Hybrid Hydraulic System

[Super Unit]

SUT06D40L16-20

SUT10D40L16-20

SUT06D60L21-20

SUT10D60L21-20

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 (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 will result in death or serious injury.
  - ⚠ WARNING: Improper handling regardless of this indication causes a potentially hazardous condition that can 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.

Contents

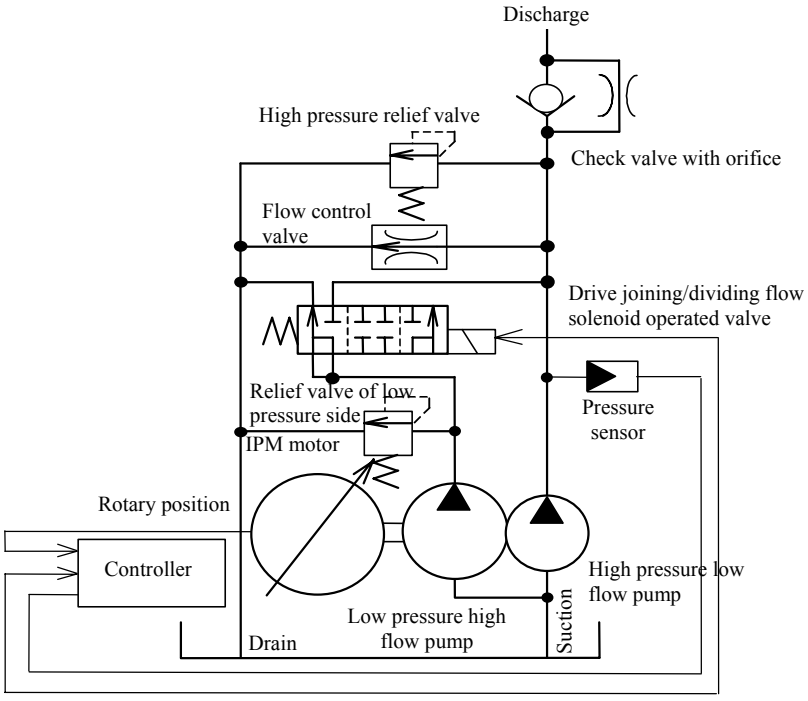
[1. Introduction]

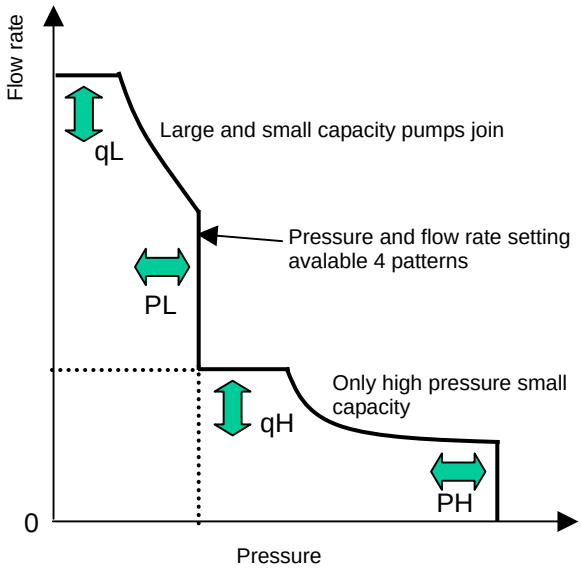
Thank you for selecting IPM Motor Drive Hydraulic Unit <Super Unit>.
Using the oil hydraulic technology and energy-saving IPM motor drive system that DAIKIN originally developed, the IPM Motor Drive Hydraulic Unit <Super Unit> provides overwhelmingly excellent energy conservation performance and advanced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

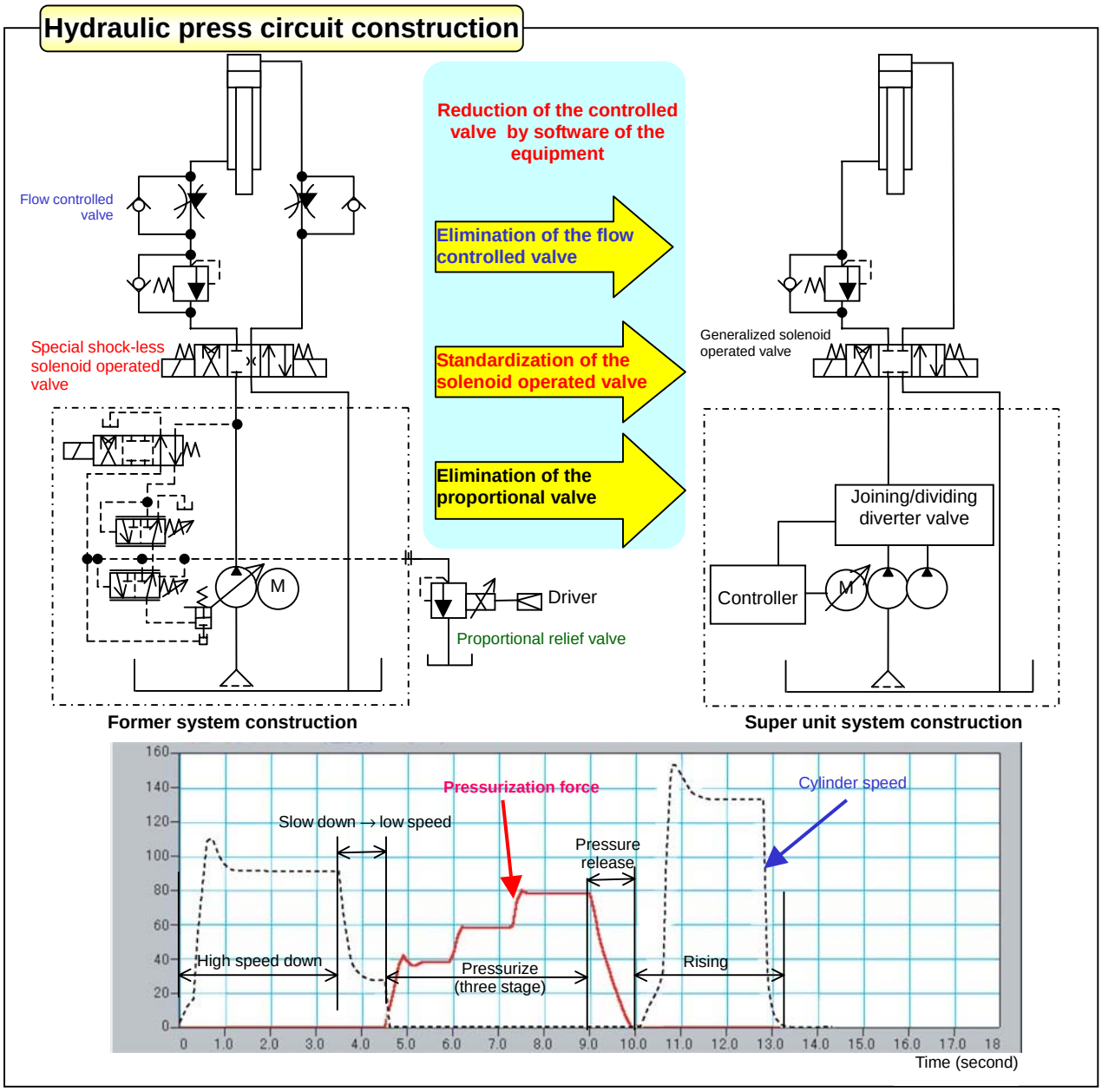
- Using the highly efficient IPM motor drive system that DAIKIN originally developed, this hydraulic unit remarkably improves the energy efficiency of the motor.
- With dual fixed-capacity pumps (small-capacity and large-capacity pumps) and a switching valve, this hydraulic unit uses the autonomous switching dual pump system that enables autonomous control by switching over combined and single operations of the pumps depending on load pressure. When a large flow rate is required, the motor runs at a high speed to operate the dual fixed-capacity pumps (small-capacity and large-capacity pumps) in combination. When a large flow rate is not required in the pressure-holding mode, the motor runs at a low speed to operate the small-capacity pump only. Thus, this dual pump system provides remarkably high energy-saving effect.





(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 4 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/adjusting the rising/falling time at changes of the P-Q characteristics.
- The functions that have been controlled with valves in a conventional system can be controlled with pumps. Therefore, when this system is used for high-speed/low-speed switching (for a press etc.) and multi-stage pressure control applications, the system configuration can be simplified, and costs can be reduced.



[3. Description on Model Identification Code]

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

(a) Series name
- SUT: SUT series

(b) Tank capacity
- 06: 60 L
- 10: 100 L

(c) Pump type
- D: Dual gear pump

(d) Maximum pump discharge rate
- 40: 41.0 L/min
- 60: 61.1 L/min

(e) Maximum operating pressure
- 16: 15.7 MPa
- 21: 20.6 MPa

(f) Design No.
- Advances according to model change.

(g) Selection of function
- No symbol: 4-pattern P-Q function, without noise filter
- F: 4-pattern P-Q function, with noise filter

(h) Non-standard control No.
- No symbol: Standard model

MFG. No

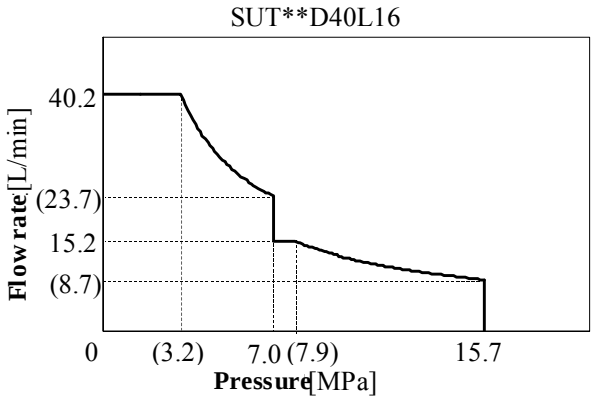
(i)	(j)		(k)
**	**	-	**_*****

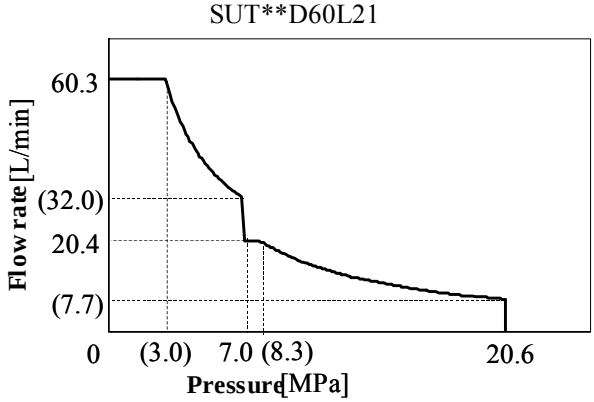
(i) Hardware revision history

(j) Software revision history

(k) Serial No.

<Typical P-Q characteristics>





* 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

				SUT06D40L16	SUT10D40L16	SUT06D60L21	SUT10D60L21
Maximum operating pressure			(MPa)	15.7		20.6	
Maximum flow rate (Note 1)			(L/min)	41.0		61.1	
Operating pressure adjusting range	Low-pressure pump (Combined operation)		(MPa)	1.5–7.0			
	High-pressure pump (Single operation)			1.5–15.7		1.5–20.6	
Operating discharge rate adjusting range (Note 1)	Low-pressure pump (Combined operation)		(L/min)	5.5–41.0		8.8–61.1	
	High-pressure pump (Single operation)			2.2–16.0		3.1–21.2	
Power supply (Note 2)				3ϕ, 200 V/50 Hz, 200 V/60 Hz, 220 V/60 Hz			
External input signal			(3ch)	Photo-coupler insulation, 24 VDC (27 V max.) 5 mA/1ch			
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, 30 mA max./1ch			
Standard paint color				Ivory white (Munsell 5Y7.5/1)			

(Note 1)

- It is preset to be Max. discharge flow rate when delivered.The maximum flow rate is a theoretical value, not a guaranteed value.
- Please refer to the specification sheet (drawing) for other specifications.
- Pressure and flow rate can be set higher than the above adjusting ranges. However, the hydraulic unit must be operated at pressure and flow rate within the above adjusting ranges.
- This hydraulic unit incorporates a high-pressure safety valve. With SUT**D40L16, the maximum pressure of the safety valve has been adjusted at “+2.0 MPa”. With SUT**D60L21, the maximum operating pressure has been adjusted at “+1.0 MPa”.
  Even when the safety valve is used with a low-pressure setting, specific adjustment is not required. However, if it is necessary to minimize surge pressure during actuator operation, adjust the pressure setting, according to “High-pressure Safety Valve Adjusting Procedure” described in the Attachment.

(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)”.) • Viscosity grade: ISO VG 32 to 68 • Viscosity range: 15 to 400 mm^2/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	• Be sure to mount a 3-pole circuit breaker and earth leakage breaker. • 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. To start/stop the hydraulic unit by turning ON/OFF the power supply repeatedly at intervals of 8 minutes or less, use the control stop 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) The standard model of this hydraulic unit does not incorporate a noise filter. If your machine is not equipped with a noise filter, you should select the Super Unit equipped with a noise filter, which is indicated with “F” at the end of the model identification code.

(2) This hydraulic unit switches over combined and single operations of the dual pumps with the solenoid valve, in order to provide excellent energy-saving performance. If an operation point of your machine is close to the switching point of this solenoid valve, the switching operation may become unstable. In this case, change the flow rate setting (qH) or pressure setting (PL) so that it is lower than the switching point.
Also, the switching operation can be stabilized by adjusting the width of the dead zone provided near the switching point. (Refer to [P16] and [P17] on page 35.)

(3) 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.

(4) This hydraulic unit is equipped with an AC fan to cool down the hydraulic oil, controller and motor. To ensure air intake and exhaust, do not place an obstacle within 10 cm from the end surfaces of the unit.

(5) 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.

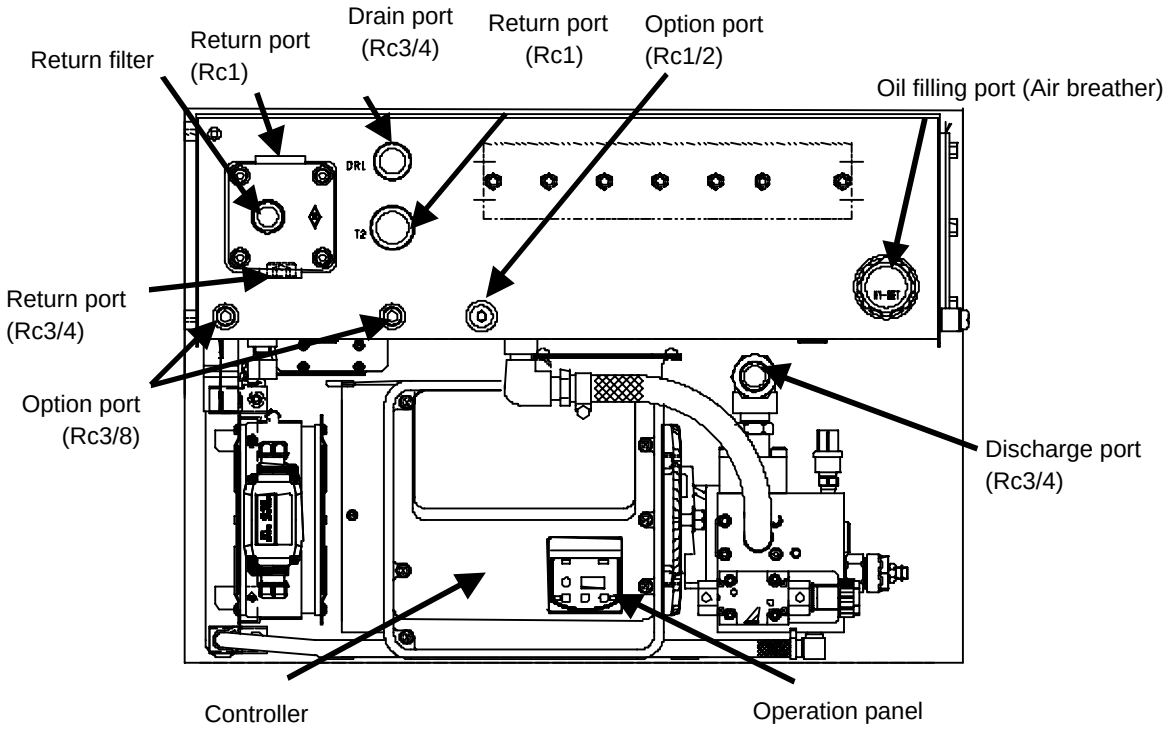
(6) This hydraulic unit incorporates a check valve that provides an orifice in the discharge line. If high response is required for machine pressure release or other purpose, the machine must be provided with an additional pressure release circuit.
If the load volume is large, you may hear a fluid flow sound from this orifice when the unit is stopped. However, this phenomenon does not indicate abnormality.

(7) 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 (with a large load volume, and resulting in large reaction force of load) that easily generate counter-electromotive force, it causes regenerative overload, resulting in unit stop.

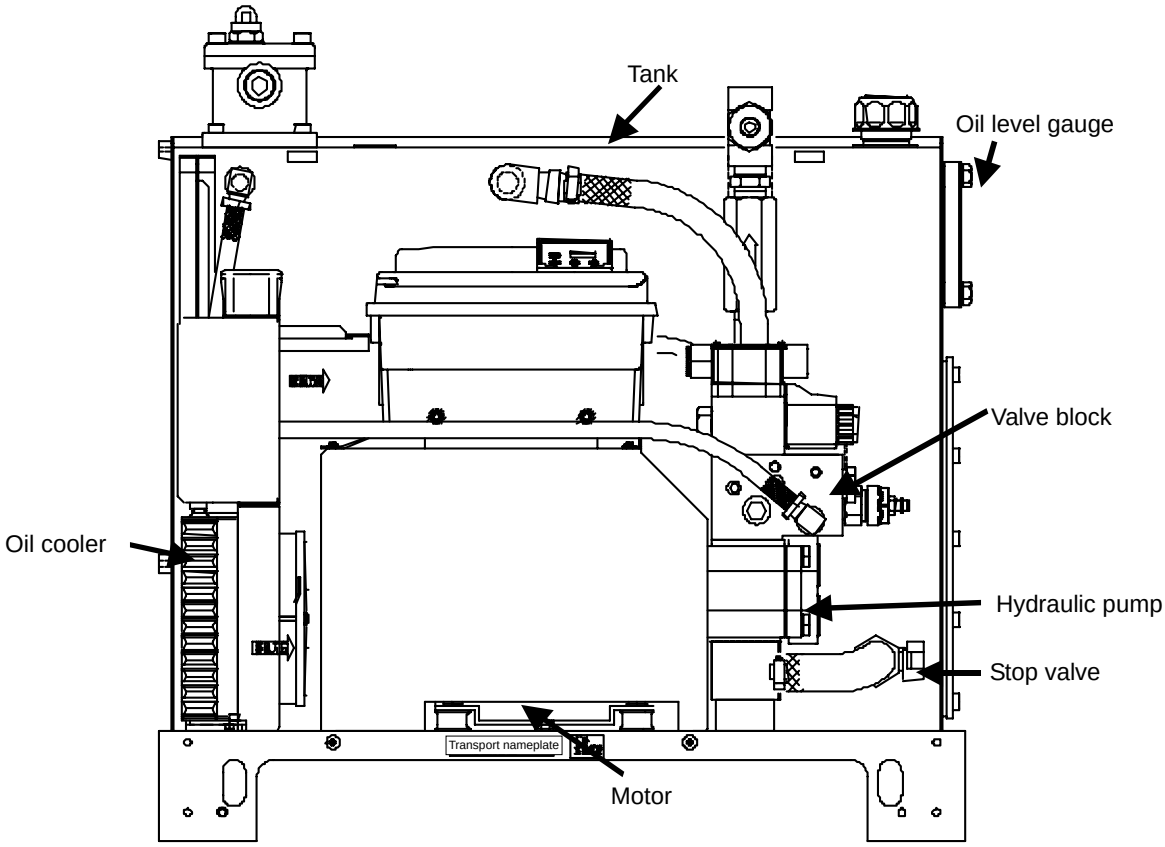
(8) This hydraulic unit is equipped with a safety valve.This safety valve has been set to a specified pressure before shipment. However, the set pressure of the safety valve may decrease while the machine is repeatedly used for a long period, or due to contaminants in the hydraulic oil.
If this unit 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 pressure setting of the high-pressure safety valve, according to “High-Pressure Safety Valve Adjusting Procedure” described in the Attachment.

(9) Continuous operations with maximum pressure is only allowable when operating flow rate is 8.0L/min or below for SUT**D40L16, and 6.5L/min or below for SUT**D60L21.

[6. Names of Unit Components]



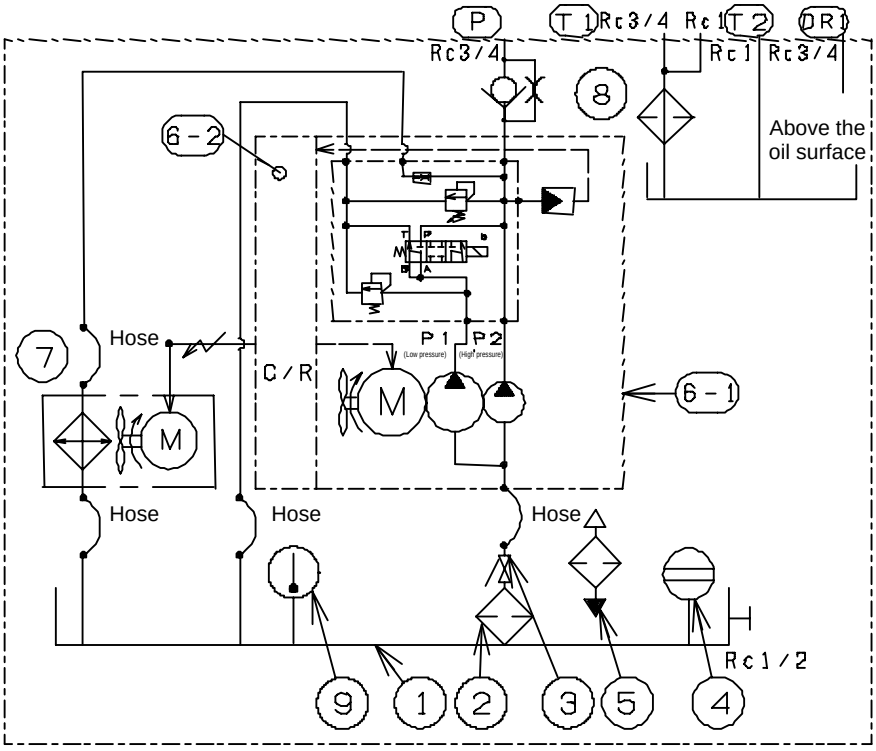
<Unit top view (When the full cover is removed)>



<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
9	Thermo indicator

■ Piping

This hydraulic unit is equipped with a return filter, and also a return port (submerged in oil), a drain port (above the oil surface) and a discharge port. Connect pipes as required. Each piping port has been covered with a taper plug (vinyl cap) before shipment.

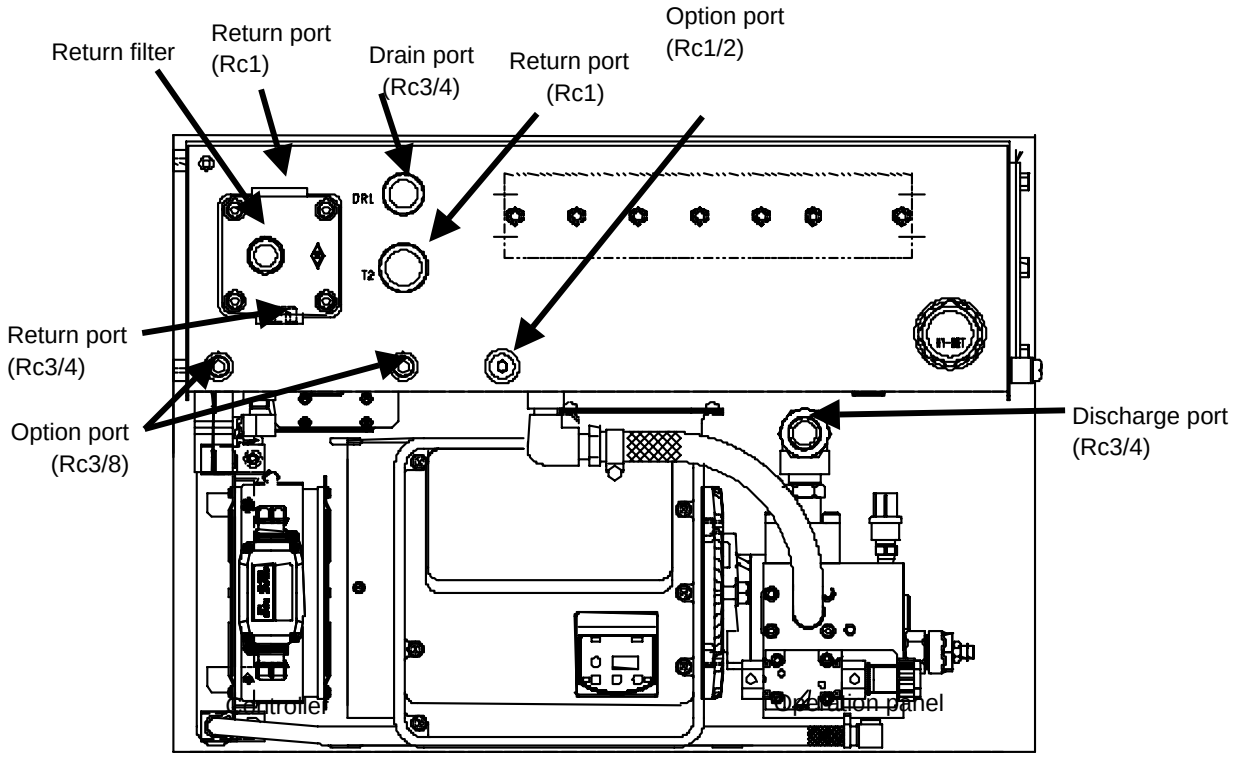
In this hydraulic unit, the motor pump unit is equipped with vibration suppressing rubber to prevent vibration of the motor pump unit from being conveyed to the whole unit. For this purpose, the discharge pipe provides a large degree of freedom. Therefore, when connecting the discharge pipe, be careful 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.



⚠ 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]

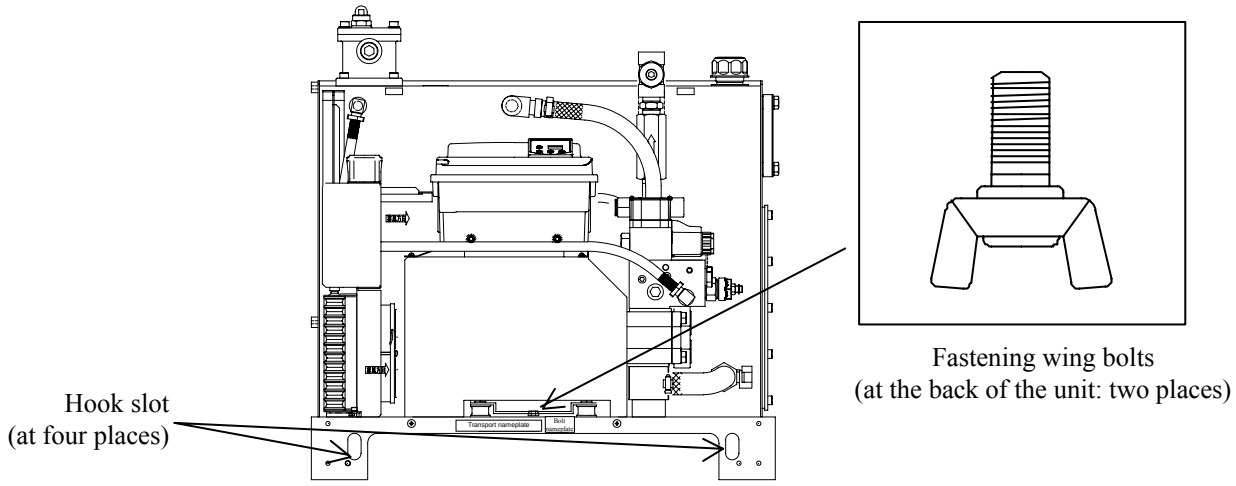
In order to suppress vibration and noise, vibration suppressing rubber is attached to each mounting leg. Before shipment, it is fastened with wing bolts **(M8 × L15: at two places)** in order to suppress transport vibration.

■ Precautions for operation

Before operation, remove the fastening wing bolts **(M8 × L15: at two places)**. Operating the unit without removing the wing bolts may increase vibration and noise.

■ Precautions for transportation

During transportation of this unit, be sure to mount the motor base to the base tank with the fastening wing bolts **(M8 × L15, at 2 places)** securely, 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 (in the table below), 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): Without noise filter>

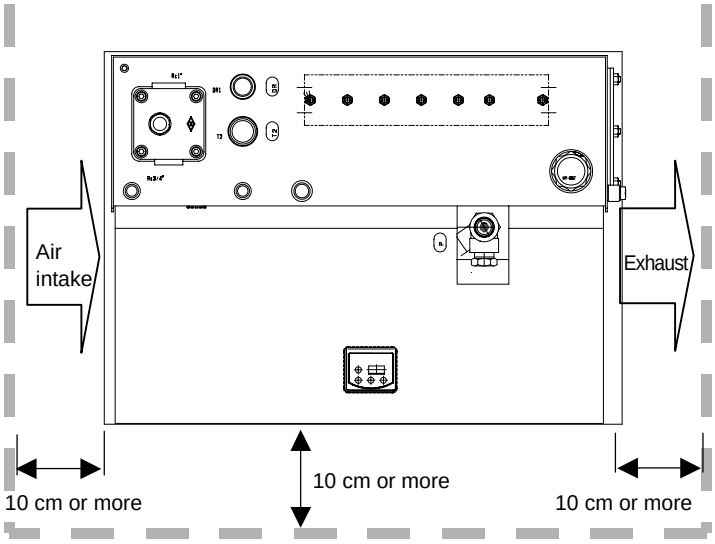
Model	SUT06D40L16	SUT10D40L16	SUT06D60L21	SUT10D60L21
Tank volume	60 L	100 L	60 L	100 L
Weight	95 kg	110 kg	100 kg	115 kg

■ 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 warning signal and alarm 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 the optional base fastening bracket mounting procedure, see the delivery specifications (model drawing).

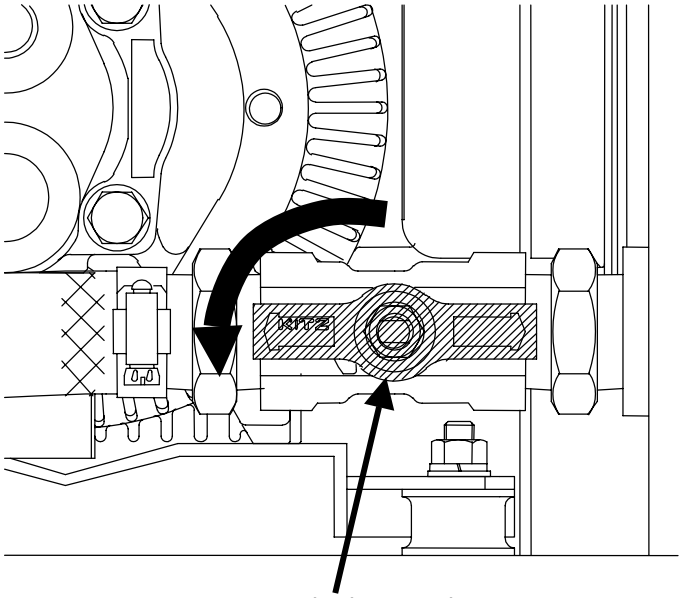
⚠ WARNING
• Unless the hydraulic unit is fastened with bolts, it may be turned over or moved by reaction force under the oil pressure in the pipe.

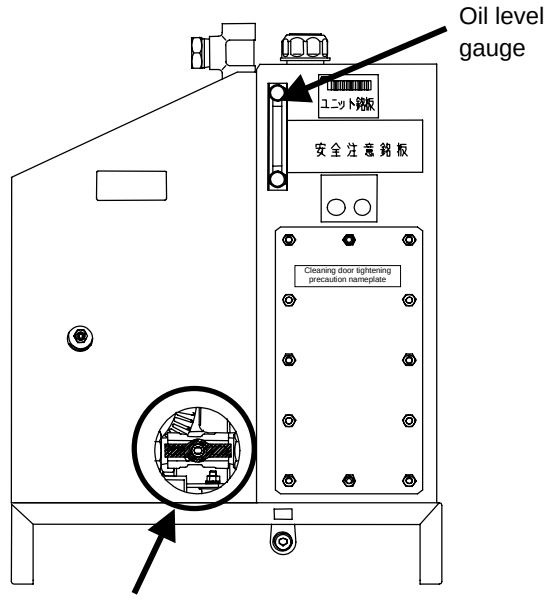
⚠ CAUTION
• If the hydraulic unit is installed on an inclined plane, oil leak or air intrusion occurs, resulting in abnormal sound or shortened service life of the equipment. Be sure to install the unit on a level plane.

[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 suitable for the operating conditions described on page 8.
- Make sure that the stop valve is opened.





- Be sure to open it before use.
(Lever is horizontal: Open, Lever is vertical: Closed)

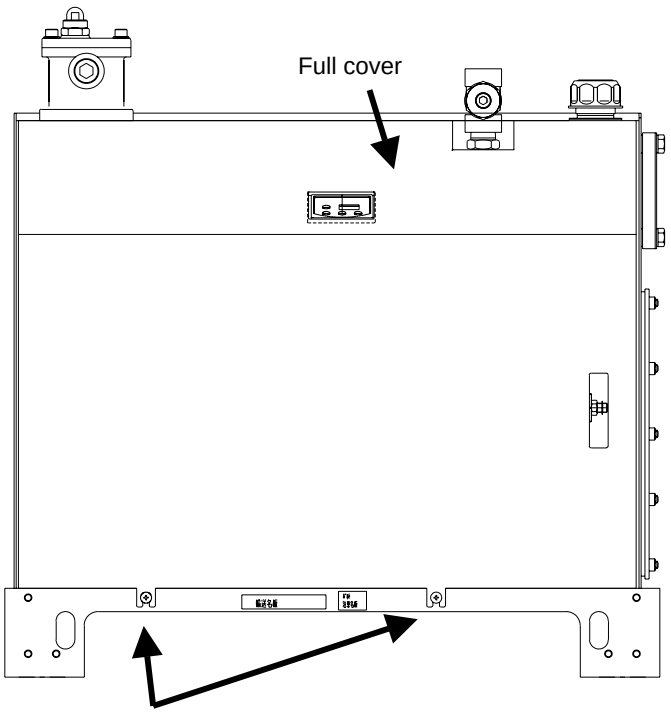
Tank capacity (L)	Oil level setting range	
	Yellow line (upper limit)	Red line (lower limit)
60	60 L	51 L
100	100 L	85 L

⚠ 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.

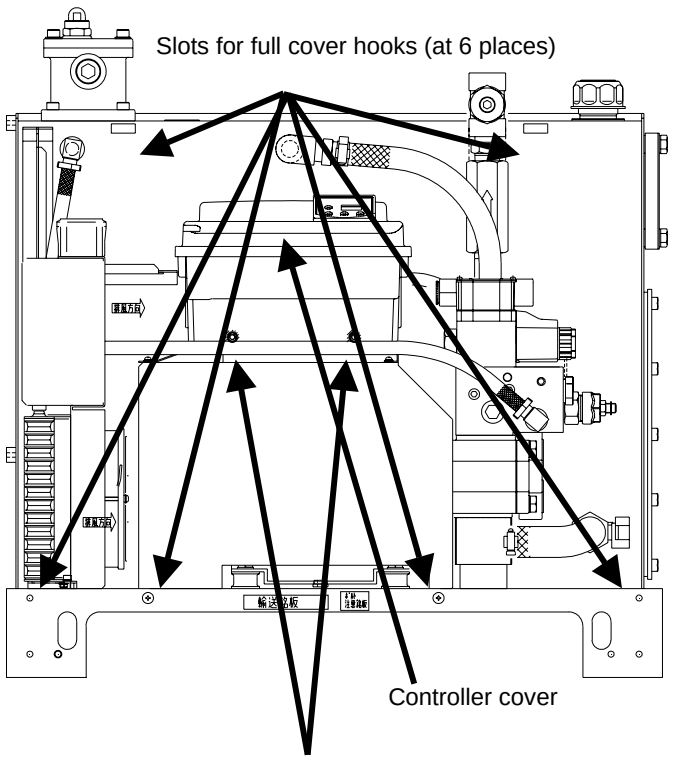
■ Electric wiring

To conduct electric wiring, remove the full cover and the controller.

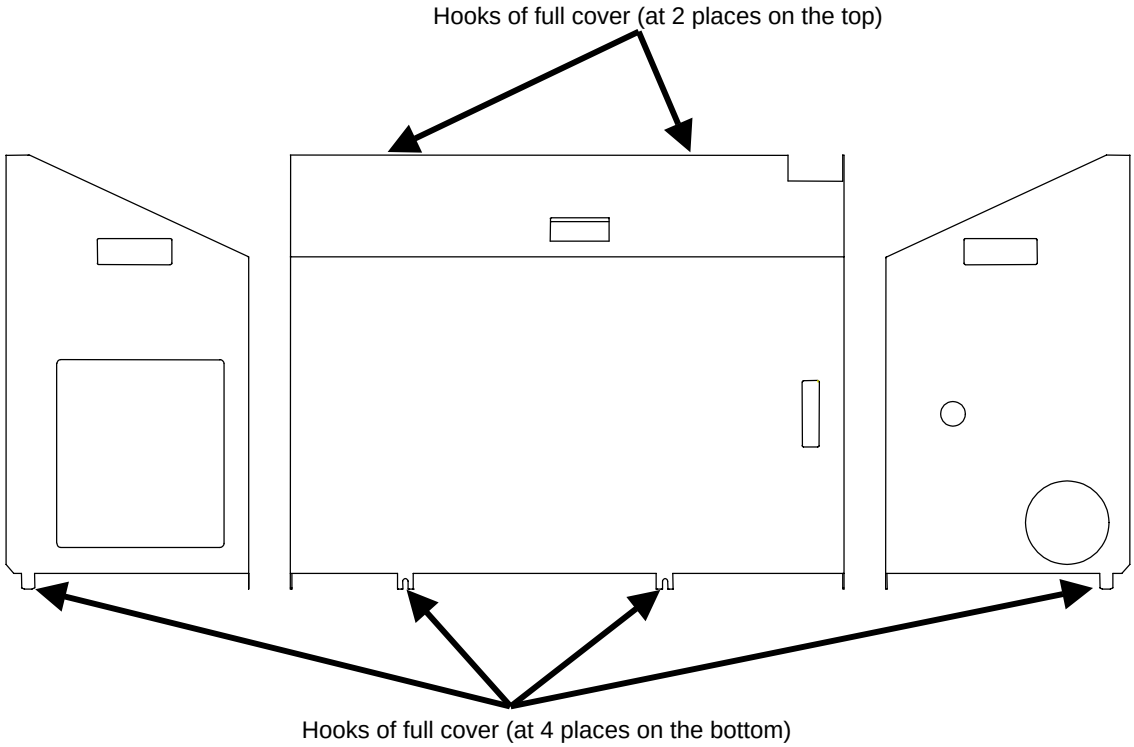
- To remove the full cover, loosen the cross-recessed truss head machine screws (at 2 places), and pull the full cover upward so as to release the hooks at the top and bottom of the full cover from the hook slots of the tank. Then, pull the cover forward to remove it.



<Unit front view>

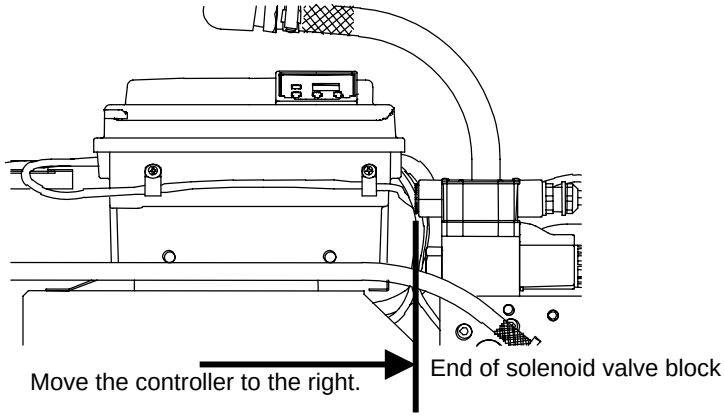


< When the full cover is removed >



- Loosen the hexagon socket head bolts that fasten the controller (at 2 places).
- Pull the controller straight upward, and move it from the front of the unit to the right, until the controller fin almost touches the end of the solenoid valve block.
  (This procedure applies to **SUT06D60L21 and SUT10D60L21** only.)

Note) • For **SUT06D40L16 or SUT10 D40L16**
Omit the above step, because you need not remove the controller.



⚠ CAUTION
[1] Before connecting the cable, you must remove the controller fastening bolts. Be careful not to drop the controller. [2] The controller has harnesses to which cables are already connected. Be careful not to disconnect other harnesses.

⚠ DANGER
• In order to protect the electric circuit against short-circuiting and over-current 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 capacity of each model, see the table below.) • The ground terminal is connected to the motor frame. 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 wiring. • Before wiring work, 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 specified power supply voltage to the hydraulic unit.

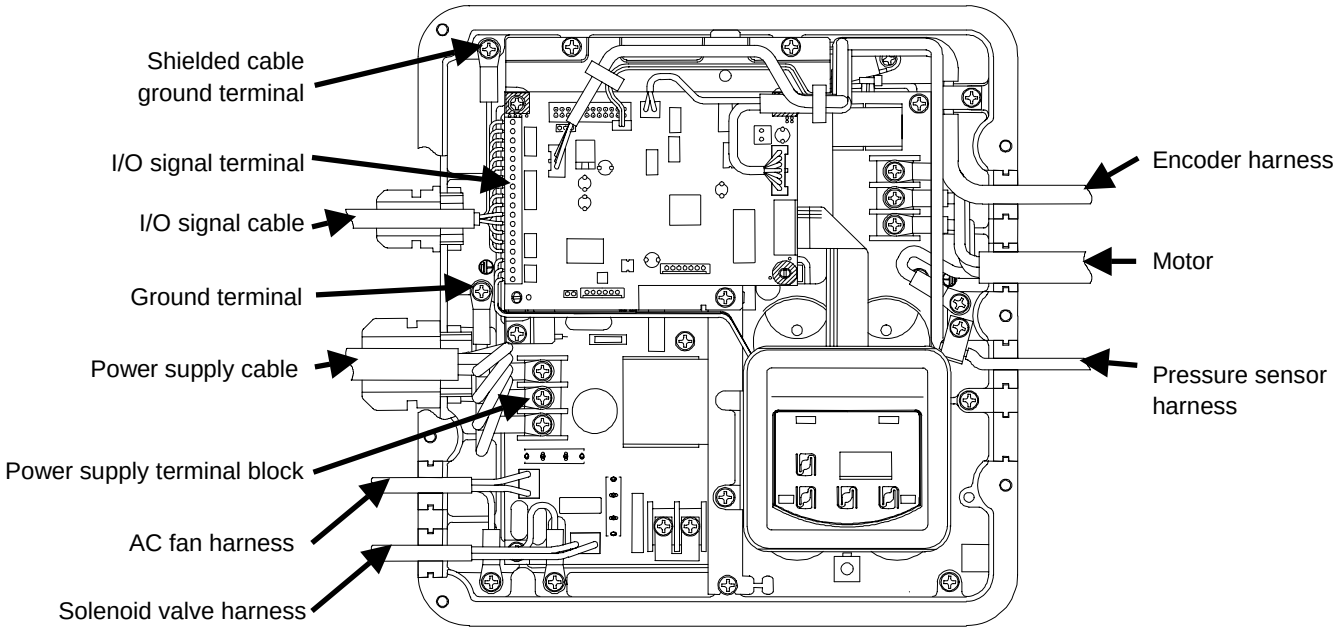
[Rated current and breaker setting for the models without code symbol "-F" (DCL: Not provided)]

Model	Power supply voltage and frequency			Breaker setting
	3ϕ, 200 V, 50 Hz	3ϕ, 200 V, 60 Hz	3ϕ, 220 V, 60 Hz	
SUT06D40L16/SUT10D40L16	19.2 A	19.2 A	17.8 A	30 A
SUT06D60L21/SUT10D60L21	24.2 A	24.2 A	22.2 A	50 A

Note) For cable connections and current ratings of the models indicated with code symbol "-F" (DCL: provided), refer to "Hydraulic Unit with Noise Filter Box" described in the Attachment.

♦ Wiring procedure

To connect the main power supply and I/O signal cables, remove the cover of the controller.
<Remove the controller cover by loosening the cross recessed head machine screws (**six M5** screws, Tightening torque: **0.9 N·m**).>

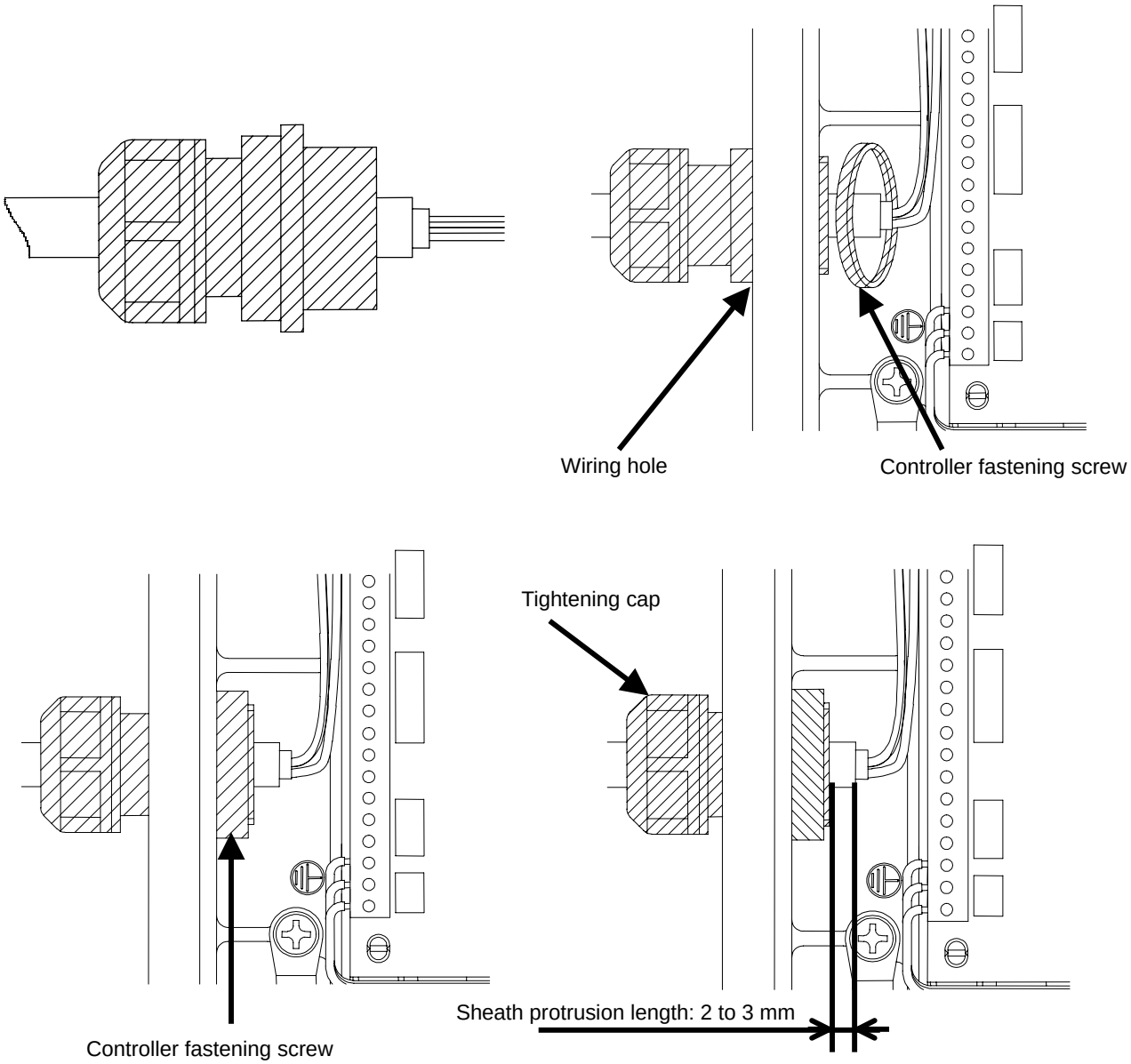


<When the unit controller cover is removed>

⚠ DANGER
[1] To access inside of the controller, follow the procedure described below. i) Turn OFF the hydraulic unit main power supply. (Turn OFF the power supply circuit breaker.) To prevent erroneous operation during wiring 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 connect cables 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. [2] Before turning ON the power supply to start operation, mount all controller covers.

<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.

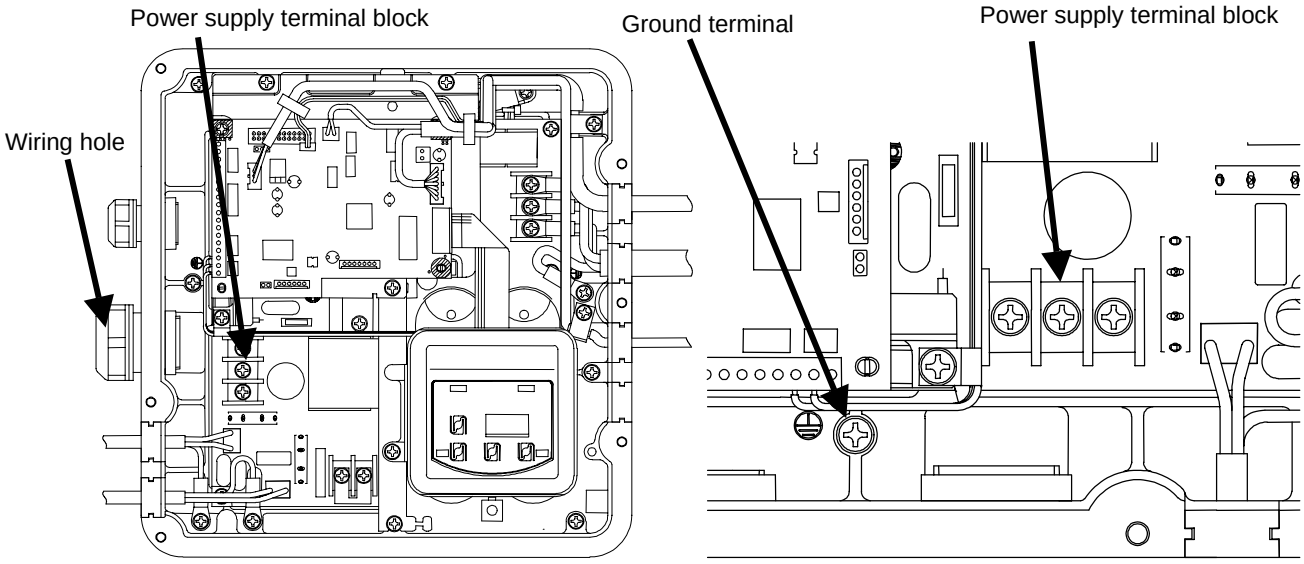


♦ Connecting the main power supply cable

(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: 27 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: **1.0 N·m**)



<When the unit controller small cover is removed> <Enlarged view of power supply terminal block>

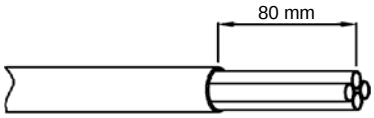
⚠ DANGER
• Use an AC power supply conforming to the power supply specifications of this product. • Use a power supply cable conforming to the power supply capacity. (See the table below.) • Do not connect the power supply cable to the ground terminal. • The ground terminal is connected with the motor 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.

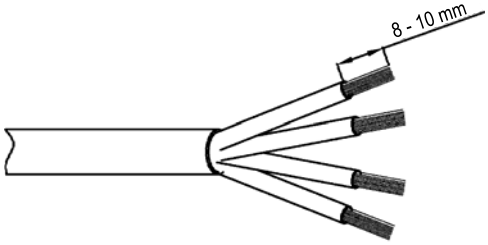
Model	Cable size	Recommended cable	Recommended crimp terminal	Recommended cable clamp
SUT06D40L16 SUT10D40L16	2.5 mm^2 or more (AWG14 or more)	CE362 2.5 mm^2 × 4 cores (manufactured by KURAMO)	RBV-2-4 (manufactured by NICHIFU)	manufactured by OHM ELECTRIC OA-W2216
SUT06D60L21 SUT10D60L21	5.5 mm^2 or more (AWG10 or more)	CE362 6.0 mm^2 × 4 cores (manufactured by KURAMO)	RBV-5.5-4 (manufactured by NICHIFU)	manufactured by OHM ELECTRIC OA-W2219

<Power supply cable connecting procedure>

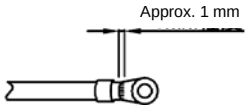
[1] Unsheathe the cable by approx. 80 mm.



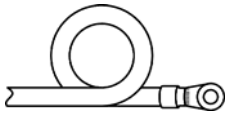
[2] Remove the inner sheath so that the core wires are exposed by 8 to 10 mm.

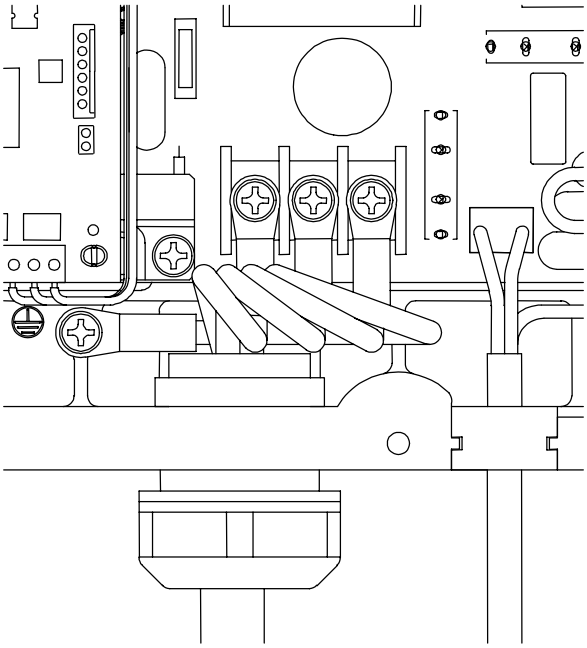


[3] As shown on the right, crimp the round crimp terminal with insulation sheath by using a dedicated tool.



[4] After looping each cable by one turn, connect it to the terminal block.



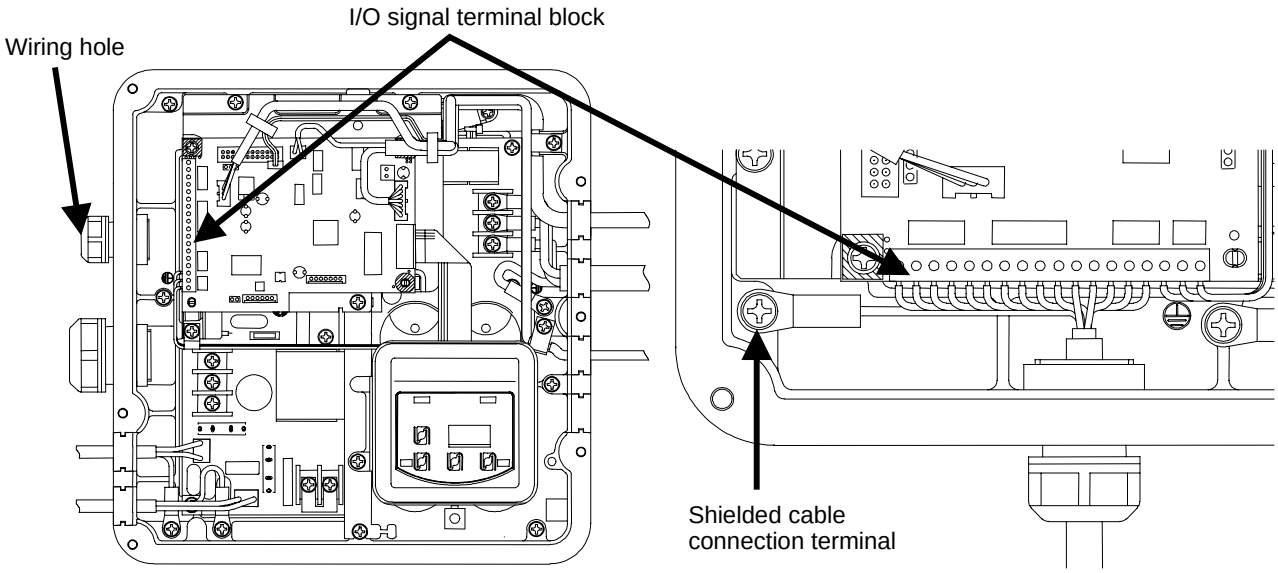


⚠ CAUTION
• If the crimp tool is not suitable for the crimp terminal, the cable will come off the terminal due to a crimp failure during operation. This results in short-circuiting or burnout of the circuit caused by abnormal heating.

♦ 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, whose protection rating should be **IP54 or higher level**. (Wiring hole diameter: 21 mm)

(2) Check the specifications of individual signal lines (see page 23), and connect the cable to the I/O signal terminal block.

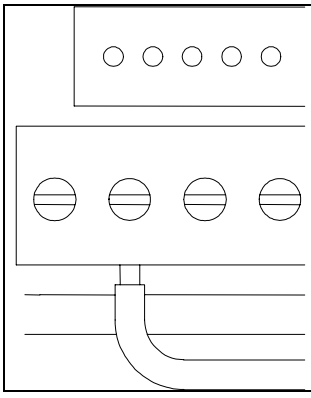


<When the unit controller cover is removed> <Enlarged view of I/O signal terminal block>

⚠ 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 page 23), 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.

Model	Cable size	Recommended cable	Recommended cable clamp
SUT06D40L16/SUT10D40L16	0.5 to 0.3 mm^2 (AWG20 to 22)	KCV-36SB 0.3 mm^2 (manufactured by KURAMO)	(manufactured by OHM ELECTRIC) OA-W1611 Applicable wire outer diameter: 9 to 11 mm
SUT06D60L21/SUT10D60L21			



[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.

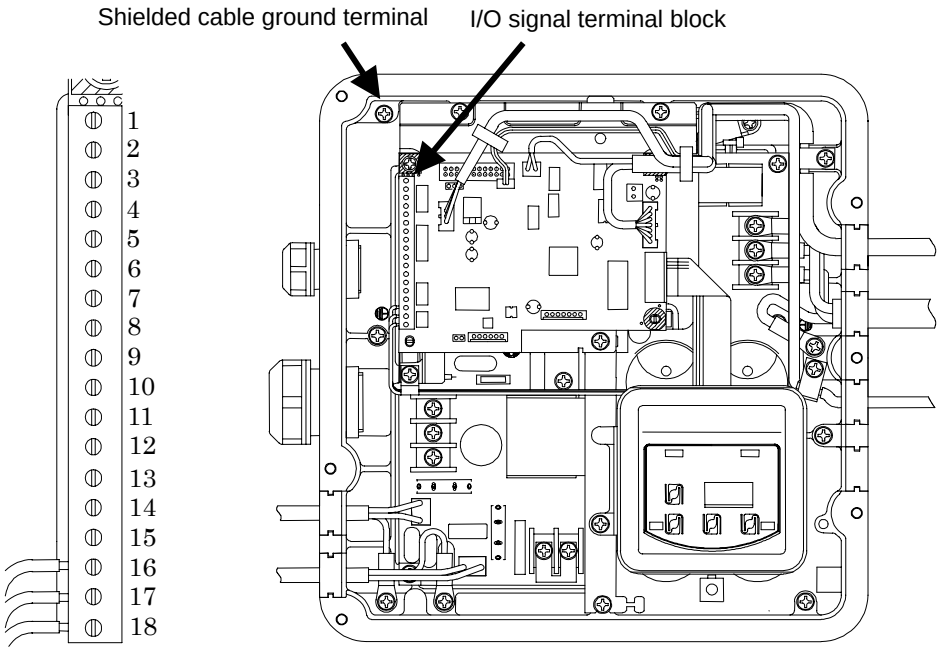
Unsheathed length of the cable: 6 mm

Procedure for connecting the cable to the terminal block

■ I/O signal cable specifications

Specifications of I/O signal terminals for interface with external equipment are shown in the table below.
For details of each signal line, see the following pages.

Terminal No.		Type	Function of terminal		Remarks
I/O signal terminal block	1	No connection			These terminals are not open to users. Do not use these terminals.
	2				
	3				
	4				
	5				
	6	Digital I/O terminal	Digital input common		Both positive and negative inputs are acceptable.
	7		Digital input 0		Used for start/stop control. With the start/stop signal switching parameter in the setting mode, the operation at signal input can be changed.
	8		Digital input 1	PQ0	P-Q selections (0 to 3) can be changed depending on combination of the input signals.
	9		Digital input 2	PQ1	
	10	Digital/contact output terminal	Digital output 0		See the table below. With the default setting, individual alarm output is selected.
	11		Digital output 1		
	12		Digital output common		
	13		Contract output a		
	14		Contract output b		
	15		Contract output common		
	16	No connection			These terminals are not open to users. Do not use these terminals.
	17				
	18				



<Enlarged view of I/O signal terminal block> <When the unit controller cover is removed>

♦ Digital input

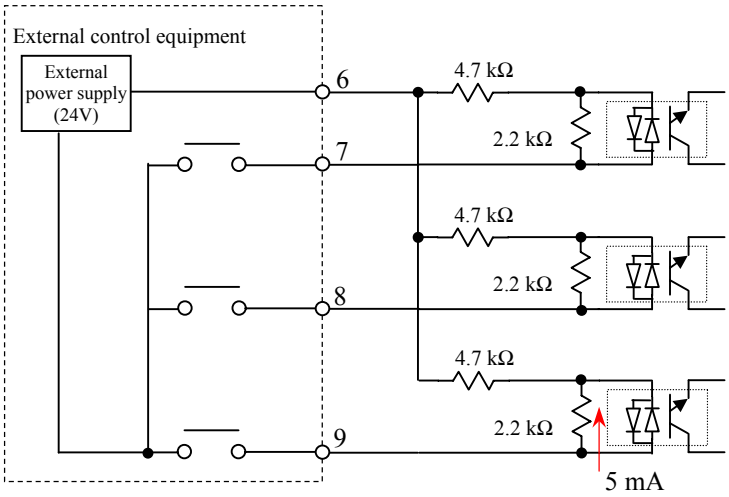
These terminals are used for sequence input signals that control the unit operations from external equipment.
Connect these terminals as required, with reference to the table below.

Terminal No. (Symbol of switchboard wiring diagram)	Signal name		Remarks
6 (COM)	Digital input common		Both positive and negative signals are acceptable.
7 (DIN0)	Digital input 0		Used for start/stop control. With the start/stop signal switching parameter (Setting mode: [P11]), you can change the operation at signal input. (See pages 34 and 35.)
8 (DIN1)	Digital input 1	PQ0	P-Q selection Nos. 0 to 3 can be selected depending on the combination of digital input status. (For P-Q selection setting, see pages 34 and 35.)
9 (DIN2)	Digital input 2	PQ1	

Note) While the unit is stopped by digital input, the panel shows “STP”.
Note) The time interval to restart the unit after the unit stop command should be at least 0.5 sec.

Combination of digital inputs for P-Q selection

P-Q selection No.	Digital input 1 PQ0	Digital input 2 PQ1
0	OFF	OFF
1	ON	OFF
2	OFF	ON
3	ON	ON



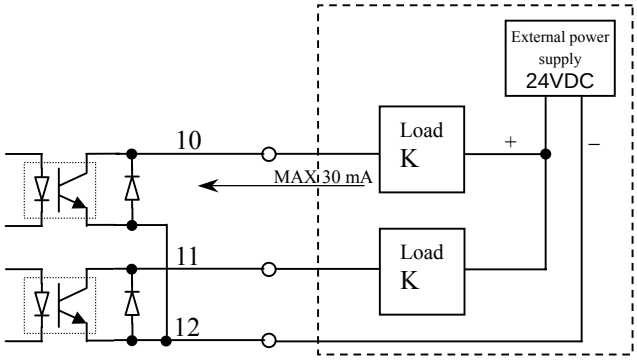
⚠ CAUTION

- For the external power supply, use a power supply with 24 VDC ± 1V, 0.5 A or higher capacity.
- Power cannot be supplied from this controller to external equipment.
- 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 page 38.

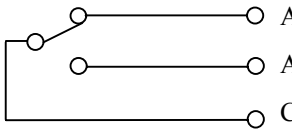
Terminal No. (Symbol of switchboard wiring diagram)	Signal name	Remarks
10 (DOUT0)	Digital output 0	Outputs the. Digital output 0
11 (DOUT1)	Digital output 1	Outputs the. Digital output 1
12 (COM1)	Digital output common	Negative common



⚠ CAUTION

- As the external power supply, prepare a 24 VDC ± 1V, 0.5 A power supply. Power cannot be supplied from this controller to external equipment.
- This controller's output circuit serves as negative 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. (Symbol of switchboard wiring diagram)	Signal name	Remarks
13 (ALMa)	Contact output a	Normally, connected with the common terminal.
14 (ALMb)	Contact output b	Connected with the common terminal when signal output.
15 (COM)	Contact output common	Negative common



Contact output a
Contact output b
Common

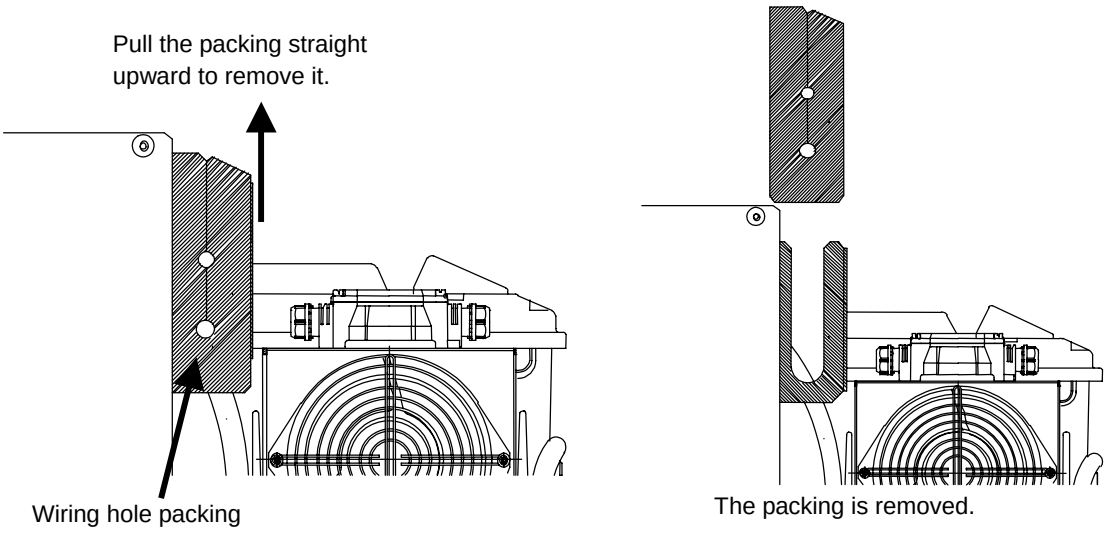
(Power ON: normal)

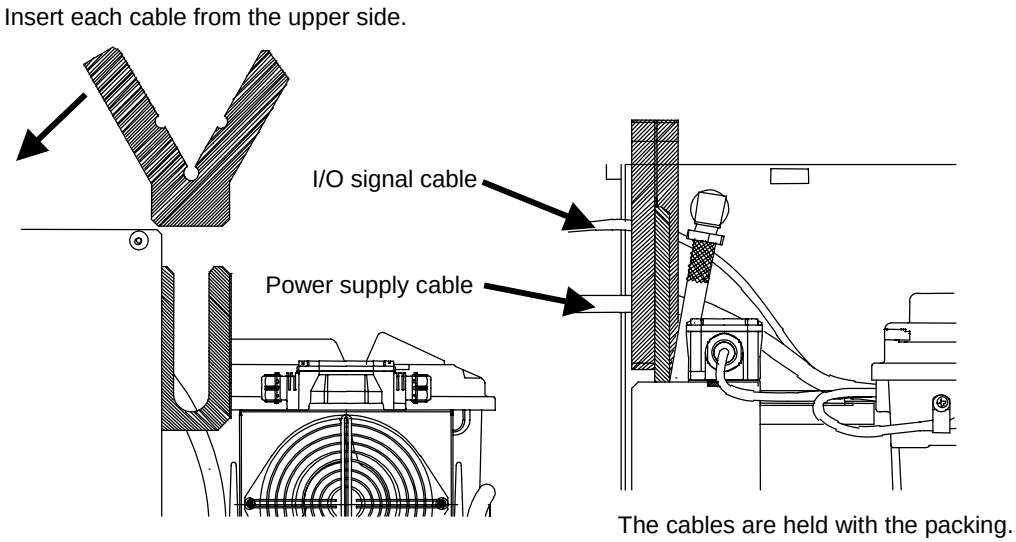
⚠ CAUTION

- 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 μA. 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.

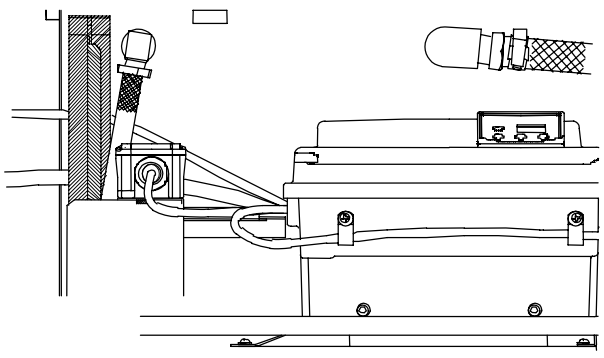
<How to use wiring hole packing>

- After connecting the power supply cable and the I/O signal cable, hold each cable with the wiring hole packing. Before shipment, the packing has been mounted to the metal stay. Pull the packing straight upward to remove it.
- The packing can be split, and each cable can be held in place between the split sections. Insert the power supply cable and the I/O signal cable between the split sections.



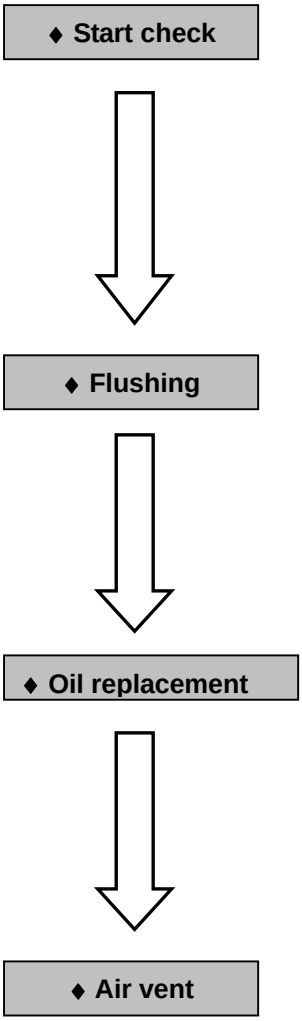


- After connecting the cables, re-mount the controller to the original position, and fasten it with hexagon socket head bolts.
- Re-mount the controller cover and the full cover securely to the original positions.



[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.)



- 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 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 dose 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.
- 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 return filter is clogged, replace the filter element, and fully drain the hydraulic oil from the tank via the oil drain port.
- 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: The return filter and element are subjected to modification. When you order a filter element for replacement, check the type of the return filter mounted to your unit.

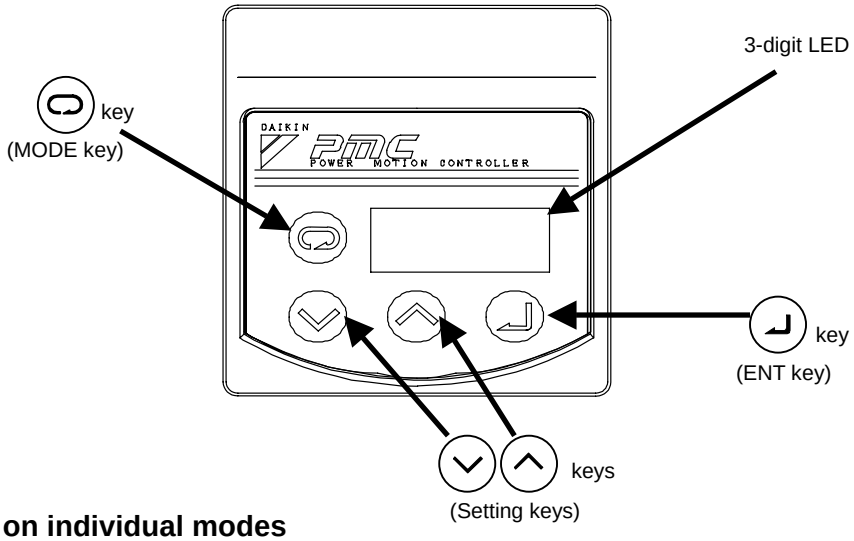
⚠ DANGER
• When evacuating air, high-pressure and high-temperature oil may spout out. Pay attention to oil splash.

[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.

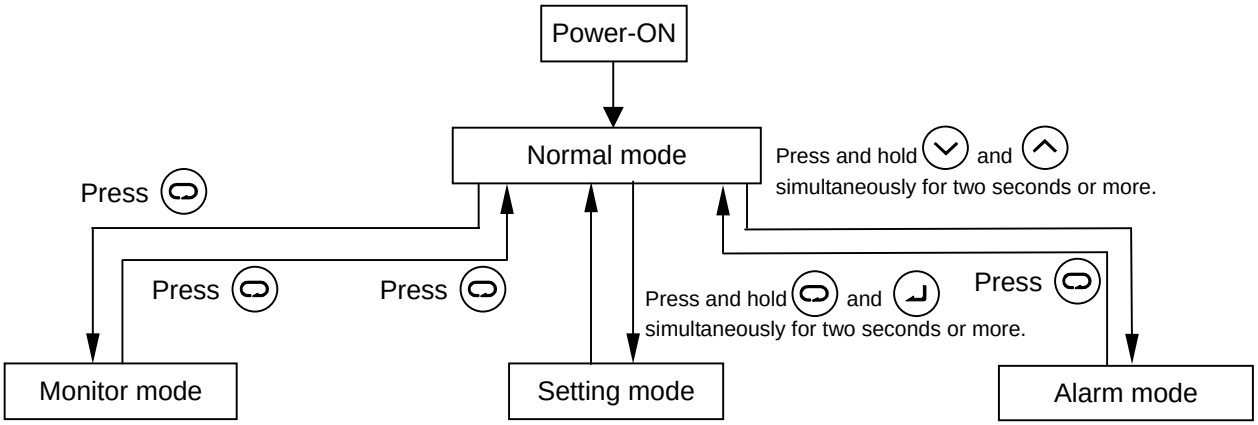


■ Description on individual modes

- 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.

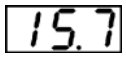
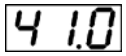
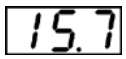
Parameter No.	Name	Description
n00	Pressure switch setting	(MPa) [When PSI unit is selected, × 10PSI] Displays a pressure switch setting.
n01[Note 1)]	Pressure setting	(MPa) [When PSI unit is selected, × 10PSI] Alternately displays the pressure settings of the high-pressure and low-pressure pumps for the current P-Q selection No.
n02	Flow rate setting	(L/min) Alternately displays the flow rate settings of the small-capacity and large-capacity pumps for the current P-Q selection No.
n03	Flow rate	(L/min) Displays the current flow rate.
n04[Note 2)]	Latest alarm code	Displays the latest alarm code.
n05	rpm	($\times 10\ min^{-1}$) 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.
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.

Note1) 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 discharge rate

Operating procedure	Key operation	3-digit LED	Remarks
• Power-ON ↓ (Startup, Run)			
• Actual pressure display			
• Shift to monitor mode			
			
• Parameter No. selection			Press the  key three times.
			Blinking
• Monitor display			
			Discharge rate (theoretical value) 41.0 L/min
• 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 pages 34 and 35.

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] Note that you cannot specify the following conditions with the pressure/flow rate settings ([P00] to [P03]):

a) If [PH*] is set to a value equal to, or lower than [PL*], the [PL*] setting will be automatically changed to a value equal to [PH*].

b) [PL*] cannot be set higher than [PH*].

c) If [qL*] is set to a value equal to, or lower than [qH*], the [qH*] setting will be automatically changed to a value equal to [qL*].

d) [qH*] cannot be set higher than [qL*].

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

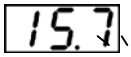
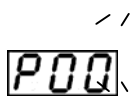
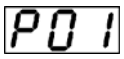
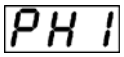
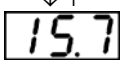
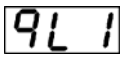
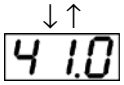
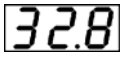
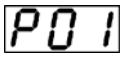
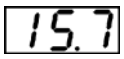
Example) If you change [PH0] to “5.5 MPa” with [PL0] set at “6.0 MPa”, the [PL0] setting will be automatically changed to “5.5 MPa”.

- Flow rate setting changing procedure

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

  <Example> Changing low-pressure pump flow rate for P-Q selection 1, from “41.0 L/min” to “32.8 L/min”

If you do not change the P-Q selection No., select “P00” without changing the item No., and set “0” for P-Q selection.

Operating procedure	Key operation	3-digit LED	Remarks
• Power-ON ↓ • Actual pressure display			
• Setting mode ↓	Press and hold two keys simultaneously for two seconds or more.		After two seconds
• Parameter No. selection ↓	or		
• Set value display ↓			P-Q selection 1[Note 1]
		 ↓↑ 	Displays a pressure setting of the high-pressure pump for P-Q selection 1
• P-Q selection ↓	Press three times. “PH1”, “qH1”, “PL1” and “qL1” are alternately displayed in this order.	 ↓↑ 	Displays a flow rate setting of the low-pressure pump for P-Q selection 1
• Changing set value ↓	or		
• Writing set value ↓			After writing of the low-pressure pump flow rate setting, the current item No. is displayed.
• Return to actual pressure display mode			

CAUTION: Since the flow rate setting is indicated in steps of “theoretical displacement volume of the pump × 100 min^{-1}”, the set value is not an integer. The follow rate is indicated by rounding down the second decimal place after calculation.

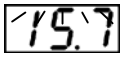
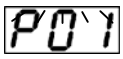
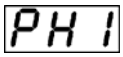
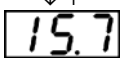
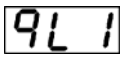
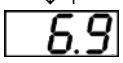
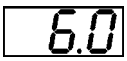
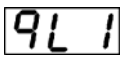
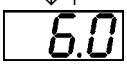
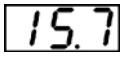
Model	Theoretical pump displacement volume (cc/rev)	
	Pump displacement volume at low pressure	Pump displacement volume at high pressure
SUT06D40L16/SUT10D40L16	9.13	3.56
SUT06D60L21/SUT10D60L21	14.55	5.05

- Pressure setting changing procedure

  An example of pressure setting changing operation is shown below.

  <Example> Changing low-pressure pump flow rate for P-Q selection 1, from “6.9 MPa” to “6.0 MPa”

If you do not change the P-Q selection No., select “P00” without changing the item No., and set “0” for P-Q selection.

Operating procedure	Key operation	3-digit LED	Remarks
• Power-ON ↓			
• Actual pressure display			
• Setting mode ↓	Press and hold two keys simultaneously for two seconds or more.	 	After two seconds
• Parameter No. selection ↓	or	 	P-Q selection 1
• Set value display ↓		 ↓↑ 	Displays a pressure setting of the high-pressure pump for P-Q selection 1
• P-Q selection ↓	Press twice. “PH1”, “qH1”, “PL1” and “qL1” are alternately displayed in this order.	 ↓↑ 	Displays a pressure setting of the low-pressure pump for P-Q selection 1.
• Changing set value ↓	or		
• Writing set value ↓		 ↓↑ 	After writing of the low-pressure pump pressure setting, a flow rate setting of the low-pressure pump is displayed.
• Return to actual pressure display mode			

- Setting range

Item	Name		Default setting	Operating range	Unit	Description
P00 to P03	Pressure/flow rate for P-Q selection 0 to 3					
	SUT06 D40L16	Pressure of high-pressure pump (PH)	3.5	1.5 to 15.7	MPa	This mode is used to set pressure, flow rate, acceleration time and deceleration time for each P-Q selection No. Please set a theoretical value for flow rate. Set the following items in sequence: PH <Pressure setting of high-pressure pump (single operation)> qH <Flow rate setting of high-pressure pump (single operation)*> PL <Pressure setting of low-pressure pump (combined operation)> qL <Flow rate setting of low-pressure pump (combined operation)*> * The flow rate is a theoretical value.
			50	22 to 227	×10PSI	
		Flow rate of high-pressure pump (qH)	5.3	2.1 to 16.0	L/min	
		Pressure of low-pressure pump (PL)	3.5	1.5 to 7.0	MPa	
			50	22 to 101	×10PSI	
		Flow rate of low-pressure pump (qL)	41	5.4 to 41.0	L/min	
	SUT06 D60L21	Pressure of high-pressure pump (PH)	3.5	1.5 to 20.6	MPa	
			50	22 to 298	×10PSI	
		Flow rate of high-pressure pump (qH)	10.1	3.0 to 21.2	L/min	
		Pressure of low-pressure pump (PL)	3.5	1.5 to 7.0	MPa	
			50	22 to 101	×10PSI	
		Flow rate of low-pressure pump (qL)	61.1	8.7 to 61.1	L/min	
P04	Pressure increasing time after P-Q selection change		0.1	0.01 to 99.99	sec/MPa	Specify a pressure increasing time, if the pressure setting must be increased after P-Q selection change.
P05	Pressure decreasing time after P-Q selection change		0.1	0.01 to 99.99	sec/MPa	Specify a pressure decreasing time, if the pressure setting must be reduced after P-Q selection change. (Unit: sec./MPa)
P06	Speed increasing time after P-Q selection change		0.1	0.01 to 99.99	sec/1000min-1	Specify a speed increasing time, if the flow rate setting must be increased after P-Q selection change.
P07	Speed decreasing time after P-Q selection change		0.1	0.01 to 99.99	sec/1000min-1	Specify a speed decreasing time, if the flow rate setting must be reduced after P-Q selection change.
P08	Pressure switch display hold		0	0: Disabled 1: Display hold 2: Display and memory	-	Specify the function to indicate that the pressure switch is activated.
P09	Pressure unit selection		0	0: MPa display 1: PSI display	-	Select the unit of normal pressure indication: “MPa” or “x10 PSI”.
P10	Thermistor alarm output enabled		1	0: Disables alarm display. 1: Enables alarm display.	-	Specify the function to output motor and controller temperature alarms.
P11	Start/stop signal switching		1	0: Starts when the signal turns ON. 1: Stops when the signal turns ON.	-	Specify whether to start or stop operation at the signal input.
P12	Pressure switch		0	0 to 35.0 (0: Disabled)	MPa	Specify whether to enable or disable the pressure switch function, and the pressure that activates the pressure switch.
				0 to 507 (0: Disabled)	×10PSI	
				0 to 150 (0: Disabled)	%	
P13	Pressure switch output delay time		0	0.00 to 9.99	sec	Specify a delay time before output of the pressure switch turns ON after the pressure lowers to the pressure switch activation level.
P14	Response gain		30	10 to 999	-	Adjust the control response value. (Setting a smaller value increases the response speed.)
P15	Regenerative load command ratio		50	30 to 100	%	If the regenerative load becomes too large at normal pressure response (FF → DH), adjust this parameter.

Item	Name	Default setting	Operating range	Unit	Description
P16	HIGH/LOW switching response time	0.2	0.05 to 1.00	sec	If an operation point is close to the switching point of the high-pressure – low-pressure switching solenoid valve and it causes unstable switching operation, adjust the shortest time for switching the solenoid valve.
P17	Single operation switching rpm dead zone	400	0 to 999	min-1	If an operation point is close to the switching point of the high-pressure – low-pressure switching solenoid valve and it causes unstable switching operation, adjust the dead zone of the actual switching rpm.
P18	Alarm output combination setting	1	0: Individual output 1: Integrated output 2: Expansion of pressure switch function(See the Attachment.)	-	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.
P19	Reset to factory-settings	0	0: Retains current settings. 1: Reset to factory-settings	-	If the power supply is turned OFF and then turned ON again, the parameter settings will be reset to the factory-set conditions.
P20 to P30	Not used	-	-	-	These parameters are not used, and have no influence on operation. However, do not change the current settings.
P31	Pressure sensor rated value	35	1 to 35	MPa	Specify the rated pressure detectable with the pressure sensor.
P32	Motor startup time	0.5	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	0.5	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	0.5	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 settings of [P14] through [P17] need not be changed. However, under a special circuit condition (large load volume etc.), you must change the current settings.
- This hydraulic unit can accept four patterns (P-Q selections 0 to 3). However, if you intend to use only one pattern, select P-Q 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.

*** [P18] 2: Expansion of pressure switch function**

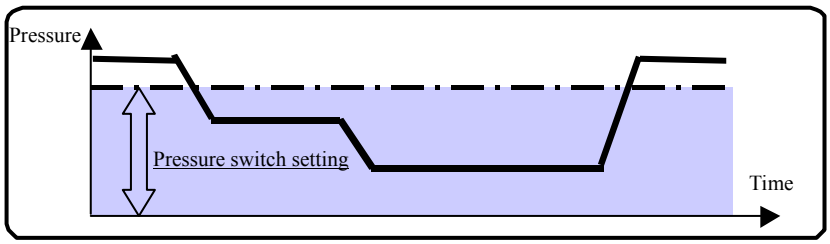
Expansion of pressure switch function is enabled when the [P18] (alarm output combination setting) parameter in the setting mode is set to "2".

Normally, the [P12] (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.

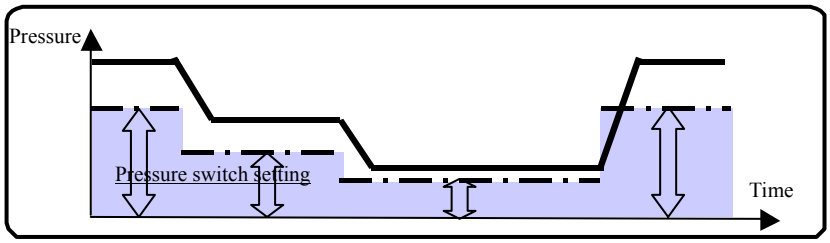
On the other hand, the "expansion of pressure switch function" parameter specifies a ratio to the pressure setting for each P-Q selection. Therefore, the pressure that activates the pressure switch varies depending on the pressure setting for the P-Q selection. The setting range is 0 to 150 [%].

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

P18 = 0 (Individual alarm output), or
P18 = 1 (Integrated alarm output)



P18 = 2 (Expansion of pressure switch function)



*** [P39] Digital output selection**

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

[P18] setting	[P39] setting	Digital output 0	Digital output 1	Contact output
0 or 2	0	warning output	Pressure switch output	Alarm output
	1	Motor operation output		
	2	High-pressure pump operation output		
1	0	Completion output	No output	Pressure switch output or Alarm output or warning output
	1	Motor operation output		
	2	High-pressure pump operation 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 (E01: IPM alarm) of an alarm before the latest one (A01)

Operating procedure	Key operation	3-digit LED	Remarks
• Power-ON ↓ • Actual pressure display		15.7	
• Alarm mode ↓	Press and hold two keys simultaneously for two seconds or more.	A00 After two seconds (Displays the latest alarm)	After two seconds
• Selecting alarm No. ↓	Press ^ once.	A01 Displays an alarm before the latest one	
• Displays alarm condition ↓	↵	E10 ↓↑ 210	Alarm code and power-ON count are alternately displayed at a second interval.
• Return to actual pressure display mode	↩	15.7	

■ 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] [4]	Warning No. and actual pressure value are alternately displayed.	Operation continued	
Normal operation	[5]	Warning No. display		

♦ Alarm codes and classification table

(Individual alarm output: When the "P18" alarm output combination setting is "0")
(Integrated alarm output: When the "P18" alarm output combination setting 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		Warning	Pressure switch	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 overload	E14	×	○	○	—	×	○
	Undervoltage	E15	×	○	○	—	×	○
	Overvoltage	E16	×	○	○	—	×	○
	Motor electronic thermal error	E17	×	○	○	—	×	○
	Magnetic pole detection error	E18	×	○	○	—	×	○
	Encoder cable break	E20	×	○	○	—	×	○
	Motor cable break	E21	×	○	○	—	×	○
	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	×	○	○	×	×	○
[3]	Motor temperature abnormal warning	L44	○	×	×	○	×	○
	Fin temperature abnormal warning	L45	○	×	×	○	×	○
	Pressure deviation abnormal warning	L60	○	×	×	○	×	○
[4]	Pressure drop	L62	○	×	×	×	×	○
[5]	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 [5]) is displayed only with the a) or b) setting below:

a) When the pressure switch display hold setting (Setting mode [P08]) is "1" or "2.

b) When the pressure switch setting [P12] is enabled (When any number other than "0" is entered)

When the pressure switch display hold setting [P08] is "1" or "2", the display hold status cannot be reset until the (↵) key is pressed.

When the pressure switch display hold setting [P08] is "2", the alarm is stored in the alarm record if the pressure falls below the value of the pressure switch setting [P12].

* For the timing chart, see "Power-ON and External I/O Signal Timing Chart" in the Attachment.

♦ Causes of alarms and corrective actions

Category	Alarm condition	Indication	Cause of alarm output	Corrective action
[1]	Output device error	E10	The power device self-protecting function is activated.	Turn OFF the power supply once, and then turn it ON again.
	Instantaneous overcurrent	E11	Detection of instantaneous overcurrent in the current control unit	Turn OFF the power supply once, and then turn it ON again.
	Overspeed	E12	The motor rotation speed exceeded the allowable speed. (Including reverse rotation)	Make sure that there is no problem in the hydraulic circuit.
	Regenerative brake overload	E14	The alarm is output when regenerative overload occurs due to regenerative current of the motor.	Check the regenerative load integration ratio [n08] in the monitor mode, and reduce the load condition in the process with an increased integration ratio.
	Undervoltage	E15	The main circuit voltage has dropped below 190 VDC (134 VAC).	Check the power supply voltage.
	Overvoltage	E16	The main circuit voltage has exceeded 400 VDC.	Check the power supply voltage.
	Motor electronic thermal error	E17	Detection of overload in current output status (for 60 seconds at 110%)	The motor output is higher than the normal level.
	Magnetic pole detection error	E18	Motor initial position detection error	The motor output is higher than the normal level.
	Encoder cable break	E20	The alarm is output during encoder cable disconnection.	Parts replacement may be required.
	Motor cable break	E21	The alarm is output during motor cable disconnection.	
	Pressure sensor error	E30	The alarm is output when the pressure sensor feedback value is invalid.	
	Motor start error	E31	The alarm is output when the actual rotation polarity is different from the command polarity.	
	Motor thermistor cable break	E40	The alarm is output when motor thermistor cable disconnection is detected.	Parts replacement may be required.
	Motor temperature abnormal rise	E41	Forced to stop when the motor thermistor temperature reaches the specified temperature (85°C) in the condition specified in “L44”.	The heat radiation capacity and cooling capacity of the motor may be lowered. Conduct maintenance.
	Radiator fin thermistor cable break	E42	The alarm is output when fin thermistor cable disconnection is detected.	Parts replacement may be required.
	Fin temperature abnormal rise	E43	Forced to stop when the motor thermistor temperature reaches the specified temperature (80°C) in the condition specified in “L45”.	The heat radiation capacity and cooling capacity of the controller may be lowered. Conduct maintenance.
	Drying operation error	E64	The alarm is output when the pressure does not increase even if the motor rpm is increased.	The stop valve is closed, or the oil level in the tank is low. Check the stop valve opening and the oil level.
	CPU runaway (watchdog)	E91	The alarm is output when the CPU is out of control.	
[2]	EEPROM data error (1)	E93	The alarm is output when EEPROM data is invalid.	
	EEPROM data error (2)	E94	The alarm is output when EEPROM data is invalid.	
[3]	Motor temperature abnormal warning	L44	The alarm is output when the motor thermistor temperature exceeds the threshold level (83°C).	The heat radiation capacity and cooling capacity of the motor may be lowered. Conduct maintenance.
	Fin temperature abnormal warning	L45	The alarm is output when the fin thermistor temperature exceeds the threshold level (78°C).	The heat radiation capacity and cooling capacity of the controller may be lowered. Conduct maintenance.
	Pressure deviation abnormal warning	L60	The alarm is output when the command signal remains ON for 5 seconds or longer.	The motor output is higher than the normal level.
[4]	Pressure drop	L62	The alarm is output when the pressure switch output remains ON continuously for 30 seconds.	
[5]	Pressure switch activation	L63	The alarm is displayed when the pressure switch is activated. (Selectable with 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
● Oil tank • Oil level check	Daily, Occasionally	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.
• Oil temperature check	Daily, Occasionally	Make sure that the oil temperature is 60°C or less. (Normally, use the oil at 15 to 50°C.)
• Oil color check	Semiannually	Deterioration of hydraulic oil can be checked by color. If the hydraulic oil turns brownish (ASTM L4 level: bright yellow), replace it.
● Return filter	Daily, Occasionally	Monitor the indicator to check the filter for clogging. If the filter is clogged, replace the filter element.
● Oil cooler • AC fan rotation	Daily, Occasionally	Make sure that the AC fan is rotating.
• Clogging of the core	Daily, Occasionally	Visually check the core for clogging. If the AC fan rotation is stopped, or the core is clogged, [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. The AC fan serves to cool the motor and the controller, as well as hydraulic oil.
● Pressure display • Operation check	Daily, Occasionally	Check if the indicated value changes according to load condition changes.
• Pressure display check	Daily, Occasionally	Make sure that the pressure display for D.H. conforms to the preset value.
● Sound and vibration	Daily, Occasionally	Check for abnormal sound and vibration.
● Electric wiring	Semiannually	[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.
● Hose	Yearly	Check the hose for cracks, fracture or flaws.
● 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 • Oil replacement	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 pages 42–46.
● Oil filling port (Air breather)	Yearly	Disassemble and clean the oil filling port (air breather) according to "Maintenance Procedure" on page 47.
● Suction strainer	Yearly	Disassemble and clean the suction strainer according to "Maintenance Procedure" on page 47.
● Return filter	If the indicator shows that the filter is clogged, replace the filter element.	

⚠ 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.

[4] When touching inside of the noise filter box, observe the following procedure in order to prevent an electric shock:

i) Turn OFF the main power supply for the hydraulic unit.
(Turn OFF the power supply circuit breaker for the power supply circuit.)
Put a sign to indicate "DO NOT OPERATE (DURING WORK)" on the power supply circuit breaker, to prevent erroneous operation during work.

ii) After elapse of at least 5 minutes, remove the cover of the noise filter box.
A large-capacitance capacitor is provided in the noise filter box. If you access the noise filter box with the capacitor being charged with electricity, you may get an electric shock. Be sure to leave the unit for 5 minutes or longer (to discharge electricity from the capacitor) before removing the noise filter box cover.

[5] To operate the unit, re-mount all covers to the noise filter box before turning ON the power supply.

■ Oil cooler maintenance procedure (For SUT06D40L16 or SUT10D40L16)

⚠ 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.

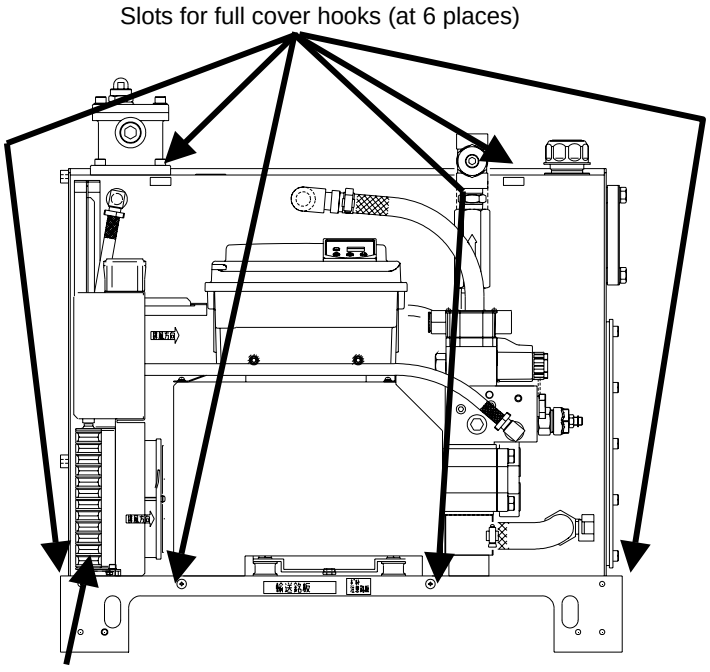
⚠ CAUTION
[1] Be careful that strong force will not be applied to the AC fan power supply cable and connector during work. [2] During disassembly process, oil will flow out of the pipes and oil cooler.

1. Dismounting the oil cooler
   [1] Loosen the cross-recessed truss head machine screws (M5 × L14, 2 pieces) of the full cover, and remove the full cover.
   - The full cover has been fastened to the unit body with hooks (at 6 places in total: 2 places at the front, 1 place on each side, and 2 places at the top of the unit). Lift the cover vertically relative to the unit.

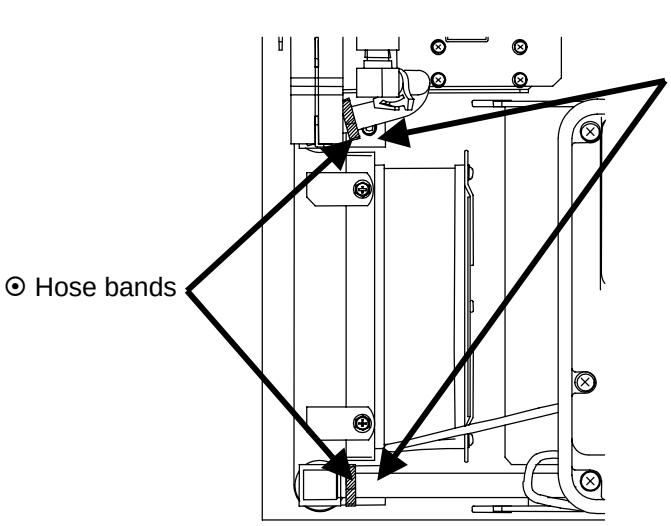
   [2] Open the controller cover, and disconnect the fan connector and fan ground cable. (Refer to pages 18 and 44.)

   [3] 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.

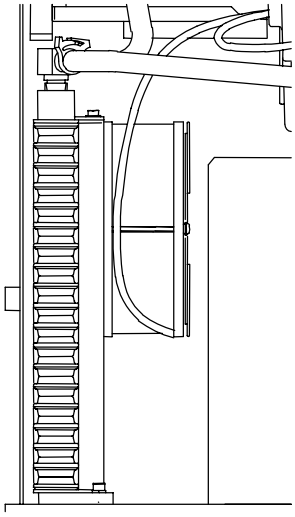
   [4] Remove the hexagon socket head bolts (M5 × L16: 2 pieces) with washers, and dismount the oil cooler.



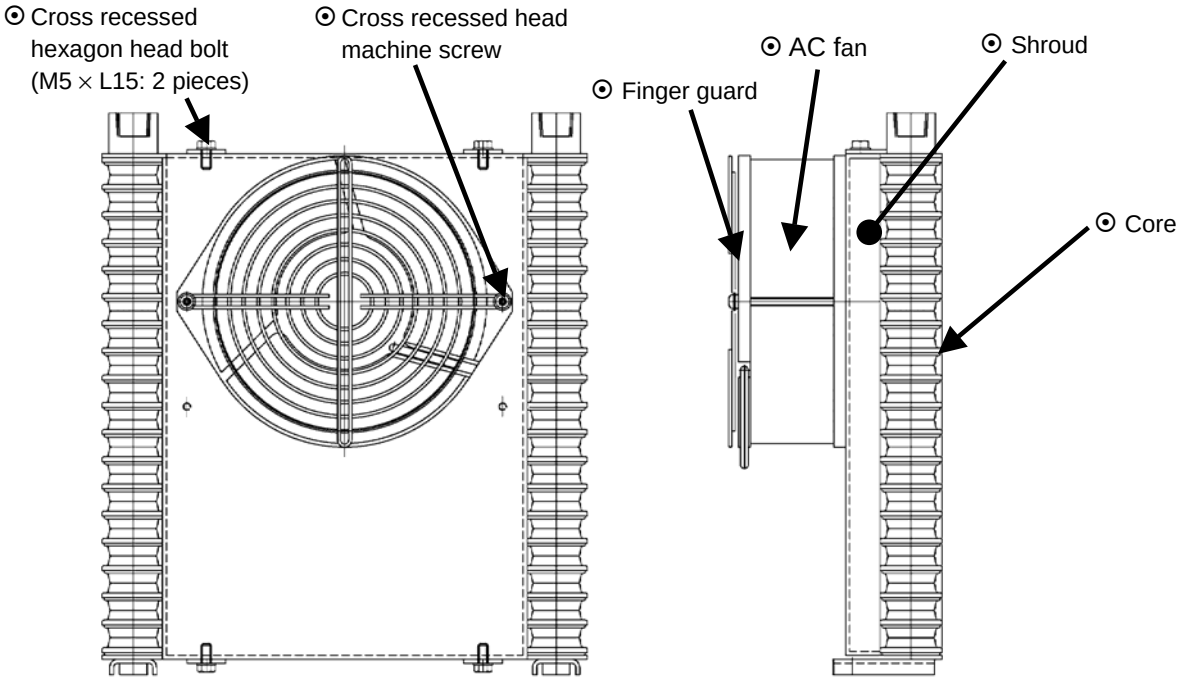
<When the full cover is removed>



<Unit top view>


<Unit side view>

2. Disassembling the oil cooler (For **SUT06D40L16 or SUT10D40L16**)
   [1] Remove the cross recessed hexagon head bolts (**M5 × L12: 4 pieces**), and separate the shroud from the core.
   [2] Remove the cross recessed head machine screws (**M4 × L70: 2 pieces**), and separate the AC fan and finger guard from the shroud.



<Oil cooler (for SUT06D40L16 or SUT10D40L16)>

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 fan motor
   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 page 27 to make sure that the hydraulic unit normally operates.
   Check if the oil cooler air intake/exhaust direction is correct. (See page 14)

■ Oil cooler maintenance procedure (For SUT06D60L21 or SUT10D60L21)

⚠ 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.

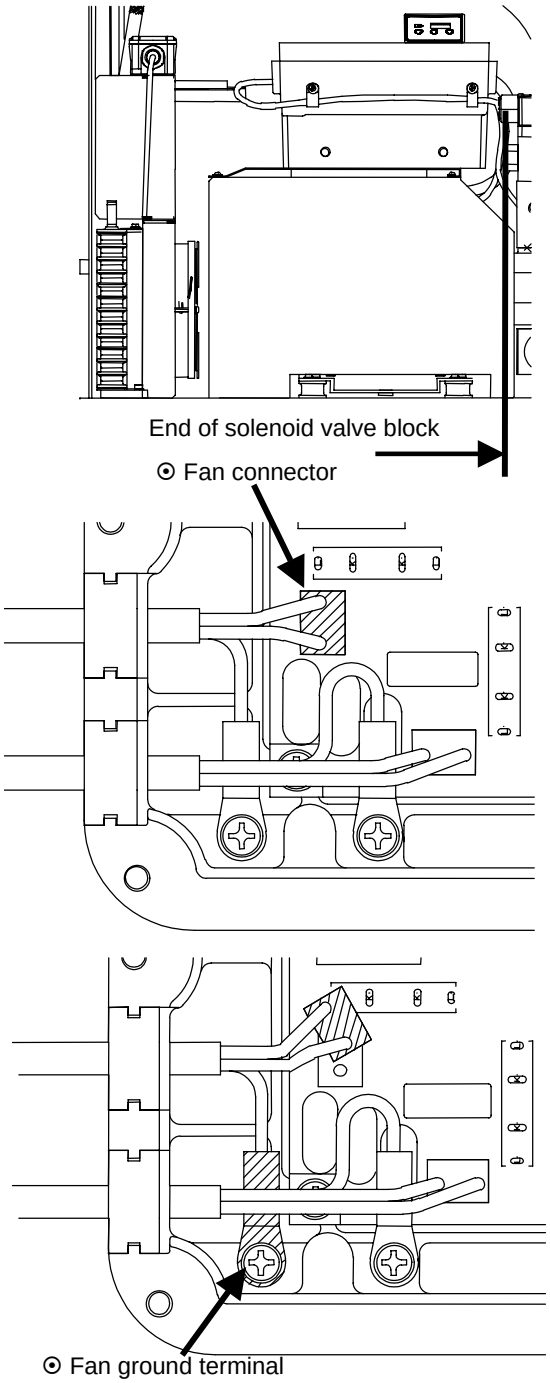
1. Dismounting the oil cooler
   [1] Remove the full cover according to the same procedure for SUT06D40L16 or SUT10D40L16. (Refer to page 42.)

   [2] Loosen the hexagon socket head bolts that fasten the controller (at 2 places). Pull the controller straight upward, and move the controller from the front of the unit to the right, until the controller fin almost touches the end of the solenoid valve block.

   [3] Open the controller cover, and disconnect the fan connector and fan ground cable.

   [4] 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.

   [5] Remove the hexagon socket head bolts (M5 × L16: 2 pieces) with washers, and dismount the oil cooler. (The bolt positions are the same as those of SUT06D40L16 or SUT10D40L16.)



<When the controller cover is removed>

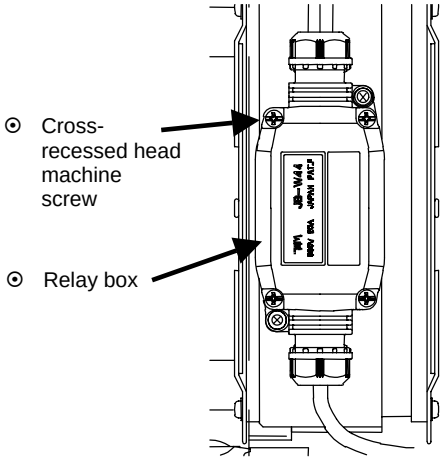
2. Disassembling the oil cooler (for SUT06D60L21 or SUT10D60L21)

[1] Remove the relay box from the AC fan bracket.

[2] Remove the cross-recessed head machine screws (M4 × L70, 2 pieces) from the lower fan of the oil cooler, and separate the AC fan and the finger guard from the oil cooler.

[3] Remove the cross-recessed hexagon socket head bolts (M5 × L12, 4 pieces), and separate the core from the shroud.

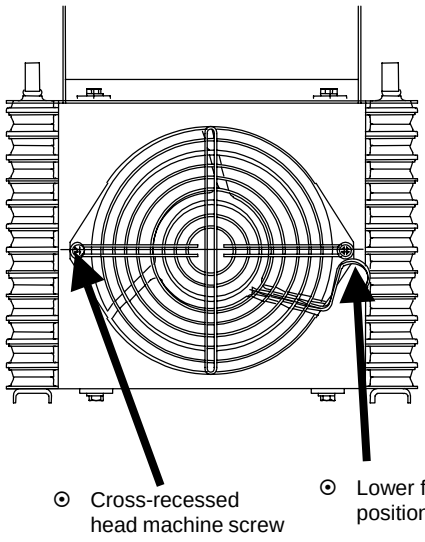
[4] Remove the cross-recessed head machine screws (M4 × L70, 2 pieces) from the upper fan, and remove the fan from the AC fan bracket.



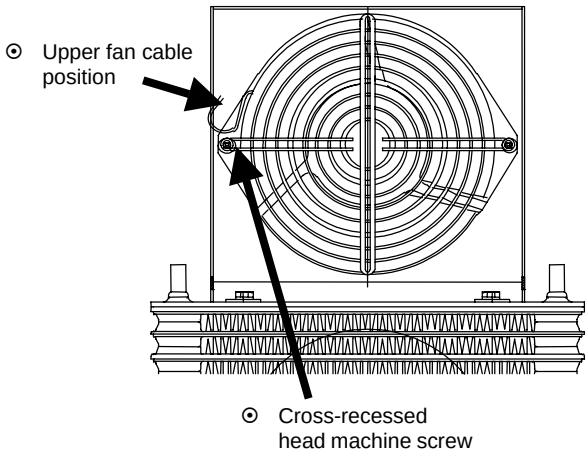
Notes) • The finger guard has the front and back faces. The projection is the front face. When re-mounting the finger guard, place the projection of the finger guard at the front of the fan.

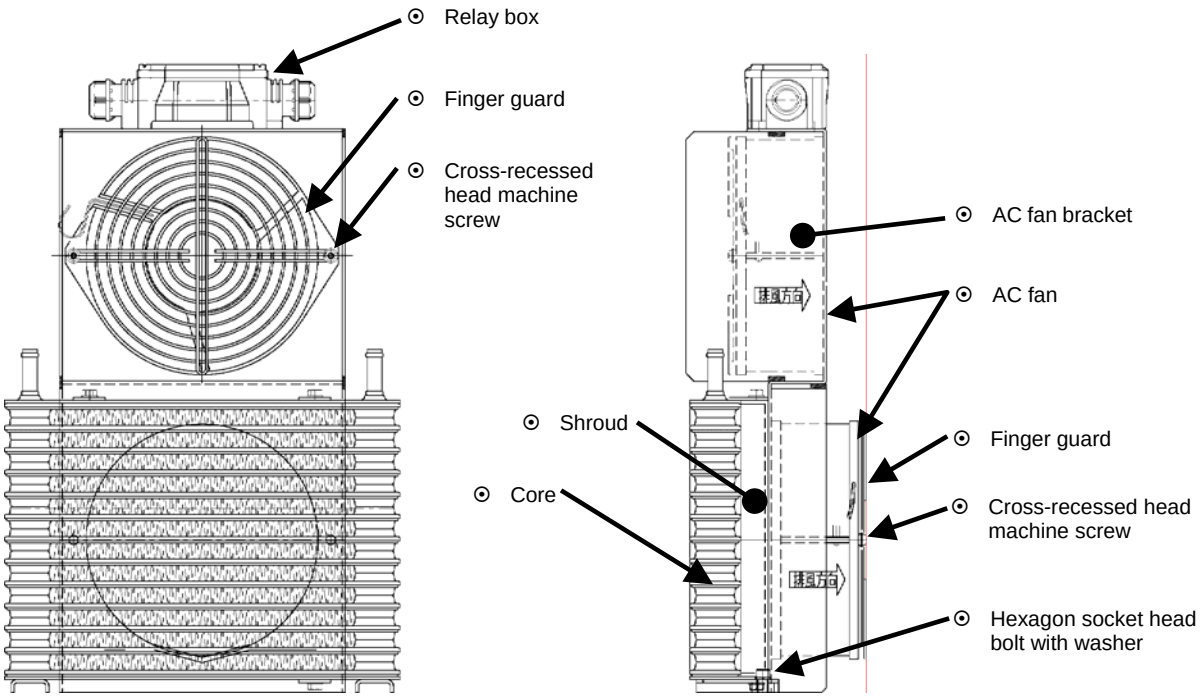
Front of finger guard

Finger guard fastening method



- The fan wind direction and cable routing direction are defined.
- To mount the fan in correct orientation, check the cable routing direction.





<Oil cooler (***)>

<Oil cooler (for SUT06D60L21 or SUT10D60L21)>

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

⚠ 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.

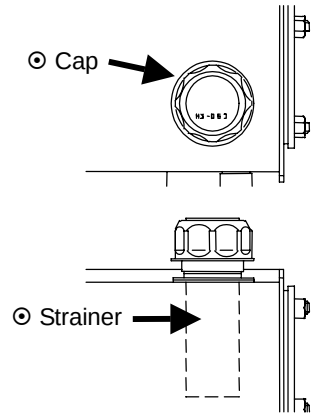
5. Reassembling the oil cooler
   After cleaning is completed, reassemble the oil cooler.
   After reassembling is completed, conduct the test run procedure described on page 27 to make sure that the hydraulic unit normally operates.
   Check if the oil cooler air intake/exhaust direction is correct. (See page 14)

■ 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.



<Oil filling port (Air breather)>

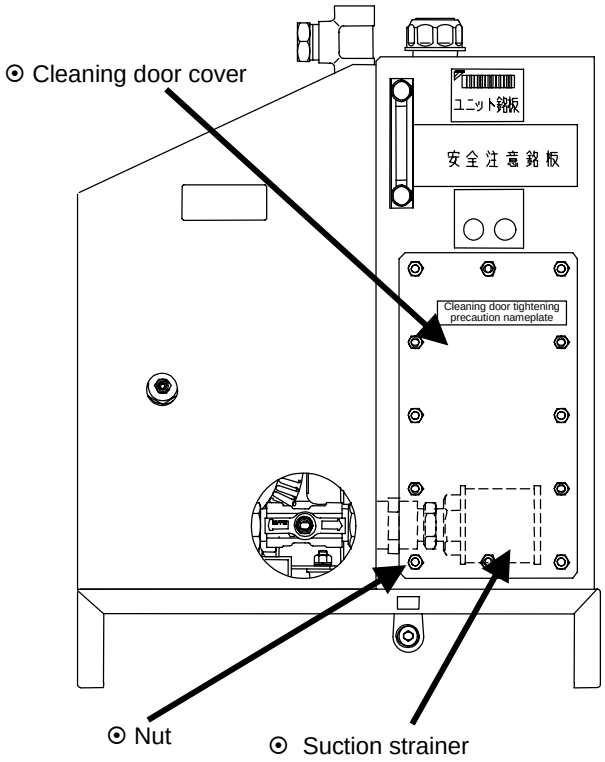
⚠ WARNING
• During air blow, wear protective goggles to prevent accumulated substances or dust from touching your eyes.

■ Suction strainer maintenance procedure

1. Removing procedure
   [1] After draining hydraulic oil completely, remove the nuts (M8: 12 pieces) from the cleaning door cover, and remove the cover from 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 page 27 to make sure that the hydraulic unit normally operates.

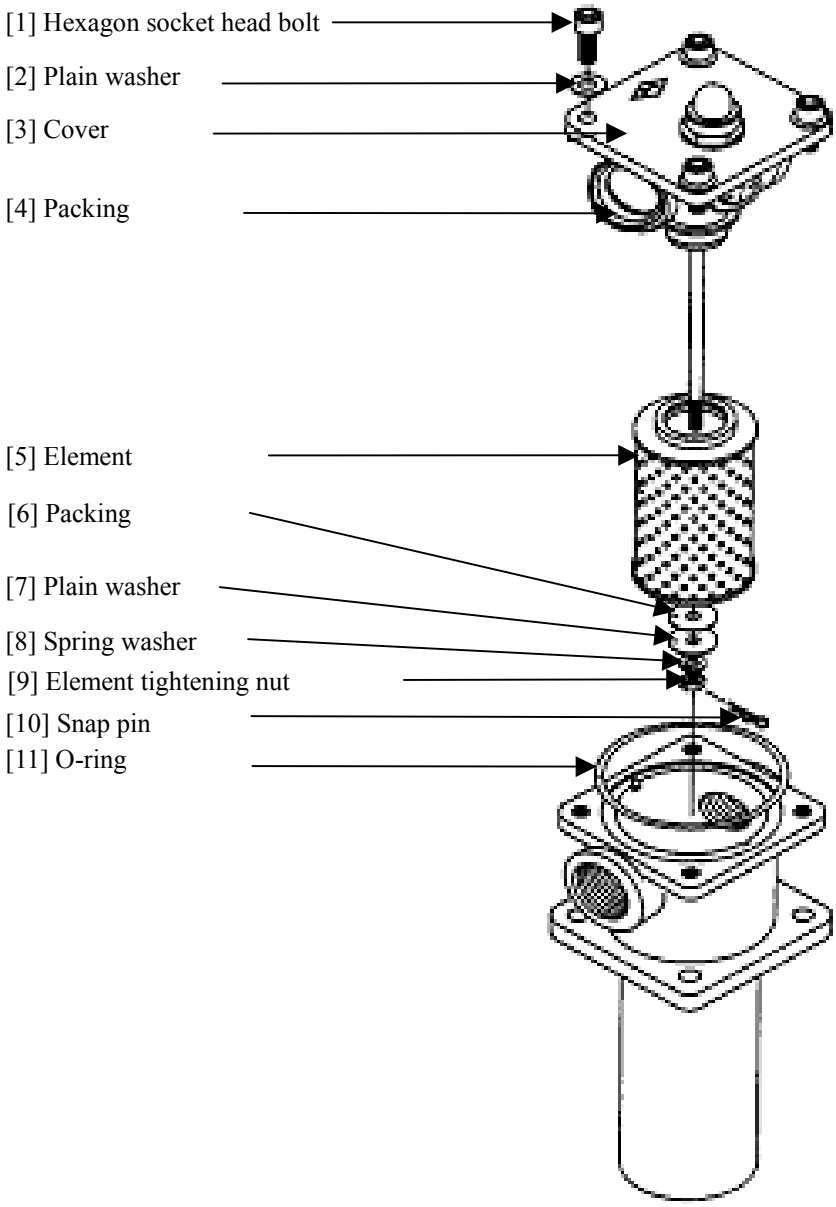


⚠ WARNING
• During air blow, wear protective goggles to prevent accumulated substances or dust from touching your eyes.

■ Replacement of the return filter element

When the detector indicates that the filter is clogged (the indicator ring is raised to hide the green part of the indication column completely), replace the filter element according to the procedure below.

1. Loosen the hexagon socket head bolts [1] that fasten the cover [3], and pull the cover upward. Now, you can remove the element [5] together with the cover.
2. To remove the element, pull out the snap pin [10], 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 according to the above procedure in reverse.
4. Tighten the hexagon socket head bolts [1] in a crisscross order thoroughly.



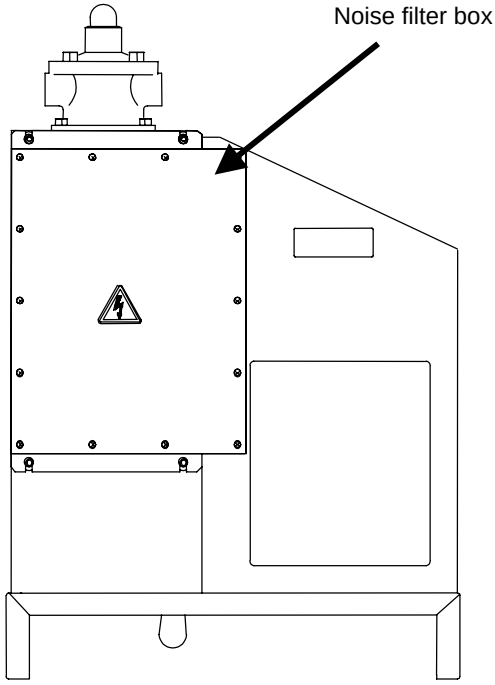
[Attachment: Hydraulic Unit with Noise Filter Box]

■ Electric wiring

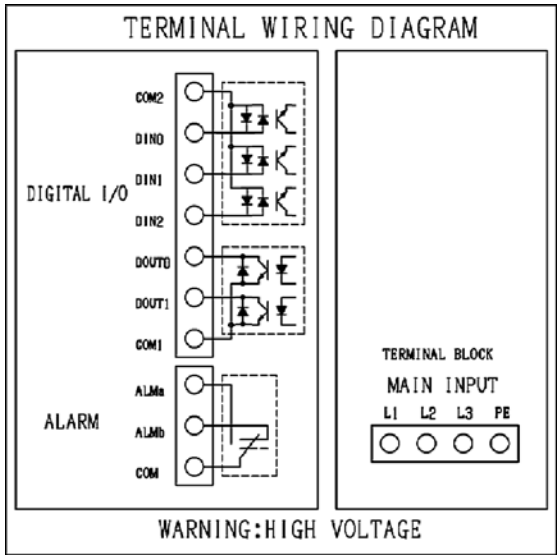
♦ Preparation for wiring

To connect the main power supply cable and the I/O signal cable, remove the cover of the noise filter box.

To remove the noise filter box cover, loosen the cross-recessed head machine screws (M4) that fasten the cover.



<Hydraulic unit (noise filter box side)>



<Wiring diagram>

⚠ DANGER
• In order to protect the electric circuit against short-circuit and over-current, and to prevent electric shocks, provide a safety device (no-fuse breaker, earth leakage breaker, etc.) conforming to European Norm EN60947-2 for the main power supply of the hydraulic unit. (For capacity of each model, see the table below.) • 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.) • Before wiring, be sure to complete installation of the hydraulic unit. • Before wiring, be sure to turn OFF the main power supply breaker, and make sure that the power is interrupted. • Do not connect the power supply cable to the I/O signal terminals. • Do not apply an excessive power supply voltage higher than the power supply voltage rating of the hydraulic unit.

⚠ CAUTION
• The hydraulic unit incorporates an overcurrent protecting function. Therefore, no thermal relay is required for protection again overcurrent. If a thermal relay is used, it may malfunction with influence of the inverter switching operation.

[Rated current and breaker setting for the models with code symbol "-F" (DCL: provided)]

Model	Power supply voltage and frequency			Breaker setting
	3ϕ 200 V 50 Hz	3ϕ 200 V 60 Hz	3ϕ 220 V 60 Hz	
SUT06D40L16/SUT10D40L16	13.0 A	12.8 A	11.6 A	30 A
SUT06D60L21/SUT10D60L21	16.8 A	16.4 A	15.2 A	30 A

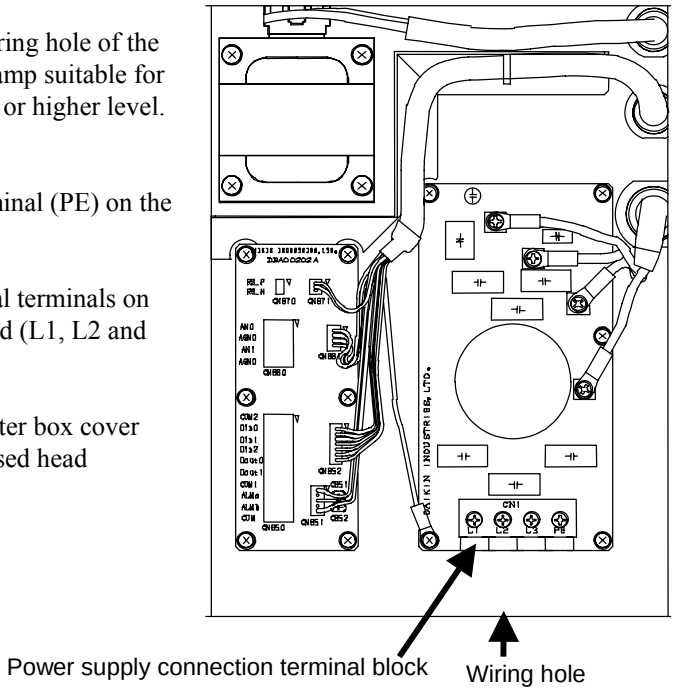
♦ Connecting the main power supply cable

(1) Pass the main power supply cable through the wiring hole of the noise filter box. Use a cable conduit and cable clamp suitable for the wiring hole, to meet protection rating of IP54 or higher level. (Wiring hole diameter: 28 mm)

[1] Connect the ground cable to the ground terminal (PE) on the power supply terminal block circuit board.

[2] Connect the power supply cable to individual terminals on the power supply terminal block circuit board (L1, L2 and L3).

(2) After connecting the cable, re-mount the noise filter box cover securely to the original position. (M4 cross-recessed head machine screw, Tightening torque: 1.0 N·m)



<When the noise filter box cover is removed>

⚠ DANGER
• Use an AC power supply conforming to the power supply rating of this product. • Use a power supply cable suitable for the power supply capacity. (See the table below.) • Do not connect the power supply cable (L1, L2 and L3) to the ground terminal on the power supply terminal block. • 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 meet the specified protection rating, because there is a clearance between the cables and the cable clamp.

Model	Cable size	Recommended cable	Recommended crimp terminal	Recommended cable clamp
SUT06D40L16 SUT10D40L16	2.5 mm^2 or more (AWG14 or larger size)	CE362 2.5 $mm^2 \times 4$ cores (Manufactured by KURAMO)	RBV-2-4 (Manufactured by NICHIFU)	Manufactured by OHM ELECTRIC OA-W2216
SUT06D60L21 SUT10D60L21	4.0 mm^2 or more (AWG10 or larger size)	CE362 5.5 $mm^2 \times 4$ cores (Manufactured by KURAMO)	RBV-5.5-4 (Manufactured by NICHIFU)	Manufactured by OHM ELECTRIC OA-W2219

<<I/O signal cables>>

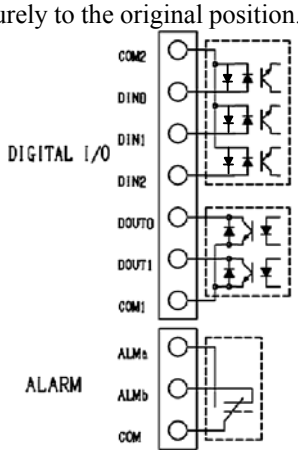
Model	Cable size	Recommended cable	Recommended crimp terminal	Recommended cable clamp
SUT06D40L16 SUT10D40L16 SUT06D60L21 SUT10D60L21	0.5–0.3 mm^2 (AWG20–22)	KCV-36SB 0.3 mm^2 (Manufactured by KURAMO)		Manufactured by OHM ELECTRIC OA-W1611 Applicable cable diameter: ϕ9–11

♦ Connecting the I/O signal cable

(1) Pass the I/O signal cable through a wiring hole of the noise filter box.
Use a cable conduit and cable clamp suitable for the wiring hole, to meet protection rating of IP54 or higher level. (Wiring hole diameter: 21 mm)

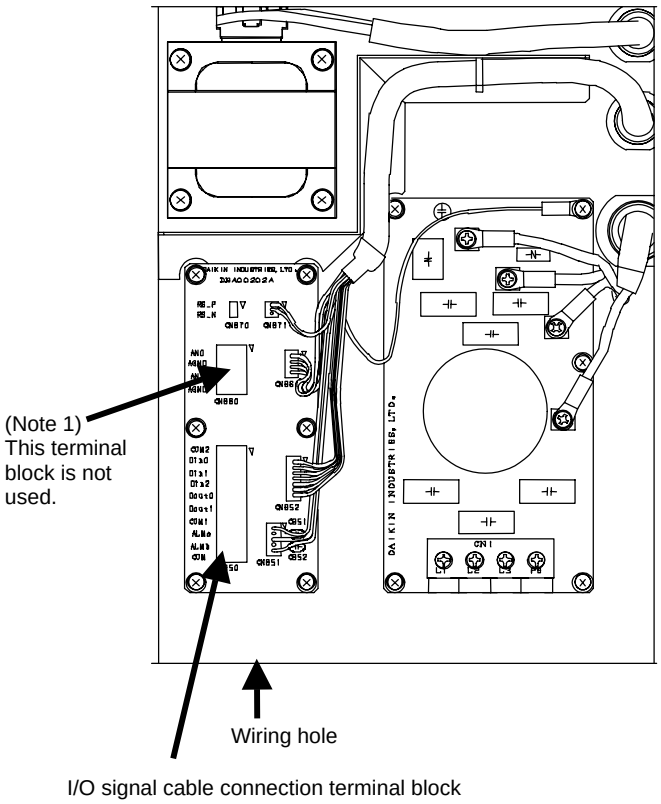
(2) Check the wiring diagram shown on the noise filter box cover, and connect the cable to the I/O signal terminal block.

(3) After connecting the cable, re-mount the noise filter box cover securely to the original position.



Between COM and ALMa: Normally closed. Opened in abnormal condition.
Between COM and ALMb: Normally opened. Closed in abnormal condition.

<I/O signal wiring diagram>



<When the noise filter box cover is removed>

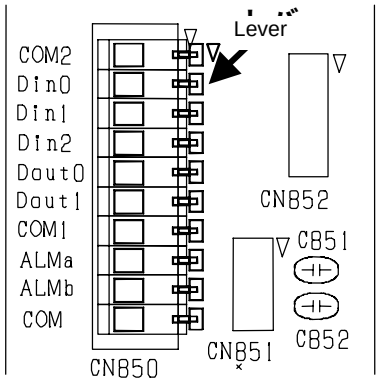
⚠ DANGER

- For the I/O signal cable, use a shielded cabtyre cable equivalent to AWG22 (0.3 sq) or larger size.
- Terminate the shielded cable securely. Ground one end of the shielded cable singly.
- 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

- During normal operation, the ALMa terminal of the alarm output signal is connected with the COM terminal, as shown in the wiring diagram.
- If special measures are required to prevent loosening or corrosion of the end of the conductors, use the crimp terminal with a dedicated insulation sleeve, as listed below. (For handling procedure, refer to the catalog issued by the manufacturer (WAGO).)
  For AWG22, 0.3 sq: 216-322 (Light green)
  For AWG20, 0.5 sq: 216-221 (White)
  Crimping tool: 206-204 (BIO CRIMP)

Type of terminal block: 255-410
(manufactured by WAGO)



[1] Push the lever with a screwdriver.
[2] Check the unsheathed length of the cable, and insert it into the terminal so that the conductors will not become loose. In this step, be careful that the cable sheath is not caught in the terminal.
[3] Remove the screwdriver from the lever.
[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 I/O signal terminals for interface with external equipment are shown in the table below.
For details of each signal line, see the following pages.

Symbol of wiring diagram	Type	Function of terminal		Remarks
COM2	Digital I/O terminal	Digital input common		Negative common
DIN0		Digital input 0		Used for start/stop control. With the start/stop signal switching parameter in the setting mode, the operation at signal input can be changed.
DIN1		Digital input 1	PQ0	P-Q selections (0 to 3) can be changed depending on combination of the input signals.
DIN2		Digital input 2	PQ1	
DOUT0	Digital/contact output terminal	Digital output 0		See the table below. With the default setting, individual alarm output is selected.
DOUT1		Digital output		
COM1		Digital output common		
ALMa		Contract output a		
ALMb		Contract output b		
COM		Contract output common		

♦ 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.

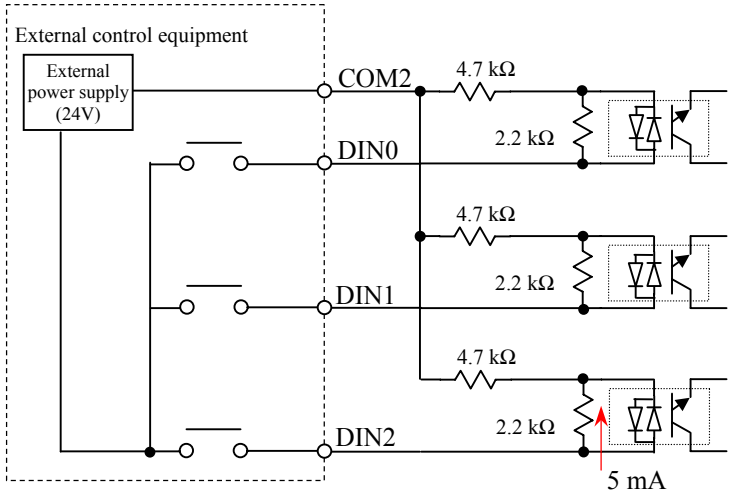
Symbol of wiring diagram	Signal name	Remarks
COM2	Digital input common	Negative common (To use COM2 as a positive common terminal, refer to "External I/O Signal Input Common Terminal" described in the Attachment.
DIN0	Digital input 0	Used for start/stop control. With the start/stop signal switching parameter (Setting mode: [P11]), you can change the operation at signal input. (See pages 34 and 35.)
DIN1	Digital input 1	P-Q selection Nos. 0 to 3 can be selected depending on the combination of digital input status. (For P-Q selection setting, see pages 34 and 35.)
DIN2	Digital input 2	

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

Note) The time interval to restart the unit after the unit stop command should be at least 0.5 sec.

Combination of digital inputs for P-Q selection

P-Q selection No.	Digital input 1 PQ0	Digital input 2 PQ1
0	OFF	OFF
1	ON	OFF
2	OFF	ON
3	ON	ON



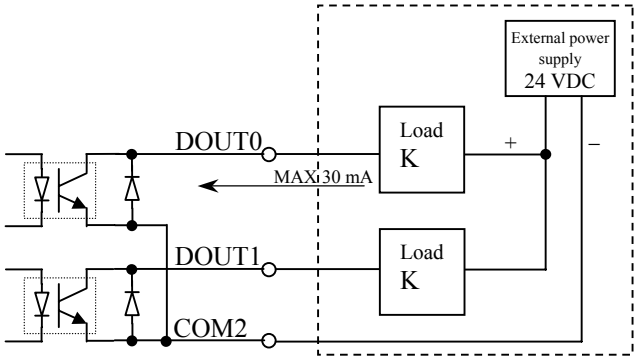
⚠ CAUTION

- For the external power supply, use a power supply with 24 VDC ± 1V, 0.5 A or higher capacity.
- Power cannot be supplied from this controller to external equipment.
- 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 page 38.

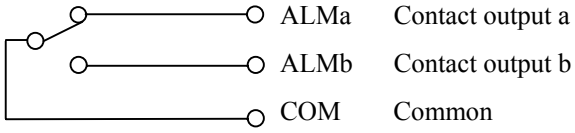
Symbol of wiring diagram	Signal name	Remarks
DOUT0	Digital output 0	Outputs the. Digital output 0
DOUT1	Digital output 1	Outputs the. Digital output 1
COM1	Digital output common	Negative common



⚠ CAUTION

- As the external power supply, prepare a 24 VDC ± 1V, 0.5 A power supply. Power cannot be supplied from this controller to external equipment.
- This controller's output circuit serves as negative 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.

Symbol of wiring diagram	Signal name	Remarks
ALMa	Contact output a	Normally, connected with the common terminal.
ALMb	Contact output b	Connected with the common terminal when signal output.
COM	Contact output a	Normally, connected with the common terminal.



(Power ON: normal)

⚠ 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 μA. 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.

[Attachment: High-pressure Safety Valve Adjusting Procedure]

With this hydraulic unit, you need not change the setting of the high-pressure safety valve specifically when you adjust the pressure setting. This hydraulic unit uses the IPM motor that remarkably improves the motor driving system, enabling stable performance without adjustment of the high-pressure safety valve setting.

However, in a case corresponding to any of the following three conditions, re-adjust the setting of the high-pressure safety valve, by referring to <High-pressure Safety Valve Adjusting Procedure> described on the next page.

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:
   To suppress surge pressure, it is recommended that the pressure setting of the safety valve should be “pressure setting of hydraulic unit + 2.0 MPa” (when SUT06D40L16 or SUT10D40L16 is used), or “pressure setting of hydraulic unit + 1.0 MPa” (when SUT06D60L21 or SUT10 D60L21 is used), for the purpose of protection of the actuator, pressure gauge and other peripheral equipment of the master machine.

Model	Pressure setting of high-pressure safety valve
SUT06D60L21 SUT10D60L21	Pressure setting of hydraulic unit + 1.0 MPa
SUT06D40L16 SUT10D40L16	Pressure setting of hydraulic unit + 2.0 MPa

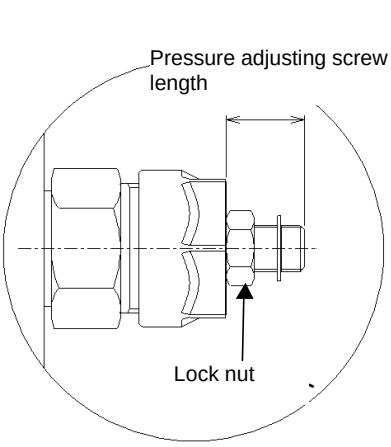
<High-pressure Safety Valve Adjusting Procedure>

[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)

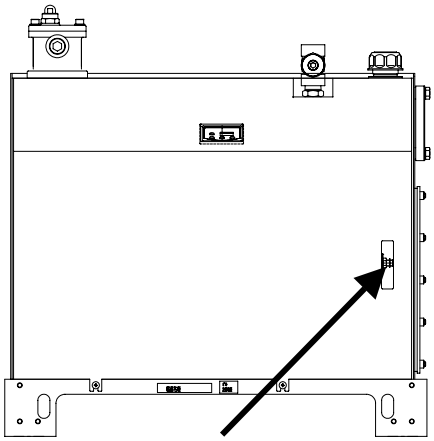
[2] According to the pressure adjusting screw length reference chart, determine the screw length corresponding to a desired control pressure setting.

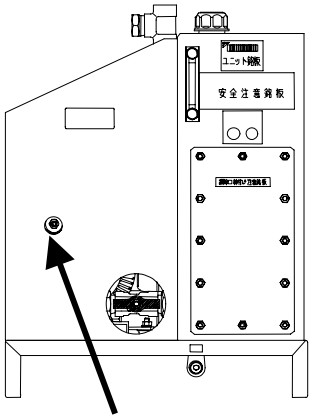
* Head of adjusting screw: Width-across-flat of hexagon socket head screw = 5 mm

* Note that one turn of the adjusting screw changes the pressure setting by approx. 7.7 MPa.



<Detailed view of safety valve>


Lock nut fastening slot

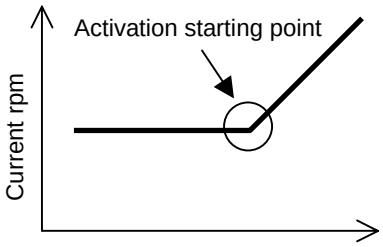

High-pressure safety valve adjusting window

[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.

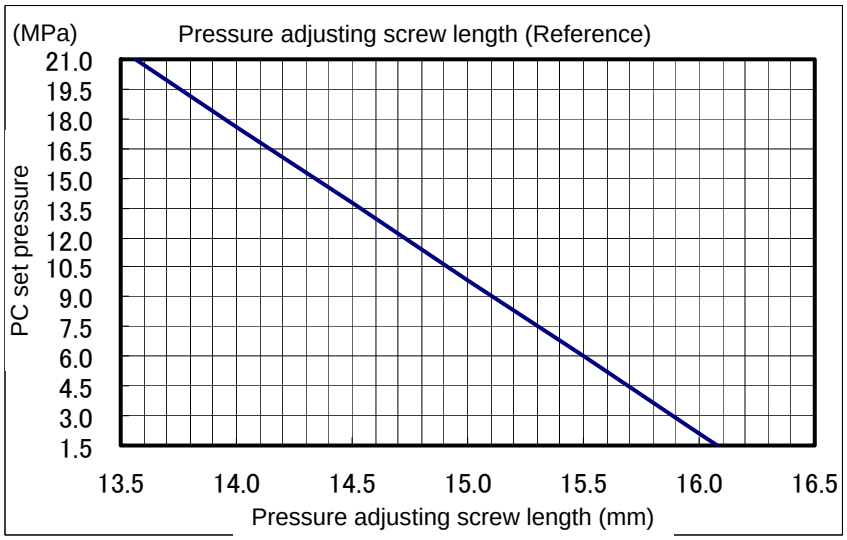
[5] Adjust the pressure adjusting screw length in the longitudinal direction, and find an activation starting point as shown on the right.

[6] Turn the pressure adjusting screw clockwise by 1/4 turn from the activation starting point to tighten the adjusting screw (when SUT06D40L16 or SUT10D40L16 is used), or by 1/8 turn (when SUT06D60L21 or SUT10 D60L21 is used).



[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.)

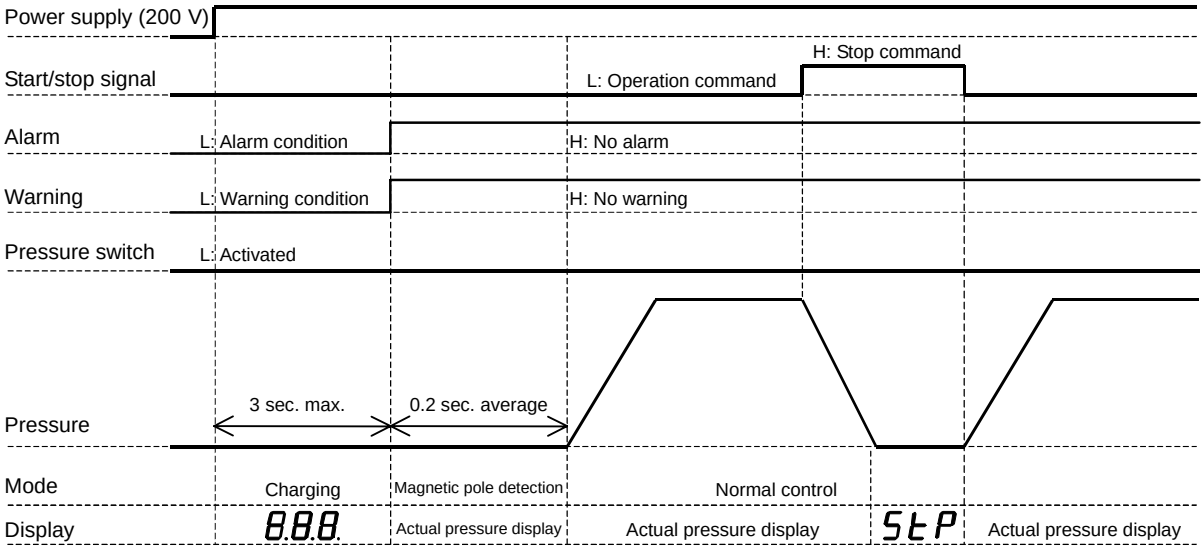
★Caution: Use caution when you set the safety valve pressure higher than 20 MPa.
(If the safety valve pressure setting is too high, the pump may be damaged by surge pressure.)
As the setting procedure, you should set the safety valve pressure at "a target pressure −7.7 MPa (corresponding to one turn of the adjusting screw), and then perform the above setting steps (1) to (5). After that, turn the pressure adjusting screw clockwise by one turn to tighten it, and perform the above step (7).



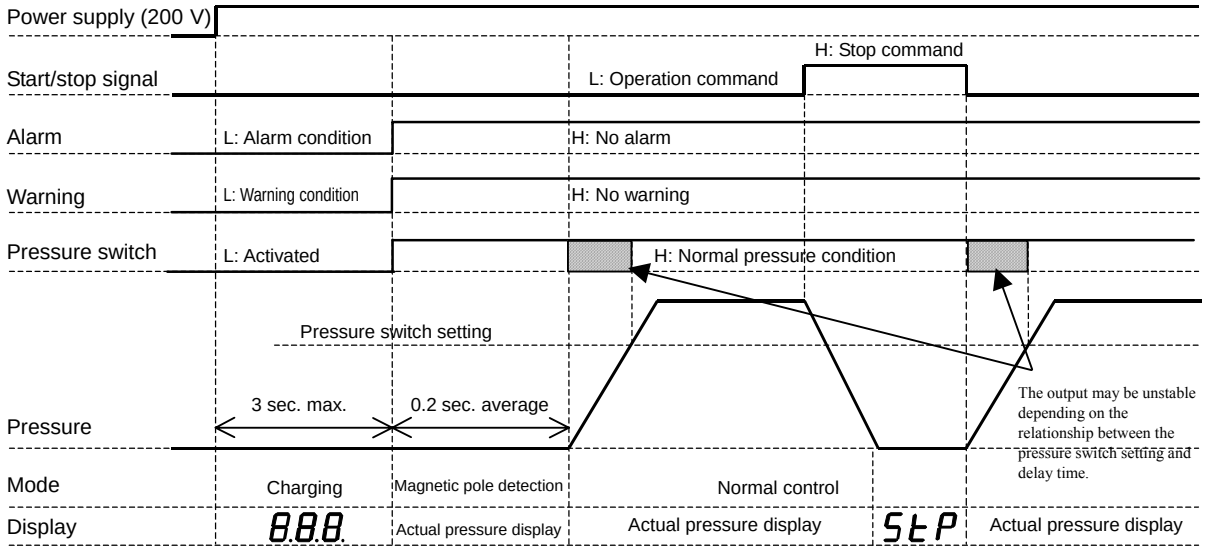
[Attachment: Power-ON External I/O Signal Timing Chart]

1. When parameter [P18] is “0”

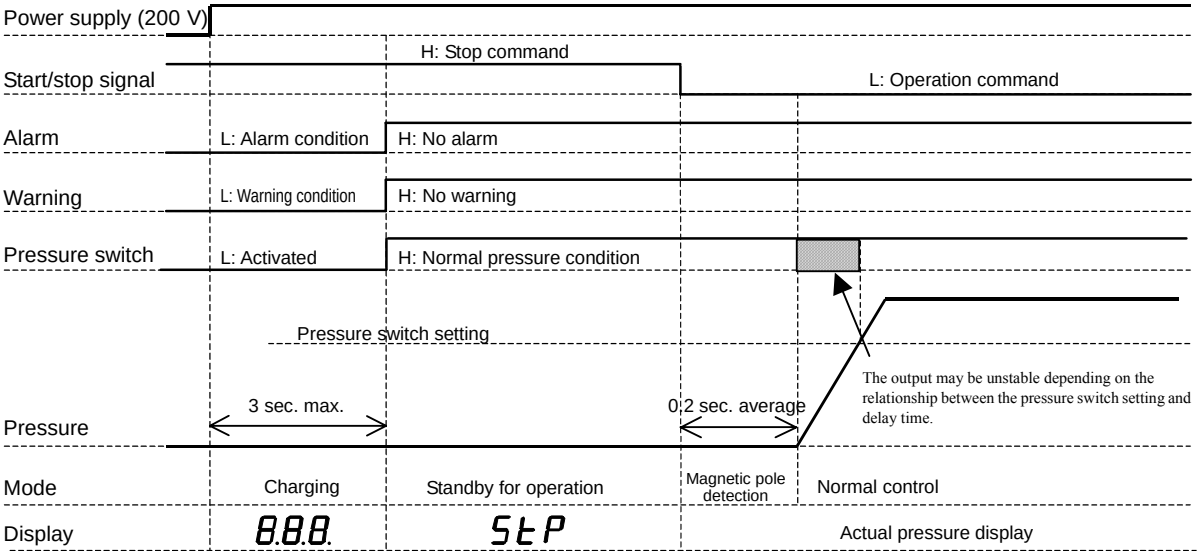
1-1 When the pressure switch function is not used



1-2 When the pressure switch function is used

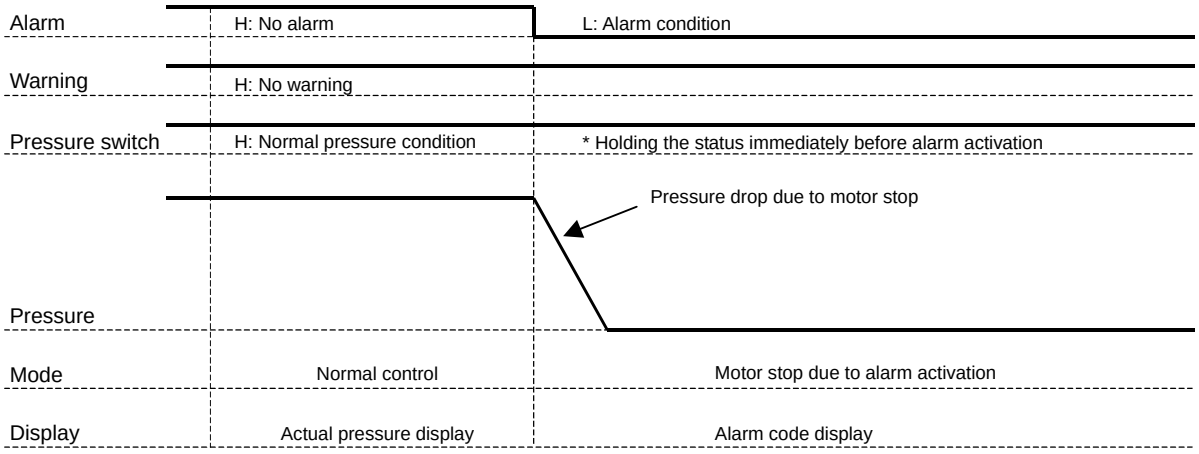


1-3 When the pressure switch function is used (Stop at power-ON)

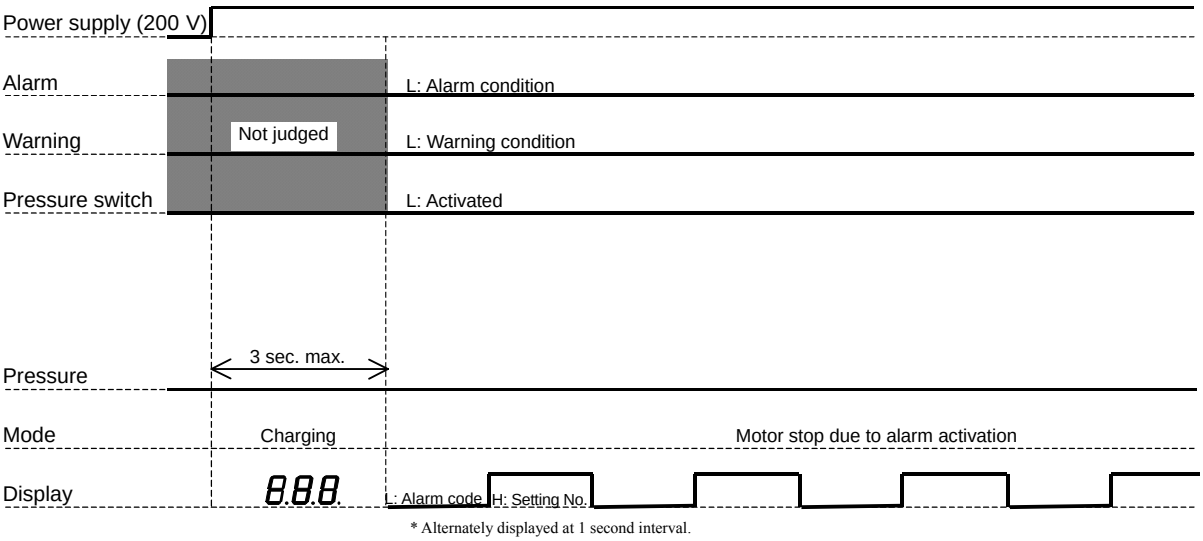


* Magnetic pole detection will be executed at the first motor startup after power-ON.

1-4 Alarm classification [1]

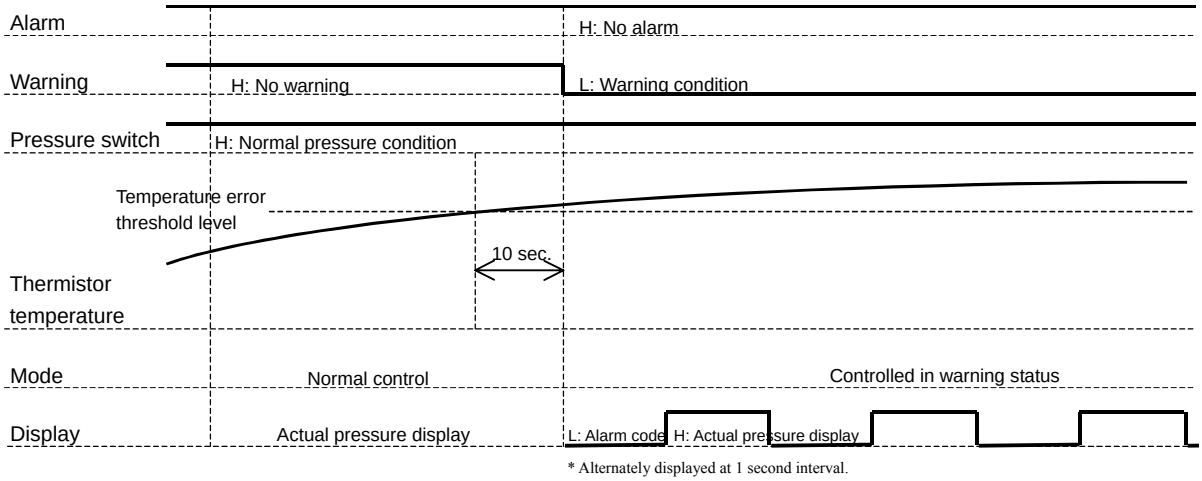


1-5 Alarm classification [2]

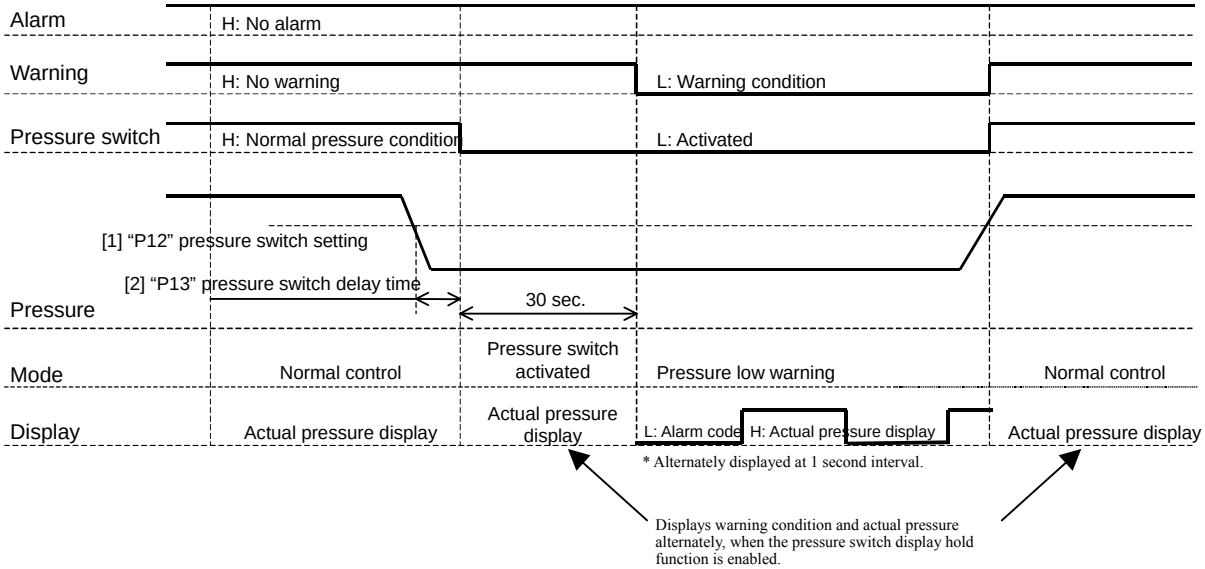


* Alternately displayed at 1 second interval.

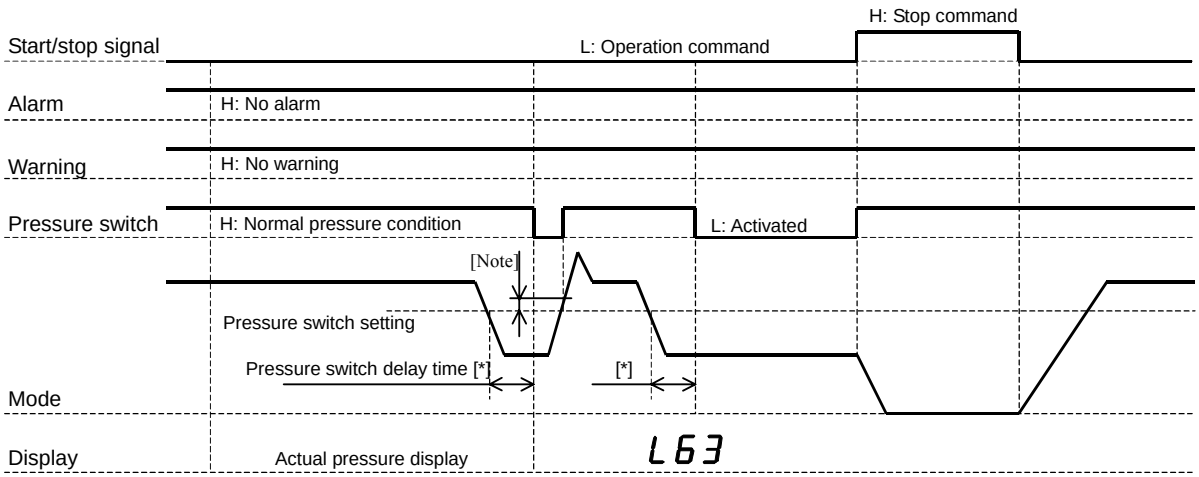
1-6 Alarm classification [3]



1-7 Alarm classification [4]



1-8 Alarm classification [5]



The above chart shows the case where “P08” (Pressure switch display hold setting) is [1] or [2].
When “P08” 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.

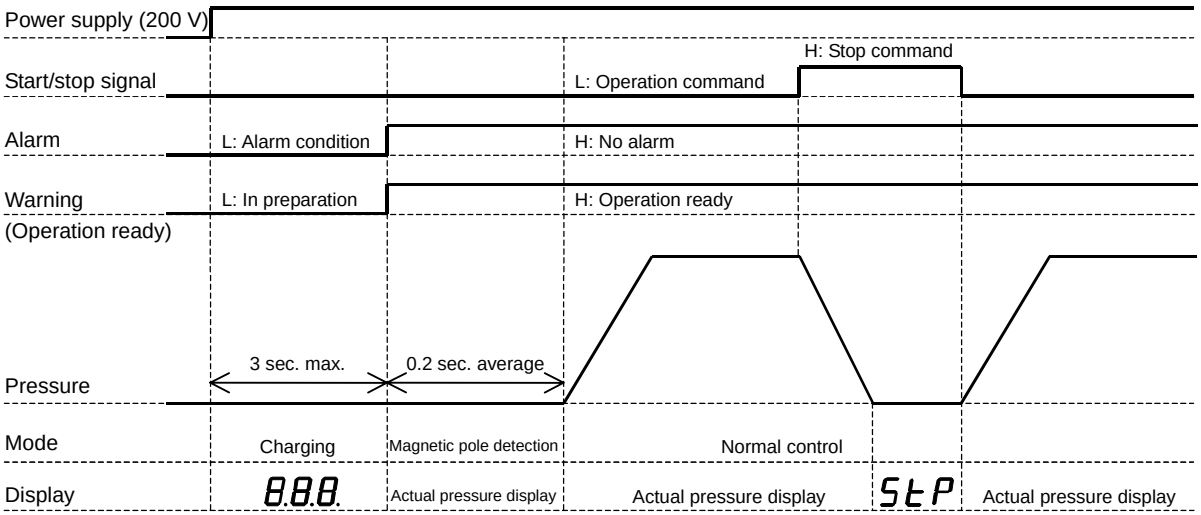
The “P12” and “P13” settings (above [1] and [2]) can be changed in the setting mode.
For the setting procedure and setting range, see “Operating procedure for each mode: b) Setting mode” on page 31.

Note) For the purpose of explanation, the above “1-8 Alarm classification [5]” 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) To activate the stop signal, provide a time interval of 0.5 sec. or longer.

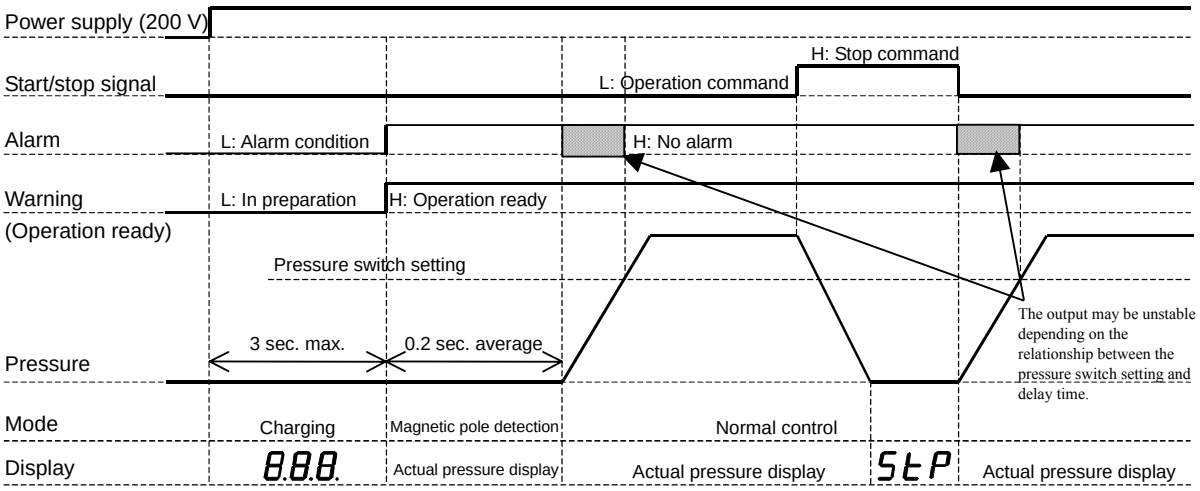
When the integrated alarm output is selected, the “warning output” in the individual alarm output mode is used as operation ready output.

2. When parameter [P08] is “1”

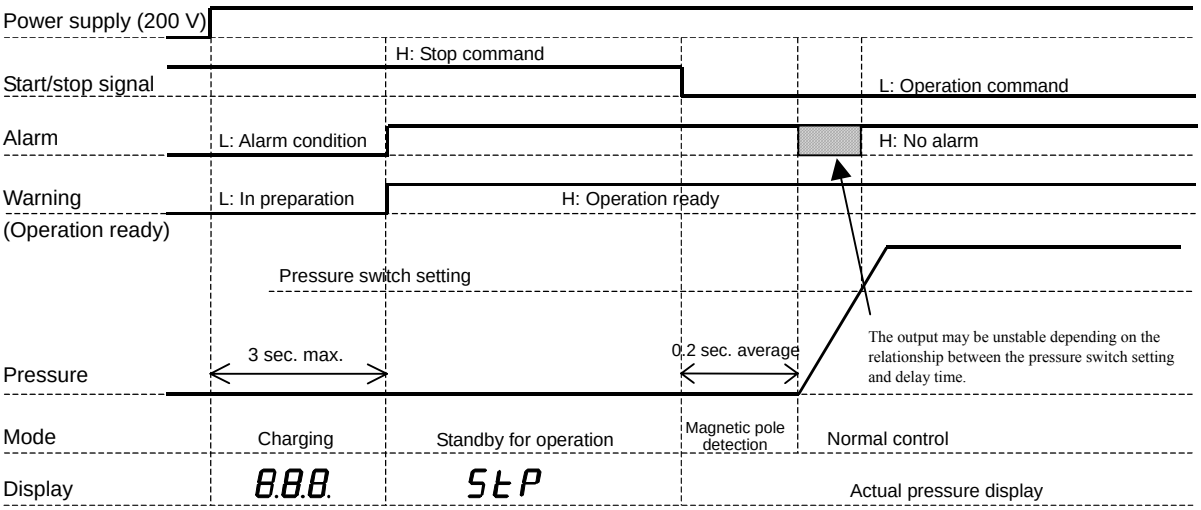
2-1 When the pressure switch function is not used



2-2 When the pressure switch function is used

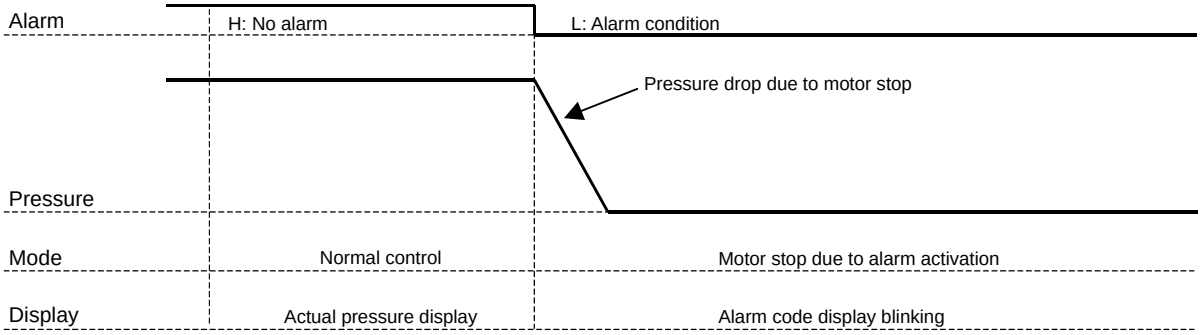


2-3 When the pressure switch function is used (Stop at power-ON)

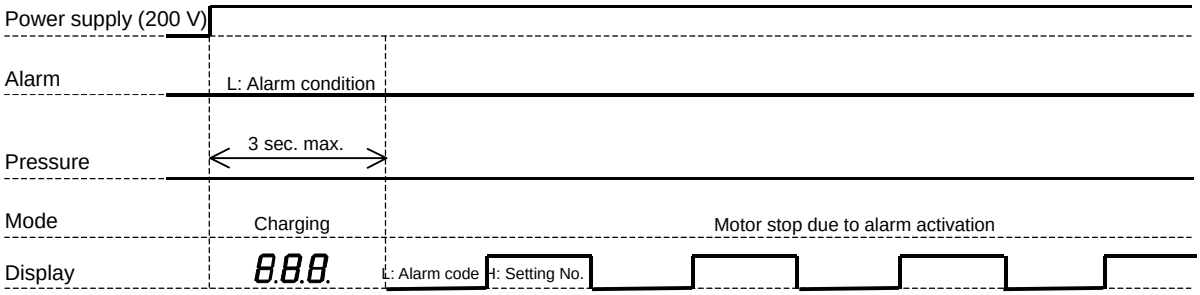


* Magnetic pole detection will be executed at the first motor startup after power-ON.

2-4 Alarm classification [1]

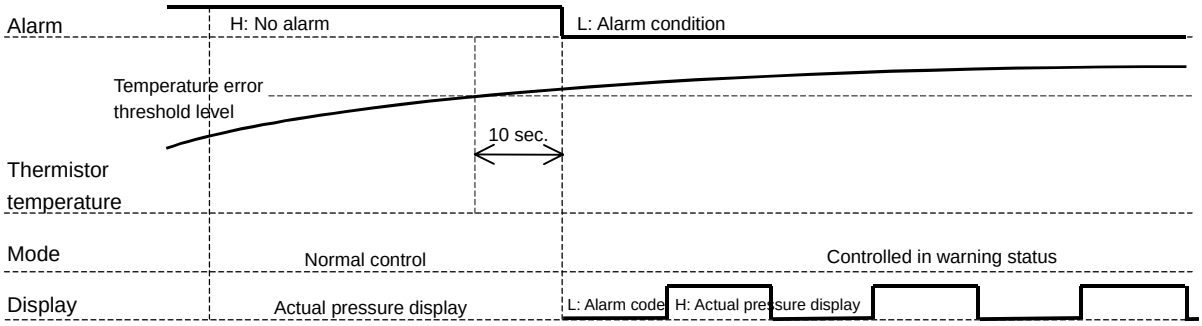


2-5 Alarm classification [2]



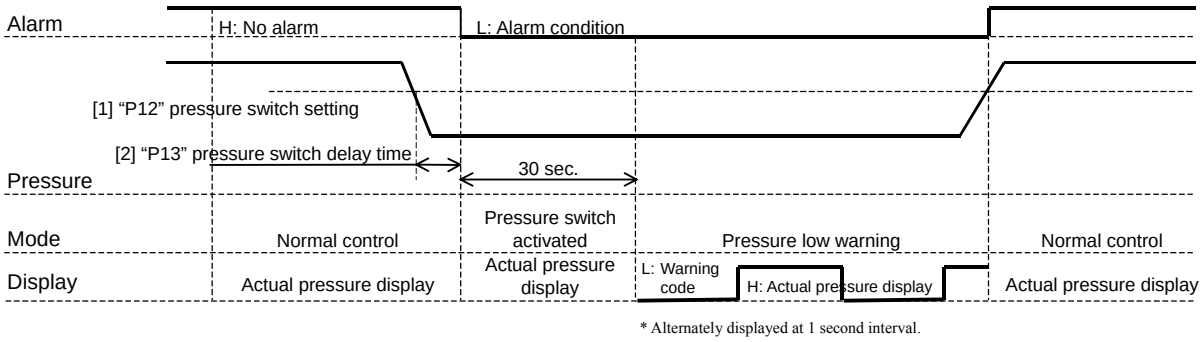
* Alternately displayed at 1 second interval.

2-6 Alarm classification [3]

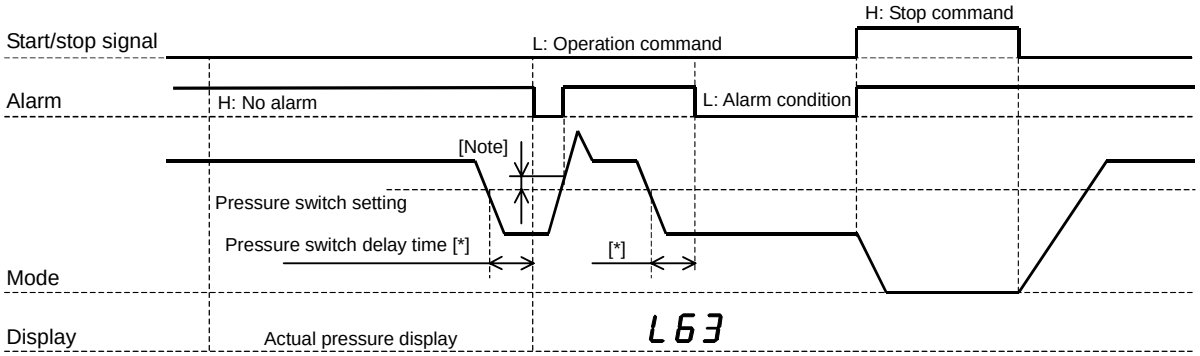


* Alternately displayed at 1 second interval.

2-7 Alarm classification [4]



2-8 Alarm classification [5]



The above chart shows the case where "P08" (Pressure switch display hold setting) is [1] or [2].
When "P08" 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.

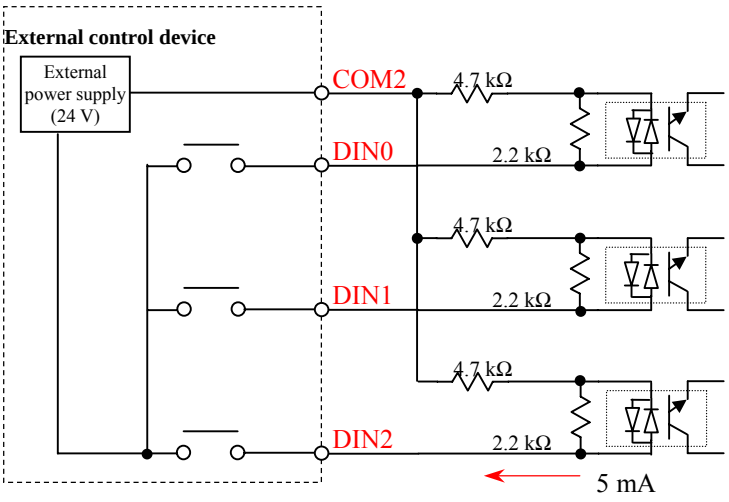
The "P12" and "P13" settings (above [1] and [2]) can be changed in the setting mode.
For the setting procedure and setting range, see "Operating procedure for each mode: b) Setting mode" on page 31.

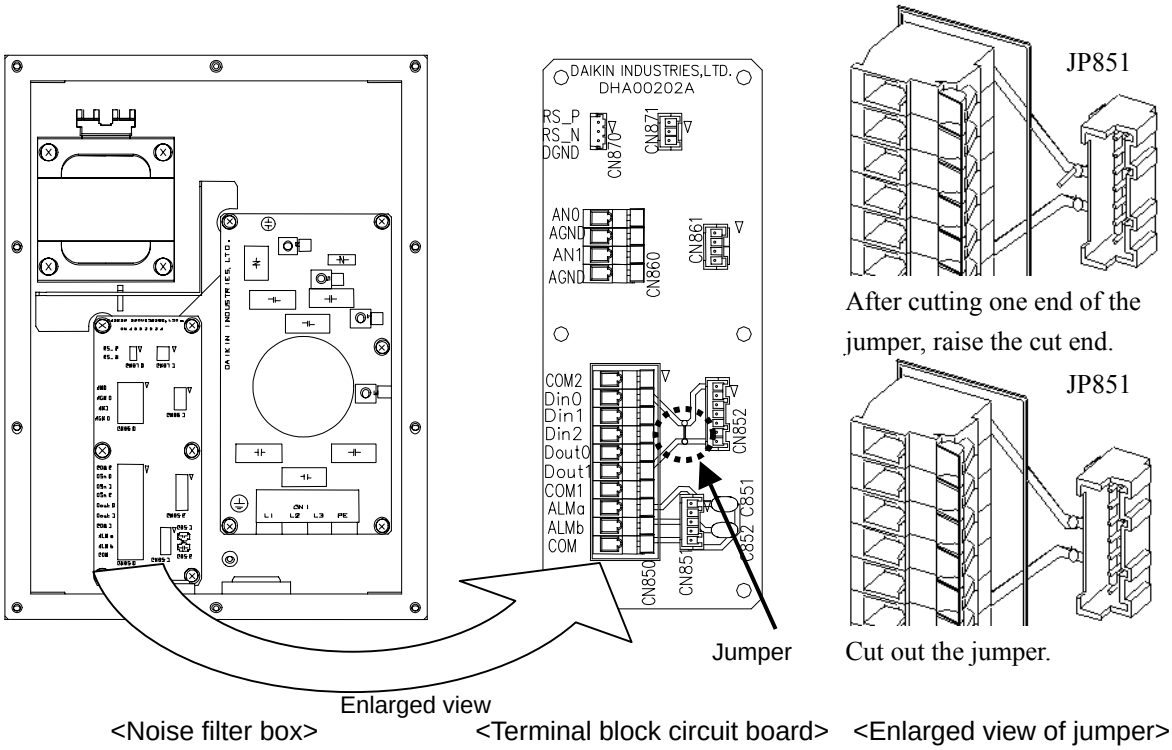
Note) For the purpose of explanation, the above "2-8 Alarm classification [5]" chart shows the case where the pressure switch is activated without a dead zone.
Actually, however, the pressure switch has a dead zone of approx. 0.5 MPa.

Note) To activate the stop signal, provide a time interval of 0.5 sec. or longer.

[Attachment: External I/O Signal Input Common Terminal]

To use the external I/O signal input common terminal (COM2) as a positive common terminal as shown below, cut out the jumper (JP851) on the terminal block circuit board.





<Noise filter box> <Terminal block circuit board> <Enlarged view of jumper>

<Cutting out the jumper from the noise filter box terminal block circuit board>

(1) Identify the jumper position (JP851).

(2) Cut one end of the jumper, and raise the cut end.

(3) While holding the raised end of the jumper with long-nose pliers, cut another end of the jumper.

Note) If you cut another end of the jumper without holding the cut end, the jumper may spring and touch your eye, or the jumper may touch conductors, resulting in short-circuit.