa.



- [3] Turn ON the hydraulic unit power supply, and select the setting mode through panel key operation. Then, set a desired pressure.
- [4] Select [n05] (rpm display) in the monitor mode through panel key operation to show the current rpm.
- [5] Adjust the pressure adjusting screw length in the longitudinal direction, and find an activation starting point as shown on the right.
- [6] Turn the pressure adjusting screw clockwise by 1/8 turn from the activation starting point to tighten the screw.



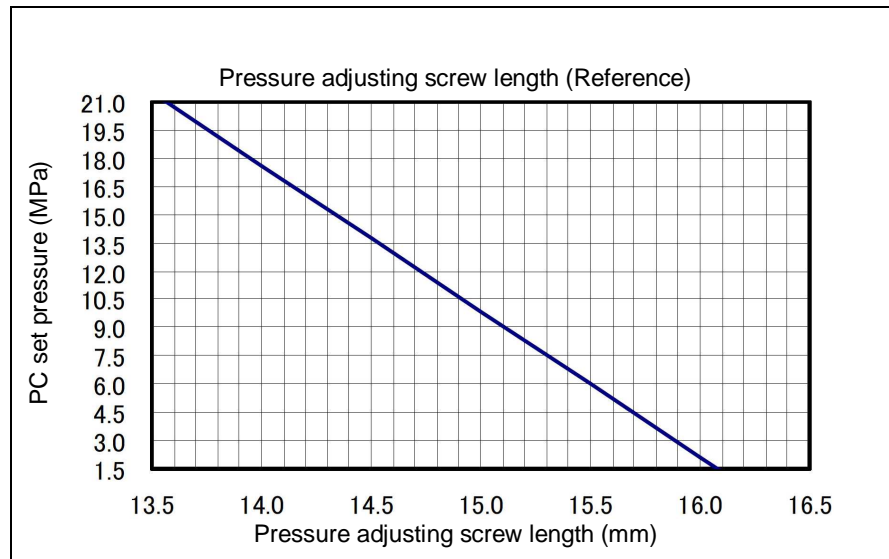
- [7] Tighten the lock nut. This completes the safety valve adjusting procedure.
(When tightening the lock nut, be careful not to allow the adjusting screw to turn.)

★CAUTION: To set the safety valve to 20 MPa or higher pressure, caution is required.

(Excessively increasing the safety valve setting causes the pump to be damaged by surge pressure.)

To adjust the safety valve, follow the procedure below:

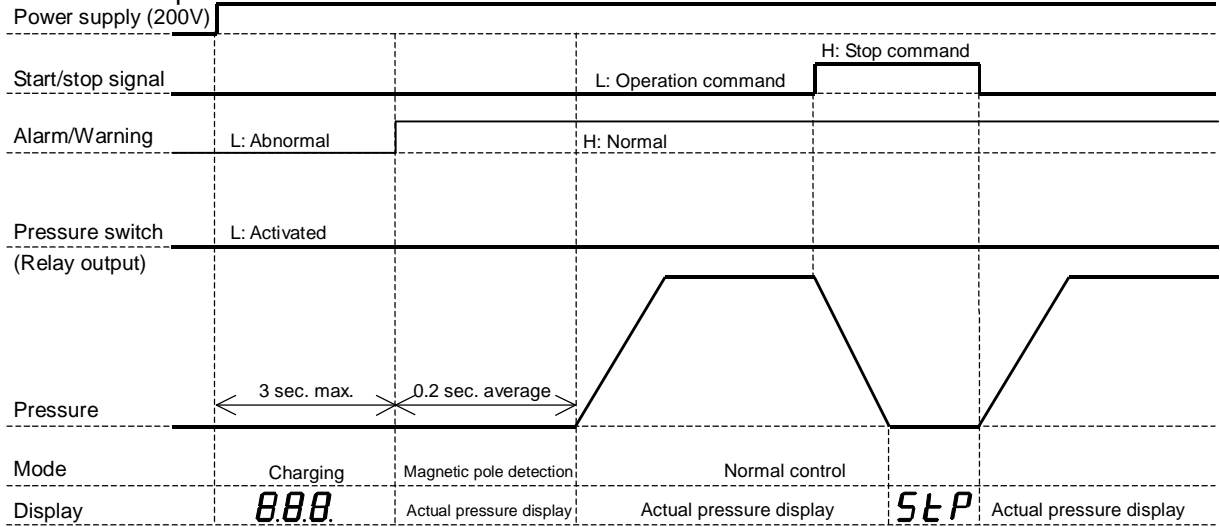
First, set the safety valve by following the above steps [1] to [5] so that the pressure setting is 7.7 MPa (corresponding to one turn of the pressure adjusting screw) lower than a target pressure. Then, tighten the adjusting screw by turning it clockwise by one turn, and conduct the above step [7].



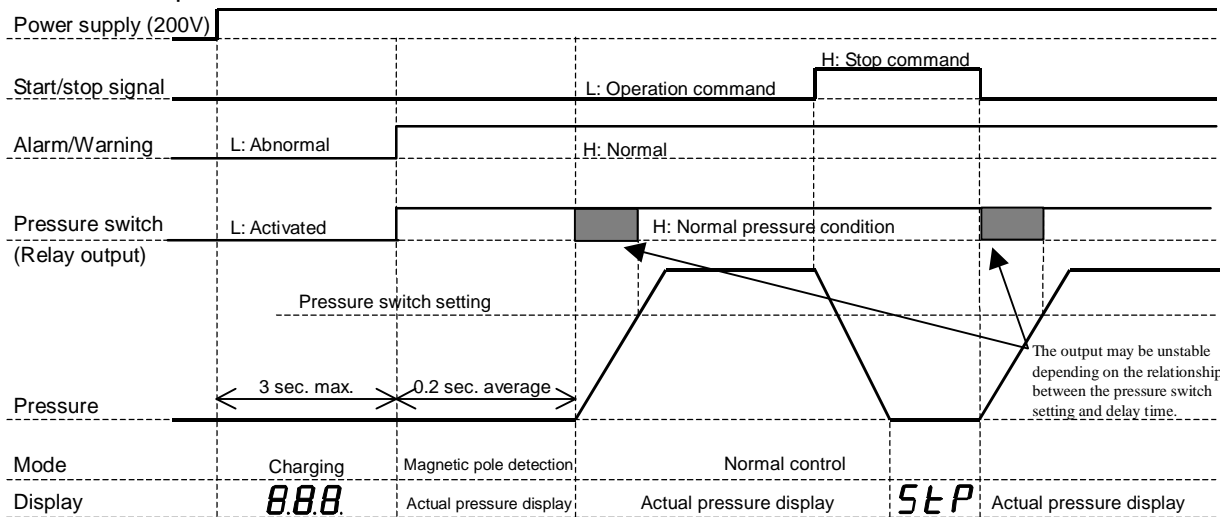
[Attachment: Power-ON External I/O Signal Timing Chart]

1. When parameter [P08] is "0"

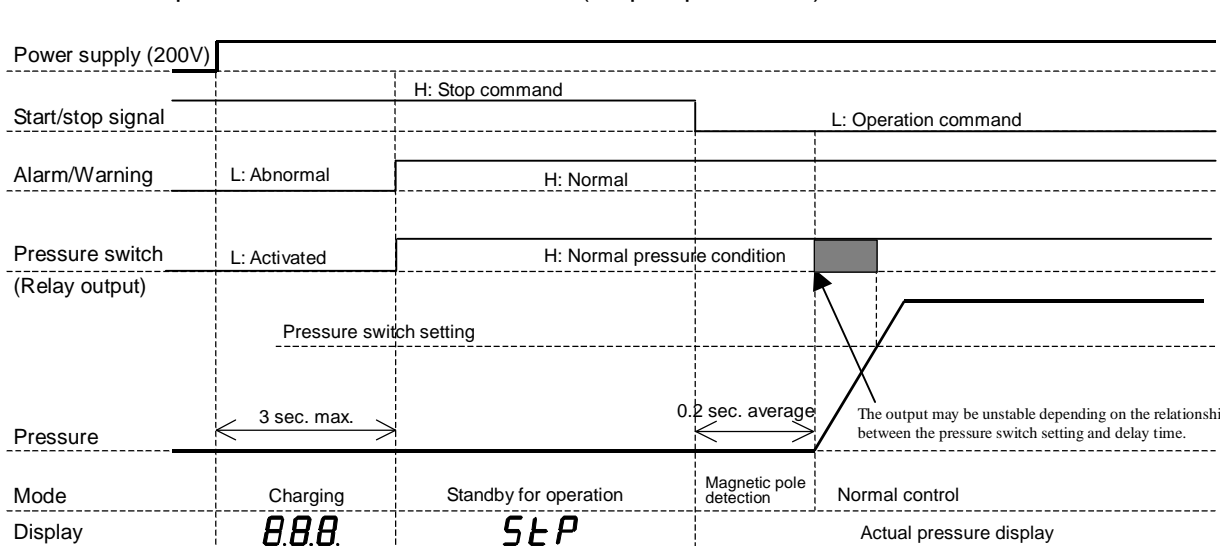
1-1 When the pressure switch function is not used



1-2 When the pressure switch function is used

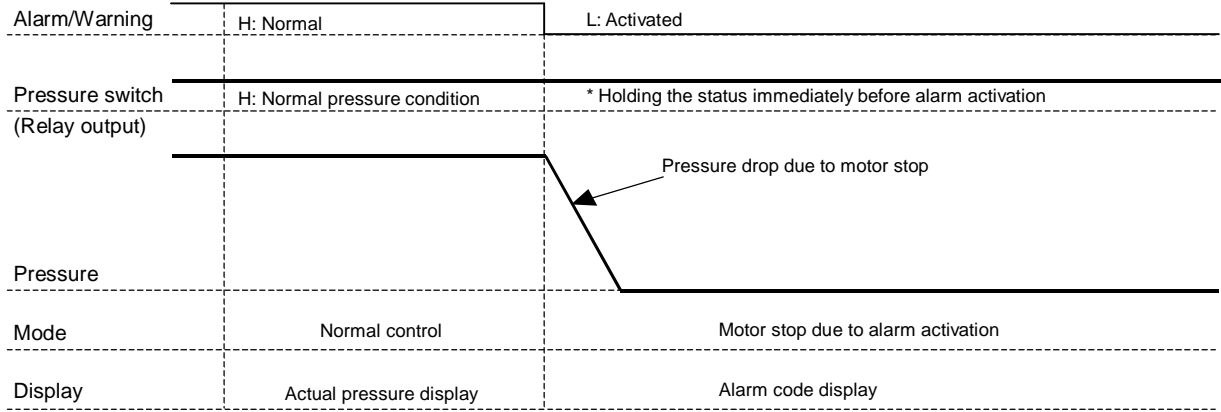


1-3 When the pressure switch function is used (Stop at power-ON)

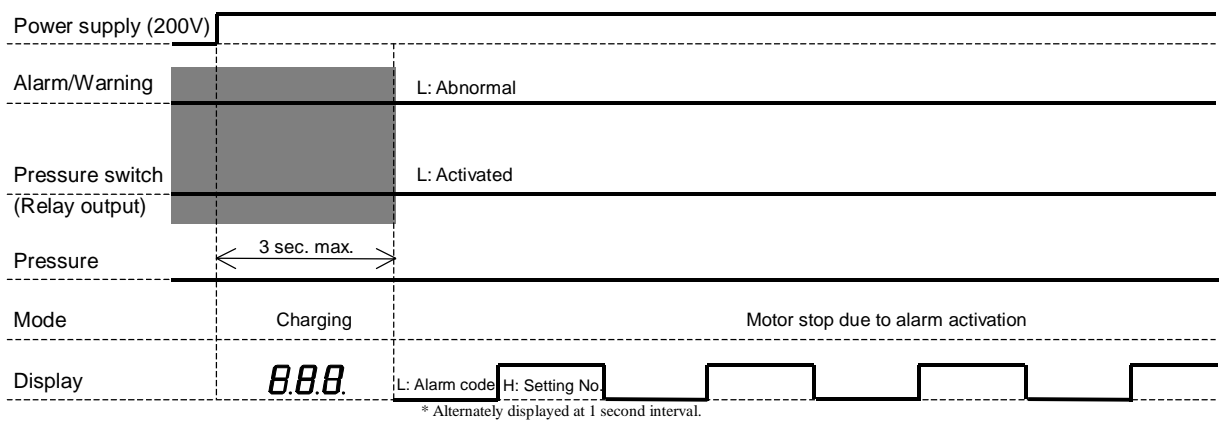


* Magnetic pole detection will be executed at the first motor startup after power-ON.

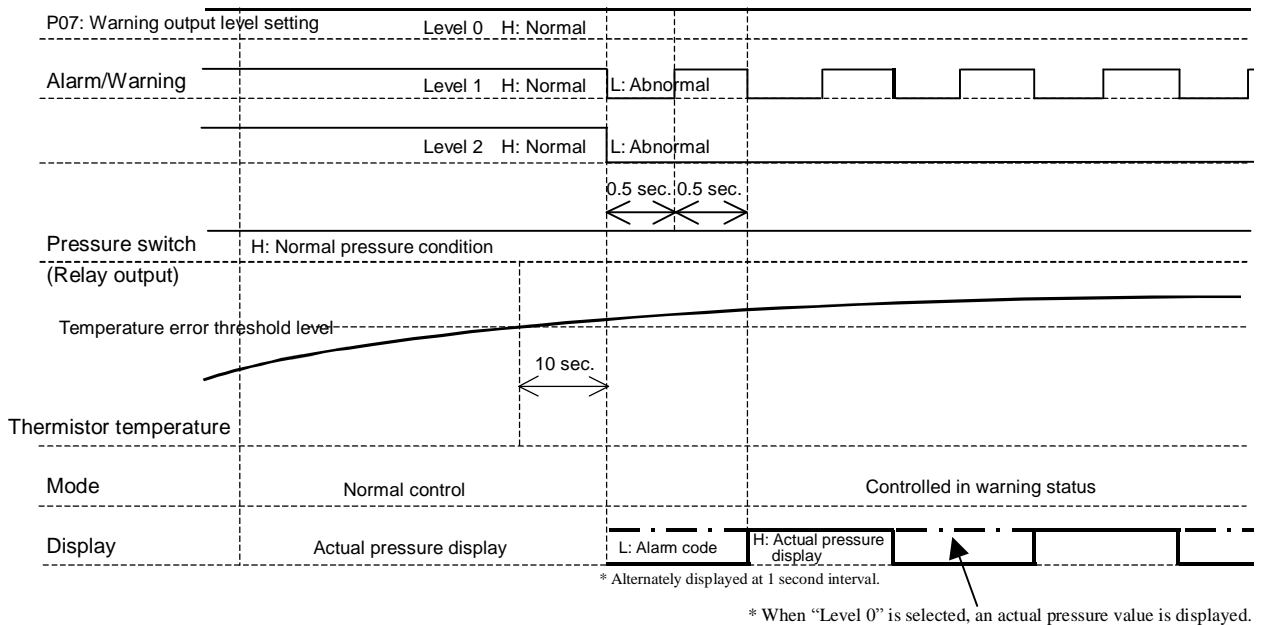
1-4 Alarm classification [1]



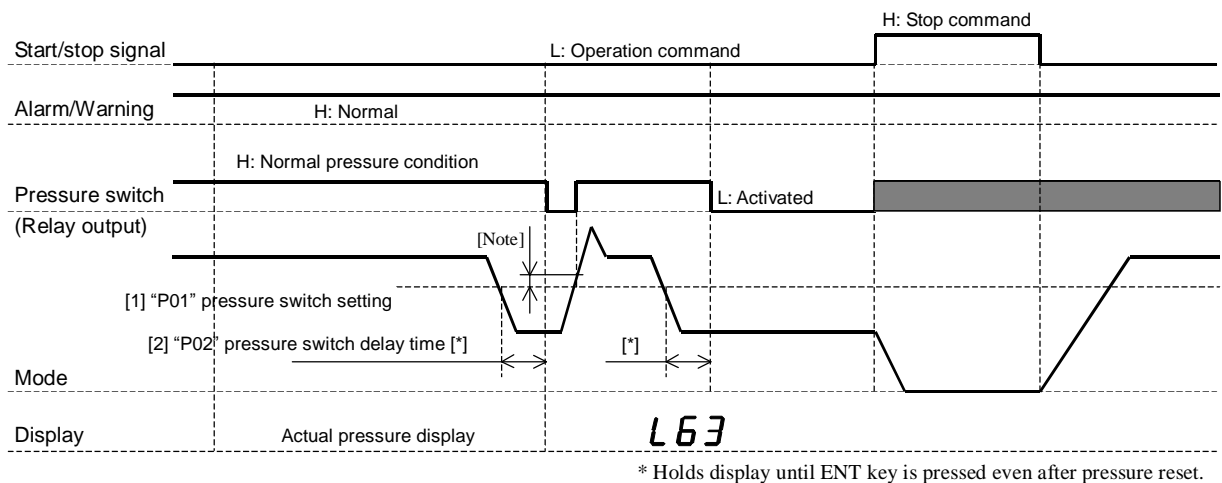
1-5 Alarm classification [2]



1-6 Alarm classification [3]



1-7 Alarm classification [4]



The above chart shows the case where "P03" (Pressure switch display hold setting) is [1] or [2].

When "P03" is [0], an actual pressure value is displayed.

When the stop command is activated by the start/stop signal, the pressure switch is in the normal condition.

The "P01" and "P02" settings (above [1] and [2]) can be changed in the setting mode.

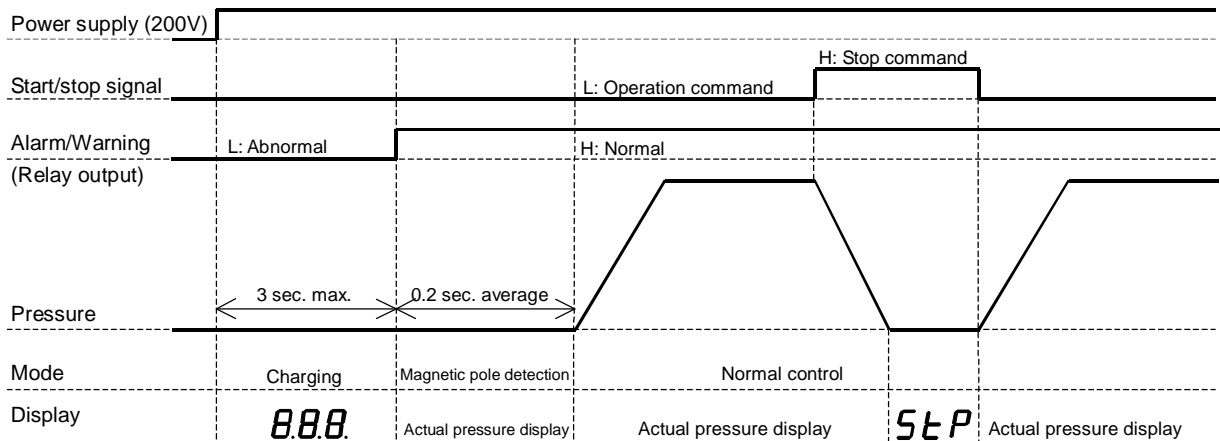
For the setting procedure and setting range, see "Operating procedure for each mode: b) Setting mode" on p. 39.

Note) For the purpose of explanation, the above "1-7 Alarm classification [4]" chart shows the case where the pressure switch is activated without a dead zone. Actually, however, the pressure switch has a dead zone of approx. 0.5 MPa.

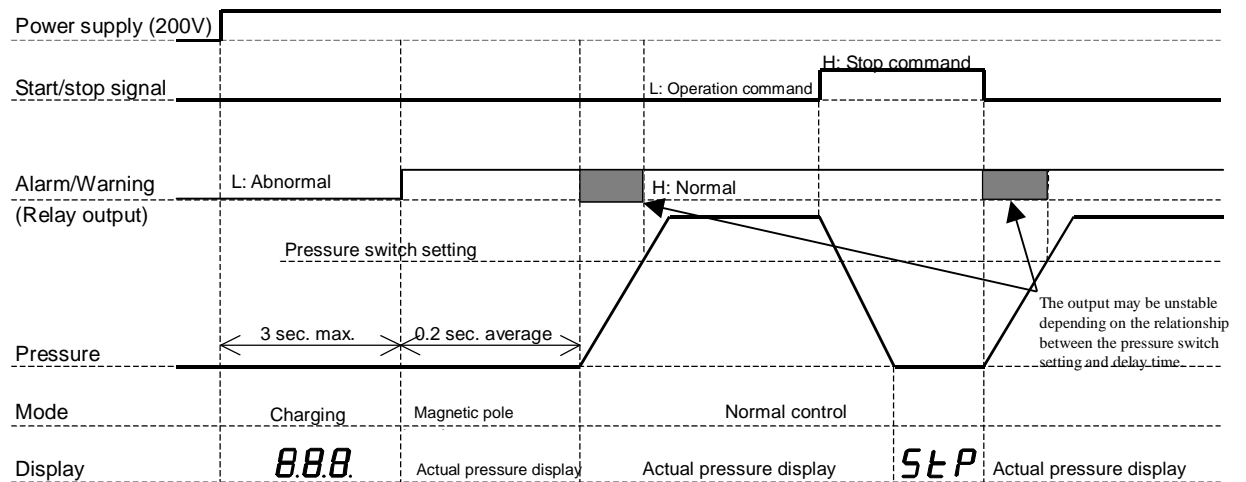
Note) Set the time interval after a stop signal at 0.5 seconds or longer.

2. When parameter [P08] is "1"

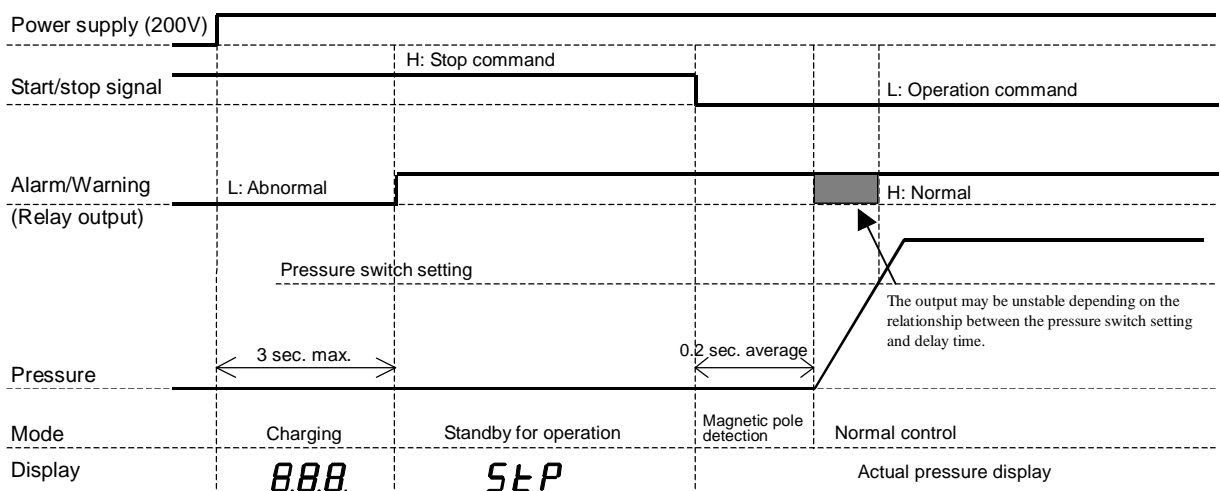
2-1 When the pressure switch function is not used



2-2 When the pressure switch function is used

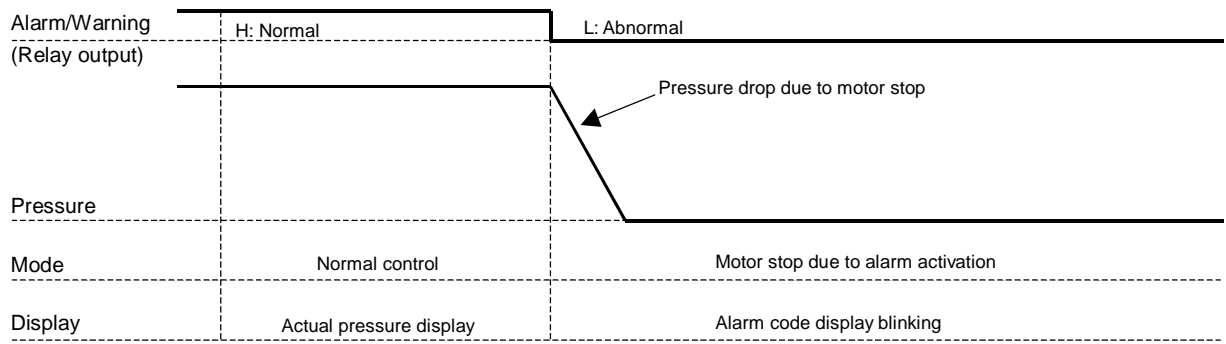


2-3 When the pressure switch function is used (Stop at power-ON)

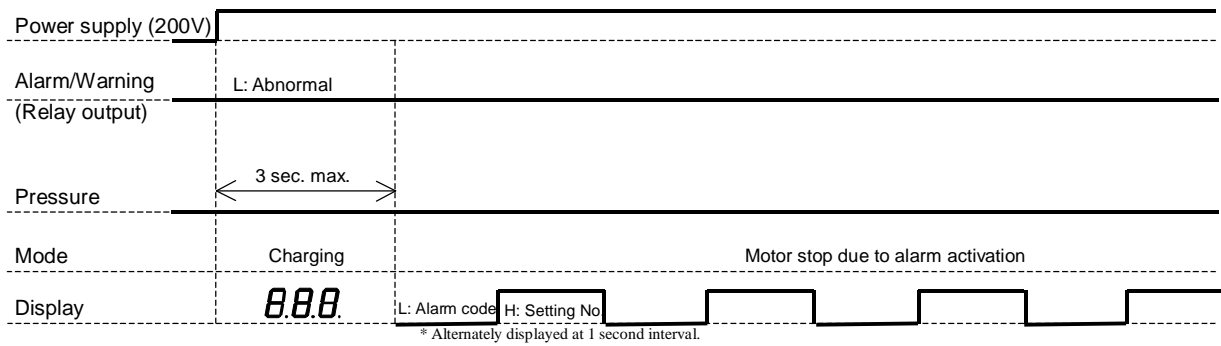


* Magnetic pole detection will be executed at the first motor startup after power-ON.

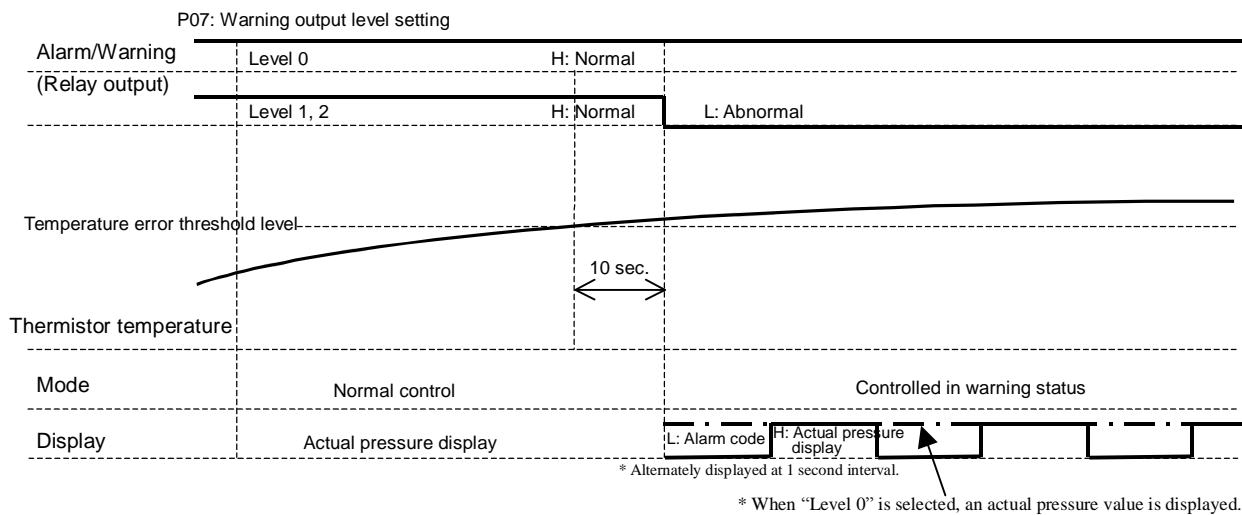
2-4 Alarm classification [1]



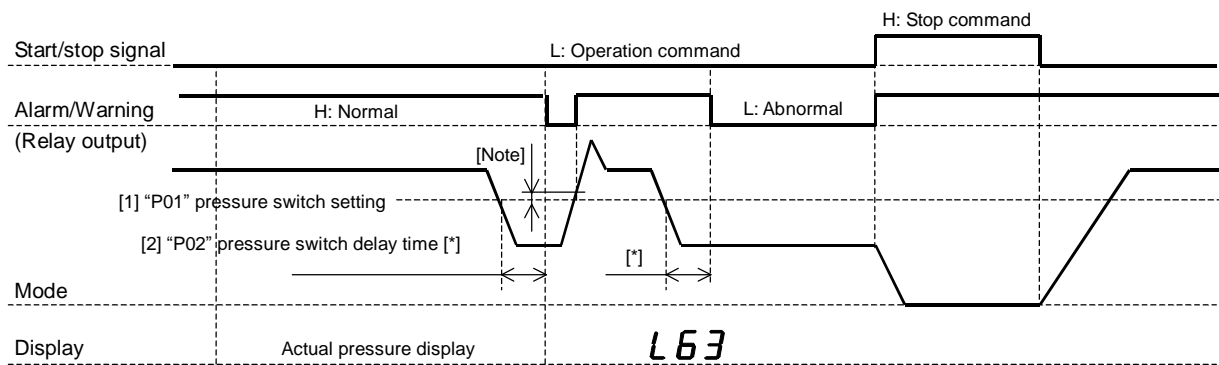
2-5 Alarm classification [2]



2-6 Alarm classification [3]



2-7 Alarm classification [4]



The above chart shows the case where "P03" (Pressure switch display hold setting) is [1] or [2].

When "P03" is [0], an actual pressure value is displayed.

When the stop command is activated by the start/stop signal, the pressure switch is in the normal condition.

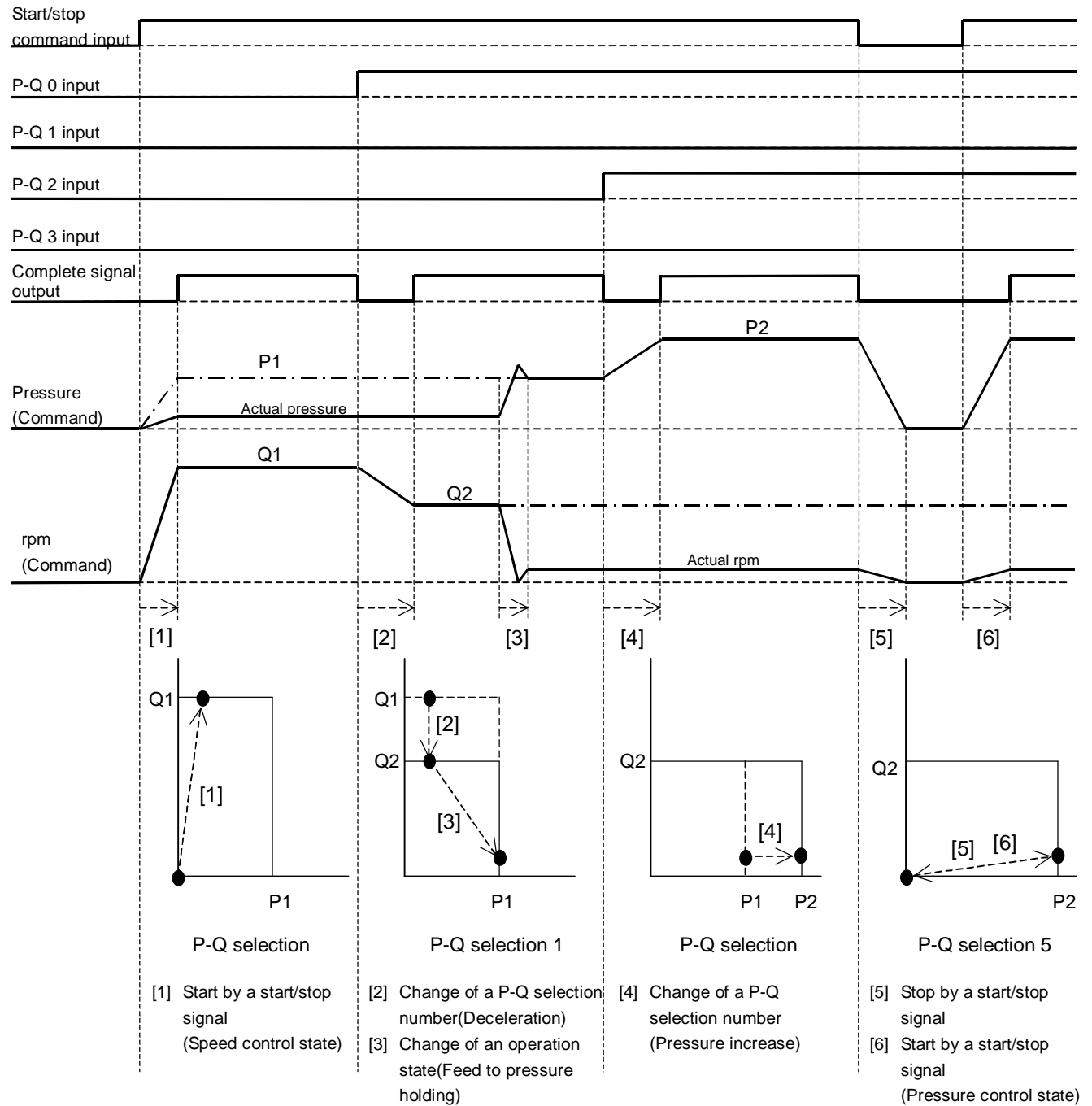
The "P01" and "P02" settings (above [1] and [2]) can be changed in the setting mode.

For the setting procedure and setting range, see "Operating procedure for each mode: b) Setting mode" on p. 39.

Note) For the purpose of explanation, the above "2-7 Alarm classification [4]" chart shows the case where the pressure switch is activated without a dead zone. Actually, however, the pressure switch has a dead zone of approx. 0.5 MPa.

Note) Set the time interval after a stop signal at 0.5 seconds or longer.

3. Contact I/O timing chart



《PQ selection setting》

PQ selection	Pressure setting	Flow rate setting
0	P1	Q1
1	P1	Q2
2	P2	Q1
3	P2	Q2

- When the command value is being changed according to a change in P-Q selection No., the complete signal status is “Lo”. When the command value does not change any more, the complete signal status is changed to “Hi”.