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## Instruction Manual

Energy-saving variable pump unit

Inverter drive N S P i series

Model number : N S P - ※※ E - ※※※ V ※ A ※ - ※※ - 2 3

Picture : Inverter drive N S P i series



September.2022

**NACHI-FUJIKOSHI CORP.**

## Overview

This Instruction Manual explains how to handle and maintain/inspect the inverter drive hydraulic unit NSPi series. Ensure to read this manual before using the unit and keep it accessible for quick reference as needed. Prior to operating the unit, please read the Inverter Instruction Manual also.




Note) The Inverter Instruction Manual mentioned in this manual refers to the instruction manual of inverter "FRENIC-Ace" from Fuji Electric Co., Ltd. (Document no.INR-SI47-1969) which is included with the hydraulic unit.

\* This Instruction Manual may be revised as needed upon product improvement.







## For Your Safety - Must follow these symbols for safety precautions.

This Instruction Manual explains precautions you must follow in order to prevent accidents by incorrect handling.

- The following symbols are used to indicate different levels of hazard and damage that could cause by failure to follow the instruction and/or incorrect product handling.

 <b>Danger</b>	Imminent death or serious injury may occur from failure to follow the instruction.
 <b>Warning</b>	Death or serious injury may occur from failure to follow the instruction.
 <b>Caution</b>	Injury and/or property damage may occur from failure to follow the instruction.
<b>Important</b>	This sign indicates "Details Needed" to handle product safely.

- The following signs are used to classify and to explain the specific instructions.

 <b>Prohibited action</b>	 indicates prohibited action. Specific prohibited action is described inside or near this sign.
 <b>Required action</b>	 indicates required action. Specific required action is described inside or near this sign.
 <b>Caution</b>	 indicates caution. Specific cautionary matter is described inside or near this sign.

The contents described in this manual are within the range that can be predicted/foreseen by our company; however, users are requested to pay sufficient attentions also to matters unlisted as needed. Also, keep in mind that there is a risk of serious accidents depending on conditions, even within the scope of items described as cautions.

## For Your Safety - Must follow these signs for safety precautions.



### Warning symbol below: Risk of Getting Caught by Parts (Clamping Accident Hazard)



- Touching the rotating fan will cause injury. Do not run the unit with the fan cover removed. Do not insert fingers or tools through any openings.



### Warning symbol below: Fire Prevention



- Hydraulic fluid used for hydraulic equipment is flammable. Therefore, it is extremely dangerous to have fire source and/or high temperature objects nearby. Use extra caution with fluid in sprayed form in particular as it catches fire easily.
- Use appropriate type of hydraulic fluid and make sure that the fluid does not overflow or leak.
- Check the motor capacity to avoid overloading. If the discharge pressure/flow rate exceeds the motor capacity, or if a voltage other than the rated voltage is applied, the motor may overheat and be damaged. Be sure to install an appropriate circuit breaker on the power supply side.



### Danger symbol below: Electric Shock Prevention



- Be sure to ground the power supply wiring to avoid an electric shock incident due to electric leakage.
- Do not use any voltage other than the rated voltage specified in the specifications.



### Warning symbol below: Beware of damage/burst under high pressure



- Improper use of unit will cause damage/burst and resulting in extremely dangerous situation such as high pressure oil blowout.
- Do not use any of hydraulic equipment above the maximum working pressure specified in the equipment specifications.
  - Select pipes and fittings that connect to hydraulic equipment to be appropriate type for the system.
  - Be sure to use the specified seals and bolts to be installed for hydraulic equipment.
  - Avoid install unit in locations where there is abnormal vibration or acceleration/deceleration.



### Caution symbol below: Use of proper fluid



- Hydraulic fluid has a significant impact on the operation, efficiency and reliability of hydraulic equipment. Use high quality petroleum-base fluid - ISO VG32 or equivalent.
- Use hydraulic fluid within proper temperature and viscosity range.

### **Important: Environmental Protection**

- Be sure to pay full attention to prevent hydraulic fluid outflow. By any chance should any fluid leak out, wipe it off immediately without leaving any behind. Fluid drainage into the sewer system can cause environmental pollution and/or fire, and adhesion to the floor is very dangerous as floor gets slippery.

### **Important: Gentle unpacking required**

- Hydraulic equipment is generally heavy and is consisted of many precision parts. When removing unit from the package box, handle it with care without hitting or dropping to avoid damage or breakage.
- Do not lift the hydraulic unit directly by hand. It may cause injury or accident.



### **Cautions for accident prevention**

- [1] When performing any electrical wiring, be sure to shut down the power beforehand to prevent electric shock.
- [2] Turn on the power after confirming there is no danger to the surroundings even if the pump discharges.
- [3] Be sure to wipe off any fluid that had spilled on the floor during lubrication and such, as it may cause slip-and-fall accident.

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## 1. Overview

Many small hydraulic units are used as power source for machine tools for chuck open/close of NC turning machines, blade table rotation and for machining center's main axes up/down movement. Inverter drive hydraulic unit NSPi series is the same as the NSP series of energy-saving hydraulic units for machine tools, but an inverter drive has been added to achieve greater energy savings for its compact body.

## 2. Features

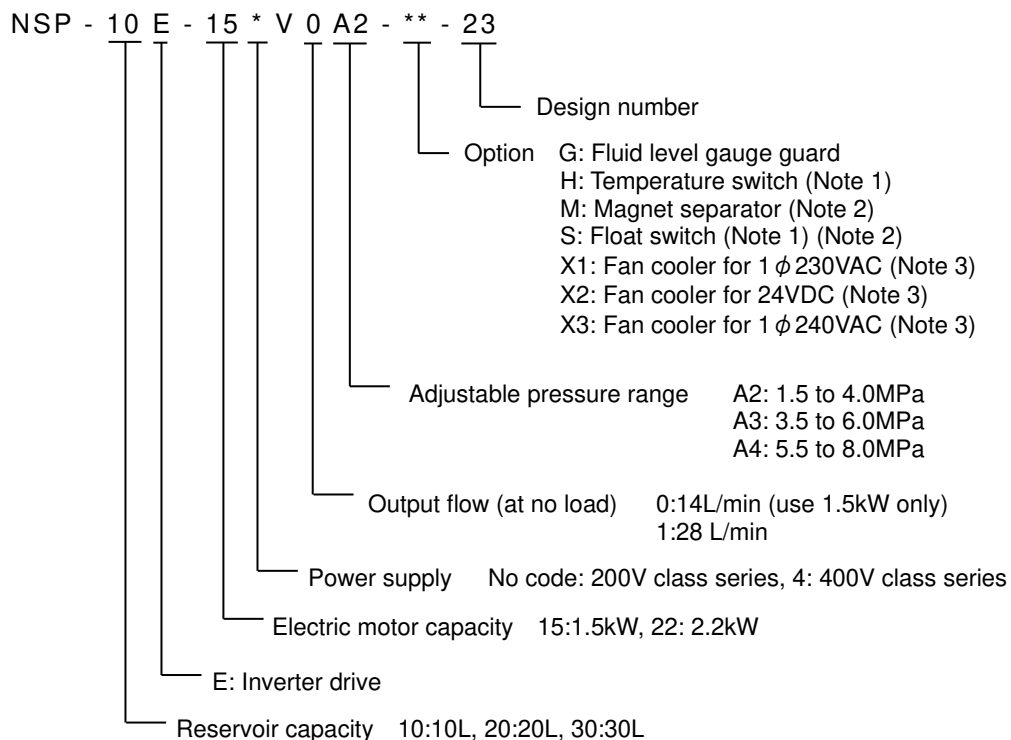
- 1) Significant energy saving  
The NSP series, which is the base model of the NSPi series, actualized approx. 46% less power consumption compared to our comparable standard unit. And adding inverter drive to NSP series, this NSPi series reduced its power consumption as much as 69%.  
(When compared to our standard unit at 6MPa holding pressure)
- 2) Compact size  
Due to NSPi series dimensions largely unchanged from NSP series, user's current NSP series unit can be replaced without having to make any design changes to the main machine.  
(For 10 liters or 20 liters)
- 3) Smaller elevation in hydraulic fluid temperature  
Due to very small hydraulic fluid temperature elevation - usually about 1.5°C above the room temperature (when held at 6MPa continuously), NSPi series contributes to improve machining accuracy, extending longevity of sealing parts and hydraulic fluid, and reduction of the air conditioning in the factory.
- 4) Low noise  
NSPi series actualized an amazing low noise level of 53dB(A). (When held at 6MPa)  
During pressure is being held, the unit runs at low speed and is as quiet as a tranquil café.
- 5) Easy operation  
Simply turn on the power, and the unit will run.  
Once the pressure is adjusted, optimal energy-efficient operation will start by a single touch of a button.
- 6) Monitor function  
Connecting to the inverter RS-485 communication port enables monitoring of operating condition, alarm information, maintenance information and so on.
- 7) Safe Torque Off function  
Safe Torque Off (STO) function of the inverter ensures compliance with the System Safety Standard EN ISO 13849-1:2006 PL=e Cat.3 without installing any external safety shut-off equipment.

### 3. Specifications

	200V class series	400V class series
1. Power supply	3 $\phi$ 200 to 220VAC, 50/60Hz	3 $\phi$ 380 to 480VAC, 50/60Hz
2. Rated input current (Excluding the value of fan cooler current)	9.5A/1.5kW 13.2A/2.2kW	5.9A/1.5kW 8.2A/2.2kW
3. Adjustable pressure range	A2:1.5 to 4.0MPa A3:3.5 to 6.0MPa A4:5.5 to 8.0MPa	
4. Output flow (at no load)	0A*:14L/min 1A*:28L/min	
5. Hydraulic fluid	General mineral-based hydraulic fluid Equivalent to ISO VG 32	
6. Hydraulic fluid temperature	10 to 60°C	
7. Paint color	Munsell value N1 (70 GU)	
8. Ambient temperature/humidity	10 to 35°C/20 to 85%RH (No condensation allowed) (Keep unit away from water-soluble cutting fluid mist.)	



#### 4. Explanation of Model Numbers



Note) Option selection limitation

- For 10L or 20L reservoir capacity, both temperature switch and float switch cannot be selected at the same time.
- Both magnet separator and float switch cannot be selected at the same time.
- When selecting X1, X2, X3 in 200V and 400V class series input, a separate wiring to the fan cooler is required.  
If both 200V and 400V class series come without X1, X2 and X3, 1  $\phi$  220VAC fan cooler is included as standard.

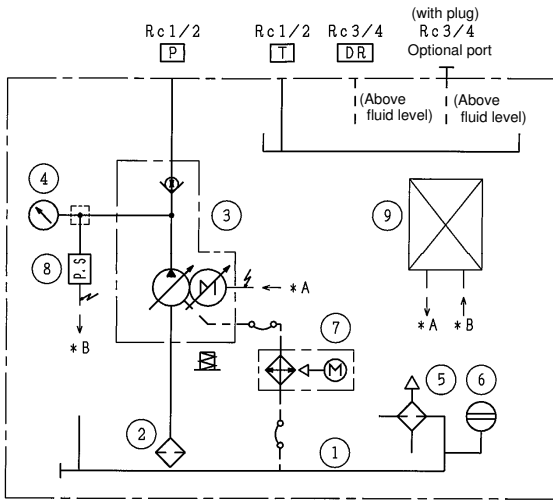
#### ■ Current value of fan cooler

The rated current value of standard fan cooler and fan cooler with option X1, X2 and X3 are follows.

Fan cooler type	Rated voltage (V)	Number of phase	Frequency (Hz)	Rated current (A)
Standard (Option: Not available)	220 AC	Single-phase	50 / 60	0.12 / 0.10
Option: X1	230 AC	Single-phase	50 / 60	0.12 / 0.10
Option: X2	24 DC	—	—	0.46
Option: X3	240 AC	Single-phase	50 / 60	0.12 / 0.10

## 5. Hydraulic Circuit and Unit Installation Dimensions

### 5.1 Hydraulic Circuit Diagram and Component parts

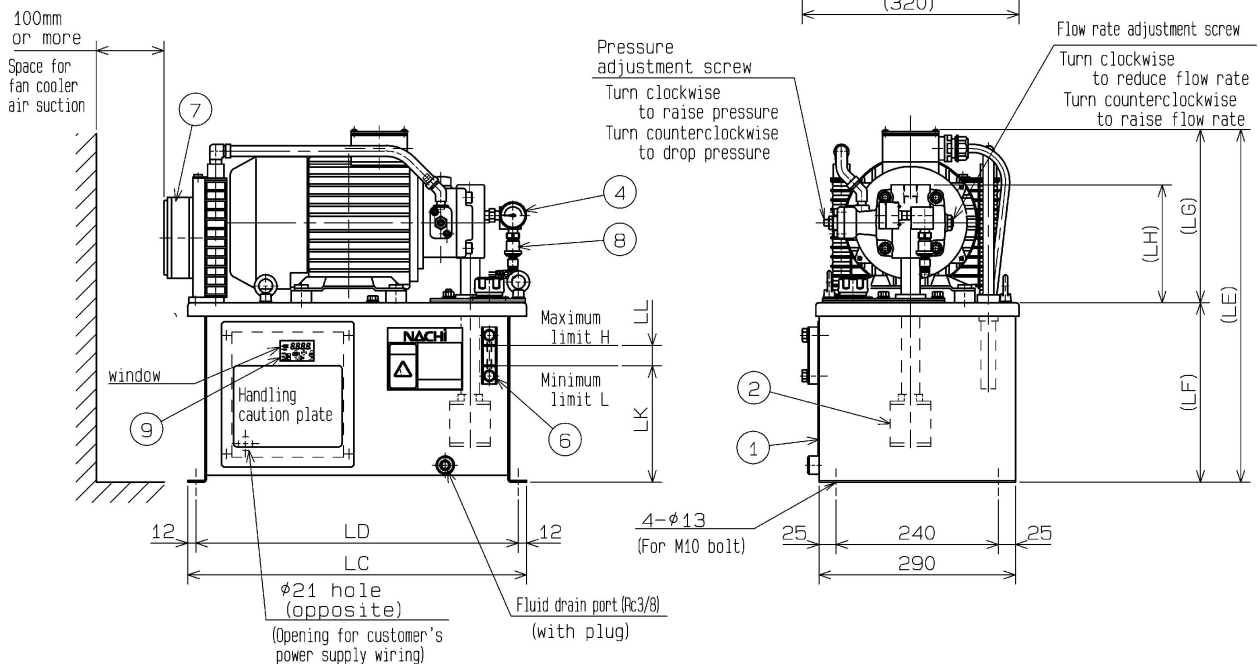
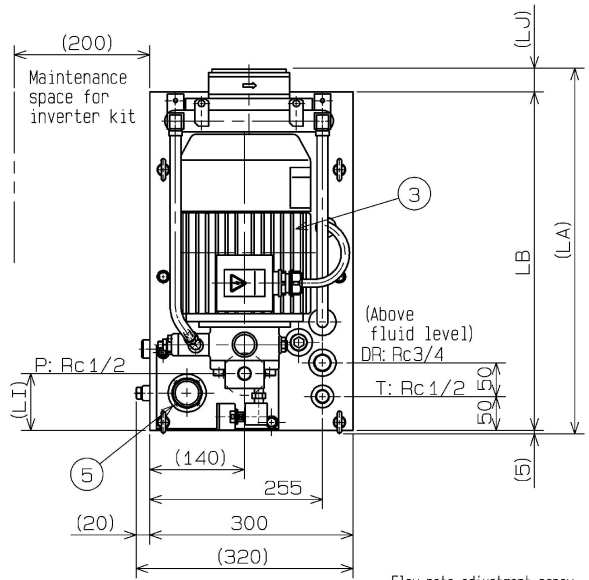


No.	Part Name	No.	Part Name
1	Hydraulic fluid reservoir	6	Fluid level gauge
2	Suction strainer	7	Fan cooler
3	Uni-pump	8	Pressure sensor
4	Pressure gauge	9	Inverter control kit
5	Air breather with filling strainer		

### 5.2 Unit Installation Dimension Drawings

Model numbers	Dimensions							
	LA	LB	LC	LD	LE	LF	LG	LH
NSP-10E-15※V※A※-23	510	500	500	476	501	265	236	164
NSP-10E-22※V 1 A※-23	540				521		256	174
NSP-20E-15※V※A※-23	510				601	236	164	
NSP-20E-22※V 1 A※-23	540	620	620	596	621	365	256	174
NSP-30E-15※V※A※-23	630				601		236	164
NSP-30E-22※V 1 A※-23					621	256	174	

Model numbers	Dimensions				Fluid quantity		Approximate mass (kg)			
	LI	LJ	LK	LL	H	L				
NSP-10E-15※V※A※-23	84	5	172	30	10L	8.5L	48			
NSP-10E-22※V 1 A※-23		35					55			
NSP-20E-15※V※A※-23		5	252				50	20L	16L	51
NSP-20E-22※V 1 A※-23		35						58		
NSP-30E-15※V※A※-23	204	5	30L	23L	55					
NSP-30E-22※V 1 A※-23	174				62					



## 6. Transportation/Installation

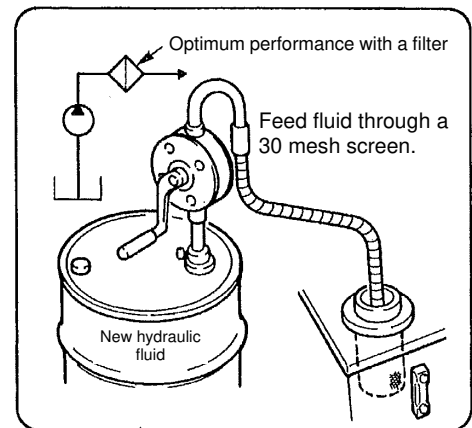
- 1) When transporting this hydraulic unit, always use the eye bolts attached on the top plate of the fluid reservoir and never hold any of the pipes/hoses or equipment by hand.  
Also, do not transport the unit while hydraulic fluid is still left in the fluid reservoir.
- 2) Install the unit in a place meeting the conditions for ambient environment according to the specification.
- 3) When installing unit, keep the unit at least 100 mm distance between the fan cooler air suction and the surrounding area.
- 4) Install the hydraulic unit in a flat surface location that is free from vibration, using bolts through the anchor holes provided at the bottom of the unit to secure.
- 5) Since some of the electrical wirings are being exposed, ensure to be careful not to damage these wires when transporting and/or installing the unit.

## 7. Initial Check and Preparation Items Before Starting Operation

- 1) Before starting the hydraulic unit, fill the fluid reservoir with clean hydraulic fluid to the specified fluid level.

Note) Majority of problems experienced with hydraulic equipment should occur shortly after the start of operation due to contaminated hydraulic fluid. One very important control point is to keep contaminated hydraulic fluid from being fed to the unit.

Level Gauge - Maximum limit : Yellow  
Specified fluid level (Nominal capacity)  
Level Gauge - Minimum limit : Red  
Minimum fluid level  
Hydraulic fluid : General mineral-based hydraulic fluid  
Equivalent to ISO VG 32



- 2) Connect the P port (discharge port) to an external manifold block using 14MPa maximum service pressure flexible hose with 1/2" inner diameter.  
To reduce any negative effect of surge pressure, use a flexible hose at least 2m in length. If the flexible hose is shorter, the holding pressure may become unstable.
- 3) Keep the maximum peak pressure (setting pressure + surge pressure) within 14MPa.  
If the maximum peak pressure exceeds 14MPa, provide a surge cutoff relief valve on the circuit side.  
If the maximum peak pressure is high, an alarm from the inverter may occur.
- 4) Leakage amount in the hydraulic circuit must be kept under 1L/min max to operate the unit.  
If the leakage amount in the hydraulic circuit exceeds 1L/min, contact us for consultation separately.
- 5) Turning the main circuit power (circuit breaker) ON/OFF in order to start/stop the unit should be limited to once per hour, as it reduces the inverter life significantly.  
If the unit must be started/stopped more frequently, refer to 10.1, 2) "External start/stop".

## 8. Power Supply Wiring

**Cautions - Please be sure to read the below statement.**

1. Never wire the power supply other than the methods explained in this manual.
2. Never change the inverter parameters other than those listed in this manual due to a risk of malfunction.

- 1) Fig. 2 shows the connection diagram of the inverter control area.
- 2) Simply wire to the power supply input terminals and to the grounding terminal of the inverter in order to operate the unit.  
Be sure to confirm that the number of phases and the voltage of power supply are matching the hydraulic unit input power specifications.
- 3) Wire the power supply correctly to the power supply input terminals R, S and T and the grounding terminal G of the inverter.  
Do not connect the power supply wires to the output terminals U, V and W of the inverter.  
Please note that when the input power of 200V class series comes without the option X1, X2 and X3, the power supply wires for the fan motor are connected to the power supply input terminals R, T and the grounding terminal G of the inverter. Regarding terminals R, T and G, tighten the wires to the unit power supply together to the fan motor power supply.  
Also, the power supply wiring must be performed by qualified electricians after confirming that the power has been turned off.  
Note) When selecting input power of 200V class series with the option X1, X2 and X3 and input power of 400V class series, perform power supply wiring for the fan motor individually according to the fan motor power supply specifications.  
If both 200V and 400V class series came without the option X1, X2 and X3, the input power specification of the fan motor is 1  $\phi$  220VAC, 50/60Hz.

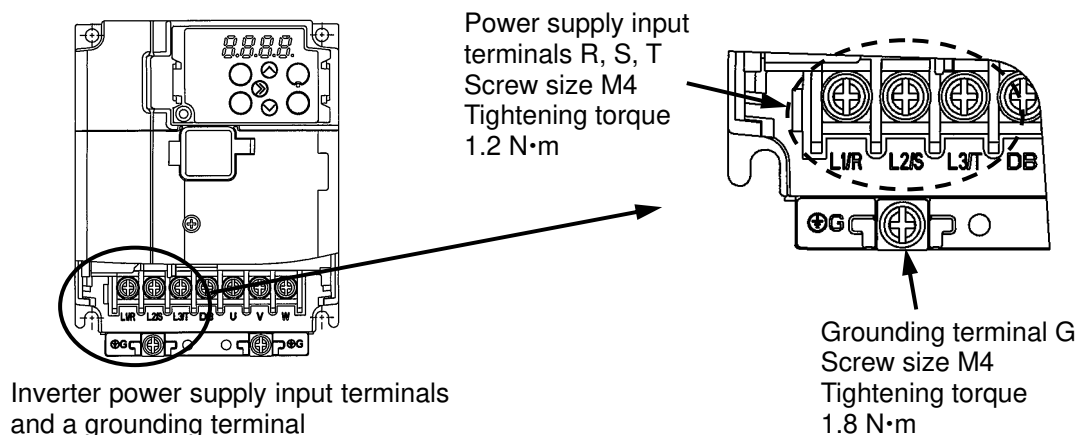


Fig. 1 Inverter Power Supply Input Terminals and Grounding Terminal

- 4) When wiring the power supply, be sure to use an oil & water resistant connector and an oil-resistant cable.  
Cable size: VCT 2.0mm<sup>2</sup> x 4 conductors (Motor capacity: 1.5kW, 2.2kW)  
Recommended cable: VCT 360 series by KURAMO ELECTRIC CO., LTD.  
Recommended connector: CAPCON OA-W series by OHM ELECTRIC CO., LTD.  
Note) If the length of power supply wiring exceeds 50m, use a larger diameter cable to reduce the voltage drop.
- 5) Be sure to ground in compliance with the national or local electric code when wiring the power supply.
- 6) Once the power is turned on, electric shock may still occur even after the power is turned off. If your work may result in accidental contact with any charged part, wait for at least 5 minutes after turning the power off. To ensure safety, further check that the DC link bus voltage between the P(+) and N(-) terminals is lower than 25VDC.  
For details, refer to the inverter instruction manual. (Refer to Fig. 3 for measuring location.)
- 7) For the wiring of optional alarm reset circuit, external start/stop circuit and alarm output circuit, etc., refer to 10, "Optional Wiring."
- 8) After having to complete wiring work and adjustment uniformly, tighten the maintenance cover mounting screws for inverter control area without fail.

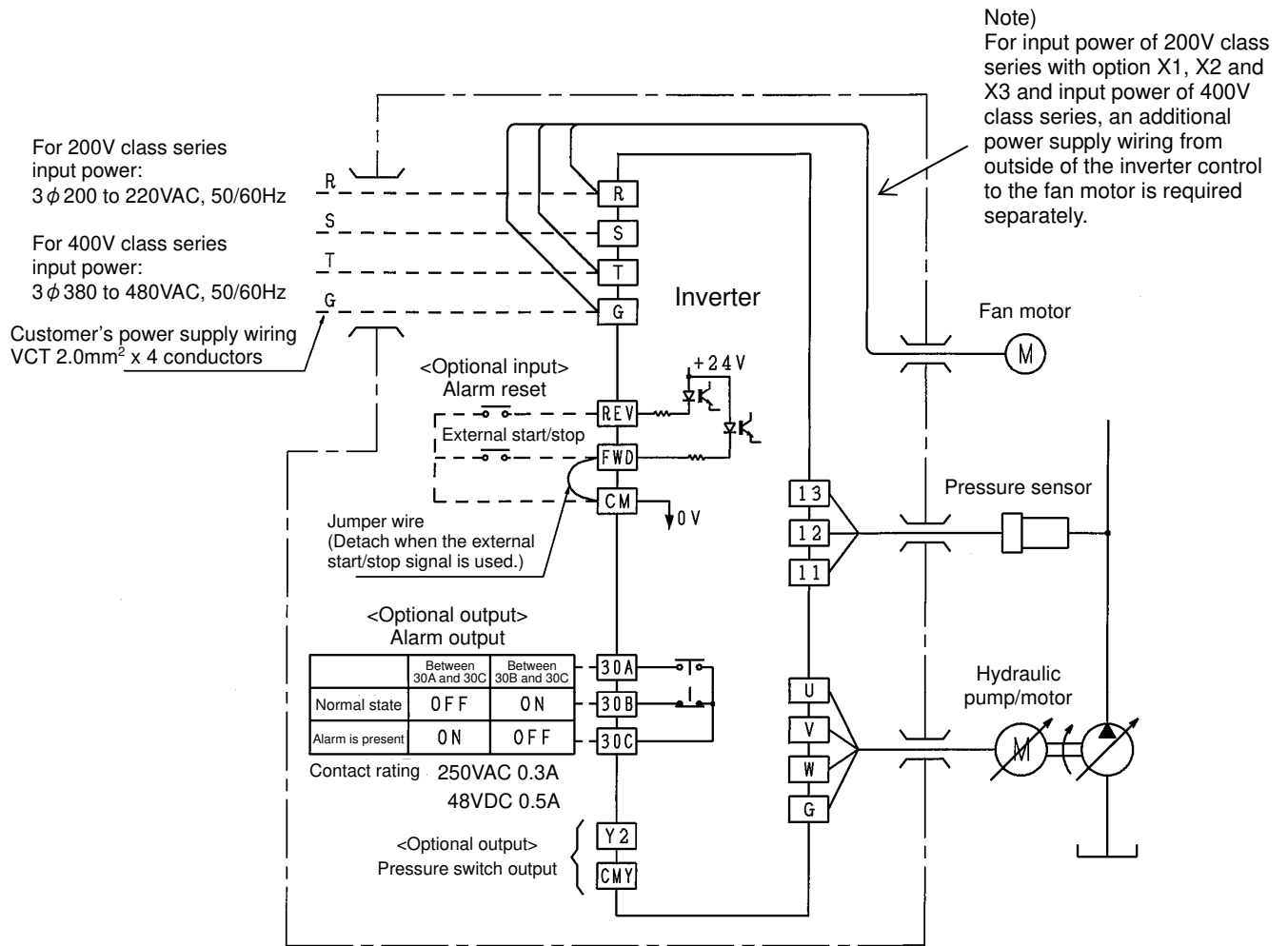


Fig. 2 Connection Diagram of Inverter Control Part  
(When optional signal inputs are the relay contact/sink type)

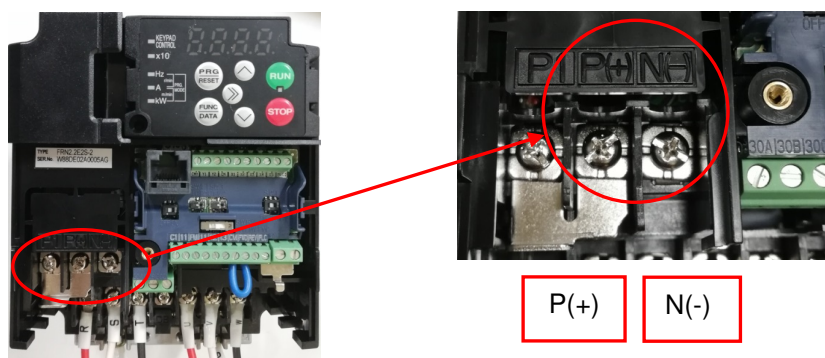




Fig. 3 Measuring Location of Inverter Internal Voltage

## 9. How to Adjust Pressure and Output Flow

- 1) This hydraulic unit was shipped from the factory in motor/pump operation-ready condition as soon as the power is turned on. Turn on the power after confirming that there is no danger even if the pump rotates and discharges pressurized oil, and no harm to the facilities.
- 2) Make sure to bleed the internal air from the hydraulic circuit by using unloading circuit, etc.
- 3) Once the pump suction and discharge stabilize, close the pump discharge port by bringing cylinder to the stroke end condition or by changing the flow position of valves.
- 4) With the pump discharge port closed, press the Up key  while holding down the Stop key  on the inverter touch panel. The pump will run at the lowest speed.  
Next, confirm that the inverter 7-segment LED monitor is showing  $P5E.L$ .

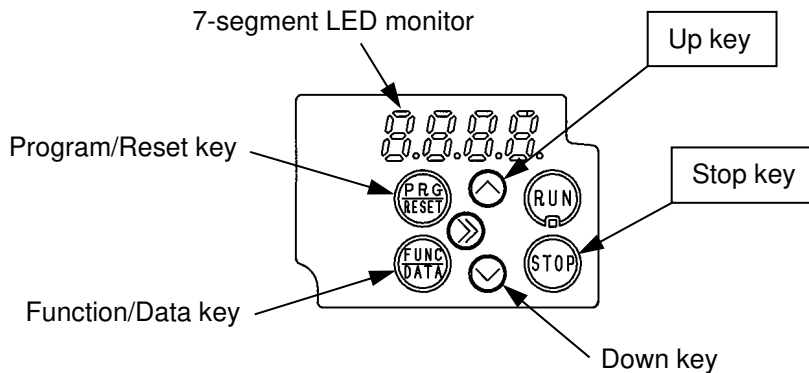


Fig. 4 Inverter Touch Panel Description

Note) Do not touch any key other than the Stop key and Up key upon pressure setting.

- 5) Operate the pump pressure adjustment screw while looking at the pressure gauge to set the discharge pressure when the pump discharge is closed.

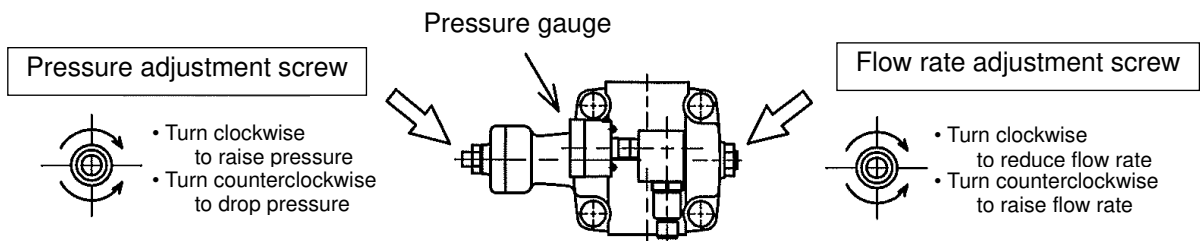


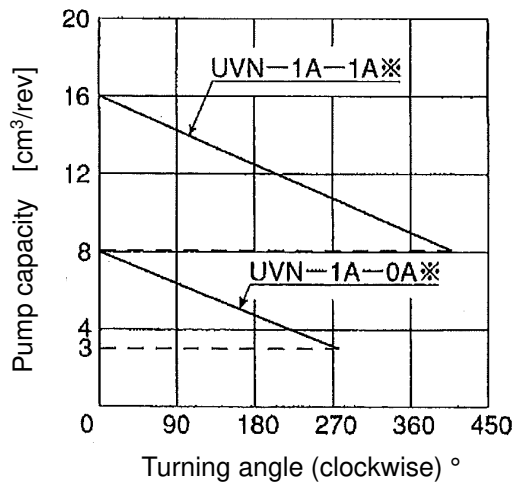
Fig. 5 Positions and Turning Directions of Pump Pressure/Flow Rate Adjustment Screws

Note) Do not turn any adjustment screw other than pump pressure adjustment screw and flow rate adjustment screw.

- 6) After setting pump discharge pressure, press the Up key  while holding down the Stop key  on the inverter touch panel again. The pressure setting is now complete.

Note) For pressure setting change, perform operation step from 3) to 6) as listed above.

- 7) Adjust the pump flow rate based on the relationship between the turning angle of the flow rate adjustment screw and the pump capacity as shown below.  
After adjusting the flow rate, securely tighten the lock nut on the flow rate adjustment screw.



Note) 0° represents the position of the adjustment screw at the maximum pump flow rate.  
The broken line indicates the lower limit of the adjustable range of the pump capacity.

Fig. 6 Relationship between Turning Angle of Flow Rate Adjustment Screw and Pump Capacity

## 10. Optional Wiring

### 10.1 Optional Signal (Input)

#### 1) Alarm reset

Resets the ongoing set alarms of inverter. Alarms are reset when the REV terminal and CM terminal are shorted with a pushbutton switch, programmable logic controller contact output, or open-collector output.

#### 2) External start/stop

Starts and stops the pump by using external contacts or open-collector output. The pump is started when the FWD terminal and CM terminal are shorted, and stopped when the terminals are opened. The unit was shipped with these terminals shorted with a jumper wire at points near them so that the pump will start immediately when the power is turned on. To start and stop the pump by using external contact, remove this jumper wire and add required wiring.

Note) The inverter input terminals are switchable between SINK type or SOURCE type. The factory setting comes with SINK type.

To set to SOURCE type, turn the slide switch SW1 to SOURCE position.

For details on how to wire both SINK/SOURCE, refer to Optional Signal (Input) Wiring Method in **【Reference】** section.

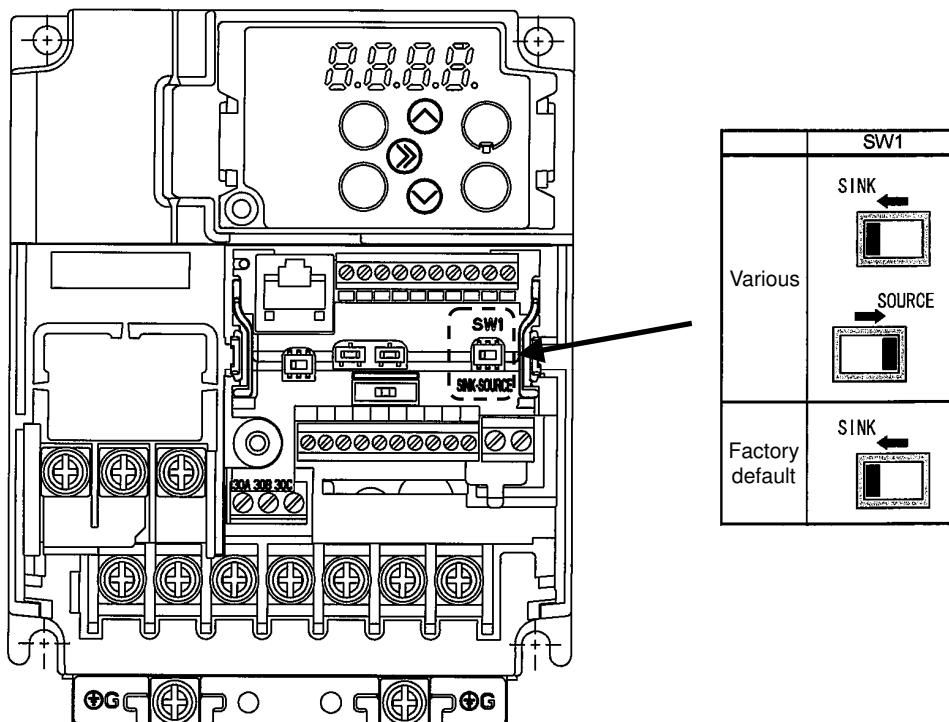


Fig. 7 Operating Direction of Slide Switch SW1



**【Reference】 Optional Signal (Input) Wiring Method**

Relay contact and open-collector can be used as optional signal (input) wiring method. Refer to the following example of the circuit configuration and perform wiring.

■ Using a relay contact to turn [FWD], [REV], [X1] ON or OFF

Fig. 8 shows examples of the circuit configuration using a relay contact. In circuit (a), the slide switch SW1 has been turned to SINK (factory default), whereas in circuit (b) it has been turned to SOURCE.

Note) To configure this kind of circuit, use a highly reliable relay which does not cause contact failure. (Recommended product: Fuji control relay Model HH54PW)

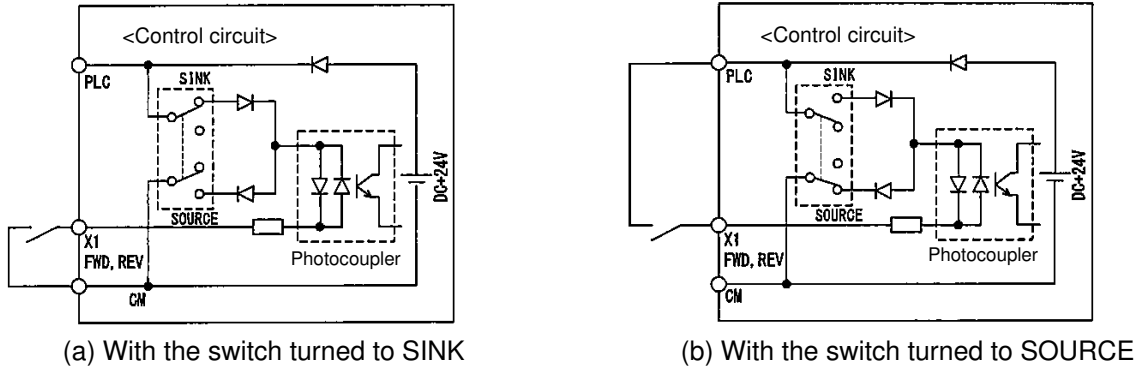


Fig. 8 Circuit Configuration Using a Relay Contact

■ Using an open-collector to turn [FWD], [REV], [X1] ON or OFF

Fig. 9 shows examples of the circuit configuration using a programmable logic controller (PLC). In circuit (a), the slide switch SW1 has been turned to SINK (factory default), whereas in circuit (b) it has been turned to SOURCE.

In circuit (a) below, short-circuiting or opening the transistor's open collector circuit in the PLC using an external power supply turns ON or OFF control signal [FWD], [REV], [X1].

When using this type of circuit, observe the following:

- Connect the positive side of the external power supply (which should be isolated from the PLC's power) to terminal [PLC] of the inverter.
- Do not connect terminal [CM] of the inverter to the common terminal of the PLC.

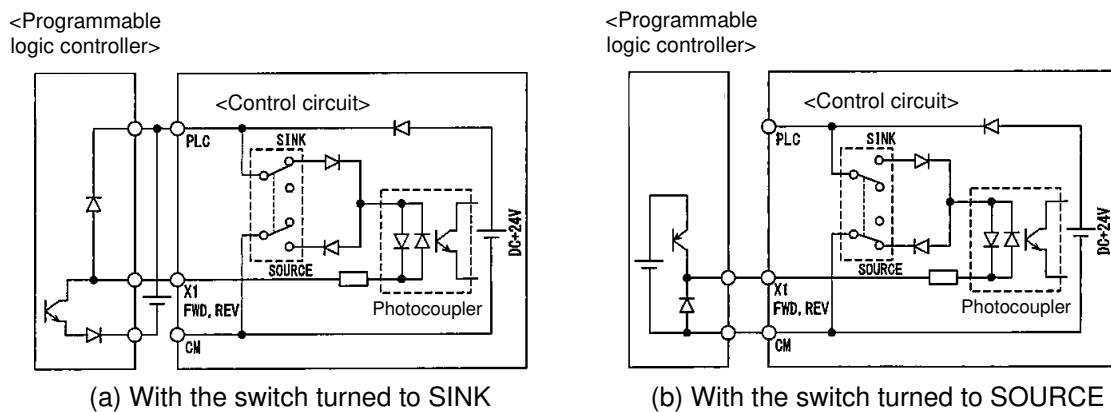


Fig. 9 Circuit Configuration Using a PLC

## 10.2 Optional Signal (Output)

### 1) Alarm output

When an alarm triggered in inverter, an alarm signal is output between the 30C terminal and 30A terminal or 30B terminal.

The contact between 30C terminal and 30A terminal is open at normal condition, and closed at abnormal occurrences.

The contact between 30C terminal and 30B terminal is closed at normal condition, and open at abnormal occurrences.









The contact capacity is 0.3A at 250VAC, 0.5A at 48VDC, so make sure the current does not exceed this level.


#### ■ Forced Output of Alarm Signal

When using alarm signal, alarm signal can be output forcedly by performing the following operations on the inverter touch panel to confirm wiring states, etc.

(Refer to Fig. 4 for the operation keys on the inverter touch panel.)

#### 【Operation Procedure of Alarm Signal Forced Output】

1. Unit in operating condition, press the Program/Reset key  .  
↓
2. 「0.Fnc」 is displayed on the 7-segment LED monitor.  
↓
3. Use the Up key  and press until 「1.H\_\_」 displayed.  
↓
4. Press the Function/Data key  to select 「1.H\_\_」.  
↓
5. Use the Up key  and press until 「H45」 displayed.  
↓
6. Press the Function/Data key  to select 「H45」.  
↓
7. 「0」 is displayed on the LED monitor.  
↓
8. Press the Up key  while holding down the Stop key  .  
↓
9. 「1」 is displayed on the LED monitor.  
↓
10. Press the Function/Data key  .  
↓
11. 「E r r」 is displayed on the LED monitor, and alarm output is in a condition of ON.  
At the same time, the output to the motor is in a condition of OFF. (Motor is in a stop state.)

Note) If the Program/Reset key  is pressed when the alarm output is in a condition of ON, operating conditions return to a normal state, and the motor rotates.  
Confirm that pumping hydraulic fluid by the motor rotation will not cause any danger around the unit, then start operation.

2) Pressure switch function

When the pressure detected by the pressure sensor mounted on the hydraulic unit rises to or above the set pressure (operation level) and continues for longer than the pressure switch ON delay time, the contact signal turns ON. Once the detected pressure falls to or below 90% of the set pressure (operation level), the contact signal turns OFF immediately. The contact signal is output from the Y2 terminal and CMY terminal (transistor output).

Adjust the set pressure and pressure switch ON delay time respectively by changing the data (set value) of function codes L68 and L69 in the following procedures.

■ Function code L68: Pressure detection (operation level)

Set range: 0.00 to 100.0%

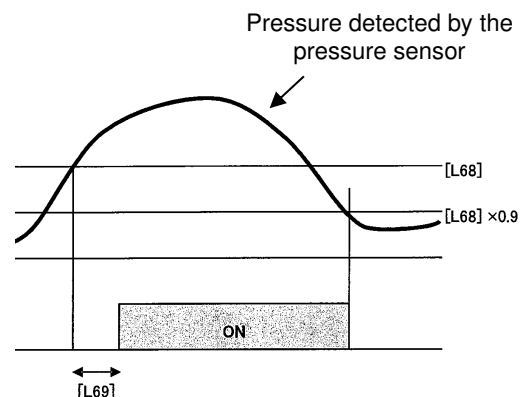
Factory set value: 100.0% (35MPa at 100.0%)

Example) With 7MPa set pressure, the set value of L68 to be  $7/35 \times 100.0\% = 20.0\%$ .











■ Function code L69: Pressure switch ON delay time

Set range: 0.01 to 600.0s

Factory set value: 10.00s



【Change Procedure of Function Code Data (Example: Change code L68)】

1. Unit in operating condition, press the Program/Reset key  .
- ↓
2. 「0.Fnc」 is displayed on the 7-segment LED monitor.
- ↓
3. Use the Up key  and press until 「1.L\_\_」 displayed.
- ↓
4. Press the Function/Data key  to select 「1.L\_\_」.
- ↓
5. Use the Up key  and press until 「L68」 displayed.
- ↓
6. Press the Function/Data key  to select 「L68」.
- ↓
7. Change the function code data by using the Up key  or Down key .
- ↓
8. Press the Function/Data key  to establish the function code data. 「SAVE」 appears and the data will be saved.
- ↓
9. Press the Program/Reset key  to return to 「1.L\_\_」 display.
- ↓
10. Press the Program/Reset key  to return to the initial state.

Note) The contact output circuit of the pressure switch can be connected to a circuit of either the SINK input type or SOURCE input type.  
 The followings show examples of connection between the contact output circuit of the pressure switch and a programmable logic controller (PLC).  
 In example Fig. 10, the input circuit of the PLC serves as a SINK for the contact output circuit, whereas in example Fig. 11, it serves as a SOURCE for the output.

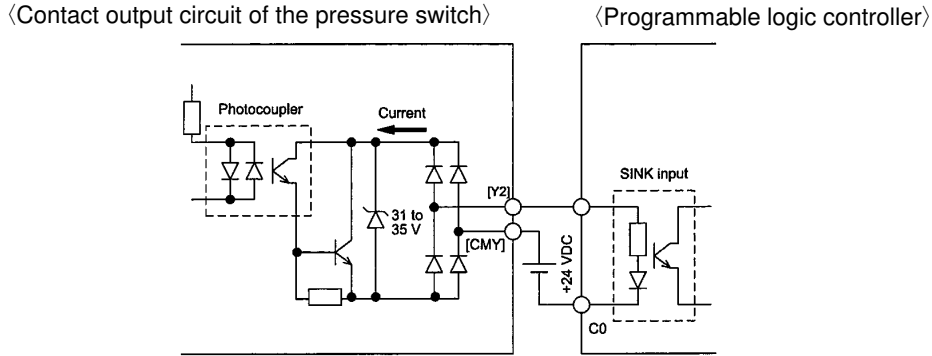


Fig. 10 PLC serving as SINK

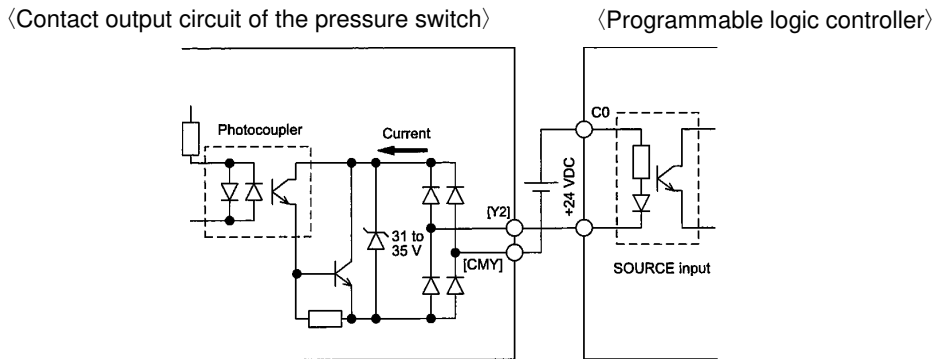
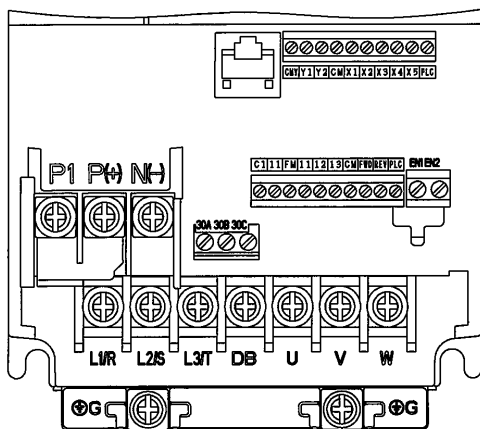


Fig. 11 PLC serving as SOURCE

### 10.3 Terminal Block for Optional Wiring

Remove the terminal cover at the front face of inverter to access the terminal block for optional wiring. The terminal block for optional wiring is designed in such a way that tightening the screw secures the terminal together with the core wire.



Terminal Symbol	Screw specification		Allowable wire sizes	Screwdriver (shape of tip)	Wire strip length	Gauge size to insert wire
	Size	Tightening torque				
30A, 30B, 30C EN1, EN2	M3	0.5N·m	0.14~1.5mm <sup>2</sup> (AWG26~16)	Flat-head (0.6mmx3.5mm)	6mm	A1*1
FWD, REV, CM Y2, CMY, X1, PLC	M2	0.19N·m	0.25~1mm <sup>2</sup> (AWG24~18)	Flat-head (0.4mmx2.5mm)	5mm	φ1.6


\*1 Defined according to IEC/EN 60947-1

Fig. 12 Terminal Block for Optional Wiring of Inverter (Shown with terminal cover removed)

Note) No issue with using stripped tip wire alone but a rod terminal is also feasible for connection as needed.

## 11. Operating Condition Check

### 11.1 Check by Inverter LED Monitor

When press the inverter touch panel Function/Data key  repeatedly during normal operation, the items displayed on the LED monitor will change one by one (see Fig. 13) and the different information can be confirmed.

The factory default for LED Monitor display is set to the output frequency for turning on the power. By changing the data (set value) of inverter function code E43 "LED monitor item selection" the display items can be changed to input power or pressure, etc.

For details regarding how to change the function code, refer to the inverter instruction manual.

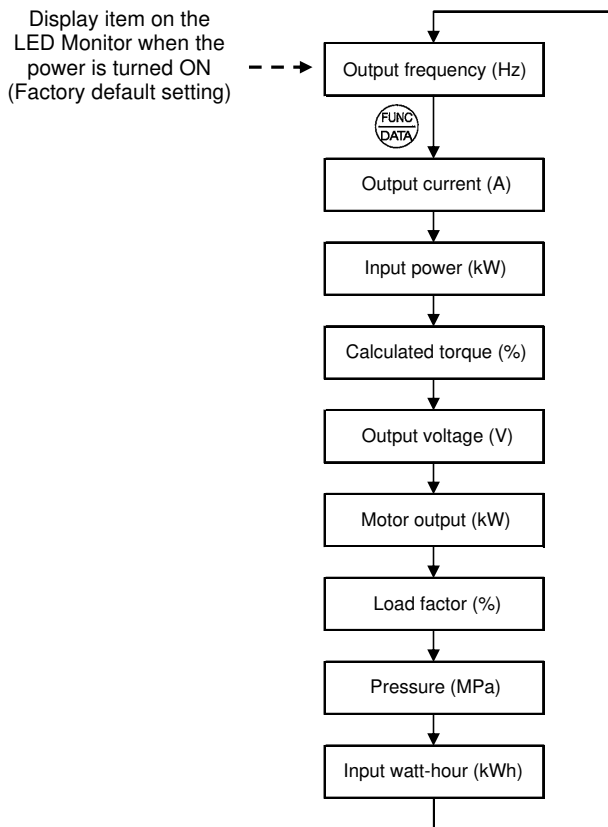


Fig. 13 LED Monitor display item sequence

Note) To change the display item on the LED monitor to pressure when the power is turned ON, change the data of inverter function code E43 "LED monitor item selection" to 17 (Pressure display).

Fig. 14 shows the pressure display.



(Display example of 5.12MPa)

Fig. 14 LED Showing Pressure

## 11.2 Check by RS-485 communication

By connecting to the RS-485 communication port (RJ-45 connector) mounted on the inverter, operating condition such as power and pressure, as well as alarm and maintenance information, etc. can be confirmed.

For details on the communication method, refer to the communication method for “FRENIC-Ace” in the FRENIC-Mini/Eco/Multi/MEGA/Ace RS-485 User's Manual (Document no. 24A7-J-0082), which can be downloaded from the homepage of the inverter manufacturer, Fuji Electric Co., Ltd.

To confirm the pressure via communication, check with the communication dedicated function code W33.

Note) Function code W33 has been changed from Fuji Electric standard specification to the function code dedicated to Pressure monitor.

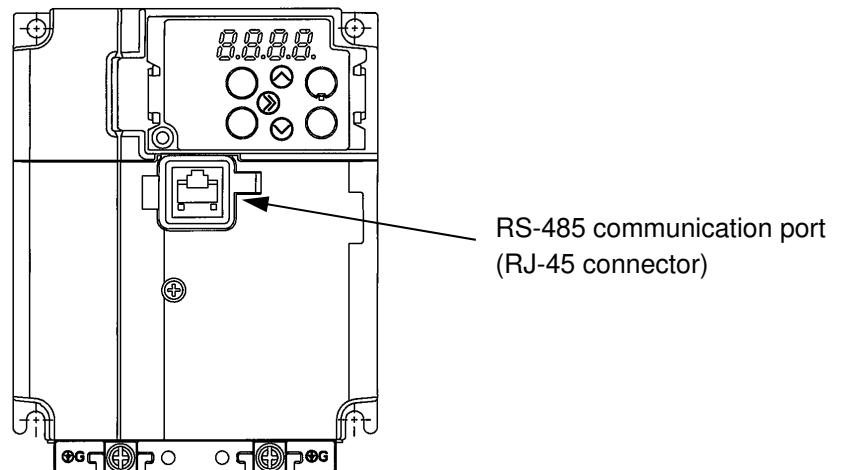


Fig. 15 Location of RS-485 communication port

## 12. Maintenance and Inspection

- 1) Operating hydraulic unit with advanced hydraulic fluid degradation not only shortens the life of the hydraulic equipment, but also hinder the operation of the machine. Periodically check and replace the hydraulic fluid. When replacing, be sure not to mix with different type of hydraulic fluid.
- 2) The timing of hydraulic fluid replacement varies depending on the machine operating conditions and the surrounding environment, but a guide line, first replace fluid after three months, and then replace it when contamination is observed or once a year. In addition, in order to grasp the replacement timing unique to the machine, periodically collect fluid from the tank and check the degree of hue, transparency, sediment, order, etc., compared with new hydraulic fluid. Request analysis from hydraulic fluid manufacturer if necessary.
- 3) Do not leave the filler port of the fluid reservoir open.
- 4) Use the hydraulic unit with fluid temperature between 10 to 60°C.
- 5) Inspect the fan cooler fins for clogging every three to six months, and inspect and clean the interior of the fluid reservoir and the suction strainer every six months.
- 6) Regularly check on the 7-segment LED monitor of the inverter that the pump runs at low speed when the pump is in the full cutoff state (at pressure hold). The reference frequency at low speed is 22 to 24Hz. However, depending on the amount of leakage on the circuit side, it may be higher than this frequency.
- 7) When changing the set pressure and flow rate of the pump, reset it according to the procedure described in 9, "How to Adjust Pressure and Output Flow."
- 8) If the output signal voltage is not output due to pressure sensor cable abnormality (such as disconnection, detached connector, etc.) or pressure sensor failure, "CUt" is displayed on the inverter LED monitor and the operation is fixed at 60Hz. Check wirings and other suspects for abnormality.



Fig. 16 LED Showing "CUt"

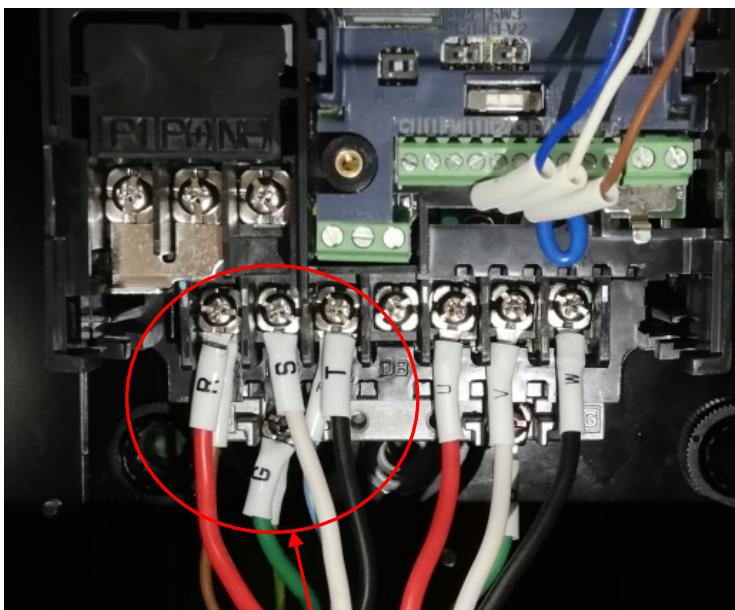
### 13. Troubleshooting

- 1) The rotation speed does not increase even when the pump discharges without load.
  - The set pressure of the pump may have been changed. When changing the set pressure of the pump, perform pressure setting again according to the procedures described in 9, "How to Adjust Pressure and Output Flow."
- 2) The rotation speed does not decrease even when the pump is in the full cutoff state (at pressure hold).
  - The set pressure of the pump may have been changed. When changing the set pressure of the pump, perform pressure setting again according to the procedures described in 9, "How to Adjust Pressure and Output Flow."
  - If the grounding wire has deficiencies, the set pressure may be read higher or lower than the actual pressure during pressure setting operation due to noise. Check the grounding wire for deficiency, and perform pressure setting again.
  - Check that the pressure sensor connector is not disconnected or damaged, and that the wiring cable is not damaged, either.
- 3) The pump does not rotate even when the power is turned on.
  - When wiring was changed to External start/stop, just turning on the power is not enough to rotate the pump. Input the start signal referring to 10.1, 2) "External start/stop."
- 4) When the hydraulic unit is needed to operate without an inverter drive due to inverter failure.

Note) Only in the case of the following input power, this hydraulic unit can be operated without inverter drive. Please note that this unit does not support any voltages and frequencies other than the following. Only the following input power types enable unit operation without inverter drive.

  - Input power of 200V class series: 200VAC 50/60Hz, 220VAC 60Hz
  - Input power of 400V class series: 380VAC 50/60Hz

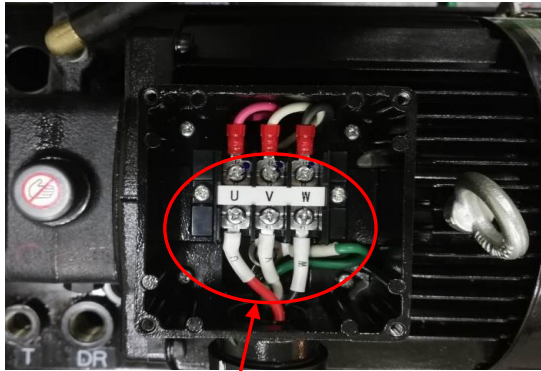
- ① Remove the power supply wires (R, S, T, G) to the inverter power supply input terminals and grounding terminal.



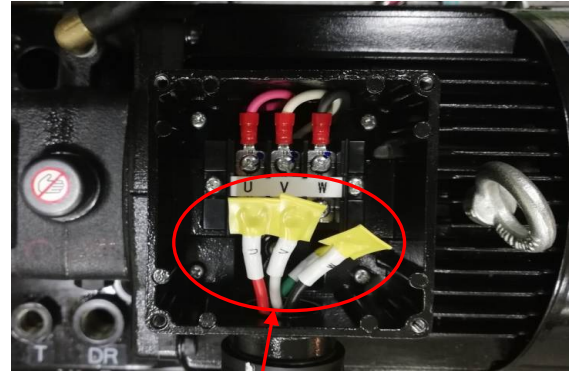
Remove the power supply wires (R, S, T, G).



- ② Open the terminal box of the motor and remove the motor wires U, V, W and the grounding wire G that were connected with the inverter. Just in case, insulate the crimp terminal parts of the removed wires by wrapping with an insulating tape, etc.



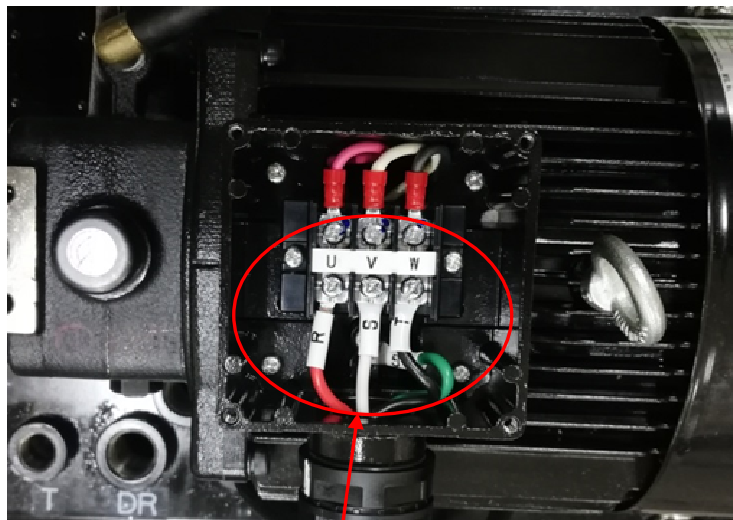
Remove the motor wires (U, V, W) and the grounding wire (G).



Insulating tape

- ③ Connect the power supply wires removed at the procedure ① to the terminal blocks in the terminal box of the motor. Basically, connect R to U, S to V, T to W and G to the grounding terminal of the motor.

If the phases of power supply wiring are in reverse, the motor will rotate in the reverse direction. In order to prevent damage to the pump, ensure to check that the motor rotates in the correct direction by inching operation when starting.



Connect the power supply wires (R, S, T, G) removed at the procedure ① to the motor.

- 5) The hunting of the motor rotation speed occurs around the pump full cutoff.
- The pump setting pressure may have been changed. When changing the pump setting pressure, perform pressure setting again according to the procedures described in 9, "Adjusting the Pressure and Output Flow."
  - In case of significant leakage in the hydraulic circuit or wide fluctuation of load pressure, the hunting of the motor rotation speed may occur around the pump full cutoff.  
In this case, the hunting can be suppressed by changing the data (set value) of function code F16 and setting the motor rotation speed at low speed higher than the reference frequency (22 to 24Hz). Note that if the motor rotation speed at low speed has been set higher than the reference frequency (22 to 24Hz), the discharge pressure in the pump full cutoff state would be lower than before changing.  
After changing the set value of function code F16, perform pressure setting again according to the procedures described in 9, "Adjusting the Pressure and Output Flow."











■ Function code F16: Frequency limiter (low)

Frequency limiter (low) specifies the lower limit of the output frequency.

Setting range: 23.33 to 60Hz

Factory set value: 0Hz

【Change Procedure of Function Code Data (F16)】

1. In operating conditions, press the Program/Reset key  .  
↓
2. 「0.Fnc」 is displayed on the 7-segment LED monitor.  
↓
3. Use the Up key  to display 「1.F\_\_」.  
↓
4. Press the Function/Data key  to select 「1.F\_\_」.  
↓
5. Use the Up key  to display 「F16」.  
↓
6. Press the Function/Data key  to select 「F16」.  
↓
7. Change the function code data by using the Up key  or Down key  .  
↓
8. Press the Function/Data key  to establish the function code data.  
「SAVE」 appears and the data will be saved.  
↓
9. Press the Program/Reset key  . The display will return to 「1.F\_\_」.  
↓
10. Press the Program/Reset key  . The display will return to the initial state.

## 14. Safe Torque Off Function

Inverter includes the Safe Torque Off function (STO) specified in the Safety Standard IEC/EN 61800-5-2. Using this function ensures compliance with the System Safety Standard EN ISO 13849-1:2006 PL=e Cat.3 without installing a safety shut-off device outside of the inverter. Contact us for more detail.

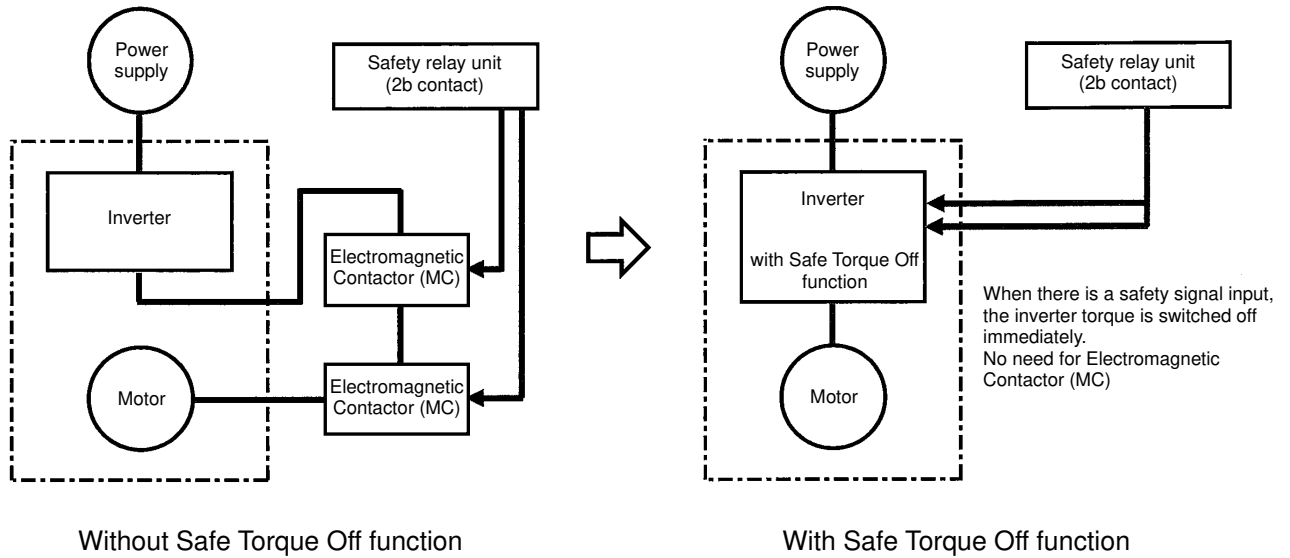


Fig. 17 Supporting system safety standard using Safe Torque Off function