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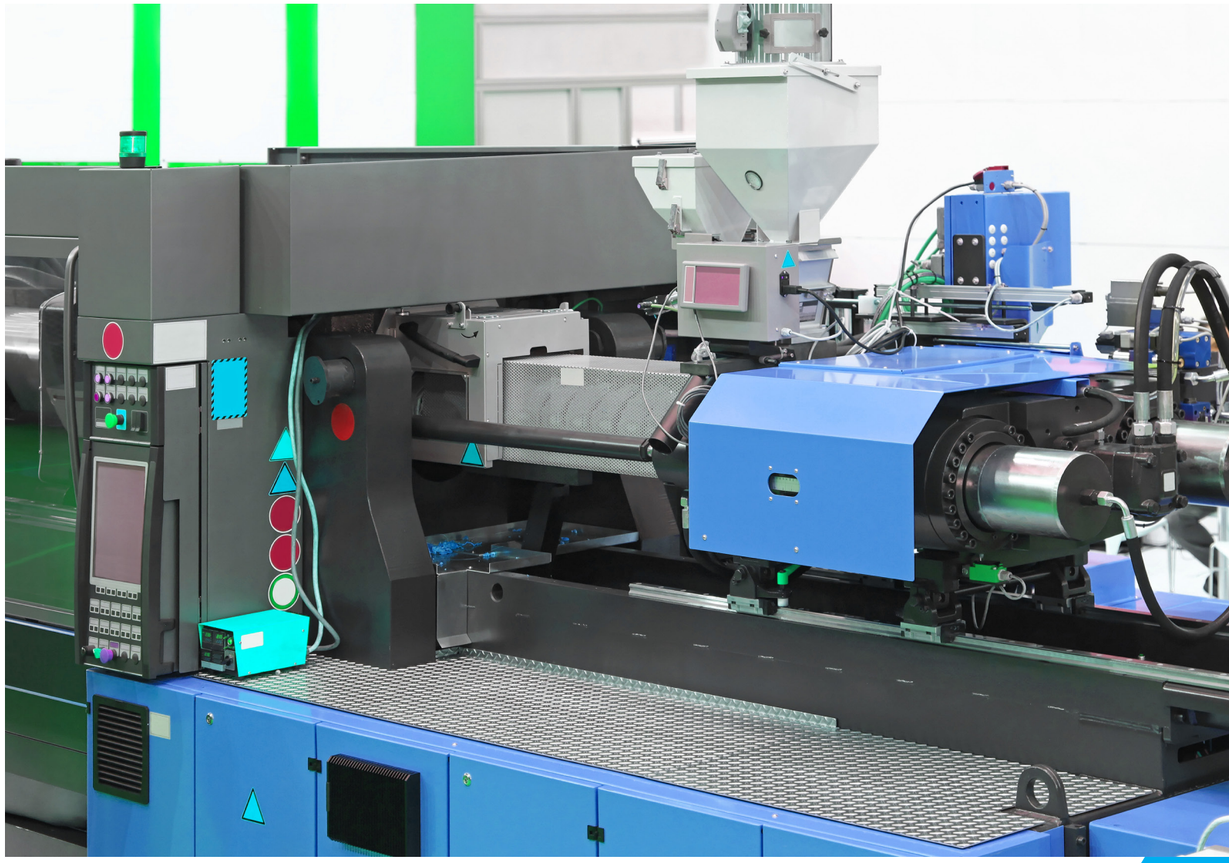
Delta Hybrid Servo Drive VFD-VJ Series - Air Cooled & Oil Cooled User Manual



Delta Hybrid Servo Drive VFD-VJ Series - Air Cooled & Oil Cooled User Manual

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Preface

Thank you for choosing Delta's high-performance hybrid servo drive VFD-VJ Series dedicated to plastic injection molding machine. The VFD-VJ series products are made of high quality components and materials that incorporate the latest microcontroller technology.

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: V1.02

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

- ☑ 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_{DC} 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 AC motor 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 AC motor 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 3-phase AC motor is stop, a charge may remain in the main circuit terminals of the AC motor drive with hazardous voltages. ☑ Only qualified persons are allowed to install, wire and maintain AC motor 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.
 CAUTION	☑ 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 Reactor for details. ☑ The rated voltage for hybrid servo drive must be ≤ 240V (≤ 480V for 460V models) and the mains supply current capacity must be ≤ 5000A RMS (≤10000A RMS for the ≥ 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°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

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1. Description of Hybrid Servo Drives

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 ˚C to +60 ˚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˚C. Temperature above 30˚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.

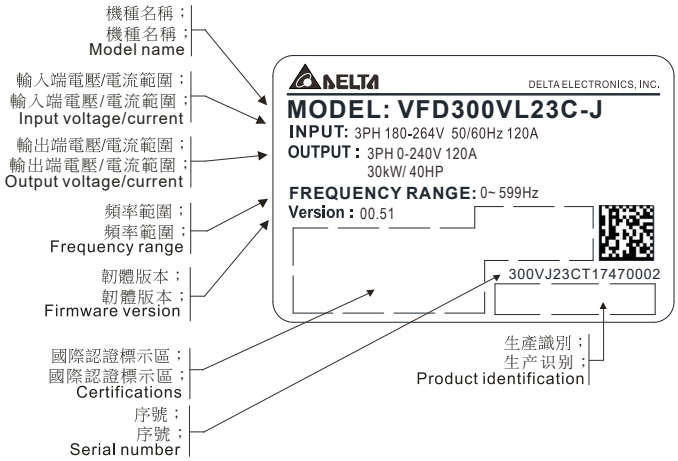
☑ Make sure the model name on the nameplate corresponds to that of your registered information in the shipping carton.

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.

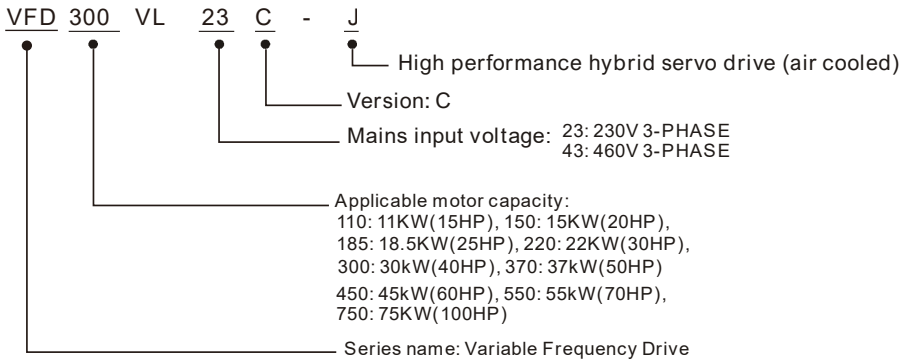
Air Cooled:

Nameplate:

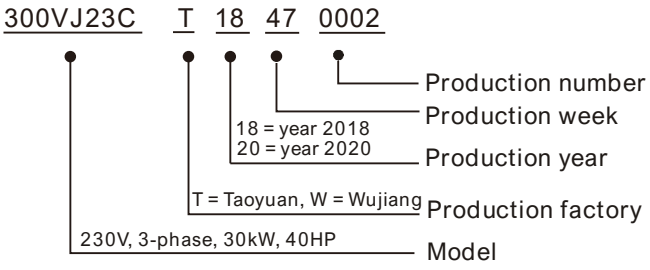
Take the 30kW, 40HP, 230V_{AC} 3-Phase model as an example.



Model Name:



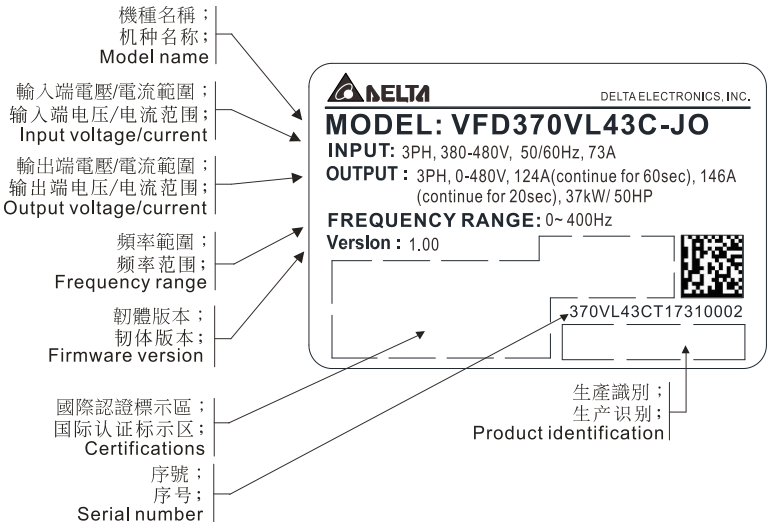
Serial Number:



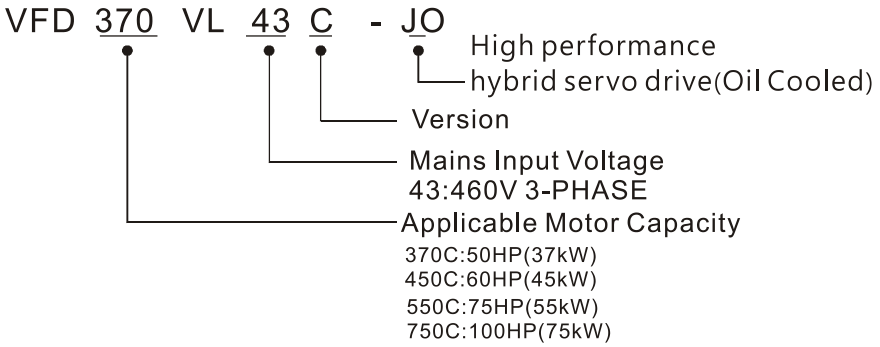
Oil Cooled:

Nameplate:

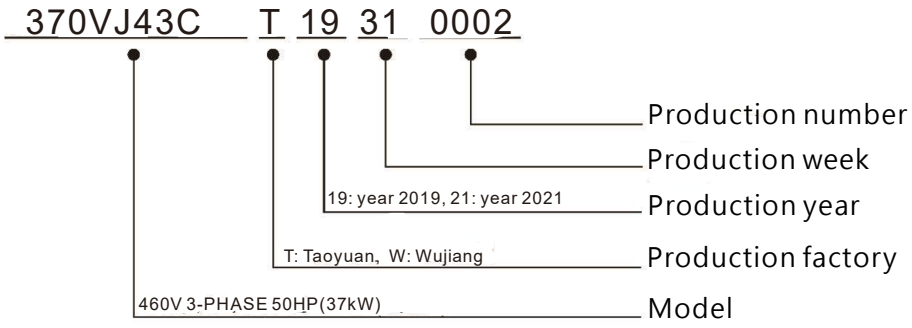
Take the 37kW, 50HP, 460V_{AC} 3-Phase model as an example.



Model Name:



Serial Number:



1-2 Product Specifications

Air Cooled VFD-VJ-C 230 series

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 series

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	110	155	187	255
	Continuous Output Current for 20 sec (A)	42	54	68	82	120	124	182	220	300
	Carrier Frequency (Hz)	4k ~ 10k adjustable								
Power Supply	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								

Oil Cooled VFD-VJ-C 460V series

Frame Size		E5				
Model VFD-___ VL43_-JO		300 C	370 C	450 C	550 C	750 C
Power (kW)		30	37	45	55	75
Horse Power (HP)		40	50	60	75	100
Output	Continuous Output Current for 60 sec (A)	102	124	155	187	255
	Continuous Output Current for 20 sec (A)	120	146	182	220	300
Power supply	Rated Input Current(A)	60	73	91	110	150
	Rated Input Voltage(V)	3-Phase. 380 ~ 480V · 50 / 60Hz				
	Mains Voltage Tolerance	-15~ +10% (323 ~ 528V)				
	Mains Frequency Tolerance	±5% (47 ~ 63Hz)				
Carrier Frequency*		4kHz ~ 10kHz adjustable				
Maximum Braking Current (A)		40	60	60	80	120
Minimum Resistance (Ω)		19	12.7	12.7	9.5	6.3
Weight (kg)		40	40	40	40	40
Cooling Method		Oil Cooled Hydraulic Oil: HL-HLP DIN 51524 Part1/2 R68, R46 Oil Temperature: 10 ~ 50 ºC				
Required cooling flow rate (L/Min.)		16	16	16	16	32

*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.

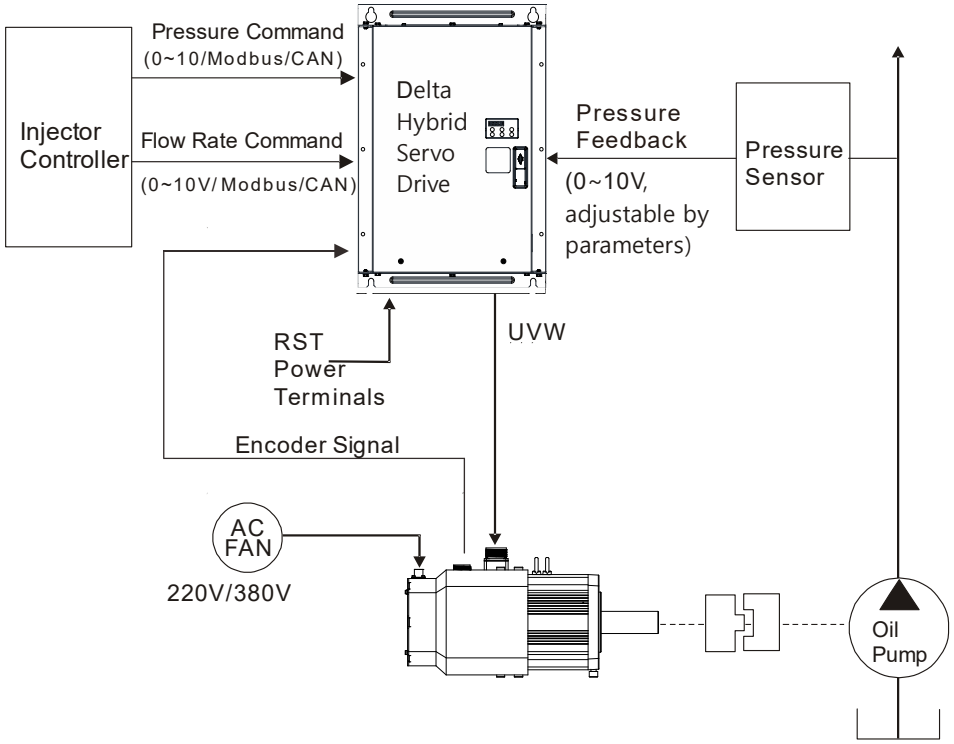
**To continuously improve our products, we reserve the rights to change features and specifications without further notice.

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	-10ºC ~ 45ºC (14°F ~ 113°F) (When the ambient temperature is around 45~60ºC, you need to decrease the rated current by 3%.)
	Storage Temperature	-20ºC ~ 60ºC (-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; Model names end with JO: Oil 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^2 every year.
Certifications		CE

We have applied for UL certification and will pass the certification sometime in 2019.

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*1000 = 32 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*32*1.3/ (2*pi) = 116 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 kt (Torque/A) in the motor's specifications fist. If kt = 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 ºC), (50 ºF ~ 122 ºF) 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 pope 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

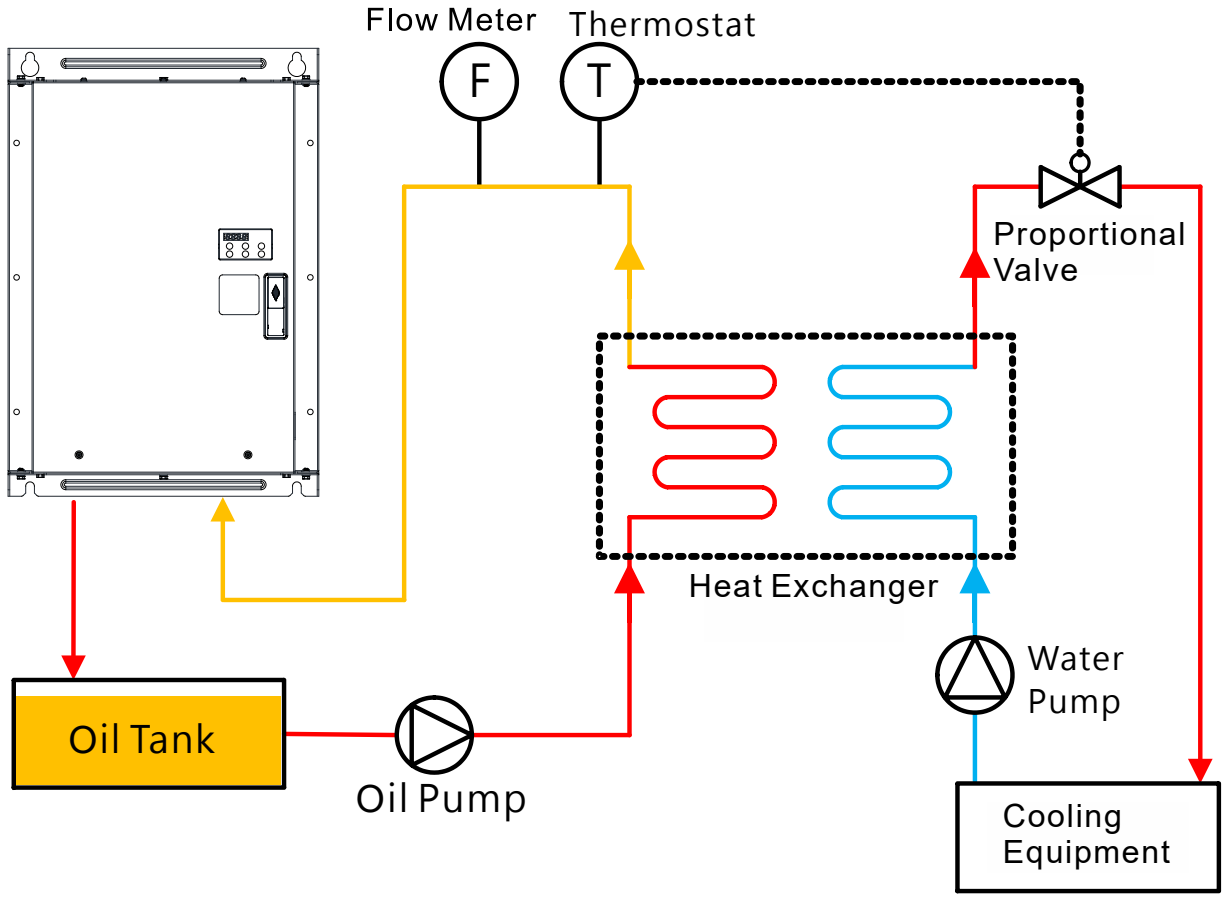
Select a pump with a suitable displacement based on the required flow rate and motor speed;

- 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

Suggestion for Installing Oil Cooling Circulation System

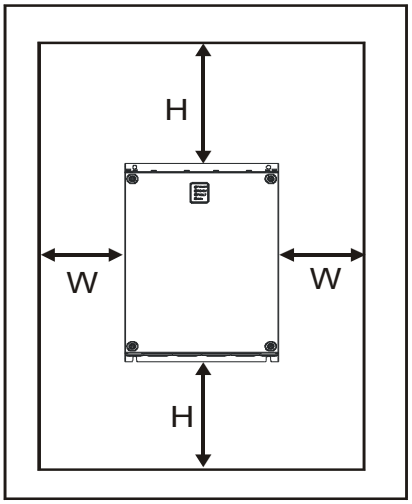


Please install the hybrid servo drive under the following environmental conditions to ensure safe use:

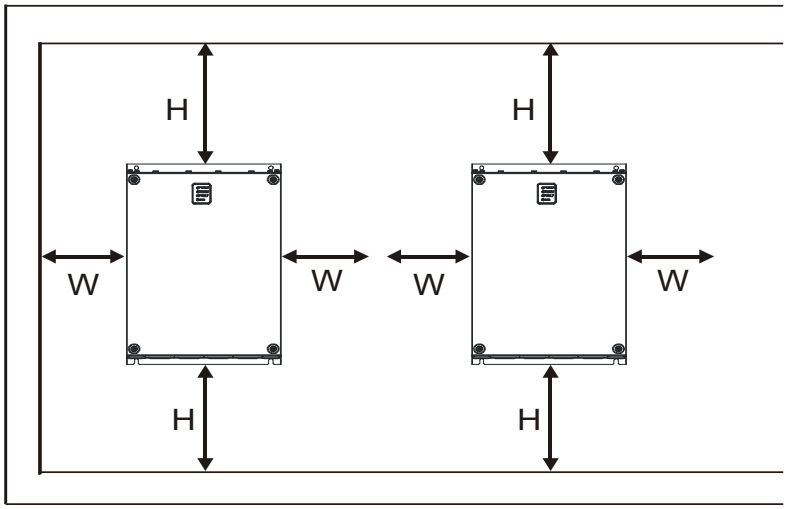
Environmental Condition for Operation	Ambient temperature Relative Humidity Pressure Installation Altitude Vibration	-10°C~ 45°C (14°F~ 113°F) <90% (non-condensing) 86 ~ 106 kPa <1000m <20Hz: 9.80 m/s^2 (1G) max; 20~50H:5.88 m/s^2 (0.6G) max
Environmental Condition for Storage and Transportation	Ambient temperature Relative Humidity Pressure Vibration	-20°C~ 60°C (-4°F ~ 140°F) <90% (non-condensing) 86 ~ 106 kPa <20Hz: 9.80 m/s^2 (1G) max; 20 ~ 50Hz: 5.88 m/s^2 (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

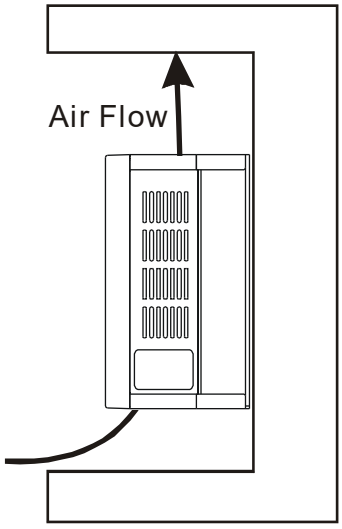


HP	**W** mm (inch)	**H** mm (inch)
7.5-20HP	75 (3)	175 (7)
25-75HP	75 (3)	200 (8)
50~100HP (oil cooled)	100 (4)	100(4)
100HP	75 (3)	250 (10)

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
460V Oil Cooled	VFD-300VL-43C-JO	1077.1	-
	VFD-370VL-43C-JO	1121.3	-
	VFD-450VL-43C-JO	1425.0	-
	VFD-550VL-43C-JO	1597.4	-
	VFD-750VL-43C-JO	2251.7	-

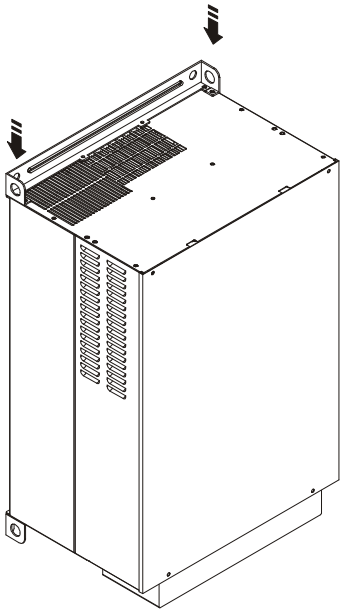
- ☑ The table above shows the required heat dissipation when installing a single drive in a confined space.
- ☑ When installing multiple drives, the required heat dissipation needs to be multiplied by the number of drives.
- ☑ The values of heat dissipation are calculated by rated voltage, rated current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

Lifting

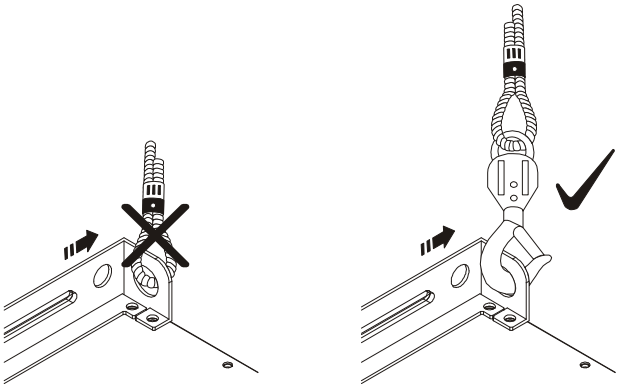
Carry only the fully assembled hybrid servo drives as shown in the following diagrams. Lift the hybrid servo drive by hooking the lift holes when driving a forklift or using a crane.

40-100HP

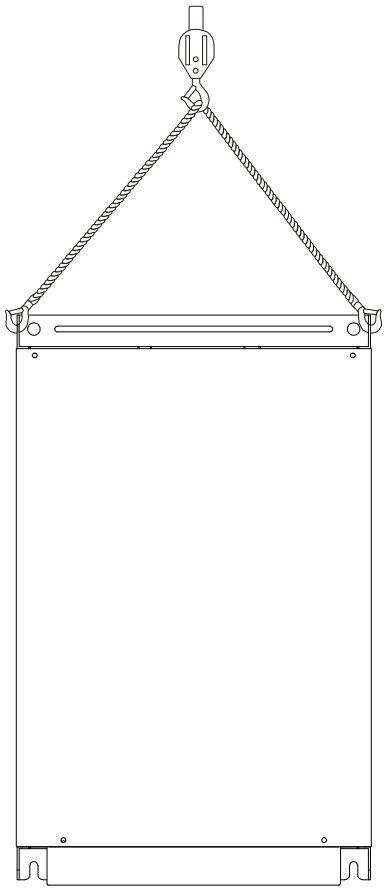
Step 1



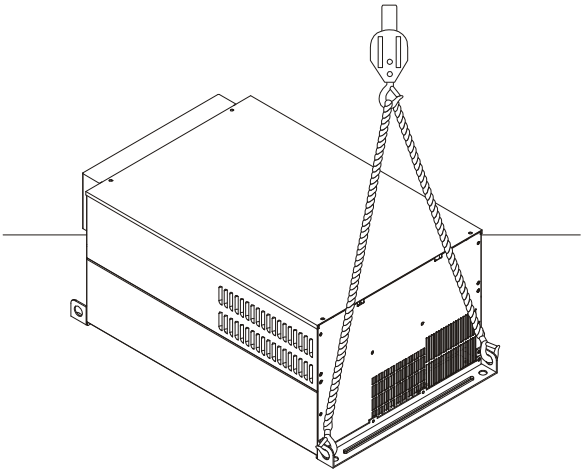
Step 2



Step 3



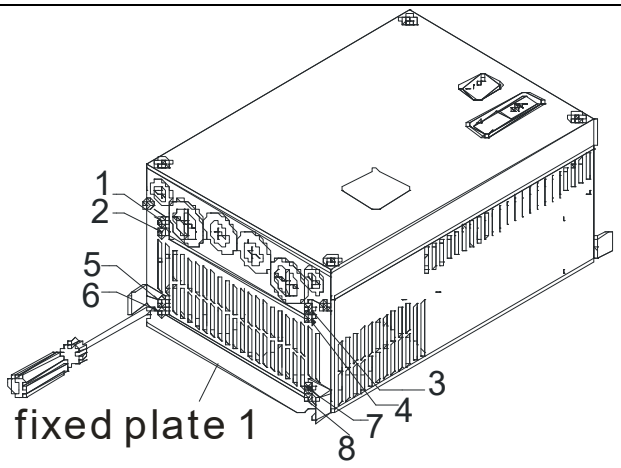
Step 4

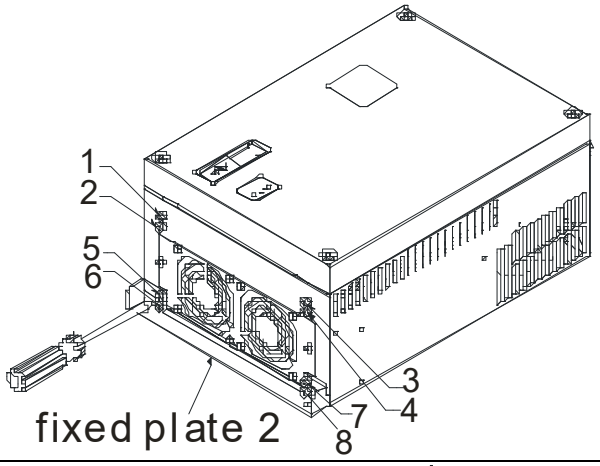


Flange Mounting

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.



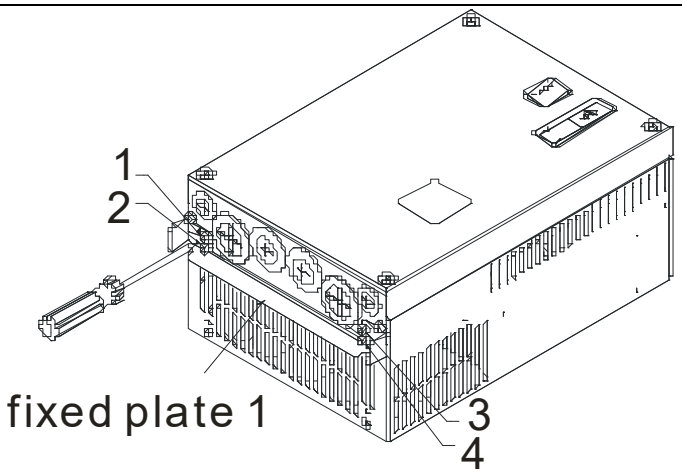


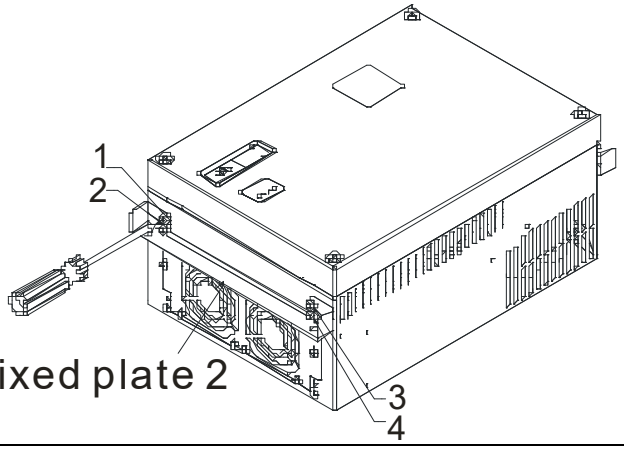
Step 2:

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: 14-17kgf-cm
[12.2-14.8in-lbf]

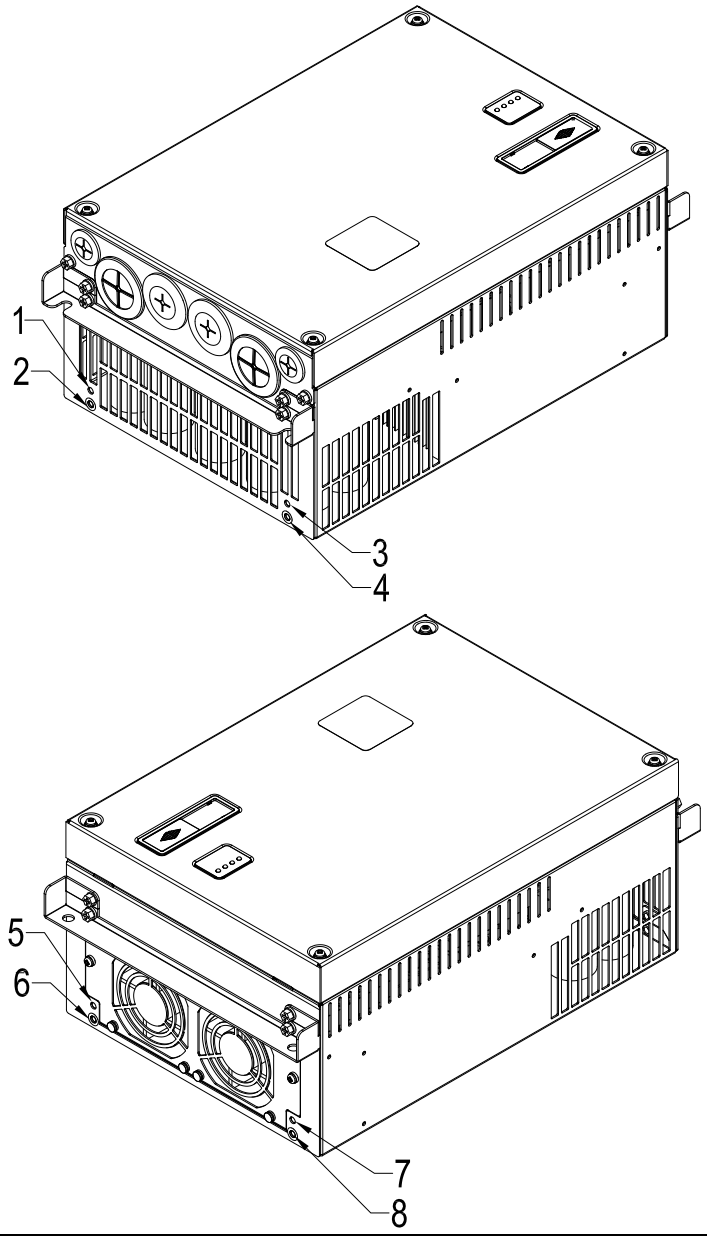
Frame D: 20-25kgf-cm
[17.4-21.7in-lbf]





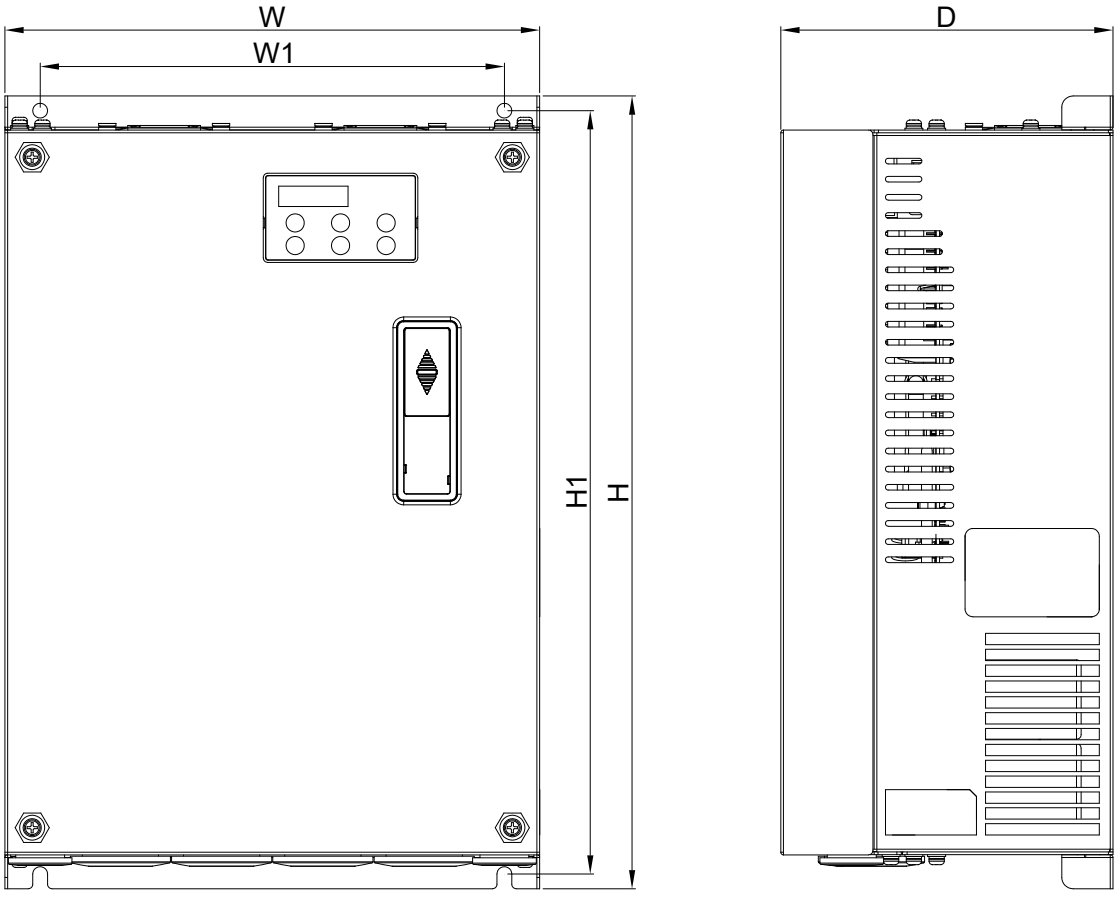
Step 3:

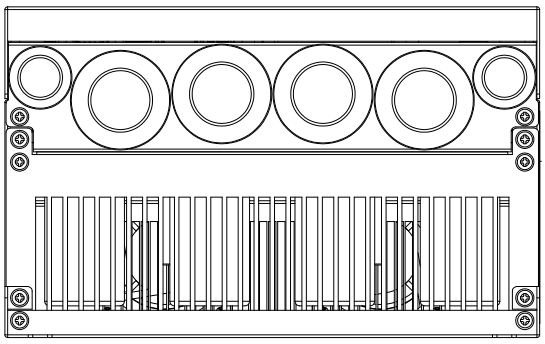
Note that it is not necessary to put back those 8 screws shown in the following figures to the drive. Moreover, make sure that these 2 different fixed plates are put in the correct side as shown in the figures.

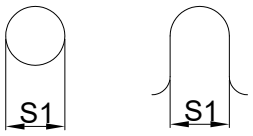


1-5 Product Dimensions

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



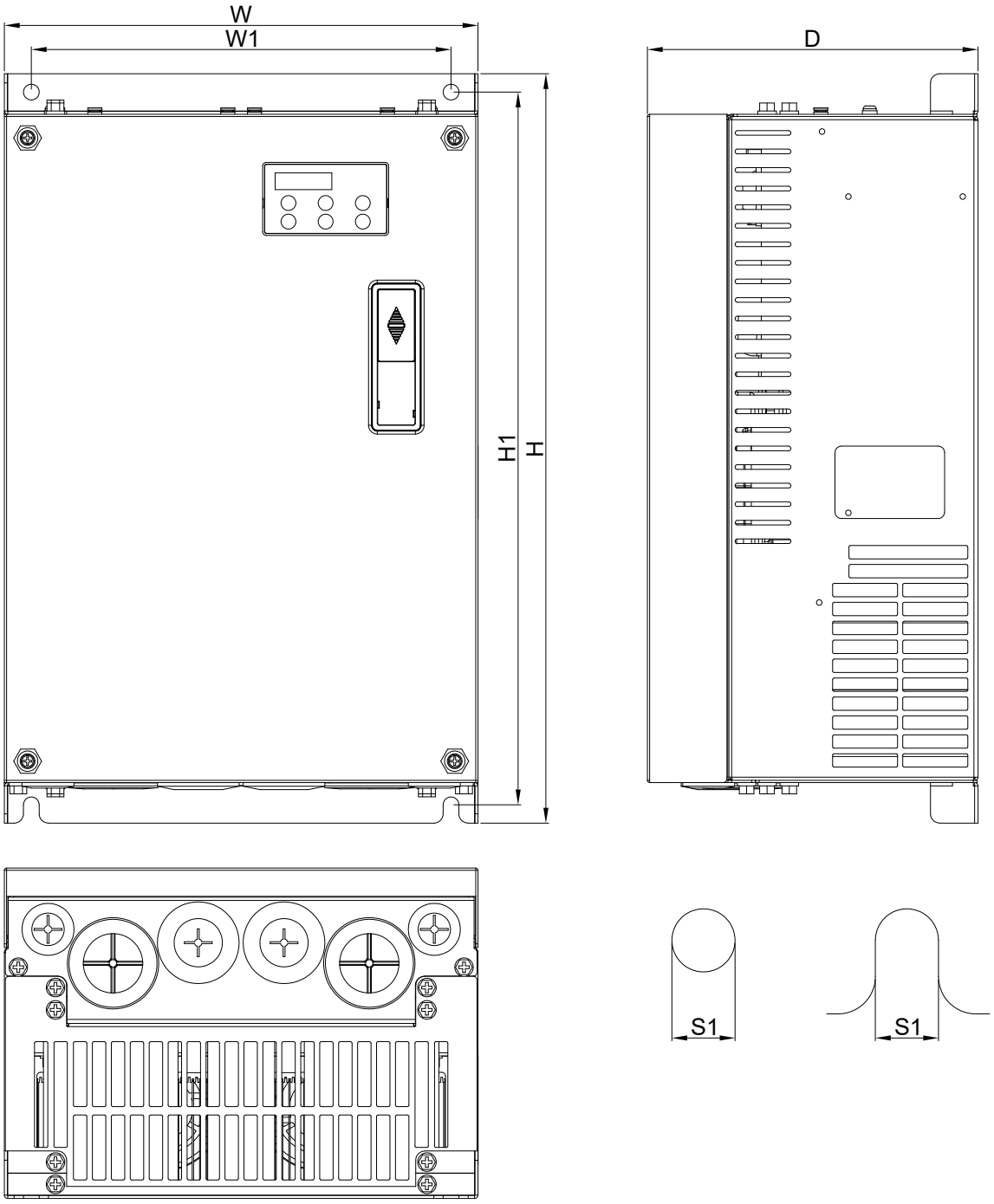




Unit: mm [inch]

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

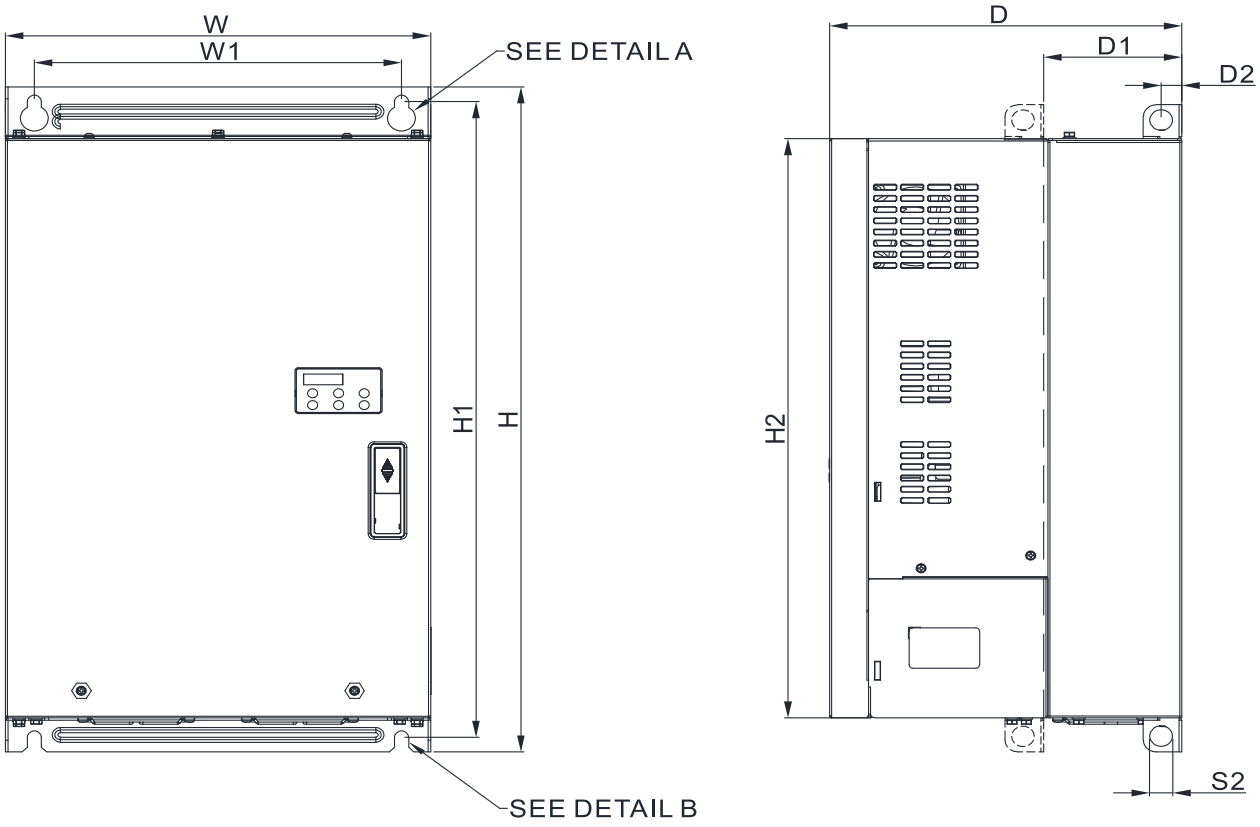
Frame D:
VFD300VL43C-J, VFD370VL43C-J

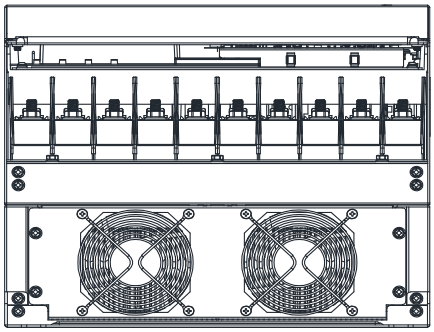


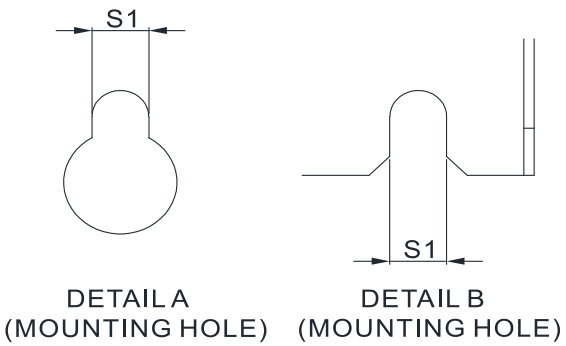
Unit: mm [inch]

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]

Frame E4:
VFD300VL23C-J, VFD370VL23C-J,
VFD450VL43C-J, VFD550VL43C-J, VFD750VL43C-J





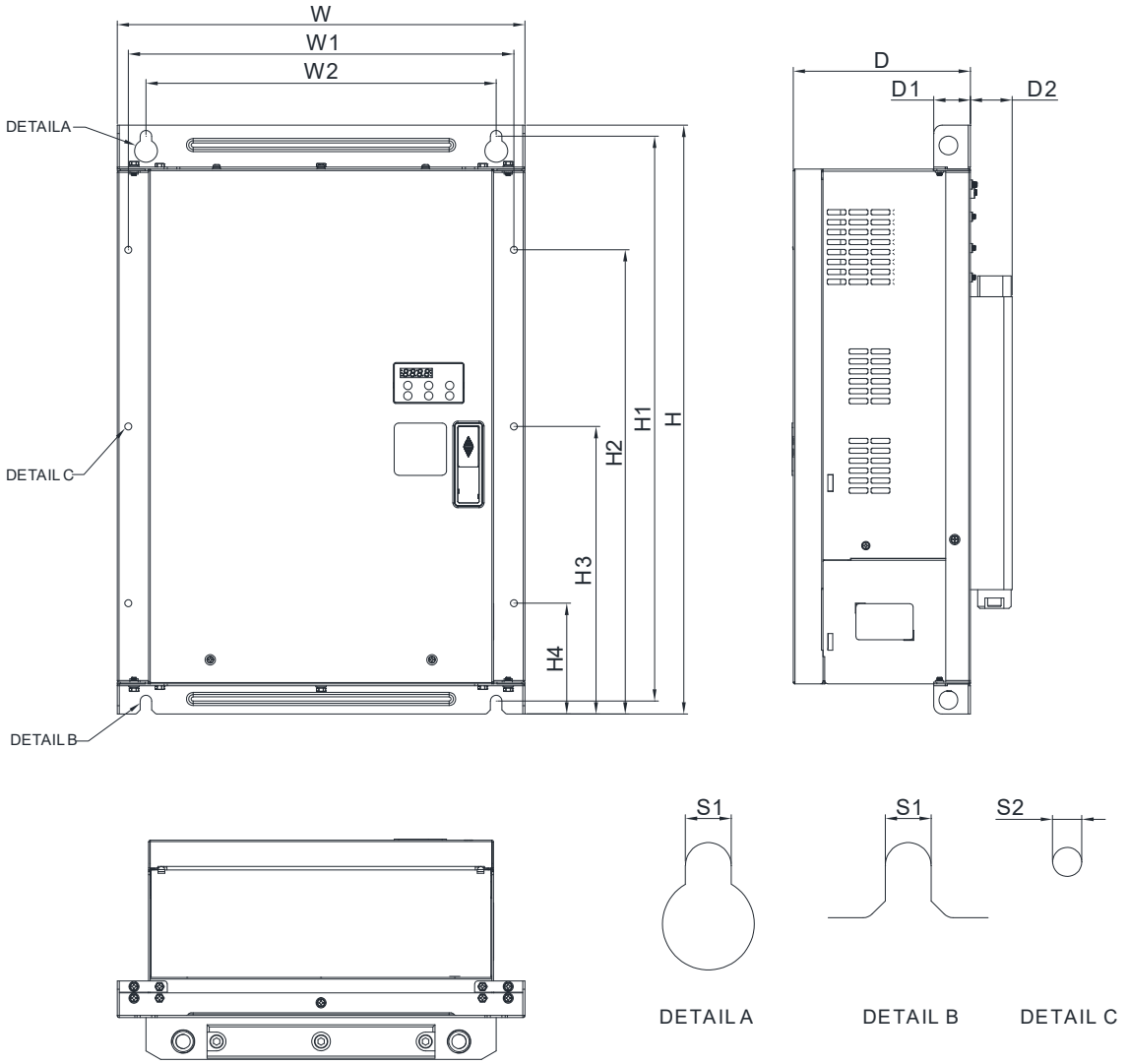


Unit: mm [inch]

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

Frame E5 (Oil Cooled):

VFD300VL43C-JO, VFD370VL43C-JO, VFD450VL43C-JO,
VFD550VL43C-JO, VFD750VL43C-JO



Unit: mm [inch]

Frame	W	W1	W2	H	H1	H2	H3	H4	D	D1	D2	S1	S2
E5	390.0 [15.35]	368.8 [14.52]	335.0 [13.19]	563.0 [22.17]	540.0 [21.26]	444.0 [17.48]	275.0 [10.83]	106.0 [4.17]	209.4 [8.24]	35.0 [1.38]	40.0 [1.57	11.0 [0.43	7.0 [0.28]

2. Wiring

2-1 Description of Wiring

2-2 Description of Terminals on Main Circuit

2-3 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?

2-1 Description of Wiring

Users must connect wires according to the circuit diagrams on the following pages.

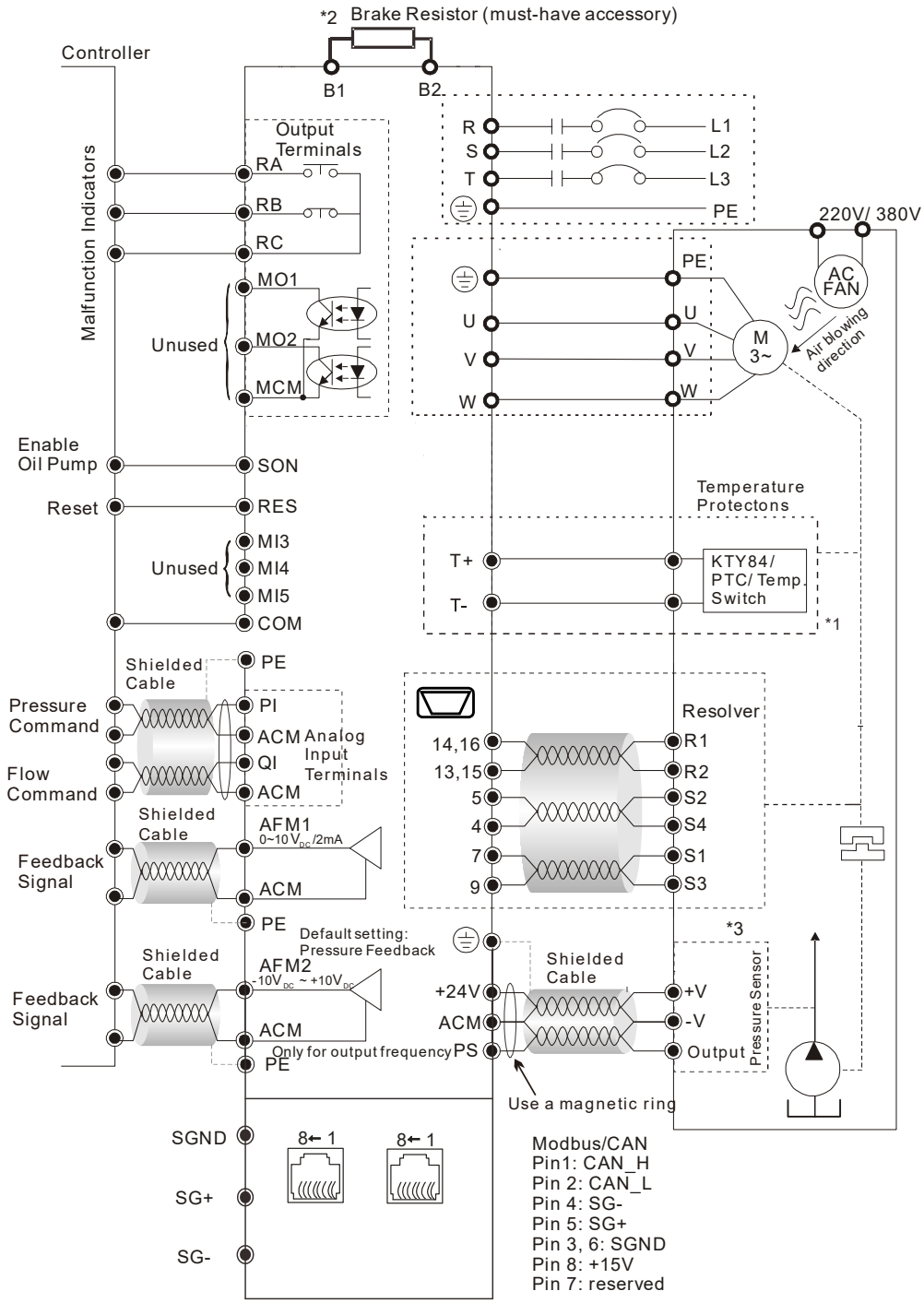
Standard wiring diagram of the VFD-VJ hybrid servo drive in factory

Wiring Diagram and Corresponding Models:

VFD300VL23C-J, VFD370VL23C-J

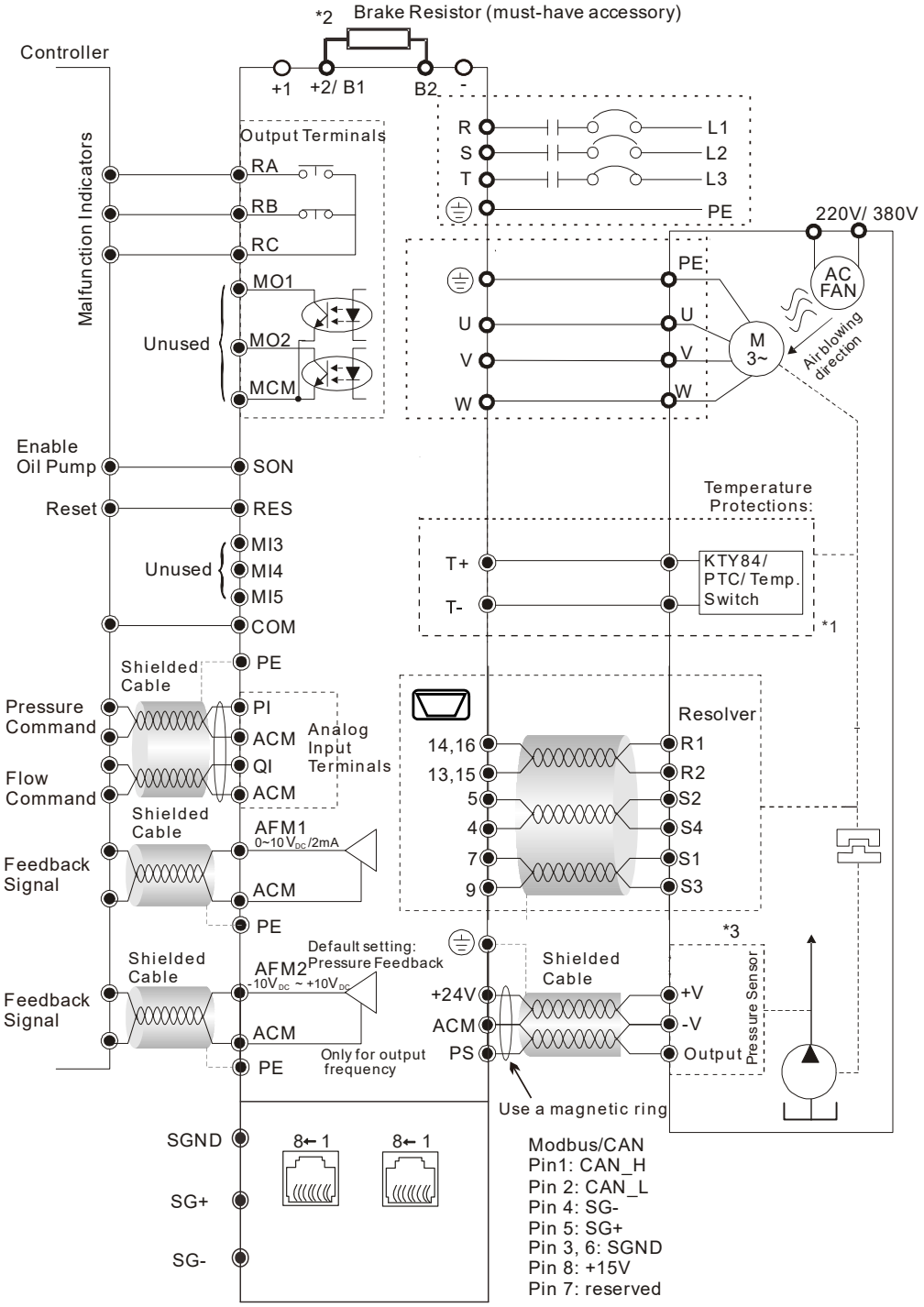
VFD450VL43C-J, VFD550VL43C-J, VFD750VL43C-J

VFD300VL43C-JO, VFD370VL43C-JO, VFD450VL43C-JO, VFD550VL43C-JO, VFD750VL43C-JO



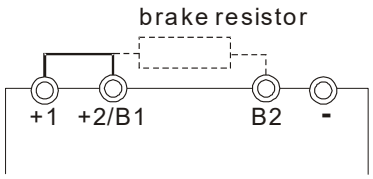
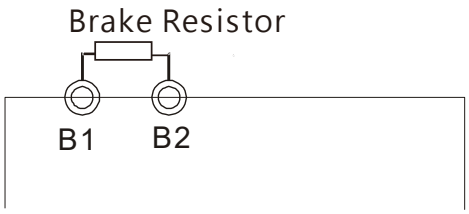
Wiring Diagram and Corresponding Models:

VFD110VL43C-J, VFD150VL43C-J, VFD185VL43C-J, VFD220VL43C-J, VFD300VL43C-J, VFD370VL43C-J



*1 Verify the polarity before using KTY84

*2

For 460V, 37kW (included) models and below: (with built-in brake unit)	For 230V_30kW, 230V_37kW and 460V_45kW (included) models and above: (with built-in brake unit)
	

*3 The peripheral braid sleeve needs to shield completely the internal signal line. Make the signal line which is not shielded by the braid sleeve as short as possible. Also bring signal line 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 line to the ACM terminal can eliminate much more noise.

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

RFI switch

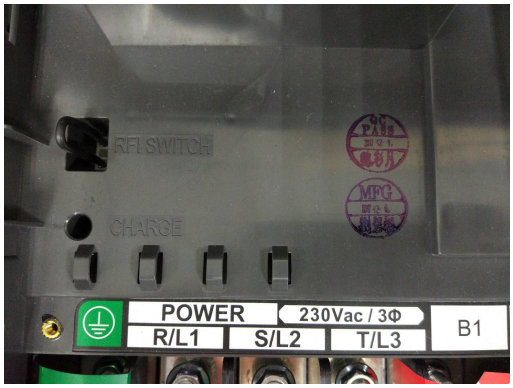
The drive contains Varistors / MOVs that are connected from phase to phase and from phase to ground to protect the drive against mains surges or voltage spikes.

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.

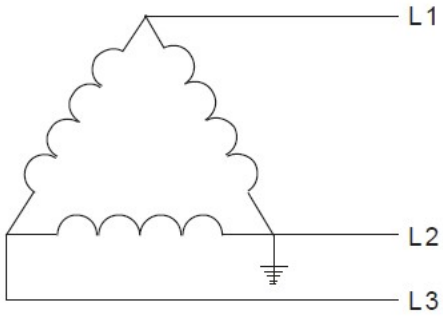
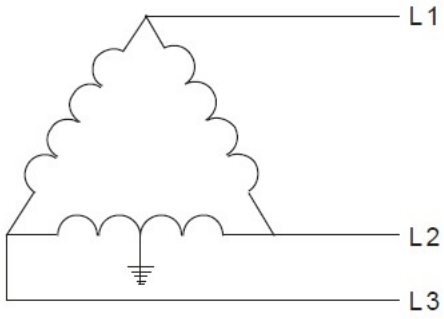
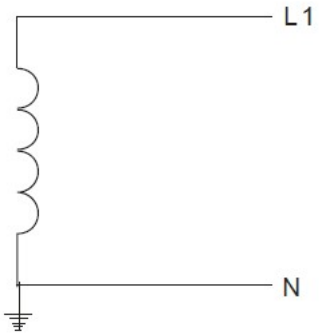
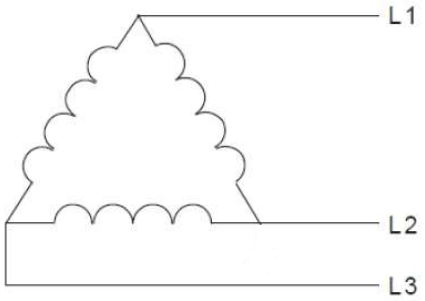
Floating Ground System (IT Systems)

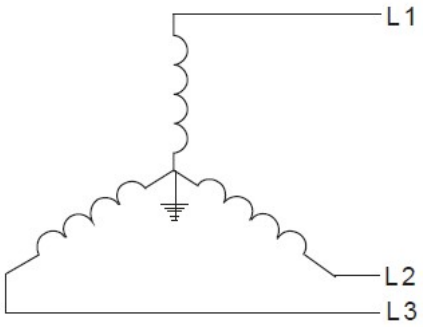
A floating ground system is also called IT system, ungrounded system, or high impedance/resistance (greater than 30Ω) grounding system.

- 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)

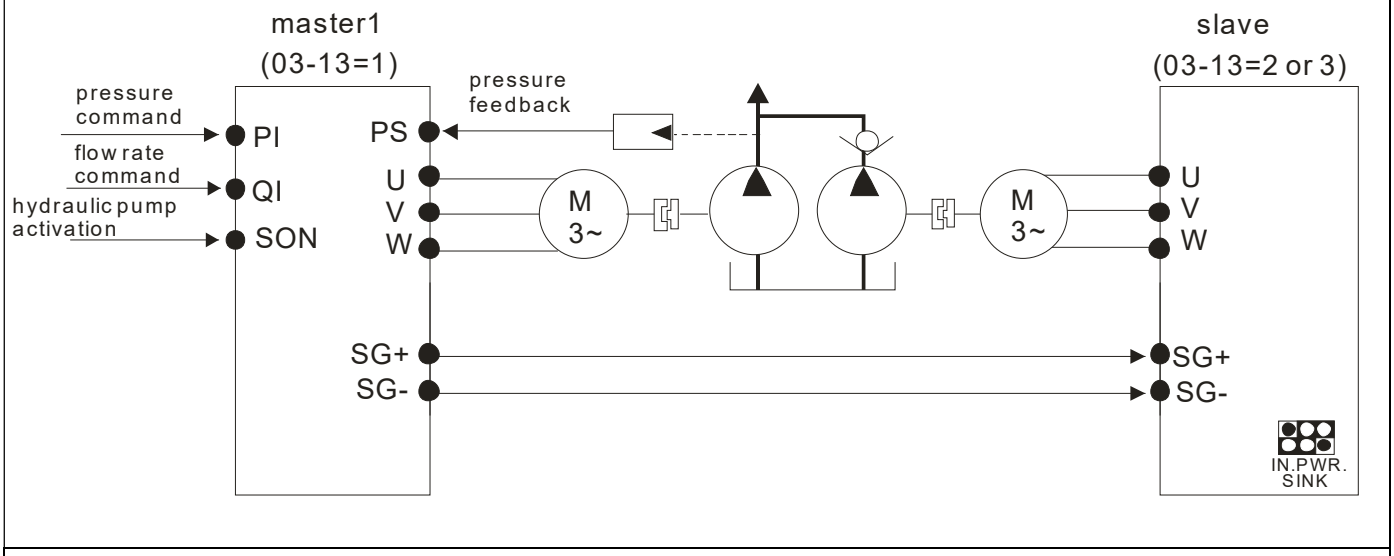
Caution: Do not remove the RFI switch while the input terminal of the hybrid servo drive carries power. In the following four situations, the RFI switch must be removed. This is to prevent the system from grounding through the RFI capacitor and damaging the hybrid servo drive

<table>
<tr><td colspan="2">Remove the RFI switch</td></tr>
<tr><td>1. Corner-Grounded Delta System)
 
</td><td>2. Center-Tap Grounded Delta System)
 
</td></tr>
<tr><td>3. Single Phase with Ground)
 
</td><td>4. Delta System without Ground)
 
</td></tr>
</table>

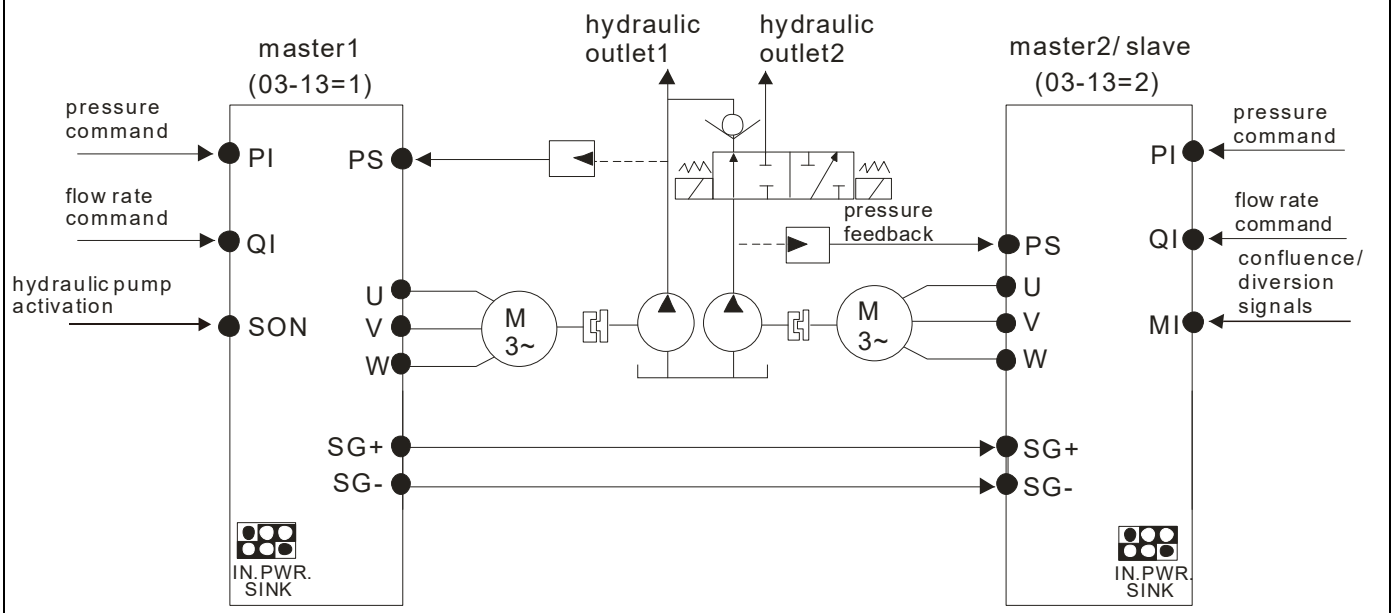
<table>
<tr><td colspan="2">Keep the RFI switch</td></tr>
<tr><td>Internal grounding through RFI capacitor, which reduces electromagnetic radiation. In a situation with higher requirements for electromagnetic compatibility, and using a symmetrical grounding power system, an EMC filter can be installed. As a reference, the diagram on the right is a symmetrical grounding power system.</td><td>Y connection (Star Connection) with stable neutral grounding point.
 
</td></tr>
</table>

Multi-pump Operation Mode

Confluence Mode



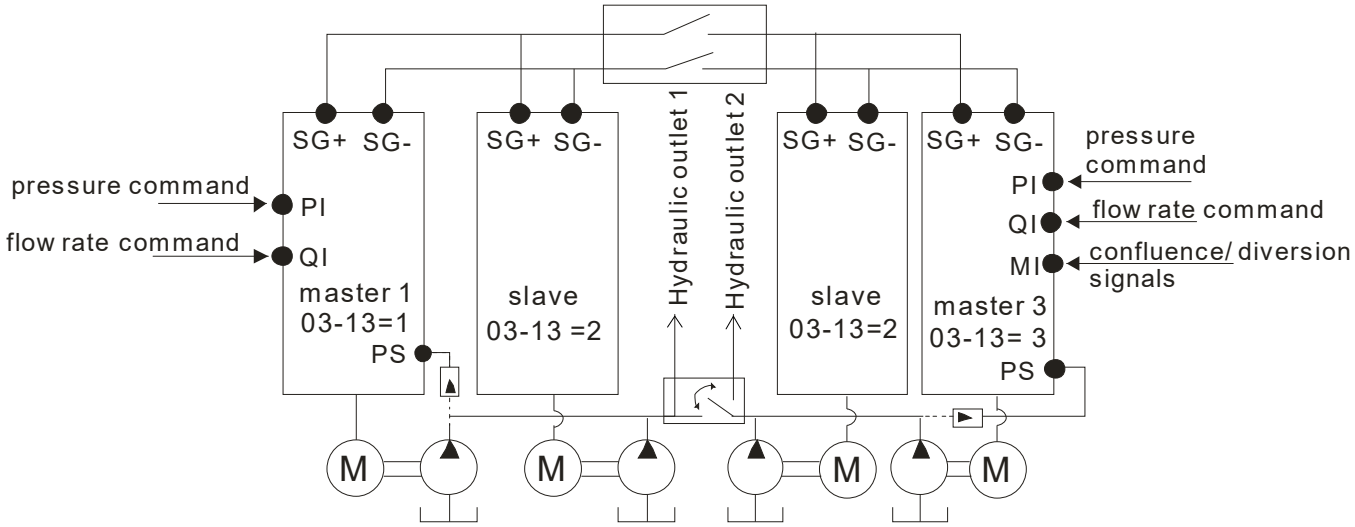
Confluence-Diversion Mode



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.

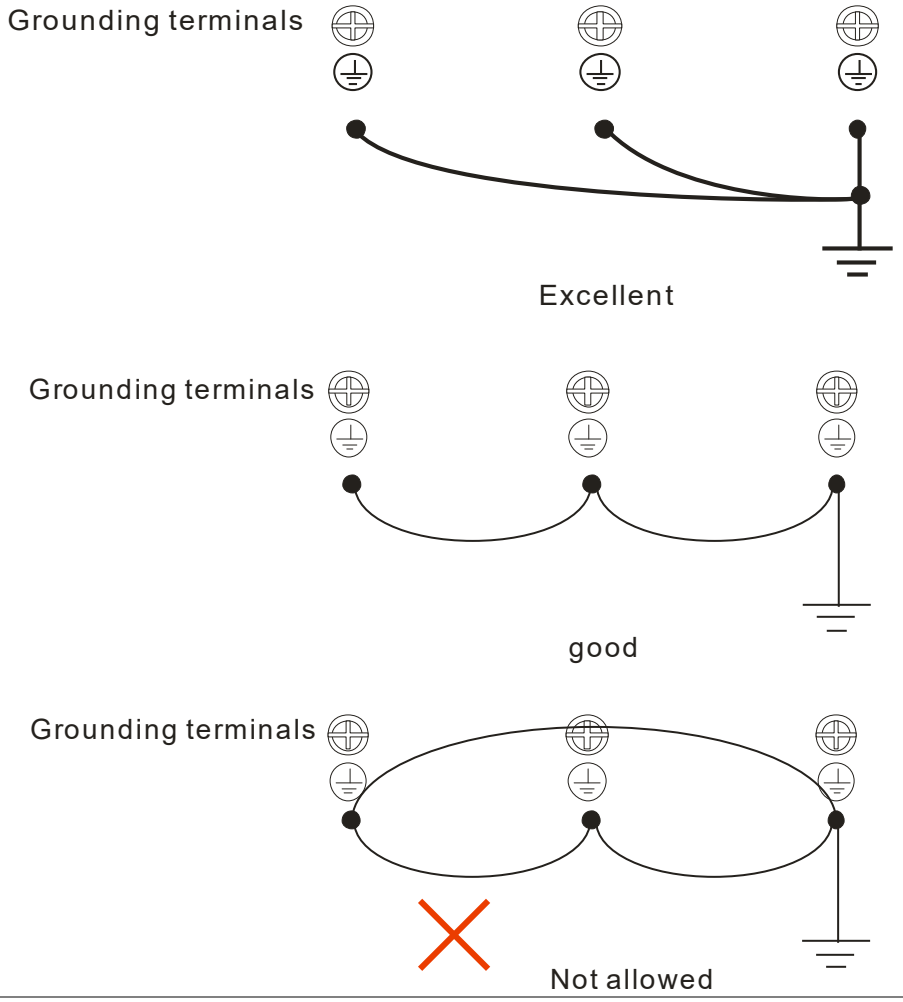


CAUTION

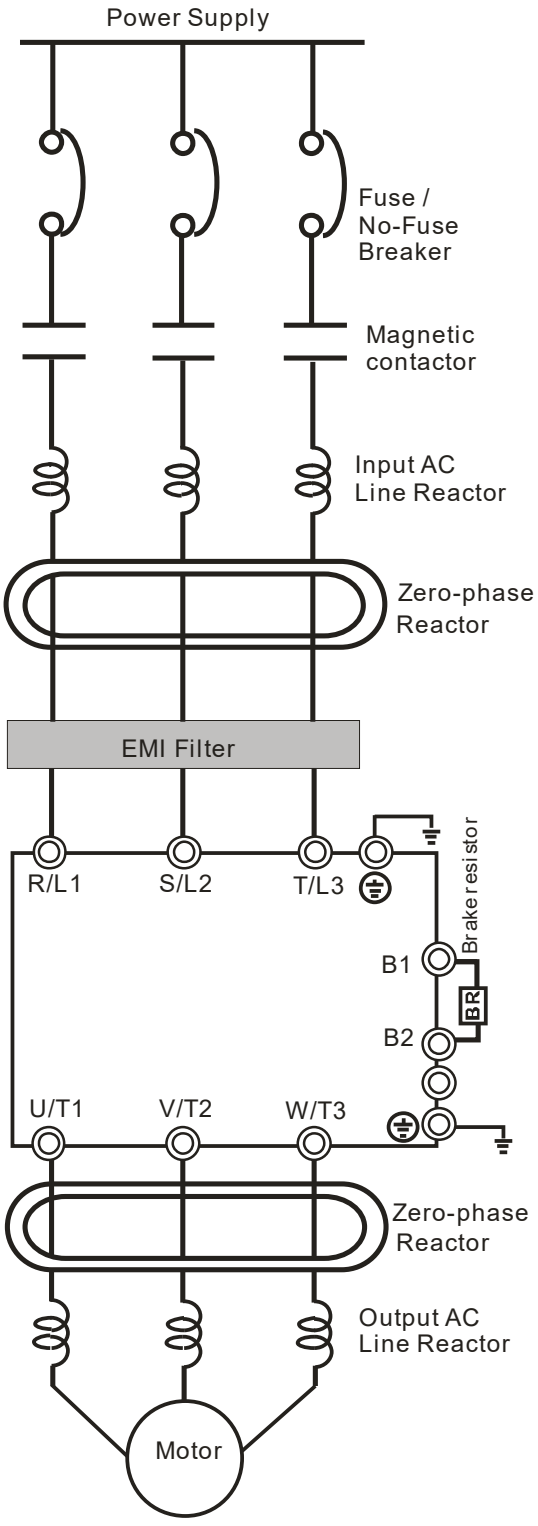
- ☑ The wiring of main circuit and control circuit should be separated to prevent erroneous actions.
- ☑ Please use shield wire for the control wiring and not to expose the peeled-off net in front of the terminal.
- ☑ Please use the shield wire or tube for the power wiring and ground the two ends of 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 lighting stroke and electric shock, use ground leads that comply with local regulations. Keep them as short as possible and have them properly connected to the ground terminal on the hybrid servo drive.

☑ 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.



2-2 Description of Terminals on Main Circuit



Items	Explanations
Power supply	Please follow the specific power supply requirements shown in Chapter 01.
Fuse/NFB (Optional)	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 an NFB is optional.
Magnetic contactor (Optional)	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.
Input AC Line Reactor (Optional)	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 ≤ 10m. We suggest to install the input reactor closed to the hybrid motor drive. See Appendix A for more details.
Zero-phase Reactor (Ferrite Core Common Choke) (Optional)	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 (Optional)	To reduce electromagnetic interference, please refer to Appendix A for more details.
Brake Resistor (Optional)	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 (Optional)	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 ≧ 45KW)
+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:

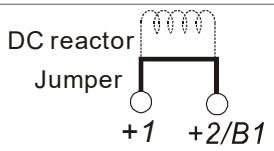
- ☑ Do not connect 3-phase model to one-phase power. R/L1, S/L2 and T/L3 has no phase-sequence requirement, it can be used upon random selection.
- ☑ It is recommend adding a magnetic contactor (MC) to the power input wiring to cut off power quickly and reduce malfunction when activating the protection 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.



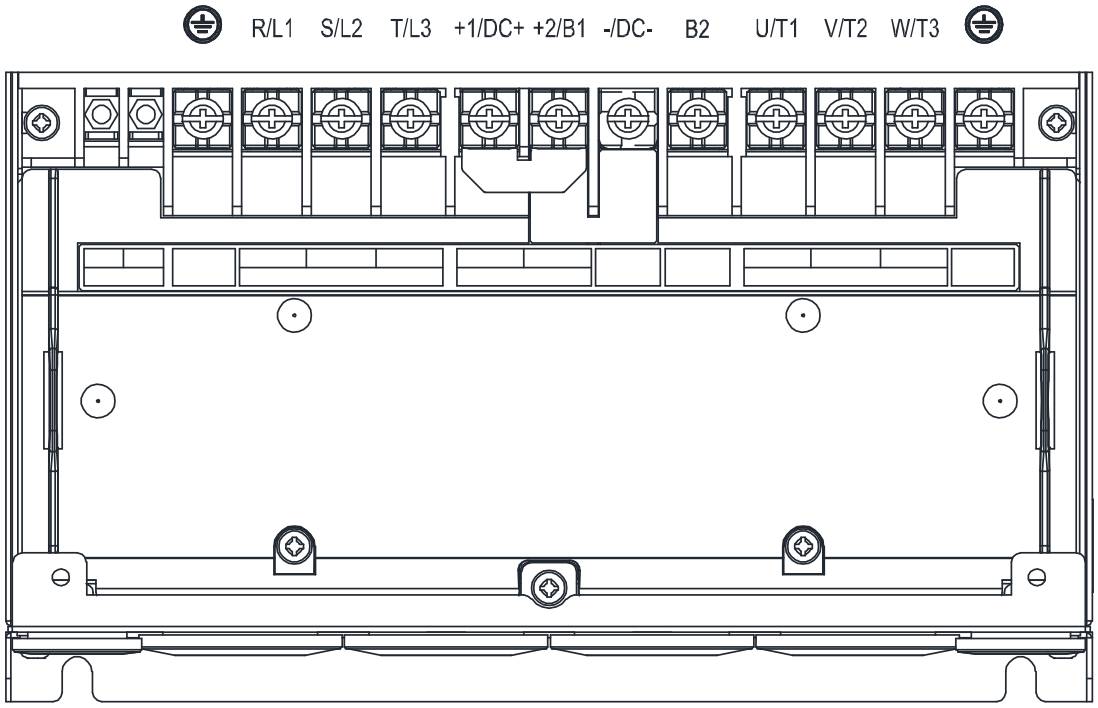
☑ For those models without built-in brake resistor, please connect external brake unit and brake resistor (both of them are optional) to increase brake torque.

☑ DO NOT connect [B2] or [-] to [+2/B1] directly to prevent drive damage.

Specifications of the Main Circuit Terminals

VJ-C Air Cooled

Frame C



	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal: ⏚		
Models	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)
VFD110VL43C-J	16 mm² (6 AWG)	10 mm² (8 AWG)	M5 30 kg-cm (26.0 lb-in) (2.94 Nm)	10 mm² (8 AWG)	10 mm² (8 AWG)	M5 30 kg-cm (26.0 lb-in.) (2.94 Nm)
VFD150VL43C-J		10 mm² (8 AWG)		10 mm² (8 AWG)	10 mm² (8 AWG)	
VFD185VL43C-J		16 mm² (6 AWG)		16 mm² (6 AWG)	16 mm² (6 AWG)	
VFD220VL43C-J		16 mm² (6 AWG)		16 mm² (6 AWG)	16 mm² (6 AWG)	

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 VFD220VL43C-J model, if you install it at Ta 35°C above environment, select copper wire with voltage rating of 600 V and temperature resistance of 90°C or above.
4. 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.
5. Do not reduce the wire gauge when using higher temperature wire.

Unit: mm

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									

- 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_{AC} insulation over the live part. Refer to Figure 2 below.

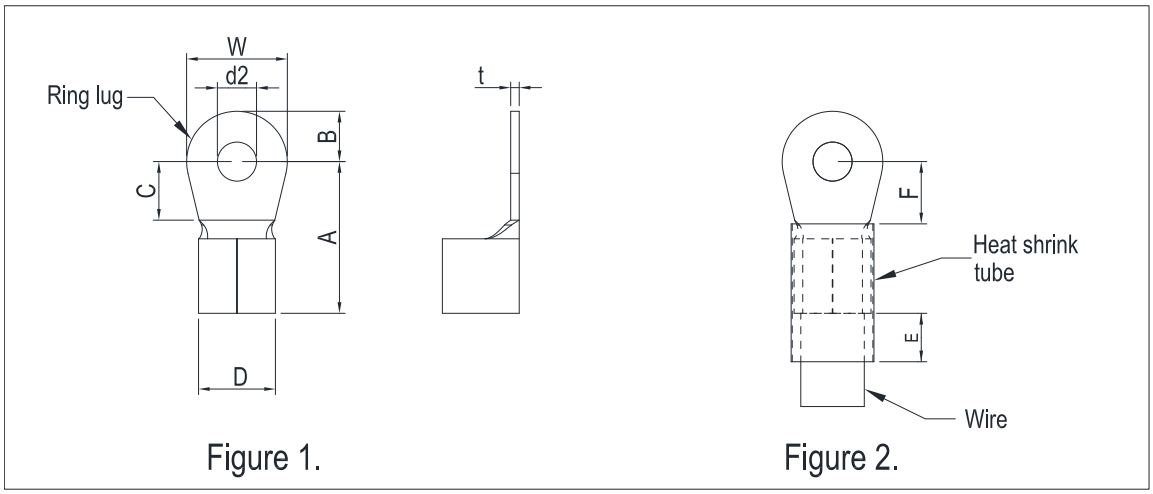
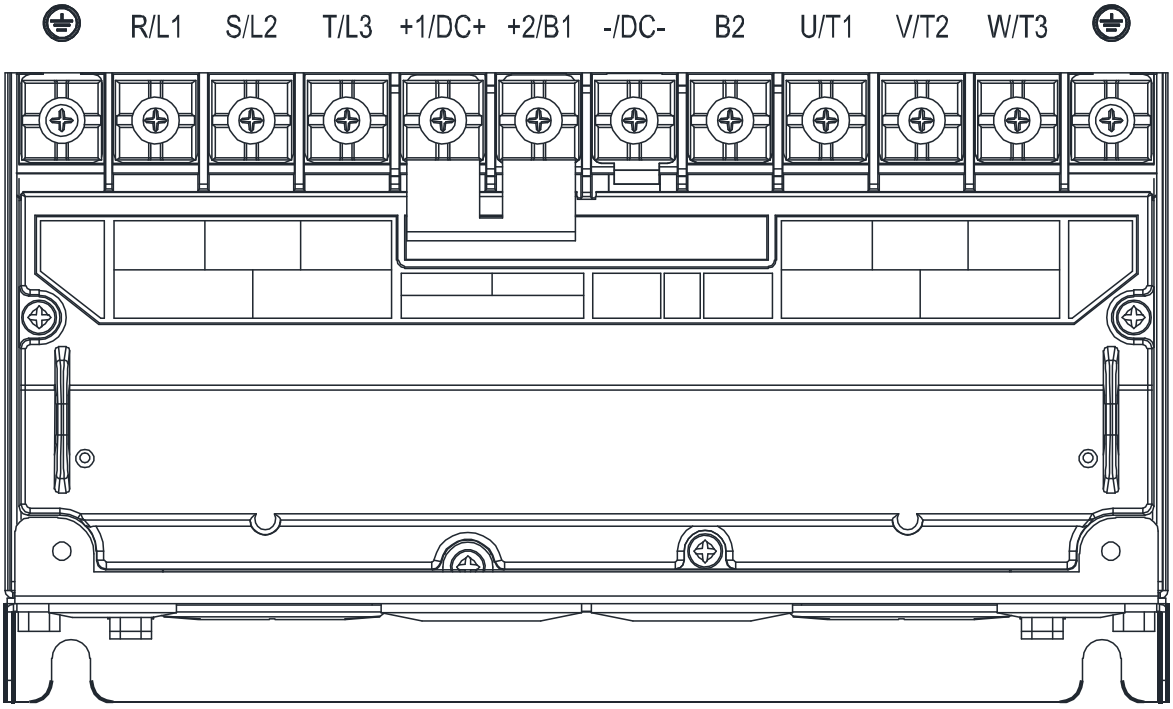


Figure 1. Figure 2.

VJ-C Air Cooled

Frame D



	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal ⏚		
Models	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)	Max. Wire Gauge	Mini. Wire Gauge	Screw Size and Torque Force (± 10%)
VFD300VL43C-J	35 mm² (2 AWG)	35 mm² (2 AWG)	M6 50 kg-cm (43.4 lb-in) (4.9 Nm)	35 mm² (2 AWG)	16 mm² (6 AWG)	M6 50 kg-cm (43.4 lb-in.) (4.9 Nm)
VFD370VL43C-J		35 mm² (2 AWG)		35 mm² (2 AWG)	16 mm² (6 AWG)	

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.

Unit: mm

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									

- 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_{AC} insulation over the live part. Refer to Figure 2 below.

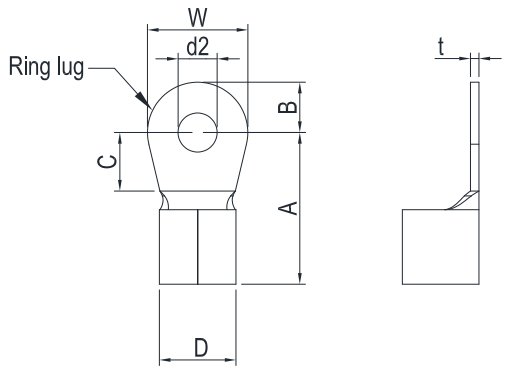


Figure 1.

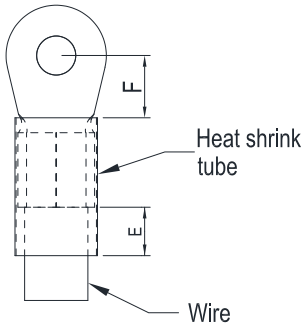
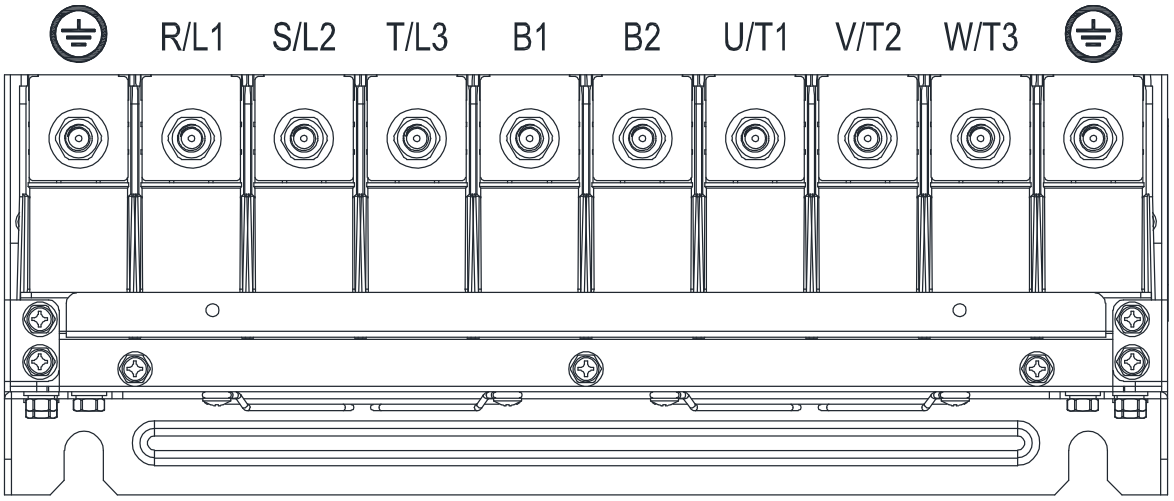


Figure 2.

VJ-C Air Cooled

Frame E4



	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal: ⏚		
Models	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	120mm² (4/0 AWG)	70 mm² (2/0 AWG)	M8 180 kg-cm (156.2 lb-in) (17.65 Nm)	70 mm² (2/0 AWG)	35 mm² (2 AWG)	M8 180 kg-cm (156.2 lb-in.) (17.65 Nm)
VFD370VL23C-J		120mm² (4/0AWG)		120 mm² (4/0 AWG)	70 mm² (2/0 AWG)	
VFD450VL43C-J		50 mm² (1/0 AWG)		50 mm² (1/0 AWG)	25 mm² (4 AWG)	
VFD550VL43C-J		70 mm² (2/0 AWG)		70 mm² (2/0 AWG)	35 mm² (2 AWG)	
VFD750VL43C-J		120 mm² (4/0 AWG)		120 mm² (4/0 AWG)	70 mm² (2/0 AWG)	

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.

Unit: mm

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									

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_{AC} insulation over the live part. Refer to Figure 2 below.

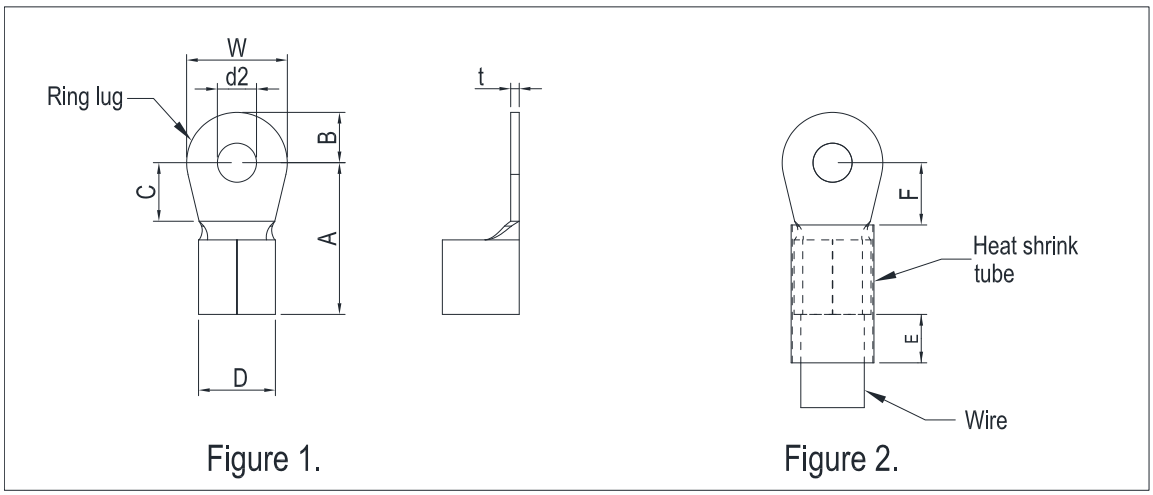
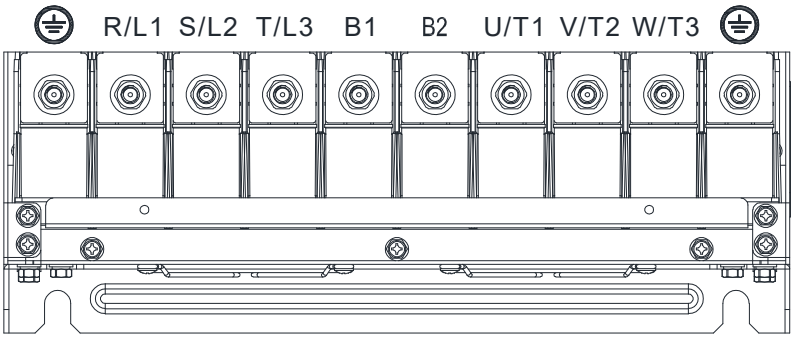


Figure 1. Figure 2.

VJ-C Oil Cooled

Frame E5



Models	Main Circuit Terminals: R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, 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%)
VFD300VL43C-JO	120mm² [4/0AWG]	35mm² [2AWG]	M8 180Kg-cm [156.2l-in.] [17.65Nm]]	35mm² [2AWG]	16mm² [6AWG]	M8 180Kg-cm [156.2l-in.] [17.65Nm]]
VFD370VL43C-JO		35mm² [2AWG]		35mm² [2AWG]	16mm² [6AWG]	
VFD450VL43C-JO		50mm² [1/0AWG]		50mm² [1/0AWG]	25mm² [4AWG]	
VFD550VL43C-JO		70mm² [2/0AWG]		70mm² [2/0AWG]	35mm² [2AWG]	
VFD750VL43C-JO		120mm² [4/0AWG]		120mm² [4/0AWG]	70mm² [2/0AWG]	

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.

Unit: mm

FRAME-SIZE	AWG	VENDOR	P/N	A (MAX.)	B (MAX.)	C (MIN.)	D (MAX.)	d2 (MIN.)	E (MIN.)	F (MIN.)	W (MAX.)	t (MAX.)
E5	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									

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_{AC} insulation over the live part. Refer to Figure 2 below.

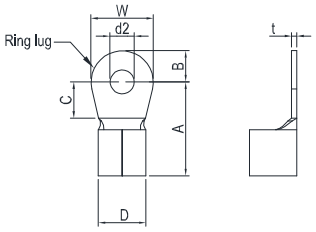


Figure 1

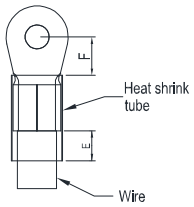
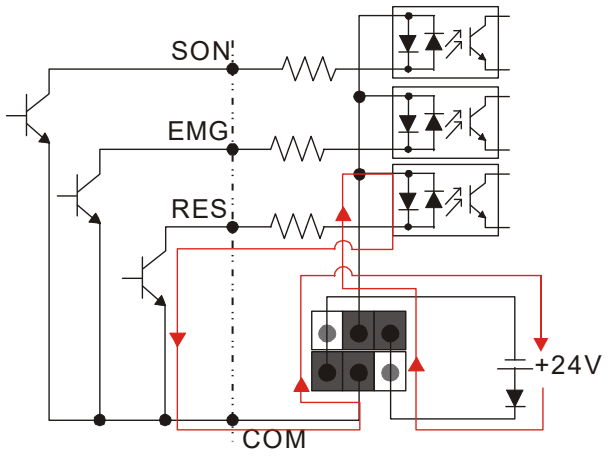


Figure 2

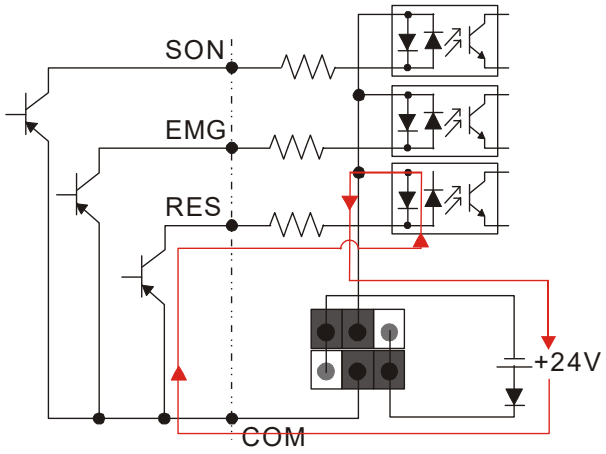
2-3 Description of Terminals on Control Circuit

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

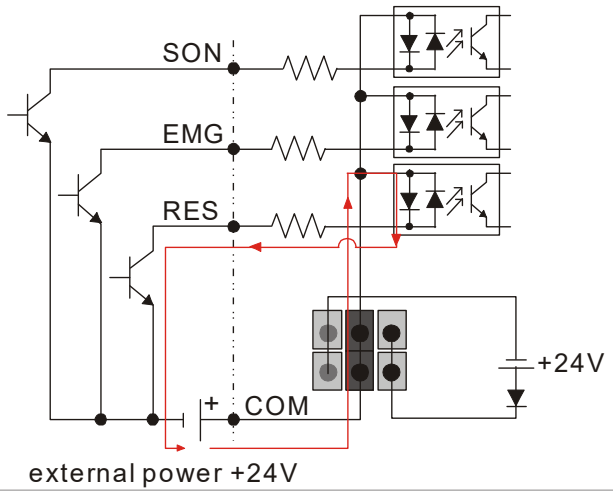
① Sink mode
uses internal power (+24 VDC)



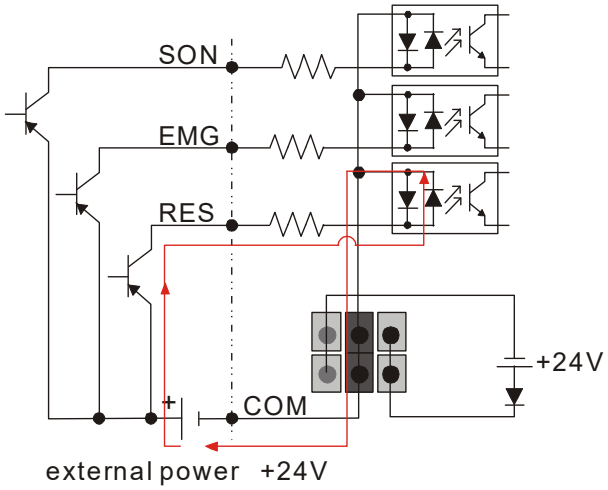
② Source mode
uses internal power (+24 VDC)

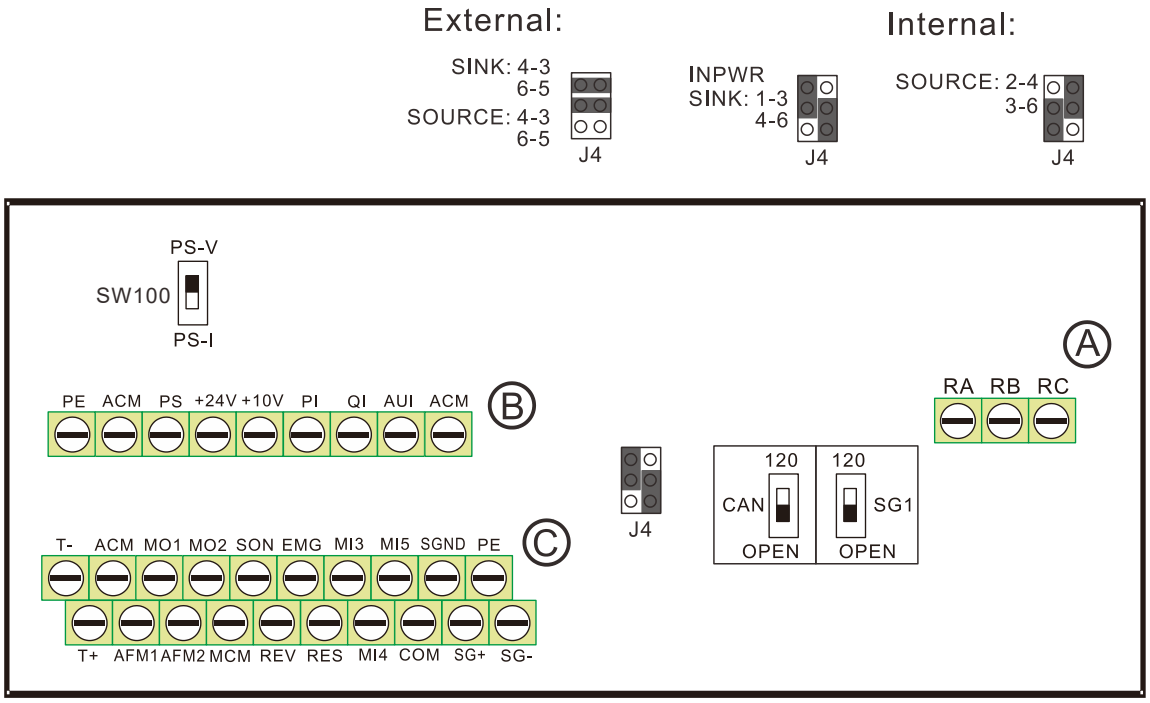


③ Sink mode



④ Source mode
uses external power





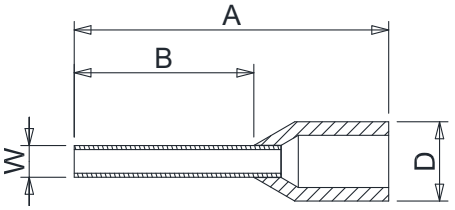
Items	Wire Gauge					Torque (±10%)
	Group	Conductor	Stripping length	Mini. Wire Gauge	Max. Wire Gauge	
Control Terminals	A	Solid	6mm	0.2mm² [24 AWG]	3.3mm² [12 AWG]	5kg-cm [4.4 lb-in.] [0.5 Nm]]
		Stranded				
	B	Solid	6mm	0.2mm² [24 AWG]	3.3mm² [12 AWG]	5kg-cm [4.4 lb-in.] [0.5 Nm]]
		Stranded				
	C	Solid	6mm	0.5mm² [20 AWG]	1.5mm² [16 AWG]	8kg-cm [7.0 lb-in.] [0.79 Nm]]
		Stranded				

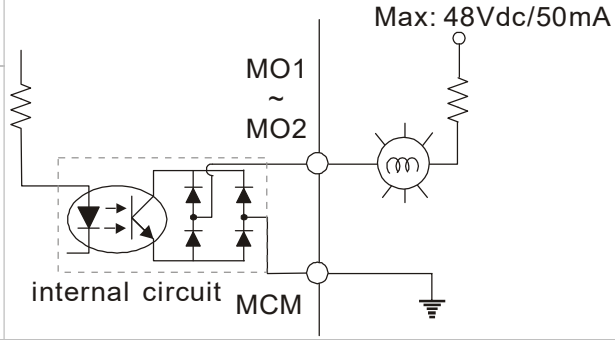
Wiring precautions:

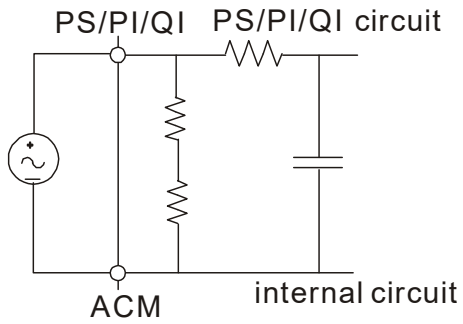
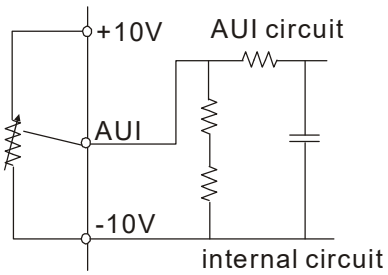
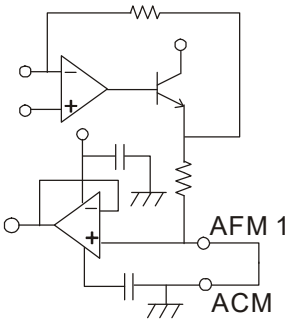
For group A, B, C:

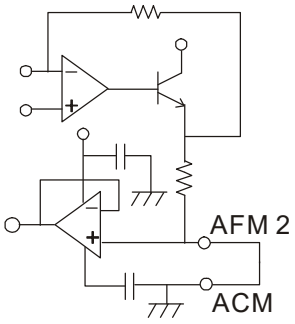
1. Tighten the wiring with a 3.5mm (wide) x 0.6mm (thick) slotted screwdriver.
2. The ideal length of stripped wire at the connection side is 6–7 mm.
3. When wiring bare wires, make sure they are perfectly arranged to go through the wiring holes.

Wiring Specifications of Control Terminal Unit: mm							
AWG	VENDOR	VENDOR P/N	A (MAX)	B (MAX)	D (MAX)	W (MAX)	
26	K.S.T	E0206	17.0	8.0	5.0	3.2	
24	K.S.T	E0306					
16	K.S.T	E1506					
12	K.S.T	E4009					



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

Terminal	Features	Factory Setting (NPN Mode)	Difference between VJ-A and VJ-B
PS		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.	Terminal PO
PI		Pressure Command Impedance: 200kΩ Resolution: 12 bits Range: 0 ~ 10V = 0 ~ the maximum pressure command value (Pr00-07)	
QI		Flow rate command Impedance: 200kΩ Resolution: 12 bits Range: 0 ~ 10V = 0 ~ the maximum flow rate	
AUI	Analog Voltage 	Impedance: 11.3kΩ Resolution: 12 bits Range: -10 ~ +10V_{DC}	
+10V	Power supply for configuration	Power supply for analog configuration +10V_{DC} 20mA	
+24V	Power supply terminal for the pressure sensor	Power supply for the pressure sensor +24V_{DC} 100mA	
AFM1		Impedance: 19.2kΩ (voltage output) Output current: 20mA max Resolution: 0 ~ 10V corresponding to the pressure feedback. Range: 0 ~ 10V	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

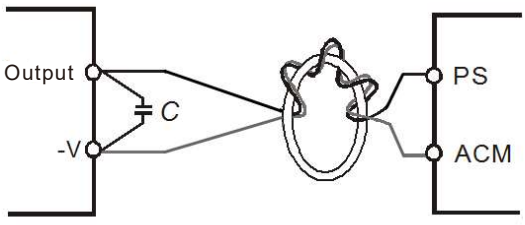
* Specifications of analog control signal wire: 18 AWG (0.75 mm^2), with shielded twisted pair

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



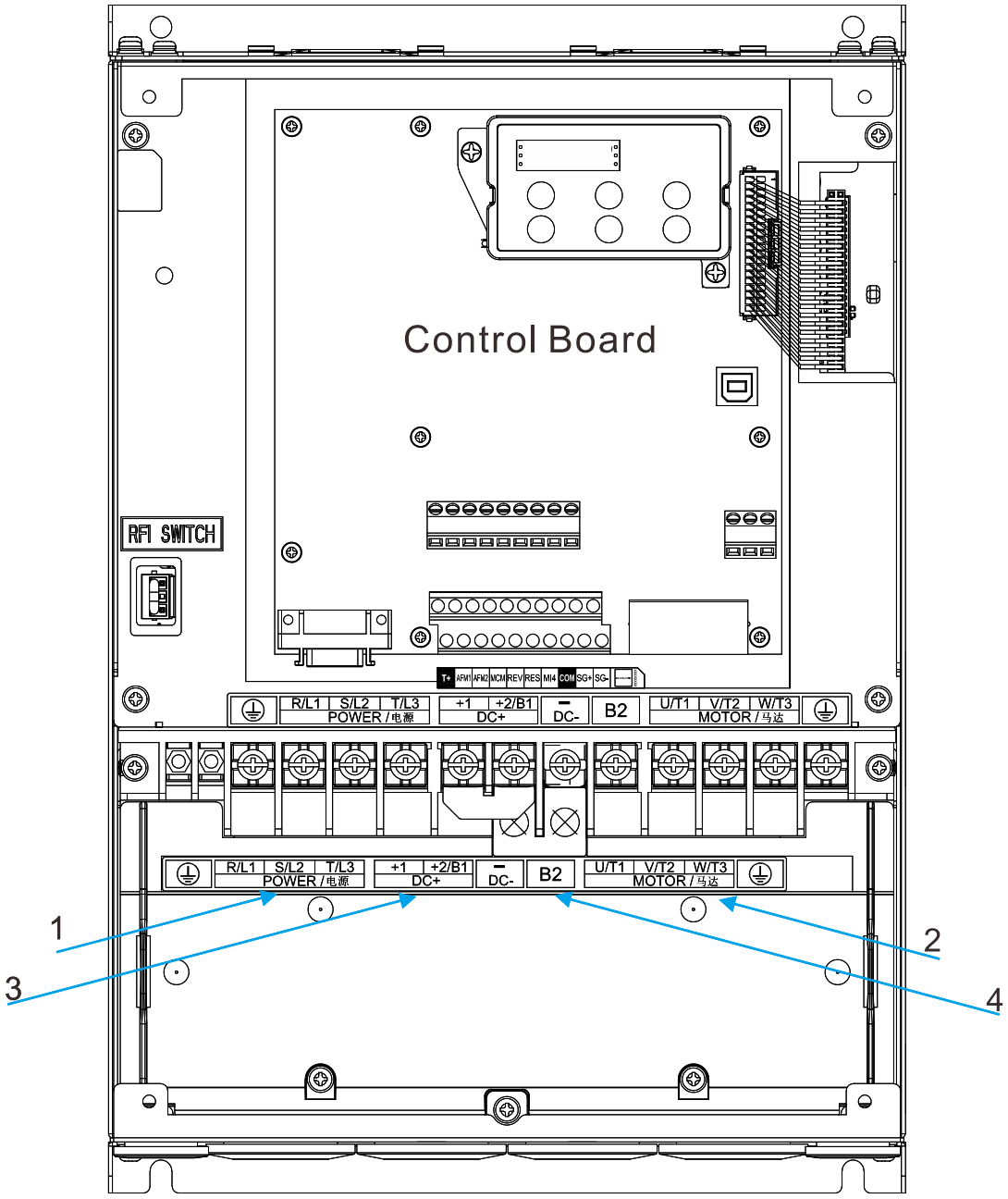
Transistor Output Terminals (MO1, MO2, MCM)

☑ 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.

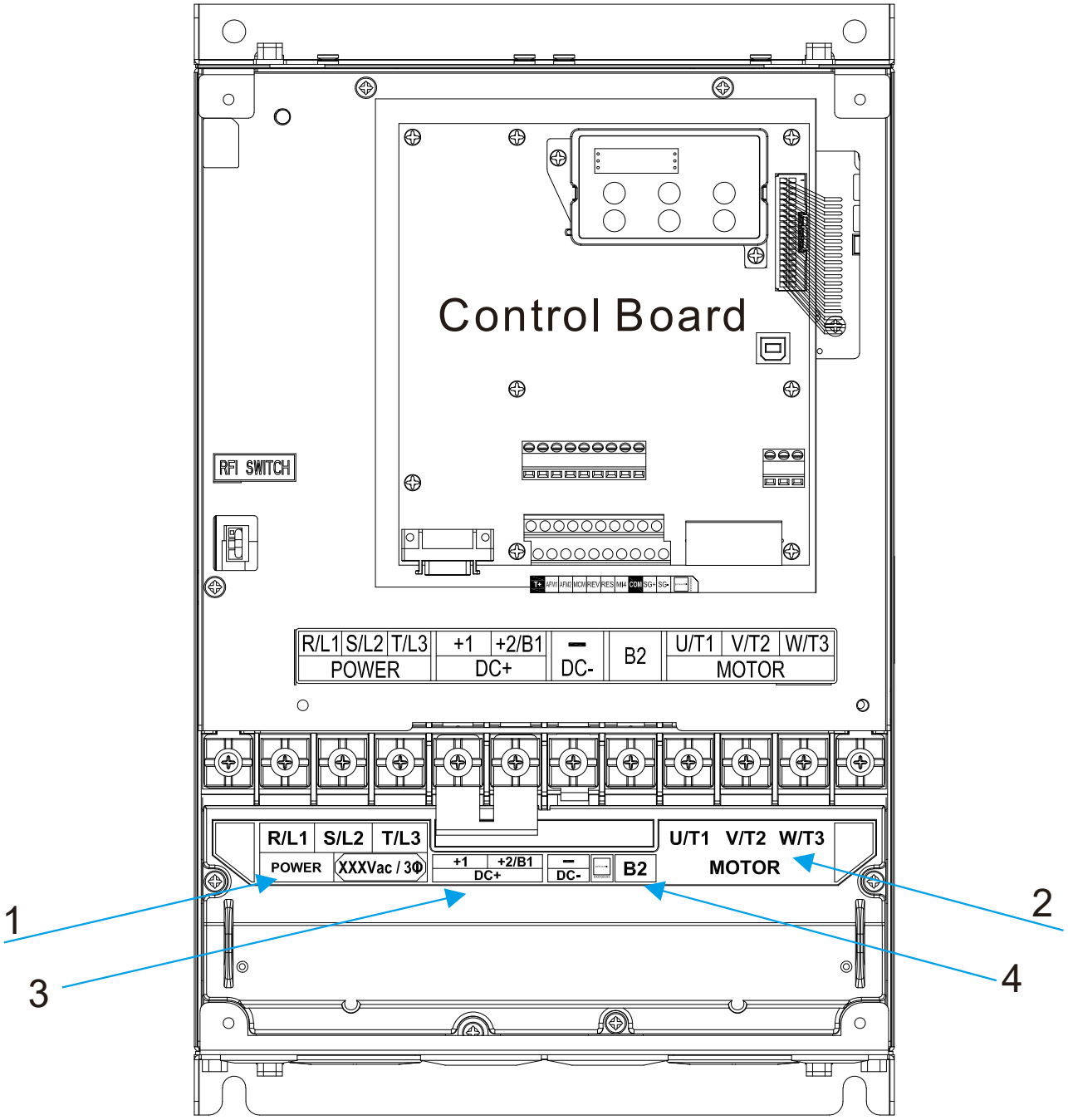
Inside the Hybrid Servo Drive

Frame C:



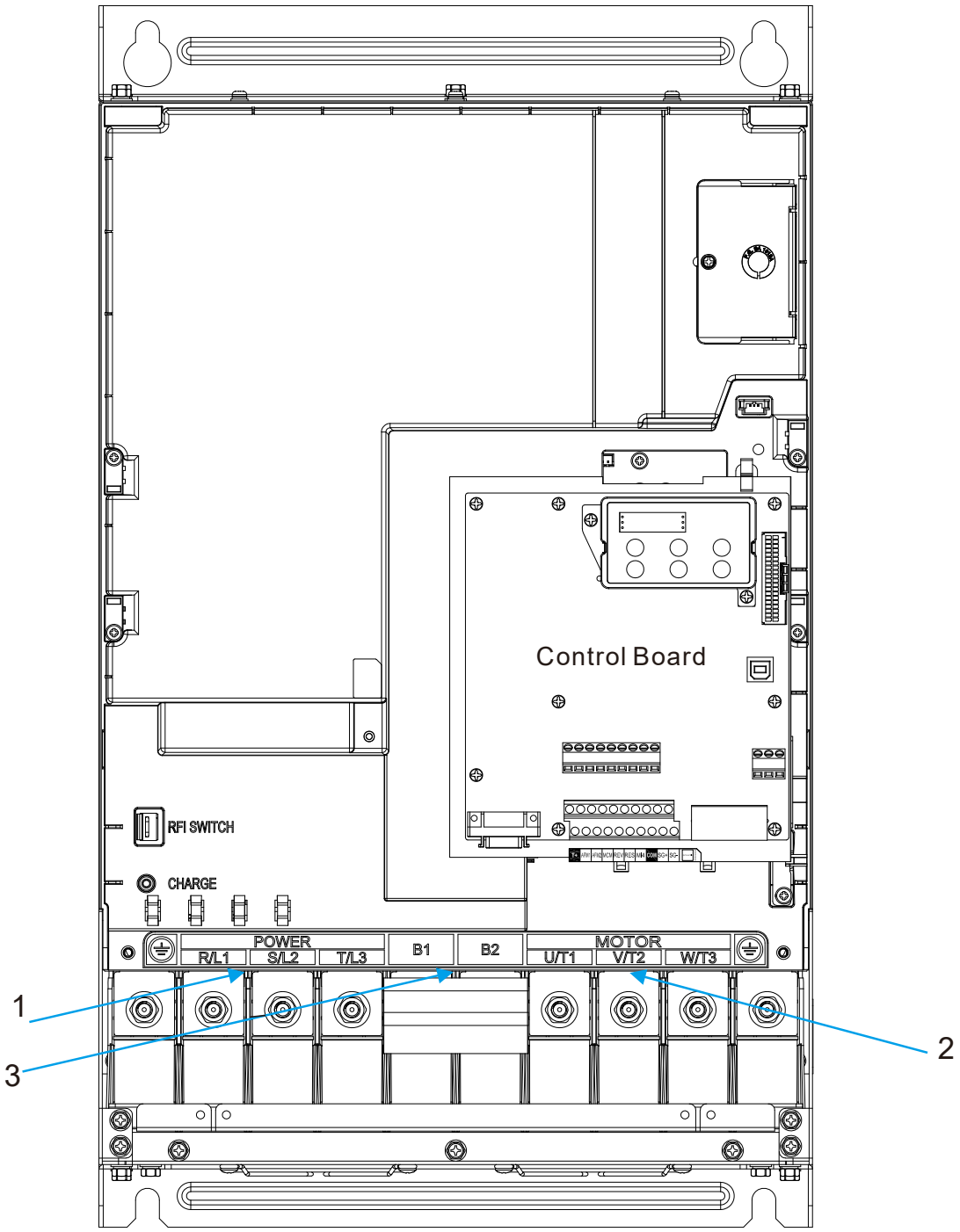
1: Mains input terminal
2: Output terminal to connect the motor
3: DC reactor terminal: Remove the RFI switch before you connect a DC reactor
4: Brake resistor terminal

Frame D:



1: Mains input terminal
2: Output terminal to connect the motor
3: DC reactor terminal: Remove the RFI switch before you connect a DC reactor
4: Brake resistor terminal

Frame E:



1: Mains input terminal
2: Output terminal to connect the mtor
3: Brake resistor terminal

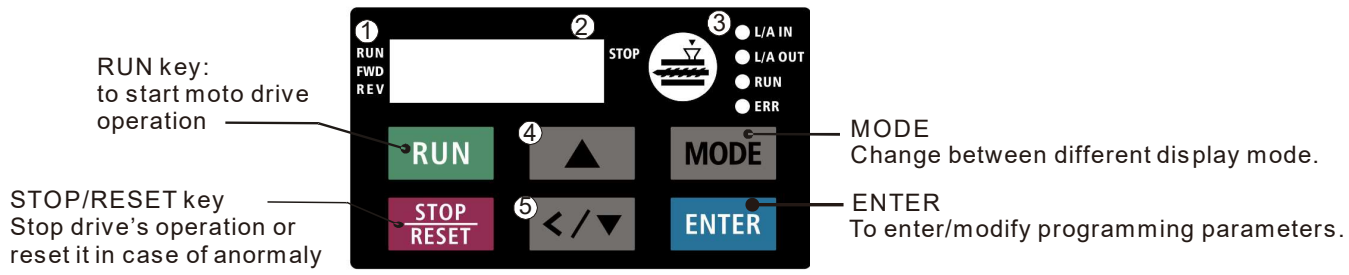
3. Machine Adjustment Procedure

3-1 Description of Control Panel
3-2 Machine Adjustment Procedure

CAUTION	☑ 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.
WARNING	☑ 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



❶ Status display
Display driv's current status

❷ LED display
Indicate frequency, voltage, current, user defined units and etc..

❸ CANopen indicator light

❹ UP key
Set the parameter value and change the numeric data such as frequency.

❺ 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

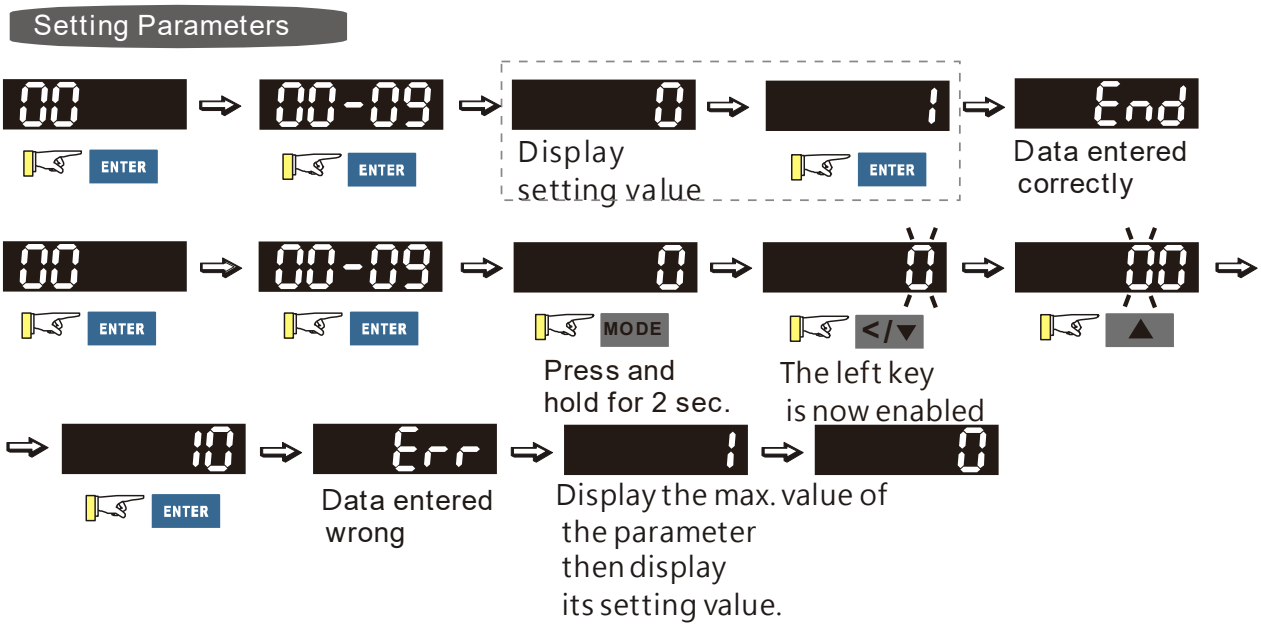
Displayed Item	Description
RUN FWD REV F60.00 STOP	The current frequency set for the hybrid servo drive
RUN FWD REV H50.00 STOP	The frequency delivered by hybrid servo drive to the motor
RUN FWD REV b 120.0 STOP	The user-defined physical quantity (Parameter 00-04)
RUN FWD REV A 5.00 STOP	Load current
RUN FWD REV Frd STOP	Forward command
RUN FWD REV rEv STOP	Reverse command
RUN FWD REV 01-00 STOP	Displays the selected parameter
RUN FWD REV 10 STOP	Display the parameter value
RUN FWD REV EF STOP	Display the external fault

	If the “End” message (as shown in the left figure) is displayed on the display area for about one second, it means that data has been accepted and automatically stored in the internal memory
	If the setting data is not accepted or its value exceeds the allowed range, this error message will be displayed

Keypad Panel Operation Procedure

A. Selecting Mode

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

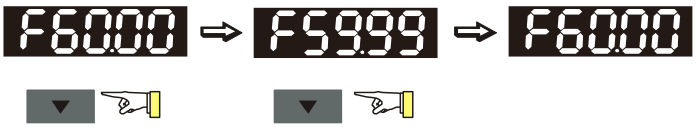


Note: In the parameter setting mode, press MODE to return to the mode selecting.

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.

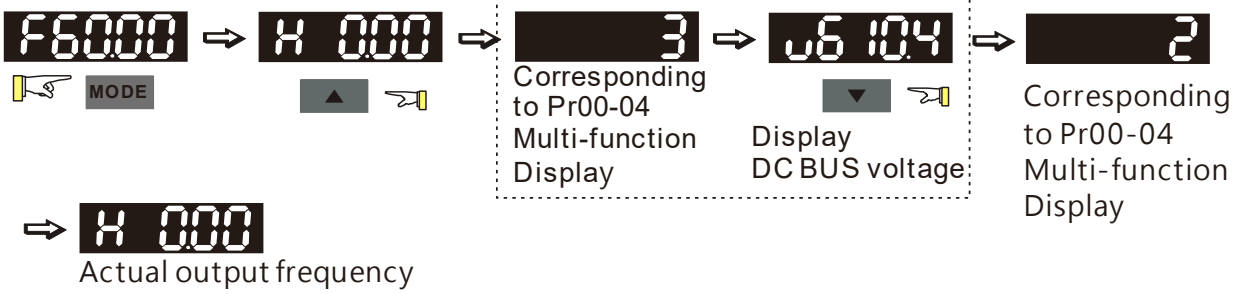
Modifying Data



Operating Direction

While the motor drive is controlled from a digital keypad.

Multi-Function Display Page



Display Fault/ Warning

Display Fault Codes

(1

Press RESET to clear fault code

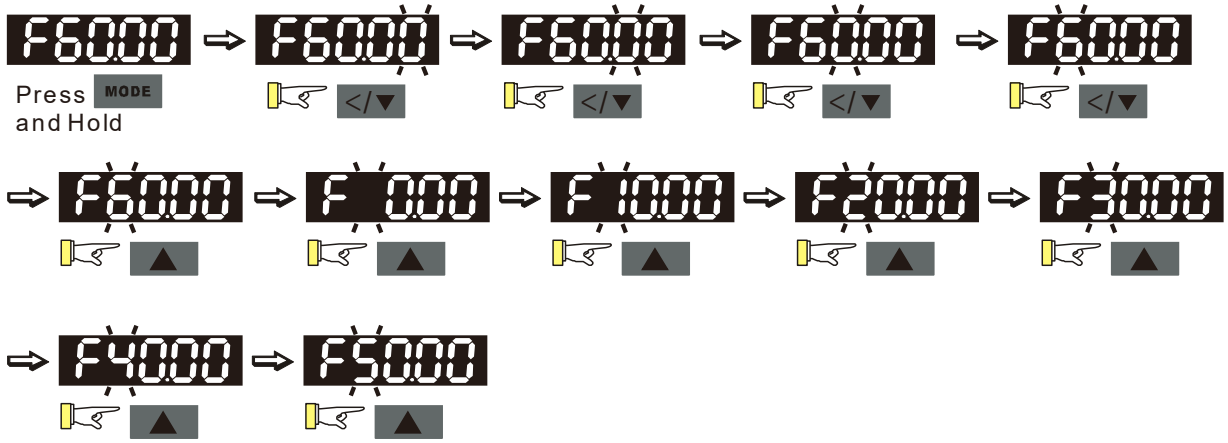
(2)

Repower on to clear fault code

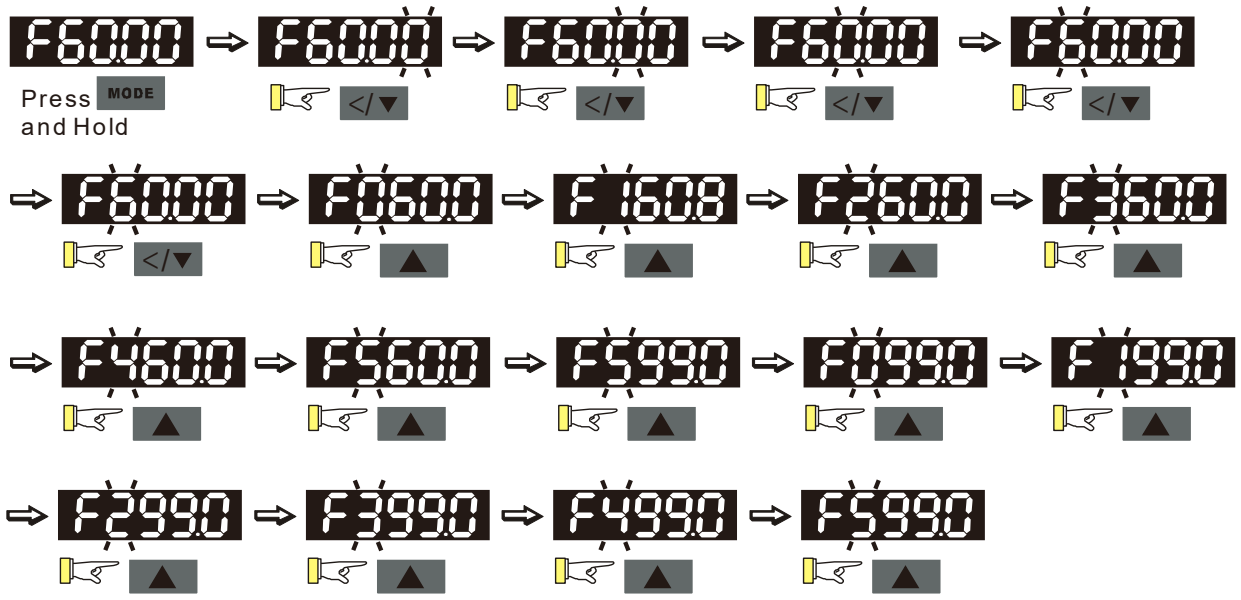
Display Warning Codes

B. Frequency Command Page

Normal Mode 1(Pr01-02: Maximum Frequency has two digits. Example: Pr01-02 = 60.00Hz)



Normal Mode 2 (Pr01-02: Maximum Frequency has three digits. Example: Pr01-02 = 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 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 Parameter 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, Parameter is 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 Parameter 01-02

  Motor's maximum operation frequency

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

- Set Parameter 01-03

  Motor's rated frequency

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

- Set Parameters 01-05 & 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 Parameter 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 Parameter 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 Parameter 01-29

Number of pulses for each revolution of the encoder

Setting value of Pr. 01-29	1~20000

- Set Parameter 01-08

The rated current of the induction motor

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

- Set Parameter 01-09

The rated power of the induction motor

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

- Set Parameter 01-10

The rated speed (rpm) of the induction motor

Setting value of Pr.01-10	0~65535

- Set Parameter 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 Parameter 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 01-12 and set Parameter 01-07 as 2. Then carry out the static measurement

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 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 Parameters 01-13 to 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 Parameter 01-00 = 3

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

- 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 Parameter 01-00 = 5

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 Parameter 01-26 = 3

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 Parameter 01-29

Number of pulses for each revolution of the encoder

Setting value of Pr.01-29	1~20000

- Set Parameter 01-17

The rated current of the synchronous motor

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

- Set Parameter 01-18

The rated power of the synchronous motor

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

- Set Parameter 01-19

The rated speed (rpm) of the synchronous motor

Setting value of Pr.01-19	0~65535

- Set Parameter 01-20

Number of poles of the synchronous motor

Setting value of Pr. 01-20	2~20

- Set Parameter 01-21

The inertia of the synchronous motor's rotor

Setting value of Pr.01-21	0.0~6553.5 *10^{-4} kg.m^2

- Check if the motor can be separated from the pump
- If it can be separated, set the Parameter 01-07 as 5 and carry out the parameter measurement of the synchronous motor
- If it cannot be separated, open the safety valve, set the Parameter 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 Parameters 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 Parameter 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 Parameters 01-05 & 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 Parameter 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 Parameter 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 Parameter 01-32 and press the [ENTER] button to complete the "write" operation.
- Set Parameter 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%

- Parameter 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 ≦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

- Parameter 00-09 = 1 for pressure control mode

Pressure control mode

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

- Parameter 00-04 = 12 PI for input voltage

Selection of multi-function display

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

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

Maximum pressure command

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

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

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

- Parameter 00-09 = 1 for pressure control mode

Pressure control mode

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

- Set Parameters 01-05 & 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

- For low-pressure and low-speed conditions (within 30% of the rated values), use the “manual operation” through the controller for the operation of each cylinder. During the operation, check the pipe connection for leaks or strange noise in the pump. (For more information, see Appendix E: Step-by-Step: Enabling Oil Pump._
- 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 though the controller

- Parameter 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 (Parameters 00-21, 00-23 , and 00-25) and Kp values to small values (≦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 (Parameter 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

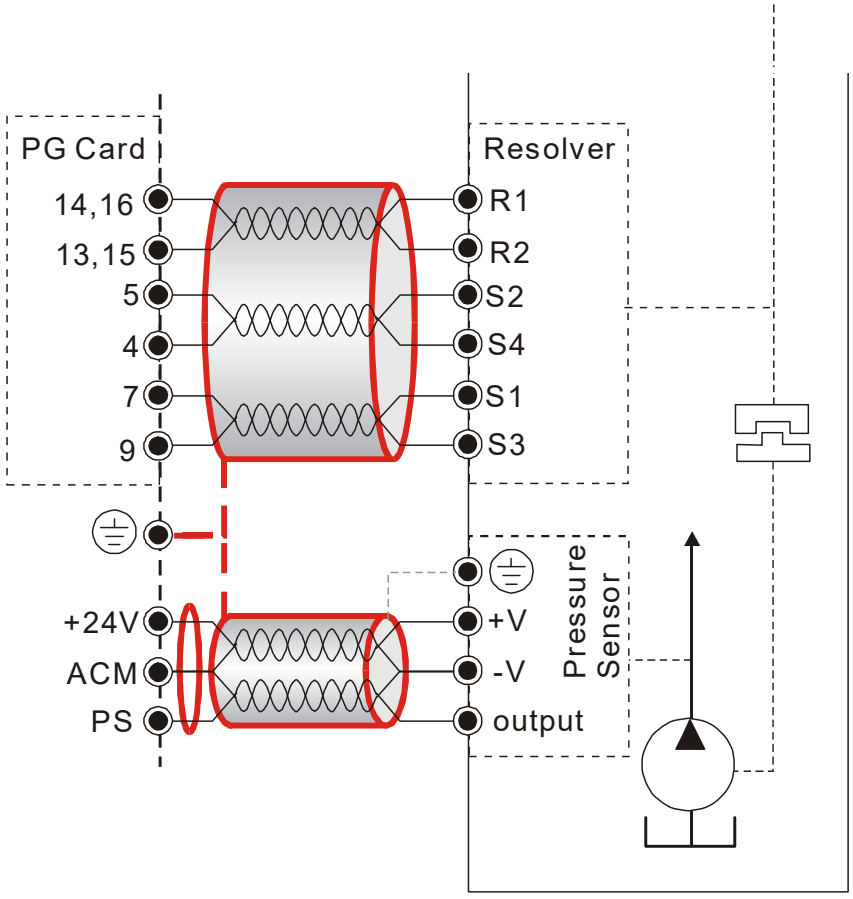
Instability at high pressure

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 Parameter 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 (parameters 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 (Parameter 00-20) and reduce the Ki1 time (Parameter 00-21)
- For pressure overshoot, increase the Kp3 time (Parameter 00-24) and reduce the Ki3 time (Parameter 00-25)

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 Parameter 03-13 = 1

Confluence Master/Slave Selection

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

- Set Parameter 03-14

Slave's proportion of the Master's flow

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

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

Slave's activation level

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

Slave setting

- Parameter 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 Parameter 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 Parameter 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 Parameter 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

- Parameter 03-21 can be set at the Slave to decide if the Salve 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 Parameter 03-16 should be set as 500%

Slave reverse operation for depressurization

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

Limit for the Slave reverse depressurization torque

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

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

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

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

- Parameter 00-09 = 1 for pressure control mode

  Pressure control mode

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

Set the Slave for speed control mode

- Parameter 00-09 = 0 for speed control mode

  Speed Control Mode

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

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

  Multi-function Input

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

- Through the controller, perform the entire confluence/diversion operation.
- New protection mechanism at version C: When Pr03-00 ~ Pr03-02 = 45, Pr01-01 is automatically set as 2 and Pr03-15 is automatically, set as 1. This is a mechanism to prevent forgetting to set up related parameters and mistakes when setting up parameters.

4. Description of Parameters

4-1 Summary of Parameters

4-2 Detailed Description of Parameters

4-1 Summary of Parameters

00 System Parameters

✍ You can set this parameter during operation.

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
00-00	Hybrid servo drive model code ID	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	○	○	○
00-01	Display of rated current of the hybrid servo drive	Display the model specific values	Read only	○	○	○
00-02	Reset parameter settings	0: No function 1: Parameter locked 5: Rest the kWh at drive stop 10: Reset CANopen Index	0	○	○	○
00-03	Software version	Read only	Read only	○	○	○

	Parameter	Explanation	Settings	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) (unit: PL) 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: ºC) 33: Reserved 34: Torque constant Kt (K.)	0	○	○	○
↗	00-05	Reserved		0			
	00-06	Display the speed (rpm) defined by the user	0~39999 rpm	2500	○	○	○
↗	00-07	Maximum value of the pressure command	0~400Bar	140	○	○	○
↗	00-08	Maximum feedback pressure	0~400 Bar	250	○	○	○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	00-09	Pressure control mode	0: Disable (Speed control) 1: Enable (Pressure control)	0	○	○	○
	00-10	Speed bandwidth	0~40Hz	20		○	○
✓	00-11	Pressure feedback filtering time	0.000~1.000 second	0.000	○	○	○
✓	00-12	Pressure command filtering time	0.000~1.000 second	0.000	○	○	○
✓	00-13	Flow command filtering time	0.000~1.000 second	0.000	○	○	○
✓	00-14	Percentage for the pressure command value (Max)	0.0~100.0%	56.0	○	○	○
✓	00-15	Percentage for the pressure command value (Mid)	0.0~100.0%	28.0	○	○	○
✓	00-16	Percentage for the pressure command value (Min)	0.0~100.0%	0.0	○	○	○
✓	00-17	Percentage for the flow command value (Max)	0.0~100.0%	100.0	○	○	○
✓	00-18	Percentage for the flow command value (Mid)	0.0~100.0%	50.0	○	○	○
✓	00-19	Percentage for the flow command value (Min)	0.0~100.0%	0.0	○	○	○
✓	00-20	P gain 1	0.0~1000.0	50.0	○	○	○
✓	00-21	I integration time 1	0.00~500.00 seconds	2.00	○	○	○
✓	00-22	P gain 2	0.0~1000.0	50.0	○	○	○
✓	00-23	I integration time 2	0.00~500.00 seconds	2.00	○	○	○
✓	00-24	P gain 3	0.0~1000.0	50.0	○	○	○
✓	00-25	I integration time 3	0.00~500.00 seconds	2.00	○	○	○
✓	00-26	Pressure stable zone	0~100%	25	○	○	○
✓	00-27	Minimum pressure	0.0~100.0%	0.1	○	○	○
✓	00-28	Depressurization speed	0~100%	25	○	○	○
✓	00-29	Ramp up rate of pressure command	0~1000ms	0	○	○	○
✓	00-30	Ramp down rate of pressure command	0~1000ms	100	○	○	○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	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	Reserved					
✓	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	○	○	○
	00-43	Maximum Flow	0~100%	100	○	○	○
	00-44	Pressure Command	0.0~400.0 bar	0.0	○	○	○
	00-45	Flow Rate Command	0.0~100.0%	0.0	○	○	○
✓	00-46	Pressure reference S1 time	0~1000ms	0	○	○	○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	00-47	Pressure reference S2 time	0~1000ms	0	○	○	○
✓	00-48	Flow reference S1 time	0~1000ms	0	○	○	○
✓	00-49	Flow reference S2 time	0~1000ms	0	○	○	○
✓	00-50	Speed bandwidth 2	0~40Hz	20	○	○	○
✓	00-51	Speed bandwidth 3	0~40Hz	20	○	○	○
✓	00-52	Overpressure Detecting Time	0.000~1.000sec	0.01	○	○	○
✓	00-53	Oil Shortage Detecting Time	0.0~60.0sec	0.0	○	○	○
✓	00-54	Oil Pump Reverse Running Detecting Time	0.0~60.0sec	0.0	○	○	○
	00-55 ~ 00-58	Reserved					
✓	00-59	Minimum Flow	0.00~ 100.00%	5.00	○	○	○
✓	00-60	Oil Shortage Detecting Time at Startup	0 ~10 min	0	○	○	○
	00-61	Minimum Pressure 2	0.0 ~ 100.0%	0.1	○	○	○
	00-62	Minimum Flow 2	0.00 ~ 100.00%	5.00	○	○	○
	00-63	Pressure Releasing Valve Opening Time Interval	0.000 ~ 0.100 sec	0.100	○	○	○

01 Motor Parameters

✓ You can set this parameter during operation.

	Parameter	Explanation	Settings	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	○	○	○
✓	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	○	○	○
	01-02	Motor's maximum operating frequency	50.00~599.00Hz	166.67	○	○	○
	01-03	Motor's rated frequency	0.00~599.00Hz	113.33	○	○	○
	01-04	Motor's rated voltage	230V Series: 0.1V~255.0V 460V Series: 0.1V~510.0V	220.0 440.0	○	○	
✓	01-05	Acceleration time setting	0.00~600.00 seconds	0.00	○	○	○
✓	01-06	Deceleration time setting	0.00~600.00 seconds	0.00	○	○	○
	01-07	Motor Parameter Auto Tuning	0: No function	0	○	○	
			1: Dynamic 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 test for SPM motor (Surface-mounted permanent magnet synchronous motor)				○
			13: Dynamic test for IPM motor (Interior permanent magnet synchronous motor)				
	01-08	Rated current of the induction motor (A)	40~120% of the drive's rated current	#.##		○	

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	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 Parameter 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	0.00			○
	01-18	Rated power of the synchronous motor	0.00~655.35kW	0.00			○
	01-19	Rated speed of the synchronous motor	0~65535rpm	1700			○
	01-20	Number of poles of the synchronous motor	2~20	8			○
	01-21	Inertia of the synchronous motor’s rotor	0.0~6553.5 *10^{-4} kg.m^2	0.0			○
	01-22	Stator’s phase resistance (Rs) of the synchronous motor	0.000~65.535Ω	0.000			○
	01-23	Stator’s phase inductance (Ld) of the synchronous motor	0.00~655.35mH	0.00			○
	01-24	Stator’s phase inductance (Lq) of the synchronous motor	0.00~655.35mH	0.00			○
	01-25	Back EMF of the synchronous motor	0~65535 V/ krpm	0			○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	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	4~ 10KHz	5	○	○	○
↗	01-34	Reserved					
	01-35	Motor ID#	0 : No Function See 4-2 Description of Parameter Settings for more information	0			
	01-36	Change the running direction	0: When the drive runs **forward,** the motor rotates **counterclockwise.** When the drive runs **reversely**, the motor rotates **clockwise**. 1: When the drive runs **forward,** the motor rotates **clockwise**. When the drive runs **reversely**, the motor rotates **counterclockwise**	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%	○	○	○

02 Protection Parameters

✓ You can set this parameter during operation.

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	02-00	Software brake level	230V series: 350.0~450.0V_{DC} 460V series: 700.0~900.0V_{DC}	380.0 760.0	○	○	○
	02-01	Fault record 1	0: No error record	0	○	○	○
	02-02	Fault record 2	1: Over-current during acceleration (ocA)	0	○	○	○
	02-03	Fault record 3	2: Over-current during deceleration (ocd)	0	○	○	○
	02-04	Fault record 4	3: Over-current during constant speed (ocn)	0	○	○	○
	02-05	Fault record 5	4: Ground fault (GFF)	0	○	○	○
	02-06	Fault record 6	5: IGBT short-circuit (occ)	0	○	○	○
			6: Over-current at stop (ocS)		○	○	○
			7: Over-voltage during acceleration (ovA)		○	○	○
			8: Over-voltage during deceleration (ovd)		○	○	○
			9: Over-voltage during constant speed (ovn)		○	○	○
			10: Over-voltage at stop (ovS)		○	○	○
			11: Low-voltage during acceleration (LvA)		○	○	○
			12: Low-voltage during deceleration (Lvd)		○	○	○
			13: Low-voltage during constant speed (Lvn)		○	○	○
			14: Low-voltage at stop (LvS)		○	○	○
			15: Phase loss protection (orP)		○	○	○
			16: IGBT over-heat (oH1)		○	○	○
			17: Heat sink over-heat for 40HP and above (oH2)		○	○	○
			18: TH1 open: IGBT over-heat protection circuit error (tH1o)		○	○	○
			19: TH2 open: heat sink over-heat protection circuit error (tH2o)		○	○	○
			20: IGBT over heated and unusual fan function (oHF)		○	○	○
			21: Hybrid servo drive overload (oL)		○	○	○
			22: Motor over-load (EoL1)		○	○	○
			23: Reserved				
			24: Motor over-heat (oH3)		○	○	○
			25: Reserved				
			26: Reserved		○	○	○
			27: Reserved		○	○	○
			28: Reserved		○	○	○
			29: Reserved		○	○	○
			30: Memory write error (cF1)		○	○	○
			31: Memory read error (cF2)		○	○	○

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
		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: Clamp 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)		○	○	○
		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 (PGF5)				○
		66: Overpressure (ovP)		○	○	○
		67: Pressure feedback fault (PfbF)		○	○	○
		68: Oil pump runs reversely (Prev)				

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
			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 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 index is out of range (CFrE)				
✓	02-07	Low voltage level	160.0~220.0V_{DC} 320.0~440.0V_{DC}	180.0 360.0	○	○	○
✓	02-08	PTC action selection	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop	1	○	○	○
✓	02-09	PTC level	0.0~150.0°C	130	○	○	○
✓	02-10	Reserved					
✓	02-11	PTC type	0: Not assigned 1: KTY84-130 2: PTC130 3: Switch (N.C. model)	0	○	○	○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	02-12	Motor fan activation level	0.0~150.0°C	50.0	○	○	○
✓	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	○	○	○
✓	02-14	Electronic thermal characteristic for motor	30.0~600.0 seconds	60.0	○	○	○
	02-15	Output frequency at malfunction	0.00~599.00 Hz	Read only	○	○	○
	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	○	○	○
	02-18	Output Current at malfunction	0.00~655.35 Amp	Read only	○	○	○
	02-19	IGBT temperature at malfunction	-3276.7~3276.7 ºC	Read only	○	○	○
	02-20	Auto-Reset LvX error	0: Disable, 1: Enable ºC	0	○	○	○
	02-21	Decode the parameter protection with the password	0~9999	0	○	○	○
	02-22	Set up a parameter protection password	0~9999	0	○	○	○
	02-23 ~ 02-31	Reserved					
	02-32	Frequency Command at malfunction	0.00 ~ 599.00 Hz	Read only	○	○	○
	02-33	Capacitor's temperature at malfunction	-3276.7~3276.7 ºC	Read only	○	○	○
	02-34	Motor's rotating speed at malfunction	-3276.7~3276.7 rpm	Read only	○	○	○
	02-35	Torque command at malfunction	-3276.7~3276.7 %	Read only	○	○	○
	02-36	Input Terminals' Status at malfunction	0 ~ 65535	Read only	○	○	○

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
02-37	Output Terminals' Status at malfunction	0 ~ 65535	Read only	○	○	○
02-38	Hybrid servo drive's status at malfunction	0 ~ 65535	Read only	○	○	○
02-39	Detecting Braking Resistor at startup	0: Disable, 1: Enable	1	○	○	○
02-40	Braking resistance	0.0~6553.5Ω	0.0	○	○	○

03 Digital/Analog Input/ Output Parameters

✓ You can set this parameter during operation.

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
	03-00	Multi-function input command 3 (MI3)	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	0	○	○	○
	03-01	Multi-function input command 4 (MI4)		0	○	○	○
	03-02	Multi-function input command 5 (MI5)		0	○	○	○
✓	03-03	Digital input response time	0.001~ 30.000 sec	0.005	○	○	○
✓	03-04	Digital input operation direction	0～65535	0	○	○	
✓	03-05	Multi-function output 1 (Relay 1)	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	11	○	○	○
✓	03-06	Multi-function Output 2 (MO1)		0	○	○	○
✓	03-07	Multi-function Output 3 (MO2)		0	○	○	○
✓	03-08	Multi-function output Direction	0～65535	0		○	
✓	03-09	Display low-pass filter time on the keypad	0.001~65.535 seconds	0.100	○	○	○
	03-10	Maximum output voltage for pressure feedback	5.0~10.0 V	10.0	○	○	○
	03-11	Minimum output voltage for pressure feedback	0.0~2.0 V	0.0	○	○	○
✓	03-12	Current/Voltage type pressure sensor selection	0: Current mode 1: Voltage mode	1	○	○	○
	03-13	Confluence Master/Slave Selection	0: No function 1: Master 1 2: Slave/Master 2 3: Slave/Master 3	0	○	○	○
	03-14	The ratio between slave's flow and master's flow	0.0~65535.5 %	100.0	○	○	○
✓	03-15	Source of frequency command	0: Digital keypad 1: RS485 Communication 2~5: Reserved 6: CANopen	0	○	○	○

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	03-16	Limit for the Slave reverse depressurization torque	0~500%	20	○	○	○
✓	03-17	Slave's activation level	0.0~100.0%	50.0	○	○	○
	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	○	○	○
✓	03-21	Slave reverse operation for depressurization	0: Disabled 1: Enabled 2: Reserved	0	○	○	○
✓	03-22	Slave closing level	0 ~400bar	400	○	○	○

04 Communication Parameters

✓ You can set this parameter during operation.

	Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
✓	04-00	Communication address	1~254	1	○	○	○
✓	04-01	COM transmission speed	4.8~115.2 Kbps	19.2	○	○	○
✓	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	○	○	○
✓	04-03	COM time-out detection	0.0~100.0 sec.	0.0	○	○	○
✓	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	○	○	○
✓	04-05	Delay time of communication response	0.0~200.0 ms	2.0	○	○	○
	04-06	Main frequency of the communication	0.00~ 599.00 Hz	60.00	○	○	○
✓	04-07	Block transfer 1	0.00~655.35	0.00	○	○	○
✓	04-08	Block transfer 2	0.00~655.35	0.00	○	○	○
✓	04-09	Block transfer 3	0.00~655.35	0.00	○	○	○
✓	04-10	Block transfer 4	0.00~655.35	0.00	○	○	○
✓	04-11	Block transfer 5	0.00~655.35	0.00	○	○	○
✓	04-12	Block transfer 6	0.00~655.35	0.00	○	○	○
✓	04-13	Block transfer 7	0.00~655.35	0.00	○	○	○
✓	04-14	Block transfer 8	0.00~655.35	0.00	○	○	○
✓	04-15	Block transfer 9	0.00~655.35	0.00	○	○	○
✓	04-16	Block transfer 10	0.00~655.35	0.00	○	○	○
	04-17	CANopen slave address	0: Disable 1~127	0	○	○	○

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
04-18	CANopen speed	0: 1 Mbps 1: 500 Kbps 2: 250 Kbps 3: 125 Kbps 4: 100 Kbps (Delta only) 5: 50 Kbps	0	○	○	○
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** **FOCPG** **FOCPM** Factory setting: Read only

Settings Read only

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

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

Settings Read only

🕮 Parameter 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 Pr00-01 can be read out to check if it is the rated current of the corresponding model. Display value of the current value of Parameter 00-01 for the related Parameter 00-00.

230V Series			460V Series							
Power (KW)	30	37	15	18.5	22	30	37	45	55	75
Horse Power (HP)	40	50	20	25	30	40	50	60	75	100
Model ID	214	215	411	412	413	414	415	416	417	418

00-02 Reset parameter settings

Control mode **VF** **FOCPG** **FOCPM** 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 (60Hz)

🕮 .

00-03 Software version

Control mode **VF** **FOCPG** **FOCPM** Factory setting: #. ##

Settings Read only

✍ 00-04 Selection of multi-function display

Control mode **VF** **FOCPG** **FOCPM** 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: ºC)

33: Reserved

34: torque constant KT (unit: K)

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

00-05 Reserved

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

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 2500

Settings 0~39999 rpm

🕮 Set the maximum speed of the motor corresponding to the 100% flow.

🕮 When the control mode is FOCPM (Pr01-00=5), Pr00-06 will follow the setting at Pr01-20<Number of poles of the synchronous motor> to modify Pr01-02<Motor's maximum operating frequency>. frequency = rpm*Pole/120

00-07 Maximum value of the pressure command

Control mode **VF** **FOCPG** **FOCPM** 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 parameters Pr00-07, Pr00-08 and Pr00-14, parameter Pr00-15 will also be modified automatically. However, when the pressure command is bigger than the pressure feedback, Pr00-07 cannot be set up.

🕮 Only when Pr00-07 is smaller than Pr00-08, you can set Pr00-07 while the hybrid servo drive is running,

.

00-08 Maximum pressure feedback value

Control mode **VF** **FOCPG** **FOCPM** 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** **FOCPG** **FOCPM** 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 bot Pr.01-05 (Acceleration time setting) and Pr01-06 (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 Parameter 00-09 as 1

Parameter 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 00-14.

Send a half pressure command through the controller and then check the multi-function display page to enter this value into 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 Parameter 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 Parameter 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 Parameter 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 Parameter 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 Parameter 00-09 =1 before setting Pr00-17, Pr00-18 and Pr00-19.

🕮 Parameter 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 00-17.

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

Send the 0% flow rate through the controller and then check the multi-function display page to enter this value into 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** **FOCPG** **FOCPM** Factory setting: 0.0

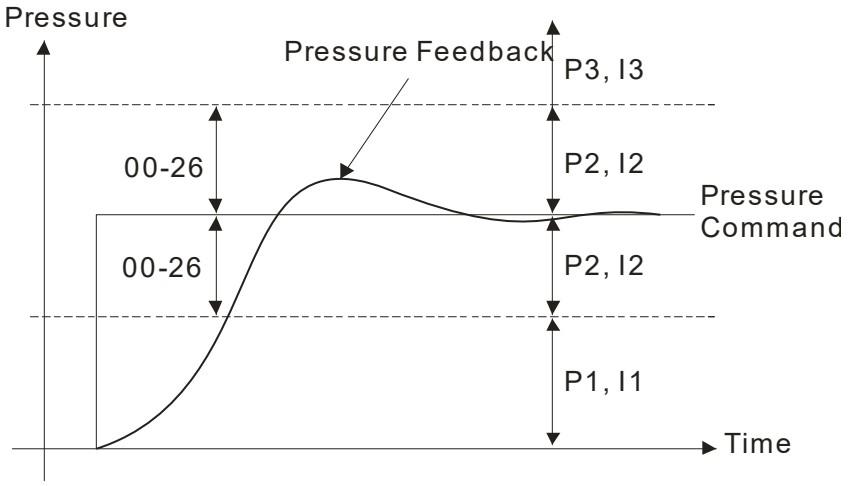
Settings 0.0~100.0 %

🕮 This parameter is functional only when Bit0 and Bit2 = 1 at Pr00-38.

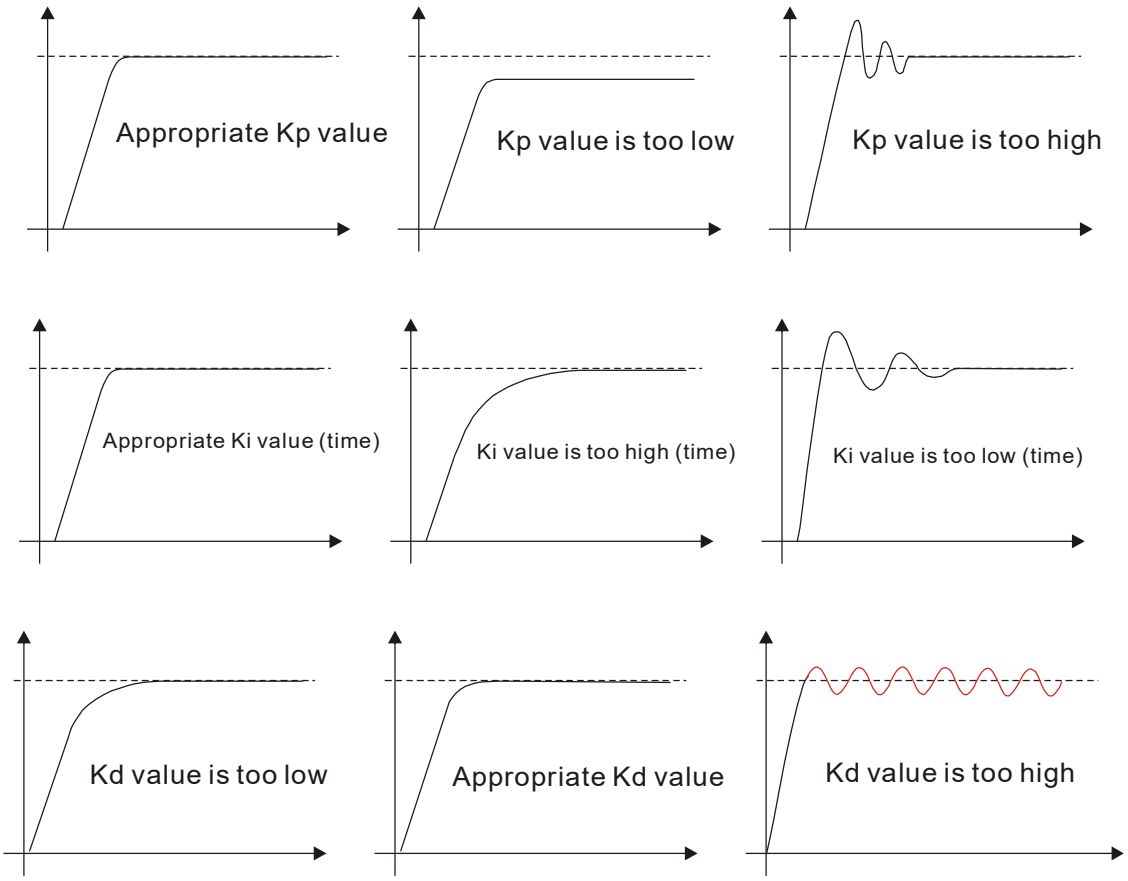
00-26 Pressure stable zone

Control mode **VF** **FOCPG** **FOCPM** 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 Parameter 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 Pr00-08 is the setting of Pr00-27 at 100%. The setting at Pr01-02 is the setting of Pr00-55 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.

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 Parameter 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

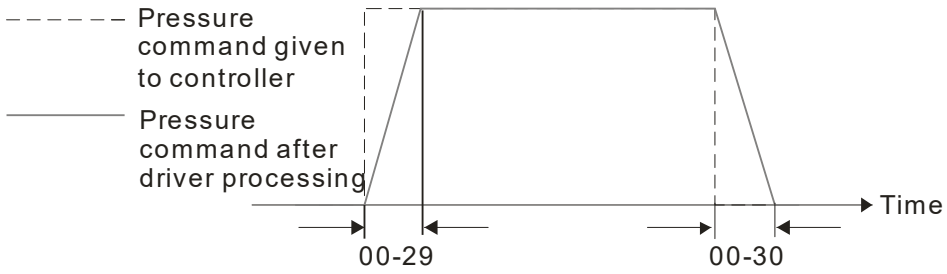
00-30 Ramp down rate of pressure command

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 (00-08).



00-31 Ramp up rate of flow command

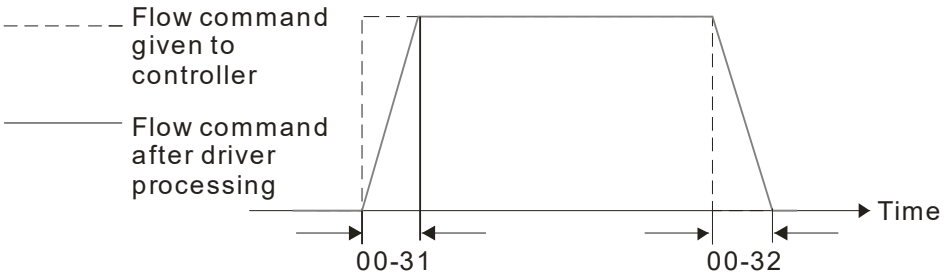
00-32 Ramp down rate of flow command

Control mode **VF FOCPG FOCPM** 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 (01-02).

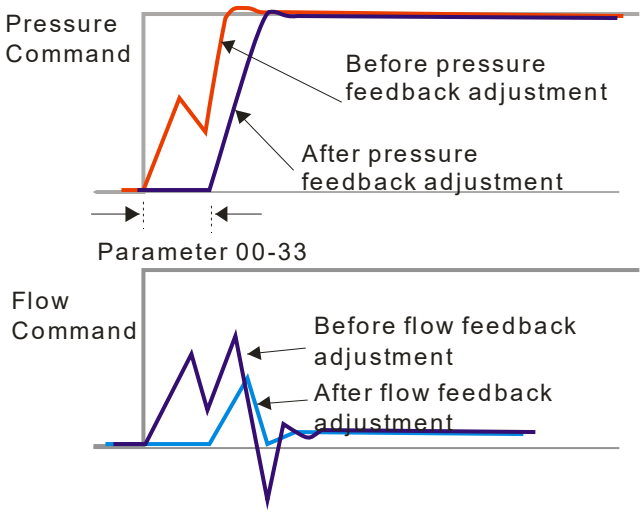


00-33 Valve opening delay time

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

00-35 Over-pressure detection level

Control mode **VF** **FOCPG** **FOCPM** 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** **FOCPG** **FOCPM** Factory setting: 0.01

Settings 0.0000~ 1.0000 sec

When the pressure feedback is larger than the level set at Pr00-35 and over the time set at Pr00-52, an ovP (over-pressure) warning code will display.

Warning code: When Pr00-35= 0, disable detection of pressure-overshoot.

00-36 Detection of disconnection of pressure feedback

Control mode **VF** **FOCPG** **FOCPM** 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** **FOCPG** **FOCPM** 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 (Pr00-20 and Pr00-21) and Pr00-10: Speed Bandwidth
ON	OFF	PI2 (Pr00-22 and Pr00-23) and Pr00-50: Speed Bandwidth 2
OFF	ON	PI3 (Pr00-24 and Pr00-25) and Pr00-51: Speed Bandwidth
Set Bit2 =1		
Multi-function input terminal = 47	Multi-function input terminal = 47	
OFF	OFF	PID1 (Pr00-20, Pr00-21 and Pr00-37) and Pr00-10: Speed Bandwidth
ON	OFF	PID2 (Pr0-22, 002-23 and Pr00-40) and Pr00-50 Speed Bandwidth 2
OFF	ON	PID3 (Pr00-24, Pr00-25 and Pr00-41) and Pr00-51: 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 Parameter 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 Pr00-39 and Pr00-42 are used to suppress pressure overshoot.

  But when Bit2 = 1, the setting at Pr00-37 is used to suppress pressure overshoot.
- When Bit3 =1:

Pressure Command	P, I Gain and Speed Bandwidth	**D** (Set Bit2 =1)
Smaller than or equal to the maximum pressure command (Pr00-07)*25%	PI1 (Pr00-20 and Pr00-21) and Pr00-10: Speed Bandwidth	Pr00-37
Equal to the maximum value for pressure command (Pr00-07)	PI2 (Pr00-22 and Pr00-23) and Pr00-50: 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 1

Control mode **VF** **FOCPG FOCPM** Factory setting: 0.2

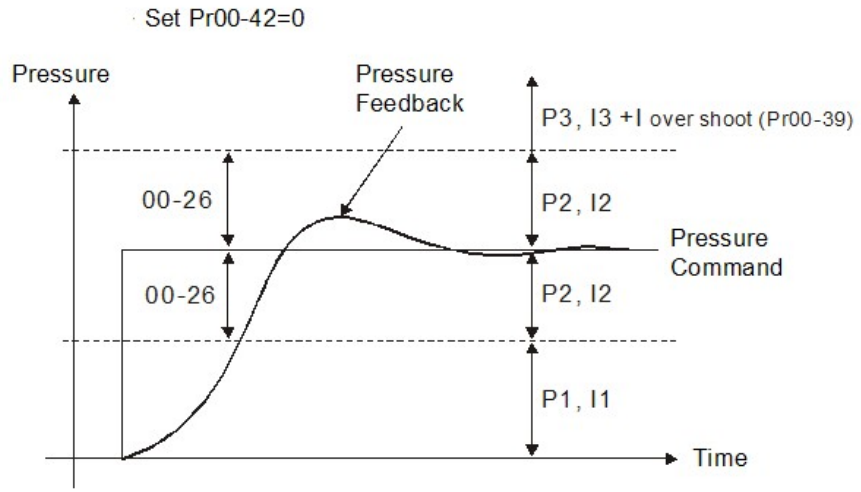
Settings 0.00~500.00 sec.

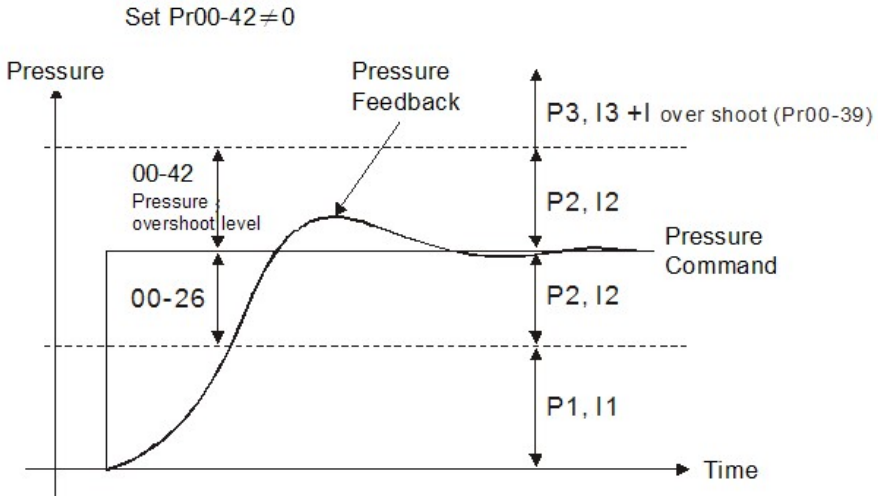
00-42 Pressure overshoot level

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

Settings 0~100%

- By using the factory setting 250 bar of the Pr00-08 Maximum Pressure Feedback, when the pressure is over 5 bar (250*2%=5 bar), another integral time of Pr00-39 will do overshoot protection.
- When Pr00-38=1 and Pr00-39=0, Pr00-42 is disabled.





00-43 Maximum Flow

Control mode **VF** **FOCPG FOCPM** 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 Pr01-02.

00-44 Pressure Command

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

Settings 0~400bar

00-45 Flow Command

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

Settings 0~100%

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

00-46 Pressure reference S1 time

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

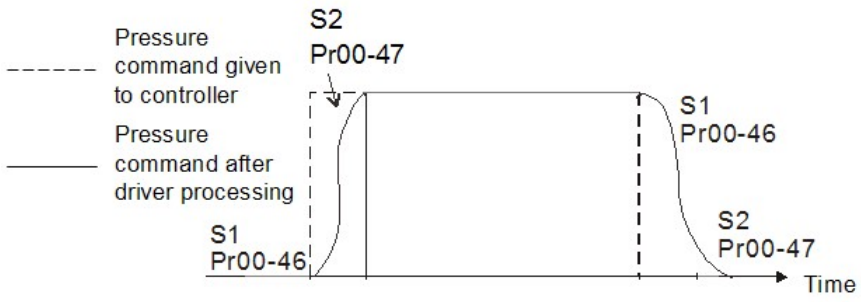
Settings 0~1000ms

00-47 Pressure reference S2 time

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

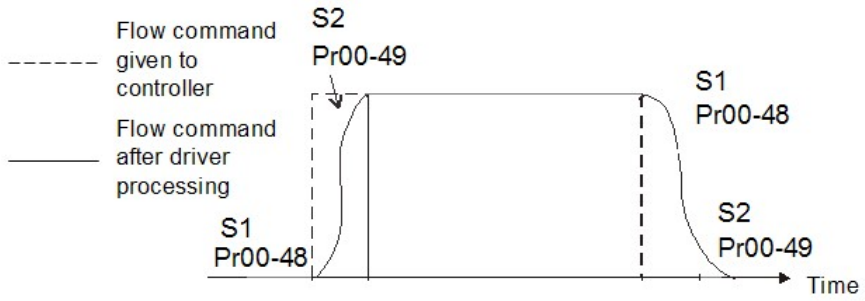
Settings 0~1000ms

00-49 Flow reference S2 time

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

Settings 0.0 ~60.0 sec

00-60 Oil shortage detecting time at startup

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

Settings 0 ~10min

- When the actual pressure is lower than the minimum pressure (Pr00-27) and exceeds the time set at Pr00-53 or Pr00-56, an oil shortage warning will pop up on the keypad.
- These two parameters are functional only when Pr00-09 (Pressure control mode) =1.
- When these two parameters are set to 0, they are disabled.
- Pr00-56 is only functional at startup of the operation. If Pr00-56 =5, the hybrid servo drive will verify if the actual pressure is bigger than the minimum pressure for 5 minutes. During these 5 minutes, a “bP” warning will display on the keypad but the hybrid servo drive keeps running with the preset minimum pressure and minimum flow rate. Besides the hybrid servo drive doesn’t accept any pressure and flow command during these 5 minutes. If the actual pressure is still under the setting at minimum pressure after running for 5 minutes, an oil shortage warning “noil” will pop up on the keypad.

00-54 Oil pump reverse running detecting time

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

Settings 0.0 ~60.0 sec

- When the oil pump runs reversely exceeds the time set at Pr00-54, a reverse running warning will pop up on the keypad.
- When Pr00-54 =0.0, this function is disabled.

00-55 ~ 00-58 Reserved

00-59 Minimum Flow

Control mode **VF** **FOCPG FOCPM** Factory setting: 5.00

Settings 0.00 ~ 100.00%

- To set the minimum pressure, the 100% of Pr00-27 matches the setting at Pr00-08 and the 100% of Pr00-55 matches the setting at Pr01-02.

🕮 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** **FOCPG FOCPM** Factory setting: 0.1

Settings: 0.0 ~ 100.0%

🕮 The setting value of Pr00-08 Maximum Feedback Pressure is the 100% of this parameter Pr00-61.

00-62 Minimum Flow 2

Control mode **VF** **FOCPG FOCPM** Factory setting: 5.00

Settings 0.00 ~ 100.00%

🕮 The setting value at Pr01-02 Maximum Operating Frequency is the 100% of this parameter Pr00-62.

00-63 Pressure Releasing Valve Opening Time Interval

Control mode **VF** **FOCPG FOCPM** 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 Pr00-63.
4) The feedback pressure doesn't reach yet the stable pressure zone.

Use Pr00-63 to set up the time interval between opening and closing pressure releasing valve to avoid unnecessary valve opening and closing (ON/ OFF)

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 (Pr01-00=5), the user defined speed display (Pr00-06) follows the setting of number of poles of synchronous motor (Pr01-20) to adjust the motor maximum operating frequency(Pr.01-02)

🕮 Frequency = Motor’s rotating speed (rpm) x 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 (Pr01-03) changes as Rated speed of the synchronous motor (Pr01-19) and Number of poles of the synchronous motor (Pr02-120) change.

01-04 Motor's rated voltage

Control mode **VF** **FOCPG** Factory setting: 220.0/440.0

Settings 230V series: 0.1 – 255.0V

460V series: 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 **VF** **FOCPG** **FOCPM** Factory setting: 0.00

Settings 0.00 – 600.00 seconds

01-06 Deceleration time setting

Control mode **VF** **FOCPG** **FOCPM** 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] (Pr01-02). The deceleration time determines the time required for the hybrid servo motor to decelerate from [the motor's maximum frequency] (Pr01-02) to 0.0Hz.

01-07 Motor Parameter Auto Tuning

Factory setting: 0

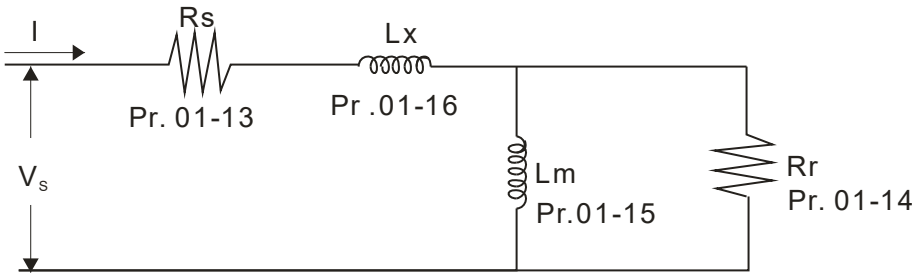
Settings	Control mode **VF**	**FOCPG**	**FOCPM**
0: No function	○	○	
1: Dynamic test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)	○	○	
2: Static test for induction motor(IM)	○	○	
3: Reserved			
4: Auto measure the angle between magnetic pole and PG origin			○
5: Dynamic test for SPM motor			○
13: Dynamic test for IPM motor			

🕮 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 Parameters 01-13~16 (no-load current, Rs, Rr, Lm, and Lx), respectively.

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

1. All parameters of the hybrid servo drive are set to factory settings and the motor is connected correctly.
2. 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 01-04, rated frequency 01-03, rated current 01-08, rated power 01-09, rated speed 01-10, and number of poles 01-11 of the motor with correct values, respectively. For the acceleration/deceleration time, please set the correct values.
4. Set Parameter 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 (parameters 01-13 ~ 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 (parameters 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 Parameters 01-22 (Rs), 01-23 & 24 (Ld & Lq), 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 01-17, rated power 01-18, rated speed 01-19, and number of poles 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 Parameter 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 (parameters 01-22 ~ 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 Parameter 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 Parameters 01-03, 01-17 to 01-25, respectively.
2. Before tuning, it is recommended to separate the motor and the load.
3. Set Parameter 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 Parameter 01-27.

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

Control mode **FOCPG**

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*40%=10 25*120%=30

01-09 Rated power of the induction motor

Control mode **FOCPG**

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 **FOCPG**

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 **FOCPG**

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 **FOCPG**

Unit: Ampere

Factory setting: 40

Settings 0~ Default value of Parameter 01-08

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

01-13 Stator resistance (Rs) of the induction motor

Control mode **FOCPG** Factory setting: 0

01-14 Rotor resistance (Rr) of the induction motor

Control mode **FOCPG** Factory setting: 0

Settings 0~65.535Ω

01-15 Magnetizing inductance (Lm) of the induction motor

Control mode **FOCPG** Factory setting: 0

01-16 Total leakage inductance (Lx) of the induction motor

Control mode **FOCPG** Factory setting: 0

Settings 0.0~6553.5mH

01-17 Rated current of the synchronous motor

Control 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 motor

Control 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 motor

Control 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 motor

Control 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 rotor

Control mode **FOCPM** Factory setting: 0.0

Settings 0.0~6553.5 *10^{-4} kg.m2

01-22 Stator's phase resistance (Rs) of the synchronous motor

Control 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 **FOCPM** Factory setting: 0.00

Settings 0.0~655.35mH

🕮 Enter the synchronous motor’s phase inductance. For surface type magnets (SPM), Ld = Lq; for built-in magnets (IPM), Ld ≠ Lq.

01-25 Back EMF of the synchronous motor

Control mode **FOCPM** Factory setting: 0

Settings 0~65535 V/krpm

🕮 Enter the back EMF of the synchronous motor.

01-26 Encoder type selection

Control mode **FOCPM** Factory setting: 3

Settings 3: Resolver

01-27 PG Offset angle of synchronous motor

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

Settings 1~5

01-29 Encoder Pulse

Control mode **FOCPG** **FOCPM** Factory setting: 1024

Settings 1~20000

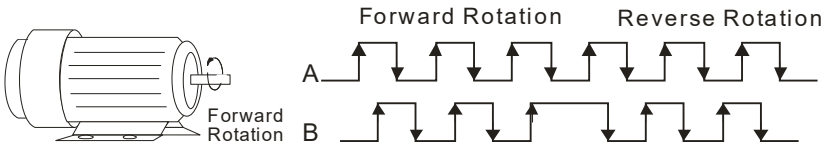
🕮 This parameter can be set the encoder's number of pulses per revolution (PPR).

01-30 Encoder's input type setting

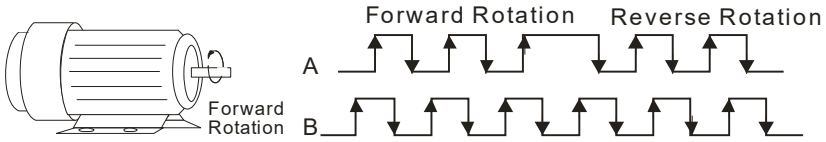
Control mode **FOCPG** **FOCPM** Factory setting: 1

Settings 0: No function

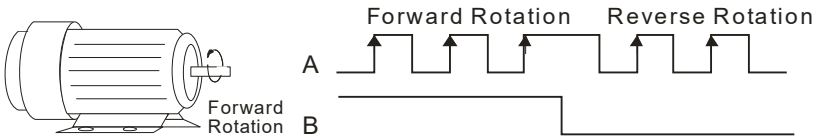
1: Phase A leads in a forward run command and phase B leads in a reverse run command.



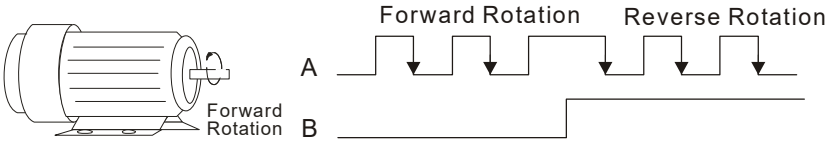
2: Phase B leads in a forward run command and phase A leads in a reverse run command.



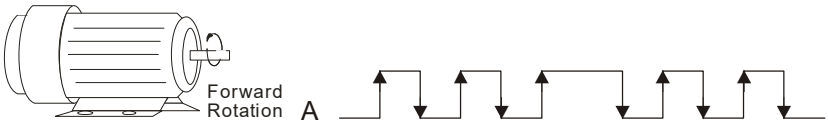
3: Phase A is a pulse input and phase B is a direction input. (low input = reverse direction, high input = forward direction).



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 Parameters 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 (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

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#
HES063H23C	2122
HES080H23C	3122
HES100H23C	4122
HES125H23C	5122
HES160H23C	6122
HES200H23C	7122
HES250G23C	8022
HES063H23A	2120
HES080G23A	3020
HES080H23A	3120
HES100G23A	4020
HES100H23A	4120
HES100Z23A	4220
HES125G23A	5020
HES125H23A	5120
HES160G23A	6020
HES160H23A	6120
HES200G23A	7020

Model	ID#
HES063G43A	2040
HES063H43A	2140
HES080G43A	3040
HES080H43A	3140
HES100G43A	4040
HES100H43A	4140
HES100Z43A	4240
HES125G43A	5040
HES125H43A	5140
HES160G43A	6040
HES160H43A	6140
HES200G43A	7040

Model	ID#
HES063H43C	2142
HES080H43C	3142
HES100H43C	4142
HES125H43C	5142
HES160H43C	6142
HES063M43C	2342
HES080M43C	3342
HES100M43C	4342
HES125M43C	5342
HES160M43C	6342
HES200M43C	7342
HES200H43C	7142
HES250M43C	8342
HES320M43C	9342

01-38 Maximum Output Voltage

Control mode **FOCPG FOCPM** Factory Setting: 100%

Settings 0 ~110%

The maximum output voltage is (V_{DC} * Pr01-38)/√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.

02 Protection Parameters

✓ You can set this parameter during operation.

✓ 02-00 Software brake level

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 380.0/760.0

Settings 230V series: 350.0~450.0V_{DC}

460V series: 700.0~900.0V_{DC}

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

26: Reserved	○	○	○
27: Reserved	○	○	○
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: Clamp 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.

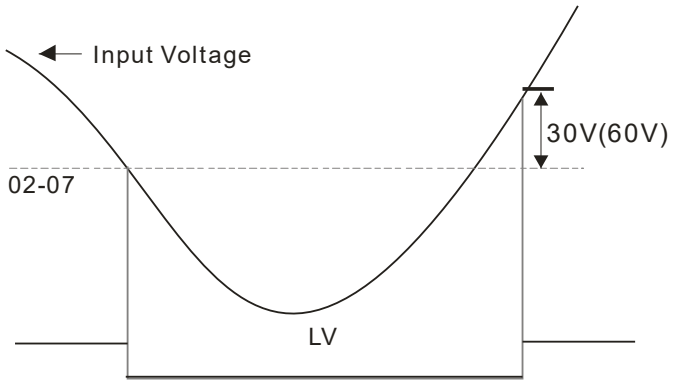
02-07 Low voltage level

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 180/360

Settings 230V Series: 160 ~ 220V

460V Series: 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 Pr02-08 to define the operation mode of the drive after the PTC is activated.

02-09 PTC level

Control mode **VF** **FOCPG** **FOCPM** Factory setting: 130.0

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 the Parameters 03-05 to 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** **FOCPG** **FOCPM** Factory setting: Read only

Settings 0.0 – 6553.5V

02-18 Output current at malfunction

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

Settings 0.00~655.35Amp

02-19 IGBT temperature at malfunction

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

Settings -3276.7~3276.7℃

02-20 Auto-reset LvX error

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

Settings 0.00 – 599.00Hz

02-33 Capacitors' temperature at malfunction

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

Settings -3276.7~3276.7℃

02-34 Motor's rotating speed at malfunction

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

Settings -32767~32767rpm

02-35 Torque command at malfunction

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

Settings -32767~32767%

02-36 Input terminals status at malfunction

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

Settings 0~65535

02-37 Output terminals status at malfunction

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

Settings 0~65535

02-38 Hybrid servo drive status at malfunction

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

Settings 0~65535

02-39 Detecting Braking Resistor at startup

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

Settings 0: Disable

1; Enable

02-40 Braking resistance

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

Settings 0.0 ~ 6553.5Ω

- Set Pr02-39 =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 <bro> 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.
- Pr02-40 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 Pr02-22 into Pr02-21, and then the parameters will be unlocked for modifications.
- Write down the setting vale after you set up this parameter to avoid inconveniences.
- Use Pr02-21 and Pr02-22 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 Pr02-22

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 Pr02-21.

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 Pr02-21, the hybrid servo drive is temporarily unlocked. To cancel the parameter protection, set Pr02-22 =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 Pr02-22 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 Pr02-22 to enable parameter protection.

Set up a password

Pr02-22

When you finish setting up a password, keypad will display 1 which means the password protection is now enabled.

Forget your password?

Pr02-21

Input 9999 and press ENTER, then repeat inputting 9999 and pressing ENTER to complete the decoding procedure. (This procedure has to be done in10 sec..
If you don't finish that in 10 sec.,repeat the same procedure until you finish the procedure in10 sec

Once you finish this decoding process, all the parameters will be back to the factory settings.

Wrong password?

Pr02-21

You only have 3 password trials to enter the correct password.

If the 1st attempt is incorrect, the keypad will display 01.

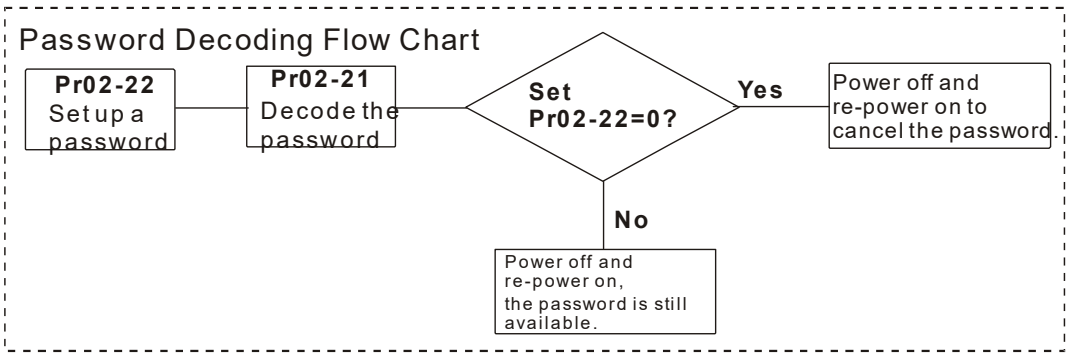
if the 2nd attempt is incorrect, the keypad will display 02.

If the 3rd attempt is incorrect, the keypad will display03.

If the 4th attempt is still wrong the keypad will display blinking error code <P code>.

After 3 failed logon attempts, the keypad will be locked.

Power off the motor drive and then re-power on to enter the password.



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** **FOCP**M 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

- 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 Parameter 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 Pr03-00 ~ Pr03-02 = 45, Pr01-01 is automatically set as 2 and Pr03-15 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 Parameters 00-36 if the setting value is 47 and 48,
- When the setting value is 51 and when the pressure control mode is enabled (Pr00-09=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 (MOI)

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** **FOCPG** **FOCPM** 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** **FOCPG** **FOCPM** 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** **FOCPG** **FOCPM** Factory setting: 10.0

Settings 5.0~10.0 V

03-11 Minimum output voltage for pressure feedback

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

Settings 0.0~2.0V

🕮 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** **FOCPG** **FOCPM** 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 Pr03-12 = 0 (4~20mA)

Set Pr00-36 =1 (Enable detection of the pressure feedback disconnection)

03-13 Confluence Master/Slave Selection

Control mode **VF** **FOCPG** **FOCPM** 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 **VF** **FOCPG** **FOCPM** 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 Parameter 03-14 should be 160/40 = 400%

03-15 Source of frequency command

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

Settings 0~500%

🕮 Set the torque limit for the Slave's reverse operation.

03-17 Slave's activation level

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

Settings 0: F (frequency command)
1: H (actual frequency)
2: Multi-function display (user-defined Pr00-04)
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 Parameter 00-04.

03-21 Slave reverse running for depressurization

Control mode **VF** **FOCPG** **FOCPM** 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 parameter 03-16 is set as 500. The maximum reverse running speed is determined by Pr00-28 Depressurization speed

03-22 Slave closing level

Factory setting: 400

Settings 0~ 400 Bar

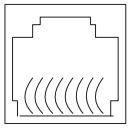
Set up this parameter from a Master. The slave pump(s) will be shut down when the master pump detects the pressure higher than the setting value at this parameter. The slave pump(s) will resume to run after the hybrid servo drive goes into stand by.

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.



Modbus RS-485:
Pin 1: CAN_H
Pin 2: CAN_L
Pin 3, 6: GND
Pin 4: SG-
Pin 5: SG+
Pin 7: Reserved
Pin 8: +15V

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:

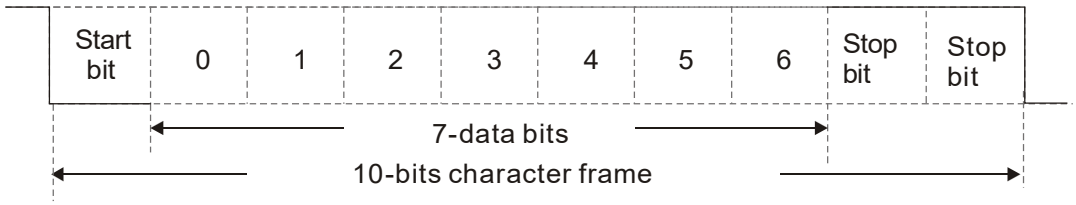
Character	'0'	'1'	'2'	'3'	'4'	'5'	'6'	'7'
ASCII code	30H	31H	32H	33H	34H	35H	36H	37H

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

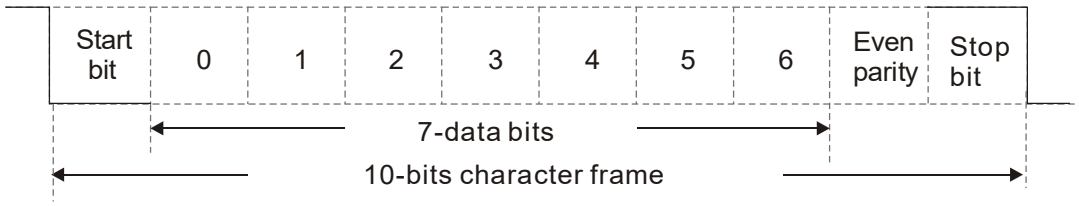
2. Data Format

10-bit character frame (For ASCII):

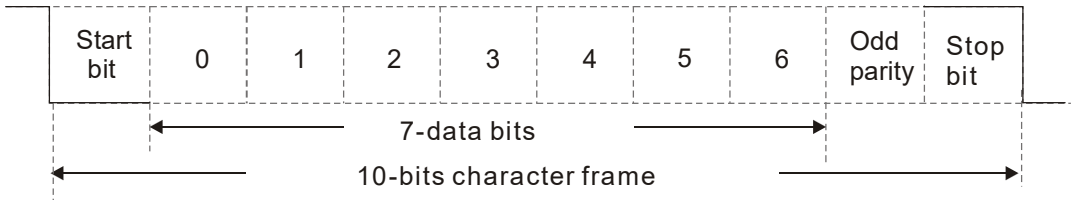
(7, N, 2)



(7, E, 1)

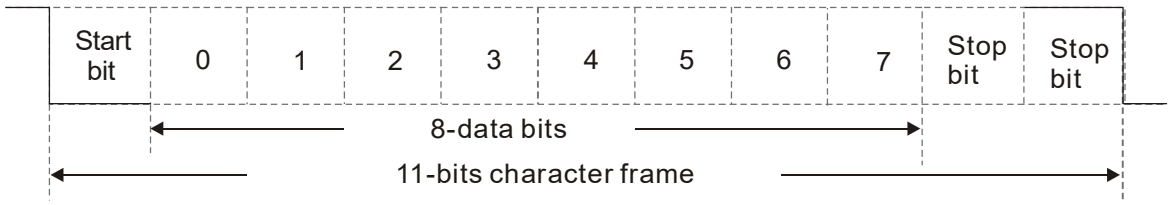


(7, O, 1)

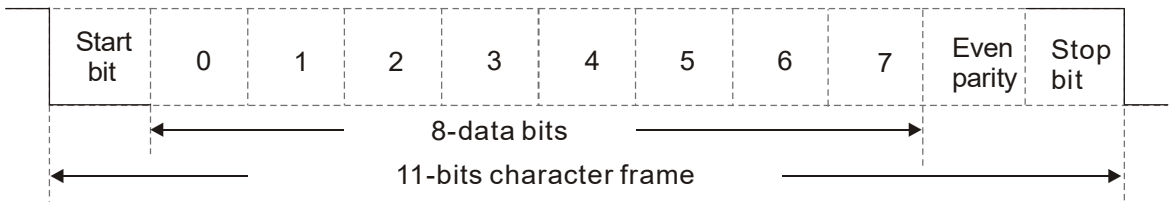


11-bit character frame (For RTU):

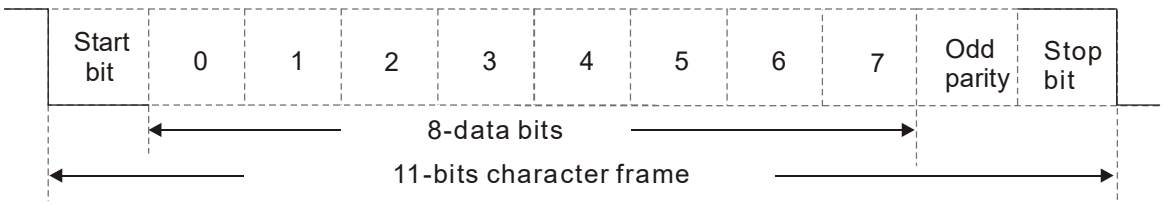
(8, N, 2)



(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:

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Starting register	'2'
	'1'
	'0'
	'2'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'D'
	'7'
END	CR
	LF

Response Message

STX	':'
Address	'0'
	'1'
Function	'0'
	'3'
Number of register (count by byte)	'0'
	'4'
Content of starting register 2102H	'1'
	'7'
	'7'
	'0'
Content of register 2103H	'0'
	'0'
	'0'
	'0'
LRC Check	'7'
	'1'
END	CR
	LF

RTU mode:

Command Message:

Address	01H
Function	03H
Starting data register	21H
	02H
Number of register (count by world)	00H
	02H
CRC CHK Low	6FH
CRC CHK High	F7H

Response Message

Address	01H
Function	03H
Number of register (count by byte)	04H
Content of register address 2102H	17H
	70H
Content of register address 2103H	00H
	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'
	'0'		'0'
Register content	'1'	Register content	'1'
	'7'		'7'
	'7'		'7'
	'0'		'0'
LRC Check	'7'	LRC Check	'7'
	'1'		'1'
END	CR	END	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:

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

Response Message

STX	':'
ADR 1	'0'
ADR 0	'1'
CMD 1	'1'
CMD 0	'0'
Target register	'0'
	'5'
	'0'
	'0'
Number of register (count by word)	'0'
	'0'
	'0'
	'2'
LRC Check	'E'
	'8'
END	CR
	LF

RTU mode:

Command Message:

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

Response Message:

ADR	01H
CMD 1	10H
Target register	05H
	00H
Number of register (Count by word)	00H
	02H
CRC Check Low	41H
CRC Check High	04H

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 **D7**H.

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 Pr00-21
			11B: Change source of operation command
		bit 15	Reserved
	2001H	Frequency command(Set Pr00-06=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 (Pr00-04)	
	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) (Pr00-04 #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
		(Pr00-04 #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:

STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘0’
	‘2’
LRC CHK	‘7’
	‘7’
END	CR
	LF

RTU mode:

Address	01H
Function	86H
Exception code	02H
CRC CHK Low	C3H
CRC CHK High	A1H

The explanation of exception codes:

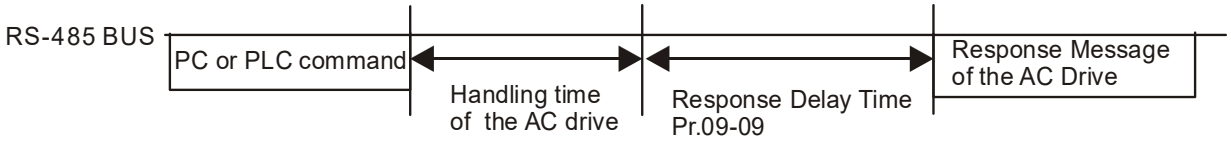
Exception code	Explanation
1	Function code is not supported or unrecognized.
2	Address is not supported or unrecognized.
3	Data is not correct or unrecognized.
4	Fail to execute this function code

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 Pr04-06 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 Pr04-06.

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 (Pr04-07 to Pr04-16). Through communication code 03H, you can use them (Pr04-07 to Pr04-1626) 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

5. Methods of Anomaly Diagnosis

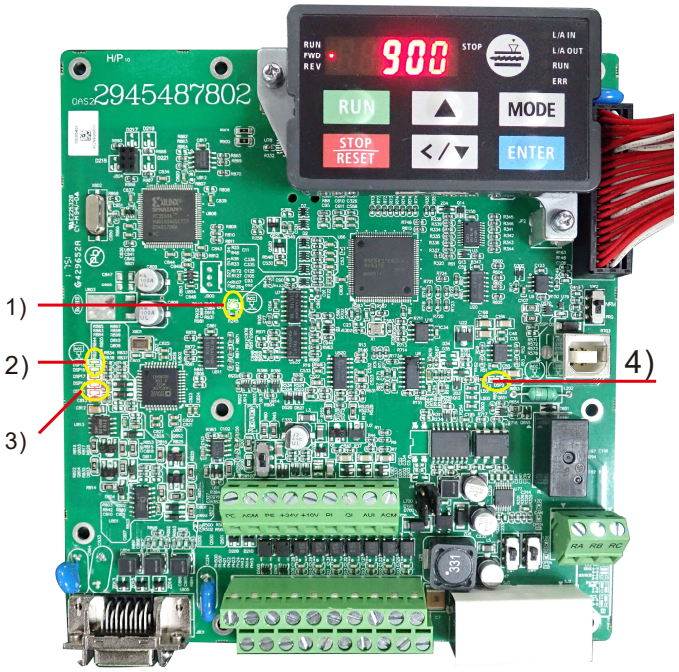
5-1) Unusual signal
5-2) Over current (oc)
5-3) Ground fault (GFF)
5-4) Over voltage (ov)
5-5) Low voltage (Lv)
5-6) Over heat (OH1)
5-7) Over load (OL)
5-8) Phase loss in power supply (PHL)
5-9) Hybrid servo drive overloading while running at low frequency (oL3)
5-10) Resolution for electromagnetic noise and induction noise
5-11) 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 stops 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.

NOTE

The LINE VFD online assistant is now available. To learn about the unusual signals, scan the QR code below. (The wechat assistant is under construction.)

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

Display Code	Display Code	Fault Description	Troubleshooting
E1		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 ● Adjust also the ramp up/down rate of pressure/flow command (Pr00-29 to Pr00-32) or ● Adjust the pressure/ flow reference time (Pr00-46~ Pr00-49) or ● Adjust the slope from the hybrid servo drive. 5. When such errors occur while pressure/ flow command is constant, adjust PI value (Pr00-20 ~ Pr00-25) Make sure if there is any disturbance/ noise, set Pr00-04: #11 (Pressure feedback), #12(Pressure command), 25 (flow command). Then observe if the values fluctuate. 6. Replace the hybrid servo drive with a larger output capacity model.
E2		Over current occurs in deceleration; output current exceeds by three times the rated current of the drive. (ocd)	
E3		Over current occurs during constant speed. Output current exceeds by three times the rated current of the drive. (ocn)	
E4		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.
E5		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.
E6		Over-current or hardware failure in current detection at Stop. (ocs)	Send back to manufacturer for repair.

Display Code	Display Code	Fault Description	Troubleshooting
E7		DC BUS over-voltage during acceleration. (ovA)	230V: DC 415V 460V: DC 830V 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. 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>
E8		DC BUS over-voltage during deceleration.(ovd)	
E9		DC BUS over-voltage at constant speed. (ovn)	
E10		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.
E11		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. 4. Lvn often occurs when the motor drive has a power failure while the operating signals are still being sent.
E12		DC bus voltage is lower than the setting in Pr02-07 during deceleration. (Lvd)	
E13		DC bus voltage is lower than the setting at Pr02-07 when running at constant speed (Lvn)	
E14		DC bus voltage is lower than the setting at Pr02-07 at stop (LvS)	
E15		Phase loss protection (PHL)	Check if only single phase power is sent or phase los occurs for three phase models
E16		IGBT's temperature exceeds the protection level (oH1)	1. Check if ambient temperature is too high. 2. Check if there is any foreign object on the heat sink and if the fan is running. 3. Check if there is sufficient space for air circulation for Hybrid Servo Drive

Display Code	Display Code	Fault Description	Troubleshooting
E17		Capacitors' temperature exceeds the protection level) (oH2)	1. Check if ambient temperature is too high. 2. Check if there is any foreign object on the heat sink and if the fan is running. 3. Check if there is sufficient space for air circulation for hybrid servo drive
E18		Hardware failure (tH1o)	Send back to manufacturer for repair.
E19		Hardware failure (tH2o)	Send back to manufacturer for repair.
E20		IGBT overheated and cooling fan failure. (oHF)	Check the fan kit to see if it is blocked. Return to factory for repair.
E21		The hybrid motor drive detects excessive output current (oL)	1. Check if the hybrid servo motor is stalled. 2. Replace the hybrid servo drive with a larger output capacity model. 3. Set Pr00-04=29, observe if the value returns to zero after every molding cycle. If the number accumulates to 100, OL occurs 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.
E22		Servo motor overload (EoL1)	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. 2. Replace with the hybrid servo drive with a larger output capacity model. 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.
E24		(02-09 PTC level) Overheating inside the motor drive detected by hybrid servo drive, exceeding the protection level (Pr02-09 PTC level) (oH3).	1. Check if the motor drive is blocked. 2. Check if the ambient temperature is too high. 3. Increase the capacity of the motor drive.
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.

Display Code	Display Code	Fault Description	Troubleshooting
E31		Error on memory readout (cF2	
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
F33		Detection of abnormal current in phase U (cd1)	
F34		Detection of abnormal current in phase V (cd2)	
F35		Detection of abnormal current in phase W (cd3)	
F36		Clamp current detection error (Hd0)	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair.
F37		Over-current detection error (Hd1)	
F38		Over-voltage detection error (Hd2)	
F39		Ground current detection error (Hd3)	
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.
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
E43		PG feedback loss (PGF2)	Check the PG feedback wiring. It could be an open circuit.
E44		Stalled PG feedback (the actual rotating speed is 115% faster than the maximum speed and the elapsed time longer than one second) (PGF3)	1. Check the PG feedback wiring. 2. Check if PI gain and the settings for acceleration/ deceleration are suitable. 3. Check if there's an output phase loss. 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.).

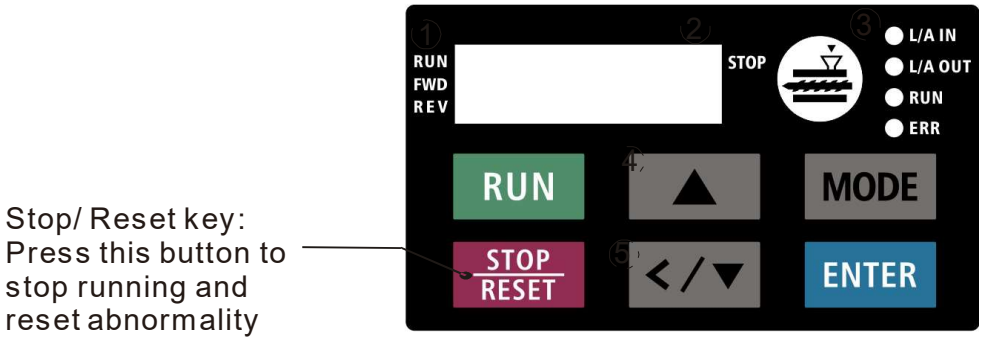
Display Code	Display Code	Fault Description	Troubleshooting
E45		PG slip error (PGF4)	1. Check if the connection between oil pump and motor is stuck. 2. Send back to manufacturer for repair.
E49		When external terminals EF are closed, Hybrid servo drive stops its output (EF)	Troubleshoot and press ”RESET”
E50		When external EMG terminal is not connected to the heating switch of hybrid servo motor or the motor is overheated (130 ºC), hybrid servo drive stops its input (EF1)	Troubleshoot and press ”RESET”
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
F53		CPU fault (ccod)	Send back to manufacturer for repair.
E54		Illegal command (cE1)	Verify if the communication command is correct (Communication code must be 03, 06, 10)
E55		Illegal data address (cE2)	Verify if the communication data length is correct.
E56		Illegal data value (cE3)	Verify if the data value is bigger than the maximum or smaller than the minimum value.
E57		Data is written to read-only address (cE4)	Verify if the communication address is correct.
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.
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.
E65		Hardware error of PG card (PGF5)	Send back to manufacturer for repair.
E66		Overpressure	1. Check if the pressure sensor is working properly and if its specification is correct. 2. Adjust pressure PI control Pr.00-20~00-37 3. Check if the wiring of pressure sensor is correct.

Display Code	Display Code	Fault Description	Troubleshooting
			4. Check the position of SW100 dip switch (current type or open collector) on the control board if correct.
E67		Pressure feedback error (PfbF)	1. Check if the wiring of pressure sensor is correct. It could be open-circuit. 2. Check if the pressure sensor signal is below 1V.
E68		Oil pump runs reversely (Prev)	1. Check if there's any zero shift at the pressure sensor. 2. Check if the wiring of pressure sensor is correct.
E69		Oil shortage (noil)	1. Check the amount of oil in the oil tank. 2. Check if any leakage at hydraulic circuit. 3. If there's a suction filter installed at the oil inlet, check if that suction filter is blocked up.
E70		Business hours end. (tUP)	Send back to manufacturer for repair.
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
F72		Braking resistor is open-circuit (bro)	Check if the braking resistor is open-circuit or properly wired?
F73		Braking resistor's resistance value is too small. (brF)	Check if the resistance value big enough?
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
E75		Error occurred on braking chopper's thermo-protection line (tH4o)	Send back to manufacturer for repair.
E82		Output Phase Loss on Phase U (oPL1)	1. Check if the wiring of motor to see if any loose or broken wires. 2. Check if the resistance of each phase is the same. 3. Use an amperemeter to measure if the 3-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.
E83		Output Phase Loss on Phase V (oPL2)	
E84		Output Phase Loss on Phase W (oPL3)	
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.

Display Code	Display Code	Fault Description	Troubleshooting
E101		Software error 1 occurred on CANopen (CGdE) (CANopen guarding error)	1. Increase guarding time (Index 100C). 2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference. 3. Make sure the communication wiring is serial. 4. Use dedicated CANopen cable and install terminating resistor. 5. Check the status of communication cable or change new cable.
E102		Software error 2 occurred on CANopen (CHbE) (CANopen heartbeat error.)	1. Increase Heart beat time (Index 1016). 2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference. 3. Make sure the communication wiring is serial. 4. Use dedicated CANopen cable and install terminating resistor. 5. Check the status of communication cable or change new cable.
E104		Hardware error occurred on CANopen (CbFE) (CANopen bus off error)	1. Re-install CANopen card. 2. Check the communication wiring and grounding. 90 degrees wiring layout or separation from main circuit is suggested to prevent interference. 3. Make sure the communication wiring is serial. 4. Use dedicated CANopen cable and install terminating resistor. 5. Check the status of communication cable or change new cable.
E105		Index setting error occurred on CANopen (CIdE) (CANopen index error)	Reset CANopen Index(Pr00-02=7)
E106		Slave # setting error occurred on CANopen (CAdE)	Disable CANopen(Pr04-17=0) Reset CANopen 設定(Pr00-02=7)
E107		CANopen's Index is Out of Range (CFrE) CANopen (CANopen memory error)	Disable CANopen(Pr04-17=0) Reset CANopen 設定(Pr00-02=7)

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 case mechanical damage or personnel casualty.



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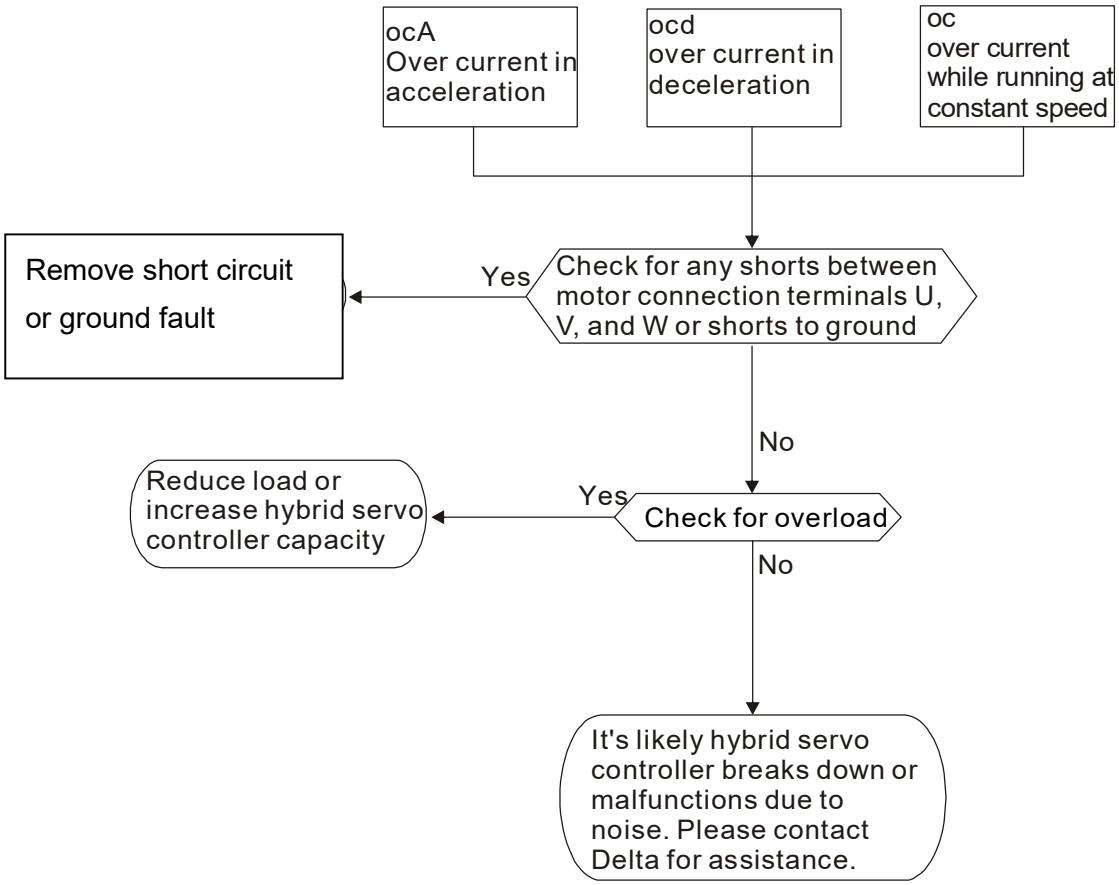
5-1-3 Warning Codes

ID No.	Display	Descriptions
A1	CE 1	Modbus function code error (Illegal function code) Corrective Actions ■ Check if the function code is correct. (Function code must be 03, 06, 10, 63)
A2	CE2	Modbus data address is error (Illegal data address (00 H to 254 H) Corrective Actions ■ Check if the communication address is correct.
A3	CE3	Modbus data error (Illegal data value) Corrective Actions ■ Check if the data value exceeds maximum / minimum value.
A4	CE4	Modbus communication error (Data is written to read-only address) Corrective Actions ■ Check if the communication address is correct.
A5	CE 10	Modbus transmission time-out
A6	CP 10	Keypad transmission time-out
A7	SE 1	Keypad COPY error 1 Keypad simulation error, including communication delays, communication error (keypad receives error FF86) and parameter value error.
A8	SE2	Keypad COPY error 2 Keypad simulation done, parameter writes error.
A9	oH 1	IGBT is over-heated than protection level: 95°C Corrective Actions ■ Ensure that the ambient temperature falls within the specified temperature range. ■ Make sure that the ventilation holes are not obstructed. ■ Remove any foreign objects from the heat sink and check for possible dirt in heat sink. ■ Provide enough spacing for adequate ventilation.

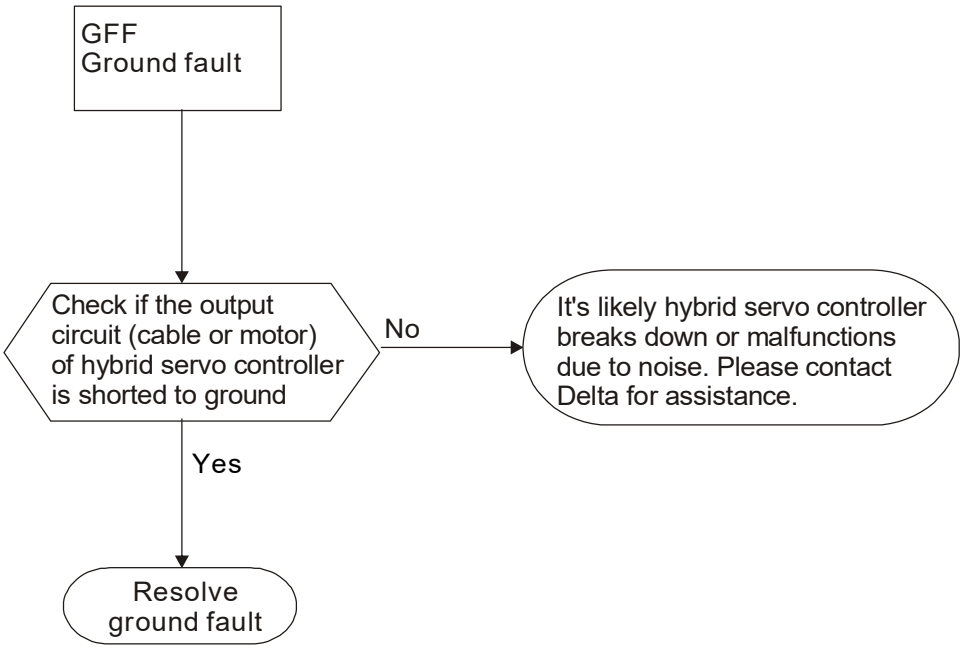
ID No.	Display	Descriptions
A10	oH2	Motor drive is over-heated than protection level: 95ºC. This warning code is ONLY for frame E, NOT for other frames. Corrective Actions ■ Ensure that the ambient temperature falls within the specified temperature range. ■ Make sure that the ventilation holes are not obstructed. ■ Remove any foreign objects from the heat sink and check for possible dirt in heat sink. ■ Provide enough spacing for adequate ventilation.
A11	PId	PID feedback loss
A14	AUE	Motor parameters auto-tuning error Corrective Actions ■ Check if motor wiring is correct. ■ Check if motor capacity and parameters are correct.
A15	PGFb	PG feedback error Corrective Actions ■ Check if the encoder's wiring is correct. ■ Check if PG card's red light is on because of some interferences.
A17	oSPd	Over speed warning
A18	dAuE	Over speed deviation warning
A19	PHL	Input Phase Loss
A22	oH3	Motor over-heating
A24	oSL	Over slip
A25	tUn	Auto-tuning in process
A26	FAn	Cooling fan jammed Corrective Actions ■ Check if the cooling spins or not. ■ Clean the cooling fan

ID No.	Display	Descriptions
A27	bP	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 Pr00-60. During this checking period, the servo drive refuses pressure command and flow command sent from keypad. The keypad displays bp (building pressure). If the pressure is still under 0.5bar after the checking period set at Pr00-60, there will be an oil shortage warning and the hybrid servo drive will stop running. The keypad will display noil (no oil). 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. ※ This function is effective when Pr00-27 <minimum pressure> is set as higher than 0.3% and the time setting at Pr00-60 is NOT 0.
A28	oPHL	Output Phase Loss
A36	CGdn	Software error 1 occurred on CANopen
A37	CHbn	Software error 2 occurred on CANopen (CHbE)
A38	CSyn	CANopen Synchronization off
A39	CbFn	CANopen bus off
A40	CIdn	CANopen index error
A41	CAdn	CANopen station address error
A42	CFrn	CANopen memory error
A43	CSdn	CANopen SDO transmission time-out
A44	CSbn	CANopen SDO received register overflow
A45	Cbtn	CANopen boot up fault
A46	CPtn	CANopen protocol format error

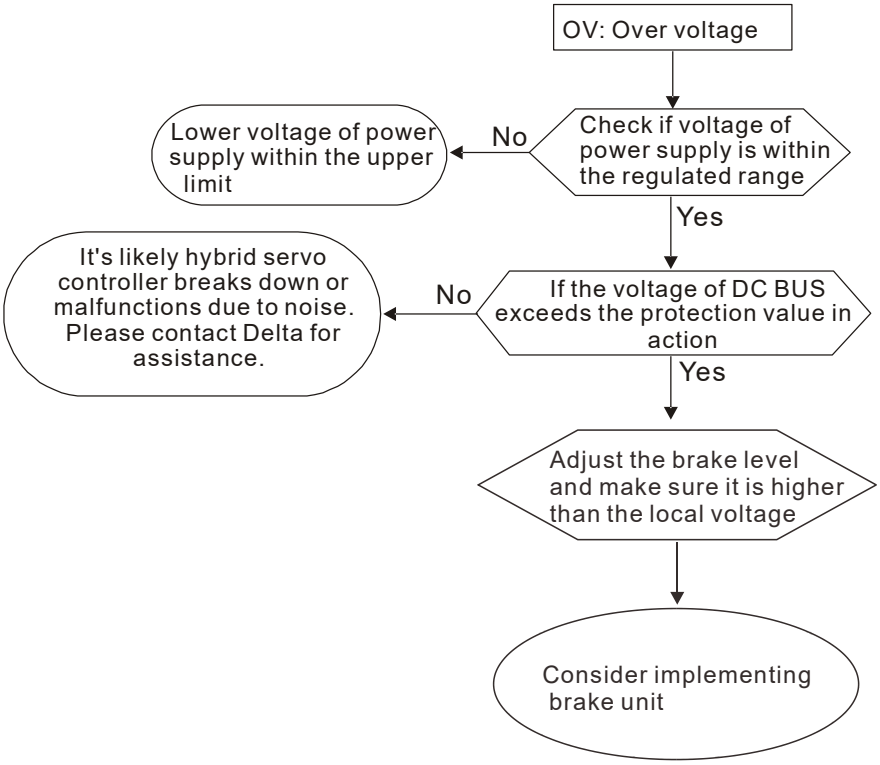
5-2 Over Current (oc)



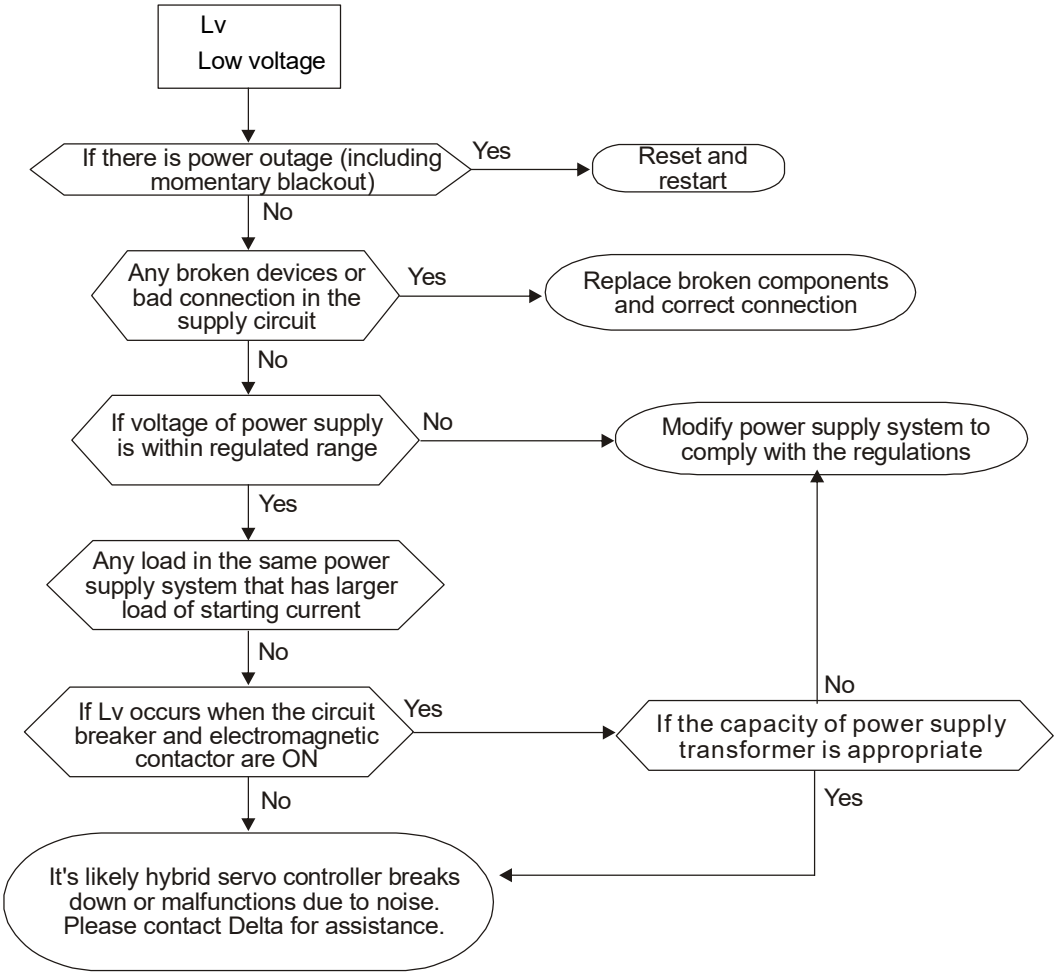
5-3 Ground Fault (GFF)



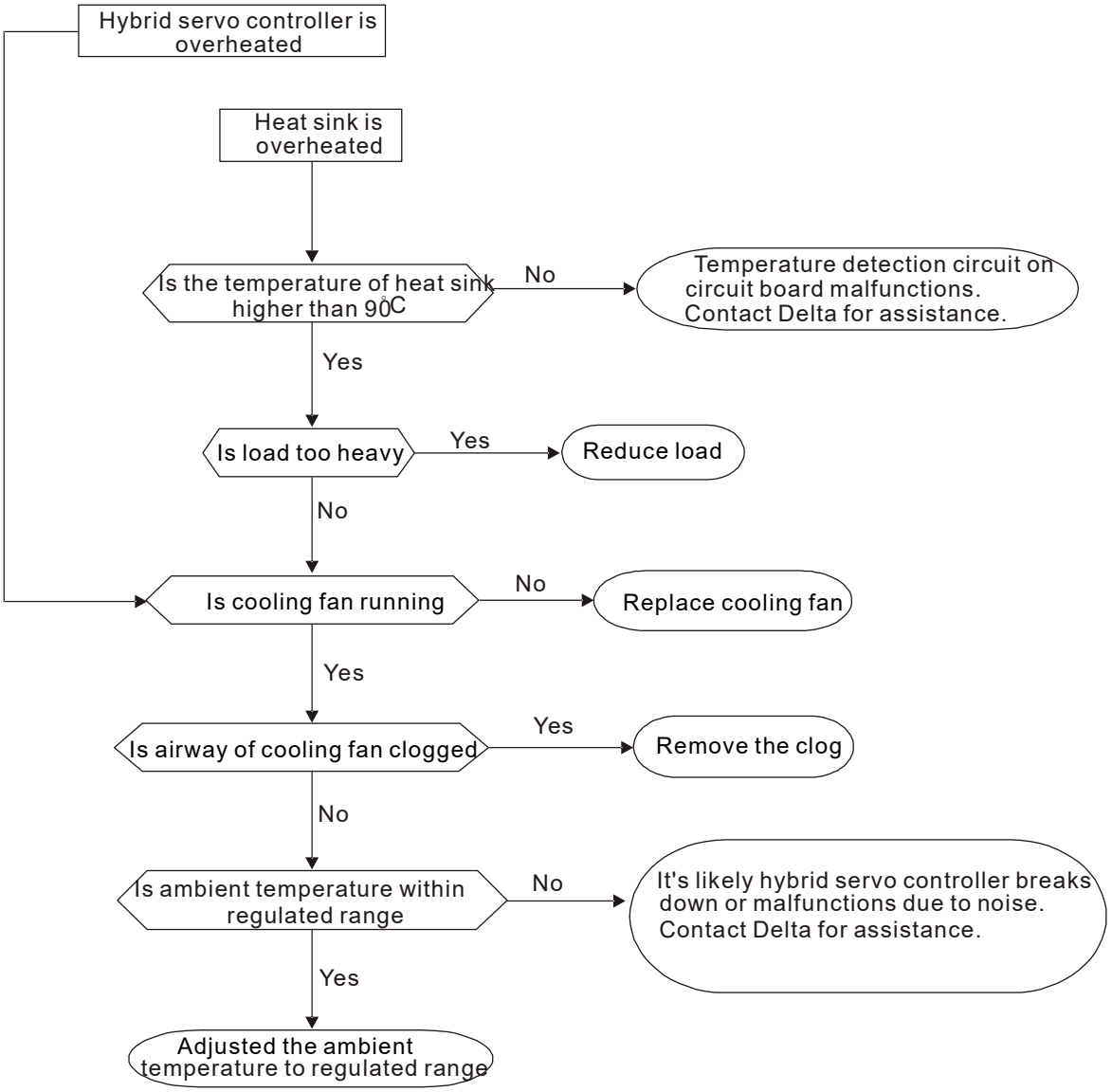
5-4 Over Voltage (ov)



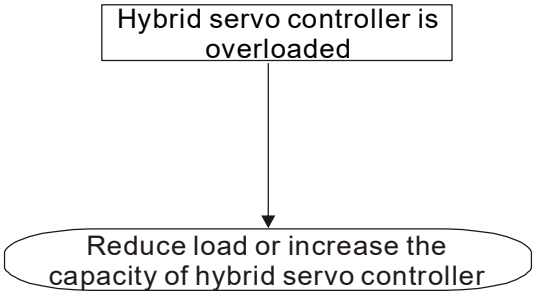
5-5 Low Voltage (Lv)



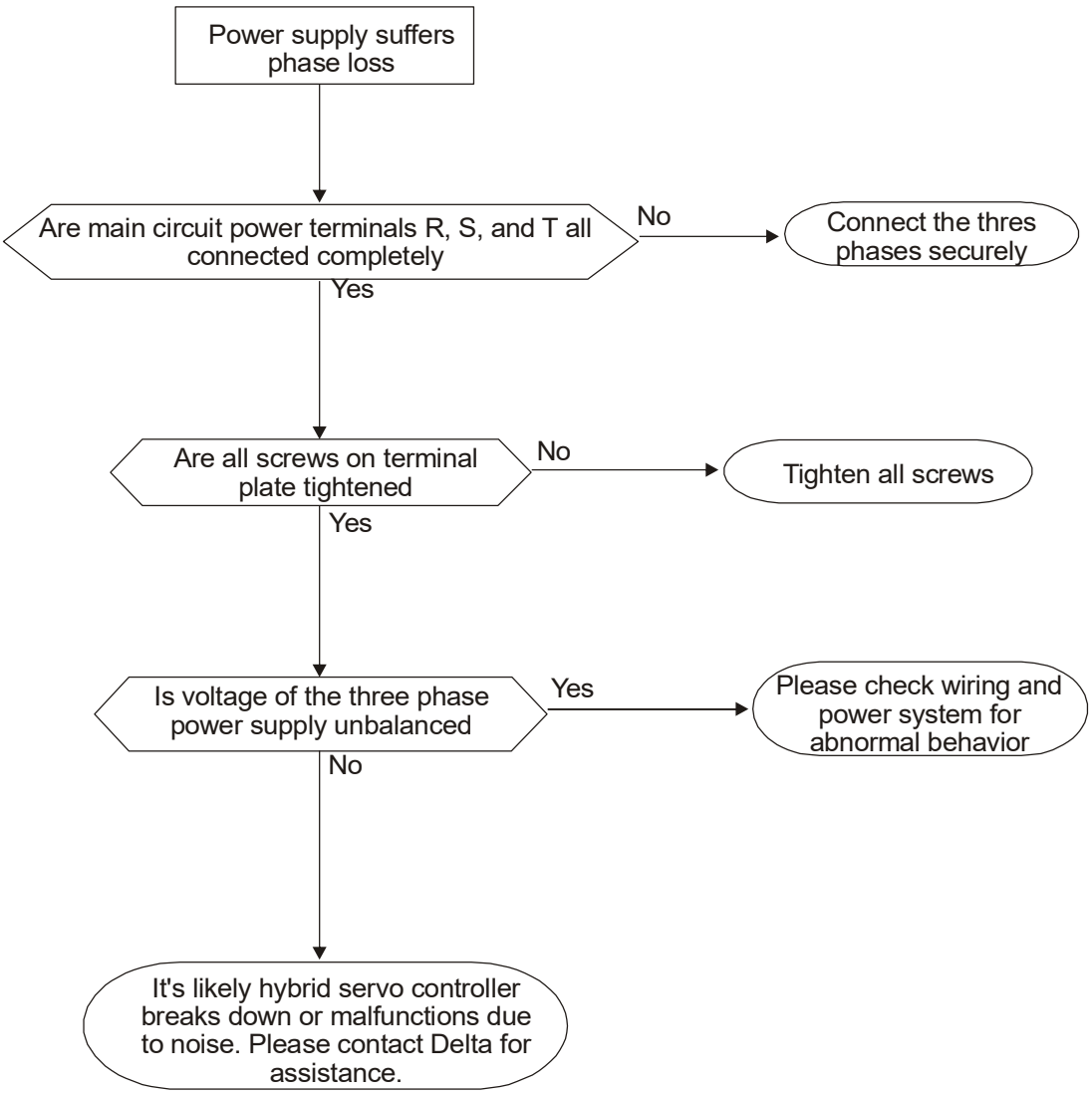
5-6 Over Heat (oH1)



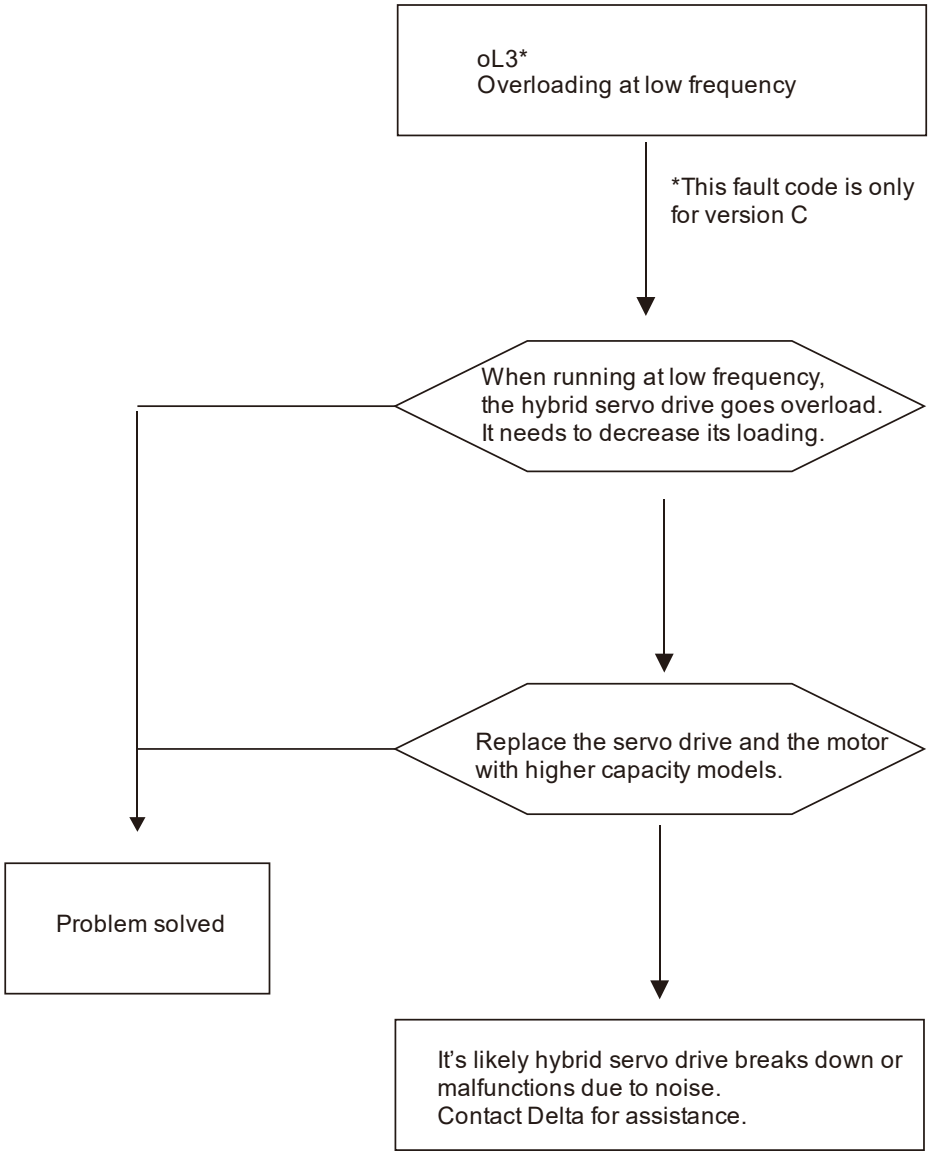
5-7 Overload (oL)



5-8 Phase Loss (PHL)



5-9 Hybrid servo drive overloading when running at low frequency (oL3)



5-10 Electromagnetic/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”.

5-11 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.

6. Suggestions and Error Corrections for Hybrid Servo Drives

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

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:

CAUTION

- ☑ 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 ≦ 22kW models and 10 minutes for ≧ 30kW 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	○		
If there are any dangerous objects	Visual inspection	○		

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	○		

Digital Keypad Display

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half Year	One Year
Is the display clear for reading	Visual inspection	○		
Any missing characters	Visual inspection	○		

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		○	
If there are any loose screws	Tighten the screws		○	
If any part is deformed or damaged	Visual inspection		○	
If there is any color change by overheating	Visual inspection		○	
If there is any dust or dirt	Visual inspection		○	

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	○		
If machine or insulator is deformed, cracked, damaged or with color change due to overheating or ageing	Visual inspection **NOTE: Please ignore the color change of copper plate**		○	
If there is any dust or dirt	Visual inspection		○	

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		○	
If the insulator of wiring is damaged or color change	Visual inspection		○	
If there is any damage	Visual inspection	○		

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	○		
If the safety valve is not removed? If valve is inflated?	Visual inspection	○		
Measure static capacity when required		○		

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	○		
If there is any disconnection	Visual inspection	○		
If connection is damaged?	Measure with multimeter with standard specification	○		

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	○		

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	○		
If the contact works correctly	Visual inspection	○		

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.		○	
If there is any peculiar smell and color change	Visual and smell inspection		○	
If there is any crack, damage, deformation or corrosion	Visual inspection		○	
If there is any liquid is leaked or deformation in capacity	Visual inspection		○	

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		○	
If there is any loose screw	Tighten the screw		○	
If there is any color change due to overheat	Change fan		○	

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.

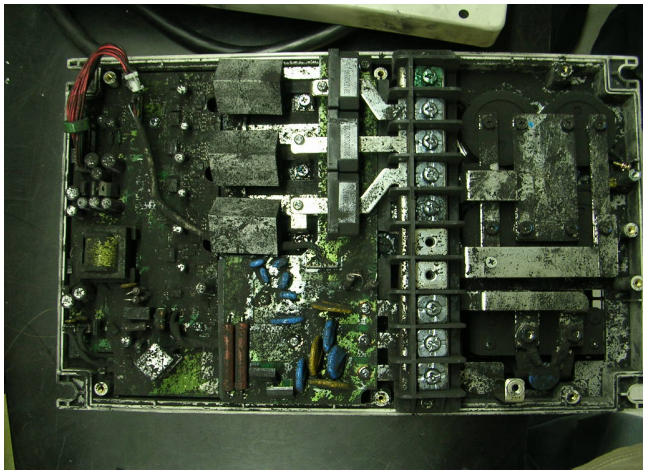
6-2 Greasy Dirt Problem

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.



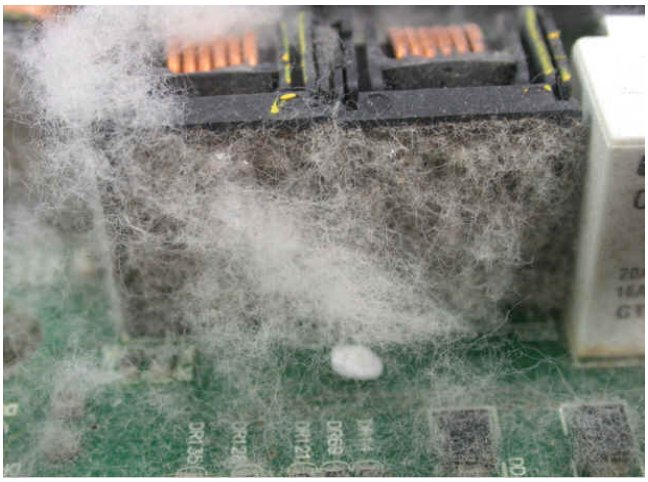
6-3 Fiber Dust Problem

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.



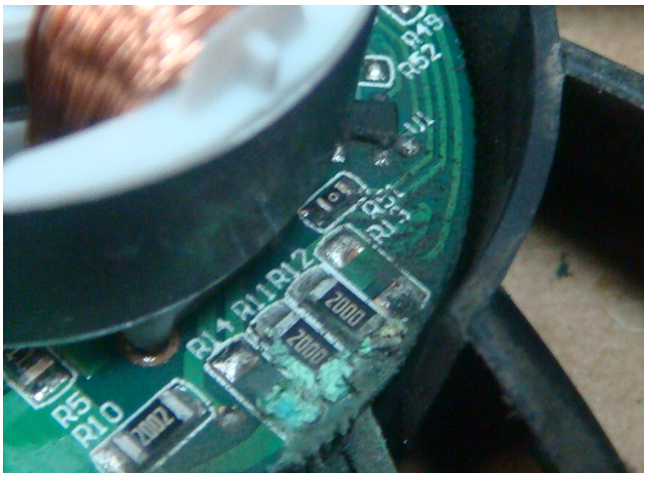
6-4 Erosion Problem

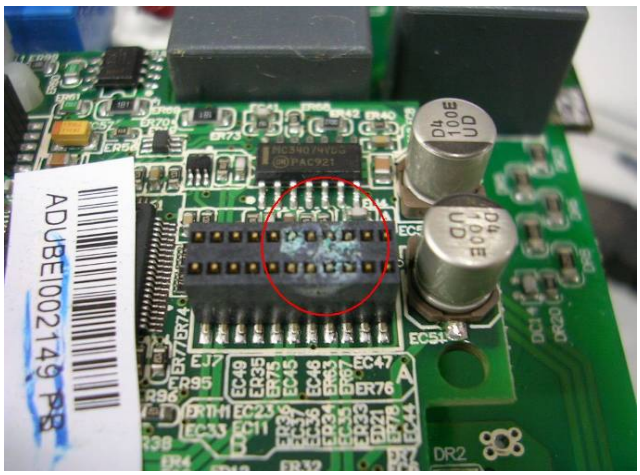
Erosion problems may occur if any fluids flow into the drives. Please be aware of the damages that erosion may cause to your drive.

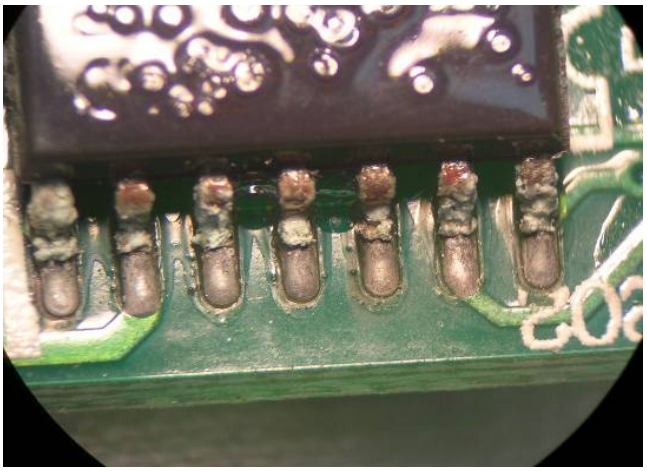
1. Erosion of internal components may cause the drive to malfunction and possibility to explode.

Solution:

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







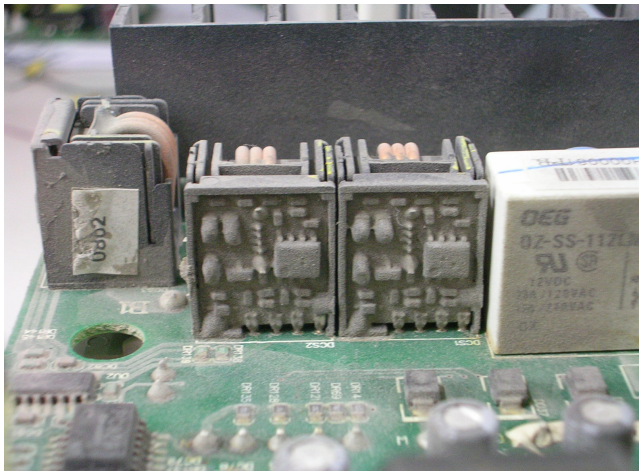
6-5 Industrial Dust Problem

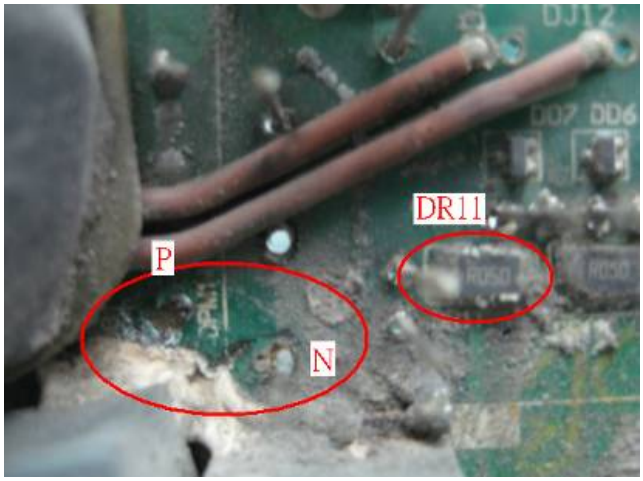
Serious industrial dust pollution frequently occurs in stone processing plants, flour mills, cement plants, and so on. Please be aware of the possible damage that industrial dust may cause to your drives:

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.





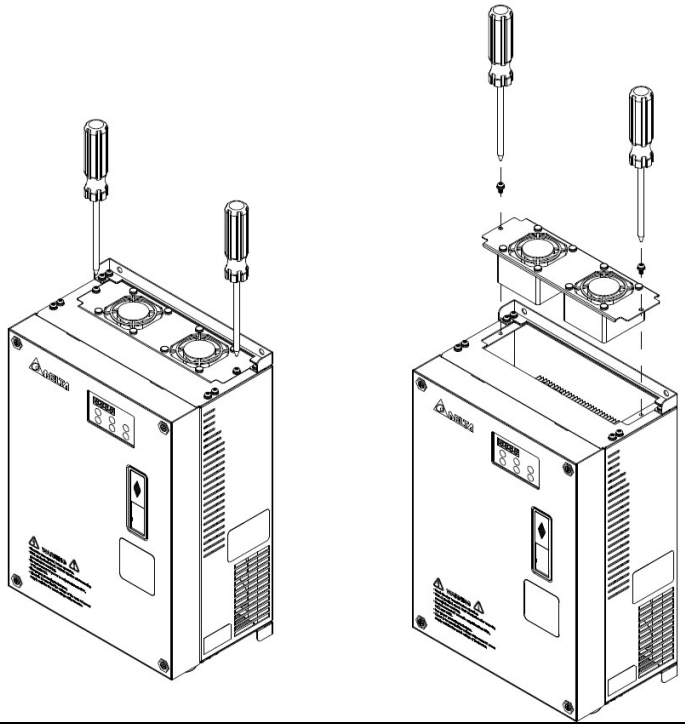
Check Items	Methods and Criterion	Troubleshooting
Visual check on the overall appearance	● Any accumulation of dirt and dust?	1. Shut down the servo drive, wait for a certain time. Make sure that the power indicator is off before you go to the next step. (≤ 22kW: wait for 5 min after shut down; ≥ 30kW: wait for 10 min after shut down) 2. Turn on a vacuum cleaner to remove the dust.
Ventilation Channel	● Any obstruction in the heat sink, air intake or air outlet? ● Any accumulation of dust on the cooling fan? ● Is the cooling fan damaged?	1. 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. (≤ 22kW: wait for 5 min after shut down; ≥ 30kW: wait for 10 min after shut down) 2. Follow the instruction in this manual to remove and clean the cooling fan. 3. Turn on a vacuum cleaner to clean the dust in the heat sink.。 ● If the cooling fan doesn't run at all, replace it with a new one. ● Clean the ventilation channel periodically to avoid accumulation of dirt and dust.

● Install and Remove Cooling Fans

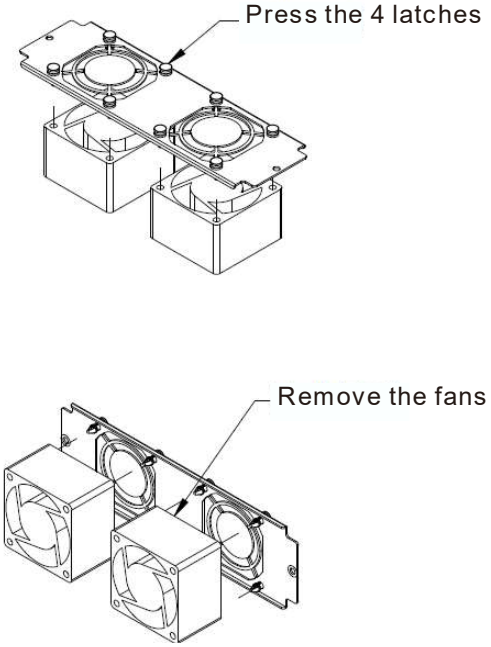
Frame-C & Frame-D

● Use a phililips-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.



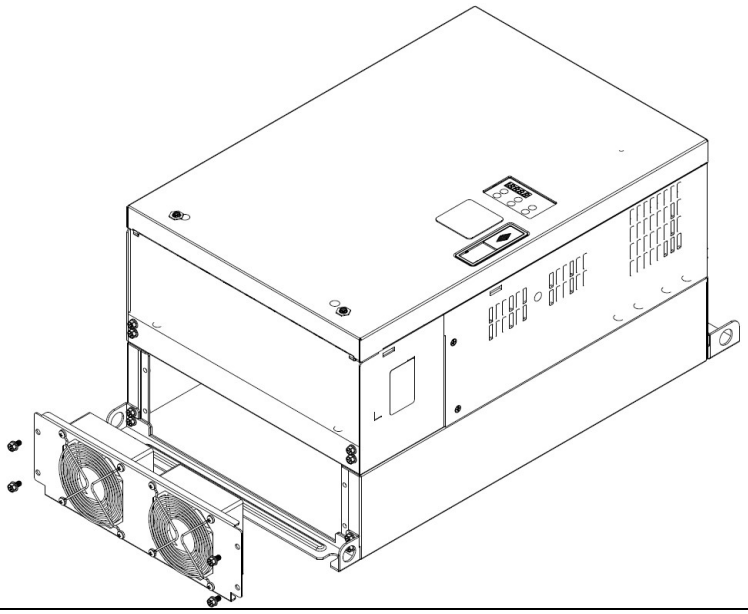
● Press the 4 latches on the fan cover, then you can remove the fan. Note that you don't need to pull up completely the latches to remove the fans. Just press gently.



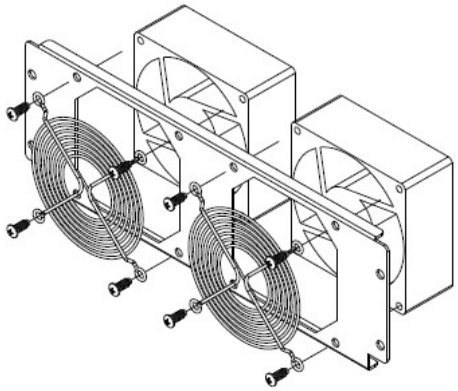
● Have the labels on the cooling fans facing outside of the servo drive when installing the cooling fans. Screw torque force: 10~12kgf-cm(8.7~10.4lb-in)

<table>
<tr><td colspan="2">Frame-E</td></tr>
<tr><td>

Use a phililips-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.


</td><td>

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


</td></tr>
<tr><td colspan="2">

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)

</td></tr>
</table>

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.

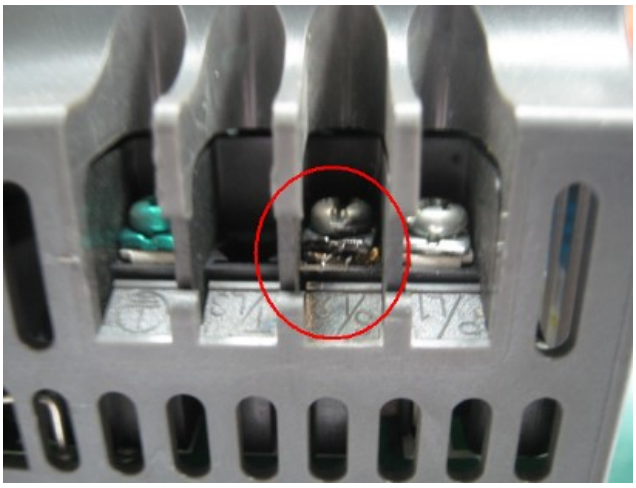
6-6 Wiring and Installation Problem

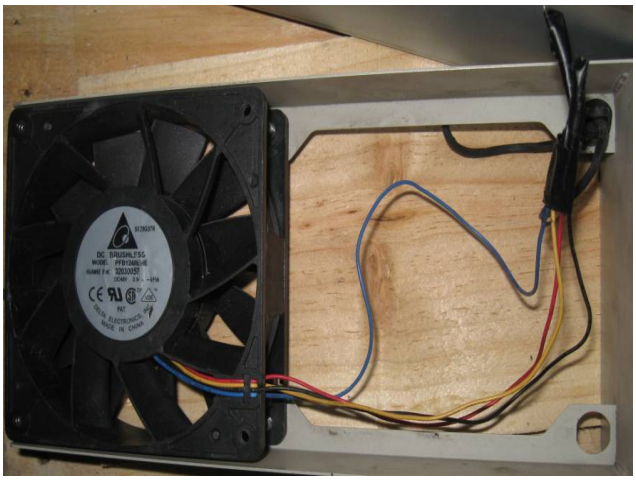
When wiring the drive, the most common problem is wrong wire installation or poor wiring. Please be aware of the possible damages that poor wiring may cause to your drives:

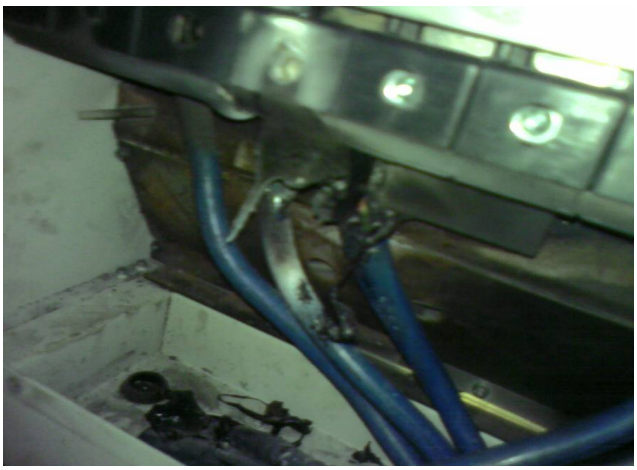
1. Screws are not fully fastened. Occurrence of sparks as impedance increases.
2. If a customer has opened the drive and modified the internal circuit board, the internal components may have been damaged.

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.







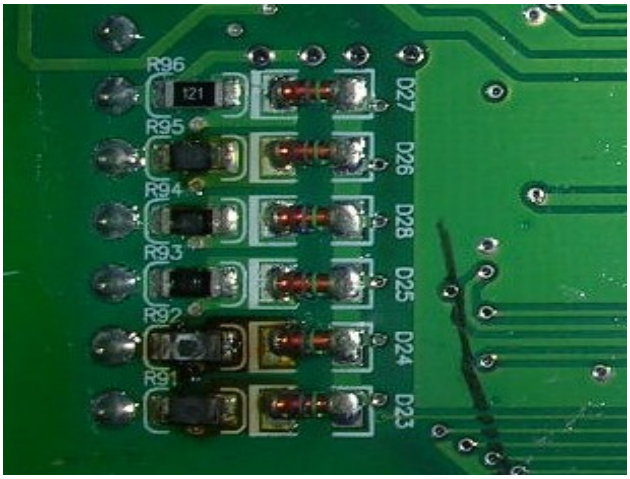
6-7 Multi-function Input/Output Terminals Problem

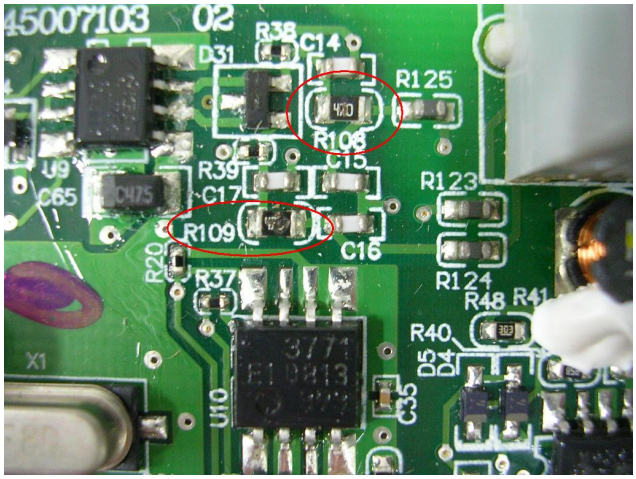
Multi-function input/output terminal errors are generally caused by over usage of terminals and not following specifications. Please be aware of the possible damages that errors on multi-function input/output terminals may cause to your drives:

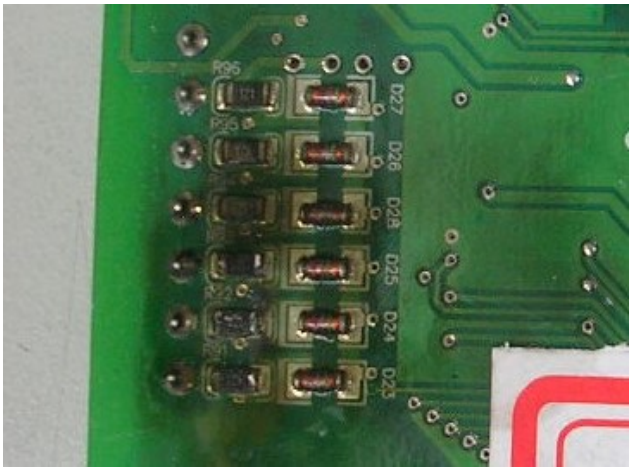
1. Input/output circuit may burns out when the terminal usage exceeds its limit.

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.







Appendix A: Optional Accessories

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 Selection Chart

VJ-C Air Cooled series:

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

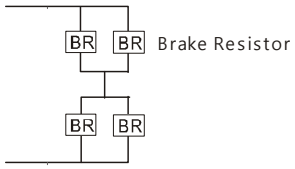
VJ-C Oil Cooled series:

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	VFD300VL43C-JO	BR1K0W5P1	4	4 in serial	4000W 20.4Ω	37	19.0	40	30.4
50	37.0	VFD370VL43C-JO	BR1K2W015	4	2 in parallel, 2 in serial *3	4800W 15Ω	50	12.7	60	45.7
60	45.0	VFD450VL43C-JO	BR1K5W013	4	2 In parallel, 2 in serial	6000W 13Ω	59	12.7	60	45.7
75	55.0	VFD550VL43C-JO	BR1K0W5P1	8	2 in parallel 4 in serial *4	8000W 10.2Ω	76	9.5	80	60.8
100	75.0	VFD750VL43C-JO	BR1K2W015	8	4 in parallel, 2 in serial *5	9600W 7.5Ω	100	6.3	120	90.7

*1 Calculation for 125% brake toque: (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).

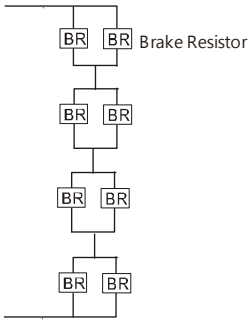
*2 For heat dissipation, a resistor of 400W or lower should be fixed to the frame and maintain the surface temperature below 250ºC; a resistor of 1000W and above should maintain the surface temperature below 350ºC.

*3



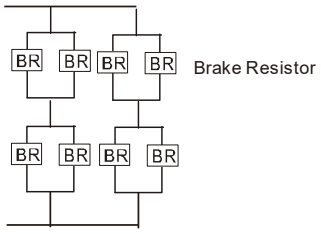
2 in parallel connection,
2 in serial connection.

*4



2 in parallel connection,
4 in serial connection

*5

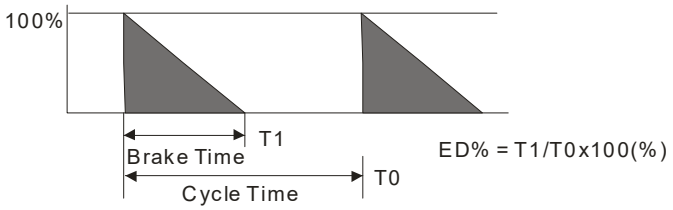


4 in parallel connection,
2 in serial connection.

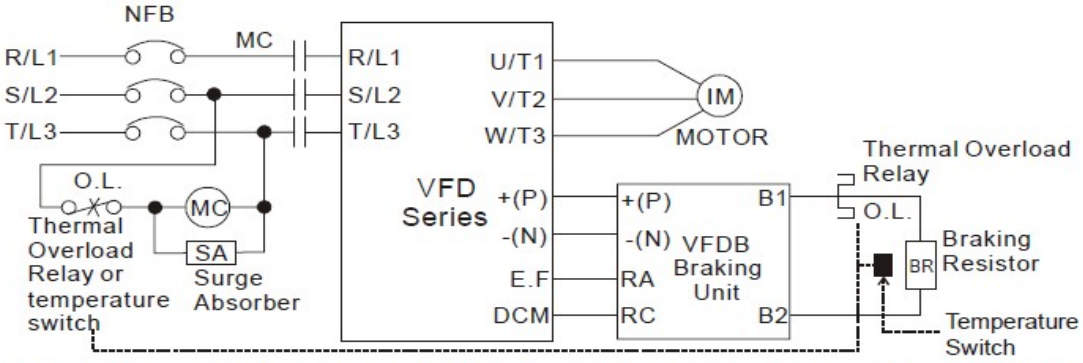
NOTE

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.

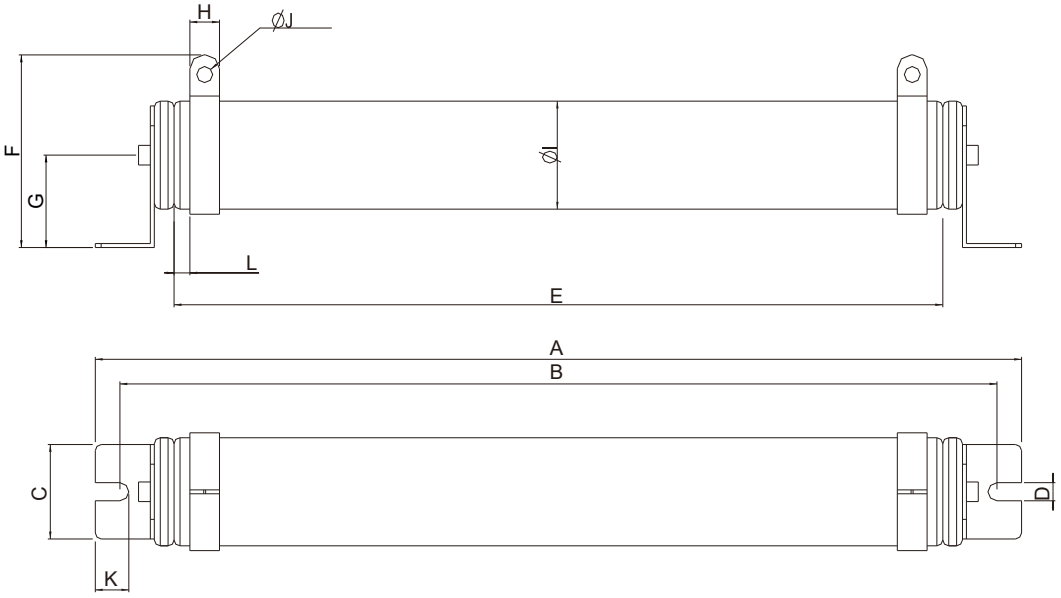


Note1: When using the AC drive with DC reactor, please refer to wiring diagram in the AC drive user manual for the wiring of terminal +(P) of Braking unit.
Note2: **Do NOT** wire terminal -(N) to the neutral point of power system.

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

7.1Wirewound resistor: for 1000W (included) and above. Refer to the following image for its appearance. See table below for specification comparison.

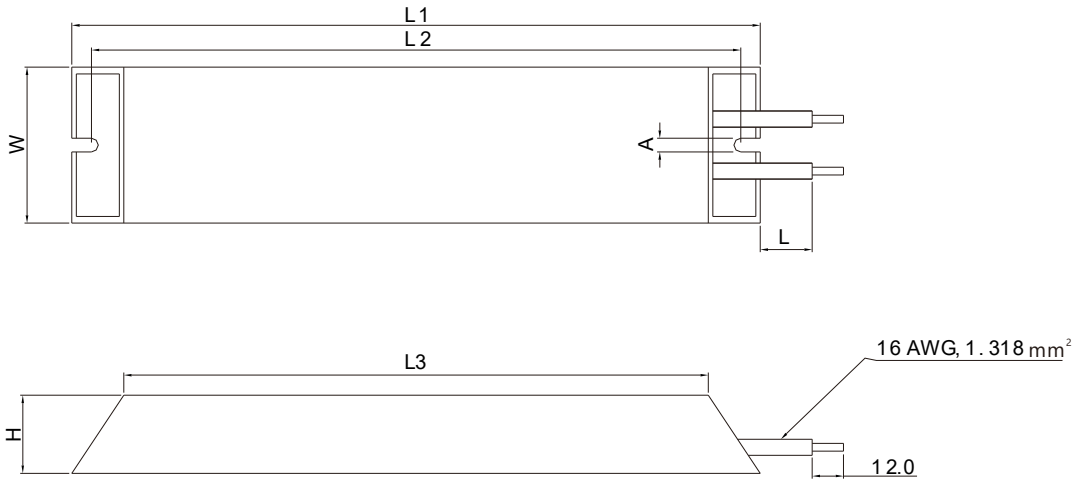


7.2 Brake Resistors' model name and comparison

Unit: mm

Model	A	B	C	D	E	F	G	H	ØI	ØJ	K	L
BR1K0W5P1	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
BR1K2W015												
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				
BR300W250							
BR400W040	265 ± 2	250 ± 2	225 ± 1				
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)
VFD300VL**23**C-J	250
VFD370VL**23**C-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

Oil Cooled:

Model	Recommended Current (A)
VFD300VL43C-JO	150
VFD370VL43C-JO	175
VFD450VL43C-JO	225
VFD550VL43C-JO	300
VFD750VL43C-JO	400

A-3 Fuse

- ☑ Fuse specifications lower 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

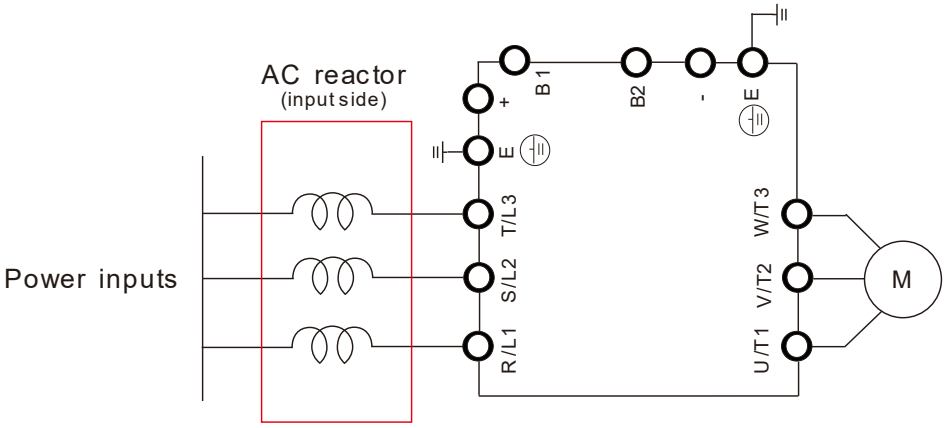
Oil Cooled:

460V model:	Input Current (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD300VL43C-JO	60	150	JJS-150
VFD370VL43C-JO	73	175	JJS-175
VFD450VL43C-JO	91	225	JJS-225
VFD550VL43C-JO	110	300	JJS-300
VFD750VL43C-JO	150	400	JJS-400

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.



Connecting an AC input reactor

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

Oil Cooled:

380V~460V/ 50~60Hz model VFDXXXVL43C-JO 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	60	102.6	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

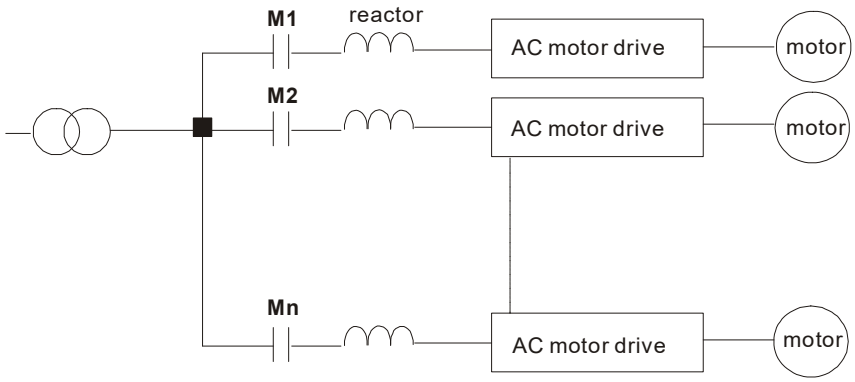
Connected in input circuit

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:

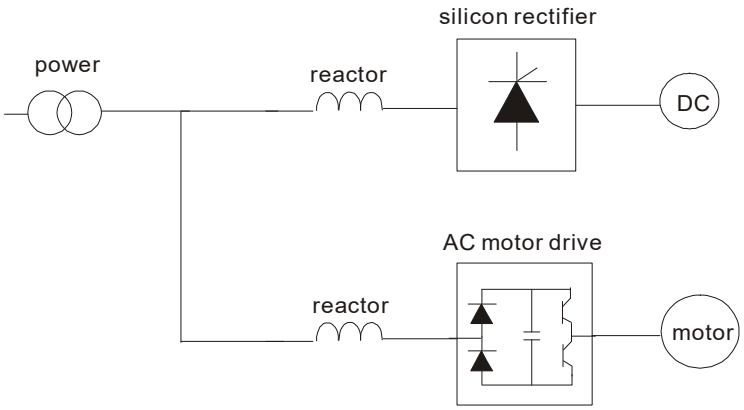


Application 2

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:

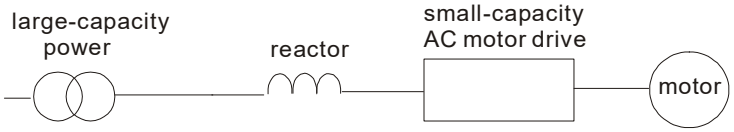


Application 3

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.

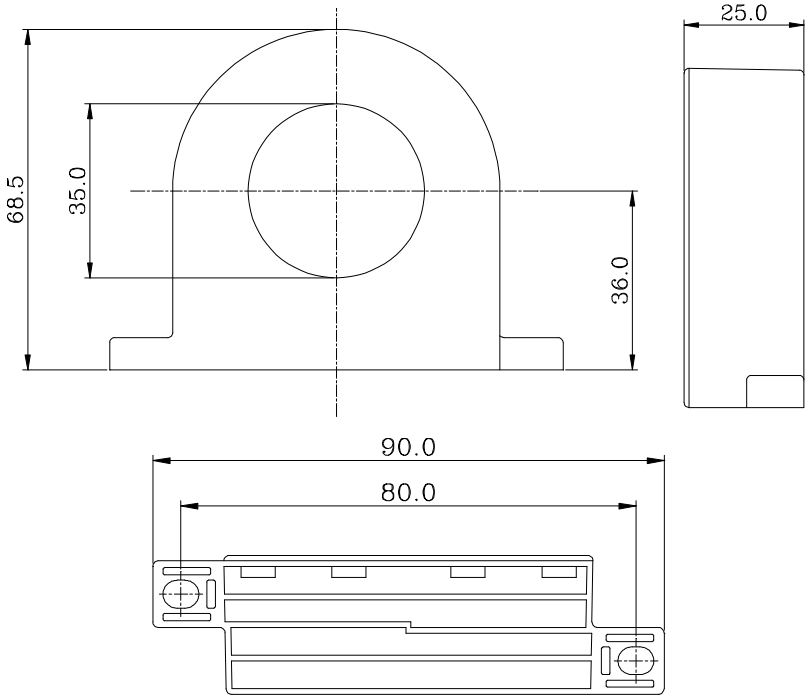
Correct wiring



A-4-2 Zero Phase Reactor

RF220X00A

Unit: mm (inch)



Cable type (Note)	Recommended Wire Size (mm^2)			Qty.	Wiring Method
	AWG	mm^2	Nominal (mm^2)		
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

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 A

Please wind each wire 4 times around the core. The reactor must be placed at inverter output as close as possible.

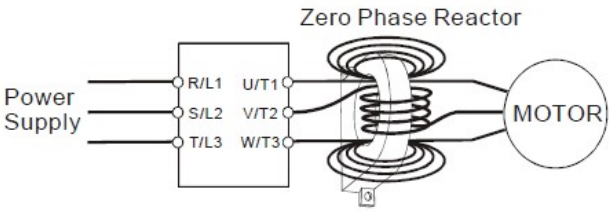
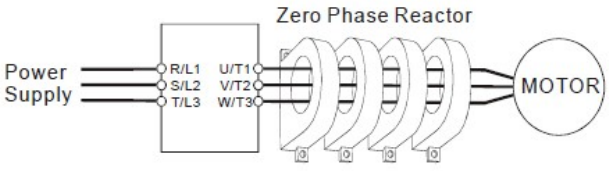


Figure B

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:

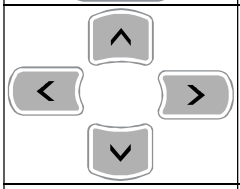
KPC-CC01

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
	Start Operation Key 1. It is only valid when the source of operation command is from the keypad. 2. It can operate the hybrid servo drive by the function setting and the RUN LED will be on. 3. It can be pressed repeatedly during stop. 4. When enabling “HAND” mode, it is only valid when the source of operation command is from the keypad.
	Stop Command Key. This key has the highest processing priority in any situation. 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. 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.
	Operation Direction Key 1. This key is only control the operation direction NOT for activate the drive. FWD: forward, REV: reverse. 2. Refer to the LED descriptions for more details.
	ENTER Key Press ENTER and go to the next level. If it is the last level then press ENTER to execute the command.
	ESC Key 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.
	Press menu to return to main menu.
	Direction: Left/Right/Up/Down 1. In the numeric value setting mode, it is to move the cursor and change the numeric value. 2. In the menu/text selection mode, it is for item selection.
	Function Key 1. The functions keys have factory settings and can be defined by users. 2. Other functions must be defined by TPEditor first.
	HAND Key 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. 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.
	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). 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.

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										
Alphabet	A	b	Cc	d	E	F	G	Hh	I	Jj
LCD										
Alphabet	K	L	n	Oo	P	q	r	S	Tt	U
LCD										
Alphabet	v	Y	Z							
LCD										

A-6 EMI Filter

VJ-C series :

Air Cooled:

Drive	Applicable Filter Model #	Reference Website
VFD110VL43C-J	B84143A0050R106	Power Line EMC Filter (EPCOS)
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-

Oil Cooled:

Drive	Applicable Filter Model #	Reference Website
VFD300VL43C-JO	B84143D0200R127	Power Line EMC Filters (EPCOS)
VFD370VL43C-JO		
VFD450VL43C-JO		
VFD550VL43C-JO		
VFD750VL43C-JO		

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 (1st 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.

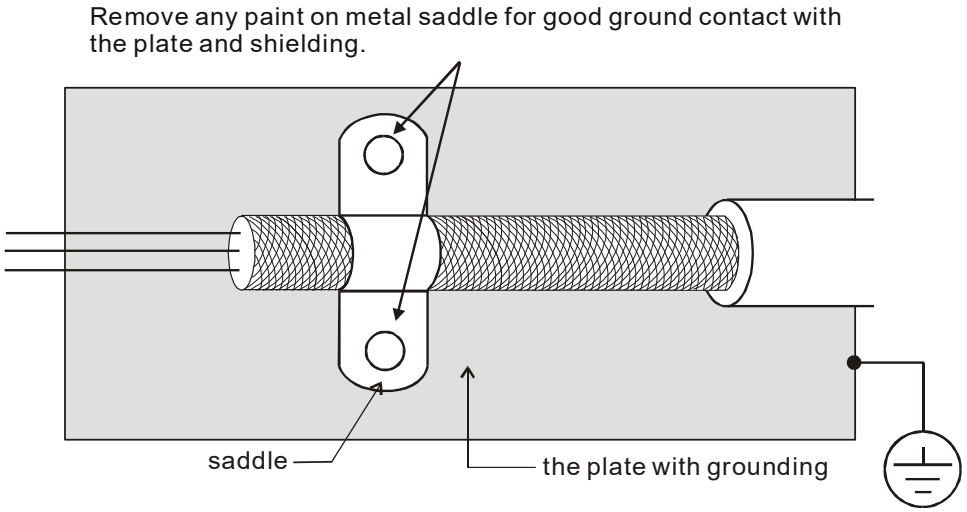
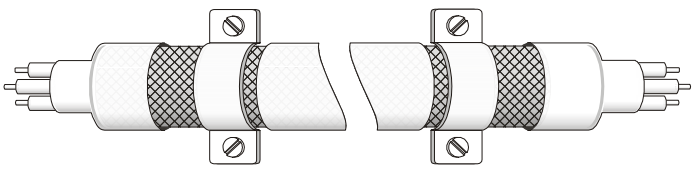
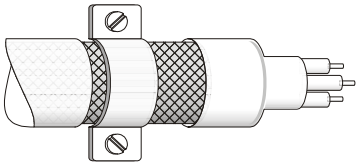


Figure 1



Saddle on both ends



Saddle on one end

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_{AC} input voltage	66 ft (20m)	328 ft (100m)	1312 ft (400m)
230V_{AC} input voltage	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)

NOTE

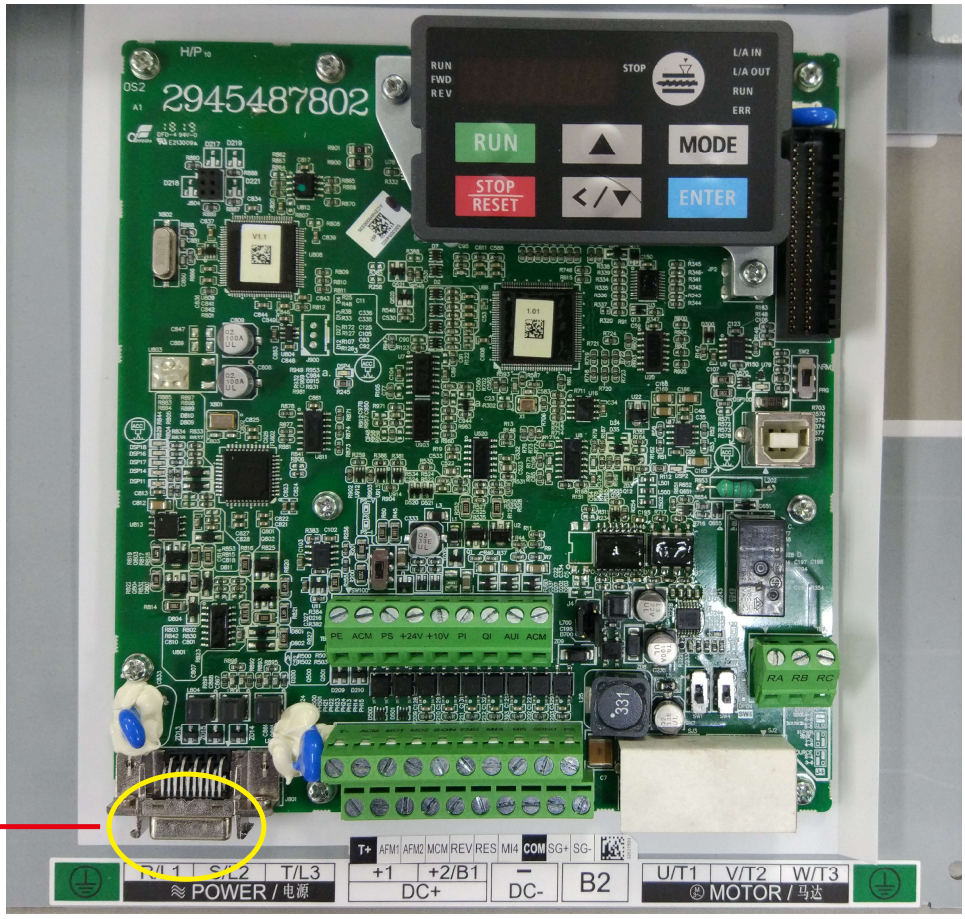
Never connect phase lead capacitors or surge absorbers to the output terminals of the hybrid drive.

- 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).

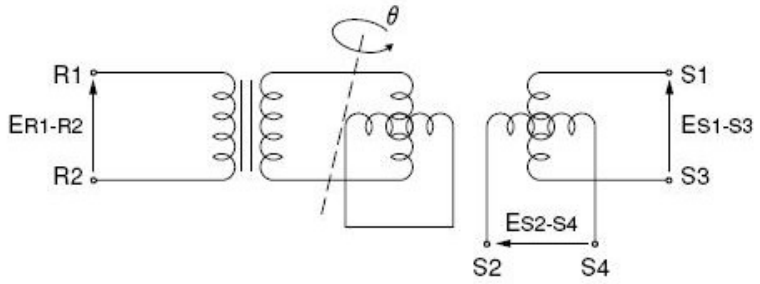
NOTE

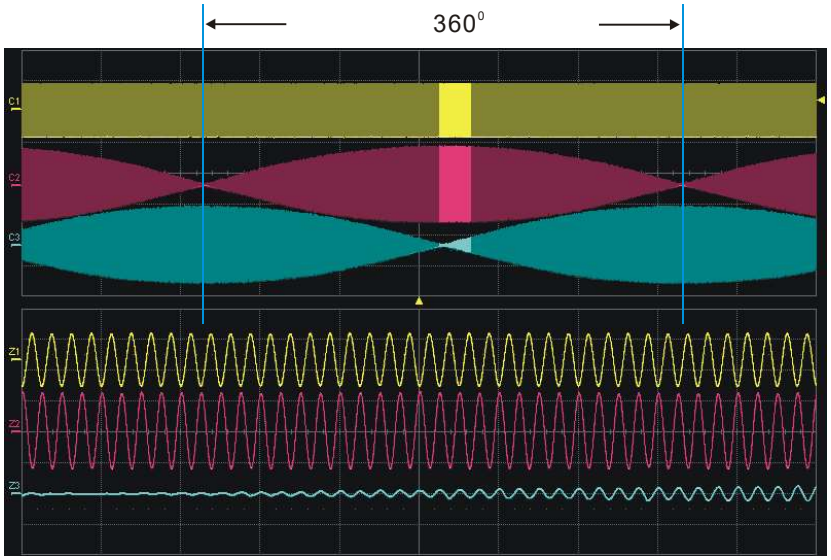
When a thermal O/L relay protected by motor is used between hybrid drive and motor, it may malfunction (especially for 460V series), even if the length of motor cable is only 165 ft (50m) or less. To prevent it, please use AC reactor and/or lower the carrier frequency (Pr. 00-17 PWM carrier frequency).

A-7 Speed Feedback Encoder



Function of J1 Terminal





As shown in the image above, from top to bottom: C1『E_{R1-R2}』, C2『E_{S1-S3}』, C3『E_{S2-S4}』

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 mm² (AWG)			
Size	# of cores (pairs)	Specification	Standard Length
0.13 mm²(AWG26)	10 cores(4 pairs)	UL2464	3m (9.84 ft)

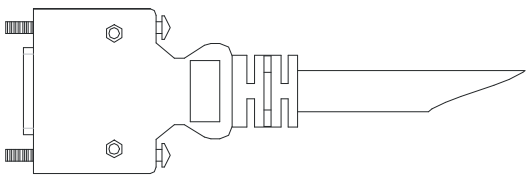
NOTE

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.

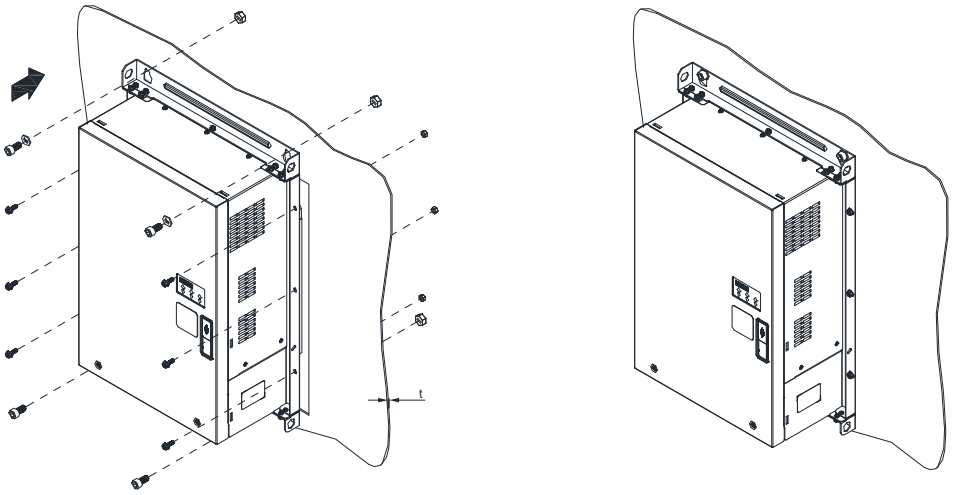
3) Please follow the Selection of Wire Rod when wiring in order to avoid the danger it may occur.

Connector Specification



Title	Part #	Manufacturer
PLUG	3M 10120-3000PE	3M
SHELL	3M 10320-52A0-008	3M

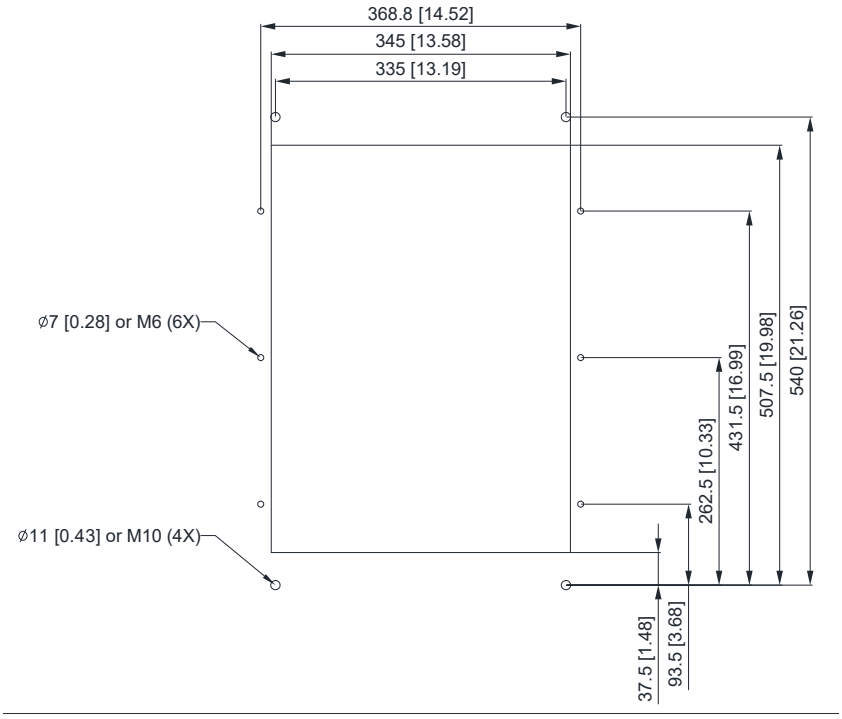
A-8 Wall-Mounted Installation



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

B-1 CANopen Overview
B-2 Wiring for CANopen
B-3 CANopen Communication Interface Description
B -3-1 CANopen Control Mode Selection (DS402 Standard Control Mode or Delta Standard)
B-3-2 DS402 Standard Control Mode
B-3-2-1 Related setup of AC motor drive (DS402 standard)
B-3-2-2 The status of the motor drive (DS402 standard)
B-3-2-3 Various control modes (DS402 standard)
B-3-3 By using Delta Standard (Old Definition, only support speed mode)
B-3-3-1 Related set up of AC motor drive
B-3-3-2 Various control modes
B-3-4 By using Delta Standard (Delta New definition)
B-3-4-1 Related set up of AC motor drive (Delta New Standard)
B-3-4-2 Various control mode (Delta New Standard)
B-4 CANopen Supporting Index
B-5 CANopen Fault Codes
B-6 CANopen LED Function

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.

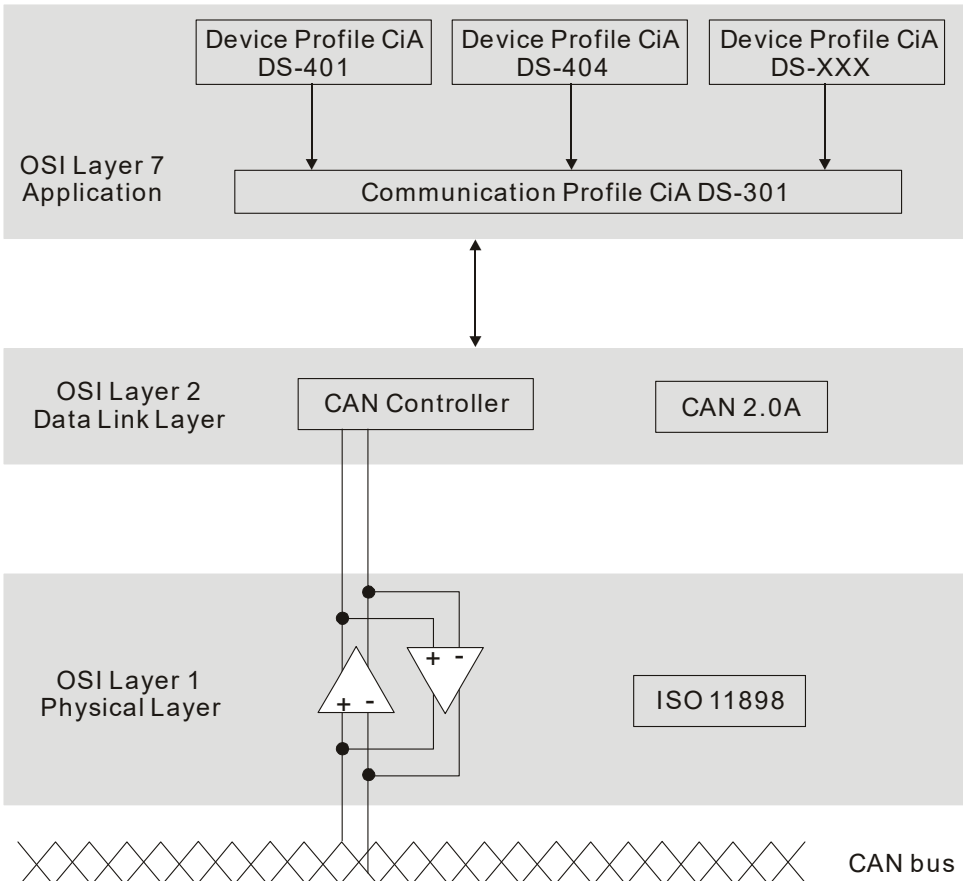
Delta CANopen does not support this service:

- Time Stamp service

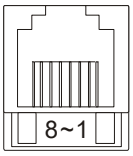
B-1 CANopen Overview

● 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



plug

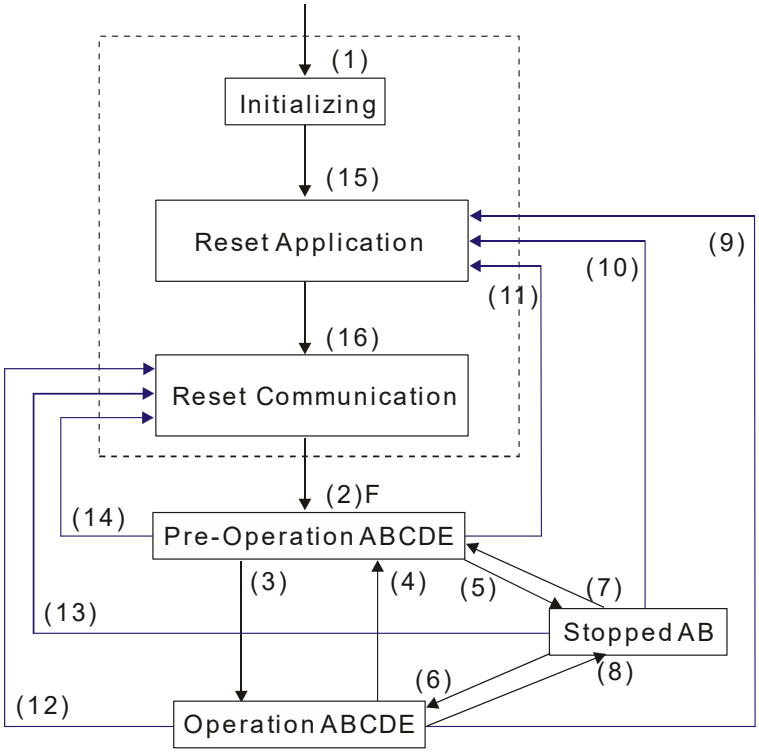
PIN	Signal	Description
1	CAN_H	CAN_H bus line (dominant high)
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground / 0 V /V-
6	CAN_GND	Ground / 0 V /V-

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.

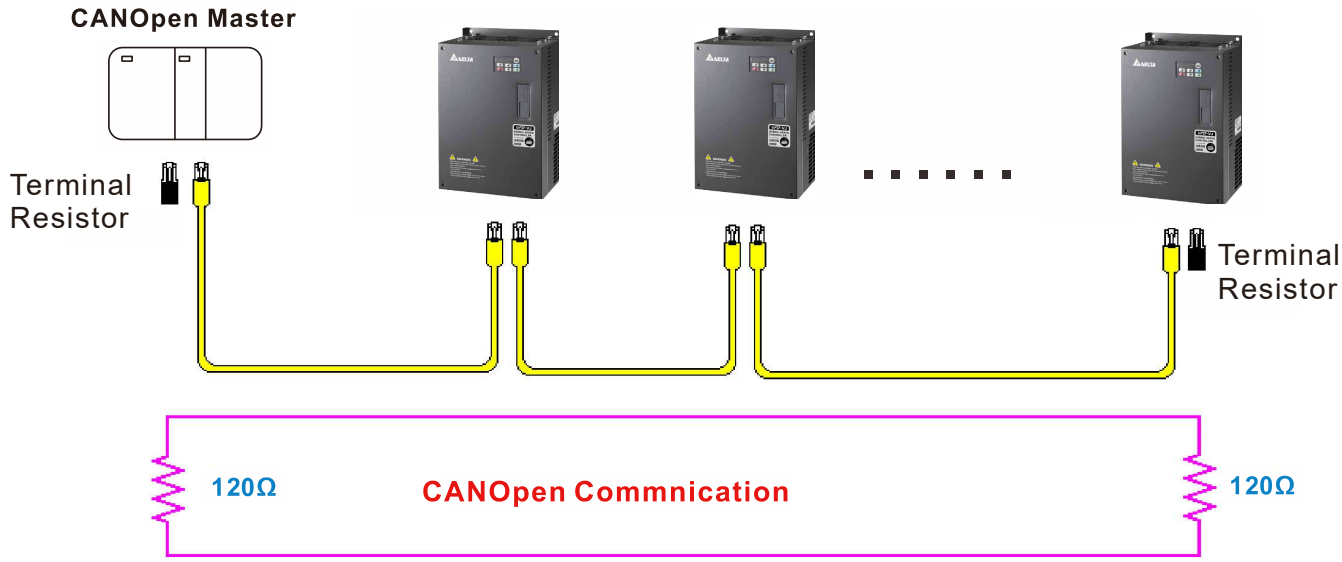
All PDO transmission data must be mapped to the index with Object Dictionary.

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.

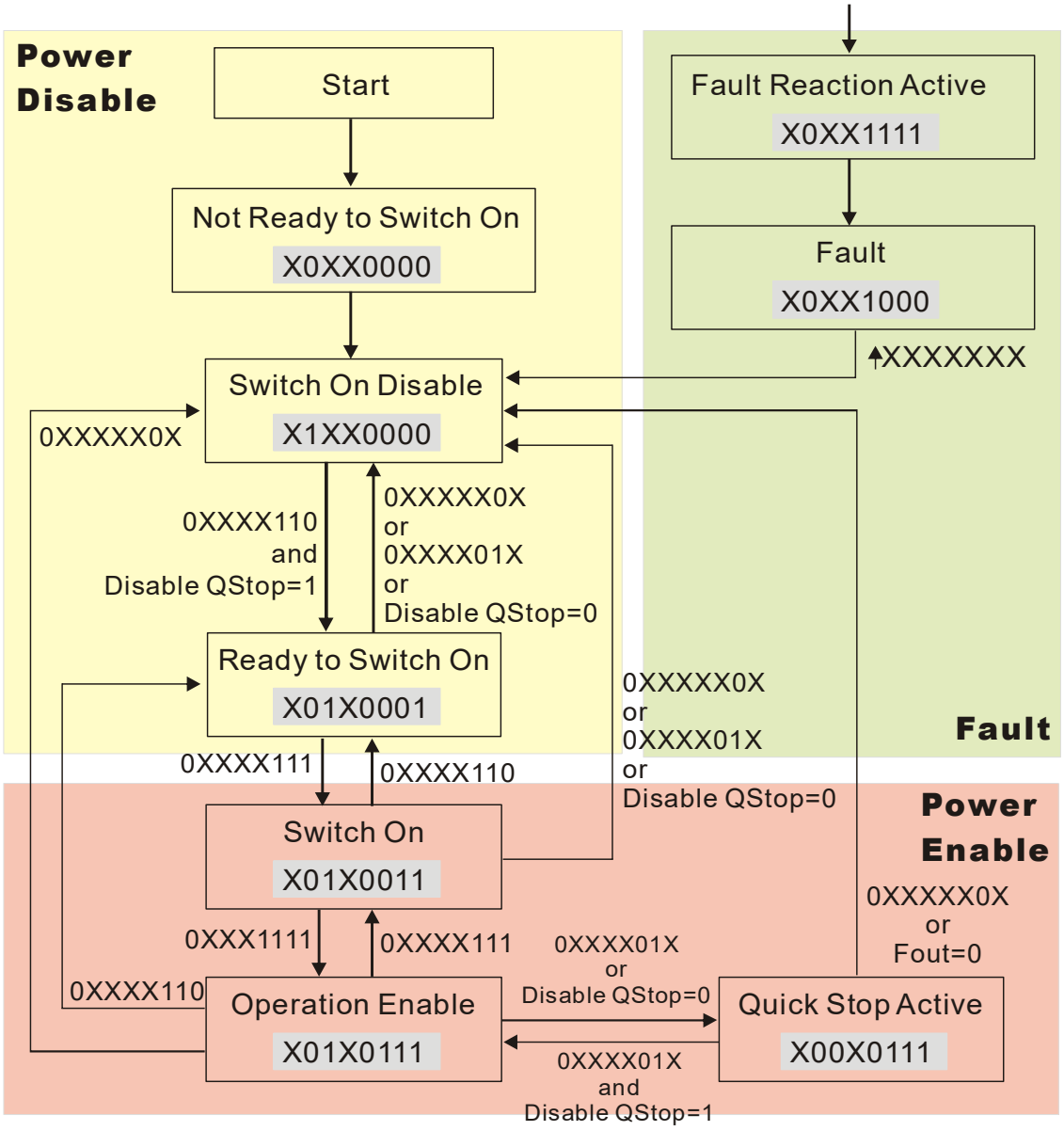
When the motor drive is turned on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operate Enable status. To do this, set the control word's bit0–bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0X6041). 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)

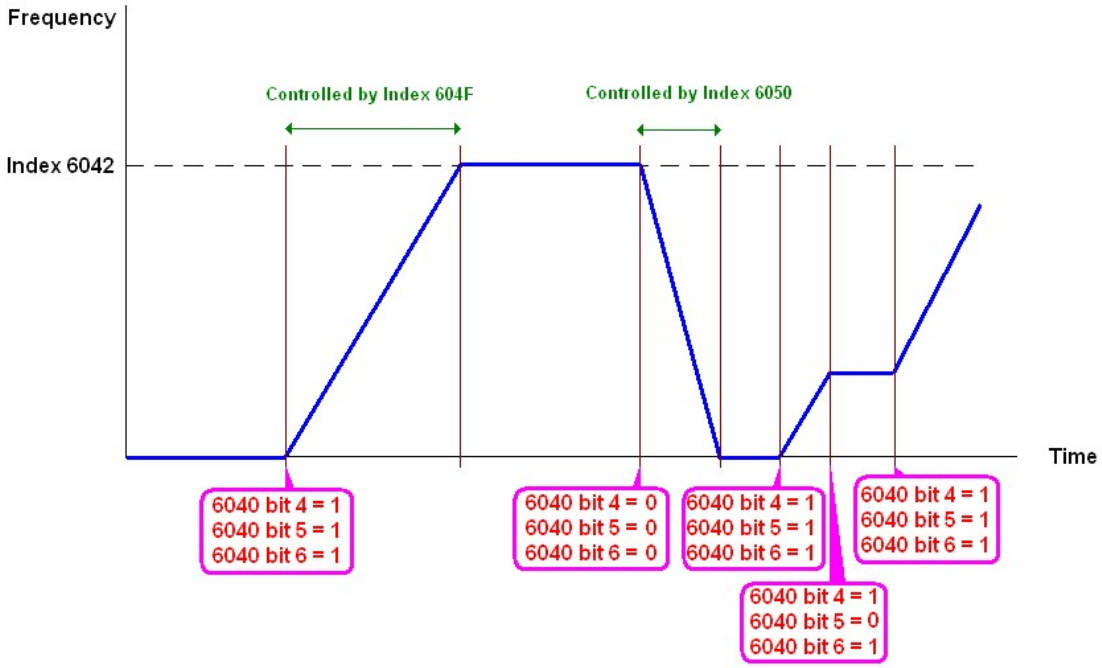
f: rotation frequency (Hz)

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:

	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
Speed mode (Index 6060=2)	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)

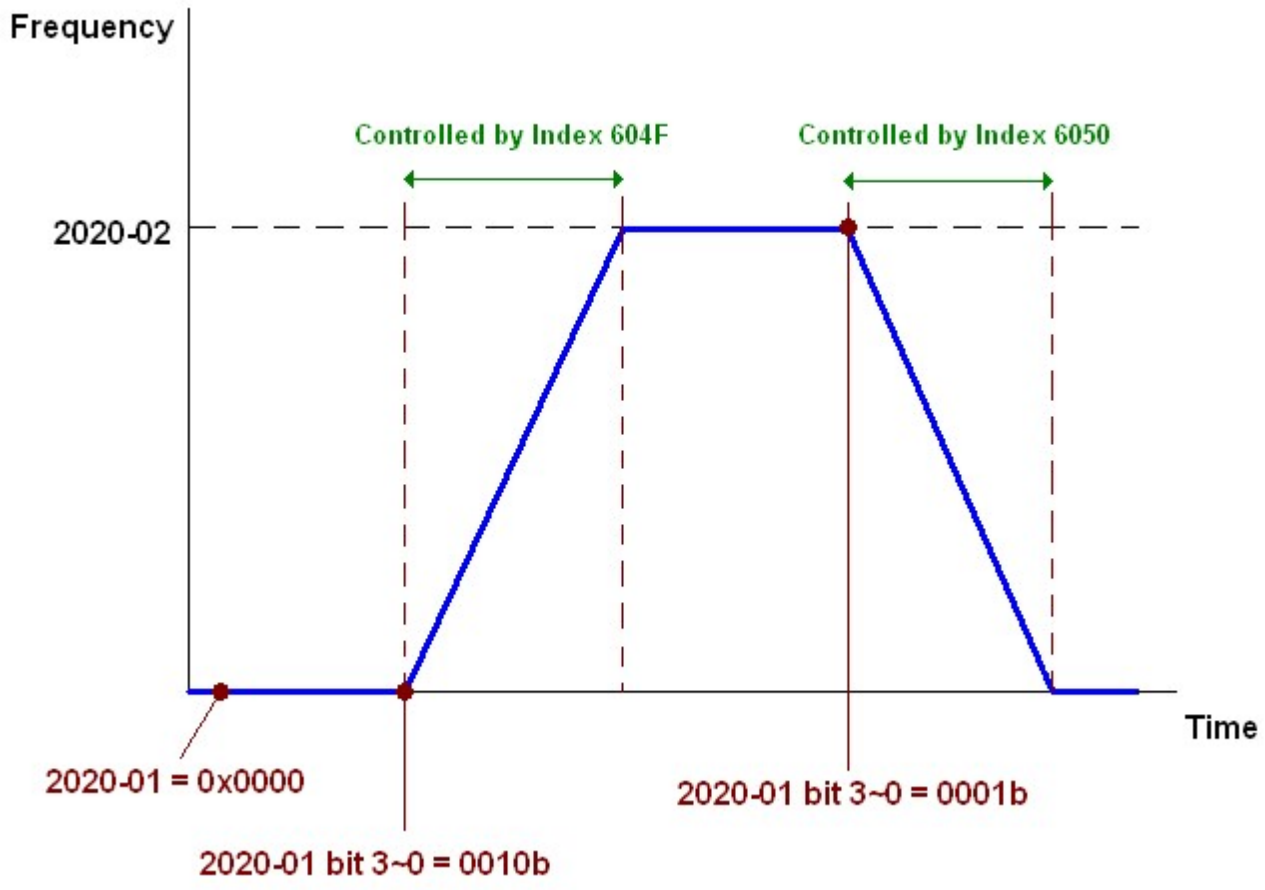
B-3-3-1 Various mode control method (Delta Old Standard).

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 commend 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)

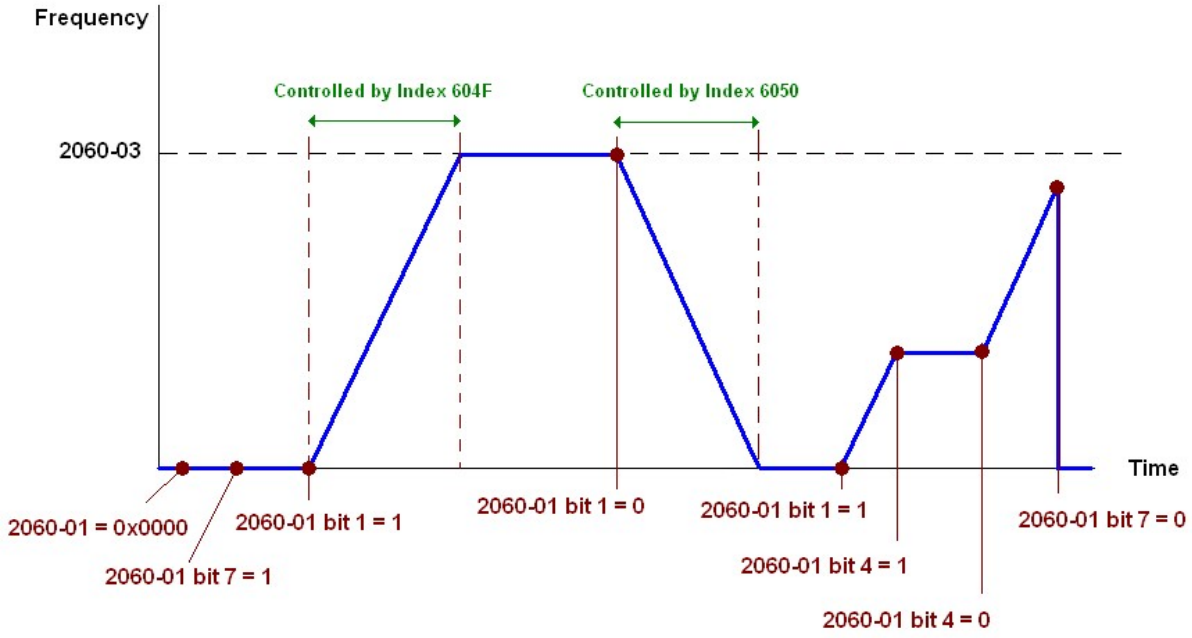
Follow the steps below:

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:

Index	**sub-Index**
2000H + Group	member+1

For example:

Pr.01-01 (Source of operation command)

Group		**member**
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 Cmmand	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	00B:Disable
							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 ℃	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 ℃	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	R0	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	R0	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

B-5 CANopen Fault Codes

* Refer to settings for Pr.06-17–Pr.06–22 and Pr.14-70–Pr.14-73

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
1		0001H	Over-current during acceleration	1	2213H
2		0002H	Over-current during deceleration	1	2213H
3		0003H	Over-current during steady status operation	1	2214H
4		0004H	Ground fault. When one of the output terminal(s) is grounded, the short circuit current is more than 50% of the AC motor drive rated current. Note: the short circuit protection is provided for AC motor drive protection, not for protection of the user.	1	2240H
6		0006H	Over-current at STOP. Hardware failure in current detection	1	2214H
7		0007H	Over-current during acceleration. Hardware failure in current detection	2	3210H
8		0008H	Over-current during deceleration. Hardware failure in current detection.	2	3210H
9		009H	Over-current during steady speed. Hardware failure in current detection.	2	3210H
10		000AH	Over-voltage at STOP. Hardware failure in current detection	2	3210H
11		000BH	DC BUS voltage is less than Pr.06.00 during acceleration.	2	3220H
12		000CH	DC BUS voltage is less than Pr.06.00 during deceleration.	2	3220H
13		000DH	DC BUS voltage is less than Pr.06.00 in constant speed.	2	3220H
14		000EH	DC BUS voltage is less than Pr.06-00 at stop	2	3220H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
15		000FH	Phase loss protection	2	3130H
16		0010H	IGBT over-heat IGBT temperature exceeds protection level.	3	4310H
18		0012H	IGBT NTC open circuit	3	FF00H
21		0015H	Overload; the AC motor drive detects excessive drive output current.	1	2310H
22		0016H	Electronic thermal relay 1 protection	1	2310H
24		0018H	Motor PTC overheat	3	FF20H
31		001FH	Internal EEPROM cannot be programmed.	5	5530H
33		0021H	U-phase error	1	FF04H
34		0022H	V-phase error	1	FF05H
35		0023H	W-phase error	1	FF06H
36		0024H	Clamp current detection error (Hd0)Abnormal cc protection hardware wire	5	FF07H
37		0025H	Over-current detection error (Hd1) Abnormal oc protection hardware wire	5	FF08H
38		0026H	Over-voltage detection error (Hd2)Abnormal ov protection hardware wire	5	FF08H
39		0027H	Ground current detection error (Hd3)Abnormal GFF protection hardware wire	5	FF08H
40		0028H	Auto tuning error	1	FF21H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
42		002AH	PG feedback error	7	7301H
43		002BH	PG feedback loss	7	7301H
44		002CH	PG feedback stall	7	7301H
45		002DH	PG slip error	7	7301H
49		0031H	External Fault; when the multi-function input terminal (EF) is active, the AC motor drive stops output.	5	9000H
50		0032H	Emergency stop; when the multi-function input terminal (EF1) is active, the AC motor drive stops output.	5	9000H
52		0034H	Keypad is locked after you enter the wrong password three times.	5	FF26H
53		0035H	CPU error	4	7500H
54		0036H	Modbus function code error (illegal function code)	4	7500H
55		0037H	Modbus data address is in error [illegal data address (00 H to 254 H)]	4	7500H
56		0038H	Modbus data error (illegal data value)	4	7500H
57		0039H	Modbus communication error (attempt to write data to read-only address)	4	7500H
58		003AH	Modbus transmission time-out	4	7500H
60		003BH	Braking chopper error	5	7110H
65		0041H	PG card information error	5	FF29H

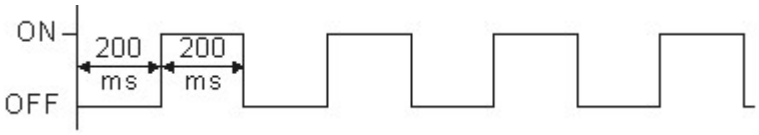
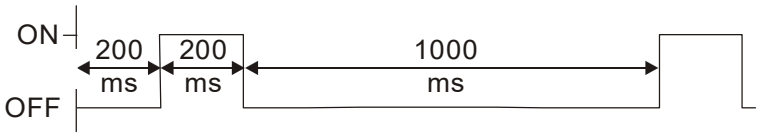
Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
66		0042H	Overpressure	5	FF29H
67		0043H	Pressure feedback fault (PfbF)	5	FF29H
68		0044H	Oil pump runs reversely (Prev)	5	FF29H
69		0045H	Oil shortage (noil)	5	FF29H
71		0047H	Over current at braking chopper (ocbs)	1	FF29H
72		0048H	Braking resistor is open-circuit (bro)	32	FF29H
73		0049H	Braking resistor’s resistance value is too small. (brF)	32	FF29H
74		004AH	Braking chopper overheated (oH4)	3	FF29H
75		004BH	Error occurred on braking chopper’s thermo-protection line (tH4o)	3	FF29H
82		0052H	Output phase loss 1 (Phase U)	2	2331H
83		0053H	Output phase loss 2 (Phase V)	2	2332H
84		0054H	Output phase loss 3 (Phase W)	2	2333H
101		0065H	CANopen guarding error	4	8130H
102		0066H	CANopen heartbeat error	4	8130H
104		0068H	CANopen bus off error	4	8140H
105		0069H	CANopen index error	4	8100H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0–7)	CANopen fault code
106		006AH	CANopen station address error	4	8100H
107		006BH	CANopen memory error	4	8100H

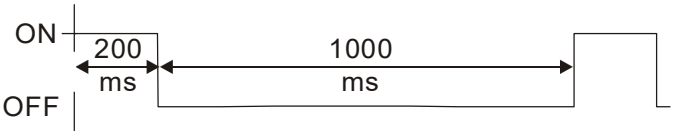
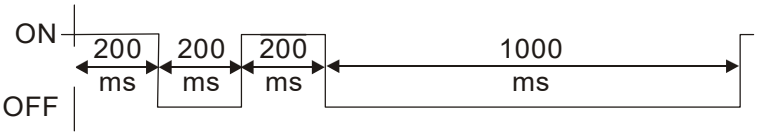
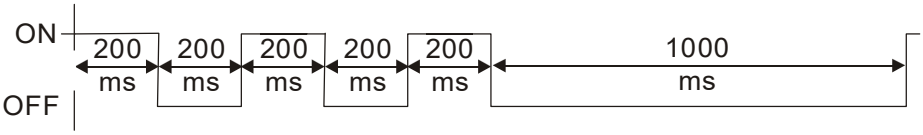
B-6 CANopen LED Function

There are two CANopen flash signs: RUN and ERR.

RUN LED (green color):

LED status	Condition	CANopen State
OFF	Keep lighting off	Initial
Blinking		Pre-operation
Single flash		Stopped
ON	Keep lighting on	Operation

ERR LED (red color):

LED status	Condition/ State
OFF	No Error
Single flash	One Message fail 
Double flash	Guarding fail or heartbeat fail 
Triple flash	SYNC fail 
ON	Bus off

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Appendix C: MSJ 220V & 380V Hybrid Servo Motor

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

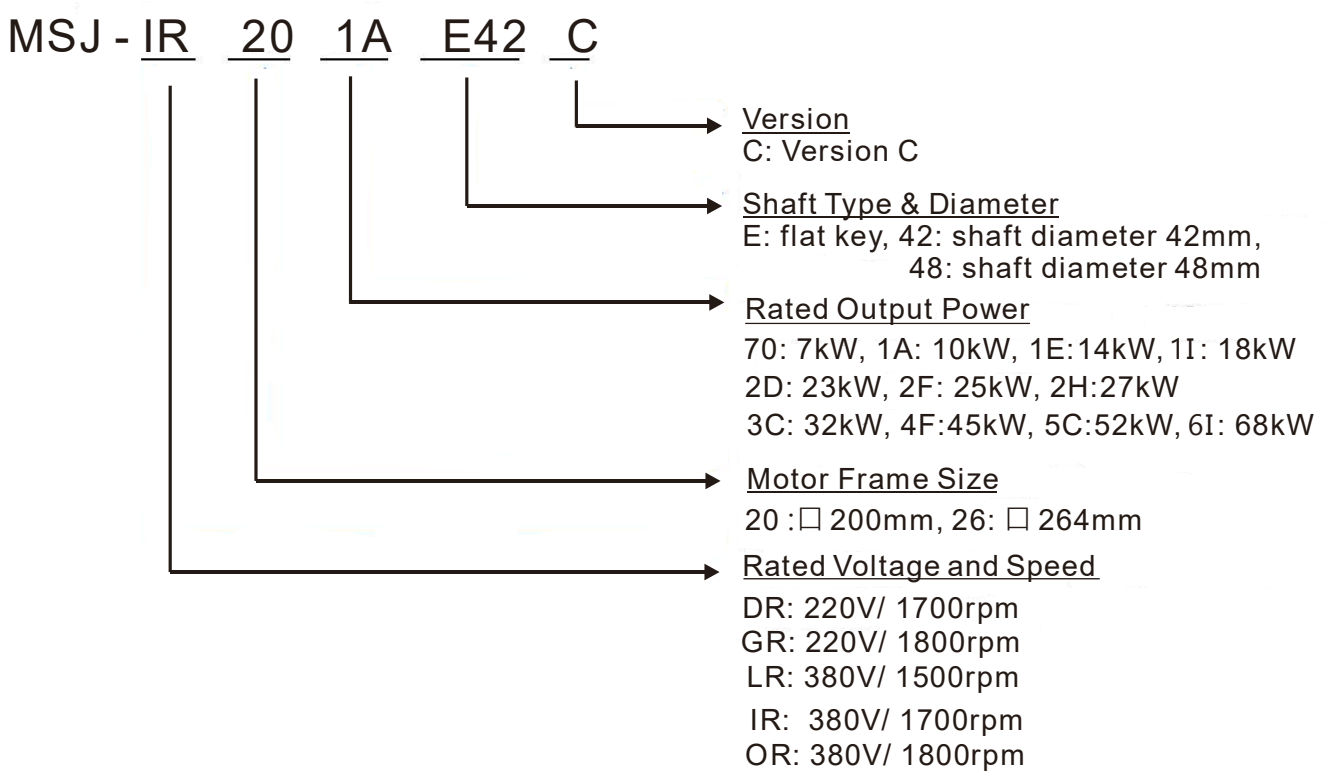
CAUTION	☑ This hybrid servo drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer. ☑ The accessories produced by Delta are only for using with Delta hybrid servo drive. Do not use with other drive to 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^2	6.8 x10^{-3}	9.0 x10^{-3}	11.7 x10^{-3}	13.3 x10^{-3}	17.5 x10^{-3}
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$_{AC}$)				
Encoder		Resolver 2 Poles				
Motor Temperature Protection		PTC temperature protection and KTY84-130 temperature sensor *3				
Operating Environment		Temperature :-15 ~ 40ºC 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 *1	rpm	2150	2150	2150	2250	1950	2150	2250	2150	2150
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^2	7.4 x10^{-3}	9.6 x10^{-3}	11.6 x10^{-3}	13.8 x10^{-3}	18.0 x10^{-3}	19.1 x10^{-3}	41.6 x10^{-3}	50.5 x10^{-3}	61.4 x10^{-3}
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$_{AC}$)								
Encoder		Resolver 2 Poles								
Motor Temperature Protection		PTC temperature protection*2 and KTY84-130 temperature sensor*3								
Operating Environment		Temperature: -15 ~ 40ºC 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.

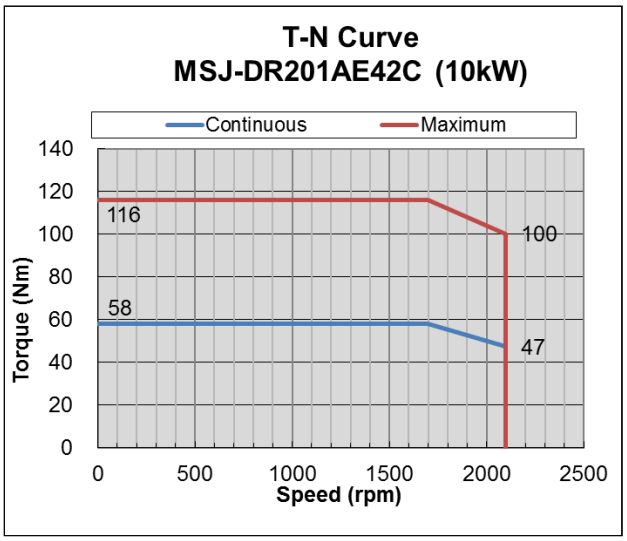
*2: Set up PTC type Pr02-11 =2 to use PTC130 as temperature protection.

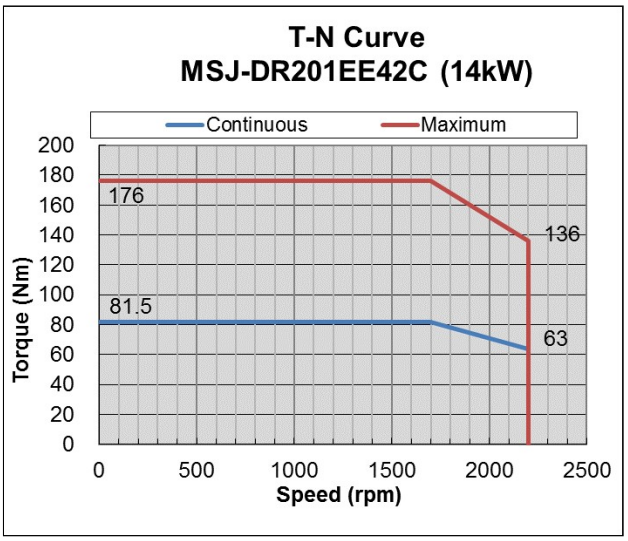
*3: Users are required to set up the parameter Pr02-09 PTC Level (factory setting: 130 ºC) when using the KTY84-130 temperature sensor (PTC type Pr02-11 =1) for motor overheating protection.

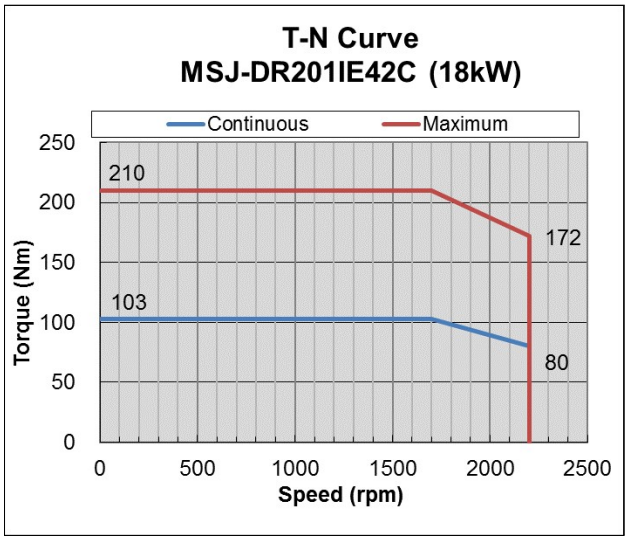
*4: Delta reserves the right to revise specifications without prior notice.

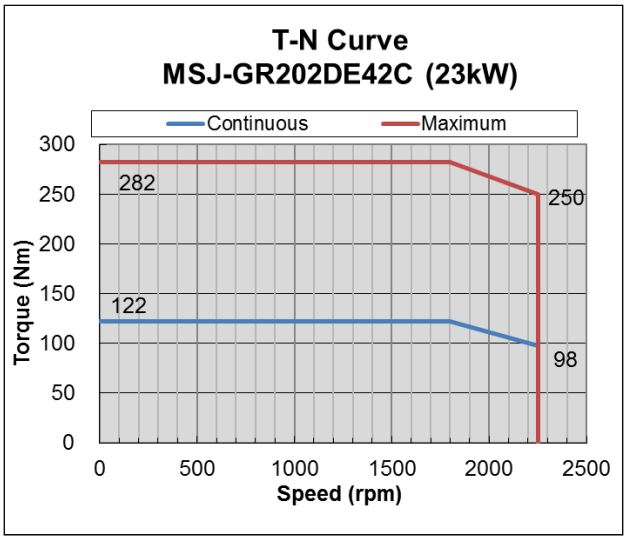
C-4 Torque – Rotation characteristic curve

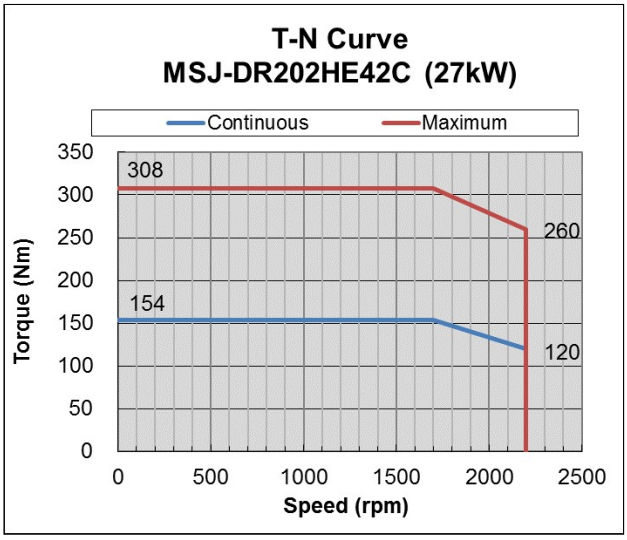
220V:



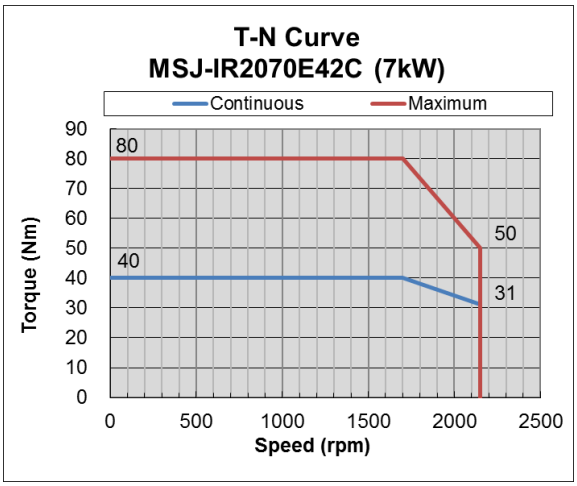


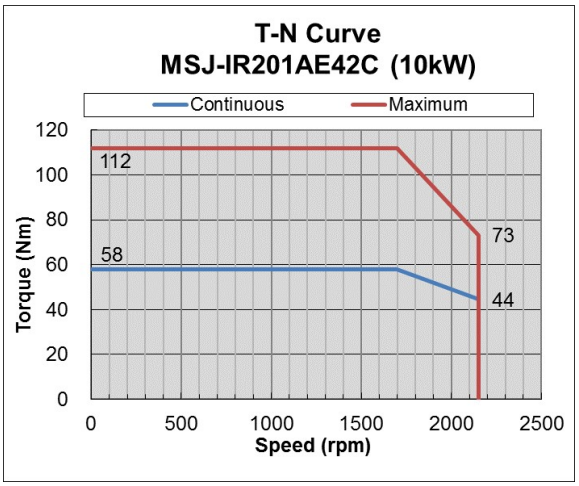


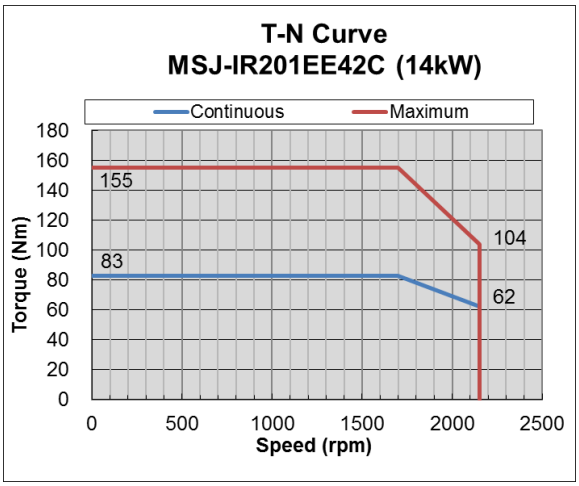


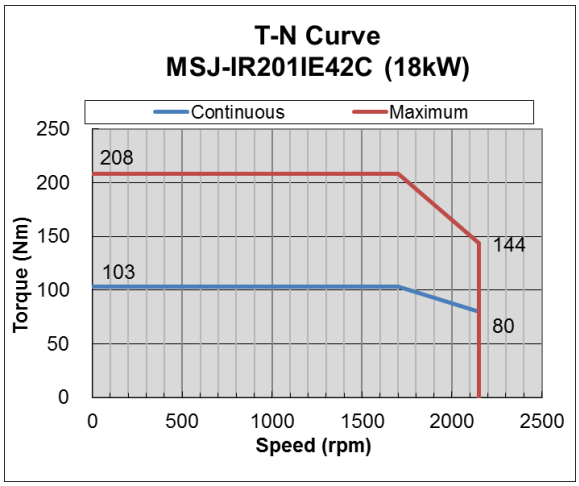


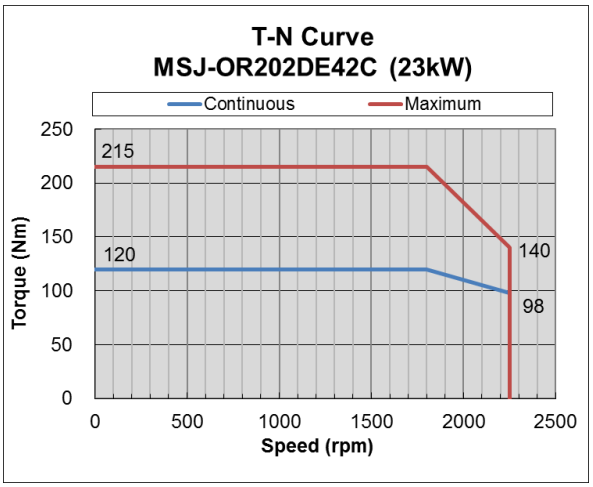
380V:

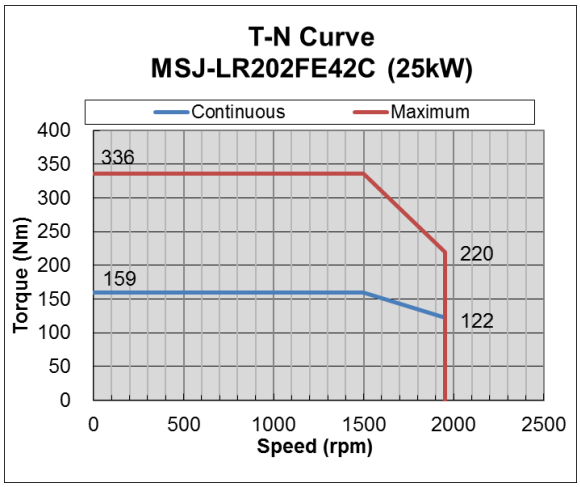

T-N Curve
MSJ-IR2070E42C (7kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
80
50
40
31


T-N Curve
MSJ-IR201AE42C (10kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
112
73
58
44

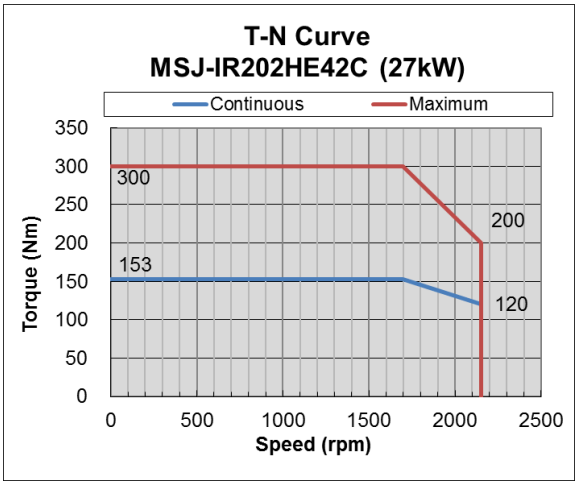

T-N Curve
MSJ-IR201EE42C (14kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
155
104
83
62

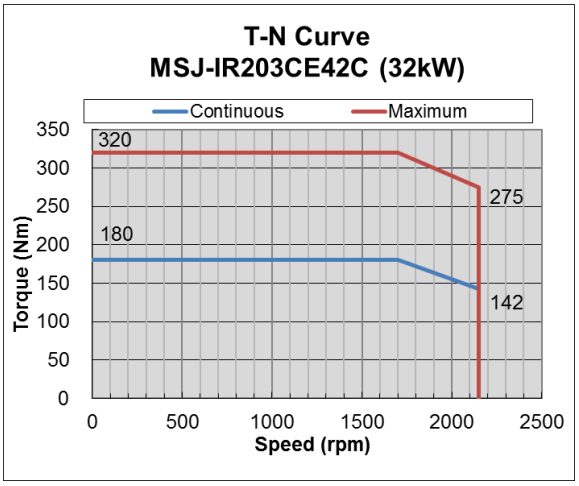

T-N Curve
MSJ-IR201IE42C (18kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
208
144
103
80

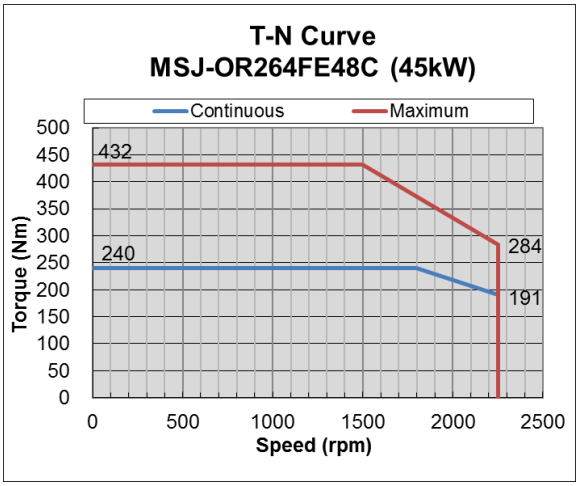

T-N Curve
MSJ-OR202DE42C (23kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
215
140
120
98

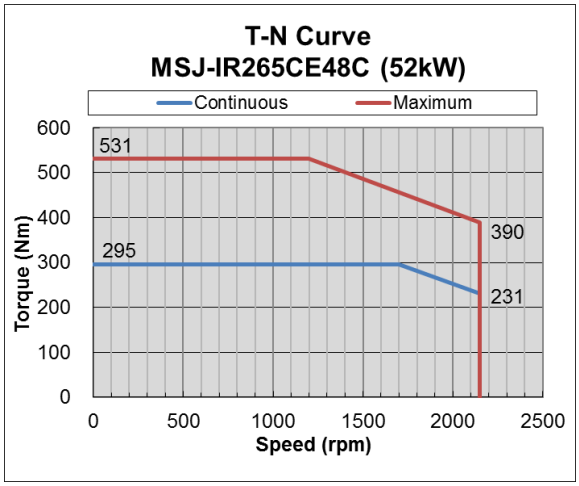

T-N Curve
MSJ-LR202FE42C (25kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
336
220
159
122

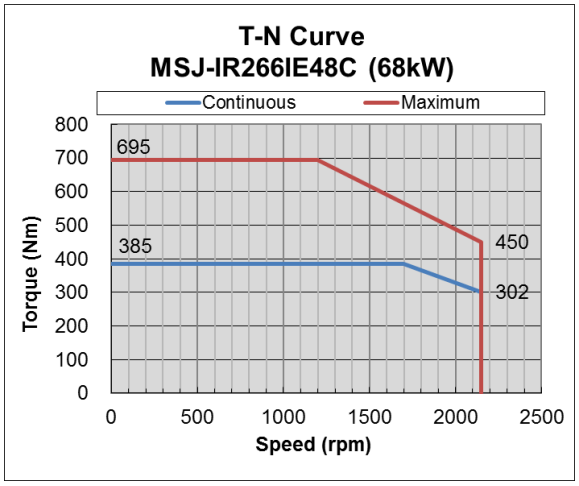
380V:


T-N Curve
MSJ-IR202HE42C (27kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
300
200
153
120


T-N Curve
MSJ-IR203CE42C (32kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
320
275
180
142


T-N Curve
MSJ-OR264FE48C (45kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
432
284
240
191

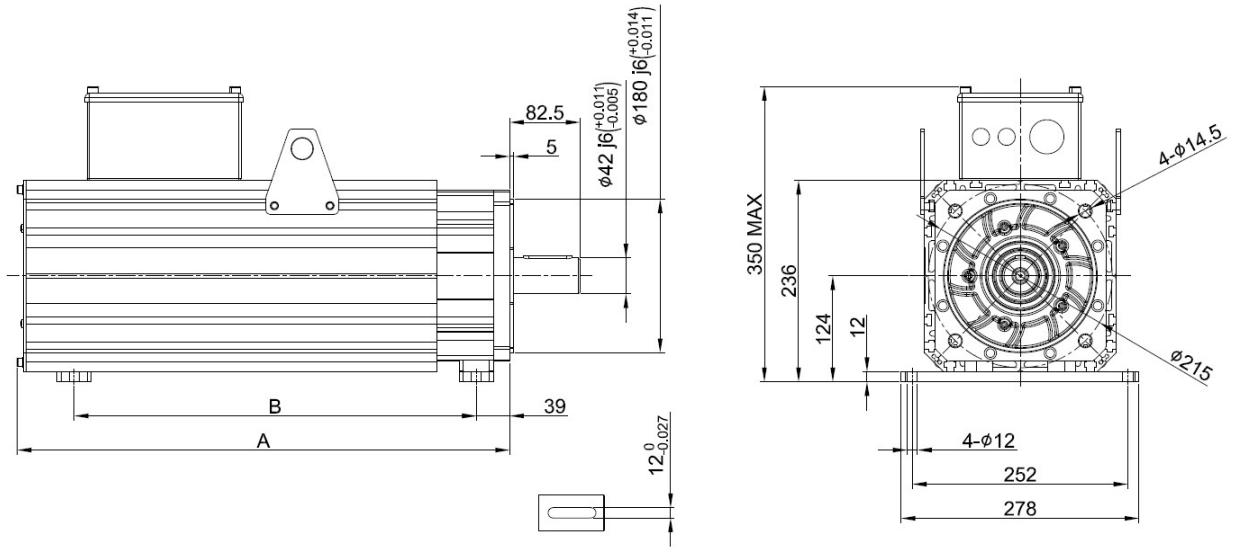

T-N Curve
MSJ-IR265CE48C (52kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
531
390
295
231


T-N Curve
MSJ-IR266IE48C (68kW)
Continuous
Maximum
Torque (Nm)
Speed (rpm)
695
450
385
302

C-5 Product Appearance and Dimensions

220V:

C-5-1: Frame 200

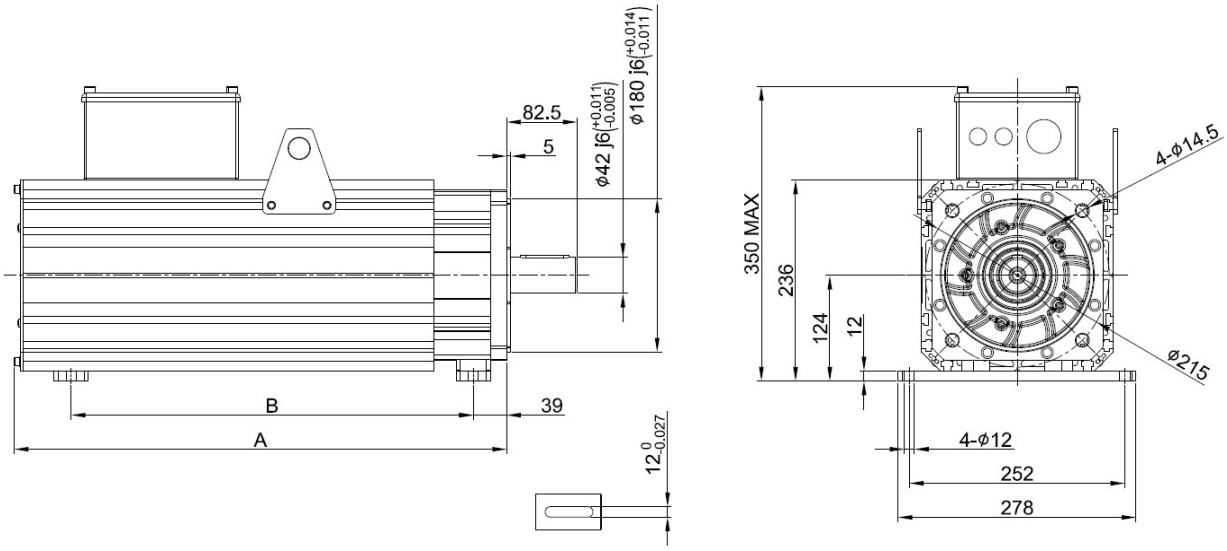


Model		MSJ-_____C				
		DR201AE42	DR201EE42	DR201IE42	GR202DE42	DR202HE42
A	mm	381	417	453	489	575
B	mm	285	310	350	395	470

*Note: Size of Model B can be customized according to your requirement.

380V:

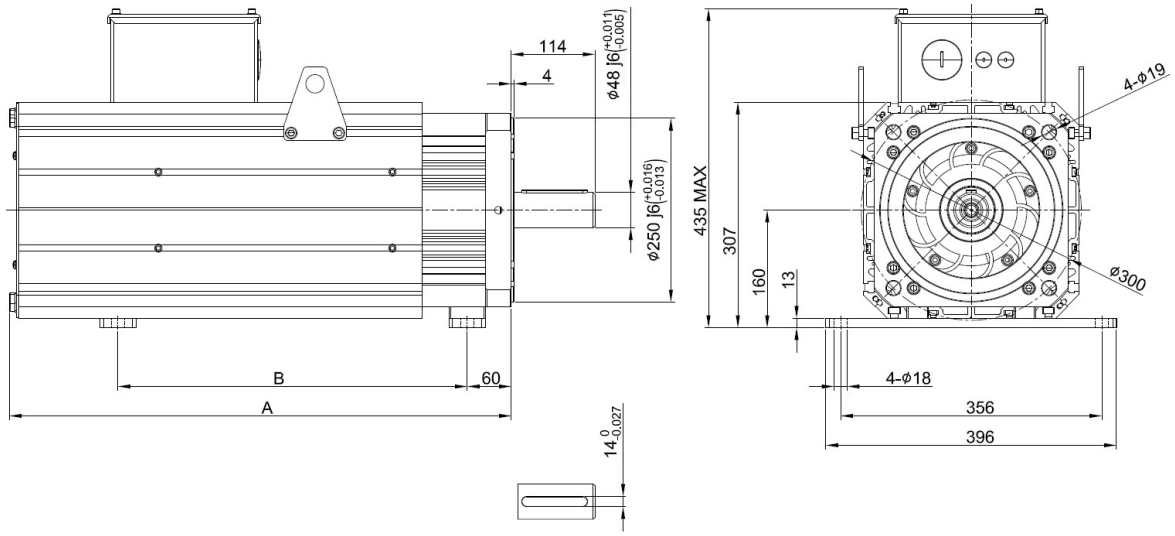
C-5-2: Frame 200



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

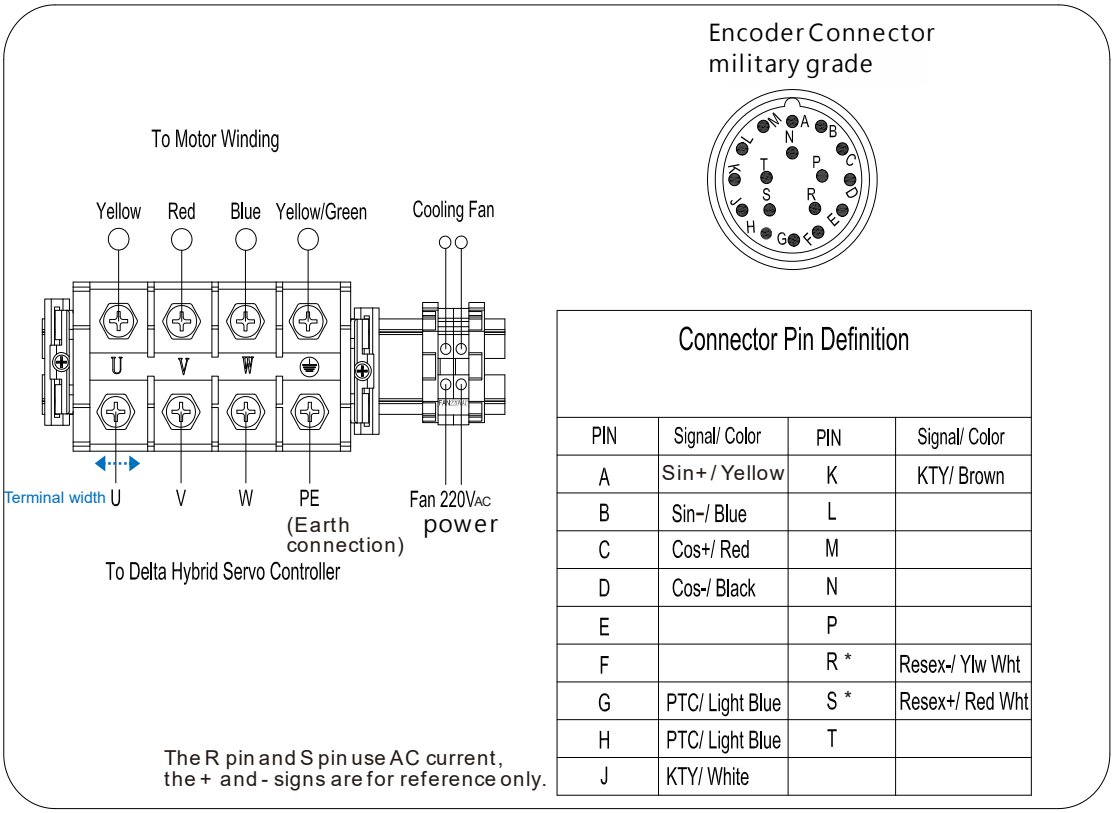


Model		MSJ-_____C		
		OR26 4FE48	IR26 5CE48	IR26 6IE48C
A	mm	577	631	684
B	mm	370	423	476

*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



Connector Pin Definition			
PIN	Signal/ Color	PIN	Signal/ Color
A	Sin+/ Yellow	K	KTY/ Brown
B	Sin-/ Blue	L	
C	Cos+/ Red	M	
D	Cos-/ Black	N	
E		P	
F		R *	Resex-/ Ylw Wht
G	PTC/ Light Blue	S *	Resex+/ Red Wht
H	PTC/ Light Blue	T	
J	KTY/ White		

C-6-2: Recommended Wiring Size and Temperature Rating

220V:

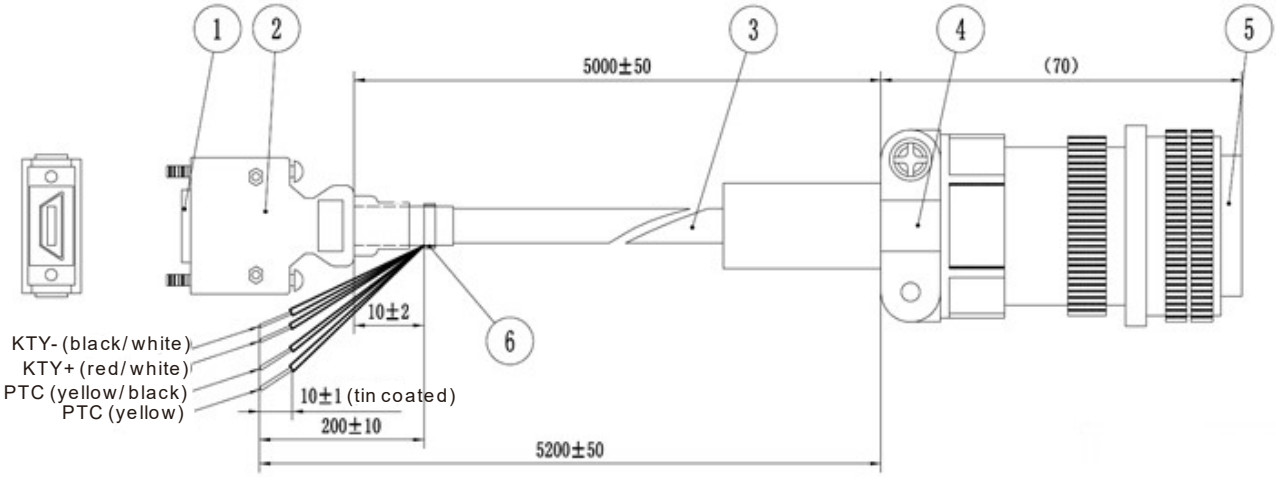
Model		MSJ-_____C				
		DR201AE42	DR201EE42	DR201IE42	GR202DE42	DR202FE42
Minimum Wiring Size	AWG	6	5	4	3	2
	mm^2	13.5	17	21	27	35
*Must use copper wires of temperature rating 90℃ for installation.						

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^2	5.3	8.5	10.5	13.5	17	21	27	35	45
	*Must use copper wires of temperature rating 90℃ for installation.									

C-6-3: Encoder Cable (CBHE-E5M)

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

Appendix D: MSO 380V Oil Cooled Hybrid Servo Motor

D-1 Product Description

D-2 Model Explanation

D-3 Motor Specifications

D-4 Torque – Rotation characteristic curve

D-5 Product Appearance and Dimensions

D-6 Wiring of Servo Oil Pump

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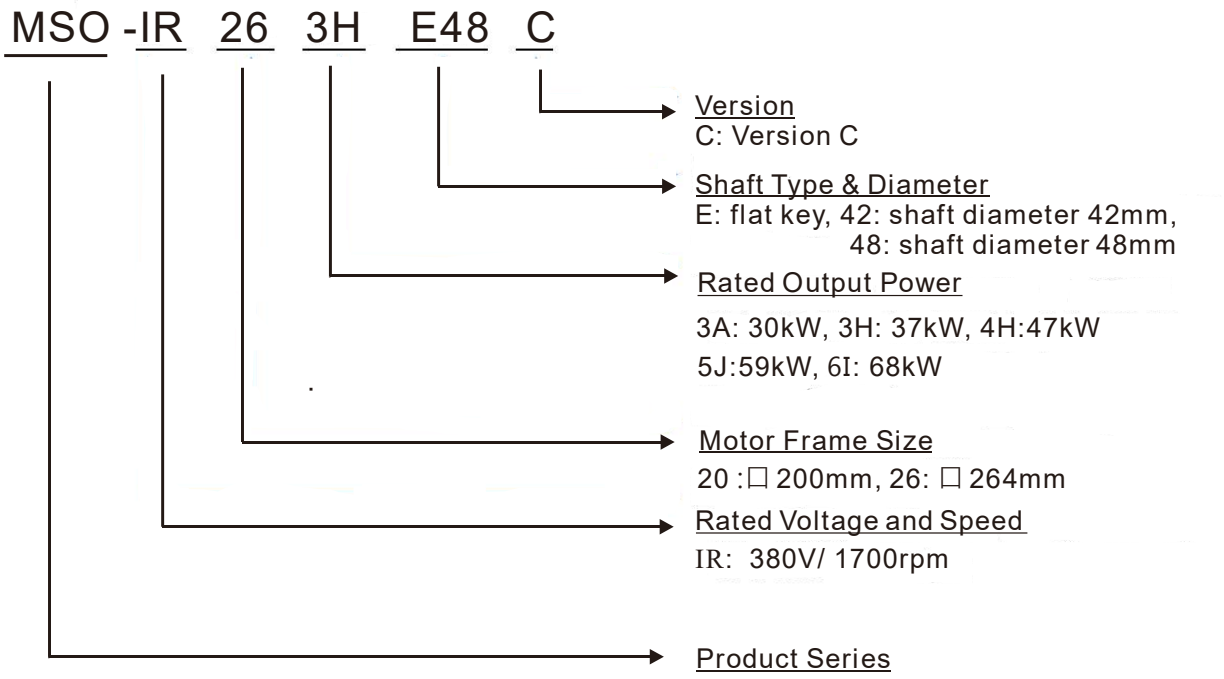
CAUTION	☑ This hybrid servo drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer. ☑ The accessories produced by Delta are only for using with Delta hybrid servo drive. Do not use with other drive to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

D-1 Product Description

Introducing Delta MSO servo motors which are designed for oil cooled hybrid servo system. The Delta MSO servo motors have specialized functions to provide efficient output when working with VFD-VJ oil cooled hybrid servo drives.

D-2 Model Name Explanation



D-3 Motor Specifications

Model		MSO-_____C				
		IR203AE42	IR263HE48	IR264HE48	IR265JE48	IR266IE48
Voltage		380V				
Rated Output Power	kW	30	37	47	59	68
No. of Poles		8				
Rated Torque	Nm	170	210	266	333	385
Maximum Torque	Nm	320	336	426	533	695
Rated Speed	rpm	1700				
Maximum Speed*1	rpm	2150				
Rated Current	A	70.5	85	102	127	149
Torque Constant	Nm/A	2.41	2.47	2.60	2.62	2.58
Voltage Constant	V/krpm	179	183	190	186	190
Phase Resistance	ohm	0.143	0.110	0.077	0.054	0.047
Inductance	mH	2.33	3.50	2.66	1.95	1.72
Rotor Moment of Inertia	kg-cm^2	180	326	416	505	588
Weight	kg	98	126.5	145	167.5	190
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		Oil Cooling (Required cooling flow rate: 15L/min, maximum oil temperature 50℃)				
Encoder		Resolver 2 Poles				
Motor Temperature Protection		PTC temperature protection and KTY84-130 temperature sensor *3				
Operating Environment		Temperature : -15 ~ 40ºC Humidity: 20 ~ 90% RH (Non-condensation) Altitude <1000m				
Installation Method		Flange				
Certifications		CE				

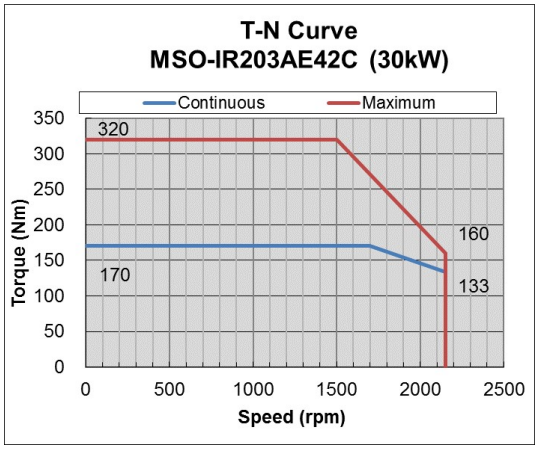
*1: This chart states the maximum operation speed of a motor without field-weakening control.

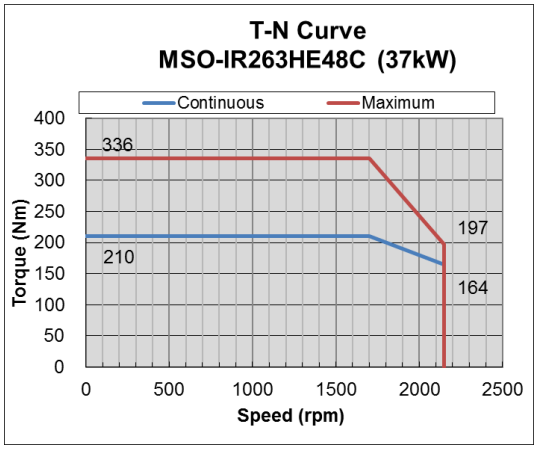
*2: Users are required to set up the parameter Pr02-09 PTC Level (factory setting: 130 ºC)
when using the KTY84-130 temperature sensor (PTC type Pr02-11 =1) for motor overheating protection.

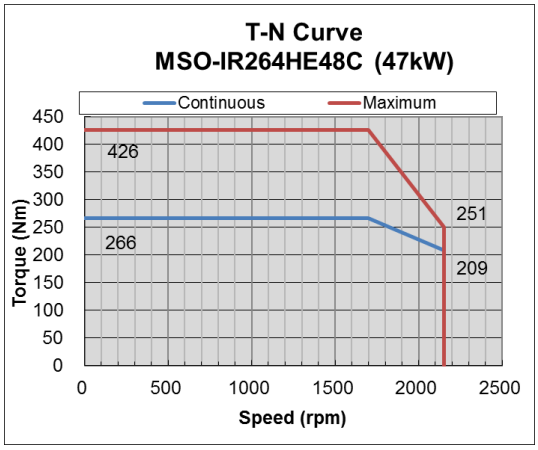
*3: Delta reserves the right to revise specifications without prior notice.

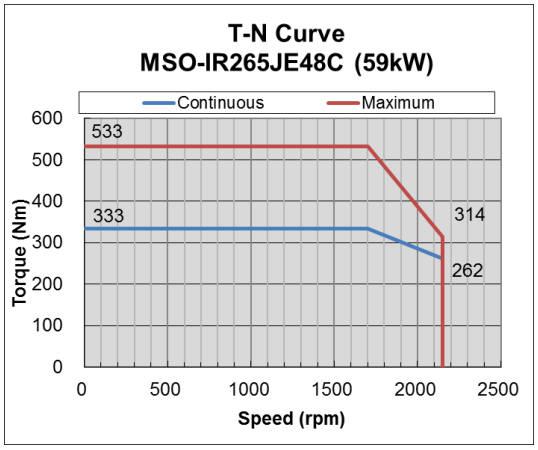
D-4 Torque-Rotation characteristic curve

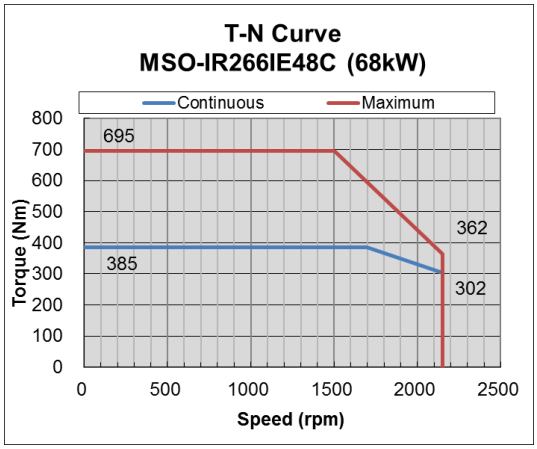
380V:







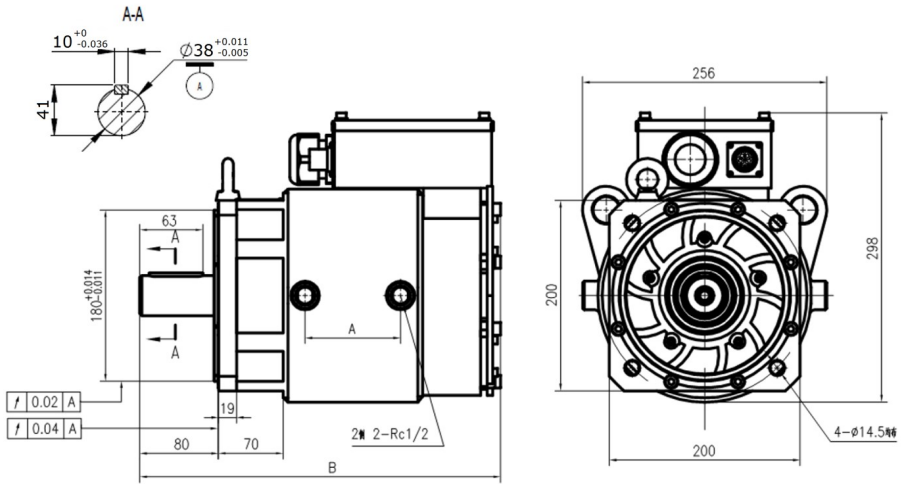




*1: The curves in images above display the maximum operation speed of a motor without field-weakening control.

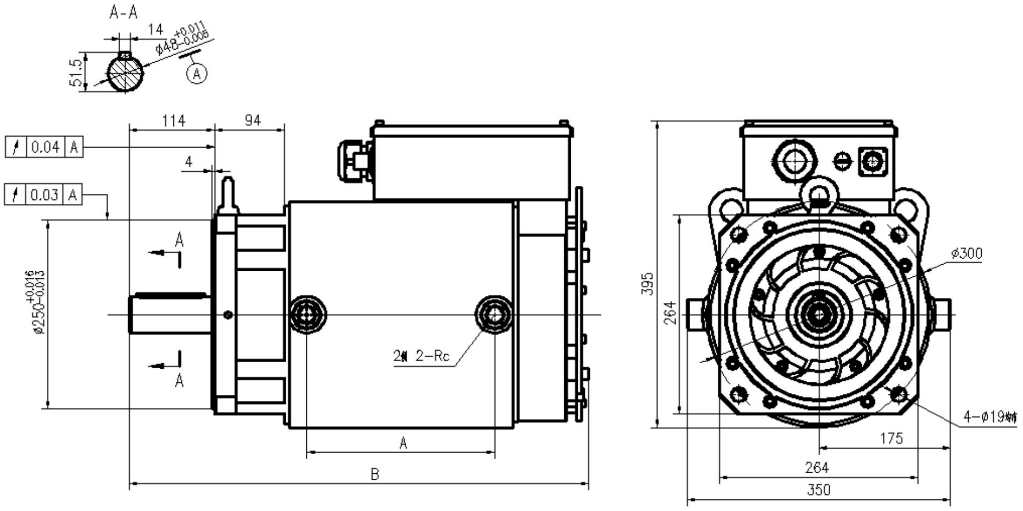
D-5 Product Appearance and Dimensions

D-5-1: Frame 200



Model		MSO-_____C
		IR203AE42
A	mm	292
B	mm	573

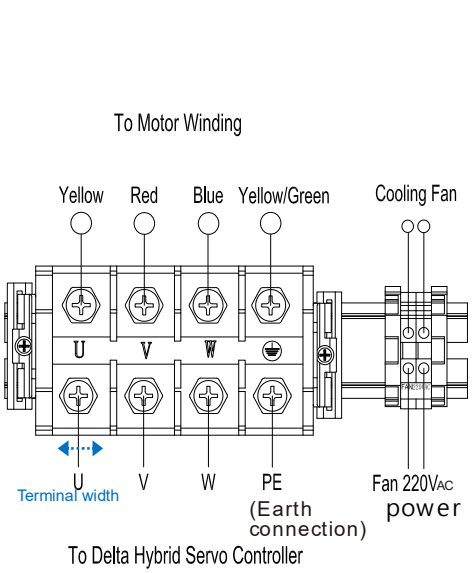
D-5-2: Frame 264

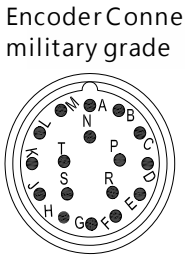


Model		**MSO-_____C**			
		IR263HE48	**IR264HE48**	**IR265JE48**	**IR266IE48**
A	mm	143	197	250	304
B	mm	503	557	610	664

D-6 Wiring of Servo Oil Pump

D-6-1: Wiring Box of 380V





Connector Pin Definition			
PIN	Signal/ Color	PIN	Signal/ Color
A	Sin+ / Yellow	K	KTY/ Brown
B	Sin-/ Blue	L	
C	Cos+/ Red	M	
D	Cos-/ Black	N	
E		P	
F		R *	Resex-/ Ylw Wht
G	PTC/ Light Blue	S *	Resex+/ Red Wht
H	PTC/ Light Blue	T	
J	KTY/ White		

The R pin and S pin use AC current, the + and - signs are for reference only.

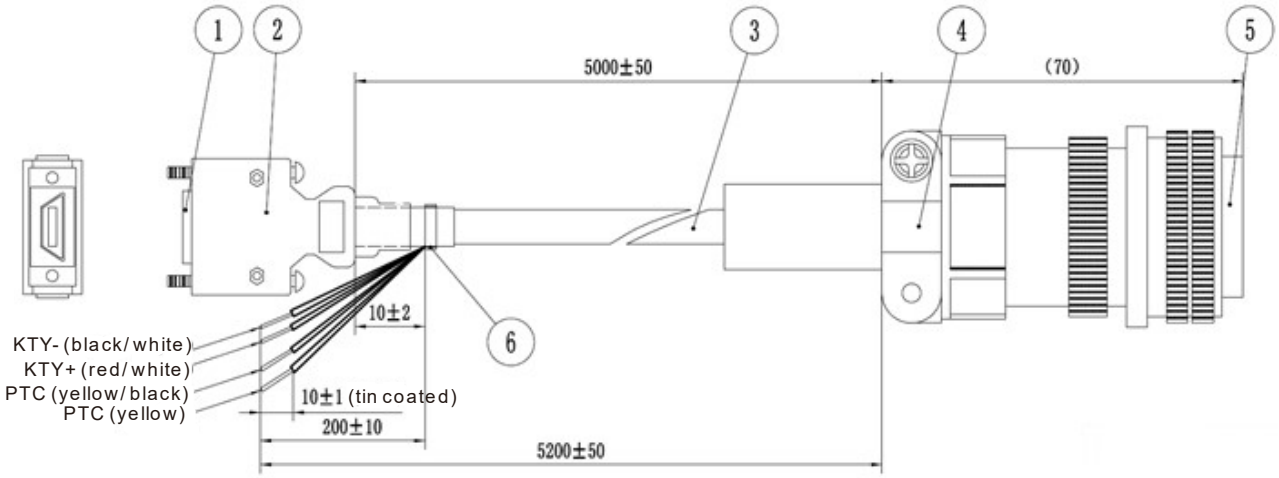
The colors mentioned above are the colors of wires inside the motor, not the colors of encoder's wires.

Voltage	380V	U, V, W, PE	
Frame size	Delta part #	Screw Size	Terminal width
Frame 200	MSO-IR203AE42C	M6	19mm
Frame 264	MSO-IR263HE48C	M8	25mm
	MSO-IR264HE48C		
	MSO-IR265JE48C		27mm
	MSO-IR266IE48C		

D-6-2: Wiring Part Spec. 380V:

Model		MJO-_____C				
		IR203AE42	IR263HE48	IR264HE48	IR265JE48	IR266IE48
Minimum	AWG	3	3	2	2	1
Wiring Size	mm^2	27	27	35	35	50
*Must use copper wires of temperature rating 90℃ for installation						

D-6-3: Encoder Cable



1	SCSI(MDR) Plug <Driver Side>
2	MDR Shell with SCSI terminal
3	Cable
4	Strain Relief
5	Military Connector <Motor Side>
6	Cable Tie

Appendix E: Activate the Oil Pump, Step by Step

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- ☑ 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.

E-1 Step by Step

Step 1. Verify if there's enough hydraulic oil in the oil tank before you turn on the power.

Step 2. After you turn on the power of the hybrid servo drive, use jogging to enable the oil pump. The jogging here means pressing ON button and release right away. Then you will hear the sound of oil pipe sucks in air. Repeat this step few more times until you no longer hear the sound of sucking in air.

Step 3. After you clear the air in the oil tank. Run the motor without any load at a rotation speed of 1200 RPM for 15minutes.

Step 4. After you finish Step 3 and before you start to test machinery, increase progressively the pressure by following the 5 stages below

For example: the maximum pressure is 1790bar and the maximum speed is 1200rpm.
Apply jogging method while increase the pressure from stage 1 to stage 5.
Stage 1: 30bar
Stag 2: 70 bar
Stage 3: 100bar
Stage 4:140bar
Stage 5:170bar

You need to finish the 5 stages above then you can start to test the machinery