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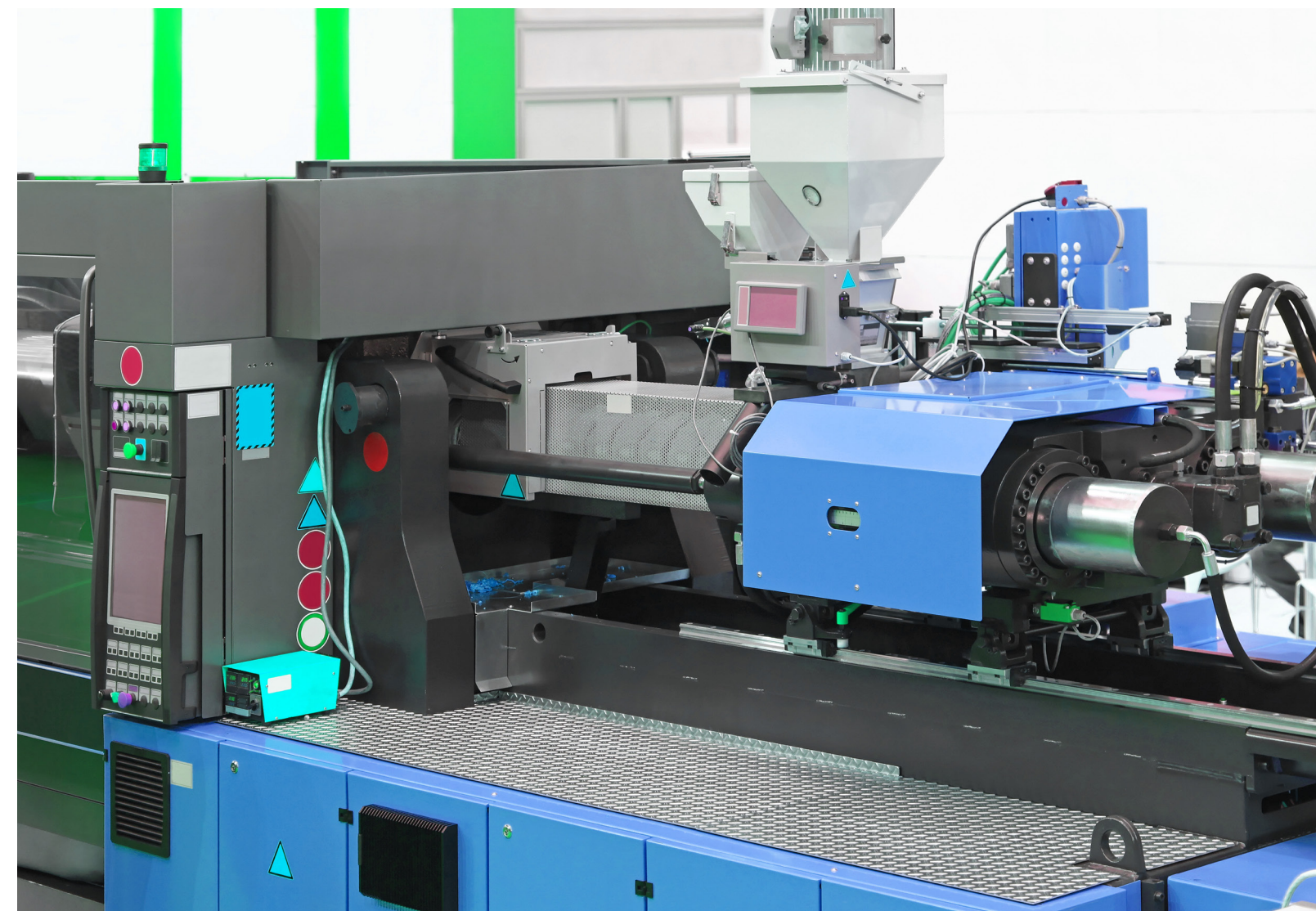
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## Delta Hybrid Servo Drive VFD-VJ Series - User Manual



## Delta Hybrid Servo Drive VFD-VJ Series User Manual

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# Preface

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This manual is to be used for the installation, parameter setting, troubleshooting, and daily maintenance of the hybrid servo drive. To guarantee safe operation of the equipment, read the following safety guidelines before connecting power to the hybrid servo drive. Keep this operating manual at hand and distribute to all users for reference.

To ensure the safety of operators and equipment, only qualified personnel familiar with hybrid servo drive are to do installation, start-up and maintenance. Always read this manual thoroughly before using VFD-VJ series Hybrid Servo Drive, especially the WARNING, DANGER and CAUTION notes. Failure to comply may result in personal injury and equipment damage. If you have any questions, please contact your dealer.

Firmware version: V1.06

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## PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

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- ☑ AC input power must be disconnected before any wiring to the hybrid servo drive is made.
- ☑ Even if the power has been turned off, a charge may remain in the DC-link capacitors with hazardous voltages before the POWER LED is OFF. Do not touch the internal circuit and components. For safe maintenance, use a multimeter to measure the voltage across the +1 and – terminals. The measured value should be lower than 25V<sub>DC</sub> for the system to operate normally.
- ☑ There are highly sensitive MOS components on the printed circuit boards. These components are especially sensitive to static electricity. Do not touch these components or the circuit boards before taking anti-static measures. Never reassemble internal components or wiring.
- ☑ Ground the hybrid servo drive using the ground terminal. The grounding method must comply with the laws of the region where the hybrid servo drive is to be installed.
- ☑ This series of products is used to control the three-phase induction motors and permanent magnet synchronous motors. It cannot be used for single-phase motors or for other purposes.
- ☑ This series of products cannot be used on occasions that may endanger personal safety.
- ☑ Please prevent children or unauthorized personnel from approaching the hybrid servo drive.



- ☑ Never connect the output terminals U/T1, V/T2 and W/T3 of the hybrid servo drive directly to the AC mains circuit power supply.
- ☑ After finishing the wiring of the hybrid servo drive, check if U/T1, V/T2, and W/T3 are short-circuited to ground with a multimeter. Do NOT power the drive if short circuits occur. Eliminate the short circuits before the drive is powered.
- ☑ DO NOT use Hi-pot test for internal components. The semi-conductor used in hybrid servo drive easily damage by high-voltage.
- ☑ Even if the three-phase hybrid servo drive is stop, a charge may remain in the main circuit terminals of the hybrid servo drive with hazardous voltages.

- ☑ Only qualified persons are allowed to install, wire and maintain hybrid servo drives.
- ☑ When the hybrid servo drive uses an external terminal as its source of operation commands, the motor may start running immediately after the power is supplied. In this case, it may be dangerous to any on-site personnel.
- ☑ The oil tank adjusts the oil volume, and the oil volume must be enough for the hybrid servo drive to run. It is absolutely prohibited to run the oil pump without oil.
- ☑ The oil temperature of the oil tank must be in control within the required range, and if necessary, install a cooler.
- ☑ Release completely the air inside the system before you add more pressure to the system.
- ☑ Do a no-load running of the oil pump under the jog mode to ensure sufficient lubrication of the oil pump.



- ☑ DO NOT install the hybrid servo drive in a place subjected to high temperature, direct sunlight, high humidity, excessive vibration, corrosive gases or liquids, or airborne dust or metallic particles.
- ☑ Only use hybrid servo drives within specification. Failure to comply may result in fire, explosion or electric shock.
- ☑ When the motor cable between hybrid servo drive and motor is too long, the layer insulation of the motor may be damaged. Please add an AC output reactor to prevent damage to the motor. Refer to Appendix A-4 Reactor for details.
- ☑ The rated voltage for hybrid servo drive must be  $\leq 240V$  ( $\leq 480V$  for 460V models) and the mains supply current capacity must be  $\leq 5000A$  RMS ( $\leq 10000A$  RMS for the  $\geq 40hp$  (30kW) models).
- ☑ Pay attention to the following when transporting and installing this package (including wooden crate, wood stave and carton box):
  1. If you need to sterilize, deworm the wooden crate or carton box, do not use steamed smoke sterilization or you will damage the product inside.
  2. Use other ways to sterilize or deworm.
  3. You may use high temperatures to sterilize or deworm. Leave the packaging materials in an environment of over  $56^{\circ}C$  for 30 minutes.
  4. It is strictly forbidden to use steamed smoking sterilization. The warranty does not cover the product damaged by steamed smoking sterilization

 **NOTE**

- For a detailed explanation of the product specifications, the cover or the safety shields will be disassembled on some pictures or graphics. When the product is put to operation, please install the top cover and safety shield and ensure correct wiring. Refer to the manual to ensure safe operation.
- The figures in this manual are for reference only, they may be slightly different from your actual drive, but it will not affect your customer rights.
- The content of this manual may be revised without prior notice. Please consult our distributors or download the latest version at [http://www.deltaww.com/iadownload\\_acmotordrive](http://www.deltaww.com/iadownload_acmotordrive)

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# Chapter 1 Description of Hybrid Servo Drives

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- 1-1 Receiving and Inspection
- 1-2 Product Specifications
- 1-3 Overview of Hybrid Servo Systems
- 1-4 Product Installation
- 1-5 Product Dimensions

The hybrid servo drive should be kept in the shipping carton or crate before installation. To retain the warranty coverage, the hybrid servo drive should be stored properly if not used in a short time. Storage conditions are:



- Store in a well-ventilated, clean and dry location.
- Store in place with ambient temperature range of  $-20^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$ .
- Store in place with a relative humidity range of 0% to 90% and non-condensing environment.
- Avoid storing the product in an environment containing corrosive gases and liquids.
- Place the product on an appropriate stand and DO NOT place it on the ground directly. Put exsiccator in the package if in a critical environment.
- Installing in location free from direct sunlight and vibration.
- DO NOT store in an area with rapid changes in temperature even though the humidity is within range. It may still cause condensation and frost.
- If the hybrid servo drive is unopened and stored for more than three months, the ambient temperature should not be above  $30^{\circ}\text{C}$ . Temperature above  $30^{\circ}\text{C}$  may affect the quality of electrolytic capacitors especially when they stored without power supply. It is always not recommended to store the product without supplying power for more than one year.
- If the hybrid servo drive was installed but not used for a certain period of time, especially in building sites or extremely humid and dusty places, it is always recommended to remove the hybrid servo drive to an environment that meets the above-mentioned requirements.

## 1-1 Receiving and Inspection

This VFD-VJ hybrid servo drive has gone through tough tests at the factory before shipping under quality control and strengthened the packaging method to secure it. Upon receiving the hybrid servo drive, please check the following items immediately:

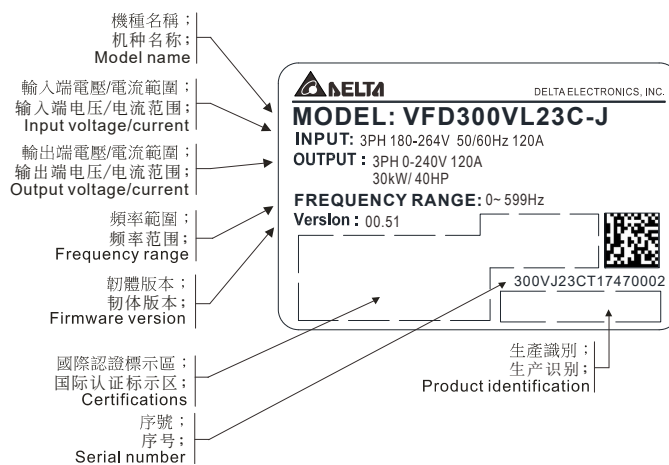
- ☑ Inspect the drive to assure it was not damaged during shipping.
- ☑ Make sure the model name on the nameplate corresponds to that of your registered information in the shipping carton.

If the registered information does not match your purchase order, or if there is any problem in the product, please contact the dealer or distributor.

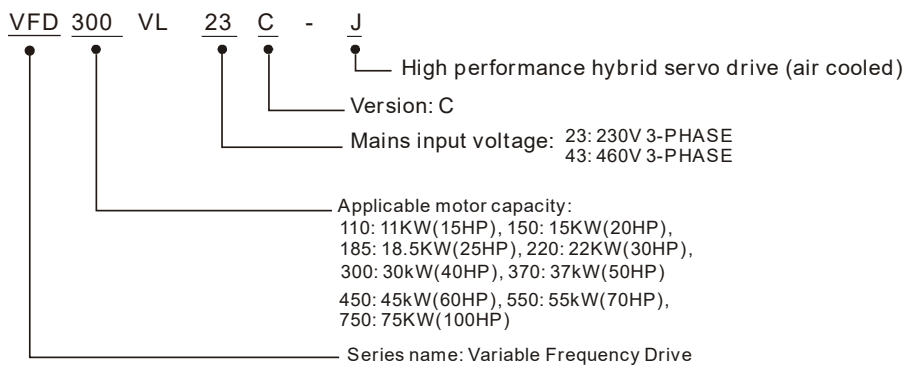
### Air Cooled:

### Nameplate:

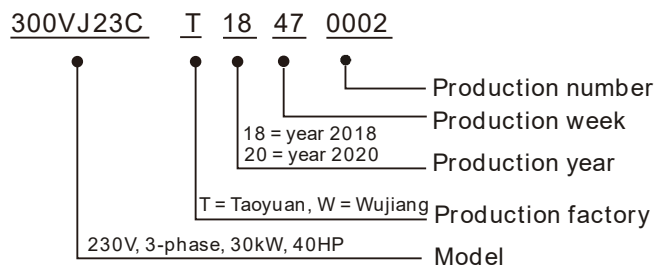
Take the 30kW, 40HP, 230V<sub>AC</sub> 3-Phase model as an example.



### Model Name:



### Serial Number:





## 1-2 Product Specifications

### Air Cooled VFD-VJ-A 230V models

Frame Size		C	D		
Model VFD-__ _ VL23A-J		110	150	185	220
Power (KW)		11	15	18.5	22
Horse Power (HP)		15	20	25	30
Rated Output Current(A)		41.1	53	70	79
Output	Continuous Output Current for 60 sec (A)	62	90	119	79
	Continuous Output Current for 20 sec (A)	70	106	140	119
Power supply	Rated Input Current(A)	47	56	73	90
	Rated Input Voltage(V)	Three-Phase Power: 200~240V 50/60Hz			
	Mains Voltage Tolerance	±10% (180~264V)			
	Mains Frequency Tolerance	±5% (47~63Hz)			
Weight (kg)		10	13	13	13

### Air Cooled VFD-VJ-C 230 models

Frame Size		E4	
Model VFD-__ _ VL23 -J		300 C	370 C
Power (KW)		30	37
Horse Power (HP)		40	50
Output	Rated Output Current(A)	120	146
	Continuous Output Current for 60 sec (A)	204	248
	Continuous Output Current for 20 sec (A)	240	292
	Carrier Frequency (Hz)	4k ~ 10k adjustable	
Power Supply	Rated Input Current(A)	120	146
	Rated Input Voltage(V)	Three-Phase Power: 200V~240V, 50Hz/ 60Hz	
	Mains Voltage Tolerance	-15% ~ +10% (170V~264V)	
	Mains Frequency Tolerance	±5% (47~63Hz)	
Weight (kg)		44	
Brake Units		Built-In	


**Air Cooled VFD-VJ-C 460V models**

Frame Size		C				D		E4		
Model VFD-	VL43 -J	110 C	150 C	185 C	220 C	300 C	370 C	450 C	550 C	750 C
Power (KW)		11	15	18.5	22	30	37	45	55	75
Horse Power (HP)		15	20	25	30	40	50	60	75	100
Output	Rated Output Current( A)	21	27	34	41	60	73	91	110	150
	Continuous Output Current for 60 sec (A)	36	46	58	70	102	124	155	187	255
	Continuous Output Current for 20 sec (A)	42	54	68	82	120	146	182	220	300
	Carrier Frequency (Hz)	4k ~ 10k adjustable								
Power Supply	Rated Input Current(A)	24	30	37	47	60	73	91	110	150
	Rated Input Voltage(V)	Three-Phase Power: 380V ~ 480V, 50Hz / 60Hz								
	Mains Voltage Tolerance	-15% ~ +10% (323V ~ 528V)								
	Mains Frequency Tolerance	±5% (47~63Hz)								
Weight (kg)		9				13		36	46	
Brake Units		Built-In								

\*When the carrier frequency is 4~ 5kHz, the rated current reaches 100%. However, as the carrier frequency increases, the rated current decreases. Therefore, the overload capacity decreases. Refer to parameter Pr01-33 for more information.

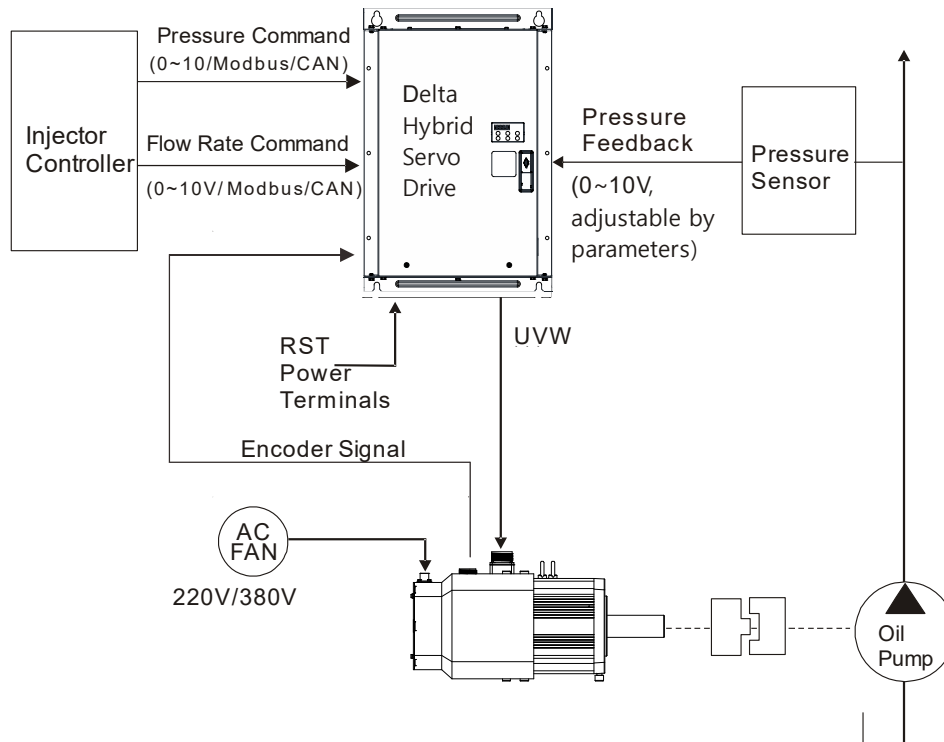
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**General Specifications**

Control Method		SVPWM
Speed Detector		Resolver
Speed Command Input		DC 0~10V, support 3-point calibration of analog input
Pressure Command Input		DC 0~10V, support 3-point calibration of analog input
Pressure Feedback Input		Support voltage type: DC 0 ~ 10V and current type: 4 ~ 20mA (For detailed instruction and settings, see Pr03-12 for more information)
Multi-function Input Signal		6 ch DC24V
Multi-function Output Signal		2 ch DC48V 50mA(max), 1 ch Relay output
Analog Output Voltage		2 channels: 1ch DC 0 ~ 10V and 1ch DC -10 ~ 10V, max. load: 2mA
Communication Port		RJ45 x2, USB x1
Communication Protocol		CANopen and Modbus (can be used at the same time)
Accessories	Speed Feedback PG Card	Built-In
	Multiple Drives Convergent Flow Card	Built-In
	Brake Resistor	Required
	Pressure Sensor	Required (Compatible with pressure sensor with output signal 0~10V or 4~ 20mA. Use Pr03-10 for maximum output voltage of pressure feedback, Pr03-11 for minimum output voltage of pressure feedback, Pr03-12 for output signal settings and Pr00-08 for maximum pressure setting.)
	EMI filter	Optional (See appendix A-7 in the user manual.)
Protection Function	Motor Protection	Real-time temperature monitoring and protection, electronic thermal relay protection (supports KTY84-130/PTC/temperature protection switch)
	Over-Current Protection	Output over-current protection and brake over-current protection
	Ground Leakage Current Protection	80% higher than drive's rated current
	Voltage Protection	Over-voltage level: $V_{DC} > 415/830V$ ; Low-voltage Level: $V_{DC} < 180/360V$
	Mains Input Over-voltage Protection	Varistor (MOV)
	Over-temperature Protection	Monitoring the temperature of Capacitor, IGBT, Braking Chopper and Motor.
	Brake Resistor Protection	Open circuited, low resistor value
Environment	Protection Level	NEMA 1/IP20
	Operation Temperature	-10°C ~ 45°C (14°F ~ 113°F) (When the ambient temperature is around 45~60°C, you need to decrease the rated current by 3%.)
	Storage Temperature	-20°C ~ 60°C (-4°F ~ 140°F)
	Humidity	Below 90% RH (non-condensing)
	Vibration	Below 20Hz: 1.0G; between 20 and 60Hz: 0.6G
	Cooling Method	Model names end with J: Fan Cooling
	Installation Altitude	DO NOT expose the hybrid servo drive to bad environmental conditions, such as dust, direct sunlight, corrosive/inflammable gasses, humidity, liquid and vibration environment. The salt in the air must be less than 0.01mg/cm <sup>2</sup> every year.
Certifications		

\*We have applied for UL certification for 230V models and we plan to have 460V models certified for UL by Q4 2020..

## 1-3 Overview of Hybrid Servo Systems



### 1-3-1 Selection of Hybrid Servo Drives and Motors

Due to the differences in the hydraulic system in practical applications, the following choice of drives and motors is provided as a reference.

In the following example, a flow of 64L/min and maximum holding pressure of 175Bar are used.

#### 1. Pump Displacement per Revolution

Based on the maximum flow of the system (L/min), the pump displacement per revolution (cc/rev) can be calculated.

Example: If the maximum flow of the system is 64L/min and the highest rotation speed of the motor is 2000rpm, the displacement per revolution would be  $64/2000 \times 1000 = 32 \text{ cc/rev}$ .

#### 2. Maximum Torque of the Motor

Based on the maximum pressure (Mpa) and pump displacement per revolution (cc/rev), the maximum torque can be calculated.

Example: If the required maximum pressure is 17.5 Mpa and pump displacement per revolution is 32cc/rev, the maximum torque would be  $17.5 \times 32 \times 1.3 / (2 \times \pi) = 116 \text{ N-m}$ , where the factor 1.3 is used to compensate the total loss in the system.

### 3. Rated Torque and Rated Power of the Motor

When holding pressure is under maximum pressure, the required torque cannot exceed 1.5 times of the motor's rated torque (depending on the data provided by the motor's manufacturer) at most or the motor would be overheated. Let us take the factor 1.5 as an example, if the rated torque of the motor is 77 N-m, the motor with a power of 12kW\* and a rated speed of 1500 rpm can be chosen.

\*The power of the motor is calculated by using  $P(W) = T(N-m) \times \omega(rpm \times 2\pi / 60)$

### 4. Maximum Current of the Motor

Example: Check the parameter  $k_t$  (Torque/A) in the motor's specifications first. If  $k_t = 3.37$ , the maximum current is approximately  $116/3.37 = 34A$  at the maximum torque of 116 N-m.

### 5. Selection of Matched Hybrid Servo Drive

Example: Look up the heavy-duty capability for each hybrid servo drive in the product specifications.







If the holding pressure is under the maximum pressure of 17.5 Mpa by using with a pump of 32cc/rev, the required motor current would be approximately 1883A.

Under such a current value, overload may occur in different times due to different models.

For model VFD450VL43C-JO, the overload may occur within 20 sec..

For model VFD550VL43C-JO, the overload may occur approximately after 60 sec..

#### NOTE

-  If there is no suitable motor that meets the specifications, a motor with a higher rated power can be used instead.
-  For any information about the hybrid servo drives or any assistance in detailed configuration of your company's products, please contact the manufacturer.
-  Before running the hybrid servo drive, verify if there's enough cooling oil in the oil circulation. You need to preheat the cooling medium such as cooling oil to prevent any condensation caused by temperature differences.
-  Make sure that the cooling medium stay liquidized to keep the heat dissipating system stays functional. So do follow the oil temperature limitation (10 ~ 50 °C), (50 °F ~ 122 °F) to prevent overheating on cooling oil.
-  Heat dissipating system: The maximum working pressure cannot go over 1.5 bar at the oil inlet. Do not exchange the positions of oil inlet and oil outlet. Verify the specification of connector's pipe thread (1/2" PT) to prevent damaging the pipe thread. Wrap pipe threads with teflon tape (thread seal tape).
-  Use wall-mounting method and follow the space requirements during the installation of the hybrid servo system

### 1-3-2 Selection of Pump for Hybrid Servo Motor

Select a pump with a suitable displacement based on the required flow rate and motor speed;

- If low noise is required, you can choose the screw pump or internal gear type. If a high volumetric efficiency is required, you can choose the piston pump or dual displacement piston pump.
- Comparison of Commonly Used Pump (This may vary for different pump manufacturers).

Type of Oil Pump	Volumetric Efficiency	Flow Pulsation	Rotation Speed	Noise
Internal Gear Pump	Low	Medium	Medium	Low
Piston Pump	High	Low	Low	High
Screw Pump	Medium	High	High	Medium

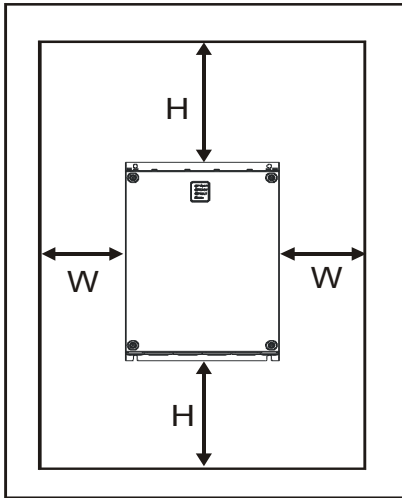
## 1-4 Product Installation

Please install the hybrid servo drive under the following environmental conditions to ensure safe use:

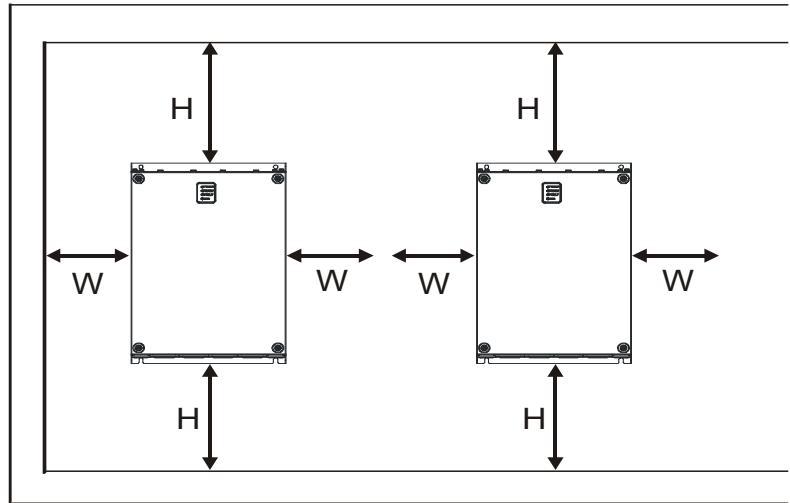
Environmental Condition for Operation	Ambient temperature Relative Humidity Pressure Installation Altitude Vibration	-10°C~ 45°C (14°F~ 113°F) <90% (non-condensing) 86 ~ 106 kPa <1000m <20Hz: 9.80 m/s <sup>2</sup> (1G) max; 20~50Hz:5.88 m/s <sup>2</sup> (0.6G) max
Environmental Condition for Storage and Transportation	Ambient temperature Relative Humidity Pressure Vibration	-20°C~ 60°C (-4°F ~ 140°F) <90% (non-condensing) 86 ~ 106 kPa <20Hz: 9.80 m/s <sup>2</sup> (1G) max; 20 ~ 50Hz: 5.88 m/s <sup>2</sup> (0.6G) max
Contamination Protection Level	Level 2: Applicable to factory environment with low-to-medium contamination	

## Space for Installation

Single Drive Installation:



Multiple Drives: Side by Side Horizontal Installation



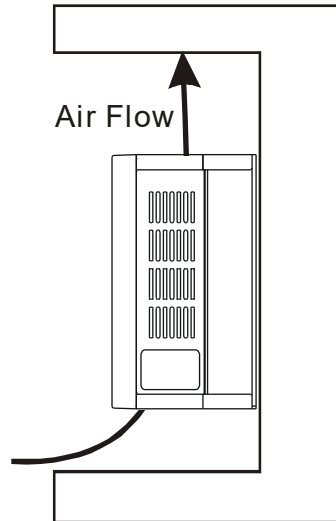
HP	W mm (inch)	H mm (inch)
7.5-20HP	75 (3)	175 (7)
25-75HP	75 (3)	200 (8)
100HP	75 (3)	250 (10)

- 1) Mount the hybrid servo drive vertically on a solid surface object by screws. Other directions are not allowed.
- 2) Because the hybrid servo drive generates heat during operation, there should be enough space for cooling airflow as shown in the figure above. Leave enough room for heat dissipation when installing. Do not install the drive beneath equipment that is not heat-resistant because the generated heat move upwards. If the drive can only be installed in a cabinet, its ambient temperature should be within regulated values. Installing the drive in a confined and insufficient cooling space would make it malfunctioned.
- 3) The temperature of heat sink in the drive varies with environmental temperature and its load capacity during its operation, reaching nearly the highest temperature of 90°C. Therefore, the material of the drive's backside should be able to bear such a high temperature.
- 4) If more than one drive are installed in one cabinet, it is recommended to install them horizontally and side by side to reduce heat generated from each other. If they can only be installed up and down, spacer plates should be put between them to decrease heat generated from lower side to upper side.
- 5) For information about air conditioning layout, please refer to the heat dissipation of hybrid servo drive (W) table below.

**NOTE**

Prevent substances like fiber particles, scraps of paper, sawdust, metal particles, and so on from entering the hybrid servo drive. The hybrid servo drive should be installed in the cabinet made from non-combustible material such as metal to prevent from fire accident.





	Model	Heat Dissipation Rate (W)	Air Flow Dissipation Rate (CFM)
460V Air Cooled	VFD110VL43C-J	383.6	50
	VFD150VL43C-J	404.1	50
	VFD185VL43C-J	500.5	50
	VFD220VL43C-J	580.9	50
	VFD300VL43C-J	1037.8	133
	VFD370VL43C-J	1078.7	133
	VFD450VL43C-J	1370.1	209
	VFD550VL43C-J	1536.5	209

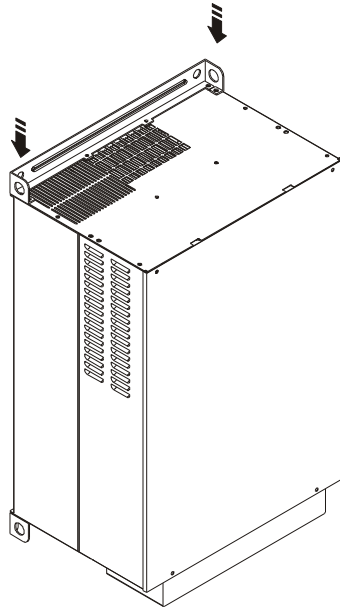
- ☑ The table above shows the required heat dissipation when installing a single drive in a confined space.
- ☑ When installing multiple drives, the required heat dissipation needs to be multiplied by the number of drives.
- ☑ The values of heat dissipation are calculated by rated voltage, rated current and default carrier wave.

## Lifting

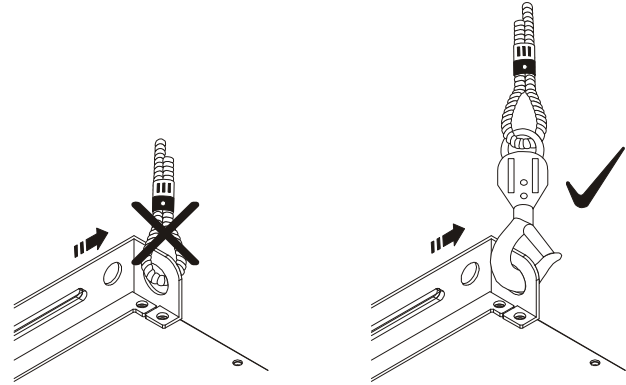
Carry only the fully assembled hybrid servo drives as shown in the following diagrams. Lift the hybrid servo drive by hooking the lift holes when driving a forklift or using a crane.

40-100HP

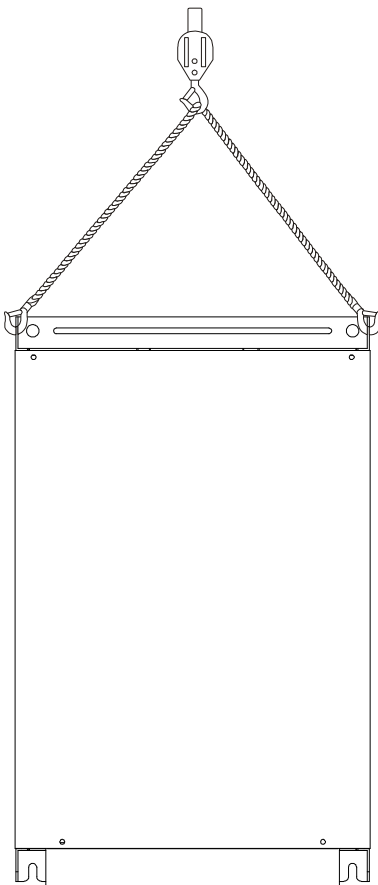
Step 1



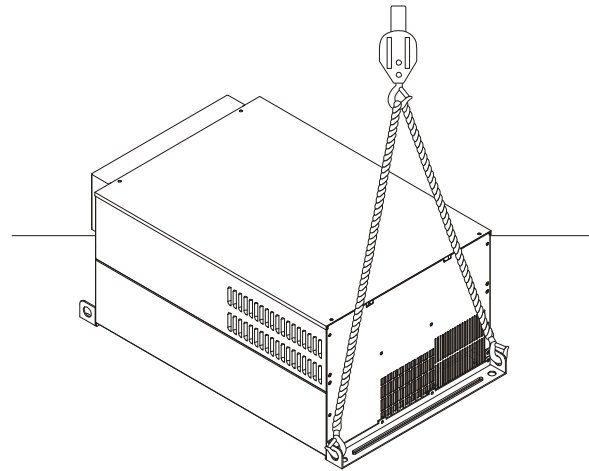
Step 2



Step 3



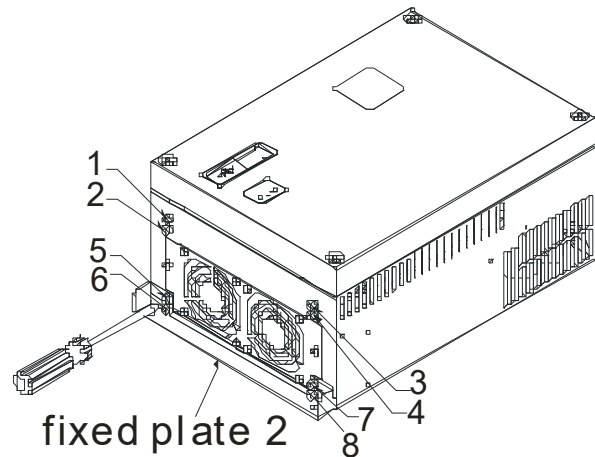
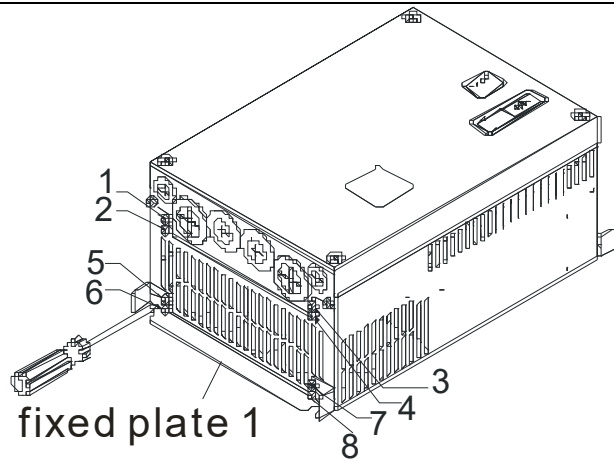
Step 4



## Flange Mounting

### Step 1:

Please take out the 16 screws (8 screws for each top and bottom side of the drive) and remove the fixed plate 1 and fixed plate 2 as shown in the following figures.

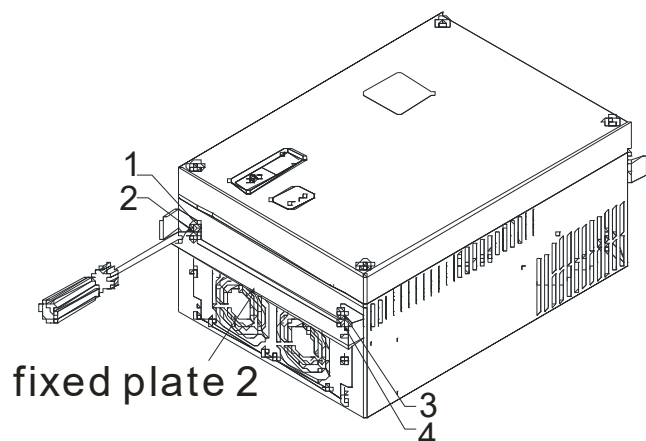
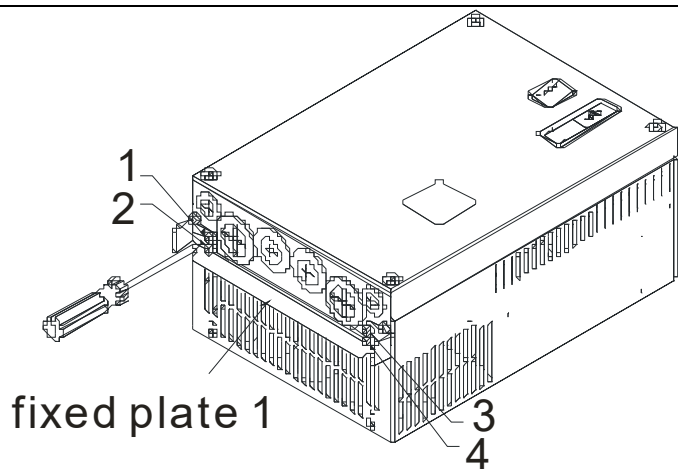


### Step 2:

Place the 8 screws back in to secure the fixed plate 1 and fixed plate 2 (as shown in the following figures) with the following torque.

Frame C: 14-17kg-cm [12.2-14.8 lb-in]

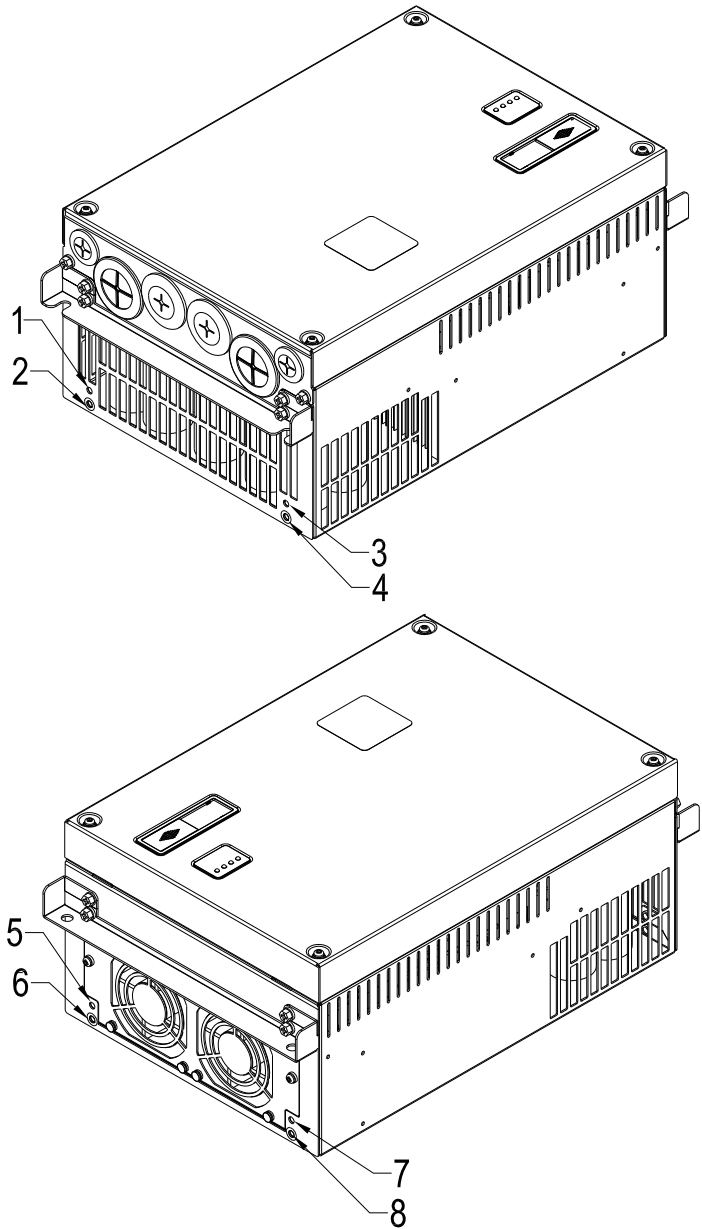
Frame D: 20-25kg-cm [17.4-21.lb-in]



Step 3:

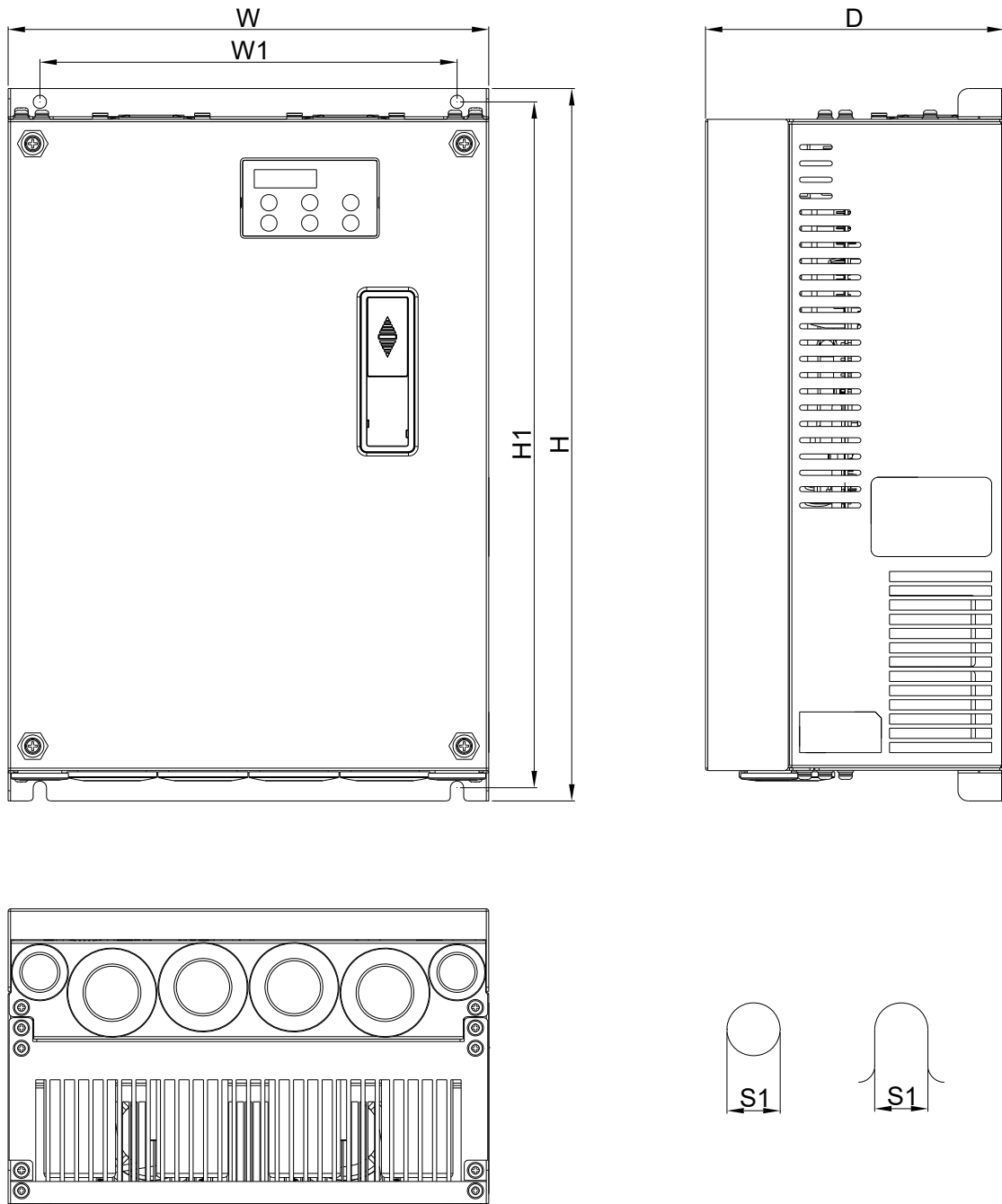
Note that it is not necessary to put back those 8 screws shown in the following figures to the drive.

Moreover, make sure that these 2 different fixed plates are put in the correct side as shown in the figures.



## 1-5 Product Dimensions

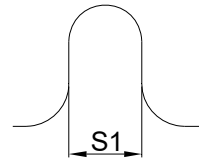
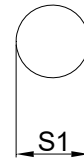
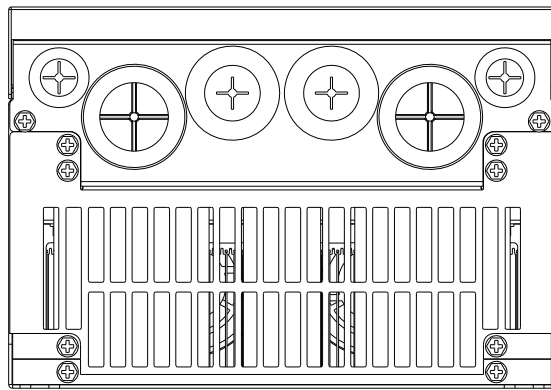
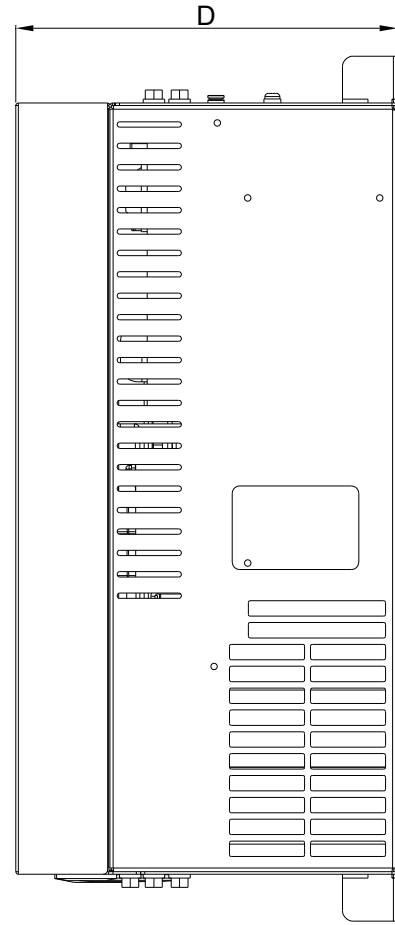
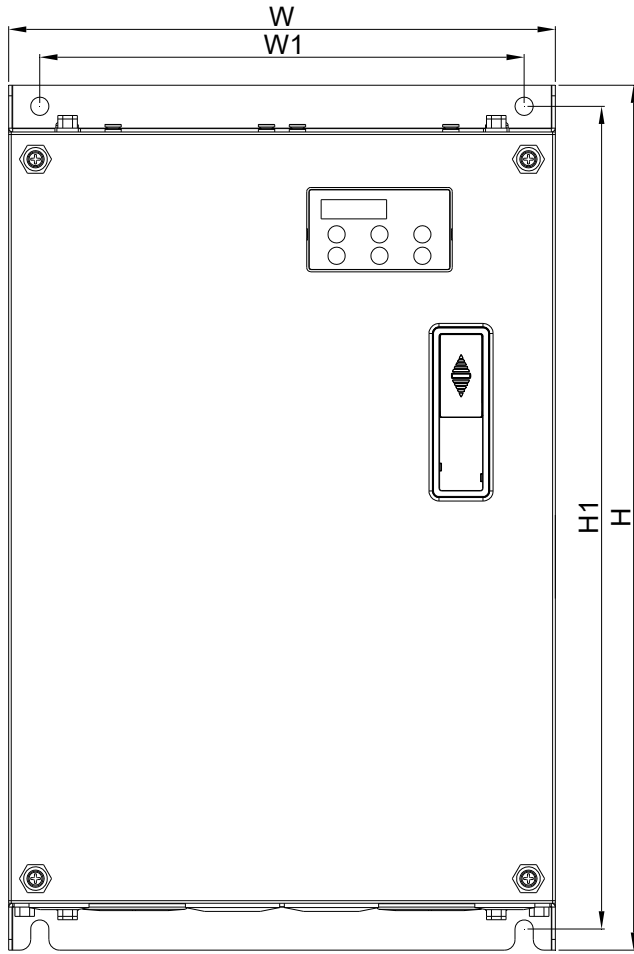
Frame C of VJ-A:  
VFD110VL23A-J



Frame	W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
<b>C</b>	235	204	350	337	320	-	146	6.5	-	34	22
	[9.25]	[8.03]	[13.78]	[13.27]	[12.60]		[5.75]	[0.26]		[1.34]	[0.87]

Unit: mm [inch]

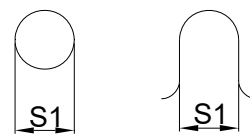
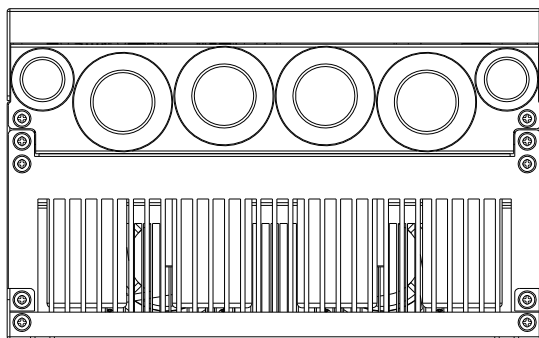
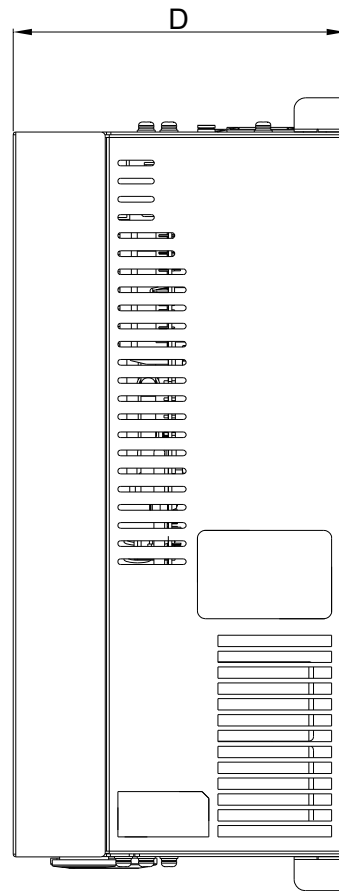
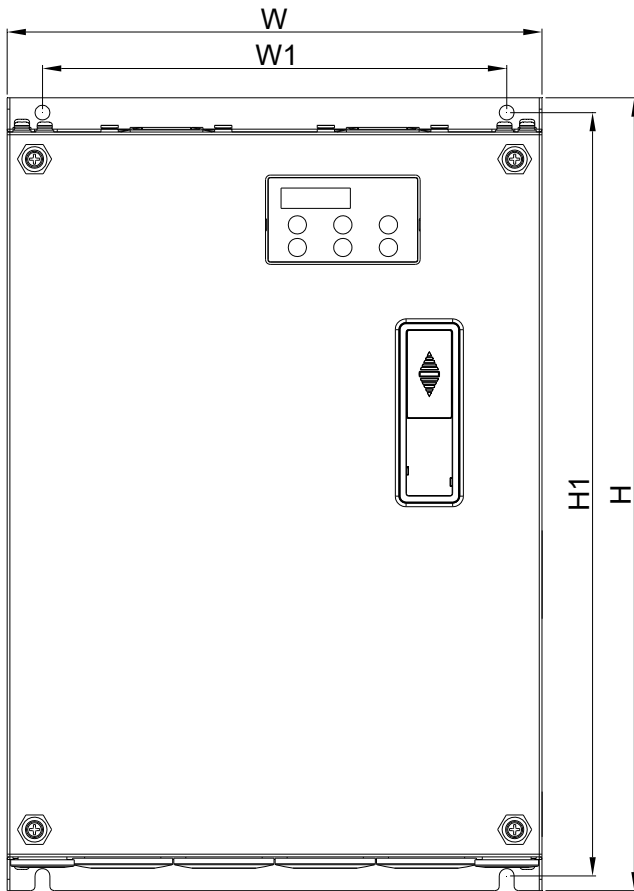
Frame D of VJ-A:  
 VFD150VL23A-J, VFD185VL23A-J, VFD220VL23A-J



Frame	W	W1	H	H1	H2	H3	D	Ø	Ø1	Ø2	Ø3
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	360.0 [14.17]	21.9 [0.86]	178.0 [7.01]	8.5 [0.33]	44 [1.73]	34 [1.34]	22 [0.87]

Unit: mm [inch]

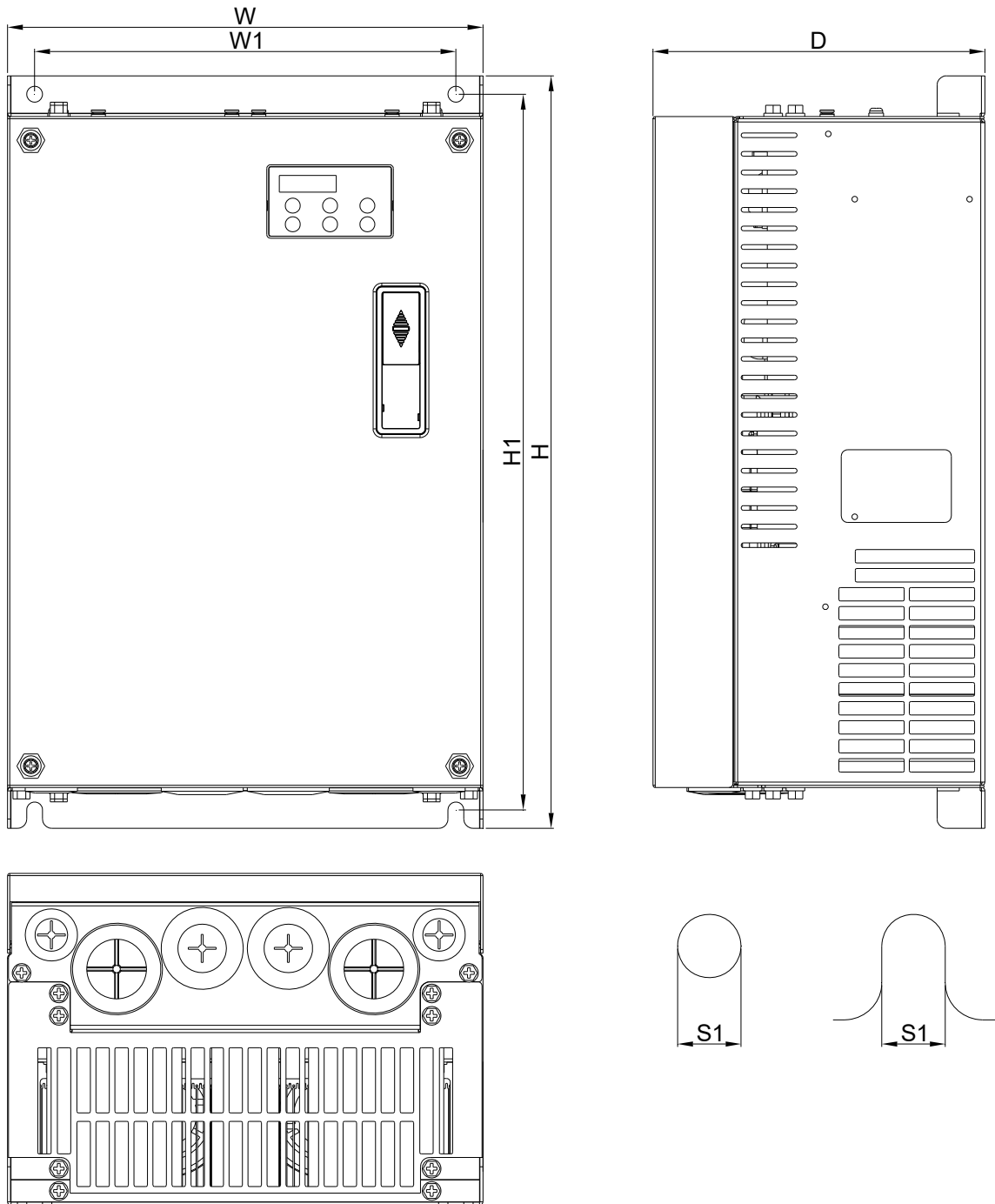
Frame C of VJ-C:  
 VFD110VL43C-J, VFD150VL43C-J,  
 VFD185VL43C-J, VFD220VL43C-J



Frame	W	W1	H	H1	D	S1
<b>C</b>	235 [9.25]	204 [8.03]	350 [13.78]	337 [13.27]	146 [5.75]	6.5 [0.26]

Unit: mm [inch]

Frame D of VJ-C:  
VFD300VL43C-J, VFD370VL43C-J



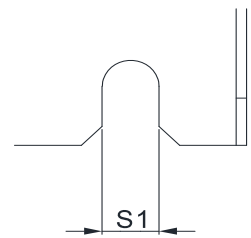
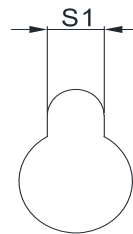
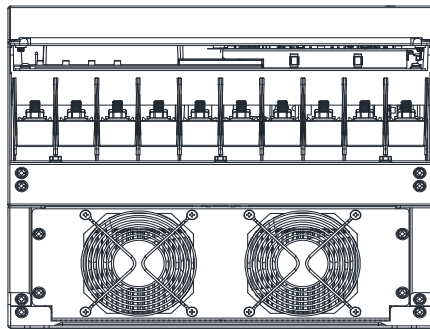
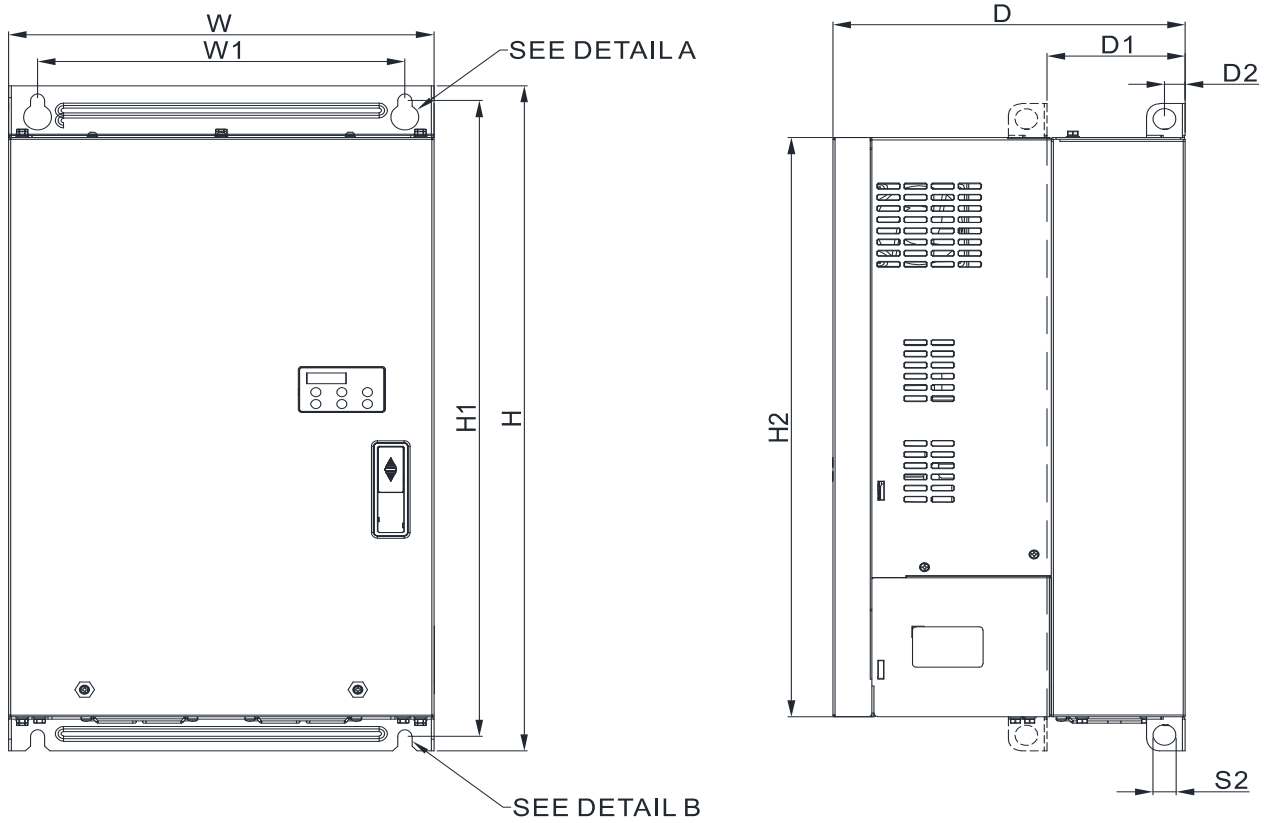
Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	178.0 [7.01]	8.5 [0.33]

Unit: mm [inch]



Frame E4 of VJ-C:

VFD300VL23C-J, VFD370VL23C-J,  
VFD450VL43C-J, VFD550VL43C-J, VFD750VL43C-J



DETAIL A (MOUNTING HOLE)      DETAIL B (MOUNTING HOLE)

Frame	W	W1	H	H1	H2	D	D1*	D2	S1	S2
<b>E4</b>	330.0	285.0	565.0	540.0	492.0	273.4	107.2	16.0	11.0	18.0
	[12.99]	[11.22]	[22.24]	[20.67]	[19.37]	[10.76]	[4.22]	[0.63]	[0.43]	[0.71]

Unit: mm [inch]

# Chapter 2 Wiring

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## 1-1 Description of Wiring

## 1-2 Description of Terminals on Main Circuit

## 1-3 Description of Terminals on Control Circuit

After removing the front cover, check if the power and control terminals are clear. Be sure to observe the following precautions when wiring.

- ☑ Make sure that power is only applied to the R/L1, S/L2, and T/L3 terminals. Failure to comply may result in damage to the equipments. The voltage and current should lie within the range as indicated on the nameplate
- ☑ All the units must be grounded directly to a common ground terminal to prevent lightning strike or electric shock.
- ☑ Please make sure to fasten the screw of the main circuit terminals to prevent sparks which is made by the loose screws due to vibration



- ☑ It is crucial to turn off the hybrid servo drive power before any wiring installation are made. A charge may remain in the DC bus capacitors with hazardous voltages even if the power has been turned off therefore it is suggested for users to measure the remaining voltage before wiring. For your personnel safety, please do not perform any wiring before the voltage drops to a safe level  $< 25 V_{DC}$ . Wiring installation with remanding voltage condition may cause sparks and short circuit.
- ☑ Only qualified personnel familiar with hybrid servo drives is allowed to perform installation, wiring and commissioning. Make sure the power is turned off before wiring to prevent electric shock.

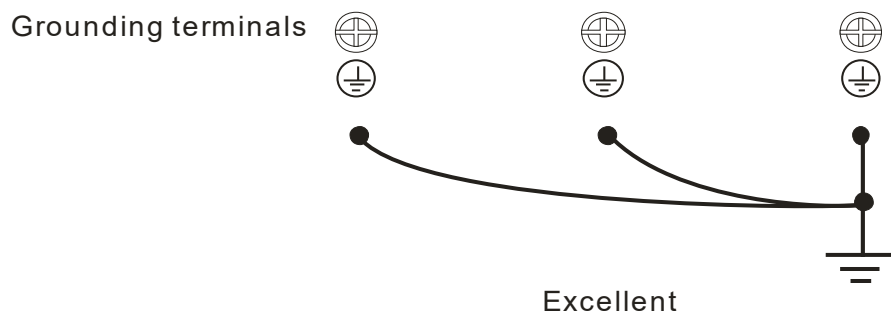


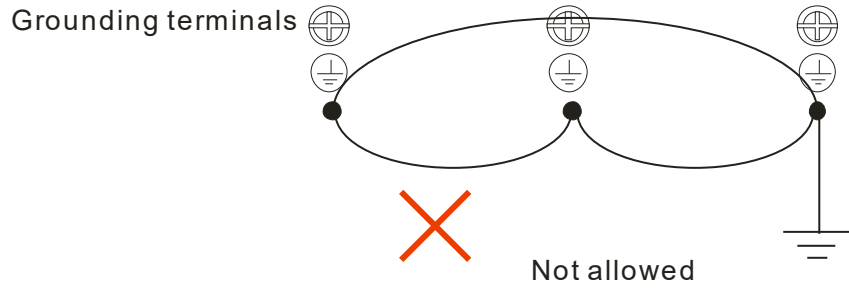
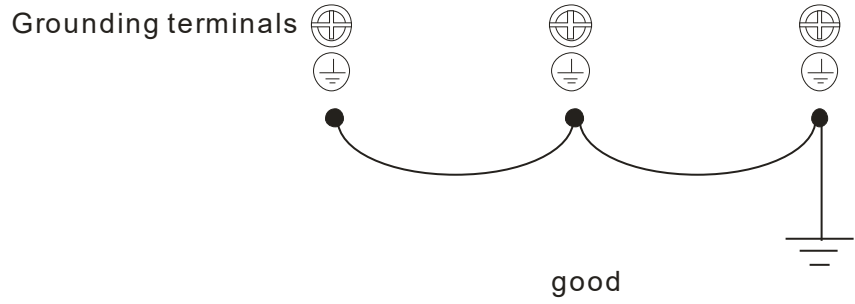
- ☑ Make sure that power is only applied to the R/L1, S/L2, and T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current should lie within the range as indicated on the nameplate.
- ☑ Check following items after finishing the wiring:
  1. Are all connections correct?
  2. No loose wires?
  3. No short-circuits between terminals or to ground?
- ☑ The wiring of main circuit and control circuit should be separated to prevent erroneous actions.
- ☑ Please use shield wire for the control wiring and not to expose the peeled-off net in front

of the terminal.

- ☑ Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.
- ☑ Damaged insulation of wiring may cause personal injury or damage to circuits/equipment if it comes in contact with high voltage.
- ☑ The AC motor drive, motor and wiring may cause interference. To prevent the equipment damage, please take care of the erroneous actions of the surrounding sensors and the equipment.
- ☑ When the hybrid servo drive output terminals U/T1, V/T2, and W/T3 are connected to the motor terminals U/T1, V/T2, and W/T3, respectively. To permanently reverse the direction of motor rotation, switch over any of the two motor leads.
- ☑ With long motor cables, high capacitive switching current peaks can cause over-current, high leakage current or lower current readout accuracy. For longer motor cables, use an AC output reactor.
- ☑ VFD-VJ series doesn't have built-in brake resistors, but brake resistor can be installed for those occasions that use higher load inertia or frequent start/stop. Refer to Appendix A-1 for details.
- ☑ Make sure that the leads are connected correctly and the hybrid servo drive is properly grounded to reduce noise and for safety.
- ☑ To prevent lightning stroke and electric shock, use ground leads that comply with local regulations. Keep them as short and thick as possible and have them properly connected to the ground terminal on the hybrid servo drive.
- ☑ Connect the peripheral braid sleeve of the pressure sensor to the grounding terminal PE.
- ☑ Multiple VFD-VJ units can be installed in one location. All the units should be grounded directly to a common ground terminal, as shown in the figure below.

**Ensure there are no ground loops.**





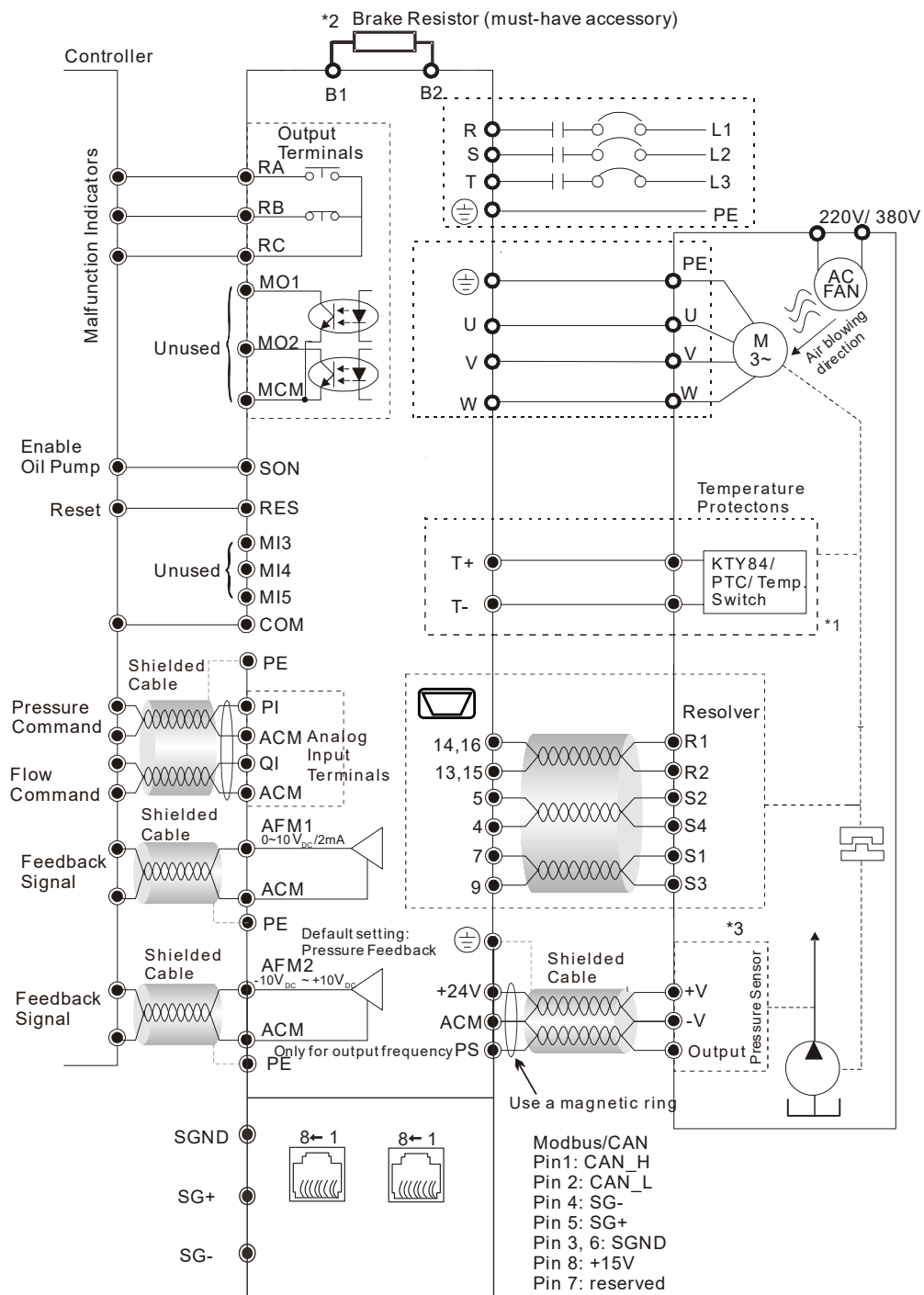
## 2-1 Description of Wiring

Users must connect wires according to the circuit diagrams on the following pages.  
 Standard wiring diagram of the VFD-VJ hybrid servo drive in factory

### Wiring Diagram and Corresponding Models:

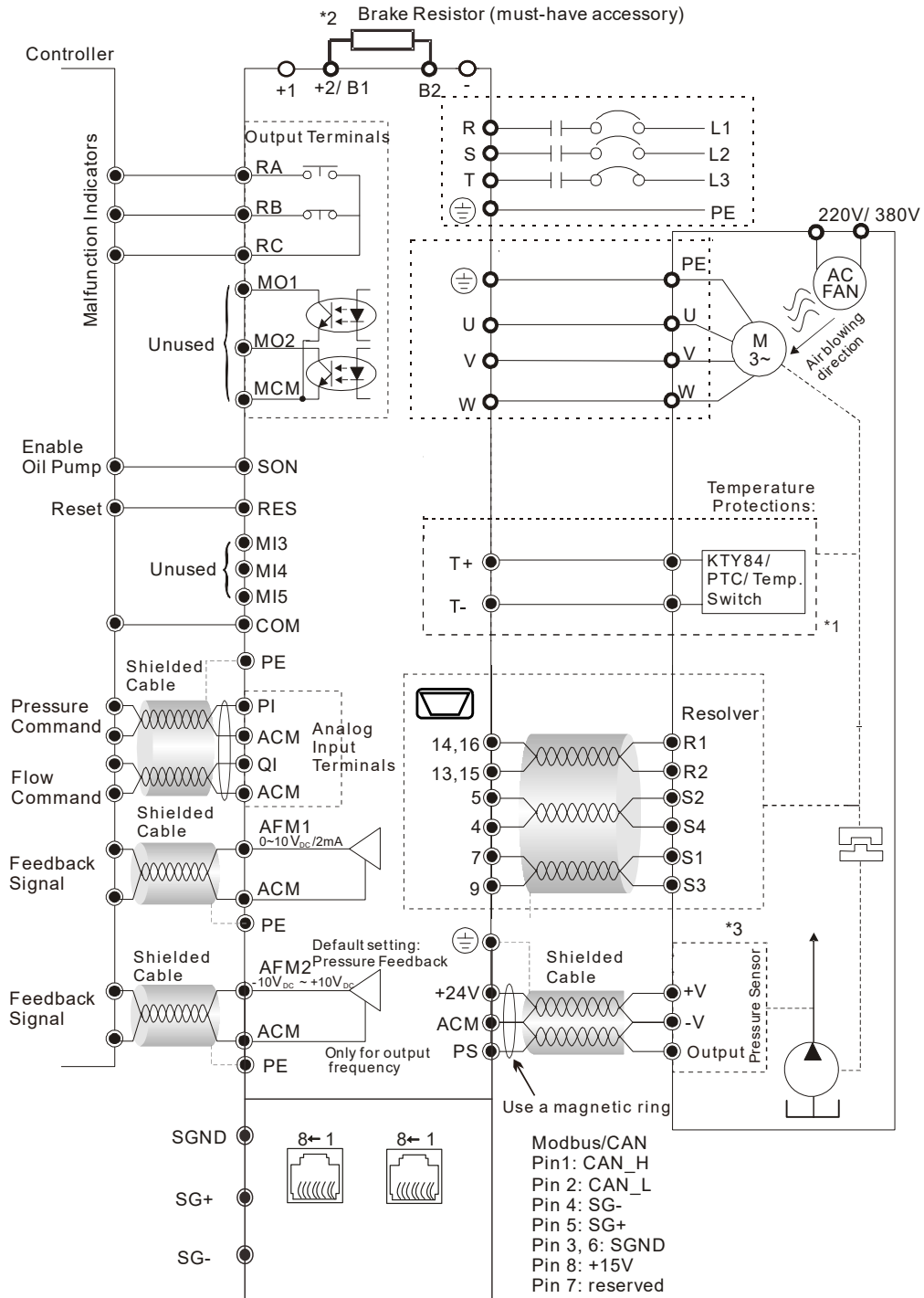
VFD300VL23C-J, VFD370VL23C-J,

VFD450VL43C-J, VFD550VL43C-J, VFD750VL43C-J



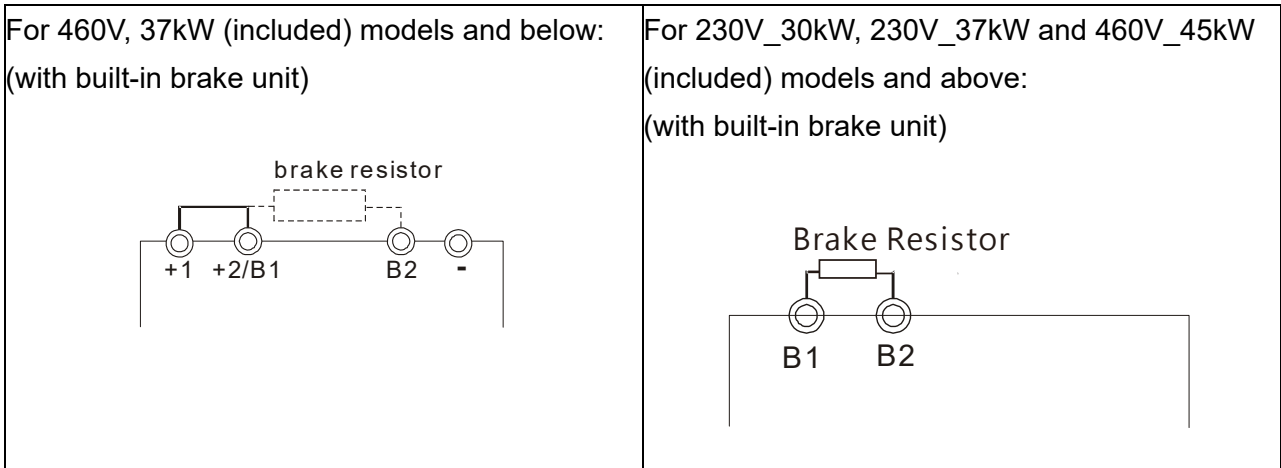
**Wiring Diagram and Corresponding Models:**

VFD110VL23A-J, VFD150VL23A-J, VFD185VL23A-J, VFD220VL23A-J, VFD110VL43C-J,  
 VFD150VL43C-J, VFD185VL43C-J, VFD220VL43C-J, VFD300VL43C-J, VFD370VL43C-J



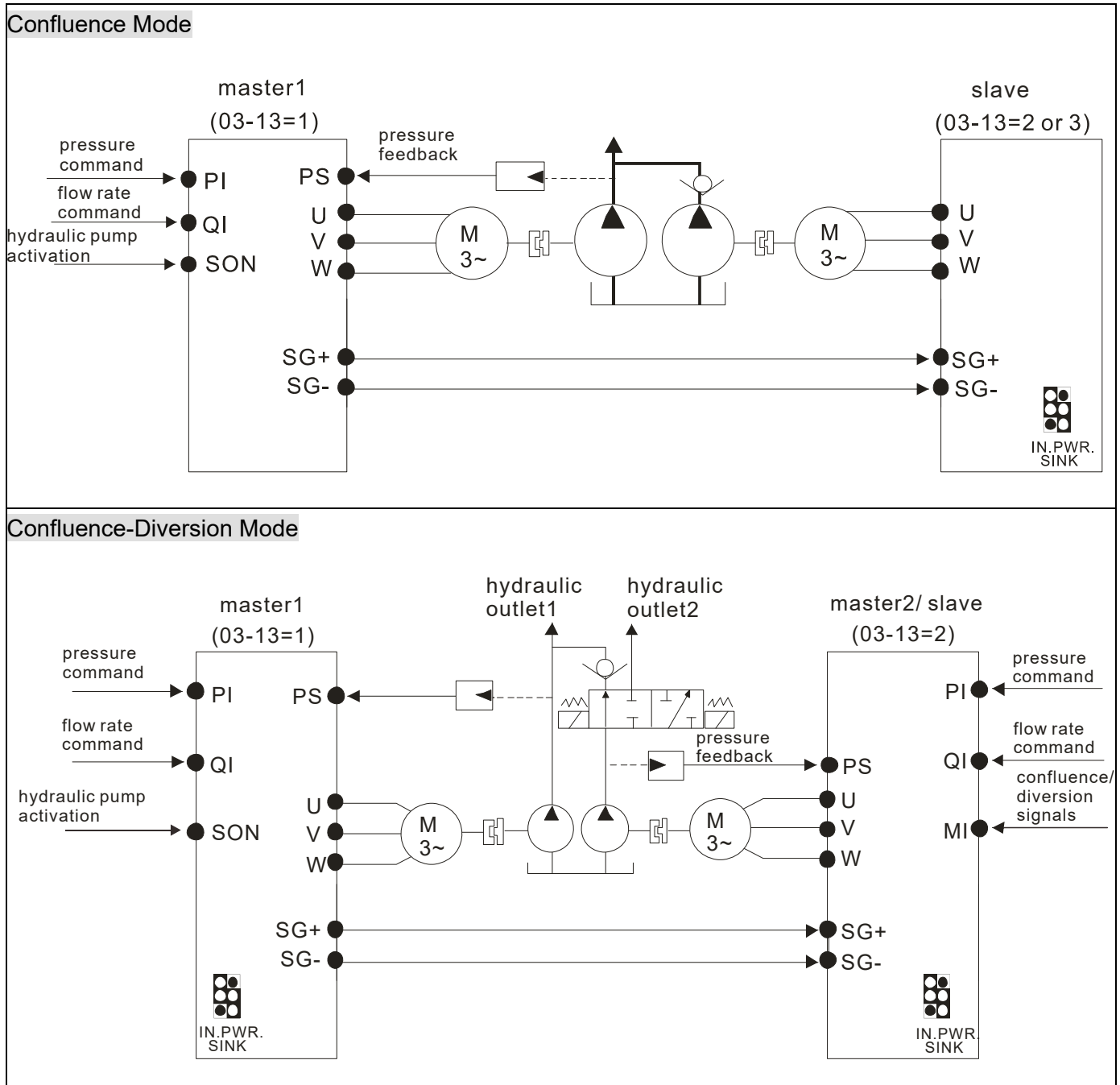
**\*1** Verify the polarity before using KTY84

**\*2**



**\*3** The peripheral braid sleeve of the pressure sensors needs to shield completely the internal signal wires. Make the signal wires which are not shielded by the braid sleeve as short as possible. Also bring signal wires as close to the control terminals as possible. Connect the peripheral braid sleeve to PE grounding terminal. If the impulse noise or any other noise is too strong, connect the signal wire to the ACM terminal to eliminate noise.

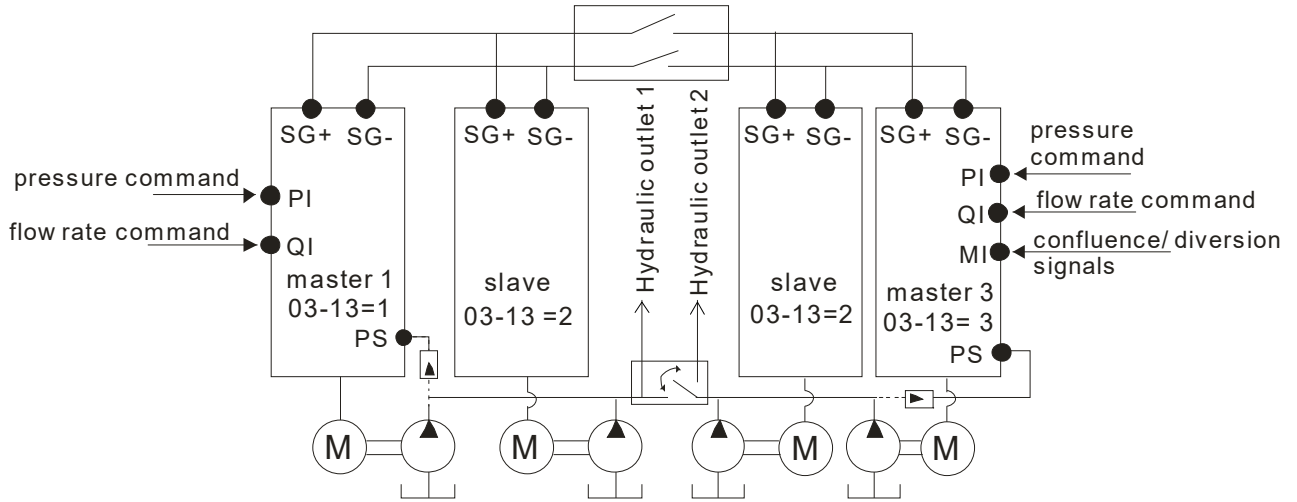
## Multi-pump Operation Mod

**NOTE:**

- 1) VFD-VJ-C series do not require external communication card EMVJ-MF01.
- 2) If you need to release the pressure by running reversely at the slave pump, you don't need to install a one-way valve at slave pump's oil outlet.



When the signals are confluent, the communication will be a short circuit.  
When the signals are diversional, the communication becomes an open circuit.



## 2-1-1 Grounding Short-Circuit Plate Description (RFI Switch)

### RFI switch

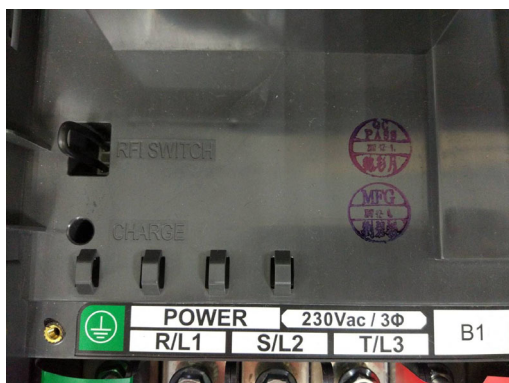
The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to protect the drive against mains surges or voltage spikes.

Because the Varistors/MOVs from phase to ground are connected to ground with the RFI switch, removing the RFI jumper disables the protection.

The RFI switch also connects the filter capacitors to ground from a return path for high frequency noise to isolate the noise from contaminating the mains power. Removing the RFI switch strongly reduces this protection.

### Isolating main power from ground

When the power distribution system of the drive is a floating ground system (IT Systems) or a TT system (Terre-Terre en français, or earth-earth in English), you must remove the RFI switch. Removing the RFI switch disconnects the internal capacitors from ground to avoid damaging the internal circuits and to reduce the ground leakage current (in accordance with IEC61800-3 regulation). The RFI switch is shown in the images below.







RFI Switch on the motor drive



Removable RFI Switch

### NOTE:

-  Do not remove the RFI switch while the power is on.
-  Efficient galvanic isolation is no longer guaranteed if removing the RFI switch. Then all the input and output terminals are low voltage terminals which have basic isolation. Removing the RFI switch also reduces the compliance with the EMC specification.
-  Do not remove the RFI switch while conducting high voltage tests. When conducting a high voltage test to the entire facility, you must disconnect the mains power and the motor if the leakage current is too high
-  Do not switch off the RFI switch when the main power is a grounded power system. To prevent motor drive damage, the RFI switch shall be removed if the motor drive is installed on an ungrounded power system, a high resistance-grounded (over 30 ohms) power system, or a corner grounded TN system.

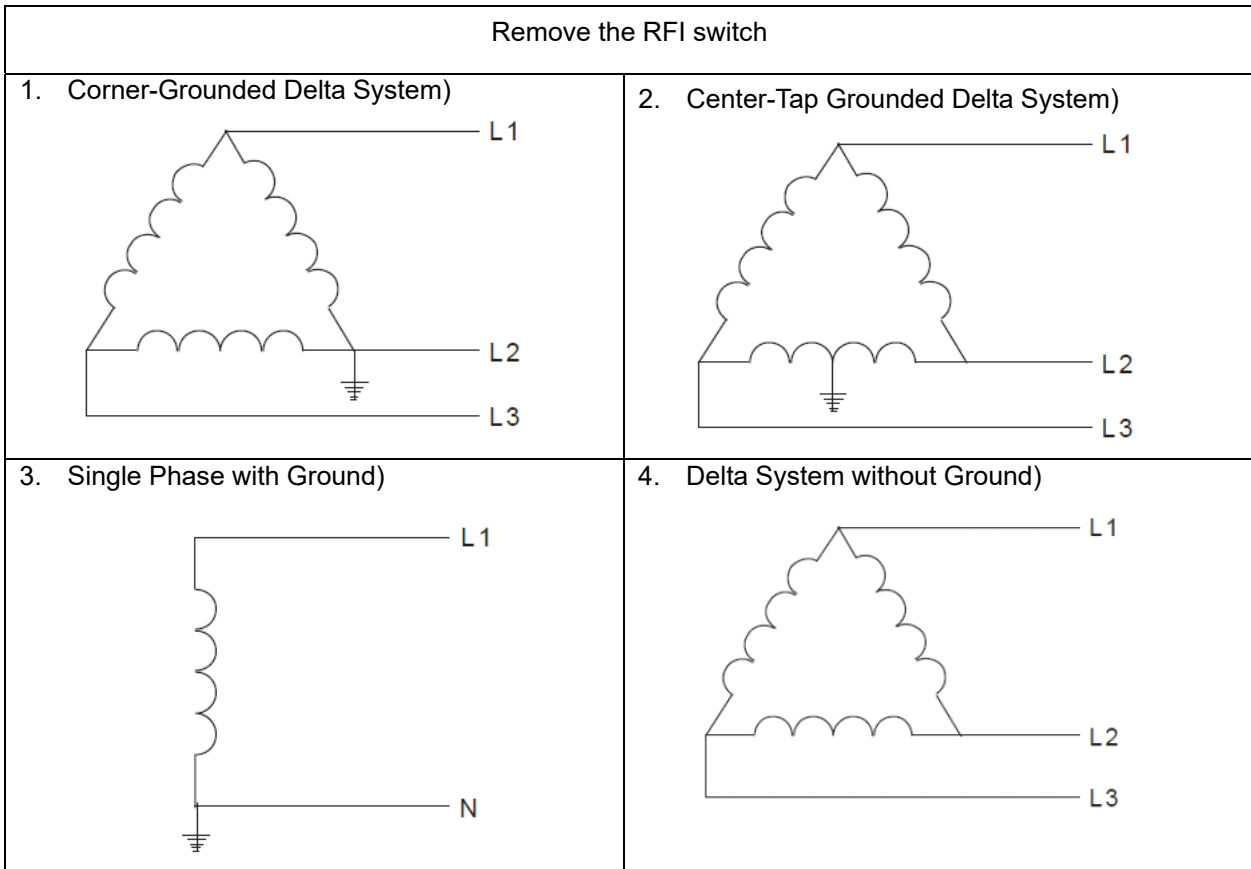
### Floating Ground System (IT Systems)

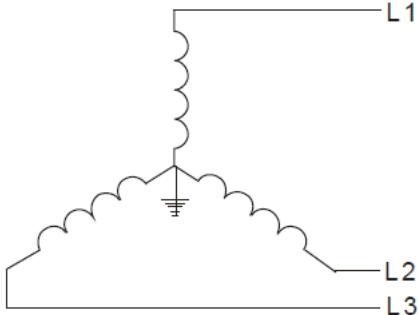
A floating ground system is also called IT system, ungrounded system, or high impedance/resistance (greater than  $30\Omega$ ) grounding system.

- Disconnect the ground cable from the internal EMC filter.
- In situations where EMC is required, check whether there is excess electromagnetic radiation affecting nearby low-voltage circuits. In some situations, the adapter and cable naturally provide enough suppression. If in doubt, install an extra electrostatic shielded cable on the power supply side between the main circuit and the control terminals to increase security.

### Asymmetric Ground System (Corner Grounded TN Systems)

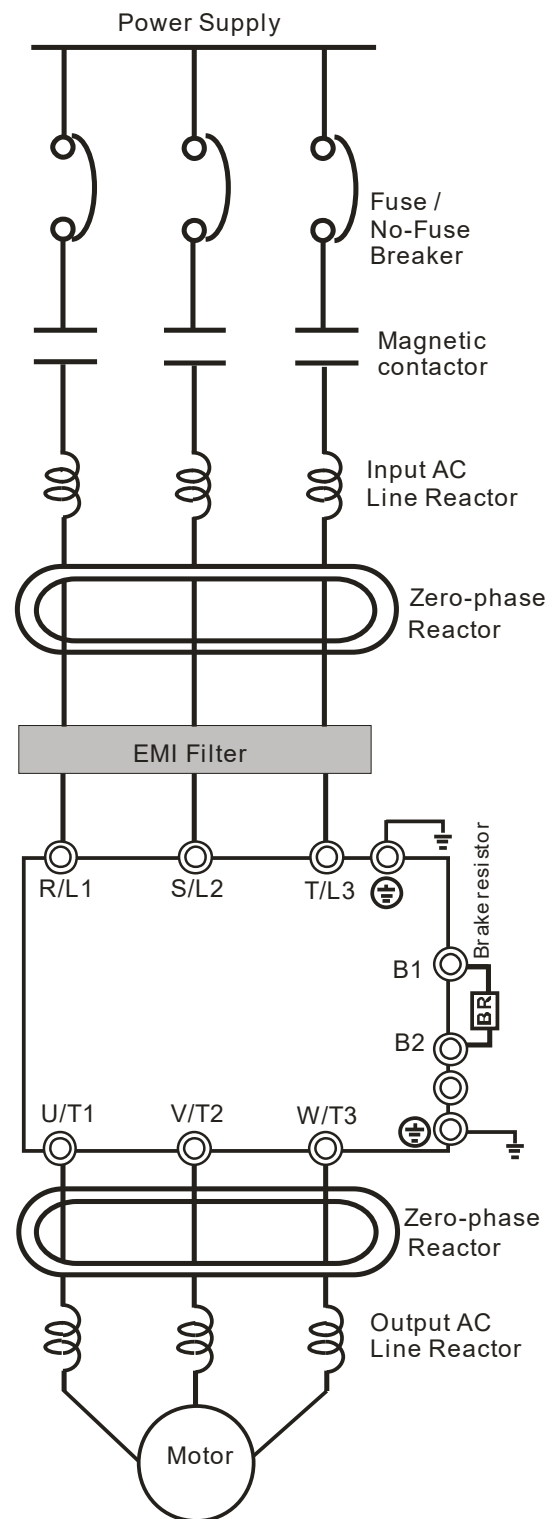
Caution: Do not remove the RFI switch while the input terminal of the hybrid servo drive carries power. In the following four situations, the RFI switch must be removed. This is to prevent the system from grounding through the RFI capacitor and damaging the hybrid servo drive




Keep the RFI switch	
<p>Internal grounding through RFI capacitor, which reduces electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility, and using a symmetrical grounding power system, an EMC filter can be installed. As a reference, the diagram on the right is a symmetrical grounding power system.</p>	<p>Y connection (Star Connection) with stable neutral grounding point.</p>  <p>The diagram illustrates a Y-connection (Star Connection) power system. It features three phase lines labeled L1, L2, and L3. L1 is at the top, L2 is at the bottom right, and L3 is at the bottom left. These three lines meet at a central neutral point, which is connected to a ground symbol. Each phase line is represented by a wavy line, likely indicating an RFI capacitor or filter component.</p>

## 2-2 Description of Terminals on Main Circuit

Items	Explanations
Power supply	Please follow the specific power supply requirements shown in Chapter 01.
Fuse/NFB	There may be an inrush current during power up. Please check the chart of Appendix A-2 and select the correct fuse with rated current. Use of a NFB is optional.
Magnetic contactor	Please do not use a Magnetic contactor as the I/O switch of the AC motor drive, as it will reduce the operating life cycle of the AC drive. If you still need to run / stop AC drives by switching ON/ OFF the magnetic contactor, you can do so only ONCE per hour.
Input AC Line Reactor	Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances (surges, switching spikes, short interruptions, etc.). AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times the inverter capacity, or the mains wiring distance $\leq 10m$ . We suggest to install the input reactor close to the hybrid motor drive. See Appendix A for more details.
Zero-phase Reactor (Ferrite Core Common Choke)	Zero phase reactors are used to reduce radio noise especially when audio equipment is installed near the inverter. Effective for noise reduction on both the input and output sides. Attenuation quality is good for a wide range from AM band to 10MHz. Appendix A specifies the zero phase reactor. (RF220X00A)
EMI filter	To reduce electromagnetic interference, please refer to Appendix A for more details.
Brake Resistor	Used to reduce the deceleration time of the motor. Please refer to the chart in Appendix A for specific Brake Resistors.
Output AC Line Reactor	Motor surge voltage amplitude depends on motor cable length. For applications with long motor cable (>20m), it is necessary to install a reactor at the inverter output side.



**Motor**

Terminal Identification	Description
R/L1, S/L2, T/L3	AC line input terminals 3-phase
U/T1, V/T2, W/T3	Output terminals of the hybrid servo drive that are connected to the motor
+1, +2/B1	Terminals to connect to DC reactor to improve the power factor. Remove the RFI switch before connecting a DC reactor to a hybrid servo drive. (DC reactor is built in for models $\geq 45\text{KW}$ )
+2/b1, B2	Terminals to connect to brake resistor (optional, see Appendix A-1 for more information)
	Grounding Terminal, please comply with local regulations.

**Power supply input terminals for the main circuit:**

- Do not connect 3-phase model to one-phase power. R/L1, S/L2 and T/L3 has no phase-sequence requirement, it can be used upon random selection.
- Connect these terminals (R/L1, S/L2, T/L3) via a non-fuse breaker or an earth leakage breaker to the three-phase AC power for circuit protection. It is unnecessary to consider phase-sequence.
- It is recommend adding a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when activating the protection function of the AC motor drive. Both ends of the MC should have an R-C surge absorber.
- Fasten the screws in the main circuit terminal to prevent sparks condition made by the loose screws due to vibration.
- Please use voltage and current within the specification. Please refer to Chapter 1 for the specifications.
- When using a general GFCI (Ground Fault Circuit Interrupter), select a current sensor with sensitivity of 200mA or above and not less than 0.1-second operation time to avoid nuisance tripping.
- Please use the shield wire or tube for the power wiring and ground the two ends of the shield wire or tube.

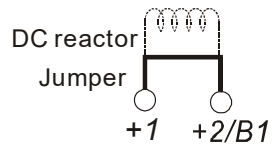
**Output terminals for the main circuit:**

- When it needs to install the filter at the output side of terminals U/T1, V/T2, W/T3 on the hybrid servo drive. Please use inductance filter. Do not use phase-compensation capacitors or L-C (Inductance-Capacitance) or R-C (Resistance-Capacitance), unless approved by Delta.
- DO NOT connect phase-compensation capacitors or surge absorbers at the output terminals of hybrid servo drives.

**The terminals of the DC reactor [+ 1, + 2],**

- This is the terminals used to connect the DC reactor to improve the power factor. For the factory setting, it connects the short-circuit object. Please remove this

short-circuit object before connecting to the DC reactor.

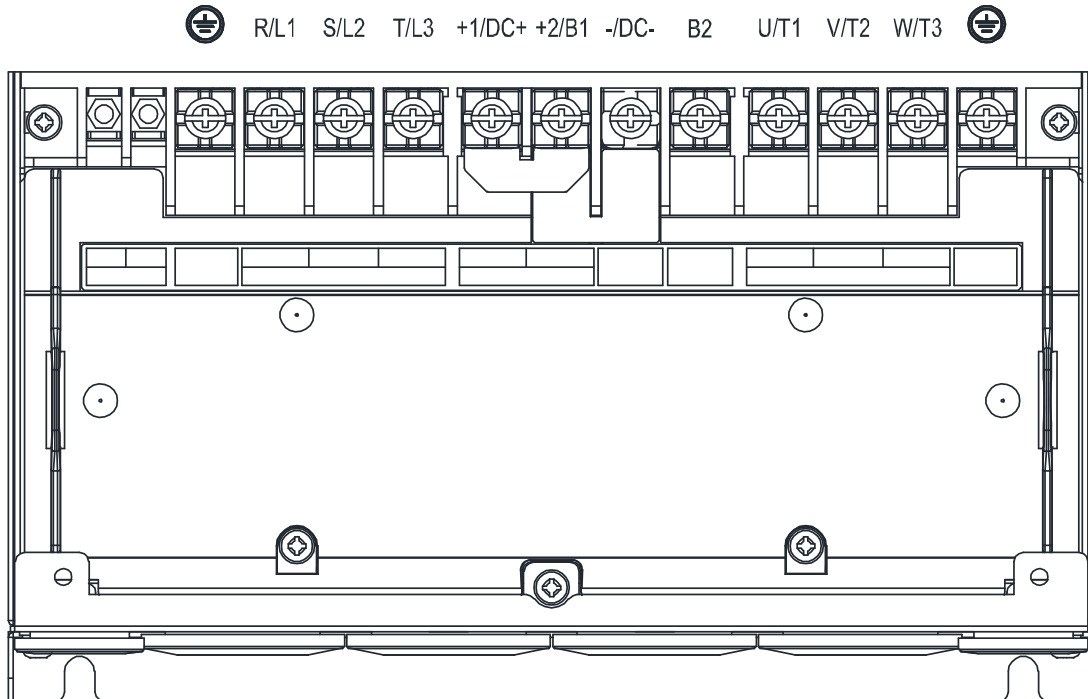


- For those models without built-in brake resistor, please connect external brake unit and brake resistor (both of them are optional) to increase brake torque.
- DO NOT connect [B2] or [-] to [+2/B1] directly to prevent drive damage.

## Specifications of the Main Circuit Terminals

### VJ-A and VJ-C Air Cooled

#### Frame C



Models	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal: ⊕		
	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)
VFD-110VL23A-J	16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	M5 30 kg-cm (26.0 lb-in.) (2.94 Nm)	16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	M5 30 kg-cm (26.0 lb-in.) (2.94 Nm)
VFD110VL43C-J		10 mm <sup>2</sup> (8 AWG)		10 mm <sup>2</sup> (8 AWG)	10 mm <sup>2</sup> (8 AWG)	
VFD150VL43C-J		10 mm <sup>2</sup> (8 AWG)		10 mm <sup>2</sup> (8 AWG)	10 mm <sup>2</sup> (8 AWG)	
VFD185VL43C-J		16 mm <sup>2</sup> (6 AWG)		16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	
VFD220VL43C-J		16 mm <sup>2</sup> (6 AWG)		16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	

#### NOTE:

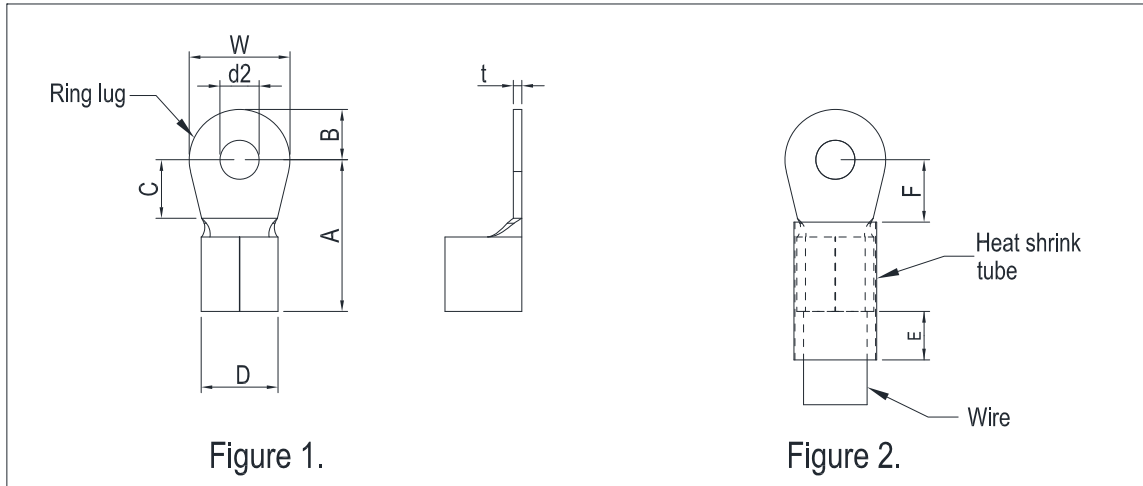
1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C
2. If you install at Ta 45°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
3. For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations.
4. Do not reduce the wire gauge when using higher temperature wire.



Frame Size	AWG	VENDOR	P/N	A (max.)	B (max.)	C (min.)	D (max.)	d2 (min.)	E (min.)	F (min.)	W (max.)	t (max.)
C	8	K.S.T.	RNBS8-5	25.0	6.0	7.0	9.0	5.2	13.0	7.0	12.5	3.0
	6	K.S.T.	RNBS14-5									

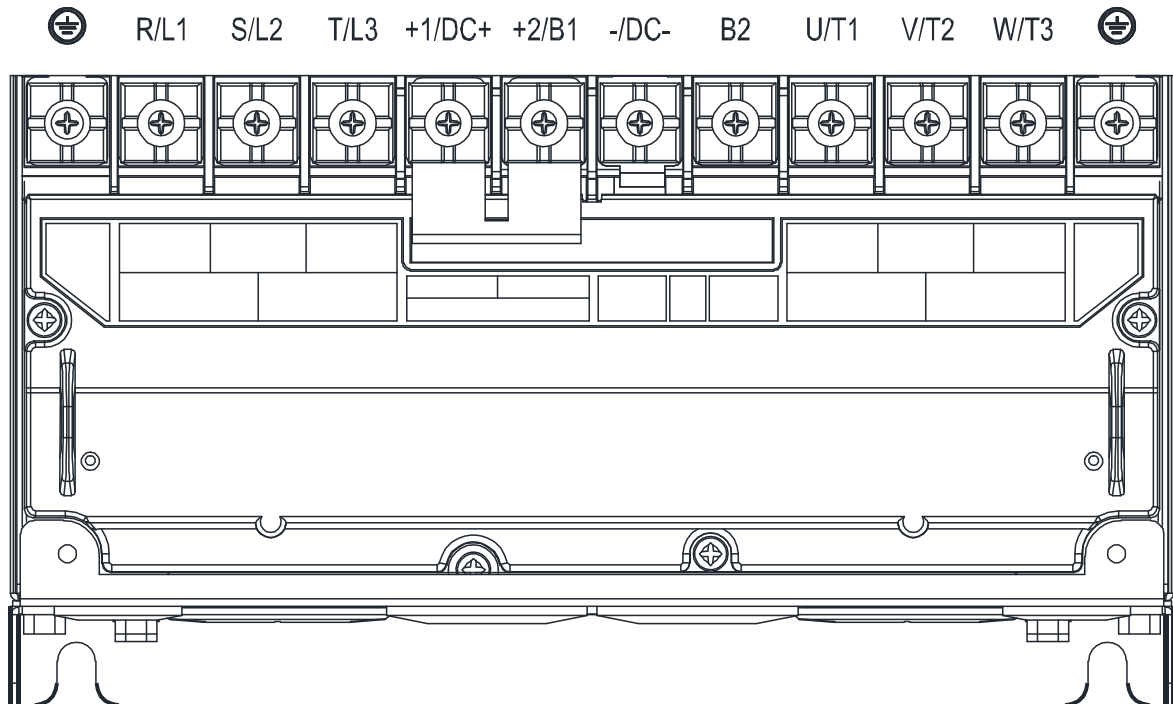
Unit: mm

- The following additional terminals are required when wiring. The additional terminal dimension should comply with Figure 1 below.
- After crimping the wire to the ring lug (must be UL approved), UL and CSA approved R/C (YDPU2), and install heat shrink tubing rated at a minimum of 600 V<sub>AC</sub> insulation over the live part. Refer to Figure 2 below.



## VJ-A and VJ-C Air Cooled

### Frame D



Models	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal: ⊕		
	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)
VFD150VL23A-J	35 mm <sup>2</sup> (2 AWG)	35 mm <sup>2</sup> (2 AWG)	M6 50 kg-cm (43.4 lb-in.) (4.9 Nm)	35 mm <sup>2</sup> (2 AWG)	35 mm <sup>2</sup> (2 AWG)	M6 50 kg-cm (43.4 lb-in.) (4.9 Nm)
VFD185VL23A-J		35 mm <sup>2</sup> (2 AWG)		35 mm <sup>2</sup> (2 AWG)	35 mm <sup>2</sup> (2 AWG)	
VFD220VL23A-J		35 mm <sup>2</sup> (2 AWG)		35 mm <sup>2</sup> (2 AWG)	35 mm <sup>2</sup> (2 AWG)	
VFD300VL43C-J		35 mm <sup>2</sup> (2 AWG)		16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	
VFD370VL43C-J		35 mm <sup>2</sup> (2 AWG)		16 mm <sup>2</sup> (6 AWG)	16 mm <sup>2</sup> (6 AWG)	

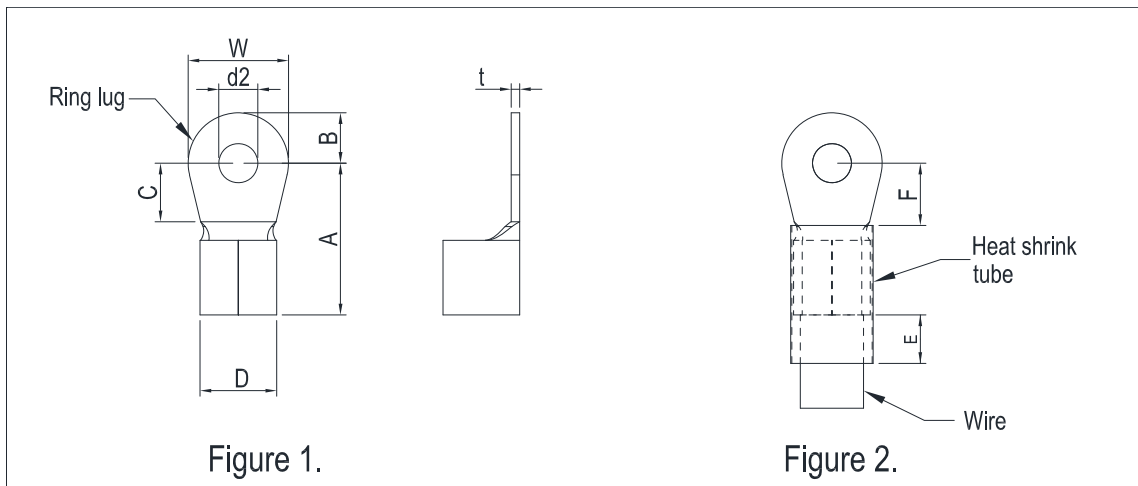
#### NOTE:

1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C
2. If you install at Ta 45°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
3. For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations.
4. Do not reduce the wire gauge when using higher temperature wire.
5. For VFD220VL43A-J model, if you install it at Ta 30°C above environment, select copper wire with voltage rating of 600V and temperature resistance of 90°C or above.

Frame Size	AWG	VENDOR	P/N	A (max.)	B (max.)	C (min.)	D (max.)	d2 (min.)	E (min.)	F (min.)	W (max.)	t (max.)
D	6	K.S.T.	RNBL14-6	30.0	10.0	9.5	14	6.2	13.0	9.5	18.5	3.0
	2	K.S.T.	RNBS38-6									

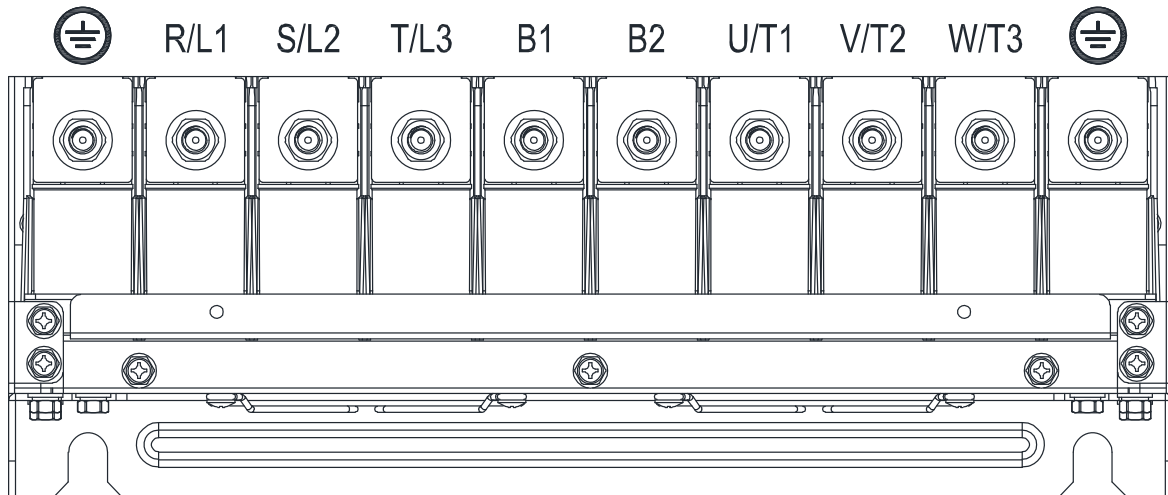
Unit: mm

- ☞ The following additional terminals are required when wiring. The additional terminal dimension should comply with Figure 1 below.
- ☞ After crimping the wire to the ring lug (must be UL approved), UL and CSA approved R/C (YDPU2), install heat shrink tubing rated at a minimum of 600 V<sub>AC</sub> insulation over the live part. Refer to Figure 2 below.



## VJ-C Air Cooled

### Frame E4



Models	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal: ⊕		
	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)
VFD300VL23C-J	120mm <sup>2</sup> (4/0 AWG)	70 mm <sup>2</sup> (2/0 AWG)	M8 180 kg-cm (156.2 lb-in) (17.65 Nm)	70 mm <sup>2</sup> (2/0 AWG)	35 mm <sup>2</sup> (2 AWG)	M8 180 kg-cm (156.2 lb-in.) (17.65 Nm)
VFD370VL23C-J		120mm <sup>2</sup> (4/0AWG)		120 mm <sup>2</sup> (4/0 AWG)	70 mm <sup>2</sup> (2/0 AWG)	
VFD450VL43C-J		50 mm <sup>2</sup> (1/0 AWG)		50 mm <sup>2</sup> (1/0 AWG)	25 mm <sup>2</sup> (4 AWG)	
VFD550VL43C-J		70 mm <sup>2</sup> (2/0 AWG)		70 mm <sup>2</sup> (2/0 AWG)	35 mm <sup>2</sup> (2 AWG)	
VFD750VL43C-J		120 mm <sup>2</sup> (4/0 AWG)		120 mm <sup>2</sup> (4/0 AWG)	70 mm <sup>2</sup> (2/0 AWG)	

#### NOTE:

1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600 V and temperature resistance of 75°C or 90°C
2. If you install at Ta 45°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
3. For UL installation compliance, use copper wires when installing. The wire gauge is based on a temperature resistance of 75°C, in accordance with UL requirements and recommendations.
4. Do not reduce the wire gauge when using higher temperature wire.

Frame Size	AWG	Vendor	P/N	A (MAX.)	B (MAX.)	C (MIN.)	D (MAX.)	d2 (MIN.)	E (MIN.)	F (MIN.)	W (MAX.)	T (MAX.)
E4	4	K.S.T	RNB22-8	50.0	16.0	10.0	27.0	8.3	13.0	14.0	28.0	6.0
	2	K.S.T	RNBS38-8									
	1/0	K.S.T	RNB60-8									
	2/0	K.S.T	RNB70-8									
	3/0	K.S.T	RNB80-8									
	4/0	K.S.T	SQNBS100-8									

Unit: mm

**NOTE:**

- The following additional terminals are needed when wiring. The additional terminal dimension should comply with Figure 1 below.
- After crimping the wire to the ring lug (must be UL approved), UL and CSA approved R/C (YDPU2), install heat shrink tubing rated at a minimum of 600 V<sub>AC</sub> insulation over the live part. Refer to Figure 2 below.

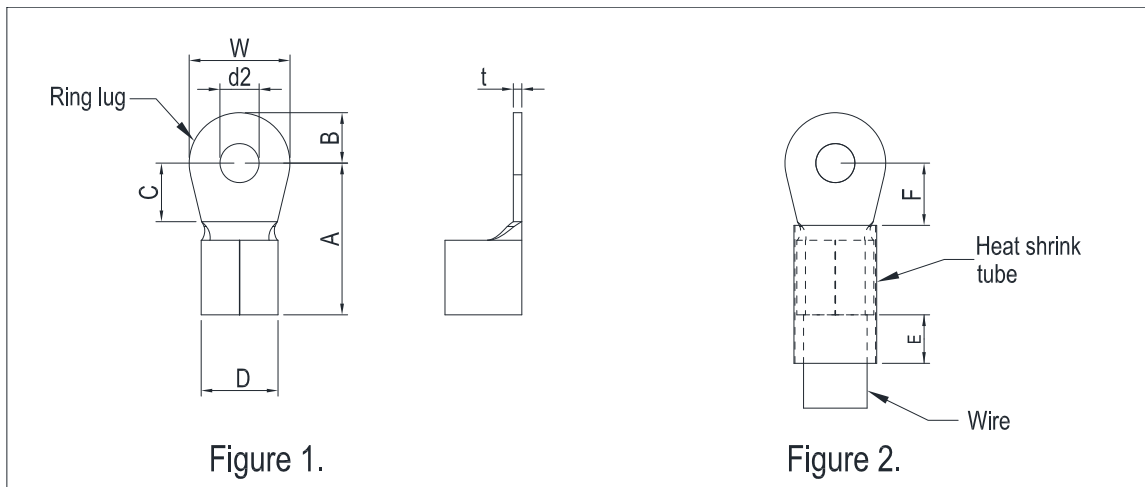
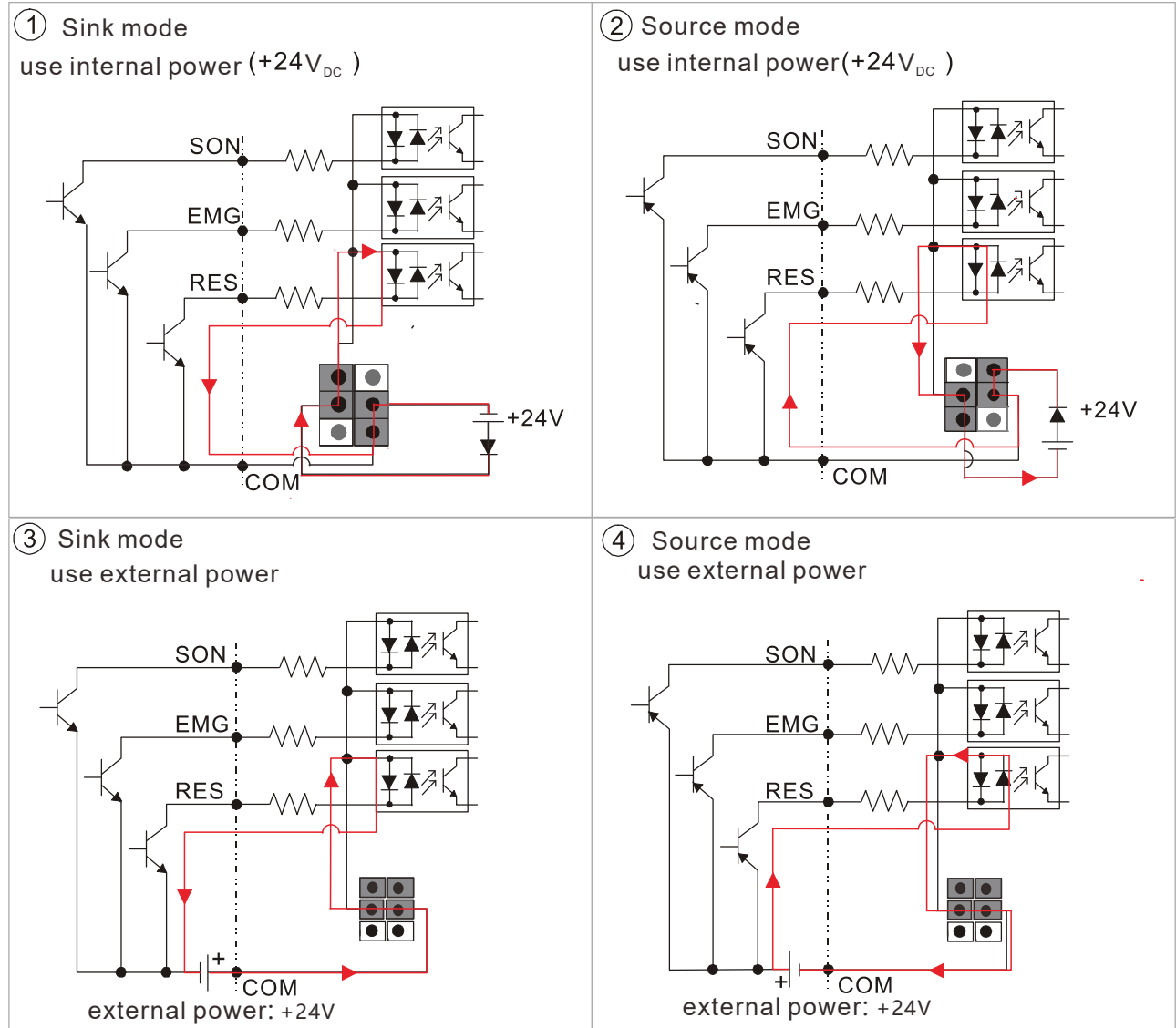


Figure 1.

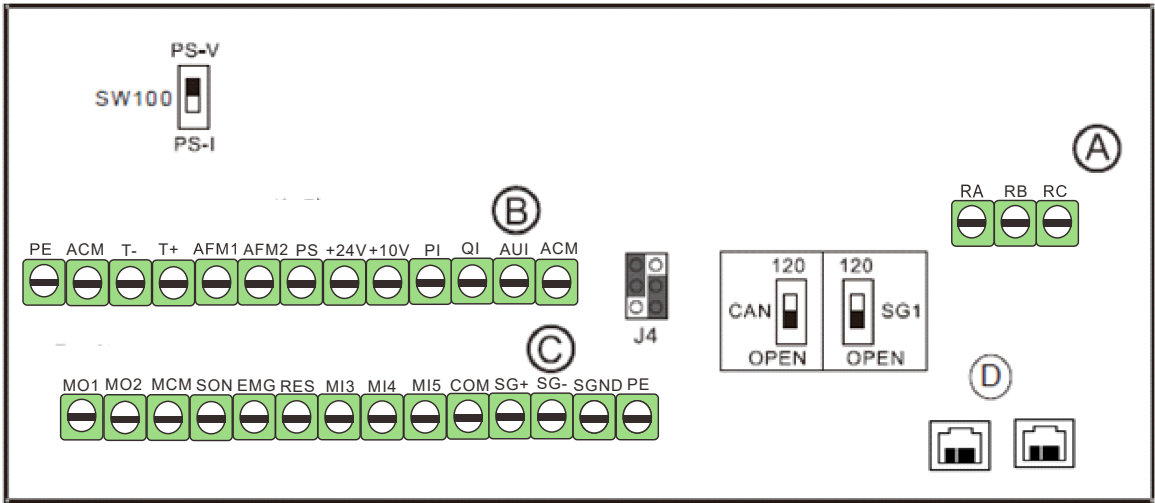
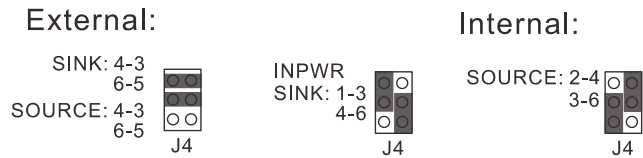
Figure 2.

## 2-3 Description of Terminals on Control Circuit

### Description of SINK (NPN)/SOURCE (PNP) Mode Selection Terminals



Pluggable Wiring Terminal Blocks:



Item	Wire Gauge					Torque (±10%)
	Group	Conductor	Stripping length	Mini. Wire Gauge	Max. Wire Gauge	
Control Terminal	A	Solid	6mm	0.2mm <sup>2</sup> [24 AWG]	1.5mm <sup>2</sup> [16 AWG]	5kg-cm [4.4 lb-in.] [0.5 Nm]
		Stranded				
RJ-45	D					

Item	Wire Gauge					Torque (±10%)
	Group	Conductor	Stripping length	Mini. Wire Gauge	Max. Wire Gauge	
	B	Solid	7-8mm	0.2mm <sup>2</sup> [24 AWG]	2.1mm <sup>2</sup> [14 AWG]	2kg-cm [1.7 lb-in.] [0.2 Nm]
		Stranded				
	C	Solid	7-8mm	0.2mm <sup>2</sup> [24 AWG]	2.1mm <sup>2</sup> [14 AWG]	2kg-cm [1.7 lb-in.] [0.2 Nm]
		Stranded				

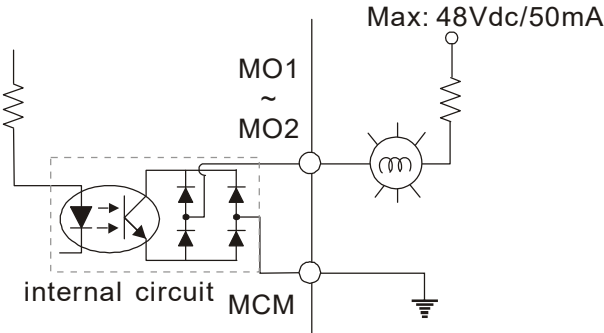
Wiring precautions:

For group A, B, C:

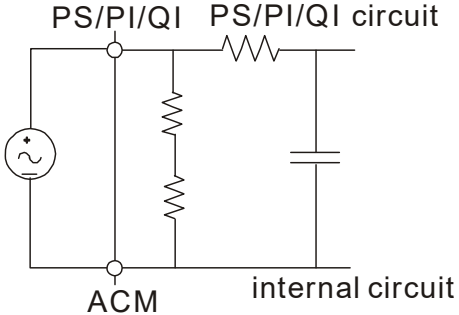
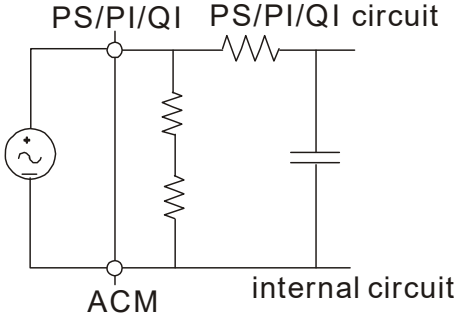
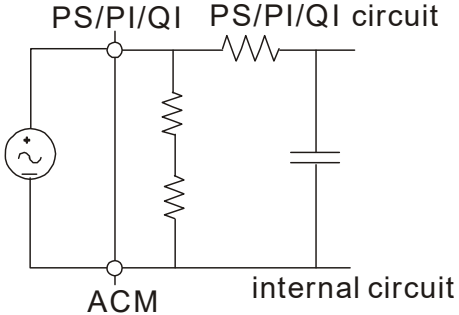
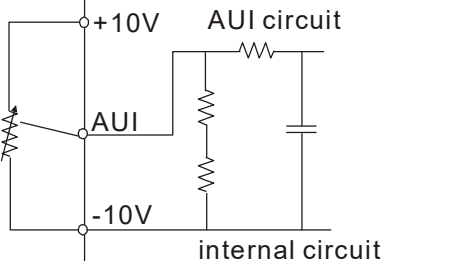
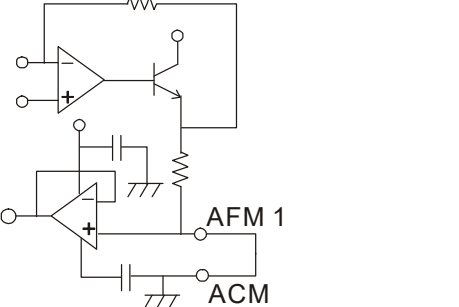
1. For group A: Tighten the wiring with a 3.5mm (wide) x 0.6mm (thick) slotted screwdriver
2. For group B, C . Tighten the wiring with a 2.5mm (wide) x 0.4mm (thick) slotted screwdriver
3. When wiring bare wires, make sure they are perfectly arranged to go through the wiring holes.

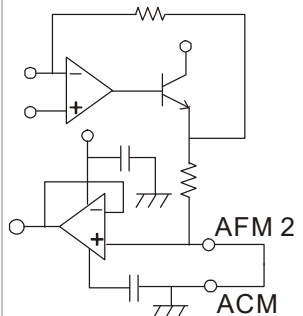
**NOTE:**

1. As we modify the fixed terminal block to the pluggable terminal blocks, the positions of the terminals are also changed. Please verify the differences between the original and new terminal blocks before wiring.
2. The RA, RB and RC terminals are still on a fixed terminal block as before.

Terminal	Features	Factory Setting (NPN Mode)	Difference between VJ-A and VJ-B
SON	Run-Stop	Terminal SON-COM: ON for Running; OFF for Stop	
EMG	External error input	External error input	
RES	Reset from error	Reset from error	
REV	TBA	TBA	New terminal
MI3	Multi-function input selection 3	Configured as no function in factory When it is ON, the input voltage is 24V <sub>DC</sub> (Max: 30V <sub>DC</sub> ) and then input impedance is 3.75k $\Omega$ ; when it is OFF, the tolerable leakage current is 10 $\mu$ A.	
MI4	Multi-function input selection 4		
MI5	Multi-function input selection 5		
COM	Common ground (Sink) for digital control signals	Common ground for multi-function input terminals	
RA	Error terminal 1 (Relay N.O. a)	Resistive load 5A(N.O.)/3A(N.C.) 240VAC	
RB	Error terminal 1 (Relay N.C. b)	5A(N.O.)/3A(N.C.) 24VDC	
RC	Command contact for multi-function output terminals (Relay)	Inductive load 1.5A(N.O.)/0.5A(N.C.) 240VAC 1.5A(N.O.)/0.5A(N.C.) 24VDC	
MO1	Multi-function output terminal 1 (photocoupler)	The hybrid servo drive sends various monitoring signals by means of open-collector configuration. 	
MO2	Multi-function output terminal 2 (photocoupler)		
MCM	Common ground for Multi-function output terminal (photocoupler)	Max 48V <sub>DC</sub> 50mA	



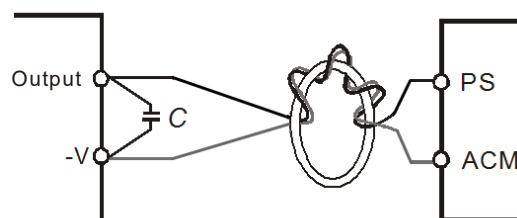
Terminal	Features	Factory Setting (NPN Mode)	Difference between VJ-A and VJ-B
PS	 <p>PS/PI/QI PS/PI/QI circuit</p>	<p>Pressure feedback                      Impedance: 200kΩ Resolution: 12 bits                      Range: 0 ~10V or 4~20mA = 0 ~ maximum pressure feedback value (Pr00-08). Use SW100 switch to input current, see Pr03-12 for more information.</p>	Terminal PO
PI	 <p>PS/PI/QI PS/PI/QI circuit</p>	<p>Pressure Command                      Impedance: 200kΩ Resolution: 12 bits                      Range: 0 ~ 10V = 0 ~ the maximum pressure command value (Pr00-07)</p>	
QI	 <p>PS/PI/QI PS/PI/QI circuit</p>	<p>Flow rate command                      Impedance: 200kΩ Resolution: 12 bits                      Range: 0 ~ 10V = 0 ~ the maximum flow rate</p>	
AUI	<p>Analog Voltage</p>  <p>AUI circuit</p>	<p>Impedance: 11.3kΩ                      Resolution: 12 bits                      Range: -10 ~ +10V<sub>DC</sub></p>	
+10V	Power supply for configuration	Power supply for analog configuration +10V <sub>DC</sub> 20mA	
+24V	Power supply terminal for the pressure sensor	Power supply for the pressure sensor +24V <sub>DC</sub> 100mA	
AFM1	 <p>AFM 1</p> <p>ACM</p>	<p>Impedance: 19.2kΩ (voltage output)                      Output current: 20mA max                      Resolution: 0 ~ 10V corresponding to the pressure feedback.                      Range: 0 ~ 10V</p>	Terminal AFM

Terminal	Features	Factory Setting (NPN Mode)	Difference between VJ-A and VJ-B
AFM2		Impedance: 33.8kΩ (voltage output) Output current: 20mA max Resolution: ±10V corresponding to the maximum frequency Range -10~10V	
ACM	Common ground for analog control signals	Common ground terminal for analog control signals	
T+ / T-	Motor's thermal protection terminals	Support KTY84-130, PTC130 thermal switch	New terminal
SG+, SG-, SGND	Modbus RS-485	See Communication Parameters in Ch04 for more information.	New terminal
PE	protective grounding terminal		New terminal

### Analog Input Terminals (PS, PI, QI, AUI, ACM)

- ☑ Analog input signals are easily affected by external noise. Use shielded wiring and keep it as short as possible (<20m) with proper grounding. If the noise is inductive, connecting the shield to terminal ACM can bring improvement.
- ☑ If the analog input signals (pressure sensor) are affected by noise from the hybrid servo drive, please connect a capacitor and ferrite core closed to the hybrid servo drive as indicated in the following diagrams. The magnetic permeability of the ferrite core should be over 5000μ to ensure an efficient noise isolation.

Wind each wires 3 times or more around the core



### Transistor Output Terminals (MO1, MO2, MCM)

- ☑ Make sure to connect the digital outputs to the right polarity.
- ☑ When connecting a relay to the digital outputs connect a surge absorber across the coil and check the polarity.

# Chapter 3 Machine Adjustment Procedure

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- 3-1 Description of Control Panel
- 3-2 System Setup and Machine Adjustment Flowcharts
- 3-3 Machine Adjustment Procedure
- 3-4 Confluence Machine Tuning Procedure
- 3-5 Confluence / Diversion Mode Adjustment Procedure



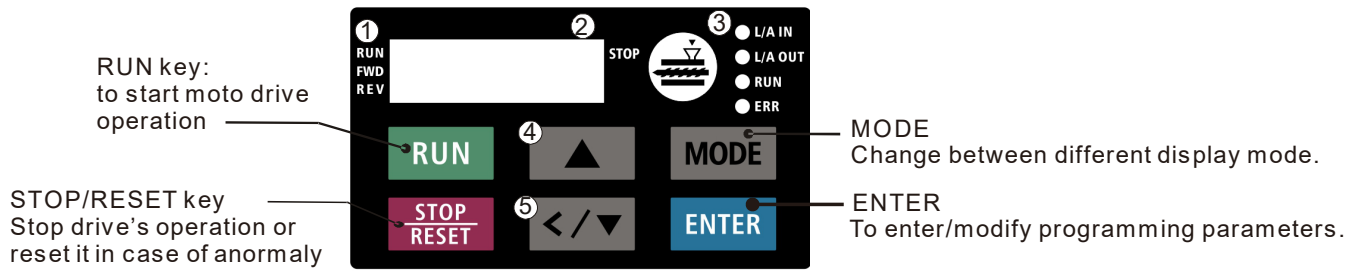
- Please re-check if the wiring is correct before start running the machine. Particularly, make sure that the output terminals of the hybrid servo drive, U/T1, V/T2, and W/T3, must not be used as power input terminals. Make sure that the good ground terminal ⊕ is grounded.
- It is not allowed to operate the switches with wet hands.
- Make sure that there is no short-circuit or ground short circuit conditions between the terminals or exposed live parts.
- The power switch can be turned on only with the cover installed.



- If any fault occurs during the operation of the hybrid servo drive and the motor, stop the machine immediately, and refer to “Troubleshooting” to check the cause of the faulty condition. After the hybrid servo drive stop its output but the main circuit power terminals L1/R, L2/S, and L3/T are not disconnected, if the operator touches the output terminals U/T1, V/T2, and W/T3 of the hybrid servo drive, electric shock may occur.











### 3-1 Description of Control Panel


#### Appearance of Keypad Control Panel KPVJ-LE02



- ① Status display  
Display driv's current status
- ② LED display  
Indicate frequency, voltage, current, user defined units and etc..
- ③ CANopen indicator light
- ④ UP key  
Set the parameter value and change the numeric data such as frequency.
- ⑤ Left/ Down key  
Set the parameter value and change the numeric data.  
Press and hold the MODE key then you can use the Left key.

#### Description of Displayed Function Items

Displayed Item	Description
RUN ● FWD ● REV ●  ● STOP	The current frequency set for the hybrid servo drive
RUN ● FWD ● REV ●  ● STOP	The frequency delivered by hybrid servo drive to the motor
RUN ● FWD ● REV ●  ● STOP	The user-defined physical quantity (Pr. 00-04)
RUN ● FWD ● REV ●  ● STOP	Load current
RUN ● FWD ● REV ●  ● STOP	Forward command
RUN ● FWD ● REV ●  ● STOP	Reverse command
RUN ● FWD ● REV ●  ● STOP	Displays the selected parameter
RUN ● FWD ● REV ●  ● STOP	Display the parameter value
RUN ● FWD ● REV ●  ● STOP	Display the external fault
RUN ● FWD ● REV ●  ● STOP	If the "End" message (as shown in the left figure) is displayed on the display area for

	<p>about one second, it means that data has been accepted and automatically stored in the internal memory</p>
	<p>If the setting data is not accepted or its value exceeds the allowed range, this error message will be displayed</p>

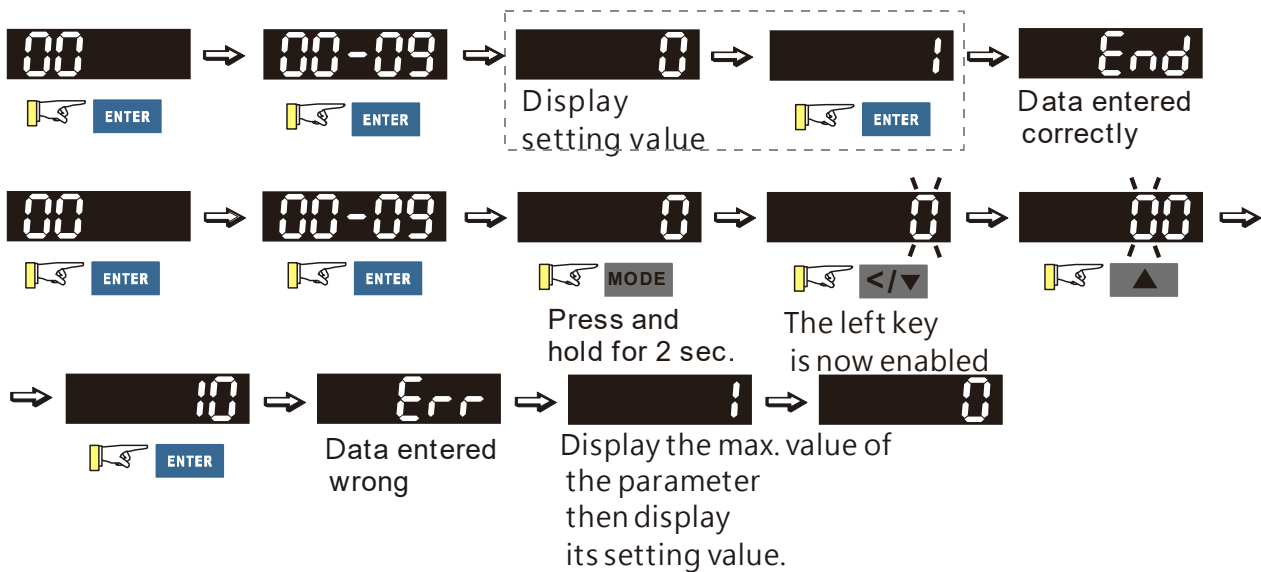
### Keypad Panel Operation Procedure:

#### A. Selecting Mode



Note: In the selection mode, press  ENTER to set the parameters

#### Setting Parameters

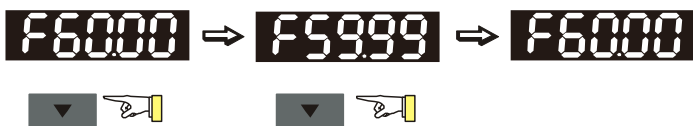


Note: In the parameter setting mode, press  MODE to return to the mode selecting.

**NOTE:**

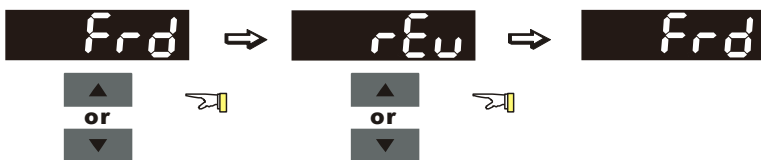
1. To disable LEFT key: press UP/ DOWN to adjust the number. When finishing the adjustment, press ENTER.
2. To enable the LEFT key: Press and hold MODE for two second until last digit of the parameter starts to blink. Now press UP, the value of the number increases. When the number reaches 9, press UP again, the number goes back to 0.
3. By pressing DOWN, the blinking cursor moves one digit to the left. Then press UP to increase the value of the number. Once reaching the desired number, press DOWN again to move the cursor one digit to the left.
4. When finishing setting the parameters, the LEFT function is still enabled. Press MODE for two seconds to disable LEFT function.

**Modifying Data**

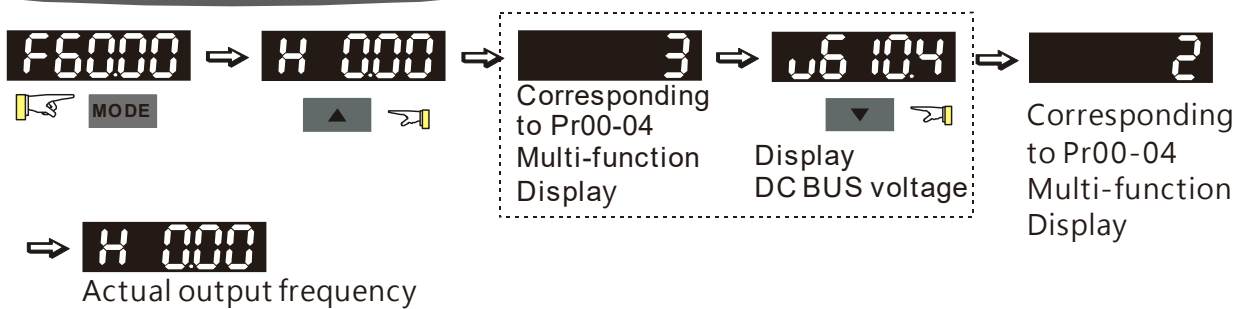


**Operating Direction**

While the motor drive is controlled from a digital keypad.



**Multi-Function Display Page**



**Display Fault/ Warning**

Display Fault Codes

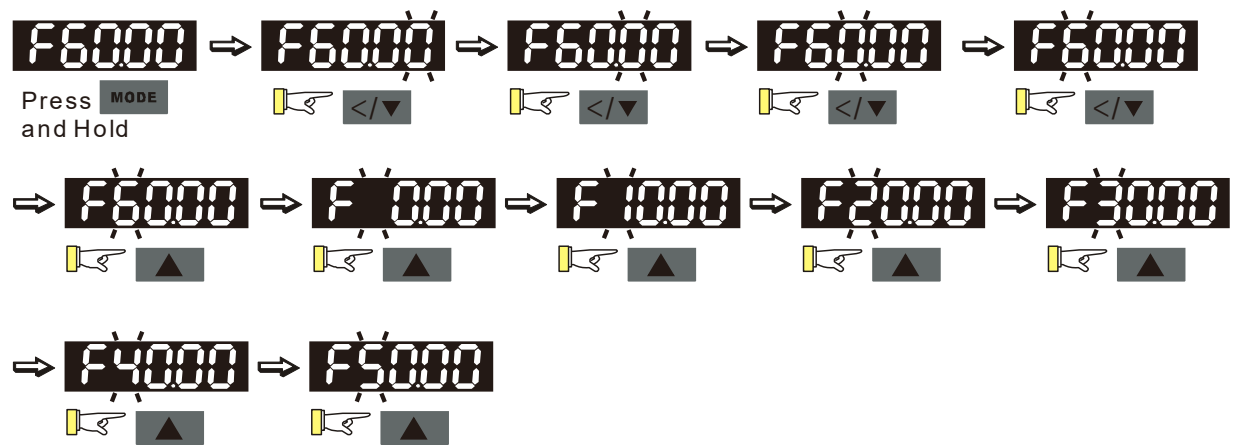
- (1) **E 75** ↔ **tH lo** Press RESET to clear fault code
- (2) **F 72** ↔ **bro** Repower on to clear fault code

Display Warning Codes

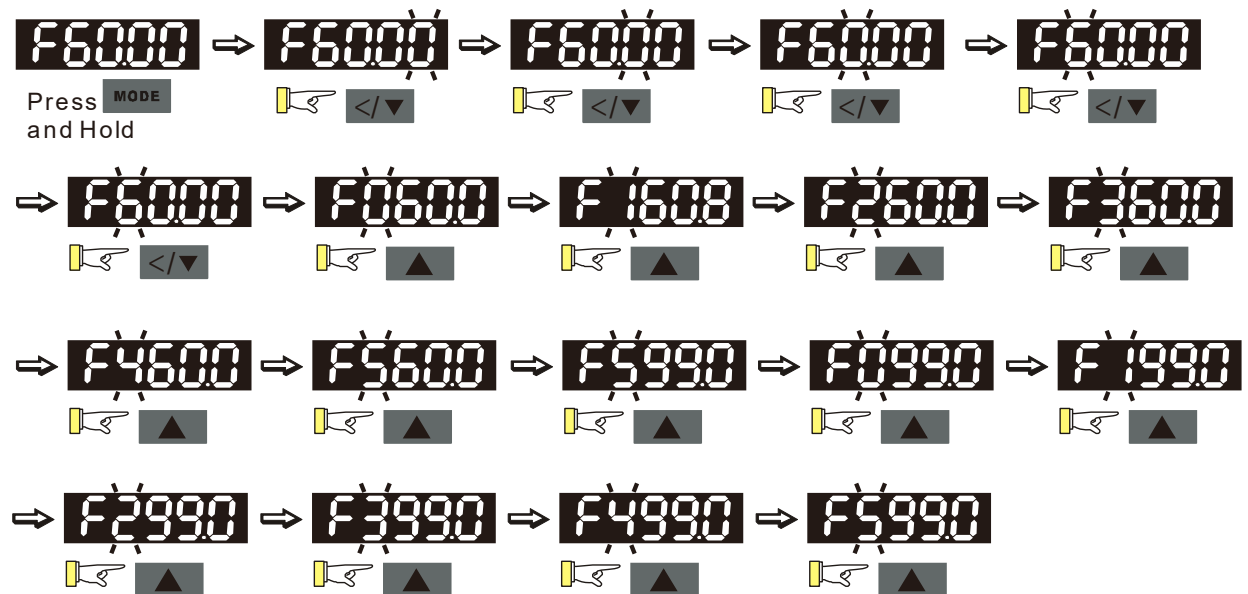


B. Frequency Command Page

Normal Mode 1 (Pr.01-02: Maximum Frequency has two digits. Example: Pr.01-02 = 60.00Hz)



Normal Mode 2 (Pr.01-02: Maximum Frequency has three digits. Example: Pr.01-02 = 599.0Hz)



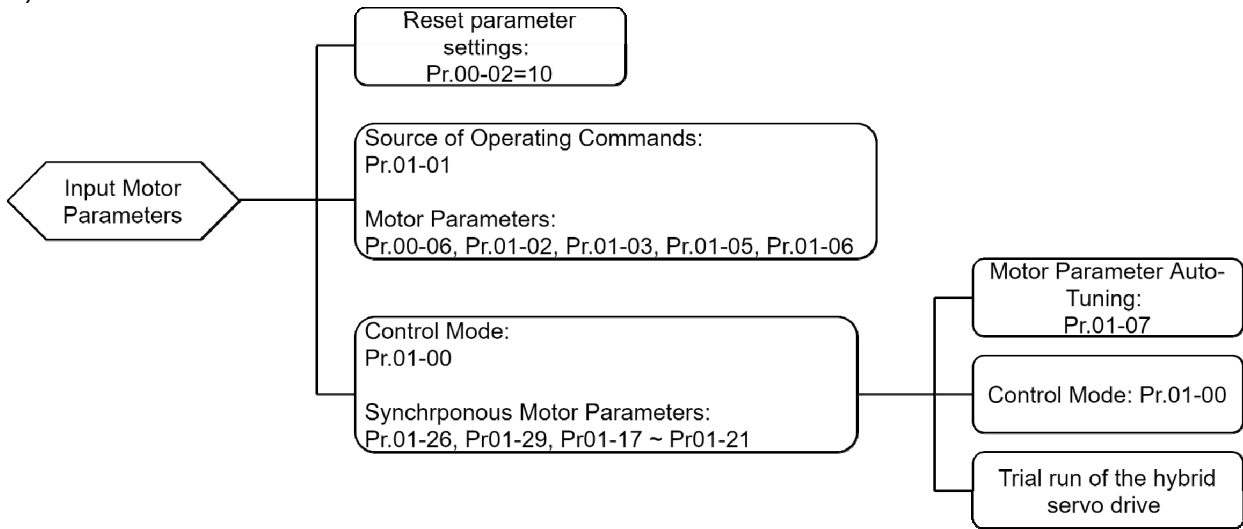
**List of Characters Shown on the Seven-segment Display of the Digital Keypad Panel**

Numeric	0	1	2	3	4	5	6	7	8	9
Seven-segment Display										
English Letter	A	a	B	b	C	c	D	d	E	e
Seven-segment Display		-	-				-			-
English Letter	F	f	G	g	H	h	I	i	J	j
Seven-segment Display		-		-						
English Letter	K	k	L	l	M	m	N	n	O	o
Seven-segment Display		-		-	-	-	-		-	
English Letter	P	p	Q	q	R	r	S	s	T	t
Seven-segment Display		-	-		-			-	-	
English Letter	U	u	V	v	W	w	X	x	Y	y
Seven-segment Display			-		-	-	-	-		-
English Letter	Z	z								
Seven-segment Display		-								

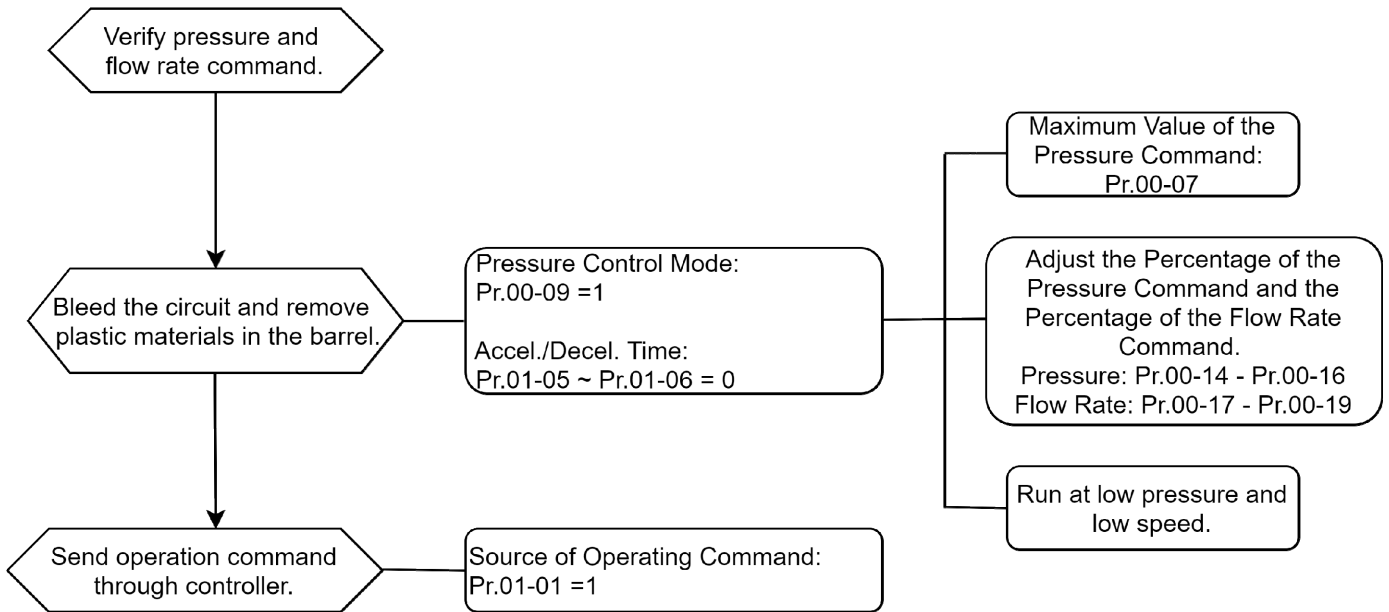


### 3-2 System Setup and Machine Adjustment Flowcharts: VFD-VJ (Choose a motor according to your own requirement.)

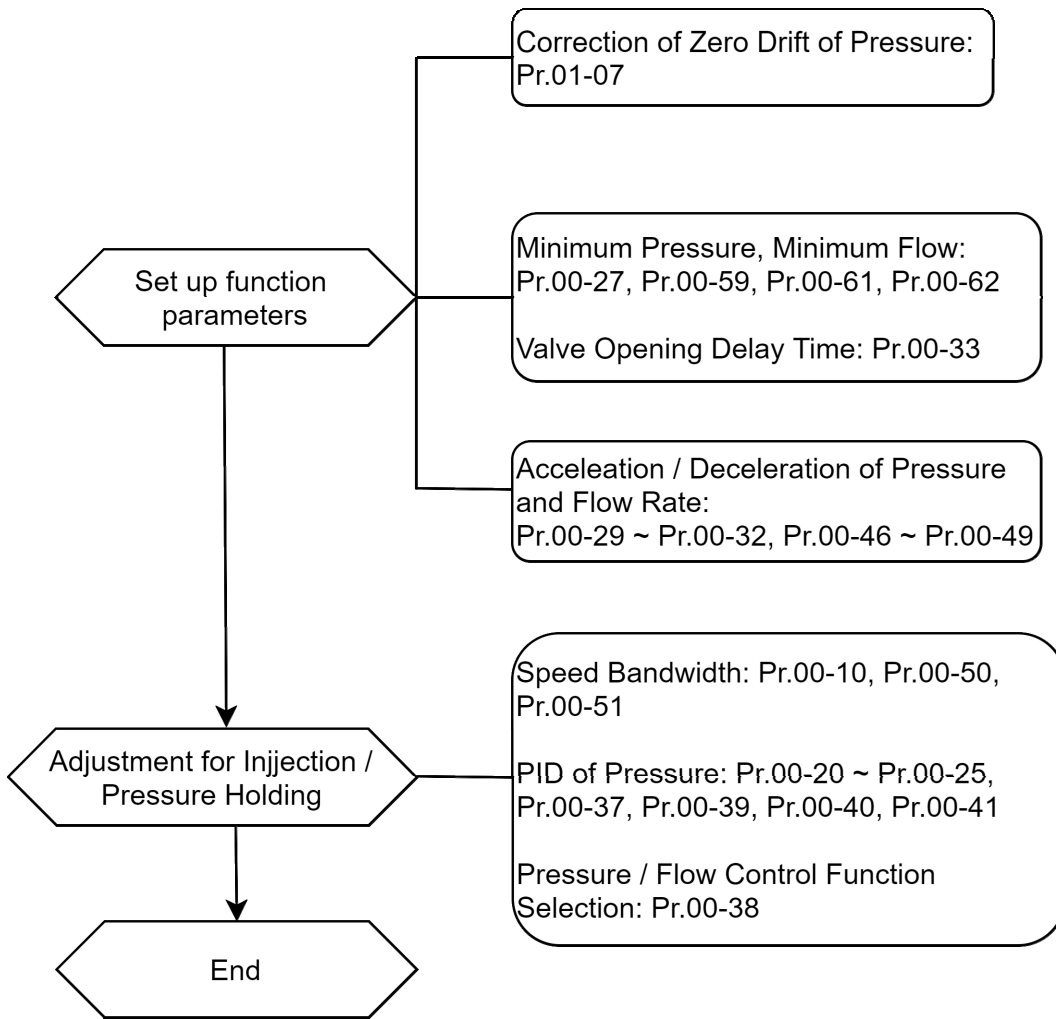
1)



2)



3)



### 3-3 Machine Adjustment Procedure

Perform the following operation procedure by using the Digital Keypad (KPVJ-LE02)

#### Step 1. Enter the motor's parameters

- Restore the factory default values by setting Pr.00-02 = 10

Reset parameter settings

Setting value of Pr.00-02	10: Reset parameter values
------------------------------	----------------------------

- Please make sure if the command source has been restored to the factory default (operation by external terminals)

If the KPVJ-LE02 is used, set Pr.01-01=0

Source of operation command

Setting value of Pr.01-01	0: Operation by using the digital keypad 1: Operation by using the external terminals. The Stop button on the keypad is disabled. 2: Communication using RS-485. The Stop button on the keypad is disabled
------------------------------	--

- Change the display type from Frequency command (Hz) into Speed (rpm)

Display the speed (rpm) defined by the user

Setting value of Pr. 00-06	0~39999rpm
-------------------------------	------------

- Set Pr. 01-02

Motor's maximum operation frequency

Setting value of Pr.01-02	50.00 – 600.00Hz
------------------------------	------------------

- Set Pr. 01-03

Motor's rated frequency

Setting value of Pr.01-03	0.00 – 600.00Hz
------------------------------	-----------------

- Set Pr.01-05 & Pr.01-06

Acceleration time setting

Setting value of Pr.01-05	0.00 – 600.00 seconds
------------------------------	-----------------------

Deceleration time setting

Setting value of Pr.01-06	0.00 – 600.00 seconds
------------------------------	-----------------------

The settings for the induction and synchronous motors are different. Please configure these parameters according to the related adjustment method for the motor.

### Induction motor

- Set Pr.01-00 = 0

Control mode

Setting value of Pr. 01-00	0: VF
	1: Reserved
	2: Reserved
	3: FOC vector control + Encoder (FOCPG)
	4: Reserved
	5: FOCPM
	6: Reserved

- Set Pr.01-26 = 0

Encode type

Setting value of Pr.01-26	0: ABZ
	1: ABZ+HALL (only used for Delta's servo motors)
	2: ABZ+HALL
	3: Resolver

- Set Pr.01-29

Number of pulses for each revolution of the encoder

Setting value of Pr.01-29	1~20000
---------------------------	---------

- Set Pr. 01-08

The rated current of the induction motor

Setting value of Pr. 01-08	0~655.35 Amps
----------------------------	---------------

- Set Pr.01-09

The rated power of the induction motor

Setting value of Pr.01-09	0.00 – 655.35kW
---------------------------	-----------------

- Set Pr.01-10

The rated speed (rpm) of the induction motor

Setting value of Pr.01-10	0~65535
---------------------------	---------

- Set Pr.01-11

Number of poles of the induction motor

Setting value of Pr.01-11	2~20
---------------------------	------

- Check if the motor can be separated from the pump
  1. If it can be separated, set Pr.01-07 as 1 and carry out a dynamic measurement
  2. If it cannot be separated, open the safety valve, enter the no-load current of the induction motor Pr.01-12 and set Pr.01-07 as 2. Then carry out the static measurement

### Motor Parameter Auto Tuning

Setting value of 0: No function

Pr. 01-07	1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)
	2: Static test for induction motor(IM)
	3: Reserved
	4: Auto measure the angle between magnetic pole and PG origin
	5: Dynamic rolling test for synchronous permanent-magnet (SPM) motor
	13: Dynamic rolling test for interior permanent-magnet (IPM) synchronous motor

- During the automatic measurement process of the induction motor, the digital keypad will show the message “tun”. After the measurement is finished, the motor automatically shuts down, and the measurement values are stored into Pr.01-13 to Pr.01-16. If the digital keypad shows “AUE”, please check if the wiring is correct and if the parameters are set correctly.
- The machine will shut off the power and then supply the power again
- Set Pr.01-00 = 3

Control mode

Setting value	0: VF
of Pr. 01-00	1: Reserved
	2: Reserved
	3: FOC vector control + Encoder (FOCPG)
	4: Reserved
	5: FOCPM
	6: Reserved

- Test run  
When the motor is in a no-load state, the speed command is set to 10 rpm for low-speed test run. Make sure that the output current value is close to the no-load current.  
If no error occurs, gradually increase the value of speed command to the highest speed.
- Make sure that the pump’s oil supply direction is the forward direction of the motor.

### Synchronous motor

- Set Pr.01-00 = 5

Control mode

Setting value	0: VF
of Pr.01-00	1: Reserved
	2: Reserved
	3: FOC vector control + Encoder (FOCPG)
	4: Reserved
	5: FOCPM
	6: Reserved

- Set Pr.01-26 = 3

Encode type

Setting value	0: ABZ
of Pr.01-26	1: ABZ+HALL (only used for Delta's servo motors)
	2: ABZ+HALL
	3: Resolver

- Set Pr.01-29

Number of pulses for each revolution of the encoder

Setting value	1~20000
of Pr.01-29	

- Set Pr.01-17

The rated current of the synchronous motor

Setting value	0~655.35 Amps
of Pr.01-17	

- Set Pr.01-18

The rated power of the synchronous motor

Setting value	0.00 – 655.35kW
of Pr.01-18	

- Set Pr.01-19

The rated speed (rpm) of the synchronous motor

Setting value	0~65535
of Pr.01-19	

- Set Pr.01-20

Number of poles of the synchronous motor

Setting value	2~20
of Pr.01-20	

- Set Pr.01-21

The inertia of the synchronous motor's rotor

Setting value of Pr.01-21	0.0~6553.5 *10 <sup>-4</sup> kg.m <sup>2</sup>
---------------------------	--

- Check if the motor can be separated from the pump
- If it can be separated, set the Pr.01-07 as 5 and carry out the parameter measurement of the synchronous motor
- If it cannot be separated, open the safety valve, set Pr.01-07 as 5 and carry out the parameter measurement of the synchronous motor

#### Motor Parameter Auto Tuning

Setting value of Pr.01-07	0: No function
	1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)
	2: Static test for induction motor(IM)
	3: Reserved
	4: Auto measure the angle between magnetic pole and PG origin
	5: Dynamic rolling test for synchronous permanent-magnet (SPM) motor
	13: Dynamic rolling test for interior permanent-magnet (IPM) synchronous motor

- During the automatic measurement process of the synchronous motor, the digital keypad will show the message “tun”. After the measurement is finished, the motor automatically shuts down, and the measurement values are stored into Pr.01-22 to 01-25. If the digital keypad shows “AUE”, please check if the wiring is correct and if the parameters are set correctly.
- Set the value of Parameter 01-07 as 4 and press [Run]. When the operation is complete, the PG offset angle of PM motor is written to Pr.01-27

#### Motor Parameter Auto Tuning

Setting value of Pr.01-07	0: No function
	1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)
	2: Static test for induction motor(IM)
	3: Reserved
	4: Auto measure the angle between magnetic pole and PG origin
	5: Dynamic rolling test for synchronous permanent-magnet (SPM) motor
	13: Dynamic rolling test for interior permanent-magnet (IPM) synchronous motor

- The machine will shut off power and then supply power again
- Test run  
When the motor is in a no-load state, the speed command is set to 10 rpm for low-speed test run. Make sure that the output current value is close to the zero current.  
If no error occurs, gradually increase the value of speed command to the highest speed. Make sure that the pump's oil supply direction is the forward direction of the motor.

**NOTE:**

- When using SPM motor, set Pr01-07=5 to do rolling test for SPM motor.
- When using IPM motor, set Pro1-07=13 to do dynamic rolling test for IPM motor.

**Step 2. Estimation of Inertia**

- Set the speed command as 1000 rpm
- Set Pr.01-05 & Pr.01-06 = 0.3~0.5 seconds

Acceleration time setting

Setting value of Pr.01-05	0.00 – 600.00 seconds
---------------------------	-----------------------

Deceleration time setting

Setting value of Pr. 01-06	0.00 – 600.00 seconds
----------------------------	-----------------------

- Set Pr.01-31 = 2 and then press [Run]

System control

Setting value of Pr.01-31	0: No function 1: ASR automatic tuning 2: Estimation of inertia
---------------------------	---

- Check if the value of Pr.01-32 is converged. If it is converged, stop the operation. If not, switch the rotation direction after the speed is stable.

The unity value of the system inertia

Setting value of Pr. 01-32	1~65535 (256 = 1 per unit)
----------------------------	----------------------------

- After the operation stops, select Pr.01-32 and press the [ENTER] button to complete the “write” operation.
- Set Pr.01-31=1 and the estimation of the motor’s inertia is complete.

**Step 3. Connect the motor and the pump and then confirm the pressure feedback signal**

- Set Parameter 00-04 = 11 and then supply voltage to PS

Selection of multi-function display

Setting value of Pr.00-04	11: display the signal value of the analog input terminal PS with 0~10V mapped to 0~100%
---------------------------	--

- Pr.00-08 = related pressure setting value of the pressure sensor at 10V

Maximum pressure feedback value

Setting value of Pr.00-08	0~250 bar
---------------------------	-----------

Set the speed command as 10rpm and press [RUN] to confirm if the pressure value through the pressure gauge > 0.

If the pressure value  $\leq 0$



- ☑ Gradually increase the rotation speed
- ☑ Confirm the operation direction of the pump
- ☑ Make sure that the direction valve is in the close state

If the pressure value > 0

- ☑ Make sure the multi-function display on the keypad panel shows the voltage indicating the same pressure as the pressure gauge

Example: If the pressure sensors indicates 250bar at 10V, when the pressure gauge shows 50 bar, the pressure sensor output voltage should be around  $50/250 * 10 = 2V$ , and the voltage shown on the keypad panel should be 20.0 (%)

- Observe if there is oil leakage.

#### Step 4. Confirm the pressure command and flow command

- Pr. 00-09 = 1 for pressure control mode

Pressure control mode

Setting value	0: Speed control
of Pr.00-09	1: Pressure control

- Pr. 00-04 = 12 PI for input voltage

Selection of multi-function display

Setting value	12: display the signal value of the analog input terminal PI with 0~10V
of Pr.00-04	mapped to 0~100%

- Pr. 00-07 = related pressure value of the pressure command at 10V

Maximum pressure command

Setting value	0~250 bar
of Pr.00-07	

- Send the maximum pressure command through the controller and then check the multi-function display page to enter this value into Pr. 00-14
- Send a half pressure command through the controller and then check the multi-function display page to enter this value into Pr. 00-15
- Send the minimum pressure command through the controller and then check the multi-function display page to enter this value into Pr. 00-16

Example: The 0~10V of the PS input terminal map to the 0~250Bar of the pressure sensor. If the maximum pressure on the controller of a machinery is 140Bar and corresponds to 10V, then Pr. 00-07=140. Now, set the pressure as 140Bar through the controller, the voltage value shown on the display is  $5.6 = 10x (140/ 250)$ . Input this value to the Pr. 00-14.

Then set the pressure as 70bar on the controller, and now the voltage value displayed on the keypad panel is about  $2.8 = 10x (70/250)$ . Input this value to the Pr. 00-15.

Then set the pressure as 0 bar on the controller, and the voltage value shown on the display is  $0.0 = 10x (0/250)$ . Input this value in the Pr.00-16.

- Set Pr.00-04 = 25 for QI input voltage

Selection of multi-function display

Setting value of Pr.00-04	25: display the signal value of the analog input terminal OI with 0~10V mapped to 0~100%
---------------------------	--

- Send the 100% flow rate through the controller and then check the multi-function display page to enter this value into Pr. 00-17
- Send the 50% flow rate through the controller and then check the multi-function display page to enter this value into Pr. 00-18
- Send the 0% flow rate through the keypad panel and then check the multi-function display page to enter this value into Pr.00-19

**Step 5. Bleed the circuit and make sure if there is any plastic material in the barrel. The machine can start operation only when there are no plastic materials inside the barrel.**

- Pr. 00-09 = 1 for pressure control mode

Pressure control mode

Setting value of Pr.00-09	0: Speed control 1: Pressure control
---------------------------	---

- Set Pr.01-05 & Pr.01-06 = 0 second

Acceleration time setting

Setting value of Pr.01-05	0.00 – 600.00 seconds
---------------------------	-----------------------

Deceleration time setting

Setting value of Pr.01-06	0.00 – 600.00 seconds
---------------------------	-----------------------

- When the air is bleeding completely, if there is any pressure fluctuation during operation, please adjust the pressure control Parameter PI in accordance with the method described in the “Description of Parameters”.

**Step 6. Send operation command through the controller**

- Pr.01-01=1

Source of operation command

Setting value of Pr. 01-01	0: Operation by using the digital keypad 1: Operation by using the external terminals. The Stop button on the keypad is disabled. 2: Communication using RS-485. The Stop button on the keypad is disabled
----------------------------	--

**Step 7. Adjustment for injection/pressure holding**

- Heat up the barrel to the required temperature and set the controller in manual control mode.
- Set the Ki values for the three stages PI to 0 (Pr.00-21, Pr.00-23 , and Pr.00-25) and Kp values to small values ( $\leq 50.0$ )

- Start the plastic injection operation. The "Target value" is low pressure ( $< 50$  bar) and low flow rate ( $< 30\%$ ).
- Press the "injection" button on the operation panel for the injection operation or the machine will enter the pressure holding operation (depending on the position of the cylinder)
- In the pressure holding state without causing the vibration of the motor, increase the speed bandwidth to the maximum value 40Hz (Pr. 00-10).
- In the pressure holding condition, if the pointer of the pressure gauge or the monitored pressure waveform has no fluctuation, it means that the pressure is stably fed back. It is allowed to increase the three Kp values.
- When the pressure feedback becomes unstable, reduce the three Kp values by 20% (example: the three Kp values are reduced from 100.0 to 80.0). Adjust the three Ki values to eliminate the steady-state error so to speed up system response.
- When the above steps are completed, increase the "target value" for the pressure command.
- Observe if the pressure feedback is stable. If there is an abnormal condition, please solve it as follows:

#### Solve the pressure instability problem

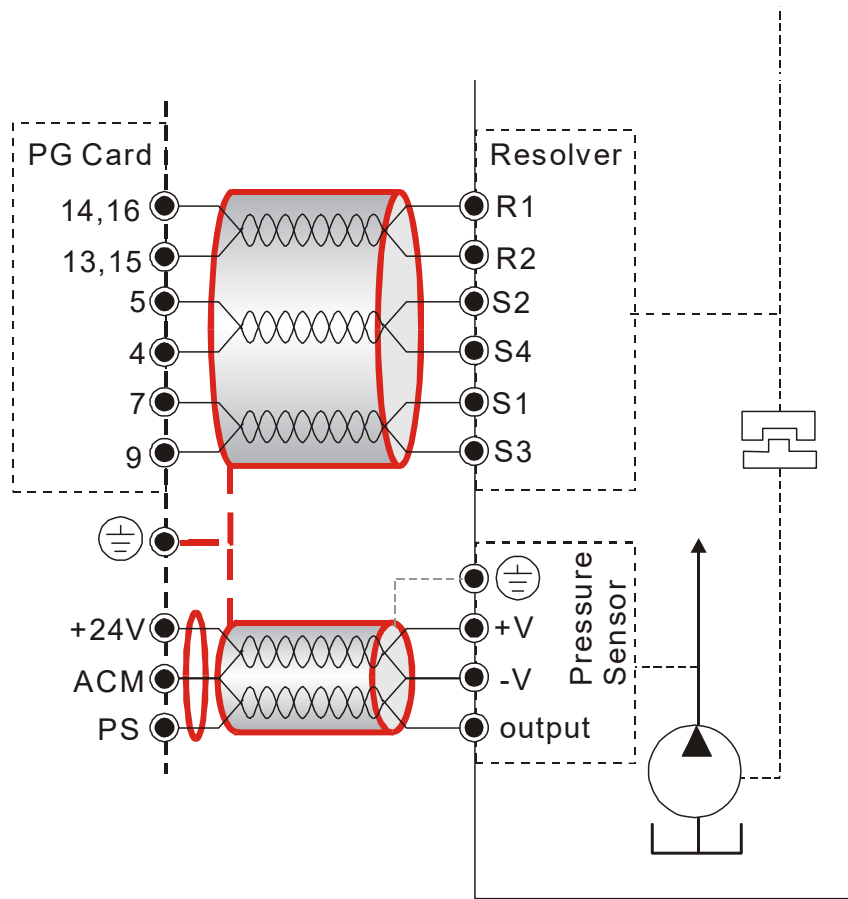
##### **Instability at high pressure**

If the hybrid servo drive has an overload condition, please increase the power rating of the hybrid servo drive

##### **Instability over the entire pressure range**

1. Set Pr.00-09 = 0 to switch to the speed control
2. If the hydraulic circuit is in the closed state, send a low speed command so as to allow a pressure feedback value of 40-50% of the value for pressure command (Pr.00-07)
3. By using the monitoring software, observe if the pressure waveform has irregular fluctuations.
  - Pressure waveform fluctuates  
It may be a ground interference problem. If the motor or the three-phase power supply is grounded, disconnect the ground wire. If the motor or three-phase power supply has no ground wire, you can install a ground wire for anti-interference protection.

It may be a grounding problem of the shield mesh (as the red thick line shown below). If the shield mesh is properly grounded, the ground wire can be removed; if the shield mesh has no grounding wire, install a ground wire for anti-interference protection.



4. If there is any abnormal condition that cannot be solved, please contact the manufacturer.

### Step 8. Adjustment of system transient response

- Reduce the pressure rise time, increase Kp1 (Pr.00-20) and reduce the Ki1 time (Pr.00-21)
- For pressure overshoot, increase the Kp3 time (Pr.00-24) and reduce the Ki3 time (Pr.00-25)

### 3-4 Confluence Machine Tuning Procedure

Wiring according to Chapter 2

Carry out the automatic measurement of the motor's parameters according to Step 1 and Step 2 described above for the Master and Slave, respectively. Then perform the following procedure

#### Master setting

- Set Pr.03-13 = 1

Confluence Master/Slave Selection

Setting value	0: No function
of Pr.03-13	1: Master 1
	2: Slave/Master 2
	3: Slave/Master 3

- Set Pr.03-14

Slave's proportion of the Master's flow

Setting value	0.0~6553.5%
of Pr.03-14	

- Pr.03-17 can be configured to determine the activation level of the Slave

Slave's activation level

Setting value	0~100%
of Pr.03-17	

**Slave setting**

- Pr.01-01=1

Source of operation command

Setting value of Pr. 01-01	0: Operation by using the digital keypad
	1: Operation by using the external terminals. The Stop button on the keypad is disabled.
	2: Communication using RS-485. The Stop button on the keypad is disabled

- Set Pr.01-01=2

Source of operation command

Setting value of Pr.01-01	0: Operation by using the digital keypad
	1: Operation by using the external terminals. The Stop button on the keypad is disabled.
	2: Communication using RS-485. The Stop button on the keypad is disabled

- Set Pr.03-15 = 1

Source of Frequency Command

Setting value of Pr. 03-15	0: Digital Operation Panel
	1: RS485 Communication
	2~5: reserved
	6: CANopen

- Shut down the power and then supply the power again  
Set an arbitrary value of the frequency command at the Master to check if the Slave has the same value of the frequency command  
Set 10rpm at the Master and then press RUN to see if the Slave is also running. If not, check the wiring or the parameter setting for any problem

- Set Slave Pr.03-13 = 2

Confluence Master/Slave Selection

Setting value of Pr.03-13	0: No function
	1: Master 1
	2: Slave/Master 2
	3: Slave/Master 3

- Pr.03-21 can be set at the Slave to decide if the Slave is performing the reversed operation for depressurization.  
**NOTE:** If it is required to reverse the operation for depressurization at the Slave, it is necessary to make sure that the pump outlet port is not installed with a check valve and Pr.03-16 should be set as 500%

## Slave reverse operation for depressurization

Setting value	0: Disable
of Pr.03-21	1: Enable

## Limit for the Slave reverse depressurization torque

Setting value	0~500%
of Pr.03-16	

- Shut off the power and the re-supply power for the Slave, and then set the Slave in the speed control mode

## Speed Control Mode

Setting value	0: Speed control
of Pr.00-09	1: Pressure control

In this case, the Master can be tuned according to the Step 3 – Step 8 described above

### 3-5 Confluence/Diversion Mode Adjustment Procedure

Wiring according to Chapter 2

In a diversion condition, adjust various parameters of the hybrid servo drive according to the Step 1 – Step 8 describe above

In a confluence condition, please refer to the machine adjustment procedure for the confluence operation

Complete the above steps

Set the Master for pressure control mode

- Pr.00-09 = 1 for pressure control mode

Pressure control mode

Setting value	0: Speed control
of Pr.00-09	1: Pressure control

Set the Slave for speed control mode

- Pr.00-09 = 0 for speed control mode

Speed Control Mode

Setting value	0: Speed control
of Pr.00-09	1: Pressure control

- Pr.03-00 ~ Pr.03-02 = 45 confluence/diversion signal input

Multi-function Input

Setting values	0: No function
of Pr.03-00~03-02	45: Confluence/Diversion signal input

- Through the controller, perform the entire confluence/diversion operation.
- New protection mechanism at version C: When Pr.03-00 ~ Pr.03-02 = 45, Pr.01-01 is automatically set as 2 and Pr.03-15 is automatically, set as 1. This is a mechanism to prevent forgetting to set up related parameters and mistakes when setting up parameters.



# Chapter 4 Summary of Parameter Settings

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00 System Parameters

01 Motor Parameters

02 Protection Parameters

03 Digital / Analog Input / Output Parameters

04 Communication Parameters

## 4-1 Summary of Parameters

### 00 System Parameters

✎ You can set this parameter during operation.

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
00-00	Hybrid servo drive model code ID	<b>VJ-A</b> 12: 230V, 7.5HP 13: 460 V, 7.5HP 14: 230V, 10HP 15: 460V, 10HP 16: 230V, 15HP 17: 460V, 15HP 18: 230V, 20HP 19: 460V, 20HP 20: 230V, 25HP 21: 460V, 25HP 22: 230V, 30HP 23: 460V, 30HP 24: 230V, 40HP 25: 460V, 40HP 26: 230V, 50HP 27: 460V, 50HP 29: 460V, 60HP 31: 460V, 75HP 33: 460V, 100HP  <b>VJ-C</b> 214: 230V, 40HP 215: 230V, 50HP 410: 460V, 15HP 411: 460V, 20HP 412: 460V, 25HP 413: 460V, 30HP 414: 460V, 40HP 415: 460V, 50HP 416: 460V, 60HP 417: 460V, 75HP 418: 460V, 100HP	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
00-01	Display of rated current of the hybrid servo drive	Display the model specific values	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
00-02	Reset parameter settings	0: No function 1: Parameter locked 5: Rest the kWh at drive stop 7: Reset CANopen Index 10: Reset to factory setting	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
00-03	Software version	Read only	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
✓	00-04 Selection of multi-function display	0: Display the output current (A) 1: Reserved 2: Display the actual output frequency (H) 3: Display the DC bus voltage (U) 4: Display the output voltage (E) 5: Display the output power angle (n) 6: Display the output power in kW (P) 7: Display the actual motor speed rpm (r) 8: Display the estimated output torque N-m (t) (%) 9: Display the PG feedback (G) 10: Reserved 11: Display the signal value of the analog input terminal PO % (1.) 12: Display the signal value of the analog input terminal PI % (2.) 13: Display the signal value of the analog input terminal AUI % (3.) 14: Display temperature of the heat sink in °C (t.) 15: Display temperature of IGBT in °C (T) 16: The status of digital input (ON/OFF) (i) 17: The status of digital output (ON/OFF) (o) 18: Reserved 19: The corresponding CPU pin status of the digital input (i.) 20: The corresponding CPU pin status of the digital output (o.) 21~24: Reserved 25: Display the signal value of the analog input terminal QI % (5.) 26: Display the actual pressure value (Bar) (b.) 27: Display the kWh value (K) 28: Display the motor temperature (currently only support KTY84) (T.) 29: Overload rate of hybrid servo drive (d.) (unit: %) 30: Over load rate of motor with last digit A of HES. (M.) (unit: %) 31: Display current at braking (A.) (unit: A) 32: Temperature of the braking chopper (4.) (unit: °C) 33: Reserved 34: Torque constant Kt (K.) 35: Reserved 36: Reserved 37: Reserved 38: Reserved 39: Reseerved 40: Reserved 41: # of times to switch on/off of the soft start relays (L) (%) 42: Amount of time to clean the cooling fans (F) %	0	○	○	○
✓	00-05 Reserved		0			
✓	00-06 Display the speed (rpm) defined by the user	0~39999 rpm	2000	○	○	○

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
✎ 00-07	Maximum value of the pressure command	0~400Bar	140	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-08	Maximum feedback pressure	0~400 Bar	250	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
00-09	Pressure control mode	0:Speed control 1:Pressure control	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
00-10	Speed bandwidth	1~200Hz	20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-11	Pressure feedback filtering time PS	0.000~1.000 second	0.000	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-12	Pressure command filtering time	0.000~1.000 second	0.000	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-13	Flow command filtering time	0.000~1.000 second	0.000	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-14	Percentage of the pressure command (Max)	0.0~100.0%	56.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-15	Percentage of the pressure command (Mid)	0.0~100.0%	28.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-16	Percentage of the pressure command (Min)	0.0~100.0%	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-17	Percentage of the flow command (Max)	0.0~100.0%	100.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-18	Percentage of the flow command value (Mid)	0.0~100.0%	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-19	Percentage of the flow command (Min)	0.0~100.0%	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-20	P (proportional) gain 1	0.0~1000.0	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-21	I (integration time) 1	0.00~500.00 seconds	2.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-22	P (proportional) gain 2	0.0~1000.0	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-23	I (integration) time 2	0.00~500.00 seconds	2.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-24	P (proportional) gain 3	0.0~1000.0	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-25	I (integration) time 3	0.00~500.00 seconds	2.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-26	Pressure stable zone	0~100%	25	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-27	Minimum pressure	0.0~100.0%	0.1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 00-28	Depressurization speed	0~100%	25	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM	
✓	00-29	Ramp up rate of pressure command	0~1000ms	0	○	○	○
✓	00-30	Ramp down rate of pressure command	0~1000ms	100	○	○	○
✓	00-31	Ramp up rate of flow command	0~1000 ms	80	○	○	○
✓	00-32	Ramp down rate of flow command	0~1000 ms	80	○	○	○
✓	00-33	Valve opening delay time	0~200 ms	0	○	○	○
	00-34	Output switching function	0.0~100.0% (100.0% is the maximum pressure feedback)	50.0	○	○	○
✓	00-35	Over-pressure detection level	0~400Bar	230	○	○	○
✓	00-36	Detection of disconnection of pressure feedback	0 : No function 1: Enable (only for the pressure feedback output signal within 1~5V or 4~20mA)	0	○	○	○
✓	00-37	Differential gain	0.0~100.0 %	0.0	○	○	○
	00-38	Pressure/flow control function selection	Bit 0: 0: Switch the PI Gain according to the pressure feedback level and use single speed bandwidth.  1: Switch the PI Gain and speed bandwidth according to the multi-function input terminal  Bit 1: 0: No pressure/flow control switch  1: Switch between the pressure and flow control  Bit 2: 0: Use the old pressure overshoot suppression  1: Use the new pressure overshoot suppression  Bit 3: 0: Switch the PI Gain and single speed bandwidth according to the pressure feedback level  1: Switch the PI Gain and speed bandwidth according to the pressure command.	0	○	○	○
	00-39	Integral time Pressure overshoot 1	0.00~500.00 sec.	0.20	○	○	○
	00-40	Differential gain 2	0.0~100.0%	0.0			
	00-41	Differential gain 3	0.0~100.0%	0.0			
	00-42	Pressure overshoot level	0~100%	2	○	○	○

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM	
	00-43	Maximum Flow	0~100%	100	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-44	Pressure Command	0.0~400.0 bar	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-45	Flow Rate Command	0.0~100.0%	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-46	Pressure reference S1 time	0~1000ms	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-47	Pressure reference S2 time	0~1000ms	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-48	Flow reference S1 time	0~1000ms	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-49	Flow reference S2 time	0~1000ms	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-50	Speed bandwidth 2	0~40Hz	20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-51	Speed bandwidth 3	0~40Hz	20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-52	Overpressure Detecting Time	0.000~1.000sec	0.01	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-53	Oil Shortage Detecting Time	0.0~60.0sec	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-54	Oil Pump Reverse Running Detecting Time	0.0~60.0sec	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-55 ~ 00-58	Reserved					
↗	00-59	Minimum Flow	0.00~ 100.00%	5.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	00-60	Oil Shortage Detecting Time at Startup	0 ~10 min	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-61	Minimum Pressure 2	0.0 ~ 100.0%	0.1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-62	Minimum Flow 2	0.00 ~ 100.00%	5.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-63	Pressure Releasing Valve Opening Time Interval	0.000 ~ 0.100 sec	0.100	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-64 ~ 00-65	For specific customers only	For certain customers only				
	00-66	Multi-flow rate / speed command 1	0.00~599.00Hz	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-67	Multi-flow rate / speed command 2	0.00~599.00Hz	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-68	Multi-flow rate / speed command 3	0.00~599.00Hz	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	00-69	Multi-flow rate / speed command 4	0.00~599.00Hz	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
00-70	Multi-flow rate / speed command 5	0.00~599.00Hz	0	○	○	○
00-71	Multi-flow rate / speed command 6	0.00~599.00Hz	0	○	○	○
00-72	Multi-flow rate / speed command 7	0.00~599.00Hz	0	○	○	○
00-73 ~ 00-90	For specific customers only	For certain customers only				
00-91	Output quantity of oil pump	0~500 cc / rev 0: Turn off pressure loss detection	0			
00-92	Pressure loss detecting time	0~60.0 sec 0: Turn off pressure dete	0			
00-93	Pressure limit percentage	0~100%	10			

**01 Motor Parameters**

⚡ You can set this parameter during operation.

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
01-00	Control mode	0: VF 1: Reserved 2: Reserved 3: FOCPGIM (Induction Motor) 4: Reserved 5: FOCPGPM (Permanent Motor) 6: Reserved 7: Reserved	5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
⚡ 01-01	Source of operating command	0: Controlled by using the digital keypad 1: Controlled by using the external terminals. The STOP button on the keypad is disabled. 2: Communication using RS-485. The STOP button on the keypad is disabled 3: Controlled by using CANopen	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
01-02	Motor's maximum operating frequency	50.00~599.00Hz	166.67	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
01-03	Motor's rated frequency	0.00~599.00Hz	113.33	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
01-04	Motor's rated voltage	230V Models: 0.1V~255.0V 460V Models: 0.1V~510.0V	220.0 440.0	<input type="radio"/>	<input type="radio"/>	
⚡ 01-05	Acceleration time setting	0.00~600.00 seconds	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
⚡ 01-06	Deceleration time setting	0.00~600.00 seconds	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
01-07	Motor Parameter Auto Tuning	0: No function	0	<input type="radio"/>	<input type="radio"/>	
		1: Dynamic test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)		<input type="radio"/>	<input type="radio"/>	
		2: Static test for induction motor(IM)		<input type="radio"/>	<input type="radio"/>	
		3: Reserved		<input type="radio"/>	<input type="radio"/>	
		4: Measuring the angle between magnetic pole and PG origin by the dynamic test of SPM motor				<input type="radio"/>
		5: Parameter measurement by the dynamic test of SPM motor (Surface-mounted Permanent Magnet synchronous Motor)				<input type="radio"/>
		9: Angle measurement between magnetic pole and PG origin and parameter measurement by the dynamic test of SPM motor.				
		13: Dynamic test for IPM motor (Interior permanent magnet synchronous motor)				



Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
		14: Correction of pressure feedback offset				
01-08	Rated current of the induction motor (A)	40~120% of the drive's rated current	###		○	
01-09	Rated power of the induction motor	0~655.35kW	###		○	
01-10	Rated speed of the induction motor	0~65535rpm 1710 (60Hz 4-pole); 1410 (50Hz 4-pole)	1710		○	
01-11	Number of poles of the induction motor	2~20	4		○	
01-12	No-load current of the induction motor (A)	0~Default value of Pr.01-08	###		○	
01-13	Stator resistance (Rs) of the induction motor	0~65.535Ω	0		○	
01-14	Rotor resistance (Rr) of the induction motor	0~65.535Ω	0		○	
01-15	Magnetizing inductance (Lm) of the induction motor	0.0~6553.5mH	0		○	
01-16	Total leakage inductance (Lx) of the induction motor	0.0~6553.5mH	0		○	
01-17	Rated current of the synchronous motor	0.00~655.35 Amps	We've set up Pr.01-17 to Pr.01-24 of each hybrid servo drive before shipping them to you.			○
01-18	Rated power of the synchronous motor	0.00~655.35kW				○
01-19	Rated speed of the synchronous motor	0~65535rpm				○
01-20	Number of poles of the synchronous motor	2~20				○
01-21	Inertia of the synchronous motor's rotor	0.0~6553.5 *10 <sup>-4</sup> kg.m <sup>2</sup>				○
01-22	Stator's phase resistance (Rs) of the synchronous motor	0.000~65.535Ω				○

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
01-23	Stator's phase inductance (Ld) of the synchronous motor	0.00~655.35mH				○
01-24	Stator's phase inductance (Lq) of the synchronous motor	0.00~655.35mH				○
01-25	Back EMF of the synchronous motor	0~65535 V/ krpm	0			○
01-26	Encoder type	3: Resolver	3			○
01-27	PG Offset angle of synchronous motor	0.0~360.0°	0.0			○
01-28	Number of poles of the resolver	1~5	1			○
01-29	Encoder pulse	1~20000	1024		○	○
01-30	Encoder's input type setting	0: No function 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction) 4: Phase A is a pulse input and phase B is a direction input. (low input=forward direction, high input=reverse direction) 5: Single-phase input	1		○	○
01-31	System control	0: No function 1: ASR automatic tuning 2: Estimation of inertia	1		○	○
01-32	Unity value of the system inertia	1~65535 (256 = 1 per unit)	260		○	○
01-33	Carrier frequency (VJ-A)	5~ 10 KHz	5	○	○	○
01-33	Carrier Frequency (VJ-C)	4-10 kHz	5			
01-34	Reserved					
01-35	Motor ID#	0 : No Function See 4-2 Description of Parameter Settings for more information	0			

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
01-36	Change the running direction	0: When the drive runs <b>forward</b> , the motor rotates <b>counterclockwise</b> . When the drive runs <b>reversely</b> , the motor rotates <b>clockwise</b> . 1: When the drive runs <b>forward</b> , the motor rotates <b>clockwise</b> . When the drive runs <b>reversely</b> , the motor rotates <b>counterclockwise</b>	0			
01-37	HES ID #	0: No Function See 4-2 Description of Parameter Settings for more information	0			
✎ 01-38	Maximum Output Voltage	0 ~110%	100%	○	○	○
01-39	PDFF (Speed overshoot suppression parameter)	0 ~ 200	100			

## 02 Protection Parameters

✎ You can set this parameter during operation.

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
✎ 02-00	Software brake level	230V models: 350.0~450.0V <sub>DC</sub> 460V models: 700.0~900.0V <sub>DC</sub>	380.0 760.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-01	Fault record 1	0: No error record	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-02	Fault record 2	1: Over-current during acceleration (ocA)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-03	Fault record 3	2: Over-current during deceleration (ocd)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-04	Fault record 4	3: Over-current during constant speed (ocn)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-05	Fault record 5	4: Ground fault (GFF)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-06	Fault record 6	5: IGBT short-circuit (occ)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		6: Over-current at stop (ocS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		7: Over-voltage during acceleration (ovA)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		8: Over-voltage during deceleration (ovd)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		9: Over-voltage during constant speed (ovn)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		10: Over-voltage at stop (ovS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		11: Low-voltage during acceleration (LvA)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		12: Low-voltage during deceleration (Lvd)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		13: Low-voltage during constant speed (Lvn)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		14: Low-voltage at stop (LvS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		15: Phase loss protection (orP)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		16: IGBT over-heat (oH1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		17: Heat sink over-heat for 40HP and above (oH2)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		18: TH1 open: IGBT over-heat protection circuit error (tH1o)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		19: TH2 open: heat sink over-heat protection circuit error (tH2o)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		20: IGBT over heated and unusual fan function (oHF)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		21: Hybrid servo drive overload (oL)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		22: Motor over-load (EoL1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		23: Reserved				
		24: Motor over-heat (oH3)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		25: Reserved				
		26: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		27: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		28: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		29: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		30: Memory write error (cF1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
		31: Memory read error (cF2)		○	○	○
		32: Isum current detection error (cd0)		○	○	○
		33: U-phase current detection error (cd1)		○	○	○
		34: V-phase current detection error (cd2)		○	○	○
		35: W-phase current detection error (cd3)		○	○	○
		36: Over- current detection error (Hd0)		○	○	○
		37: Over-current detection error (Hd1)		○	○	○
		38: Over-voltage detection error (Hd2)		○	○	○
		39: Ground current detection error (Hd3)		○	○	○
		40: Auto tuning error (AuE)			○	○
		41: Reserved		○	○	○
		42: PG feedback error (PGF1)			○	○
		43: PG feedback loss (PGF2)			○	○
		44: PG feedback stall (PGF3)			○	○
		45: PG slip error (PGF4)			○	○
		46: Reserved		○	○	○
		47: Reserved		○	○	○
		48: Reserved				
		49: External fault input (EF)		○	○	○
		50: Emergency stop (EF1)		○	○	○
		51: Reserved				
		52: Password error(Pcod)		○	○	○
		53: CPU error (ccod) (VJ-C)		○	○	○
		54: Communication error (wrong command)(cE1)		○	○	○
		55: Communication error (wrong data address) (cE2)		○	○	○
		56: Communication error (wrong data value) (cE3)		○	○	○
		57: Communication error (wrong data written address) (cE4)		○	○	○
		58: RS-485 Communication time out (cE10)		○	○	○
		59: Reserved		○	○	○
		60: Braking transistor error (bF)		○	○	○
		61~63: Reserved		○	○	○
		64: Reserved		○	○	○
		65: PG card information error or magnetic pole angle tuning error (PGF5)				○

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM	
		66: Overpressure (ovP)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		67: Pressure feedback fault (PfbF)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		68: Oil pump runs reversely (Prev)					
		69: Oil shortage (noil)					
		70: Reserved					
		71: Over current at Braking chopper (ocbs)					
		72: Braking resistor is open-circuit (bro)					
		73: Resistance of braking resistor is too small (brF)					
		74: Braking chopper overheated (oH4)					
		75: Error occurred on Brake chopper's thermal protection line (tH4o)					
		76~81: Reserved					
		82: Output Phase Loss on Phase U (oPL1)					
		83: Output Phase Loss on Phase V (oPL2)					
		84: Output Phase Loss on Phase W (oPL3)					
		85, 86, 88~100: Reserved					
		87: Hybrid servo drive overloading while running at low frequency (oL3)					
		101: Software error 1 occurred on CANopen (CGdE)					
		102: Software error 2 occurred on CANopen (CHbE)					
		103: Reserved					
		104: Hardware error occurred on CANopen (CbFE)					
		105: Index setting error occurred on CANopen (CIdE)					
		106: Slave # setting error occurred on CANopen (CAde)					
		107: CANopen index is out of range (CFrE)					
↗	02-07	Low voltage level	160.0~220.0V <sub>DC</sub> 320.0~440.0V <sub>DC</sub>	180.0 360.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	02-08	PTC action selection	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	02-09	PTC level	0.0~150.0°C	VJ-A: 120°C; VJ-C : 140°C	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗	02-10	Reserved					

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
✎ 02-11	PTC type	0: Not assigned 1: KTY84-130 2: PTC130 3: Switch (N.C. model)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 02-12	Motor fan activation level	0.0~150.0°C	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 02-13	Electronic thermal relay selection 1	0: Inverter motor (Separate heat dissipating, the cooling fan and the rotating shaft are not synchronized) 1: Standard motor (In-lined heat dissipating, the cooling fan and the rotating shaft are synchronized) 2: Disable	2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 02-14	Electronic thermal characteristic for motor	30.0~600.0 seconds	60.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-15	Output frequency at malfunction	0.00~599.00 Hz	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-16	Output voltage at malfunction	0.0~6553.5 V	Read only			
02-17	Output of DC side voltage at malfunction	0.0~6553.5 V	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-18	Output Current at malfunction	0.00~655.35 Amp	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-19	IGBT temperature at malfunction	0.0~6553.5 °C	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-20	Auto-Reset LvX error	0: Disable, 1: Enable °C	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-21	Decode the parameter protection with the password	0~9998	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-22	Set up a parameter protection password	0~9998, 1000~65535	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-23 ~ 02-31	Reserved					
02-32	Frequency Command at malfunction	0.00 ~ 599.00 Hz	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-33	Capacitor's temperature at malfunction	-3276.7~3276.7 °C	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-34	Motor's rotating speed at malfunction	-3276.7~3276.7 rpm	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-35	Torque command at	-3276.7~3276.7 %	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
	malfunction					
02-36	Input Terminals' Status at malfunction	0 ~ 65535	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-37	Output Terminals' Status at malfunction	0 ~ 65535	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-38	Hybrid servo drive's status at malfunction	0 ~ 65535	Read only	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-39	Detecting Braking Resistor at startup	0: Disable, 1: Enable	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-40	Braking resistance	0.0 ~ 6553.5Ω	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
02-41	Limit of current	0 ~ 250%	200			
02-42	Maintenance period of the soft-start relay	0 ~ 65535 (X10) 0: Turn off the reminder of the remaining lifespan of the soft-start relay.	0			
02-43	Maintenance period of the cooling fan.	0 ~ 65535 hour 0: Turn off the reminder of the remaining maintenance hour of the cooling fan.	0			



**03 Digital/Analog Input/ Output Parameters**

✎ You can set this parameter during operation.

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
03-00	Multi-function input command 3 (MI3)	0: No function 44: Injection signal input	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-01	Multi-function input command 4 (MI4)	45: Confluence/Diversion signal input 46: Hybrid servo drive runs backward	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-02	Multi-function input command 5 (MI5)	47: Multi-level pressure PI command 1 48: Multi-level pressure PI command 2 51: Flow rate mode 52: Multi-flow rate / speed command 1 53: Multi-flow rate / speed command 2 54: Multi-flow rate / speed command 3	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-03	Digital input response time	0.001~ 30.000 sec	0.005	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-04	Digital input operation direction	0~65535	0	<input type="radio"/>	<input type="radio"/>	
✎ 03-05	Multi-function output 1 (Relay 1)	0: No function 1: Operation indication	11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-06	Multi-function Output 2 (MO1)	9: Hybrid servo drive is ready 11: Error indication	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-07	Multi-function Output 3 (MO2)	44: Displacement switch signal 45: Motor fan control signal 46: Pressure release valve control signal	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-08	Multi-function output Direction	0~65535	0		<input type="radio"/>	
✎ 03-09	Display low-pass filter time on the keypad	0.001~65.535 seconds	0.100	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-10	Maximum output voltage for pressure feedback	5.00~10.00 V	10.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-11	Minimum output voltage for pressure feedback	0.00~2.00 V	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 03-12	Current/Voltage type pressure sensor selection	0: Current mode 1: Voltage mode	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-13	Confluence Master/Slave Selection	0: No function 1: Master 1 2: Slave/Master 2 3: Slave/Master 3	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-14	The ratio between slave's flow and master's flow	0.0~65535.5 %	100.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Name of Parameter	Setting	Factory Setting	VF	FOCPG	FOCPM
↗ 03-15	Source of frequency command	0: Digital keypad 1: RS485 Communication 2~5: Reserved 6: CANopen	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗ 03-16	Limit for the Slave reverse depressurization torque	0~500%	20	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗ 03-17	Slave's activation level	0.0~100.0%	50.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
03-18	Reserved					
03-19	Reserved					
↗ 03-20	Start-up display selection	0: F (frequency command) 1: H (actual frequency) 2: Multi-function display (user-defined 00-04) 3: A (Output current)	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗ 03-21	Slave reverse operation for depressurization	0: Disabled 1: Enabled 2: Reserved	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
↗ 03-22	Slave closing level	0 ~400bar	400	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**04 Communication Parameters**

✎ You can set this parameter during operation.

Pr.	Explanation	Settings	Factory Setting	V/F	FOCPG	FOCPM
✎ 04-00	Communication address	1~254	1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-01	COM transmission speed	4.8~115.2 Kbps	19.2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-02	COM transmission fault treatment	0: Warn and continue operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No warning and continue operation	3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-03	COM time-out detection	0.0~100.0 sec.	0.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-04	COM1 communication protocol	0: 7N1 (ASCII) 1: 7N2 (ASCII) 2: 7E1 (ASCII) 3: 7O1 (ASCII) 4: 7E2 (ASCII) 5: 7O2 (ASCII) 6: 8N1 (ASCII) 7: 8N2 (ASCII) 8: 8E1 (ASCII) 9: 8O1 (ASCII) 10: 8E2 (ASCII) 11: 8O2 (ASCII) 12: 8N1 (RTU) 13: 8N2 (RTU) 14: 8E1 (RTU) 15: 8O1 (RTU) 16: 8E2 (RTU) 17: 8O2 (RTU)	13	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-05	Delay time of communication response	0.0~200.0 ms	2.0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
04-06	Main frequency of the communication	0.00~ 599.00 Hz	60.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-07	Block transfer 1	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-08	Block transfer 2	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-09	Block transfer 3	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-10	Block transfer 4	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-11	Block transfer 5	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-12	Block transfer 6	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-13	Block transfer 7	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-14	Block transfer 8	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-15	Block transfer 9	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
✎ 04-16	Block transfer 10	0.00~655.35	0.00	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
04-17	CANopen slave address	0: Disable 1~127	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
04-18	CANopen speed	0: 1 Mbps	0	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Pr.	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
		1: 500 Kbps 2: 250 Kbps 3: 125 Kbps 4: 100 Kbps (Delta only) 5: 50 Kbps				
04-19	CANopen warning record	bit 0: CANopen Guarding Time out bit 1: CANopen Heartbeat Time out Bit 2: CANopen SYNC Time out bit 3: CANopen SDO Time out bit 4: CANopen SDO buffer overflow bit 5: CAN bus Off bit 6: Error protocol of CANopen bit 8: The setting value of CANopen index failed bit 9: The setting value of CANopen address failed bit10: The checksum value of CANopen index failed	0	○	○	○
04-20	CANopen decoding method	0: Delta defined decoding method 1: CANopen Standard DS402 protocol	1	○	○	○
04-21	CANopen communication status	0: Node reset state 1: Com reset state 2: Boot up state 3: Pre operation state 4: Operation state 5: Stop state	0	○	○	○
04-22	CANopen control status	0: Not ready for use state 1: Inhibit start state 2: Ready to switch on state 3: Switched on state 4: Enable operation state 7: Quick stop active state 13: Error reaction activation state 14: Error state	0	○	○	○
04-23	Reserved					
04-24	Communication decoding method	0: Decoding method 1 (20xx) 1: Decoding method 2 (60xx)	1	○	○	○

## 4-2 Description of Parameter Settings

### 00 System Parameters

✎ You can set this parameter during operation.

#### **00-00** Hybrid servo drive model code ID

Control mode **VF FOC PG FOC PM**

Factory setting: Read only

Settings Read only

#### **00-01** Display of rated current of the hybrid servo drive

Control mode **VF FOC PG FOC PM**

Factory setting: Read only

Settings Read only

Pr.00-00 is to determine the capacity of the hybrid servo motor, which has been configured in this parameter in factory. In addition, the current value of Pr.00-01 can be read out to check if it is the rated current of the corresponding model. Display value of the current value of Pr.00-01 for the related Pr.00-00.

230V Models											
Power (KW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Horse Power (HP)	7.5	10	15	20	25	30	40	50	60	75	100
Model ID	12	14	16	18	20	22	214	215			
460V Models											
Power (KW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Horse Power (HP)	7.5	10	15	20	25	30	40	50	60	75	100
Model ID	13	15	410	411	412	413	414	415	416	417	418

#### **00-02** Reset parameter settings

Control mode **VF FOC PG FOC PM**

Factory setting: 0

Settings  
 0: No function  
 1: Parameter Locked  
 5: Rest the kWh at drive stop  
 7: Reset CANopen index  
 10: Reset all the parameters to factory setting



#### **00-03** Software version

Control mode **VF FOC PG FOC PM**

Factory setting: #. ##

Settings Read only

#### ✎ **00-04** Selection of multi-function display

Control mode **VF FOC PG FOC PM**

Factory setting: 0

Settings  
 0: Display the output current (A)  
 1: Reserved  
 2: Display the actual output frequency (H) (unit: Hz)  
 3: Display the DC bus voltage (U) (unit: V)  
 4: Display the three-phase U, V, W output voltage (E) (unit: V)



5: Display the three-phase U, V, W output power angle (n) (unit: deg)	
6: Display the output power in kW (P)	
7: Display the actual motor speed in rpm estimated by the motor drive or encoder's feedback. (r 00: forward speed; - 00: negative speed) (unit: rpm)	
8: Display the estimated output torque N-m (t 0.0: positive torque; - 0.0: negative torque) (unit: %)	
9: Display the PG feedback (G) (unit: PLS)	
10: Reserved	
11: Display the signal value of the analog input terminal PS with 0~10V mapped to 0~100% (unit: %)	
12: Display the signal value of the analog input terminal PI with 0~10V mapped to 0~100% (unit: %)	
13: Display the signal value of the analog input terminal AUI with -10~10V mapped to 0~100% (unit: %)	
14: Display temperature of the power module IGBT in °C (t.)	
15: Display temperature of the power capacitor °C	
16: The status of digital input (ON/OFF)	
17: The status of digital output (ON/OFF)	
18: Reserved	
19: The corresponding CPU pin status of the digital input	
20: The corresponding CPU pin status of the digital output	
21~24: Reserved	
25: Display the signal value of the analog input terminal QI with 0~10V mapped to 0~100% (unit: %)	
26: Display the actual pressure value (unit: Bar)	
27: Display the kWh value (unit: kWh)	
28: Display the motor temperature in °C (currently only support KTY84)	
29: Over load rate of hybrid servo drive, get overloaded at 100% (d.) (unit: %)	
30: Over load rate of motor with last digit A of HES, get EOL1 at 100% (M.) (unit: %)	
31: Display current at braking (A.) (unit: A)	
32: Display temperature of the braking chopper (4.) (unit: °C)	
33: Reserved	
34: torque constant KT (unit: K)	
37: Reserved	
38: Reserved	
39: Reserved	
41: # of times to switch on/off of the soft start relays (L) (%)	

This parameter defines the contents to be displayed in the U page of the digital keypad KPJVJ-LE02 (as shown in the figure).

**00-05** Reserved




**00-06** Display the speed (rpm) defined by the user

Control mode **VF FOC PG FOC PM** Factory setting: 2500  
 Settings 0~39999 rpm

-  Set the maximum speed of the motor corresponding to the 100% flow.
-  When the control mode is FOC PM (Pr.01-00=5), Pr.00-06 will follow the setting at Pr.01-20<Number of poles of the synchronous motor> to modify Pr.01-02<Motor's maximum operating frequency>. frequency = rpm\*Pole/120


**00-07** Maximum value of the pressure command

Control mode **VF FOC PG FOC PM** Factory setting: 140  
 Settings 0~400Bar

-  The 0~10V for the pressure command on the controller is mapped to 0~the value of this parameter.
-  When you set up Pr.00-07 and Pr.00-08, these two parameters Pr.00-14 and Pr.00-15 will also be modified automatically. However, when the pressure command is bigger than the pressure feedback, Pr.00-07 cannot be set up.
-  Only when Pr.00-07 is smaller than Pr.00-08, you can set Pr.00-07 while the hybrid servo drive is running,



**00-08** Maximum pressure feedback value

Control mode **VF FOC PG FOC PM** Factory setting: 250  
 Settings 0~400Bar

-  The 0~10V for the pressure sensor is mapped to 0~the value of this parameter.

**00-09** Pressure control mode

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0: Speed control  
 1: Pressure control

-  This parameter determines the control mode of the hybrid servo drive. It is recommended to use the speed control at the initial startup. After the motor, pump, pressure sensor, and the entire system are checked without any error, switch to the pressure control mode to enter the process control.
-  In pressure control (Pr.00-09=1), it is necessary to set both Pr.01-05 (Acceleration time setting) and Pr.01-06 (Deceleration time setting) as zero, or it will affect the stability of pressure control

**00-10** Speed bandwidth

Control mode      **FOCPG FOCPM**      Factory setting: 20

Settings      0~40Hz

---

Set the speed response. The larger value indicates the faster response.

**00-50** Speed Bandwidth 2

Control mode      **FOCPG FOCPM**      Factory setting: 20

Settings      0 ~ 40Hz

**00-51** Speed bandwidth 3

Control mode      **FOCPG FOCPM**      Factory setting: 20

Settings      0 ~ 40Hz

---

Set the speed response. The larger value indicates the faster response.

**00-11** Pressure feedback filtering time PS

**00-12** Pressure feedback filtering time PI

**00-13** Pressure feedback filtering time QI

Control mode      **VF FOCPG FOCPM**      Factory setting: 0.000

Settings      0.000~1.000 seconds

---

Noises may reside in the analog input signals of the control terminals PS, PI, and QI. The noise may affect the control stability. Use an input filter to eliminate such noise.

If the time constant is too large, a stable control is obtained with poorer control response. If it is too small, a fast response is obtained with unstable control. If the optimal setting is not known, adjust it properly according to the instability or response delay.

**00-14** Percentage for the pressure command value (Max)

Control mode      **VF FOCPG FOCPM**      Factory setting: 56.0

Settings      0.0~100.0%

---

**00-15** Percentage for the pressure command value (Mid)

Control mode      **VF FOCPG FOCPM**      Factory setting: 28.0

Settings      0.0~100.0%

---

**00-16** Percentage for the pressure command value (Min)

Control mode      **VF FOCPG FOCPM**      Factory setting: 0.0

Settings      0.0~100.0%

---

When setting maximum value for the pressure command (Pr.00-07) and maximum pressure feedback value (Pr.00-08), Percentage for the pressure command value (Pr.00-14) and (Pr.00-15) will be revised as well; it cannot be set when pressure command is higher than pressure feedback value.

Pr.00-07 can be changed when the drive is in operation, but it can be set when Pr.00-07 is lower than Pr.00-08.

To set these parameters, it is necessary to set Pr.00-09 = 1.

Set Pr.00-04 = 12 for PI input voltage.



Send the maximum pressure command through the controller and then check the multi-function display page to enter this value into Pr.00-14.

Send a half pressure command through the controller and then check the multi-function display page to enter this value into Pr.00-15.

Send the minimum pressure command through the controller and then check the multi-function display page to enter this value into 00-16.

Example: If the pressure sensor indicates 250bar at 10V. If the controller's maximum pressure of 140bar corresponds to 10V, then Pr.00-07=140. Set the pressure as 140bar by using the controller, the voltage value shown on the display is about 56.0 ( $140/250 * 100\%$ ). Enter this value into the Pr.00-14. Then set the pressure as 70bar on the controller, and now the value displayed on the keypad is about 28.0 ( $70/250 * 100\%$ ). Enter this value to the Pr.00-15. Then set the pressure as 0 bar on controller, and the voltage value shown on the keypad is about 0.0 ( $0/250 * 100\%$ ). Enter this value in the Pr.00-16.

#### ↗ **00-17** Percentage for the flow command value (Max)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 100.0  
Settings 0.0~100.0%

#### ↗ **00-18** Percentage for the flow command value (Mid)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 50.0  
Settings 0.0~100.0%

#### ↗ **00-19** Percentage for the flow command value (Min)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0.0  
Settings 0.0~100.0%

📖 Set Pr.00-09 = 1 before setting Pr.00-17, Pr.00-18 and Pr.00-19.

📖 Set Pr.00-04 = 25 for QI input voltage.

Send the 100% flow rate through the controller and then check the multi-function display page to enter this value into Pr.00-17.

Send the 50% flow rate through the controller and then check the multi-function display page to enter this value into Pr.00-18.

Send the 0% flow rate through the controller and then check the multi-function display page to enter this value into Pr.00-19.

#### ↗ **00-20** P gain 1

#### ↗ **00-22** P gain 2

#### ↗ **00-24** P gain 3

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 50.0  
Settings 0.0~1000.0

#### ↗ **00-21** I integration time 1

#### ↗ **00-23** I integration time 2

#### ↗ **00-25** I integration time 3

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 2.00  
Settings 0.00 – 500.00 seconds

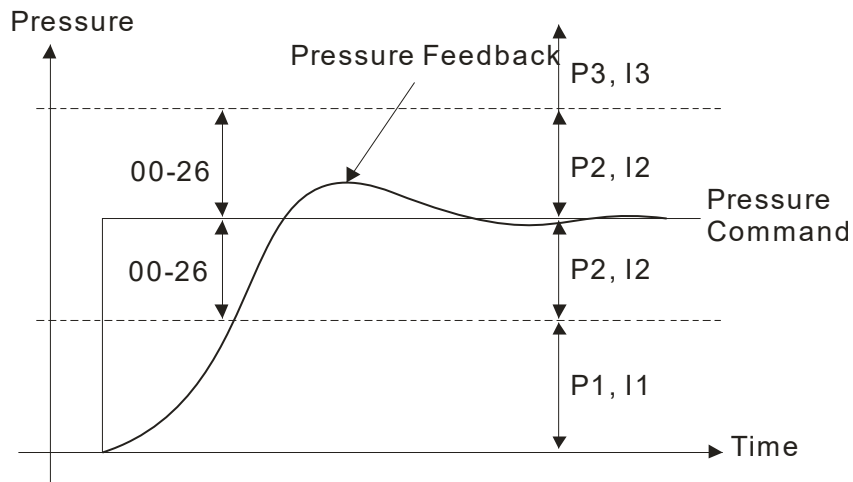
00-37 Differential gain  
00-40 Differential gain 2  
00-41 Differential gain 3

Control mode **VF FOC PG FOC PM** Factory setting: 0.0  
 Settings 0.0~100.0 %

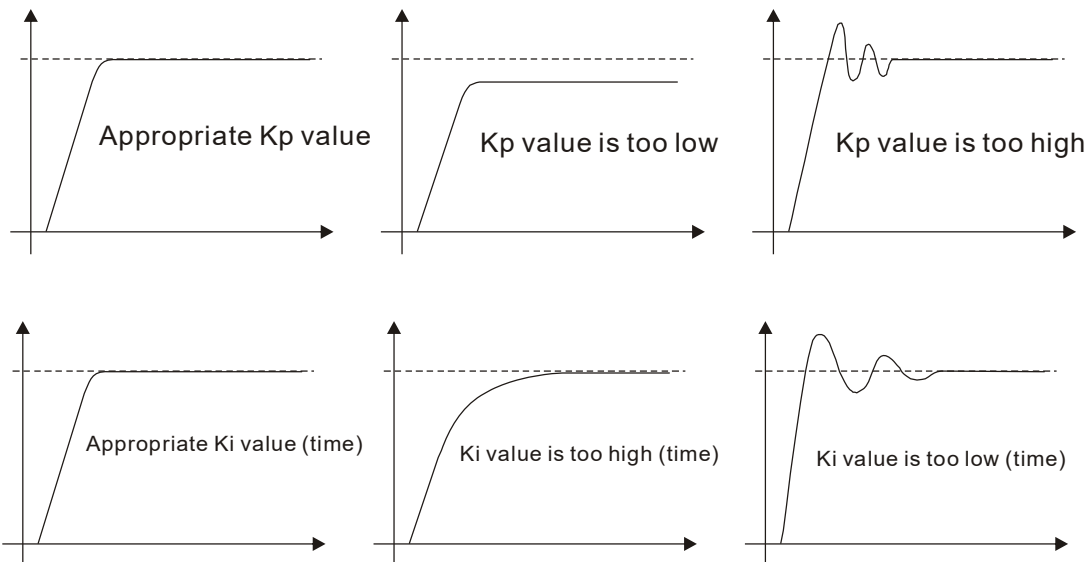
This parameter is functional only when Bit0 and Bit2 = 1 at Pr.00-38.

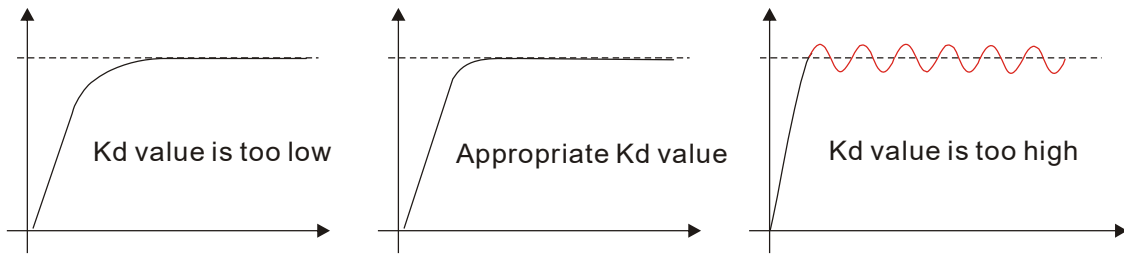
00-26 Pressure stable zone

Control mode **VF FOC PG FOC PM** Factory setting: 25  
 Settings 0~100%



Adjust the Kp value to a proper level first, and then adjust the Ki value (time). If the pressure has overshoot, adjust the kd value.





### ➤ **00-27** Minimum pressure

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0.1  
 Settings 0.0~100.0%

- 📖 Set the minimum pressure value 100% corresponding to Pr.00-08
- 📖 Maintain a minimum pressure to ensure that the oil pipe is in fully filled condition to avoid the activation delay of the cylinder when a pressure/flow command is activated.

### ➤ **00-55** Minimum flow

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 5.0  
 Settings 0.00 ~ 100.00%

- 📖 The setting at Pr.00-08 is the setting of Pr.00-27 at 100%. The setting at Pr.01-02 is the setting of Pr.00-55 at 100%.
- 📖 A minimum pressure must be maintain to ensure the oil circuit is full at all to time. This will prevent delay of oil tank activation when receiving a pressure/ flow rate command.
- 📖 When the pressure command is 0, keep the minimum pressure (Setting value of Pr.00-27).
- 📖 When the pressure command is below the minimum pressure but over 0.7bar, the hybrid servo drive follows the pressure command to do control. For example, when the pressure command is 1 bar, the hybrid servo drive follows this command to keep the pressure at 1 bar.
- 📖 When the pressure command is lower than 0.7bar, the hybrid servo drive keeps the minimum pressure.

### ➤ **00-28** Depressurization speed

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 25  
 Settings 0~100%

- 📖 Set the highest rotation speed at depressurization. The 100% value is mapped to Pr.01-02 (the maximum rotation speed of the motor)

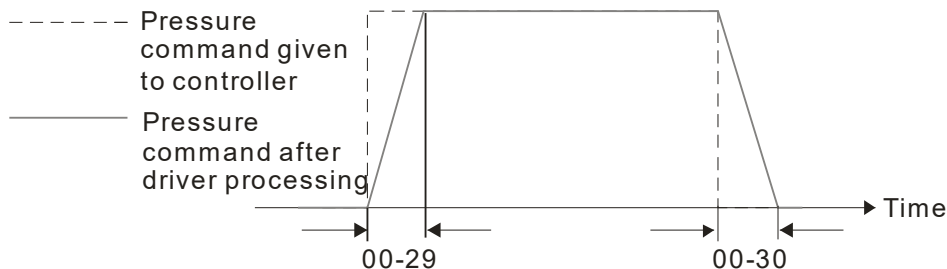
### ➤ **00-29** Ramp up rate of pressure command

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0~1000ms

### ➤ **00-30** Ramp down rate of pressure command

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 100  
 Settings 0~1000ms

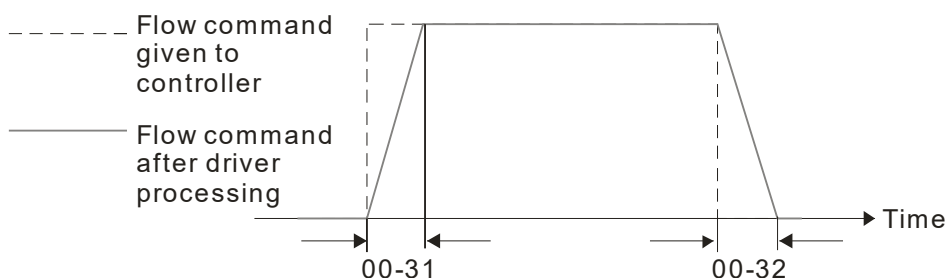
- 📖 Ramp the pressure value for the pressure command to reduce the vibration of the machine.
- 📖 Set the time required for ramping the pressure from 0 ~the maximum pressure (Pr.00-08).



00-31 Ramp up rate of flow command  
00-32 Ramp down rate of flow command

Control mode **VF FOC PG FOC PM** Factory setting: 80  
 Settings 0~1000ms

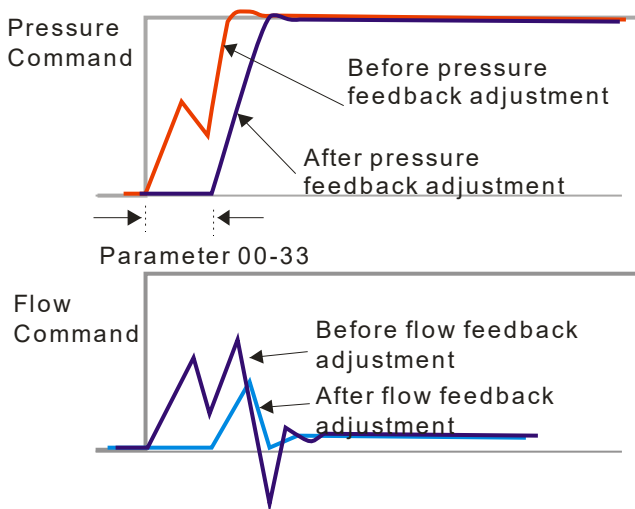
- Ramp the flow value for the flow command to reduce the vibration of the machine.
- Set the time required for ramping the flow from 0 ~the maximum flow (Pr.01-02).



00-33 Valve opening delay time

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0 – 200ms

- When both the pressure command and flow command activate the machine to start from idle, the flow starts to output. However, due to the slower response of the valve in the hydraulic circuit, the sudden surge of the pressure may occur. The pressure may recover to normal until the valve is fully opened. To avoid the aforementioned effect, set this parameter to increase time for the flow output delay.



00-34 Output switching function

Control mode **VF FOC PG FOC PM** Factory setting: 50.0  
 Settings 0.0 ~ 100.0%

### ➤ **00-35** Over-pressure detection level

Control mode **VF FOC PG FOC PM** Factory setting: 230  
 Settings 0~400 Bar

- 📖 When the pressure feedback exceeds this parameter setting, an “ovP over pressure” error message may occur.
- 📖 Firmware version 2.04 and above, maximum value 400Bar, the previous version’s maximum allowed value is 250Bar.

### ➤ **00-52** Detecting time of pressure-overshoot

Control mode **VF FOC PG FOC PM** Factory setting: 0.01  
 Settings 0.0000~ 1.0000 sec

- 📖 When the pressure feedback is larger than the level set at Pr.00-35 and over the time set at Pr.00-52, an ovP (over-pressure) warning code will display.
- 📖 Warning code: When Pr.00-35= 0, disable detection of pressure-overshoot.

### ➤ **00-36** Detection of disconnection of pressure feedback

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0: No function  
 1: Enable (only for the pressure feedback output signal within 1~5V and 4~20mA)

- 📖 When this parameter is set as 1 and if the pressure feedback signal is below 1V or 4mA, an “PFbF pressure feedback fault” error message may occur.

### ➤ **00-38** Pressure/flow control function selection

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings **Bit 0:**  
 0: Switch the PI Gain according to the pressure feedback level and use single speed bandwidth  
 1: Switch the PI Gain according to the multi-function input terminal

**Bit 1:**  
 0: No pressure/flow control switch  
 1: Switch between the pressure and flow control

**Bit 2:**  
 0: Use the old pressure overshoot suppression  
 1: Use the new pressure overshoot suppression

**Bit3:**  
 0: Switch the PI Gain and single speed bandwidth according to the pressure feedback level.  
 1: Switch the PI Gain and speed bandwidth according to the pressure command.

- 📖 When the Bit 0 of this parameter is set as 1, the PI Gain for the pressure can be switched in conjunction with the multi-function input terminal

Set Bit2 = 0		
Multi-function input terminal = 47	Multi-function input terminal = 48	
OFF	OFF	PI1 (Pr.00-20 and Pr.00-21) and Pr.00-10: Speed Bandwidth
ON	OFF	PI2 (Pr.00-22 and Pr.00-23) and Pr.00-50: Speed Bandwidth 2
OFF	ON	PI3 (Pr.00-24 and Pr.00-25) and Pr.00-51: Speed Bandwidth
Set Bit2 =1		
Multi-function input terminal = 47	Multi-function input terminal = 47	
OFF	OFF	PID1 (Pr.00-20, Pr.00-21 and Pr.00-37) and Pr.00-10: Speed Bandwidth
ON	OFF	PID2 (Pr.0-22, Pr.02-23 and Pr.00-40) and Pr.00-50 Speed Bandwidth 2
OFF	ON	PID3 (Pr.00-24, Pr.00-25 and Pr.00-41) and Pr.00-51: Speed Bandwidth 3

- 📖 When the Bit 1 of this parameter is set as 1, the pressure feedback is lower than the pressure stable region (please refer to the description of Pr.00-26) so the flow control will be performed. When it enters the pressure stable region, the pressure control will be applied.
- 📖 When Bit1= 0, the Pressure Response is slow and the pressure overshoot is weak.  
When Bit1 = 1, the Pressure Response is fast and the pressure overshoot is strong.
- 📖 Set Bit2 = 0, the setting at Pr.00-39 and Pr.00-42 are used to suppress pressure overshoot.  
But when Bit2 = 1, the setting at Pr.00-37 is used to suppress pressure overshoot.
- 📖 When Bit3 =1:

Pressure Command	P, I Gain and Speed Bandwidth	<b>D</b> (Set Bit2 =1)
Smaller than or equal to the maximum pressure command (Pr.00-07)*25%	PI1 (Pr.00-20 and Pr.00-21) and Pr.00-10: Speed Bandwidth	Pr.00-37
Equal to the maximum value for pressure command (Pr.00-07)	PI2 (Pr.00-22 and Pr.00-23) and Pr.00-50: Speed Bandwidth 2	
Pressure command between 25% and 100%.	The PI Gain and Speed Bandwidth can be obtained by calculating the linear interpolation.	

**00-39** I gain of Pressure overshoot 1Control mode **VF FOC PG FOC PM**

Factory setting: 0.2

Settings 0.00~500.00 sec.

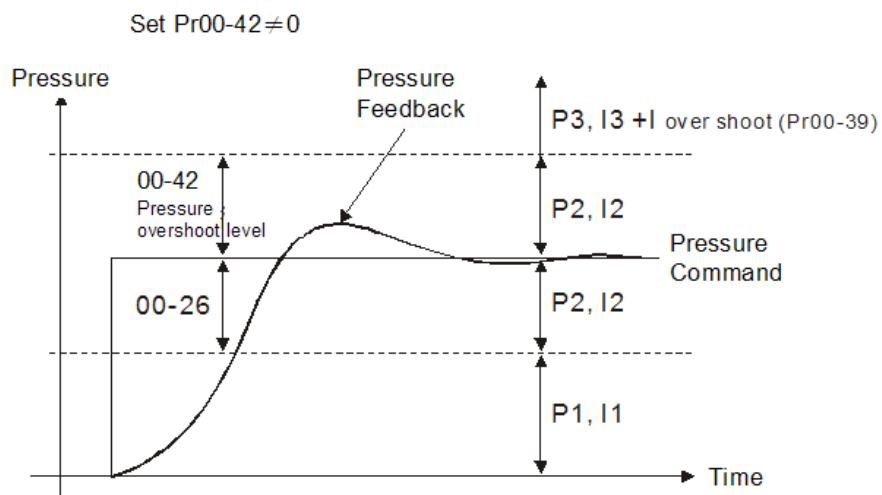
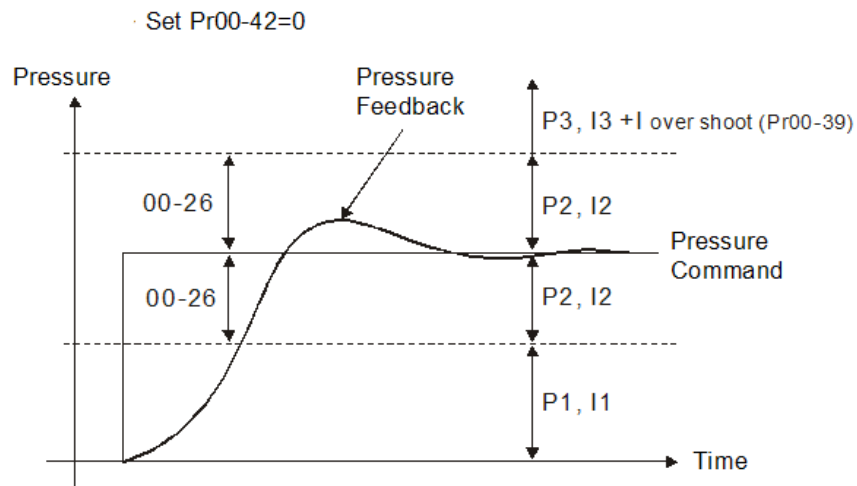
**00-42** Pressure overshoot levelControl mode **VF FOC PG FOC PM**

Factory setting: 2

Settings 0~100%

By using the factory setting 250 bar of the Pr.00-08 Maximum Pressure Feedback, when the pressure is over 5 bar ( $250 \times 2\% = 5$  bar), another integral time of Pr.00-39 will do overshoot protection.

When Pr.00-38=1 and Pr.00-39=0, Pr.00-42 is disabled.

**00-43** Maximum FlowControl mode **VF FOC PG FOC PM**

Factory setting: 100

Settings 0~100%

Set up this parameter to adjust the maximum rotation frequency (maximum flow rate). It is not necessary to stop the hybrid servo drive to set up this parameter. When this parameter is set to be 100%, it corresponds to the maximum rotation frequency of Pr.01-02.

**00-44** Pressure Command

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~400bar

**00-45** Flow Command

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~100%

- 📖 When Pr.00-44 ≠ 0, Pressure Command will not be given by the analog signal but input by Pr.00-44.
- 📖 When Pr.00-45 ≠ 0, Flow Command will not be given by the analog signal but input by Pr.00-45.
- 📖 Pr00-44 & Pr.00-45 can be applied in an environment without input of analog signal to do simple test.

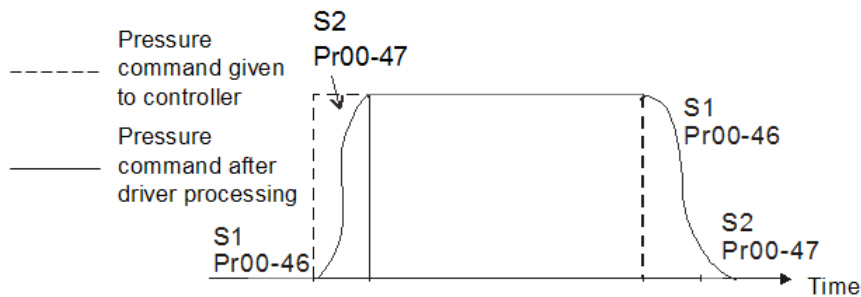
**00-46** Pressure reference S1 time

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~1000ms

**00-47** Pressure reference S2 time

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~1000ms

- 📖 To increase the smoothness at start or stop while increasing or decreasing the percentage of the pressure command. The longer the pressure reference time, the smoother it will be.



**00-48** Flow reference S1 time

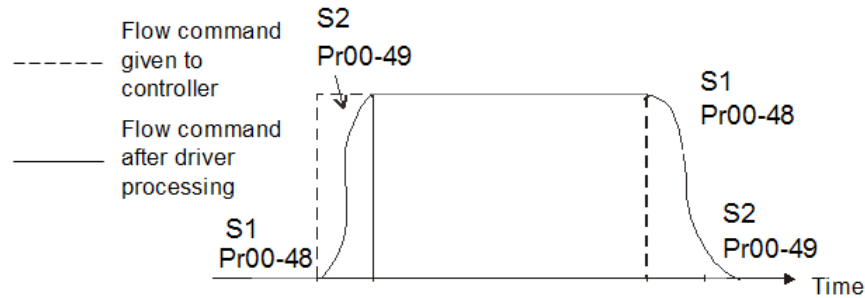
Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~1000ms

**00-49** Flow reference S2 time

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~1000ms

- 📖 To increase the smoothness at start or stop while increasing or decreasing the percentage of the flow command. The longer the flow reference time, the smoother it will be.





### 00-53 Oil shortage detecting time

Control mode **VF FOC PG FOC PM** Factory setting: 0.0

Settings 0.0 ~ 60.0 sec

### 00-60 Oil shortage detecting time at startup

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings 0 ~ 10min

### 00-54 Oil pump reverse running detecting time

Control mode **VF FOC PG FOC PM** Factory setting: 0.0

Settings 0.0 ~ 60.0 sec

When the oil pump runs reversely exceeds the time set at Pr.00-54, a reverse running warning will pop up on the keypad.

When Pr.00-54 = 0.0, this function is disabled.

00-55

~

Reserved

00-58

### 00-59 Minimum Flow

Control mode **VF FOC PG FOC PM** Factory setting: 5.00

Settings 0.00 ~ 100.00%

To set the minimum pressure, the 100% of Pr.00-27 matches the setting at Pr.00-08 and the 100% of Pr.00-55 matches the setting at Pr.01-02.

It is necessary to maintain a minimum flow to make sure that the oil passage is filled with oil at all times. So that there will not be a delay on oil tank activation when sending a pressure/ flow command.

### 00-61 Minimum Pressure 2

Control mode **VF FOC PG FOC PM** Factory setting: 0.1

Settings: 0.0 ~ 100.0%

The setting value of Pr.00-08 Maximum Feedback Pressure is the 100% of this parameter Pr.00-61.

**00-62** Minimum Flow 2

Control mode **VF FOC PG FOC PM** Factory setting: 5.00

Settings 0.00 ~ 100.00%

The setting value at Pr.01-02 Maximum Operating Frequency is the 100% of this parameter Pr.00-62.

**00-63** Pressure Releasing Valve Opening Time Interval

Control mode **VF FOC PG FOC PM** Factory setting: 0.100

Settings 0.000 ~ 0.100 sec

The output signal MO-46 opens the pressure releasing valve when:

- 1) Speed command is to run reversely,
- 2) Pressure command is to decrease the pressure
- 3) The elapsed time is longer than time set at Pr.00-63.
- 4) The feedback pressure doesn't reach yet the stable pressure zone.

Use Pr.00-63 to set up the time interval between opening and closing pressure releasing valve to avoid unnecessary valve opening and closing (ON / OFF)

**00-64**  
~  
**00-65** For specific customers only

**00-66** Multi-flow rate / speed command 1

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings 0.00 ~ 599.00Hz

**00-67** Multi-flow rate / speed command 2

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings 0.00 ~ 599.00Hz

**00-68** Multi-flow rate / speed command 3

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings 0.00 ~ 599.00Hz

**00-69** Multi-flow rate / speed command 4

Control mode **VF FOC PG FOC PM** Factory setting: 0

Settings 0.00 ~ 599.00Hz

### 00-70 Multi-flow rate / speed command 5





Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0.00 ~ 599.00Hz

### 00-71 Multi-flow rate / speed command 6

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0.00 ~ 599.00Hz

### 00-72 Multi-flow rate / speed command 7

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0.00 ~ 599.00Hz

-  You can set up multi-function input commands (Pr.03-00 to Pr.03-02) to choose different multi-flowrate / speed commands (MI functions #52, #53, #54).
-  The multi-flow rate / speed commands 1~7 (Pr.00-66 ~ Pr.00-72) correspond to the MI functions (#52, #53, #54) in binary code.
-  When MI functions #52, #53 and #54 are set to 0, the flowrate command becomes the setting value of Pr.00-45.
-  Use Pr.00-66 to Pr.00-72 to set up multi-flow rate / speed commands 1~7.

00-73



~

For specific customers only

00-90




### 00-91 Output quantity of oil pump

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0 ~ 500cc/rev

-  0: Turn off pressure loss detection
-  To detect if there is a pressure loss.



### 00-92 Pressure loss detecting time

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0  
 Settings 0 ~ 60.0 sec

-  0: Turn off pressure loss detection
-  To detect if there is a pressure loss.
-  The larger the value, the less sensitive to detect the pressure loss. The smaller the value, the more sensitive to detect the pressure loss.

### 00-93 Pressure limit percentage

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 10  
 Settings 0 ~ 100%

-  Pressure limit = Pressure command x Pressure limit %
-  Set MI =44 as ON, when the pressure error is smaller than the pressure limit, the hybrid servo motor switches to pressure more. When the pressure error is larger than the pressure limit, the hybrid servo drive switches to flowrate mode.

## 01 Motor Parameters

✎ You can set this parameter during operation.

### 01-00 Control mode

Control mode	VF	FOCPG	FOCPM	Factory setting: 5
Settings			0 : V/F 1: Reserved 2: Reserved 3: FOCPGIM (Induction Motor) 4: Reserved 5: FOCPGPM (Synchronous Motor) 6: Reserved 7: Reserved	

📖 This parameter determines the control mode of this motor.

0: V/F control, the user can design the required V/F ratio. This control mode needs induction motors.

1: Reserved

2: Reserved

3: FOC vector control + Encoder. This control mode needs induction motors.

4: Reserved

5: FOC vector control + Encoder. This control mode needs synchronous motors.

6: Reserved

7: Reserved

### ✎ 01-01 Source of operating command

Control mode	VF	FOCPG	FOCPM	Factory setting: 0
Settings			0: The operating command is controlled by the digital keypad 1: The operating command is controlled by the external terminals. The STOP button on the keypad is disabled 2: The operating command is controlled by the communication interface. The STOP button on the keypad is disabled 3: The operating command is controlled by CANopen	

📖 For the operating command, press the PU button to allow the “PU” indicator to be lit. In this case, the RUN, JOG, and STOP button are enabled.

### 01-02 Motor’s maximum operating frequency

Control mode	VF	FOCPG	FOCPM	Factory setting: 166.67
Settings			50.00 – 599.00Hz	

📖 Set the maximum operating frequency range of the motor. This setting is corresponding to the maximum flow for the system.

📖 When the control mode is FOCPGPM (Pr.01-00=5), the user defined speed display (Pr.00-06) follows the setting of number of poles of synchronous motor (Pr.01-20) to adjust the motor maximum operating frequency(Pr.01-02)

📖  $\text{Frequency} = \text{Motor's rotating speed (rpm)} \times \text{Motor's number of pole} / 120$

### 01-03 Motor’s rated frequency

Control mode	VF	FOCPG	FOCPM	Factory setting: 113.33
Settings			0.00~599.00Hz	

📖 Typically, this setting is configured according to the rated voltage and frequency listed in the specifications on the motor’s nameplate. If the motor is intended for 60Hz, set this value as 60Hz; if the motor is intended for 50Hz, set this value as 50Hz.

Motor's rated frequency (Pr.01-03) changes as Rated speed of the synchronous motor (Pr.01-19) and Number of poles of the synchronous motor (Pr.02-120) change.

### 01-04 Motor's rated voltage

Control mode	<b>VF</b> <b>FOCPG</b>	Factory setting: 220.0/440.0
Settings	230V models: 0.1 – 255.0V 460V models: 0.1 – 510.0V	

Typically, this setting is configured according to the rated operation voltage shown on the motor's nameplate. If the motor is intended for 220V, set this value as 220.0V; if the motor is intended for 200V, set this value as 200.0V.

### 01-05 Acceleration time setting

Control mode	<b>VF</b> <b>FOCPG</b> <b>FOCPM</b>	Factory setting: 0.00
Settings	0.00 – 600.00 seconds	

### 01-06 Deceleration time setting

Control mode	<b>VF</b> <b>FOCPG</b> <b>FOCPM</b>	Factory setting: 0.00
Settings	0.00 – 600.00 seconds	

The acceleration time determines the time required for the hybrid servo motor to accelerate from 0.00Hz to [the motor's maximum frequency] (Pr.01-02). The deceleration time determines the time required for the hybrid servo motor to decelerate from [the motor's maximum frequency] (Pr.01-02) to 0.0Hz.

### 01-07 Motor Parameter Auto Tuning

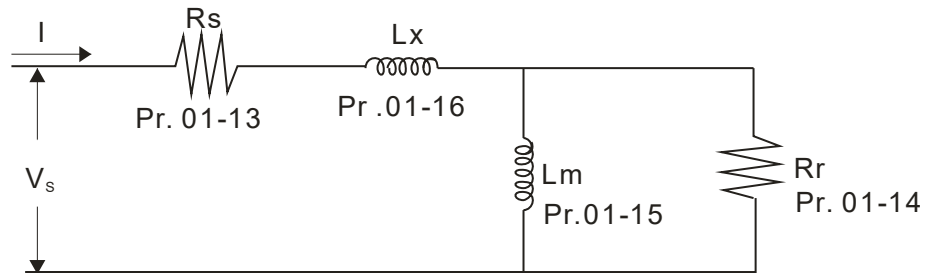
Settings	Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>
0: No function		<input type="radio"/>	<input type="radio"/>	
1: Dynamic test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)		<input type="radio"/>	<input type="radio"/>	
2: Static test for induction motor(IM)		<input type="radio"/>	<input type="radio"/>	
3: Reserved				
4: Auto measure the angle between magnetic pole and PG origin				<input type="radio"/>
5: Dynamic test for SPM motor				<input type="radio"/>
13: Dynamic test for IPM motor				
14: Correction of pressure feedback offset				

If the parameter is set as 1~2, it will perform the parameter automatic tuning for the Induction motor. In this case, press the [Run] button to perform the automatic measurement operation immediately. After the measurement is complete, the values are filled into Pr.01-13 ~ Pr.01-16 (no-load current, Rs, Rr, Lm, and Lx), respectively.

Induction motor *AUTO-Tuning procedure*: (Rolling test)

- All parameters of the hybrid servo drive are set to factory settings and the motor is connected correctly.
- Users are strongly advised to disconnect the motor from any load before tuning. That is to say, the motor contains only the output shaft and connects to neither a belt nor a decelerator. Otherwise, it will be impossible to disconnect the motor from any loads. Static tuning is advised✖.

3. Set the rated voltage Pr.01-04, rated frequency Pr.01-03, rated current Pr.01-08, rated power Pr.01-09, rated speed Pr.01-10, and number of poles Pr.01-11 of the motor with correct values, respectively. For the acceleration/deceleration time, please set the correct values.
4. Set Pr.01-07 as 1 and then press the RUN button on the keypad. The auto tuning process for the motor is carried out immediately. (Note: the motor starts running).
5. After the process is finished, check if the motor's parameters (Pr.01-13 ~ Pr.01-16) have been automatically entered with the measurement data.
6. Equivalent circuit of the motor



Motor equivalent circuit used by VJ

**NOTE**

※.When the static tuning (Pr.01-07 = 2) is used, you must enter the no-load current to the motor. It is generally 20 to 50% of the rated current.

📖 If the parameter is set as 5 or 13, it will perform the parameter automatic tuning for the synchronous motor. In this case, press the [Run] button to perform the automatic measurement operation immediately. After the measurement is complete, the values are filled into Pr.01-22 (Rs), Pr.01-23 & 24 (Ld & Lq), Pr.01-25 (Back EMF of the synchronous motor), respectively.

Synchronous motor *AUTO-Tuning procedure*: (static measurement)

1. All parameters of the hybrid servo drive are set to factory settings and the motor is connected correctly.
2. Set the rated current Pr.01-17, rated power Pr.01-18, rated speed Pr.01-19, and number of poles Pr.01-20 of the motor with correct values, respectively. For the acceleration/deceleration time, please set the values according to the motor's capacity.
3. Set Pr.01-07 as 5 and then press the RUN button. The auto tuning process for the motor is carried out immediately. (Note: the motor starts running slightly).
4. After the process is finished, check if the motor's parameters (Pr.01-22 ~ Pr.01-25) have been automatically entered with the measurement data.

📖 If the parameter is set as 4, the automatic measurement of the angle between magnetic pole and the PG origin for the synchronous motor is performed. In this case, press the [Run] button to immediately perform automatic measurement. The measured data will be entered into Pr.01-27.


Angle between magnetic pole and the PG origin Auto-Tuning process for the synchronous motor:

1. After the measurement process for parameter value of 5 is performed completely or manually enter the Pr.01-03, Pr.01-17 to Pr.01-25, respectively.
2. Before tuning, it is recommended to separate the motor and the load.
3. Set Pr.01-07 as 4 and then press the RUN button on the keypad. The auto tuning process for the motor is carried out immediately. (Note: the motor starts running).

4. After the process is complete, please check if the values for the angle between magnetic poles and PG origin have been automatically entered in the Pr.01-27.

### 01-08 Rated current of the induction motor (A)

Control mode	<b>FOCPG</b>	Unit: Ampere
		Factory setting: #. ##
Settings	40~120% of the rated driving current	

 To set this parameter, the user can set the rated motor current range shown on the motor's nameplate. The Factory setting is 90% of the rated current of the hybrid servo drive.

For example: For the 7.5HP (5.5kW) motor, the rated current is 25, the factory settings: 22.5A.

The customers can set the parameter within the range 10 ~ 30A.

$$25 \times 40\% = 10 \quad 25 \times 120\% = 30$$


### 01-09 Rated power of the induction motor

Control mode	<b>FOCPG</b>	Factory setting: #.##
Settings	0 – 655.35kW	

 Set the motor's rated power. The Factory setting value is the power of the hybrid servo drive.


### 01-10 Rated speed of the induction motor

Control mode	<b>FOCPG</b>	Factory setting:
		1710 (60Hz 4-pole)
		1410 (50Hz 4-pole)
Settings	0~65535	

 This parameter sets the rated speed of the motor. It is necessary to refer to the specifications shown on the motor's nameplate.


### 01-11 Number of poles of the induction motor

Control mode	<b>FOCPG</b>	Factory setting: 4
Settings	2~20	

 This parameter sets the number of motor number of poles (odd number is not allowed).

### 01-12 No-load current of the induction motor (A)

Control mode	<b>FOCPG</b>	Unit: Ampere
		Factory setting: 40
Settings	0~ Default value of Pr.01-08	

 The Factory setting is 40% of the rated current of the hybrid servo drive.

**01-13** Stator resistance (Rs) of the induction motorControl mode **FOCPG** Factory setting: 0**01-14** Rotor resistance (Rr) of the induction motorControl mode **FOCPG** Factory setting: 0

Settings 0~65.535Ω

**01-15** Magnetizing inductance (Lm) of the induction motorControl mode **FOCPG** Factory setting: 0**01-16** Total leakage inductance (Lx) of the induction motorControl mode **FOCPG** Factory setting: 0


Settings 0.0~6553.5mH

**01-17** Rated current of the synchronous motorControl mode **FOCPM** Factory setting: 0.00


Settings 0~655.35 Amps

 The user can set the rated current shown on the synchronous motor's nameplate.**01-18** Rated power of the synchronous motorControl mode **FOCPM** Factory setting: 0.00


Settings 0.00 – 655.35kW

 This parameter sets the rated power of the synchronous motor.**01-19** Rated speed of the synchronous motorControl mode **FOCPM** Factory setting: 1700


Settings 0~65535

 This parameter sets the rated speed of the synchronous motor. It is necessary to refer to the specifications shown on the motor's nameplate.**01-20** Number of poles of the synchronous motorControl mode **FOCPM** Factory setting: 8

Settings 2~20

 This parameter sets the number of the synchronous motor's number of poles (odd number is not allowed).**01-21** Inertia of the synchronous motor's rotorControl mode **FOCPM** Factory setting: 0.0Settings 0.0~6553.5 \*10<sup>-4</sup> kg.m<sup>2</sup>**01-22** Stator's phase resistance (Rs) of the synchronous motorControl mode **FOCPM** Factory setting: 0.000


Settings 0,000~65.535Ω

 Enter the phase resistance of the synchronous motor.




**01-23** stator's phase inductance(Ld) of the synchronous motor**01-24** stator's phase inductance(Lq) of the synchronous motor

Control mode	<b>FOCPM</b>	Factory setting: 0.00
Settings	0.0~655.35mH	

 Enter the synchronous motor's phase inductance. For surface type magnets (SPM),  $L_d = L_q$ ; for built-in magnets (IPM),  $L_d \neq L_q$ .

**01-25** Back EMF of the synchronous motor

Control mode	<b>FOCPM</b>	Factory setting: 0
Settings	0~65535 V/krpm	

 Enter the back EMF of the synchronous motor.

**01-26** Encoder type selection

Control mode	<b>FOCPM</b>	Factory setting: 3
Settings	3: Resolver	

**01-27** PG Offset angle of synchronous motor

Control mode	<b>FOCPM</b>	Factory setting: 0.0
Settings	0.0~360.0°	

 Offset angle of the PG origin for the synchronous motor.

**01-28** Number of poles of the resolver

Control mode	<b>FOCPM</b>	Factory setting: 1
Settings	1~5	

**01-29** Encoder Pulse

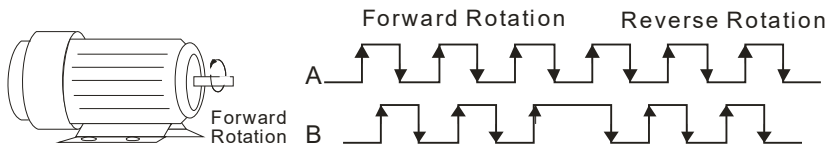
Control mode	<b>FOCPG</b> <b>FOCPM</b>	Factory setting: 1024
Settings	1~20000	

 This parameter can be set the encoder's number of pulses per revolution (PPR).

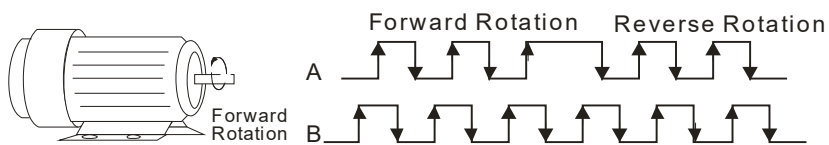
### 01-30 Encoder's input type setting

Control mode **FOCPG** **FOCPM** Factory setting: 1

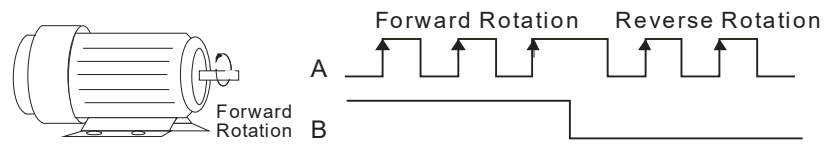
Settings 0: No function  
 1: Phase A leads in a forward run command and phase B leads in a reverse run command.



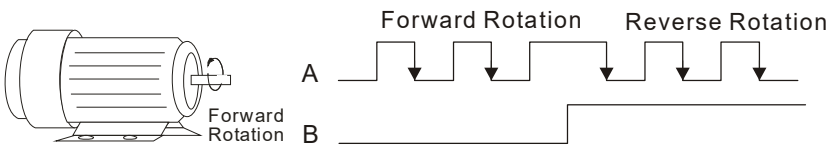
2: Phase B leads in a forward run command and phase A leads in a reverse run command.



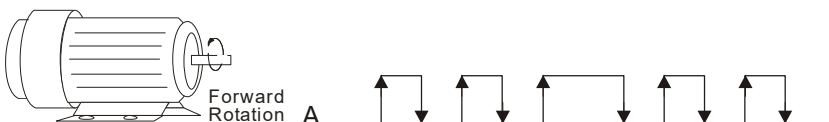
3: Phase A is a pulse input and phase B is a direction input. (low input = reverse direction, high input = forward direction).



4: Phase A is a pulse input and phase B is a direction input. (low input = forward direction, high input = reverse direction).



5: Single-phase input



📖 Enter the correct setting for the pulse type is helpful in controlling the stability.

### 01-31 System control

Control mode **FOCPG** **FOCPM** Factory setting: 1

Settings 0: No function  
 1: ASR automatic tuning  
 2: Estimation of inertia

📖 If the setting value is 1: The speed control gain is determined by Pr.00-10.

If the setting value is 2: The system inertia is estimated. Refer to descriptions in Chapter 3.

### 01-32 Unity value of the system inertia

Control mode **FOCPG** **FOCPM** Factory setting: 260

Settings 1~65535 (256 = 1 per unit)

**01-33** Carrier frequency




Control mode

**FOCPG****FOCPM**

Factory setting: 5

Settings

4~ 10KHz

-  When this parameter is configured, please restart the hybrid servo drive.
-  The carrier frequency of the PWM output has a significant influence on the electromagnetic noise of the motor. The heat dissipation of the hybrid servo drive and the interference from the environment may also affect the noise. Therefore, if the ambient noise is greater than the motor noise, reducing the carrier frequency of the drive may have the benefits of reducing a temperature rise; if the carrier frequency is high, even if a quiet operation is obtained, the overall wiring and interference control should be taken into consideration.
-  When the carrier frequency increases, the rated current decreases as shown in the table below. So the overload capacity also decreases.

Carrier Frequency (kHz)	Rated Current (Pr.00-01)
4	100%
5	100%
6	90%
7	82%
8	75%
9	68%
10	62%

**01-34** Reserved

**01-35** Motor ID

Control mode

**FOCPG FOCPM**

Factory setting: 0

## Settings

	Delta's Hybrid Servo Motor	
0	Disabled	
16	ECMA-ER181BP3	11kW220V motor
17	ECMA-KR181BP3	11kW380V motor
18	ECMA-ER221FPS	15kW220V motor
19	ECMA-KR221FPS	15kW380V motor
20	ECMA-ER222APS	20kW220V motor
21	ECMA-KR222APS	20kW380V motor
125	MSJ-KR133AE48B	30kW380V motor
215	MSJ-IR2070E42C	7kW380V motor
216	MSJ-DR201AE42C	10.4kW220V motor
217	MSJ-IR201AE42C	10.3kW380V motor
218	MSJ-DR201EE42C	14.6kW220V motor
219	MSJ-IR201EE42C	14.2kW380V motor
220	MSJ-DR201IE42C	18.4kW220V motor
221	MSJ-IR201IE42C	18.3kW380V motor
222	MSJ-GR202DE42C	23.1kW220V motor
223	MSJ-OR202DE42C	23kW380V motor
224	MSJ-DR202HE42C	27.6kW220V motor
225	MSJ-LR202FE42C	25kW380V motor
227	MSJ-IR203CE42C	32kW380V motor
229	MSJ-OR264FE48C	45.2kW380V motor
231	MSJ-IR265CE48C	52.5kW380V motor
233	MSJ-IR266IE428	68kW380V motor
245	MSJ-IR202HE42C	27kW380V motor
617	MSJ-IR201BE42E	11kW380V motor
619	MSJ-IR201FE42E	15kW380V motor
621	MSJ-IR201IE42E	18.5kW380V motor
623	MSJ-IR202CE42E	22kW380V motor
625	MSJ-IR203AE42E	30kW380V motor
627	MSJ-LR263HE48E	37kW380V motor
629	MSJ-LR264FE48E	45kW380V motor
633	MSJ-LR266AE48E	60kW380V motor
645	MSJ-IR202GE42E	26kW380V motor

**01-36** Change the rotation direction

Control mode


**FOCPG FOCPM**

Factory setting: 0

Settings

0: When the drive runs forward, the motor rotates counterclockwise. When the drive runs reverse, the motor rotates clockwise.

1: When the drive runs forward, the motor rotates clockwise. When the drive runs reverse, the motor rotates counterclockwise.

 This parameter can be modified only when the whole system is at stop.**01-37** HES ID#

Control mode

**FOCPG FOCPM**

Factory setting: 0


Settings

0 : No function

Model	ID#	Model	ID#	Model	ID#
HES063H23C	2122	HES063G43A	2040	HES063H43C	2142
HES080H23C	3122	HES063H43A	2140	HES080H43C	3142
HES100H23C	4122	HES080G43A	3040	HES100H43C	4142
HES125H23C	5122	HES080H43A	3140	HES125H43C	5142
HES160H23C	6122	HES100G43A	4040	HES160H43C	6142
HES200H23C	7122	HES100H43A	4140	HES063M43C	2342
HES250G23C	8022	HES100Z43A	4240	HES080M43C	3342
HES063H23A	2120	HES125G43A	5040	HES100M43C	4342
HES080G23A	3020	HES125H43A	5140	HES125M43C	5342
HES080H23A	3120	HES160G43A	6040	HES160M43C	6342
HES100G23A	4020	HES160H43A	6140	HES200M43C	7342
HES100H23A	4120	HES200G43A	7040	HES200H43C	7142
HES100Z23A	4220	HES125H43F/HES100M43F	5143	HES250M43C	8342
HES125G23A	5020	HES160H43F/HES125M43F	6143	HES320M43C	9342
HES125H23A	5120	HES160M43F	6343	HES063Z43F	2243
HES160G23A	6020	HES200H43F	7143	HES080Z43F	3243
HES160H23A	6120	HES250M43F	8343	HES100Z43F	4243
HES200G23A	7020	HES400M43F	10343	HES125Z43F	5243
		HES250Z43F	8243	HES160Z43F	6243

**01-38** Maximum Output Voltage

Control mode      **FOCPG FOCPM**      Factory Setting: 100%  
 Settings      0 ~110%

 The maximum output voltage is  $(V_{DC} * Pr.01-38)/\sqrt{2}$ . Once the motor is in the weak magnetic field, user can increase the output voltage to decrease motor's current by using DC bus voltage. However, if the output voltage is too high, there will be a current distortion, which will affect the stability of motor torque force.

**01-39** PDFF (Speed overshoot suppression parameter)

Control mode      **FOCPG FOCPM**      Factory Setting: 100  
 Settings      0 ~200

## 02 Protection Parameters

✎ You can set this parameter during operation.

### ✎ 02-00 Software brake level

Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 380.0/760.0
Settings	230V models: 350.0~450.0V <sub>DC</sub>			
	460V models: 700.0~900.0V <sub>DC</sub>			

📖 Sets the reference point of software brake. The reference value is the DC bus voltage.

### 02-01 Fault record 1

### 02-02 Fault record 2

### 02-03 Fault record 3

### 02-04 Fault record 4

### 02-05 Fault record 5

### 02-06 Fault record 6

Settings	Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>
0: No error record		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1: Over-current during acceleration (ocA)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2: Over-current during deceleration (ocd)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3: Over-current during constant speed (ocn)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4: Ground fault (GFF)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5: IGBT short-circuit (occ)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6: Over-current at stop (ocS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7: Over-voltage during acceleration (ovA)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8: Over-voltage during deceleration (ovd)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9: Over-voltage during constant speed (ovn)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10: Over-voltage at stop (ovS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11: Low-voltage during acceleration (LvA)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12: Low-voltage during deceleration (Lvd)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13: Low-voltage during constant speed (Lvn)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
14: Low-voltage at stop (LvS)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15: Phase loss protection (PHL)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16: IGBT over-heat (oH1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17: Heat sink over-heat for 40HP and above (oH2)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
18: TH1 open: IGBT over-heat protection circuit error (tH1o)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
19: TH2 open: heat sink over-heat protection circuit error (tH2o)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
20: IGBT over heated and unusual fan function (oHF)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
21: Hybrid servo drive overload (oL)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
22: Motor 1 overload (EoL1)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
23: Reserved				
24: Motor over-heat, detect by PTC (oH3)		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
25: Reserved				
26: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
27: Reserved		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

28: Reserved			
29: Reserved			
30: Memory write error (cF1)	○	○	○
31: Memory read error (cF2)	○	○	○
32: Isum current detection error (cd0)	○	○	○
33: U-phase current detection error (cd1)	○	○	○
34: V-phase current detection error (cd2)	○	○	○
35: W-phase current detection error (cd3)	○	○	○
36: Over current detection error (Hd0)	○	○	○
37: Over current detection error (Hd1)	○	○	○
38: Over voltage current detection error (Hd2)	○	○	○
39: Ground current detection error (Hd3)	○	○	○
40: Auto tuning error (AuE)			○
41: Reserved	○	○	○
42: PG feedback error (PGF1)		○	○
43: PG feedback loss (PGF2)		○	○
44: PG feedback stall (PGF3)		○	○
45: PG feedback slip (PGF4)		○	○
46: Reserved	○	○	○
47: Reserved	○	○	○
48: Reserved			
49: External fault input (EF)	○	○	○
50: Emergency stop (EF1)	○	○	○
51: Reserved			
52: Password error (Pcod)	○	○	○
53: CPU error (ccod)			
54: Communication error (cE1)	○	○	○
55: Communication error (cE2)	○	○	○
56: Communication error (cE3)	○	○	○
57: Communication error (cE4)	○	○	○
58: RS-485 Modbus Communication time out (cE10)	○	○	○
59: Reserved	○	○	○
60: Braking transistor error (bF)	○	○	○
61~64: Reserved	○	○	○
65: PG card information error (PGF5)			○
66: Over pressure (ovP)	○	○	○
67: Pressure feedback fault (PFbF)	○	○	○
68: Oil pump runs reversely (Prev)			
69: Oil shortage (noil)			
70: Reserved			
71: Over current at braking chopper overflowed (ocbS)			
72: Braking resistor is open-circuit (bro)			



- 73: Resistance of braking resistor is too small (brF)  
 74: Braking chopper overheated (oH4)  
 75: Error occurred on Brake chopper's thermal protection line (tH4o)  
 76~81: Reserved  
 82: Output Phase Loss on Phase U (oPL1)  
 83: Output Phase Loss on Phase V (oPL2)  
 84: Output Phase Loss on Phase W (oPL3)  
 85, 86, 88~100: Reserved  
 87: Hybrid motor drive overloading while running at low frequency (oL3)  
 101: Software error 1 occurred on CANopen (CGdE)  
 102: Software error 2 occurred on CANopen (CHbE)  
 103: Reserved  
 104: Hardware error occurred on CANopen (CbFE)  
 105: Index setting error occurred on CANopen (CIde)  
 106: Slave # setting error occurred on CANopen (CAde)  
 107: CANopen's Index is out of range (CFrE)

As soon as a fault is occurred, the whole system is forced shutting down. The fault will be recorded. During shutting down, the LvS (low voltage when stop) is not recorded.

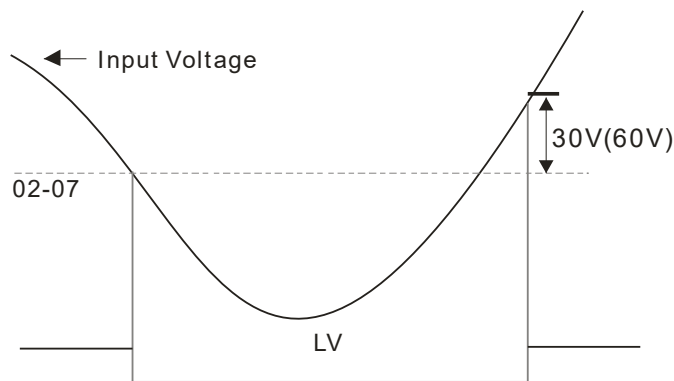
#### 02-07 Low voltage level

Control mode **VF** **FOCPG** **FOCPM**

Factory setting: 180/360

Settings 230V Models: 160 ~ 220V  
 460V Models: 320 ~ 440V

This parameter is to set the LV discrimination level.



#### 02-08 PTC action selection

Control mode **VF** **FOCPG** **FOCPM**

Factory setting: 1

Settings 0: Warn and keep operation  
 1: Warn and ramp to stop  
 2: Warn and coast to stop

Set Pr.02-08 to define the operation mode of the drive after the PTC is activated.

**02-09** PTC level

Control mode **VF** **FOCPG** **FOCPM** Factory setting: VJ-A: 120.0;  
VJ-C: 140.0

Settings  
0.0~150.0°C

This parameter only works on KTY84-130.

**02-10** Reserved

**02-11** PTC type

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0

Settings  
0: Not assigned  
1: KTY84-130  
2: PTC130  
3: Switch (N.C. type)

**02-12** Motor fan activation level

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 50.0

Settings  
0.0~100.0%  
0.0~150.0°C

When Pr.03-05 to Pr.03-07 for the multi-function output terminal are set to 45, the motor fan will start or stop according to this parameter setting.

**02-13** Electronic thermal relay 1 selection

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 2

Settings  
0: Inverter motor (independent cooling, the cooling fan and the shaft are not synchronized)  
1: Standard motor (co-axial cooling, the cooling fan and the shaft are synchronized)  
2: Disable

**02-14** Electronic thermal relay 1 activation time

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 60.0

Settings  
30.0 ~ 600.0 seconds

To prevent self-cooled motor from overheating at low speed operation, the user can set the electronic thermal relay to limit the allowed output power of the hybrid servo drive.

**02-15** Output frequency at malfunction

Control mode **VF** **FOCPG** **FOCPM** Factory setting: Read only

Settings  
0.00 – 599.00Hz

**02-16** Output voltage at malfunction

Control mode **VF** **FOCPG** **FOCPM** Factory setting: Read only

Settings  
0.0 – 6553.5V

**02-17** Output of DC side voltage at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0.0 – 6553.5V

**02-18** Output current at malfunction


Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0.00~655.35Amp

**02-19** IGBT temperature at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings -3276.7~3276.7°C

**02-20** Auto-reset LvX error

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0: Disable, 1: Enable

 When this parameter is enabled and when there is RUN signal, the hybrid servo drive will automatically restart after repowering on.

**02-23** ~ **02-31** Reserved**02-32** Frequency command at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0.00 – 599.00Hz

**02-33** Capacitors' temperature at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings -3276.7~3276.7°C

**02-34** Motor's rotating speed at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings -32767~32767rpm

**02-35** Torque command at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings -32767~32767%

**02-36** Input terminals status at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0~65535

**02-37** Output terminals status at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0~65535

**02-38** Hybrid servo drive status at malfunction

Control mode **VF FOC PG FOC PM** Factory setting: Read only  
 Settings 0~65535

**02-39** Detecting Braking Resistor at startup

Control mode **VF FOC PG FOC PM** Factory setting: 1  
 Settings 0: Disable  
 1; Enable

**02-40** Braking resistance

Control mode **VF FOC PG FOC PM** Factory setting: 0.0  
 Settings 0.0 ~ 6553.5Ω

- 📖 Set Pr.02-39 =1 (Enable detection of braking resistor at startup), then as soon as the hybrid servo drive is powered on, a checkup will be performed to know if the braking resistance is appropriate and if the braking resistor is working properly.
- 📖 If the braking resistance is too small, the braking resistor could be on an open circuit or is not properly installed. The error code <br0> will be displayed on the keypad.
- 📖 If the braking resistance is smaller than the allowable minimum resistance or is on a short circuit, the error code <brF > or <ocbS> will be displayed on the keypad.
- 📖 Pr.02-40 is the detected braking resistance.

↗ **02-21** Decode the parameter protection with the password

Control mode Factory setting: 0  
 Settings 0~9999  
 Display 0~3 times of entering wrong password

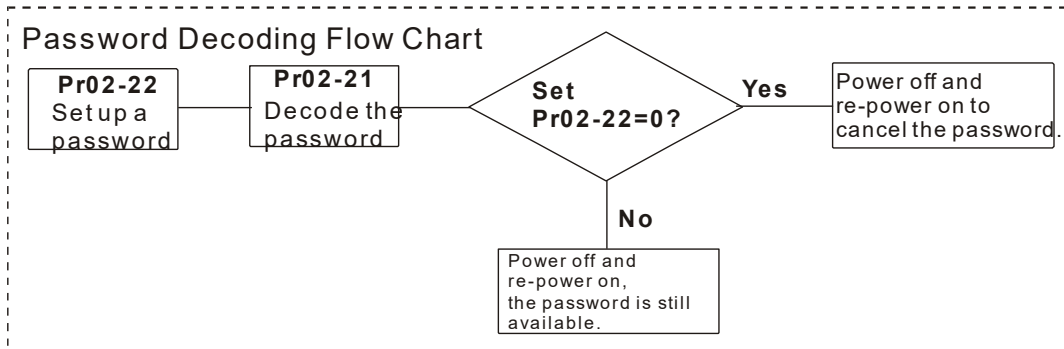
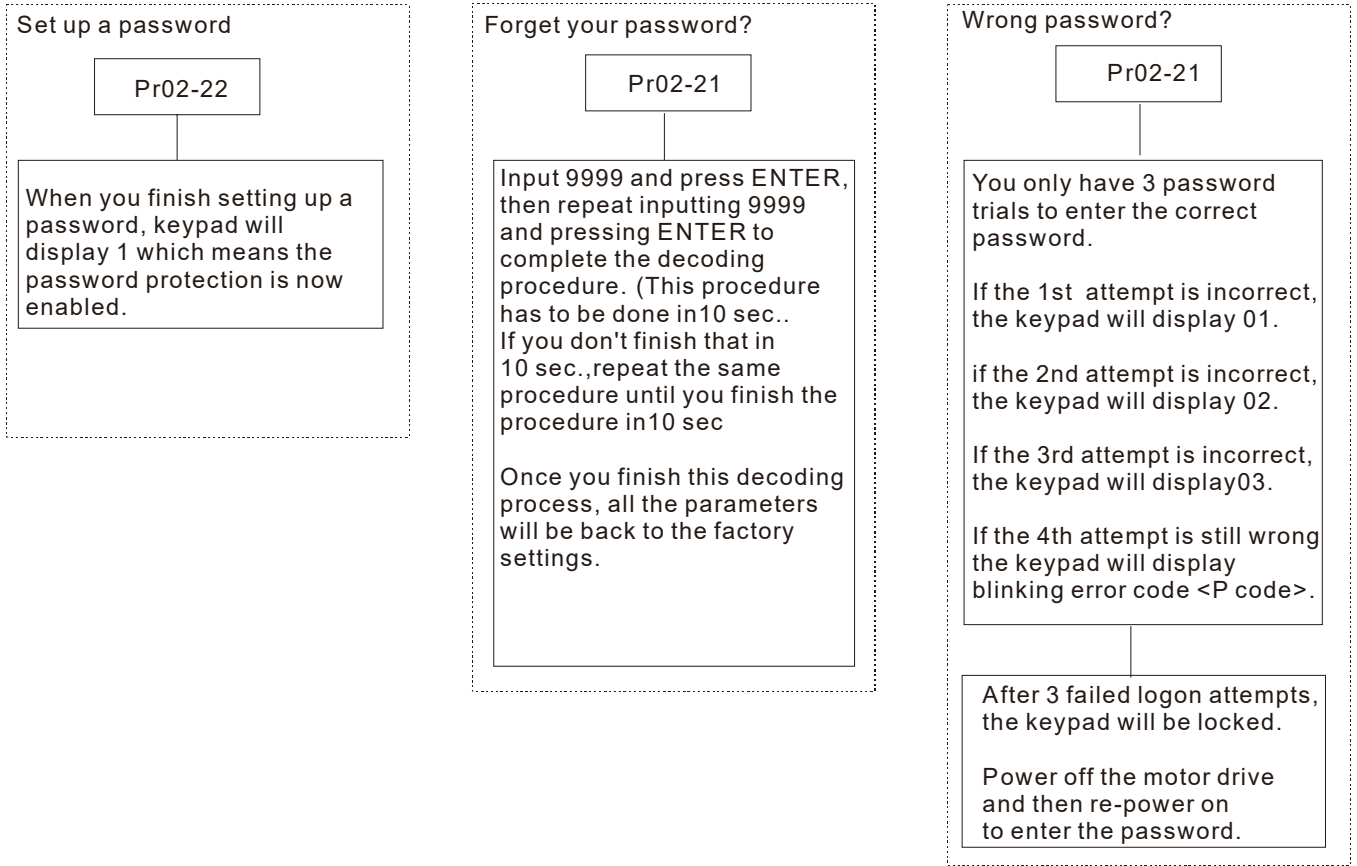
- 📖 Enter the password set at Pr.02-22 into Pr.02-21, and then the parameters will be unlocked for modifications.
- 📖 Write down the setting value after you set up this parameter to avoid inconveniences.
- 📖 Use Pr.02-21 and Pr.02-22 to prevent any unauthorized personnel to modify/ delete parameters.
- 📖 If you forget the password, input 9999 and press ENTER, then repeat inputting 9999 and pressing ENTER to complete the decoding procedure (This procedure has to be done in 10 seconds, if you don't finish that in 10 seconds, repeat the same procedure until you finish the procedure in 10 sec.). Once you finish this decoding process, all the parameters will be back to the factory settings.
- 📖 When setting up a password, all the parameters will be read as 0, except Pr.02-22

↗ **02-22** Set up a parameter protection password

Control mode Factory setting: 0  
 Settings 0~ 9999  
 Display 0: No password set or password entered successfully in Pr.02-21.  
 1: Parameters are locked

- 📖 This parameter is for setting up a password to protect parameters. When you finish setting up a password, keypad will display 1, which means the password protection is now effective.
- 📖 Once you input the correct password into Pr.02-21, the hybrid servo drive is temporarily unlocked. To cancel the parameter protection, set Pr.02-22 =0. Once the parameter protection is cancelled, the hybrid servo drive is without password protection even after reboot.
- 📖 Decode temporarily or cancel the password then you will be able to use keypad to copy parameters. But the password set at Pr.02-22 will not be copied. When the parameters saved in the keypad are transferred to

the hybrid servo drive, you will need to set up a password at Pr.02-22 to enable parameter protection.



↗ **02-41** Limit of current

Control mode **FOCPG FOCPM** Factory setting: 200  
Settings 0 ~ 250%

---

**02-42** Maintenance period of the soft-start relay

Factory setting: 0  
Settings 0~65535(x10)  
0: Turn off the reminder of the remaining lifespan of the soft-start relay.

---

**02-43** Maintenance period of the cooling fan

Factory setting: 0  
Settings 0~65535 hour  
0: Turn off the reminder of the remaining maintenance hour of the cooling fan.

---

### 03 Digital/Analog Input/ Output Parameters

✎ You can set this parameter during operation.

**03-00** Multi-function input command 3 (MI3)

**03-01** Multi-function input command 4 (MI4)

**03-02** Multi-function input command 5 (MI5)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0

Settings

0: No function

44: Injection signal input

45: Confluence/Diversion signal input

46: Reserved

47: Multi-level pressure PI command 1

48: Multi-level pressure PI command 2

51: Flow rate mode

52: Multi-flow rate / speed command 1

53: Multi-flow rate / speed command 2

54: Multi-flow rate / speed command 3

📖 When the value of this parameter is set as 44, the pressure feedback is lower than the pressure stable region (please refer to the description of Pr.00-26) so the flow control will be performed. When it enters the pressure stable region, the pressure control will be performed.

📖 If the setting value is 45, the confluence (OFF)/diversion (ON) function will be performed. For detailed operation, please refer to Chapter 2 for wiring and Chapter 3 for tuning.

📖 New protection mechanism at version C:: When Pr.03-00 ~ Pr.03-02 = 45, Pr.01-01 is automatically set as 2 and Pr.03-15 is automatically, set as 1. This is a mechanism to prevent forgetting to set up related parameters and mistakes when setting up parameters.

📖 Please refer to the description Pr.00-36 if the setting value is 47 and 48,

📖 When the setting value is 51 and when the pressure control mode is enabled (Pr.00-09=1), the speed command is the flow command. The PI calculation is no longer required.

✎ **03-03** Digital input response time

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0.005

Settings 0.001~30.000 sec

📖 This parameter is to delay and confirm the signal on the digital input terminal.

✎ **03-04** Digital input operation direction

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0

Settings 0~65535

📖 This parameter defines the activation level of the input signal.

📖 Bit 0 for the SON terminal, bit 2 for the EMG terminal, bit 3 for the RES terminal, bits 4~6 correspond to MI3~MI5, respectively.

✎ **03-05** Multi-function output 1 (Relay 1)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 11

✎ **03-06** Multi-function Output 2 (MO1)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0

✎ **03-07** Multi-function Output 3 (MO2)

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 0

- Settings 0: No function
- 1: Operation indication
- 9: hybrid servo drive is ready
- 11: Error indication
- 45: Motor fan control signal
- 46: Pressure release valve control signal

**03-08 Multi-function output direction**

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0~65535

This parameter is for bit-wise setting. If the corresponding bit is 1, the multi-function output is set as reverse direction.

**03-09 Display low-pass filtering time on the keypad**

Control mode **VF FOC PG FOC PM** Factory setting: 0.100  
 Settings 0.001~65.535 seconds

This parameter helps to reduce the fluctuation of the readings on the keypad.

**03-10 Maximum output voltage for pressure feedback**

Control mode **VF FOC PG FOC PM** Factory setting: 10.00  
 Settings 5.00~10.00 V

**03-11 Minimum output voltage for pressure feedback**

Control mode **VF FOC PG FOC PM** Factory setting: 0.0  
 Settings 0.00~2.00V

This parameter defines the pressure feedback output voltage.

If the pressure feedback has a bias, adjust this parameter to eliminate the bias.

**03-12 Current/Voltage mode pressure sensor selection**

Control mode **VF FOC PG FOC PM** Factory setting: 1  
 Settings 0: Current mode (4mA~20mA)  
 1: Voltage mode

PS (Pressure Feedback) terminal: Add a current-fed pressure feedback (4~20mA)

The following are required when using it:

Switch the PS on the I/O board to "I" (factory setting is PS-V).

Set Pr.03-12 = 0 (4~20mA)

Set Pr.00-36 =1 (Enable detection of the pressure feedback disconnection)

**03-13 Confluence Master/Slave Selection**

Control mode **VF FOC PG FOC PM** Factory setting: 0  
 Settings 0: No function  
 1: Master 1  
 2: Slave/Master 2  
 3: Slave/Master 3

In a stand-alone system, this parameter is set as 0



- 📖 In a confluence system, the parameter is set as 1 for the Master and 2 for the Slave
- 📖 With multi-function input terminal function 45, the confluence/diversion can be configured. For detailed operation, please refer to Chapter 2 for wiring and Chapter 3 for tuning.
- 📖 The difference between Master 2 and Master 3 is that the Master 3 can be configured as confluent with other Slaves during confluence; however, the Master 2 can be configured for stand-alone operation.

### 03-14 The ration between slave's flow and master's flow

Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 100.0
Settings			0.0~6553.5 %	

- 📖 This parameter setting is required only for the Master but not needed for the Slave.
- 📖 In a confluence system, this parameter value defines the Slave's portion of the Master's flow.

Example: Slave is 60L/min and Master is 40L/min, so the setting is  $60/40 * 100\% = 150\%$

For confluence of more than 2 pump, the values for the slaves must be the same. For example, if the total flow for a three-pump system is 200L/min, where the Master is 40L/min, then the two Slaves should be 80L/min. The setting of Pr.03-14 should be  $160/40 = 400\%$

### 03-15 Source of frequency command

Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 0
Settings			0: Digital Keypad 1: RS485 Communication 2~5: Reserved 6: CANopen	

- 📖 In a confluence system, if the Slave's frequency command is given through the RS485 communication, the setting value should be 1.

### 03-16 Limit for the Slave reverse depressurization torque

Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 0
Settings			0~500%	

- 📖 Set the torque limit for the Slave's reverse operation.

### 03-17 Slave's activation level

Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 50
Settings			0~100%	


- 📖 This parameter setting is required only for the Master but not needed for the Slave.
- 📖 This parameter determines the activation level for the Slave. A 100% value corresponds to the full flow of the Master.

### 03-18 Reserved

### 03-19 Reserved


↗ **03-20** Start-up display selection


Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 0
Settings		0: F (frequency command)		
		1: H (actual frequency)		
		2: Multi-function display (user-defined Pr.00-04)		
		3: A (Output current)		

 This parameter is to set up the contents of the start-up screen. The content of the user-defined option is displayed in accordance with the setting value of Pr.00-04.

↗ **03-21** Slave reverse running for depressurization


Control mode	<b>VF</b>	<b>FOCPG</b>	<b>FOCPM</b>	Factory setting: 0
Settings		0: Disable		
		1: Enable		
		2: Reserved		

 This parameter setting is required only for the Slave but not needed for the Master.

 When the parameter is set as 1, make sure that the outlet end of the Slave is not installed with any one-way valve and the Pr.03-16 is set as 500. The maximum reverse running speed is determined by Pr.00-28  
Depressurization speed

↗ **03-22** Slave closing level

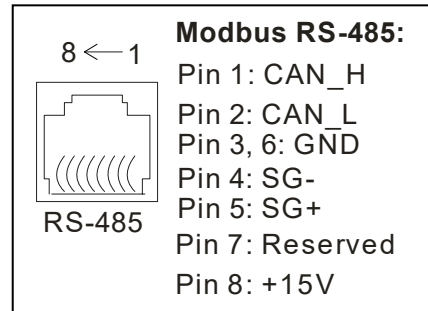
Settings	0~ 400 Bar	Factory setting: 400
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 Set up this parameter from a Master. The slave pump(s) will be shut down when the master pump detects the pressure higher than the setting value at this parameter. The slave pump(s) will resume to run after the hybrid servo drive goes into stand by.

## 04 Communication Parameters

✎ You can set this parameter during operation.

The communication port is defined as shown in the figure on the right. We recommend using Delta IFD6500 or IFD6530 as your communication converter between the hybrid servo drive and your computer. See wiring diagram in Ch02 to know the position of this communication port.



### ✎ 04-00 COM1 Communication Address

Factory Setting: 1

Settings 1~254

📖 If the hybrid servo drive is controlled by RS-485 serial communication, the communication address for this drive must be set via this parameter and each hybrid servo drive's communication address must be different.

### ✎ 04-01 COM1 Transmission Speed

Factory Setting: 19.2

Settings 4.8~115.2 Kbps

📖 This parameter is for setting up the transmission speed of computer and the hybrid servo drive.

📖 Please set 4.8 Kbps, 9.6 Kbps, 19.2 Kbps, 38.4 Kbps, 57.6 Kbps, or 115.2 Kbps. Otherwise the transmission speed will be replaced by 19.2 Kbps.

### ✎ 04-02 COM1 Transmission Fault Treatment

Factory Setting: 3

Settings 0: Warn and keep operation  
 1: Warn and ramp to stop  
 2: Warn and coast to stop  
 3: No warning and continue operation

📖 This parameter is to set the response to the transmission errors such as a disconnection.

### ✎ 04-03 COM1 Time-out Detection

Factory Setting: 0.0

Settings 0.0~100.0 sec.

📖 Use this parameter to set the communication transmission time-out.


## 04-04 COM1 Communication Protocol

Factory Setting: 13

- Settings
- 0) 7, N, 1 for ASCII
  - 1) 7, N, 2 for ASCII
  - 2) 7, E, 1 for ASCII
  - 3) 7, O, 1 for ASCII
  - 4) 7, E, 2 for ASCII
  - 5) 7, O, 2 for ASCII
  - 6) 8, N, 1 for ASCII
  - 7) 8, N, 2 for ASCII
  - 8) 8, E, 1 for ASCII
  - 9) 8, O, 1 for ASCII
  - 10) 8, E, 2 for ASCII
  - 11) 8, O, 2 for ASCII)
  - 12) 8, N, 1 for RTU)
  - 13) 8, N, 2 for RTU
  - 14) 8, E, 1 for RTU
  - 15) 8, O, 1 for RTU
  - 16) 8, E, 2 for RTU
  - 17) 8, O, 2 for RTU

### Control by PC (Computer Link)

When using RS-485 serial communication interface, each drive must be pre-specified its communication address in Pr.09-00, the computer can implement control according to their individual address.

 Modbus ASCII (American Standard Code for Information Interchange): Each byte data is the combination of two ASCII characters. For example, a 1-byte data: 64 Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

### 1. Code Description

Communication protocol is in hexadecimal, ASCII: "0" ... "9", "A" ... "F", every 16 hexadecimal represent ASCII code. For example:

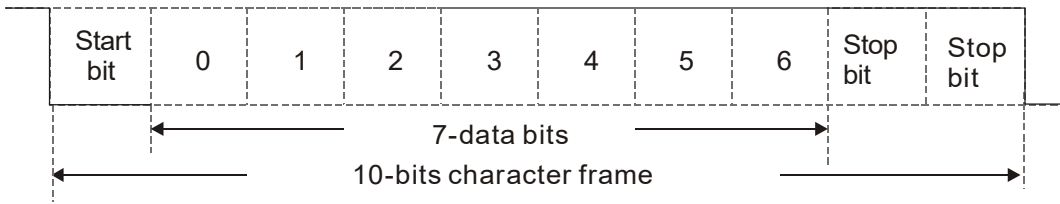
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

Character	'8'	'9'	'A'	'B'	'C'	'D'	'E'	'F'
ASCII code	38H	39H	41H	42H	43H	44H	45H	46H

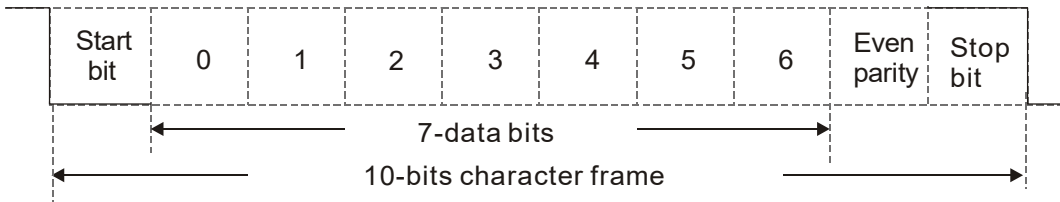
## 2. Data Format

10-bit character frame (For ASCII):

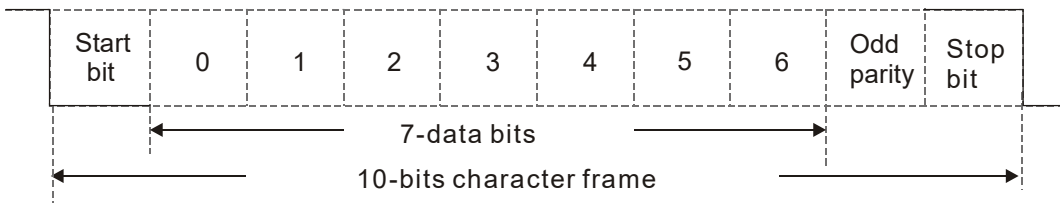
(7, N, 2)



(7, E, 1)

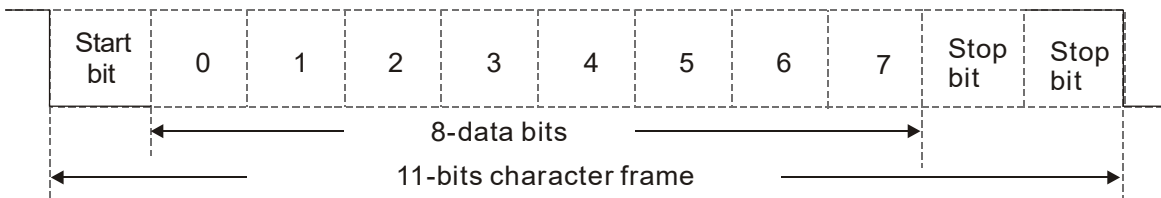


(7, O, 1)

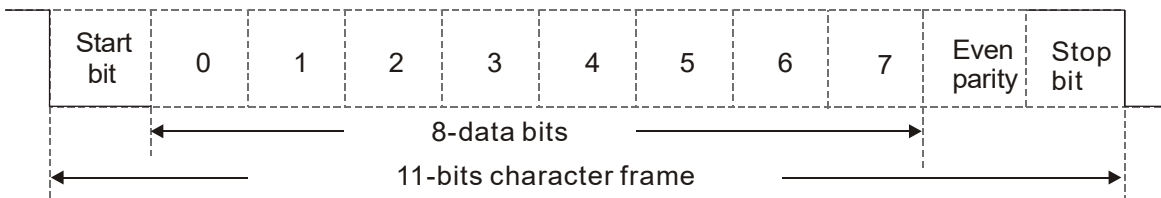


11-bit character frame (For RTU):

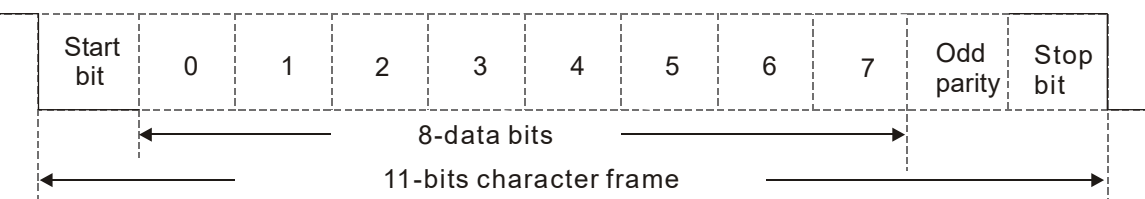
(8, N, 2)



(8, E, 1)



(8, O, 1)



### 3. Communication Protocol

#### Communication Data Frame

ASCII mode :

STX	Start character = ':' (3AH)
Address Hi	Communication address: 8-bit address consists of 2 ASCII codes
Address Lo	
Function Hi	Command code: 8-bit command consists of 2 ASCII codes
Function Lo	
DATA (n-1)	Contents of data: N x 8-bit data consist of 2n ASCII codes N ≤ 16, maximum of 32 ASCII codes (20 sets of data)
.....	
DATA 0	
LRC CHK Hi	LRC check sum: 8-bit check sum consists of 2 ASCII codes
LRC CHK Lo	
END Hi	End characters: END Hi = CR (0DH), END Lo = LF (0AH)
END Lo	

RTU mode:

START	A silent interval of more than 10 ms
Address	Communication address: 8-bit address
Function	Command code: 8-bit command
DATA (n-1)	Contents of data: N × 8-bit data, n ≤ 16
.....	
DATA 0	
CRC CHK Low	CRC check sum: 16-bit check sum consists of 2 8-bit characters
CRC CHK High	
END	A silent interval of more than 10 ms

#### Communication Address (Address)

00H: broadcast to all hybrid servo drives

01H: hybrid servo drive of address 01

0FH: hybrid servo drive of address 15

10H: hybrid servo drive of address 16

:

FEH: Hybrid servo drive of address 254

#### Function code (Function) and DATA (Data characters)

03H: read data from register

06H: write single register

Example: reading continuous 2 data from register address 2102H, AMD address is 01H.

ASCII mode:

Command Message:		Response Message	
STX	'.'	STX	'.'
Address	'0'	Address	'0'
	'1'		'1'
Function	'0'	Function	'0'
	'3'		'3'
Starting register	'2'	Number of register (count by byte)	'0'
	'1'		'4'
	'0'	Content of starting register 2102H	'1'
	'2'		'7'
Number of register (count by word)	'0'	Content of register 2103H	'7'
	'0'		'0'
	'0'		'0'
	'2'		'0'
LRC Check	'D'	LRC Check	'0'
	'7'		'7'
END	CR	END	'1'
	LF		CR
			LF

RTU mode:

Command Message:		Response Message	
Address	01H	Address	01H
Function	03H	Function	03H
Starting data register	21H	Number of register (count by byte)	04H
	02H		Content of register address 2102H
Number of register (count by word)	00H		17H
	02H	Content of register address 2103H	70H
CRC CHK Low	6FH		00H
CRC CHK High	F7H		00H
		CRC CHK Low	FEH
		CRC CHK High	5CH

06H: single write, write single data to register.

Example: writing data 6000 (1770H) to register 0100H. AMD address is 01H.

ASCII mode:

Command Message:		Response Message	
STX	‘.’	STX	‘.’
Address	‘0’	Address	‘0’
	‘1’		‘1’
Function	‘0’	Function	‘0’
	‘6’		‘6’
Target register	‘0’	Target register	‘0’
	‘1’		‘1’
	‘0’		‘0’
Register content	‘0’	Register content	‘0’
	‘1’		‘1’
	‘7’		‘7’
	‘7’		‘7’
LRC Check	‘0’	LRC Check	‘0’
	‘7’		‘7’
END	‘1’	END	‘1’
	CR		CR
	LF		LF

RTU mode:

Command Message:		Response Message	
Address	01H	Address	01H
Function	06H	Function	06H
Target register	01H	Target register	01H
	00H		00H
Register content	17H	Register content	17H
	70H		70H
CRC CHK Low	86H	CRC CHK Low	86H
CRC CHK High	22H	CRC CHK High	22H

10H: write multiple registers (write multiple data to registers) (at most 20 sets of data can be written simultaneously)

Example: Set the multi-stage speed of hybrid servo drive (address is 01H):

Pr.04-00 = 50.00 (1388H), Pr.04-01 = 40.00 (0FA0H)



## ASCII Mode

Command Message:		Response Message	
STX	'.'	STX	'.'
ADR 1	'0'	ADR 1	'0'
ADR 0	'1'	ADR 0	'1'
CMD 1	'1'	CMD 1	'1'
CMD 0	'0'	CMD 0	'0'
Target register	'0'	Target register	'0'
	'5'		'5'
	'0'		'0'
	'0'		'0'
Number of register (count by word)	'0'	Number of register (count by word)	'0'
	'0'		'0'
	'2'		'2'
Number of register (count by Byte)	'0'	LRC Check	'E'
	'4'		'8'
The first data content	'1'	END	CR
	'3'		LF
	'8'		
	'8'		
The second data content	'0'		
	'F'		
	'A'		
LRC Check	'0'		
	'9'		
END	'A'		
	CR		
	LF		

## RTU mode:

Command Message:		Response Message:	
ADR	01H	ADR	01H
CMD	10H	CMD 1	10H
Target register	05H	Target register	05H
	00H		00H
Number of register (Count by word)	00H	Number of register (Count by word)	00H
	02H		02H
Quantity of data (Byte)	04	CRC Check Low	41H
The first data content	13H	CRC Check High	04H
	88H		
The second data content	0FH		
	A0H		
CRC Check Low	'9'		
CRC Check High	'A'		

## Check sum

## ASCII mode:

LRC (Longitudinal Redundancy Check) is calculated by summing up, module 256 and the values of the bytes from ADR1 to last data character then calculating the hexadecimal representation of the 2's-complement negation of the sum.

For example:

$01H + 03H + 21H + 02H + 00H + 02H = 29H$ , the 2's-complement negation of 29H is **D7H**.

## RTU mode:

CRC (Cyclical Redundancy Check) is calculated by the following steps:

**Step 1:** Load a 16-bit register (called CRC register) with FFFFH.

**Step 2:** Exclusive OR the first 8-bit byte of the command message with the low order byte of the 16-bit CRC register, putting the result in the CRC register.

**Step 3:** Examine the LSB of CRC register.

**Step 4:** If the LSB of CRC register is 0, shift the CRC register one bit to the right with MSB zero filling, then repeat step 3. If the LSB of CRC register is 1, shift the CRC register one bit to the right with MSB zero filling, Exclusive OR the CRC register with the polynomial value A001H, then repeat step 3.

**Step 5:** Repeat step 3 and 4 until eight shifts have been performed. When this is done, a complete 8-bit byte will be processed.

**Step 6:** Repeat step 2 to 5 for the next 8-bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the lower order byte will be transmitted first.

The following is an example of CRC generation using C language. The function takes two arguments:

Unsigned char\* data ← a pointer to the message buffer

Unsigned char length ← the quantity of bytes in the message buffer

The function returns the CRC value as a type of unsigned integer.

```
Unsigned int crc_chk(unsigned char* data, unsigned char length)
{
    int j;
    unsigned int reg_crc=0xffff;
    while(length--){
        reg_crc ^= *data++;
        for(j=0;j<8;j++){
            if(reg_crc & 0x01){ /* LSB(b0)=1 */
                reg_crc=(reg_crc>>1) ^ 0xa001;
            }else{
                reg_crc=reg_crc >>1;
            }
        }
    }
    return reg_crc;           // return register CRC
}
```

## 4. Address list

Content	Register	Function	
Hybrid servo drive parameters	GGnnH	GG means parameter group, nn means parameter number, for example, the address of Pr.04-01 is 0401H.	
Command write only	2000H	bit 1~0	00B: No function
			01B: Stop
			10B: Run
			11B: Enable JOG
		bit 3~2	Reserved
		bit 5~4	00B: No function
			01B: FWD
	10B: REV		
	11B: Change direction		
	bit 14~13	00B: No function	
		01B: Operated by digital keypad	
		10B: Operated by Pr.00-21	
		11B: Change source of operation command	
bit 15	Reserved		
2001H	Frequency command(Set Pr.00-06=0, Input XXX.XX Hz)		
2002H	bit 0	1: EF (external fault) on	
	bit 1	1: Reset	
	bit 2	1: B.B ON	
	bit 15~3	Reserved	
Status monitor read only	2100H	High byte: Warn code Low Byte: Error code	
	2101H	bit 1~0	Hybrid servo drive operation status
			00B: Drive stops
			01B: Drive decelerating
			10B: Drive standby
11B: Drive in operation			
bit 2	1: Reserved		
bit 4~3	Operation direction		
	00B: FWD run		
	01B: From REV run to FWD run		
	10B: From FWD run to REV run		
11B: REV run			
		bit 8	1: Master frequency controlled by communication interface
		bit 9	1: Master frequency controlled by analog signal or external input terminals.
		bit 10	1: Operation command controlled by communication interface
		bit 11	1: Parameter locked
		bit 12~15	Reserved
	2102H	Frequency command (XXX.XX Hz)	
	2103H	Output frequency (XXX.XX Hz)	
	2104H	Output current (XX.XX A).	
	2105H	DC bus voltage (XXX.X V)	
	2106H	Output voltage (XXX.X V)	
	2107H	Reserved	
	2108H	Reserved	
	2116H	Multi-function display (Pr.00-04)	
	2200H	Display output current (A)	
	2201H	Reserved	
	2202H	Actual output frequency (XXX.XX Hz)	
	2203H	DC bus voltage (XXX.X V)	
	2204H	Output voltage (XXX.X V)	
	2205H	Power angle (XXX.X)	
	2206H	Display actual motor speed kW of U, V, W (XXXXX kW)	
	2207H	Display motor speed in rpm estimated by the drive or encoder feedback (XXXXX rpm) (Pr.00-04 #7)	
	2208H	Display positive / negative output torque in %, estimated by the motor drive (t0.0: positive torque, -0.0: negative torque) (XXX.X %)	

Content	Register	Function
		(Pr.00-04 #8)
	2209H	Display PG feedback (Pr.00-04 #9)
	220AH	Reserved
	220BH	Display the signal value of the analog input terminal PS with 4~20mA/ 0~10V mapped to 0~100%
	220CH	Display the signal value of the analog input terminal PI with 0~10V mapped to 0~100%
	220DH	Display the signal value of the analog input terminal AUI with -10~10V mapped to -100~100%
	220EH	Display the temperature of the power module IGBT (XXX.X °C)
	220FH	Display the temperature of the power capacitor (XXX.X °C)
	2210H	Display the status of digital input (ON / OFF)
	2211H	Display the status of digital output (ON / OFF)
	2212H	Reserved
	2213H	The corresponding CPU pin status of digital input (d.)
	2214H	The corresponding CPU pin status of digital output (O.)
	2215H	Reserved
	2216H	Reserved
	2217H	Reserved
	2218H	Reserved
	2219H	Display the signal value of the analog input terminal QI with 0~10V mapped to 0~100%
	221AH	Display the actual pressure value (XXX.X Bar)
	221BH	Display the kWh value (XXX.X kWh)
	221CH	Display the motor temperature (XXX.X °C)
	221DH	Over load rate of hybrid servo drive (XXX.X %)
	221EH	Over load rate of motor with last digit A of HES (XXX.X %)
	221FH	Display current at braking (XXX A)
	2220H	Display temperature of the braking chopper (XXX.X °C)

**5. Exception response:**

When drive is doing communication connection, if an error occurs drive will respond the error code and set the highest bit (bit 7) of code to 1 (function code AND 80H) then response to control system to know that an error occurred.

If keypad displays “CE-XX” as a warning message, “XX” is the error code at that time. Please refer to the meaning of error code in communication error for reference.

Example:

ASCII mode:		RTU mode:	
STX	‘.’	Address	01H
Address	‘0’	Function	86H
	‘1’	Exception code	02H
Function	‘8’	CRC CHK Low	C3H
	‘6’	CRC CHK High	A1H
Exception code	‘0’		
	‘2’		
LRC CHK	‘7’		
	‘7’		
END	CR		
	LF		

The explanation of exception codes:

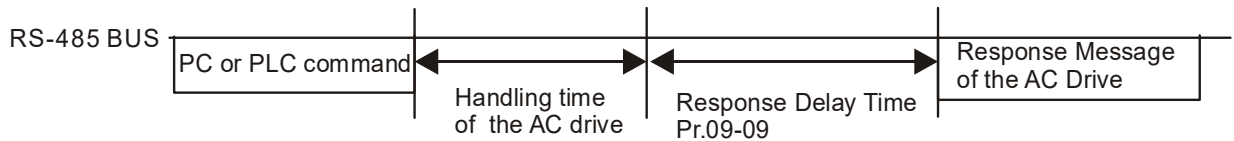
Exception code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Fail to execute this function code

**04-05 Delay Time of Communication Response**

Factory Setting: 2.0

Settings 0.0~200.0 ms

This parameter is the response delay time after hybrid servo drive receives communication command as shown in the following.



**04-06 Main Frequency of the Communication**

Factory Setting: 60.00

Settings 0.00~599.00 Hz


When Pr.00-20 is set to 1 (RS-485 communication). The hybrid servo drive will save the last frequency command at Pr.04-06 when abnormal turn-off or momentary power loss.

After rebooting the power, if no new frequency command is given, the hybrid servo drive will continue to run by using the frequency set at Pr.04-06.

- ↗ **04-07** Block Transfer 1
- ↗ **04-08** Block Transfer 2
- ↗ **04-09** Block Transfer 3
- ↗ **04-10** Block Transfer 4
- ↗ **04-11** Block Transfer 5
- ↗ **04-12** Block Transfer 6
- ↗ **04-13** Block Transfer 7
- ↗ **04-14** Block Transfer 8
- ↗ **04-15** Block Transfer 9
- ↗ **04-16** Block Transfer 10

Factory Setting: 0.00

Settings 0.00~655.35

 There is a group of block transfer parameter available in the hybrid servo drive (Pr.04-07 to Pr.04-16). Through communication code 03H, you can use them (Pr.04-07 to Pr.04-16) to save those parameters that you want to read.

**04-17** CANopen Slave Address

Factory Setting: 0

Settings 0: Disable  
1~127

**04-18** CANopen Speed

Factory Setting: 0

Settings 0) 1 Mbps  
1) 500 kbps  
2) 250 kbps  
3) 125 kbps  
4) 100 kbps (Delta only)  
5) 50 kbps

**04-19** CANopen Warning Record

Factory Setting: 0

Settings bit 0: CANopen software disconnection 1 (CANopen Guarding Time out)  
bit 1: CANopen software disconnection 2 (CANopen Heartbeat Time out)  
bit 2: CANopen SYNC time out  
bit 3: CANopen SDO time out  
bit 4: CANopen SDO buffer overflow  
bit 5: CANopen hardware disconnection warning (CAN bus Off)  
bit 6: Error protocol of CANopen  
bit 8: The setting values of CANopen indexes fail.  
bit 9: The setting value of CANopen address fails.  
bit10: The checksum value of CANopen indexes fail.

**04-20** CANopen Decoding Method

Factory Setting: 1

- Settings 0: Delta defined decoding method  
1: CANopen Standard DS402 protocol

**04-21** CANopen Communication Status

Factory Setting: Read Only

- Settings 0: Node Reset State  
1: Com Reset State  
2: Boot up State  
3: Pre Operation State  
4: Operation State  
5: Stop State
- 

**04-22** CANopen Control Status

Factory Setting: Read Only

- Settings 0: Not ready for use state  
1: Inhibit start state  
2: Ready to switch on state  
3: Switched on state  
4: Enable operation state  
7: Quick stop active state  
13: Error reaction activation state  
14: Error state

**04-23** Reserved**04-24** Communication Decoding Method

Factory Setting: 1

- Settings 0: Decoding method 1  
1: Decoding method 2
- 

		Decoding Method 1	Decoding Method 2
Source of Operation Control	Digital Keypad	Digital keypad controls the drive action regardless decoding method 1 or 2.	
	External Terminal	External terminal controls the drive action regardless decoding method 1 or 2.	
	RS-485	Refer to address: 2000h~20FFh	Refer to address: 6000h ~ 60FFh
	CANopen	Refer to index: 2020-01h~2020-FFh	Refer to index:2060-01h ~ 2060-FFh

# Chapter 5 Methods of Anomaly Diagnosis

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5-1 Unusual signal

5-2 Dynamic fault processing and troubleshooting

5-3 Resolution for electromagnetic noise and induction noise

5-4 Environment and facilities for installation

The hybrid servo drive is capable of displaying warning messages such as over voltage, low voltage, and over current and equipped with the protection function. Once any malfunction occurs, the protection function will be enabled and the hybrid servo drive will stop its input, followed by the action of the anomaly connection point and stopping of the servo oil pump. Please refer to the cause and resolution that corresponds to the error message displayed by the hybrid servo drive for troubleshooting. The error record will be stored in the internal memory of the hybrid servo drive (up to the last six error messages) and can be read by the digital keypad or communication through parametric readout.

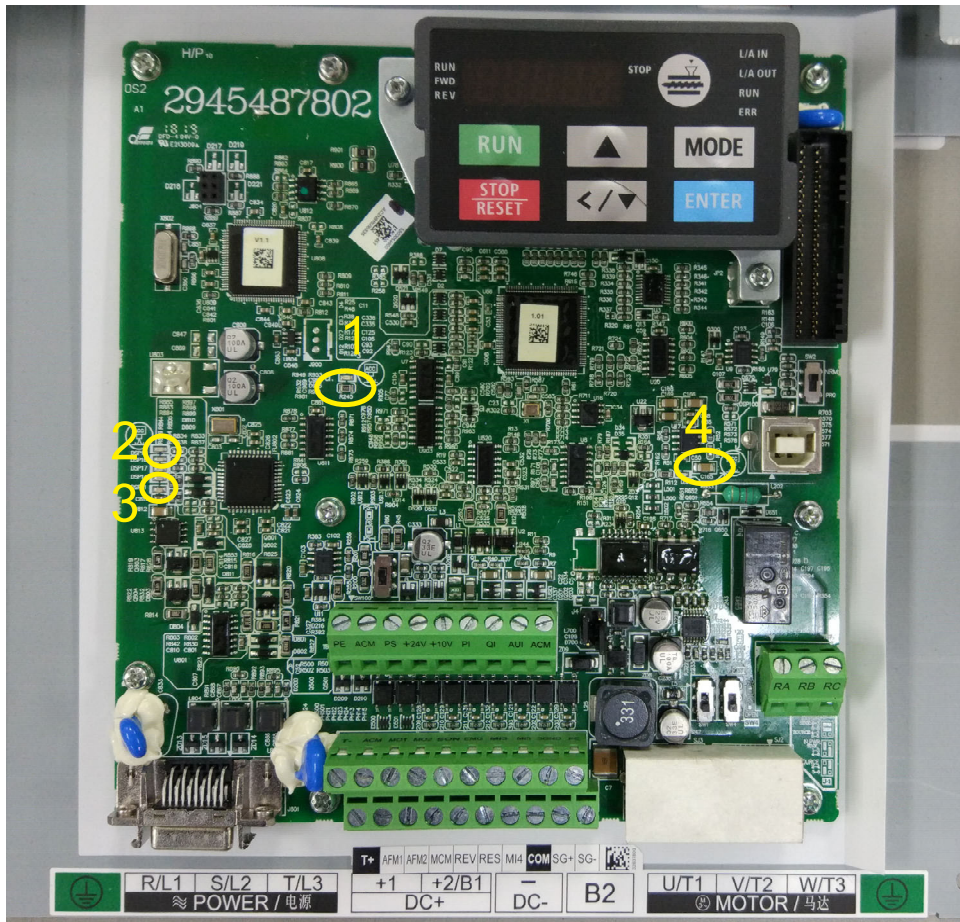


- Upon the occurrence of anomaly, wait for five seconds after the anomaly is resolved before pressing the RESET key.
- Verify that the power indicator is off before opening the machine cover and starting the inspection.



## 5-1 Unusual Signal

### 5-1-1 Indicator Display







1: Power Indicator, 2: Encoder Feedback Indicator, 3: Encoder Feedback Warning Indicator, 4: Brake Indicator



















Here are two images of KPVJ-LE02 displaying unusual signals. On the left, it shows the number of the unusual signals. On the right, it shows the name of the unusual signal. The KPVJ-LE02 switches automatically back and forth between these two ways of displaying the unusual signal.




- <E> = Error, press the RESET key to clear the error.
- <F> = Fault, power off the hybrid servo drive, wait for 3 minutes before you repower on the servo drive
- <A> = Alarm.














### 5-1-2 Error Messages Displayed on Digital Operation Panel KPVJ-LE02









No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E1	ocA 	Over current occurs in acceleration; output current exceeds by three times the rated current of the drive.(ocA)	1. Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad. 2. Check if the hybrid servo motor is stalled. 3. Such errors occur when the red light of PG card flashes. The causes of these errors could be loose contact/ disconnection between encoder, motor drive and motor. 4. When such errors occur at the beginning, during or at the end of pressure/ flow command <ul style="list-style-type: none"> <li>● Adjust also the ramp up/down rate of pressure/flow command (Pr00-29 to Pr00-32)</li> <li>or</li> <li>● Adjust the pressure/ flow reference time (Pr00-46~ Pr00-49) or</li> <li>● Adjust the slope from the hybrid servo drive.</li> </ul> 5. When such errors occur while pressure/ flow command is constant, adjust PI value (Pr00-20 ~ Pr00-25) 6. Make sure if there is any disturbance/ noise, set Pr00-04: #11 (Pressure feedback), #12(Pressure command), 25 (flow rate command). Then observe if the values fluctuate. 7. Replace the hybrid servo drive with a larger output capacity model.	0001H	1	2213H
E2	ocd 	Over current occurs in deceleration; output current exceeds by three times the rated current of the drive. (ocd)		0002H	1	2213H
E3	ocn 	Over current occurs during constant speed. Output current exceeds by three times the rated current of the drive. (ocn)		0003H	1	2214H
E4	GFF 	Ground fault: Ground wire protection applies when one of the output terminal is grounded and the ground current is higher than its rated value by over 80%. Note that this protection is only for hybrid servo drive and not for human. (GFF)	1. Check the wire of hybrid servo motor is shorted or grounded. 2. Check if IGBT power module is damaged 3. Check if the output side wire has bad insulation.	0004H	1	2240H









No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E5	occ 	IGBT short circuit between upper and lower bridge. (occ)	Short-circuit is detected between the upper and lower bridge of the IGBT module. Check the motor wiring. Cycle the power, if occ still exists, return to the factory for repair.	0005H	2	2250H
E6	ocS 	Over-current or hardware failure in current detection at Stop. (ocs)	Send back to manufacturer for repair.	0006H	1	2214H
E7	ovA 	DC BUS over-voltage during acceleration. (ovA)	230V: DC 415V 460V: DC 830V	0007H	2	3210H
E8	ovd 	DC BUS over-voltage during deceleration.(ov d)	1. Check if the input voltage is within the range of voltage rating of Hybrid Servo Drive and monitor for any occurrence of surge voltage. 2. The issue can be resolved by adjusting the software brake action level in Pr.02-00.	0008H	2	3210H
E9	ovn 	DC BUS over-voltage at constant speed. (ovn)	3. When such error occurred at the beginning, during or at the end of the pressure/ flow command, adjust Pr00-29 ~Pr0032 <Ramp up/down rate of pressure/ flow command> or Pr00-46 ~Pr00-49 <Pressure/ flow reference S1/S2 time>	009H	2	3210H
E10	ovS 	Over voltage occurs at stop and hardware failure. (ovS)	Check if the input voltage is within the range of voltage rating of hybrid servo drive and monitor for any occurrence of surge voltage.	000AH	2	3210H
E11	LvA 	DC bus voltage is lower than the setting at Pr02-07 during acceleration. (LvA)	1. Check if the voltage of input power is normal. 2. Check if there is any sudden heavy load. 3. Adjust the low voltage level in Pr02-07.	000BH	2	3220H

No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E12	Lvd 	DC bus voltage is lower than the setting in Pr02-07 during deceleration. (Lvd)	4. Lvn often occurs when the motor drive has a power failure while the operating signals are still being sent.	000CH	2	3220H
E13	Lvn 	DC bus voltage is lower than the setting at Pr02-07 when running at constant speed (Lvn)		000DH	2	3220H
E14	LvS 	DC bus voltage is lower than the setting at Pr02-07 at stop (LvS)		000EH	2	3220H
E15	orP 	Phase loss protection (orP)	Check if only single phase power is sent or phase los occurs for three phase models	000FH	2	3130H
E16	oH1 	IGBT's temperature exceeds the protection level (oH1)	<ol style="list-style-type: none"> <li>1. Check if ambient temperature is too high.</li> <li>2. Check if there is any foreign object on the heat sink and if the fan is running.</li> <li>3. Check if there is sufficient space for air circulation for Hybrid Servo Drive</li> </ol>	0010H	3	4310H
E17	oH2 	Capacitors' temperature exceeds the protection level ) (oH2)	<ol style="list-style-type: none"> <li>1. Check if ambient temperature is too high.</li> <li>2. Check if there is any foreign object on the heat sink and if the fan is running.</li> <li>3. Check if there is sufficient space for air circulation for hybrid servo drive</li> </ol>	0012H	3	FF00H
E18	tH1o 	Hardware failure (tH1o)	Send back to manufacturer for repair.	0012H	8	FF00H
E19	tH2o 	Hardware failure (tH2o)	Send back to manufacturer for repair.	0012H	8	FF01H
E20	oHF 	IGBT overheated and cooling fan failure. (oHF)	<p>Check the fan kit to see if it is blocked.</p> <p>Return to factory for repair.</p>	0013H	4	FF02H

No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E21		The hybrid motor drive detects excessive output current (oL)	<ol style="list-style-type: none"> <li>1. Check if the hybrid servo motor is stalled.</li> <li>2. Replace the hybrid servo drive with a larger output capacity model.</li> <li>3. Set Pr00-04=29, observe if the value returns to zero after every molding cycle. If the number accumulates to 100, OL occurs</li> <li>4. The causes of this error could be loose contact/ disconnection between encoder, servo drive and the motor. This error also occurs when a motor or an oil pump is stalled which make unusual rotating speed and over current.</li> </ol>	0015H	1	2310H
E22		Servo motor overload (EoL1)	<ol style="list-style-type: none"> <li>1. Set Pr00-04=30 (v2.06 and above), observe if the value returns to zero after every molding cycle. If the number accumulates to 100, EoL occurs. Change the molding conditions.</li> <li>2. Replace with the hybrid servo drive with a larger output capacity model.</li> <li>3. If the pressure –flow is too high during the blending, such error occurs easily. To clear this error, decrease the pressure command and the flow command.</li> </ol>	0016H	1	2310H
E24		(02-09 PTC level) Overheating inside the motor drive detected by hybrid servo drive, exceeding the protection level (Pr02-09 PTC level) (oH3).	<ol style="list-style-type: none"> <li>1. Check if the motor drive is blocked.</li> <li>2. Check if the ambient temperature is too high.</li> <li>3. Increase the capacity of the motor drive.</li> </ol>	0018H	3	FF20H







No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E30		Error on memory write-in (cF1)	Press RESET key to return all parameters to factory default values If the above does not work, send back to manufacturer for repair.	001EH	32	5530H
E31		Error on memory readout (cF2)		001FH	5	5530H
F32		Detection of abnormal output of three-phase total current (cd0)	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair	0020H	2	FF03H
F33		Detection of abnormal current in phase U (cd1)		0021H	1	FF04H
F34		Detection of abnormal current in phase V (cd2)		0022H	1	FF05H
F35		Detection of abnormal current in phase W (cd3)		0023H	1	FF06H
F36		Clamp current detection error (Hd0)	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair.	0024H	5	FF07H
F37		Over-current detection error (Hd1)		0025H	5	FF08H
F38		Over-voltage detection error (Hd2)		0026H	5	FF08H
F39		Ground current detection error (Hd3)		0027H	5	FF08H
E40		Auto tuning error (AuE)	1. Check if the wiring of the motor is correct. 2. Check if the motor's parameter settings are correct.	0028H	1	FF21H
E42		PG feedback error (PGF1)	The actual rotating speed doesn't follow speed command and the elapsed time longer than one second. In this case, check if Pr01-30 is not equal to zero and check PG feedback wiring	002AH	7	7301H
E43		PG feedback loss (PGF2)	Check the PG feedback wiring. It could be an open circuit.	002BH	7	7301H

No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E44		Stalled PG feedback (the actual rotating speed is 115% faster than the maximum speed and the elapsed time longer than one second) (PGF3)	<ol style="list-style-type: none"> <li>1. Check the PG feedback wiring.</li> <li>2. Check if PI gain and the settings for acceleration/ deceleration are suitable.</li> <li>3. Check if there's an output phase loss.</li> <li>4. The causes of these errors could be loose contact/ disconnection between encoder, hybrid servo motor drive and motor. (OC might also occur in different conditions.)</li> </ol>	002CH	7	7301H
E45		PG slip error (PGF4)	<ol style="list-style-type: none"> <li>5. Check if the connection between oil pump and motor is stuck.</li> <li>6. Send back to manufacturer for repair.</li> </ol>	002DH	7	7301H
E49		When external terminals EF are closed, Hybrid servo drive stops its output (EF)	Troubleshoot and press "RESET"	0031H	5	9000H
E50		When external EMG terminal is not connected to the heating switch of hybrid servo motor or the motor is overheated (130 °C), hybrid servo drive stops its input (EF1)	Troubleshoot and press "RESET"	0032H	5	9000H
F52		Password is locked after three attempts (Pcod)	Shut down the servo drive, wait for certain time. Make sure that the power indicator is off. (≤ 22kW: wait for 5 min after shut down; ≥ 30kW: wait for 10 min after shut down). Then restart the servo drive and enter the right password	0034H	5	FF26H
F53		CPU fault (ccod)	Send back to manufacturer for repair.	0035H	4	7500H
E54		Illegal command (cE1)	Verify if the communication command is correct (Communication code must be 03, 06, 10)	0036H	4	7500H
E55		Illegal data address (cE2)	Verify if the communication data length is correct.	0037H	4	7500H






No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E56		Illegal data value (cE3)	Verify if the data value is bigger than the maximum or smaller than the minimum value.	0038H	4	7500H
E57		Data is written to read-only address (cE4)	Verify if the communication address is correct.	0039H	4	7500H
E58		Modbus transmission time-out (cE10)	Verify the wiring and grounding of the communication circuit. Press RESET button on the keypad to clear this error code. If cE10 persists, send back to manufacturer for repair.	003AH	4	7500H
E60		Brake transistor error (bF)	Press RESET button on the keypad to clear this error code. If bF persists, send back to manufacturer for repair.	003BH	5	7110H
E65		Hardware error of PG card or magnetic pole tuning fault (PGF5)	Verify the setting of Pr.01-07 Motor Parameter Auto Tuning. If this fault is persistent, send it back to the manufacturer for repairing.	0041H	5	FF29H
E66		Overpressure (ovP)	<ol style="list-style-type: none"> <li>1. Check if the pressure sensor is working properly and if its specification is correct.</li> <li>2. Adjust pressure PI control Pr.00-20~00-37</li> <li>3. Check if the wiring of pressure sensor is correct.</li> <li>4. Check the position of SW100 dip switch (current type or open collector) on the control board if correct.</li> </ol>	0042H	5	FF29H
E67		Pressure feedback error (PfbF)	<ol style="list-style-type: none"> <li>1. Check if the wiring of pressure sensor is correct. It could be open-circuit.</li> <li>2. Check if the pressure sensor signal is below 1V.</li> </ol>	0043H	5	FF29H
E68		Oil pump runs reversely (Prev)	<ol style="list-style-type: none"> <li>1. Check if there's any zero shift at the pressure sensor.</li> <li>2. Check if the wiring of pressure sensor is correct.</li> </ol>	0044H	5	FF29H
E69		Oil shortage (noil)	<ol style="list-style-type: none"> <li>1. Check the amount of oil in the oil tank.</li> <li>2. Check if any leakage at hydraulic circuit.</li> <li>3. If there's a suction filter installed at</li> </ol>	0045H	5	FF29H



No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
			the oil inlet, check if that suction filter is blocked up.			
E70		Business hours end. (tUP)	Send back to manufacturer for repair.	0046H	32	FF29H
E71		Over current at braking chopper (ocbs)	1. Check if the braking chopper is short-circuit? 2. Is the resistance value too small? 3. Send back to manufacturer for repair	0047H	1	FF29H
F72		Braking resistor is open-circuit (bro)	Check if the braking resistor is open-circuit or properly wired?	0048H	32	FF29H
F73		Braking resistor's resistance value is too small. (brF)	Check if the resistance value big enough?	0049H	32	FF29H
E74		Braking chopper overheated (oH4)	1. Check if there are too many times of deceleration and pressure releasing during formation period? 2. Modify formation period	004AH	3	FF29H
E75		Error occurred on braking chopper's thermo-protection line (th4o)	Send back to manufacturer for repair.	004BH	3	FF29H
E78		.The ground short is detected before running the servo drive, because all the upper arms or all the lower arms are turned on.(b.GFF)	Only after this fault occurs for 5 seconds, you can reset the servo drive. If this fault is persistent, send it back to the manufacturer for repairing.	004Eh	2	0x2240H
E79		The U-phase short is detected before running the servo drive because	Only after this fault occurs for 5 seconds, you can reset the servo drive. If this fault is persistent, send it back to the manufacturer for repairing.	004Fh	2	0x2213H

No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
		U-phase and V-phase are turned on.(A.oc)				
E80	b.oc 	The V-phase short is detected before running the servo drive because V-phase and W-phase are turned on.(b.oc)	Only after this fault occurs for 5 seconds, you can reset the servo drive. If this fault is persistent, send it back to the manufacturer for repairing.	0050h	2	0x2213H
E81	c.oc 	The W-phase short is detected before running the servo drive because U-phase and W-phase are turned on.(c.oc)	Only after this fault occurs for 5 seconds, you can reset the servo drive. If this fault is persistent, send it back to the manufacturer for repairing.	0051h	2	0x2213H
E82		Output Phase Loss on Phase U (oPL1)	1 Check if the wiring of motor to see if any loose or broken wires.	0052H	2	FF29H
E83		Output Phase Loss on Phase V (oPL2)	2. Check if the resistance of each phase is the same. 3. Use an ampere-meter to measure if the	0053H	2	FF29H
E84		Output Phase Loss on Phase W (oPL3)	three-phase current is in balance. If this error code still pops up when it is in balance, send back to manufacturer for repair. 4. Choose a motor and a servo drive which are compatible with each other.	0054H	2	FF29H
E87		Servo drive overloading while running at low frequency (oL3)	1. Reduce the ambient temperature of the operating drive. 2. Replace the drive with a larger power model. 3. Reset drive parameters or decrease carrier frequency. Send back to the manufacturer for repair if none of the above works.	0057H	2	2310H

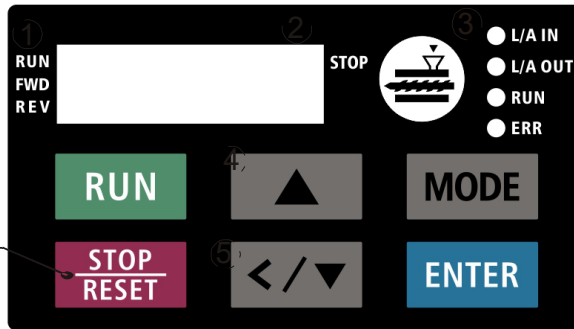
No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
E93	AUE.A 	The current at U-phase is too small. (The IGBT at U-phase is open circuit or an error occurs on the current sensor.)	<p>- 電機未接線：重新正確接線 在變頻器輸出側 ( U / V / W ) 有使用電磁接觸器為開路狀態：確認電磁閥為閉合狀態</p> <ol style="list-style-type: none"> <li>1. Verify if the servo drive and the motor are properly connected</li> <li>2. The magnetic contactor installed on the output side (U/V/W) of the servo drive is at open-circuit. Make sure that it has to be at close-circuit.</li> </ol>	005Dh	2	3210H
E94	AUE.b 	The current at V-phase is too small. (The IGBT at V-phase is open circuit or an error occurs on the current sensor.)	<ol style="list-style-type: none"> <li>1. Verify if the servo drive and the motor are properly connected</li> <li>2. The magnetic contactor installed on the output side (U/V/W) of the servo drive is at open-circuit. Make sure that it has to be at close-circuit.</li> </ol>	005Eh	2	3210H
E95	AUE.c 	The current at W-phase is too small. (The IGBT at W-phase is open circuit or an error occurs on the current sensor.)	<ol style="list-style-type: none"> <li>1. Verify if the servo drive and the motor are properly connected</li> <li>2. The magnetic contactor installed on the output side (U/V/W) of the servo drive is at open-circuit. Make sure that it has to be at close-circuit.</li> </ol>	005Fh	2	3210H
E96	AUE.P 	Error occurred on the encoder (cable connection error)	<ol style="list-style-type: none"> <li>1. Verify if the encoder is properly connected to the servo drive and if the parameters are correctly set.</li> <li>2. Reboot the hybrid servo drive.</li> <li>3. If this fault is persistent, sent it back to the manufacturer for repairing.</li> </ol>	0060h	128	7301H
E101	CGdE 	Software error 1 occurred on CANopen (CGdE) (CANopen guarding error)	<ol style="list-style-type: none"> <li>1. Increase guarding time (Index 100C).</li> <li>2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference.</li> <li>3. Make sure the communication wiring is serial.</li> <li>4. Use dedicated CANopen cable and install terminating resistor.</li> </ol>	0065H	4	8130H

No.	Display Code	Fault Description	Troubleshooting	Fault codes defined by Delta (2021H Low Byte)	CANopen Fault Register (1001H bit 0~7)	DS402 Fault Codes (603FH)
			5. Check the status of communication cable or change new cable.			
E102		Software error 2 occurred on CANopen (CHbE) (CANopen heartbeat error.)	<ol style="list-style-type: none"> <li>1. Increase Heart beat time (Index 1016).</li> <li>2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference.</li> <li>3. Make sure the communication wiring is serial.</li> <li>4. Use dedicated CANopen cable and install terminating resistor.</li> <li>5. Check the status of communication cable or change new cable.</li> </ol>	0066H	4	8130H
E104		Hardware error occurred on CANopen (CbFE) (CANopen bus off error)	<ol style="list-style-type: none"> <li>1. Re-install CANopen card.</li> <li>2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference.</li> <li>3. Make sure the communication wiring is serial.</li> <li>4. Use dedicated CANopen cable and install terminating resistor.</li> <li>5. Check the status of communication cable or change new cable.</li> </ol>	0068H	4	8140H
E105		Index setting error occurred on CANopen (CIdE) (CANopen index error)	<p>Disable CANopen (Pr.04-17=0) Reset CANopen Index (Pr.04-17)</p>	0069H	4	8100H
E106		Slave # setting error occurred on CANopen (CAde)	<p>Disable CANopen (Pr.04-17=0) Reset CANopen Index (Pr.04-17)</p>	006AH	4	8100H
E107		CANopen's Index is Out of Range (CFrE) (CANopen memory error)	<p>Disable CANopen(Pr04-17=0) Reset CANopen Index (Pr04-17)</p>	006BH	4	8100H

### Reset Alarm:

Once the issue that tripped the system and triggers the alarm is eliminated, one can resume the system to normal status by pressing the RESET key on the digital keypad (as shown in the figure) to set the external terminal to "Anomaly reset command" and sending the command by turning on the terminal or via communication. Before any anomaly alarm is resolved, make sure the operation signal is at open circuit status (OFF) to avoid immediate machine running upon anomaly reset that may cause mechanical damage or personnel casualty.

Stop/ Reset key:  
Press this button to  
stop running and  
reset abnormality



## 5-1-3 Warning Codes

No.	Display	Fault codes defined by Delta (2021H High Byte)	Descriptions
A1	CE 1	0001H	Modbus function code error (Illegal function code) (CE1) <b>Corrective Actions</b> <ul style="list-style-type: none"> <li>■ Check if the function code is correct. (Function code must be 03, 06, 10, 63)</li> </ul>
A2	CE 2	0002H	Modbus data address is error (Illegal data address (00 H to 254 H) (CE2) <b>Corrective Actions</b> <ul style="list-style-type: none"> <li>■ Check if the communication address is correct.</li> </ul>
A3	CE 3	0003H	Modbus data error (Illegal data value) (CE3) <b>Corrective Actions</b> <ul style="list-style-type: none"> <li>■ Check if the data value exceeds maximum / minimum value.</li> </ul>
A4	CE 4	0004H	Modbus communication error (Data is written to read-only address) (CE4) <b>Corrective Actions</b> <ul style="list-style-type: none"> <li>■ Check if the communication address is correct.</li> </ul>
A5	CE 10	0005H	Modbus transmission time-out (CE10)
A6	CP 10	0006H	Keypad transmission time-out (CP10)
A7	SE 1	0007H	Keypad COPY error 1 (SE1) Keypad simulation error, including communication delays, communication error (keypad receives error FF86) and parameter value error.
A8	SE 2	0008H	Keypad COPY error 2 (SE2) Keypad simulation done, parameter writes error.
A9	oH 1	0009H	IGBT is over-heated than protection level: 95°C (oH1) <b>Corrective Actions</b> <ul style="list-style-type: none"> <li>■ Ensure that the ambient temperature falls within the specified temperature range.</li> <li>■ Make sure that the ventilation holes are not obstructed.</li> <li>■ Remove any foreign objects from the heat sink and check for possible dirt in heat sink.</li> <li>■ Provide enough spacing for adequate ventilation.</li> </ul>

No.	Display	Fault codes defined by Delta (2021H High Byte)	Descriptions
A10	oH2	000AH	<p>Motor drive is over-heated than protection level: 95°C. This warning code is ONLY for frame E, NOT for other frames.(oH2)</p> <p><b>Corrective Actions</b></p> <ul style="list-style-type: none"> <li>■ Ensure that the ambient temperature falls within the specified temperature range.</li> <li>■ Make sure that the ventilation holes are not obstructed.</li> <li>■ Remove any foreign objects from the heat sink and check for possible dirt in heat sink.</li> <li>■ Provide enough spacing for adequate ventilation.</li> </ul>
A11	PI d	000BH	PID feedback loss (PID)
A14	AUE	000EH	<p>Motor parameters auto-tuning error (AuE)</p> <p><b>Corrective Actions</b></p> <ul style="list-style-type: none"> <li>■ Check if motor wiring is correct.</li> <li>■ Check if motor capacity and parameters are correct.</li> </ul>
A15	PGFb	000FH	<p>PG feedback error (PGFb)</p> <p><b>Corrective Actions</b></p> <ul style="list-style-type: none"> <li>■ Check if the encoder's wiring is correct.</li> <li>■ Check if PG card's red light is on because of some interferences.</li> </ul>
A17	oSPd	0011H	Over speed warning (oSPd)
A18	dAUE	0012H	Over speed deviation warning (dAUE)
A19	PHL	0013H	Input Phase Loss (PHL)
A22	oH3	0016H	Motor over-heating (oH3)
A24	oSL	0018H	Over slip (oSL)
A25	tUn	0019H	Auto-tuning in process (tUn)
A26	FAn	001AH	<p>Cooling fan jammed (FAn)</p> <p><b>Corrective Actions</b></p> <ul style="list-style-type: none"> <li>■ Check if the cooling spins or not.</li> <li>■ Clean the cooling fan</li> </ul>

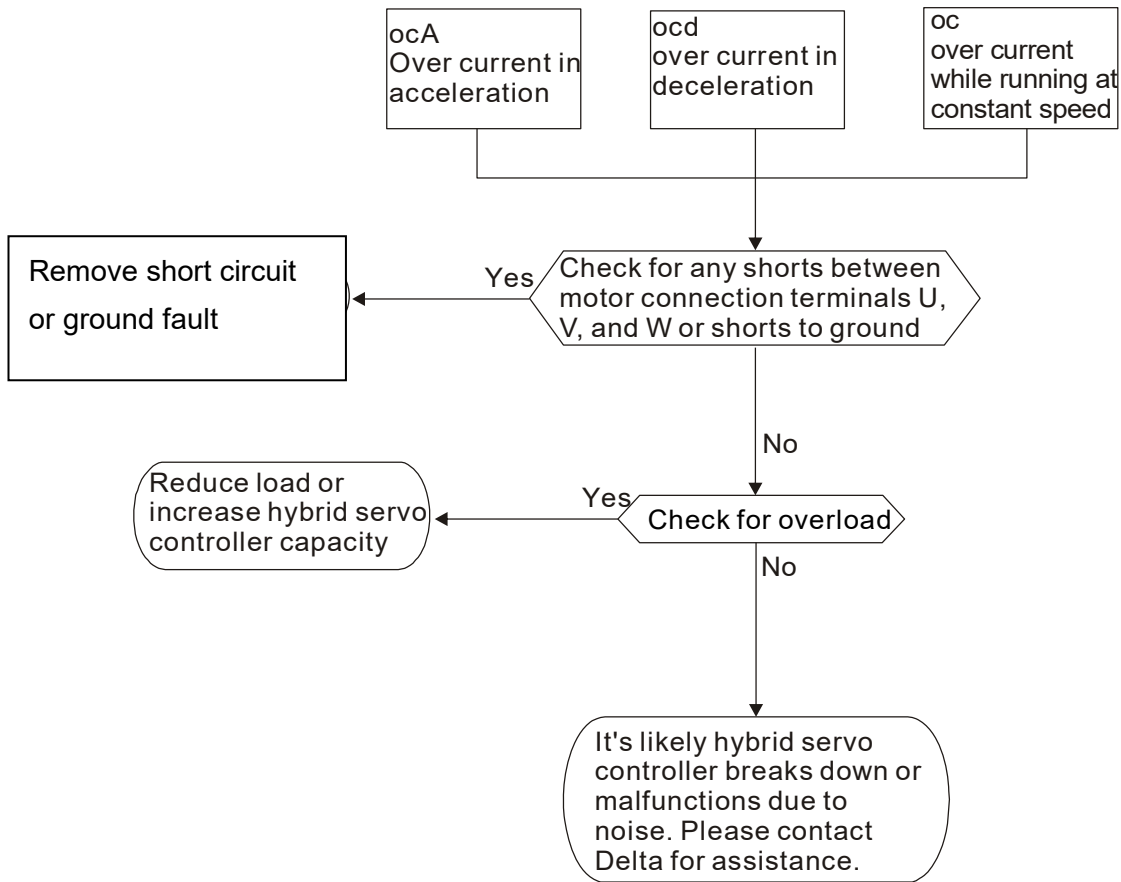
No.	Display	Fault codes defined by Delta (2021H High Byte)	Descriptions
A27	bP	001BH	<p>The function of this warning code is to prevent oil pump from damaging while running without sucking in any hydraulic oil. When the hybrid servo drive goes from STOP to RUN, it starts to check if the pressure is over 0.5Bar within the time set at Pr.00-60. During this checking period, the servo drive refuses pressure command and flow command sent from keypad. The keypad displays bp (building pressure).</p> <p>If the pressure is still under 0.5bar after the checking period set at Pr.00-60, there will be an oil shortage warning and the hybrid servo drive will stop running. The keypad will display noil (no oil).</p> <p>If the pressure is over 0.5bar within the checking time set at Pr00-60, the hybrid servo drive continues to run normally. There won't be a bp warning. (bP)</p> <p>※ This function is effective when Pr.00-27 &lt;minimum pressure&gt; is set as higher than 0.3% and the time setting at Pr.00-60 is NOT 0.</p>
A28	oPHL	001CH	Output Phase Loss (oPHL)
A36	CGdn	0024H	Software error 1 occurred on CANopen (CGdn)
A37	CHbn	0025H	Software error 2 occurred on CANopen (CHbn)
A38	CSyn	0026H	CANopen Synchronization off (CSyn)
A39	CbFn	0027H	CANopen bus off (CbFn)
A40	CI dn	0028H	CANopen index error (CI dn)
A41	CA dn	0029H	CANopen station address error (CA dn)
A42	CFrn	002AH	CANopen memory error (CFrn)
A43	CSdn	002BH	CANopen SDO transmission time-out (CSdn)
A44	CSbn	002CH	CANopen SDO received register overflow (CSbn)



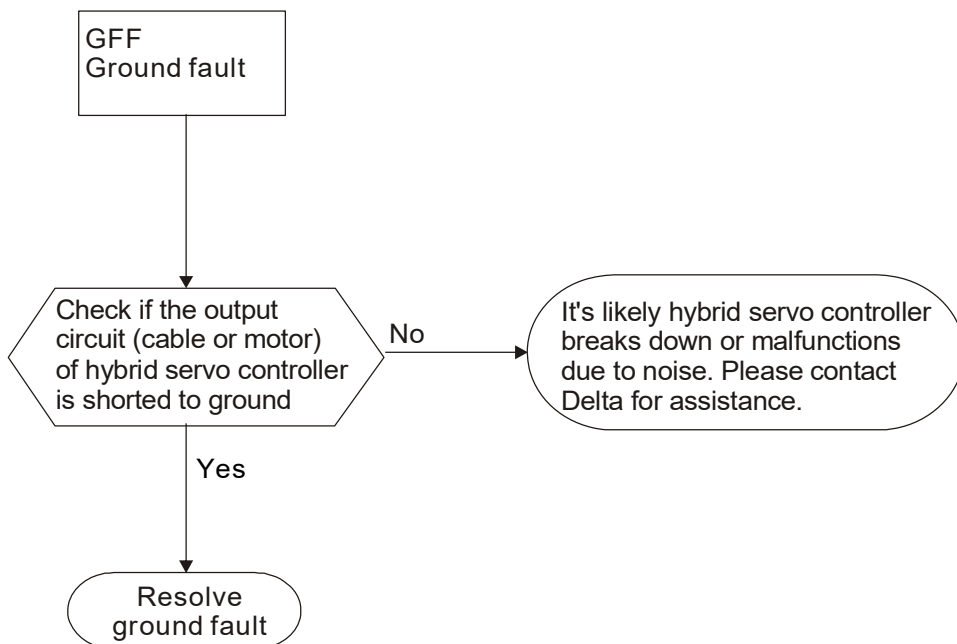
No.	Display	Fault codes defined by Delta (2021H High Byte)	Descriptions
A45	CBtn	002DH	CANopen boot up fault (CBtn)
A46	CPtn	002EH	CANopen protocol format error (CPtn)
A50	SFA <sub>n</sub>	0032H	Reminder of the maintenance of the cooling fan. (S.FA <sub>n</sub> )
A60	LrEL	003CH	Reminder of the remaining lifespan of the soft-start relay. (L.rEL)
A61	LFA <sub>n</sub>	003DH	Reminder of the remaining lifespan of the cooling fan. (L.FA <sub>n</sub> )

## 5-2 Dynamic fault processing and troubleshooting

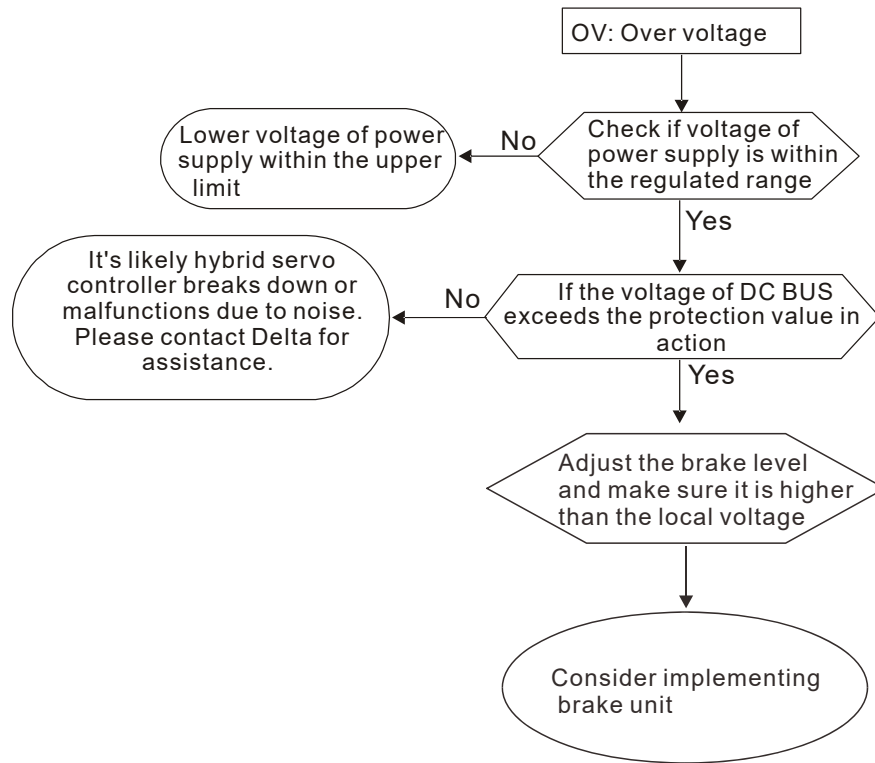
### 5-2-1 Over Current (oc)



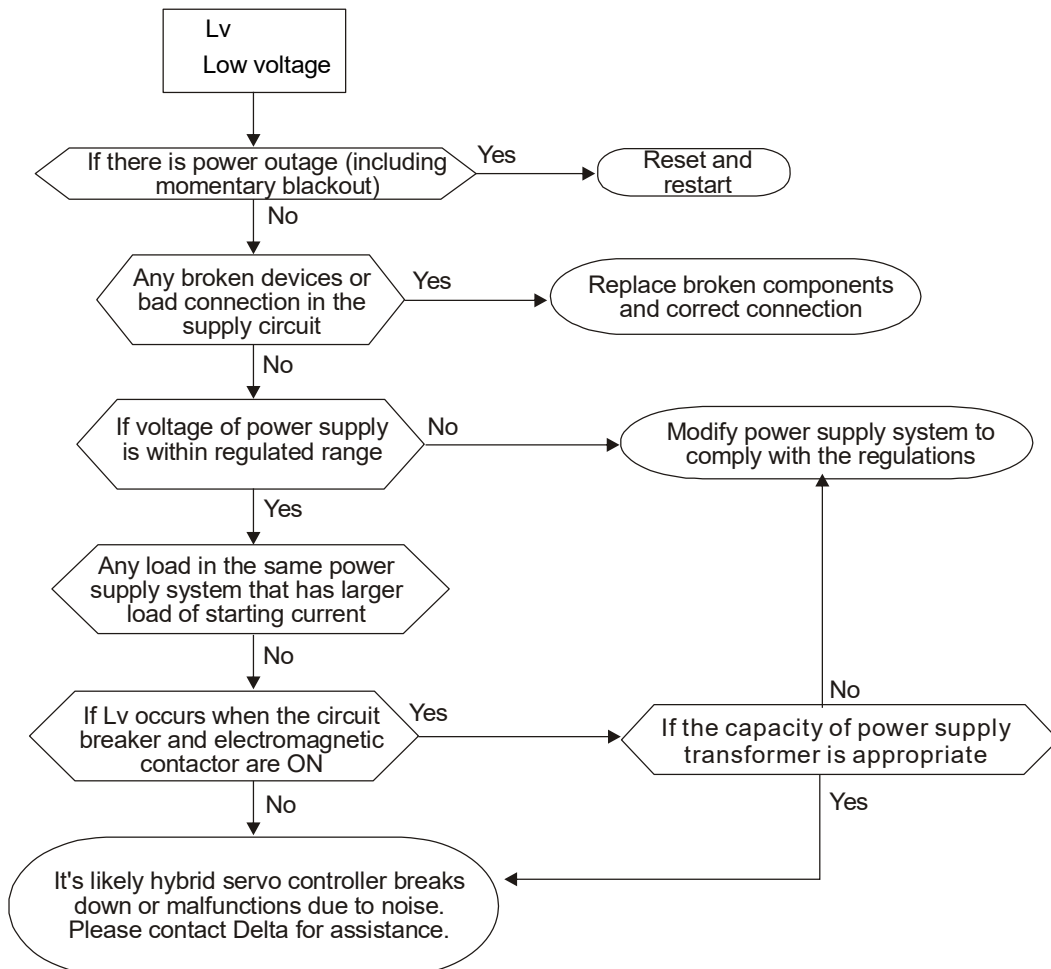
### 5-2-2 Ground Fault (GFF)



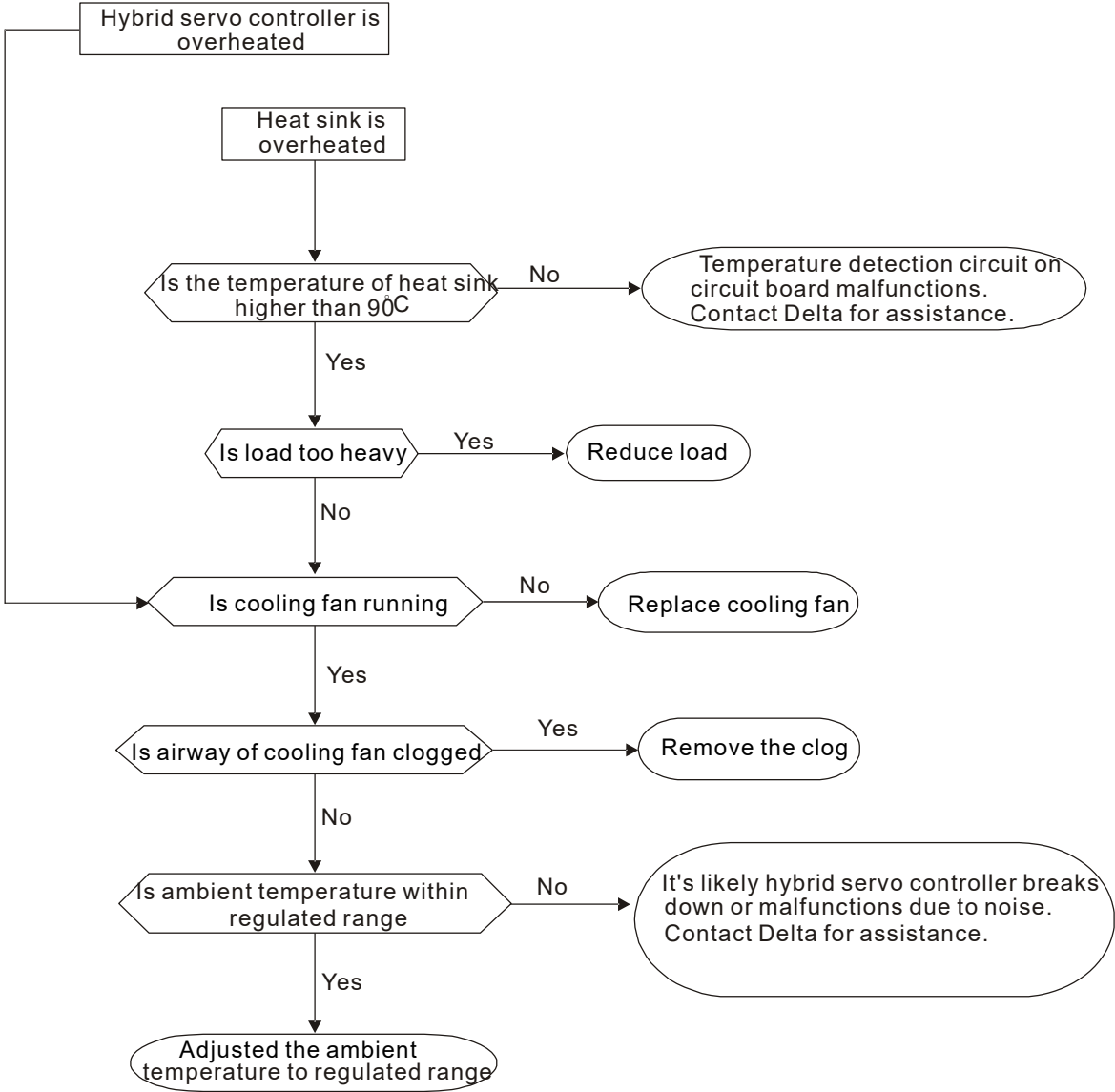
### 5-2-3 Over Voltage (ov)



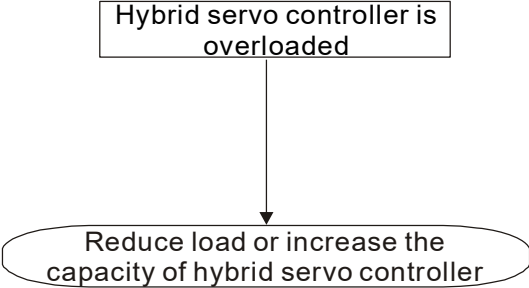
### 5-2-4 Low Voltage (Lv)



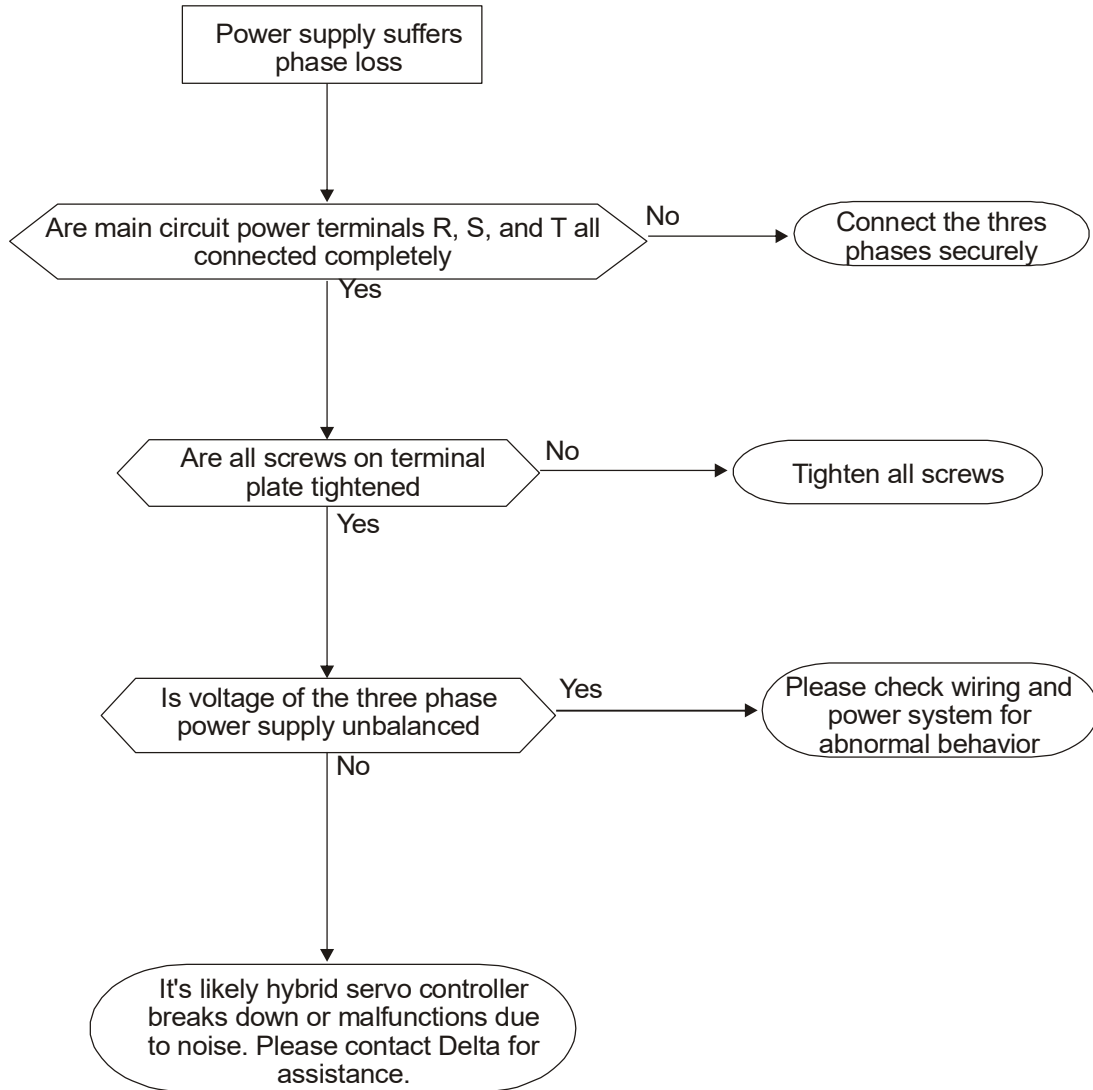
5-2-5 Over Heat (oH1)



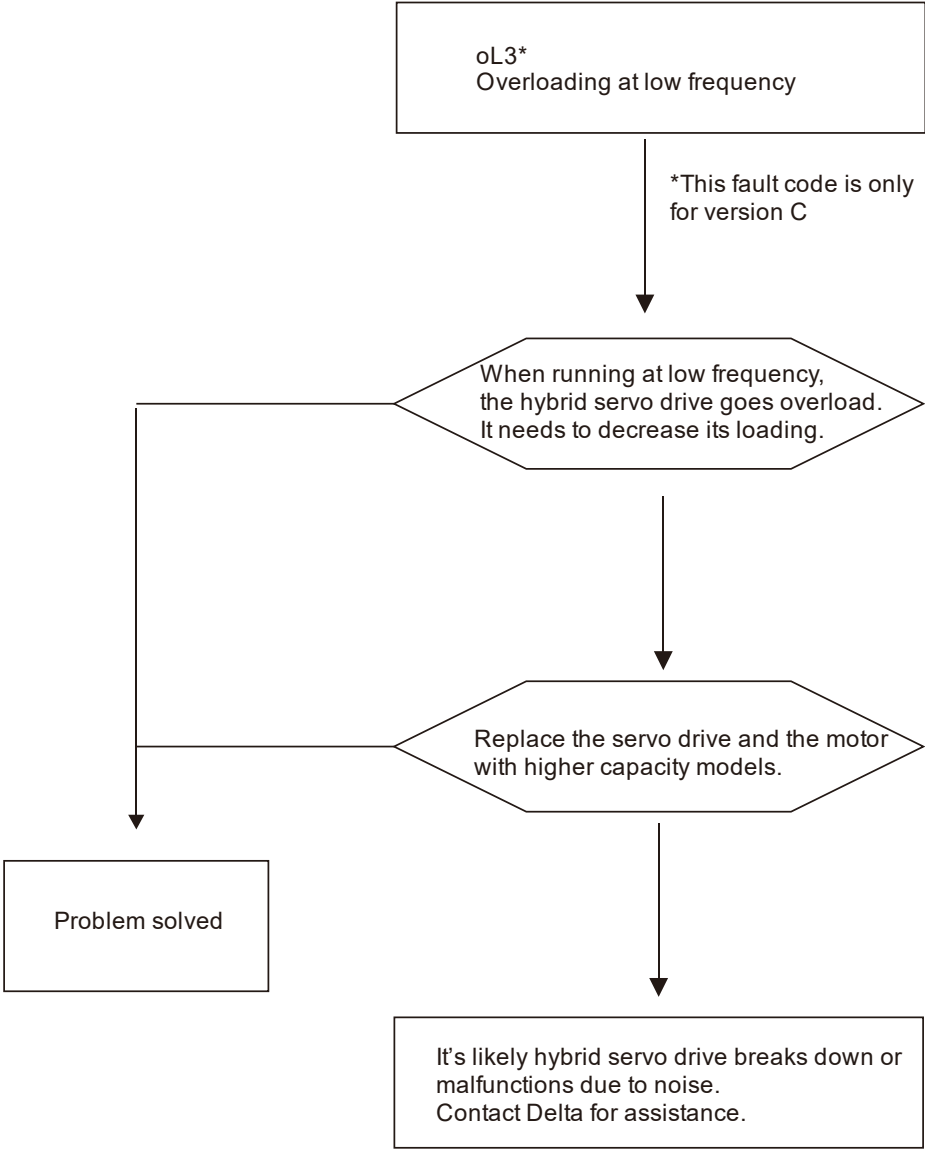
5-2-6 Overload (oL)



### 5-2-7 Phase Loss (PHL)



5-2-8 Hybrid servo drive overloading when running at low frequency (oL3)



### 5-3 Resolution for electromagnetic noise and induction noise

If there exist noise sources around hybrid servo drive, they will affect hybrid servo drive through radiation or the power lines, leading to malfunction of control loop and causing tripping or even damage of hybrid servo drive. One natural solution is to make hybrid servo drive more immune to noise. However, it is not economical and the improvement is limited. It is best to resort to methods that achieve improvements outside hybrid servo drive.

1. Add surge killer on the relay or contact to suppress switching surge between ON/OFF.
2. Shorten the wiring length of the control circuit or serial circuit and separate from the main circuit wiring.
3. Comply with the wiring regulation for those shielded wire and use isolation amplifier for long wire.
4. The ground terminal of hybrid servo drive must be connected to ground by following the associated regulations. It must have its own ground connection and cannot share with electrical welder and other power equipment.
5. Insert noise filter to the input terminal of hybrid servo drive to prevent the noise entering from the power lines.

In a word, three-level solutions for electromagnetic noise are “no product”, “no spread” and “no receive”.

## 5-4 Environment and facilities for installation

The hybrid servo drive is a device for electronic components. Detailed descriptions of the environment suitable for its operation can be found in the specifications. If the listed regulations cannot be followed for any reason, there must be corresponding remedial measures or contingency solutions.

1. To prevent vibration, anti-vibration spacer is the last choice. The vibration tolerance must be within the specification. The vibration effect is equal to the mechanical stress and it cannot occur frequently, continuously or repeatedly to prevent damaging AC motor drive.
2. Store in a clean and dry location free from corrosive fumes/dust to prevent rustiness, poor contact. It also may cause short by low insulation in a humid location. The solution is to use both paint and dust-proof. For particular occasion, use the enclosure with whole-seal structure.
3. The ambient temperature must be just right. If the temperature is too high or too low, the lifetime and action reliability of electronic components will be affected. For semiconductor devices, once the conditions exceed the rated values, consequences associated with “damage” are expected. As a result, in addition to providing cooler and shades that block the direct sunlight that are aimed to achieve required ambient temperature, it is also necessary to perform cleaning and spot check the air filter in the storage tray of hybrid servo drive and the angle of cooling fan. Moreover, the microcomputer may not work at extremely temperature, space heater is needed for machines that are installed and operated in cold regions.
4. Avoid moisture and occurrence of condensation. If the hybrid servo drive is expected to be shut down for an extended period of time, be careful not to let condensation happen once the air conditioning is turned off. It is also preferred that the cooling equipment in the electrical room can also work as a dehumidifier.



# Chapter 6 Suggestions and Error Corrections for Hybrid Servo Drives

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- 6-1 Maintenance and Inspections
- 6-2 Greasy Dirt Problem
- 6-3 Fiber Dust Problem
- 6-4 Erosion Problem
- 6-5 Industrial Dust Problem
- 6-6 Wiring and Installation Problem
- 6-7 Multi-function Input/Output Terminals Problem
- 6-8 Maintenance of Coupling

The hybrid servo drive has a comprehensive fault diagnostic system that includes several different alarms and fault messages. Once a fault is detected, the corresponding protective functions will be activated. The following faults are displayed as shown on the hybrid servo drive digital keypad display. The six most recent faults can be read from the digital keypad or communication.

The hybrid servo drive is made up by numerous components, such as electronic components, including IC, resistor, capacity, transistor, and cooling fan, relay, etc. These components can't be used permanently. They have limited-life even under normal operation. Preventive maintenance is required to operate this hybrid servo drive in its optimal condition, and to ensure a long life.

Check your hybrid servo drive regularly to ensure there are no abnormalities during operation and follows the precautions:



- Wait 5 seconds after a fault has been cleared before performing reset via keypad of input terminal.
- When the power is off after 5 minutes for  $\leq 22\text{kW}$  models and 10 minutes for  $\geq 30\text{kW}$  models, please confirm that the capacitors have fully discharged by measuring the voltage between + and -. The voltage between + and - should be less than  $25V_{DC}$ .
- Only qualified personnel can install, wire and maintain drives. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed.
- Never reassemble internal components or wiring.
- Make sure that installation environment comply with regulations without abnormal noise, vibration and smell.

## 6-1 Maintenance and Inspections

Before the check-up, always turn off the AC input power and remove the cover. Wait at least 10 minutes after all display lamps have gone out, and then confirm that the capacitors have fully discharged by measuring the voltage between DC+ and DC-. The voltage between DC+ and DC- should be less than  $25V_{DC}$ .

### Ambient environment

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check the ambient temperature, humidity, vibration and see if there are any dust, gas, oil or water drops	Visual inspection and measurement with equipment with standard specification	<input type="radio"/>		
If there are any dangerous objects	Visual inspection	<input type="radio"/>		

### Voltage

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Check if the voltage of main circuit and control circuit is correct	Measure with multimeter with standard specification	<input type="radio"/>		

### Digital Keypad Display

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Is the display clear for reading	Visual inspection	<input type="radio"/>		
Any missing characters	Visual inspection	<input type="radio"/>		

### Mechanical parts

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual and aural inspection		<input type="radio"/>	
If there are any loose screws	Tighten the screws		<input type="radio"/>	
If any part is deformed or damaged	Visual inspection		<input type="radio"/>	
If there is any color change by overheating	Visual inspection		<input type="radio"/>	
If there is any dust or dirt	Visual inspection		<input type="radio"/>	
If plastic between couplings are damaged	Visual inspection			<input type="radio"/>

**Main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose or missing screws	Tighten or replace the screw	<input type="radio"/>		
If machine or insulator is deformed, cracked, damaged or with color change due to overheating or ageing	Visual inspection <b>NOTE: Please ignore the color change of copper plate</b>		<input type="radio"/>	
If there is any dust or dirt	Visual inspection		<input type="radio"/>	

**Terminals and wiring of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If the terminal or the plate is color change or deformation due to overheat	Visual inspection		<input type="radio"/>	
If the insulator of wiring is damaged or color change	Visual inspection		<input type="radio"/>	
If there is any damage	Visual inspection	<input type="radio"/>		

**DC capacity of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any leak of liquid, color change, crack or deformation	Visual inspection	<input type="radio"/>		
If the safety valve is not removed? If valve is inflated?	Visual inspection	<input type="radio"/>		
Measure static capacity when required		<input type="radio"/>		

**Resistor of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any peculiar smell or insulator cracks due to overheat	Visual inspection, smell	<input type="radio"/>		
If there is any disconnection	Visual inspection	<input type="radio"/>		
If connection is damaged?	Measure with multimeter with standard specification	<input type="radio"/>		

**Transformer and reactor of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal vibration or peculiar smell	Visual, aural inspection and smell	<input type="radio"/>		

**Magnetic contactor and relay of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws	Visual and aural inspection	<input type="radio"/>		
If the contact works correctly	Visual inspection	<input type="radio"/>		

**Printed circuit board and connector of main circuit**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there are any loose screws and connectors	Tighten the screws and press the connectors firmly in place.		<input type="radio"/>	
If there is any peculiar smell and color change	Visual and smell inspection		<input type="radio"/>	
If there is any crack, damage, deformation or corrosion	Visual inspection		<input type="radio"/>	
If there is any liquid is leaked or deformation in capacity	Visual inspection		<input type="radio"/>	

**Cooling fan of cooling system**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any abnormal sound or vibration	Visual, aural inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly		<input type="radio"/>	
If there is any loose screw	Tighten the screw		<input type="radio"/>	
If there is any color change due to overheat	Change fan		<input type="radio"/>	

**Ventilation channel of cooling system**

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
If there is any obstruction in the heat sink, air intake or air outlet	Visual inspection		○	

 **NOTE**

Please use the neutral cloth for clean and use dust cleaner to remove dust when necessary.

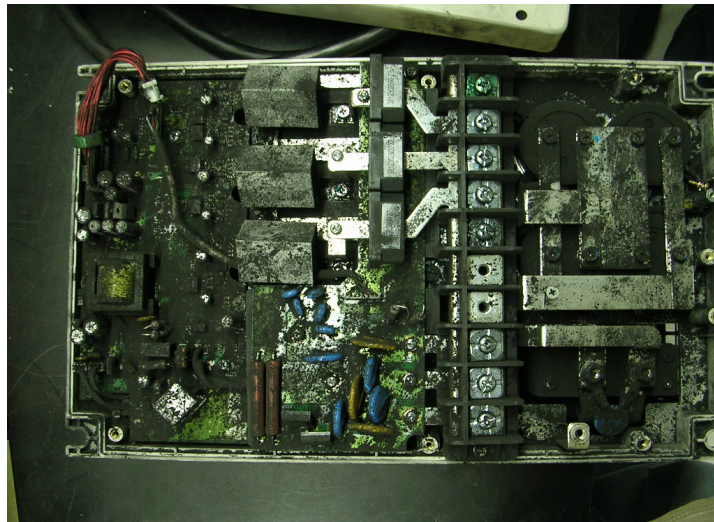
## 6-2 Greasy Dirt Problem

Serious greasy dirt problems generally occur in processing industries such as machine tools, punching machines and so on. Please be aware of the possible damages that greasy oil may cause to your drive:

1. Electronic components that silt up with greasy oil may cause the drive to burn out or even explode.
2. Most greasy dirt contains corrosive substances that may damage the drive.

**Solution:**

Install the hybrid servo drive in a standard cabinet to keep it away from dirt. Clean and remove greasy dirt regularly to prevent damage of the drive.



### 6-3 Fiber Dust Problem

Serious fiber dust problems generally occur in the textile industry. Please be aware of the possible damages that fiber may cause to your drives:

1. Fiber that accumulates or adheres to the fans will lead to poor ventilation and cause overheating problems.
2. Plant environments in the textile industry have higher degrees of humidity that may cause the drive to burn out, become damaged or explode due to wet fiber dust adhering to the devices.

**Solution:**

Install the hybrid servo drive in a standard cabinet to keep it away from fiber dust. Clean and remove fiber dust regularly to prevent damage to the drive.



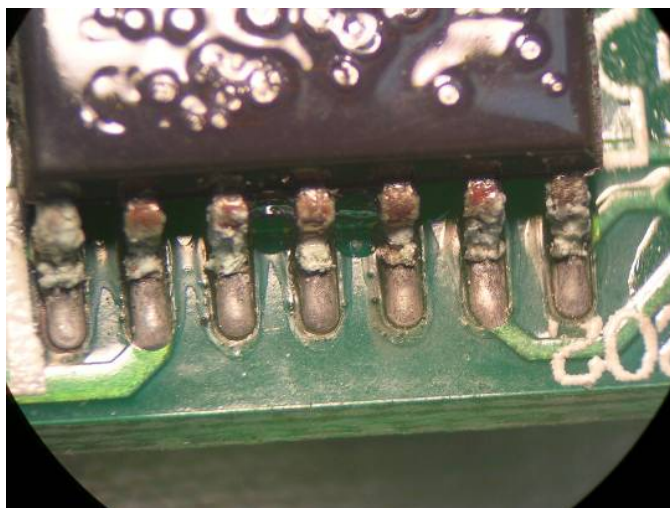
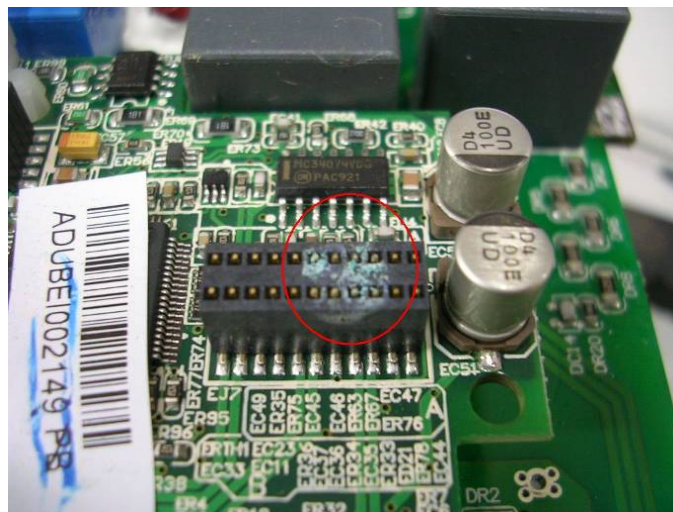
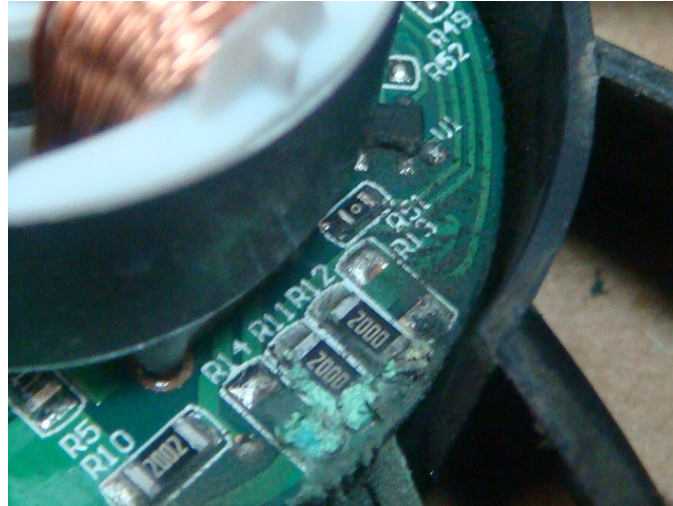
## 6-4 Erosion Problem

Erosion problems may occur if any fluids flow into the drives. Please be aware of the damages that erosion may cause to your drive.

1. Erosion of internal components may cause the drive to malfunction and possibility to explode.

**Solution:**

Install the hybrid servo drive in a standard cabinet to keep it away from fluids. Clean the drive regularly to prevent erosion.





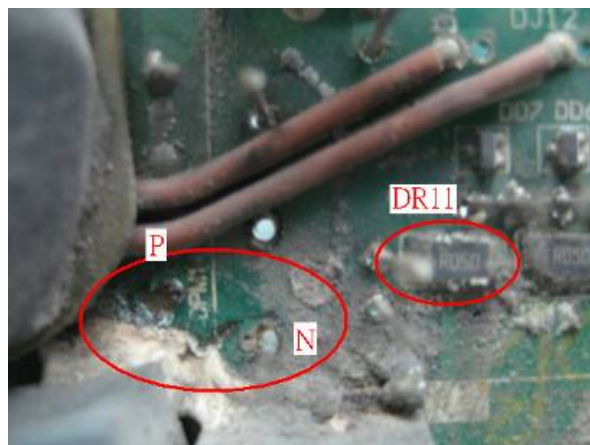
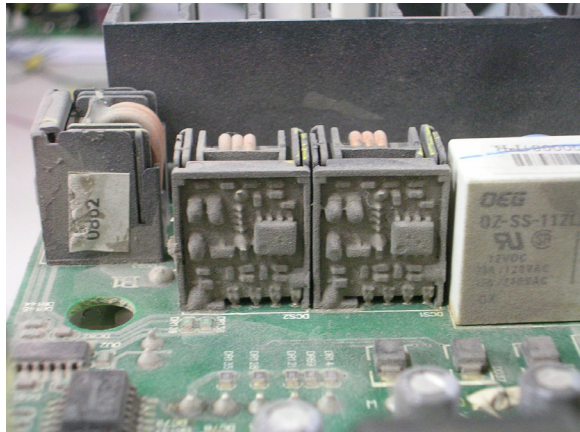
## 6-5 Industrial Dust Problem

Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damage that industrial dust may cause to your drives:

1. Dust accumulating on electronic components may cause overheating problem and shorten the service life of the drive.
2. Conductive dust may damage the circuit board and may even cause the drive to explode.

### **Solution:**

Install the hybrid servo drive in a standard cabinet and cover the drive with a dust cover. Clean the cabinet and ventilation hole regularly for good ventilation.

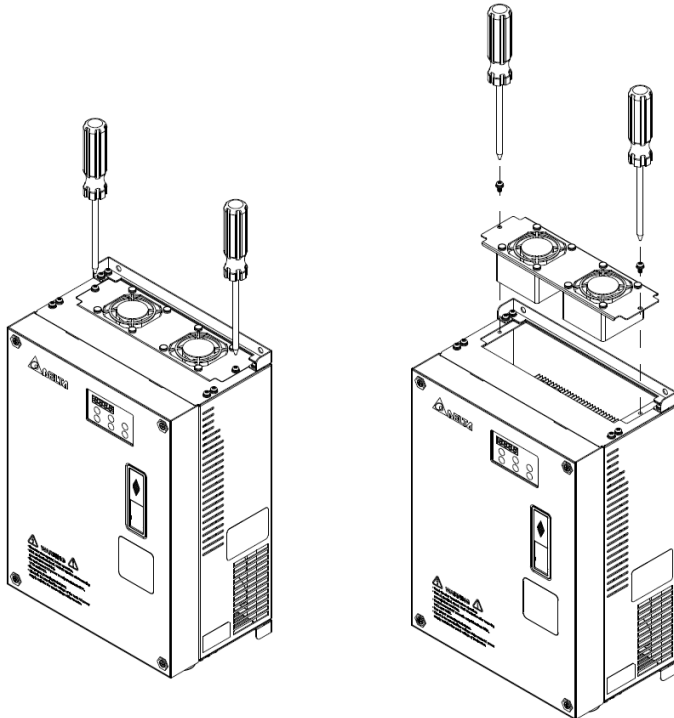


Check Items	Methods and Criterion	Troubleshooting
Visual check on the overall appearance	<ul style="list-style-type: none"> <li>Any accumulation of dirt and dust?</li> </ul>	<ol style="list-style-type: none"> <li>Shut down the servo drive, wait for a certain time. Make sure that the power indicator is off before you go to the next step. (<math>\leq 22\text{kW}</math>: wait for 5 min after shut down; <math>\geq 30\text{kW}</math>: wait for 10 min after shut down)</li> <li>Turn on a vacuum cleaner to remove the dust.</li> </ol>
Ventilation Channel	<ul style="list-style-type: none"> <li>Any obstruction in the heat sink, air intake or air outlet?</li> <li>Any accumulation of dust on the cooling fan?</li> <li>Is the cooling fan damaged?</li> </ul>	<ol style="list-style-type: none"> <li>Shut down the servo drive, wait for a certain time. Make sure that the power indicator is off before you go to the next step. (<math>\leq 22\text{kW}</math>: wait for 5 min after shut down; <math>\geq 30\text{kW}</math>: wait for 10 min after shut down)</li> <li>Follow the instruction in this manual to remove and clean the cooling fan.</li> <li>Turn on a vacuum cleaner to clean the dust in the heat sink. °</li> </ol> <ul style="list-style-type: none"> <li>If the cooling fan doesn't run at all, replace it with a new one.</li> <li>Clean the ventilation channel periodically to avoid accumulation of dirt and dust.</li> </ul>

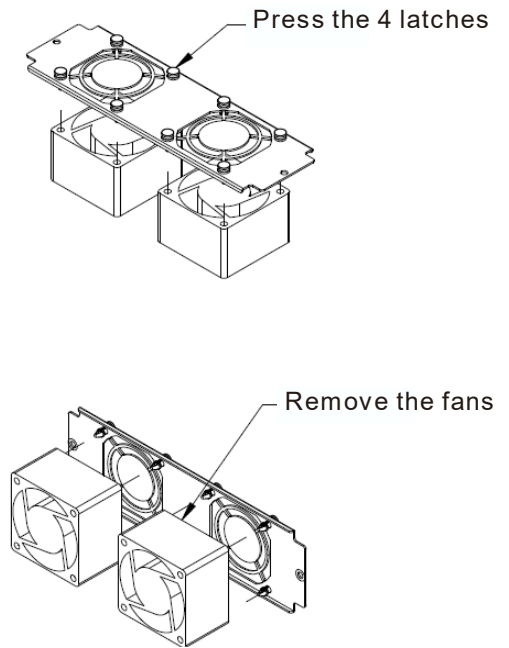
● Install and Remove Cooling Fans

Frame-C & Frame-D

- Use a phillips-head screw driver to loose the two screws on the two sides of the cooling fan.
- Press the latch to disconnect the fan power. Pay attention to the direction of the latch during installation. Then remove the fan cover.



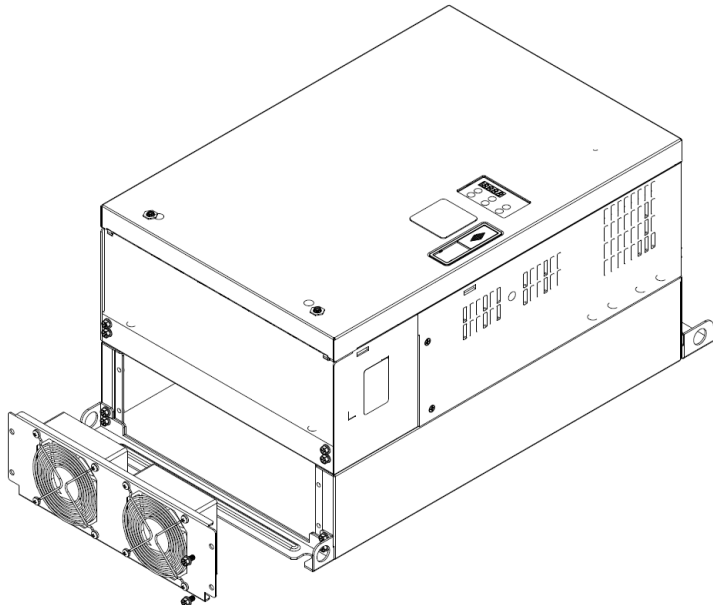
- Press the 4 latches on the fan cover, then you can remove the fan. Note that you don't need to pull up completely the latches to remove the fans. Just press gently.



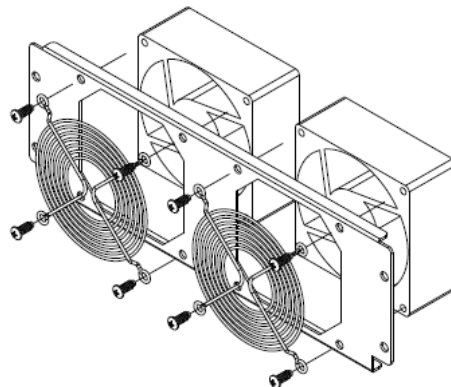
- Have the labels on the cooling fans facing outside of the servo drive when installing the cooling fans. Screw torque force: 10~12kgf-cm(8.7~10.4lb-in)

## Frame-E

- Use a philillips-head screw driver to loose the 4 screws on the two sides of the cooling fan.
- Press the latch to disconnect the fan power. Pay attention to the direction of the latch during installation. Then remove the fan cover.



- Loosen the 4 screws around each fan (8 screws in total), then remove the protective cover and the fan.



- Have the labels on the cooling fans facing inside of the servo drive when installing the cooling fans. Screw torque force: 10~12kgf-cm (8.7~10.4lb-in)

 **NOTE**

- Do follow the fan installing/ removing instructions in this manual. Make sure the air outlet is facing the right direction. If air outlet is facing the wrong direction, the servo drive might be damaged.
- You can see arrow symbols indicating the air blowing direction on the side of the cooling fans.

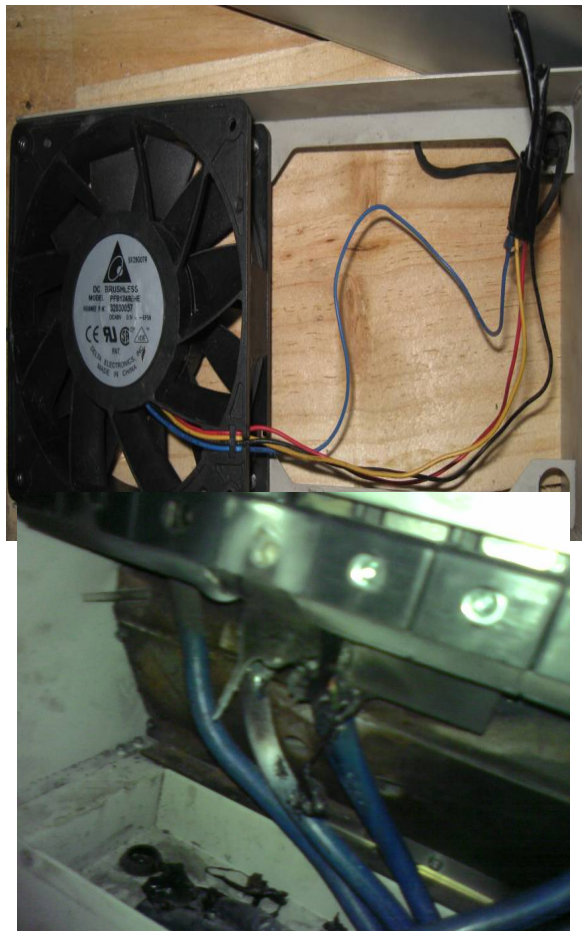
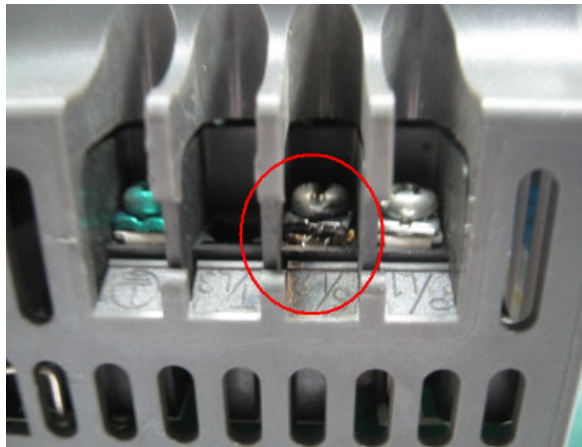
## 6-6 Wiring and Installation Problem

When wiring the drive, the most common problem is wrong wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your drives:

1. Screws are not fully fastened. Occurrence of sparks as impedance increases.
2. If a customer has opened the drive and modified the internal circuit board, the internal components may have been damaged.

### Solution:

Ensure all screws are fastened when installing the hybrid servo drive. If the hybrid servo drive functions abnormally, send it back to the repair station. DO NOT try to reassemble the internal components or wire.



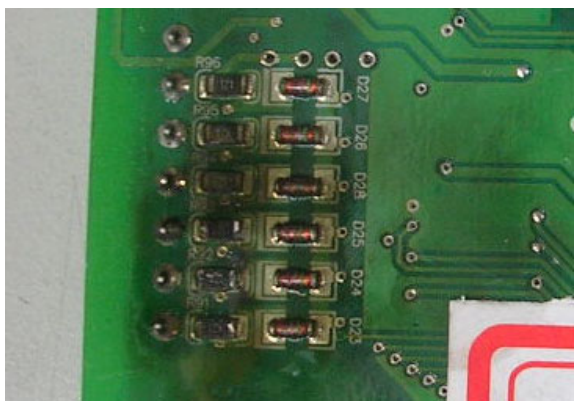
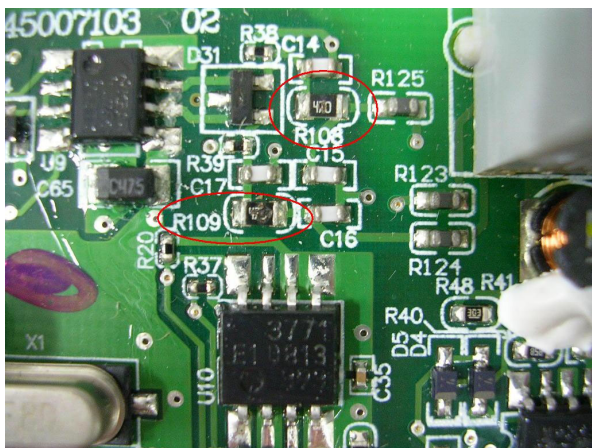
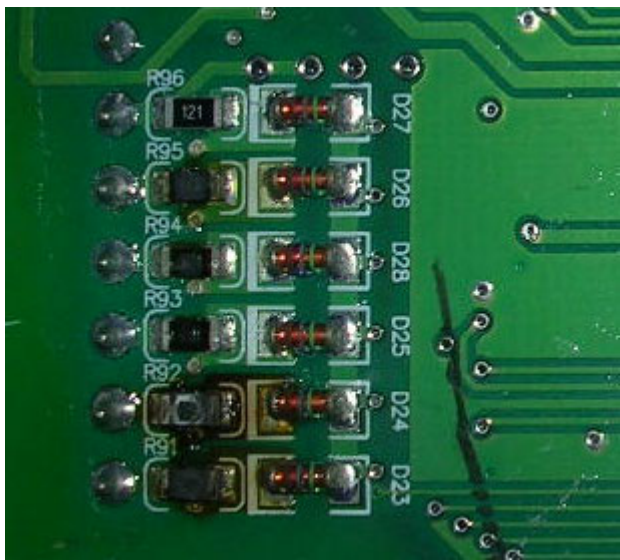
### 6-7 Multi-function Input/Output Terminals Problem

Multi-function input/output terminal errors are generally caused by over usage of terminals and not following specifications. Please be aware of the possible damages that errors on multi-function input/output terminals may cause to your drives:

1. Input/output circuit may burn out when the terminal usage exceeds its limit.

**Solution:**

Refer to the user manual for multi-function input output terminals usage and follow the specified voltage and current. DO NOT exceed the specification limits.



## 6-8 Maintenance of Coupling

It is recommended that you visually check the condition of the coupling at least once a year, and pay special attention to the condition of the wye junction on the couplings.

Since the passive bearing and the active bearing of the mechanical bearings goes up and down while the hybrid servo drive runs, verify if the couplings are aligned and realign the couplings if necessary.

Verify the parts of the couplings periodically such as if the metal parts on both sides and the middle plastic sleeve are deformed or damaged. Also visually verify if the screws are loose.

# Appendix A: Optional Accessories

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- A-1 Braking Resistor
- A-2 Non-fuse Circuit Breaker
- A-3 Fuse
- A-4 Reactor
- A-5 Digital Keypad KPV-CC01
- A-6 EMI Filter
- A-7 Speed Feedback Encoder
- A-8 Wall-Mounted Installation



- This hybrid servo drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer.
- The accessories produced by Delta are only for using with Delta hybrid servo drive. Do NOT use with other drive to prevent damage.

## A-1 Braking Resistor

### VJ-A 230 model:

Applicable Motor		125% Braking Torque 10%ED *1				Maximum Braking Torque			
Model	Braking Torque (kg-m)	Braking Unit	Braking Resistor Models *2	Effective Braking Resistance of Each Drive	Total Braking Current (A)	Min. Braking Resistance (Ω)	Maximum Total Braking Current (A)	Max. Peak Power (KW)	
		VFDB *3							
VFD110VL23A-J	7.4	-	BR1K5W013*1	1500W13Ω	29	9.5	40.0	15.2	
VFD150VL23A-J	10.2	-	BR1K0W4P3*2	2 in serial	2000W8.6Ω	44	8.3	46.0	17.5
VFD185VL23A-J	12.2	-	BR1K2W3P9*2	2 in serial	2400W7.8Ω	49	5.8	66.0	25.1
VFD220VL23A-J	14.9	-	BR1K5W3P3*2	2 in serial	3000W6.6Ω	58	5.8	66.0	25.1

\*1 Calculation for 125% brake torque: (kW)\*125%\*0.8; where 0.8 is motor efficiency.

Because there is a resistor limit of power consumption, the longest operation time for 10% ED is 10sec (on: 10sec/ off: 90sec).

\*2 For heat dissipation, a resistor of 400W or lower should be fixed to the frame and maintain the surface temperature below 250°C; a resistor of 1000W and above should maintain the surface temperature below 350°C.

\*3 See user guides of braking units for more information.

### VJ-C Air Cooled 230V and 460V models:

Applicable Motor			125% Braking Torque 10%ED *1				Maximum Braking Torque			
HP	KW	Model	Braking Resistor Models *2	Quantity	Parallel or Serial Connection	Effective Braking Resistance of Each Drive	Total Braking Current (A)	Min. Braking Resistance	Maximum Total Braking Current (A)	Max. Peak Power (KW)
40	30.0	VFD300VL23C-J	BR1K0W5P1	4	2 in parallel, 2 in serial*3	4000W 5.1Ω	75	4.8	80	30.4
50	37.0	VFD370VL23C-J	BR1K2W3P9	4	2 in parallel, 2 in serial	4800W 3.9Ω	97	3.2	120	45.6
15	11.0	VFD110VL43C-J	BR1K5W043	1		1500W 43Ω	17.6	30.8	24.7	18.8
20	15.0	VFD150VL43C-J	BR1K0W016	2	2 in serial	2000W 32Ω	24	25.0	30.4	23.1
25	18.5	VFD185VL43C-J	BR1K5W013	2	2 in serial	3000W 26Ω	29	20.8	36.5	27.7
30	22.0	VFD220VL43C-J	BR1K5W013	2	2 in serial	3000W 26Ω	29	19.0	40	30.4
40	30.0	VFD300VL43C-J	BR1K0W5P1	4	4 in serial	4000W 20.4Ω	37	19.0	40	30.4

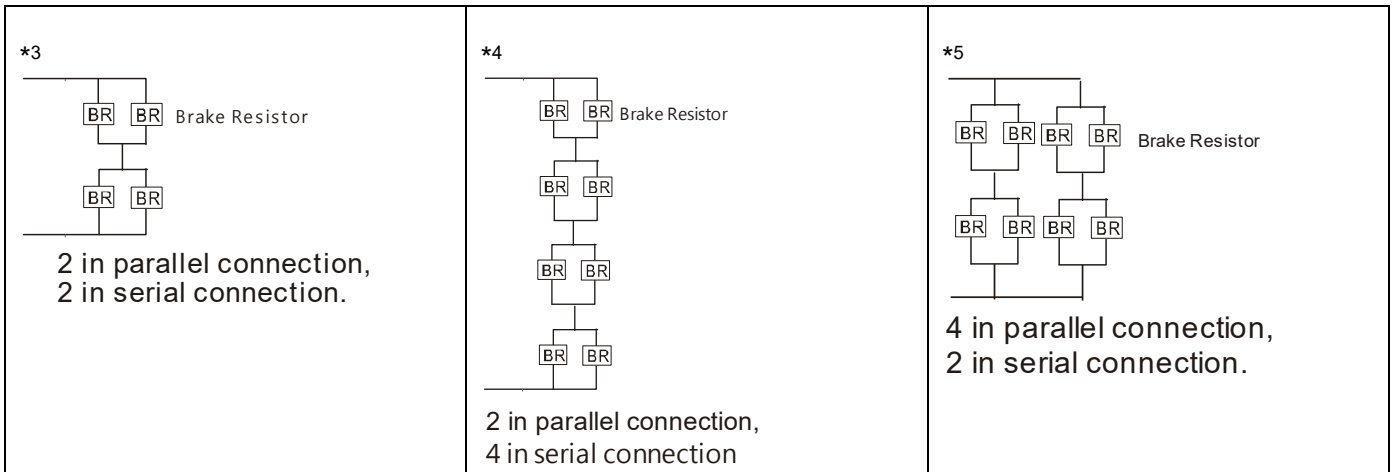


50	37.0	VFD370VL43C-J	BR1K2W015	4	2 in parallel, 2 in serial	4800W 15Ω	50	14.0	54	40.8
60	45.0	VFD450VL43C-J	BR1K5W013	4	2 in parallel, 2 in serial	6000W 13Ω	59	12.7	60	45.7
75	55.0	VFD550VL43C-J	BR1K0W5P1	8	2 in parallel, 4 in serial *4	8000W 10.2Ω	76	9.5	80	60.8
100	75.0	VFD750VL43C-J	BR1K2W015	8	4 in parallel, 2 in serial *5	9600W 7.5Ω	100	6.3	120	90.7

\*1 Calculation for 125% brake torque: (kW)\*125%\*0.8; where 0.8 is motor efficiency.

Because there is a resistor limit of power consumption, the longest operation time for 10% ED is 10sec (on: 10sec/ off: 90sec).

\*2 For heat dissipation, a resistor of 400W or lower should be fixed to the frame and maintain the surface temperature below 250°C; a resistor of 1000W and above should maintain the surface temperature below 350°C.

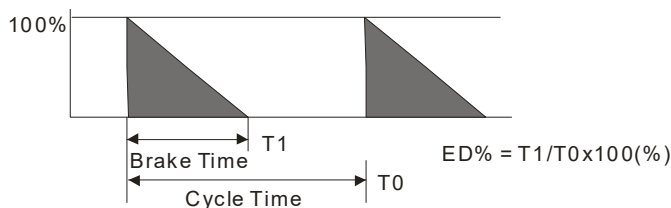


**NOTE**

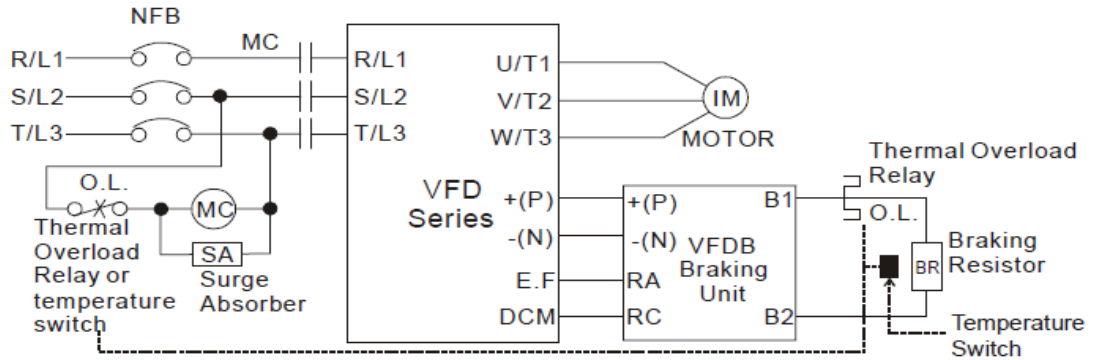
1. Definition for Brake Usage ED%:

Explanation: The definition of the brake usage ED (%) is for assurance of enough time for the brake unit and brake resistor to dissipate away heat generated by braking. When the brake resistor heats up, the resistance would increase with temperature, and brake torque would decrease accordingly. Recommended cycle time is one minute.

Definition of Brake Usage ED%



For safety concern, install an overload relay (O.L.) between the brake unit and the brake resistor in conjunction with the magnetic contactor (MC) prior to the drive for abnormal protection. The purpose of installing the thermal overload relay is to protect the brake resistor from damage due to frequent brake, or due to brake unit keeping operating resulted from unusual high input voltage. Under such circumstance, just turn off the power to prevent damaging the brake resistor.



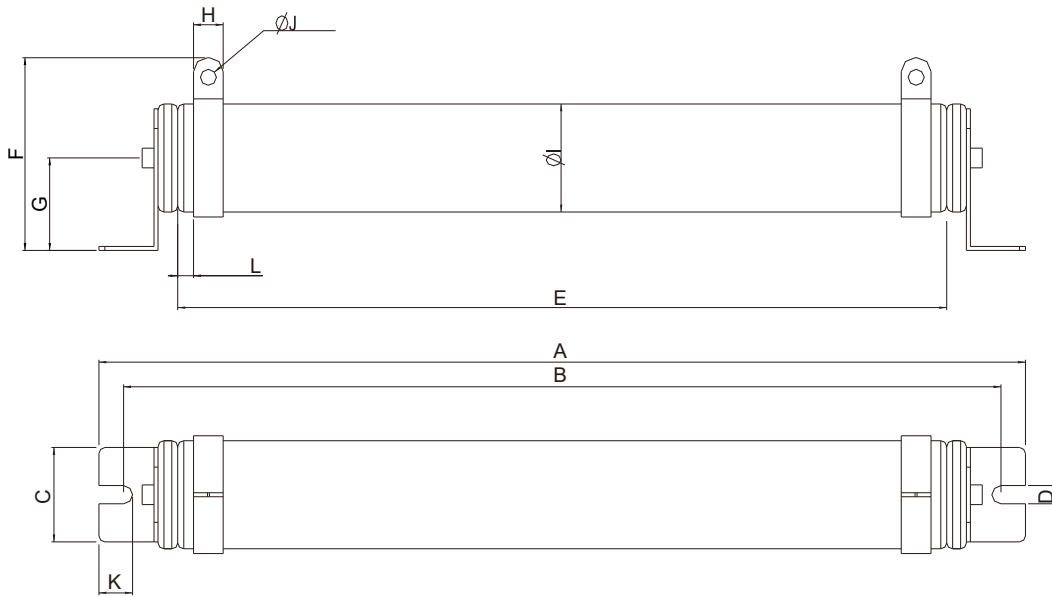
Note1: When using the AC drive with DC reactor, please refer to wiring diagram in the AC drive user manual for the wiring of terminal +(P) of Braking unit.

Note2: **Do NOT** wire terminal -(N) to the neutral point of power system.

2. If damage to the drive or other equipment is due to the fact that the brake resistors and brake modules in use are not provided by Delta, the warranty will be void.
3. Take into consideration the safety of the environment when installing the brake resistors. If the minimum resistance value is to be utilized, consult local dealers for the calculation of Watt figures.
4. When using more than 2 brake units, equivalent resistor value of parallel brake unit cannot be less than the value in the column "Minimum Equivalent Resistor Value for Each Hybrid Servo Drive" (the right-most column in the table). Please read the wiring information in the user manual of brake unit thoroughly prior to operation.
5. This chart is for normal usage; if the hybrid servo drive is applied for frequent braking, it is suggested to enlarge 2~3 times of the Watts.
6. The position to install brake units needs to be at least 15cm away from the hybrid servo drive.

7. Appearance and specification of brake resistors

7.1 Wirewound resistor: for 1000W (included) and above. Refer to the following image for its appearance. See table below for specification comparison.

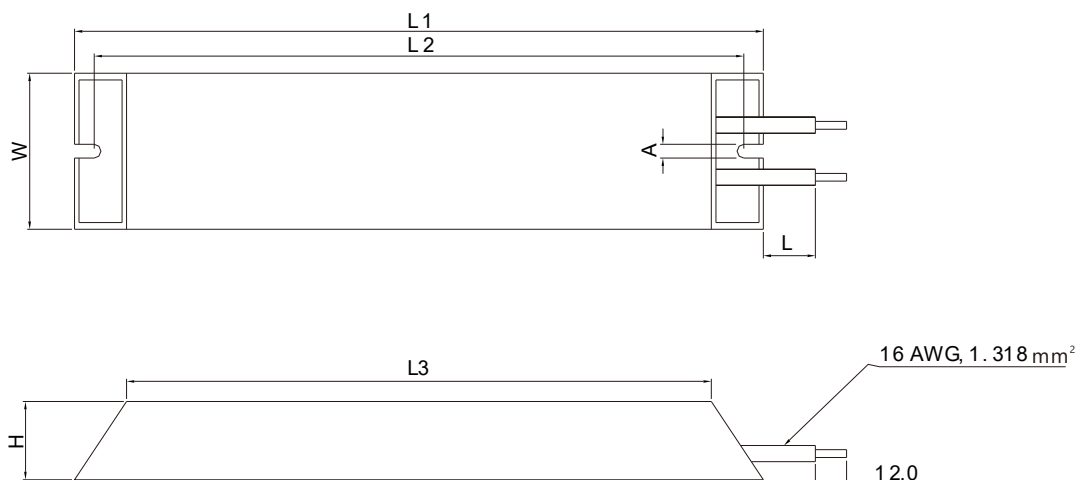


7.2 Brake Resistors' model name and comparison

Unit: mm

Model	A	B	C	D	E	F	G	H	ØI	ØJ	K	L
BR1K0W5P1												
BR1K2W015	470 ± 10	445 ± 5	48 ± 0.2	9.1 ± 0.1	390 ± 3	98 ± 5	47 ± 5	15 ± 1	55 ± 5	8.1 ± 0.1	21 ± 0.2	8 ± 1
BR1K5W013												

7.3 Aluminum housed resistor: for below 1000W. Refer to the following image for its appearance. See table below for specification comparison.



7.4 Brake Resistors' model name and comparison

Unit: mm

Model	L1	L2	L3	W	H	A	L
BR080W200	140 ± 2	125 ± 2	100 ± 1	40 ± 0.5	20 ± 0.5	5.3 ± 0,5	200 ± 20
BR080W750							
BR200W091	165 ± 2	150 ± 2	125 ± 1	60 ± 0.5	30 ± 0.5		
BR200W360							
BR300W070	215 ± 2	200 ± 2	175 ± 1	60 ± 0.5	30 ± 0.5		
BR300W250							
BR400W040	265 ± 2	250 ± 2	225 ± 1	60 ± 0.5	30 ± 0.5		
BR400W150							

## A-2 Non-Fuse Circuit Breaker

### VJ-C series:

Comply with the UL standard: Per UL 508, paragraph 45.8.4, part a,

The rated current of the breaker shall be 2 - 4 times of the maximum rated input current of hybrid servo drive.

### Air Cooled:

Model	Recommended Current (A)
VFD300VL23C-J	250
VFD370VL23C-J	300
VFD110VL43C-J	50
VFD150VL43C-J	60
VFD185VL43C-J	80
VFD220VL43C-J	100
VFD300VL43C-J	125
VFD370VL43C-J	150
VFD450VL43C-J	200
VFD550VL43C-J	225
VFD750VL43C-J	300

## A-3 Fuse

- ☑ Fuse specifications smaller than the table below are allowed.
- ☑ For installation in the United States, branch circuit protection must be provided in accordance with the National Electrical Code (NEC) and any applicable local codes. Use UL classified fuses to fulfill this requirement.
- ☑ For installation in Canada, branch circuit protection must be provided in accordance with Canadian Electrical Code and any applicable provincial codes. Use UL classified fuses to fulfill this requirement.

### Air Cooled

230V model	Input Current (A)	Line Fuse	
		Input Current (A)	Bussmann P/N
VFD300VL23C-J	120	250	JJS-250
VFD370VL23C-J	146	300	JJS-300

### Air Cooled:

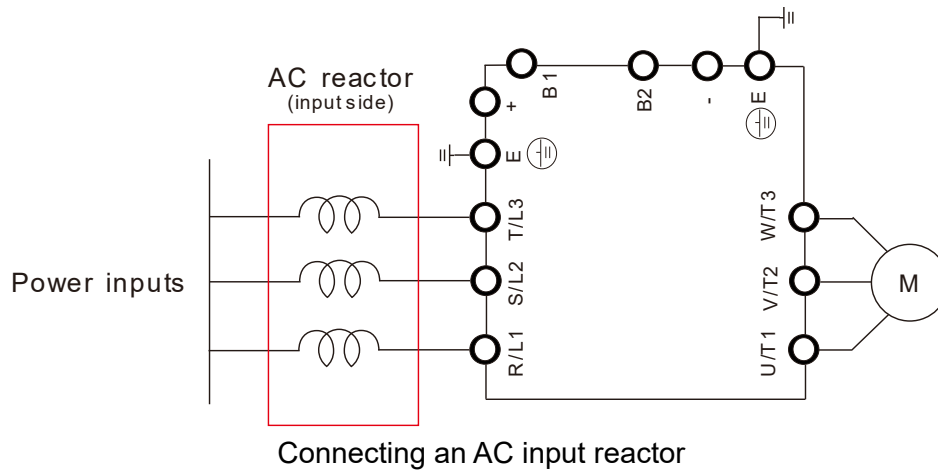
460V model	Input Current (A)	Line Fuse	
		Input (A)	Bussmann P/N
VFD110VL43C-J	24	50	JJS-50
VFD150VL43C-J	30	60	JJS-60
VFD185VL43C-J	37	80	JJS-80
VFD220VL43C-J	47	100	JJS-100
VFD300VL43C-J	60	125	JJS-125
VFD370VL43C-J	73	150	JJS-150
VFD450VL43C-J	91	200	JJS-200
VFD550VL43C-J	110	225	JJS-225
VFD750VL43C-J	150	300	JJS-300

## A-4 Reactor

Installing an AC reactor on the input side of a hybrid servo drive can increase line impedance, improve the power factor, reduce input current, and reduce interference generated from the hybrid servo drive. It also reduces momentary voltage surges or abnormal current spikes. For example, when the main power capacity is higher than 500 kVA, or when using a switching capacitor bank, momentary voltage and current spikes may damage the hybrid servo drive's internal circuit. An AC reactor on the input side of the hybrid servo drive protects it by suppressing surges.

Installation:

As shown in the image below, an AC input reactor is installed between the mains power inputs and the R S T input terminals on the hybrid servo drive.



**A-4-1 AC Reactor**

**Specifications: AC Input Reactor**

Air Cooled

200V~230V/ 50~60Hz model VFDXXXVL23C-J series AC Input Reactor							
Model	KW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	3% Input Reactor: Delta Part #
300	30	40	120	240	0.12	0.2	DR105AP106
370	37	50	146	292	0.087	0.145	DR146AP087

380V~460V/ 50~60Hz model VFDXXXVL43C-J series AC Input Reactor							
Model	KW	HP	Rated Current (Arms)	Saturation Current (Arms)	3% Reactor (mH)	5% Reactor (mH)	3% Input Reactor: Delta Part#
110	11	15	21	42	1.01	1.683	DR024AP881
150	15	20	27	54	0.76	1.267	DR032AP660
185	18.5	25	34	68	0.639	1.066	DR038AP639
220	22	30	41	82	0.541	0.9	DR045AP541
300	30	40	60	120	0.405	0.675	DR060AP405
370	37	50	73	146	0.334	0.555	DR073AP334
450	45	60	91	182	0.267	0.445	DR091AP267
550	55	75	110	220	0.221	0.368	DR110AP221
750	75	100	150	300	0.162	0.27	DR150AP162



## Specifications: AC Output Reactor

230V, 50/60Hz, Three-Phase

kW	HP	Rated Current of Reactor	Maximum Continuous Current	Inductance ( mH )	
				3% Impedance	5% Impedance
30	40	130	195	0.1	0.2
37	50	160	240	0.075	0.15

460V, 50/60Hz, Three-Phase

kW	HP	Rated Current of Reactor	Maximum Continuous Current	Inductance ( mH )	
				3% Impedance	5% Impedance
15	20	35	52.5	0.8	1.2
18.5	25	45	67.5	0.7	1.2
22	30	45	67.5	0.7	1.2
30	40	80	120	0.4	0.7
37	50	80	120	0.4	0.7
45	60	100	150	0.3	0.45
55	75	130	195	0.2	0.3
75	100	160	240	0.15	0.23

### Application of AC Reactor

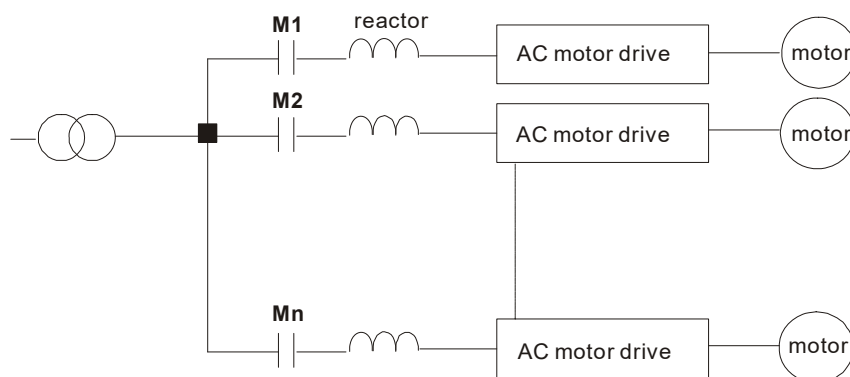
Connected in input circuit

#### Application 1

When more than one hybrid drive is connected to the same mains power and one of them is ON during operation.

Problem: When applying power to one of the hybrid drive, the charge current of the capacitors may cause voltage dip. The hybrid drive may be damaged when over current occurs during operation.

Correct wiring:

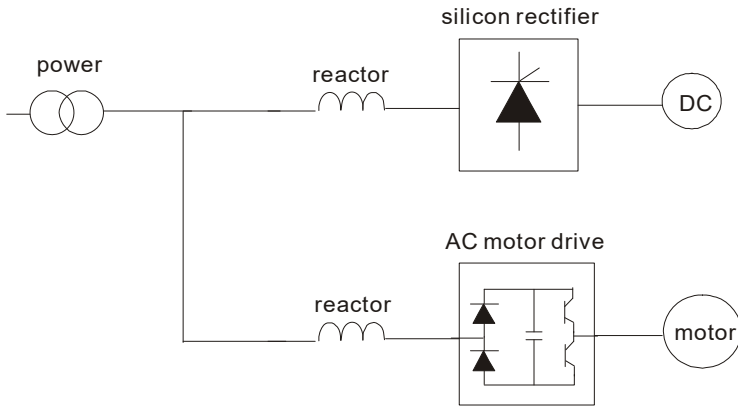


### Application 2

Silicon rectifier and hybrid drive are connected to the same power.

Problem: Switching spikes will be generated when the silicon rectifier switches ON/OFF. These spikes may damage the mains circuit.

Correct wiring:

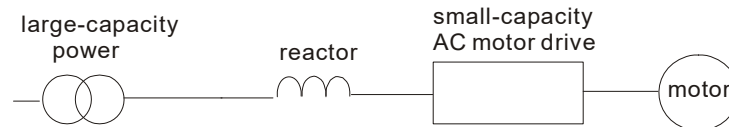


### Application 3

When the power supply capacity exceeds 10 times of the inverter capacity.

Problem: When the mains power capacity is too large, line impedance will be small and the charge current will be too high. This may damage hybrid drive due to higher rectifier temperature.

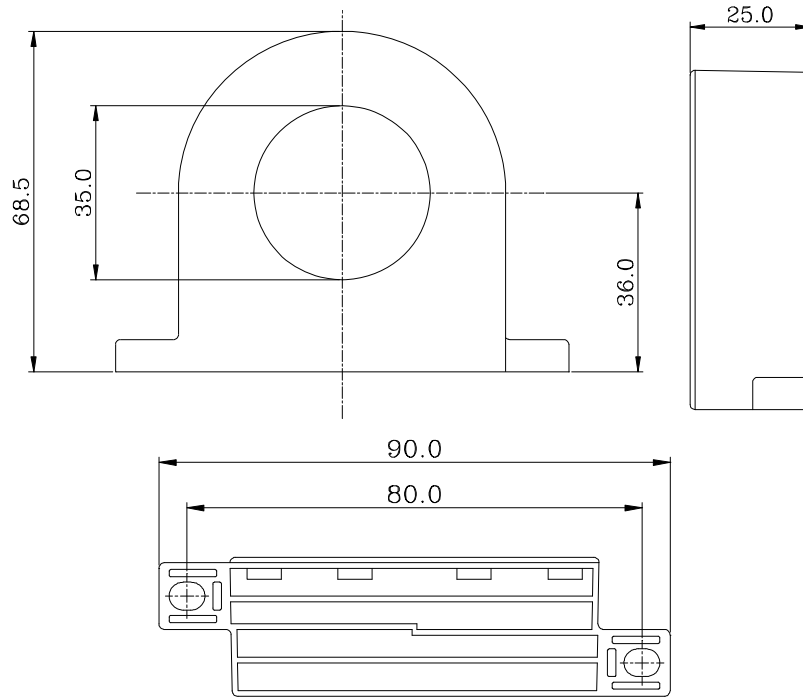
Correct wiring



### A-4-2 Zero Phase Reactor

RF220X00A

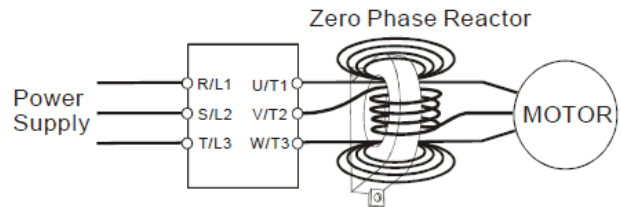
Unit: mm (inch)



Cable type (Note)	Recommended Wire Size (mm <sup>2</sup> )			Qty.	Wiring Method
	AWG	mm <sup>2</sup>	Nominal (mm <sup>2</sup> )		
Single-core	≤10	≤5.3	≤5.5	1	Figure A
	≤2	≤33.6	≤38	3	Figure B
Three-core	≤12	≤3.3	≤3.5	1	Figure A
	≤1	≤42.4	≤50	3	Figure B

**Figure A**

Please wind each wire 4 times around the core. The reactor must be placed at inverter output as close as possible.



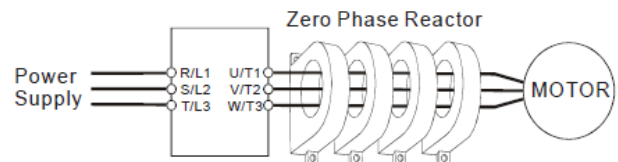
**NOTE**

600V insulated power line.

1. The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted i.e. the cable must fit through the center hole of zero phase reactors.
2. Only the phase conductors should pass through, not the earth core or screen.
3. When long motor output cables are used an output zero phase reactor may be required to reduce radiated emissions from the cable.

**Figure B**

Please put all wires through 4 cores in series without winding.



## A-5 Digital Keypad KPC-CC01

The VFD-VJ series products use the digital keypad KPC-CC01 as the display unit. For the actual keypad appearance, please refer to the actual product. This picture shows the schematic diagram for illustrative purposes only.

### KPC-CC01 Digital Keypad:







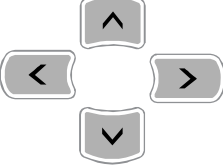





**Communication Interface**  
RJ-45 (socket) , RS-485(Interface)




#### Installation

- ☑ **Embedded type and can be put flat on the surface of the control box. The front cover is waterproof.**
- ☑ **Buy a MKC-KPPK model to do wall mounting or embedded mounting. Its protection level is IP66.**
- ☑ **The maximum RJ45 extension lead is 5 m (16ft)**

## Descriptions of Keypad Functions

Key	Descriptions
	<p>Start Operation Key</p> <ol style="list-style-type: none"> <li>1. It is only valid when the source of operation command is from the keypad.</li> <li>2. It can operate the hybrid servo drive by the function setting and the RUN LED will be on.</li> <li>3. It can be pressed repeatedly during stop.</li> <li>4. When enabling “HAND” mode, it is only valid when the source of operation command is from the keypad.</li> </ol>
	<p>Stop Command Key. This key has the highest processing priority in any situation.</p> <ol style="list-style-type: none"> <li>1. When it receives STOP command, no matter the hybrid servo drive is in operation or stop status, the hybrid servo drive needs to execute “STOP” command.</li> <li>2. The RESET key can be used to reset the drive after the fault occurs. For those faults that cannot be reset by the RESET key, see the fault records after pressing MENU key for details.</li> </ol>
	<p>Operation Direction Key</p> <ol style="list-style-type: none"> <li>1. This key is only control the operation direction NOT for activate the drive. FWD: forward, REV: reverse.</li> <li>2. Refer to the LED descriptions for more details.</li> </ol>
	<p>ENTER Key</p> <p>Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command.</p>
	<p>ESC Key</p> <p>ESC key function is to leave current menu and return to the last menu. It is also functioned as a return key in the sub-menu.</p>
	<p>Press menu to return to main menu.</p>
	<p>Direction: Left/Right/Up/Down</p> <ol style="list-style-type: none"> <li>1. In the numeric value setting mode, it is to move the cursor and change the numeric value.</li> <li>2. In the menu/text selection mode, it is for item selection.</li> </ol>
	<p>Function Key</p> <ol style="list-style-type: none"> <li>1. The functions keys have factory settings and can be defined by users.</li> <li>2. Other functions must be defined by TPEditor first.</li> </ol>
	<p>HAND Key</p> <ol style="list-style-type: none"> <li>1. This key is controlled by the parameter settings of the source of Hand frequency and hand operation. The factory settings of both source of Hand frequency and hand operation are the digital keypad.</li> <li>2. Press HAND key at stop, the setting will switch to hand frequency source and hand operation source. Press HAND key when the hybrid servo drive is running, it stops the hybrid servo drive first (display AHSP warning), and switch to hand frequency source and hand operation source.</li> </ol>
	<ol style="list-style-type: none"> <li>1. This key is controlled by the parameter settings of the source of AUTO frequency and AUTO operation. The factory setting is the external terminal (source of operation is 4-20mA).</li> <li>2. Press Auto key at stop, the setting will switch to hand frequency source and hand operation source. Press Auto key when the hybrid servo drive is running, it stops the hybrid servo drive first (display AHSP warning), and switch to auto frequency source and auto operation source.</li> </ol>

### Descriptions of LED Functions

LED	Descriptions
	Steady ON: operation indicator of the hybrid servo drive, including DC brake, zero speed, standby, restart after fault and speed search. Blinking: drive is decelerating to stop or in the status of base block. Steady OFF: drive doesn't execute the operation command
	Steady ON: stop indicator of the hybrid servo drive. Blinking: drive is in the standby status. Steady OFF: drive does not execute "STOP" command.
	Operation Direction LED 1. Green light is on, the drive is running forward. 2. Red light is on, the drive is running backward. 3. Twinkling light: the drive is changing direction.

### Characters of Digital Keypad Displayed on the LCD

Number	0	1	2	3	4	5	6	7	8	9
LCD	0	1	2	3	4	5	6	7	8	9
Alphabet	A	b	Cc	d	E	F	G	Hh	I	Jj
LCD	A	b	Cc	d	E	F	G	Hh	I	Jj
Alphabet	K	L	n	Oo	P	q	r	S	Tt	U
LCD	K	L	n	Oo	P	q	r	S	Tt	U
Alphabet	v	Y	Z							
LCD	v	Y	Z							

## A-6 EMI Filter

VJ-C Air Cooled Models::

Drive	Applicable Filter Model #	Reference Website
VFD110VL43C-J	B84143A0050R106	<a href="https://www.tdk-electronics.tdk.com/en/530116/products/product-catalog/emc-components/power-line-emc-filters--epcos-">Power Line EMC Filter (EPCOS)</a>
VFD150VL43C-J		
VFD185VL43C-J		
VFD220VL43C-J		
VFD300VL43C-J	B84143A0100R106	
VFD370VL43C-J		
VFD450VL43C-J	B84143D0200R127	
VFD550VL43C-J		
VFD750VL43C-J		
VFD300VL23C-J		
VFD370VL23C-J		

<https://www.tdk-electronics.tdk.com/en/530116/products/product-catalog/emc-components/power-line-emc-filters--epcos->

## EMI Filter Installation

All electrical equipment, including hybrid drives, will generate high-frequency/low-frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMI filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMI filter to have the best interference elimination performance.

We assure that it can comply with following rules when hybrid drive and EMI filter are installed and wired according to user manual:

- EN61000-6-4
- EN61800-3: 1996
- EN55011 (1991) Class A Group 1 (1<sup>st</sup> Environment, restricted distribution)

### General precaution

1. EMI filter and hybrid drive should be installed on the same metal plate.
2. Please install hybrid drive on footprint EMI filter or install EMI filter as close as possible to the hybrid drive.
3. Please wire as short as possible.
4. Metal plate should be grounded.
5. The cover of EMI filter and hybrid drive or grounding should be fixed on the metal plate and the contact area should be as large as possible.

### Choose suitable motor cable and precautions

Improper installation and choice of motor cable will affect the performance of EMI filter. Be sure to observe the following precautions when selecting motor cable.

1. Use the cable with shielding (double shielding is the best).
2. The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
3. Remove any paint on metal saddle for good ground contact with the plate and shielding.

Remove any paint on metal saddle for good ground contact with the plate and shielding.

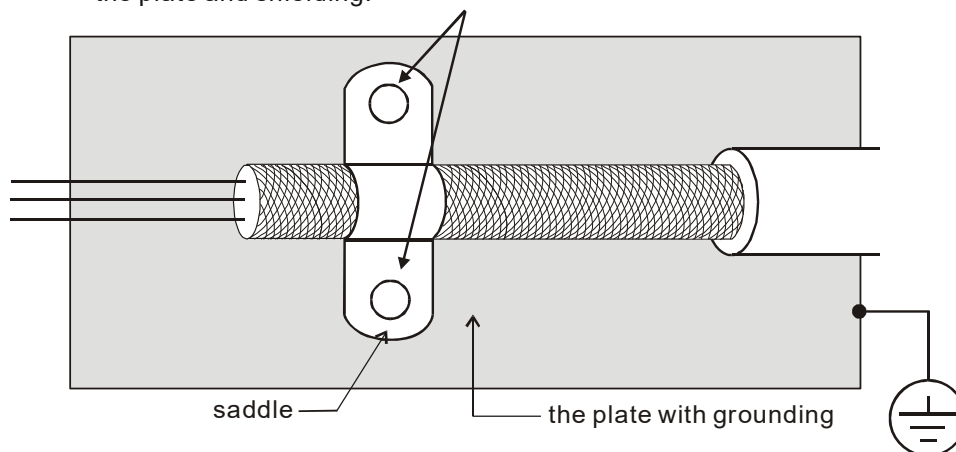
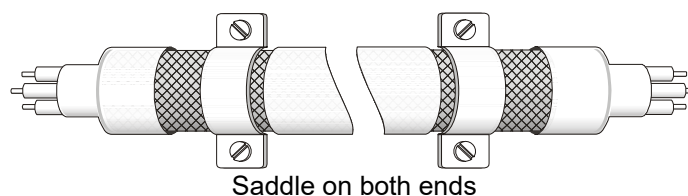
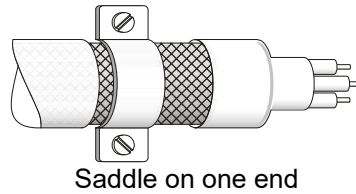


Figure 1







**Figure 2**

**The length of motor cable**

When motor is driven by a hybrid drive of PWM type, the motor terminals will experience surge voltages easily due to components conversion of hybrid drive and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages may reduce insulation quality. To prevent this situation, please follow the rules below:

- Use a motor with enhanced insulation.
- Connect an output reactor (optional) to the output terminals of the hybrid drive
- The length of the cable between hybrid drive and motor should be as short as possible (10 to 20 m or less)
- For models 7.5hp and above:

Insulation level of motor	1000V	1300V	1600V
460V <sub>AC</sub> input voltage	66 ft (20m)	328 ft (100m)	1312 ft (400m)
230V <sub>AC</sub> input voltage	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)

**NOTE**

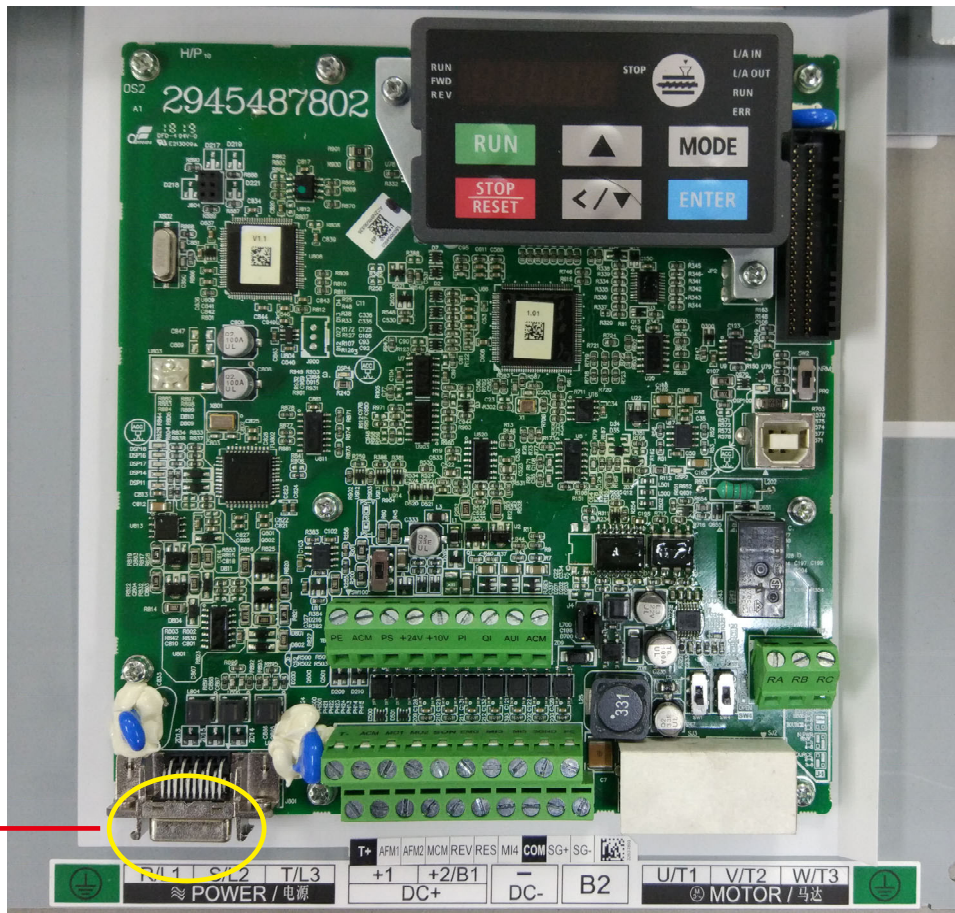
Never connect phase lead capacitors or surge absorbers to the output terminals of the hybrid drive.

- If the length is too long, the stray capacitance between cables will increase and may cause leakage current. It will activate the protection of over current, increase leakage current or not insure the correction of current display. The worst case is that hybrid drive may damage.
- If more than one motor is connected to the hybrid drive, the total wiring length is the sum of the wiring length from hybrid drive to each motor.
- For the 460V series hybrid drive, when an overload relay is installed between the drive and the motor to protect motor from overheating, the connecting cable must be shorter than 50m. However, an overload relay malfunction may still occur. To prevent the malfunction, install an output reactor (optional) to the drive or lower the carrier frequency setting (Pr.00-17).

**NOTE**

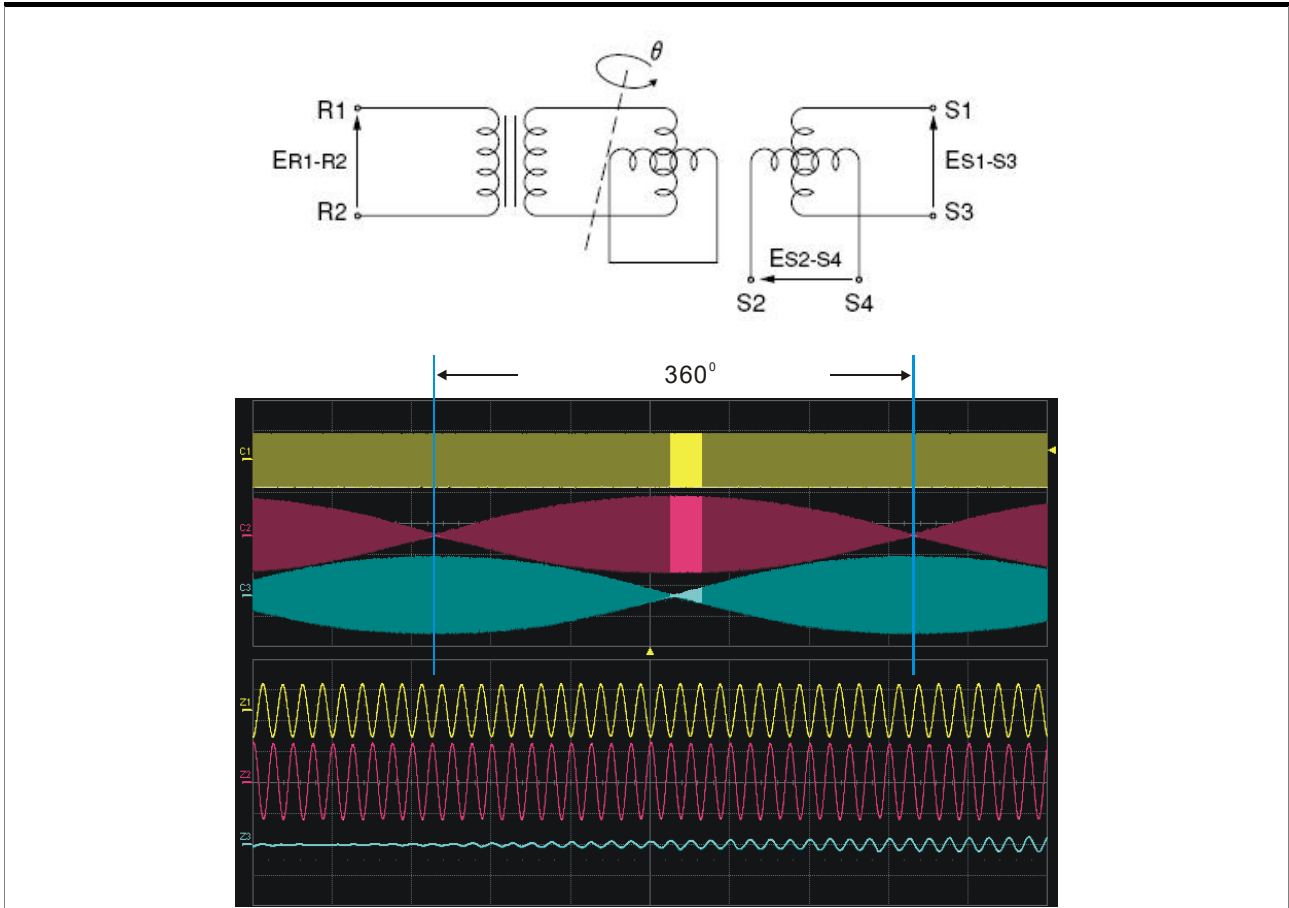
When a thermal O/L relay protected by motor is used between hybrid drive and motor, it may malfunction (especially for 460V series), even if the length of motor cable is only 165 ft (50m) or less. To prevent it, please use AC reactor and/or lower the carrier frequency (Pr. 00-17 PWM carrier frequency).

# A-7 Speed Feedback Encoder



Encoder Connector

## Function of J1 Terminal



As shown in the image above, from top to bottom: C1 『E<sub>R1-R2</sub>』, C2 『E<sub>S1-S3</sub>』, C3 『E<sub>S2-S4</sub>』

Pin #	Terminal	Function	Specification
4	SIN- (S4)	Resolver output signal	3.5±0.175Vrms, 10kHz
5	SIN+ (S2)		
7	COS+ (S1)		
9	COS- (S3)		
14,16	REF+ (R1)	Resolver input power	7Vrms, 10kHz
13,15	REF- (R2)		
	blocked	Blocked	

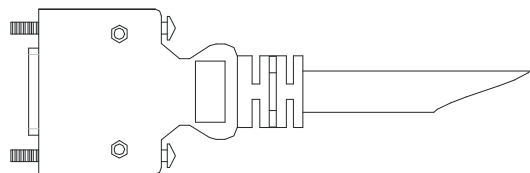
## Selection of Wiring Rod

Encoder Wiring — Wire Gauge mm <sup>2</sup> (AWG)			
Size	# of cores (pairs)	Specification	Standard Length
0.13 mm <sup>2</sup> (AWG26)	10 cores(4 pairs)	UL2464	3m (9.84 ft)

**NOTE**

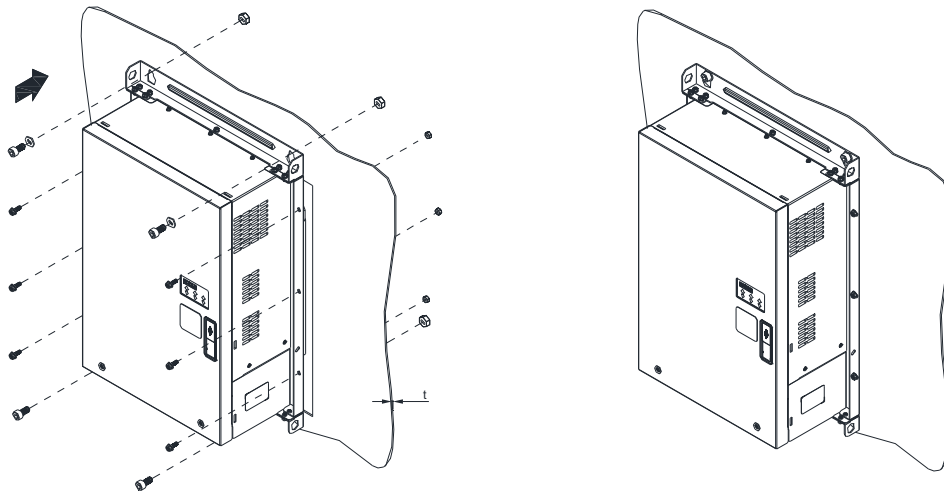
- 1) Please use shielded twisted-pair cable for encoder wiring so as to reduce the interference of the noise.
- 2) The shield should connect to the Ⓢ phase of SHIELD.
- 3) Please follow the Selection of Wire Rod when wiring in order to avoid the danger it may occur.

## Connector Specification



Title	Part #	Manufacturer
PLUG	3M 10120-3000PE	3M
SHELL	3M 10320-52A0-008	3M

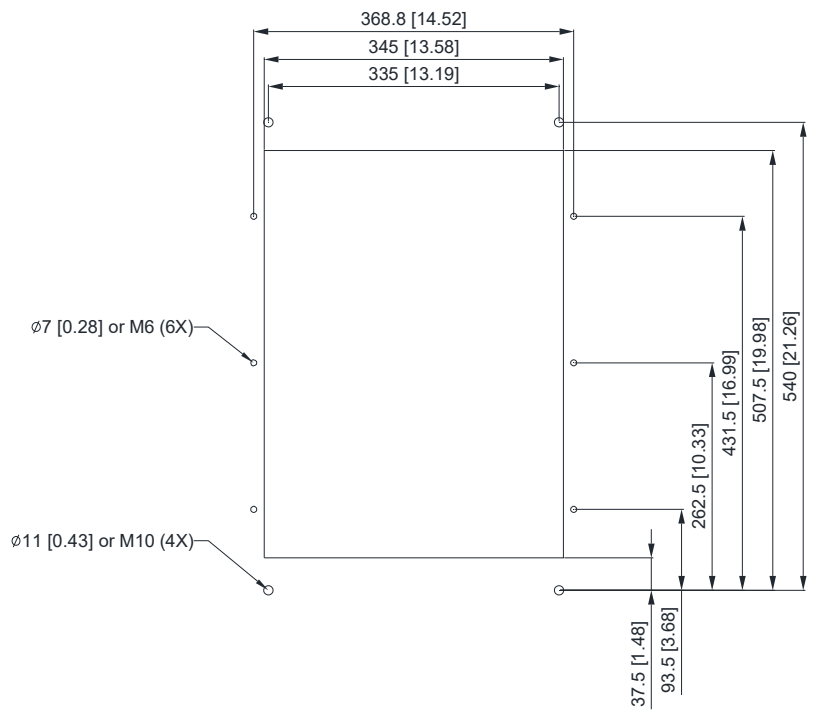
## A-8 Wall-Mounted Installation



Push the hybrid servo drive through the wall, then fasten 4 pieces of M10 screw, 6 pieces of M6 screw an their nuts to fix the hybrid servo drive.

- M10 screw length  $L1 = t$  (wall thickness) + 16mm. srew torque = 200Kg-cm [173.4lb-in.]
- M6 srew length  $L2 = t$  (wall thickness) + 12mm, scfew torque = 40Kg-cm [34.7lb-in.]

Cutout Dimensions:



# Appendix B: CANopen Overview

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- B-1** CANopen Overview
- B-2** Wiring for CANopen
- B-3** CANopen Communication Interface Description
- B-4** CANopen Supporting Index

The built-in CANopen function is a kind of remote control. You can control the AC motor drive using the CANopen protocol. CANopen is a CAN-based higher layer protocol that provides standardized communication objects, including real-time data (Process Data Objects, PDO), configuration data (Service Data Objects, SDO), and special functions (Time Stamp, Sync message, and Emergency message). It also has network management data, including Boot-up message, NMT message, and Error Control message. Refer to the CiA website <http://www.can-cia.org/> for details. The content of this instruction sheet may be revised without prior notice. Consult our distributors or download the most updated version at <http://www.delta.com.tw/industrialautomation>

***Delta CANopen supported functions:***

- Supports CAN2.0A Protocol
- Supports CANopen DS301 V4.02
- Supports DSP-402 V2.0

***Delta CANopen supported services:***

- PDO (Process Data Objects): PDO1–PDO4
- SDO (Service Data Object):
  - Initiate SDO Download;
  - Initiate SDO Upload;
  - Abort SDO;You can use the SDO message to configure the slave node and access the Object Dictionary in every node.
- SOP (Special Object Protocol):
  - Supports default COB-ID in Predefined Master/Slave Connection Set in DS301 V4.02;
  - Supports SYNC service;
  - Supports Emergency service.
- NMT (Network Management):
  - Supports NMT module control;
  - Supports NMT Error control;
  - Supports Boot-up.

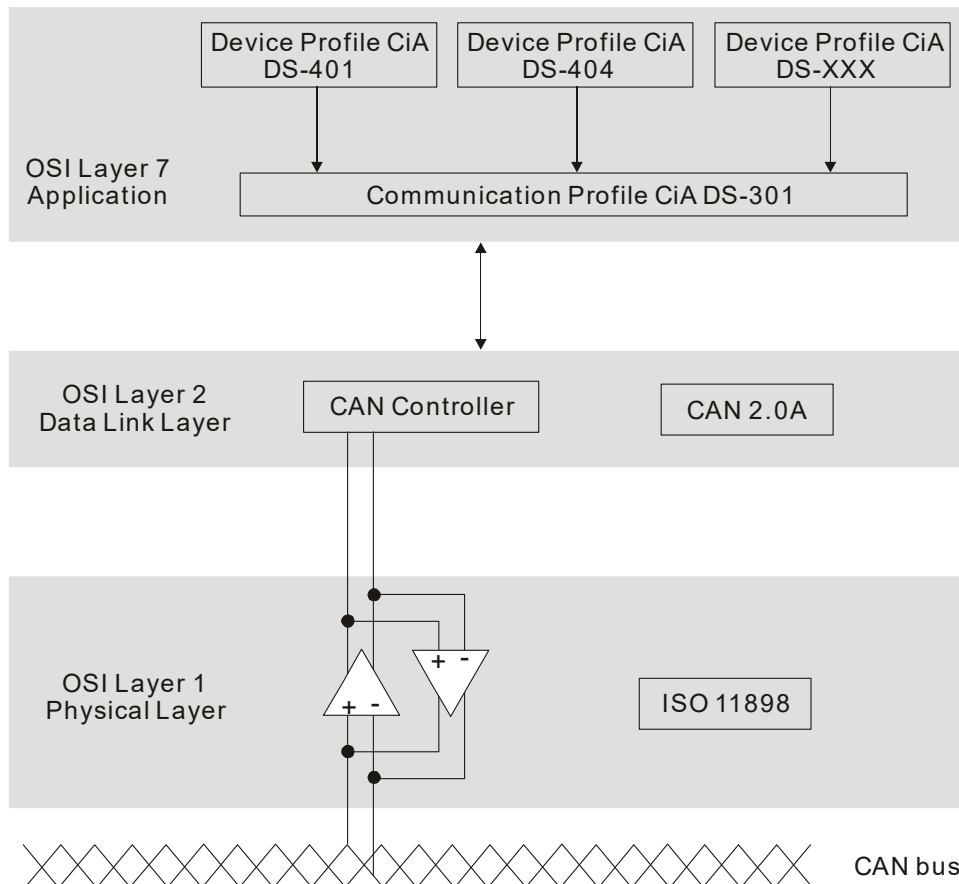
***Delta CANopen does not support this service:***

- Time Stamp service

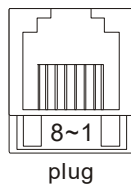
## B-1 CANopen Overview

- **CANopen Protocol**

CANopen is a CAN-based higher layer protocol, and was designed for motion-oriented machine control networks such as handling systems. Version 4.02 of CANopen (CiA DS301) is standardized as EN50325-4. The CANopen specifications cover the application layer and communication profile (CiA DS301), as well as a framework for programmable devices (CiA 302), recommendations for cables and connectors (CiA 303-1) and SI units and prefix representations (CiA 303-2).



### RJ-45 Pin Definition



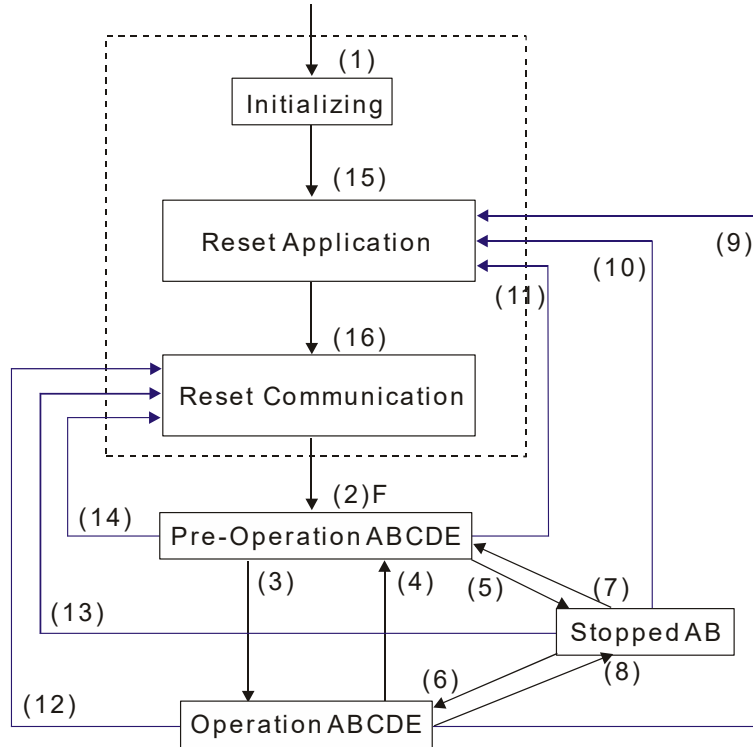
PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0 V /V-
6	CAN_GND	Ground / 0 V /V-

**CANopen Communication Protocol** contains the following services:

- NMT (Network Management Object)
- SDO (Service Data Objects)
- PDO (Process Data Object)
- EMCY (Emergency Object)

### NMT (Network Management Object)

The Network Management (NMT) follows a Master/Slave structure for executing NMT service. A network has only one NMT master, and the other nodes are slaves. All CANopen nodes have a present NMT state, and the NMT master can control the state of the slave nodes. The following shows the state diagram of a node:



- (1) After power is applied, start in the auto-initialization state
  - (2) Automatically enter the pre-operational state
  - (3) (6) Start remote node
  - (4) (7) Enter the pre-operational state
  - (5) (8) Stop remote node
  - (9) (10) (11) Reset node
  - (12) (13) (14) Reset communication
  - (15) Automatically enter reset application state
  - (16) Automatically enter reset communication state
- A: NMT
  - B: Node Guard
  - C: SDO
  - D: Emergency
  - E: PDO
  - F: Boot-up

	Initializing	Pre-Operational	Operational	Stopped
PDO			○	
SDO		○	○	
SYNC		○	○	
Time Stamp		○	○	
EMCY		○	○	
Boot-up	○			
NMT		○	○	○



## SDO (Service Data Objects)

Use SDO to access the Object Dictionary in every CANopen node using the Client/Server model. One SDO has two COB-IDs (request SDO and response SDO) to upload or download data between two nodes. There is no data limit for SDOs to transfer data, but it must transfer data by segment when the data exceeds four bytes with an end signal in the last segment. The VJ series does not currently support segment transmission.

The Object Dictionary (OD) is a group of objects in a CANopen node. Every node has an OD in the system, and OD contains all parameters describing the device and its network behavior. The access path in the OD is the index and sub-index; each object has a unique index in the OD, and has a sub-index if necessary. The following shows the request and response frame structure of SDO communication:

## PDO (Process Data Object)

PDO communication can be described by the producer/consumer model. Each node of the network listens to the messages of the transmission node and distinguishes whether the message has to be processed or not after receiving the message. A PDO can be transmitted from one device to one another device or to many other devices. Every PDO has two PDO services: a TxPDO and an RxPDO. PDOs are transmitted in a non-confirmed mode. All transmission types are listed in the following table:

Type Number	PDO				
	Cyclic	Acyclic	Synchronous	Asynchronous	RTR only
0		○	○		
1-240	○		○		
241-251	Reserved				
252			○		○
253				○	○
254				○	
255				○	

Type number 0 indicates the synchronous aperiodic message between two PDO transmissions.

Type number 1-240 indicates the number of SYNC message between two PDO transmissions.

Type number 252 indicates the data is updated (but not sent) immediately after receiving SYNC.

Type number 253 indicates the data is updated immediately after receiving RTR.

Type number 254: Delta CANopen doesn't support this transmission format.

Type number 255 indicates the data is an asynchronous aperiodic transmission.

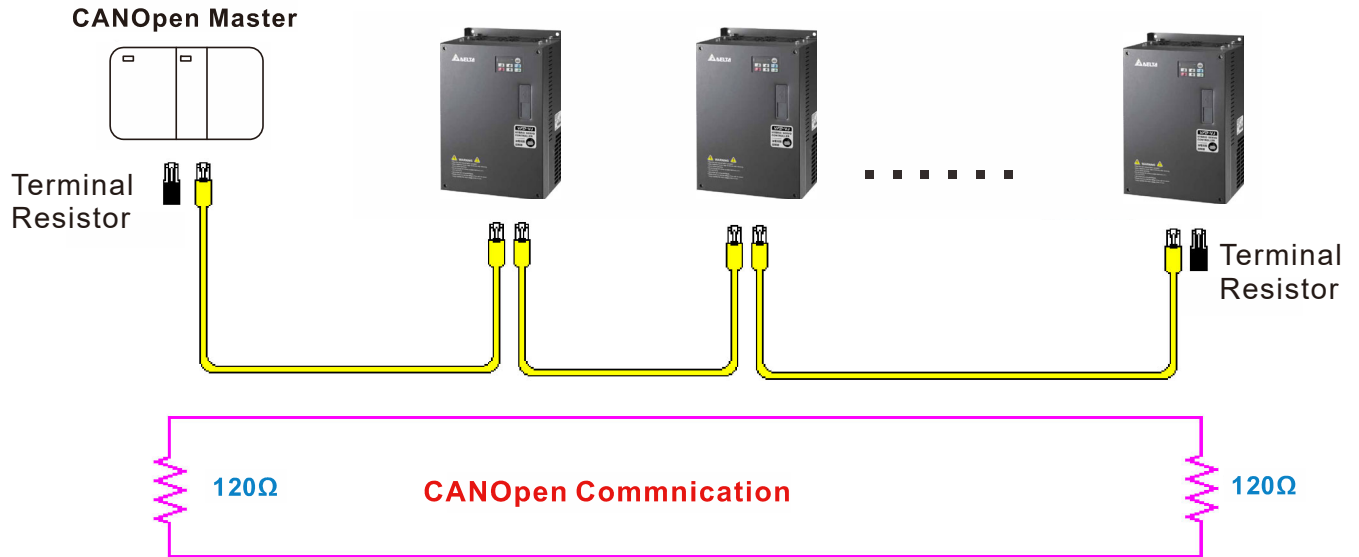
All PDO transmission data must be mapped to the index with Object Dictionary.

## EMCY (Emergency Object)

When errors occur inside the hardware, an emergency object is triggered. An emergency object is only sent when an error occurs. As long as there is nothing wrong with the hardware, there is no emergency object warning of an error message.

## B-2 Wiring for CANopen

The wiring between CANopen and VJ doesn't require any external communication card. Use an RJ45 cable to connect CANopen to a VJ. You must terminate the two farthest ends with 120Ω terminating resistors as shown in the picture below.



## B-3 CANopen Communication Interface Descriptions

### B-3-1 CANopen Control Mode Selection

There are two control modes for CANopen: the DS402 standard (Pr.04-20 set to 1) is the factory setting, and the Delta's standard setting (Pr.04-20 set to 0). There are two control modes according to Delta's standard. One is the old control mode (Pr.04-24=0); this control mode can only control the motor drive under frequency control. The other mode is a new standard (Pr.04-24=1); this new control mode allows the motor drive to be controlled under multiple modes. The VJ currently supports speed mode. The following table shows the control mode definitions:

CANopen control mode	Control mode	
	Speed	
	Index	Description
DS402 Pr.04-20=1	6042-00	Target rotating speed (RPM)
	-----	-----
Delta Standard (Old definition) Pr.04-20=0, Pr.04-24=0	2020-02	Target rotating speed (Hz)
Delta Standard (New definition) Pr.04-20=0, Pr.04-24=1	2060-03	Target rotating speed (Hz)
	2060-04	Torque limit (%)

CANopen control mode	Operation control	
	Index	Description
DS402 Pr.04-20=1	6040-00	Operation Command
	-----	-----
Delta Standard (Old definition) Pr.04-20=0, Pr.04-24=0	2020-01	Operation Command
Delta Standard (New definition) Pr.04-20=0, Pr.04-24=1	2060-01	Operation Command
	-----	-----

CANopen control mode	Other	
	Index	Description
DS402 Pr.04-20=1	605A-00	Quick stop processing mode
	605C-00	Disable operation processing mode
Delta Standard (Old definition) Pr.04-20=0, Pr.04-24=0	-----	-----
Delta Standard (New definition) Pr.04-20=0, Pr.04-24=1	-----	-----
	-----	-----

You can use some indices in either DS402 or Delta's standard. For example:

1. Indices that are defined as RO attributes
2. The corresponding index of available parameter groups: (2000-00–200E-XX)
3. Accelerating/Decelerating Index: 604F 6050

## B-3-2 DS402 Standard Control Mode

### B-3-2-1 Related set up for an AC motor drive (following the DS402 standard)

If you want to use the DS402 standard to control the motor drive, follow these steps:

1. Wire the hardware (refer to chapter B-2 Wiring for CANopen).
2. Set the operation source: set Pr.01-01 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.03-15 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set DS402 for the control mode: Pr.04-20=1
5. Set the CANopen station: set the CANopen station (range 1-127, 0 is the disable CANopen slave function) with Pr.04-17. Note: set Pr.00-02 = 7 to reset if the station number error CAde or CANopen memory error CFrE appears.
6. Set the CANopen baud rate: set Pr.04-18 (CANBUS Baud Rate: 1M (0), 500K (1), 250K (2), 125K (3), 100K (4) or 50K (5)).

### B-3-2-2 The status of the motor drive (by following DS402 standard)

According to the DS402 definition, the motor drive is divided into 3 blocks and 9 statuses as described below.

#### **3 blocks**

1. Power Disable: without PWM output
2. Power Enable: with PWM output
3. Fault: one or more errors have occurred.

#### **9 status**

1. Start: power on
2. Not Ready to Switch On: the motor drive is initiating.
3. Switch On Disable: occurs when the motor drive finishes initiating.
4. Ready to Switch On: warming up before running.
5. Switch On: the motor drive has the PWM output, but the reference command is not effective.
6. Operate Enable: able to control normally.
7. Quick Stop Active: when there is a Quick Stop request, stop running the motor drive.
8. Fault Reaction Active: the motor drive detects conditions which might trigger error(s).
9. Fault: one or more errors have occurred in the motor drive.

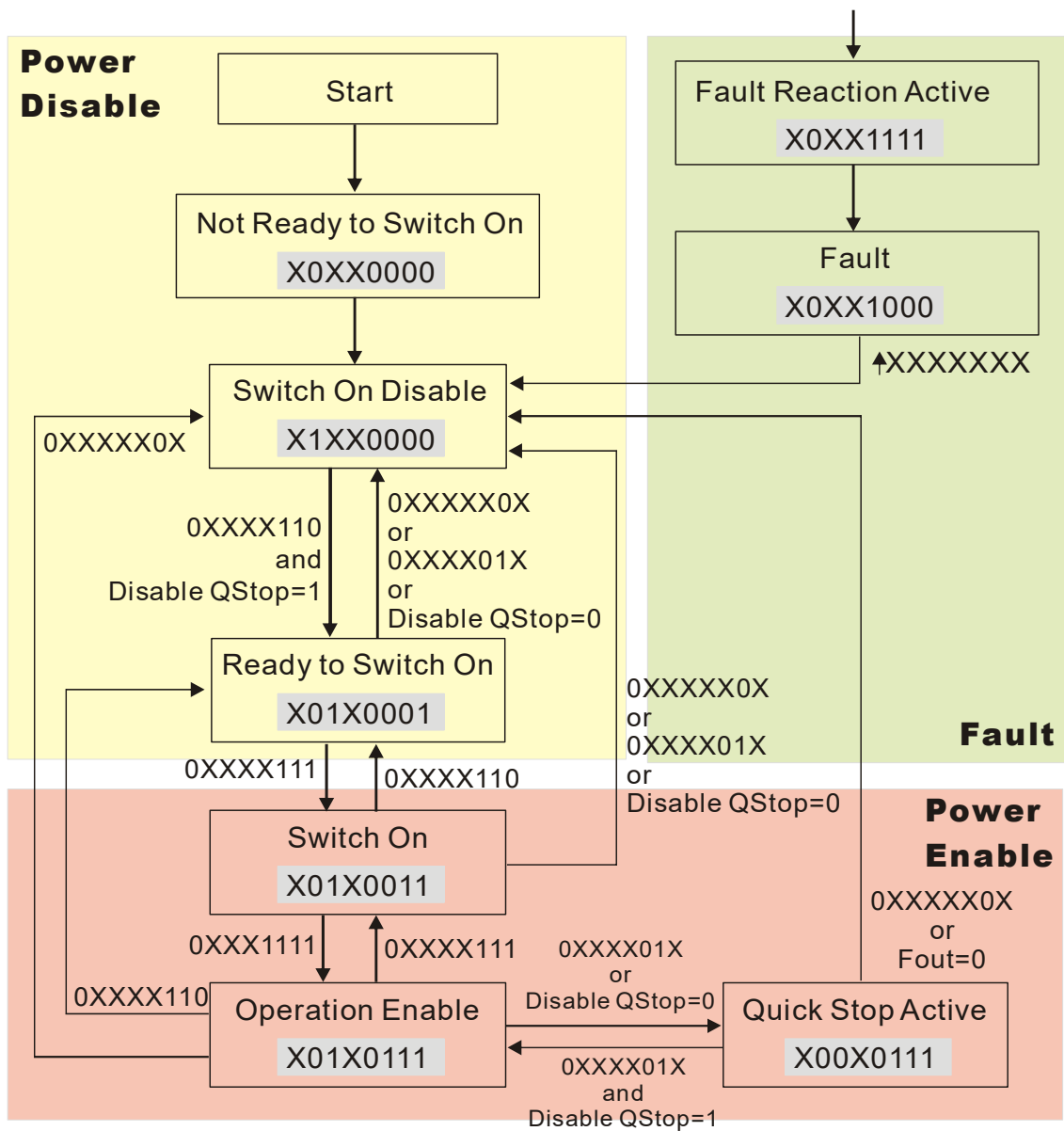
When the motor drive is turned on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operate Enable status. To do this, set the control word's bit0-bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0X6041). The control steps and index definition are described below:

Index 6040

15-9	8	7	6-4	3	2	1	0
Reserved	Halt	Fault Reset	Operation	Enable operation	Quick Stop	Enable Voltage	Switch On

Index 6041

15-14	13-12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved	Operation	Internal limit active	Target reached	Remote	Reserved	Warning	Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enable	Switch on	Ready to switch on



Set command 6040=0xE, then set another command 6040=0xF. Then you can switch the motor drive to Operation Enable. The Index 605A determines the direction of the lines from Operation Enable when the control mode changes from Quick Stop Active. When the setting value is 5–7, both lines are active, but when the setting value of 605A is not 5–7, once the motor drive is switched to Quick Stop Active, it is not able to switch back to Operation Enable.

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function
									1: Slow down on slow down ramp
									2: Slow down on quick stop ramp
									5: Slow down on slow down ramp and stay in Quick Stop
									6: Slow down on quick stop ramp and stay in Quick Stop
7: Slow down on the current limit and stay in Quick Stop									

When the control section switches from Power Enable to Power Disable, use 605C to define the parking method.

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	note
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function

### B-3-2-3 Various mode control method (by following DS402 standard)

#### Speed mode

1. Set VJ to speed control mode: set Index6060 to 2.
2. Switch to Operation Enable mode: set 6040=0xE, then set 6040=0xF.
3. Set the target frequency: set target frequency for 6042, since the operation unit of 6042 is rpm, a transform is required:

$$n = f \times \frac{120}{p}$$

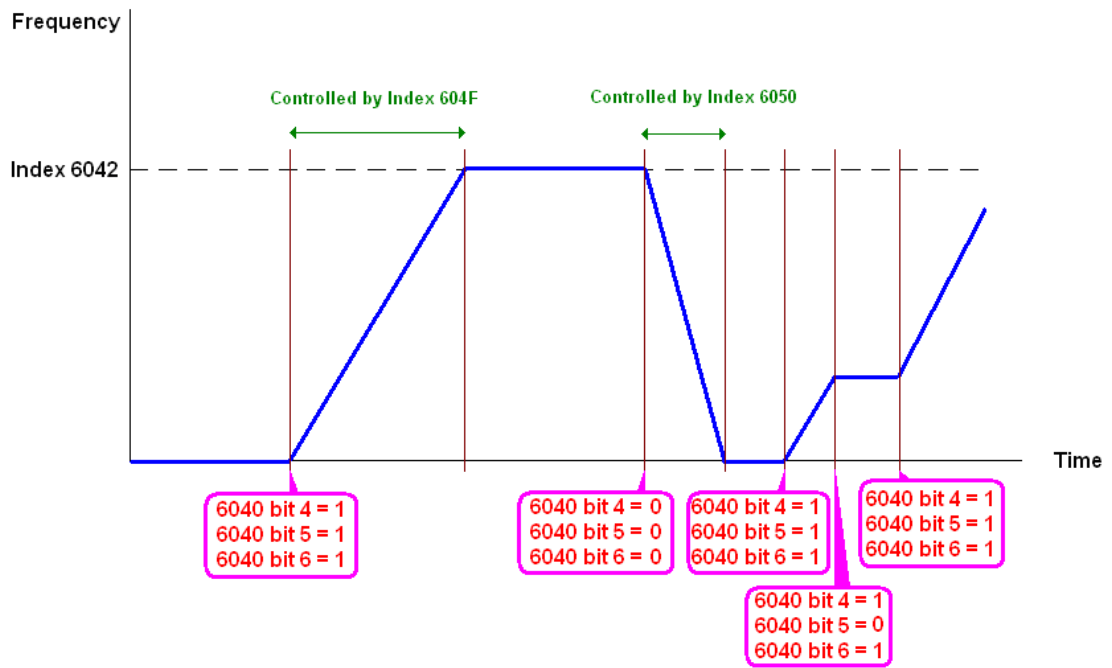
n: rotation speed (rpm) (rounds/minute)    p: number of poles in the motor  
(Pole)  
f: rotation frequency (Hz)

For example:

Set 6042H = 1500 (rpm), if the number of poles is 4 (Pr.05-04 or Pr.05-16), then the motor drive's operation frequency is 1500 (120/4) = 50 Hz. The 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter-clockwise.

4. To set acceleration and deceleration: use 604F (Acceleration) and 6050 (Deceleration).
5. Trigger an ACK signal: in the speed control mode, the bit 6–4 of Index 6040 needs to be controlled. It is defined below:

Speed mode (Index 6060=2)	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
	1	0	1	Locked at the current signal.
	1	1	1	Run to reach targeting signal.
	Other			Decelerate to 0 Hz.



NOTE 01: Read 6043 to get the current rotation speed (unit: rpm).

NOTE 02: Read bit 10 of 6041 to find if the rotation speed has reached the targeting value (0: Not reached; 1: Reached).

### B-3-3 Using Delta Standard (Old definition)

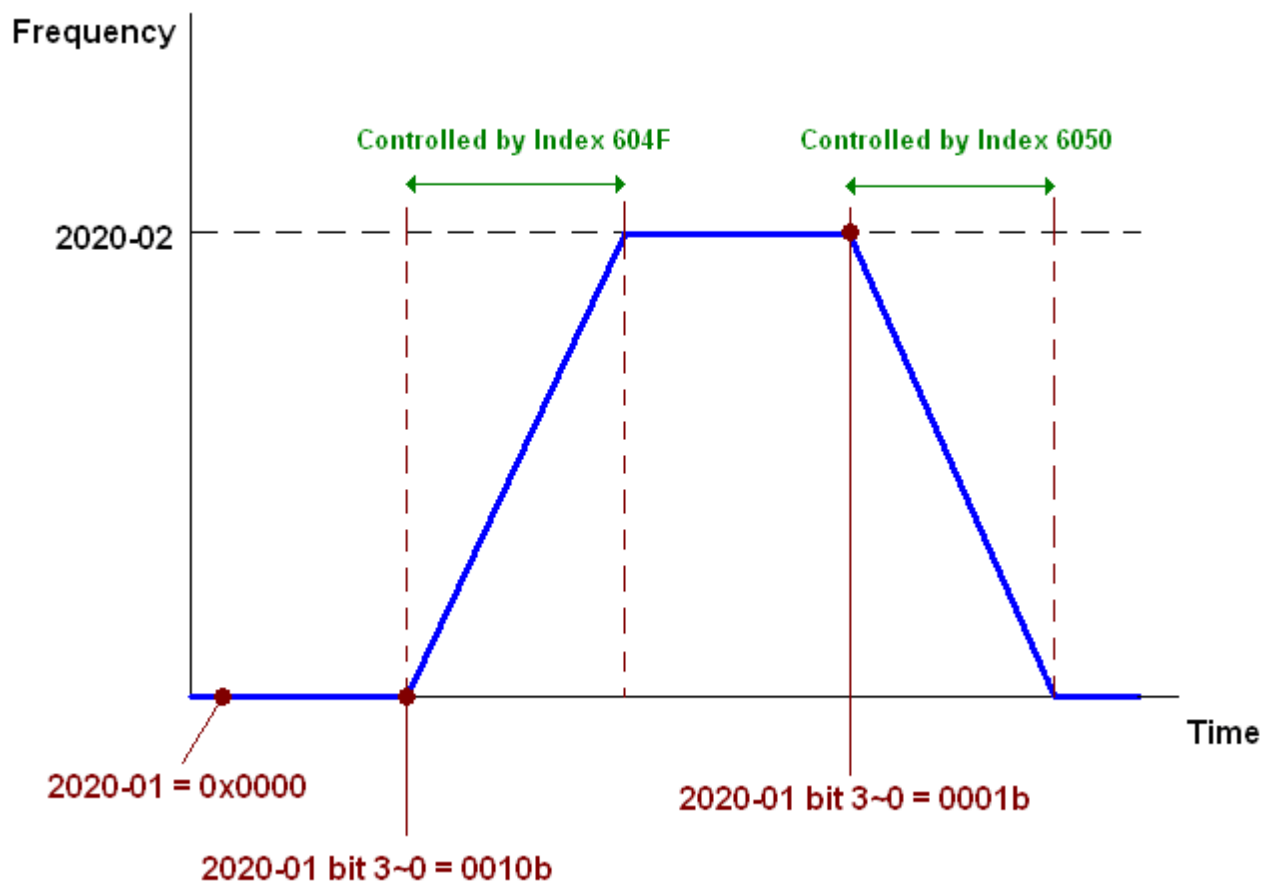
#### B-3-3-1 Various mode control method (Delta Old Standard).

Follow the steps below:

1. Wire the hardware (refer to Section B-2 Wiring for CANopen).
2. Set the operation source: set Pr.01-01 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.03-15 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set Delta Standard (Old definition, only supports speed mode) as the control mode: Pr.04-20 = 0 and Pr.04-24 = 0.
5. Set the CANopen station: set Pr.09-36; the range is between 1–127. When Pr.09-36=0, the CANopen slave function is disabled. Note: if an error appears (CAde or CANopen memory error) as you complete the station setting, set Pr.00-02=10 to reset.
6. Set the CANopen baud rate: set Pr.04-18 (CANBUS Baud Rate: 1M (0), 500K (1), 250K (2), 125K (3), 100K (4) and 50K (5))

#### B-3-3-2 By speed mode

1. Set the target frequency: set 2020-02, the unit is Hz, with 2 decimal places. For example 1000 is 10.00 Hz.
2. Operation control: set 2020-01 = 0002H for running, and set 2020-01 = 0001H for stopping.





## B-3-4 Using Delta Standard (New definition)

### B-3-4-1 Related set up for an AC motor drive (Delta New Standard)

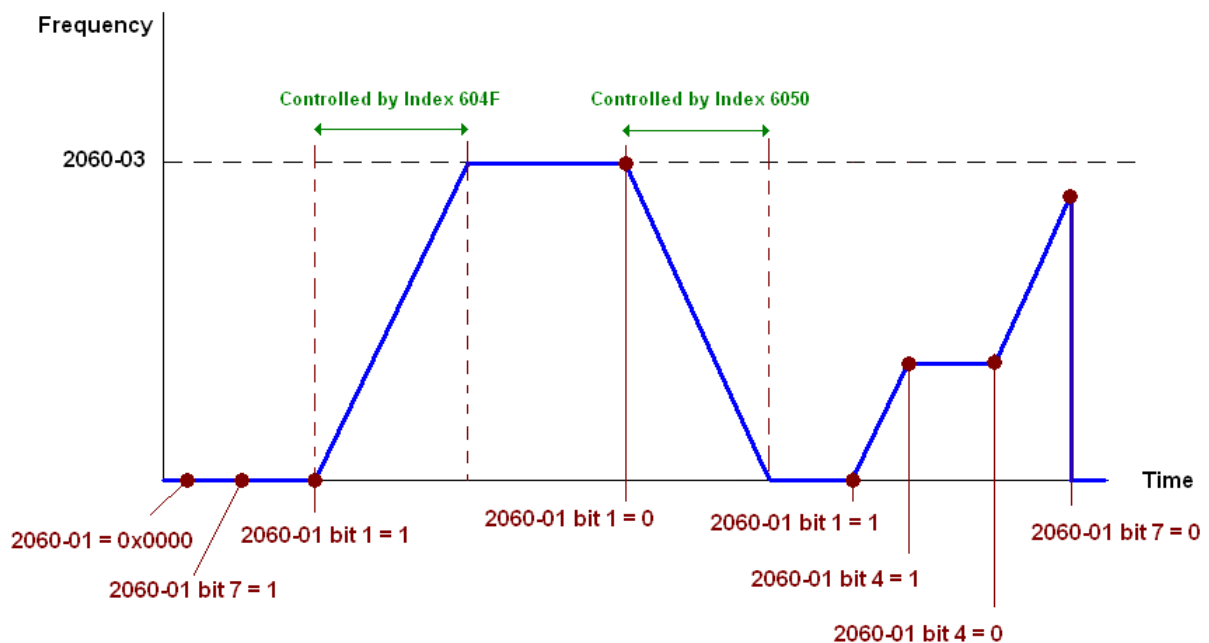
Follow the steps below:

1. Wire the hardware (refer to Section B-2 Wiring for CANopen).
2. Set the operation source: set Pr.01-01 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr.03-15 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set Delta Standard (New definition) as the control mode: Pr.04-20 = 0 and 04-24 = 1.
5. Set the CANopen station: set Pr.04-17; the range is between 1–127. When Pr.04-17=0, the CANopen slave function is disabled. Note: if an error appears (CAde or CANopen memory error) as you complete the station setting, set Pr.00-02=10 to reset.
6. Set the CANopen baud rate: set Pr.04-18 (CANBUS Baud Rate: 1M (0), 500K (1), 250K (2), 125K (3), 100K (4) and 50K (5))

### B-3-4-2 Various mode control method (Delta New Standard)

#### Speed Mode

1. Set VJ to speed control mode: set index 6060 = 2.
2. Set the target frequency: set 2060-03, unit is Hz, with 2 decimal places. For example 1000 is 10.00 Hz.
3. Operation control: set 2060-01 = 0080H for server on, and set 2060-01 = 0081H for running.



## B-4 CANopen Supporting Index

VJ Index:

The parameter index corresponds as shown in this example:

<b>Index</b>	<b>sub-Index</b>
2000H + Group	member+1

For example:

Pr.01-01 (Source of operation command)

<b>Group</b>	-	<b>member</b>
01(01H)		01(01H)

Index = 2000H + 01H = 2001

Sub Index = 01H + 1H = 2H

VJ Control Index:

### Delta Standard Mode (Old definition)

Index	Sub	Definition	Factory Setting	R/W	Size	Note	
2000H	2D	Pressure Command	0	RW	U16		
	2E	Flow Command	0	RW	U16		
2020H	0	Number	3	R	U8		
	1	Control word	0	RW	U16	Bit 1–0	00B: Disable
							01B: Stop
							10B: Disable
							11B: JOG Enable
						Bit3–2	Reserved
							Bit5–4
						01B: Direction forward	
						10B: Direction reverse	
						11B: Switch direction	
						Bit7–6	Reserved
	Bit11–8	Reserved					
	Bit12	Reserved					
Bit14–13	00B: No function						
	01B: Operation command by the digital keypad						
						10B: Operation command according to Pr.01-01 setting	
						11B: Switch the source of operation command	
						Bit 15: Reserved	
2	Freq. command (XXX.XX Hz)	0	RW	U16			
3	Other trigger	0	RW	U16	Bit0	1: E.F. ON	
					Bit1	1: Reset	
					Bit15–3	Reserved	
2021H	0	Number	10	R	U8		
	1	Error code	0	R	U16	High byte: Warn Code	
						Low Byte: Error Code	
	2	AC motor drive status	0	R	U16	Bit 1–0	00B: Stop
							01B: Decelerate to stop
							10B: Waiting for operation command
							11B: In operation
						Bit 2	Reserved
					Bit 4–3	00B: Run forward	
						01B: Switch from run in reverse	

Index	Sub	Definition	Factory Setting	R/W	Size	Note
						to run forward
						10B: Switch from run forward to run in reverse
						11B: Run in reverse
					Bit 7–5	Reserved
					Bit 8	1: Master Frequency command controlled by communication interface
					Bit 9	1: Master Frequency command controlled by analog / external terminal signal input
					Bit 10	1: Operation command controlled by communication interface
					Bit 11	1: Parameter lock
					Bit 12	Reserved
					Bit 15–13	Reserved
	3	Frequency command (XXX.XXHz)	0	R	U16	
	4	Output freq. (XXX.XX Hz)	0	R	U16	
	5	Output current (XXX.XX A)	0	R	U16	
	6	DC BUS voltage (XXX.X V)	0	R	U16	
	7	Output voltage (XXX.X V)	0	R	U16	
	8	Reserved	0	R	U16	
	9	Reserved	0	R	U16	
	A	Reserved	0	R	U16	
	B	Reserved	0	R	U16	
	C	Reserved	0	R	U16	
	D	Reserved	0	R	U16	
	E	Reserved	0	R	U16	
	F	Reserved	0	R	U16	
	10	Reserved	0	R	U16	
	17	Multi-function display (Pr.00-04)	0	R	U16	
2022H	0	Reserved	0	R	U16	
	1	Display output current (XX.XXA)	0	R	U16	
	2	Display counter value	0	R	U16	
	3	Display actual output frequency(XXX.XX Hz)	0	R	U16	
	4	Display DC-BUS voltage (XXX.X V)	0	R	U16	
	5	Display output voltage (XXX.X V)	0	R	U16	
	6	Display output power angle (XXX.X°)	0	R	U16	
	7	Display output power by U, V, W in kW (XX.XXX kW)	0	R	U16	
	8	Display actual motor speed (XXXXX rpm)	0	R	U16	
	9	Display estimate output torque (XXX.X%)	0	R	U16	
	A	Display PG feedback	0	R	U16	
	B	Reserved	0	R	U16	
	C	Display signal for PS analog	0	R	U16	

Index	Sub	Definition	Factory Setting	R/W	Size	Note
		input terminal, 4~20mA/ 0–10 V corresponds to 0–100% (to two decimal places)				
	D	Display signal of PI analog input terminal, 0~10 V corresponds to 0 ~100% (to two decimal places)	0	R	U16	
	F	Display the IGBT temperature of drive power module (XXX.X°C)	0	R	U16	
	10	Display motor drive's capacitor temperature (XXX.X°C)	0	R	U16	
	11	The status of digital input (ON/OFF), refer to Pr.02-12	0	R	U16	
	12	The status of digital output (ON/OFF), refer to Pr.02-18	0	R	U16	
	13	Reserved	0	R	U16	
	14	The corresponding CPU pin status of digital input	0	R	U16	
	15	The corresponding CPU pin status of digital output	0	R	U16	
	16	Reserved	0	R	U16	
	17	Reserved	0	R	U16	
	18	Reserved .	0	R	U16	
	1A	Display signal of QI analog input terminal, 0~10 V corresponds to 0 ~100% (to two decimal places)	0	R	U16	
	1B	Display actual pressure (Bar)	0	R	U16	
	1C	Display kw/ hr	0	R	U16	
	1D	Display motor's temperature °C	0	R	U16	
	1E	Display motor drive's over load in %	0	R	U16	
	1F	Display motor's over load in % of HES type A	0	R	U16	
	20	Display current at braking (Ampere)	0	R	U16	
	21	Display braking chopper's temperature °C	0	R	U16	

**Delta Standard Mode (New definition)**

Index	sub	R/W	Size	Descriptions			Speed Mode
				bit	Definition	Priority	
2060h	00h	R	U8				
	01h	RW	U16	0	Ack	4	0: fcmd =0 1: fcmd = Fset(Fpid)
				1	Dir	4	0: FWD run command 1: REV run command
				2			
				3	Halt	3	0: Drive runs until target speed is reached 1: Drive stops by declaration setting
				4	Hold	4	0: Drive runs until target speed is reached 1: Frequency stop at current frequency
				5	JOG	4	0:JOG OFF Pulse 1:JOG RUN
				6	QStop	2	Quick Stop
				7	Power	1	0: Power OFF 1: Power ON
				8	Ext_Cmd2	4	0 → 1: Clear the absolute position.
				14-8			
				15	RST	4	Pulse 1: Fault code cleared
	02h	RW	U16		Mode Cmd		0: Speed Mode
	03h	RW	U16				Speed command (unsigned decimal)
04h	RW	U16					
05h	RW	S32					
06h	RW						
07h	RW	S16					
08h	RW	U16					
2061h	01h	R	U16	0	Arrive		Frequency reached
				1	Dir		0: Motor FWD run 1: Motor REV run
				2	Warn		Warning
				3	Error		Error detected
				4			
				5	JOG		JOG
				6	QStop		Quick stop
				7	Power ON		Switch ON
	15-8						
	02h	R					
	03h	R	U16				Actual output frequency
	04h	R					
	05h	R	S32				Actual position (absolute)
	06h	R					
07h	R	S16				Actual torque	

**DS402 Standard**

Index	Sub	Definition	Factory Setting	R/W	Size	Unit	PDO Map	Mode	Note
6007h	0	Abort connection option code	2	RW	S16		Yes		0: No action
									2: Disable voltage
									3: Quick Stop
603Fh	0	Error code	0	RO	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	RO	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	10000	RW	U32	1ms	Yes	vl	Unit must be 100 ms, and check if the setting is 0.
6050h	0	vl slow down time	10000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	1000	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0: Disable drive function
									1: Slow down on slow down ramp
									2: Slow down on quick stop ramp
									5: Slow down on slow down ramp and stay in QUICK STOP
									6: Slow down on quick stop ramp and stay in QUICK STOP
605Ch	0	Disable operation option code	1	RW	S16		No		0: Disable drive function 1: Slow down with slow down ramp; disable the drive function
6060h	0	Mode of operation	2	RW	S8		Yes		2: Velocity mode
6061h	0	Mode of operation display	2	RO	S8		Yes		Same as above

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# Appendix C: MSJ 220V & 380V Hybrid Servo Motor

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- C-1 Product Description
- C-2 Model Explanation
- C-3 Motor Specifications
- C-4 Torque – Rotation characteristic curve
- C-5 Product Appearance and Dimensions
- C-6 Wiring of Servo Oil Pump



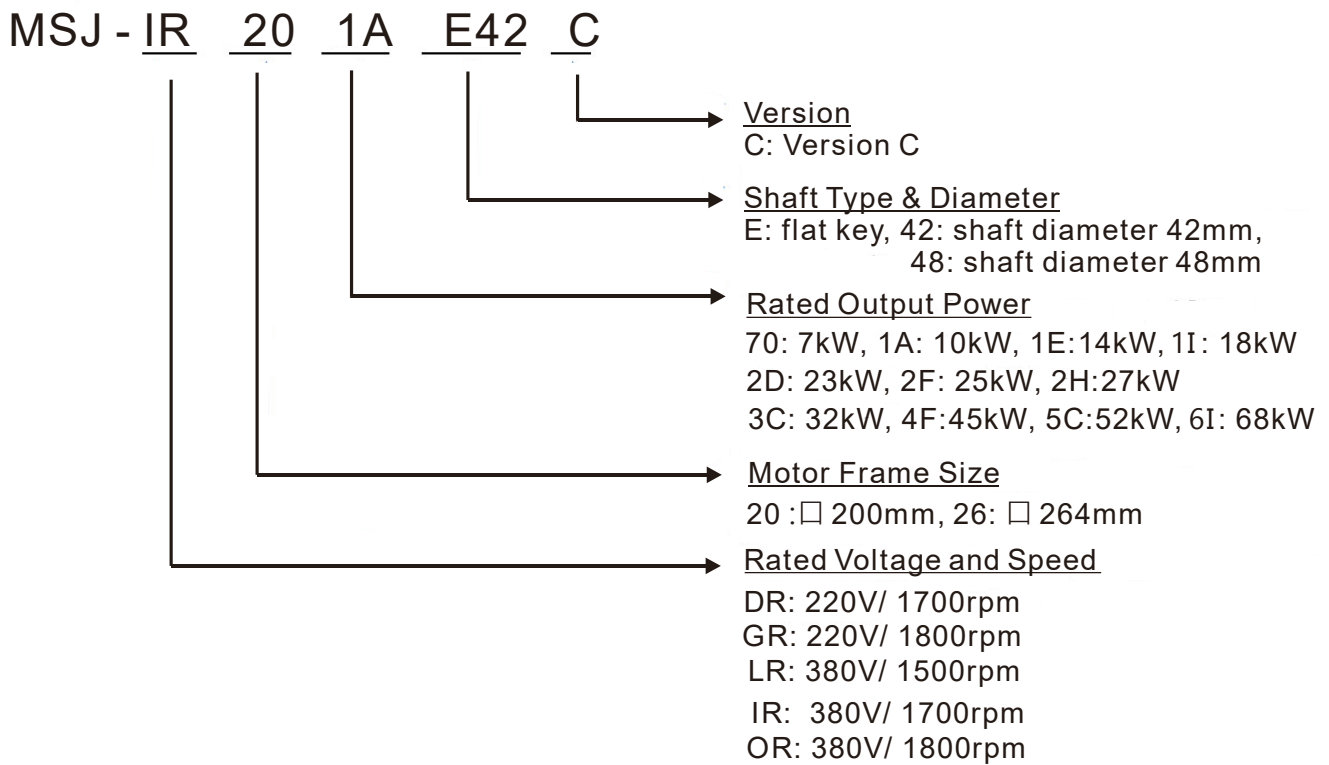
- This hybrid servo drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer.
  - The accessories produced by Delta are only for using with Delta hybrid servo drive. Do not use with other drive to prevent damage.
  - Do not use accessories, which are not produced or recommended by Delta on Delta hybrid servo drive.
-



## C-1 Product Description

Introducing Delta MSJ servo motors, which are designed for hybrid servo system. The Delta MSJ servo motors have specialized functions to provide efficient output when working with VFD-VJ hybrid servo drives.

## C-2 Model Name Explanation



## C-3 Motor Specifications

### 220V:

Model		MSJ-_____C				
		DR201AE42	DR201EE42	DR201IE42	GR202DE42	DR202HE42
Pr01-35 Motor ID#		216	218	220	222	224
Voltage		220V				
Rated Output Power	kW	10	14	18	23	27
No. of Poles		8				
Rated Torque	Nm	58	81.5	103	122	154
Maximum Torque	Nm	116	176	210	282	308
Rated Speed	rpm	1700	1700	1700	1800	1700
Maximum Speed*1	rpm	2100	2200	2200	2250	2200
Rated Current	A	38	53	69	87	101
Torque Constant	Nm/A	1.52	1.54	1.49	1.47	1.52
Voltage Constant	V/krpm	100	95	96.5	90	95
Phase Resistance	ohm	0.239	0.145	0.110	0.064	0.060
Inductance	mH	2.740	1.791	1.438	0.939	0.864
Rotor Moment of Inertia	kg-m <sup>2</sup>	6.8 x10 <sup>-3</sup>	9.0 x10 <sup>-3</sup>	11.7 x10 <sup>-3</sup>	13.3 x10 <sup>-3</sup>	17.5 x10 <sup>-3</sup>
Weight	kg	46	53	59.5	67.5	83.6
Frame	mm	200 x 200				
Insulation Class	Class F ( Winding Class H)					
Protection Class	IP54					
Efficiency Class	IE3 / GB30253-2013 (Chinese Standard on Minimum Allowable Values of Energy Efficiency and Energy Efficiency Grades					
Cooling Method	Fan cooling by AC Fan (220V <sub>AC</sub> )					
Encoder	Resolver 2 Poles					
Motor Temperature Protection	PTC temperature protection and KTY84-130 temperature sensor *3					
Operating Environment	Temperature :-15 ~ 40°C Humidity: 20 ~ 90% RH (Non-condensation) Altitude <1000m					
Installation Method	Flange / Support Legs					
Certifications	CE					

**380V:**

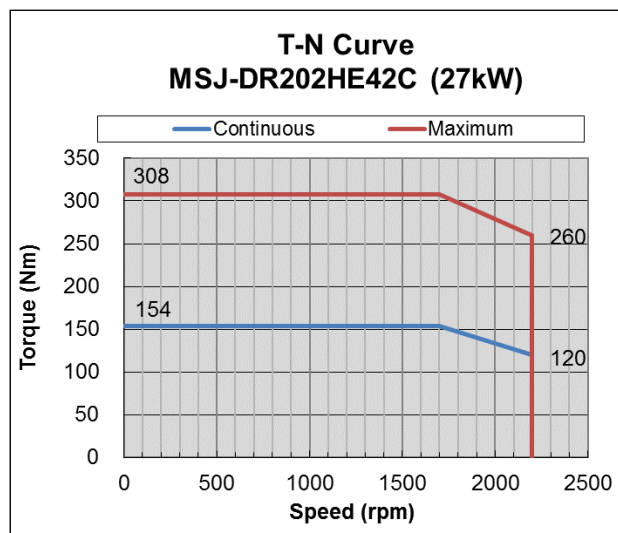
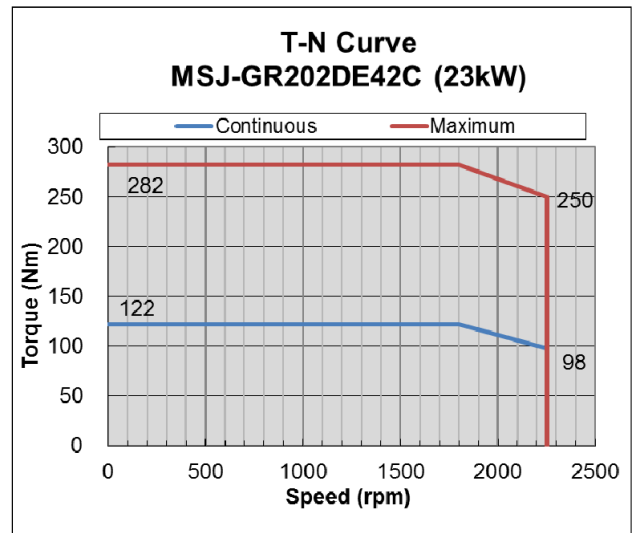
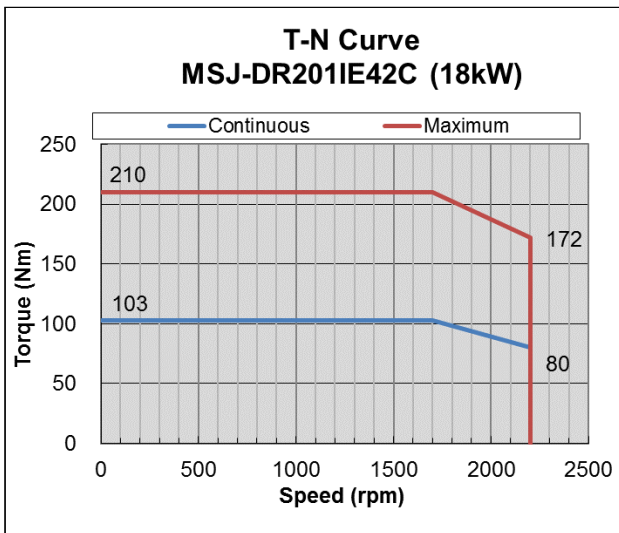
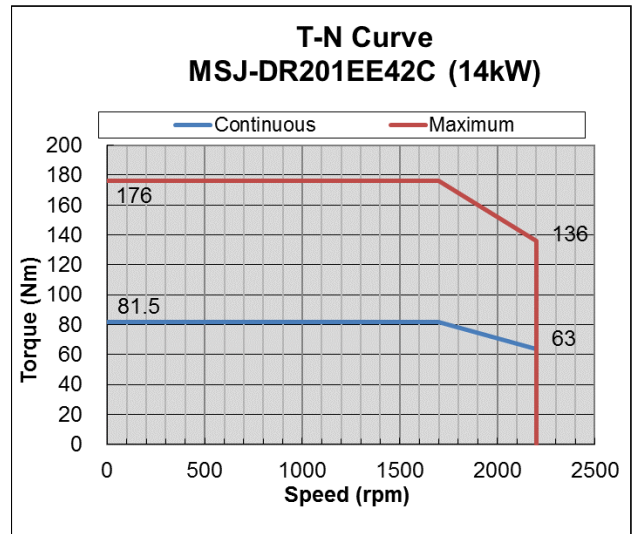
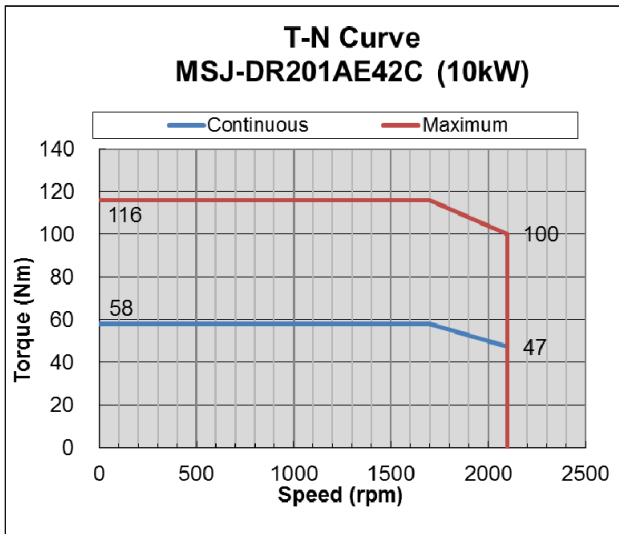
Model		MSJ-_____C								
		IR201AE42	IR201EE42	IR201IE42	OR202DE42	LR202FE42	IR203CE42	OR264FE48	IR265CE48	IR266IE48
Pr01-35 Motor ID#		217	219	221	223	225	227	229	231	TBA
Voltage		380V								
Rated Output Power	kW	10	14	18	23	25	32	45	52	68
# of Poles		8								
Rated Torque	Nm	58	83	103	120	159	180	240	295	385
Maximum Torque	Nm	112	155	208	215	336	320	365	455	695
Rated Speed	rpm	1700	1700	1700	1800	1500	1700	1800	1700	1700
Maximum Speed	rpm	2150	2150	2150	2250	1950	2150	2250	2150	2150
		<i>*1</i>								
Rated Current	A	23	32.8	42.1	46.7	55.9	70	96.5	115	149
Torque Constant	Nm/A	2.52	2.53	2.45	2.57	2.85	2.6	2.49	2.57	2.58
Voltage Constant	V/krpm	171	171	180	171	192	177	175	182	190
Phase Resistance	ohm	0.673	0.396	0.319	0.271	0.232	0.148	0.088	0.074	0.047
Inductance	mH	8.584	6.218	4.663	3.995	3.636	2.740	2.385	2.305	1.721
Rotor Moment of Inertia	kg-m <sup>2</sup>	7.4	9.6	11.6	13.8	18.0	19.1	41.6	50.5	61.4
		x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>	x10 <sup>-3</sup>
Weight	kg	46	53	59.5	67.5	83.6	85	134	152	171
Frame	mm	200 x 200						264 x 264		
Insulation Class	Class F (Winding Class H)									
Protection Class	IP54									
Efficiency Class	IE3 / GB30253-2013 (Chinese Standard on Minimum Allowable Values of Energy Efficiency and Energy Efficiency Grades)									
Cooling Method	Fan Cooling (AC Fan 220V <sub>AC</sub> )									
Encoder	Resolver 2 Poles									
Motor Temperature Protection	PTC temperature protection <sup>*2</sup> and KTY84-130 temperature sensor <sup>*3</sup>									
Operating Environment	Temperature: -15 ~ 40°C Humidity 20 ~ 90% RH (Non-condensation) Altitude <1000m									
Installation Method	Flange / Support Legs									
Certifications	CE									

\*1: This chart states the maximum operation speed of a motor with no field-weakening control.

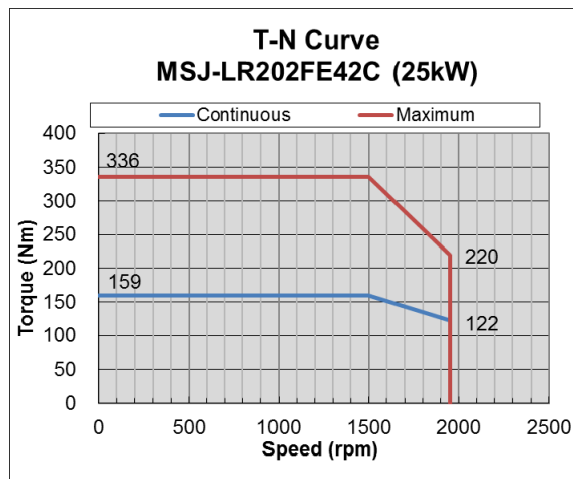
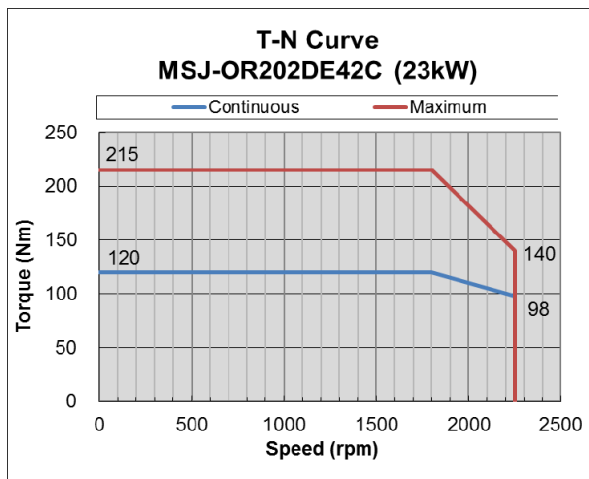
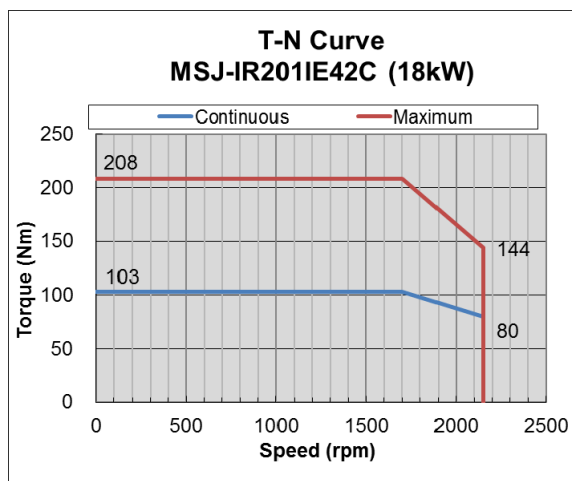
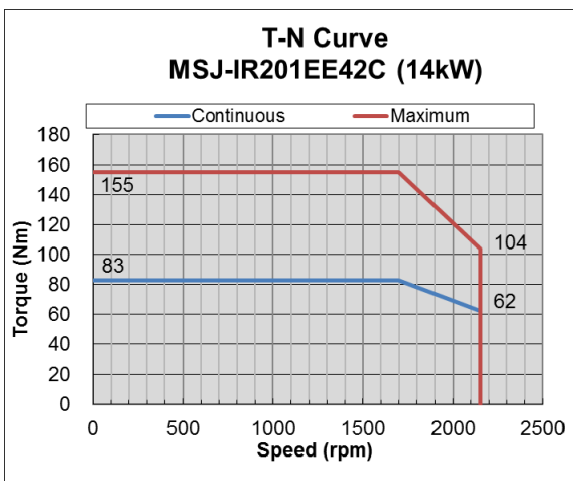
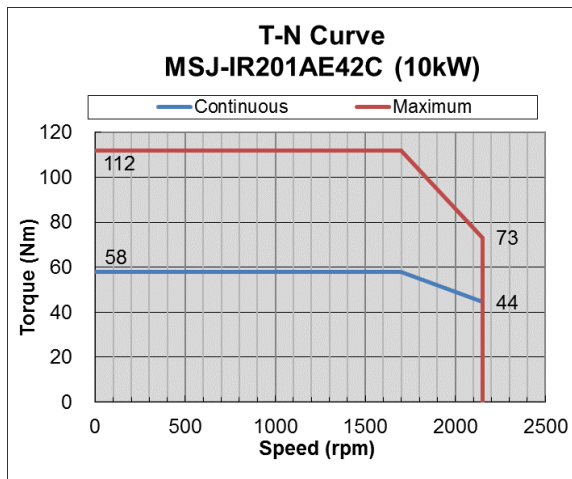
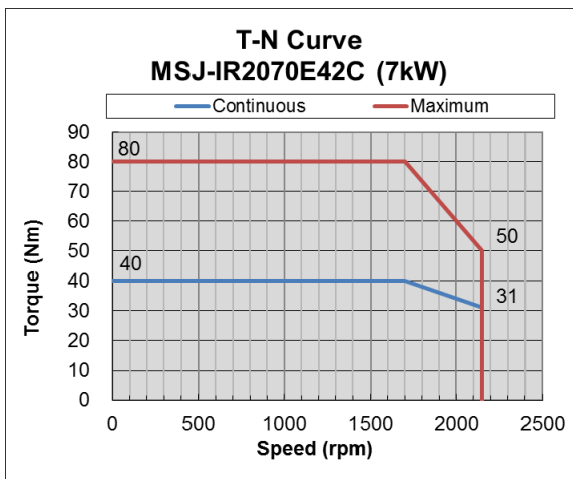
- \*2: Set up PTC type Pr02-11 =2 to use PTC130 as temperature protection.
- \*3: Users are required to set up the parameter Pr02-09 PTC Level (factory setting: 130 °C) when using the KTY84-130 temperature sensor (PTC type Pr02-11 =1) for motor overheating protection.
- \*4: Delta reserves the right to revise specifications without prior notice.

### C-4 Torque – Rotation characteristic curve

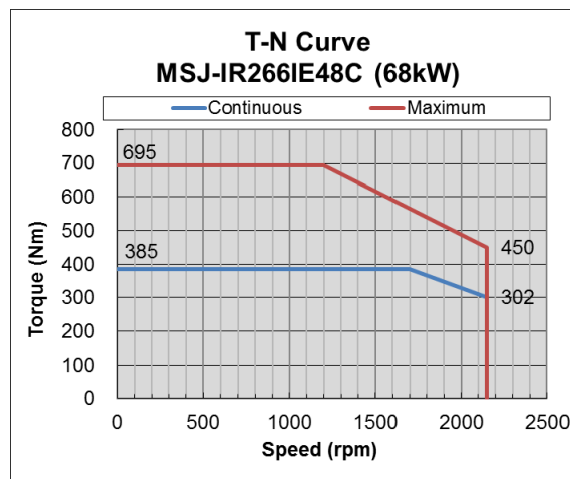
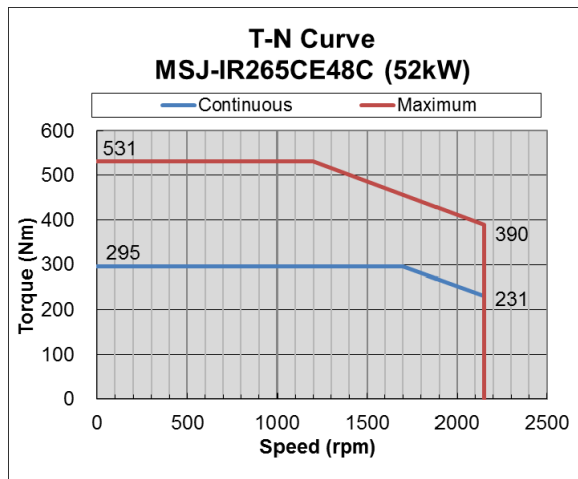
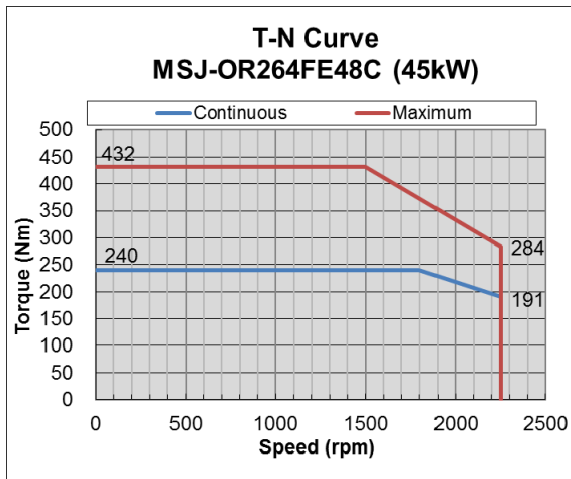
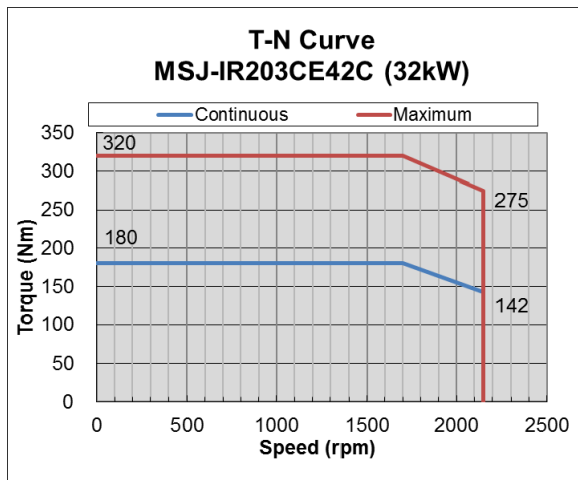
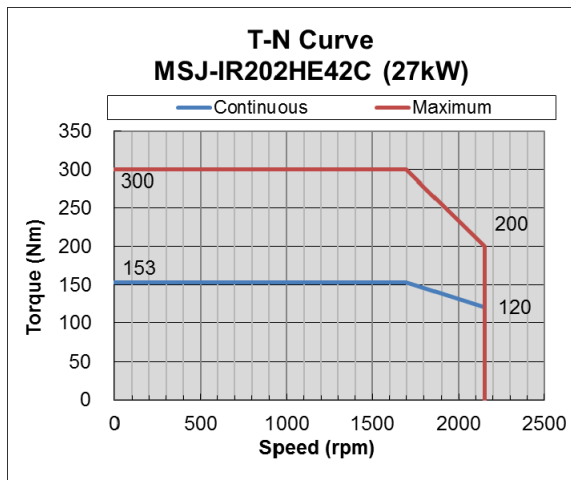
220V:



380V:



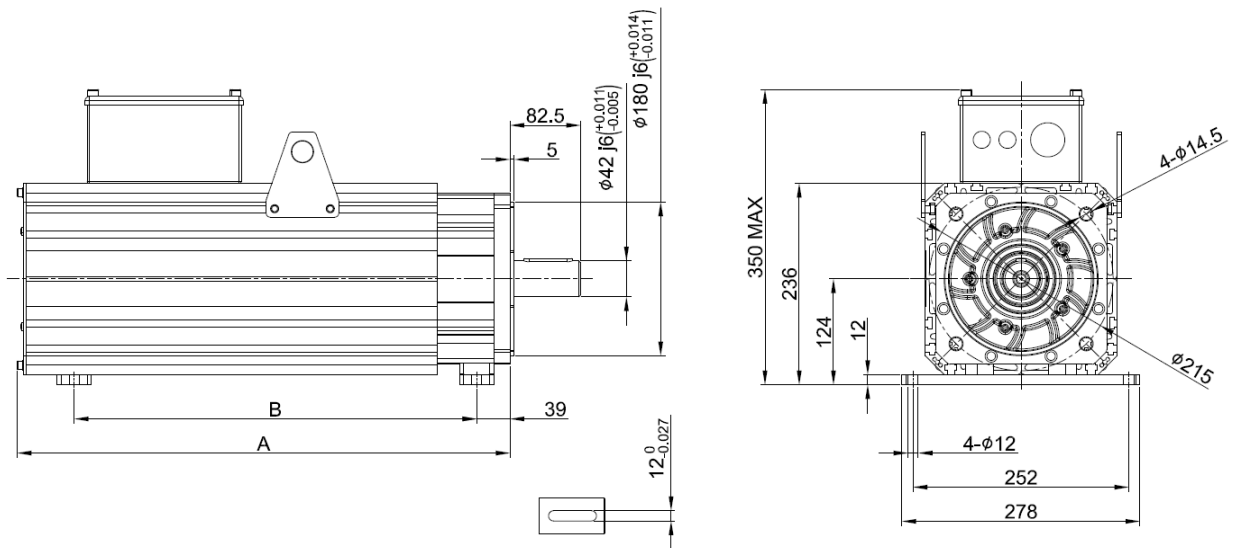
**380V:**



## C-5 Product Appearance and Dimensions

**220V:**

C-5-1: Frame 200



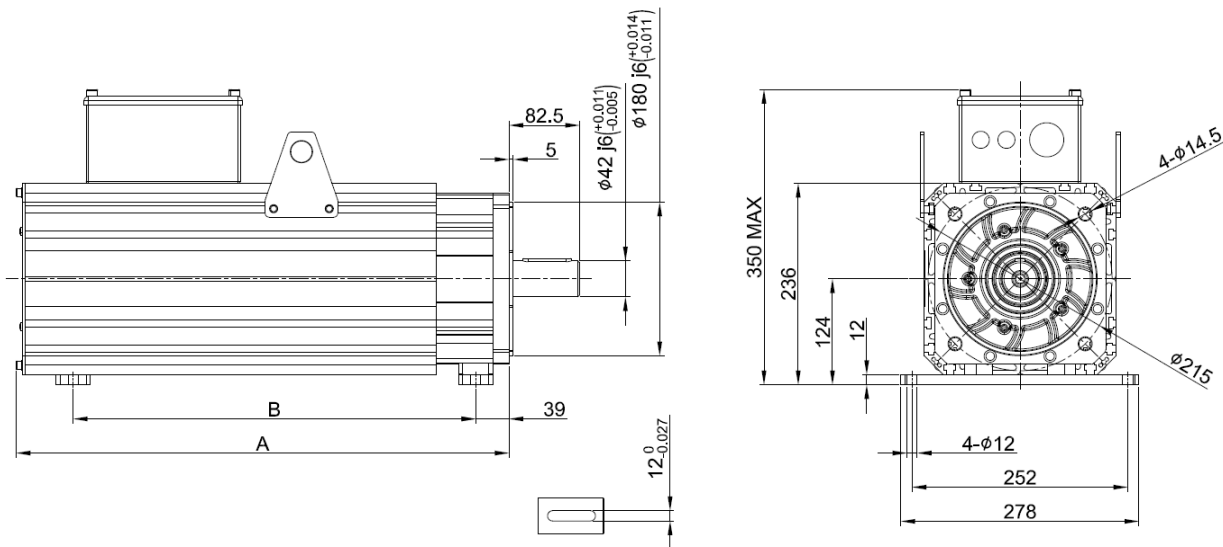
Model		MSJ-_____C				
		DR201AE42	DR201EE42	DR201IE42	GR202DE42	DR202HE42
A	mm	381	417	453	489	575
B	mm	285	310	350	395	470

\*Note: Size of Model B can be customized according to your requirement.



**380V:**

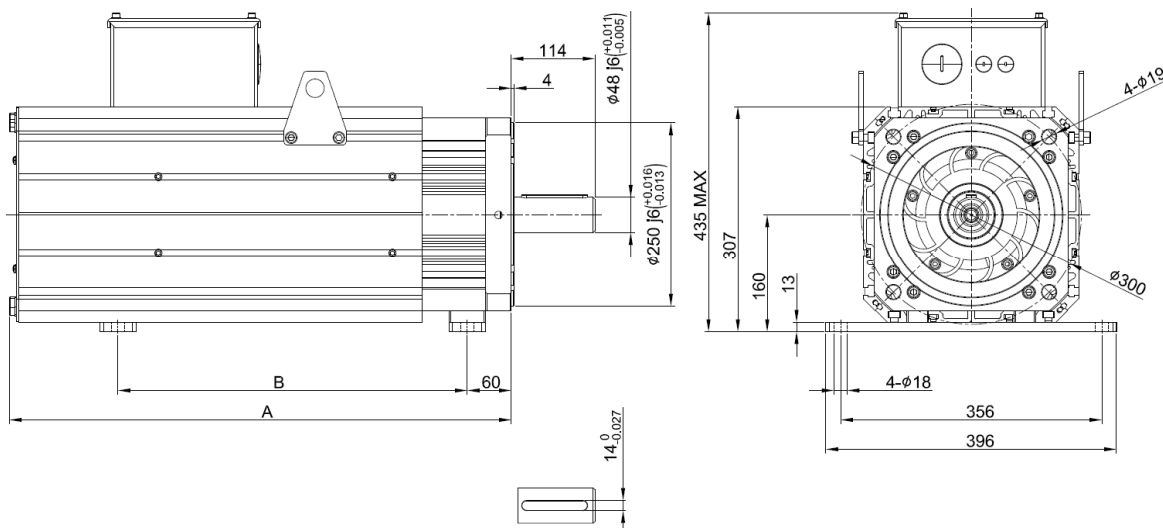
**C-5-2: Frame 200**



Model		MSJ-_____C					
		IR201AE42	IR201EE42	IR201IE42	OR202DE42	LR202FE42	IR203CE42C
A	mm	381	417	453	489	575	590
B	mm	285	310	350	395	470	470

\* Note: Size of Model B can be customized according to your requirement.

**C-5-3: Frame 264**

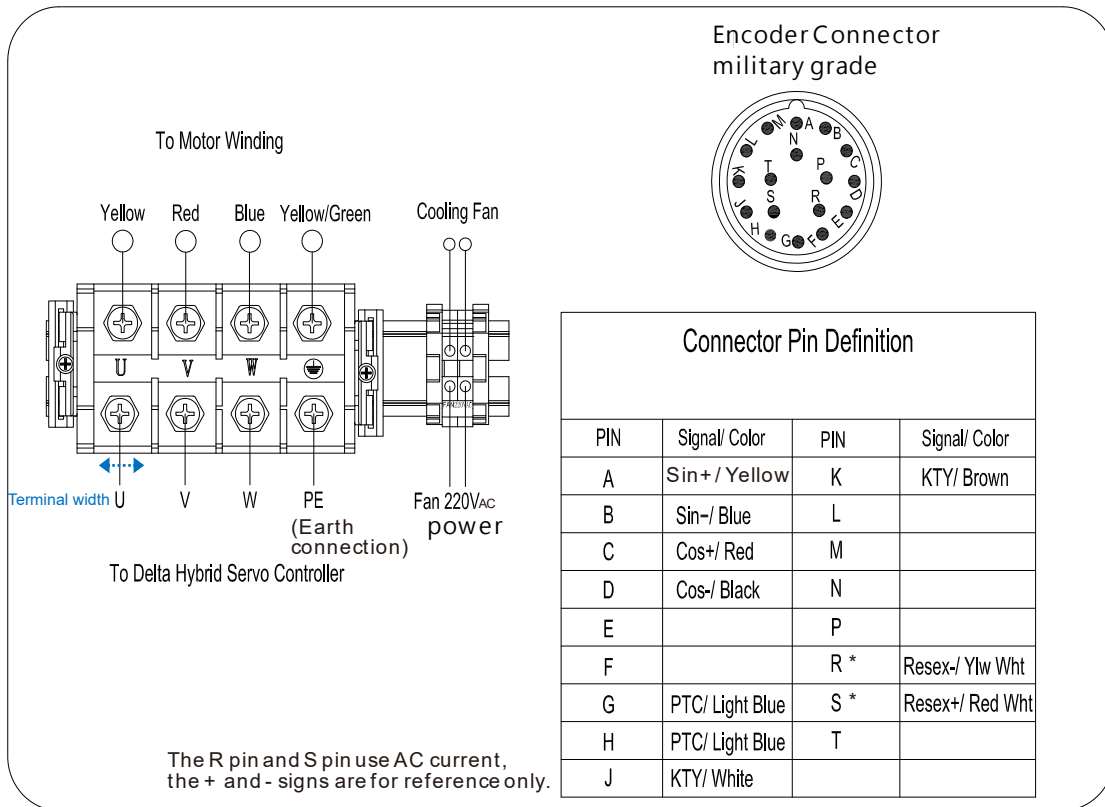


Model		MSJ-_____C		
		OR26 4FE48	IR26 5CE48	IR26 6IE48C
A	mm	577	631	684
B	mm	370	423	476

\*Note: Size of Model B can be customized according to your requirement.

## C-6 Wiring of Servo Oil Pump

### C-6-1: Wiring Box of 220V & 380V



### C-6-2: Recommended Wiring Size and Temperature Rating

#### 220V:

Model		MSJ-_____C				
		DR201AE42	DR201EE42	DR201IE42	GR202DE42	DR202FE42
Minimum Wiring Size	AWG	6	5	4	3	2
	mm <sup>2</sup>	13.5	17	21	27	35

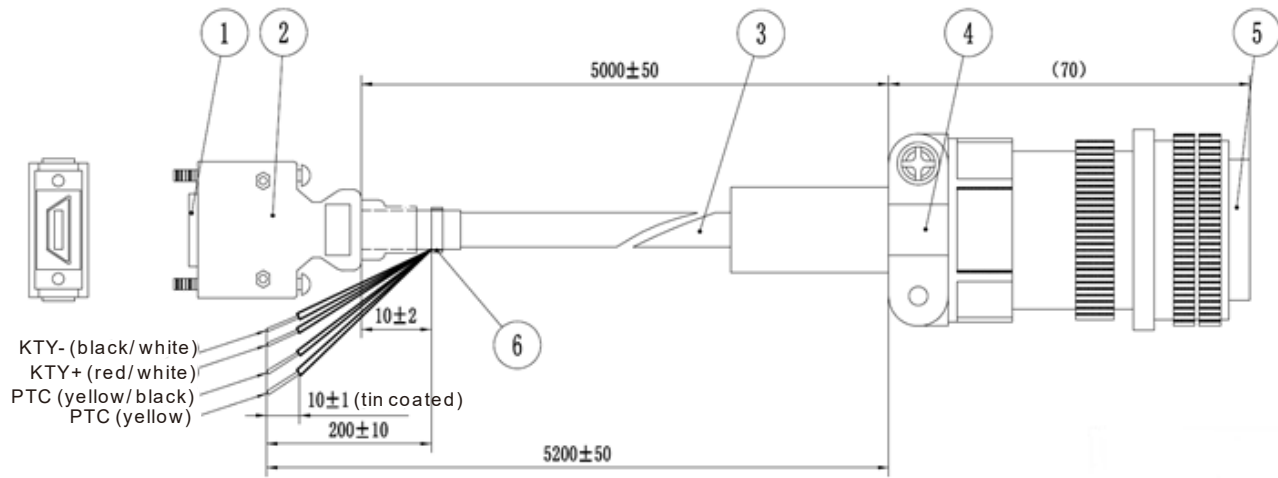
\*Must use copper wires of temperature rating 90°C for installation.

#### 380V:

Model		MSJ-_____C								
		IR2070E42	IR201AE42	IR201EE42	IR201IE42	OR202DE42	LR202FE42, IR202HE42	IR203CE42	OR264FE48, IR265CE48	IR266IE48
Minimum Wiring Size	AWG	10	8	7	6	5	4	3	2	1
	mm <sup>2</sup>	5.3	8.5	10.5	13.5	17	21	27	35	45

\*Must use copper wires of temperature rating 90°C for installation.

**220V & 380V:**



1	SCSI(MDR) Plug <Drive Side>
2	MDR Shell with SCSI terminal
3	Cable
4	Strain Relief
5	Military Connector <Motor Side>
6	Cable Tie