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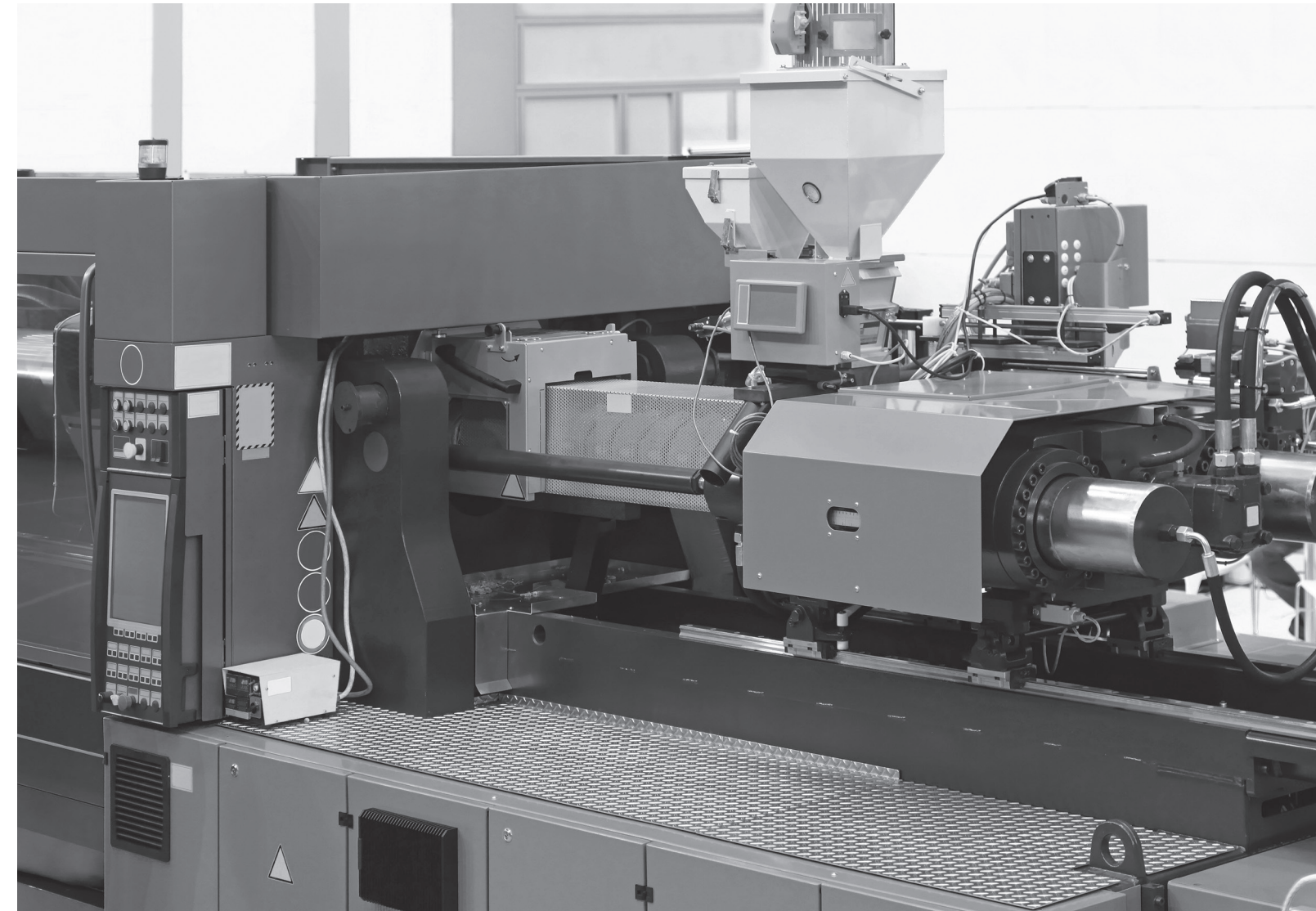
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Delta Hybrid Servo Drive VFD-VJ Series - Air Cooled User Manual



Delta Hybrid Servo Drive VFD-VJ Series - Air 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 V1.01

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY



DANGER

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.



WARNING

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.

DONOT 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.



DONOT 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 with in 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 5000ARMS (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.**



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 distributor or download the latest version at

<http://www.deltaww.com/services/DownloadCenter2.aspx?secID=88&pid=28&cid=08&itemID=060101&ypeID=1&downloadID=81&file=&dataType=&check=081-en-US>

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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:



CAUTION

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 desiccator 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 VFDVJ 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:

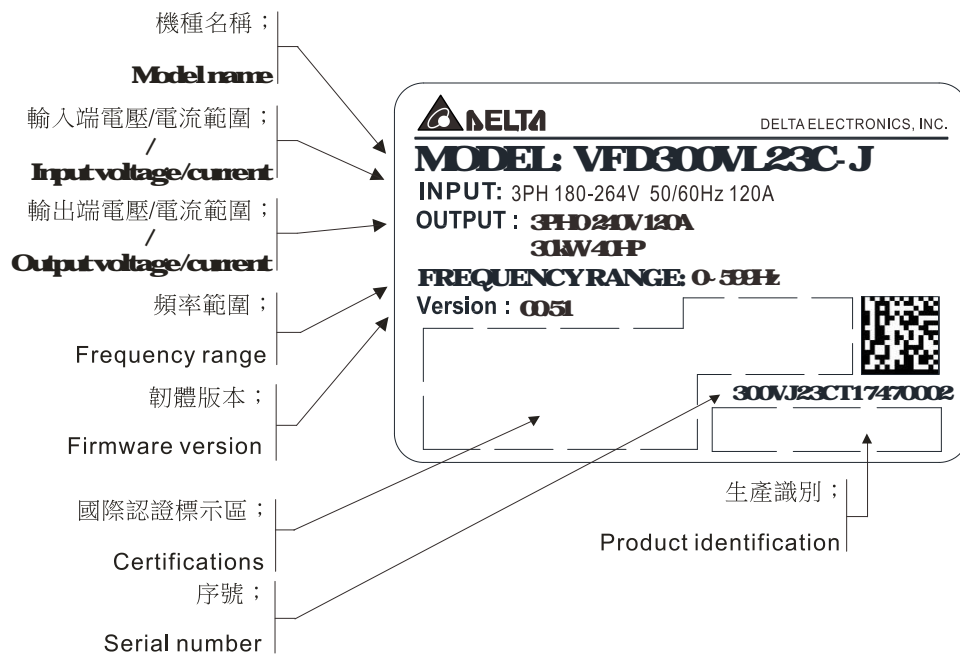
Inspect the drive to assure it was not damaged during shipping

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

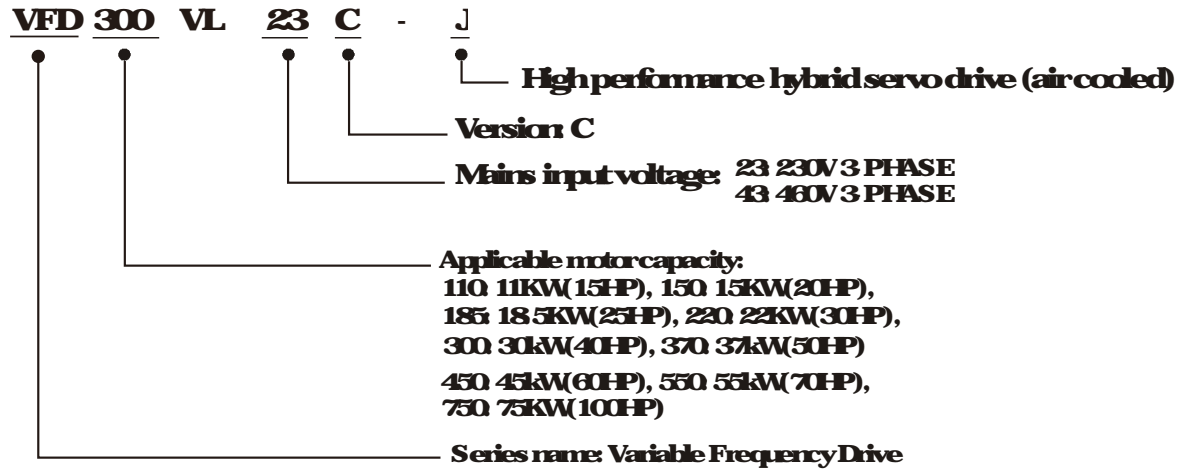
If the registered information does not match your purchase order, or if there is any problem in the product, please contact the dealer or distributor.

Nameplate Information

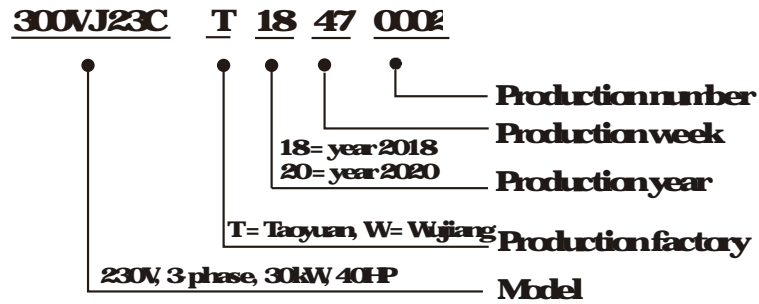
Take the 30kW/40HP 230V_{AC} 3 Phase model as an example



Model Name Explanation



Serial Number Explanation



1-2 Product Specifications


Air-Cooled VFD VJ-C 230 series

Frame Size		E4	
Model VFD__VL23-J		30C	37C
Power (KW)		30	37
Horse Power (HP)		40	50
Output	Rated Output Current (A)	120	146
	Continuous Output Current for 60sec (A)	204	248
	Continuous Output Current for 20sec (A)	240	292
	Carrier Frequency (Hz)	4k~ 10kadjustable	
Power Supply	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	
Base Units		Built In	

Air-Cooled VFD VJ-C 460V series

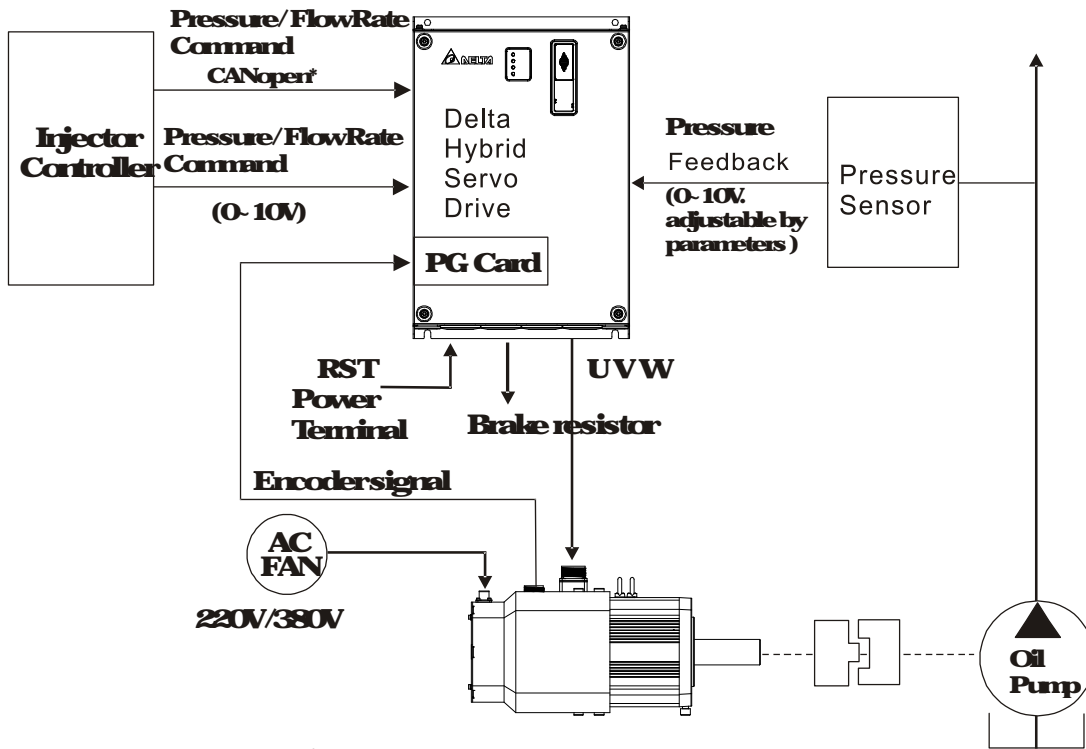
Frame Size		C				D		E4		
Model VFD__VL43-J		110C	150C	185C	220C	300C	370C	450C	550C	750C
Power (KW)		11	15	18.5	22	30	37	45	55	75
Horse Power (HP)		15	20	25	30	40	50	60	75	100
Output	Rated Output Current (A)	21	27	34	41	60	73	91	110	150
	Continuous Output Current for 60sec (A)	36	46	58	70	102	110	155	187	255
	Continuous Output Current for 20sec (A)	42	54	68	82	120	124	182	220	300
	Carrier Frequency (Hz)	4k~ 10kadjustable								
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	
Base Units		Built In								

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 P103 12 for more information)
Multi-function Input Signal		6chDC24V
Multi-function Output Signal		2chDC48V 50mA(max), 1chRelay output
Analog Output Voltage		1chDC 0~ 10V 2mA and -10~ 10V 2mA
Communication Port		RJ45x2, 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 P103 10 for maximum output voltage of pressure feedback, P103 11 for minimum output voltage of pressure feedback, P103 12 for output signal settings and P100 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 KIY84 130PIC/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: $V_{DC} < 180/360V$
	Minus Input Over voltage Protection	Varistor(MOV)
	Over temperature Protection	Monitoring the temperature of Capacitor, IGBT, Braking Chopper and Motor
	Brake Resistor Protection	Open circuited, low resistor value
Environment	Protection Level	NEMA 1/IP20
	Operation Temperature	-10°C ~ 45°C (14°F ~ 113°F)
	Storage Temperature	-20°C ~ 60°C (-4°F ~ 140°F)
	Humidity	Below 90% RH (non condensing)
	Vibration	Below 20Hz: 1.0G; between 20 and 60Hz: 0.6G
	Cooling Method	Fan Cooling
	Installation Altitude	DONOT 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/cm² every year.
Certifications		

*Delta reserves the right to modify specifications without prior notice.

1-3 Overview of Hybrid Servo Systems



*Only for VFD VJ-C series

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 64 L/min and maximum holding pressure of 17.5 Bar 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 64 L/min and the highest rotation speed of the motor is 2000 rpm, the displacement per revolution would be $64/2000 \times 1000 = 32 \text{ cc/rev}$.

2. Maximum Torque of the Motor

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

Example: If the required maximum pressure is 17.5 Mpa and pump displacement per revolution is 32 cc/rev, the maximum torque would be $17.5 \times 32 \times 1.3 / (2\pi) = 116 \text{ N}\cdot\text{m}$, 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 77N·m, the motor with a power of 12kW* and a rated speed of 1500rpm can be chosen.

*The power of the motor is calculated by using $P(W) = T(N \cdot m) \cdot (\text{rpm} / 60)$

4 Maximum Current of the Motor

Example: Check the parameter k_t (Torque/A) in the motor's specifications list. If $k_t = 337$, the maximum current is approximately $116/337 = 34A$ at the maximum torque of 116N·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 17.5Mpa by using with a pump of 32cc/rev, the required motor current would be approximately 34A.

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

For model VFD450M43A-J, the overload may occur within 20sec.

For model VFD550M43A-J, the overload may occur approximately after 60sec.

 **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.

Use wall-mounting method and follow the space requirements during the installation of the hybrid servo system.

1-32 Selection of Pump for Hybrid Servo Motor

Select a pump with a suitable displacement based on the required flow rate and motor speed. If low noise is required, you can choose the screw pump or internal gear type. If a high volumetric efficiency is required, you can choose the piston pump or dual displacement piston pump.

Comparison of Commonly Used Pump (This may vary for different pump manufacturers).

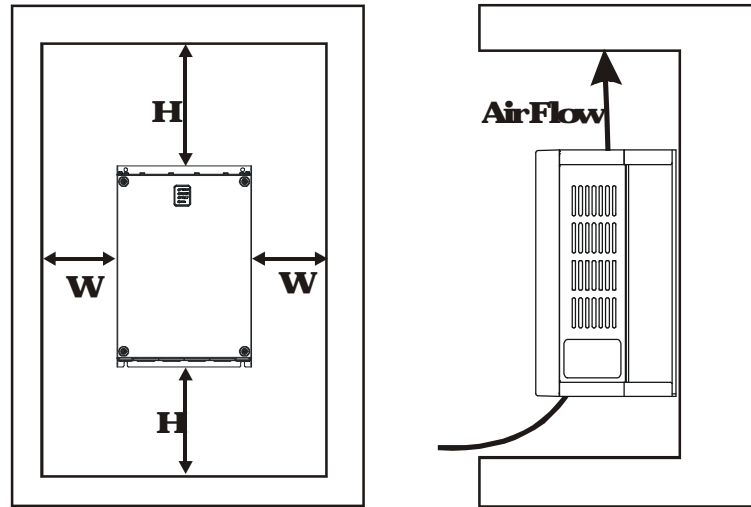
Type of Oil Pump	Volumetric Efficiency	Flow Pulsation	Rotation Speed	Noise
Internal Gear Pump	Low	Medium	Medium	Low
Piston Pump	High	Low	Low	High
Screw Pump	Medium	High	High	Medium

1-4 Product Installation

Please install the hybrid servodrive 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 980m/s² (1G) max, 20-50Hz 588m/s² (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 980m/s² (1G) max, 20 ~ 50Hz 588m/s² (0.6G) max
Contamination Protection Level	Level 2 Applicable to factory environment with low to medium contamination	

Space for Installation



HP	W mm(inch)	H mm(inch)
7.5 (2)HP	75 (3)	175 (7)
25 (7)HP	75 (3)	200 (8)
10HP	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 moves 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**

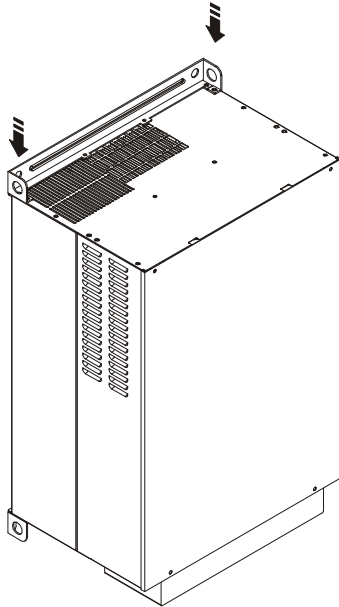
Prevent substances like fiber particles, scraps of paper, sawdust, metal particles, and so on from entering the hybrid servo drive. The hybrid servo drive should be installed in the cabinet made from non-combustible material such as metal to prevent fire accident.

Lifting

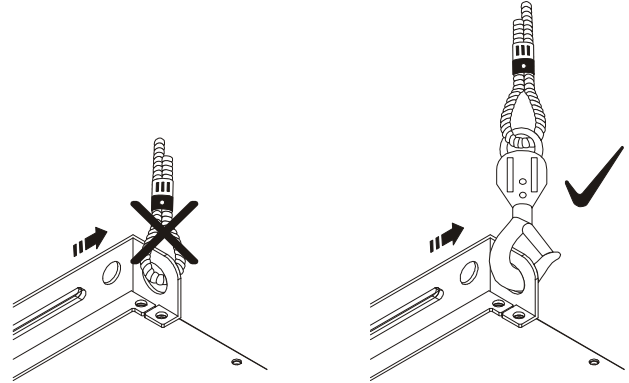
Carry only the fully assembled hybrid servo drives as shown in the following diagrams. Lift the hybrid servo drive by hooking the lift holes when diving a full lift using a crane.

40 100HP

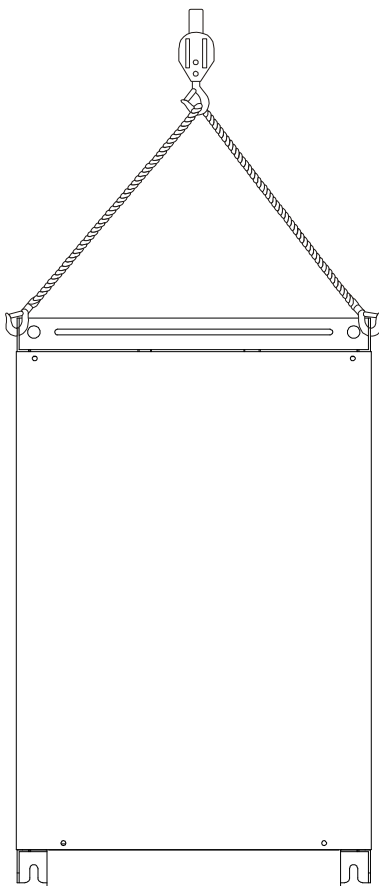
Step 1



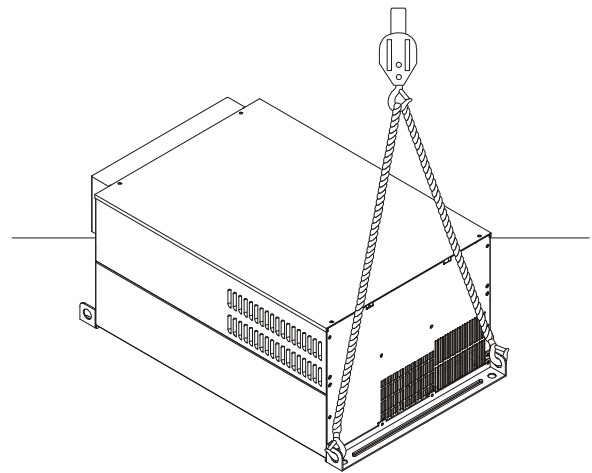
Step 2



Step 3



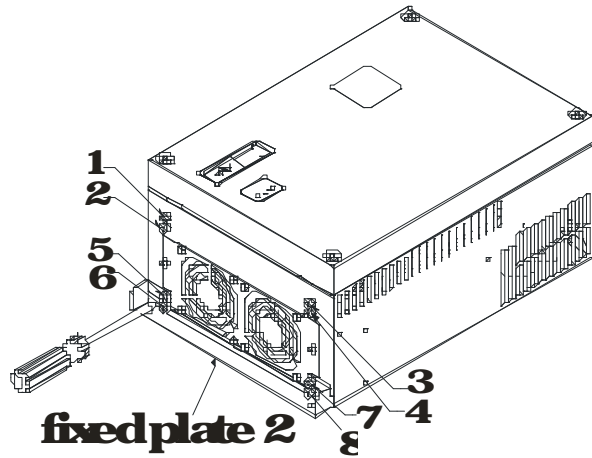
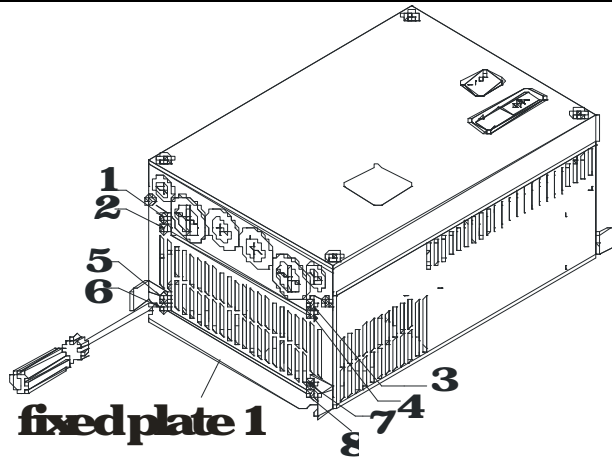
Step 4



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.

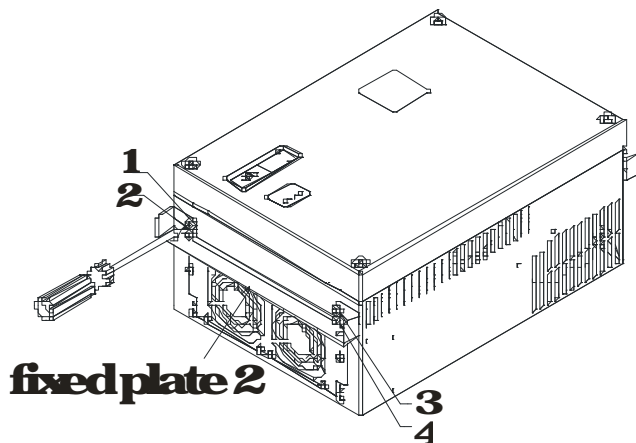
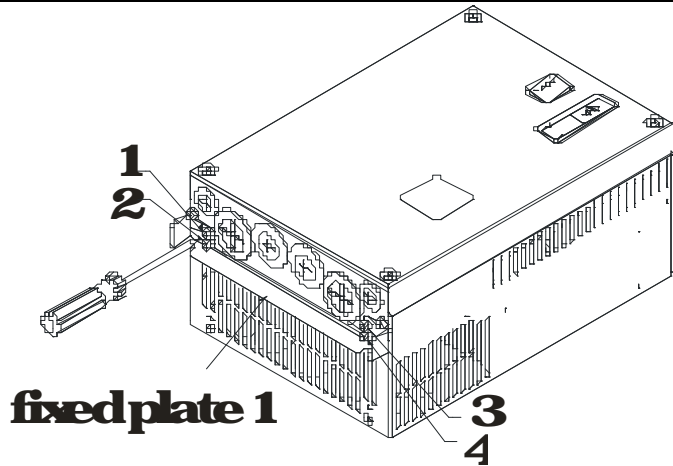


Step 2

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.

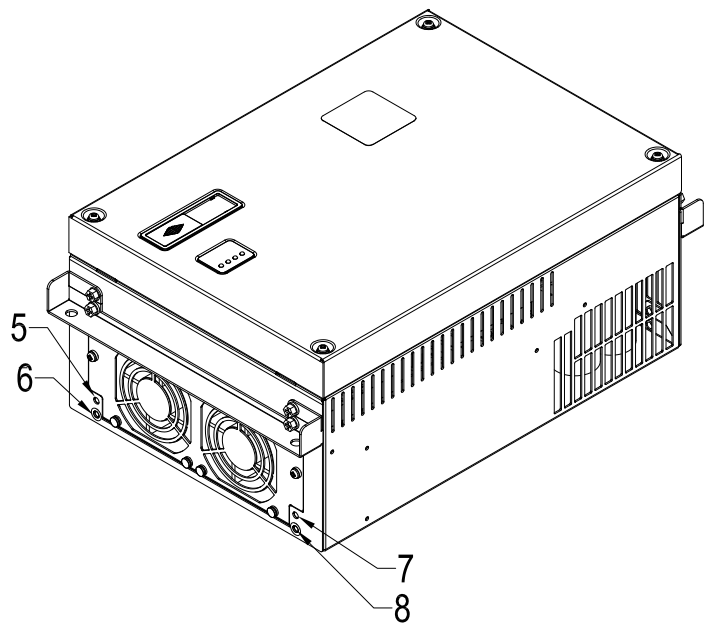
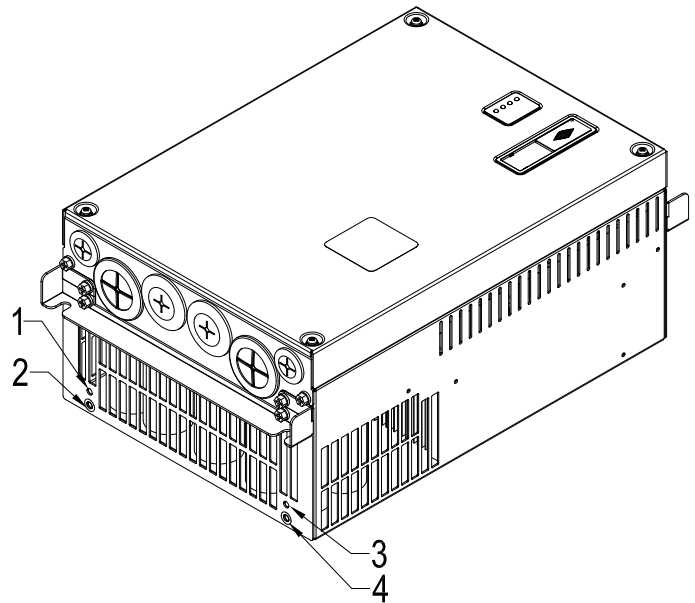
Frame C: 14.17kgf·cm
[122.148n·bf]

Frame D: 20.25kgf·cm
[174.21.7n·bf]



Step 3

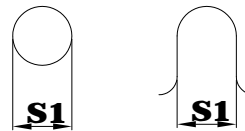
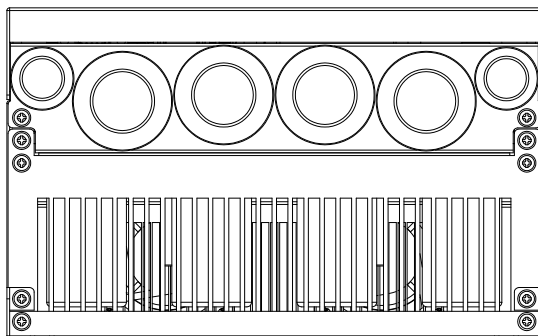
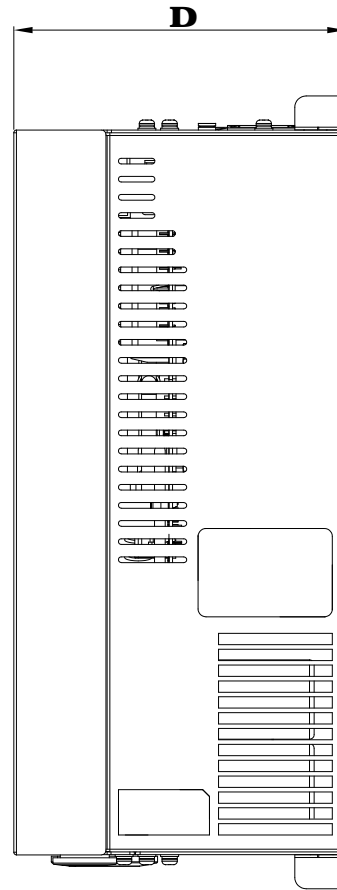
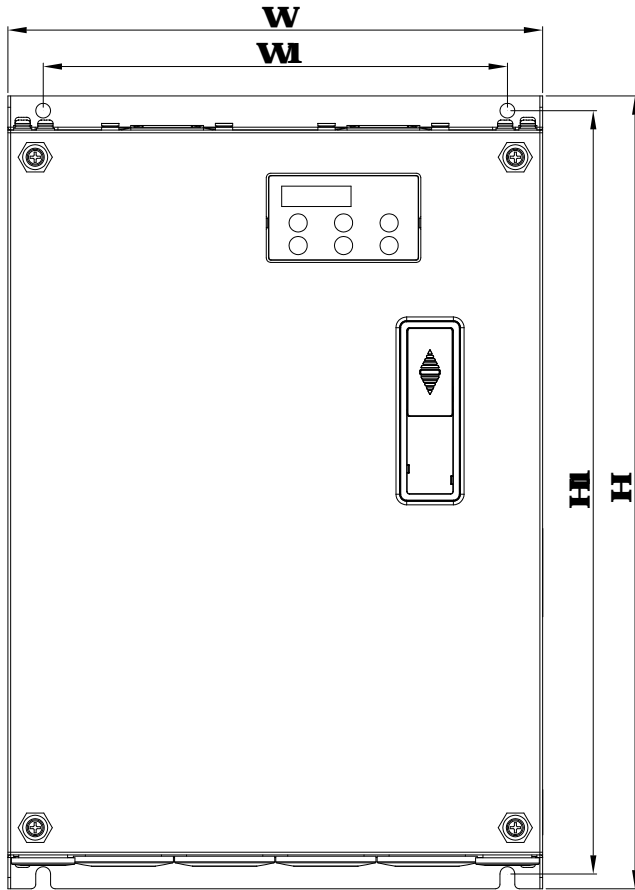
Note that it is not necessary to put back those 8 screws shown in the following figures to the drive. Moreover, make sure that these 2 different fixed plates are put in the correct side as shown in the figures.



1-5 Product Dimensions

Frame C:

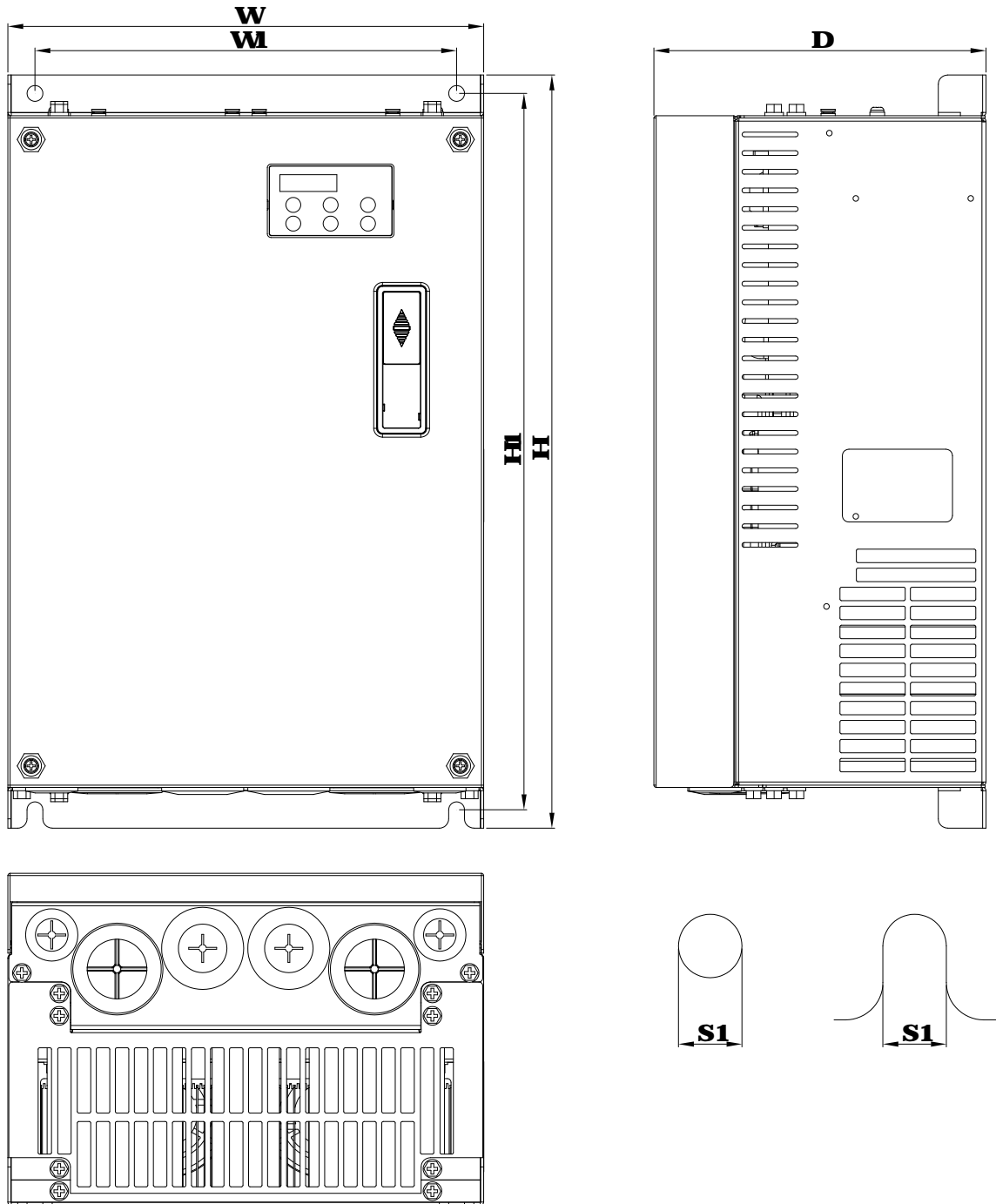
VFD110M43C-J, VFD150M43C-J,
VFD185M43C-J, VFD220M43C-J



Unit: mm

Frame	W	WI	H	HI	D	S1
C	235 [925]	204 [808]	350 [1378]	337 [1327]	146 [575]	65 [263]

Frame D
VFD300M43C-J, VFD370M43C-J



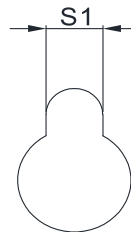
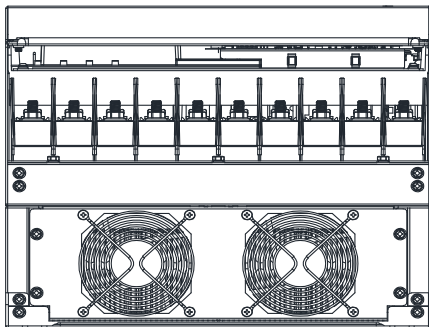
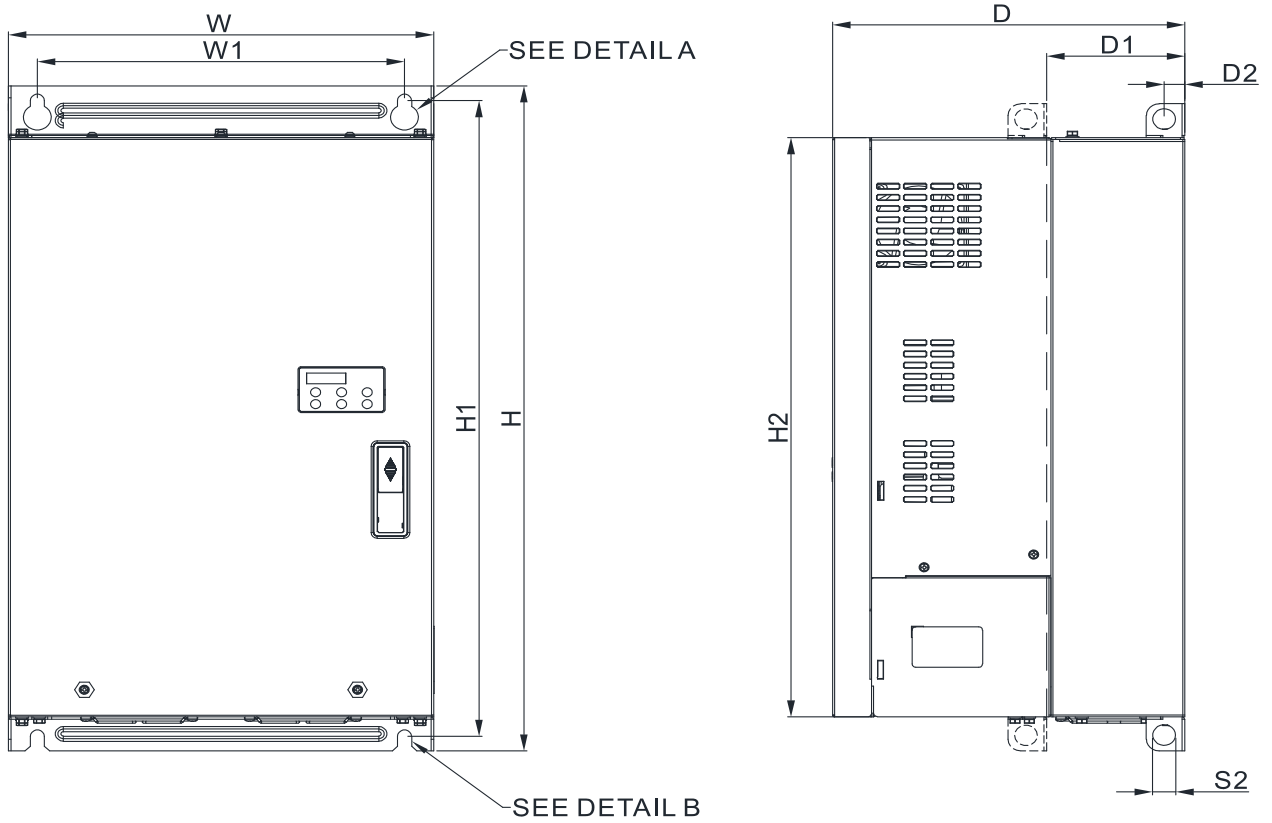
Unit: mm[inch]

Frame	W	WI	H	HI	D	S1
D	250 [100]	260 [89]	408 [159]	380 [151]	178 [70]	85 [33]

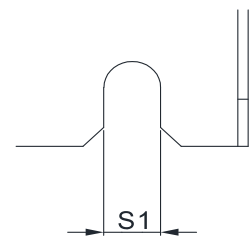
Frame E4

VFD300L23C-J, VFD 370L23C-J,

VFD450L43C-J, VFD550L43C-J, VFD750L43C-J



DETAIL A
(MOUNTING HOLE)



DETAIL B
(MOUNTING HOLE)

Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1*	D2	S1	S2
E4	3300	2850	5650	5400	4920	2734	1072	160	11.0	180
	[1299]	[11.22]	[22.24]	[20.67]	[19.37]	[10.76]	[4.22]	[0.63]	[0.43]	[0.71]

2 Wing

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 be 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 capacitor 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 remaining 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.



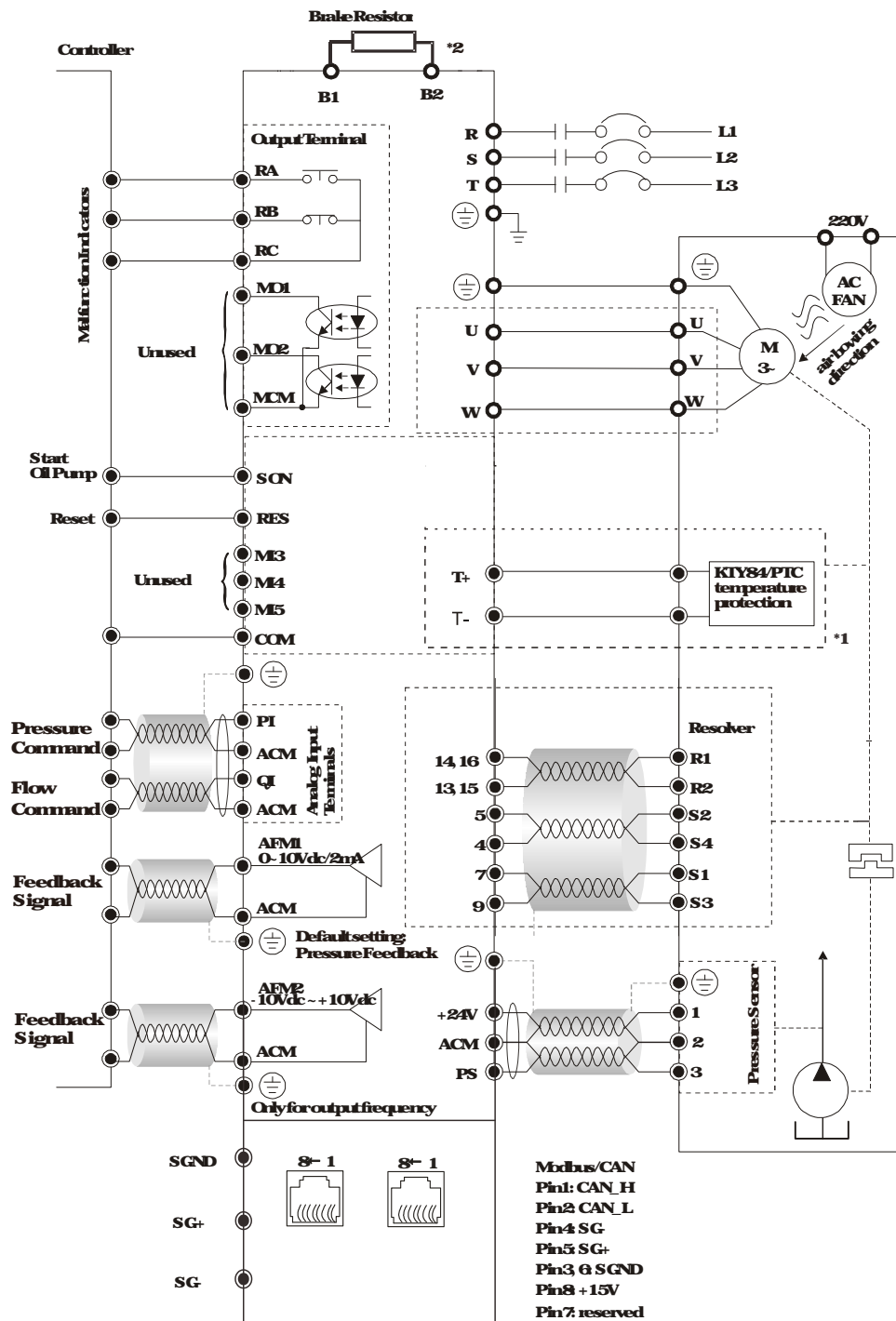
Make sure that power is only applied to the R/L1, S/L2, and T/L3 terminals. Failure to comply may result in damage to the equipment. The voltage and current should be within the range as indicated on the nameplate.

Check following items after finishing the wiring.

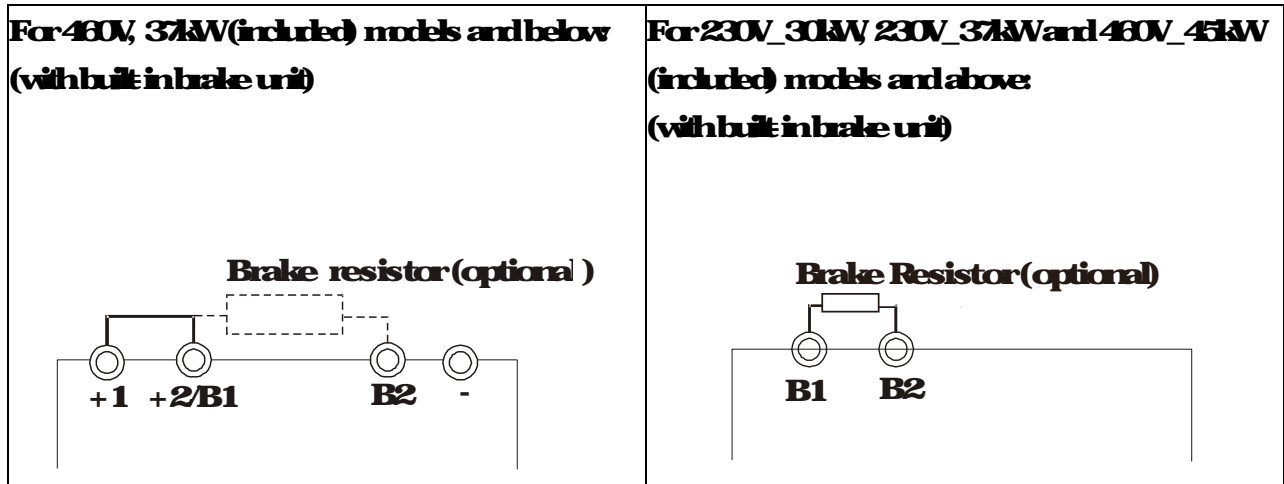
- 1. Are all connections correct?**
- 2. No loose wires?**
- 3. No short circuits between terminals or to ground?**

2 1 Description of Wiring

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



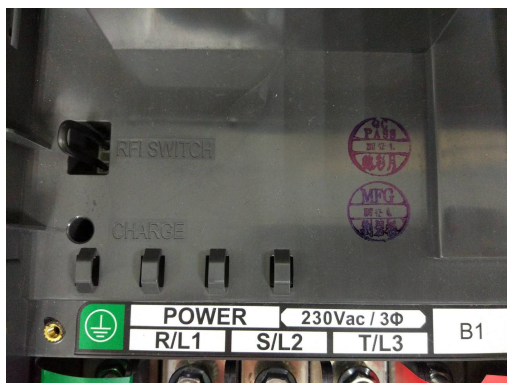
*2



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

Isolating main power from ground

When the power distribution system of the drive is a floating ground system (IT Systems) or a TT system (Tene Tene 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

Pay particular attention to the following points

1. Do not remove the RFI switch while the power is on
2. Make sure the power is turned off before removing RFI switch
3. Removing the RFI switch disconnects the internal capacitors from ground

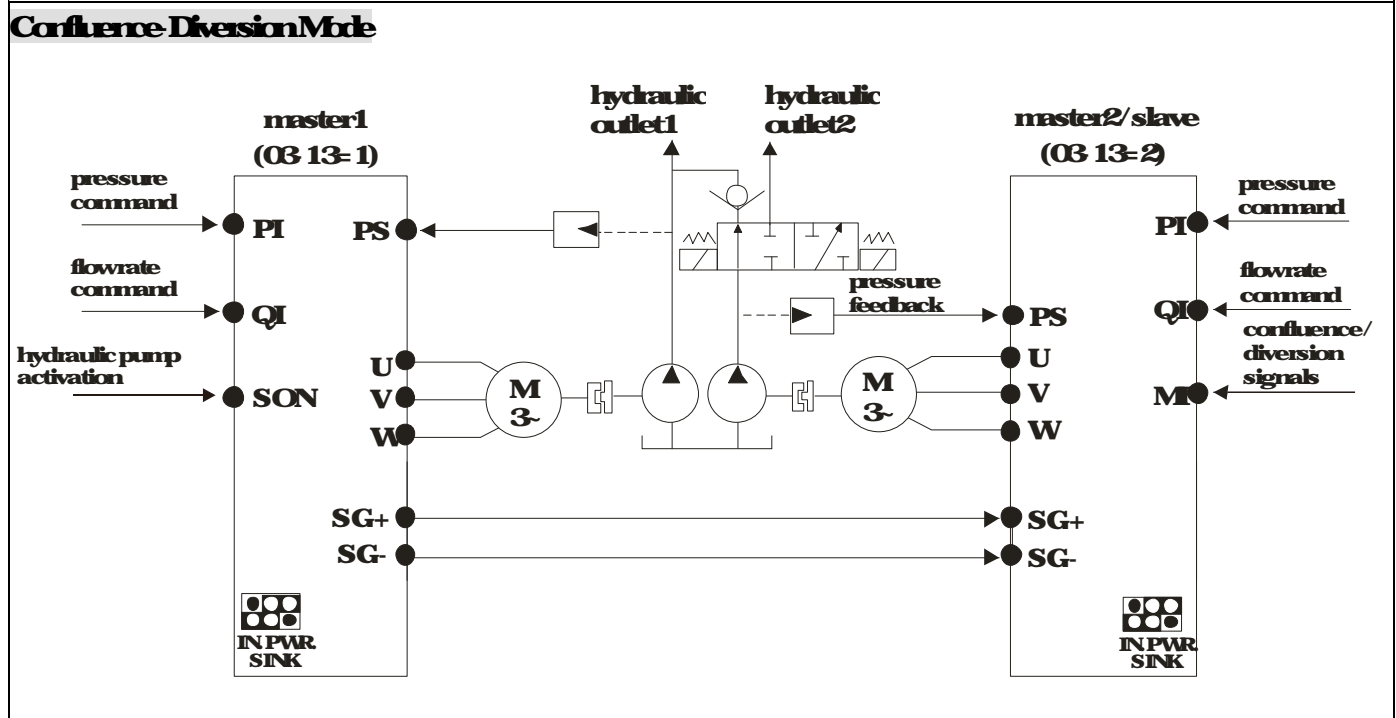
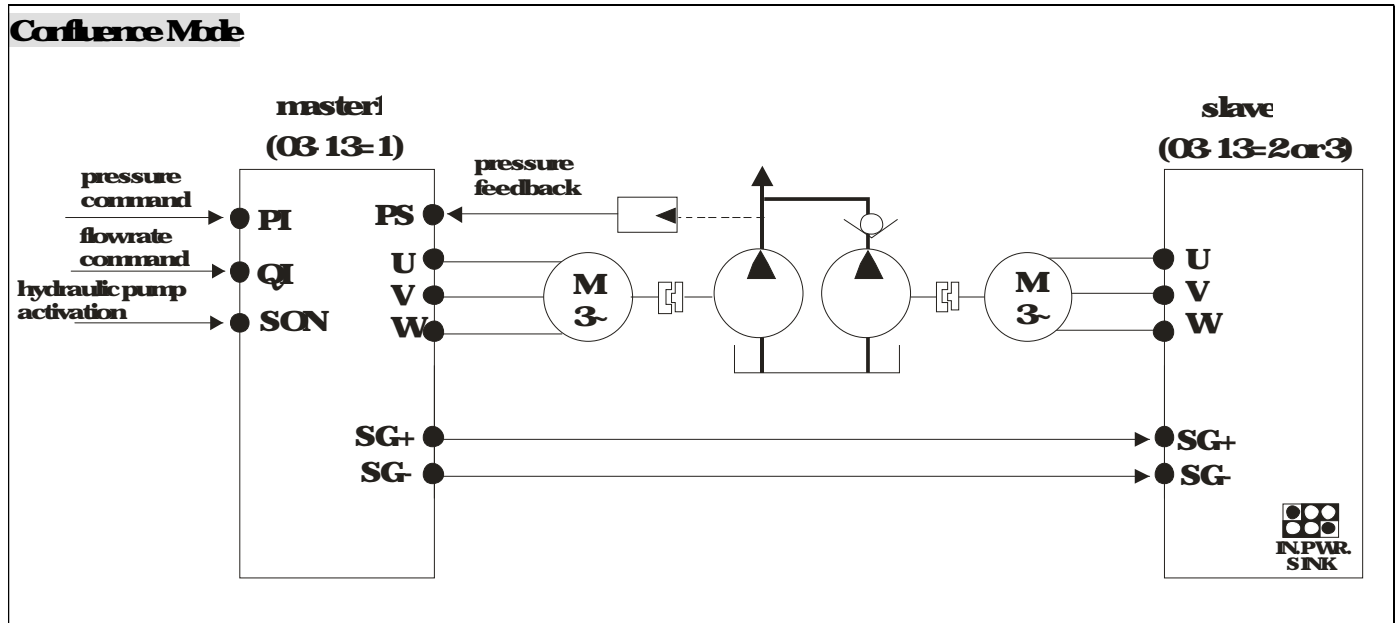
Removing the RFI switch also disconnects the built-in EMC filter capacitors. Compliance with the EMC specifications is no longer guaranteed.

Do not remove the RFI switch if the main power is a symmetrical grounded power system. 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 main 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

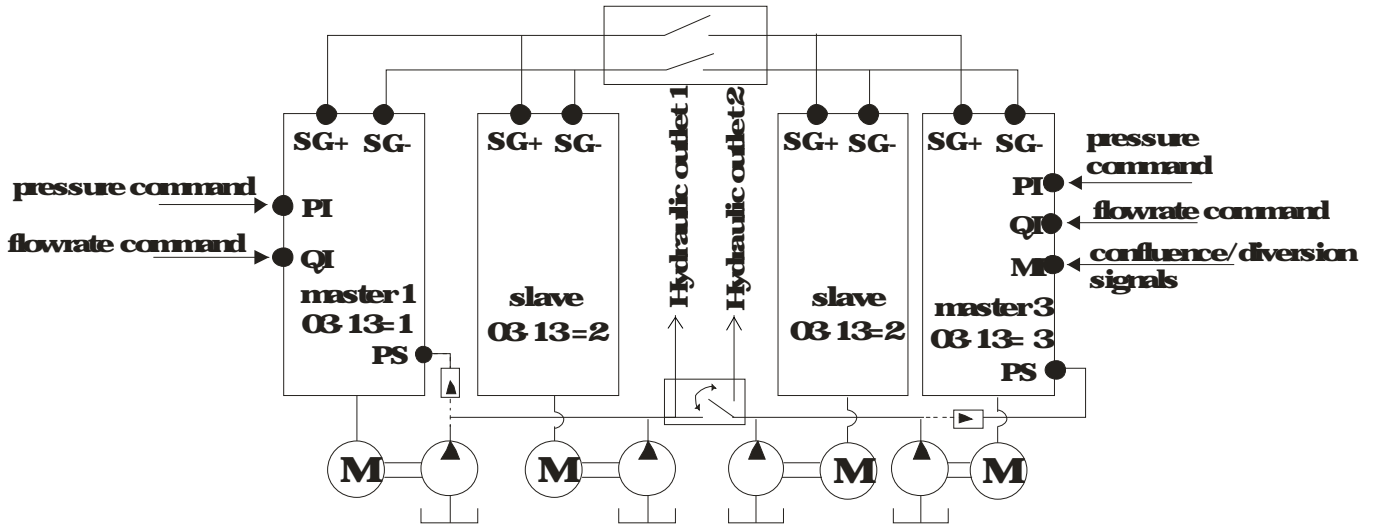
Multi-pump Operation Mode



NOTE

1) VFDVJ-C series do not require external communication card EM/J-MF01.

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



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.

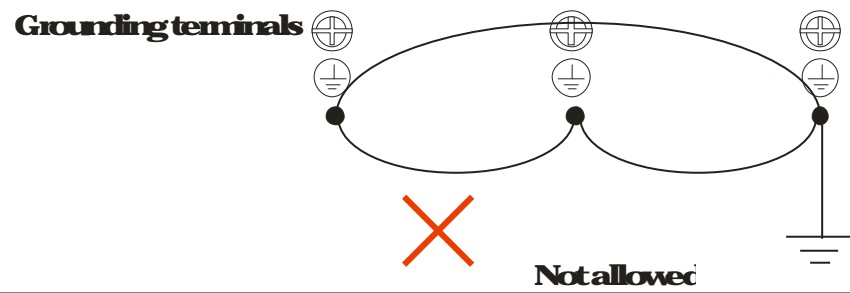
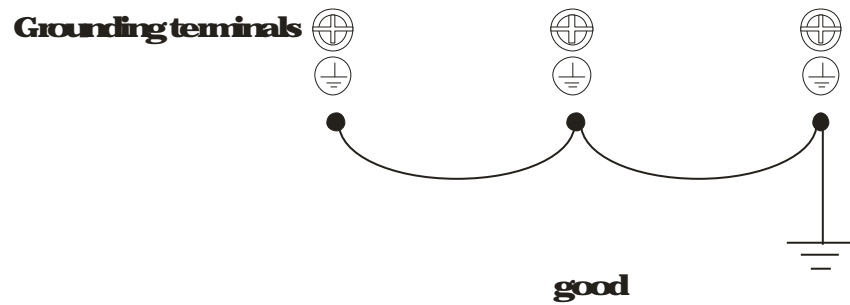
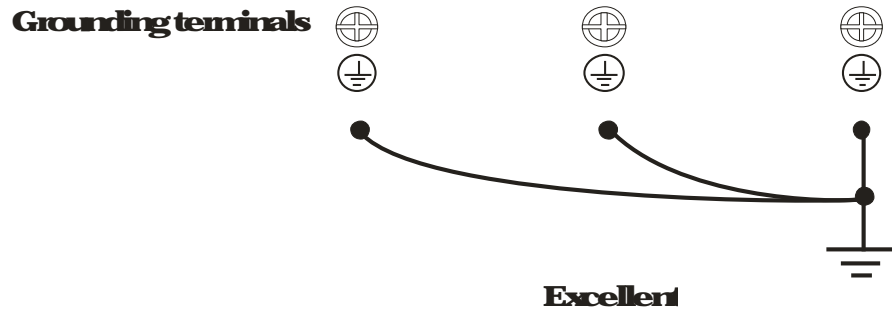
VFDVJ series doesn't have built-in brake resistors, but brake resistor can be installed for those occasions that use higher load inertia or frequent start/stop. Refer to Appendix A-1 for details.

Make sure that the leads are connected correctly and the hybrid servo drive is properly grounded to reduce noise and for safety.

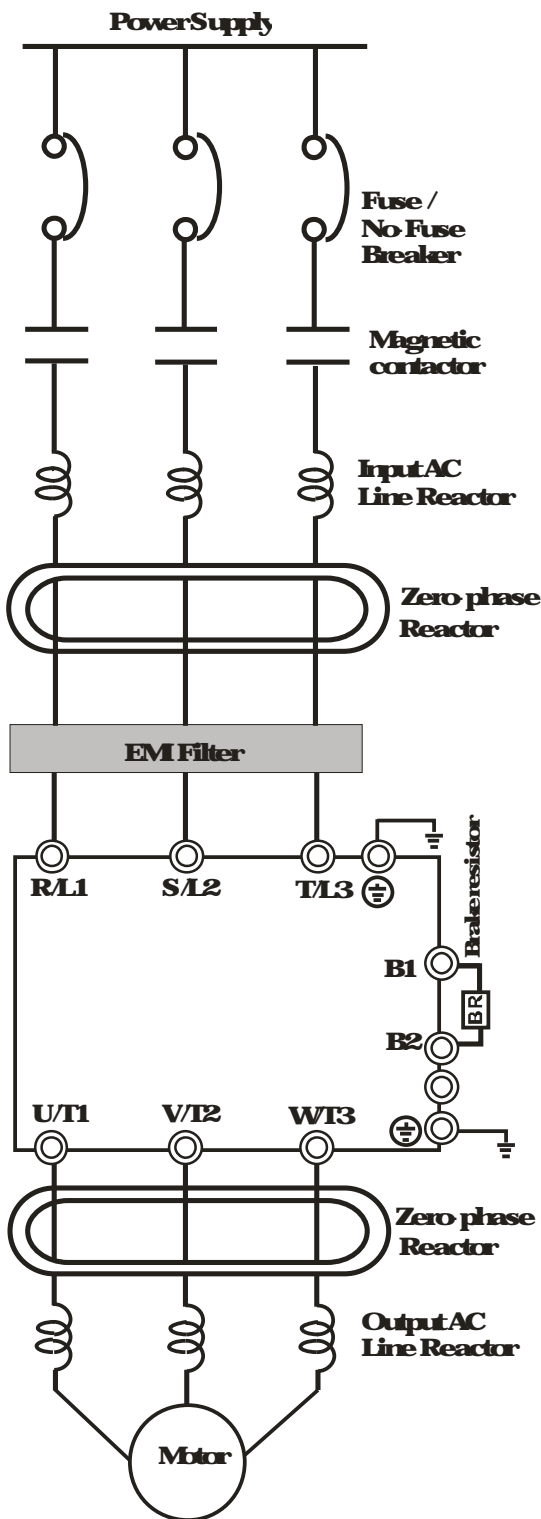
To prevent lightning stroke and electric shock, use ground leads that comply with local regulations. Keep them as short as possible and have them properly connected to the ground terminal on the hybrid servo drive.

Multiple VFDVJ 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 IO 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 main wiring distance 10m.
Zero phase Reactor (Fenite 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 (RF220N00A).
EM 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
RL1, S/L2, T/L3	AC line input terminals 3 phase
U/T1, V/I2, W/I3	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	z 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. RL1, S/L2 and T/L3 has no phase sequence requirement, it can be used upon random selection.

It is recommended 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.

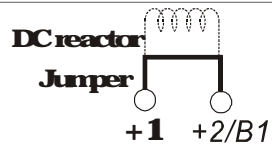
Output terminals for the main circuit:

When it needs to install the filter at the output side of terminals U/T1, V/I2, W/I3 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.

DONOT 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.

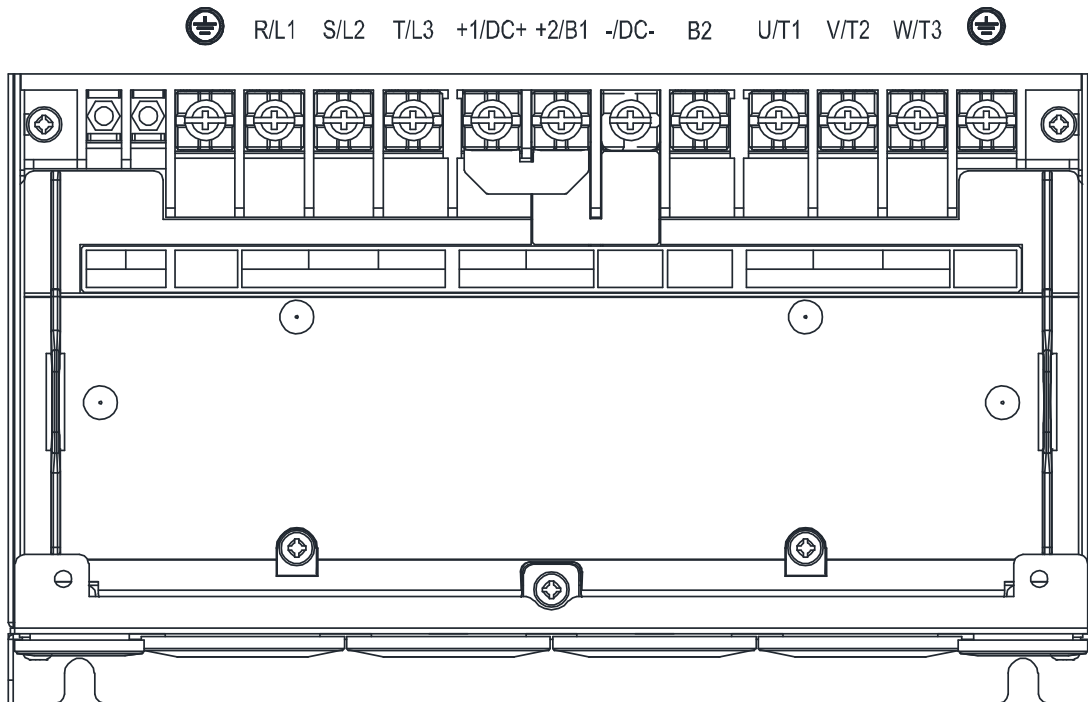


For those models without built in brake resistor, please connect external brake unit and brake resistor (both of them are optional) to increase brake torque. DONOT connect [B2] or [-] to [+2/B1] directly to prevent drive damage.

Specifications of the Main Circuit Terminals

VJ-C Air Cooled

Frame C



Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal ⊕		
	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)
VFD110M43C-J	16mm ² (6AWG)	10mm ² (8AWG)	M5 30kg·cm (260lb·in) (294Nm)	10mm ² (8AWG)	10mm ² (8AWG)	M5 30kg·cm (260lb·in) (294Nm)
VFD150M43C-J		10mm ² (8AWG)		10mm ² (8AWG)	10mm ² (8AWG)	
VFD185M43C-J		16mm ² (6AWG)		16mm ² (6AWG)	16mm ² (6AWG)	
VFD220M43C-J		16mm ² (6AWG)		16mm ² (6AWG)	16mm ² (6AWG)	

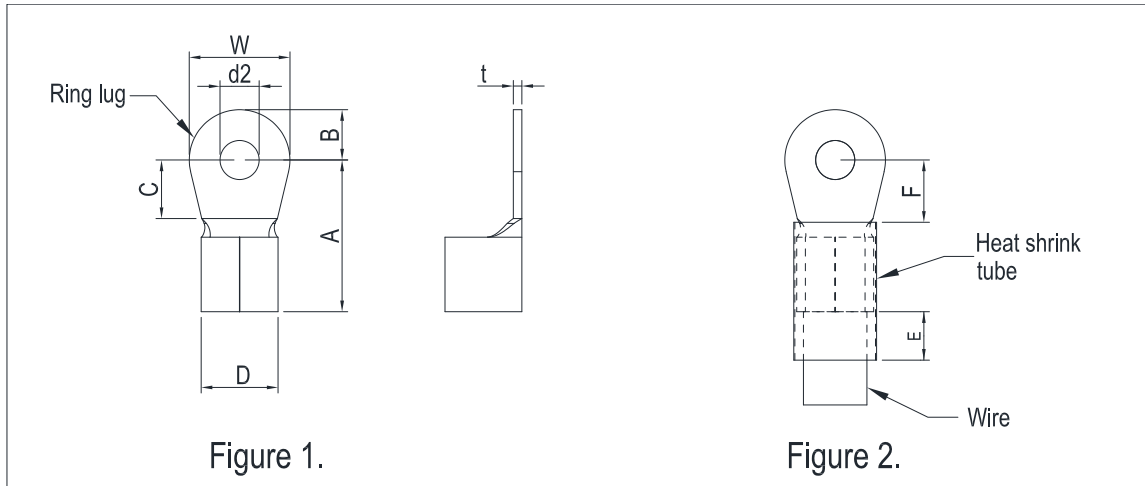
1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600V and temperature resistance of 75°C or 90°C
2. If you install at Ta 45°C above environment, select copper wire with voltage rating of 600V and temperature resistance of 90°C or above.
3. For VFD220M43C-J model, if you install it at Ta 35°C above environment, select copper wire with voltage rating of 600V 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	KS.T	RNBS85	250	60	70	90	52	130	70	125	30
	6	KS.T	RNBS145									

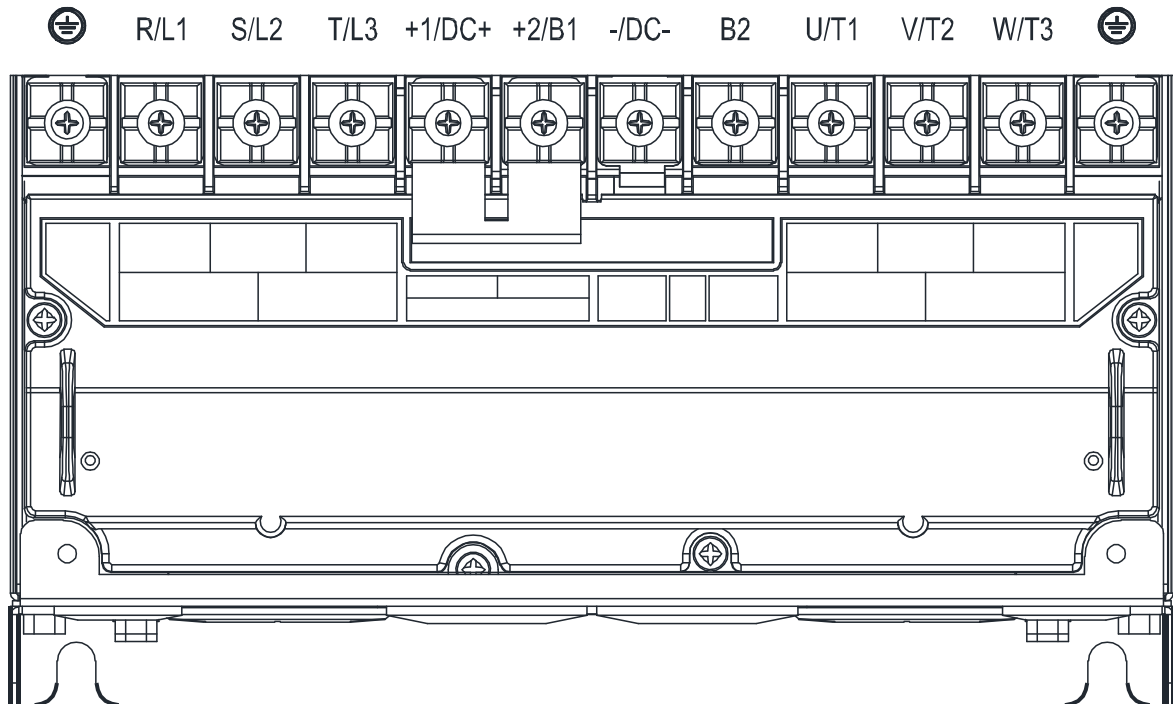
The following additional terminals are required when wiring. The additional terminal dimensions should comply with Figure 1 below.

After crimping the wire to the ring lug (must be UL approved), UL and CSA approved RC (YDPU2), and install heat shrink tubing rated at a minimum of 600VAC insulation over the live part. Refer to Figure 2 below.



VJ-C Air Cooled

Frame D



Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal ⊕		
	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)
VFD300L43C-J	35mm ² (2AWG)	35mm ² (2AWG)	M6	35mm ² (2AWG)	16mm ² (6AWG)	M6
VFD370L43C-J		35mm ² (2AWG)	50kg cm (434lb in) (49Nm)	35mm ² (2AWG)	16mm ² (6AWG)	50kg cm (434lb in) (49Nm)

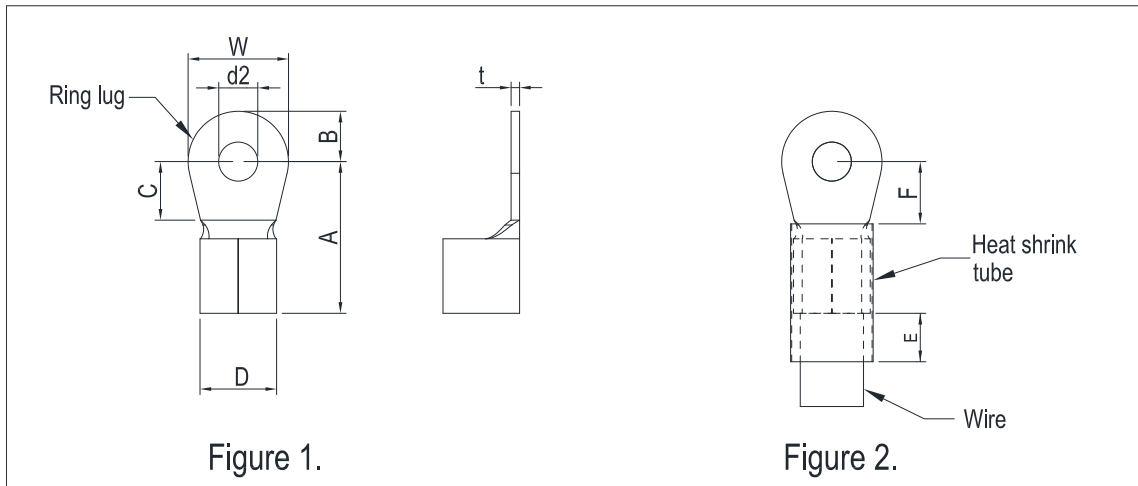
1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600V and temperature resistance of 75°C or 90°C
2. If you install at Ta 45°C above environment, select copper wire with voltage rating of 600V and temperature resistance of 90°C or above.
3. For UL installation compliance, 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	RNEL146	300	100	95	14	62	130	95	185	30
	2	K.S.T	RNES386									

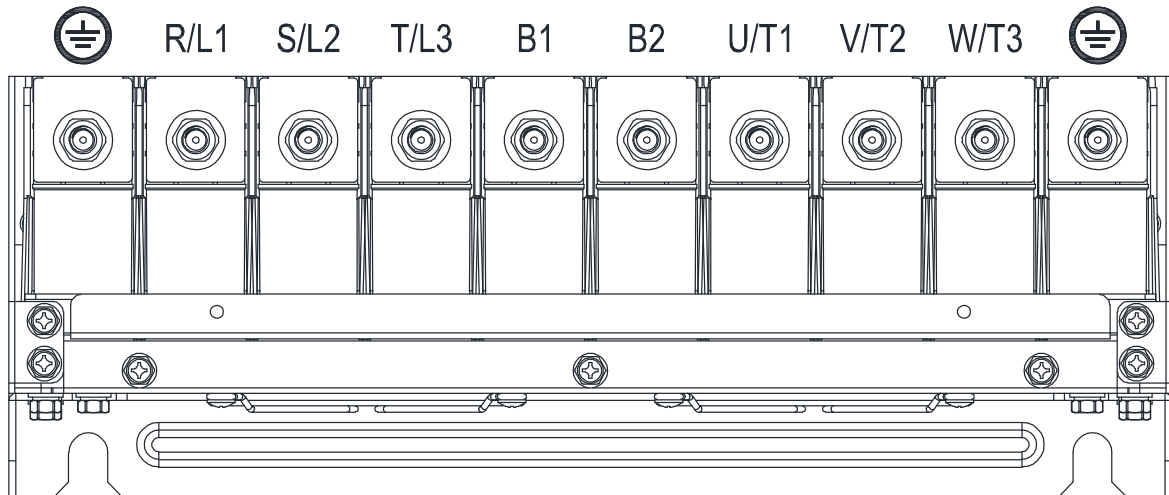
The following additional terminals are required when wiring. The additional terminal dimensions should comply with Figure 1 below.

After crimping the wire to the ring lug (must be UL approved), UL and CSA approved RC (YDFU2), install heat shrink tubing rated at a minimum of 600VAC insulation over the live part. Refer to Figure 2 below.



VJ-C Air Cooled

Frame E4



Models	Main Circuit Terminals R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, DC+, DC-, B1, B2			Grounding Terminal ⊕		
	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)	Max Wire Gauge	Mini Wire Gauge	Screw Size and Torque Force (± 10%)
VFD300L23C-J	120mm ² (40AWG)	70mm ² (20AWG)	M5 180kg·cm (1562lb·in) (1765Nm)	70mm ² (20AWG)	35mm ² (2AWG)	M5 180kg·cm (1562lb·in) (1765Nm)
VFD370L23C-J		120mm ² (40AWG)		120mm ² (40AWG)	70mm ² (20AWG)	
VFD450L43C-J		50mm ² (10AWG)		50mm ² (10AWG)	25mm ² (4AWG)	
VFD550L43C-J		70mm ² (20AWG)		70mm ² (20AWG)	35mm ² (2AWG)	
VFD750L43C-J		120mm ² (40AWG)		120mm ² (40AWG)	70mm ² (20AWG)	

1. If you install at Ta 45°C environment, select copper wire with voltage rating of 600V 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 600V 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

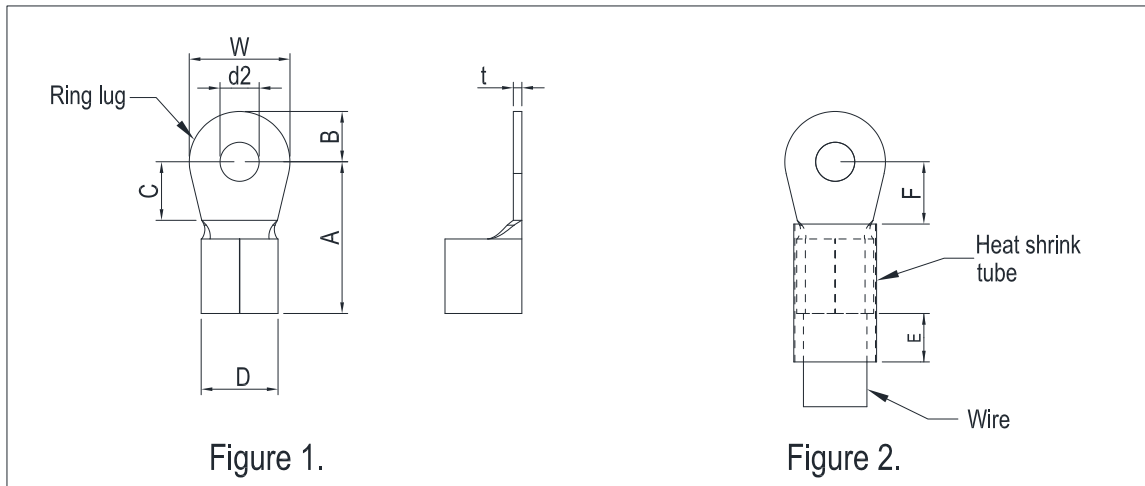
Unit: mm

Frame Size	AWG	Vendor	PN	A (MAX)	B (MAX)	C (MIN)	D (MAX)	d2 (MIN)	E (MIN)	F (MIN)	W (MAX)	T (MAX)
E4	4	KS.T	RNB228	500	160	100	270	83	130	140	280	60
	2	KS.T	RNB338									
	10	KS.T	RNB608									
	20	KS.T	RNB708									
	30	KS.T	RNB808									
	40	KS.T	SQNB1008									

NOTE:

The following additional terminals are needed when wiring. The additional terminal dimensions should comply with Figure 1 below.

After crimping the wire to the ring lug (must be UL approved), UL and CSA approved RC (YDPU2), install heat shrink tubing rated at a minimum of 600VAC insulation over the live part. Refer to Figure 2 below.

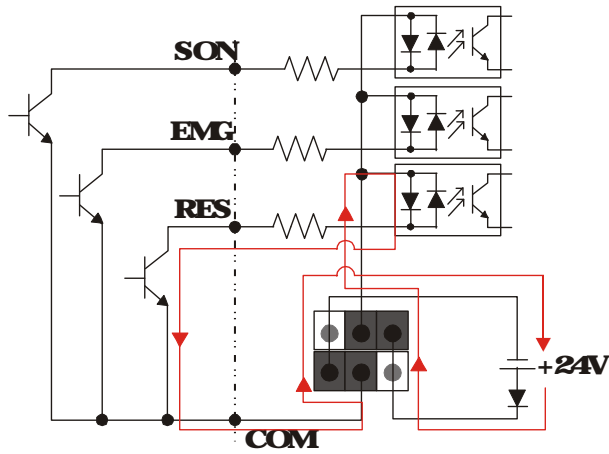


2.3 Description of Terminals on Control Circuit

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

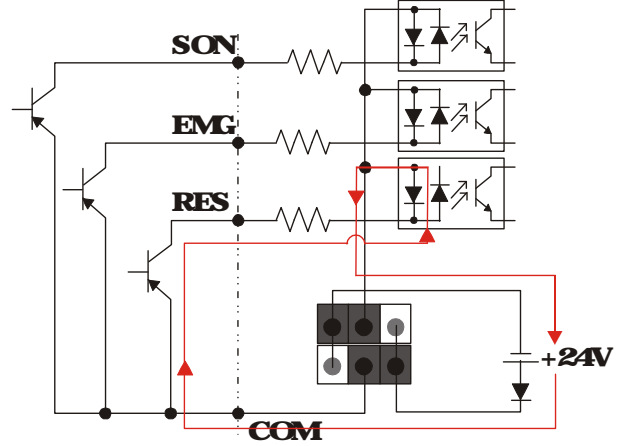
① Sinkmode

uses internal power (+24 Vd)



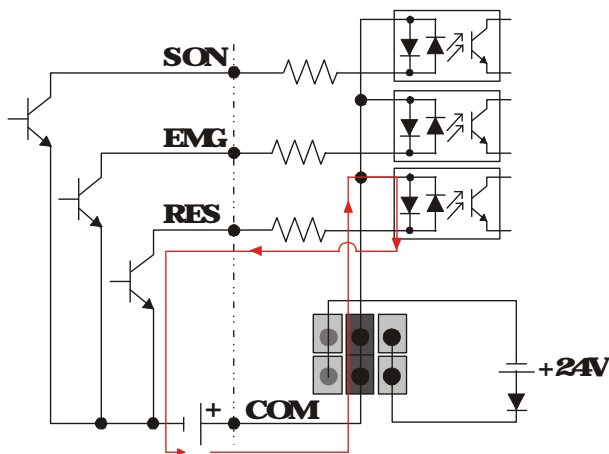
② Source mode

uses internal power (+24 Vd)



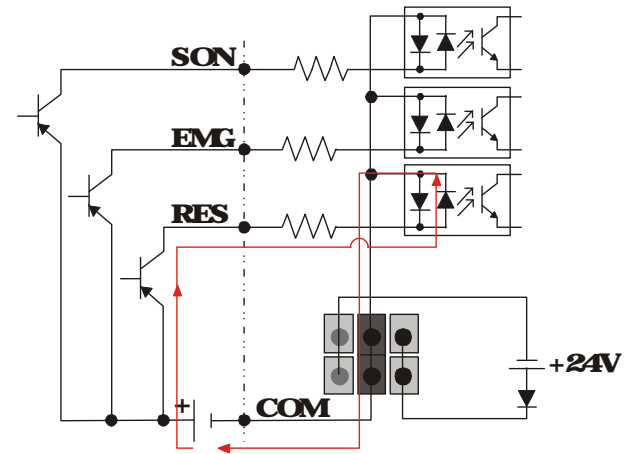
③ Sinkmode

external power +24V



④ Source mode

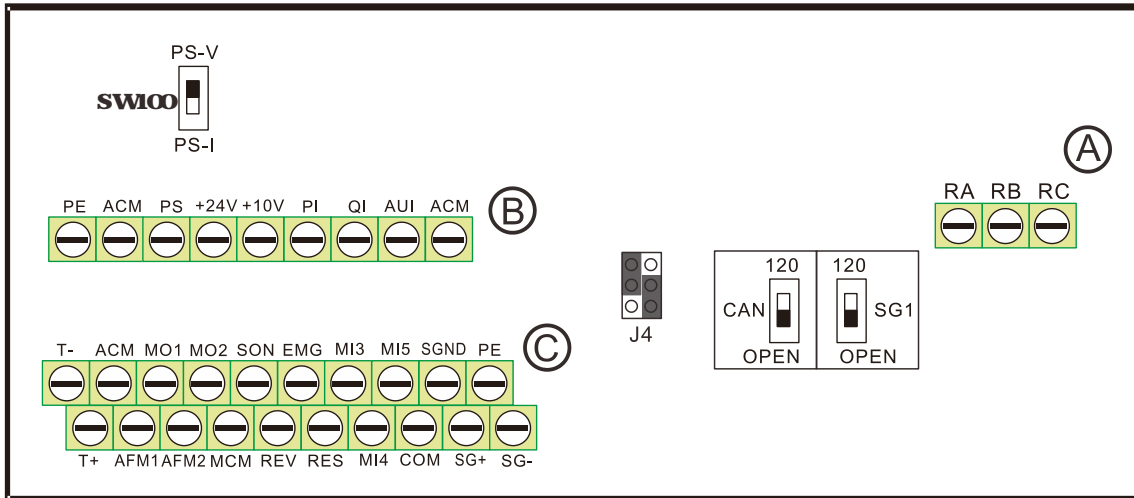
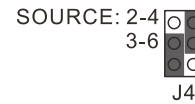
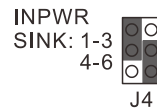
uses external power



External:



Internal:



Items	Wire Gauge					Torque (±10%)
	Group	Conductor	Stripping length	Mini Wire Gauge	Max Wire Gauge	
Control Terminals	A	Solid	6mm	0.2mm ² [24AWG]	3.3mm ² [12AWG]	5g cm [44lb in] [0.5Nm]
		Stranded				
	B	Solid	6mm	0.2mm ² [24AWG]	3.3mm ² [12AWG]	5g cm [44lb in] [0.5Nm]
		Stranded				
	C	Solid	6mm	0.5mm ² [20AWG]	1.5mm ² [16AWG]	8g cm [70lb in] [0.79Nm]
		Stranded				

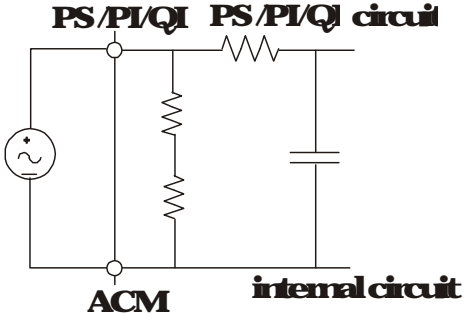
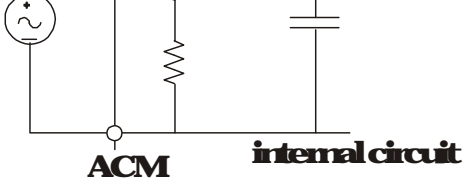
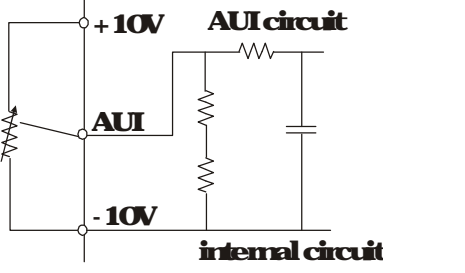
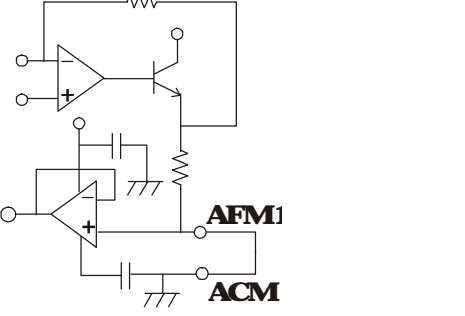
Wiring precautions

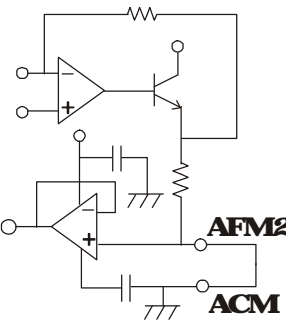
For group A, B, C

1. Tighten the wing with a 35mm (wide) x 0.6mm (thick) slotted screwdriver
2. The ideal length of stripped wire at the connection side is 6-7mm
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	KS.T	E0206	170	80	50	32
24	KS.T	E0806				
16	KS.T	E1506				
12	KS.T	E4009				

Terminal	Features	Factory Setting (NPNMde)	Difference between VJA and VJB
SON	Run/Stop	Terminal SON COM ON for Running OFF for Stop	
EMG	External error input	External error input	
RES	Reset from error	Reset from error	
REV	TBA	TBA	New terminal
M3	Multi-function input selection 3	Configured as no function in factory When it is ON, the input voltage is 24V _{DC} (Max 30V _{DC}) and the input impedance is 375k ; when it is OFF, the tolerable leakage current is 10μA	
M4	Multi-function input selection 4		
M5	Multi-function input selection 5		
COM	Common ground (Sink) for digital control signals	Common ground for multi-function input terminals	
RA	Error terminal 1 (Relay NO. a)	Resistive load 5A(NO)/3A(NC.) 240VAC	
RB	Error terminal 1 (Relay NC. b)	5A(NO)/3A(NC.) 24VDC	
RC	Command contact for multi-function output terminals (Relay)	Inductive load 1.5A(NO)/0.5A(NC.) 240VAC 1.5A(NO)/0.5A(NC.) 24VDC	
MD1	Multi-function output terminal 1 (photocoupler)	The Hybrid servodrive sends various monitoring signals by means of open collector configuration	
MD2	Multi-function output terminal 2 (photocoupler)		
MCM	Common ground for Multi-function output terminal (photocoupler)		Max 48V _{DC} 50mA

Terminal	Features	Factory Setting (NPN Mode)	Difference between VJA and VJB
PS	<p>PS/PI/QI PS/PI/QI circuit</p> 	<p>Pressure feedback Impedance: 20k Resolution 12bits Range: 0~ 10V or 4~ 20mA = 0~ maximum pressure feedback value (Pr0008). Use SW100 switch to input current, see Pr03 12 for more information</p>	<p>Terminal PO</p>
PI	<p>ACM internal circuit</p> 	<p>Pressure Command Impedance: 20k Resolution 12bits Range: 0~ 10V = 0~ the maximum pressure command value (Pr0007)</p>	
QI		<p>Flowrate command Impedance: 20k Resolution 12bits Range: 0~ 10V = 0~ the maximum flowrate</p>	
AUI	<p>Analog Voltage</p> 	<p>Impedance: 11.3k Resolution 12bits Range: -10~ +10V_{DC}</p>	
+10V	<p>Power supply for configuration</p>	<p>Power supply for analog configuration +10V_{DC} 20mA</p>	
+24V	<p>Power supply terminal for the pressure sensor</p>	<p>Power supply for the pressure sensor +24V_{DC} 100mA</p>	
AFM1		<p>Impedance: 192k (voltage output) Output current 20mA max Resolution 0~ 10V corresponding to the pressure feedback Range: 0~ 10V</p>	<p>Terminal AFM</p>

Terminal	Features	Factory Setting (NPNMde)	Difference between VJA and VJB
AFM2		<p>Impedance: 338k (voltage output) Output current: 20mA max Resolution: $\pm 10V$ corresponding to the maximum frequency Range: 10-10V</p>	
ACM	Common ground for analog control signals	Common ground terminal for analog control signals	
T+/T-	Motor's thermal protection terminals	Support K1Y84 130, PIC130 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: 18AWG (0.75mm²), with shielded twisted pair

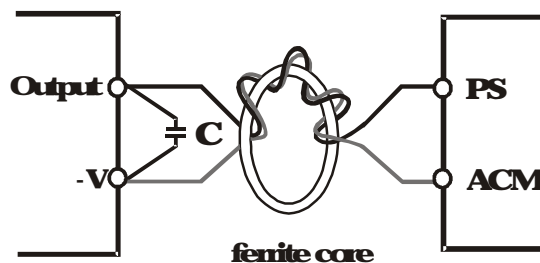
Analog Input Terminals (PS, PI, QI, AUI, ACM)

The maximum input voltage of PI, PS, and QI cannot exceed +12V and no more than +/- 12V for AUI. Otherwise, the analog input function may become ineffective.

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 as indicated in the following diagrams:

wind each wire 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.

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 \oplus 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.

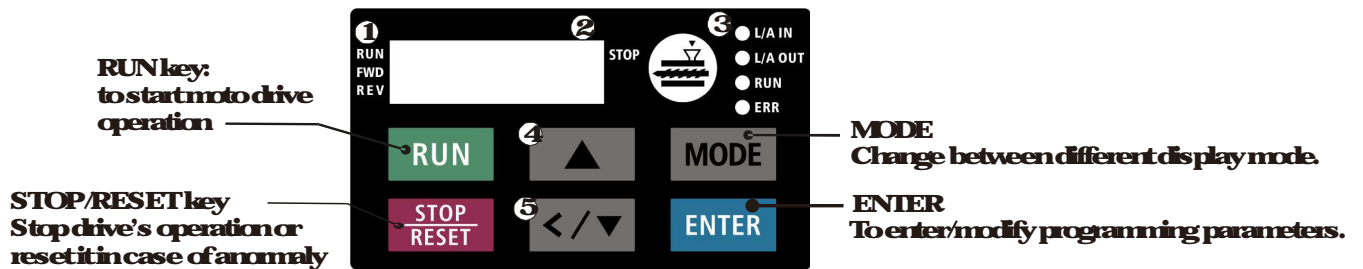


WARNING

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 div'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 ● ● STOP	The current frequency set for the Hybrid servo drive
RUN ● FWD ● REV ● ● STOP	The frequency Hybrid servo drive actually delivers to the motor
RUN ● FWD ● REV ● ● STOP	The user defined physical quantity (Parameter 0004)
RUN ● FWD ● REV ● ● STOP	Load current
RUN ● FWD ● REV ● ● STOP	Forward command
RUN ● FWD ● REV ● ● STOP	Reverse command
RUN ● FWD ● REV ● ● STOP	Displays the selected parameter
RUN ● FWD ● REV ● ● STOP	Display the parameter value
RUN ● FWD ● REV ● ● STOP	Display the external fault

 <p>RUN ● FWD ● REV ●</p>	<p>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</p>
 <p>RUN ● FWD ● REV ●</p>	<p>If the setting data is not accepted or its value exceeds the allowed range, this error message will be displayed</p>

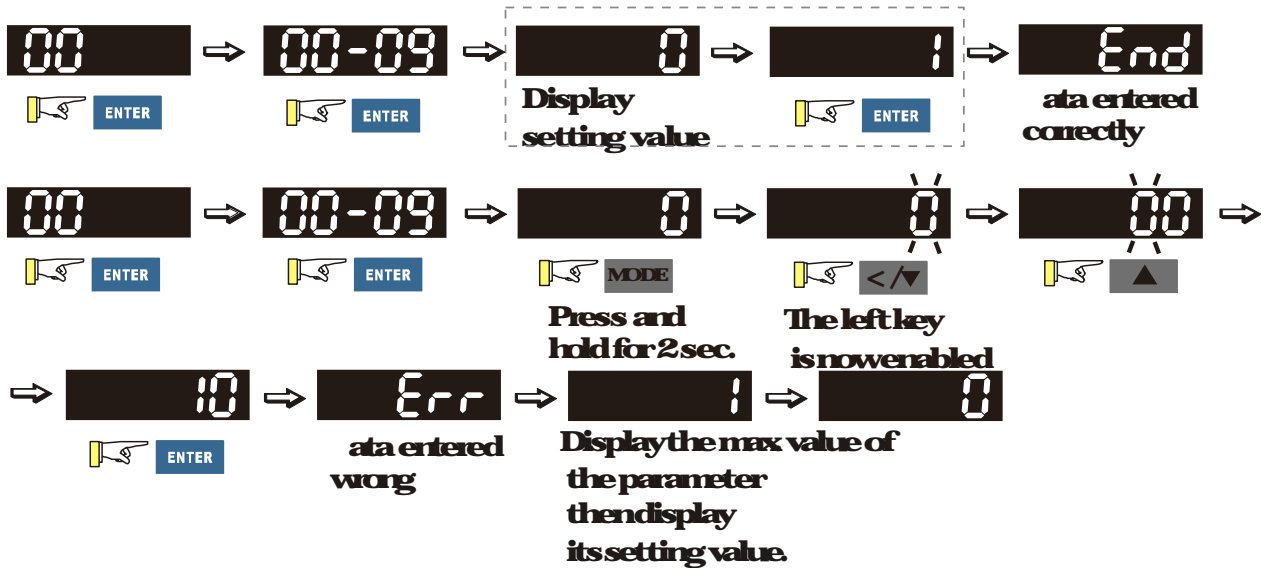
Keypad Panel Operation Procedure

A Selecting Mode



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

Setting Parameters

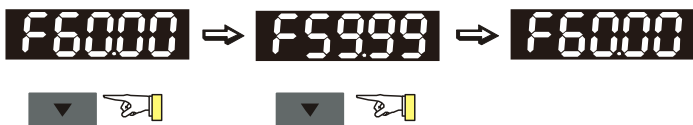


Note: In the parameters setting mode, press MODE to return to the mode selecting

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

Modifying Data

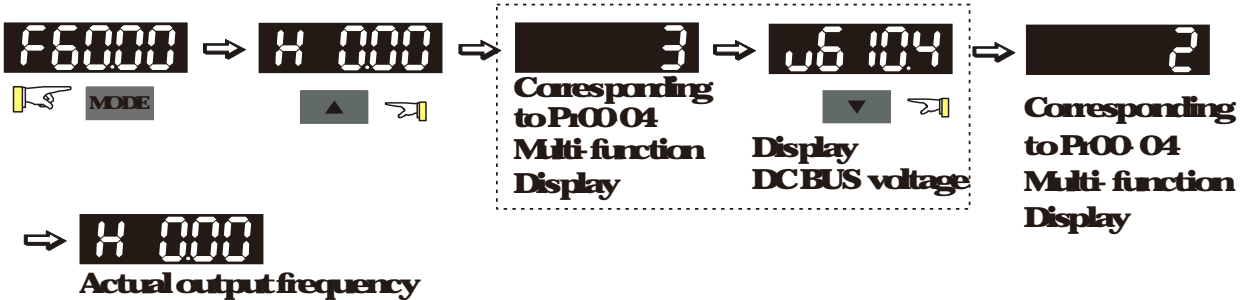


Operating Direction

While the motor drive is controlled from a digital keypad



Multi-Function Display Page



Display Fault/Warning

Display Fault Codes

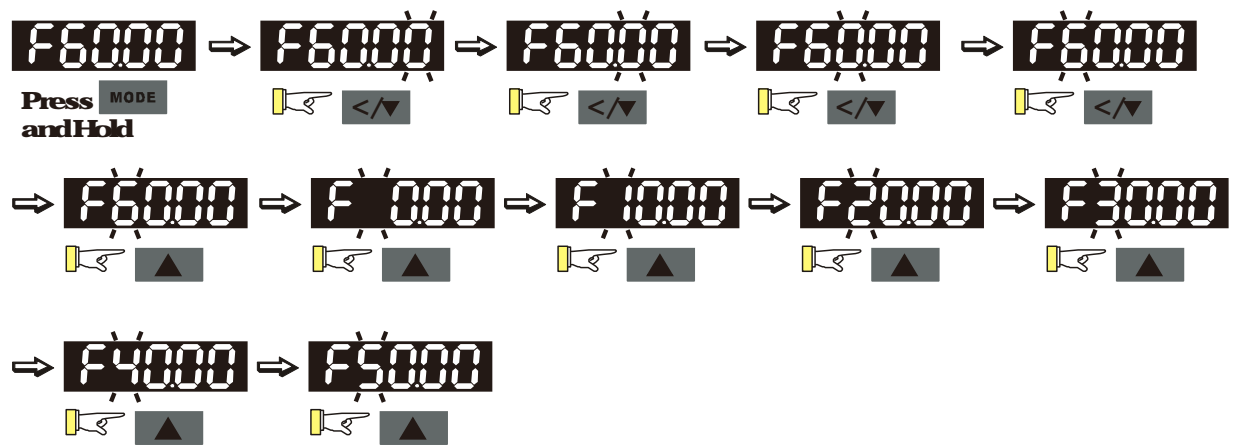
- (1) E 75 ↔ tH 10 Press RESET to clear fault code
- (2) F 72 ↔ bro Repower on to clear fault code

Display Warning Codes

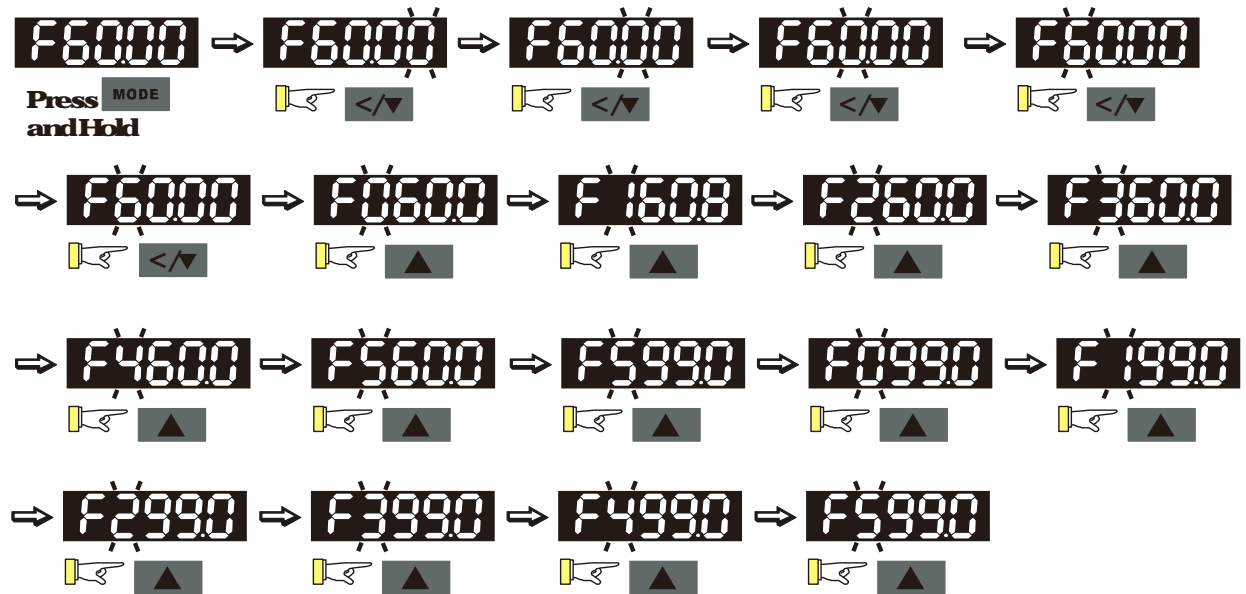


B F page

Normal Mode 1 (Pr01-02 Maximum Frequency has two digits. Example: Pr01-02= 600Hz)



Normal Mode 2 (Pr01-02 Maximum Frequency has three digits. Example: Pr01-02= 599Hz)



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

3.2 Machine Adjustment Procedure

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

Step 1. Enter the motor's parameters

Restore the factory default values by setting the Parameter 0002= 10

Reset parameter settings

Setting value of Pr:0002	10 Reset parameter values
--------------------------	---------------------------

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

If the KP-VJ-LE02 is used, the 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: 0006	0-39999rpm
---------------------------	------------

Set the Parameter 01-02

Motor's maximum operation frequency

Setting value of Pr:01-02	5000- 6000Hz
---------------------------	--------------

Set the Parameter 01-03

Motor's rated frequency

Setting value of Pr:01-03	000- 6000Hz
---------------------------	-------------

Set the Parameters 01-05 & 01-06

Acceleration time setting

Setting value of Pr:01-05	000- 6000seconds
---------------------------	------------------

Deceleration time setting

Setting value of Pr:01-06	000- 6000seconds
---------------------------	------------------

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

Pr: 01-00

Set the 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 the 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 the Parameter 01-29

Number of pulses for each revolution of the encoder

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

Set the Parameter 01-08

The rated current of the induction motor

Setting value of Pr: 01-08	0-655.35Amps
-----------------------------------	---------------------

Set the Parameter 01-09

The rated power of the induction motor

Setting value of Pr: 01-09	000- 655.35kW
-----------------------------------	----------------------

Set the Parameter 01-10

The rated speed (rpm) of the induction motor

Setting value of Pr: 01-10	0-65535
-----------------------------------	----------------

Set the 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 the 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 the Parameter 01-07 as 2. Then carry out the static measurement**

Motor Parameter Auto Tuning

Setting value of 0 No function	
Pr: 01-07	1: Rolling test for induction motor(IM) (Rs, Rr; Lm, Lx, no load current)
	2 Static test for induction motor(IM)
	3 Reserved
	4 Auto measure the angle between magnetic pole and PG origin
	5 Rolling test for PM motor

During the automatic measurement process of the induction motor, the digital keypad will show the message “turi”. 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 the Parameter 01-00 = 3

Control mode

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

Test run

When the motor is in a no load state, the speed command is set to 10rpm for low speed test run. Make sure that the output current value is close to the no load current. From now on, 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 the Parameter 01-00= 5

Control mode

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

Set the Parameter 01-26= 3

Encode type

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

Set the Parameter 01-29

Number of pulses for each revolution of the encoder

Setting value	1-20000
of Pr:01-29	

Set the Parameter 01-17

The rated current of the synchronous motor

Setting value	0-65535Amps
of Pr:01-17	

Set the Parameter 01-18

The rated power of the synchronous motor

Setting value	000- 65535kW
of Pr:01-18	

Set the Parameter 01-19

The rated speed (rpm) of the synchronous motor

Setting value	0-65535
of Pr:01-19	

Set the Parameter 01-20

Number of poles of the synchronous motor

Setting value	2-20
of Pr: 01-20	

Set the Parameter 01-21

The inertia of the synchronous motor's rotor

Setting value of Pr:01-21	00-65535 * 10 ⁴ kgm 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 Rolling test for PM motor

During the automatic measurement process of the synchronous motor, the digital keypad will show the message “turi”. 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 Rolling test for PM 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 10rpm 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.

Step 2 Estimation of Inertia

Set the speed command as 1000rpm

Set the Parameters 01-05 & 01-06= 0.3-0.5 seconds

Acceleration time setting

Setting value of Pr:01-05	0.00- 600.00seconds
---------------------------	---------------------

Deceleration time setting

Setting value of Pr: 01-06	0.00- 600.00seconds
----------------------------	---------------------

Set the 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 the 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 the 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	0-250Bar
---------------------------	----------

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 sensor 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 200(%)

Observe if there is oil leakage

Step 4 Confirm the pressure command and flow command

Parameter 0009 = 1 for pressure control mode

Pressure control mode

Setting value	0 Speed control
of Pr: 0009	1: Pressure control

Parameter 0004 = 12 PI for input voltage

Selection of multi-function display

Setting value	12 display the signal value of the analog input terminal PI with 0-10V
of Pr: 0004	mapped to 0-100%

Parameter 0007 = related pressure value of the pressure command at 10V

Maximum pressure command

Setting value	0-250Bar
of Pr: 0007	

Send the maximum pressure command through the controller and then check the multi-function display page to enter this value into Parameter 0014

Send a half pressure command through the controller and then check the multi-function display page to enter this value into Parameter 0015

Send the minimum pressure command through the controller and then check the multi-function display page to enter this value into Parameter 0016

Example: If the pressure sensor indicates 250bar at 10V. If the maximum pressure on the controller is 140bar and corresponds to 10V, then Parameter 0007 = 140

Set the pressure as 140bar through the controller; the voltage value shown on the display is about 560 ($140/250 * 100\%$). Enter this value into the Parameter 0014

Then set the pressure as 70bar on the controller; and now the value displayed on the keypad panel is about 280 ($70/250 * 100\%$). Enter this value to the Parameter 0015

Then set the pressure as 0bar on the controller; and the voltage value shown on the display is about 00 ($0/250 * 100\%$). Enter this value in the Parameter 0016

Parameter 00 04 = 25 for QI input voltage

Selection of multi-function display

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

Send the 100% flowrate through the controller and then check the multi-function display page to enter this value into Parameter 00 17

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

Send the 0% flowrate 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	0 Speed control
of Pr: 00 09	1: Pressure control

Set the Parameters 01-05 & 01-06 = 0 second

Acceleration time setting

Setting value	000- 60000seconds
of Pr: 01-05	

Deceleration time setting

Setting value	000- 60000seconds
of Pr: 01-06	

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

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

Step 6 Send operation command through the controller

Parameter 01-01 = 1

Source of operation command

Setting value	0 Operation by using the digital keypad
of Pr: 01-01	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 0021, 0023, and 0025) and Kp values to small values (500)

Start the plastic injection operation. The "Target value" is low pressure (50Bar) 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 0010).

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 1000 to 800). 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.

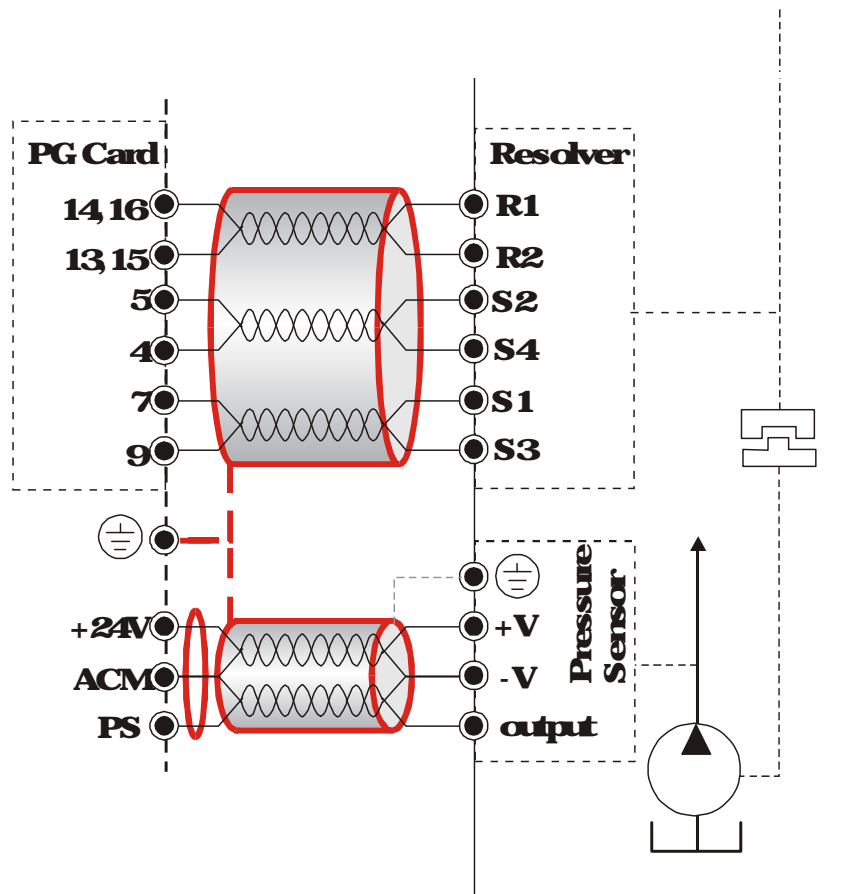
Instability over the entire pressure range

1. Set Parameter 0009 = 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 0007).
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 the Parameter 03 06 = 1

Multifunction Output 2 (MD1)

Setting value of Pr: 03 06	1: Operation indication
-------------------------------	-------------------------

Connect the Master's MD1 output terminal to the Slave's SON terminal and Master's MCM terminal to the Slave's COM terminal

For the firmware version 2.03 and above, it is not necessary to perform the two steps described above

Set the 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 the Parameter 03 14

Slave's proportion of the Master's flow

Setting value of Pr: 03 14	00-65535%
-------------------------------	-----------

For firmware version 2.03 and above, the Parameter 03 17 can be configured to determine the activation level for the Slave

Slave's activation level

Setting value of Pr: 03 17	0-100%
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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

For firmware version 2.03 and above, set the 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 the Parameter 03 15= 1

Source of Frequency Command

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

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 the 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

For firmware version 2.03 and above, the Parameter 03 21 can be set at the Slave to decide if the Slave is performing the reversed operation for depressurization

Note: If it is required to reverse the operation for depressurization at the Slave, it is necessary to make sure that the pump outlet port is not installed with a check valve and the Parameter 03 16 should be set as 500%

Slave reverse operation for depressurization

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

Limit for the Slave reverse depressurization torque

Setting value	0-500%
of Pr: 03 16	

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

Speed Control Mode

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

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

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

Set the Slave for speed control mode

Parameter 00 09 = 0 for speed control mode

Speed Control Mode

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

Respectively set the master/slave multi-function input state. For the firmware version 2.03 and above, it is necessary to set these parameters for the Slave only

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

Multi-function Input

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

Through the controller, perform the entire confluence/diversion operation

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	FOCFM
0000	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			
0001	Display of rated current of the hybrid servo drive	Display the model specific values	Read only			
0002	Reset parameter settings	0 No function 1: Parameter locked 5 Rest the kVhat drive stop 7: Reset CANopen Index 10 Reset parameter values	0			
0003	Software version	Read only	Read only			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
0004	Selection of multi-function display	<p>0 Display the output current (A)</p> <p>1: Reserved</p> <p>2 Display the actual output frequency (Hz)</p> <p>3 Display the DC-BUS voltage (U)</p> <p>4 Display the output voltage (E)</p> <p>5 Display the output power angle (r)</p> <p>6 Display the output power in kW (P)</p> <p>7 Display the actual motor speed rpm (n)</p> <p>8 Display the estimated output torque (%)</p> <p>9 Display the PG feedback (G)</p> <p>10 Reserved</p> <p>11: Display the signal value of the analog input terminal PO % (1)</p> <p>12 Display the signal value of the analog input terminal PI % (2)</p> <p>13 Display the signal value of the analog input terminal AUI % (3)</p> <p>14 Display temperature of the heat sink in °C (t)</p> <p>15 Display temperature of IGBT in °C (T)</p> <p>16 The status of digital input (ON/OFF) (j)</p> <p>17 The status of digital output (ON/OFF) (o)</p> <p>18 Reserved</p> <p>19 The corresponding CPU pin status of the digital input (i)</p> <p>20 The corresponding CPU pin status of the digital output (o)</p> <p>21-24 Reserved</p> <p>25 Display the signal value of the analog input terminal QI % (5)</p> <p>26 Display the actual pressure value (Bar) (b)</p> <p>27 Display the kWh value (K)</p> <p>28 Display the motor temperature (currently only support KIY84) (L)</p> <p>29 Overload rate of hybrid servo drive (d) (unit: %)</p> <p>30 Overload rate of motor with last digit A of HES. (M) (unit: %)</p> <p>31: Display current at braking (A) (unit: A)</p> <p>32 Display temperature of the braking chopper (4) (unit: °C)</p> <p>33 Reserved</p> <p>34 torque constant (K) (unit: KI)</p>	0			
0005	Reserved		0			
0006	Display the speed (rpm) defined by the user	0-39999rpm	2500			
0007	Maximum value of the pressure command	0-400Bar	140			
0008	Maximum pressure feedback value	0-400Bar	250			
0009	Pressure control mode	<p>0 Disable (Speed control)</p> <p>1: Enable (Pressure control)</p>	0			
0010	Speed bandwidth	0-4Hz	20			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
00 11	Pressure feedback filtering time (PS)	0000-1.000second	0000			
00 12	Pressure command filtering time (PI)	0000-1.000second	0000			
00 13	Flowcommand filtering time (QI)	0000-1.000second	0000			
00 14	Percentage for the pressure command value (Max)	00-100%	560			
00 15	Percentage for the pressure command value (Mid)	00-100%	280			
00 16	Percentage for the pressure command value (Min)	00-100%	00			
00 17	Percentage for the flow command value (Max)	00-100%	1000			
00 18	Percentage for the flow command value (Mid)	00-100%	500			
00 19	Percentage for the flow command value (Min)	00-100%	00			
00 20	P gain1	00-10000	500			
00 21	I integration time 1	000-50000seconds	200			
00 22	P gain2	00-10000	500			
00 23	I integration time 2	000-50000seconds	200			
00 24	P gain3	00-10000	500			
00 25	I integration time 3	000-50000seconds	200			
00 26	Pressure stable zone	0-100%	25			
00 27	Minum pressure	00-100%	01			
00 28	Depressuization 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			
00 31	Ramp up rate of flow command	0-1000ms	80			
00 32	Ramp down rate of flow command	0-1000ms	80			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
0033	Valve opening delay time	0-200ms	0			
0034	Reserved					
0035	Over pressure detection level	0-400Bar	230			
0036	Detection of disconnection of pressure feedback	0: No function 1: Enable (only for the pressure feedback output signal within 1-5V and 4-20mA)	0			
0037	Differential gain	00-1000%	00			
0038	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			
0039	I gain of Pressure overshoot 1	000-50000sec	020			
0040	Differential gain 2	00-1000%	00			
0041	Differential gain 3	00-1000%	00			
0042	Pressure overshoot level	0-100%	2			
0043	Maximum Flow	0-100%	100			
0044	Pressure Command	00-4000bar	00			
0045	Flow Rate Command	00-1000%	00			
0046	Pressure reference S1 time	0-1000ms	0			
0047	Pressure reference S2 time	0-1000ms	0			
0048	Flow reference S1 time	0-1000ms	0			
0049	Flow reference S2 time	0-1000ms	0			

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Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
0050	Speed bandwidth2	0-40Hz	20			
0051	Speed bandwidth3	0-40Hz	20			
0052	Overpressure Detecting Time	0000-1.000sec	001			
0053	Oil Shortage Detecting Time	00-600sec	00			
0054	Oil Pump Reverse Running Detecting Time	00-600sec	00			
0055	Minimum Flow	000- 10000%	500			
0056	Oil Shortage Detecting Time at Startup	0~ 10min	5			

01 Motor Parameters

You can set this parameter during operation

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
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 operation 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 operation frequency	5000-59900Hz	16667			
01-03	Motor's rated frequency	000-59900Hz	11333			
01-04	Motor's rated voltage	230V Series: 01V~2550V 460V Series: 01V~5100V	2200 4400			
01-05	Acceleration time setting	000-60000seconds	000			
01-06	Deceleration time setting	000-60000seconds	000			
01-07	Motor Parameter Auto Tuning	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 Static test for SPM motor (Surface mounted permanent magnet synchronous motor) 13 Static test for IPM motor (Interior permanent magnet synchronous motor)	0			
01-08	Rated current of the induction motor(A)	40- 120% of the drive's rated current	###			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
01-09	Rated power of the induction motor	0-65535kW	###			
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	0-65.535	#####			
01-14	Rotor resistance (Rr) of the induction motor	0-65.535	#####			
01-15	Magnetizing inductance (Lm) of the induction motor	00-65535mH	##			
01-16	Total leakage inductance (Lσ) of the induction motor	00-65535mH	##			
01-17	Rated current of the synchronous motor	0-65535Amps	000			
01-18	Rated power of the synchronous motor	000- 65535kW	000			
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	00-65535*10 ⁴ kg/m ²	00			
01-22	Stator's phase resistance (Rs) of the synchronous motor	0000-65.535	0000			
01-23	Stator's phase inductance (Ld) of the synchronous motor	0000-65535mH	000			
01-24	Stator's phase inductance (Lq) of the synchronous motor	0000-65535mH	000			
01-25	Back EMF of the synchronous motor	0-65535 V/krpm	0			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
01-26	Encode type	3 Resolver	3			
01-27	PG Offset angle of synchronous motor	00-3600°	00			
01-28	Number of poles of the resolver	1-5	1			
01-29	Encoder pulse	1-2000	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			

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Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
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%	110%			

02 Protection Parameters

You can set this parameter during operation

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
0200	Software brake level	230V series: 3500-4500V _{dc} 460V series: 7000-9000V _{dc}	3800 7600			
0201	Fault record 1	0 No error record	0			
0202	Fault record 2	1: Over current during acceleration (ocA)	0			
0203	Fault record 3	2 Over current during deceleration (ocD)	0			
0204	Fault record 4	3 Over current during constant speed (ocS)	0			
0205	Fault record 5	4 Ground fault (GFF)	0			
0206	Fault record 6	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 (ovS) 10 Over voltage at stop (ovS) 11: Low voltage during acceleration (LvA) 12 Low voltage during deceleration (LvD) 13 Low voltage during constant speed (LvS) 14 Low voltage at stop (LvS) 15 Phase loss protection (PHL) 16 IGBT over heat (oH1) 17 Heatsink over heat for 40HP and above (oH2) 18 TH1 open IGBT over heat protection circuit error (TH1o) 19 TH2 open heatsink over heat protection circuit error (TH2o) 20 IGBT over heated and unusual fan function (oHF) 21: Hybrid servodrive overload (oL) 22 Motor 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 (oF1) 31: Memory read error (oF2)	0			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
		32 Isuncurrent detection error (cd)				
		33 U-phase current detection error (cd1)				
		34 V-phase current detection error (cd2)				
		35 Wphase current detection error (cd3)				
		36 Clamp current detection error (Hd)				
		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 (Pcode)				
		53 CPU error (cod)				
		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 Communication time out (cE10)				
		59 Reserved				
		60 Baking 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	FOCFM
		69 Oil shortage (noil)				
		70 Reserved				
		71: Overcurrent at Braking chopper (ocbs)				
		72 Braking resistor is open circuit (bro)				
		73 Resistance of braking resistor is too small (brF)				
		74 Braking chopper overheated (cH)				
		75 Error occurred on Brake chopper's thermal protection line (tHb)				
		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)				
		85-100 Reserved				
		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 (CAeE)				
		107 CANopen index is out of range (CFiE)				
0207	Low voltage level	1600-2200V _{dc} 32000-4100V _{dc}	1800 3600			
0208	PTC action selection	0 Warn and keep operation 1: Warn and ramp to stop 2 Warn and coast to stop	1			
0209	PTC level	00-150°C	130			
0210	Reserved					
0211	PTC type	0 Not assigned 1: KTY84 1310 2 PTC130 3 Switch (NC mode)	0			
0212	Motor fan activation level	00-150°C	500			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
02 13	Electronic thermal relay selection 1	0 Inverter motor 1: Standard motor 2 Disable	2			
02 14	Electronic thermal characteristic for motor	300-6000seconds	600			
02 15	Frequency command at malfunction	000-59900Hz	Read only			
02 16	Output frequency at malfunction	000-59900Hz	Read only			
02 17	Output voltage at malfunction	00-65535V	Read only			
02 18	DC voltage at malfunction	00-65535V	Read only			
02 19	Output current at malfunction	0-65535Amps	Read only			
02 20	IGBT temperature at malfunction	-32767-32767°C	Read only			
02 21	Capacitors' Temperature at malfunction	-32767-32767°C	Read only			
02 22	Motor's rotating speed at malfunction	-32767-32767rpm	Read only			
02 23	Torque command at malfunction	-32767-32767%	Read only			
02 24	Input Terminals' Status at malfunction	0~ 65535	Read only			
02 25	Output Terminals' Status at malfunction	0~ 65535	Read only			
02 26	Hybrid servodrive's status at malfunction	0~ 65535	Read only			
02 27	Auto Reset LxXenar	0 Disable, 1: Enable	0			
02 28	Detecting Baking Resistor at startup	0 Disable, 1: Enable	1			
02 29	Baking resistance	00-65535	00			
02 30	Decode the parameter protection with the password	0- 9999	0			
02 31	Set up the parameter protection password	0- 9999	0			

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
0232 ~ 0239	Reserved					

03 Digital/Analog Input/ Output Parameters

You can set this parameter during operation

Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCPM
0300	Multi-function input command 3 (M3)	0 No function 44 Injection signal input	0			
0301	Multi-function input command 4 (M4)	45 Confluence/Diversion signal input 46 Reserved	0			
0302	Multi-function input command 5 (M5)	47 Multi-level pressure PI command 1 48 Multi-level pressure PI command 2 51: Flow rate mode	0			
0303	Digital input response time	0001~ 30000sec	0005			
0304	Digital input operation direction	0 65535	0			
0305	Multi-function output 1 (Relay 1)	0 No function 1: Operation indication	11			
0306	Multi-function Output 2 (MO1)	9 Hybrid servo drive is ready 11: Error indication	0			
0307	Multi-function Output 3 (MO2)	45 Motor fan control signal	0			
0308	Multi-function output Direction	0 65535	0			
0309	Display lowpass filter time on the keypad	0001-65535seconds	0100			
0310	Maximum output voltage for pressure feedback	50-100V	100			
0311	Minimum output voltage for pressure feedback	00-20V	00			
0312	Current/Voltage type pressure sensor selection	0 Current mode 1: Voltage mode	1			
0313	Confluence Master/Slave Selection	0 No function 1: Master 1 2 Slave/Master 2 3 Slave/Master 3	0			
0314	The ratio between slave's flow and master's flow	00-65535.5%	1000			
0315	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	00-1000%	500			
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 0004) 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	FOCFM
0400	Communication address	1~254	1			
0401	COM1 transmission speed	48-1152Kbps	192			
0402	COM1 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			
0403	COM1 time-out detection	00-1000sec	00			
0404	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			
0405	Delay time of communication response	00-2000ms	20			
0406	Main frequency of the communication	000-5990Hz	6000			
0407	Block transfer 1	000-65535	000			
0408	Block transfer 2	000-65535	000			
0409	Block transfer 3	000-65535	000			
0410	Block transfer 4	000-65535	000			
0411	Block transfer 5	000-65535	000			
0412	Block transfer 6	000-65535	000			
0413	Block transfer 7	000-65535	000			
0414	Block transfer 8	000-65535	000			
0415	Block transfer 9	000-65535	000			
0416	Block transfer 10	000-65535	000			
0417	CANopen slave address	0 Disable 1~127	0			

Parameter	Explanation	Settings	Factory Setting	VF	FOOPG	FOCFM
04 18	CANopen speed	0 1 Mbps 1: 500Kbps 2 250Kbps 3 125Kbps 4 100Kbps (Delta only) 5 50Kbps	0			
04 19	CANopen warning record	bit0 CANopen software disconnection 1 (CANopen Guarding Time out) bit 1: CANopen software disconnection 2 (CANopen Heartbeat Time out) bit 3 CANopen SYNC 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 value of CANopen index fails bit 9 The setting value of CANopen address fails bit 10 The checksum value of CANopen index fails	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: Comm 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					

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Parameter	Explanation	Settings	Factory Setting	VF	FOCPG	FOCFM
0424	Communication decoding method	0 Decoding method 1 (20%) 1: Decoding method 2 (60%)	1			

4.2 Description of Parameter Settings

00 System Parameters

You can set this parameter during operation

00-00 Hybrid servo drive model code ID

Control mode VF FOC PG FOC PM

Factory setting Read only

Settings Read only

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

Control mode VF FOC PG FOC PM

Factory setting Read only

Settings Read only

Parameter 0000 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 P0001 can be read out to check if it is the rated current of the corresponding model. Display value of the current value of Parameter 0001 for the related Parameter 0000.

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 FOC PG FOC PM

Factory setting 0

- Settings
- 0 No function
 - 1 Parameter Locked
 - 5 Rest the kW hat drive stop
 - 7 Reset CAN open index
 - 10 Reset parameter values

If it is necessary to restore the parameters to factory setting, just set this parameter to "10".

00-03 Software version

Control mode VF FOC PG FOC PM

Factory setting # ##

Settings Read only

00-04 Selection of multi-function display

Control mode VF FOC PG FOC PM

Factory setting 0

- Settings
- 0 Display the output current (A)
 - 1: Reserved
 - 2 Display the actual output frequency (F) (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 (r00 forward speed; - 00 negative speed) (unit: rpm)	
8	Display the estimated output torque N·m (t00 positive torque; - 00 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	Overload rate of hybrid servodrive, get overloaded at 100% (d) (unit: %)	
30	Overload rate of motor with last digit A of HES, get EOL1 at 100% (M) (unit: %)	
31	Display current at braking (A) (unit: A)	
32	Display temperature of the braking chopper (4) (unit: °C)	
33	Reserved	
34	torque constant (K) (unit: KI)	

This parameter defines the contents to be displayed in the U page of the digital keypad KP-VJ-LE01 (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	0-39999rpm				

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

When the control mode is FOCPM (Pr01-00-5), Pr0006 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 setting up Pr0007 and Pr0008, Pr0014<Percentage for the pressure command value (Max)> and Pr0015<Percentage for the pressure command value (Mid)> will also be modified. However, when the pressure command is bigger than the pressure feedback, Pr0007 cannot be set up. Pr0007 can be set up while the hybrid servo drive is running, but Pr0007 has to be smaller than Pr0008.

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 (Pr0009=1), it is necessary to set both Pr01-05 (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	0-4Hz				

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	0000
Settings	0000-1.000seconds				

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	560
Settings					00-1000%

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

Control mode	VF	FOCPG	FOCPM	Factory setting	280
Settings					00-1000%

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

Control mode	VF	FOCPG	FOCPM	Factory setting	00
Settings					00-1000%

When setting maximum value for the pressure command (Pr:0007) and maximum pressure feedback value (Pr:0008), Percentage for the pressure command value (Pr:0014) and (Pr:0015) will be revised as well; it cannot be set when pressure command is higher than pressure feedback value.

Pr:0007 can be changed when the drive is in operation, but it can be set when Pr:0007 is lower than Pr:0008.

To set these parameters, it is necessary to set Parameter 0009 as 1.

Parameter 0004 = 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 0014.

Send a half pressure command through the controller and then check the multi-function display page to enter this value into 0015.

Send the minimum pressure command through the controller and then check the multi-function display page to enter this value into 0016.

Example: If the pressure sensor indicates 250bar at 10V. If the controller's maximum pressure of 140bar corresponds to 10V, then Parameter 0007 = 140. Set the pressure as 140bar by using the controller; the voltage value shown on the display is about 560 (140/250 * 100%). Enter this value into the Parameter 0014. Then set the pressure as 70bar on the controller; and now the value displayed on the keypad is about 280 (70/250 * 100%). Enter this value to the Parameter 0015. Then set the pressure as 0bar on controller; and the voltage value shown on the keypad is about 00 (0/250 * 100%). Enter this value in the Parameter 0016.

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

Control mode VF FOC PG FOC PM Factory setting 1000
 Settings 00 100%

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

Control mode VF FOC PG FOC PM Factory setting 500
 Settings 00 100%

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

Control mode VF FOC PG FOC PM Factory setting 00
 Settings 00 100%

Set Parameter 0009=1 before setting Pr00 17, Pr00 18 and Pr00 19

Parameter 0004= 25 for Q 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 FOC PG FOC PM Factory setting 500
 Settings 00 1000

00-21 Integration time 1

00-23 Integration time 2

00-25 Integration time 3

Control mode VF FOC PG FOC PM Factory setting 200
 Settings 000- 5000 seconds

00-37 Differential gain

00-40 Differential gain 2

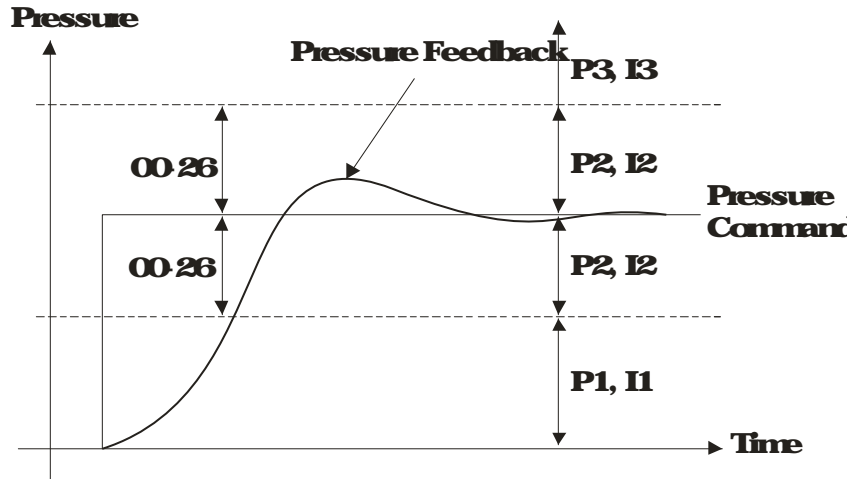
00-41 Differential gain 3

Control mode VF FOC PG FOC PM Factory setting 00
 Settings 00-1000%

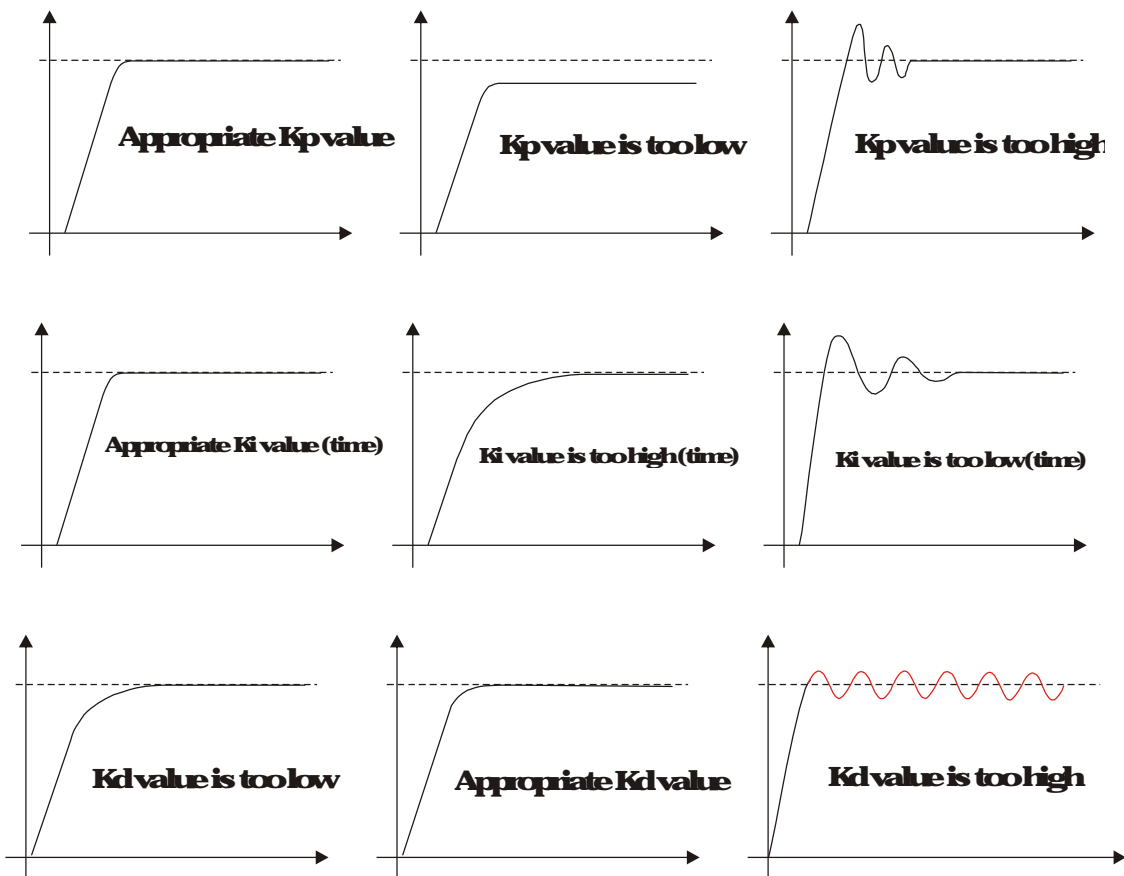
This parameter is functional only when Bit0 and Bit2= 1 at Pr00 38

00-26 Pressure stable zone

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



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



00-27 Minimum pressure

Control mode VF FOC PG FOC PM

Factory setting 01

Settings 00 100%

Set the minimum pressure value 100% corresponding to Parameter 0008

Maintain a minimum pressure to ensure that the oil pipe is 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 FOC PG FOC PM

Factory setting 50

Settings 000~10000%

The setting at P0008 is the setting of P0027 at 100%. The setting at P0102 is the setting of P0055 at 100%.

A minimum pressure must be maintained to ensure the oil circuit is full at all times. This will prevent delay of oil tank activation when receiving a pressure/flow rate command.

00-28 Depressurization speed

Control mode VF FOC PG FOC PM

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 FOC PG FOC PM

Factory setting 0

Settings 0~1000ms

00-30 Ramp down rate of pressure command

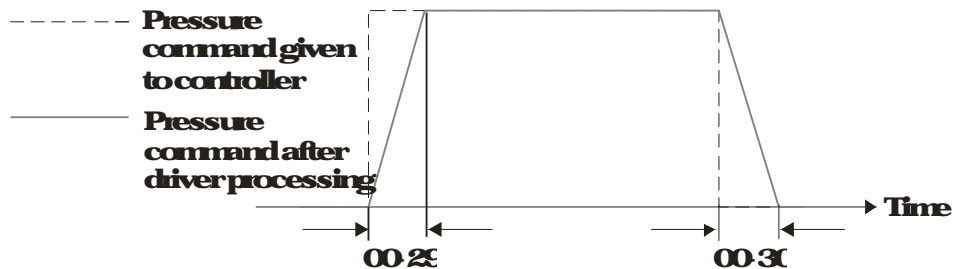
Control mode VF FOC PG FOC PM

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 (0008).



00-31 Ramp up rate of flow command

00-32 Ramp down rate of flow command

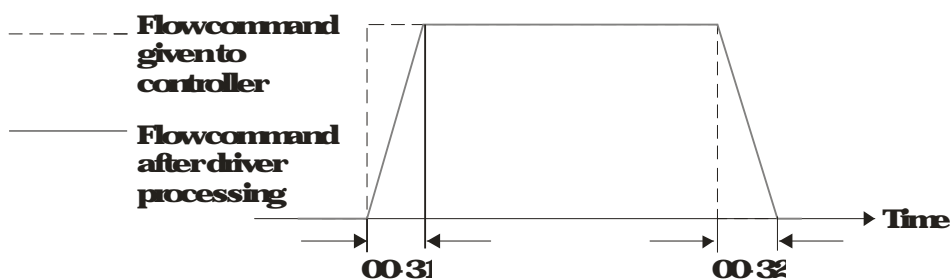
Control mode VF FOC PG FOC PM

Factory setting 80

Settings 0~1000ms

Ramp the flow value for the flow command to reduce the vibration of the machine.

Set the time required for ramping the flow from 0~the maximum flow (01-02).



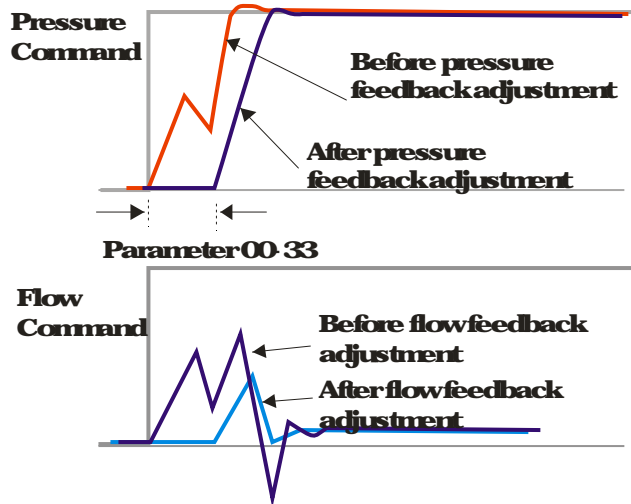
00-33 Valve opening delay time

Control mode VF FOC PG FOC PM

Factory setting 0

Settings 0- 200ms

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



00-34 Reserved

00-35 Over pressure detection level

Control mode VF FOC PG FOC PM

Factory setting 230

Settings 0-400Bar

When the pressure feedback exceeds this parameter setting an "oP over pressure" error message may occur.

From version 2.04 and above, maximum value 400Bar; the previous version's maximum allowed value is 250Bar.

00-52 Detecting time of pressure overshoot

Control mode VF FOC PG FOC PM

Factory setting 0.01

Settings 0.000- 1.000sec

When the pressure feedback is larger than the level set at P0035 and over the time set at P0052, an oP (over pressure) warning code will display.

Warning code: When P0035= 0 disable detection of pressure overshoot

00-36 Detection of disconnection of pressure feedback

Control mode VF FOC PG FOC PM

Factory setting 0

Settings 0 No function

- 1: Enable (only for the pressure feedback output signal within 1-5V and 4-20mA)

When this parameter is set as 1 and if the pressure feedback signal is below 1V or 4mA, an "P16f pressure feedback fault" error message may occur.

00-38 Pressure/flow control function selection

Control mode VF FOC PG FOC PM Factory setting 0

- Settings**
- Bit 0**
0 Switch the PI Gain according to the pressure feedback level and use single speed bandwidth
1: Switch the PI Gain according to the multi-function input terminal
- Bit 1:**
0 No pressure/flow control switch
1: Switch between the pressure and flow control
- Bit 2**
0 Use the old pressure overshoot suppression
1: Use the new pressure overshoot suppression
- 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

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 Bit 2 = 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 Bit 2 = 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 P026) 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 P039 and P042 are used to suppress pressure overshoot.

But when Bit2= 1, the setting at P037 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 (P007)*25%	PI1 (P020 and P021) and P010 Speed Bandwidth	P037
Equal to the maximum value for pressure command (P007)	PI2 (P022 and P023) and P050 Speed Bandwidth	
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 FOC PG FOC PM

Factory setting 02

Settings 000-5000sec

00-42 **Pressure overshoot level**

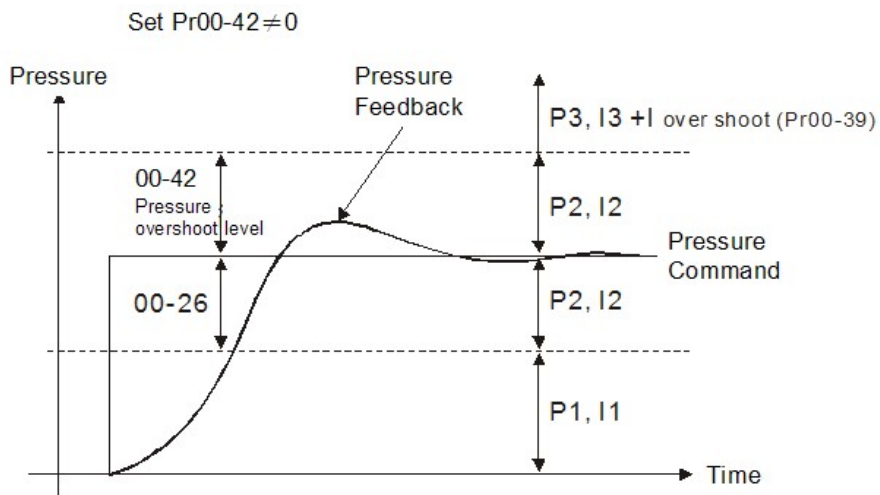
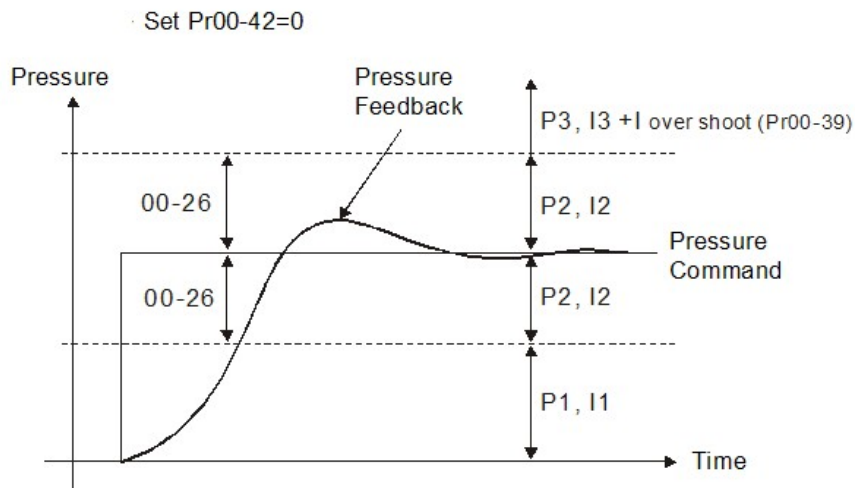
Control mode VF FOC PG FOC PM

Factory setting 2

Settings 0-100%

By using the factory setting 250bar of the P1008 Maximum Pressure Feedback, when the pressure is over 5bar (250*2%=5 bar), another integral time of P10039 will do overshoot protection

When P10038=1 and P10039=0 P10042 is disabled



00-43 **Maximum Flow**

Control mode VF FOC PG FOC PM

Factory setting 100

Settings 0-100%

Setup this parameter to adjust the maximum rotation frequency (maximum flow rate). It is not necessary to stop the hybrid servodrive to setup this parameter. When this parameter is set to be 100%, it corresponds to the maximum rotation frequency of P101-02.

00-44 Pressure Command

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-400bar

00-45 Flow Command

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-100%

When Pr0044 = 0 Pressure Command will not be given by the analog signal but input by Pr0044
 When Pr0045 = 0 Flow Command will not be given by the analog signal but input by Pr0045
 Pr0044 & Pr0045 can be applied in an environment without input of analog signal to do simple test

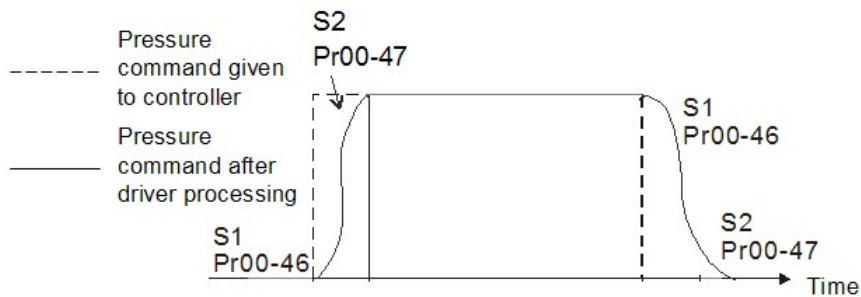
00-46 Pressure reference S1 time

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-1000ms

00-47 Pressure reference S2 time

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-1000ms

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



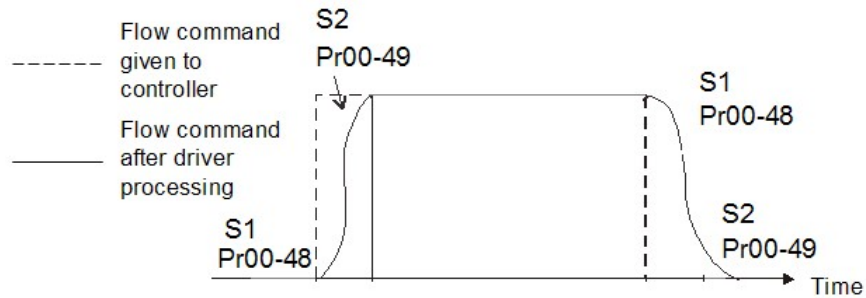
00-48 Flow reference S1 time

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-1000ms

00-49 Flow reference S2 time

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-1000ms

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



00-53 Oil shortage detecting time

Control mode VF FOC PG FOC PM Factory setting 00
 Settings 00~600sec

00-54 Oil shortage detecting time at startup

Control mode VF FOC PG FOC PM Factory setting 5
 Settings 0~10min

When the actual pressure is lower than the minimum pressure (Pr0027) and exceeds the time set at Pr0053 or Pr0056, an oil shortage warning will pop up on the keypad. These two parameters are functional only when Pr0009 (Pressure control mode) = 1. When these two parameters are set to 0, they are disabled. Pr0056 is only functional at startup of the operation. If Pr0056 = 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 'hP' 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 FOC PG FOC PM Factory setting 00
 Settings 00~600sec

When the oil pump runs reversely exceeds the time set at Pr0054, a reverse running warning will pop up on the keypad.

When Pr0054 = 00, this function is disabled.

00-55 Minimum Flow

Control mode VF FOC PG FOC PM Factory setting 500
 Settings 000~10000%

To set the minimum pressure, the 100% of Pr0027 matches the setting at Pr0008 and the 100% of Pr0055 matches the setting at Pr0102.

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.

01 Motor Parameters

You can set this parameter during operation

01-00 Control mode

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

01-01 Source of operating command

Control mode	VF	FOCPG	FOCPM	Factory setting
Settings			0 The operating command is controlled by the digital keypad	0
			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 buttons are enabled

01-02 Motor's maximum operating frequency

Control mode	VF	FOCPG	FOCPM	Factory setting
Settings			5000-59900Hz	16667

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 FOC PGPM (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 (Pr01-02)

$$f = \text{rpm} \times \text{Pole} / 120$$

01-03 Motor's rated frequency

Control mode	VF	FOCPG	FOCPM	Factory setting
Settings			000-59900Hz	11333

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 (P01-03) changes as Rated speed of the synchronous motor (P01-19) and Number of poles of the synchronous motor (P02-120) change.

01-04 Motor's rated voltage

Control mode	VF	FOCPG	Factory setting 2200/400
Settings	230V series: 01 - 255.0V		
	460V series: 01 - 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 0Hz to [the motor's maximum frequency] (P01-02). The deceleration time determines the time required for the hybrid servo motor to decelerate from [the motor's maximum frequency] (P01-02) to 0Hz.

01-07 Motor Parameter Auto Tuning

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

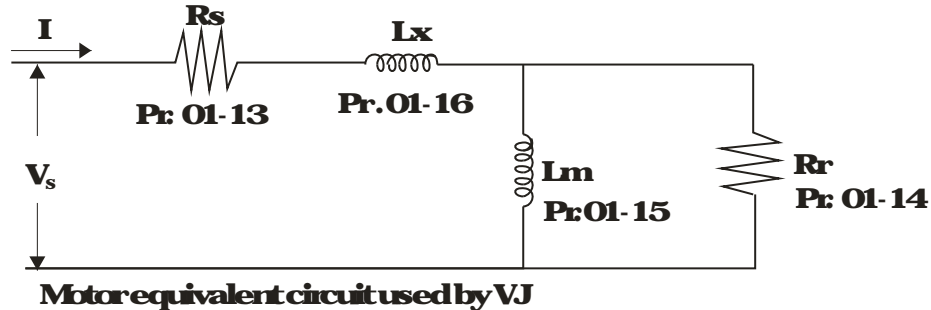
If the parameter is set as 1-2, it will perform the parameter automatic tuning for the Induction motor. In this case, press the [Run] button to perform the automatic measurement operation immediately. After the measurement is complete, the values are filled into Parameters 01-13-16 (no load current,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



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 customer 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- 65535kW	

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 FOC PG Factory setting ###

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

Control mode FOC PG Factory setting ###

Settings 0-65535

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

Control mode FOC PG Factory setting ###

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

Control mode FOC PG Factory setting ###

Settings 00-65535mH

01-17 Rated current of the synchronous motor

Control mode FOC PM Factory setting 000

Settings 0-65535Amps

The user can set the rated current shown on the synchronous motor's nameplate.

01-18 Rated power of the synchronous motor

Control mode FOC PM Factory setting 000

Settings 000- 65535kW

This Parameter sets the rated power of the synchronous motor:

01-19 Rated speed of the synchronous motor

Control mode FOC PM 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 FOC PM 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 FOC PM Factory setting 00

Settings 00-65535*10⁴kgm²

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

Control mode FOC PM Factory setting 0000

Settings 0-65535

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 000
Settings	00-655.35mH	

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

01-25 BackEMF of the synchronous motor

Control mode	FOCPM	Factory setting 0
Settings	0-65535 V/kpm	

Enter the backEMF 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 00
Settings	00-360°	

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	1-2000		

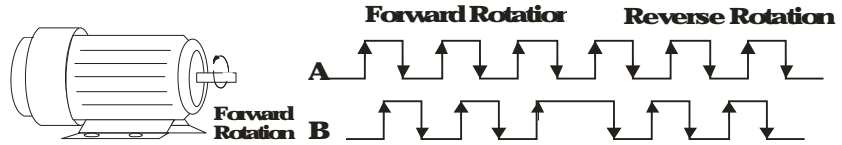
This parameter can be set the encoder's number of pulses per revolution (PPR).

01-30 Encoder's input type setting

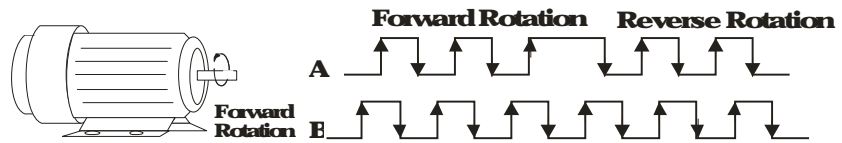
Control mode FOC PG FOC PM Factory setting 1

Settings 0 No function

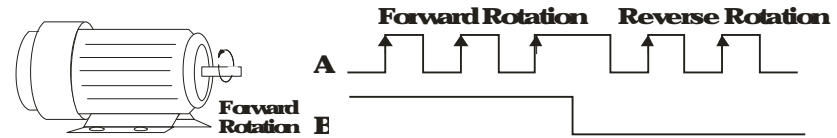
1: Phase A leads in a forward run command and phase B leads in a reverse run command



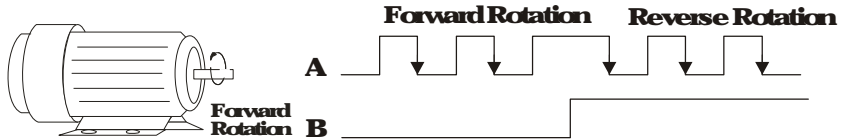
2 Phase B leads in a forward run command and phase A leads in a reverse run command



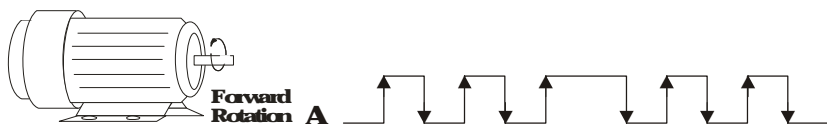
3 Phase A is a pulse input and phase B is a direction input (low input = reverse direction, high input = forward direction).



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 FOC PG FOC PM 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 FOC PG FOC PM Factory setting 260

Settings 1-6535 (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.

01-34 Reserved**01-35** Motor ID

Control mode	FOCPG	FOCPM	Factory setting 0
--------------	-------	-------	-------------------

Settings

	Delta's Hybrid Motor	
0	Disabled	
16	ECMA-ER181BP3	11kW/220V motor
17	ECMA-KR181BP3	11kW/380V motor
18	ECMA-ER221FPS	15kW/220V motor
19	ECMA-KR221FPS	15kW/380V motor
20	ECMA-ER222APS	20kW/220V motor
21	ECMA-ER222APS	20kW/380V motor
125	MSJ-KR133AE4B	30kW/380V motor
216	MSJ-DR201AE42C	10.4kW/220V motor
217	MSJ-IR201AE42C	10.3kW/380V motor
218	MSJ-DR201EE42C	14.6kW/220V motor
219	MSJ-IR201EE42C	14.2kW/380V motor
220	MSJ-DR201E42C	18.4kW/220V motor
221	MSJ-IR201E42C	18.3kW/380V motor
222	MSJ-GR202E42C	23.1kW/220V motor
223	MSJ-CR202E42C	23kW/380V motor
224	MSJ-DR202E42C	27.6kW/220V motor
225	MSJ-IR202E42C	25kW/380V motor
227	MSJ-IR203CE42C	34kW/380V motor
229	MSJ-CR231FE42C	45.2kW/380V motor
231	MSJ-IR235CE42C	52.5kW/380V motor

01-36 Change the rotation direction

Control mode	FOCPG	FOCPM	Factory setting
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.		0

This parameter can be modified only when the whole system is at stop

When applying P01-36 on a synchronous motor, the hybrid servo drives which use firmware

01-37 HES ID#

Control mode FOC PG FOC PM Factory setting 0
 Settings 0: No function

Model	Code	Model	Code	Model	Code
-	-	HES050H3C*	1142	HES063H3C	2142
HES050H23C*	1122	HES063G43A	2040	HES080H3C	3142
HES063H23C	2122	HES063H3A	2140	HES100H3C	4142
HES080H23C	3122	HES080G43A	3040	HES125H3C	5142
HES100H23C	4122	HES080H3A	3140	HES160H3C	6142
HES125H23C	5122	HES100G43A	4040	HES063M3C	2342
HES160H23C	6122	HES100H3A	4140	HES080M3C	3342
HES200H23C	7122	HES100Z43A	4240	HES100M3C	4342
HES250G23C	8022	HES125G43A	5040	HES125M3C	5342
HES063H23A	2120	HES125H3A	5140	HES160M3C	6342
HES080G23A	3020	HES160G43A	6040	HES200M3C	7342
HES080H23A	3120	HES160H3A	6140	HES200H3C	7142
HES100G23A	4020	HES200G43A	7040	HES250M3C	8342
HES100H23A	4120			HES320M3C	9342
HES100Z23A	4220				
HES125G23A	5020				
HES125H23A	5120				
HES160G23A	6020				
HES160H23A	6120				
HES200G23A	7020				

01-38 Maximum Output Voltage

Control FOC PG FOC PM Factory Setting 110%
 Mode
 Settings 0~110%

The maximum output voltage is $(V_{dc} * P101-38) / 2$. 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				Factory setting 3800/7600
Control mode	VF	FOCPG	FOCPM		
Settings		230V series: 3500-4500V _{DC}			
		460V series: 7000-9000V _{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 (ocr)				
4	Ground fault (GFF)				
5	IGBT short circuit (oc)				
6	Over current at stop (ocS)				
7	Over voltage during acceleration (ovA)				
8	Over voltage during deceleration (ovd)				
9	Over voltage during constant speed (ovr)				
10	Over voltage at stop (ovS)				
11	Low voltage during acceleration (LvA)				
12	Low voltage during deceleration (Lvd)				
13	Low voltage during constant speed (Lvr)				
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 (fH1o)				
19	TH2 open heat sink over heat protection circuit error (fH2o)				
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 Is 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 (HI1)**
- 37 Over current detection error (HI1)**
- 38 Over voltage current detection error (HI2)**
- 39 Ground current detection error (HI3)**
- 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 (PcodE)**
- 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 Blaking transistor error (bF)**
- 61-64 Reserved**
- 65 PG card information error (PGF5)**
- 66 Overpressure (oP)**
- 67 Pressure feedback fault (PfbF)**
- 68 Oil pump runs reversely (Prev)**
- 69 Oil shortage (noil)**
- 70 Reserved**

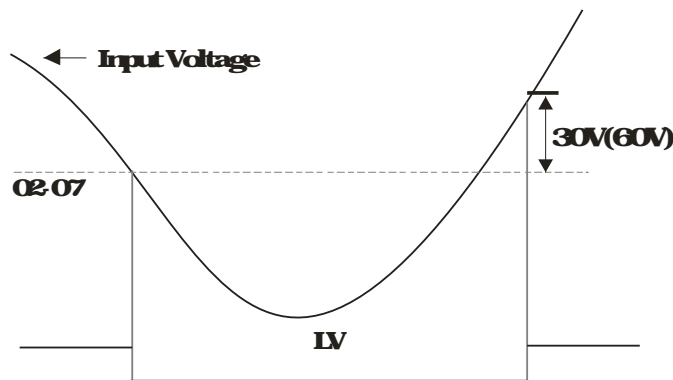
- 71: Overcurrent at braking chopper overflowed (ocbs)
- 72 Braking resistor is open circuit (br)
- 73 Resistance of braking resistor is too small (brF)
- 74 Braking chopper overheated (oH)
- 75 Error occurred on Brake chopper's thermal protection line (tH)
- 76-81: Reserved
- 82 Output Phase Loss on Phase U (oPL1)
- 83 Output Phase Loss on Phase V (oPL2)
- 84 Output Phase Loss on Phase W (oPL3)
- 85- 100 Reserved
- 101: Software error 1 occurred on CANopen (CGdE)
- 102 Software error 2 occurred on CANopen (CHbE)
- 103 Reserved
- 104 Hardware error occurred on CANopen (ChFE)
- 105 Index setting error occurred on CANopen (CIdE)
- 106 Slave # setting error occurred on CANopen (CAeE)
- 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 LxS 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 IV 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 P0208 to define the operation mode of the drive after the PTC is activated.

02-09 PTC level

Control mode	VF	FOCPG	FOCPM	Factory setting	1300
Settings					00-1500°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(NC type)

02-12 Motor fan activation level

Control mode	VF	FOCPG	FOCPM	Factory setting	500
Settings					00-1000% 00-1500°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	600
Settings					300~ 6000seconds

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 Frequency command at malfunction

Control mode	VF	FOCPG	FOCPM	Factory setting	Read only
Settings					000- 5990Hz

02-16 Output Frequency at malfunction

Control mode	VF	FOCPG	FOCPM	Factory setting	Read only
Settings					00- 5990Hz

02-17	Output voltage at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	00-65535V			
02-18	DC side voltage at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	000-65535V			
02-19	Output current at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	000-65535Amp			
02-20	IGBT temperature at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	-32767-32767			
02-21	Capacitors' temperature at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	-32767-32767			
02-22	Motor's rotating speed at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	-32767-32767rpm			
02-23	Torque command at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	-32767-32767%			
02-24	Input terminals status at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	0-65535			
02-25	Output terminals status at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	0-65535			
02-26	Hybrid servo drive status at malfunction			
Control mode	VF	FOCPG	FOCPM	Factory setting Read only
Settings	0-65535			
02-27	Auto reset LxX 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

02-28 Detecting Braking Resistor at startup

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

02-29 Braking resistance

Control mode	VF FOC PG FOC PM	Factory setting	00
Settings	00~6535		

Set P0228=1 (Enable detection of braking resistor at startup), then as soon as the hybrid servo drive is powered on, a checkup will be performed to know if the braking resistance is appropriate and if the braking resistor is working properly.

If the braking resistance is too small, the braking resistor could be on an open circuit or is not properly installed. The error code <br0> will be displayed on the keypad.

If the braking resistance is smaller than the allowable minimum resistance or is on a short circuit, the error code <brF> or <obS> will be displayed on the keypad.

P0229 is the detected braking resistance.

02-30 Decode the parameter protection with the password

Control mode		Factory setting	0
Settings	1~9998		
Display	0-3 times of entering wrong password		

Enter the password set at P0231 into P0230 and then the parameters will be unlocked for modifications. Write down the setting value after you set up this parameter to avoid inconveniences.

Use P0230 and P0231 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 P0231.

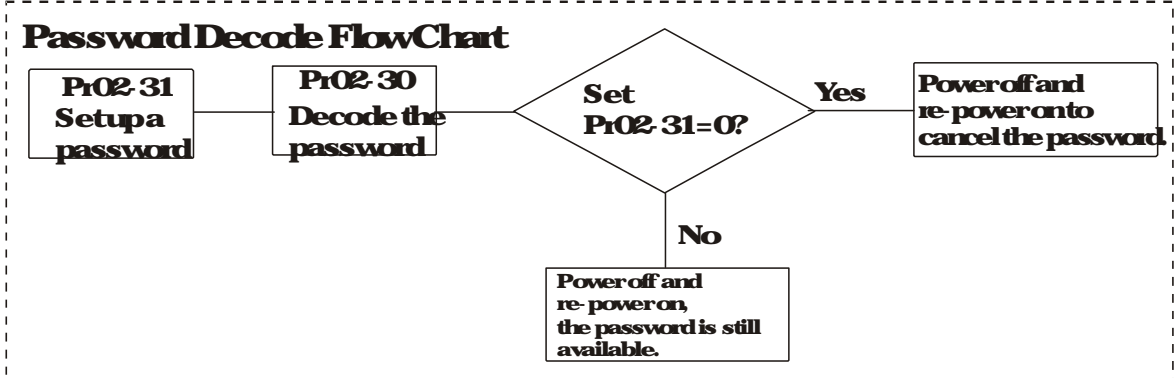
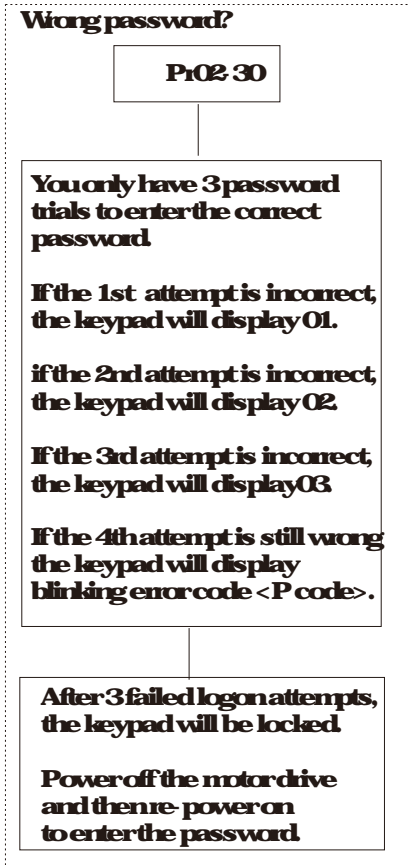
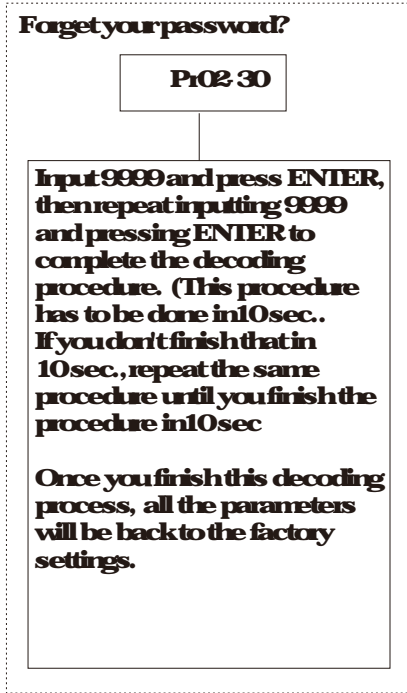
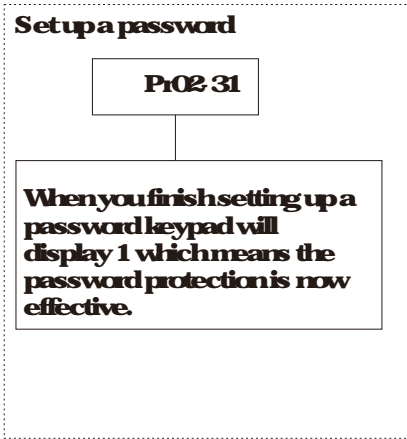
02-31 Setup a parameter protection password

Control mode		Factory setting	0
Settings	1~9998 1000~6535		
Display	0 No password set or password entered successfully in P0230 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 P0230, the hybrid servo drive is temporarily unlocked. To cancel the parameter protection, set P0231=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 P0231 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 P0231 to enable parameter protection.



02-32 ~ 02-39 Reserved

03 Digital/Analog Input/ Output Parameters

You can set this parameter during operation

03-00 Multi-function input command 3 (M3)

03-01 Multi-function input command 4 (M4)

03-02 Multi-function input command 5 (M5)

Control mode	VF	FOCPG	FOCPM	Factory setting
Settings				0
			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 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 0026) 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.

Please refer to the description Parameters 0036 if the setting value is 47 and 48.

When the setting value is 51 and when the pressure control mode is enabled (P0009=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
Settings				0005
				0001~30000sec

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
Settings				0
				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 M3-M5 respectively.

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

Control mode	VF	FOCPG	FOCPM	Factory setting
				11

03-06 Multi-function Output 2 (MO1)

Control mode	VF	FOCPG	FOCPM	Factory setting
				0

03-07 Multi-function Output 3 (MO2)

Control mode	VF	FOCPG	FOCPM	Factory setting
Settings				0
			0	No function
			1	Operation indication
			9	Hybrid servodrive is ready
			11	Error indication
			45	Motor fan control signal

03-08 Multi-function output direction

Control mode VF FOC PG FOC PM Factory setting 0
 Settings 0-65535

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

03-09 Display lowpass filtering time on the keypad

Control mode VF FOC PG FOC PM Factory setting 0010
 Settings 0001-65535 seconds

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

03-10 Maximum output voltage for pressure feedback

Control mode VF FOC PG FOC PM Factory setting 100
 Settings 50-100V

03-11 Minimum output voltage for pressure feedback

Control mode VF FOC PG FOC PM Factory setting 00
 Settings 00-20V

This parameter defines the pressure feedback output voltage.

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

03-12 Current/Voltage mode pressure sensor selection

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

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

The following are required when using it:

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

Set P0312=0 (4-20mA)

Set P0036=1 (Enable detection of the pressure feedback disconnection)

03-13 Confluence Master/Slave Selection

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

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

In a confluence system, the parameter is set as 1 for the Master and 2 for the Slave.

With multi-function input terminal function 45, the confluence/division 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 ratio between slave's flow and master's flow

Control mode	VF	FOCPG	FOCPM	Factory setting	1000
Settings			00-65555%		

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 pumps, 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 Pr0004)		
	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 0004.

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 0316 is set as 500. The maximum reverse running speed is determined by Pr0028 Depressurization speed.

03-22 Slave closing level

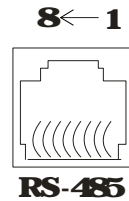
Settings	0- 400Bar	Factory setting 400
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Set up this parameter from a Master. The slave pump(s) will be shut down when the master pump detects the pressure higher than the setting value at this parameter. The slave pump(s) will resume to run after the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

04 Communication Parameters

This parameter can be set during the operation

When using communication devices, connects AC drive with PC by using Delta IFD6530 or IFD6500



- Modbus RS-485
- Pin 1: CAN_H
- Pin 2: CAN_L
- Pin 3: 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 192

Settings 48-1152Kbps

This parameter is for setting up the transmission speed of computer and the hybrid servo drive. Please set 48Kbps, 96Kbps, 192Kbps, 384Kbps, 576Kbps, or 1152Kbps. Otherwise the transmission speed will be replaced by 192Kbps.

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 00

Settings 00-1000sec.

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 Q, 1 for ASCII
- 10) 8 E, 2 for ASCII
- 11) 8 Q, 2 for ASCII
- 12) 8 N, 1 for RIU
- 13) 8 N, 2 for RIU
- 14) 8 E, 1 for RIU
- 15) 8 Q, 1 for RIU
- 16) 8 E, 2 for RIU
- 17) 8 Q, 2 for RIU

Control by PC (Computer Link)

When using RS-485 serial communication interface, each drive must be pre-specified its communication address in Pr: 0900 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: 64Hex, shown as '64' in ASCII, consists of '6' (36Hex) and '4' (34Hex).

1. Code Description

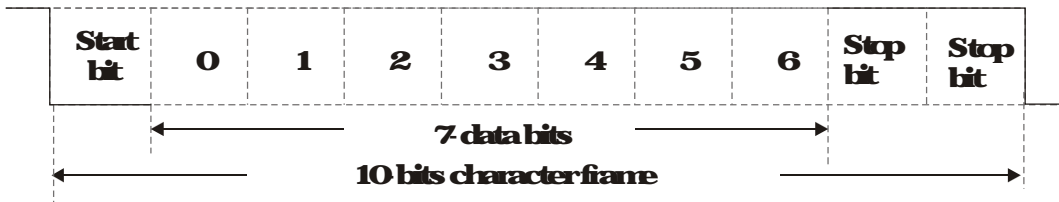
Communication protocol is in hexadecimal, ASCII '0'... '9', 'A'... 'F', every 16 hexadecimal represent ASCII code. For example:

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

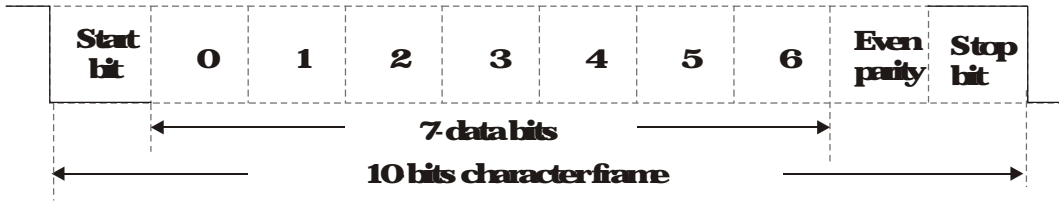
2 Data Format

10 bit character frame (For ASCII):

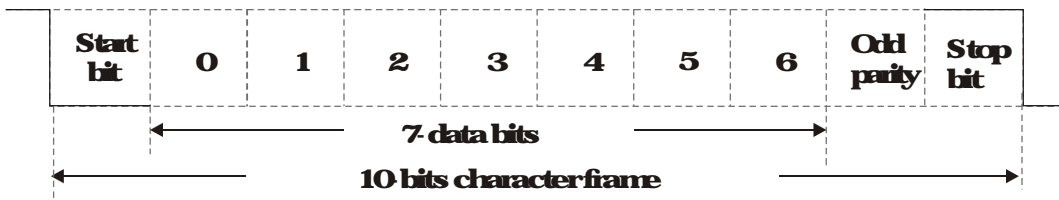
(7, N, 2)



(7, E, 1)

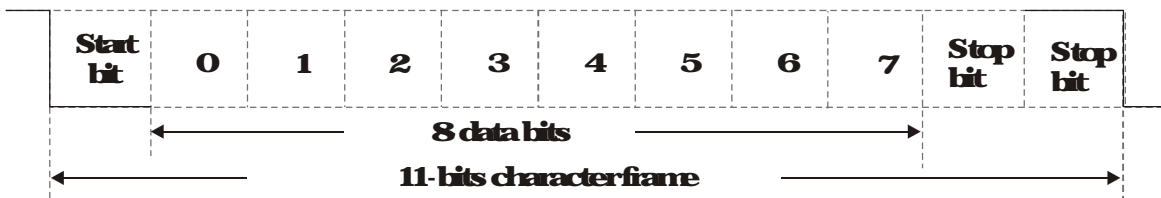


(7, O, 1)

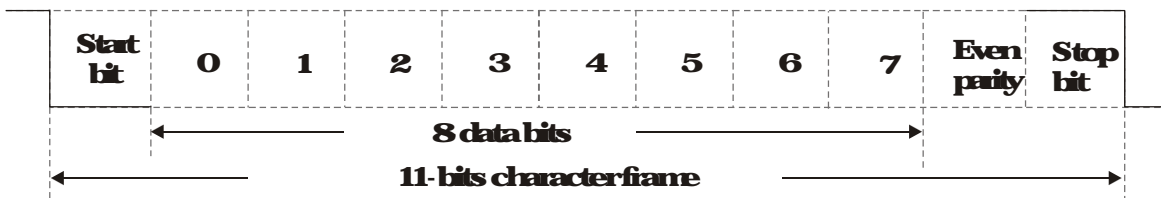


11-bit character frame (For RIU):

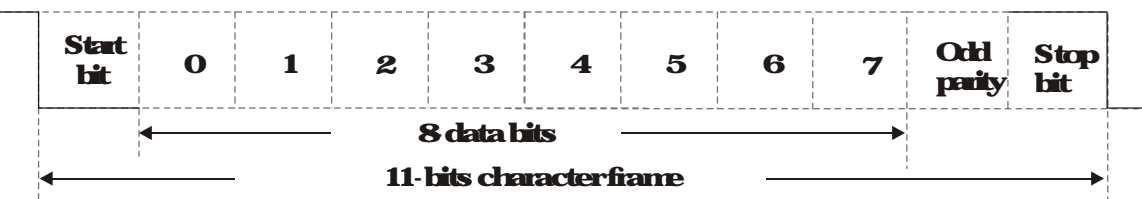
(8, N, 2)



(8, E, 1)



(8, O, 1)



3 Communication Protocol

Communication Data Frame

ASCII mode:

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

RTU mode:

START	Asilent interval of more than 10ms
Address	Communication address: 8bit address
Function	Command code: 8bit command
DATA (n 1)	Contents of data: N× 8bit data, n 16
.....	
DATA 0	
CRC CHK Low	CRC checksum 16bit checksum consists of 28bit characters
CRC CHK High	
END	Asilent interval of more than 10ms

Communication Address (Address)

- 00H broadcast to all hybrid servo drives**
- 01H hybrid servo drive of address 01**
- 0FH hybrid servo drive of address 15**
- 10H hybrid servo drive of address 16**
- :**
- FEH Hybrid servo drive of address 254**

Function code (Function) and DATA (Data characters)

- 03H read data from register**
- 06H write single register**

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

ASCII mode:

Command Message		Response Message	
STX	'?	STX	'?
Address	'0	Address	'0
	'1		'1
Function	'0	Function	'0
	'3		'3
Starting register	'2	Number of register (count by byte)	'0
	'1		'4
	'0		'1
	'2		'7
Number of register (count by word)	'0	Content of starting register 2102H	'7
	'0		'7
	'0		'0
	'2		'0
IRC Check	'D	Content of register 2108H	'0
	'7		'0
	'7		'0
END	CR	IRC Check	'7
	LF		'1
		END	CR
			LF

RTU mode:

Command Message		Response Message	
Address	01H	Address	01H
Function	08H	Function	08H
Starting data register	21H	Number of register (count by byte)	04H
	02H		
Number of register (count by word)	00H	Content of register address 2102H	17H
	02H		70H
CRC CHKLow	6FH	Content of register address 2108H	00H
CRC CHKHigh	F7H		00H
		CRC CHKLow	FEH
		CRC CHKHigh	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	'0'	STX	'0'
Address	'1'	Address	'1'
Function	'0'	Function	'0'
	'6'		'6'
Target register	'0'	Target register	'0'
	'1'		'1'
	'0'		'0'
Register content	'0'	Register content	'0'
	'1'		'1'
	'7'		'7'
	'7'		'7'
IRC Check	'0'	IRC Check	'0'
	'7'		'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 CHKLow	86H	CRC CHKLow	86H
CRC CHKHigh	22H	CRC CHKHigh	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: 0400 = 5000(1388H), Pr: 0401 = 4000(0FA0H)

ASCII Mode

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

RTU mode:

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

Checksum

ASCII mode:

IRC (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 2s-complement negation of the sum

For example:

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

RTU mode:

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

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

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

Step 3: Examine the LSB of CRC register

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

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

Step 6: Repeat step 2 to 5 for the next 8 bit byte of the command message. Continue doing this until all bytes are processed. The final contents of the CRC register are the CRC value. When transmitting the CRC value in the message, the upper and lower bytes of the CRC value must be swapped, i.e. the low 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(L0)=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	GGnH	GG means parameter group, n means parameter number; for example, the address of Pr 04 01 is 0401H		
Command write only	200H	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		
		200IH	Frequency command (Set Pr00 06-0 Input XXXXXHz)	
		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 (XXXXXXHz)		
	2103H	Output frequency (XXXXXXHz)		
	2104H	Output current (XXXXA).		
	2105H	DC-BUS voltage (XXXXV)		
	2106H	Output voltage (XXXXV)		
	2107H	Reserved		
	2108H	Reserved		
	2116H	Multi-function display (Pr00 04)		
	2200H	Display output current (A)		
	2201H	Reserved		
	2202H	Actual output frequency (XXXXXXHz)		
	2203H	DC-BUS voltage (XXXXV)		
	2204H	Output voltage (XXXXV)		
	2205H	Power angle (XXXX°)		
	2206H	Display actual motor speed kW of U, V, W (XXXXXkW)		
	2207H	Display motor speed in rpm estimated by the drive or encoder feedback (XXXXXrpm) (Pr00 04 #7)		
	2208H	Display positive / negative output torque in %, estimated by the motor drive (00 positive torque, -00 negative torque) (XXXX%)		

Content	Register	Function
		(Pr0004 #8)
	2209H	Display PG feedback (Pr 0004 #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 (XXXX°C)
	220FH	Display the temperature of the power capacitor (XXXX°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 (XXXXBar)
	221BH	Display the kWh value (XXXXkWh)
	221CH	Display the motor temperature (XXXX°C)
	221DH	Overload rate of hybrid servo drive (XXXX%)
	221EH	Overload rate of motor with last digit A of HES (XXXX%)
	221FH	Display current at braking (XXXXA)
	2220H	Display temperature of the braking chopper (XXXX°C)

5 Exception response

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

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

Example:

ASCII mode:		RTU mode:	
STX	'0'	Address	01H
Address	'0'	Function	86H
	'1'	Exception code	02H
Function	'8'	CRC CHK Low	C3H
	'6'	CRC CHK High	A1H
Exception code	'0'		
	'2'		
IRC CHK	'7'		
	'7'		
END	CR		
	IF		

The explanation of exception codes:

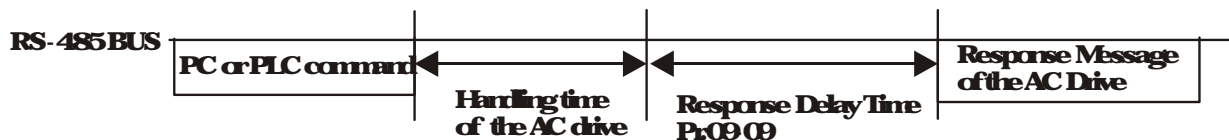
Exception code	Explanation
1	Function code is not supported or unrecognized
2	Address is not supported or unrecognized
3	Data is not correct or unrecognized
4	Fail to execute this function code

04-05 Delay Time of Communication Response

Factory Setting 20

Settings 00-2000ms

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 6000

Settings 000-59900Hz

When Pr: 00 20 is set to 1 (RS-485 communication), The Hybrid servo drive will save the last frequency command at P104 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 P104 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 000

Settings 000-65535

There is a group of block transfer parameter available in the Hybrid servo drive (P04 07 to P04 16). Through communication code 08H, you can use them (P04 07 to P04 16) to save those parameters that you want to read.

04-17 CANopen Slave Address

Factory Setting 0

Settings 0 Disable
1-127

04-18 CANopen Speed

Factory Setting 0

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

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.
bit 10 The checksum value of CANopen indexes fail

04-20 CANopenDecodingMethod

Factory Setting 1

- Settings** 0 Delta defined decoding method
 1: CANopenStandard DS402 protocol

04-21 CANopenCommunicationStatus

Factory Setting Read Only

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

04-22 CANopenControl 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 CommunicationDecodingMethod

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: 200h~20FFh	Refer to address: 600h~ 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

5.1.1 Indicator Display

5.1.2 Error Messages Displayed on Digital Operation Panel KPVJ-LE01

5.2 Overcurrent (OC)

5.3 Ground fault (GFF)

5.4 Overvoltage (OV)

5.5 Low voltage (Lv)

5.6 Overheat (OHI)

5.7 Overload (OL)

5.8 Phase loss in power supply (PHL)

5.9 Resolutions for electromagnetic noise and induction noise

5.10 Environment and facilities for installation

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

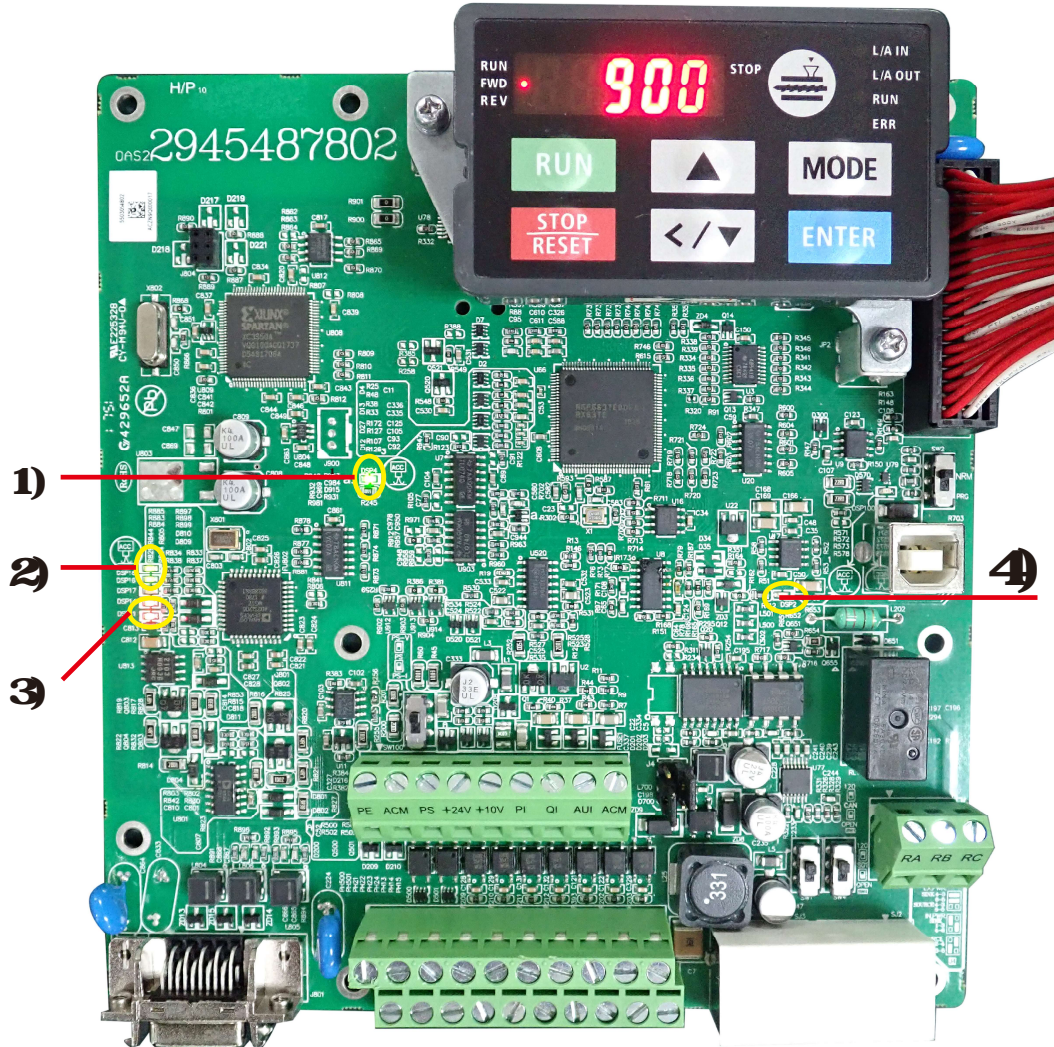


Upon the occurrence of anomaly, wait for five seconds after the anomaly is resolved before pressing the RESET key.

For Hybrid Servo Drives with power $\leq 22\text{kW}$, wait for five minutes after the power is turned off and wait for ten minutes for models with power $> 30\text{kW}$. Verify that the charging indicator is off. Measure the DC voltage between terminals $\oplus \sim \ominus$, which should be below DC 25V 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**












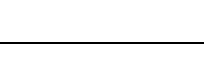
5 1-2 Error Messages Displayed on Digital Operation Panel KPVJ-LE01










Display Code	Description of Anomaly	Troubleshooting
	Overcurrent occurs in acceleration; output current exceeds by three times the rated current of the frequency inverter (ocA)	<p>1. Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad</p> <p>2. Check if the hybrid servo motor is stalled</p>
	Overcurrent occurs in deceleration; output current exceeds by three times the rated current of the frequency inverter (ocd)	<p>1. 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</p> <p>2. When such errors occur at the beginning during or at the end of pressure/ flow command, adjust the pressure/flow reference time (Pr0046- Pr0049). Adjust also the ramp up/down rate of pressure/flow command (Pr0029 to Pr0032) from a dive or the motor drive</p>
	Overcurrent occurs during constant speed; output current exceeds by three times the rated current of the frequency inverter (ocn)	<p>1. When such errors occur while pressure/ flow command is constant; adjust PI value (Pr0020~ Pr0025).</p> <p>2. Make sure if there is any disturbance/ noise, set Pr0004 #11 (Pressure feedback), #12 (Pressure command), 25 (flow command). Then observe if the values fluctuate</p> <p>3. Replace with the Hybrid Servo Drive with larger output capacity</p>
	Ground fault (GFF): Ground wire protection applies when Hybrid Servo Drive detects the output 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	<p>1. Check the wire of hybrid servo motor is shorted or grounded</p> <p>2. Check if IGBT power module is damaged</p> <p>3. Check if the output side wire has bad insulation</p>
	Overcurrent occurs when the system is at stop. Unusual hardware circuit by current detection (ocS)	Send back to manufacturer for repair
	Overvoltage occurs on the internal DC high voltage side detected by Hybrid Servo drive during acceleration (ovA)	<p>230V: DC 415V 460V: DC 830V</p> <p>1. Check if the input voltage is within the range of voltage rating of Hybrid</p>






Display Code	Description of Anomaly	Troubleshooting
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Drive during deceleration (ovd)	Servo Drive and monitor for any occurrence of surge voltage 2 For Hybrid Servo Drive, the issue can be resolved by adjusting the software brake action level in Pr:02:00
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Drive during constant speed	3 When such error occurred at the beginning during or at the end of the pressure/ flow command, adjust Pr:00:29~Pr:00:32 <Ramp up/down rate of pressure/ flow command> or Pr:00:46~Pr:00:49 <Pressure/ flow reference S1/S2 time>. 4 When such error occurred while the pressure/ flow command is constant, adjust Pr:00:20~ Pr:00:25 <PI value>.
	Over voltage occurs when the system is at stop Unusual hardware circuit by current detection (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
	The DC voltage of Hybrid Servo Drive is lower than the setting in Pr:02:07 in acceleration (LVA)	1. Check if the voltage of input power is normal
	The DC voltage of Hybrid Servo Drive is lower than the setting in Pr:02:07 in deceleration (Lvd)	2 Check if there is any sudden heavy load
	The DC voltage of Hybrid Servo Drive is lower than the setting in Pr:02:07 when running at constant speed (Lvn)	3 Adjust the low voltage level in Pr:02:07. 4 Lvn often occurs when the motor drive has a power failure while the operating signals are still being sent
	The DC voltage of Hybrid Servo Drive is lower than the setting in Pr:02:07 when off	
	Phase loss protection	Check if only single phase power is sent or phase loss occurs for three phase models
	Overheating of IGBT detected by Hybrid Servo Drive, exceeding the protection level (oHI)	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





Display Code	Description of Anomaly	Troubleshooting
	Overheating of capacitors detected by Hybrid Servo Drive, exceeding the protection level) (OH2).	<p>for air circulation for Hybrid Servo Drive</p> <ol style="list-style-type: none"> 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
	(OH3 PTC level) Overheating inside the motor drive detected by Hybrid Servo Drive, exceeding the protection level (OH3 PTC level) (OH3).	<ol style="list-style-type: none"> 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
	IGBT overheated and unusual fan function	<p>Check the fan kit to see if it is blocked Return to factory for repair</p>
	Output current exceeds the maximum capacity of Hybrid Servo Drive	<ol style="list-style-type: none"> 1. Check if the hybrid servo motor is stalled 2. Check if the oil pump is stuck 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. Set P0004=29, observe if the value returns to zero after every molding cycle. If the number accumulates to 100 OL occurs. 5. Change the molding conditions. 6. Replace with the Hybrid Servo Drive with larger output capacity
	Servo motor overloaded	<ol style="list-style-type: none"> 1. Set P00-04=30(≥206 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 larger output capacity

Display Code	Description of Anomaly	Troubleshooting
		<p>3 If the pressure-flow is too high during blending, such an error occurs easily. To clear this error, decrease the pressure command and the flow command.</p> <p>Note that this overload protection is only available for version A motors.</p>
	Error on memory write in (cf1)	<p>Press RESET key to return all parameters to factory default values. If the above does not work, send back to manufacturer for repair.</p>
	Error on memory readout (cf2)	
	Detection of abnormal output of three-phase total current (cd)	<p>Turn off the power and restart. If the same problem persists, send back to manufacturer for repair.</p>
	Detection of abnormal current in phase U (cd1)	
	Detection of abnormal current in phase V (cd2)	
	Detection of abnormal current in phase W (cd3)	
	When external terminals EF are closed, Hybrid Servo Drive stops its output (EF)	Troubleshoot and press 'RESET'
	When external EMG terminal is not connected to the heating switch of hybrid servo motor or the motor is overheated (130°C), Hybrid Servo Drive stops its input (EF1)	Troubleshoot and press 'RESET'
	Braking transistor error	Press RESET. If the display still shows 'bf', please send the unit back to manufacturer for repair.

Display Code	Description of Anomaly	Troubleshooting
	Abnormal in OH1 hardware wire	Send back to manufacturer for repair
	Abnormal in OH2 hardware wire	Send back to manufacturer for repair
	Clamp current detection error (H0)	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair
	Over current detection error (H1)	
	Over voltage detection error (H2)	
	Ground current detection error (H3)	
	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
	PG feedback loss (PGF2)	Check the PG feedback wiring. It could be an open circuit.
	Stalled PG feedback (the actual rotating speed is 115% faster than the maximum speed and the elapsed time longer than one second)	1. Check the PG feedback wiring. 2. Check if PI gain and the settings for acceleration/ deceleration are suitable.
	PG slip error (PGF4)	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). 4. Check if the connection between oil pump and motor is stuck. 5. Send back to manufacturer for repair.
	PG card information error (PGF5)	Check if the settings of Pr:01-26 match those in the installed PG card. If so, please send back to manufacturer for repair.
	Overpressure (ovP)	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. Check if the wiring of pressure

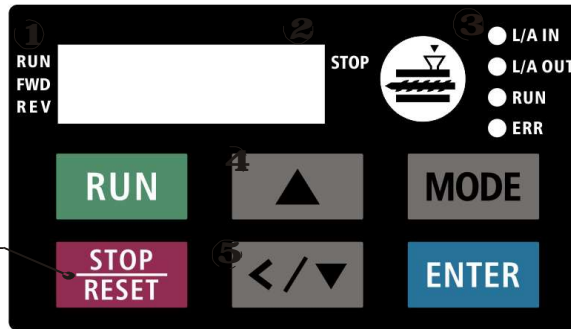
Display Code	Description of Anomaly	Troubleshooting
		<p>sensor is connect</p> <p>3 Check the position of SW100 dp switch (current type or open collector) on the control board if connect</p>
	Pressure feedback fault (PF6F)	<p>1 Check if the wiring of pressure sensor is connect. It could be open circuit.</p> <p>2 Check if the pressure sensor signal is below 1V.</p>
	Auto tuning error (AUE)	<p>1 Check if the wiring of the motor is connect</p> <p>2 Check if the motor's parameter settings are connect</p>
	Oil pumps reversely (PrEv)	<p>1 Check if there's any zero shift at the pressure sensor</p> <p>2 Check if the wiring of pressure sensor is connect</p>
	Oil shortage (noIL)	<p>1 Check the amount of oil in the oil tank</p> <p>2 Check if any leakage at hydraulic circuit</p> <p>3 If there's a suction filter installed at the oil inlet, check if that suction filter is blocked up</p>
	Overcurrent at braking chopper (ocbS)	<p>1 Check if the braking chopper is short circuit?</p> <p>2 Is the resistance value too small?</p> <p>3 Send back to manufacturer for repair</p>
	Braking resistor is open circuit (brO)	Check if the braking resistor is open circuit or properly wired?
	Braking resistor's resistance value is too small (brF)	Check if the resistance value big enough?
	Braking chopper overheated (oH4)	<p>1 Check if there are too many times of deceleration and pressure releasing during formation period?</p> <p>2 Modify formation period</p>
	Error occurred on braking chopper's thermo protection line (th4o)	Send back to manufacturer for repair

Display Code	Description of Anomaly	Troubleshooting
	Output Phase Loss on Phase U (oPL1)	Check the wiring of motor to see if any loose or broken wires.
	Output Phase Loss on Phase V (oPL2)	Check if the resistance of each phase is the same
	84 Output Phase Loss on Phase W(oPL3)	<ol style="list-style-type: none"> 1. Use an ammeter 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. 2. Choose a motor and a motor drive which are compatible with each other.
	Software error 1 occurred on CANopen (CGdE) (CANopen guarding error)	<ol style="list-style-type: none"> 1. Increase guarding time (Index 100). 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.
	Software error 2 occurred on CANopen (CHbE) (CANopen heartbeat error)	<ol style="list-style-type: none"> 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

Display Code	Description of Anomaly	Troubleshooting
		resistor 5 Check the status of communication cable or change new cable
	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
	Index setting error occurred on CANopen (C1dE) (CANopen index error)	Reset CANopen Index (Pr00 02=7)
	Slave # setting error occurred on CANopen (CAde)	Disable CANopen (Pr04 17=0) Reset the station address (Pr04 17)
	CANopen is Index is Out of Range (CFrE) CANopen (CANopen memory error)	Disable CANopen (Pr04 17=0) Reset the station address (Pr04 17)

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

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



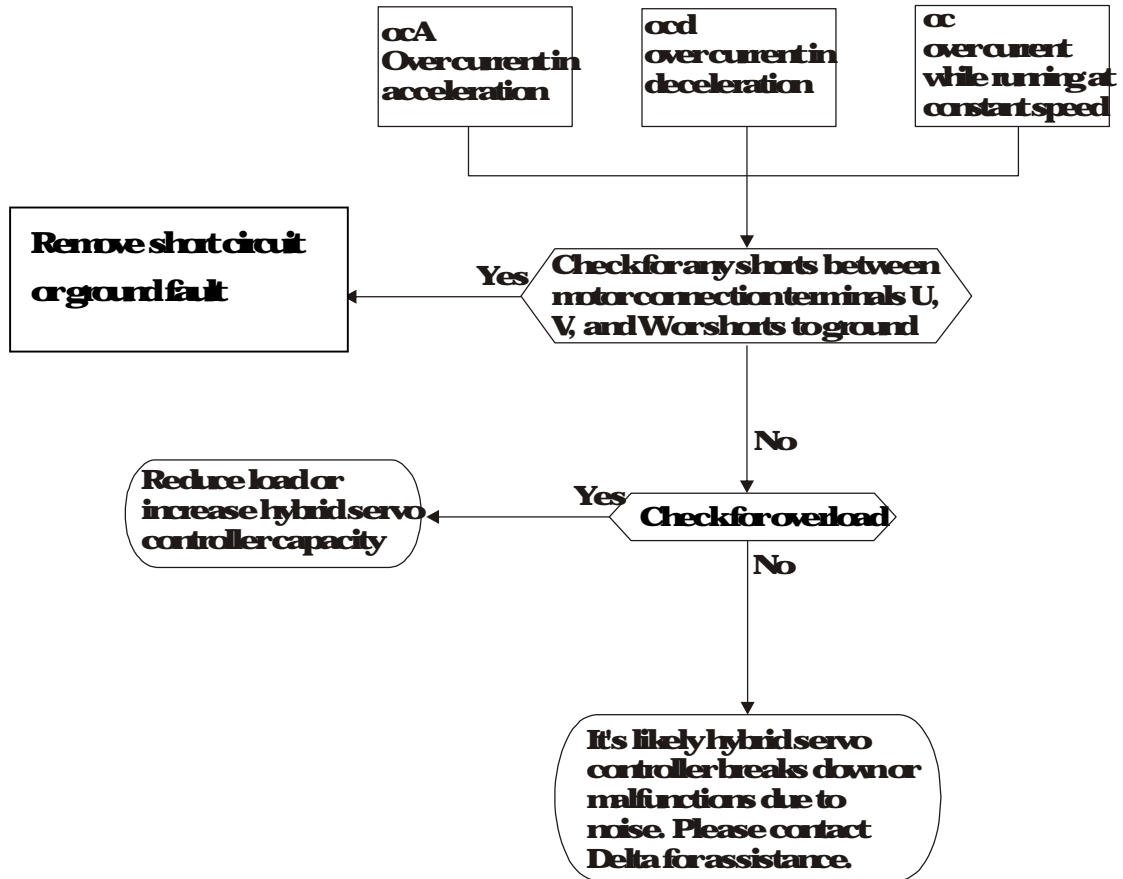
5 1-3 Warning Codes

IDNo.	Display	Descriptions
1	CE 1	Mdbus function code error (Illegal function code) Conective Actions Check if the function code is correct (Function code must be 03 06 10 63)
2	CE 2	Mdbus data address is error (Illegal data address (00H to 254H)) Conective Actions Check if the communication address is correct
3	CE 3	Mdbus data error (Illegal data value) Conective Actions Check if the data value exceeds maximum/minimum value.
4	CE 4	Mdbus communication error (Data is written to read only address) Conective Actions Check if the communication address is correct
5	CE 10	Mdbus transmission time-out
6	CP 10	Keypad transmission time-out
7	SE 1	Keypad COPY error 1 Keypad simulation error; including communication delays, communication error (keypad receives error FF86) and parameter value error
8	SE 2	Keypad COPY error 2 Keypad simulation done, parameter writes error:
9	OH 1	IGBT is over heated than protection level 95°C Conective 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 Check the fan and clean it Provide enough spacing for adequate ventilation

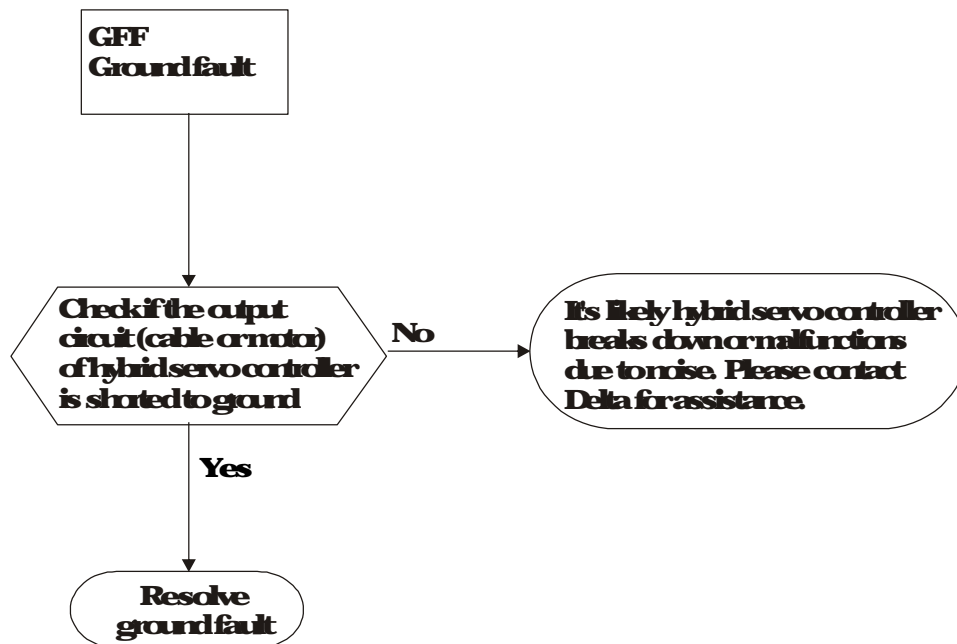
IDNo.	Display	Descriptions
10		<p>Motor drive is over heated than protection level 95°C. This warning code is ONLY for frame E, NOT for other frames.</p> <p>Corrective Actions</p> <ul style="list-style-type: none"> Ensure that the ambient temperature falls within the specified temperature range. Make sure that the ventilation holes are not obstructed Remove any foreign objects from the heat sink and check for possible dirt in heat sink Check the fan and clean it Provide enough spacing for adequate ventilation
11	Pld	<p>PID feedback loss</p>
14	RUE	<p>Motor parameters auto tuning error</p> <p>Corrective Actions</p> <ul style="list-style-type: none"> Check if motor wiring is correct Check if motor capacity and parameters are correct
15	PGFb	<p>PG feedback error</p> <p>Corrective Actions</p> <ul style="list-style-type: none"> Check if the encoder's wiring is correct Check if PG cards red light is on because of some interferences.
17	oSPd	<p>Overspeed warning</p>
18	dRUE	<p>Overspeed deviation warning</p>
19	PHL	<p>Input Phase Loss</p>
22	oH3	<p>Motor over heating</p>
24	oSL	<p>Overslip</p>
25	tUn	<p>Auto tuning processing</p>
26		<p>Cooling fan jammed</p> <p>Corrective Actions</p> <ul style="list-style-type: none"> Check if the cooling spins or not Clean the cooling fan

IDNo.	Display	Descriptions
27		Building pressure on startup
28	oPHL	Output Phase Loss
36	[Cdn	Software error 1 occurred on CANopen
37	[Hbn	Software error 2 occurred on CANopen (CHE)
38	[Syn	CANopen Synchronization off
39	[bFn	CANopen bus off
40	[Cdn	CANopen index error
41	[Adn	CANopen station address error
42	[Fnn	CANopen memory error
43	[Sdn	CANopen SDO transmission time out
44	[Sbn	CANopen SDO received register overflow
45	[btn	CANopen boot up fault
46	[Ptn	CANopen protocol format error

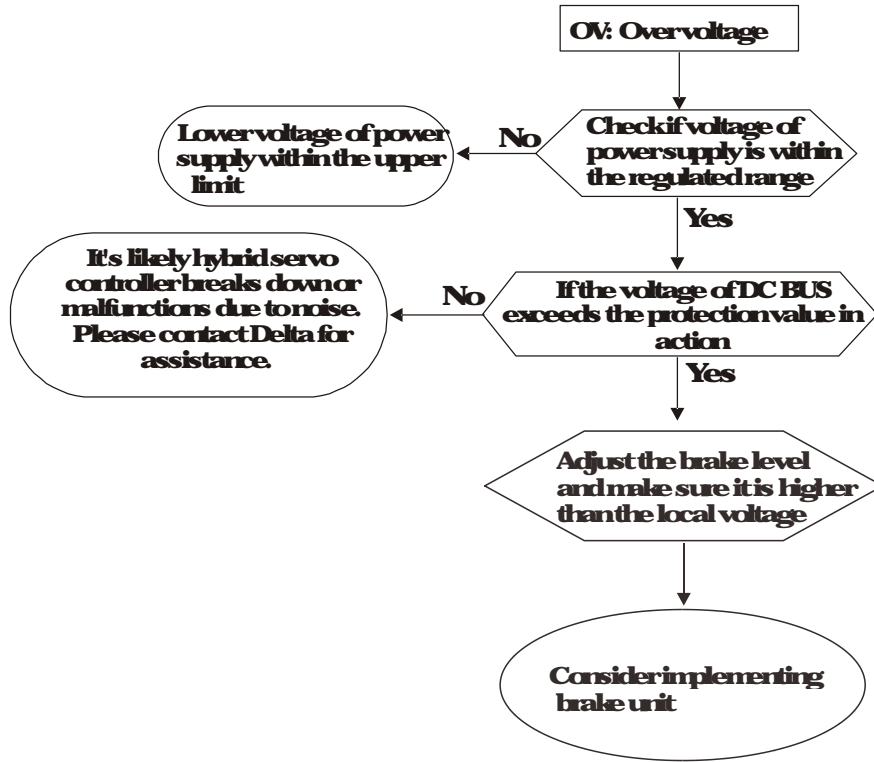
52 Over Current (OC)



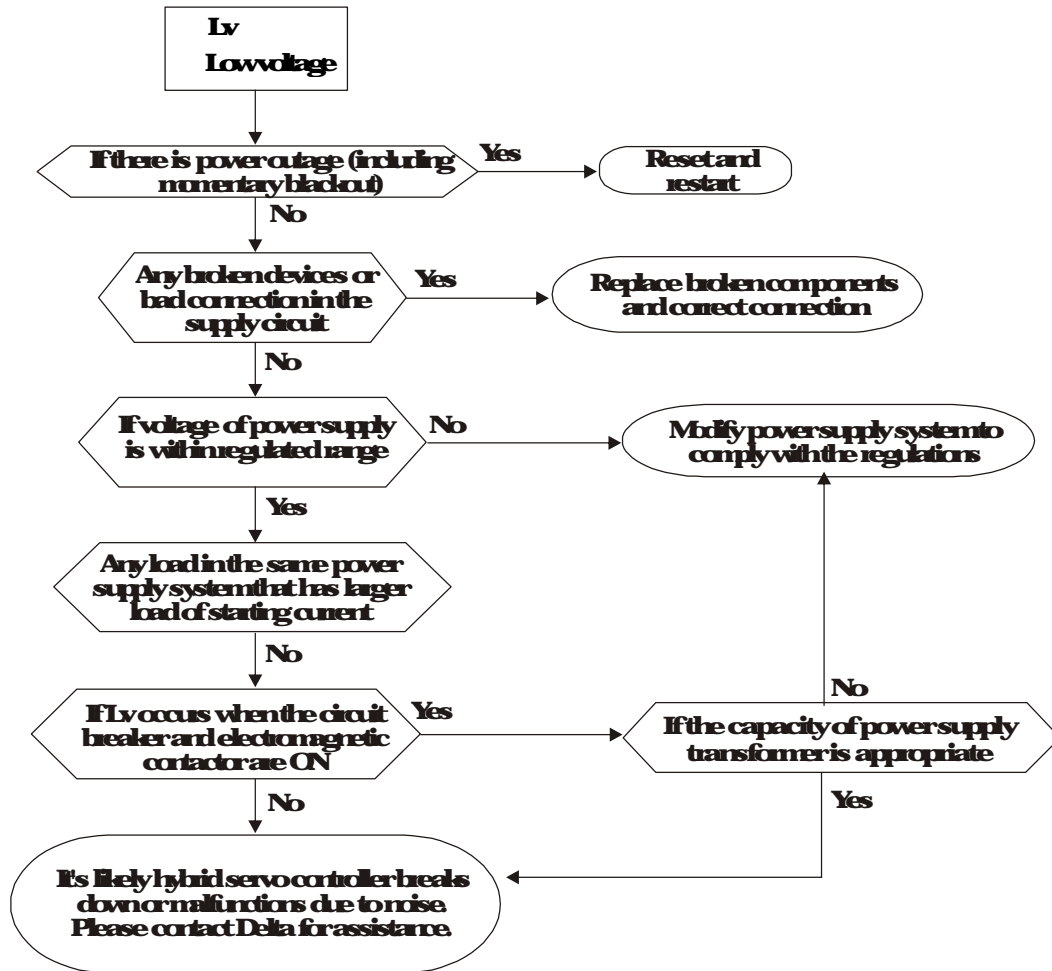
53 Ground Fault (GFF)



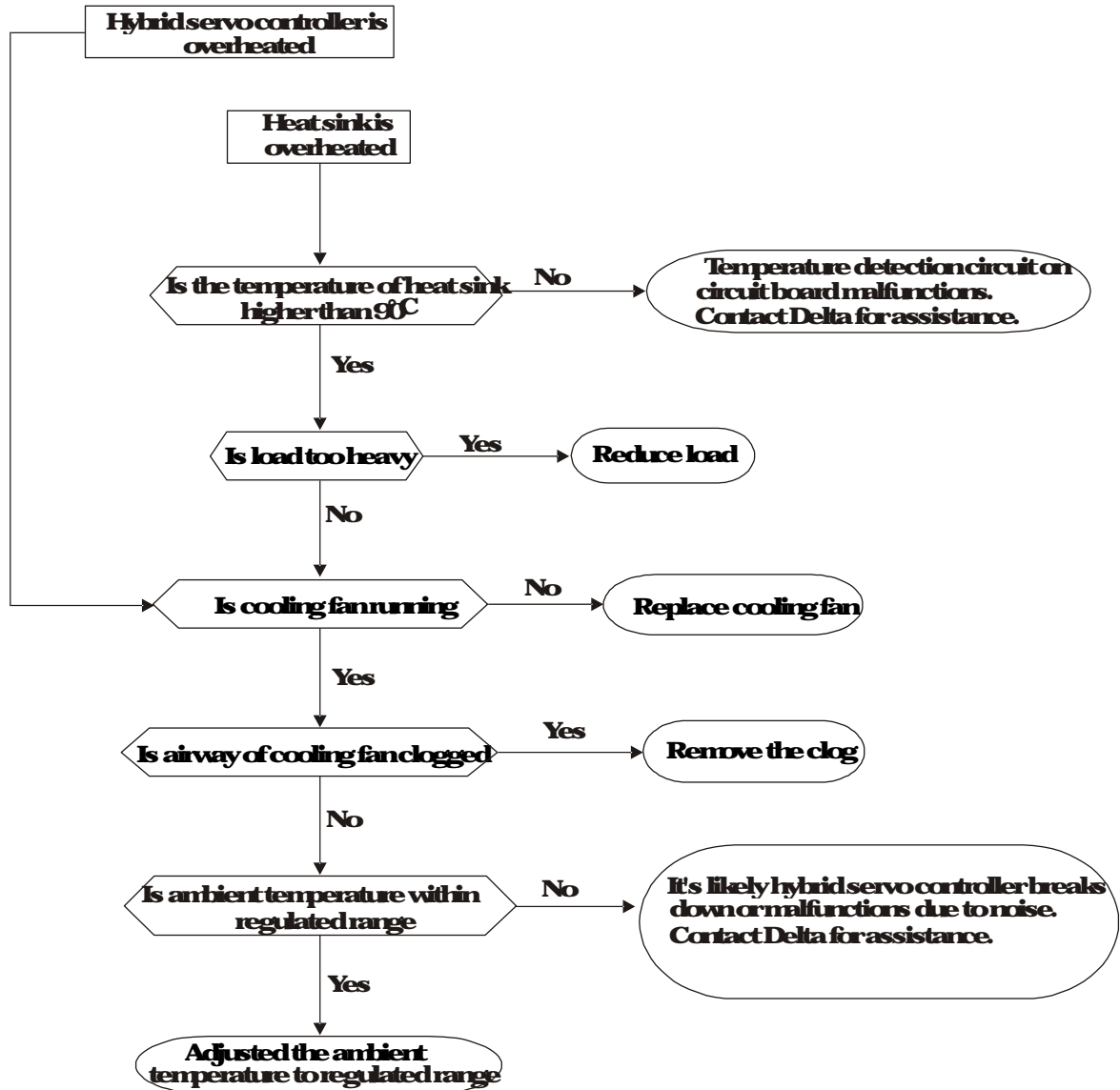
54 Over Voltage (ov)



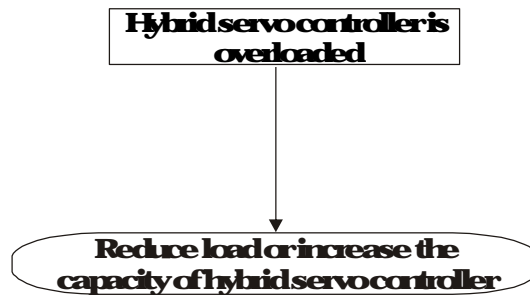
5.5 Low Voltage (Lv)



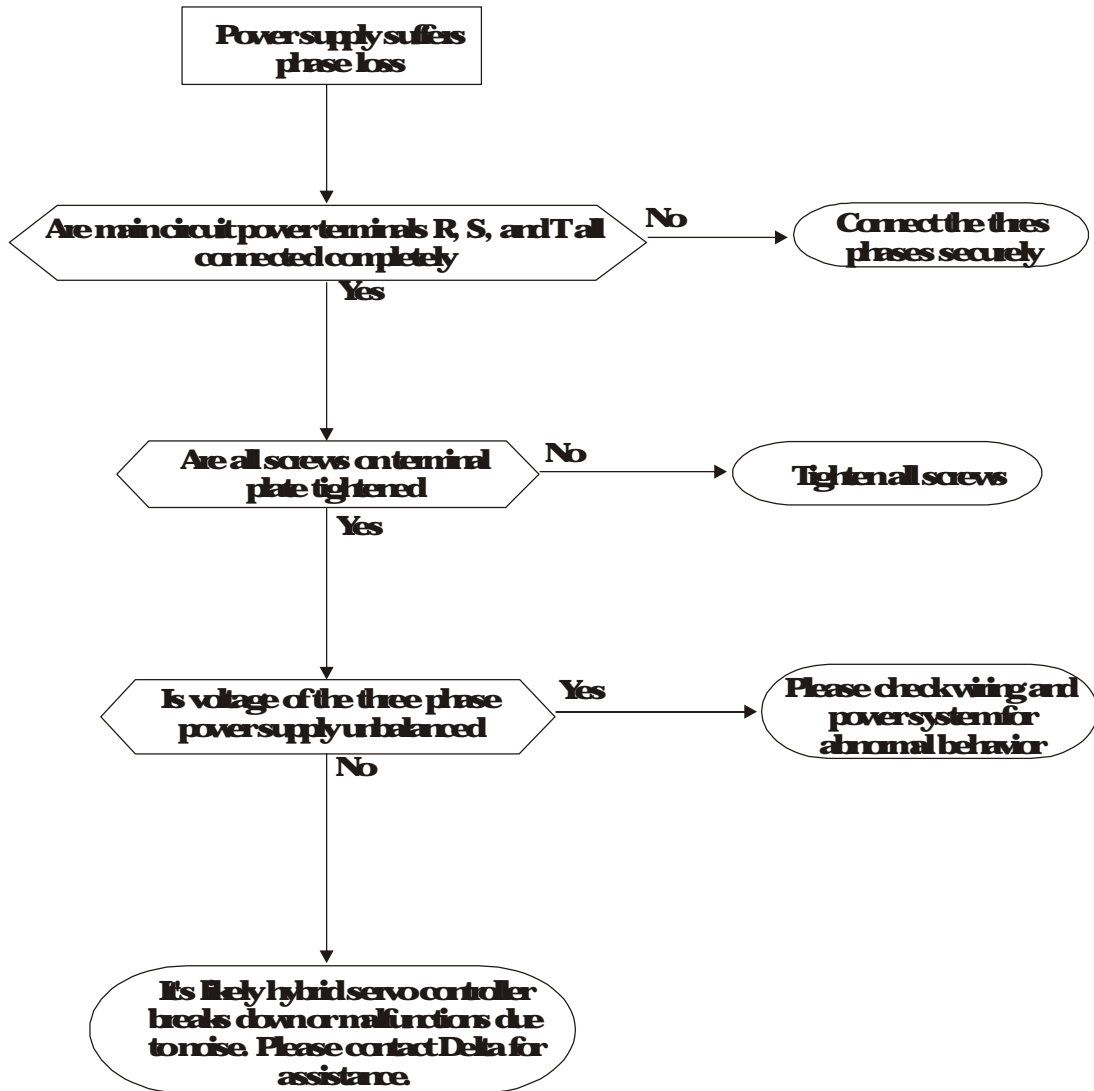
56 Over Heat (OH1)



57 Overload (OL)



5.8 Phase Loss (PHL)



59 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 equipments.
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”.

5.10 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, capacitor, 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 follow the precautions:



Wait 5 seconds after a fault has been cleared before performing reset via keypad or 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 25VDC.

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 complies with regulations without abnormal noise, vibration and smell.

6.1 Maintenance and Inspections

Before the checkup, 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 25VDC.

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 aging	Visual inspection NOIE: 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

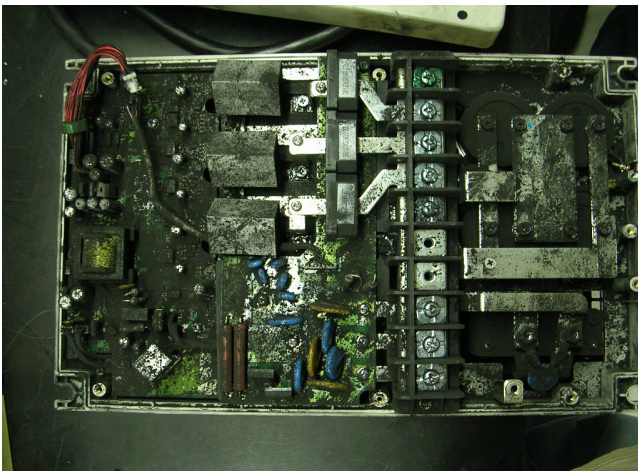
6.2 Greasy Dirt Problem

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 sit 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.



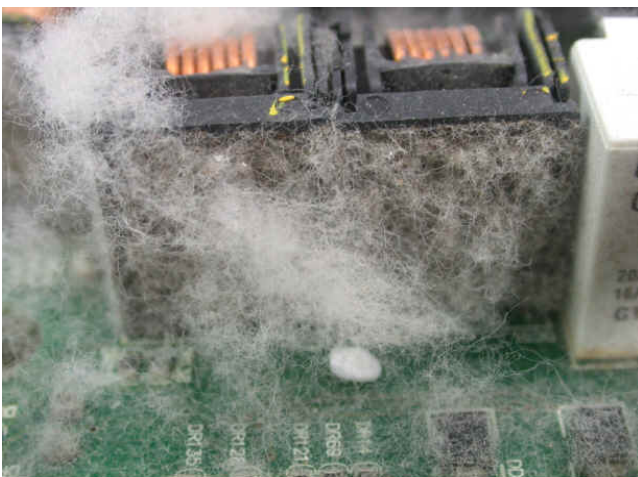
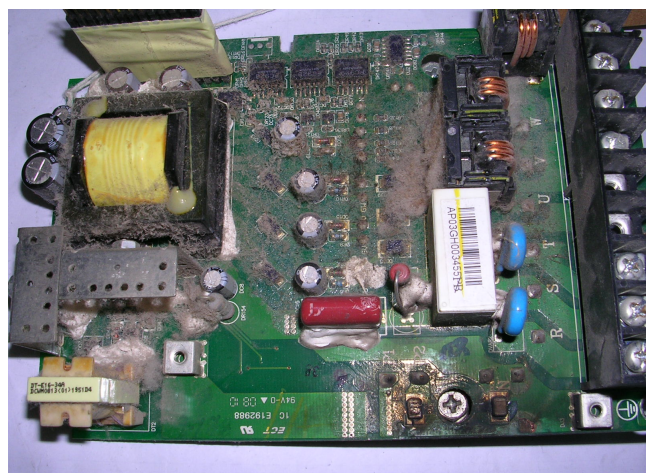
6.3 Fiber Dust Problem

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.



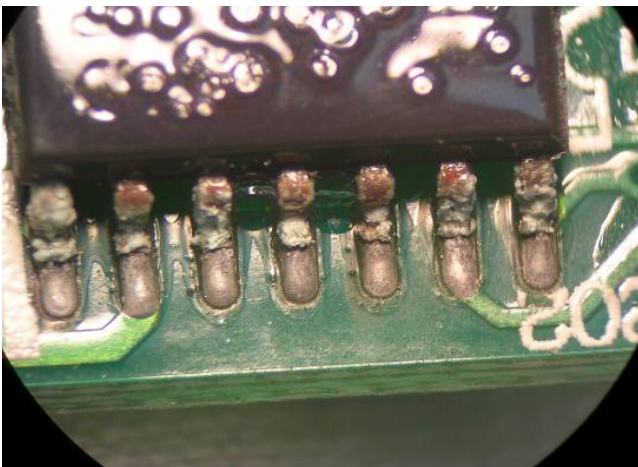
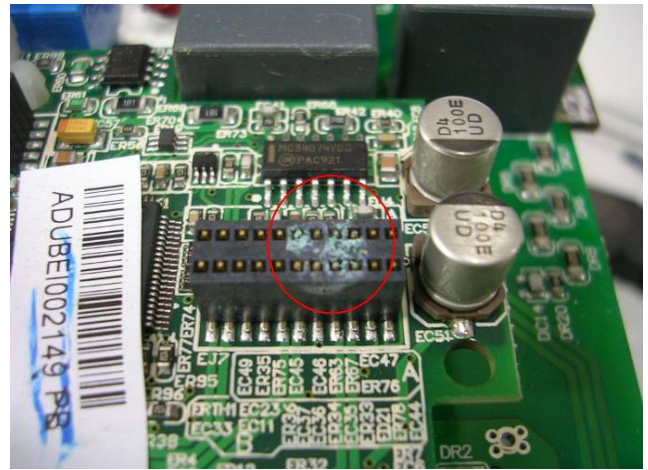
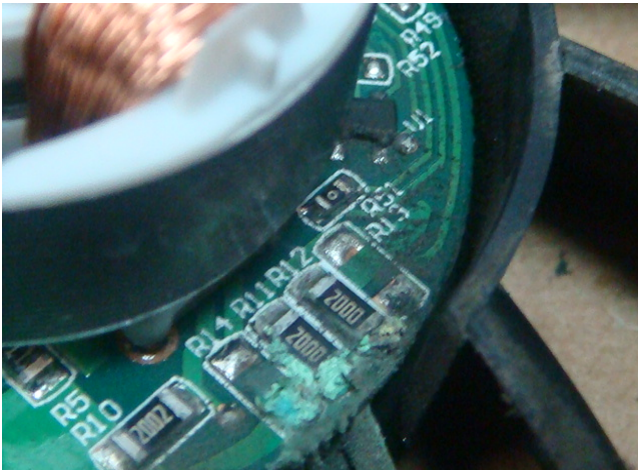
6.4 Erosion Problem

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 possibly 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.



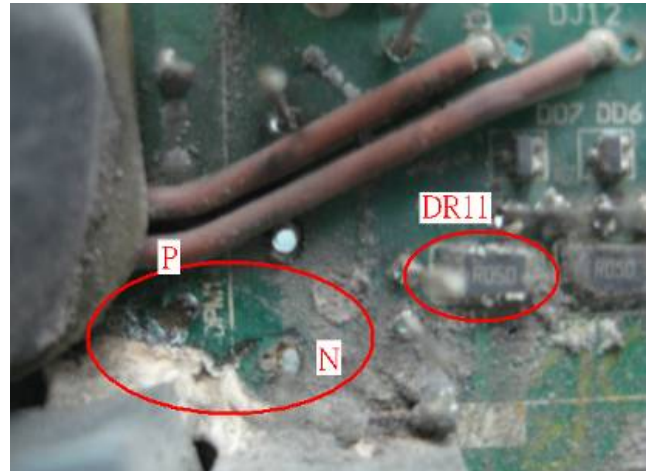
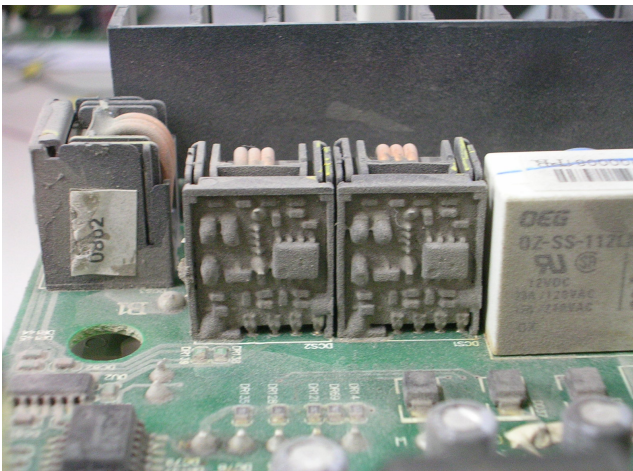
6.5 Industrial Dust Problem

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 problems 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.



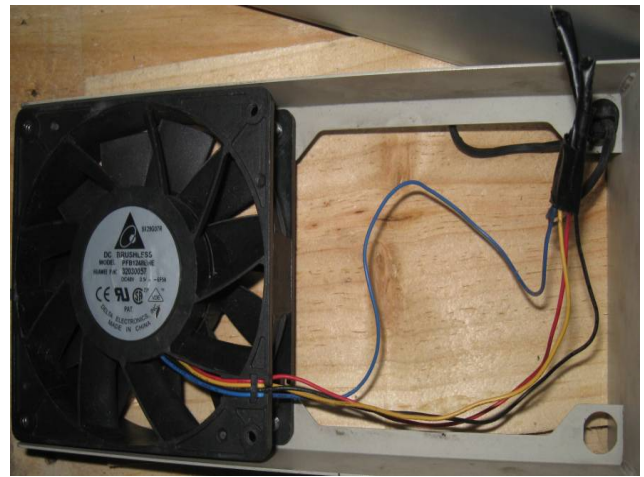
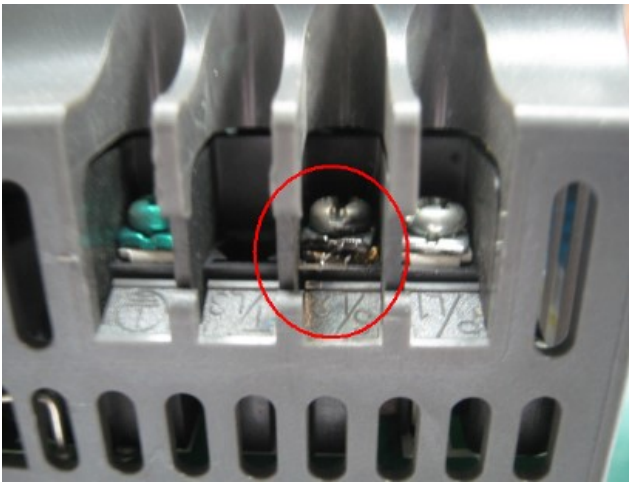
6.6 Wiring and Installation Problem

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

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

Solution:

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



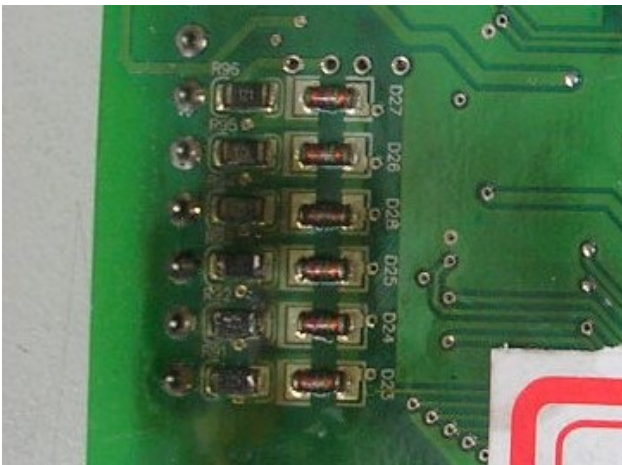
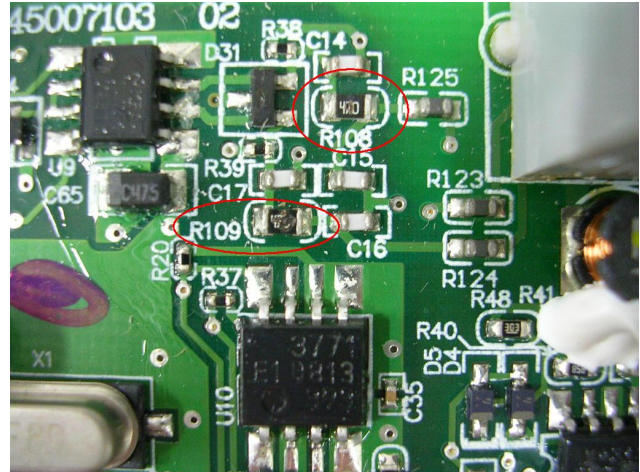
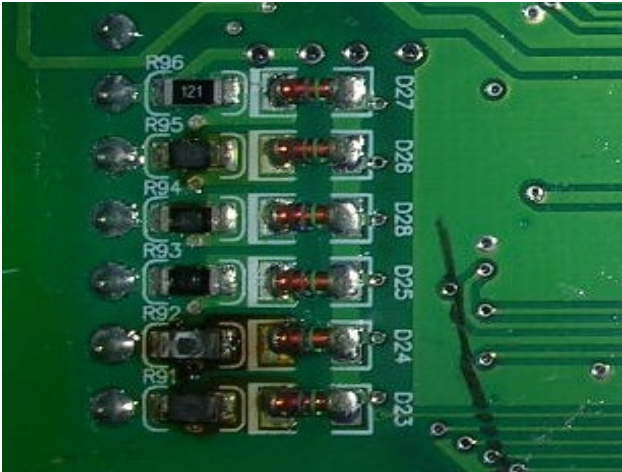
6.7 Multi-function Input/Output Terminals Problem

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

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

Solution:

Refer to the user manual for multi-function input/output terminals usage and follow the specified voltage and current. **DONOT** exceed the specification limits.



Appendix A: Optional Accessories

A 1 Baking Resistor Selection Chart

A 2 Non fuse Circuit Breaker & Fuse Specification

A 3 Reactor

A 4 Digital Keypad KPVC001

A 5 EM Filter



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.

A-1 Braking Resistor Selection Chart

VJ-C series

Applicable Motor			125% Braking Torque 10%ED ¹				
HP	kW	Model	Braking Resistor Models ²	Quantity	Parallel or Serial Connection	Effective Braking Resistance of Each Drive	Total Braking Current (A)
40	300	VFD300M23C-J	BR1K0W5P1	4	² in parallel connection and ² in series connection	400W51	75
50	370	VFD370M23C-J	BR1K2W3P9	4	² in parallel connection and ² series connection	480W39	97
15	11.0	VFD110M43C-J	BR1K5W043	1	/	1500W43	176
20	15.0	VFD150M43C-J	BR1K0W016	2	² in series connection	200W32	24
25	18.5	VFD185M43C-J	BR1K5W013	2	² in series connection	300W26	29
30	22.0	VFD220M43C-J	BR1K5W013	2	² in series connection	300W26	29
40	300	VFD300M43C-J	BR1K0W5P1	4	² in parallel connection and ² in series connection	400W204	37
50	37.0	VFD370M43C-J	BR1K2W015	4	² in parallel connection and ² in series connection	480W15	50
60	45.0	VFD450M43C-J	BR1K5W013	4	² in parallel connection and ² in series connection	600W13	59

Applicable Motor			Maximum Braking Torque Limit		
HP	kW	Model	Minimum Resistance Limit	Highest Total Braking Current Limit (A)	Maximum Peak Power (kW)
40	300	VFD300M23C-J	48	80	304
50	370	VFD370M23C-J	32	120	456
15	11.0	VFD110M43C-J	308	247	188
20	150	VFD150M43C-J	250	304	231
25	185	VFD185M43C-J	208	365	277
30	220	VFD220M43C-J	190	40	304
40	300	VFD300M43C-J	190	40	304
50	370	VFD370M43C-J	140	54	408
60	450	VFD450M43C-J	127	60	457
75	550	VFD550M43C-J	95	80	608
100	750	VFD750M43C-J	63	120	907

¹ Calculation for 125% brake torque: $(kW) \times 125\% \times 0.8$ where 0.8 is motor efficiency

Because there is a resistor limit of power consumption, the longest operation time for 10% ED is 10sec (on 10sec/off: 90sec).

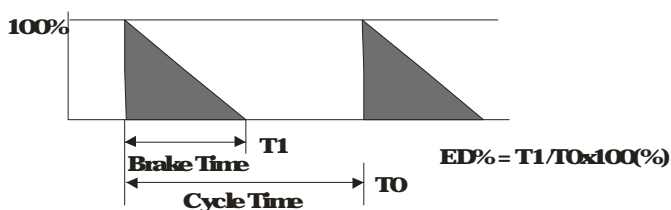
² For heat dissipation, a resistor of 400W or lower should be fixed to the frame and maintain the surface temperature below 250°C; a resistor of 1000W and above should maintain the surface temperature below 350°C.

NOTE

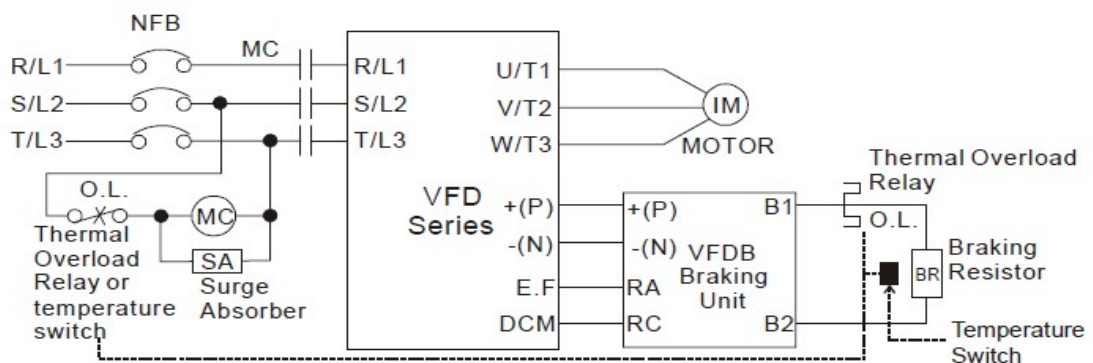
1. Definition for Brake Usage ED%

Explanation The definition of the brake usage ED(%) is for assurance of enough time for the brake unit and brake resistor to dissipate away heat generated by braking. When the brake resistor heats up, the resistance would increase with temperature, and brake torque would decrease accordingly. Recommended cycle time is one minute.

Definition of Brake Usage ED%



For safety concern, install an overload relay (OL) 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 OOO needs to be at least 15cm away from the hybrid servo drive.

A-2 Non Fuse Circuit Breaker and Fuse

VJ-C series:

Comply with the UL standard Per UL 508 paragraph 4584, part a,

The rated current of the breaker shall be 2~ 4 times of the maximum input current of hybrid servo drive

Model	Recommended Current (A)
VFD300M23C-J	250
VFD370M23C-J	300
VFD110M43C-J	50
VFD150M43C-J	60
VFD185M43C-J	80
VFD220M43C-J	100
VFD300M43C-J	125
VFD370M43C-J	150
VFD450M43C-J	200
VFD550M43C-J	225
VFD750M43C-J	300

Fuse Specifications (the specifications fuses)

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

230V model	Input Current (A)	Line Fuse	
		Input Current (A)	Bus name PN
VFD300M23C-J	120	250	JIS-250
VFD370M23C-J	146	300	JIS-300

460V model	Input Current (A)	Line Fuse	
		Input (A)	Bus name PN
VFD110M43C-J	24	50	JIS-50
VFD150M43C-J	30	60	JIS-60
VFD185M43C-J	37	80	JIS-80
VFD220M43C-J	47	100	JIS-100
VFD300M43C-J	60	125	JIS-125
VFD370M43C-J	73	150	JIS-150
VFD450M43C-J	91	200	JIS-200
VFD550M43C-J	110	225	JIS-225
VFD750M43C-J	150	300	JIS-300

A-3 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 sags or abnormal current spikes. For example, when the main power capacity is higher than 500kVA, 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 sags.

A-3 1 AC Reactor

Specifications: AC Input Reactor

200V~230V/ 50-60Hz model VFDXXM23C-J series AC Input Reactor							
Model	KW	HP	Rated Current (Ams)	Saturation Current (Ams)	3% Reactor (mH)	5% Reactor (mH)	3% Input Reactor: Delta Part #
300	30	40	120	240	012	02	DR105AP106
370	37	50	146	292	0087	0145	DR146AP087

380V~460V/ 50-60Hz model VFDXXM43C-J series AC Input Reactor							
Model	KW	HP	Rated Current (Ams)	Saturation Current (Ams)	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	185	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

380V~460V/ 50-60Hz model VFDXXM43C-JO series AC Input Reactor							
Model	KW	HP	Rated Current (Ams)	Saturation Current (Ams)	3% Reactor (mH)	5% Reactor (mH)	3% Input Reactor: Delta Part #
300	30	40	60	1026	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	01	02
37	50	160	240	0075	015

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	08	1.2
18.5	25	45	67.5	07	1.2
22	30	45	67.5	07	1.2
30	40	80	120	04	0.7
37	50	80	120	04	0.7
45	60	100	150	03	0.45
55	75	130	195	02	0.3
75	100	160	240	015	0.23

Application of AC Reactor

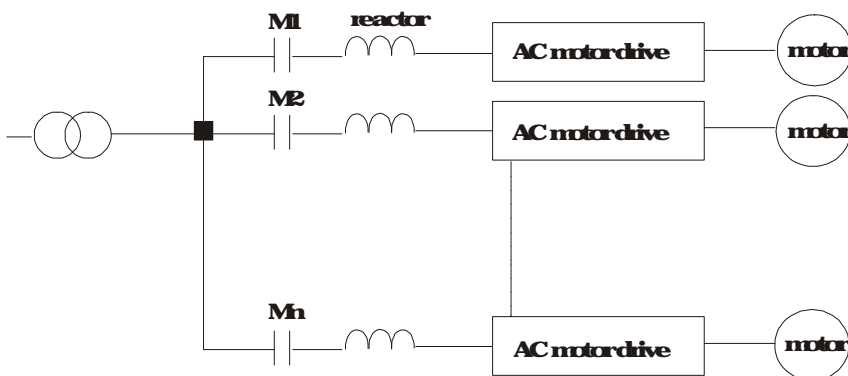
Connected in input circuit

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

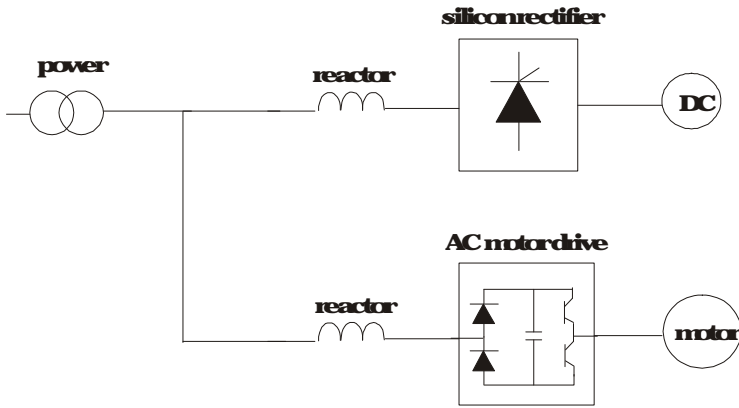


Application 2

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.

Connect 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.

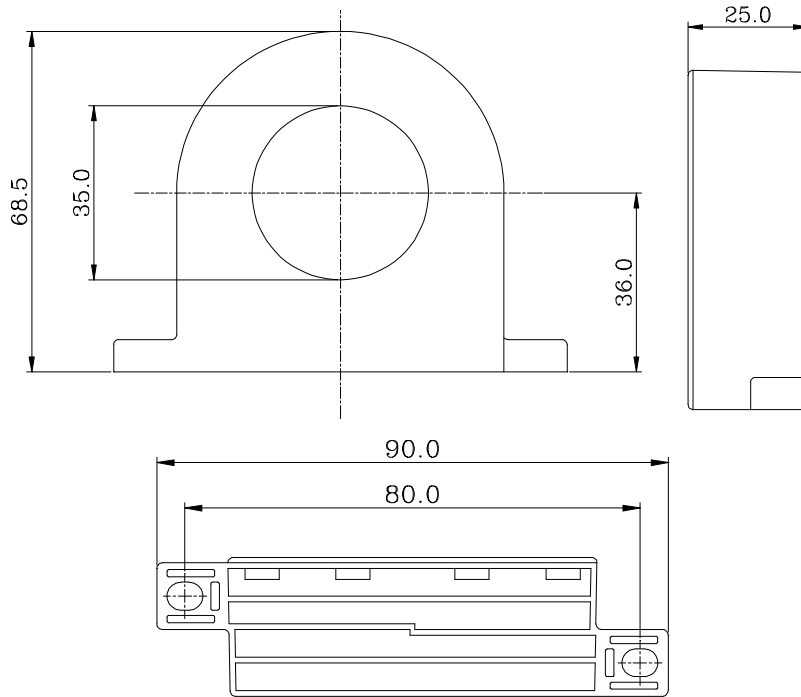
Connect wiring



A-32 Zero Phase Reactor

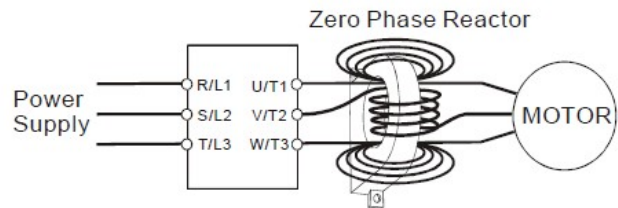
RF220M00A

Unit: mm(inch)



Cable type (Note)	Recommended Wire Size (mm ²)			Qty.	Wiring Method
	AWG	mm ²	Nominal (mm ²)		
Single core	10	53	55	1	Figure A
	2	336	38	3	Figure B
Three core	12	33	35	1	Figure A
	1	424	50	3	Figure B

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

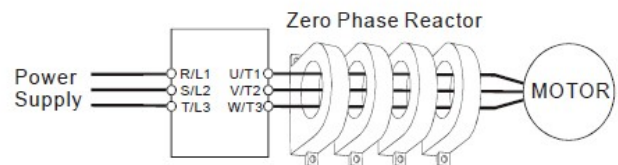


NOTE

600V insulated power line

1. The table above gives approximate wire size for the zero phase reactors but the selection is ultimately governed by the type and diameter of cable fitted i.e. the cable must fit through the center hole of zero phase reactors.
2. Only the phase conductors should pass through, not the earth core or screen
3. When long motor output cables are used an output zero phase reactor may be required to reduce radiated emissions from the cable.

Figure B
Please put all wires through 4 cores in series without winding



A-4 Digital Keypad KPC-CC01

The VFD VJ series products use the digital keypad VFD KPV-CC01 as the display unit. For the actual keypad appearance, please refer to the actual product. This picture shows the schematic diagram for illustrative purposes only.

KPC-CC01 Digital Keypad







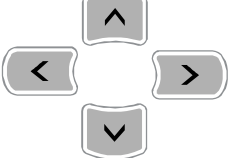





Communication Interface
RJ-45 (socket), RS-485 (Interface)




Installation

Embedded type and can be put flat on the surface of the control box. The front cover is waterproof. Buy a MKC-KPPK model to do wall mounting or embedded mounting. Its protection level is IP66. The maximum RJ45 extension lead is 5m (16ft).

Descriptions of Keypad Functions

Key	Descriptions
	<p>Start Operation Key</p> <ol style="list-style-type: none"> 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
	<p>Stop Command Key: This key has the highest processing priority in any situation</p> <ol style="list-style-type: none"> 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.
	<p>Operation Direction Key</p> <ol style="list-style-type: none"> 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.
	<p>ENIER Key Press ENIER and go to the next level. If it is the last level then press ENIER to execute the command</p>
	<p>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</p>
	<p>Press menu to return to main menu</p>
	<p>Direction Left/Right/Up/Down</p> <ol style="list-style-type: none"> 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
	<p>Function Key</p> <ol style="list-style-type: none"> 1 The functions keys have factory settings and can be defined by users. 2 Other functions must be defined by IPEditor first
	<p>HAND Key</p> <ol style="list-style-type: none"> 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 AFSP warning), and switch to hand frequency source and hand operation source.
	<ol style="list-style-type: none"> 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 AFSP warning), and switch to auto frequency source and auto operation source.

Descriptions of LED Functions

LED	Descriptions
	<p>Steady ON: operation indicator of the hybrid servo drive, including DC brake, zero speed, standby, restart after fault and speed search</p> <p>Blinking: drive is decelerating to stop or in the status of base block</p> <p>Steady OFF: drive doesn't execute the operation command</p>
	<p>Steady ON: stop indicator of the hybrid servo drive</p> <p>Blinking: drive is in the standby status.</p> <p>Steady OFF: drive does not execute 'STOP' command</p>
	<p>Operation Direction LED</p> <p>1. Green light is on, the drive is running forward</p> <p>2. Red light is on, the drive is running backward</p> <p>3. Twinkling light: the drive is changing direction</p>

Characters of Digital Keypad Displayed on the LCD

Number	0	1	2	3	4	5	6	7	8	9
LCD	0	1	2	3	4	5	6	7	8	9
Alphabet	A	b	Cc	d	E	F	G	Hh	I	Jj
LCD	A	b	Cc	d	E	F	G	Hh	I	Jj
Alphabet	K	L	n	Oo	P	q	r	S	Tt	U
LCD	K	L	n	Oo	P	q	r	S	Tt	U
Alphabet	v	Y	Z							
LCD	v	Y	Z							

A-5EM Filter

VJ-C series

Drive	Applicable Filter Model #	Reference Website
VFD110M43C-J	B84143A0050R106	PowerLine EMC Filter (EPCOS)
VFD150M43C-J		
VFD185M43C-J		
VFD220M43C-J		
VFD300M43C-J	B84143A0100R106	
VFD370M43C-J		
VFD450M43C-J	B84143D0200R127	
VFD550M43C-J		
VFD750M43C-J		
VFD600M23C-J		
VFD370M23C-J		

EM 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 EM filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EM filter to have the best interference elimination performance.

We assure that it can comply with following rules when hybrid drive and EM 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. EM filter and hybrid drive should be installed on the same metal plate.
2. Please install hybrid drive on footprint EM filter or install EM 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 EM 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

Inproper installation and choice of motor cable will affect the performance of EM filter. Be sure to observe the following precautions when selecting motor cable.

- 1 Use the cable with shielding (double shielding is the best).**
- 2 The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.**
- 3 Remove any paint on metal saddle for good ground contact with the plate and shielding.**

Remove any paint on metal saddle for good ground contact with the plate and shielding

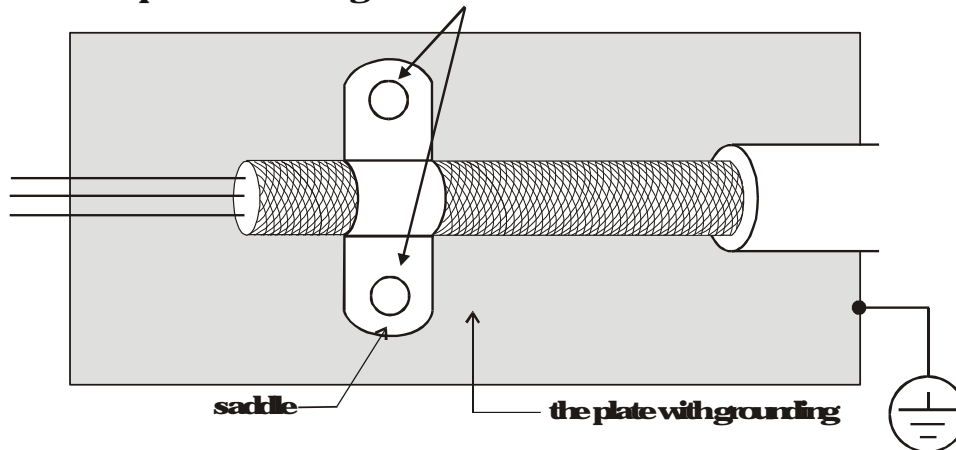


Figure 1

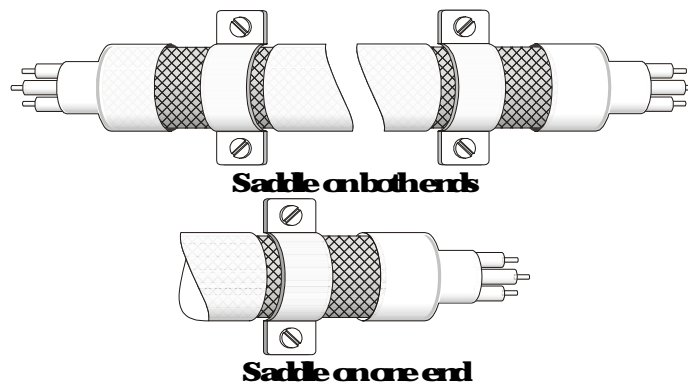


Figure 2

The length of motor cable

When motor is driven by a hybrid drive of PWM type, the motor terminals will experience surge voltages easily due to components conversion of hybrid drive and cable capacitance. When the motor cable is very long (especially for the 460V series), surge voltages may reduce insulation quality. To prevent this situation, please follow the rules below.

Use a motor with enhanced insulation

Connect an output reactor (optional) to the output terminals of the hybrid drive

The length of the cable between hybrid drive and motor should be as short as possible (10 to 20m or less)

For models 7.5hp and above:

Insulation level of motor	1000V	1300V	1600V
460VAC input voltage	66ft (20m)	328ft (100m)	1312ft (400m)
230VAC input voltage	1312ft (400m)	1312ft (400m)	1312ft (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 connection 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:0017).

 **NOTE**

When a thermal OL 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: 0017 PWM carrier frequency).

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 setup 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 setup 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 instructionsheet 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

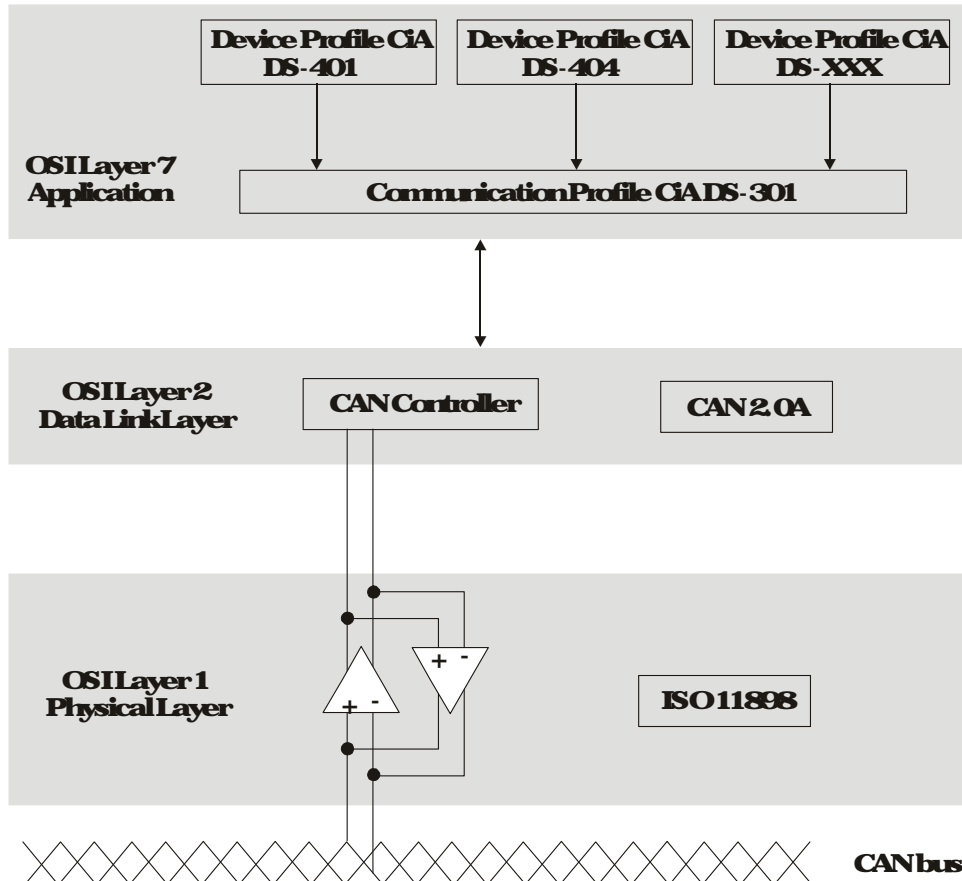
Delta CANopen does not support this service:

Time Stamp service

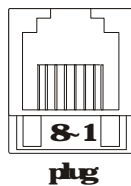
B-1 CANopen Overview

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 (CiADS301) is standardized as EN50254. The CANopen specifications cover the application layer and communication profile (CiADS301), as well as a framework for programmable devices (CiA302), recommendations for cables and connectors (CiA303.1) and SI units and prefix representations (CiA303.2).



RJ-45 Pin Definition



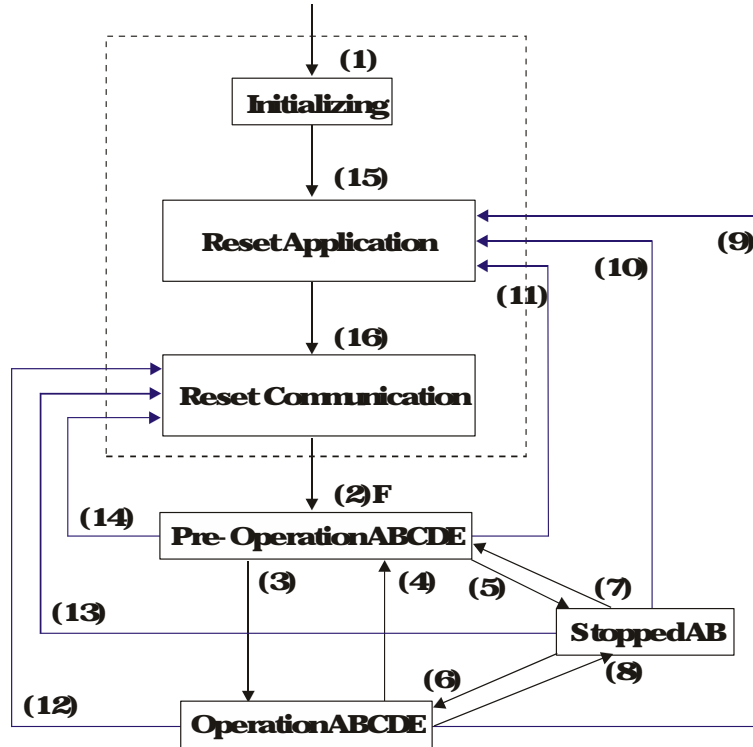
PIN	Signal	Description
1	CAN_H	CAN_Hbus line (dominant high)
2	CAN_L	CAN_Lbus line (dominant low)
3	CAN_GND	Ground / C V / N-
6	CAN_GND	Ground / C V / N-

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 does not support this transmission format.

Type number 255 indicates the data is an asynchronous aperiodic transmission.

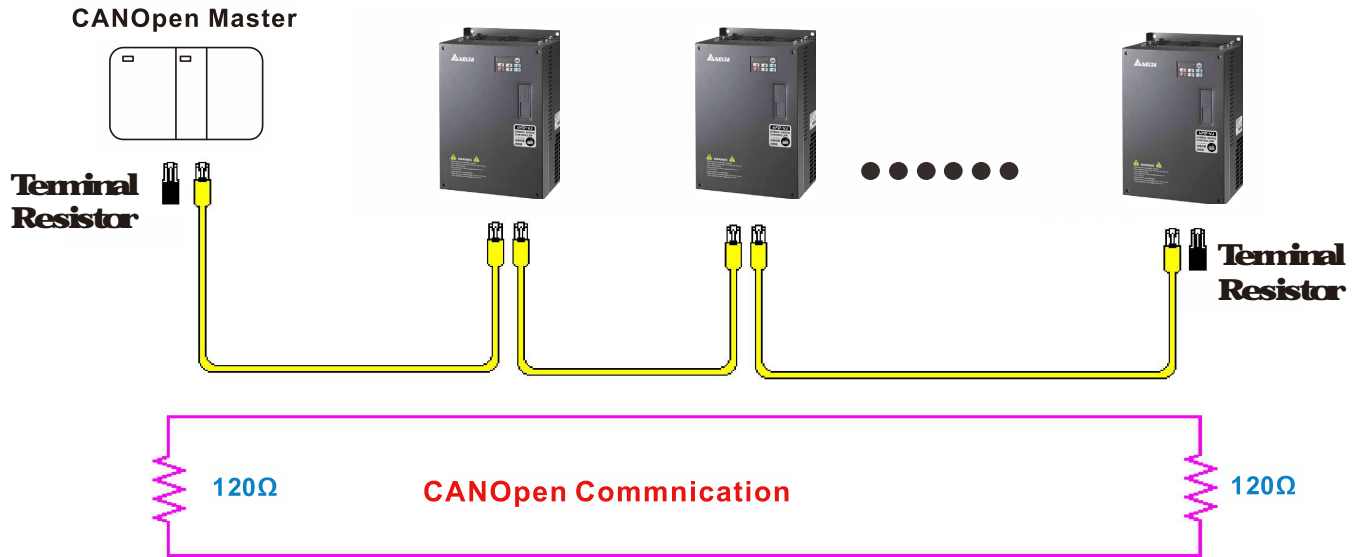
All PDO transmission data must be mapped to the index with Object Dictionary.

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 operations 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:0002= 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.**

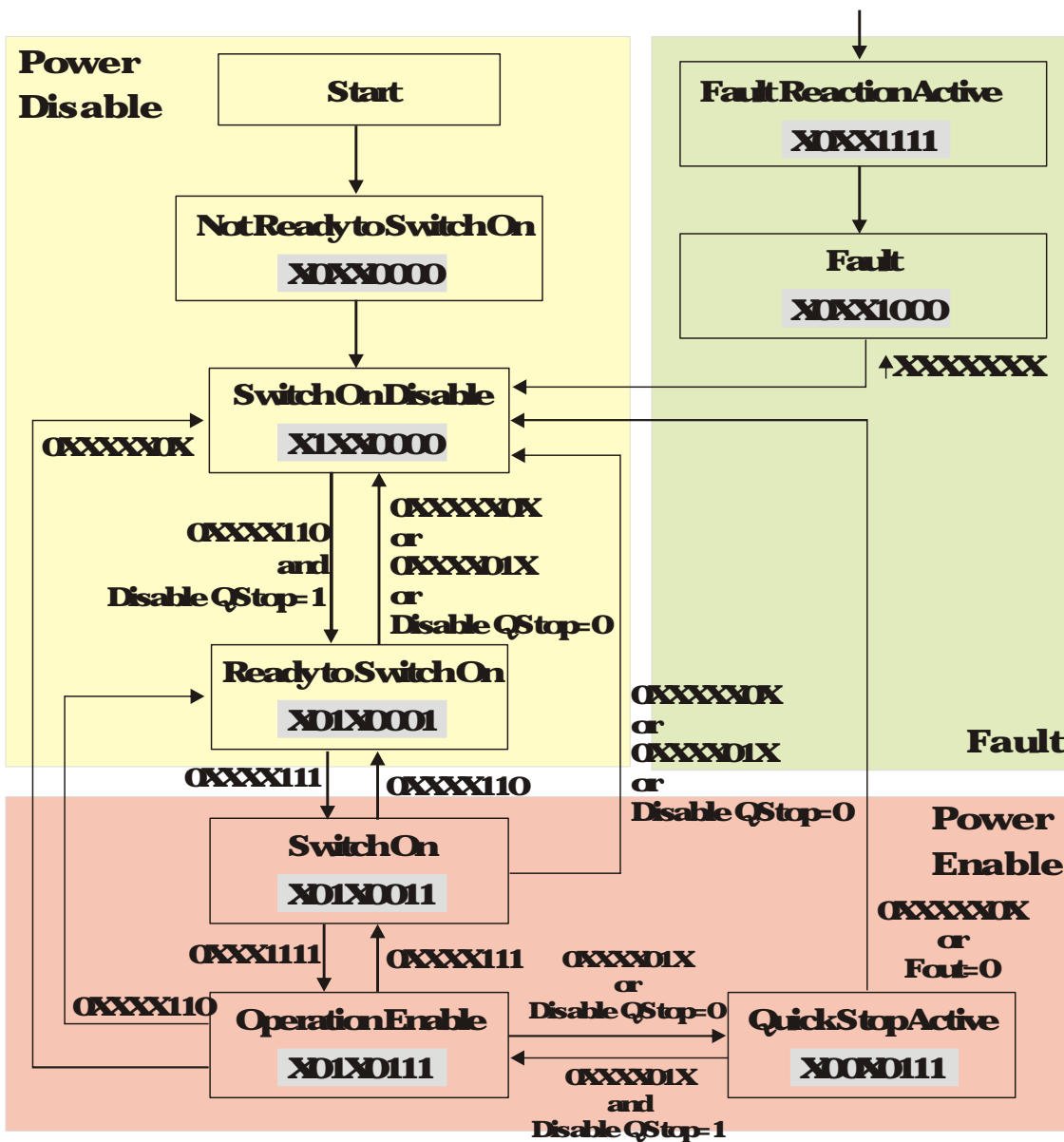
When the motor drive is turned on and finishes the initiation, it remains in Ready to Switch On status. To control the operation of the motor drive, change to Operate Enable status. To do this, set the control words bit0-bit3 and bit7 of the Index 6040H and pair with Index Status Word (Status Word 0x6041). 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	Operate 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	Quickstop option code	2	RW	S16		No		0 Disable drive function
									1: Slowdown on slowdown ramp
									2 Slowdown on quick stop ramp
									5 Slowdown on slowdown ramp and stay in Quick Stop
									6 Slowdown on quick stop ramp and stay in Quick Stop
7 Slowdown 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: Slowdown with slowdown 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 Index 6060 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

$$n = f \frac{120}{p}$$

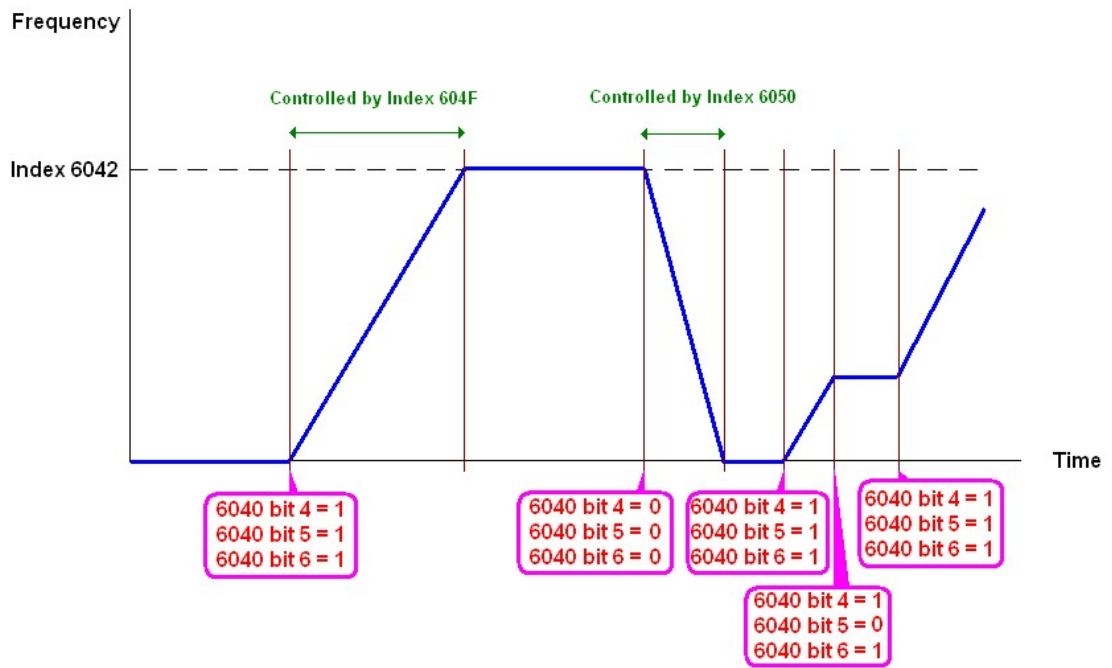
(Pole) n: rotation speed (rpm) (rounds/minute) p: number of poles in the motor
f: rotation frequency (Hz)

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) = 50Hz. The 6042 is defined as a signed operation. The plus or minus sign means to rotate clockwise or counter-clockwise.

4. To set acceleration and deceleration use 604F (Acceleration) and 6050 (Deceleration).
5. Trigger an ACK signal: in the speed control mode, the bit 6-4 of Index 6040 needs to be controlled. It is defined below.

Speed mode (Index 6060-2)	Index 6040			SUM
	Bit 6	Bit 5	Bit 4	
	1	C	1	Locked at the current signal
	1	1	1	Run to reach targeting signal
	Other			Decelerate to C Hz



NOTE 01: Read 6043 to get the current rotation speed (unit: rpm).

NOTE 02: Read bit 10 of 6041 to find if the rotation speed has reached the targeting value (0: Not reached; 1: Reached).

B.3.3 Using Delta Standard (Old definition)

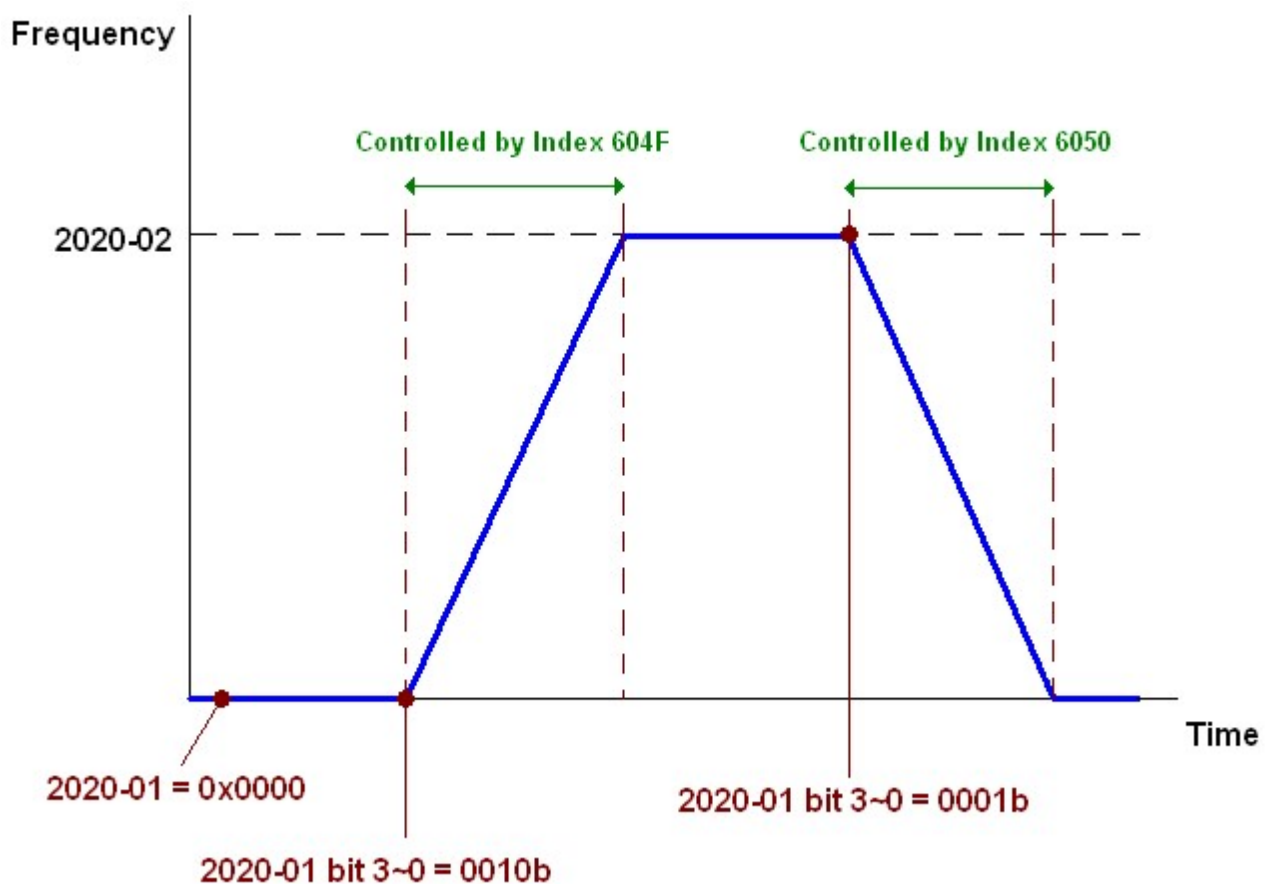
B.3.3.1 Various mode control method (Delta Old Standard).

Follow the steps below

1. Wire the hardware (refer to Section B.2 Wiring for CANopen).
2. Set the operation source: set Pr:01-01 to 3 for CANopen communication card control.
3. Set the frequency source: set Pr:03-15 to 6. Choose the source for the Frequency command from the CANopen setting.
4. Set Delta Standard (Old definition, only supports speed mode) as the control mode: Pr:04-20 = 0 and Pr:04-24 = 0.
5. Set the CANopen station: set Pr:09-33. 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 1000Hz.
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 setup for an AC motor drive (Delta New Standard)

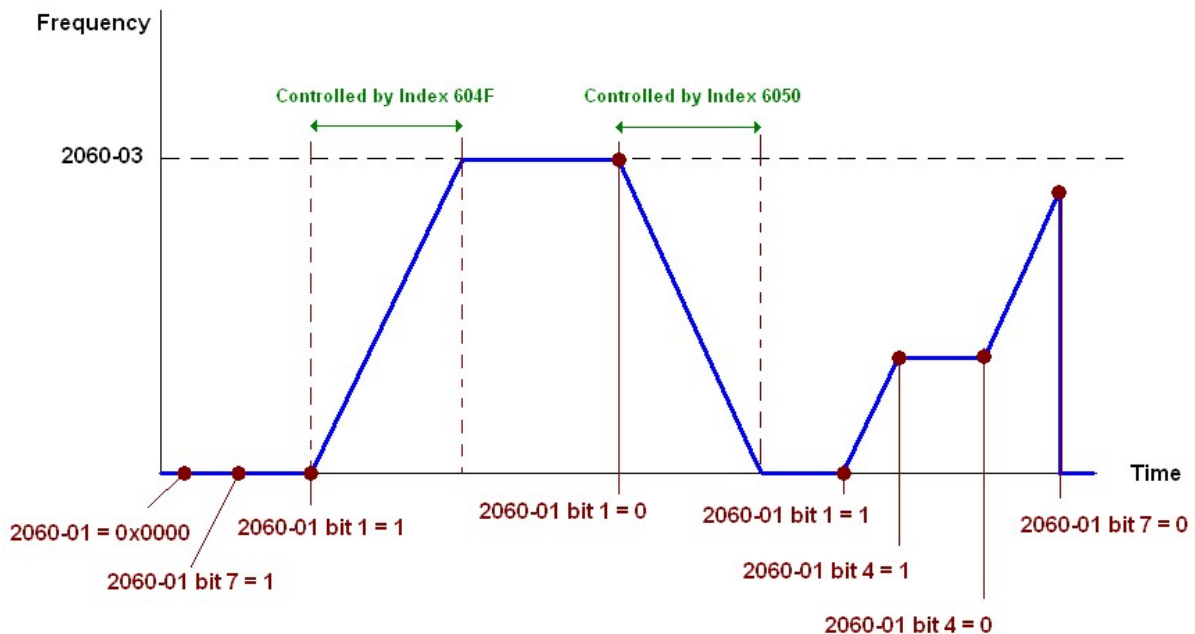
Follow the steps below

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 (CAE 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 1000Hz.
3. Operation control: set 2060-01 = 0080H for server on, and set 2060-01 = 0081H for running.



Index	Sub	Definition	Factory Setting	R/W	Size	Note
						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 (XXXXXXHz)	0	R	U16	
	4	Output freq (XXXXXXHz)	0	R	U16	
	5	Output current (XXXXXA)	0	R	U16	
	6	DC BUS voltage (XXXXXV)	0	R	U16	
	7	Output voltage (XXXXXV)	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 (Pr0004)	0	R	U16	
2022H	0	Reserved	0	R	U16	
	1	Display output current (XXXXA)	0	R	U16	
	2	Display counter value	0	R	U16	
	3	Display actual output frequency (XXXXXXHz)	0	R	U16	
	4	Display DC-BUS voltage (XXXXXV)	0	R	U16	
	5	Display output voltage (XXXXXV)	0	R	U16	
	6	Display output power angle (XXXX°)	0	R	U16	
	7	Display output power by U, V, Win kW (XXXXXkW)	0	R	U16	
	8	Display actual motor speed (XXXXXrpm)	0	R	U16	
	9	Display estimate output torque (XXXX%)	0	R	U16	
	A	Display PG feedback	0	R	U16	
	B	Reserved	0	R	U16	
	C	Display signal for PS analog input terminal, 4-20mA/0-10V corresponds to	0	R	U16	

Index	Sub	Definition	Factory Setting	R/W	Size	Note
		0-100% (to two decimal places)				
	D	Display signal of PI analog input terminal, 0-10V corresponds to 0~100% (to two decimal places)	0	R	U16	
	F	Display the IGBT temperature of drive power module (XXXX°C)	0	R	U16	
	10	Display motor drive's capacitor temperature (XXXX°C)	0	R	U16	
	11	The status of digital input (ON/OFF), refer to Pr02 12	0	R	U16	
	12	The status of digital output (ON/OFF), refer to Pr02 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, 0-10V corresponds to 0~100% (to two decimal places)	0	R	U16	
	1B	Display actual pressure (Bar)	0	R	U16	
	1C	Display kw/hr	0	R	U16	
	1D	Display motor's temperature °C	0	R	U16	
	1E	Display motor drive's over load in %	0	R	U16	
	1F	Display motor's over load in % of HES type A	0	R	U16	
	20	Display current at braking (Ampere)	0	R	U16	
	21	Display braking chopper's temperature °C	0	R	U16	

Delta Standard Mode (New definition)

Index	sub	RW	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 deceleration 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	QuickStop
				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 Cntrl		0 Speed Mode
	08h	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	Encr		Encr detected
				4			
				5	JOG		JOG
				6	QStop		Quickstop
				7	Power ON		Switch ON
	15-8						
	02h	R					
	08h	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 QuickStop
603Fh	0	Error code	0	RO	U16		Yes		
6040h	0	Control word	0	RW	U16		Yes		
6041h	0	Status word	0	RO	U16		Yes		
6042h	0	vl target velocity	0	RW	S16	rpm	Yes	vl	
6043h	0	vl velocity demand	0	RO	S16	rpm	Yes	vl	
6044h	0	vl control effort	0	RO	S16	rpm	Yes	vl	
604Fh	0	vl ramp function time	1000	RW	U32	1ms	Yes	vl	Unit must be 100ms, and check if the setting is 0
6050h	0	vl slowdown time	1000	RW	U32	1ms	Yes	vl	
6051h	0	vl quick stop time	100	RW	U32	1ms	Yes	vl	
605Ah	0	Quick stop option code	2	RW	S16		No		0 Disable dive function
									1: Slowdown on slow down ramp
									2 Slowdown on quick stop ramp
									5 Slowdown on slow down ramp and stay in QUICKSTOP
									6 Slowdown on quick stop ramp and stay in QUICKSTOP
605Ch	0	Disable operation option code	1	RW	S16		No	0 Disable dive function 1: Slowdown with slow down ramp, disable the dive 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	ocA	0001H	Over current during acceleration	1	2213H
2	ocd	0002H	Over current during deceleration	1	2213H
3	ocn	0003H	Over current during steady status operation	1	2214H
4	OFF	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	2210H
6	ocS	0006H	Over current at STOP. Hardware failure in current detection	1	2214H
7	ovA	0007H	Over current during acceleration Hardware failure in current detection	2	3210H
8	ovd	0008H	Over current during deceleration Hardware failure in current detection	2	3210H
9	ovn	0009H	Over current during steady speed Hardware failure in current detection	2	3210H
10	ovS	000AH	Over voltage at STOP. Hardware failure in current detection	2	3210H
11	LvA	000BH	DC BUS voltage is less than Pr:0600 during acceleration	2	3220H
12	Lvd	000CH	DC BUS voltage is less than Pr:0600 during deceleration	2	3220H
13	Lvn	000DH	DC BUS voltage is less than Pr:0600 in constant speed	2	3220H
14	LvS	000EH	DC BUS voltage is less than Pr:0600 at stop	2	3220H

Setting*	Display	Fault code	Description	CANopen fault register (bit 0-7)	CANopen fault code
15	PHL	000FH	Phase loss protection	2	3130H
16	oH1	0010H	IGBT over heat IGBT temperature exceeds protection level	3	4310H
18	oH2	0012H	IGBT NIC open circuit	3	FF00H
21	oL	0015H	Overload, the AC motor drive detects excessive drive output current	1	2310H
22	EoL1	0016H	Electronic thermal relay 1 protection	1	2310H
24	oH3	0018H	Motor PIC overheat	3	FF20H
31	cf2	001FH	Internal EEPROM cannot be programmed	5	5530H
33	cd1	0021H	U-phase error	1	FF04H
34	cd2	0022H	V-phase error	1	FF05H
35	cd3	0023H	W-phase error	1	FF06H
36	Hd0	0024H	Clamp current detection error (Hd0) Abnormal cc protection hardware wire	5	FF07H
37	Hd1	0025H	Over current detection error (Hd1) Abnormal cc protection hardware wire	5	FF08H
38	Hd2	0026H	Over voltage detection error (Hd2) Abnormal ov protection hardware wire	5	FF08H
39	Hd3	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	PGF1	002AH	PG feedback error	7	7301H
43	PGF2	002BH	PG feedback loss	7	7301H
44	PGF3	002CH	PG feedback stall	7	7301H
45	PGF4	002DH	PG slip error	7	7301H
49	EF	0031H	External Fault; when the multi-function input terminal (EF) is active, the AC motor drive stops output	5	9000H
50	EF1	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	Mdbus function code error (illegal function code)	4	7500H
55		0037H	Mdbus data address is in error [illegal data address (00H to 254H)]	4	7500H
56		0038H	Mdbus data error (illegal data value)	4	7500H
57		0039H	Mdbus communication error (attempt to write data to read-only address)	4	7500H
58		003AH	Mdbus transmission time-out	4	7500H
60	bf	003BH	Braking chopper error	5	7110H
65	PGF5	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	Overcurrent at braking chopper (ocbs)	1	FF29H
72		0048H	Braking resistor is open circuit (br)	32	FF29H
73		0049H	Braking resistor's resistance value is too small (brF)	32	FF29H
74		004AH	Braking chopper overheated (oH)	3	FF29H
75		004BH	Error occurred on braking chopper's thermo protection line (tHb)	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	<p>One Message fail</p>
Double flash	<p>Guarding fail or heartbeat fail</p>
Triple flash	<p>SYNC fail</p>
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.

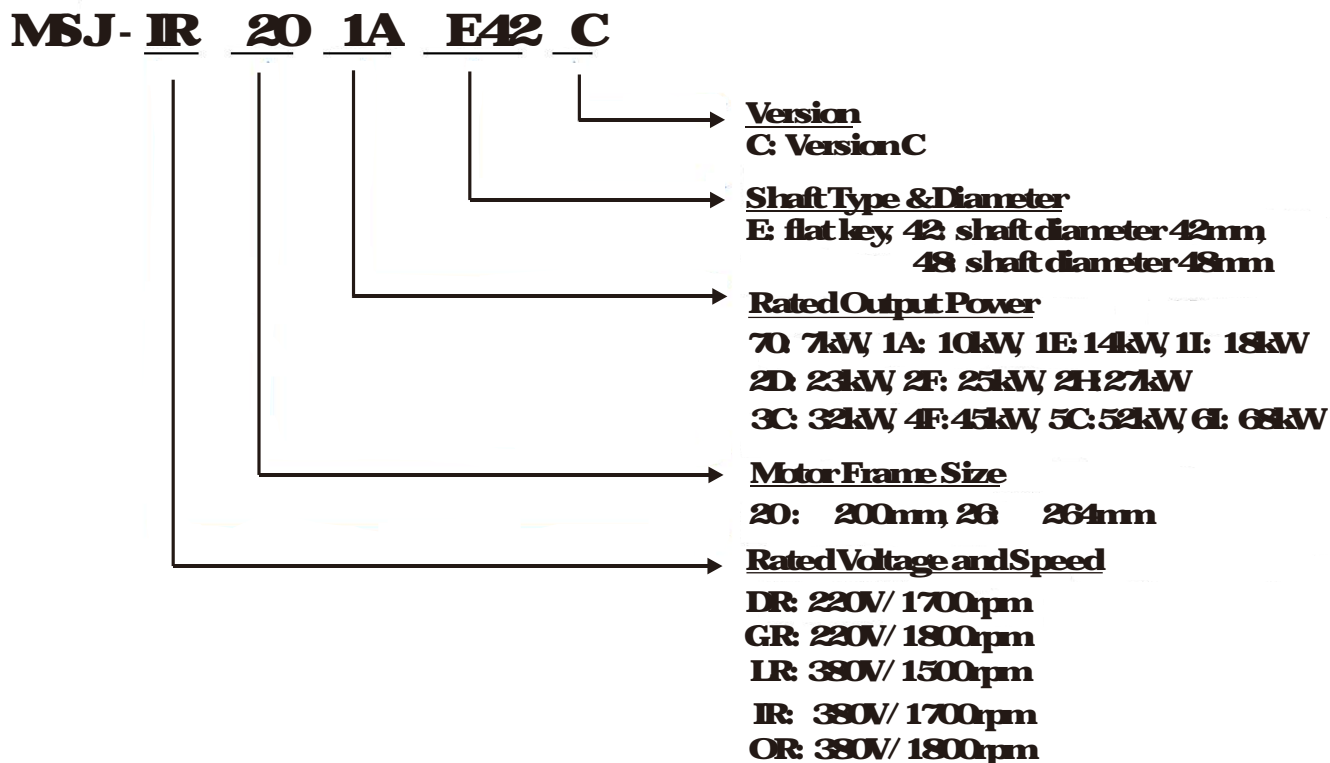
The accessories produced by Delta are only for using with Delta Hybrid servo drive. Do not use with other drive to prevent damage.

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		M&J _____ C				
		DR201AE42	DR201EE42	DR201E42	GR202DE42	DR202HE42
P01-35 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	173	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/rpm	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	68×10 ³	90×10 ³	11.7×10 ³	133×10 ³	17.5×10 ³
Weight	kg	46	53	59.5	67.5	83.6
Frame	mm	200×200				
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 (220VAC)					
Encoder	Resolver 2 Poles					
Motor Temperature Protection	PIC temperature protection and KIY84-130 temperature sensor ^{*3}					
Operating Environment	Temperature: -15 ~ 40°C Humidity: 20 ~ 90% RH (Non condensation) Altitude < 1000m					
Installation Method	Flange / Support Legs					
Certifications	CE					

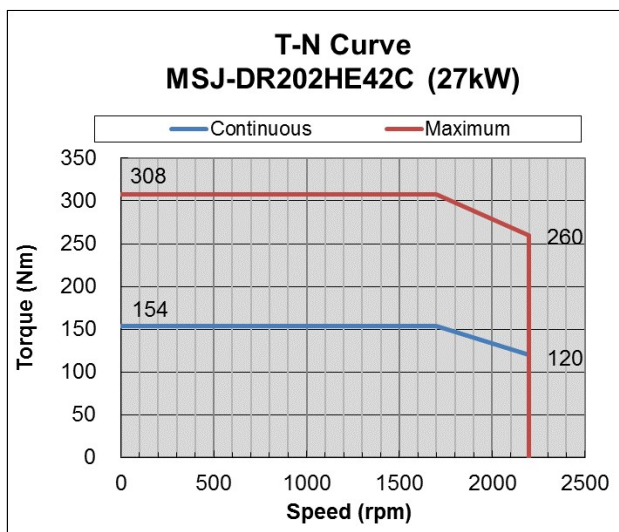
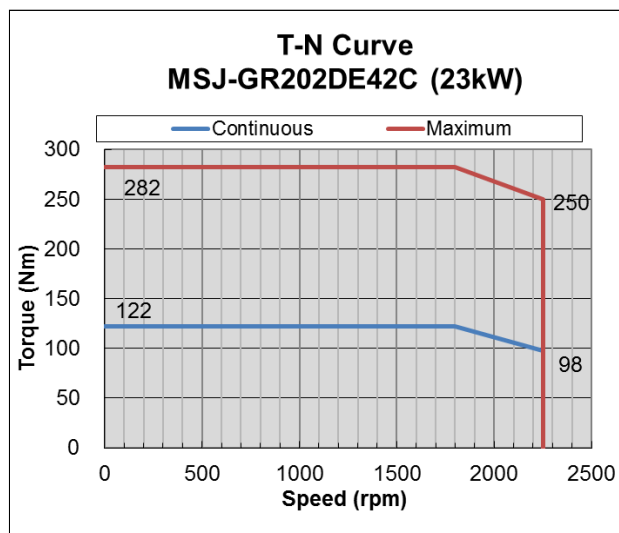
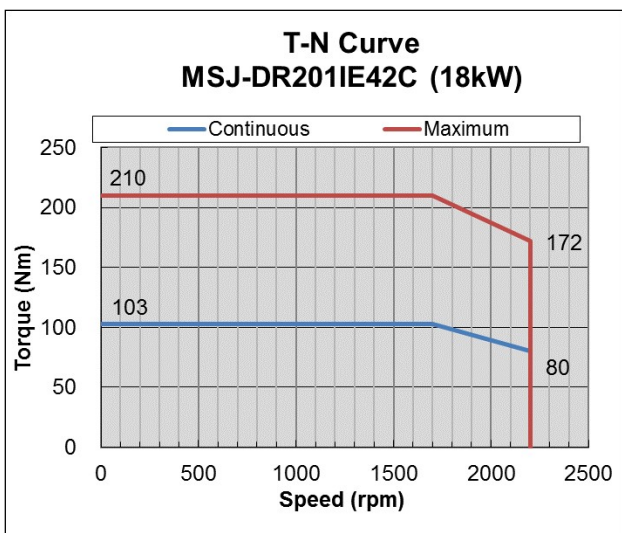
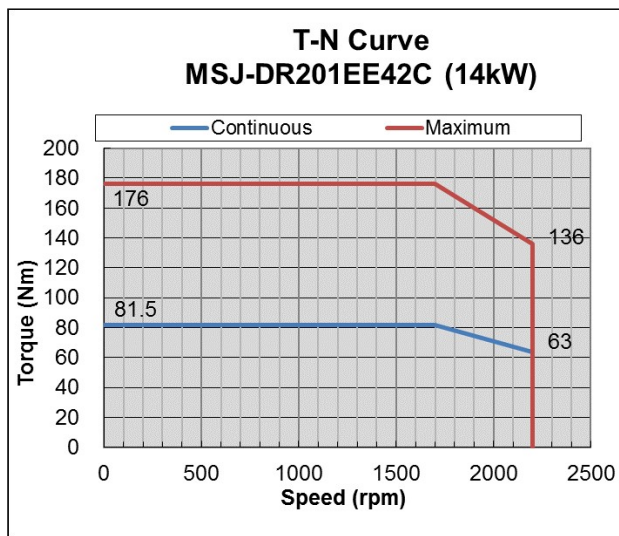
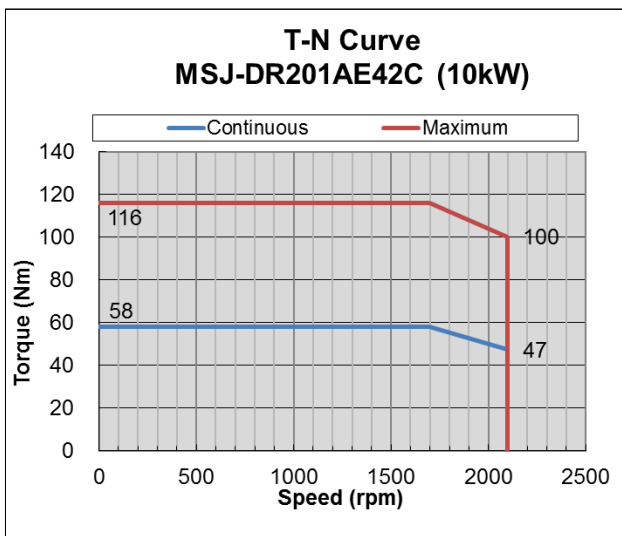
380V:

Model		MSJ_____C								
		R201AE42	R201EE42	R201E42	CR20DE42	LR20FE42	R20CE42	CR26FE48	R26CE48	R26EE48
P/OI-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	245	336	320	365	455	685
Rated Speed	rpm	1700	1700	1700	1800	1500	1700	1800	1700	1700
Maximum Speed	rpm	2150	2150	2150	2250	1950	2150	2250	2150	2150
		<small>*1</small>								
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	kgm ²	7.4	9.6	11.6	13.8	18.0	19.1	41.6	50.5	61.4
		$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$	$\times 10^3$
Weight	kg	46	53	59.5	67.5	83.6	85	134	152	171
Flange	mm	200x200						264x264		
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 ~ 40C Humidity: 20 ~ 90% RH (Non condensation) Altitude < 1000m									
Installation Method	Flange / Support Legs									
Certifications	CE									

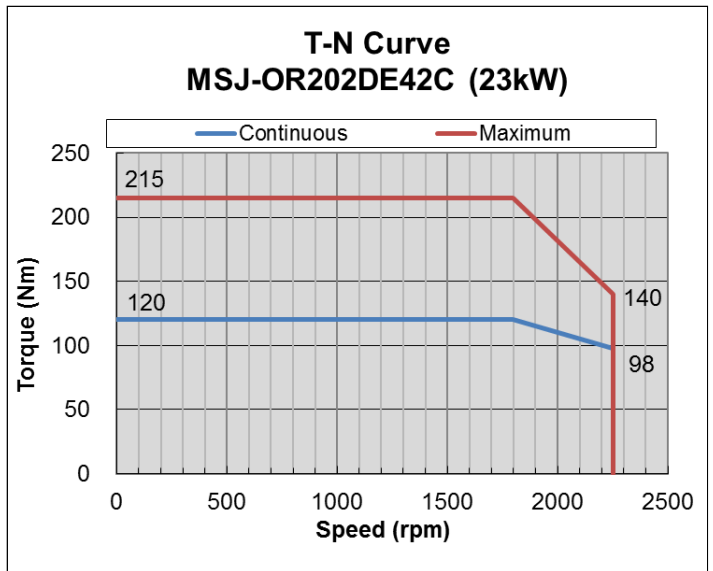
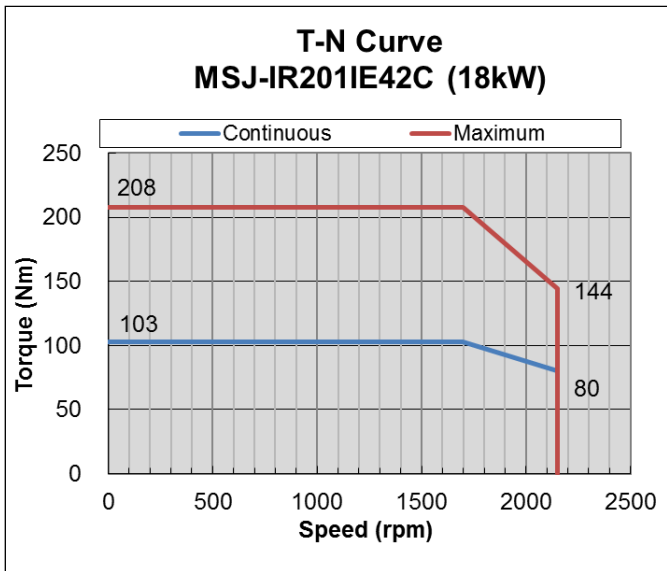
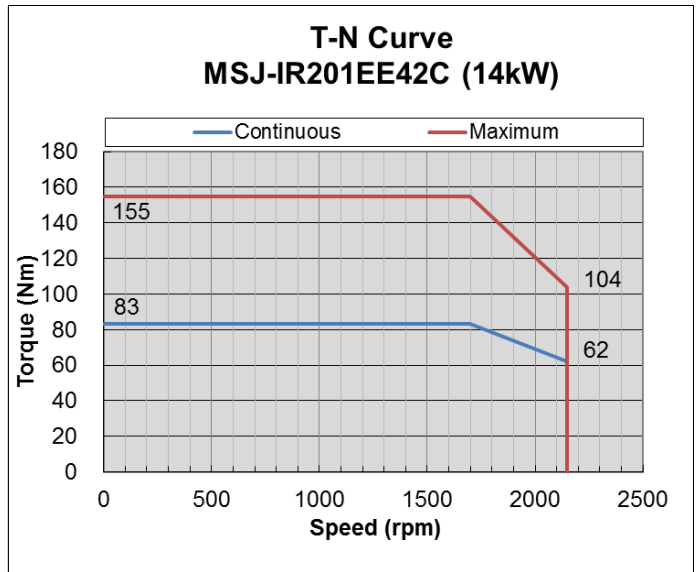
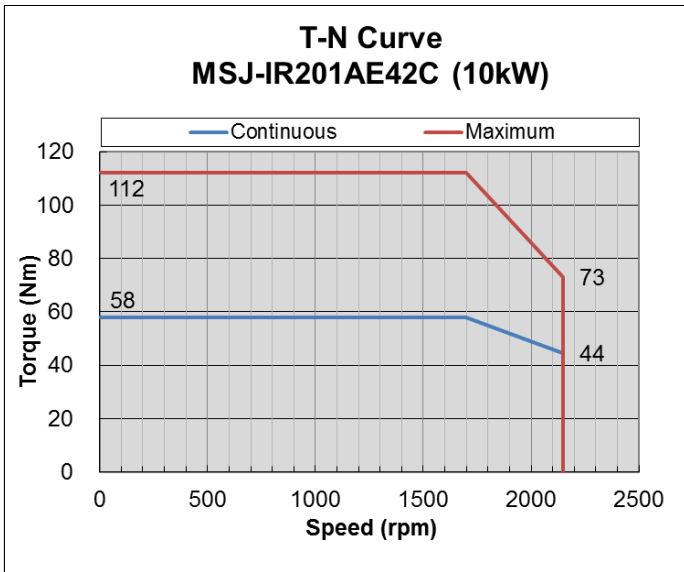
- *1: This chart states the maximum operation speed of a motor with no field weakening control.**
- *2 Set up PIC type Pr02 11 =2 to use PIC130 as temperature protection**
- *3 Users are required to set up the parameter Pr02 09 PIC Level (factory setting 130°C) when using the KTY84 130 temperature sensor (PIC type Pr02 11 =1) for motor overheating protection**
- *4 Delta reserves the right to revise specifications without prior notice.**

C-4 Torque - Rotation characteristic curve

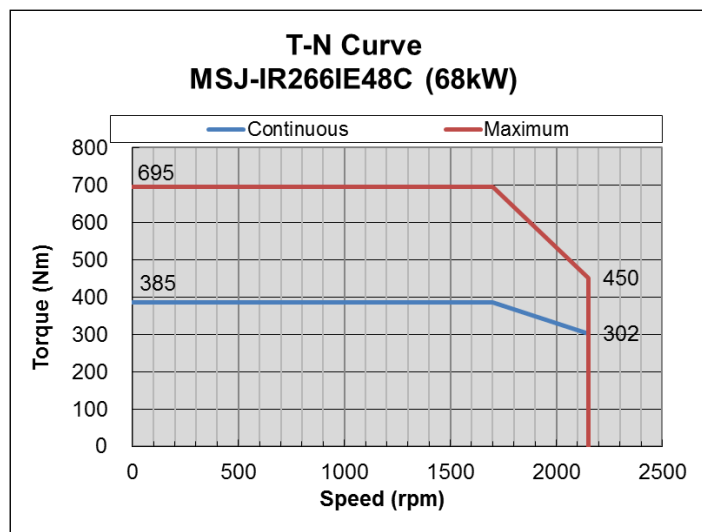
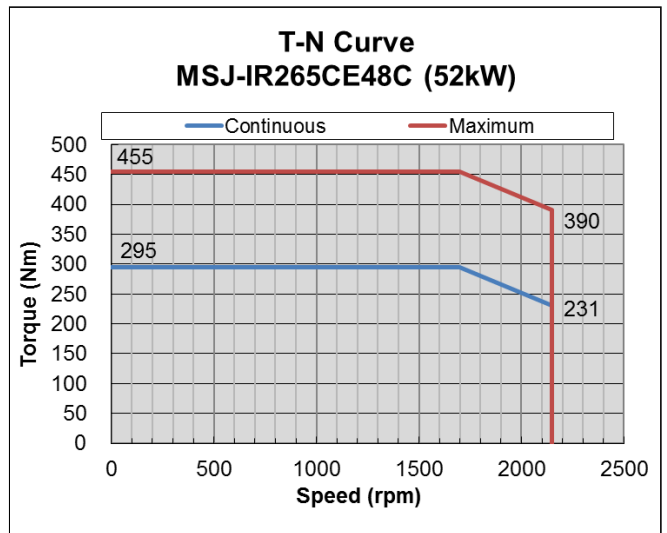
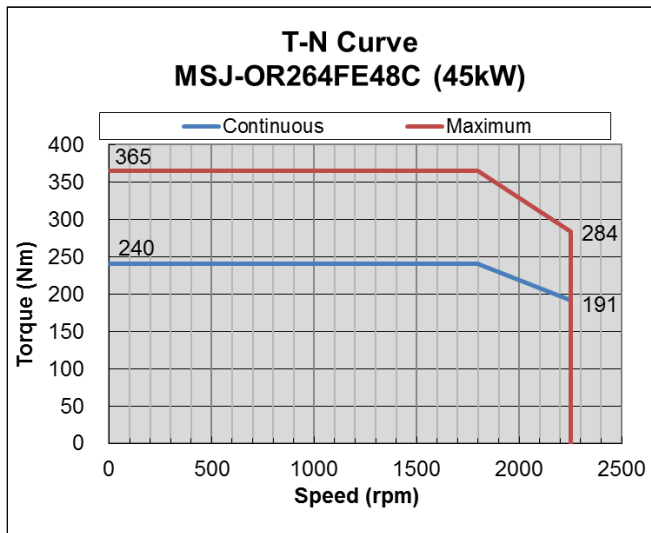
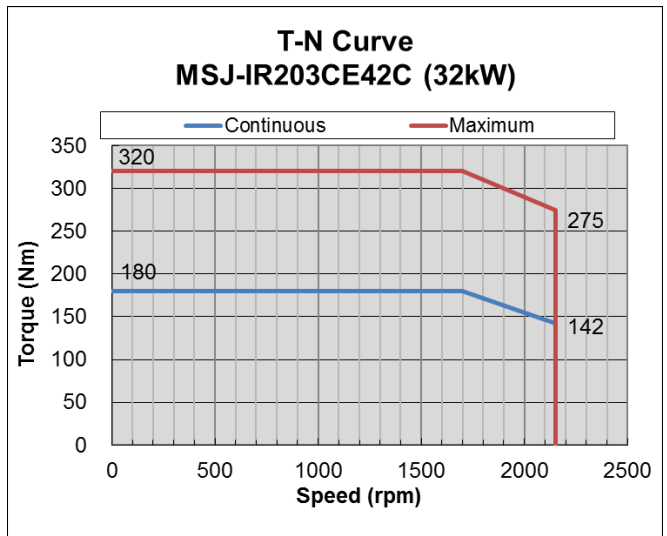
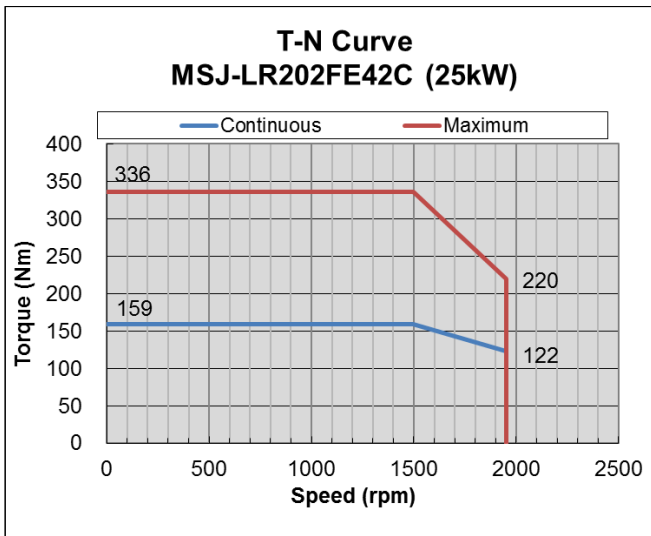
220V:



380V:



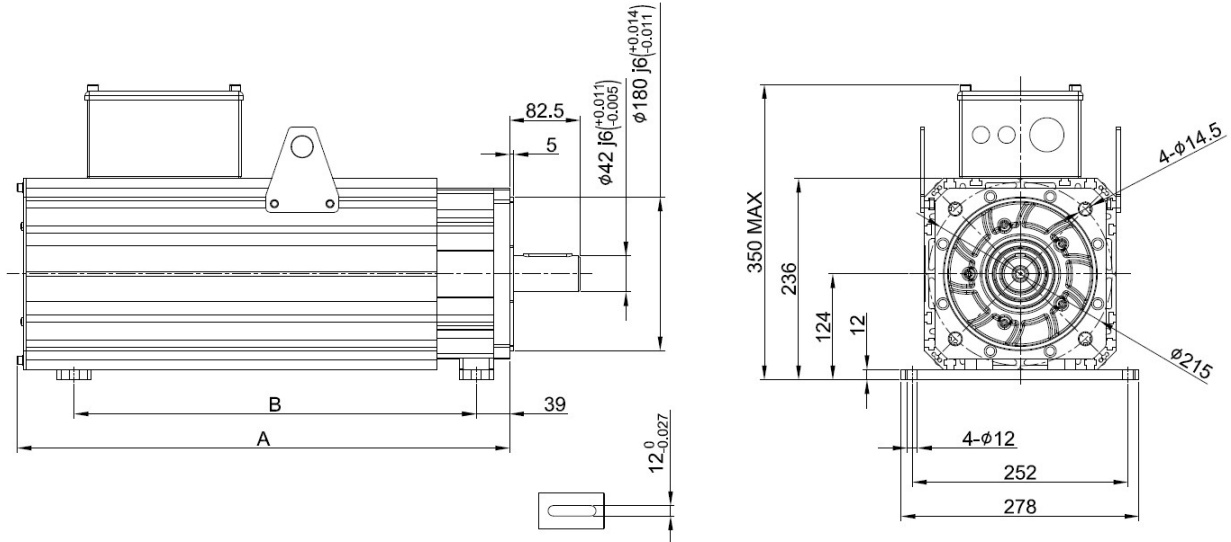
380V



C-5 Product Appearance and Dimensions

220V:

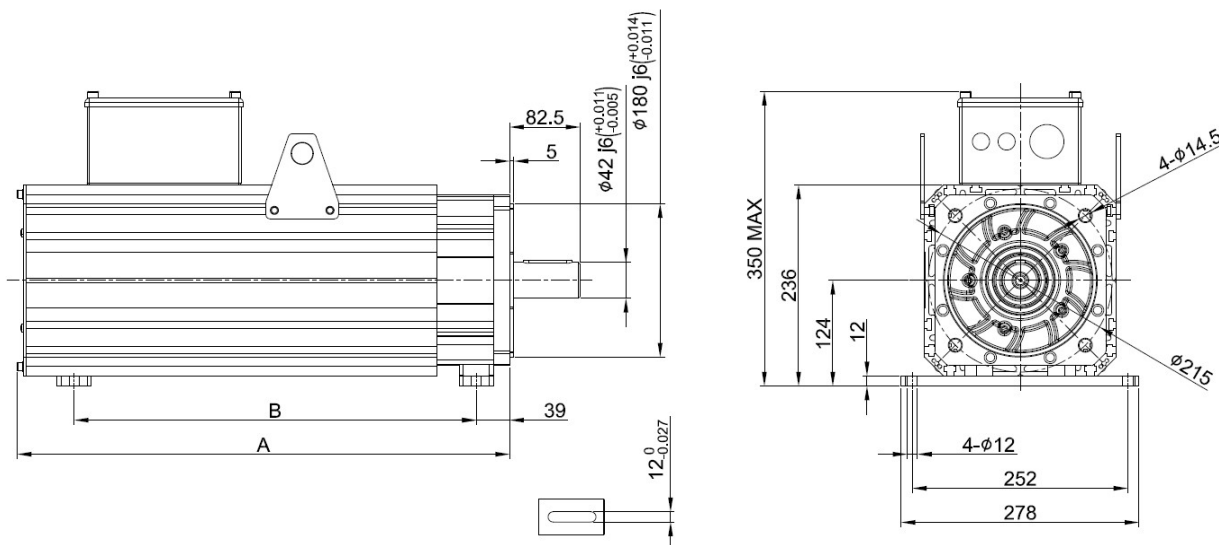
C-5 1: Frame 200



Model		MSJ _____ C				
		DR201AE42	DR201EE42	DR201E42	GR202DE42	DR202HE42
A	mm	381	417	453	489	525
B	mm	285	310	350	385	420

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

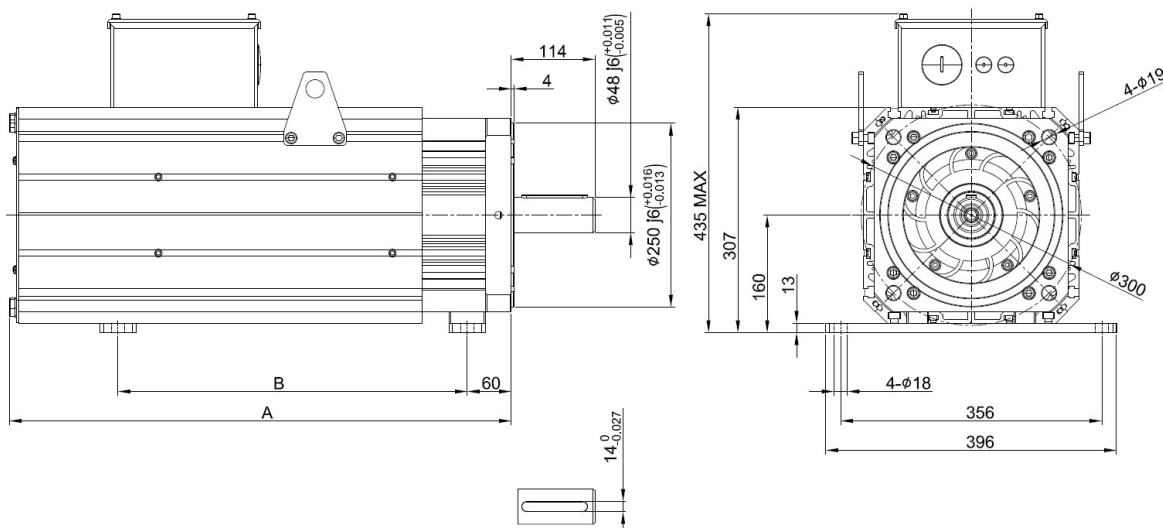
**380V:
C-52 Frame 200**



Model	MSJ_____C					
	IR201AE42	IR201FE42	IR201E42	OR202FE42	LR202FE42	IR203CE42C
A	mm	381	417	453	489	525
B	mm	285	310	350	395	470

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

C-53 Frame 264

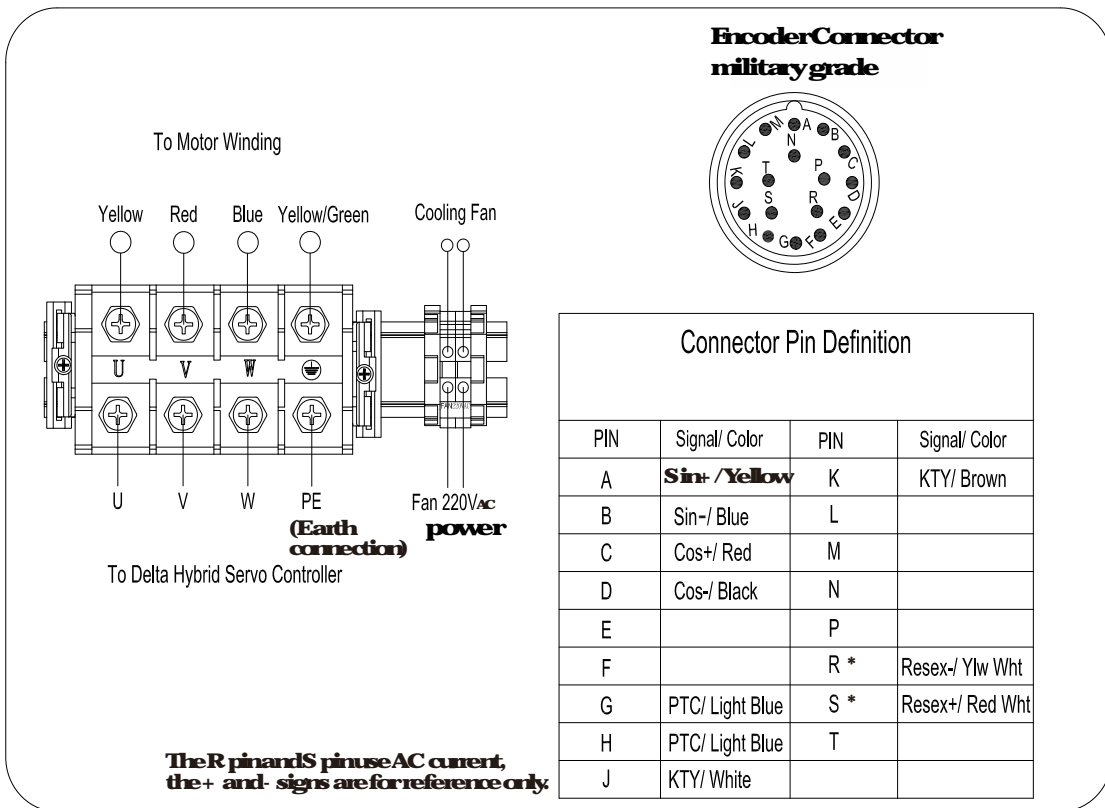


Model	MSJ_____C			
	OR264FE48	IR265CE48	IR266E48C	
A	mm	577	631	684
B	mm	370	423	476

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

C6Wiring of Servo Oil Pump

C6 1: Wiring Box of 220V & 380V



C6 2 Recommended Wiring Size and Temperature Rating

220V:

Model		MSJ _____ C				
		R201AE42	R201EE42	R201E42	OR202E42	LR202FE42
Minimum	AWG	5		4		3
Wiring Size	mm ²	17		21		27

***Must use copper wires of temperature rating 90 for installation**

380V:

Model		MSJ _____ C						
		R201AE42	R201EE42	R201E42 OR202E42	LR202FE42 R202E42	R203CE42	OR204FE48 R205CE48	R206E48
Minimum	AWG	8	7	6	4	3	2	1
Wiring Size	mm ²	85	105	135	21	27	35	45

***Must use copper wires of temperature rating 90 for installation**

C-63 Encoder

220V & 380V:

