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DELTA Hybrid Energy System HES Series User Manual

DELTA
Hybrid Energy System
HES Series User Manual

www.delta.com.tw/ia

Preface

Thank you for choosing the Hybrid Energy System (HES) designed exclusively for the Delta Injection Machine, which consists of Hybrid Servo Controller (VFD-VJ) series and servo oil pump.

These production instructions provide the users with complete information regarding the installation, parameter configuration, anomaly diagnosis, troubleshooting, and routine maintenance of the Hybrid Servo Driver. To ensure correct installation and operation of the hybrid servo driver, please read the instructions carefully before installing the machine. In addition, please store the enclosed CD-ROM properly and pass down to the machine users.

The Hybrid servo driver is a delicate power electronics product. For the safety of the operators and the security of the machine, please only allow professional electrical engineers to conduct installation, tests, and adjust machine parameters. Please carefully read the contents of the instructions that are marked with "Danger" and "caution". Please contact your local Delta agents for any questions and our professional team will be happy to assist you.

PLEASE READ PRIOR TO INSTALLATION FOR SAFETY.

DANGER

- ☑ Make sure to turn off the power before starting wiring.
- ☑ Once the AC power is turned off, when the POWER indicator of the Hybrid Servo Controller is still on, it means there is still high voltage inside the Hybrid Servo Controller, which is very dangerous and do not touch the internal circuits and components. To conduct the maintenance safely, please make sure the voltage between ＋1 and － is lower than 25Vdc using the handheld multimeter before starting the operation.
- ☑ The internal circuit board of Hybrid Servo Controller houses CMOS IC, which is vulnerable to electrostatics. Please do not touch the circuit board by and without any anti-electrostatics measures.
- ☑ Never modify the components or wiring inside the Hybrid Servo Controller.
- ☑ The E⏚ terminal of Hybrid Servo Controller must be grounded correctly. The 230V series uses the third type of ground scheme while the 460V series uses special ground.
- ☑ This series of products cannot be operated in environments that endanger human safety.
- ☑ Please keep children or strangers from approaching Hybrid Servo Controller.

WARNING	☑ Never connect AC power to the output terminals U/T1, V/T2, and W/T3 of Hybrid Servo Controller. ☑ Please do not conduct stress test on the internal components of Hybrid Servo Controller, for the semiconductor devices therein may be damaged by high-voltage breakdown. ☑ Even when the servo oil pump is off, the main loop terminal of Hybrid Servo Controller can still be loaded with high voltage that can be seriously dangerous. ☑ Only qualified professional electrical engineers can conduct tasks of installation, wiring, and maintenance of Hybrid Servo Controller。 ☑ When Hybrid Servo Controller uses external terminals as its run command sources, the servo oil pump may start running immediately after the power is connected, which may be dangerous with any personnel present.
CAUTION	☑ Please choose a safe area to install Hybrid Energy System, where there is no high temperature, direct sunlight, moisture, and water dripping and splash. ☑ Please follow the instructions when installing Hybrid Energy System. Any unapproved operation environment may lead to fire, gas explosion, and electroshock. ☑ When the wiring between the hybrid controller and the hybrid servo motor is too long, it may compromise the interlayer insulation of the motor. Please install a reactor between them (please refer to Appendix A) to avoid burning of the hybrid servo motor from damaged insulation. ☑ The voltage rating of the power supply of Hybrid Servo Controller 230 series cannot be higher than 240V (no higher than 480V for 460 series) and the associated current cannot exceed 5000A RMS (no higher than 10000A RMS for models with 40HP (30kW))

NOTE

- To provide detailed product descriptions, the illustrations are made with the exterior cover or safety shield removed. When the product is running, please make sure the exterior cover is secured and the wiring is correct to ensure safety by following the instructions of the manual.
- The figures in the manual are made for illustration purposes and will be slightly different from the actual products. However, the discrepancy will not affect the interests of clients.
- Since our products are being constantly improved, for information about any changes in specifications, please contact our local agents or visit (http://www.delta.com.tw/industrialautomation/) to download the most recent versions.

Table of Contents

Chapter 1 Use and Installation

Upon receipt of the product, the clients are advised to keep the product in its original packaging box. If the machine won't be used temporarily, for future maintenance safety and compliance with the manufacturer's warranty policy, please pat attention to the following for product storage:

- ☑ Store in a clean and dry location free from direct sunlight or corrosive fumes.
- ☑ Store within an ambient temperature range of -20 °C to +60 °C.
- ☑ Store within a relative humidity range of 0% to 90% and non-condensing environment.
- ☑ Avoid storing the product in environments with caustic gases and liquids.
- ☑ Avoid placing the product directly on the ground. The product should be placed on suitable benches and desiccators should be placed in the packaging bags in harsh storage environments.
- ☑ Avoid installing the product in places with direct sunlight or vibrations.
- ☑ Even if the humidity is within the required value, condensation and freezing can still happen when there is drastic change of temperature. Avoid storing products in such environment.
- ☑ If the product has been taken out of the packaging box and in use for over three months, the temperature of the storage environment must be below 30°C. This considers the fact when the electrolytic capacitor is stored with no current conduction and the environment temperature is too high, its properties may deteriorate. Please do not store the product in the situation of no current conduction for more than one year.

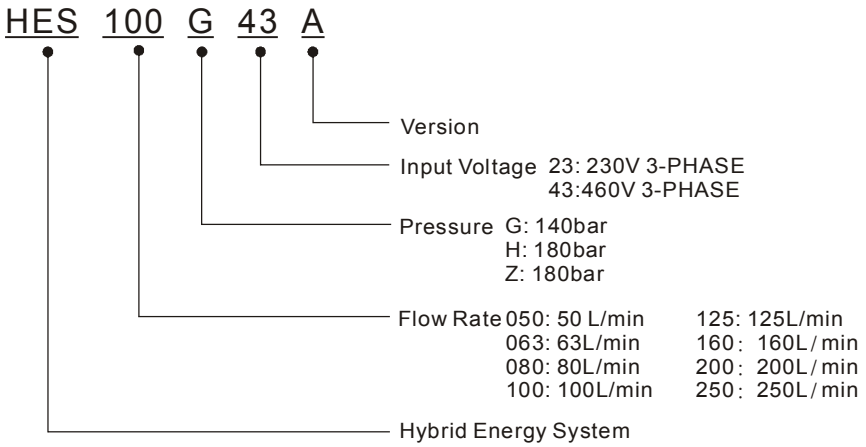
1-1 Exterior of Product

All Hybrid Energy System has passed strict quality control before being shipped out from the factory, with enforced packaging that sustains impacts. Upon opening the packaging of the Hybrid Energy System, the customers are recommended to conduct the examination by the following steps:

- ☑ Check if there is any damage to Hybrid Energy System during shipping.
- ☑ Upon opening the box, check if the model number of Hybrid Energy System matches that listed on the external box.

For any mismatch of the listed data with your order or any other issues with the product, please contact your local agent or retailer.

Model Explanation



1-2 Specifications

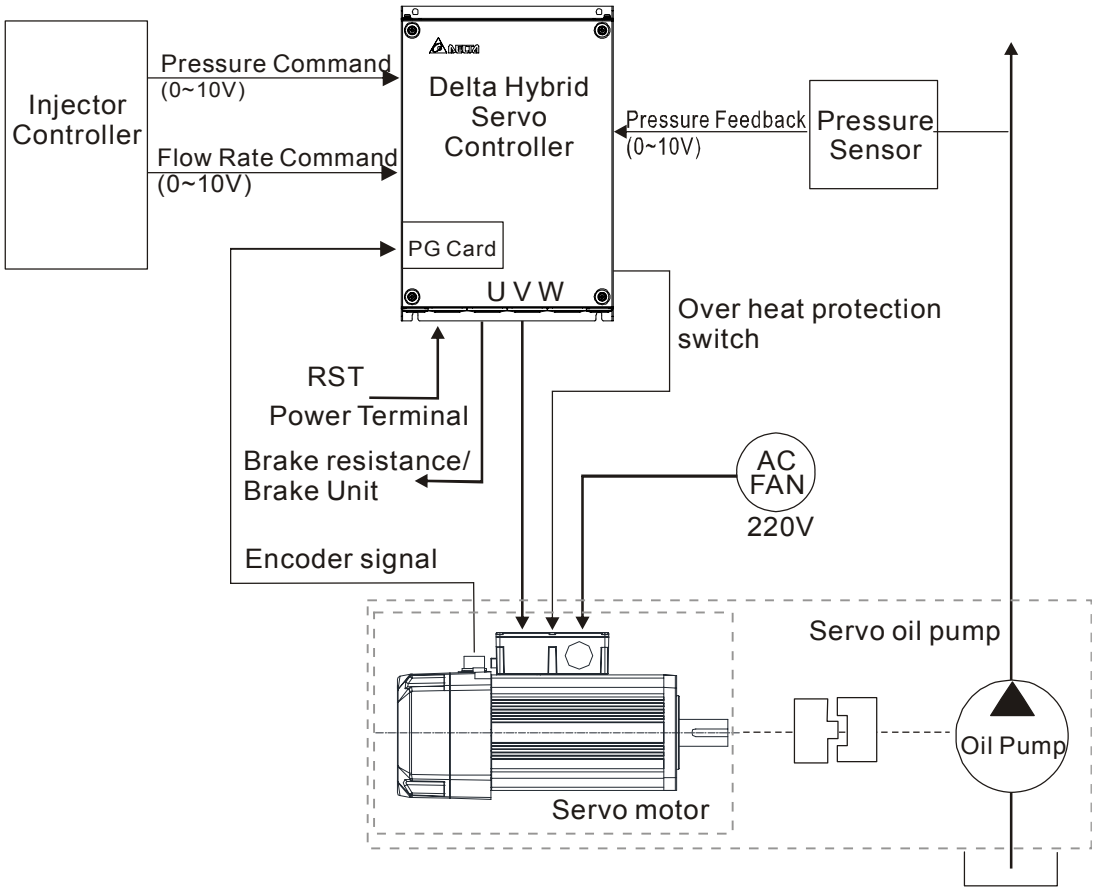
230V Series Specifications

Model Number			HES___23A										
			063H	080G	080H	100G	100H	100Z	125G	125H	160G	160H	200G
Oil Pump Capacity		cc/rev	25	32		40			50		64		80
Flow Rate Specifications	Flow Rate	L/min	63	80		100			125		160		200
	Linear	%	Below 1% F.S.										
	Magnetic Hysteresis	%	Below 1% F.S.										
Pressure Specifications	Maximum Pressure	Mpa	18	14	18	14	18	18	14	18	14	18	14
	Minimum Pressure	Mpa	0.1										
	Linear	%	Below 1% F.S.										
	Magnetic Hysteresis	%	Below 1% F.S.										
Servo Oil Pump Specifications	Power	kW	11					15				20	
	Insulation Grade		Grade A (UL)										
	Cooling Method		Forced Air Cooling										
	Environment Temperature		0 ~ 40 °C										
	Environment Humidity		20 ~ 90 RH (No condensation)										
	Weight	kg	82			83		95	108		110		144
Servo Controller Specifications	VFD-___VL23A(_)		110 (06HA)	110 (08GA)	150 (08HA)	150 (10GA)	185 (10HA)	220 (10ZA)	220 (12GA)	300 (12HA)	300 (16GA)	370 (16HA)	370 (20GA)
	Input Voltage (V)		3-Phase 200~240V, 50/60Hz										
	Rated Output Capacity	kVA	19		25		29	34		46			56
	Weight	kg	10		13					36			
	Brake Unit		Built-in									Plugged-in	
	Brake resistor	W	1000									1500	
		Ω	8.3		5.8								
	Speed Inspector		Resolver										
	Pressure Command Input		0~10V Support three-point calibration										
	Flow Rate Command Input		0~10V Support three-point calibration										
	Multi-functional Input Terminal		5ch DC24V 8mA										
	Multi-functional Output Terminal		2 ch DC24V 50mA, 1 ch Relay output										
	Analog Output Voltage		2 ch dc 0~10V										
	Cooling Method		Forced Air Cooling										
	Environment Temperature		-10 ~ 45 °C										
	Environment Humidity		Below 90 RH (No condensation)										
	Protection Functions		Over current, over voltage, low voltage,, over heating, and overload in Hybrid Servo Controller and over heating, overload, and abnormal speed in Hybrid Servo Motor.										
Actuation Oil	Working Medium		HL-HLP DIN51 524 Part1/2 R68,R46										
	Operation Temperature	°C	-20 to 100										
	Viscosity	@40 °C	67.83										
		@100 °C	8.62										
Miscellaneous			Safety, Reactor, and EMI filter are optional.										

460V Series Specifications

Model Number			HES____43A											
			063G	063H	080G	080H	100G	100H	100Z	125G	125H	160G	160H	200G
Oil Pump Capacity		cc/rev	25		32		40			50		64		80
Flow rate Specifications	Flow Rate	L/min	63		80		100			125		160		200
	Linear	%	Below 1% F.S.											
	Magnetic Hysteresis	%	Below 1% F.S.											
Pressure Specifications	Maximum Pressure	Mpa	14	18	14	18	14	18	18	14	18	14	18	14
	Minimum Pressure	Mpa	0.1											
	Linear	%	Below 1% F.S.											
	Magnetic Hysteresis	%	Below 1% F.S.											
Servo Oil Pump Specifications	Power	kW	11							15			20	
	Insulation Grade		A grade (UL)											
	Cooling Method		Forced Air Cooling											
	Environment Temperature		0 ~ 40 °C											
	Environment Humidity		20 ~ 90 RH(No condensation)											
	Weight of Servo Oil Pump	kg	82				83		95	108		110		144
Servo Controller Specifications	Model Number VFD-___VL43A(_)		110A (06GA)	150B (06HA)	150B (08GA)	185B (08HA)	185B (10GA)	220A (10HA)	220A (10ZA)	220A (12GA)	300B (12HA)	300B (16GA)	370B (16HA)	370B (20GA)
	Input Voltage		Three-Phase 380 ~ 460V, 50/60Hz											
	Rated Output Capacity	KVA	19	25		29		34			46		56	
	Weight	kg	10				13						36	
	Brake Unit		Built-in										Plugged-in	
	Brake resistor	W	1000										1500	
		Ω	25						20		14		13	
	Speed Inspector		Resolver											
	Pressure Command Input		0~10V Support three-point calibration											
	Flow Rate Command Input		0~10V Support three-point calibration											
	Multi-functional Input Terminal		5ch DC24V 8mA											
	Multi-functional Output Terminal		2 ch DC24V 50mA, 1 ch Relay output											
	Analog Output Voltage		2 ch dc 0~10V											
	Cooling Method		Forced Air Cooling											
	Environment Temperature		-10 ~ 45 °C											
	Environment Humidity		Below 90 RH(No condensation)											
	Protection Functions		Over current, over voltage, low voltage, over heating, and overload in Hybrid Servo Controller and over heating, overload, and abnormal speed in Hybrid Servo Motor.											
Actuation Oil	Working Medium		HL-HLP DIN51 524 Part1/2 R68,R46											
	Operation Temperature	°C	-20 to 100											
	Viscosity	@40 °C	67.83											
		@100 °C	8.62											
Miscellaneous			Safety, Reactor, and EMI filter are optional.											

1-3 Introduction of Hybrid Energy System



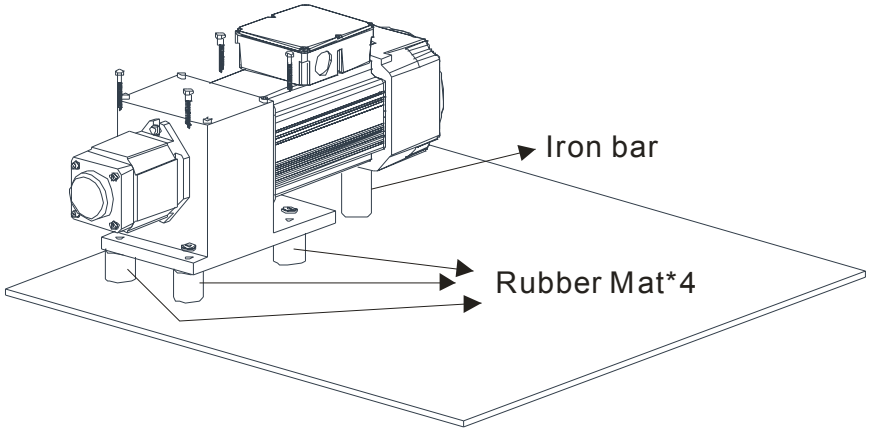
1-4 Installation

Servo Oil Pump

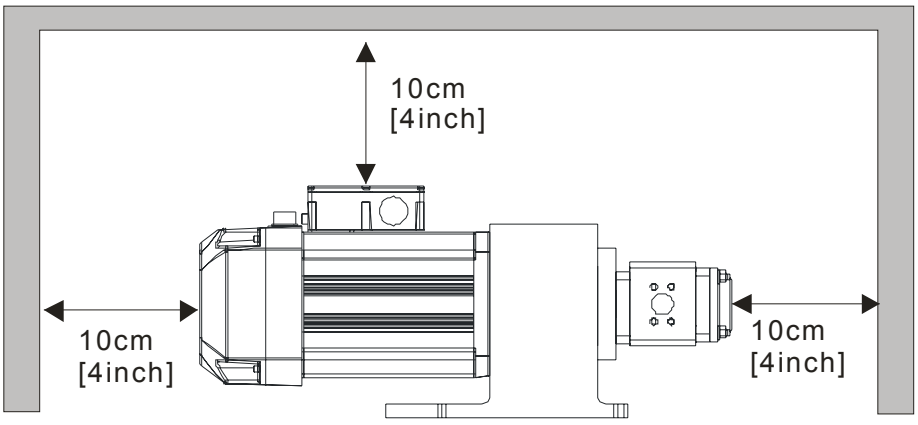
Please install the servo oil pump in an environment with the following conditions to ensure safe product operation:

Conditions of Operation Environment	Environment Temperature	0°C~ 40°C
	Relative Humidity	20%~90%, No condensation
	Oil Temperature	0°C~ 60°C (15°C~ 50°C is recommended)

The figure below shows that HES is installed on the machine. The screws must be secured to the rubber mat to fixate the servo oil pump. It is recommended to add iron bars as the support of the hybrid servo motor.



Installation Space



Installation Distance

Since heat is generated as the hybrid servo motor is running, certain space must be reserved to ensure good circulation of the cooling air as shown in the figure above.

When the hybrid servo motor is running, the temperature of the external cover will reach to about 100°C. Please do not touch it with hand to avoid burns.

NOTE

Please do not let any foreign objects such as fiber, paper pieces, wood chips or metal pieces to adhere to the cooling fan of the hybrid servo motor.

Pipelines & Connections

- Remove all protection caps on the pump
- Choose suitable oil tube and connectors (Maximum intake flow rate 1m/s)

Recommended Specifications of intake oil tube		
Flow Rate(L/min)	Tube Diameter (inch)	Length (m)
80	Above 1.5	Within 1.5
100	Above 1.5	Within 1.5
125	Above 2	Within 1.5
160	Above 2.25	Within 1.5
200	Above 2.5	Within 1.5

- Absolute intake oil pressure: Maximum 2 bar
- Prior to assembly, the iron dusts in the connectors and oil tubes must be removed.
- The filter for the oil inlet must be above 150mesh.

NOTE

For safety, please install safety valve in the oil line loop.

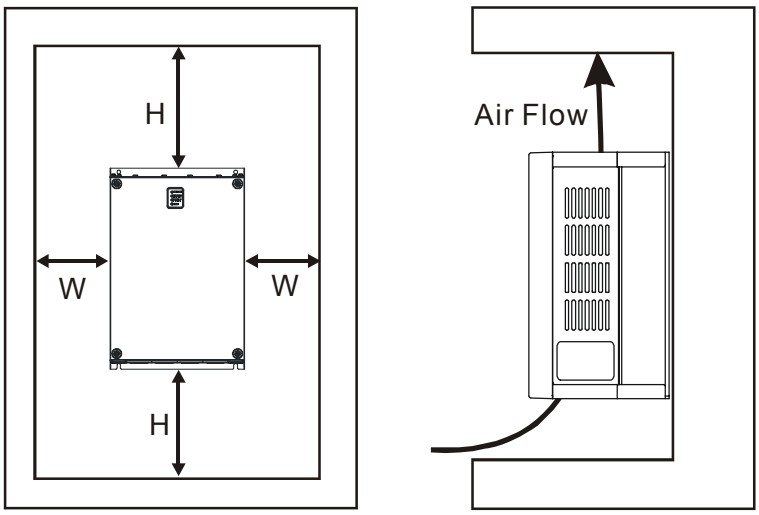
Do not add check valve to the oil outlet of the oil pump to avoid poor response of Hybrid Energy System.

Hybrid Servo Controller

Please install the Hybrid Servo Controller in an environment with the following conditions to ensure safe product operation:

Conditions of Operation Environment	Environment Temperature Relative Humidity Pressure Installation heights Vibration	-10°C~ +45°C <90%，No condensation 86 ~ 106 kPa <1000m <20Hz: 9.80 m/s^2 (1G) max; 20~50H:5.88 m/s^2 (0.6G) max
Conditions of Storage and Shipping Environment	Environment Temperature Relative Humidity Pressure Vibration	-20°C~ +60°C (-4°F ~ 140°F) <90%，No condensation 86 ~ 106 kPa <20Hz: 9.80 m/s^2 (1G) max; 20 ~ 50Hz: 5.88 m/s^2 (0.6G) max
Contamination Protection Grade	2nd Grade: suitable for factory environments with medium to low contamination	

Installation Space



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

- ☑ The Hybrid Servo Controller must be installed vertically with screws to sturdy structures. Do not install it upside down, tilted, or horizontally.
- ☑ Since heat is generated when Hybrid Servo Controller is running, good circulation of the cooling air must be provided as shown in the figure above. Certain space is reserved in the design to allow the heat generated to dissipate upwards. As a result, do not install the machine below any equipment that cannot stand excessive heat. If the machine is installed in the control plate, special care must be given to maintain good air flow for cooling so that the surrounding temperature of Hybrid Servo Controller won't exceed the regulated values. Do not install Hybrid Servo Controller in any closed box with poor air flow and cooling, which will lead to machine malfunction.
- ☑ As the Hybrid Servo Controller is running, the temperature of the cooling plate will change with the environment temperature and the load, with the maximum temperature reaching to about 90°C. Therefore, the backside of installation materials for Hybrid Servo Controller must be able to sustain high temperature.
- ☑ When multiple Servo Controllers are installed in one single control plate, it is recommended to install them with laterally to avoid heat interference among each other. If stacking installation is needed, spacers must be installed to minimize the effect of the heat from the lower machine on the upper machine.

NOTE

Do not add check valve to the oil outlet of the oil pump to avoid poor response of Hybrid Energy System.

The product should be installed in a control plate made of inflammable materials such as metal to avoid the risk of fire.

Chapter 2 Wiring

Upon opening the top cover of the Hybrid Servo Controller and reveal the wiring terminal bus, check if the terminals of each Main circuit circuit and control loop circuit are labeled clearly. Pay attention to the following wiring descriptions to avoid any incorrect connection.

- ☑ The Main circuit power terminals R/L1, S/L2, and T/L3 of the Hybrid Servo Controller are for power input. If the power supply is connected by accident to other terminals, the Hybrid Servo Controller will be damaged. In addition, it is necessary to verify that the voltage/current rating of power supply is within the numbers listed on the name plate.
- ☑ The ground terminal must be grounded well, which can avoid being stricken by lightning or occurrence of electrocution and minimize interference by noise.
- ☑ The screw between each connection terminal and the wire must be tightened securely to avoid sparking by getting loose from vibration.

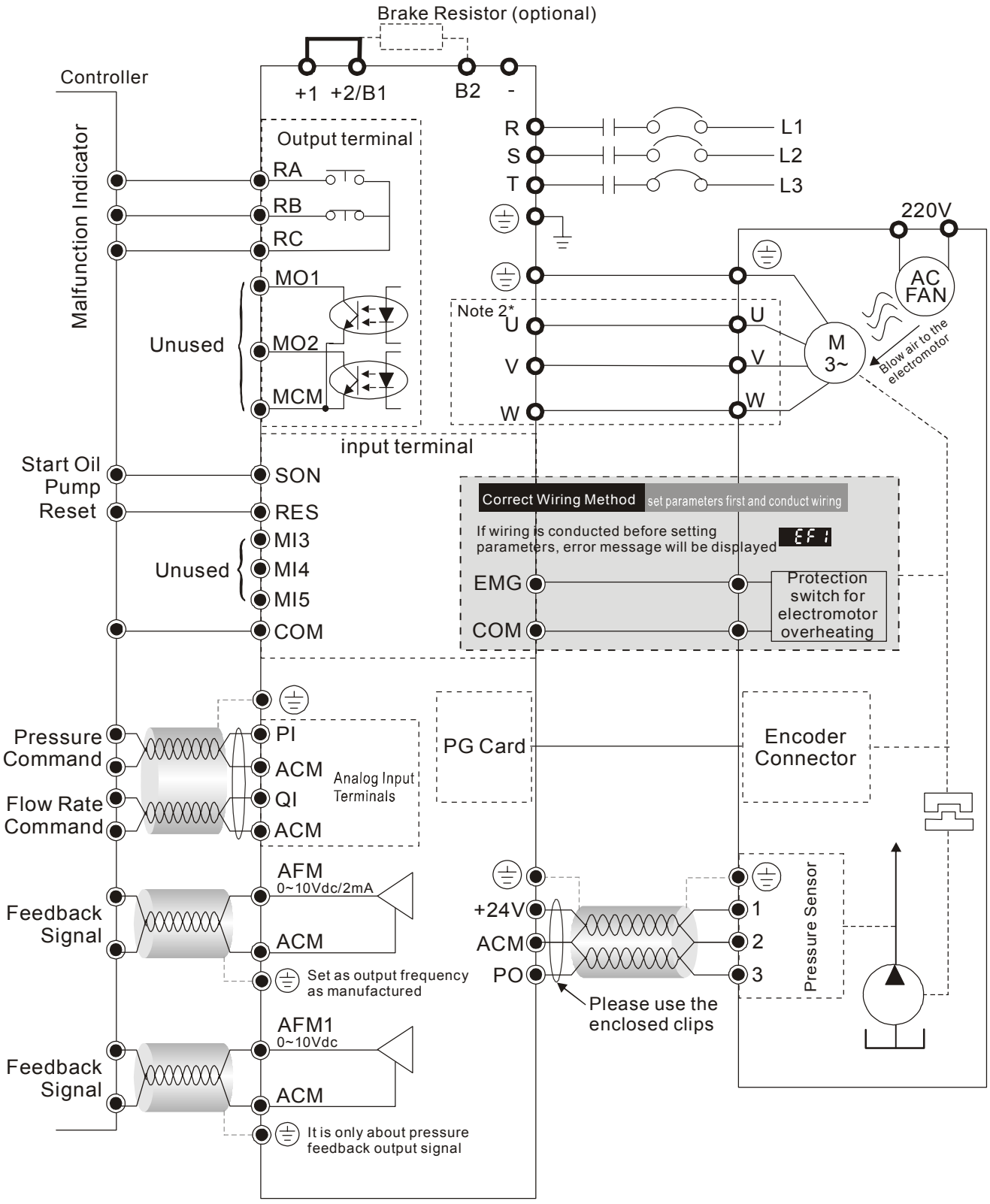
 **DANGER**	☑ If the wiring is to be changed, first step is to turn off the power of the Hybrid Servo Controller, for it takes time for the DC filter capacitor in the internal loop to completely discharge. To avoid any danger, the customer can wait for the charging indicator (READY light) to be of completely and measure the voltage with a DC voltmeter. Make sure the measured voltage is below the safety value of 25Vdc before starting the wiring task. If the user fails to let the Hybrid Servo Controller completely discharge, residual voltage will build up internally, which will cause short circuit and spark if wiring is conducted. Therefore, it is recommended that the user should only conduct the wiring when there is no voltage to ensure his/her safety. ☑ The wiring task must be conducted only by professional personnel. Make sure that the power is off before starting to avoid incidence such as electrocution.
 **CAUTION**	☑ During wiring, please follow the requirements of the electrical regulations to select proper gauges and conduct wiring accordingly to ensure safety. ☑ Check the 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 Wiring

The wiring of the hybrid energy system consists of that for the servo oil pump and that for the Hybrid Servo Controller. The user must follow the wiring loop below for all wire connections.

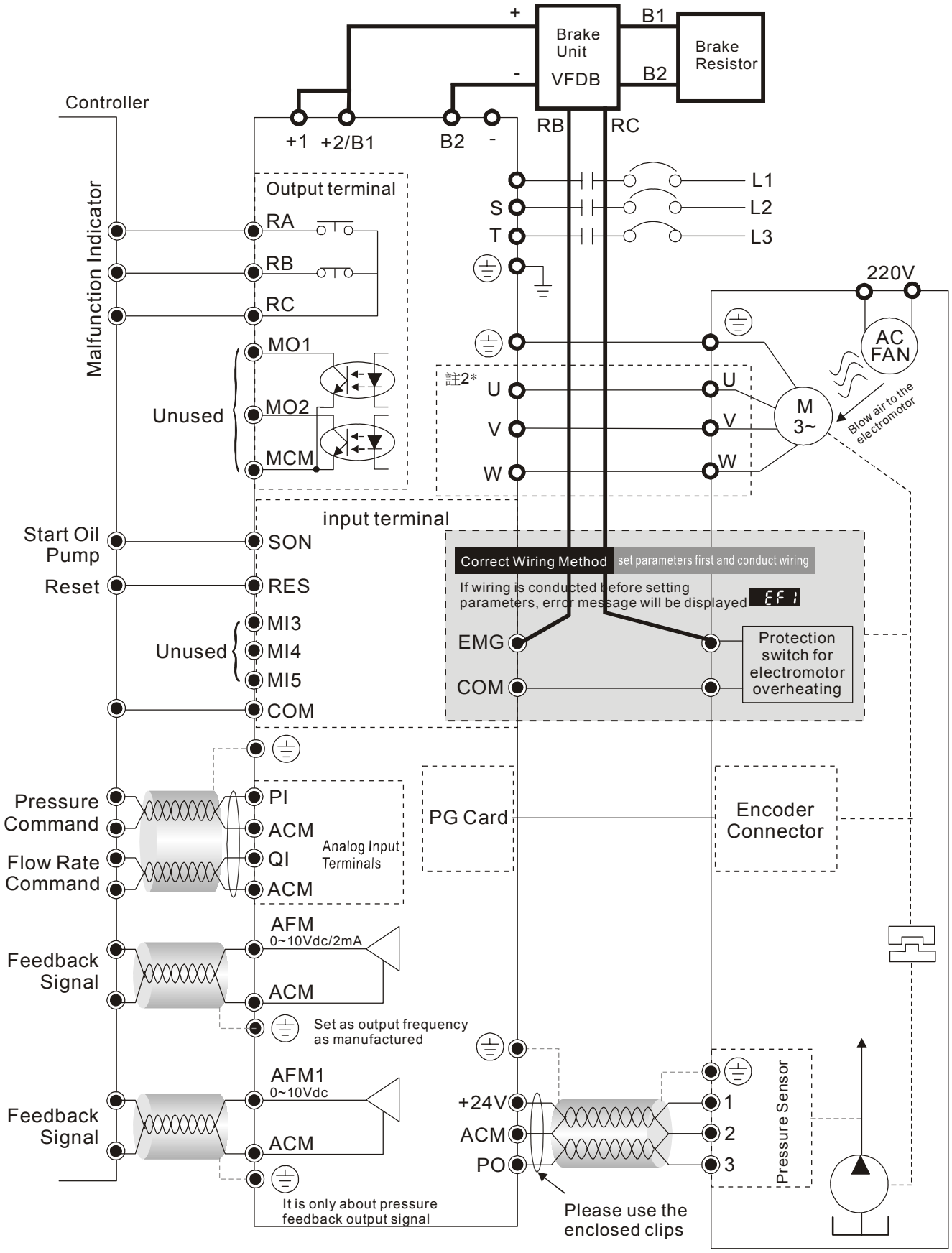
Standard Wiring Diagram

HES063A23A~HES125G23A; HES063G43A~HES160G43A;

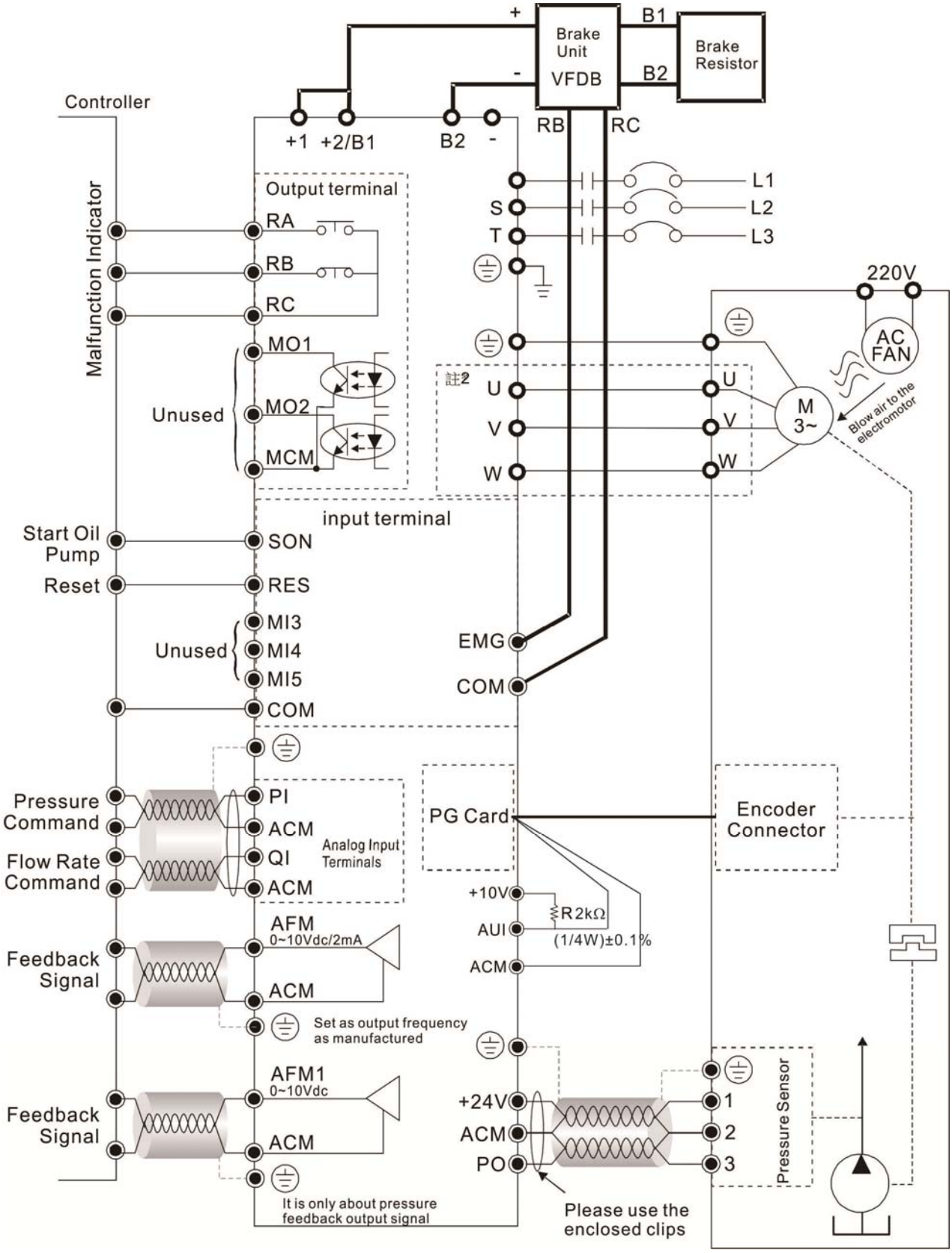


HES125H23A~HES200G23A;

HES160H43A~HES200G43A;



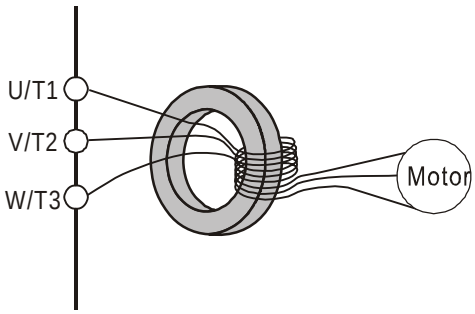
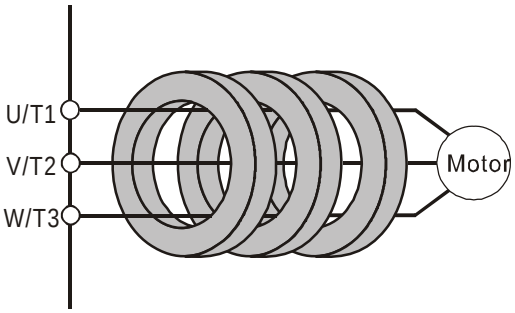
HES250M43C



Note 1*

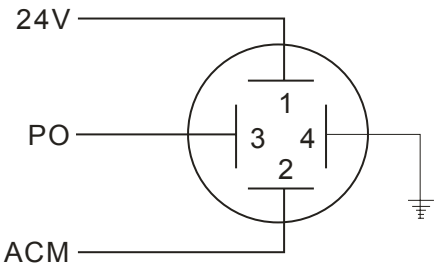
The RB, RC wiring of the braking unit: the overheat protection wiring of the braking unit.

Note 2*

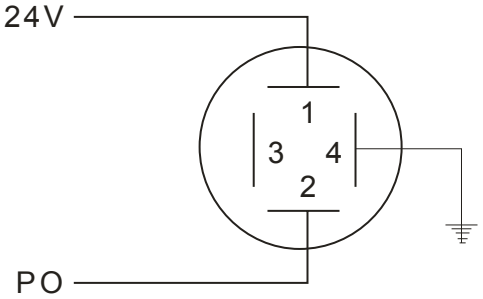
For models with power rating below 22kW (including 22kW) (it is recommended to wrap the output wire around the zero-phase reactor for over three times before connecting it to the motor)	For models with power rating below 30kW (including 30kW)
	

Wiring Diagram of Pressure Sensor

Voltage type pressure Sensor => Pin1: 24V， Pin2 : ACM， Pin3 : PO

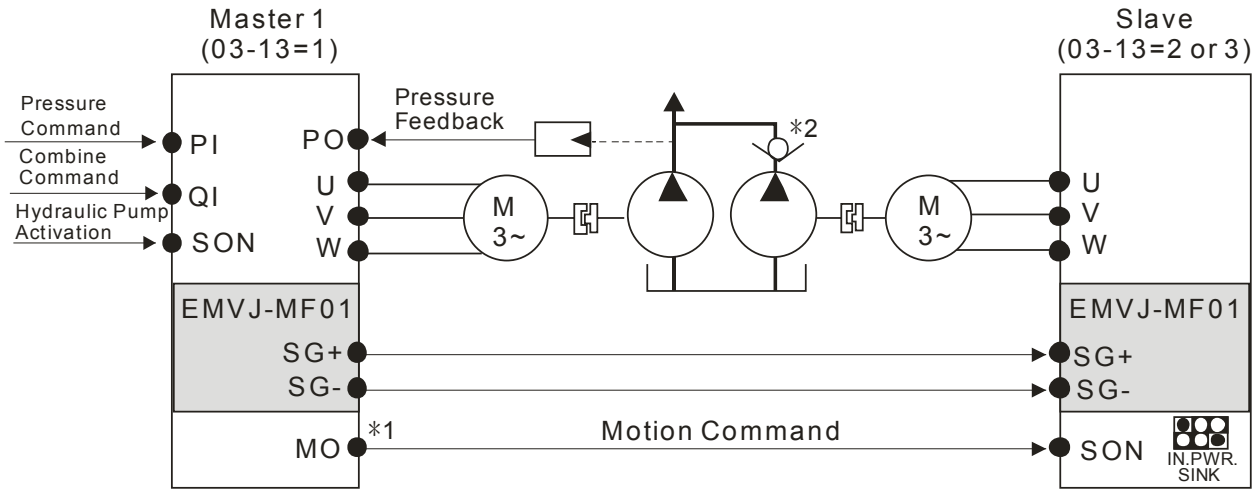
 Connector of Pressure Sensor	

Current type pressure Sensor => Pin1: 24V ，Pin2 : PO ， Pin3 : N/A

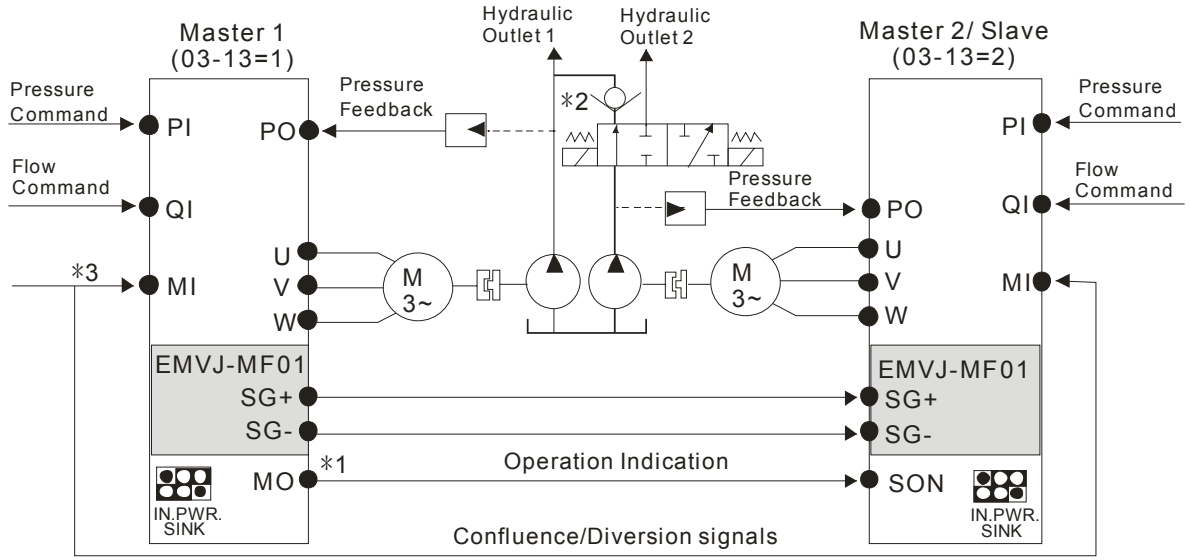
 Connector of Pressure Sensor	

Multi-pump Operation Mode

Confluence Mode



Confluence-Diversion Mode



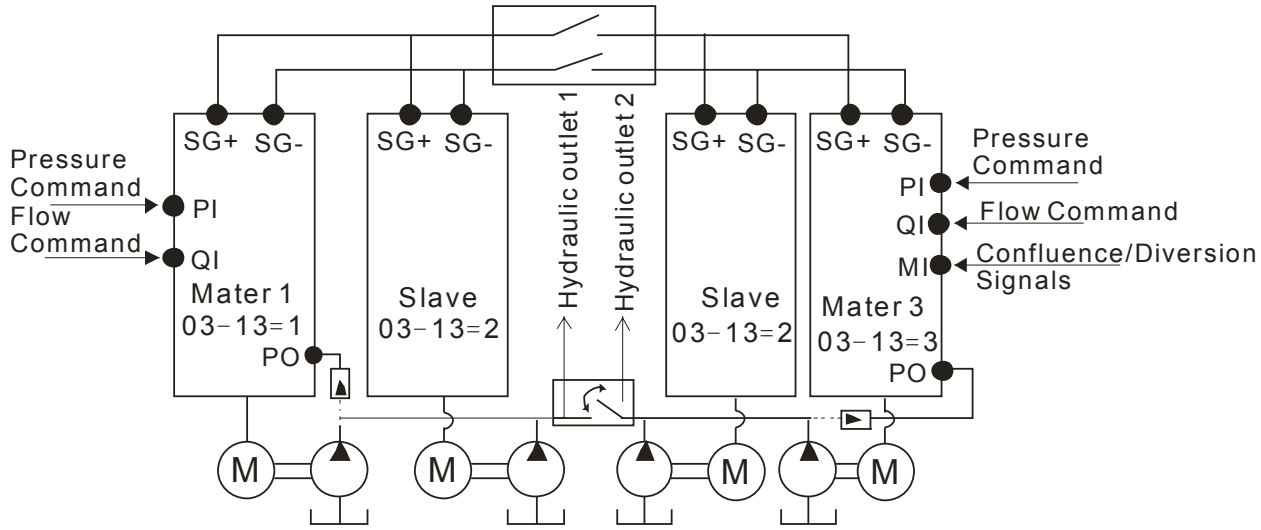
NOTE

*1 For firmware version 2.03 and above, the operating commands are given through the communications. Therefore, the parameters for the slave is 01-01 = 2

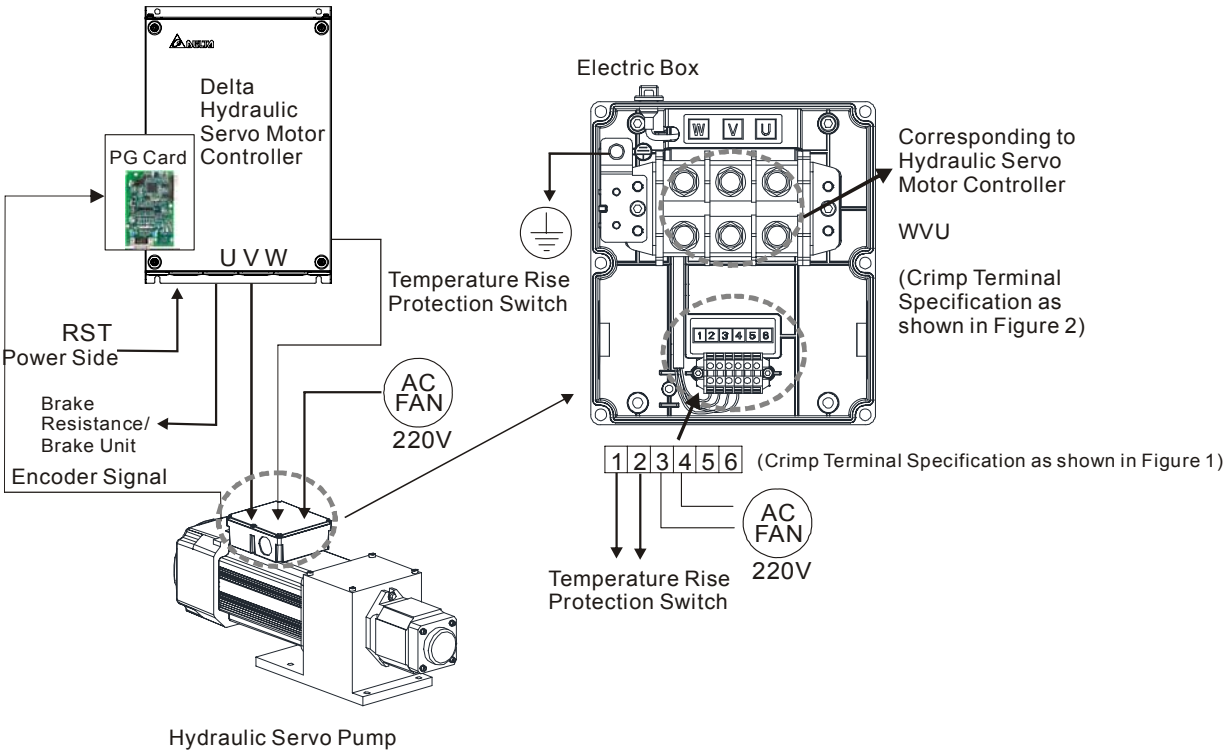
*2 For firmware version 2.03 and above, it is not necessary to install this check valve. By selecting the slave parameter 03-21 at the slave to see if the slave will perform the reverse depressurization. Parameters 03-21 = 0 for not performing the reverse depressurization.

*3 For firmware version 2.03 and above, the diversion/confluence signal is supplied to only Master 2/Slave. It is not necessary to supply the signal to Master 1.For the following control arrangement, it is necessary to disconnect the communications during diversion.

When the signals areConfluence , the communication will be a short circuit
When the signals areDiversion , the communication becomes an open circuit.



2-2 Wiring of Servo oil Pump



Crimp Terminals

Terminal Torque: 82kg-m (71in-lbf)

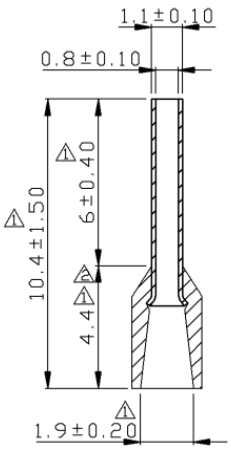


Figure 1

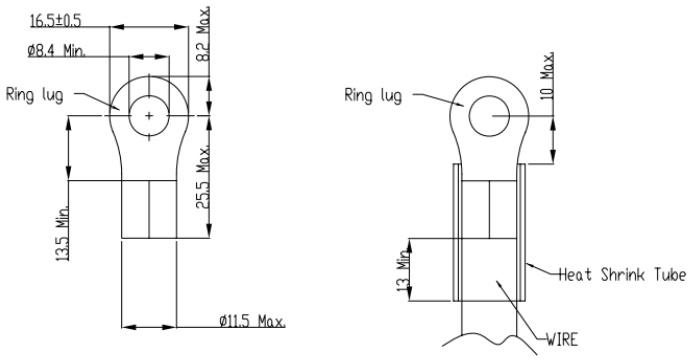
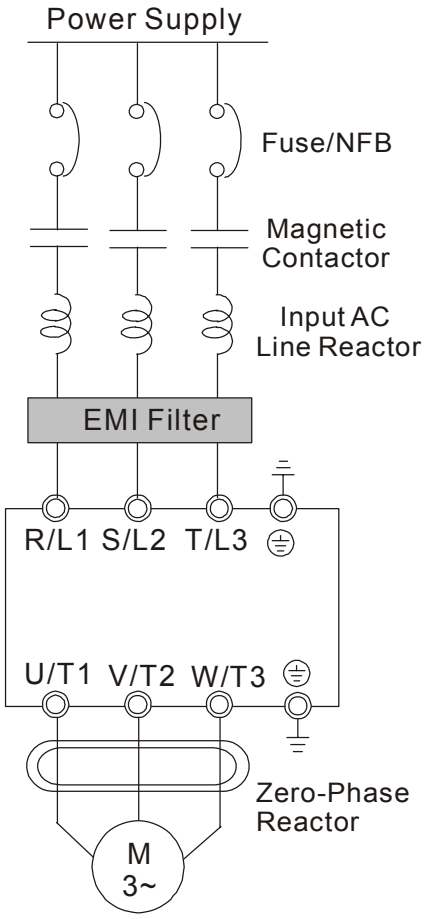


Figure 2

External Wiring of Hybrid Servo Controller

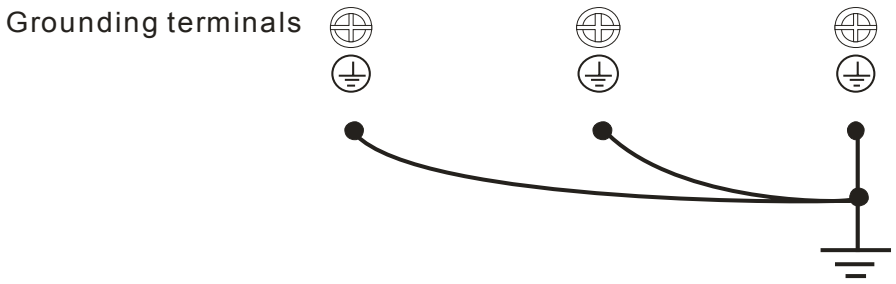


Power Supply	Please follow the power rating listed in the user's manual (chapter 1)
Fuse/NFB (Optional)	A larger current may be generated when the power is turned on. Please refer to Appendix B-1 to select suitable non-fused switch or fuse.
Magnetic Contactor	Turning on/off the side electromagnetic contactor can start/stop the hybrid servo controller. However, frequent switching may lead to malfunction. It is advised not to turn on/off the hybrid servo controller for more than 1 time/hour.
Input AC Line Reactor (Optional)	When the output capacity exceeds 1000kVA, it is recommended to add an AC reactor to improve the power factor, with the wiring distance within 10m. Please refer to Appendix B-2 for details.
Zero-Phase Reactor	This is to reduce the radiation interference, especially in places with audio devices. It can also reduce the interferences at the input and output sides. Please refer to appendix B-2 for details. The effective range is from AM band to 10MHz.
EMI Filter	It can be used to reduce electromagnetic interference. Please refer to Appendix B-5 for details.

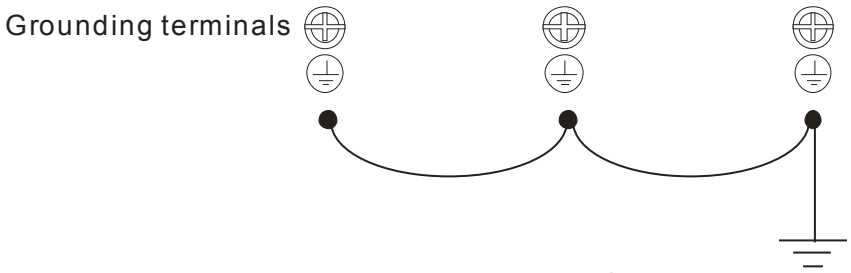
2-3 Main Circuit

Terminal Label	Description
R/L1, S/L2, T/L3	AC line input terminals
U/T1, V/T2, W/T3	Output of Hybrid Servo Controller, connected to hybrid servo motor
+1, +2/B1	For power improvement of the connection terminal of DC reactor. Please remove the shorting plate in installation (DC reactors are built-in in models with power ≧37KW)
+2/B1, B2	Connection terminal of brake resistor. Please follow the selection table to purchase suitable ones.
⏚	Earth connection, please comply with local regulations.

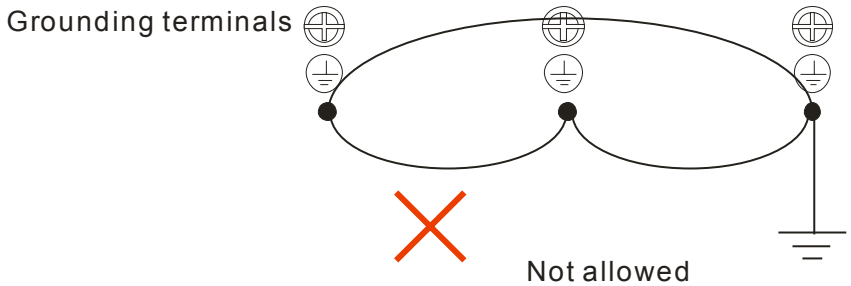
- ☑ The wiring for the Main circuit must be isolated from that for the control loop to avoid malfunction.
- ☑ Please use isolation wires for control wiring as much as possible. Do not expose the section where the isolation mesh is stripped before the terminal.
- ☑ Please use isolation wire or wire tube for power supply wiring and ground the isolation layer or both ends of wire tube.
- ☑ Usually the control wire does not have good insulation. If the insulation is broken for any reason, high voltage may enter the control circuit (control board) and cause circuit damage, equipment accident, and danger to operation personnel.
- ☑ Noise interferences exist between the Hybrid Servo Controller, hybrid servo motor, and their wirings. Check if the pressure sensor and associated equipments for any malfunction to avoid accidents.
- ☑ The output terminals of the Hybrid Servo Controller must be connected to the hybrid servo motor with the correct order of phases.
- ☑ When the wiring between the Hybrid Servo Controller and hybrid servo motor is very long, it may cause tripping of hybrid servo motor from over current due to large high-frequency current generated by the stray capacitance between wires. In addition, when the leakage current increases, the precision of the current value becomes poor. In such case, an AC reactor must be connected to the output side.
- ☑ The ground wire of the Hybrid Servo Controller cannot be shared with other large current load such as electric welding tool. It has to be grounded separately.
- ☑ To avoid lightning strike and incidence of electrocution, the external metal ground wire for the electrical equipments must be thick and short and connected to the ground terminal of the Hybrid Servo Controller system.
- ☑ When multiple Hybrid Servo Controllers are installed together, all of them must be directly connected to a common ground terminal. Please refer to the figure below to make sure there is no ground loop.



Excellent



good



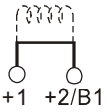
Not allowed

Mains power terminals (R/L1, S/L2, T/L3):

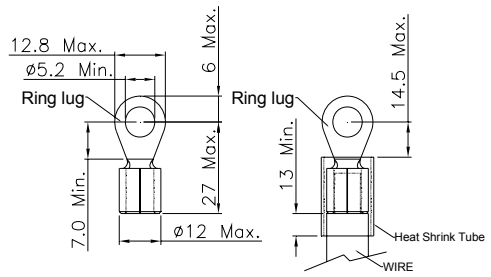
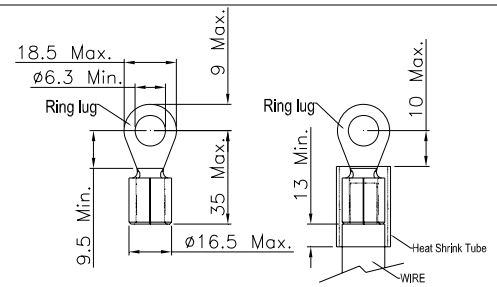
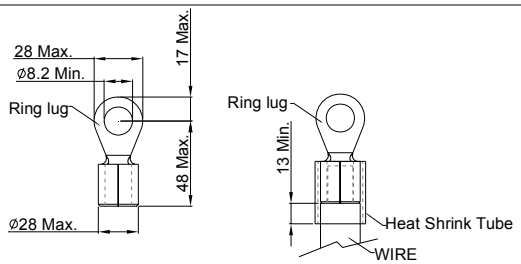
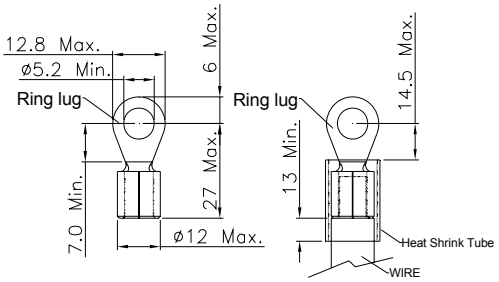
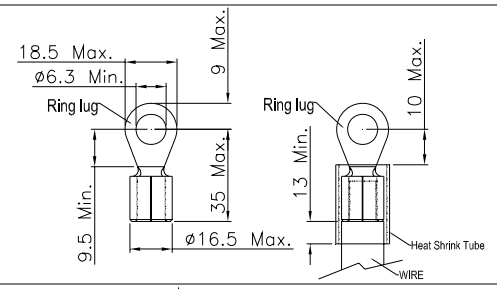
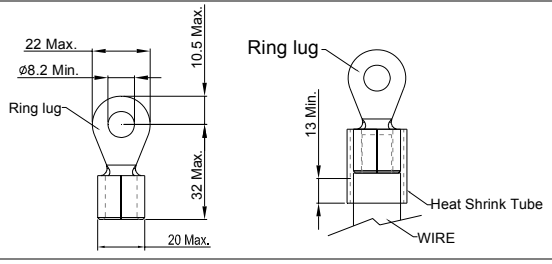
- ☑ Connect these terminals (R/L1, S/L2, T/L3) via a non-fuse breaker or earth leakage breaker to 3-phase AC power (some models to 1-phase AC power) for circuit protection. It is unnecessary to consider phase-sequence.
- ☑ The wire between the three-phase AC input power supply and the Main circuit terminals (R/L1, S/L2, and T/L3) must be connected to a non-fused switch.
- ☑ 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.
- ☑ Verify the voltage of power supply and the associated maximum available current. Please refer to Chapter 1 Descriptions of Specifications.
- ☑ If the Hybrid Servo Controller is equipped with a leakage circuit breaker for leakage protection, please select the circuit breaker that has a sensing current above 200mA and action time over 0.1 second to avoid malfunction.
- ☑ Please use isolation wire or wire tube for power supply wiring and ground the isolation layer or both ends of wire tube.

Output terminals for main circuit (U, V, W) :

- ☑ The output side of Hybrid Servo Controller cannot be connected with advance phase capacitor, surge absorber, advance phase capacitor, or L-C and R-C filters.

	Terminals [+1, +2] for connecting DC reactor, terminals [+1, +2/B1] for connecting brake resistor: ☑ These terminals are used to improve the power factor of DC reactor. There are shorting plates on them when they leave the factory. Remove the shorting plates before connecting the DC reactor.  Shorting Plate of DC Reactor ☑ For models with power ＞30kW, there is no driver loop for brake resistor inside. To increase the brake capability, please use an external brake unit and brake resistor (both are optional). ☑ Never short [B2] or [-] to [＋2/B1], which will damage the Hybrid Servo Controller.

Main Circuit Terminals

Model No.	Wiring	tightening torque on the drive's terminal	crimp type terminal
HES063H23A HES080G23A	4AWG (21mm^2)	30kgf-cm (26 lbf-in)	
HES080H23A	4AWG (21mm^2)	50kgf-cm (43.4 lbf-in)	
HES100G23A	4AWG (21mm^2)		
HES100H23A	4AWG (21mm^2)		
HES100Z23A	2AWG (33mm^2)		
HES125G23A	2AWG (33mm^2)		
HES125H23A HES160G23A HES160H23A HES200G23A	2AWG (33mm^2)	200kgf-cm (173 lbf-in)	
HES063G43A HES063H43A HES080G43A HES080H43A HES100G43A	8AWG (8mm^2)	30kgf-cm (26 lbf-in)	
HES100H43A	8AWG (8mm^2)	50kgf-cm (43.4 lbf-in)	
HES100Z43A HES125G43A HES125H43A HES160G43A	6AWG (13mm^2)		
HES160H43A HES200G43A	4AWG (21mm^2)	80kgf-cm (70 lbf-in)	

NOTE:

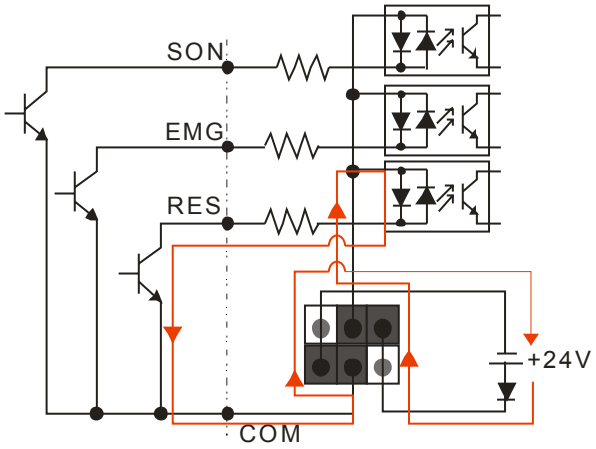
HES160H23A, HES200G23A installations must use 90℃ wire.

The other model use UL installations must use 600V, 75℃ or 90℃ wire. Use copper wire only. Please contact Delta for more information, if you want to use higher class of overheat protection material.

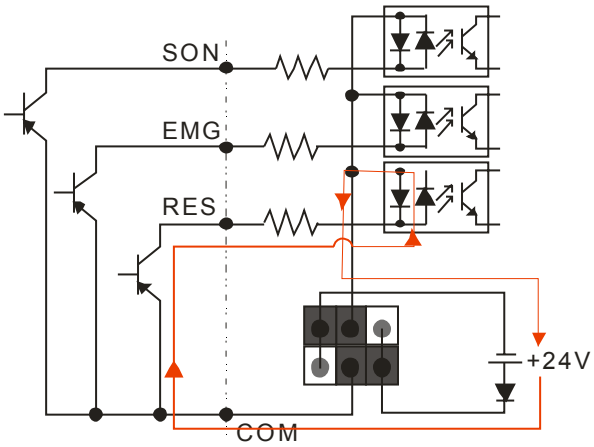
2-4 Control Terminals

Description of SINK（NPN）/SOURCE（PNP）Mode Switching Terminal

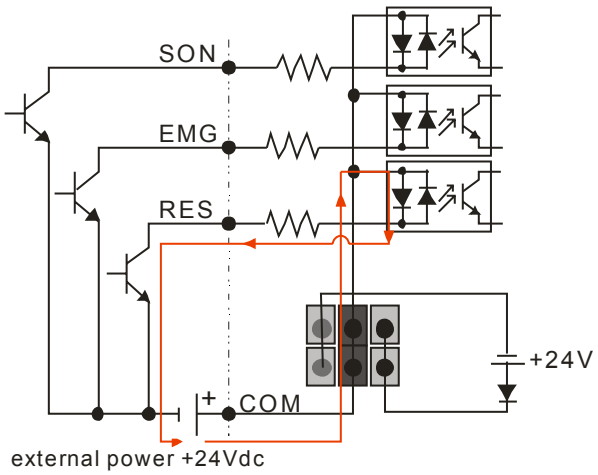
① Sink mode
With internal power (+24Vdc)



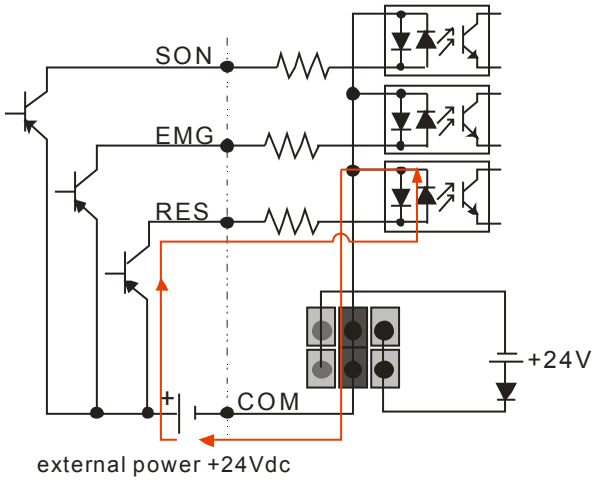
② Source mode
With internal power(+24Vdc)

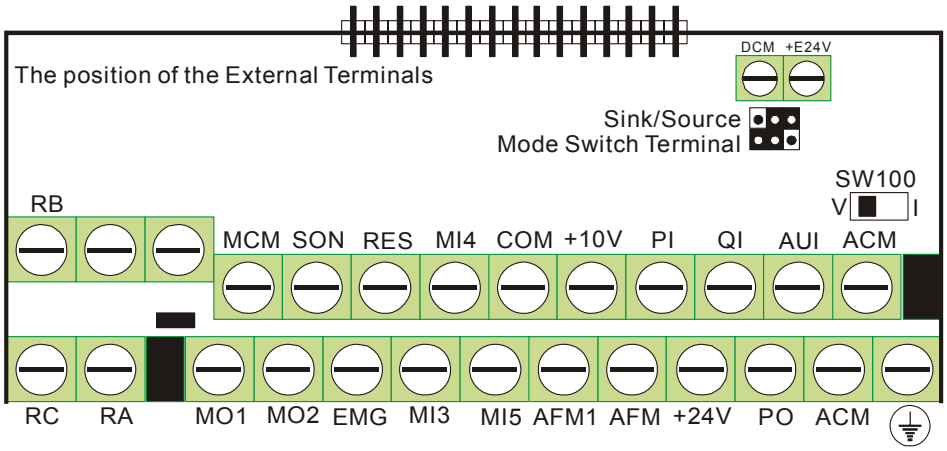


③ Sink mode
With external power (+24Vdc)

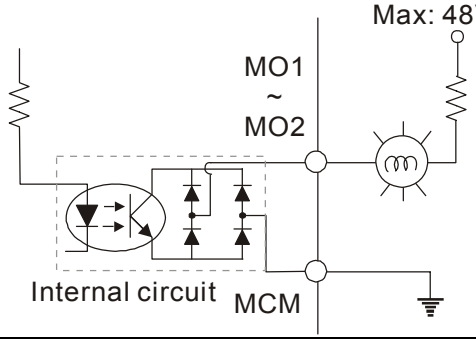
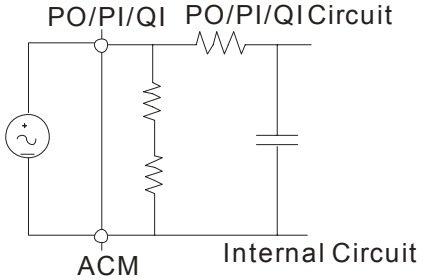


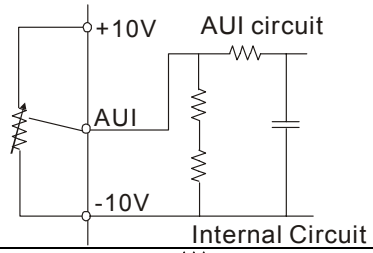
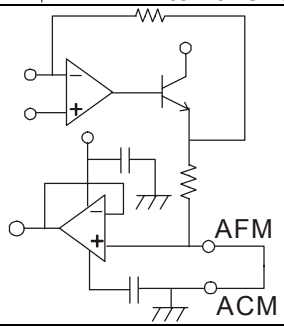
④ Source mode
With external power (+24Vdc)





Frame	Torque		Wire Gauge
C, D, E	8 kgf-com (6.9 in-lbf)		22-14 AWG (0.3-2.1mm^2)
	Terminal: 0V/24V	1.6 kgf-com(1.4 in-lbf)	30-16 AWG (0.051-1.3mm^2)

<table>
<tr><th>Terminal</th><th>Function</th><th>Factory Setting (NPN mode)</th></tr>
<tr><td>SON</td><td>Run-Stop</td><td>Between terminals SON-DCM: conducting (ON)；run: open circuit (OFF), Stop</td></tr>
<tr><td>EMG</td><td>Abnormal input from outside</td><td>Abnormal input from outside</td></tr>
<tr><td>RES</td><td>Reset</td><td>reset</td></tr>
<tr><td>MI3</td><td>Multiple Function Input: Option 3</td><td rowspan="3">No function is set for default setting
When conducting (ON), input voltage is 24Vdc (Max:30Vdc) and output impedance is 3.75kΩ；In open circuit (OFF), the allowable leakage current is 10μA</td></tr>
<tr><td>MI4</td><td>Multiple Function Input: Option 4</td></tr>
<tr><td>MI5</td><td>Multiple Function Input: Option 5</td></tr>
<tr><td>COM</td><td>Common terminal of digital control signals (Sink)</td><td>Common terminal of multiple function input terminals</td></tr>
<tr><td>+E24V</td><td>Common terminal of digital control signals (Source)</td><td>+24V 80mA</td></tr>
<tr><td>DCM</td><td>Common terminal of digital control signals (Sink)</td><td>Common terminal of multiple function input terminals</td></tr>
<tr><td>RA</td><td>Malfunctioning abnormal connection 1 (Relay always open a)</td><td rowspan="3">Resistive Load:
5A(N.O.)/3A(N.C.) 240VAC
5A(N.O.)/3A(N.C.) 24VDC
Inductive Load:
1.5A(N.O.)/0.5A(N.C.) 240VAC
1.5A(N.O.)/0.5A(N.C.) 24VDC</td></tr>
<tr><td>RB</td><td>Malfunctioning abnormal connection 1 (Relay always closed b)</td></tr>
<tr><td>RC</td><td>Multi-function Relay Common</td></tr>
<tr><td>MO1</td><td>Multi-function Output 1 (Photocoupler)</td><td rowspan="2">Hybrid Servo Controller outputs various types of monitoring signals with the transistor operating in open collector mode.
Max: 48Vdc/50mA
  </td></tr>
<tr><td>MO2</td><td>Multi-function Output 2 (Photocoupler)</td></tr>
<tr><td>MCM</td><td>Multi-function Output Common (Photocoupler)</td><td>Max. 48VDC 50mA</td></tr>
<tr><td>PO</td><td rowspan="3">PO/PI/QI circuit
  </td><td>Pressure Feedback
Impedance:200kΩ
Resolution:12 bits
Range:0 ~ 10V or 4~20mA=
0~maximum Pressure Feedback value (Pr.00-08)
To input current, firmware v2.04 or above and a new I/O control board (the one has SW100 switch) are required.
See parameter 03-12 for more information.</td></tr>
<tr><td>PI</td><td>Pressure Command
Impedance:200kΩ
Resolution:12 bits
Range:0 ~ 10V=
0~maximum pressure command value (Pr.00-07)</td></tr>
<tr><td>QI</td><td>Flow Rate Command
Impedance:200kΩ
Resolution:12 bits
Range:0 ~ 10V=0~maxium flow rate</td></tr>
<tr><td>+10V</td><td>Configuration Voltage</td><td>Power supply for analog configuration +10Vdc 20mA (variable resistor 3~5kΩ)</td></tr>
<tr><td>+24V</td><td>Power supply terminal of pressure sensor</td><td>Configuration power supply for pressure sensor +24Vdc 100mA</td></tr>
</table>

Terminal	Function	Factory Setting (NPN mode)
AUI	Analog Voltage 	Impedance:11.3kΩ Resolution:12 bits Range:-10~+10VDC
AFM		Impedance:16.9kΩ (voltage output) Output Current: 20mA max Resolution: 0~10V corresponds to maximum operation frequency Range: 0~10V Function Setting: Pr.00-05
ACM	Analog control signal (common)	Common for ACI, AUI1, AUI2

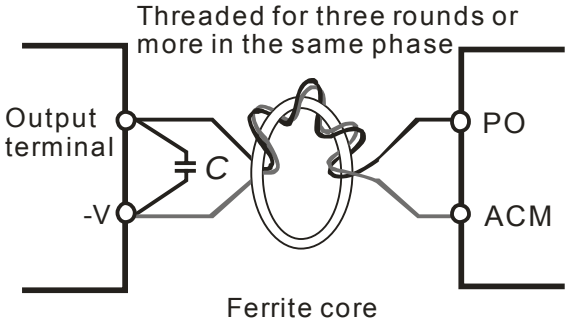
*Control signal wiring size: 18 AWG (0.75 mm^2) with shielded wire.

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

☑ The maximum input voltage of PI, PO, 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.

☑ The interference generated by the Hybrid Servo Controller can cause the pressure sensor to malfunction. IN this case, a capacitor and a ferrite core can be connected to the pressure sensor side, as shown in the figure below:



Transistor outputs (MO1, MO2, MCM)

☑ Make sure to connect the digital outputs to the right polarity.

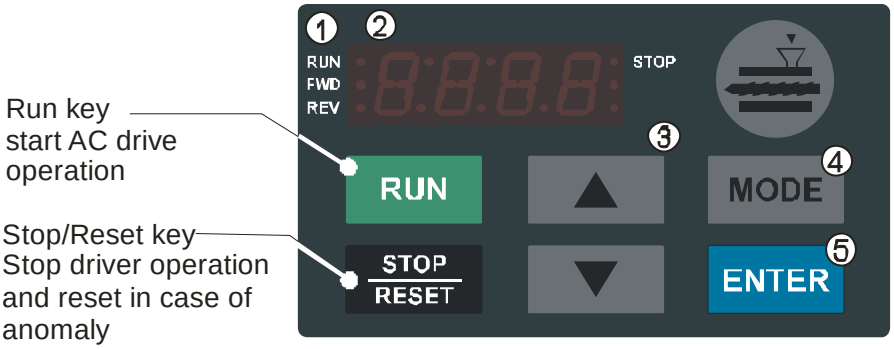
☑ When connecting a relay to the digital outputs connect a surge absorber across the coil and check the polarity.

Chapter 3 Start Up

 CAUTION	☑ Please verify again before operation that the wiring is done correctly, especially that the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller cannot have any power input. Make sure that the ground terminal ⏚ is connected correctly. ☑ Do NOT operate the AC motor drive with humid hands. ☑ Check for loose terminals, connectors or screws. ☑ Make sure that the front cover is well installed before applying power.
 WARNING	☑ In case of abnormal operation of the Hybrid Servo Controller and the associated servo motor, stop the operation immediately and refer to “Troubleshooting” to check the causes of anomalies. After the output of the Hybrid Servo Controller is stopped, when the power terminals L1/R, L2/S, and L3/T of the main circuit are still connected, touching the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller may lead to electric shock.

3-1 Description of Control Panel

Description of the Digital Keypad KPVJ-LE01



❶ Status Display
Display the driver's current status.

❷ LED Display
Indicates frequency, voltage, current, user defined units and etc.

❸ UP and DOWN Key
Set the parameter number and changes the numerical data, such as Master Frequenc

❹ MODE
Change between different display mode.

❺ ENTER
Used to enter/modify programming parameters.

Descriptions of Function Display Items

Display **Message**	Descriptions
RUN FWD REV STOP F60.0	Displays theAc driver Master frequency
RUN FWD REV STOP H50.0	Displays the actual output frequency at terminals U/T1, V/T2, and W/T3.
RUN FWD REV STOP U180	User defined unit (where U = F x Pr.00.04)
RUN FWD REV STOP A 5.0	Displays the output current at terminals U/T1, V/T2, and W/T3.
RUN FWD REV STOP Frd	Displays the AC motor drive forward run status.
RUN FWD REV STOP rEv	Displays the AC motor drive reverse run status.
RUN FWD REV STOP 01.00	Displays the parameter item
RUN FWD REV STOP 10	Displays the actual stored value of the selected parameter.

Display **Message**	Descriptions
	External Fault.
	Display “End” for approximately 1 second if input has been accepted by pressing ENTER key. After a parameter value has been set, the new value is automatically stored in memory. To modify an entry, use the ▲ and ▼ keys.
	Display “Err”, if the input is invalid.

How to Operate the Digital Keypad

Setting Mode

START

GO START

NOTE: In the selection mode, press ENTER to set the parameters.

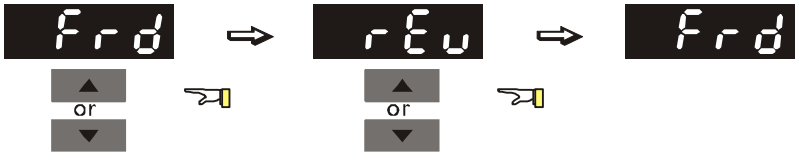
Setting parameters

NOTE：In the parameter setting mode, you can press ENTER to return the selecting mode.

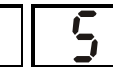
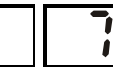
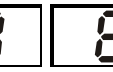
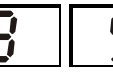
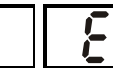
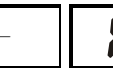
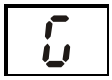
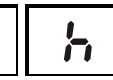
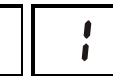
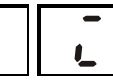
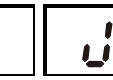
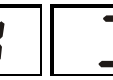
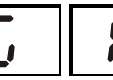
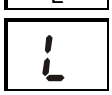
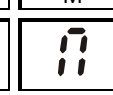
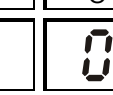
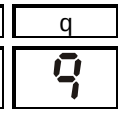
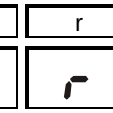
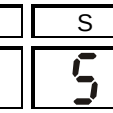
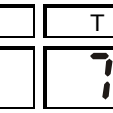
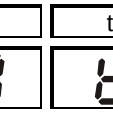
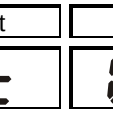
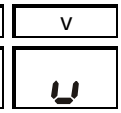
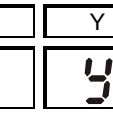
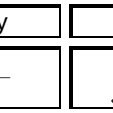
To shift data

START

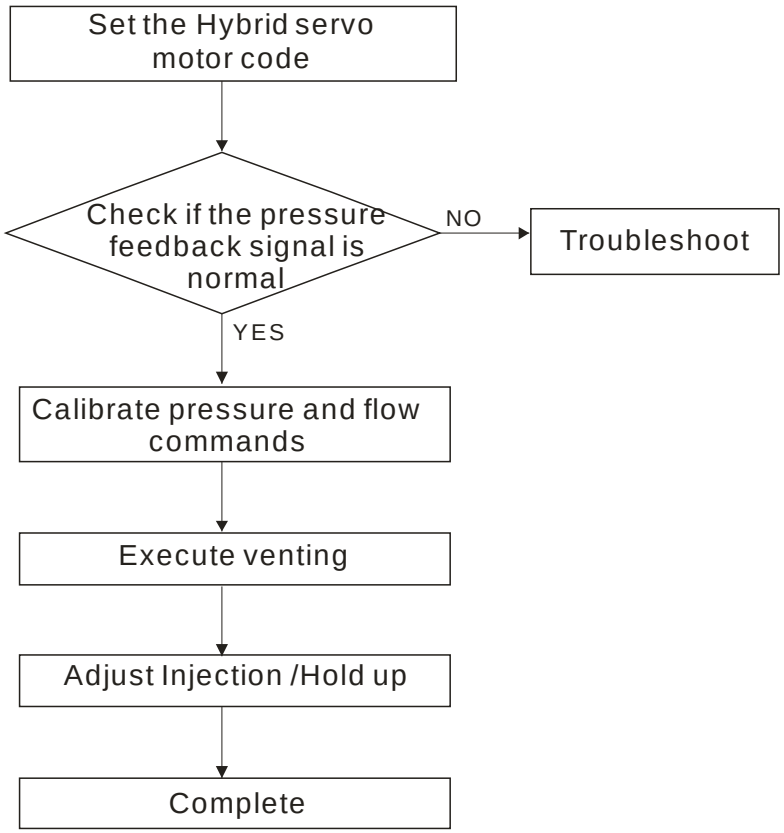
Setting direction (When operation source is digital keypad)



Reference Table for the 7-segment LED Display of the Digital Keypad

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

3-2 Adjustment Flow Chart



*The firmware version is 2.04 and above, just proceeds the process to set up HES ID code.

*The firmware version is 2.05 and above, starts from “Execute venting”.

3-3 Explanations for the Adjustment Steps

Operate the following steps with the digital operator (KPVJ-LE01/ KPV-CE01)

Prior to starting running, please verify again if the wiring is correct, especially that the output terminals U/T1, V/T2, and W/T3 of the Hybrid Servo Controller must correspond to the U, V, and W terminals of the Hybrid servo motor, respectively.

Step 1. Parameter Entry of Hybrid Servo Motor

- Do not connect the external terminals SON-COM and EMG-COM for the time being.
- Restore the factory default values by setting the Parameter 00-02 = 10

  Parameter reset

Pr. 00-02	10: Parameter reset

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

  When KPVJ-LE01/KPV-CE01 is used, set Pr. 01-01=0

  Source of Run Command

Pr. 01-01	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

- Set Pr. 01-35 of the Hybrid servo motor

HES063H23A, HES080G23A, HES080H23A, HES100G23A,HES100H23A	Pr. 01-35 = 16
HES063G43A, HES063H43A, HES080G43A, HES080H43A, HES100G43A,HES100H43A	Pr. 01-35 = 17
HES125G23A, HES125H23A, HES160G23A,HES160H23A	Pr. 01-35 = 18
HES125G43A, HES125H43A, HES160G43A,HES160H43A	Pr. 01-35 = 19
HES160H23A, HES200G23A	Pr. 01-35 = 20
HES160H43A, HES200G43A	Pr. 01-35 = 21

- Disregard the error message EF1 that will appear at this point.
- After power outage, connect the heating switch of the hybrid servo motor to the external terminal EMG-COM and restart the power supply.

***** For firmware version 2.04 and above

Step 2. Entry HES ID code*

- Do not connect the external terminals SON-COM and EMG-COM for the time being.
- Restore the factory default values by setting the Parameter 00-02 = 10

  Parameter reset

Pr. 00-02	10: Parameter reset

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

  When KPVJ-LE01/KPV-CE01 is used, set Pr. 01-01=0

  Source of Run Command

Pr. 01-01	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

  Source of Run Command

Pr. 01-01	0: Operated by digital operator
	1: Operated by external terminals, Stop on keypad is disabled
	2: Communication port RS-485 is activated and Stop on keypad is disabled

- Set Pr. 01-37 of HES ID#

Model	ID#
HES063H23A	2120
HES080G23A	3020
HES080H23A	3120
HES100G23A	4020
HES100H23A	4120
HES100Z23A	4220
HES125G23A	5020
HES125H23A	5120
HES160G23A	6020
HES200G23A	7020

Model	ID#
HES063G43A	2040
HES063H43A	2140
HES080G43A	3040
HES080H43A	3140
HES100G43A	4040
HES100H43A	4140
HES100Z43A	4240
HES125G43A	5040
HES125H43A	5140
HES160G43A	6040
HES160H43A	6140
HES200G43A	7040
HES200H43C	7142
HES320M43C	9342

- Disregard the error message EF1 that will appear at this point.
- After power outage, connect the heating switch of the hybrid servo motor to the external terminal EMG-COM and restart the power supply.

Step 3.Check Pressure Feedback Signal

- Firs, set input voltage Pr. 00-04 = 11 PO

  Selection of Display Mode

Pr. 00-04	11: Display the signal of PO analog input terminal, with 0~10V corresponding to 0~100%.

- Set Pr. 00-08=corresponding pressure settings of the 10V pressure sensor

  Maximum value of pressure feedback

Pr. 00-08	0~250Bar

- Set speed command to 10rpm and press【RUN】. Check the pressure value is >0 on the pressure gauge.

  When the pressure value is ≦0,

  ☑ Gradually increase the rotation speed.

  ☑ Check that each directional valve is closed.

  When the pressure value is ＞0

  ☑ Check that the voltage reading displayed on the operation panel is consistent with the pressure reading on the pressure gauge.

  Example: 10V on the pressure sensor corresponds to 250bar. When the pressure gauge reading is 50 bar, the output voltage on the pressure sensor should be approximately 50/250*10=2V. So the voltage displayed on the operation panel will be 20.0(%).

- Meanwhile, observe if there is any oil leak.

Step 4. Check Pressure and Flow Commands

- This action does not need to start the servo oil pump.
- For the firmware version is 2.04 and above, theoretical values of three-point calibration of pressure and flow commands are auto-imported after entering HES ID code. Afterward, detailed adjustment can be proceeded with the following methods.
- Pr. 00-09 = 1 refers to the pressure control mode

  Pressure Control Mode

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

- Pr. 00-04 = 12 sets the PI input voltage

  Selection of Display Mode

Pr. 00-04	12: Display the signal value of the PI analog input terminal, with 0~10V corresponding to 0~100%.

- Pr. 00-07 = corresponding pressure value with 10V on the pressure controller command

  Maximum pressure command

Pr. 00-07	0~250Bar

- With the maximum pressure set by the controller, observe the associated value displayed on the operation panel and set it to 00-14.
- With the controller setting at half the maximum pressure, observe the associated value

displayed on the operation panel and set it to 00-15.

- With the controller setting at the lowest pressure, observe the associated value displayed on the operation panel and set it to 00-16.

  Example: 10V on the pressure sensor corresponds to 250bar. If the maximum pressure on the controller is 140bar and corresponds to 10V, the Pr. 00-07=140. Set 140bar through the controller and the voltage reading displayed on the operation panel is approximately 56.0(140/250*100%). Enter this value to Pr. 00-14. Next, set 70bar through the controller and the voltage reading displayed on the operation panel is approximately 28.0 (70/250*100%). Enter this value to Pr. 00-15. Lastly, set 0bar through the controller and the voltage reading displayed on the operation panel is approximately 0.0(0/250*100%). Enter this value to Pr. 00-16.

  Example: 10V on the pressure sensor corresponds to 250bar. However, the maximum pressure on the controller is 140bar and corresponds to 7V. As a result, Pr. 00-07= 140/7*10=200. The following steps are the same as described in the previous example. Set 200bar through the controller first, followed by setting 100bar, and 0bar in the last step. Enter the corresponding values to the associated parameters.

- Pr. 00-04 = 25 refers to the QI input voltage

  Selection of Display Mode

Pr. 00-04	25: Displays the signal value of the QI analog input terminal, with 0~10V corresponding to 0~100%.

- Set 100% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-17
- Set 50% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-18
- Set 0% flow rate through the controller, observe the reading displayed on the operation panel and enter it to 00-19

Step 5. Send Run Command via Controller

- Check that Pr. 00-09 is 1 (pressure control mode)

  Pressure Control Modes

Parameter Settings	00-09 0: Speed Control 1: Pressure Control

- Pr. 01-01=1

  Source of Run Command

Pr. 01-01	0: Operated by digital operator 1: Operated by external terminals, Stop on keypad is disabled 2: Communication port RS-485 is activated and Stop on keypad is disabled

- In case of power outage, connect SON-COM and turn on the power supply.

Step 6. 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.

- 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 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 value of the three-stage PI to 0 (Pr. 00-21, 00-23, and 00-25) and the three-stage Kp value to be small (≦50.0)
- Execute the injection, with "Preset Target" set at low pressure (＜50Bar) and low flow rate (＜30%)
- Press "Injection" on the controller and the injection will be started or the system will directly enter the pressure holding operation (depending on the location of the oil cylinder)
- In the hold up state, Increase the speed bandwidth to the maximum value of 40Hz (Pr. 00-10) while causing no vibration to the hybrid servo motor.
- In the pressure holding state, when the pressure gauge needle or the monitored waveform shows no signs of vibration, the pressure feedback is stabilizing. Now the three sets of Kp values can be increased.
- When the pressure feedback becomes unstable, lower the three sets of Kp values by 20% (Example: lower the preset values of the three sets of Kp values from 100% to 80%), followed by adjusting the three sets of Ki values to eliminate the steady-state error and speed up the system response.
- Upon completion of the above steps, increase the pressure command of "Preset Target".
- Observe if the pressure feedback becomes stable. Proceed with troubleshooting in case of any anomaly, as described below:

Troubleshooting for Pressure Instability

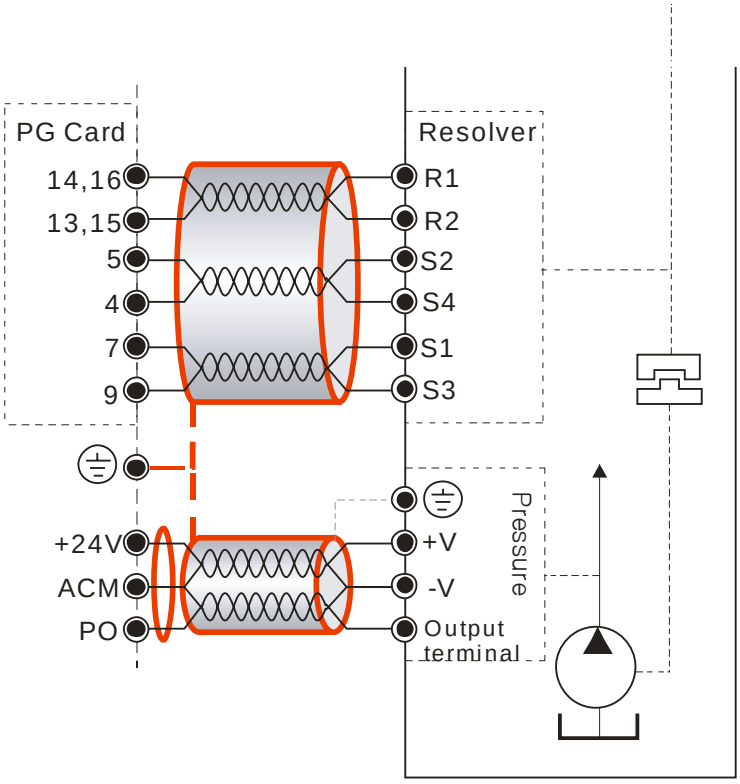
Unstable pressure over the entire section

1. Set Pr. 00-09 = 0 for speed control
2. With the oil line in the closed state, send the low speed rotation command to make the pressure feedback 40~50% of the pressure command value (Pr. 00-07)
3. Check if the pressure waveform shows any jitters through the monitoring software.
   - Jitter in Pressure Waveform

     The possible cause is interference from ground. If the motor or the three-phase

power supply is grounded, disconnect the ground wire. If the motor or the three-phase power supply is not grounded, add the ground wire for interference protection.

The other possibility is the ground issue of the shielding mesh (as illustrated by the bold red lines in the figure below). If the shielding mesh is grounded, disconnect the ground wire. If the shielding mesh is not grounded, add the ground wire for interference protection.



4. Please contact the original manufacturer if the anomaly still cannot be resolved after resorting to the methods described above.

Step 8. Adjustment of System Transient Response

- Reduce the pressure ramp up time by increasing Kp1 (Pr. 00-20) and reducing Ki1 (Pr. 00-21) times
- When the pressure is over-adjusted, increase Kp3 (Pr. 00-24) and reduce Ki3 (Pr. 00-25) times

Confluence Machine Tuning Procedure

Follow the associated descriptions in Chapter 2 to lay out the wiring.

Follow steps 1 and 2 described above to enter the electrical codes for the master/slave machines. Then proceed with the steps below.

Master setting

- Set the Parameter 03-06 = 1

  Multifunction Output 2 (MO1)

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

- Connect the Master’s MO1 output terminal to the Slave’s SON terminal and Master's MCM terminal to the Salve'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	0.0~6553.5%

- 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%

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 Salve is performing the reversed operation for depressurization.

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

Slave reverse operation for depressurization

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

Limit for the Slave reverse depressurization torque

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

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

Speed Control Mode

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

In this case, the Master can be tuned according to the Step 3 – Step 6 described above

Confluence/Diversion Mode Adjustment Procedure

Follow the associated descriptions in Chapter 2 to lay out the wiring.

In the diversion state, follow steps 1-8 described above to individually adjust the parameters of each driver.

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.

Chapter 4 Parameters

4-1 Summary of Parameter Settings

00 System Parameters

✓ the parameter can be set during operation

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
	00-00	Hybrid Servo Controller model code ID	12：230V, 7.5HP 13：460 V, 7.5HP 14：230V, 10HP 15：460V, 10HP 16：230V, 15HP 17：460V, 15HP 18：230V, 20HP 19：460V, 20HP 20：230V, 25HP 21：460V, 25HP 22：230V, 30HP 23：460V, 30HP 24：230V, 40HP 25：460V, 40HP 26：230V, 50HP 27：460V, 50HP 29：460V, 60HP 31：460V, 75HP 33：460V, 100HP	Read only	○	○	○
	00-01	Display of rated current of the Hybrid Servo Controller	Display the model specific values	Read only	○	○	○
	00-02	Reset parameter settings	5: Rest the kWh at drive stop 10: Reset parameter values	0	○	○	○
	00-03	Software version	Read only	Read only	○	○	○
✓	00-04	Selection of multi-function display	0: Display the output current (A) 1: Reserved 2: Display the actual output frequency (H) 3: Display the DC-BUS voltage (U) 4: Display the output voltage (E) 5: Display the output power angle (n) 6: Display the output power in kW (P) 7: Display the actual motor speed rpm (r) 8: Display the estimated output torque (%) 9: Display the PG feedback (G) 10: Reserved 11: Display the signal value of the analog input terminal PO % (1.) 12: Display the signal value of the analog input terminal PI % (2.) 13: Display the signal value of the analog input terminal AUI % (3.) 14: Display temperature of the heat sink in °C (t.) 15: Display temperature of IGBT in °C (T) 16: The status of digital input (ON/OFF) (i) 17: The status of digital output (ON/OFF) (o) 18: Reserved 19: The corresponding CPU pin status of the digital input (i.) 20: The corresponding CPU pin status of the digital output (o.) 21~24: Reserved 25: Display the signal value of the analog input terminal QI % (5.) 26: Display the actual pressure value (Bar) (b.) 27: Display the kWh value (K) 28: Display the motor temperature (currently only support KTY84) (T.)	0	○	○	○

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
✓	00-05	Analog output function selection	0: Output frequency (Hz)	0	○	○	○
			1: Frequency command (Hz)		○	○	○
			2: Motor speed (Hz)		○	○	○
			3: Output current (A)			○	○
			4: Output voltage		○	○	○
			5: DC Bus voltage		○	○	○
			6: Power factor		○	○	○
			7: Power		○	○	○
			8: Output torque		○	○	○
			9: PO		○	○	○
			10: PI		○	○	○
			11: AUI		○	○	○
			12~20: Reserved		○	○	○
	00-06	Display the speed (rpm) defined by the user	0~39999 rpm	2500	○	○	○
✓	00-07	Maximum value for the pressure command	0~400Bar	140	○	○	○
✓	00-08	Maximum pressure feedback value	0~400 Bar	250	○	○	○
	00-09	Pressure control mode	0: Speed control 1: Pressure control	0	○	○	○
	00-10	Speed bandwidth	0~40Hz	20		○	○
✓	00-11	Pressure feedback filtering time PO	0.000~1.000 second	0.000	○	○	○
✓	00-12	Pressure command filtering time PI	0.000~1.000 second	0.000	○	○	○
✓	00-13	Flow command filtering time QI	0.000~1.000 second	0.000	○	○	○
✓	00-14	Percentage for the pressure command value (Max)	0.0~100.0%	56.0	○	○	○
✓	00-15	Percentage for the pressure command value (Mid)	0.0~100.0%	28.0	○	○	○
✓	00-16	Percentage for the pressure command value (Min)	0.0~100.0%	0.0	○	○	○
✓	00-17	Percentage for the flow command value (Max)	0.0~100.0%	100.0	○	○	○
✓	00-18	Percentage for the flow command value (Mid)	0.0~100.0%	50.0	○	○	○
✓	00-19	Percentage for the flow command value (Min)	0.0~100.0%	0.0	○	○	○
✓	00-20	P gain 1	0.0~1000.0	50.0	○	○	○
✓	00-21	I integration time 1	0.00~500.00 seconds	2.00	○	○	○
✓	00-22	P gain 2	0.0~1000.0	50.0	○	○	○
✓	00-23	I integration time 2	0.00~500.00 seconds	2.00	○	○	○
✓	00-24	P gain 3	0.0~1000.0	50.0	○	○	○
✓	00-25	I integration time 3	0.00~500.00 seconds	2.00	○	○	○
✓	00-26	Pressure stable region	0~100%	25	○	○	○
✓	00-27	Base pressure	0.0~100.0%	0.1	○	○	○
✓	00-28	Depressurization speed	0~100%	25	○	○	○
✓	00-29	Ramp up rate of pressure command	0~1000ms	0	○	○	○
✓	00-30	Ramp down rate of pressure command	0~1000ms	100	○	○	○
✓	00-31	Ramp up rate of flow command	0~1000 ms	80	○	○	○

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
✓	00-32	Ramp down rate of flow command	0~1000 ms	80	○	○	○
✓	00-33	Valve opening delay time	0~200 ms	0	○	○	○
	00-34	Reserved					
✓	00-35	Over-pressure detection level	0~400Bar	230	○	○	○
✓	00-36	Detection of disconnection of pressure feedback	0 : No function 1: Enable (only for the pressure feedback output signal within 1~5V)	0	○	○	○
✓	00-37	Differential gain	0.0~100.0 %	0.0	○	○	○
	00-38	Pressure/flow control function selection	Bit 0: 0: Switch the PI Gain according to the pressure feedback level 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	0	○	○	○
	00-39	I gain of pressure overshoot 1	0.00~500.00 seconds	0.2	○	○	○
	00-40	Reserved					
	00-41	Reserved					
	00-42	Pressure overshoot level	0~100%	2	○	○	○
	00-43	Percentage of maximum flow	0~100%	100	○	○	○
	00-44	Pressure command	0~400 bar	0	○	○	○
	00-45	Percentage of flow command	0~100%	0	○	○	○
	00-46	Pressure reference S1 time	0~1000ms	0	○	○	○
	00-47	Pressure reference S2 time	0~1000ms	0	○	○	○
	00-48	Flow reference S1 time	0~1000ms	0	○	○	○
	00-49	Flow reference S2 time	0~1000ms	0	○	○	○

01 Motor Parameters

✓ the parameter can be set during operation

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
	01-00	Control mode	0: VF 1: Reserved 2: Reserved 3: FOCPG 4: Reserved 5: FOCPM 6: Reserved	5	○	○	○
✓	01-01	Source of operation command	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	1	○	○	○
	01-02	Motor's maximum operation frequency	50.00~600.00Hz	166.67	○	○	○
	01-03	Motor's rated frequency	0.00~600.00Hz	113.33	○	○	○
	01-04	Motor's rated voltage	230V Series: 0.1V~255.0V 460V Series: 0.1V~510.0V	220.0 440.0	○	○	
✓	01-05	Acceleration time setting	0.00~600.00 seconds	0.00	○	○	○
✓	01-06	Deceleration time setting	0.00~600.00 seconds	0.00	○	○	○
	01-07	Motor Parameter Auto Tuning	0: No function	0	○	○	
			1: 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				○
	01-08	Rated current of the induction motor (A)	40~120% of the drive's rated current	#.##		○	
✓	01-09	Rated power of the induction motor	0~655.35kW	#.##		○	
✓	01-10	Rated speed of the induction motor	0~65535rpm 1710 (60Hz 4-pole); 1410 (50Hz 4-pole)	1710		○	
	01-11	Number of poles of the induction motor	2~20	4		○	
	01-12	No-load current of the induction motor (A)	0~Default value of Parameter 01-08	#.##		○	
	01-13	Stator resistance (Rs) of the induction Motor	0~65.535Ω	#.###		○	
	01-14	Rotor resistance (Rr) of the induction Motor	0~65.535Ω	#.###		○	
	01-15	Magnetizing inductance (Lm) of the induction Motor	0.0~6553.5mH	#.#		○	
	01-16	Total leakage inductance (Lx) of the induction motor	0.0~6553.5mH	#.#		○	
	01-17	Rated current of the synchronous motor	0~655.35 Amps	0.00			○
	01-18	Rated power of the synchronous motor	0.00 – 655.35kW	0.00			○

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
	01-19	Rated speed of the synchronous motor	0~65535rpm	1700			○
	01-20	Number of poles of the synchronous motor	2~20	8			○
	01-21	Inertia of the synchronous motor's rotor	0.0~6553.5 *10^{-4} kg.m^2	0.0			○
	01-22	Stator's phase resistance (Rs) of the synchronous motor	0.000~65.535Ω	0.000			○
	01-23	Stator's phase inductance (Ld) of the synchronous motor	0.00.0~655.35mH	0.00			○
	01-24	Stator's phase inductance (Lq) of the synchronous motor	0.00.0~655.35mH	0.00			○
	01-25	Back EMF of the synchronous motor	0~65535 V/krpm	0			○
	01-26	Encode type	0: ABZ 1: ABZ+HALL (only used for Delta's servo motors) 2: ABZ+HALL 3: Resolver	3			○
	01-27	PG Offset angle of synchronous motor	0.0~360.0°	0.0			○
	01-28	Number of poles of the resolver	1~5	1			○
	01-29	Encoder pulse	1~20000	1024		○	○
	01-30	Encoder's input type setting	0: No function 1: Phase A leads in a forward run command and phase B leads in a reverse run command 2: Phase B leads in a forward run command and phase A leads in a reverse run command 3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction) 4: Phase A is a pulse input and phase B is a direction input. (low input=forward direction, high input=reverse direction) 5: Single-phase input	1		○	○
	01-31	System control	0: No function 1: ASR automatic tuning 2: Estimation of inertia	1		○	○
✓	01-32	Unity value of the system inertia	1~65535 (256 = 1 per unit)	400		○	○
	01-33	Carrier frequency	5KHz; 10KHz	5	○	○	○
✓	01-34	Reserved					
	01-35	Motor ID	0 : No function 16: Delta's Hybrid servo motor ECMA-ER181BP3 (11kW220V) 17: Delta's Hybrid servo motor ECMA-KR181BP3 (11kW380V) 18: Delta's Hybrid servo motor ECMA-ER221FPS (15kW220V) 19: Delta's Hybrid servo motor ECMA-KR221FPS (15kW380V) 20: Delta's Hybrid servo motor ECMA-ER222APS (20kW220V) 21: Delta's Hybrid servo motor ECMA-KR222APS (20kW380V)	0	○	○	○

Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
01-36	Change the rotation direction	0: When the driver runs forward, the motor rotates counterclockwise. When the driver runs reverse, the motor rotates clockwise. 1: When the driver runs forward, the motor rotates clockwise. When the driver runs reverse, the motor rotates counterclockwise.	0	○	○	○
01-37	HES ID #	0: non-functional See parameter description	0	○	○	○

02 Parameters for Protection

↗ the parameter can be set during operation

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
↗	02-00	Software brake level	230V series: 350.0~450.0Vdc 460V series: 700.0~900.0Vdc	380.0 760.0	○	○	○
	02-01	Present fault record	0: No error record	0	○	○	○
	02-02	Second most recent fault record	1: Over-current during acceleration (ocA)	0	○	○	○
	02-03	Third most recent fault record	2: Over-current during deceleration (ocd)	0	○	○	○
	02-04	Fourth most recent fault record	3: Over-current during constant speed (ocn)	0	○	○	○
	02-05	Fifth most recent fault record	4: Ground fault (GFF)	0	○	○	○
	02-06	Sixth most recent fault record	5: IGBT short-circuit (occ)	0	○	○	○
			6: Over-current at stop (ocS)		○	○	○
			7: Over-voltage during acceleration (ovA)		○	○	○
			8: Over-voltage during deceleration (ovd)		○	○	○
			9: Over-voltage during constant speed (ovn)		○	○	○
			10: Over-voltage at stop (ovS)		○	○	○
			11: Low-voltage during acceleration (LvA)		○	○	○
			12: Low-voltage during deceleration (Lvd)		○	○	○
			13: Low-voltage during constant speed (Lvn)		○	○	○
			14: Low-voltage at stop (LvS)		○	○	○
			15: Phase loss protection (PHL)		○	○	○
			16: IGBT over-heat (oH1)		○	○	○
			17: Heat sink over-heat for 40HP and above (oH2)		○	○	○
			18: TH1 open: IGBT over-heat protection circuit error (tH1o)		○	○	○
			19: TH2 open: heat sink over-heat protection circuit error (tH2o)		○	○	○
			20: IGBT over heated and unusual fan function (oHF)		○	○	○
			21: Hybrid Servo Controller overload (oL)		○	○	○
			22: Motor over-load (EoL1)		○	○	○
			23: Reserved				
			24: Motor over-heat, detect by PTC (oH3)		○	○	○
			25: Reserved				
			26: Over-torque 1 (ot1)		○	○	○
			27: Over-torque 2 (ot2)		○	○	○
			28: Reserved		○	○	○
			29: Reserved		○	○	○
			30: Memory write error (cF1)		○	○	○
			31: Memory read error (cF2)		○	○	○
			32: Isum current detection error (cd0)		○	○	○
			33: U-phase current detection error (cd1)		○	○	○
			34: V-phase current detection error (cd2)		○	○	○
			35: W-phase current detection error (cd3)		○	○	○
			36: Clamp current detection error (Hd0)		○	○	○
			37: Over-current detection error (Hd1)		○	○	○
			38: Over-voltage 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)			○	○

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
			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: Reserved		○	○	○
			54: Communication error (cE1)		○	○	○
			55: Communication error (cE2)		○	○	○
			56: Communication error (cE3)		○	○	○
			57: Communication error (cE4)		○	○	○
			58：Communication time out (cE10)		○	○	○
			59: PU time out (cP10)		○	○	○
			60: Braking transistor error (bF)		○	○	○
			61~63: Reserved		○	○	○
			64: Safety relay Error (SRY)		○	○	○
			65: PG card information error (PGF5)				○
			66: Over pressure (ovP)		○	○	○
			67: Pressure feedback fault (PfbF)		○	○	○
✓	02-07	Low voltage level	160.0~220.0Vdc 320.0.0~440.0Vdc	180.0 360.0	○	○	○
✓	02-08	PTC action selection	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop	0	○	○	○
✓	02-09	PTC level	0.0~150.0% 0.0~150.0℃	50.0	○	○	○
✓	02-10	PTC detection filtering time	0.00~10.00 seconds	0.20	○	○	○
✓	02-11	PTC type	0: Not assigned 1: KTY84	0	○	○	○
✓	02-12	Motor fan activation level	0.0~100.0% 0.0~150.0℃	50.0	○	○	○
✓	02-13	Electronic thermal relay selection 1	0: Inverter motor 1: Standard motor 2: Disable	2	○	○	○
✓	02-14	Electronic thermal characteristic for motor	30.0~600.0 seconds	60.0	○	○	○
	02-15	Output frequency at malfunction	0.00~655.35 Hz	Read only	○	○	○
	02-16	Output voltage at malfunction	0.0~6553.5 V	Read only	○	○	○
	02-17	DC voltage at malfunction	0.0~6553.5 V	Read only	○	○	○
	02-18	Output current at malfunction	0~655.35 Amps	Read only	○	○	○
	02-19	IGBT temperature at malfunction	0.0~6553.5 ℃	Read only	○	○	○

03 Digital/Analog Input/Output Parameters

↗ the parameter can be set during operation

	Parameter code	Function of the parameter	Settings	Default value	VF	FOCPG	FOCPM
	03-00	Multi-function input command 3 (MI3)	0: No function 44: Injection signal input 45: Confluence/Diversion signal input 46: Reserved 47: Multi-level pressure PI command 1 48: Multi-level pressure PI command 2 51: flow command	0	○	○	○
	03-01	Multi-function input command 4 (MI4)		0	○	○	○
	03-02	Multi-function input command 5 (MI5)		0	○	○	○
↗	03-03	Digital input response time	0.001~ 30.000 sec	0.005	○	○	○
↗	03-04	Digital input operation direction	0~65535	0	○	○	
↗	03-05	Multi-function output 1 (Relay 1)	0: No function 1: Operation indication 9: Hybrid Servo Controller is ready 11: Error indication 44: Displacement switch signal 45: Motor fan control signal	11	○	○	○
↗	03-06	Multi-function Output 2 (MO1)		0	○	○	○
↗	03-07	Multi-function Output 3 (MO2)		0	○	○	○
↗	03-08	Multi-function output direction	0~65535	0		○	
↗	03-09	Low-pass filter time of keypad display	0.001~65.535 seconds	0.010	○	○	○
	03-10	Maximum output voltage for pressure feedback	5.0~10.0 V	10.0	○	○	○
	03-11	Minimum output voltage for pressure feedback	0.0~2.0 V	0.0	○	○	○
↗	03-12	Type of Pressure Feedback Selection	0: Current 1: Voltage	1			
	03-13	Confluence Master/Slave Selection	0: No function 1: Master 1 2: Slave/Master 2 3: Slave/Master 3	0	○	○	○
	03-14	Slave's proportion of the Master's flow	0.0~65535.5 %	100.0	○	○	○
↗	03-15	Source of frequency command	0: Digital keypad 1: RS485 Communication 2~5: Reserved	0	○	○	○
↗	03-16	Limit for the Slave reverse depressurization torque	0~500%	20	○	○	○
↗	03-17	Slave's activation level	0.0~100.0%	50.0	○	○	○
↗	03-18	Communication error treatment	0: Warn and keep operation 1: Warn and ramp to stop 2: Warn and coast to stop 3: No action and no display	3	○	○	○
↗	03-19	Time-out detection	0.0~100.0 seconds	0.0	○	○	○
↗	03-20	Start-up display selection	0: F (frequency command) 1: H (actual frequency) 2: Multi-function display (user-defined 00-04) 3: A (Output current)	0	○	○	○
↗	03-21	Slave reverse operation for depressurization	0: Disabled 1: Enabled	0	○	○	○

4-2 Detailed Description of Parameters

00 System Parameters

✓ the parameter can be set during operation

00-00 Hybrid Servo Controller model code ID

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

Settings Read only

00-01 Display of rated current of the Hybrid Servo Controller

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

Settings Read only

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

230V Series								
Power (KW)	5.5	7.5	11	15	18.5	22	30	37
Horse Power (HP)	7.5	10	15	20	25	30	40	50
Model ID	12	14	16	18	20	22	24	26

460V Series											
Power (KW)	5.5	7.5	11	15	18.5	22	30	37	45	55	75
Horse Power (HP)	7.5	10	15	20	25	30	40	50	60	75	100
Model ID	13	15	17	19	21	23	25	27	29	31	33

00-02 Reset parameter settings

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

Settings 0: No function
5: Rest the kWh at drive stop
10: Reset parameter values

📖 If it is necessary to restore the parameters to factory default, just set this parameter to “10”.

00-03 Software version

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

Settings Read only

✓ 00-04 Selection of multi-function display

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

Settings
0: Display the output current (A)
1: Reserved
2: Display the actual output frequency (H)
3: Display the DC-BUS voltage (U)
4: Display the output voltage (E)
5: Display the output power angle (n)
6: Display the output power in kW (P)
7: Display the actual motor speed(r 00: forward speed; - 00: negative speed)

8: Display the estimated output torque (%) (t 0.0: positive torque; - 0.0: negative torque) (%)

9: Display the PG feedback (G)

10: Reserved

11: Display the signal value of the analog input terminal PO with 0~10V mapped to 0~100%

12: Display the signal value of the analog input terminal PI with 0~10V mapped to 0~100%

13: Display the signal value of the analog input terminal PI with -10~10V mapped to 0~100%

14: Display temperature of the heat sink in °C (t.)

15: Display temperature of the IGBT power module °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 OI with 0~10V mapped to 0~100%

26: Display the actual pressure value (Bar)

27: Display the kWh value

28: Display the motor temperature (currently only support KTY84)

🕮 This parameter defines the contents to be displayed in the U page of the digital keypad KPV-CE01 (as shown in the figure).

00-05 Analog output function selection

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

Settings 0~20

Summary of functions

Setting Value	Function	Description
0	Output frequency (Hz)	The maximum frequency is 100%
1	Frequency command (Hz)	The maximum frequency is 100%
2	Motor speed (Hz)	600Hz is used as 100%
3	Output current (A)	2.5 times of the rated current of the Hybrid Servo Controller is used as 100%
4	Output voltage	2 times of the rated current of the Hybrid Servo Controller is used as 100%
5	DC BUS voltage	450V (900V) =100%
6	Power factor	-1.000~1.000=100%
7	Power	Rated power of the drive =100%
8	Output torque	Rated torque =100%
9	PO	(0~10V=0~100%)
10	PI	(0~10V=0~100%)
11	AUI	(-10~10V=0~100%)
12~20	Reserved	

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

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

Settings 0~39999 rpm

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

00-07 Maximum value for the pressure command

Control mode **VF** **FOCPG** **FOCPM** Factory default: 250

Settings 0~400Bar

🕮 The 0~10V for the pressure command on the controller is mapped to 0~the value of this parameter.

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

00-08 Maximum pressure feedback value

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

Settings 0: Speed control
1: Pressure control

🕮 This parameter determines the control mode of the Hybrid Servo Controller. It is recommended to use the speed control at the initial start up. 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.

00-10 Speed bandwidth

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

Settings 0~40Hz

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

00-11 Pressure feedback filtering time PO
00-12 Pressure Command Filter Time PI
00-13 Pressure Command Filter Time PI

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

Settings 0.000~1.000 seconds

🕮 Noises may reside in the analog input signals of the control terminals PO, 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)
00-15 Percentage for the pressure command value (Mid)
00-16 Percentage for the pressure command value (Min)

Control mode **VF** **FOCPG** **FOCPM** Factory default: 100.0

Settings 0.0~100.0%

🕮 To set these parameters, it is necessary to set Parameter 00-09 as 1

Parameter 00-04 = 12 for PI input voltage
Send the maximum pressure command through the controller and then check the multi-function display page to enter this value into 00-14
Send a half pressure command through the controller and then check the multi-function display page to enter this value into 00-15
Send the minimum pressure command through the controller and then check the multi-function display page to enter this value into 00-16
Example: If the pressure sensor indicates 250bar at 10V. If the controller's maximum pressure of 140bar corresponds to 10V, then Parameter 00-07=140. Set the pressure as 140bar by using the controller, the voltage value shown on the display is about 56.0 (140/250 * 100%). Enter this value into the Parameter 00-14. Then set the pressure as 70bar on the controller, and now the value displayed on the keypad is about 28.0 (70/250 * 100%). Enter this value to the Parameter 00-15. Then set the pressure as 0 bar on controller, and the voltage value shown on the keypad is about 0.0 (0/250 * 100%). Enter this value in the Parameter 00-16.

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

Control mode **VF** **FOCPG** **FOCPM** Factory default: 100.0

Settings 0.0~100.0%

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

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

Settings 0.0~100.0%

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

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

Settings 0.0~100.0%

🕮 To set these parameters, it is necessary to set Parameter 00-09 as 1

🕮 Parameter 00-04 = 25 for QI input voltage

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

00-20 P gain 1
00-22 P gain 2
00-24 P gain 3

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

Settings 0.0～1000.0

00-21 I integration time 1
00-23 I integration time 2
00-25 I integration time 3

Control mode **VF** **FOCPG** **FOCPM** Factory default: 2.00

Settings 0.00~500.00 seconds

00-37 Differential gain

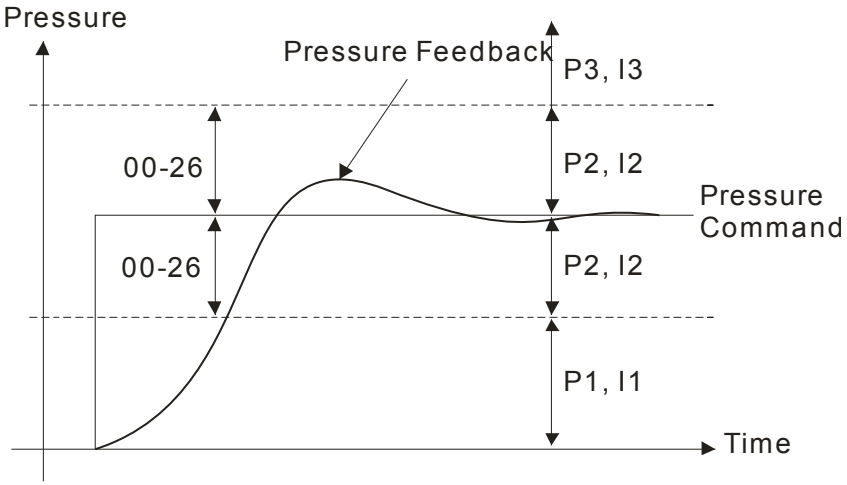
Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.0

Settings 0.0~100.0 %

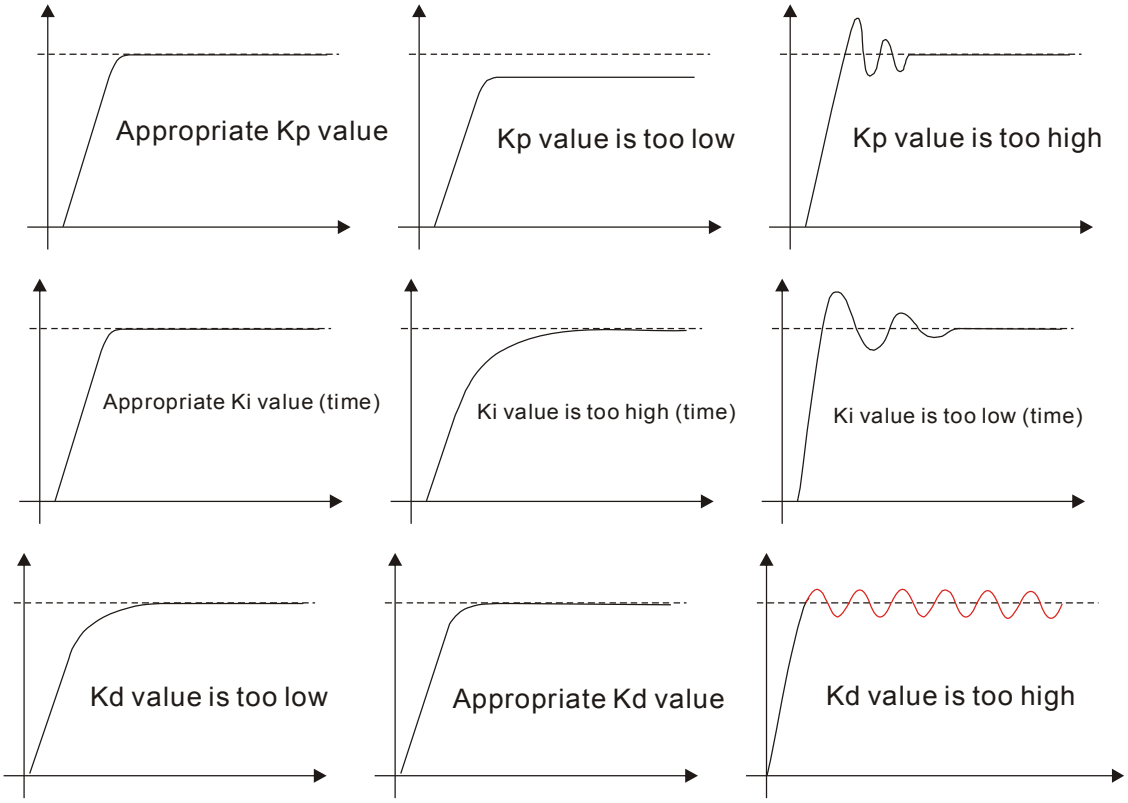
00-26 Pressure stable region

Control mode **VF** **FOCPG** **FOCPM** Factory default: 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 Base pressure

Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.1

Settings 0.0~100.0%

🕮 Set the minimum pressure value 100% corresponding to Parameter 00-08

🕮 Typically, it is necessary to maintain a certain base pressure to ensure that the oil pipe is in fully filled condition so as to avoid the activation delay of the cylinder when a pressure/flow command is activated.

00-28 Depressurization speed

Control mode **VF** **FOCPG** **FOCPM** Factory default: 25

Settings 0~100%

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

00-29 Ramp up rate of pressure command

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

Settings 0~1000ms

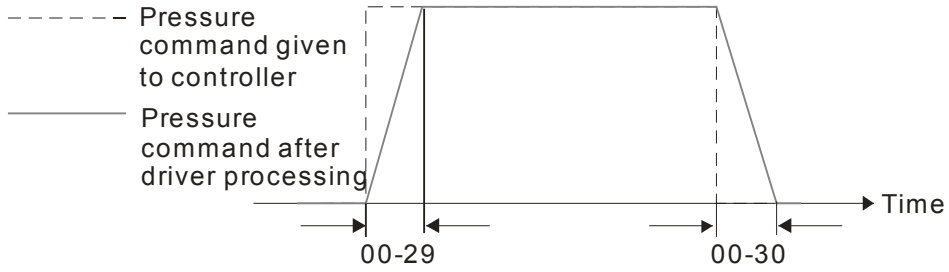
00-30 Ramp down rate of pressure command

Control mode **VF** **FOCPG** **FOCPM** Factory default: 100

Settings 0~1000ms

🕮 Ramp the pressure value for the pressure command so as to reduce the vibration of the machine.

🕮 Set the time required for ramping the pressure from 0~the maximum pressure (00-08).



00-31 Ramp up rate of flow command

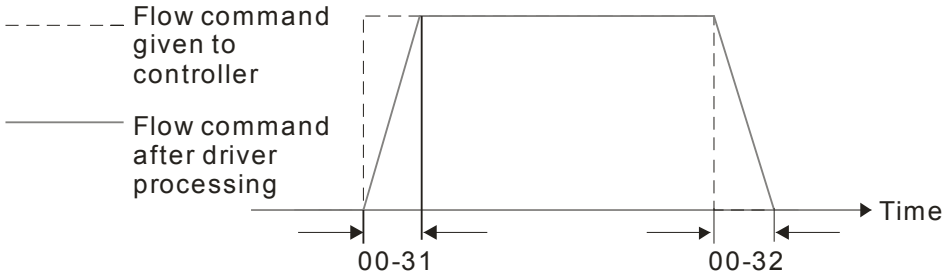
00-32 Ramp down rate of flow command

Control mode **VF** **FOCPG** **FOCPM** Factory default: 80

Settings 0~1000ms

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

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

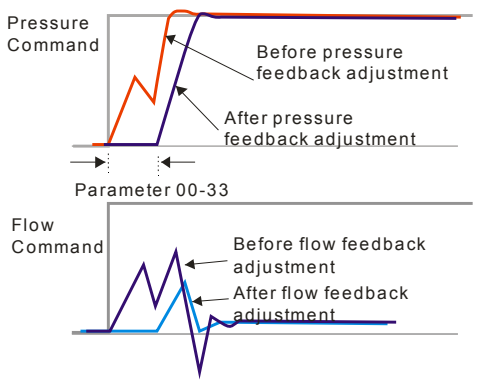


00-33 Valve opening delay time

Control mode **VF** **FOCPG** **FOCPM** Factory default: 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 till the valve is fully opened. To avoid the aforementioned effect, set this parameter to increase time for the flow output delay.



00-34 Reserved

00-35 Over-pressure detection level

Control mode **VF** **FOCPG** **FOCPM** Factory default: 230

Settings 0~400 Bar

📖 When the pressure feedback exceeds this parameter setting, an “ovP over pressure” error message may occur.

📖 Firmware version 2.04 and above, maximum value 400Bar, the previous version’s maximum allowed value is 250Bar.

00-36 Detection of disconnection of pressure feedback

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

Settings 0: No function
1: Enable (only for the pressure feedback output signal within 1~5V)

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

00-38 Pressure/flow control function selection

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

Settings
Bit 0:
0: Switch the PI Gain according to the pressure feedback level
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

📖 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

Pr. 03-00~03-02 d= 47	Pr. 03-00~03-02 d= 48	
OFF	OFF	PI1(Parameters 00-20 & 00-21)
ON	OFF	PI2(Parameters 00-22 & 00-23)
OFF	ON	PI3(Parameters 00-24 & 00-25)

📖 When the Bit 1 of this parameter is set as 1, the pressure feedback is lower than the pressure stable region (please refer to the description of Parameter 00-26) so the flow control will be performed. When it enters the pressure stable region, the pressure control will be performed.

00-39 Integration Time – Pressure Overshoot 1

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

Settings 0.00~500.00 seconds

00-42 Level of the pressure overshoot

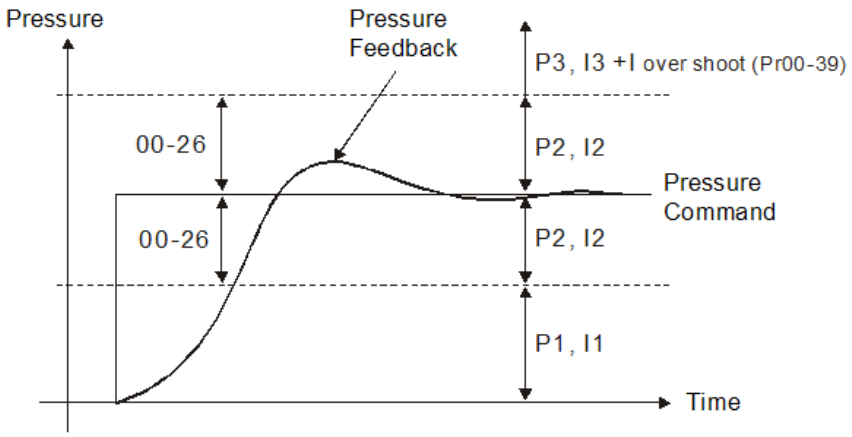
Control mode **VF** **FOCPG** **FOCPM** Factory default : 2

Settings 0~100%

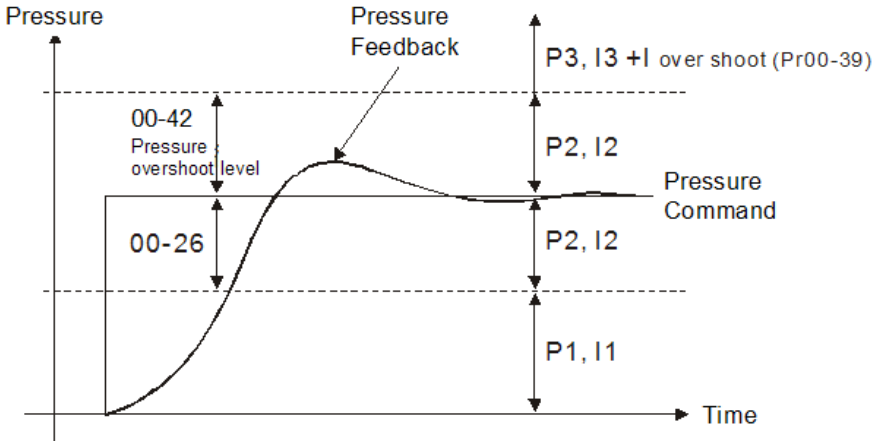
📖 By using the factory setting 250 bar of the Pr00-08 Maximum Pressure Feedback, when the pressure is over 5 bar (250*2%=5 bar), another integral time of Pr00-39 will do overshoot protection.

📖 When Pr00-38=1 and Pr00-39=0,Pr00-42 is disable.

Set Pr00-42=0



Set Pr00-42≠0



00-40 Reserved

00-41 Reserved

00-43 Percentage of the maximum flow

Control mode **VF FOCPG FOCPM** Factory default : 100

Settings 0~100%

🕮 Set up this parameter to adjust the maximum rotation frequency (maximum flow rate). It is not necessary to stop the motor drive to set up this parameter. When this parameter is set to be 100%, it corresponds to the maximum rotation frequency of Pr01-02.

00-44 Pressure Command

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

Settings 0~400bar

00-45 Percentage of Flow command

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

Settings 0~100%

🕮 When Pr00-44 ≠ 0, Pressure Command will not be given by the analog signal but input by Pr00-44.

🕮 When Pr00-45 ≠ 0, Flow Command will not be given by the analog signal but input by Pr00-45.

🕮 Pr00-44 & Pr00-45 can be applied in an environment without input of analog signal to do simple test.

00-46 Pressure Command Rising/ Descending S1 curve

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

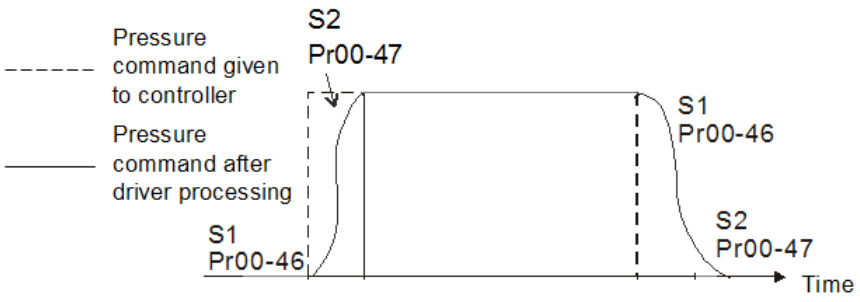
Settings 0~1000ms

00-47 Pressure Command Rising/ Descending S2 Curve

Control mode **VF FOCPG FOCPM** Factory default : 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 Pressure Command Rising/ Descending S1 Curve

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

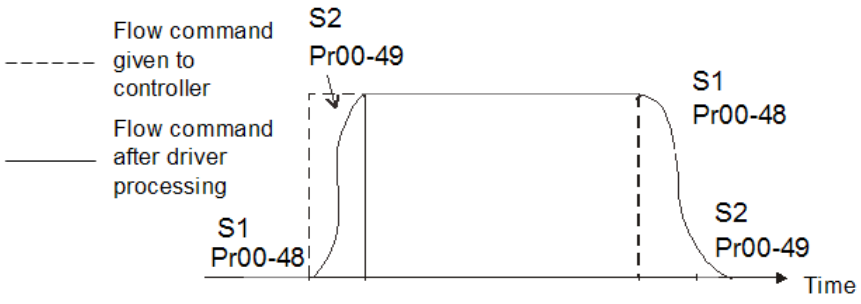
Settings 0~1000ms

00-49 Flow Command Rising/.Descending S2 Curve

Control mode **VF FOCPG FOCPM** Factory default : 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.



01 Motor Parameters

✓ the parameter can be set during operation

01-00 Control mode

Control mode **VF FOCPG FOCPM**

Factory default: 5

Settings
0：V/F
1: Reserved
2: Reserved
3: FOCPG
4: Reserved
5: FOCPM
6: Reserved

🕮 This parameter determines the control mode of this AC motor.

0: V/F control, the user can design the required V/F ratio. It is used for induction motors.
1: Reserved
2: Reserved
3: FOC vector control + Encoder. It is used for induction motors.
4: Reserved
5: FOC vector control + Encoder. It is used for synchronous motors.
6: Reserved

✓ 01-01 Source of operation command

Control mode **VF FOCPG FOCPM**

Factory default: 1

Settings
0: The operation command is controlled by the digital operation panel
1: The operation command is controlled by the external terminals. The STOP button on the keypad panel is disabled
2: The operation command is controlled by the communication interface. The STOP button on the keypad panel is disabled

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

01-02 Motor’s maximum operation frequency

Control mode **VF FOCPG FOCPM**

Factory default: 166.67

Settings 50.00~600.00Hz

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

01-03 Motor’s rated frequency

Control mode **VF FOCPG FOCPM**

Factory default: 113.33

Settings 0.00~600.00Hz

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

🕮 The motor’s rated frequency will be different as Rated speed of the synchronous motor (Pr.01-19) and Number of poles of the synchronous motor (Pr.01-20) change.

01-04 Motor’s rated voltage

Control mode **VF FOCPG**

Factory default: 220.0/440.0

Settings
230V series: 0.1~255.0V
460V series: 0.1~510.0V

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

01-05 Acceleration time setting

Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.00

Settings 0.00~600.00 seconds

01-06 Deceleration time setting

Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.00

Settings 0.00~600.00 seconds

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

01-07 Motor Parameter Auto Tuning

Factory default: 0

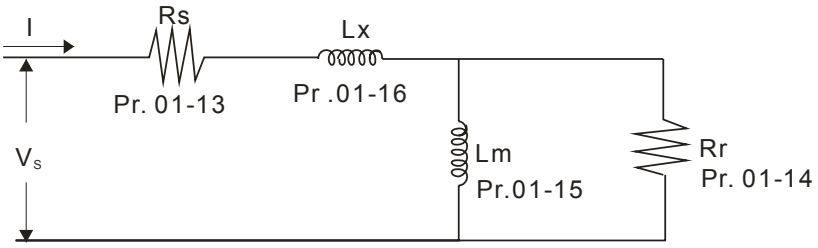
Settings	Control mode	VF	FOCPG	FOCPM
0: No function		○	○	
1: Rolling test for induction motor(IM) (Rs, Rr, Lm, Lx, no-load current)		○	○	
2: Static test for induction motor(IM)		○	○	
3: Reserved				
4: Auto measure the angle between magnetic pole and PG origin				○
5: Rolling test for PM motor				○

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

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

1. All parameters of the Hybrid Servo Controller are set to factory settings and the motor is connected correctly.
2. Users are strongly advised to disconnect the motor from any load before tuning. That is to say, the motor contains only the output shaft and connects to neither a belt nor a decelerator. Otherwise, it will be impossible to disconnect the motor from any loads. Static tuning is advised※.
3. Set the rated voltage 01-04, rated frequency 01-03, rated current 01-08, rated power 01-09, rated speed 01-10, and number of poles 01-11 of the motor with correct values, respectively. For the acceleration/deceleration time, please set the correct values.
4. Set Parameter 01-07 as 1 and then press the RUN button on the keypad. The auto tuning process for the motor is carried out immediately. (Note: the motor starts running).
5. After the process is finished, check if the motor's parameters (parameters 01-13 ~ 16) have been automatically entered with the measurement data.

6. Equivalent circuit of the motor



Motor equivalent circuit used by VJ

NOTE

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

🕮 If the parameter is set as 5, 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 Controller 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 and 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 default: #.##

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 default is 90% of the rated current of the Hybrid Servo Controller.

For example: For the 7.5HP (5.5kW) motor, the rated current is 25, the factory settings: 22.5A. The customers can set the parameter within the range 10 ~ 30A.
25*40%=10 25*120%=30

01-09 Rated power of the induction motor

Control mode **FOCPG**

Factory default: #.##

Settings 0 – 655.35kW

📖 Set the motor's rated power. The factory default value is the power of the Hybrid Servo Controller.

01-10 Rated speed of the induction motor

Control mode **FOCPG**

Factory default:
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 default: 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 default: 40

Settings 0~ Default value of Parameter 01-08

📖 The factory default is 40% of the rated current of the Hybrid Servo Controller.

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

Control mode **FOCPG**

Factory default: #.##

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

Control mode **FOCPG**

Factory default: #.##

Settings 0~65.535Ω

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

Control mode **FOCPG**

Factory default: #.##

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

Control mode **FOCPG**

Factory default: #.##

Settings 0.0~6553.5mH

01-17 Rated current of the synchronous motor

Control mode **FOCPM**

Factory default: 0.00

Settings 0~655.35 Amps

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

01-18 Rated power of the synchronous motor

Control mode **FOCPM** Factory default: 0.00

Settings 0.00 – 655.35kW

🕮 This Parameter sets the rated power of the synchronous motor.

01-19 Rated speed of the synchronous motor

Control mode **FOCPM** Factory default: 1700

Settings 0~65535

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

01-20 Number of poles of the synchronous motor

Control mode **FOCPM** Factory default: 8

Settings 2~20

🕮 This parameter sets the number of the synchronous motor's number of poles (odd number is not allowed).

01-21 Inertia of the synchronous motor's rotor

Control mode **FOCPM** Factory default: 0.0

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

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

Control mode **FOCPM** Factory default: 0

Settings 0~65.535Ω

🕮 Enter the phase resistance of the synchronous motor.

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

Control mode **FOCPM** Factory default: 0.00

Settings 0.0~655.35mH

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

01-25 Back EMF of the synchronous motor

Control mode **FOCPM** Factory default: 0

Settings 0~65535 V/krpm

🕮 Enter the back EMF of the synchronous motor.

01-26 Encoder type selection

Control mode **FOCPM** Factory default: 3

Settings 0: ABZ
1: ABZ+HALL (only used for Delta's servo motors)
2: ABZ+HALL
3: Resolver

🕮 Look up table for Encoders & PG cards

Parameter Setting	Encoder Type	Applicable PG Card
01-26=0	A, B, Z	EMVJ-PG01U
01-26=1,2	A, B, Z+U, V, W	EMVJ-PG01U
01-26=3	Resolver	EMVJ-PG01/02R

01-27 PG Offset angle of synchronous motor

Control mode **FOCPM** Factory default: 0.0

Settings 0.0～360.0°

🕮 Offset angle of the PG origin for the synchronous motor.

01-28 Number of poles of the resolver

Control mode **FOCPM** Factory default: 1

Settings 1~5

01-29 Encoder Pulse

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

Settings 1~20000

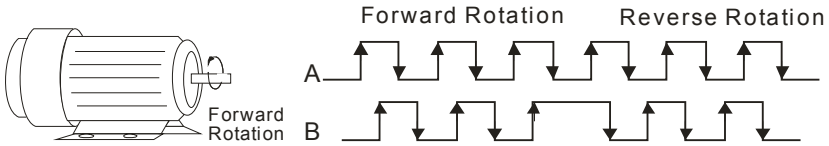
🕮 This parameter can be set the encoder's number of pulses per revolution (PPR).

01-30 Encoder's input type setting

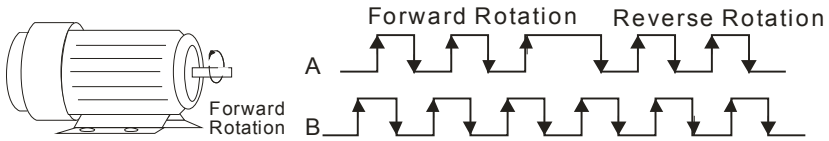
Control mode **FOCPG** **FOCPM** Factory default: 1

Settings 0: No function

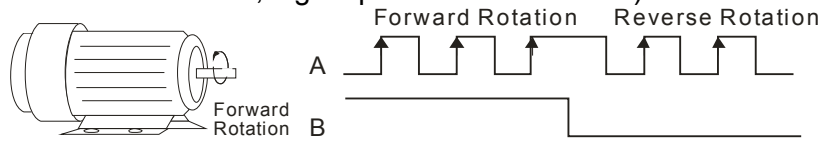
1: Phase A leads in a forward run command and phase B leads in a reverse run command.



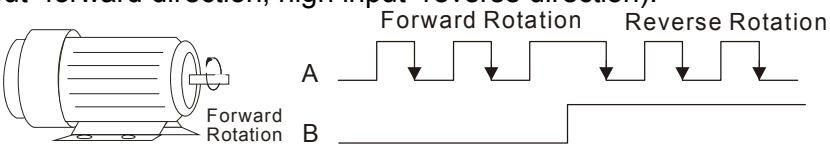
2: Phase B leads in a forward run command and phase A leads in a reverse run command.



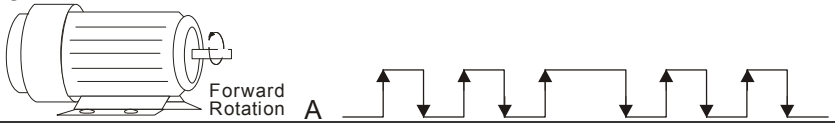
3: Phase A is a pulse input and phase B is a direction input. (low input=reverse direction, high input=forward direction).



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



5: Single-phase input



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

01-31 System control

Control mode **FOCPG** **FOCPM** Factory default: 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. Please refer to descriptions in Chapter 3

01-32 Unity value of the system inertia

Control mode **FOCPG FOCPM** Factory default: 400

Settings 1~65535 (256 = 1 per unit)

01-33 Carrier frequency

Control mode **FOCPG FOCPM** Factory default: 5

Settings 5 kHz; 10kHz

- When this parameter is configured, please re-start the Hybrid Servo Controller.
- 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 Controller 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 default: 0

Settings
0 : No function
16: Delta's Hybrid servo motor ECMA-ER181BP3 (11kW220V)
17: Delta's Hybrid servo motor ECMA- KR181BP3 (11kW380V)
18: Delta's Hybrid servo motor ECMA-ER221FPS (15kW220V)
19: Delta's Hybrid servo motor ECMA-KR221FPS (15kW380V)
20: Delta's Hybrid servo motor ECMA-ER222APS (20kW220V)
21: Delta's Hybrid servo motor ECMA-KR222APS (20kW380V)

01-36 Change the rotation direction

Control mode **FOCPG FOCPM** Factory default: 0

Settings
0: When the driver runs forward, the motor rotates counterclockwise. When the driver runs reverse, the motor rotates clockwise.
1: When the driver runs forward, the motor rotates clockwise. When the driver runs reverse, the motor rotates counterclockwise.

- This parameter can be modified only when the machine is shut down. For an induction motor after the parameters are configured completely, it will change the running direction. For a synchronous motor, it is necessary to perform the magnetic pole detection and re-start the drive.

01-37 HES ID#

Control mode **FOCPG FOCPM**

Factory default: 0

Settings 0 : No function

Example: HES100G23A

Model	ID#
HES063H23A	2120
HES080G23A	3020
HES080H23A	3120
HES100G23A	4020
HES100H23A	4120
HES100Z23A	4220
HES125G23A	5020
HES125H23A	5120
HES160G23A	6020
HES220G23A	7020

Model	ID#
HES063G43A	2040
HES063H43A	2140
HES080G43A	3040
HES080H43A	3140
HES100G43A	4040
HES100H43A	4140
HES100Z43A	4240
HES125G43A	5040
HES125H43A	5140
HES160G43A	6040
HES160H43A	6140
HES200G43A	7040
HES200H43C	7142
HES320M43C	9342

02 Parameters for Protection

✓ the parameter can be set during operation

✓ 02-00 Software brake level

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

Factory default: 380.0/760.0

Settings 230V series: 350.0~450.0Vdc
460V series: 700.0~900.0Vdc

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

02-01 Present fault record
02-02 Second most recent fault record
02-03 Third most recent fault record
02-04 Fourth most recent fault record
02-05 Fifth most recent fault record
02-06 Sixth most recent fault record

Settings	Control mode VF	FOCPG	FOCPM
0: No error record	○	○	○
1: Over-current during acceleration (ocA)	○	○	○
2: Over-current during deceleration (ocd)	○	○	○
3: Over-current during constant speed (ocn)	○	○	○
4: Ground fault (GFF)	○	○	○
5: IGBT short-circuit (occ)	○	○	○
6: Over-current at stop (ocS)	○	○	○
7: Over-voltage during acceleration (ovA)	○	○	○
8: Over-voltage during deceleration (ovd)	○	○	○
9: Over-voltage during constant speed (ovn)	○	○	○
10: Over-voltage at stop (ovS)	○	○	○
11: Low-voltage during acceleration (LvA)	○	○	○
12: Low-voltage during deceleration (Lvd)	○	○	○
13: Low-voltage during constant speed (Lvn)	○	○	○
14: Low-voltage at stop (LvS)	○	○	○
15: Phase loss protection (PHL)	○	○	○
16: IGBT over-heat (oH1)	○	○	○
17: Heat sink over-heat for 40HP and above (oH2)	○	○	○
18: TH1 open: IGBT over-heat protection circuit error (tH1o)	○	○	○
19: TH2 open: heat sink over-heat protection circuit error (tH2o)	○	○	○
20: IGBT over heated and unusual fan function (oHF)	○	○	○
21: Hybrid Servo Controller overload (oL)	○	○	○
22: Motor 1 overload (EoL1)	○	○	○
23: Reserved			
24: Motor over-heat, detect by PTC (oH3)	○	○	○
25: Reserved			
26: Over-torque 1 (ot1)	○	○	○
27: Over-torque 2 (ot2)	○	○	○
28: Reserved			
29: Reserved			
30: Memory write error (cF1)	○	○	○
31: Memory read error (cF2)	○	○	○
32: Isum current detection error (cd0)	○	○	○
33: U-phase current detection error (cd1)	○	○	○
34: V-phase current detection error (cd2)	○	○	○
35: W-phase current detection error (cd3)	○	○	○
36: Clamp current detection error (Hd0)	○	○	○
37: Over-current detection error (Hd1)	○	○	○
38: Over-voltage current detection error (Hd2)	○	○	○
39: Ground current detection error (Hd3)	○	○	○
40: Auto tuning error (AuE)			○

41: Reserved	○	○	○
42: PG feedback error (PGF1)		○	○
43: PG feedback loss (PGF2)		○	○
44: PG feedback stall (PGF3)		○	○
45: PG feedback slip (PGF4)		○	○
46: Reserved	○	○	○
47: Reserved	○	○	○
48: Reserved			
49: External fault input (EF)	○	○	○
50: Emergency stop (EF1)	○	○	○
51: Reserved			
52: Password error (PcodE)	○	○	○
53: Reserved			
54: Communication error (cE1)	○	○	○
55: Communication error (cE2)	○	○	○
56: Communication error (cE3)	○	○	○
57: Communication error (cE4)	○	○	○
58: Communication time out (cE10)	○	○	○
59: PU time out (cP10)	○	○	○
60: Braking transistor error (bF)	○	○	○
61~63: Reserved	○	○	○
64: Safety relay Error (SRY)	○	○	○
65: PG card information error (PGF5)			○
66: Over pressure (ovP)	○	○	○
67: Pressure feedback fault (PfbF)	○	○	○

🕮 As a fault occurs and the machine is forced shutting down, the event will be recorded. During shutting down, the LvS is not recorded.

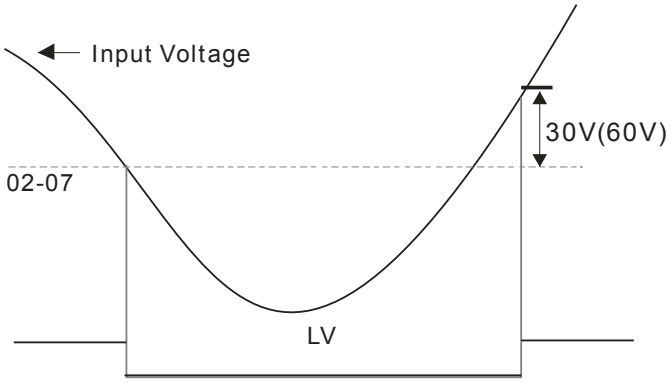
02-07 Low voltage level

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

Factory default: 180/360

Settings 230V Series: 160 – 220V
460V Series: 320 – 440V

🕮 This parameter is used to set the LV discrimination level.



02-08 PTC action selection

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

Factory default: 0

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

🕮 Parameter 02-08 is used to define the operation mode of the drive after the PTC is activated.

02-09 PTC level

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

Factory default: 50.0

Settings 0.0~150.0%
0.0~150.0℃

🕮 This parameter defines the maximum value of the analog input for 100% of the activation level of the PTC.

02-10 PTC detection filtering time

Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.20

Settings 0.00 – 10.00 seconds

02-11 PTC type

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

Settings 0: Not assigned
1: KTY84

🕮 When this parameter is set as 1, the unit for Parameters 02-09 and 02-12 will be changed from % to °C.

🕮 When this parameter is set as 1, the default setting of Pr.02-09 will change from 50% to 125℃.

02-12 Motor fan activation level

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

Settings 0.0~100.0%
0.0~150.0℃

🕮 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 selection 1

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

Settings 0: Inverter motor
1: Standard motor
2: Disable

02-14 Electronic thermal characteristic for motor

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

Settings 30.0~600.0 seconds

🕮 To prevent self-cooled motor from over heating at low speed operation, the user can set the electronic thermal relay to limit the allowed output power of the Hybrid Servo Controller.

02-15 Output frequency at malfunction

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

Settings 0.00~655.35Hz

02-16 Ourput voltage at malfunction

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

Settings 0.0~6553.5V

02-17 DC side voltage at malfunction

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

Settings 0.0~6553.5V

02-18 Ourput current at malfunction

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

Settings 0.00~655.35Amp

02-19 IGBT temperature at malfunction

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

Settings 0.0~6553.5℃

03 Digital/Analog Input/Output Parameters

✍ the parameter can be set during operation

03-00 Multi-function input command 3 (MI3)
03-01 Multi-function input command 4 (MI4)
03-02 Multi-function input command 5 (MI5)

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

Settings
0: No function
44: Injection signal input
45: Confluence/Diversion signal input
46: Reserved
47: Multi-level pressure PI command 1
48: Multi-level pressure PI command 2
51: flow command

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

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

🕮 Please refer to the description Parameters 00-36 if the setting value is 47 and 48,

🕮 When under the pressure control (Pr00-09=1) and the external terminal is ON, the speed command is the flow command. It is no longer necessary to learn what the flow command is through the calculation of PI pressure.

✍ 03-03 Digital input response time

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

Settings 0.001~30.000 sec

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

✍ 03-04 Digital input operation direction

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

Settings 0~65535

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

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

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

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

✍ 03-06 Multi-function Output 2 (MOI)

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

✍ 03-07 Multi-function Output 3 (MO2)

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

Settings
0: No function
1: Operation indication
9: Hybrid Servo Controller is ready
11: Error indication
44: Displacement switch signal
45: Motor fan control signal

03-08 Multi-function output direction

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

Settings 0~65535

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

03-09 Low-pass filtering time of keypad display

Control mode **VF** **FOCPG** **FOCPM** Factory default: 0.010

Settings 0.001~65.535 seconds

📖 This parameter can be set to reduce the fluctuation of the readings on the keyapd.

03-10 Maximum output voltage for pressure feedback

Control mode **VF** **FOCPG** **FOCPM** Factory default: 10.0

Settings 5.0~10.0 V

03-11 Minimum output voltage for pressure feedback

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

Settings 0.0~2.0V

📖 This parameter defines the pressure feedback output voltage type.

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

03-12 Type of Pressure Feedback Selection

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

Settings 0: Current
1: Voltage

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

The following are required when using it:
Switch the SW100 on the I/O board to “I”.
Set Pr03-12 = 0 (4~20mA)
Set Pr00-36 =1 (Enable detection of the pressure feedback disconnection)

03-13 Confluence Master/Slave Selection

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

Settings 0: No function
1: Master 1
2: Slave/Master 2
3: Slave/Master 3

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

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

📖 With multi-function input terminal function 45, the confluence/diversion can be configured. For detailed operation, please refer to Chapter 2 for wiring and Chapter 3 for tuning.

📖 The difference between Master 2 and Master 3 is that the Master 3 can be configured as confluent with other Slaves during confluence, however, the Master 2 can be configured for stand-alone operation.

📖 When Pr.03-13 is set as 2: Slave, at the same time, Pr.01-01 will be set as 2 and Pr.03-15 will be set as 1 automatically.

03-14 Slave's proportion of the Master's flow

Control mode **VF** **FOCPG** **FOCPM** Factory default: 100.0

Settings 0.0~65535.5 %

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

Example: Slave is 60L/min and Master is 40L/min, so the setting is 60/40 * 100% = 150%
For confluence of more than 2 pump, the values for the slaves must be the same. For example, if the total flow for a three-pump system is 200L/min, where the Master is 40L/min, then the two Slaves should be 80L/min. The setting of Parameter 03-14 should be 160/40 = 400%

03-15 Source of frequency command

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

Settings 0: Digital Operation Panel
1: RS485 Communication
2~5: Reserved

- This parameter is used for EMVJ-MF01.For detailed operation, please refer to Chapter 3 for tuning.
- 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 default: 20

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 default: 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 Communication error treatment

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

Settings 0: Warn and keep operation
1: Warn and ramp to stop
2: Warn and coast to stop
3: No action and no display

- This parameter is used to set the handling status of the drive when a communication timeout error (such as disconnection) occurs.

03-19 Time-out detection

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

Settings 0.0~100.0 seconds

- This parameter is used to set the time of the time-out event for the communication and the keypad transmission.

03-20 Start-up display selection

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

Settings 0: F (frequency command)
1: H (actual frequency)
2: Multi-function display (user-defined 00-04)
3: A (Output current)

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

03-21 Slave reverse operation for depressurization

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

Settings 0: Disabled
1: Enabled

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

🕮 When the parameter is set as 1, it is necessary to make sure that the outlet end of the Slave is not installed with any one-way valve and the parameter 03-16 is set as 500.

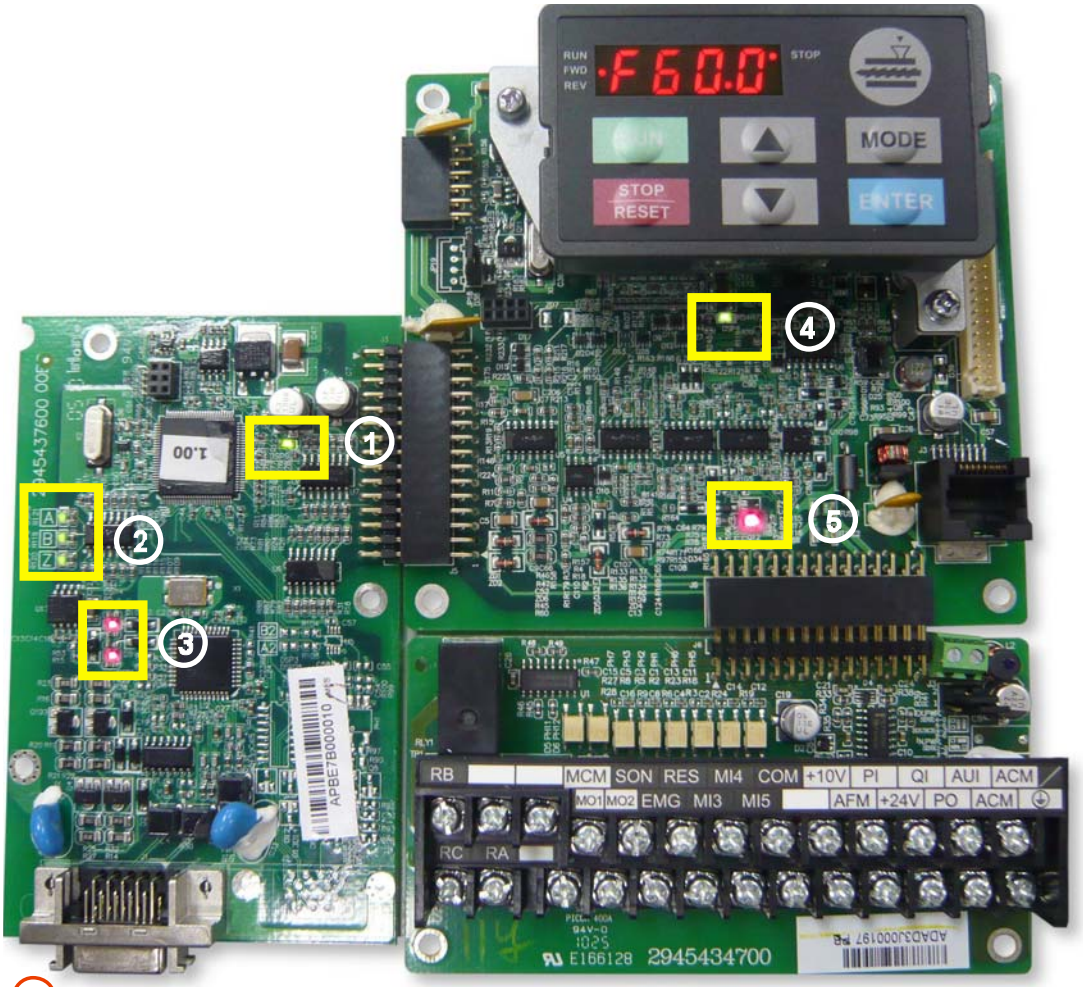
Chapter 5 Methods of Anomaly Diagnosis

The Hybrid Servo Controller is capable of displaying warning messages such as over voltage, low voltage, and over current and equipped with the protection function. Once any malfunction occurs, the protection function will be activated and the Hybrid Servo Controller will stops its input, followed by the action of the anomaly connection point and stopping of the servo oil pump. Please refer to the cause and resolution that corresponds to the error message displayed by the Hybrid Servo Controller for troubleshooting. The error record will be stored in the internal memory of the Hybrid Servo Controller (up to the most recent six error messages) and can be read by the digital operation panel 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 Controllers with power ≦ 22kW, wait for five minutes after the power is turned off and for ten minutes for models with power ≧ 30kW. Verify that the charging indicator is off. Measure the DC voltage between terminals ⊕~⊖, which should be below DC25V before opening the machine cover and starting the inspection.

5-1 Unusual Signal

5-1-1 Indicator Display



1. Indicator of PG card power
2. Indicator of Encoder feedback
3. Warning indicator
   When the sin or cos phase voltage is lower than required values in the rotational transformer, the warning indicator will be on. Please check if the encoder wire is connected correctly. If it happens in operation, please check for any interference.
4. Power indicator
5. Power indicator

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

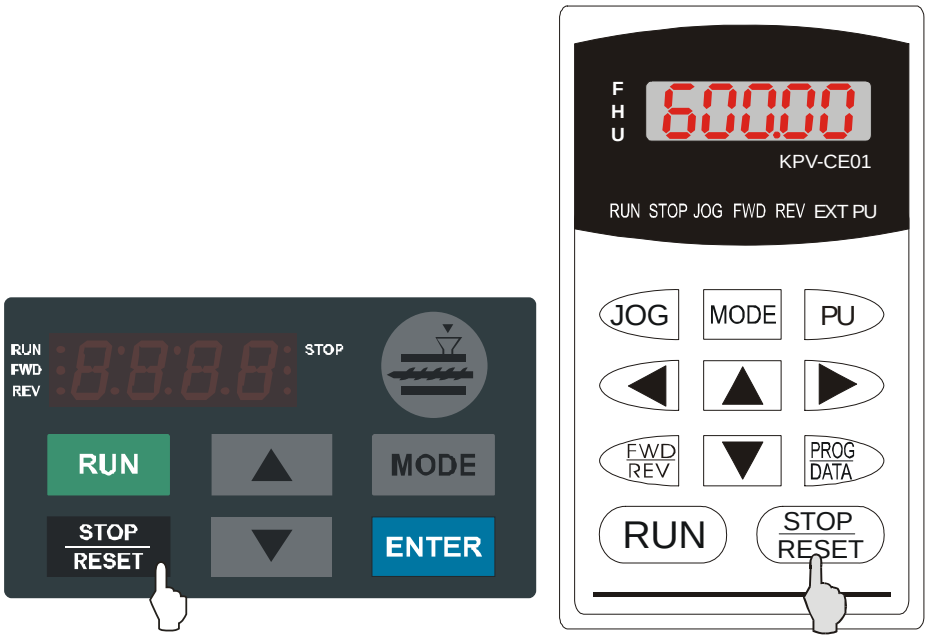
Display Code	Description of Anomaly	Troubleshooting
	Over current occurs in acceleration; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs in deceleration; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs when running; output current exceeds by three times the rated current of the frequency inverter	Check if the insulation of the wire from U-V-W to the hybrid servo motor is bad Check if the hybrid servo motor is stalled Replace with the Hybrid Servo Controller with larger output capacity
	Over current occurs when the system is off. Unusual hardware circuit by current detection	Send back to manufacturer for repair
	Shorting of top and bottom bridges in IGBT module are detected by Hybrid Servo Controller	Send back to manufacturer for repair
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller in acceleration	230: DC 450V 460V: DC 900V Check if the input voltage is within the range of voltage rating of Hybrid Servo Controller and monitor for any occurrence of surge voltage For Hybrid Servo Controller with power below 22kW, the issue can be resolved by adjusting the software brake action level in Pr.02-00 For Hybrid Servo Controller with power above 22kW, the issue can be resolved by adjusting the action level in the brake unit (Please refer to Appendix B-6 for details.)
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller in deceleration	
	Over voltage occurs on the internal DC high voltage side detected by Hybrid Servo Controller when running	
	Over voltage occurs when the system is off. Unusual hardware circuit by current detection	Check if the input voltage is within the range of voltage rating of Hybrid Servo Controller and monitor for any occurrence of surge voltage
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 in acceleration	Check if the voltage of input power is normal Check if there is any sudden heavy load Adjust the low voltage level in Pr.02-07
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 in deceleration	
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 when running at constant speed	
	The DC voltage of Hybrid Servo Controller is lower than the setting in Pr.02-07 when off	
	Phase los protection	Check if only single phase power is sent or phase los occurs for three phase models For models with 40HP and above, check if the AC side fuse is blown

Display Code	Description of Anomaly	Troubleshooting
	Ground wire protection, applies when Hybrid Servo Controller detects the output is grounded and the ground current is higher than its rated value by over 50%. Note that this protection is only for Hybrid Servo Controller and not for human.	Check the wire of hybrid servo motor is shorted or grounded Check if IGBT power module is damaged Check if the output side wire has bad insulation
	Overheating of IGBT detected by Hybrid Servo Controller, exceeding the protection level 7.5~15HP: 90℃ 20~100HP: 100℃	Check if environment temperature if too high Check if there is any foreign object on the heat sink and if the fan is running Check if there is sufficient space for air circulation for Hybrid Servo Controller
	Over heating of heat sink detected by Hybrid Servo Controller, exceeding the protection level (90℃)	Check if environment temperature if too high Check if there is any foreign object on the heat sink and if the fan is running Check if there is sufficient space for air circulation for Hybrid Servo Controller
	IGBT over heated and unusual fan function	Check the fan kit to see if it is blocked. Return to factory for repair.
	Output current exceeds the maximum capacity of Hybrid Servo Controller	Check if the motor is overloaded Increase the output capacity of Hybrid Servo Controller
	Servo motor overloaded	Change the product conditions
	DC Fuse blown on (FUSE), for models below (including) 30HP	Check if the transistor module fuse is bad Check if the load side is shorted
	Abnormal memory write in	Press RESET key to return all parameters to factory default values If the above does not work, send back to manufacturer for repair
	Abnormal memory readout	
	Detection of abnormal output of three-phase total current	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair
	Detection of abnormal current in U phase	
	Detection of abnormal current in V phase	
	Detection of abnormal current in W phase	
	When external EF terminals are closed, Hybrid Servo Controller stops its output	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℃), Hybrid Servo Controller stops its input	Troubleshoot and press ”RESET”
	Abnormal brake crystal detected by Hybrid Servo Controller	Press RESET. If the display still shows “bF”, please send the unit back to manufacturer for repair

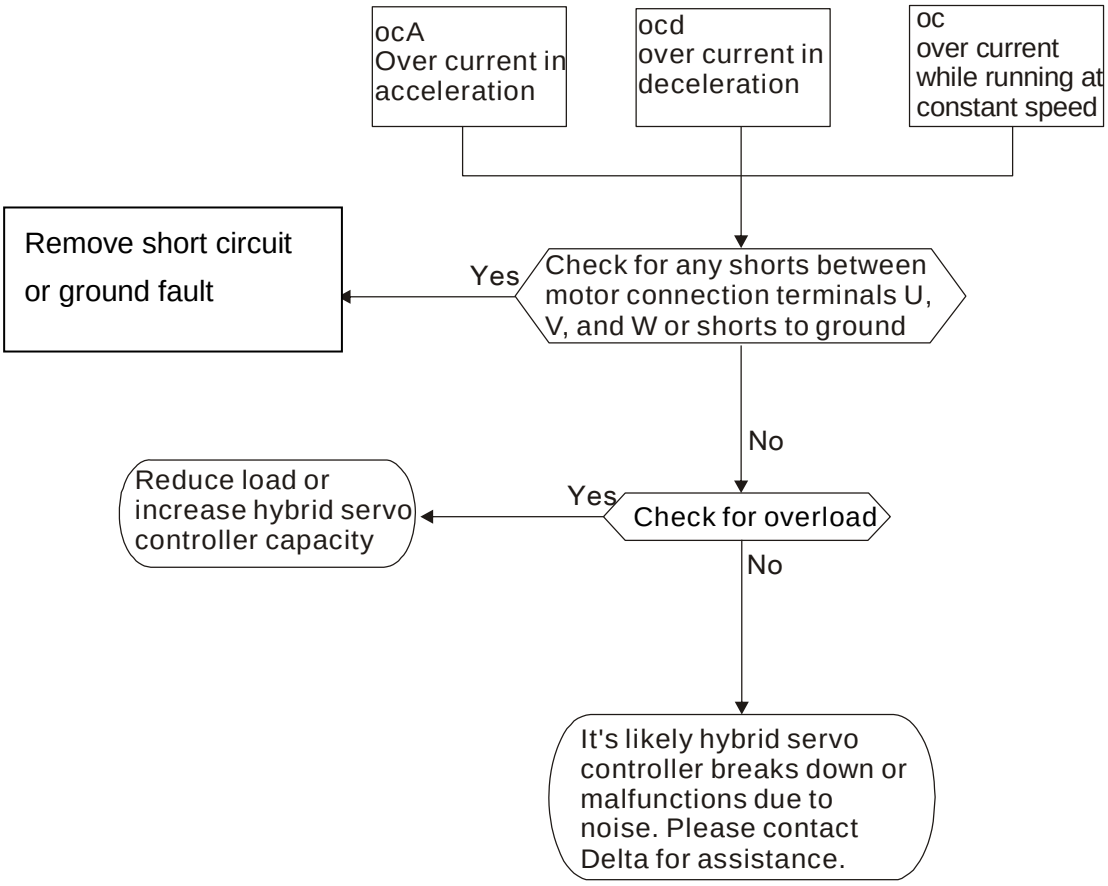
Display Code	Description of Anomaly	Troubleshooting
	Abnormal in OH1 hardware wire	Send back to manufacturer for repair
	Abnormal in OH2 hardware wire	Send back to manufacturer for repair
	Abnormal cc protection hardware wire	Turn off the power and restart. If the same problem persists, send back to manufacturer for repair
	Abnormal oc protection hardware wire	
	Abnormal ov protection hardware wire	
	Abnormal GFF protection hardware wire	
	Open circuit of PG feedback	Check the PG feedback wiring
	Stalled PG feedback	Check the PG feedback wiring Check PI gain and the settings for acceleration/deceleration are suitable Send back to manufacturer for repair
	Abnormal PG slip	
	Incorrect PG card information	Check if the settings of Pr.01-26 match those in the installed PG card. If so, please send back to manufacturer for repair
	Abnormal installation or action of JP18, the safety loop card/control board pin	Check if the safety loop card is installed correctly on the control board and if the output action is normal Check if pin JP18 is inserted into the wrong position on the control board
	Pressure is too high	Check if the pressure sensor is working properly Adjust pressure PI control Pr.00-20~00-37
	Open circuit of pressure feedback	Check if the wiring of pressure sensor is correct Check if the pressure sensor signal is below 1V

Alarm reset

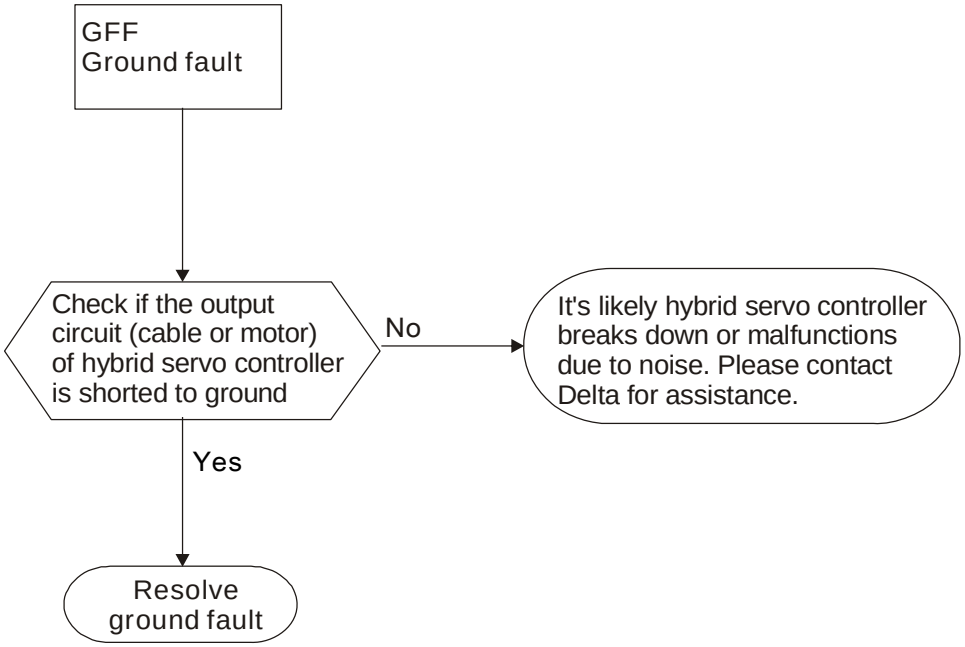
Once the issue that tripped the system and triggers the alarm is eliminated, one can resume the system to normal status by pressing the Reset key on the panel (as shown in the figure) to set the external terminal to "Anomaly reset command" and sending the command by turning on the terminal or via communication.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


RUN
FWD
REV
STOP
RUN
MODE
STOP
RESET
ENTER
F
H
U
60.00
KPV-CE01
RUN STOP JOG FWD REV EXT PU
JOG
MODE
PU
FWD
REV
PROG
DATA
RUN
STOP
RESET

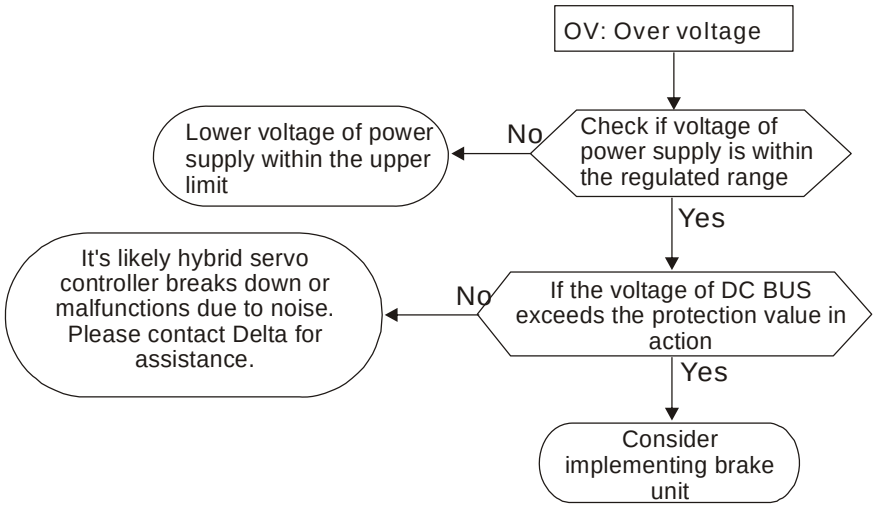
5-2 Over Current (OC)



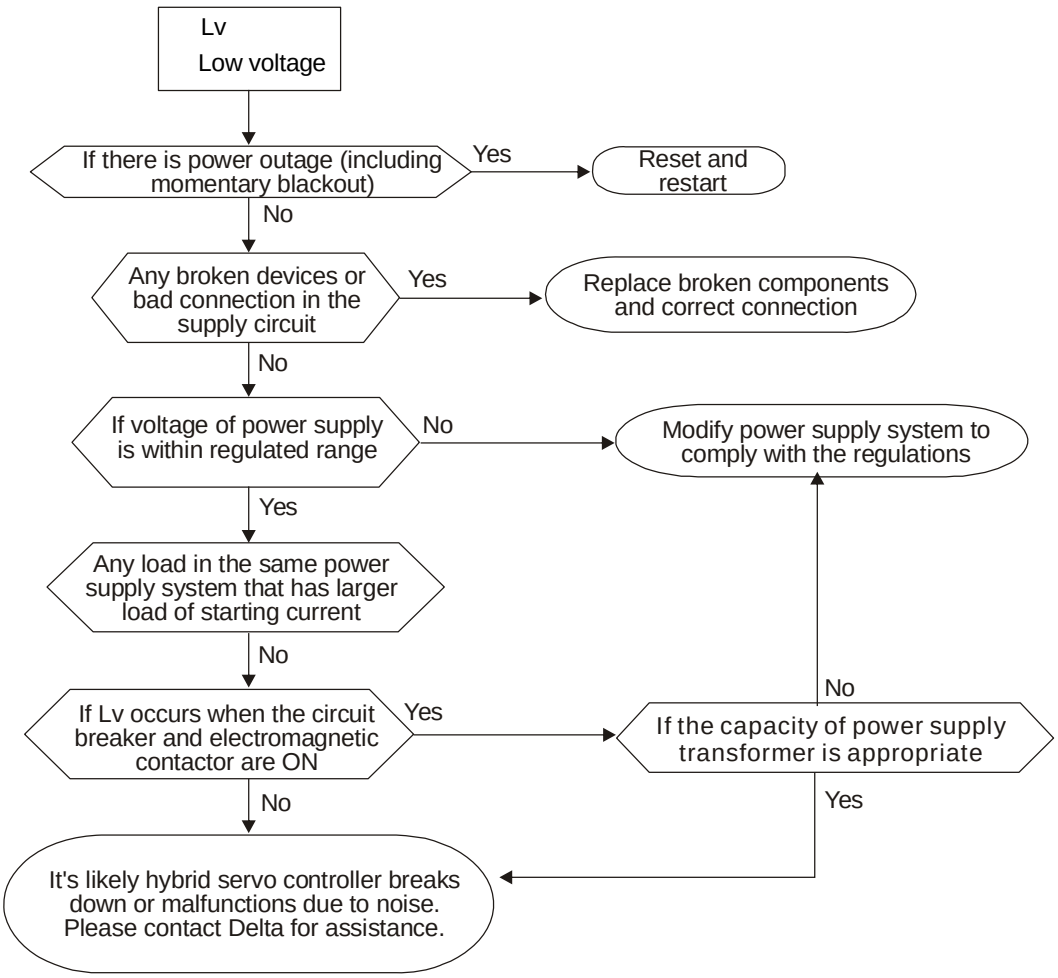
5-3 Ground Fault (GFF)



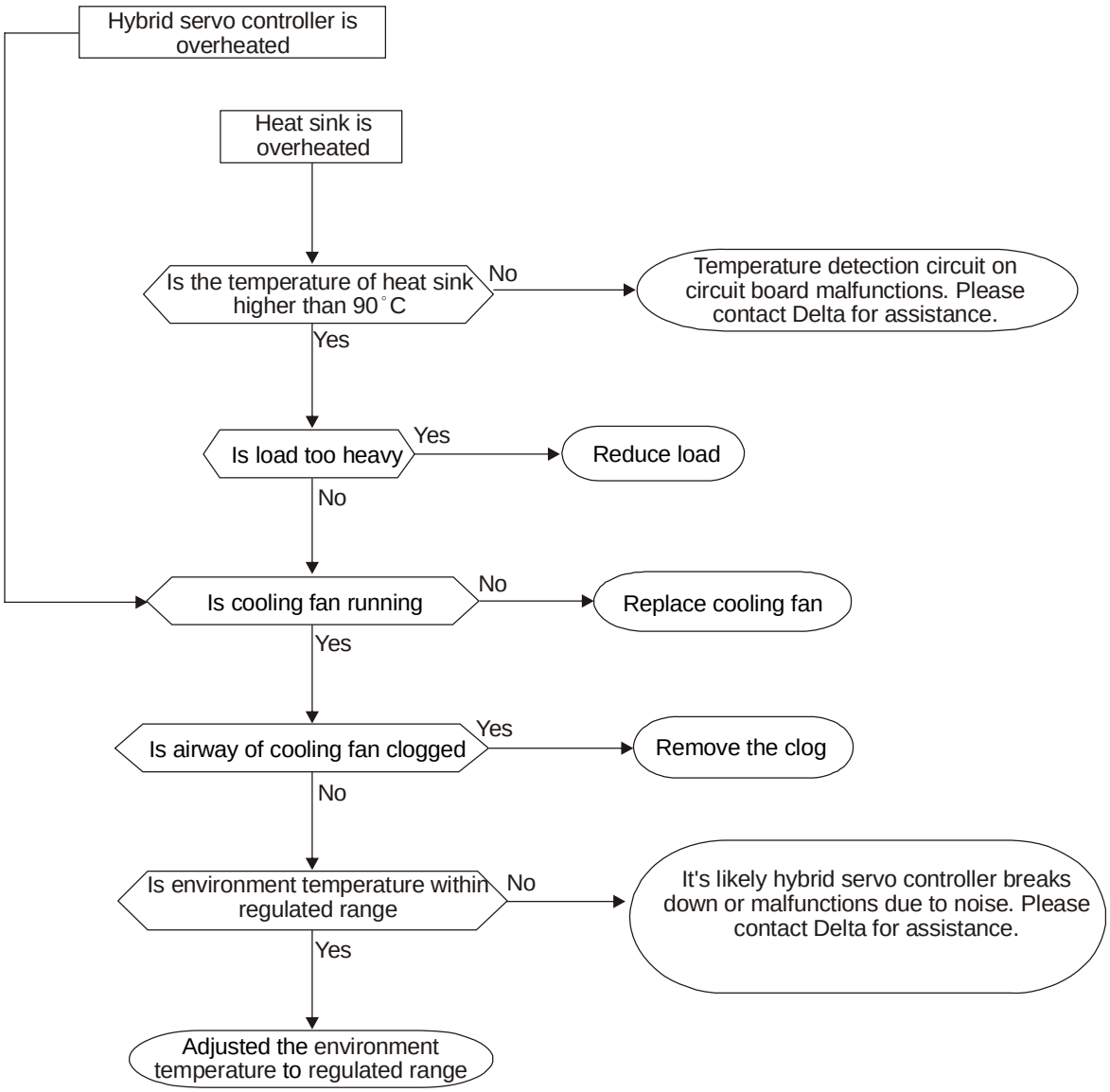
5-4 Over Voltage (ov)



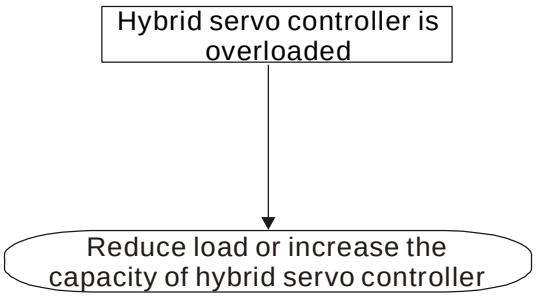
5-5 Low Voltage (Lv)



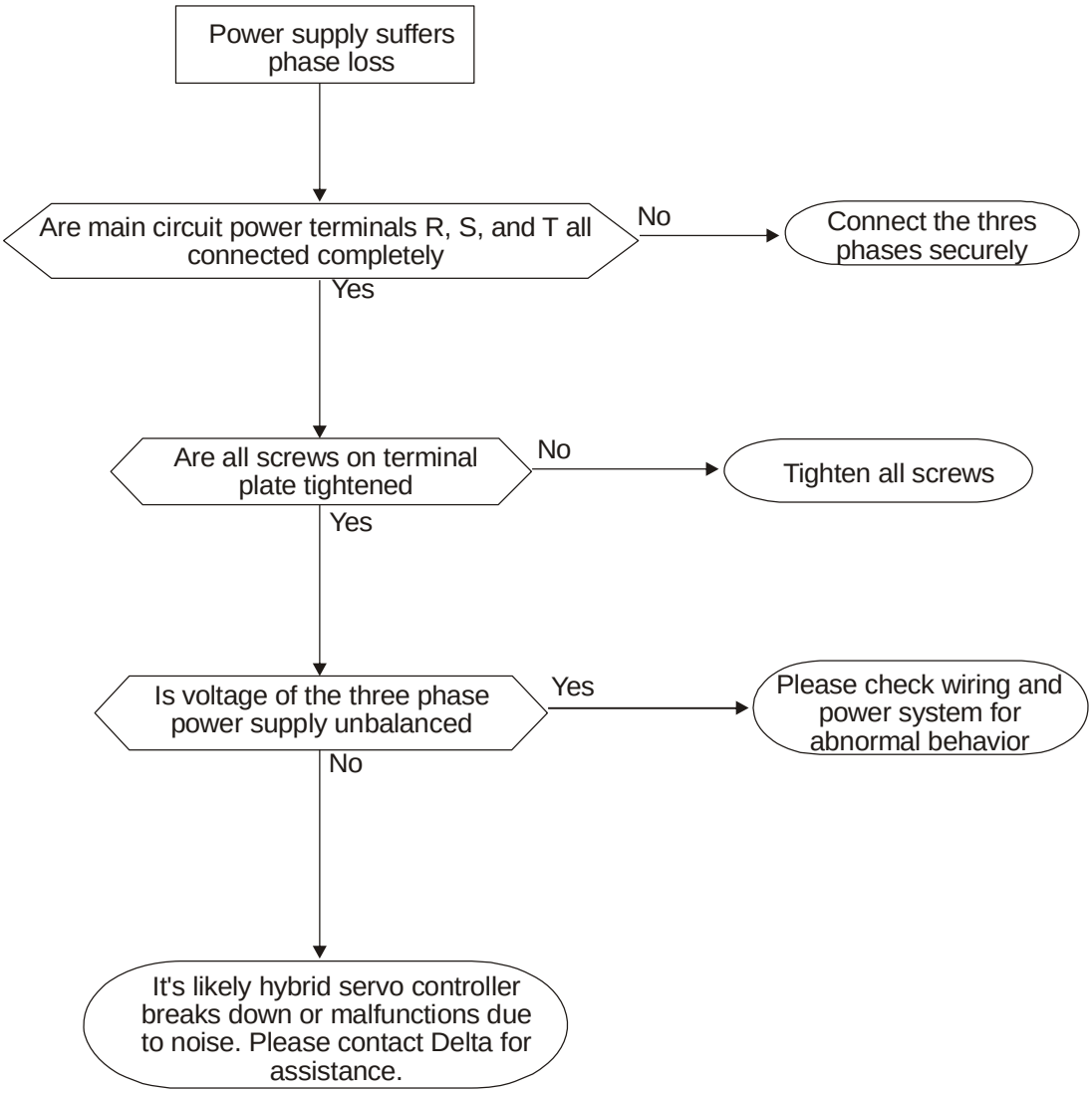
5-6 Over Heat (OH)



5-7 Overload (oL)



5-8 Phase Loss (PHL)



5-9 Electromagnetic/Induction Noise

If there exist noise sources around Hybrid Servo Controller, they will affect Hybrid Servo Controller through radiation or the power lines, leading to malfunction of control loop and causing tripping or even damage of Hybrid Servo Controller. One natural solution is to make Hybrid Servo Controller 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 Controller.

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 Controller 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 Controller 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 Controller 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 environment 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 environment temperature, it is also necessary to perform cleaning and spot check the air filter in the storage tray of Hybrid Servo Controller 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 Controller is expected to be shut down for an extended period of time, be careful not to let condensation happen once the air conditioning is turned off. It is also preferred that the cooling equipment in the electrical room can also work as a dehumidifier.

Chapter 6 Maintenance

Maintenance and Inspections

The Hybrid Servo Controller 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 Controller digital keypad display. The six most recent faults can be read from the digital keypad or communication.

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

Check your Hybrid Servo Controller regularly to ensure there are no abnormalities during operation and follows the precautions::

 **CAUTION**	☑ Wait for five minutes after the Hybrid Servo Controller with power ≦ 22kW is disconnected with power supply and wait for ten minutes for units with power ≧ 30kW and verify that the charging indicator is off. Measure to make sure that the DC voltage between terminals ⊕ ~ ⊖ is lower than DC25V before starting the inspection. ☑ Only qualified personnel can install, wire and maintain Hybrid Servo Controller. Please take off any metal objects, such as watches and rings, before operation. And only insulated tools are allowed. ☑ Never attempt any alternation of the Hybrid Servo Controller. ☑ Make sure that installation environment comply with regulations without abnormal noise, vibration and smell.

Maintenance and Inspections

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

Actuation Oil

Check Items	Methods and Criterion	Maintenance Period		
		Daily	Half year	One Year
If oil is sufficient	Visual inspection	○		
If the oil temperature is below 60°C (recommended temperature is 15°C~ 50°C)	By thermometer	○		
If the oil color is normal	Visual inspection		○	
Replace Actuation Oil regularly				○

Servo Oil Pump

Check Items	Methods and Criterion	Period of inspection		
		Daily	Half year	One Year
If the set screws of Servo Oil Pump are loose	Visual inspection		○	
If the coupling screws of Servo Oil Pump are loose	Visual inspection		○	
If the cooling fan of hybrid servo motor is running normally and the air flow is sufficient	Visual inspection		○	
Clean the cooling fan of hybrid servo motor regularly				○

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	○		

Keypad

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

Mechanical parts

Check Items	Methods and Criterion	Period of inspection		
		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 Part

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Have any bolts become loose or missing?	Tighten	○		
Is there any distortion, cracking, breaking of machine and insulation or discoloration due to overheating and aging?	Visual inspection		○	
Are there any dust or stains?	Visual inspection		○	

Main Circuit ~Terminals & Wiring

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any discoloration and distortion of terminals and copper plate due to overheating?	Visual inspection		○	
Is there any breaking and discoloration of the protection layer of wires?	Visual inspection		○	

Main Circuit~Terminal Unit

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any damage?	Visual inspection	○		

Main Circuit ~Filter Capacitor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any leakage, discoloration, crack, and buckling of exterior cover?	Visual inspection	○		
Is the safety valve out? Is there any obvious expansion of the valve?	Visual inspection	○		
Measure the electrostatic capacity according to the actual requirements		○		

Main Circuit ~Resistor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any odor from overheating and breaking of insulation?	Visual inspection and listening	○		
Is there any open circuit?	Visual inspection	○		
Is there any damage of the connection end?	Measure by hand-held	○		

	multimeter			

Main Circuit ~Transformer & Reactor

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Any unusual vibration and odor?	Visual inspection and listening	○		

Main Circuit ~Electromagnetic Contactor & Relay

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any sound of vibration while running?	Aural inspection	○		
Is the connection contact is good?	Visual inspection	○		

Control Circuit ~Control Printed Circuit & Connector

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Has the screw and connector become loose?	Tighten		○	
Is there any unusual odor and discoloration?	By smelling and visual		○	
Are there any cracks, breaking, distortion, and apparent rust?	Visual inspection		○	
Are there any leaks and signs of distortion of the capacitor?	Visual inspection		○	

Cooling fan of cooling system

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is there any unusual sound and vibration?	Visual, aural inspection and turn the fan with hand (turn off the power before operation) to see if it rotates smoothly		○	
Have any bolts become loose?	Tighten		○	
Is there any discoloration due to overheating?	Visual inspection		○	

Cooling System ~Air Duct

Check Items	Method of Inspection	Period of inspection		
		Daily	Half year	One Year
Is the heatsink, the inlet and exhaust unclogged and free of foreign objects?	Aural inspection		○	

NOTE

To treat the contaminated spots, please wipe clean with cloths that is chemically neutral. Use air purifier to remove the dust.

Appendix A. Instructions of Product Packaging

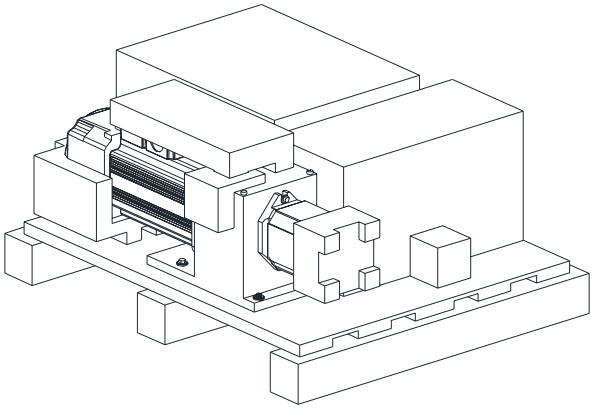
A-1 Descriptions of Product packaging
A-2 Detailed List of Product Packaging

☑ This product is made by a manufacturing process with strict quality control. If the product is damaged in the delivery by external force or crushing, please contact your local agents.

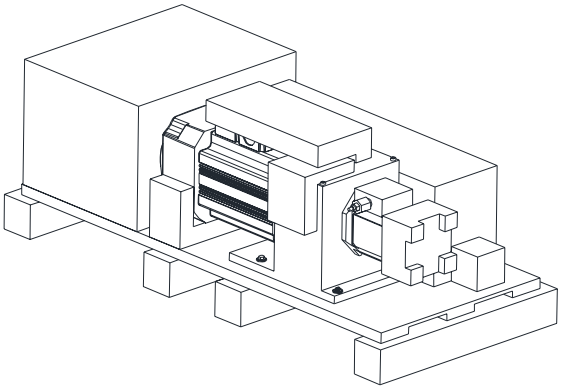
A-1 Descriptions of Product Packaging

Remove the packaging of the external box

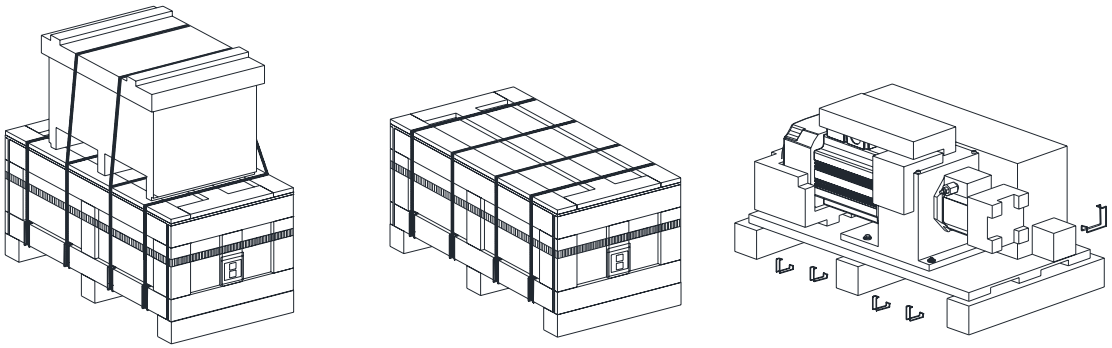
Models:
HES063H23A; HES080G23A; HES080H23A;
HES100G23A; HES100H23A;
HES063G43A;HES063H43A; HES080G43A;
HES080H43A; HES100G43A; HES100H43A;



Models:
HES125G23A; HES125G43A;



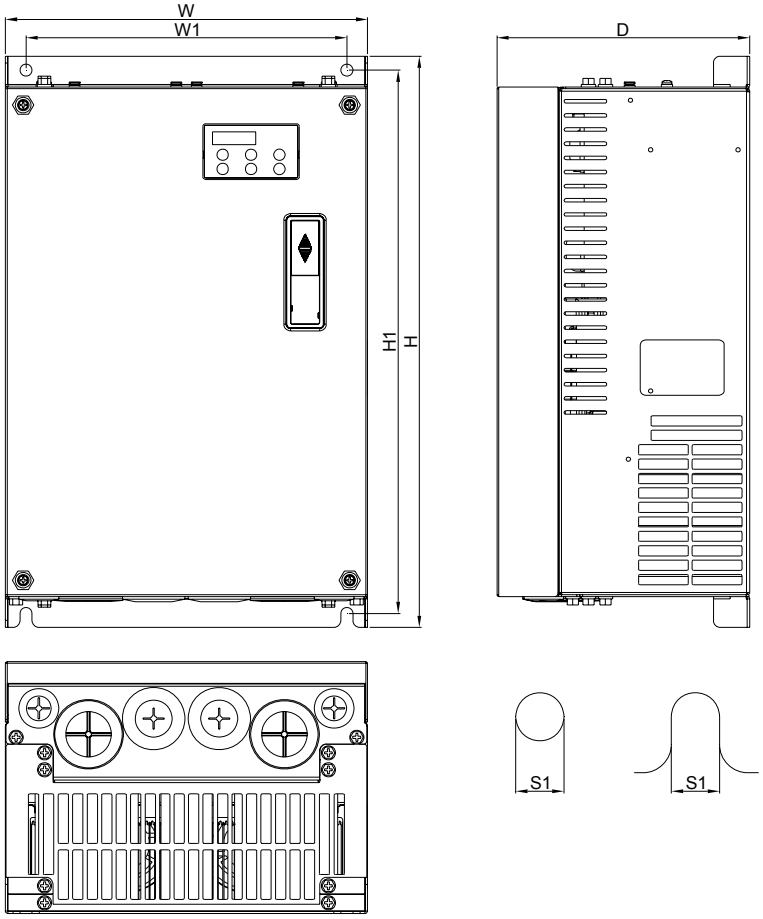
Models:
HES125H23A; HES160G23A;
HES125H43A; HES160G43A; HES160H43A; HES200G43A



A-2 Detailed List of Product Packaging

HES063H23A

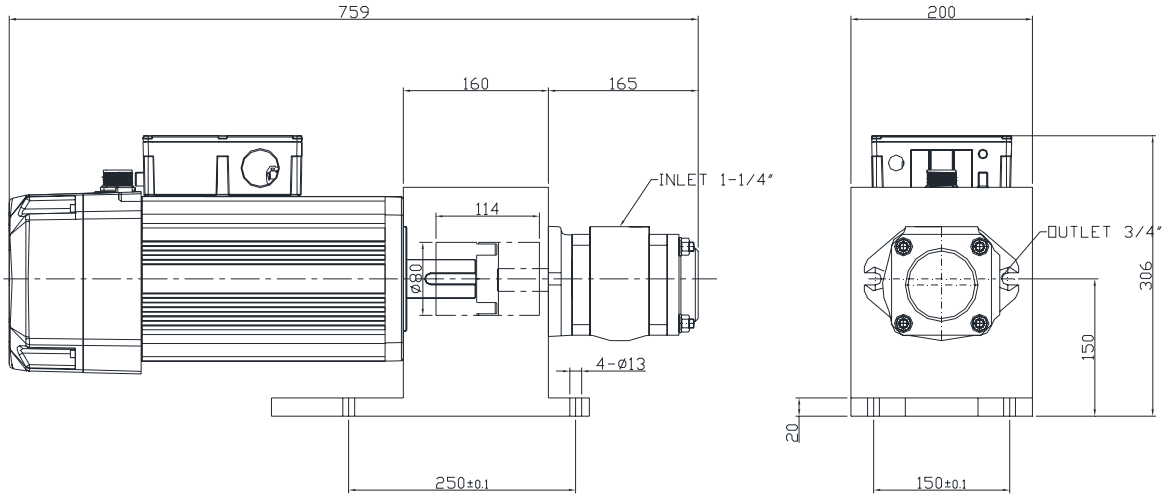
1 Servo controller VFD110VL23A06HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-025-110-23A

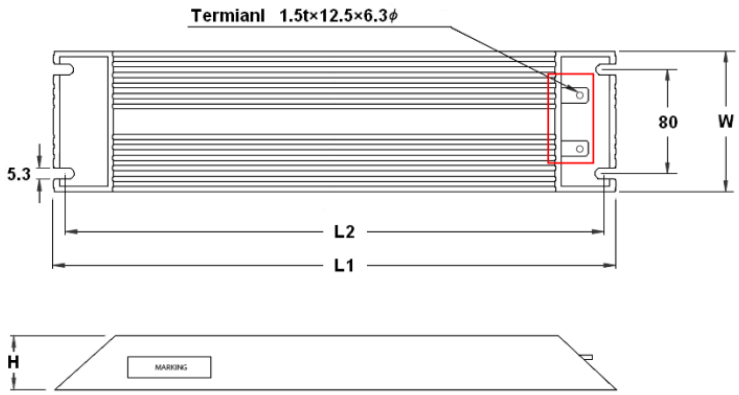


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-063-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W8P3	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

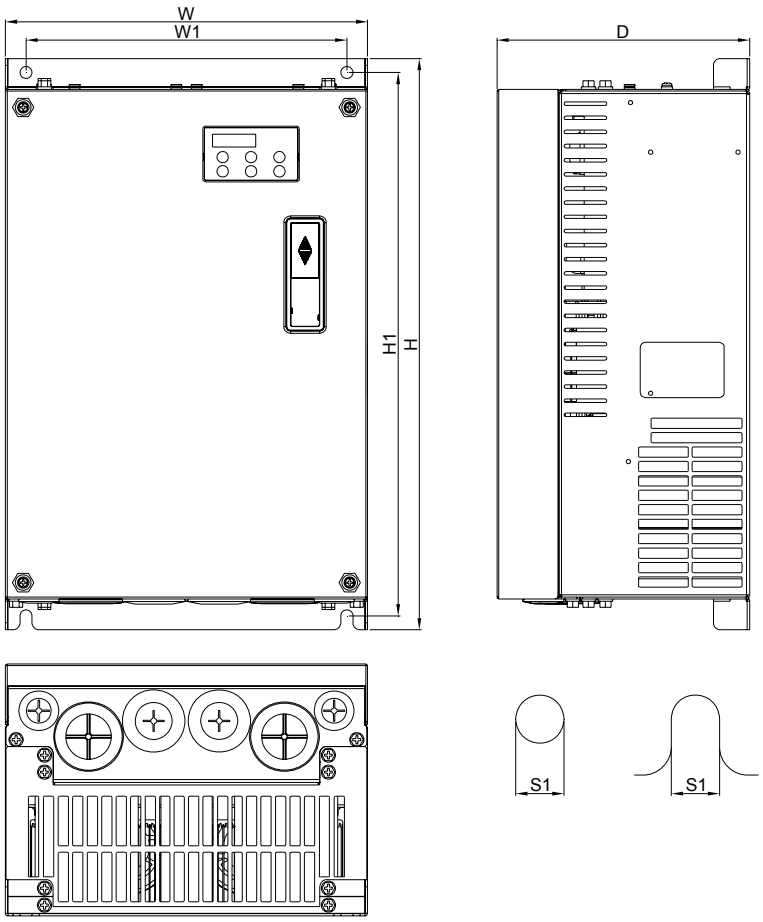
※ Braking resistor 1000W 8.3Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES080G23A

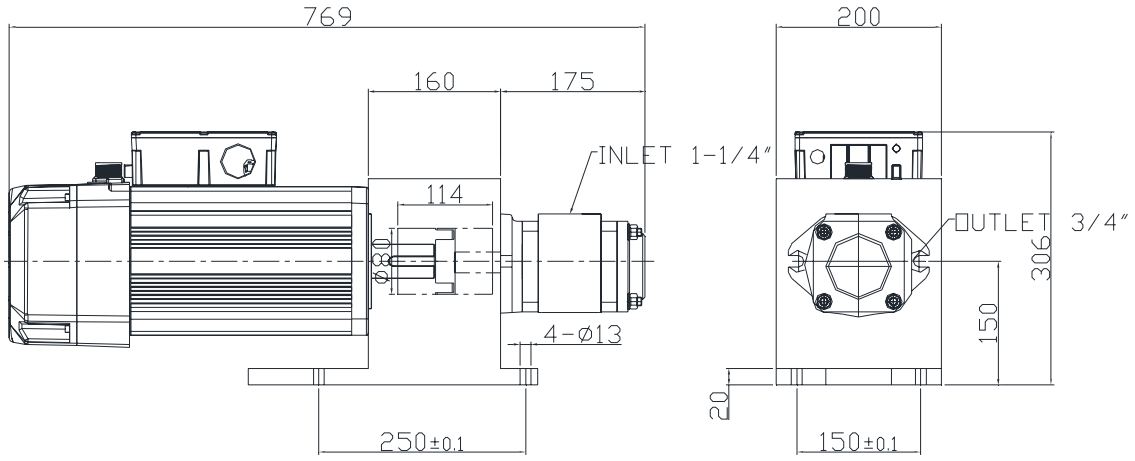
1 Servo controller VFD110VL23A08GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-032-110-23A

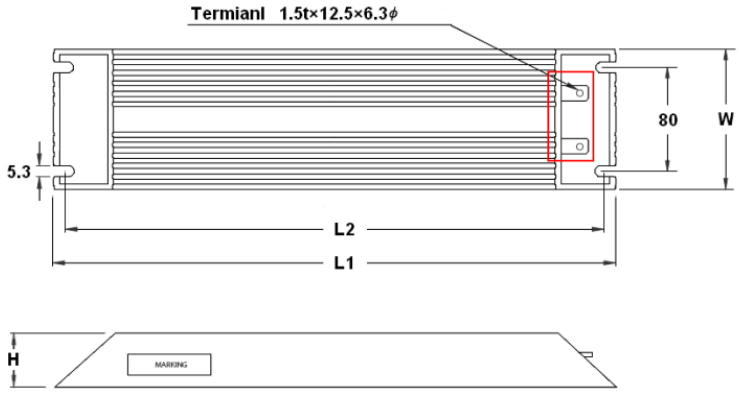


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-080-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W8P3	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

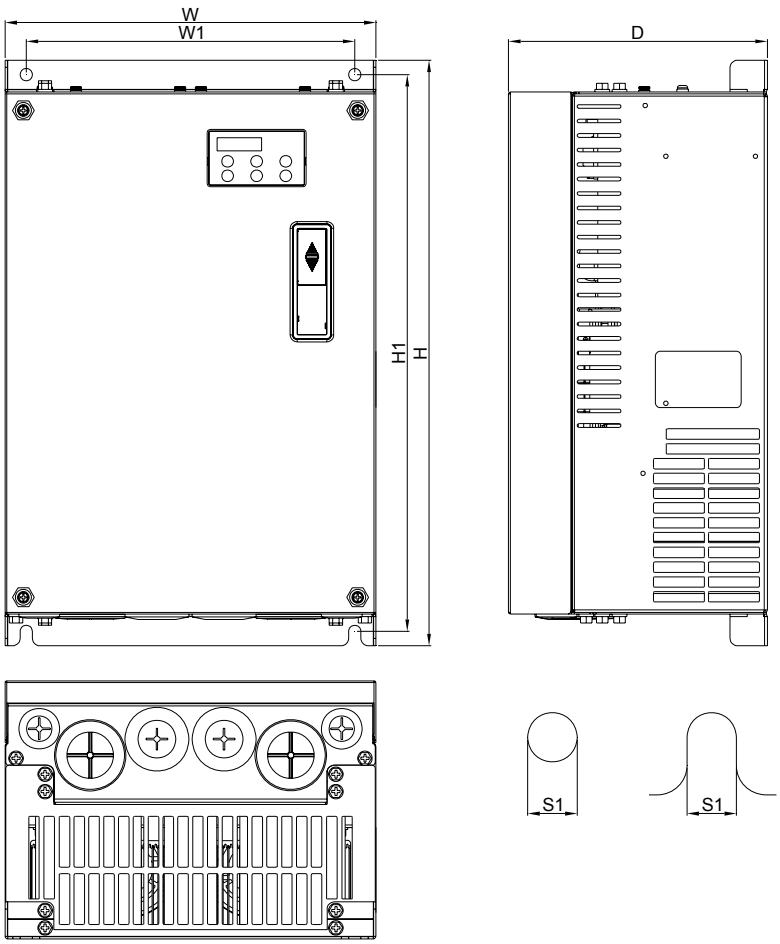
※ Braking resistor 1000W 8.3Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES080H23A

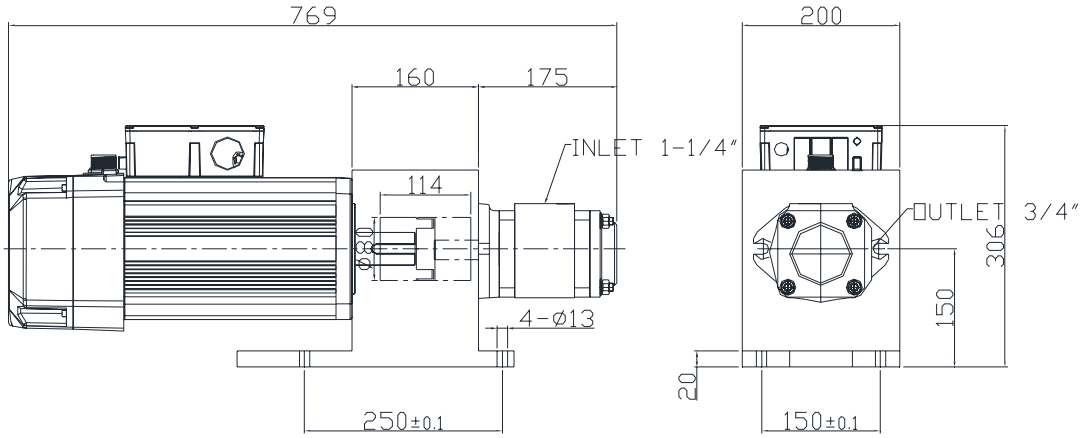
1 Servo controller VFD150VL23A08HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-032-110-23A

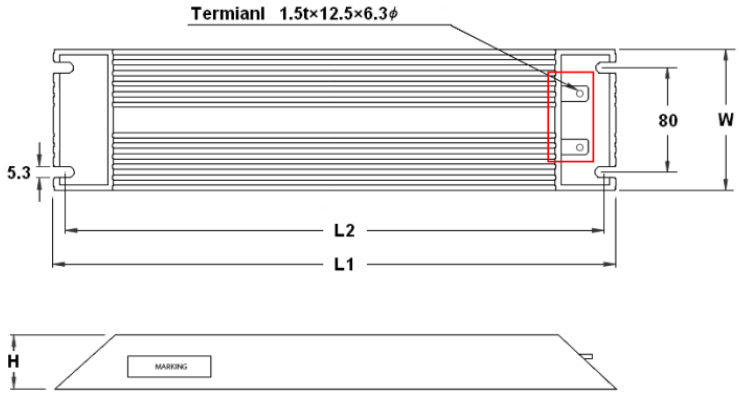


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-080-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

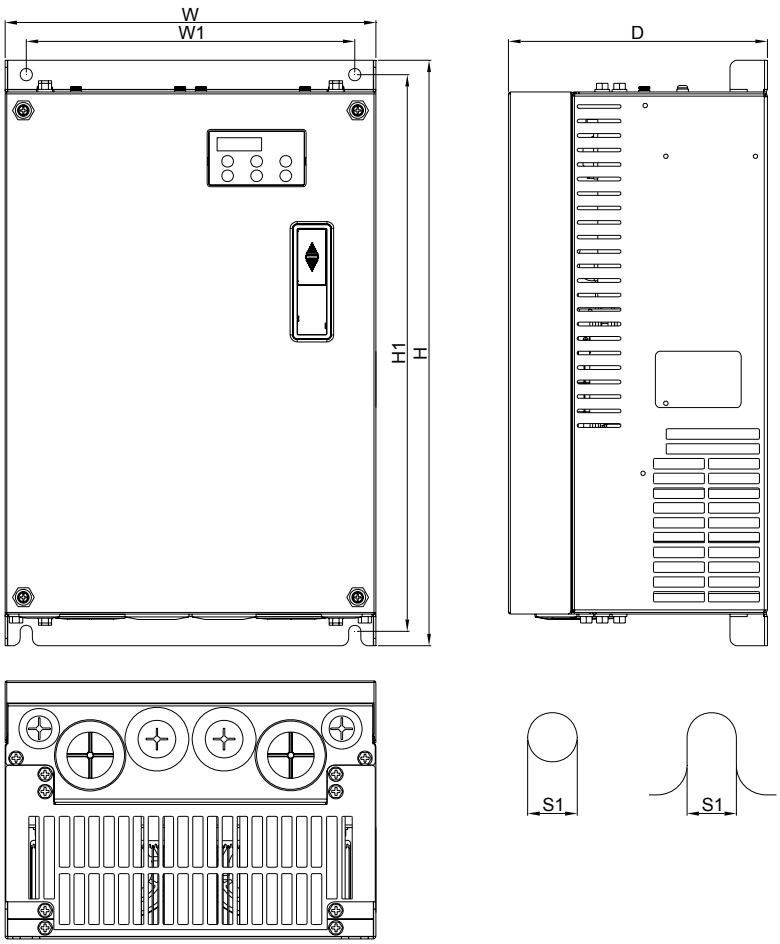
※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100G23A

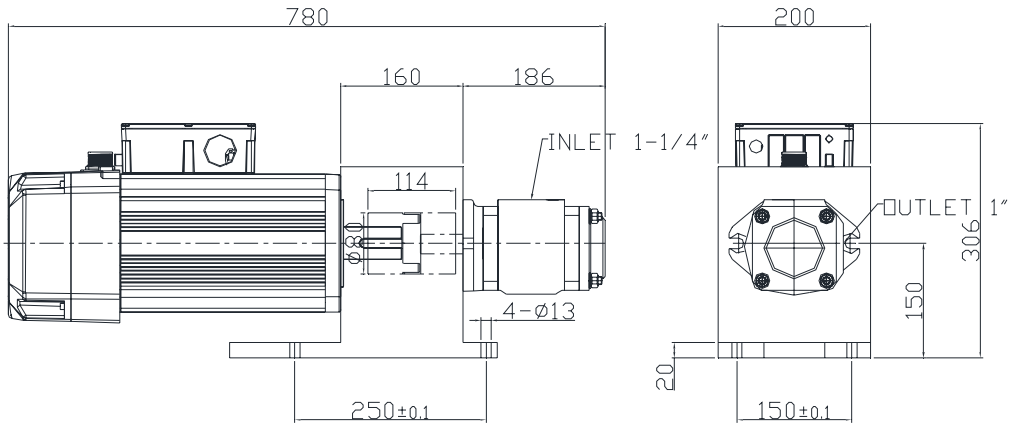
1 Servo controller VFD150VL23A10GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-040-110-23A

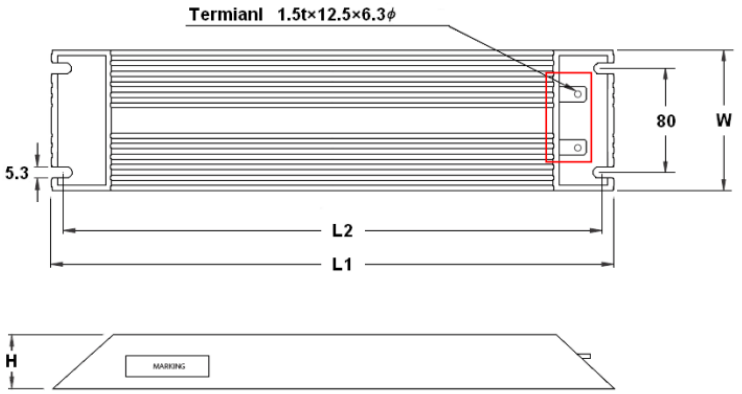


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

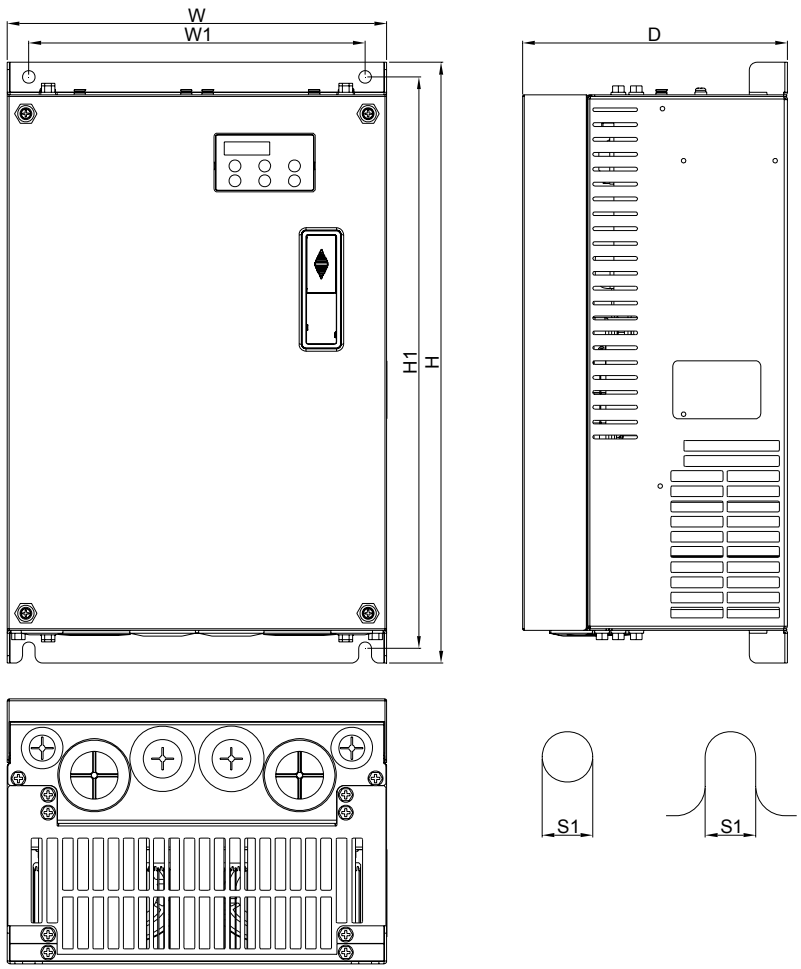
※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100H23A

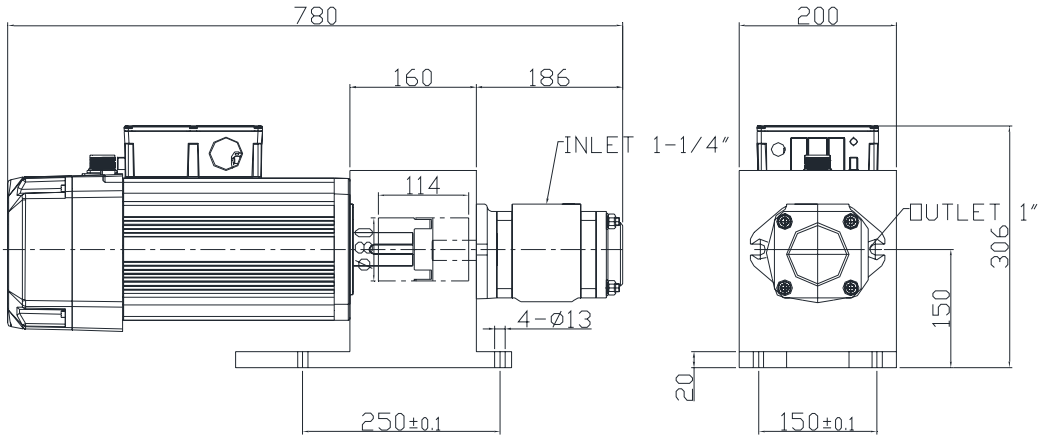
1 Servo controller VFD185VL23A10HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-040-110-23A

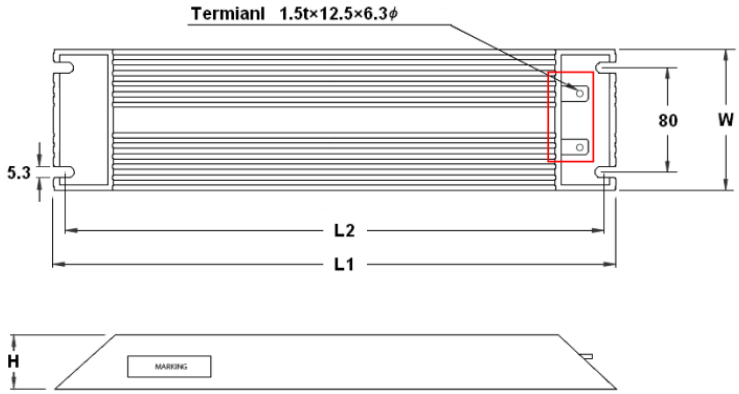


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-H-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

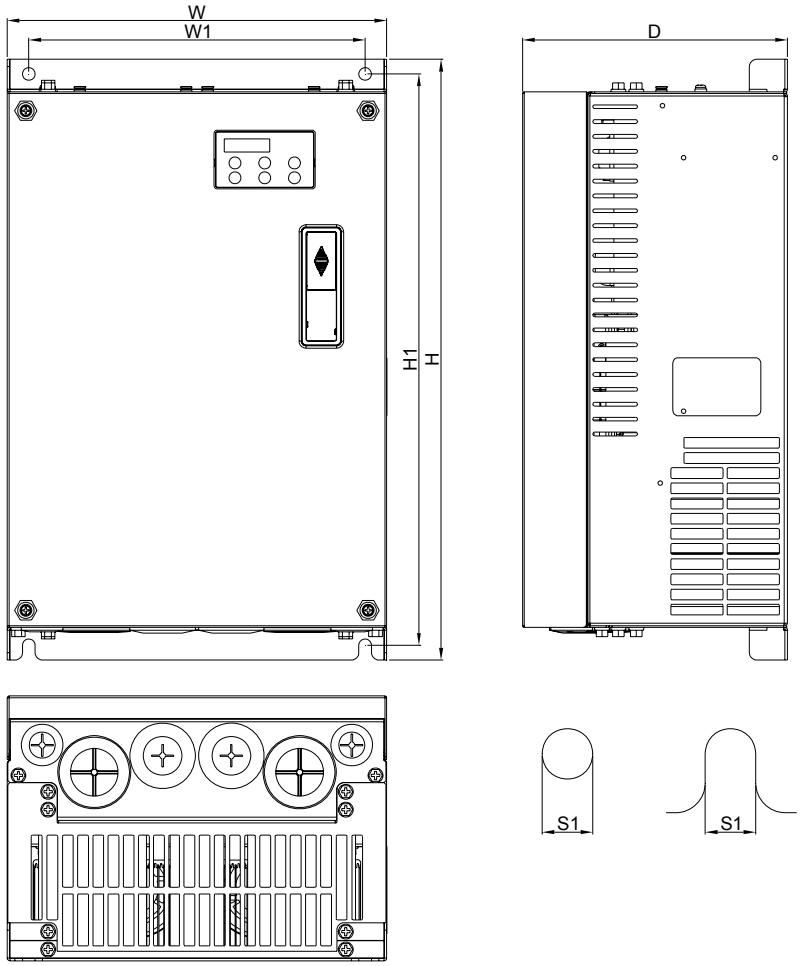
※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100Z23A

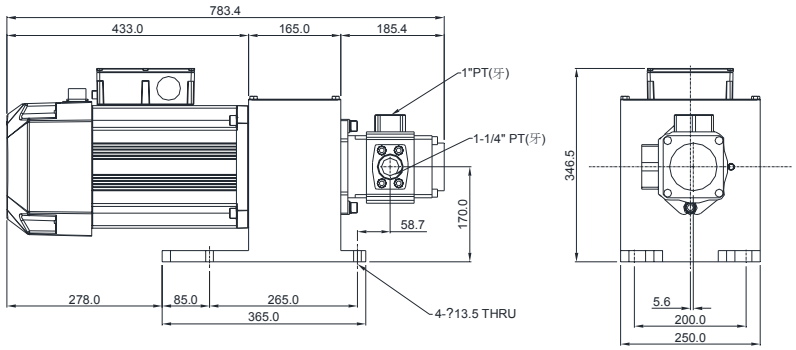
1 Servo controller VFD220VL23A10ZA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-040-150-23A

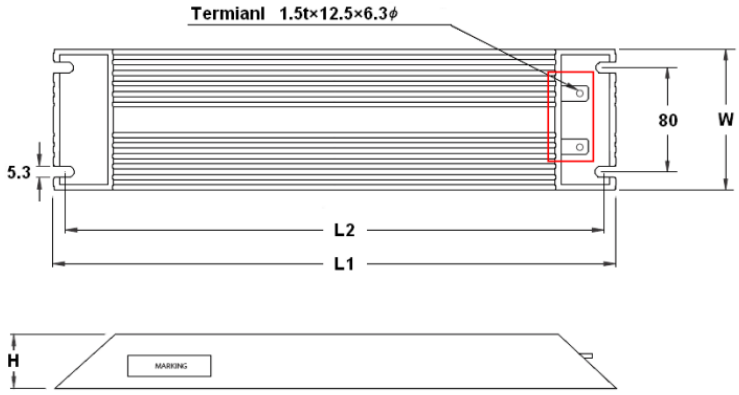


Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-040RA23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-Z-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

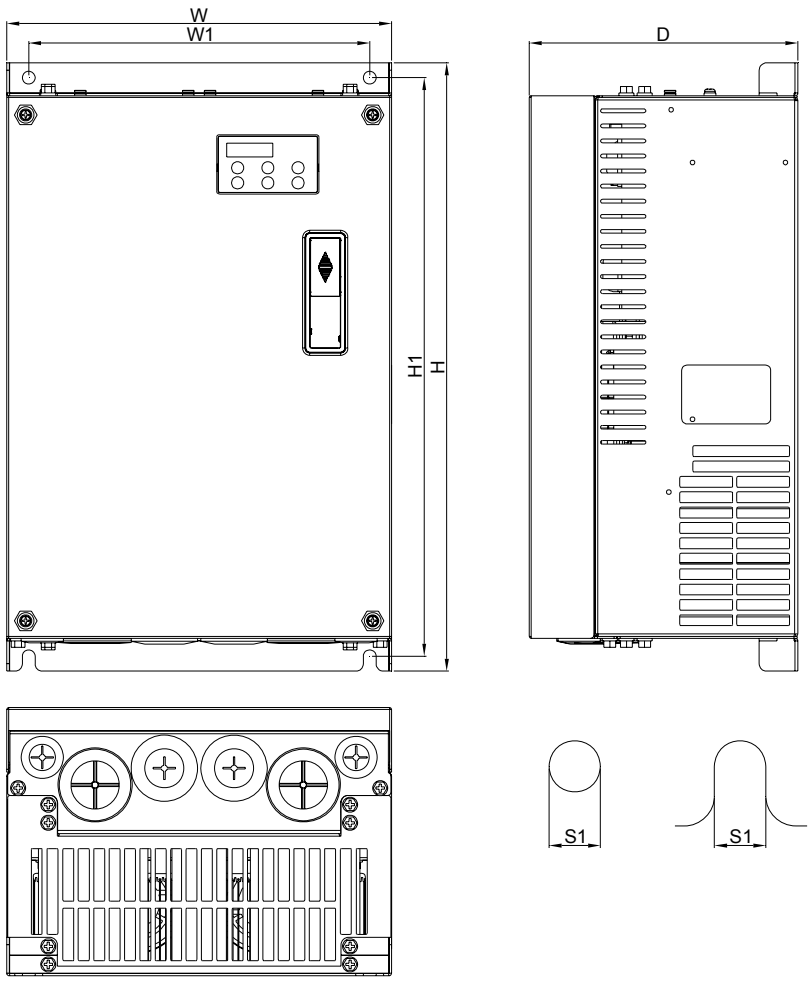
※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES125G23A

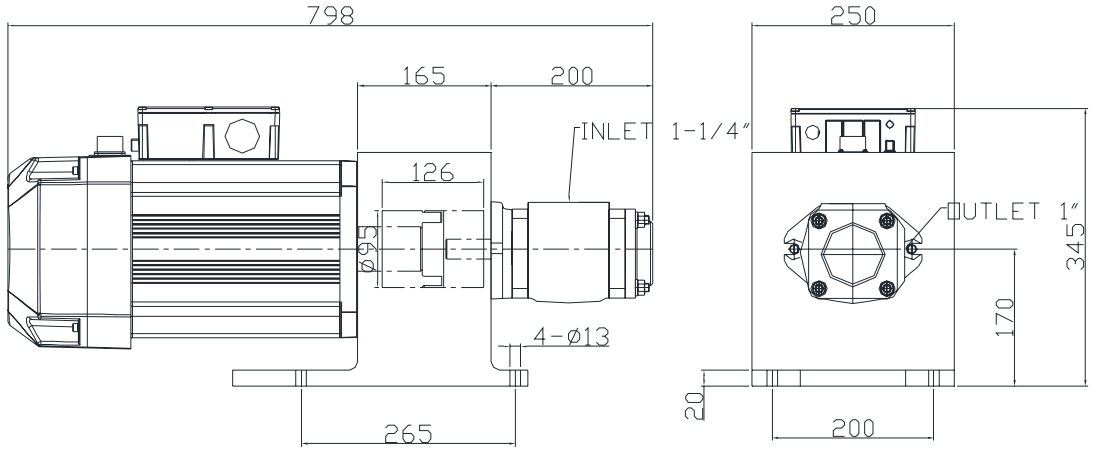
1 Servo controller VFD220VL23A12GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-050-150-23A

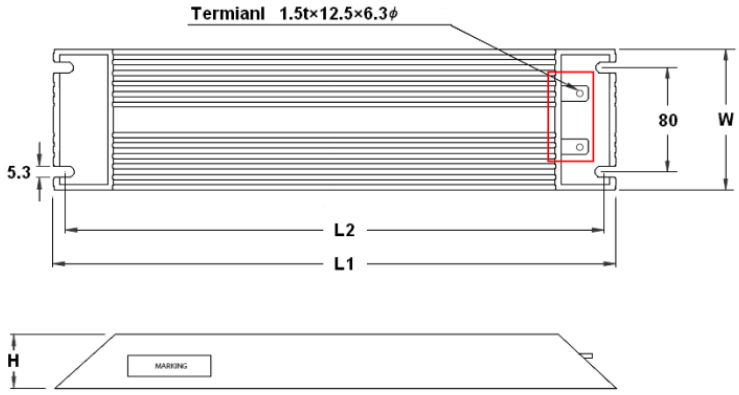


Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-125-G-N-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W5P8	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

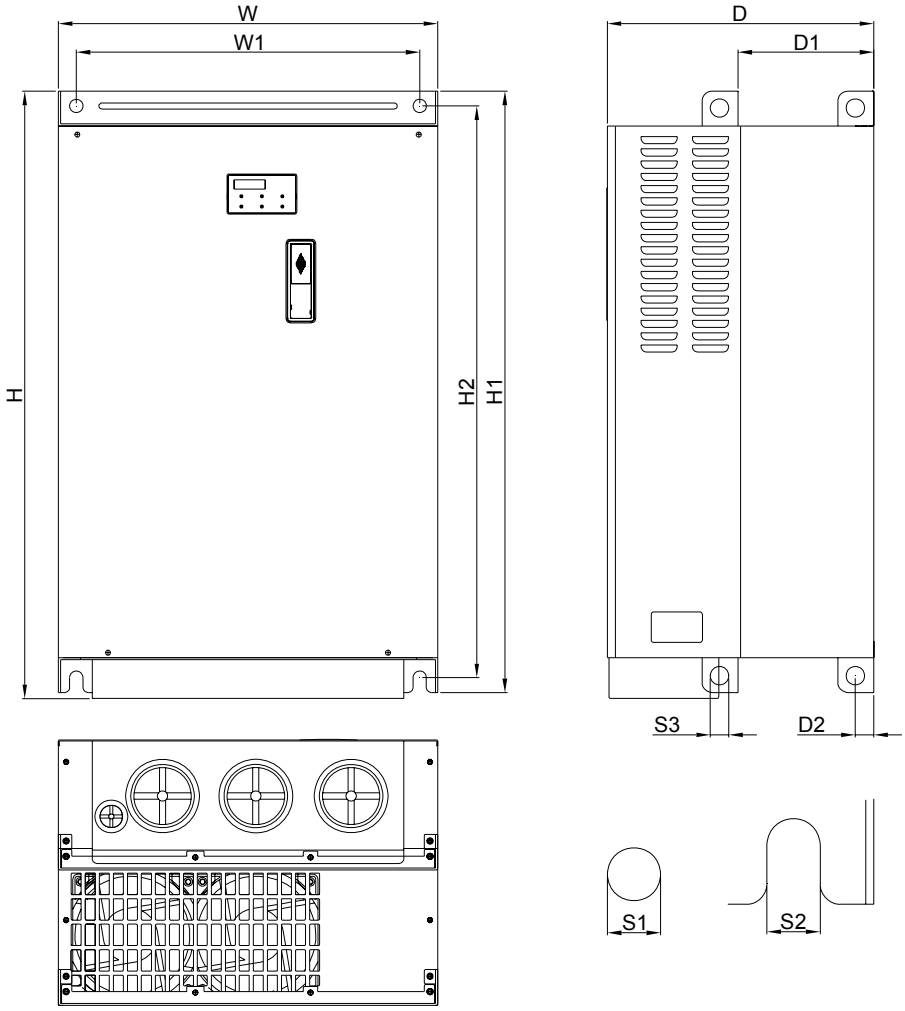
※ Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES125H23A

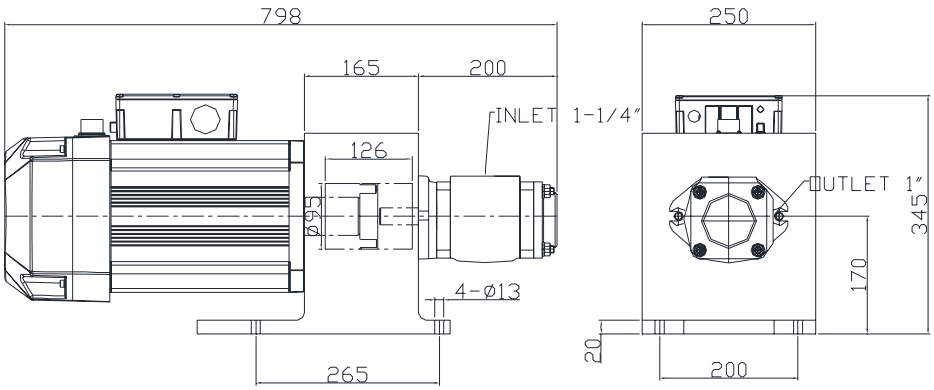
1 Servo controller VFD300VL23A12HA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
E2	370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-050-150-23A



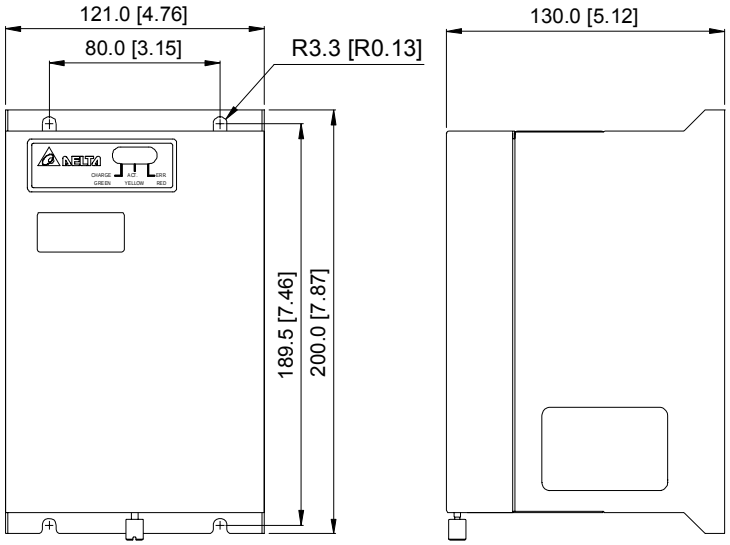
Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

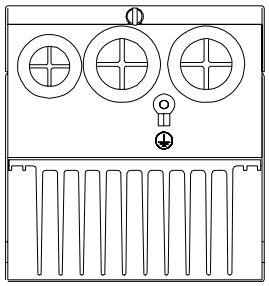
3 Accessories Kit HESP-125-H-B-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR1K0W5P8	1

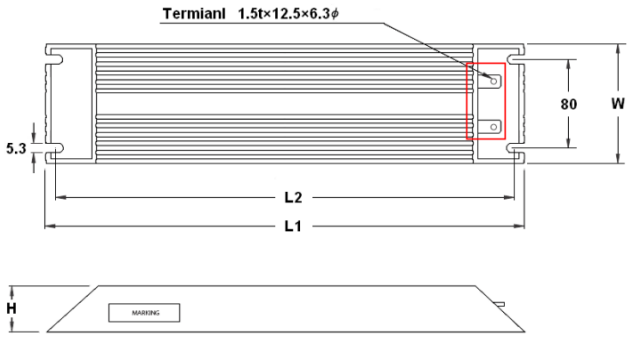
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-2022





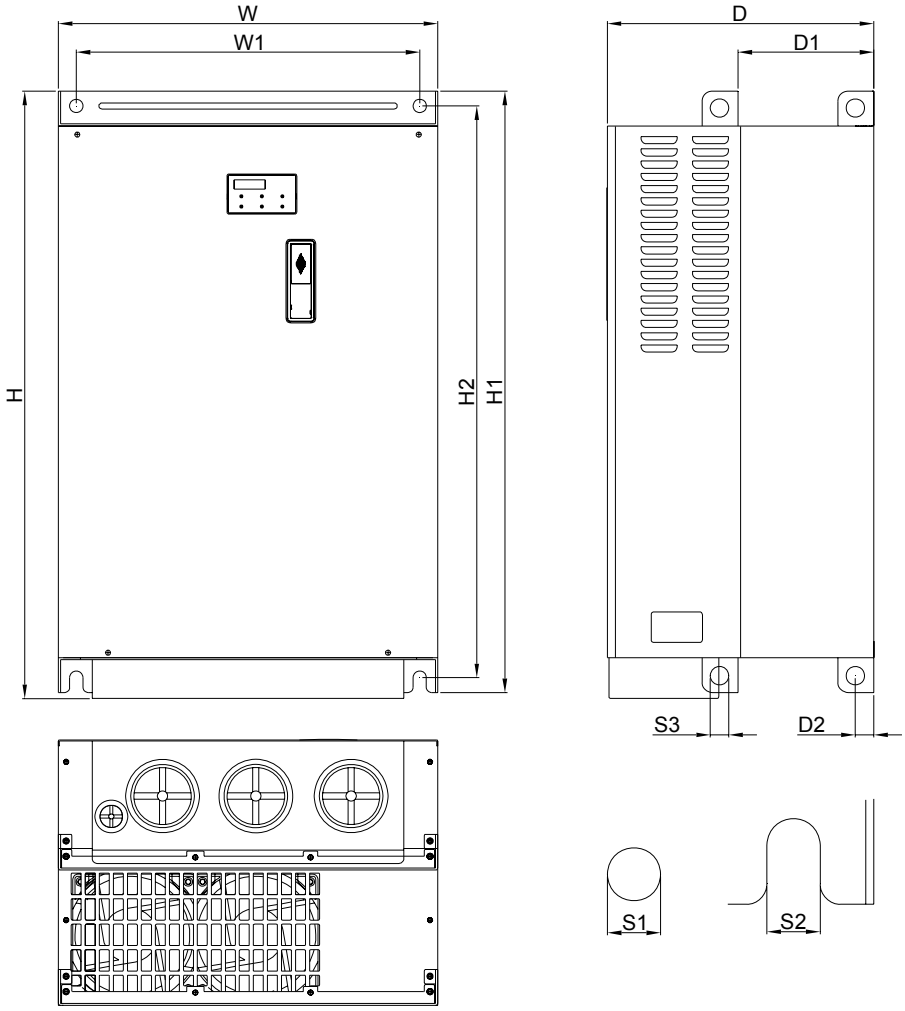
※ 2 Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES160G23A

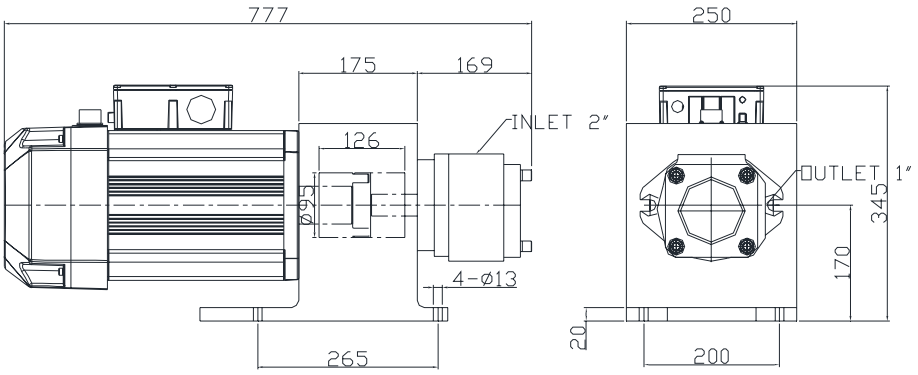
1 Servo controller VFD300VL23A16GA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
E2	370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-064-150-23A



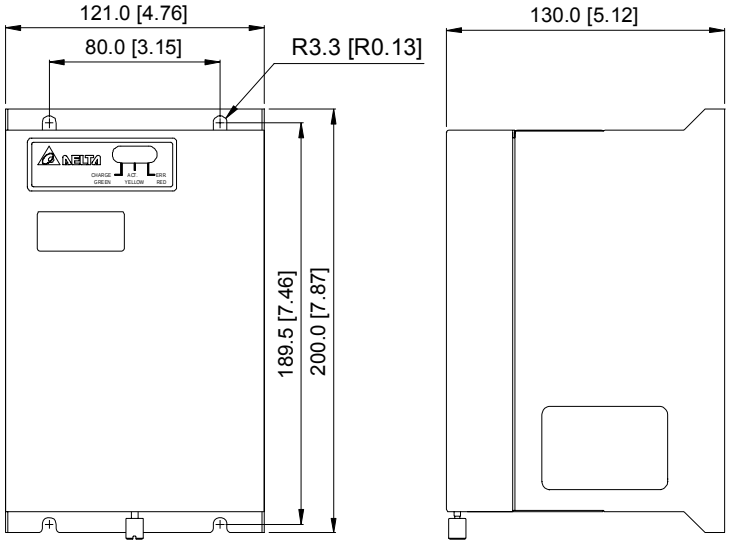
Component	Model Number	Quantity
Motor	ECMA-ER221FPS	1
Oil pump	EIPC3-064RK23	1
Pressure sensor	WIKA A-10	1

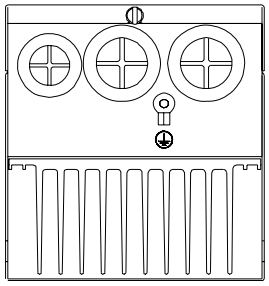
3 Accessories Kit HESP-160-G-B-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR1K0W5P8	1

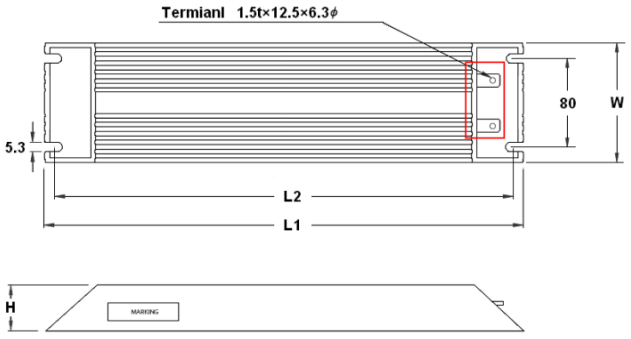
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-2022





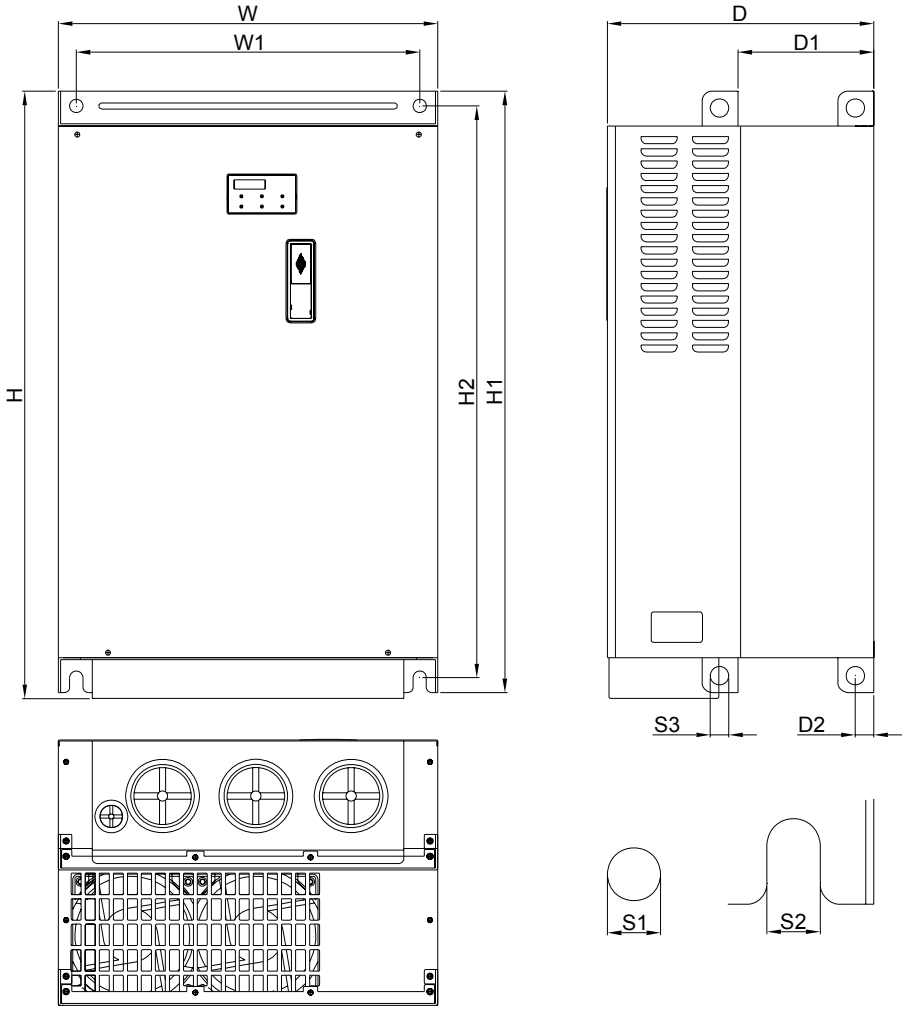
※2 Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES160H23A

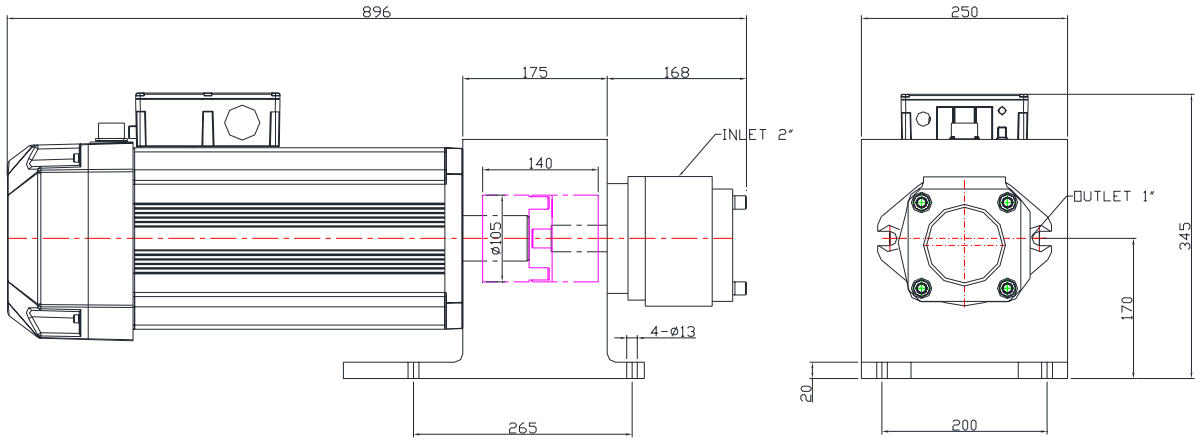
1 Servo controller VFD370VL23A16HA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
E2	370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0. 1]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-064-200-23A



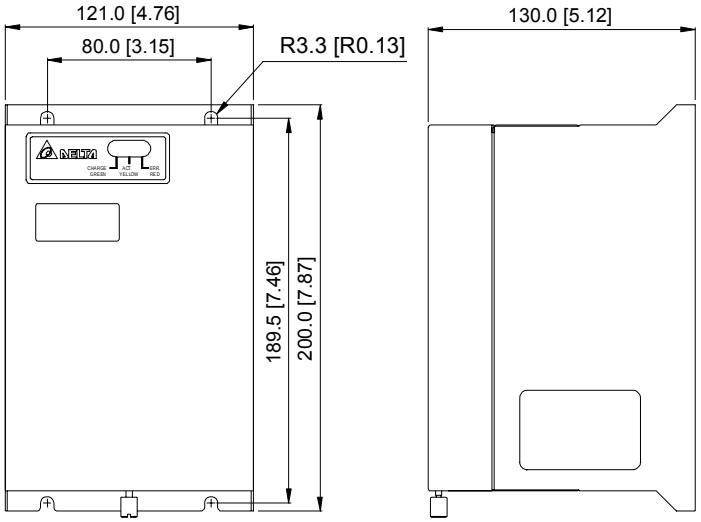
Component	Model Number	Quantity
Motor	ECMA-ER222APS	1
Oil pump	EIPC3-064RA23	1
Pressure sensor	WIKA A-10	1

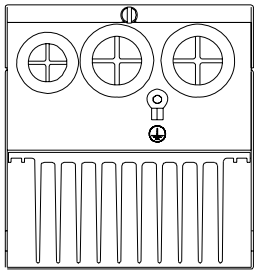
3 Accessories Kit HESP-160-H-B-23

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR1K0W5P8	1

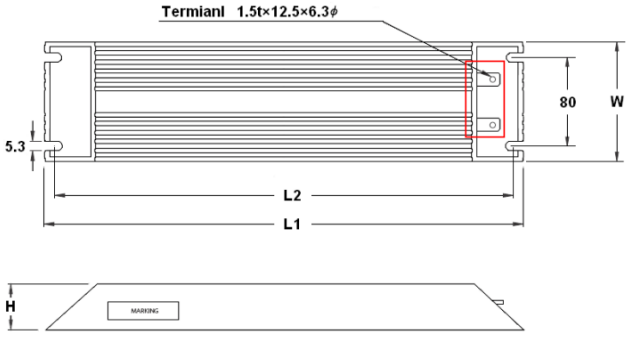
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-2022





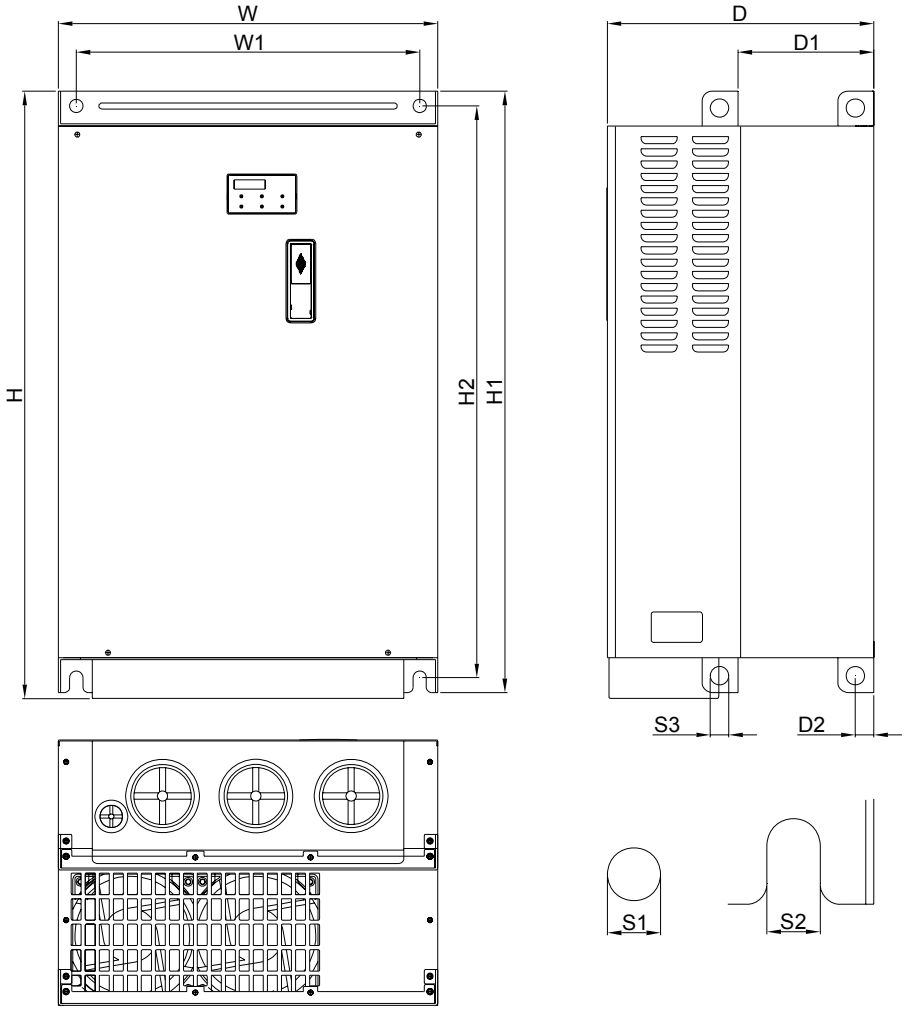
※2 Braking resistor 1000W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES200G23A

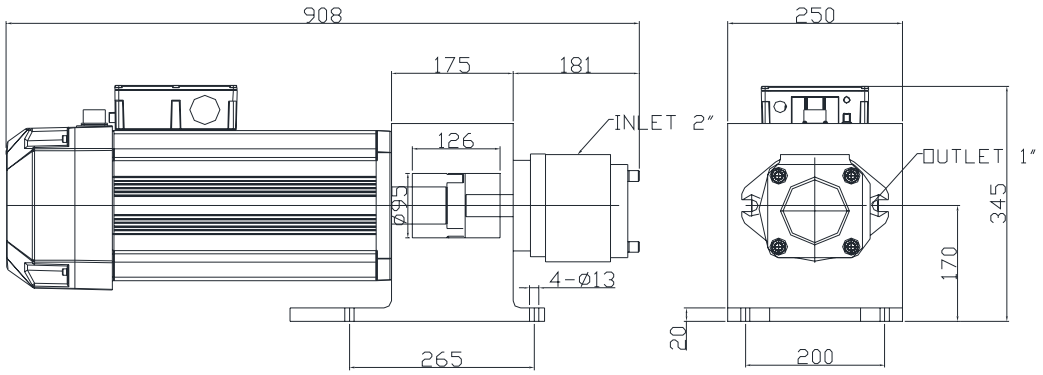
1 Servo controller VFD370VL23A20GA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	D	D1	D2	S1	S2	S3
E2	370.0 [14.57]	335.0 [13.19]	595.0 [23.43]	589.0 [23.19]	560.0 [22.05]	260.0 [10.24]	132.5 [5.22]	18.0 [0.71]	13.0 [0.51]	13.0 [0.51]	18.0 [0.71]

2 Servo oil pump HSP-200-G-B-23



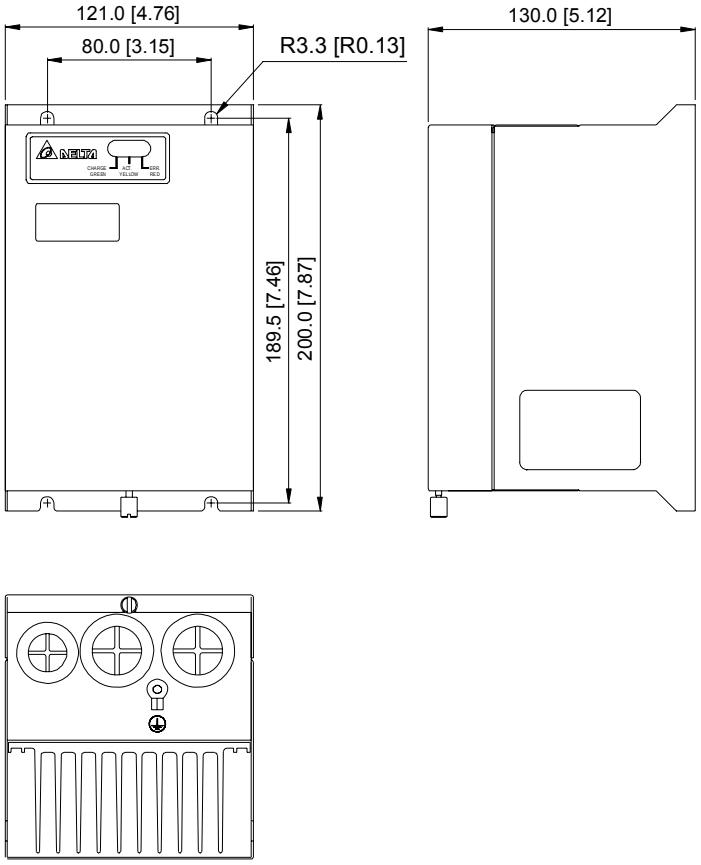
Component	Model Number	Quantity
Motor	ECMA-ER222APS	1
Oil pump	EIPC3-080RA23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-200-G-B-23

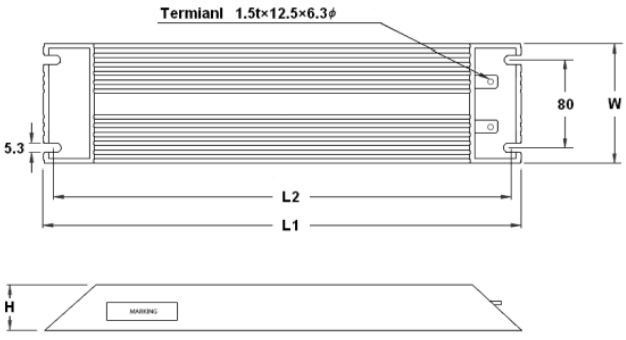
Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-2022	1
※2 Braking resistor	BR1K5W5P8	1

Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-2022



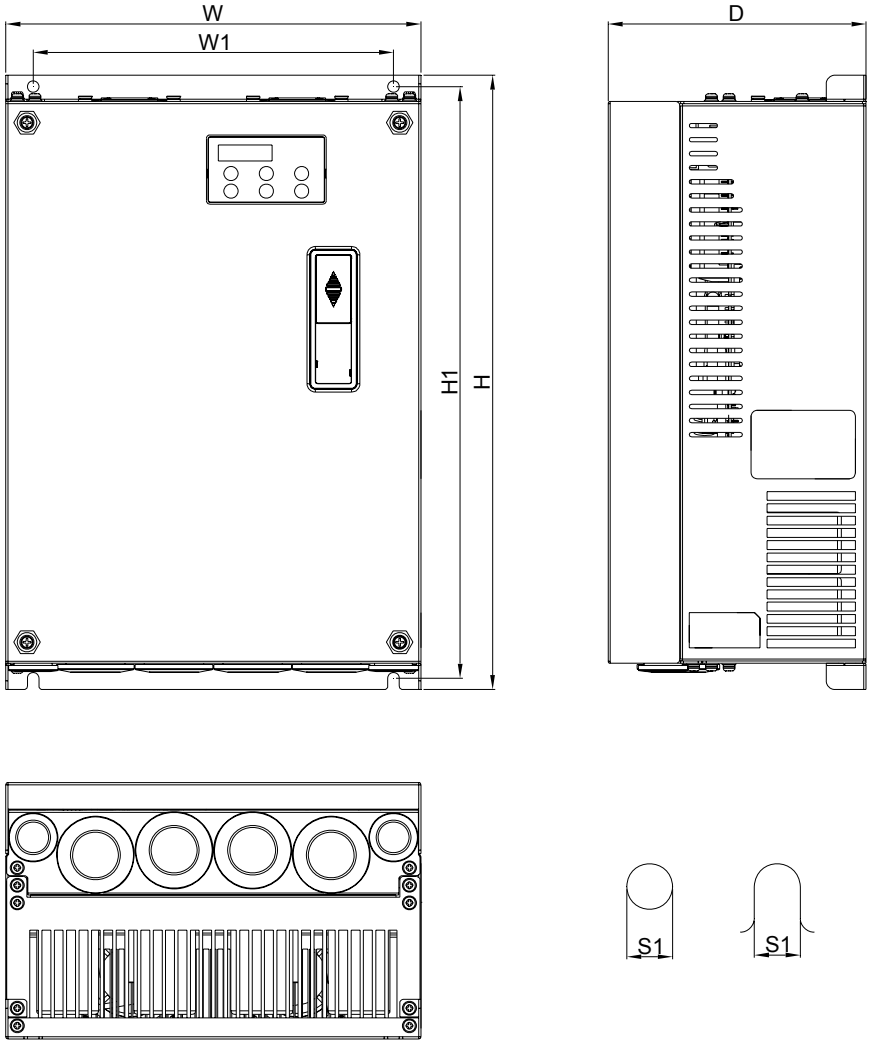
※2 Braking resistor 1500W 5.8Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	H ± 1	W ± 1
MH 1500 W	550	535	50	100

HES063G43A

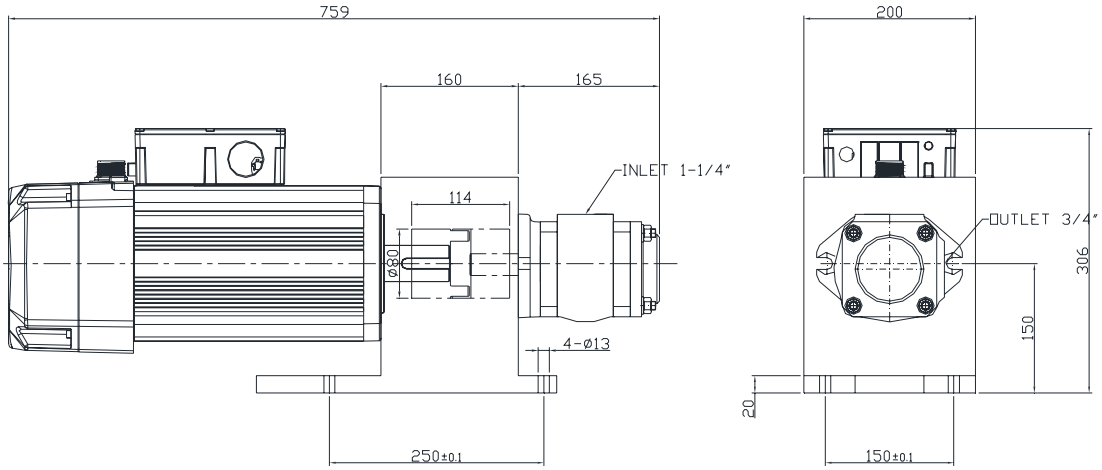
1 Servo controller VFD110VL43A06GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-025-110-43A

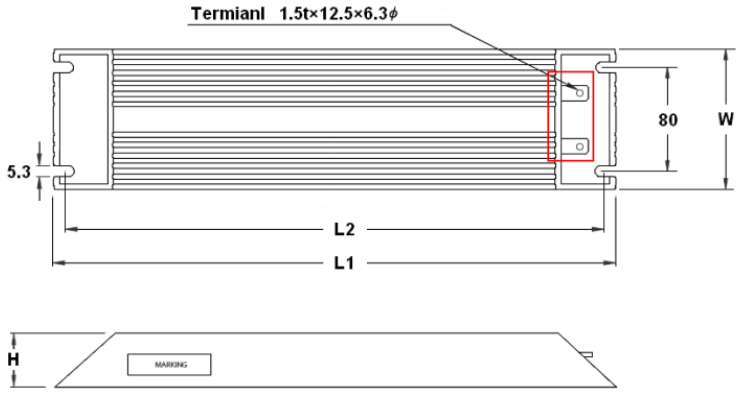


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-063-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

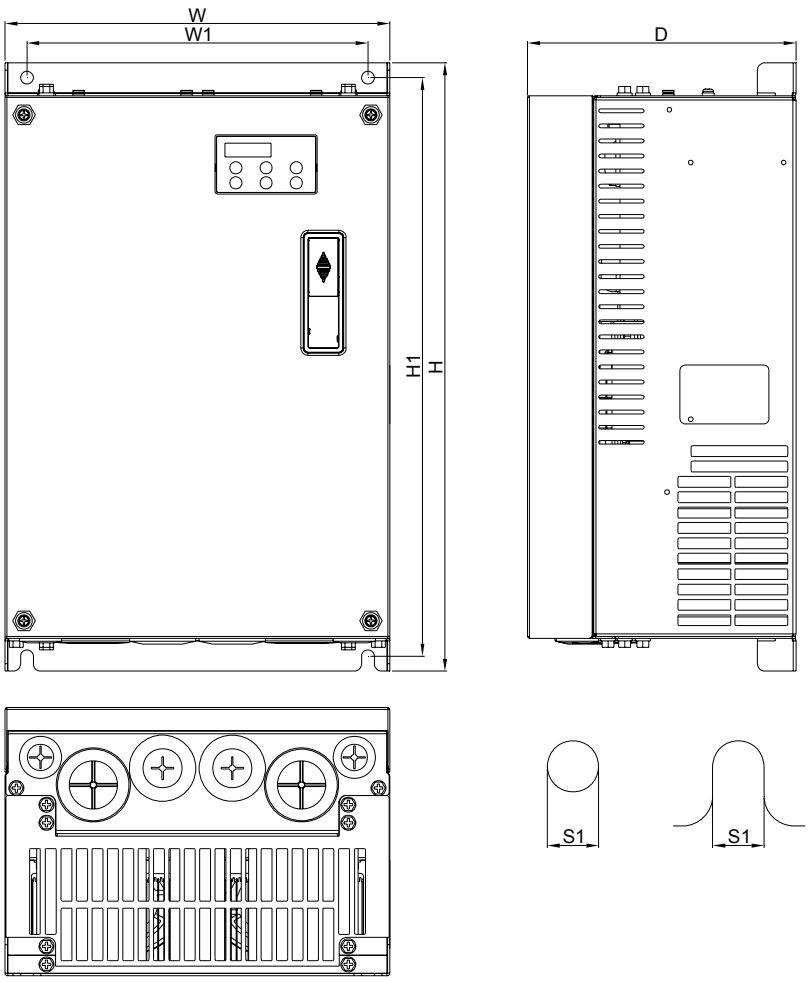
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES063H43A

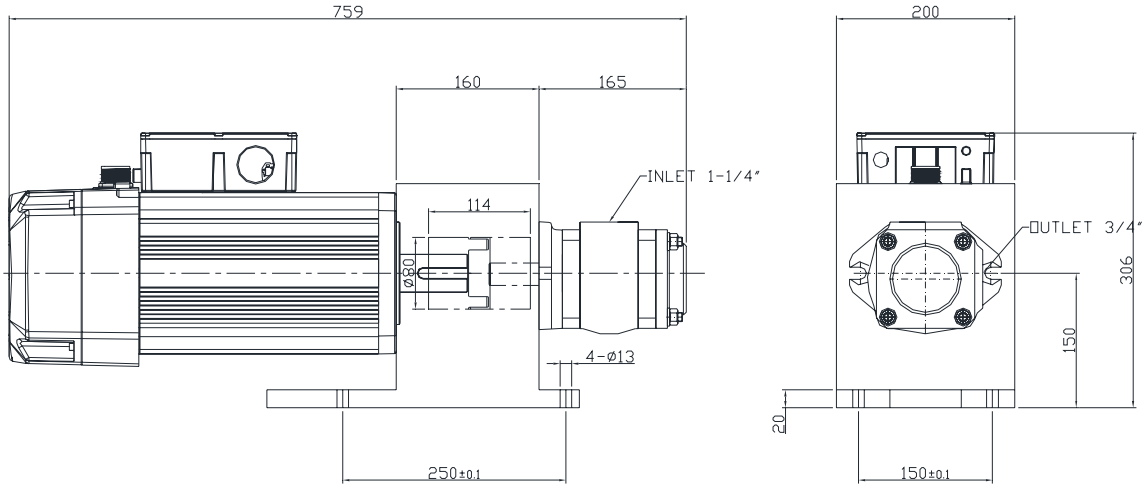
1 Servo controller VFD150VL43B06HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-025-110-43A

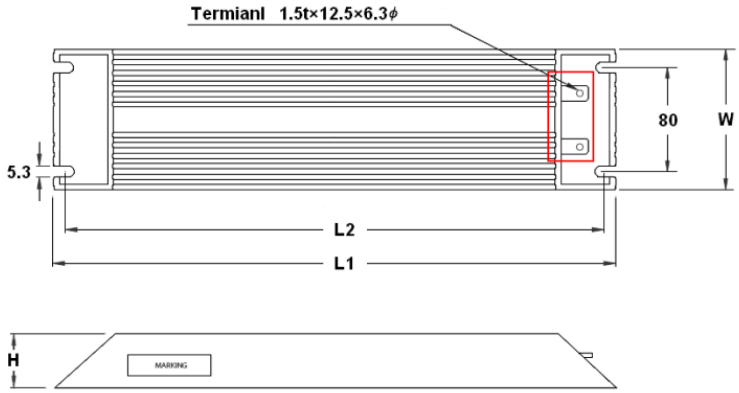


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-025RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-063-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

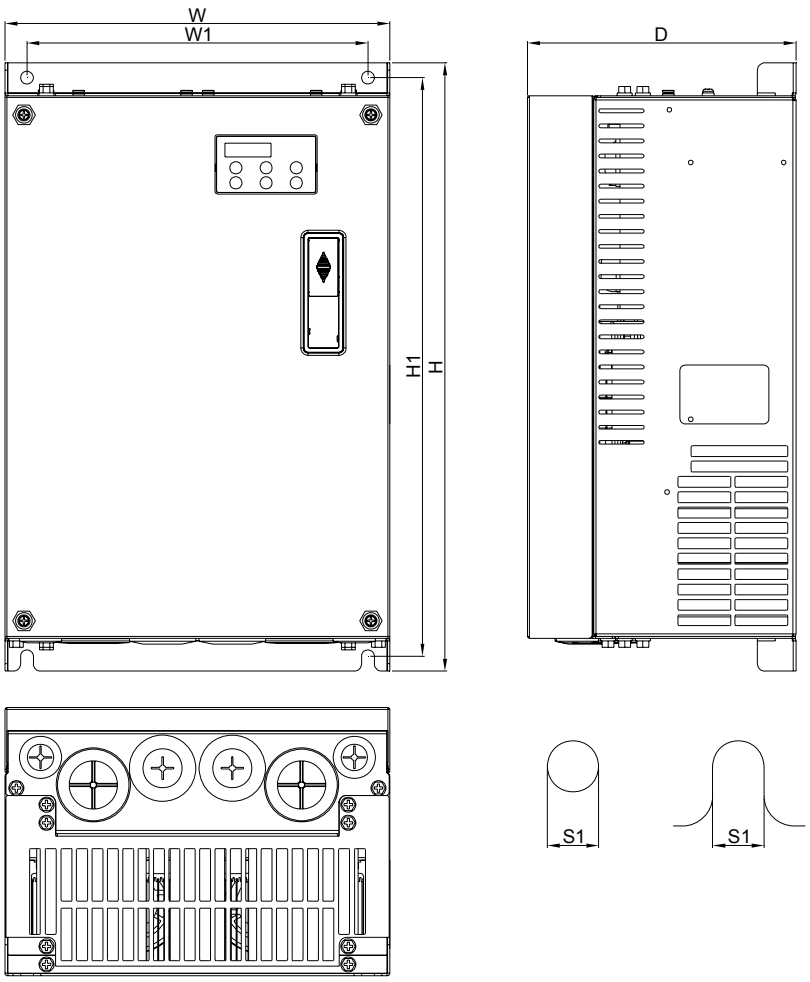
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES080G43A

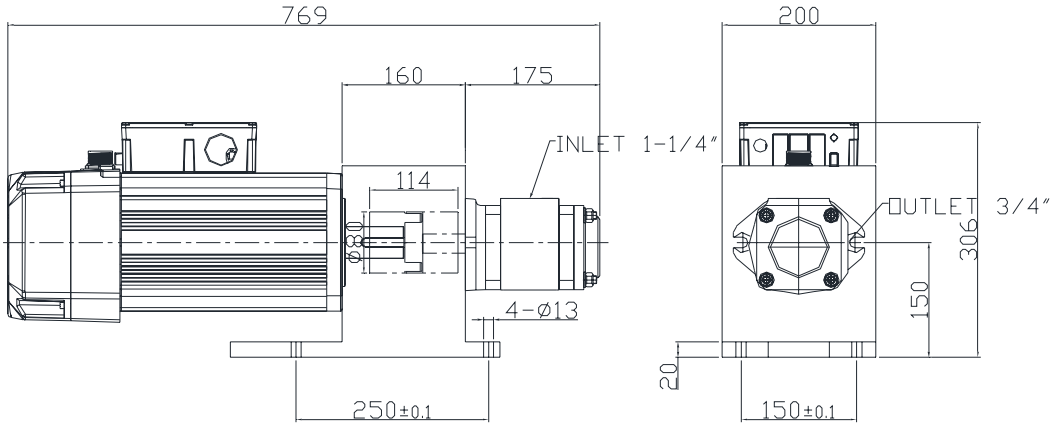
1 Servo controller VFD150VL43B08GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-032-110-43A

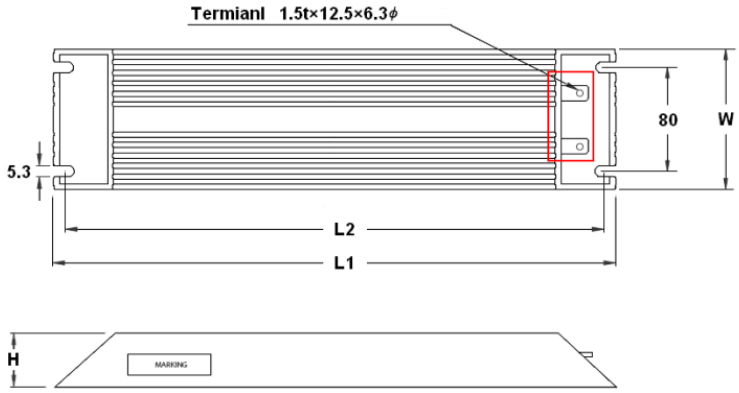


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-080-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

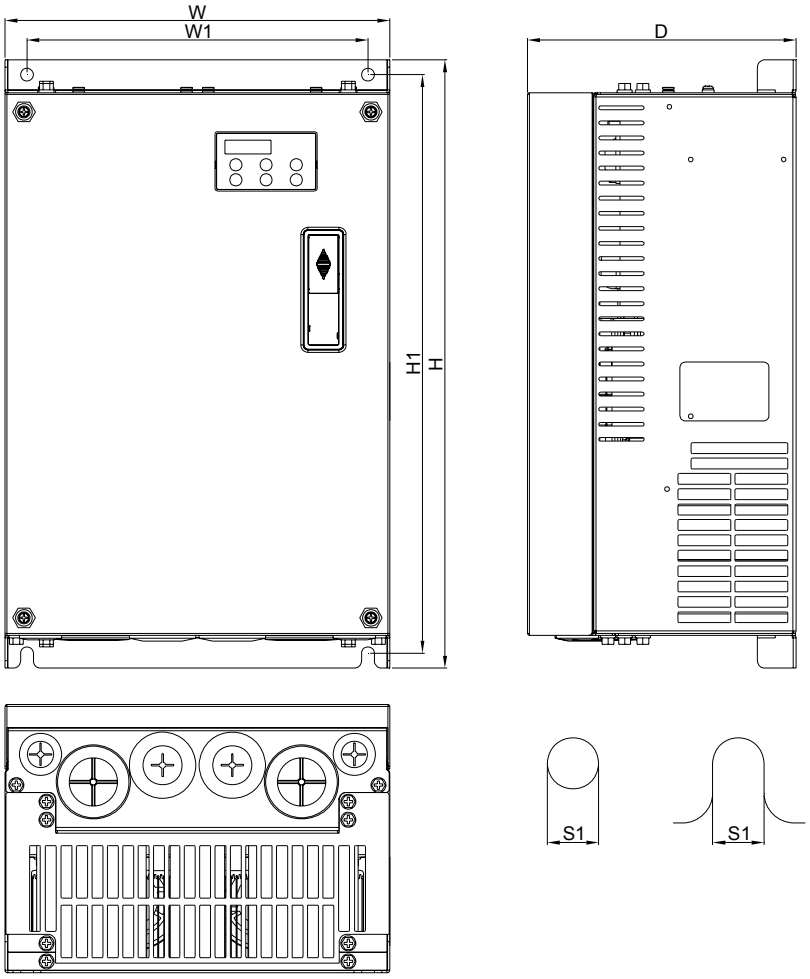
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES080H43A

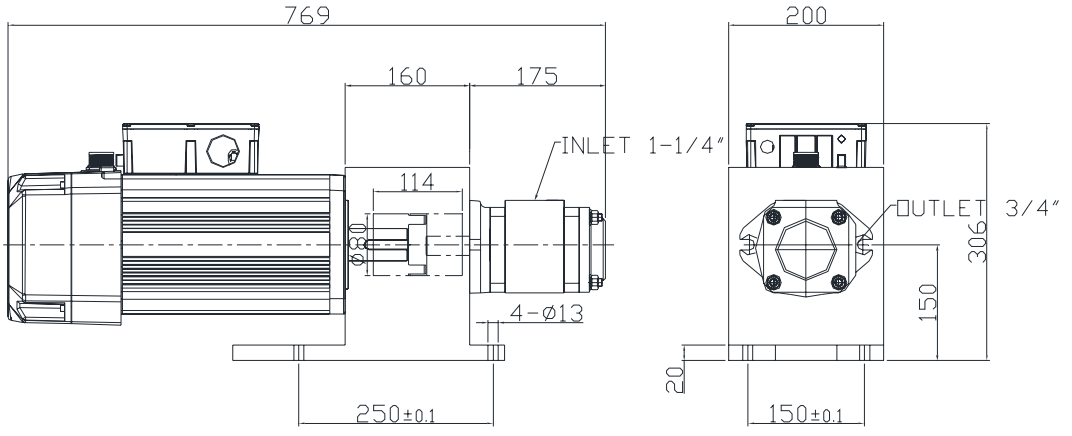
1 Servo controller VFD185VL43B



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-032-110-43A

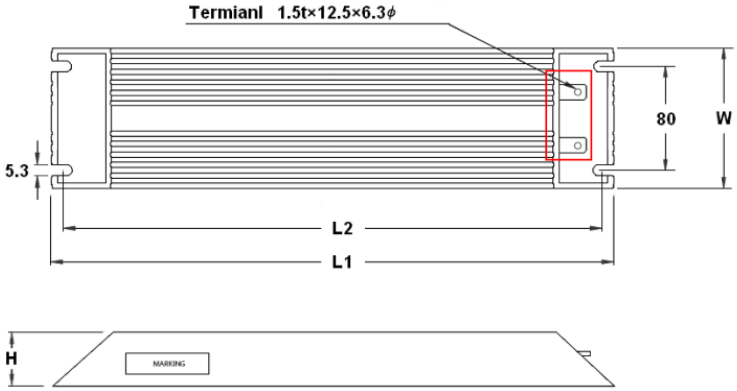


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-032RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-080-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

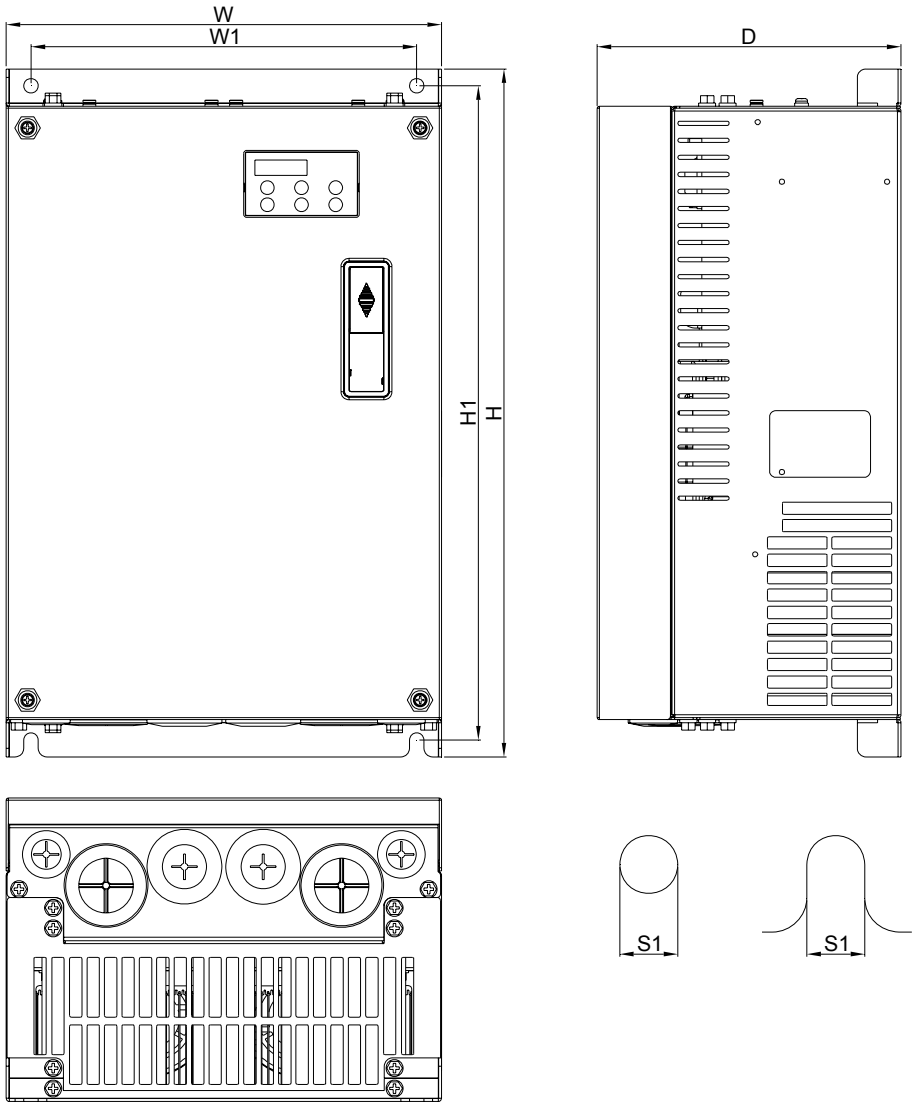
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100G43A

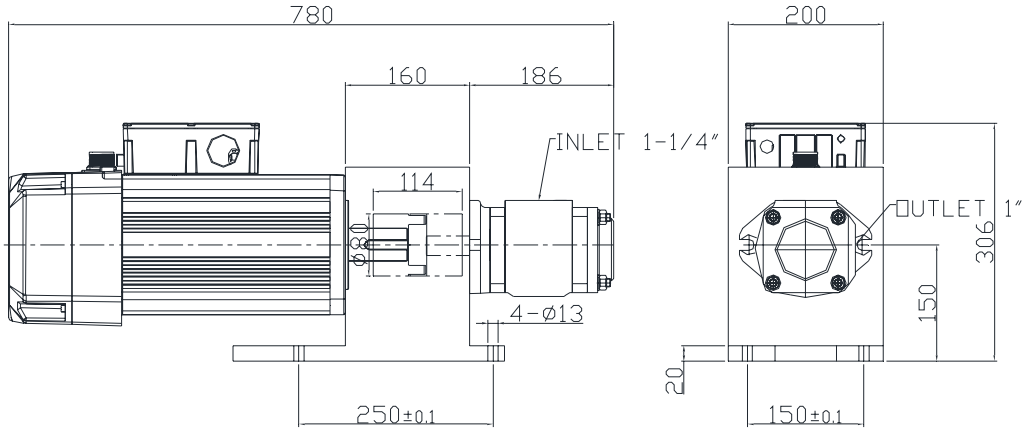
1 Servo controller VFD185VL43B10GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
C	235.0 [9.25]	204.0 [8.03]	350.0 [13.78]	337.0 [13.27]	146.0 [5.75]	6.5 [0.26]

2 Servo oil pump HSP-040-110-43A

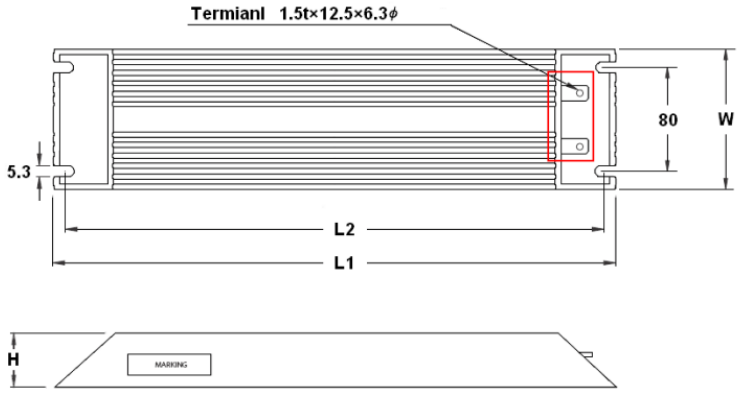


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

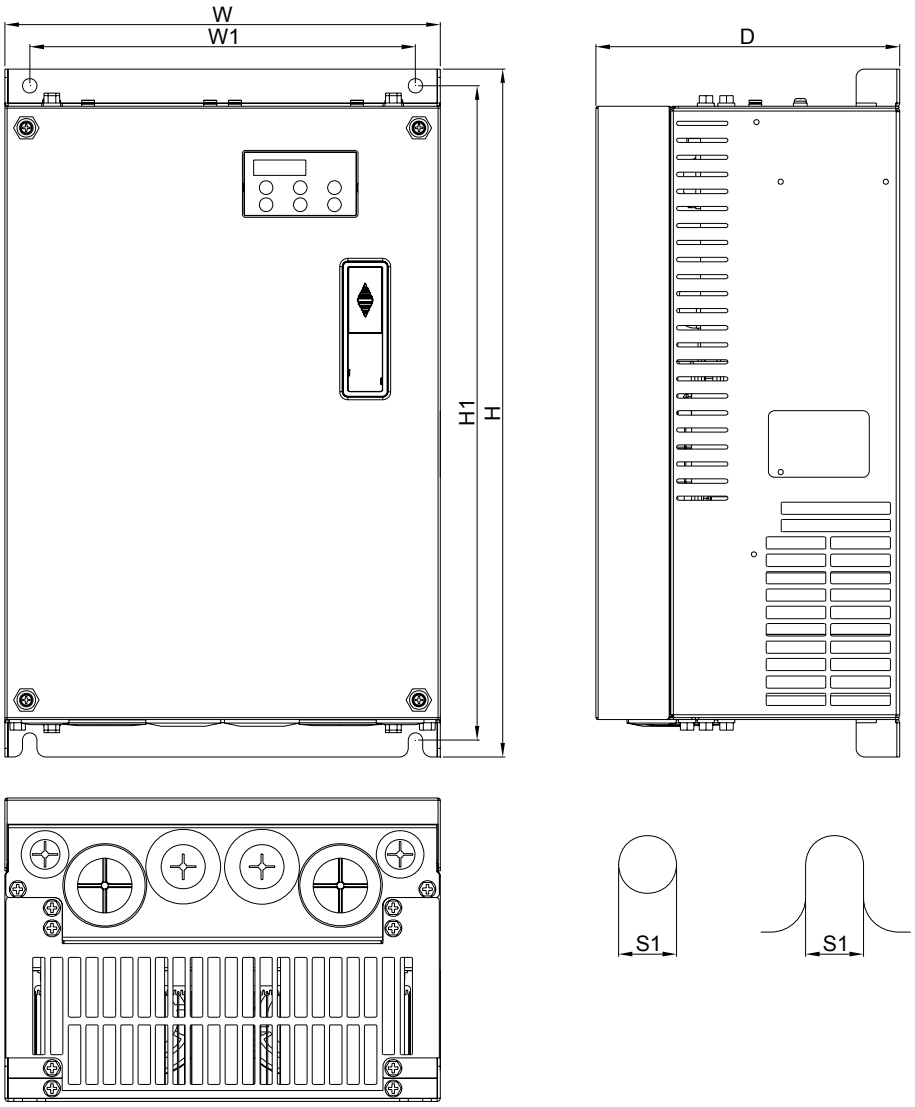
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100H43A

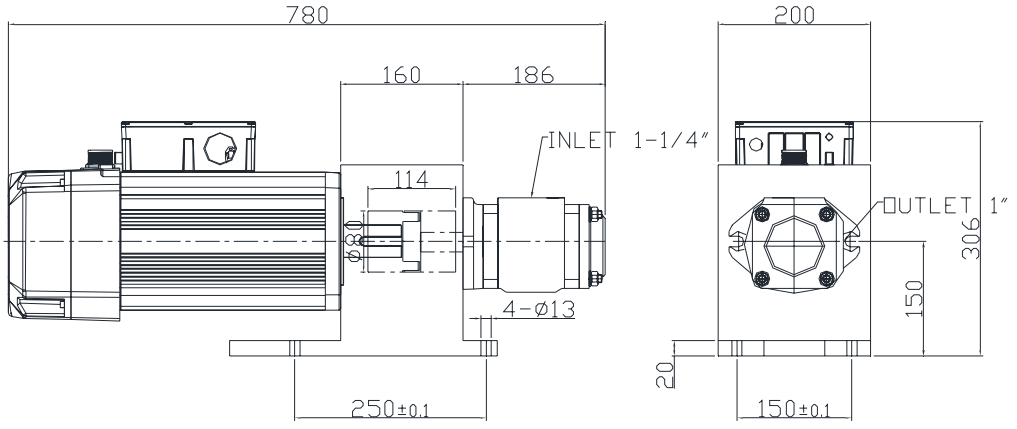
1 Servo controller VFD220VL43A10HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-040-110-43A

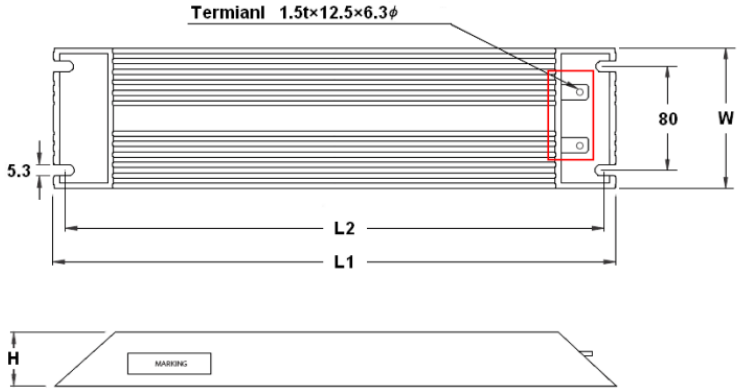


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

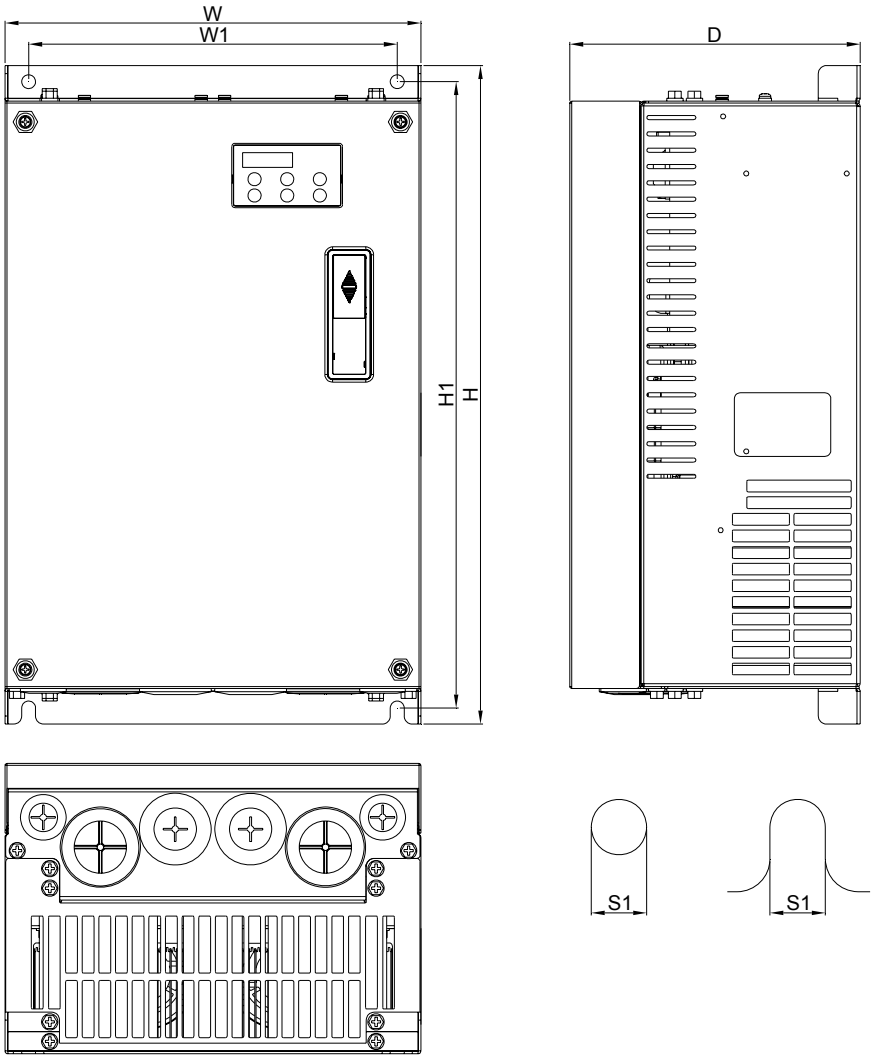
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES100Z43A

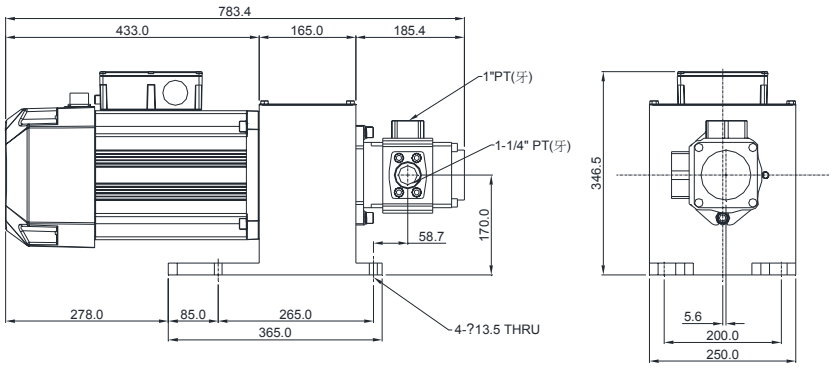
1 Servo controller VFD220VL43A10ZA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-040-150-43A

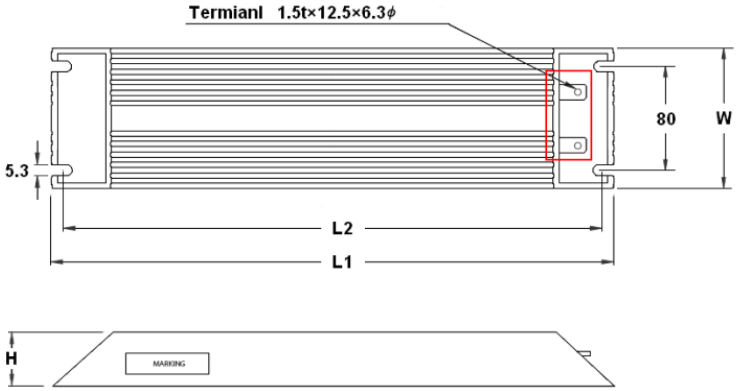


Component	Model Number	Quantity
Motor	ECMA-ER181BP3	1
Oil pump	EIPC3-040RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-100-Z-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W025	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

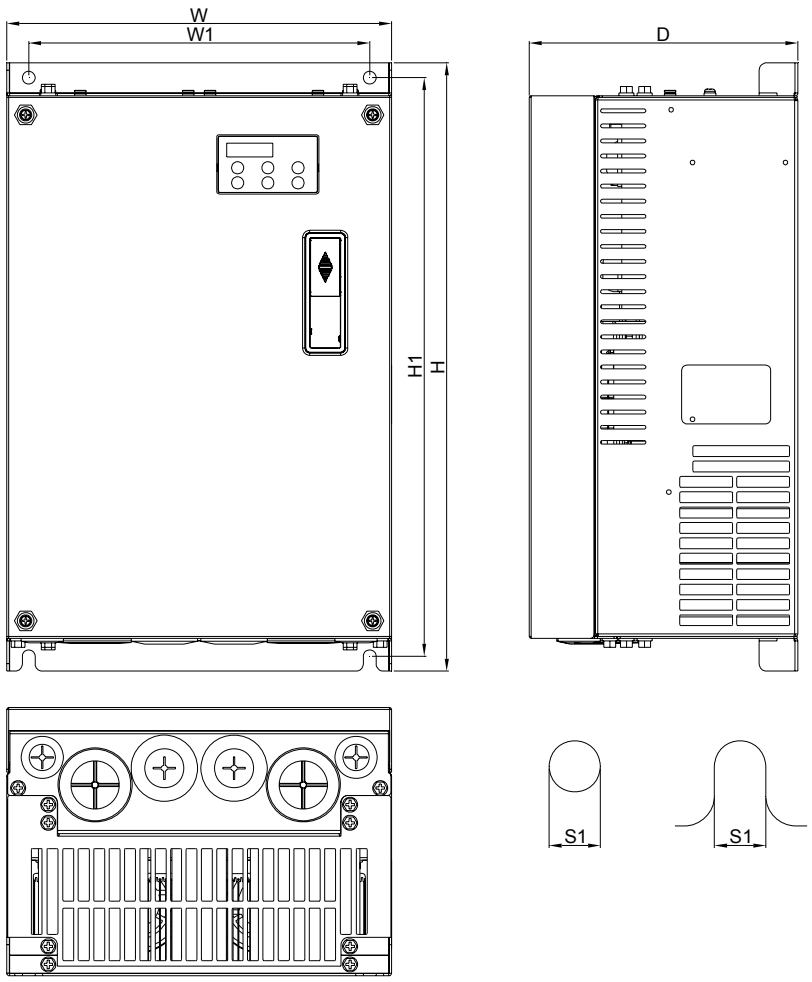
※ Braking resistor 1000W 25Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 1	H ± 1
MH 1000 W	400	385	100	50

HES125G43A

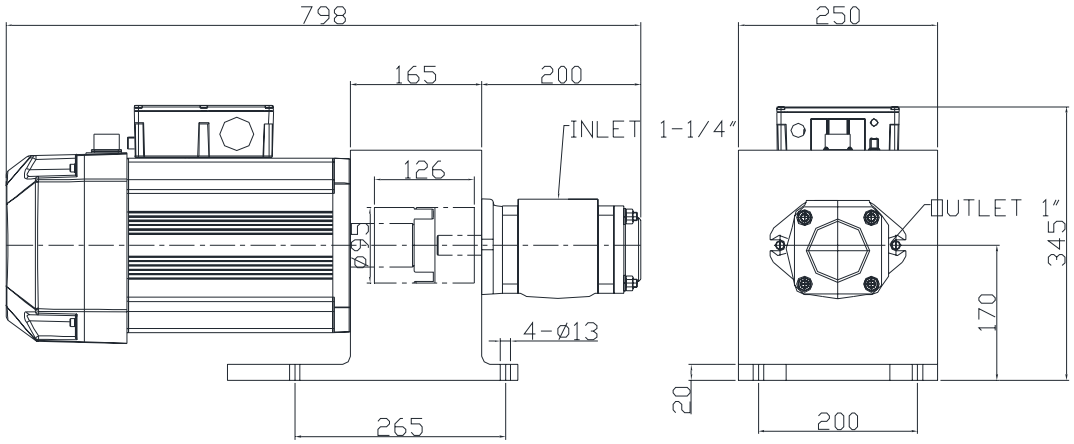
1 Servo controller VFD220VL43A12GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-050-150-43A

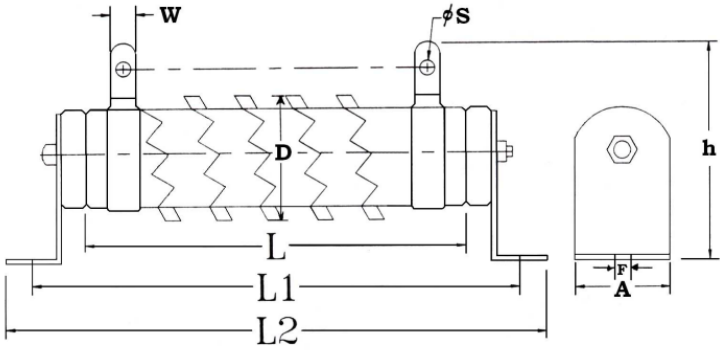


Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-125-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W020	1
Coding device cable 5m		1
Magnetic ring of power cable		1
Sensor clamp		1

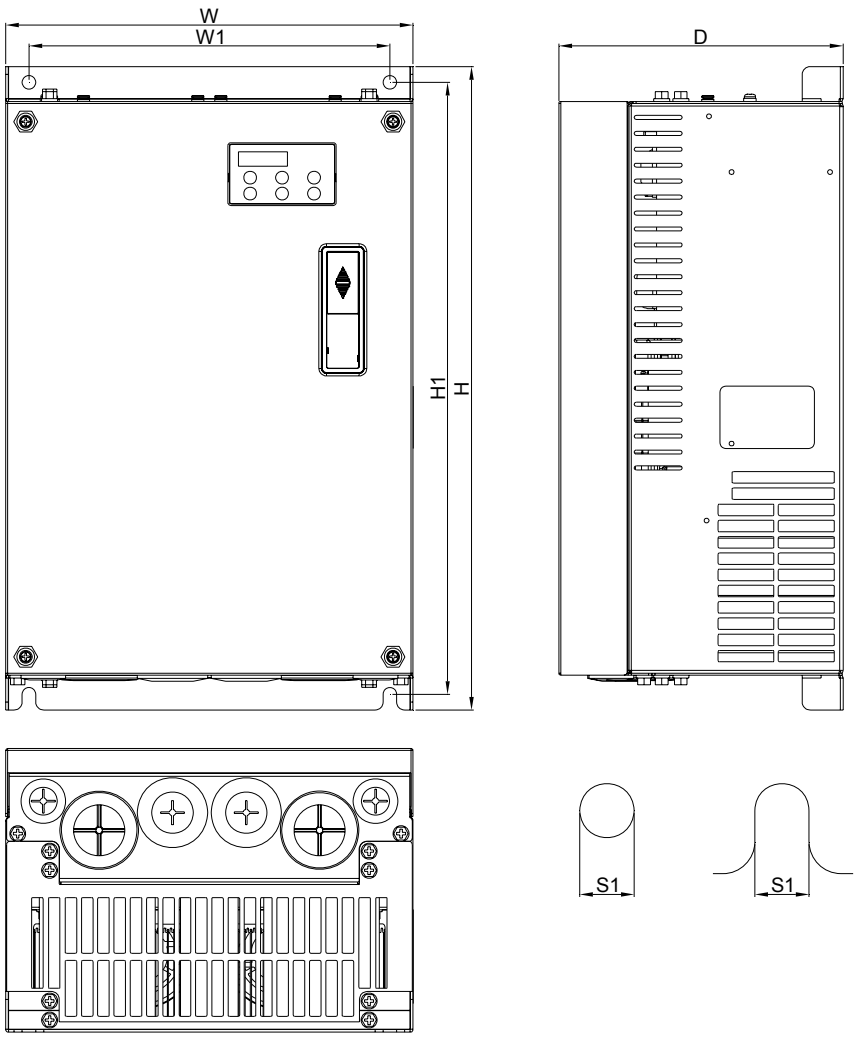
※ Braking resistor10000W 20Ω Unit: min



L ± 5	L1 ± 10	L2 ± 10	D ± 5	W ± 0.2	S ± 0.1	A ± 1	F ± 0.1	h ± 10
500	584	610	72	15	8.1	65	9.1	130

HES125H43A

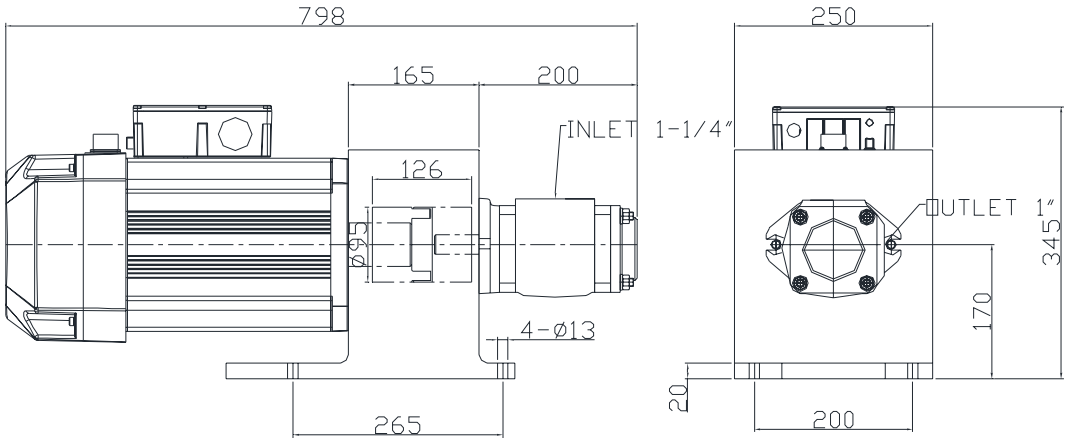
1 Servo controller VFD300VL43B12HA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-050-150-43B



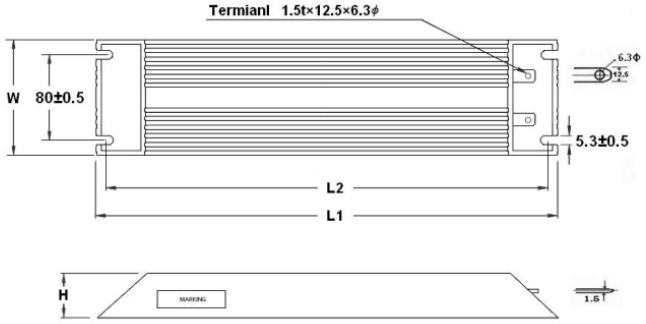
Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC3-050RK23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-125-H-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※ Braking resistor	BR1K0W014	1

Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

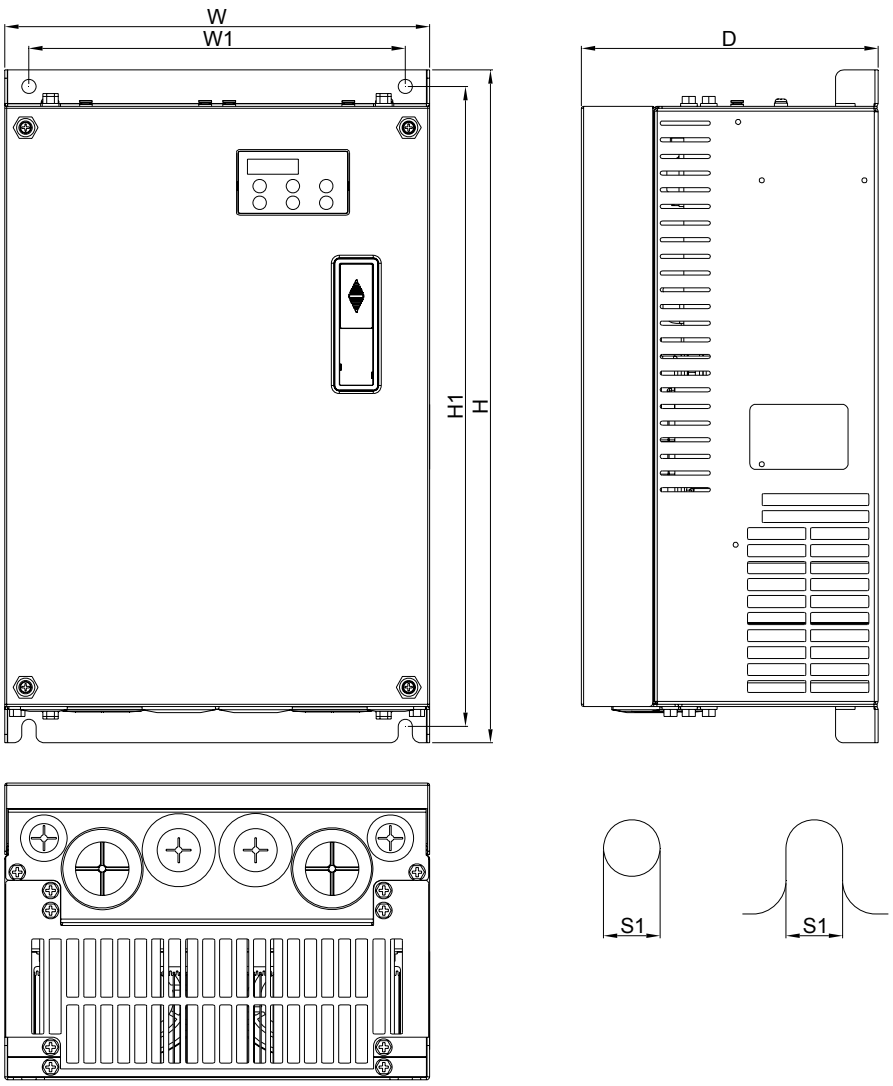
※ Braking resistor 1000W 14Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 0.5	H ± 0.5
MH 1000 W	400	385	100	50

HES160G43A

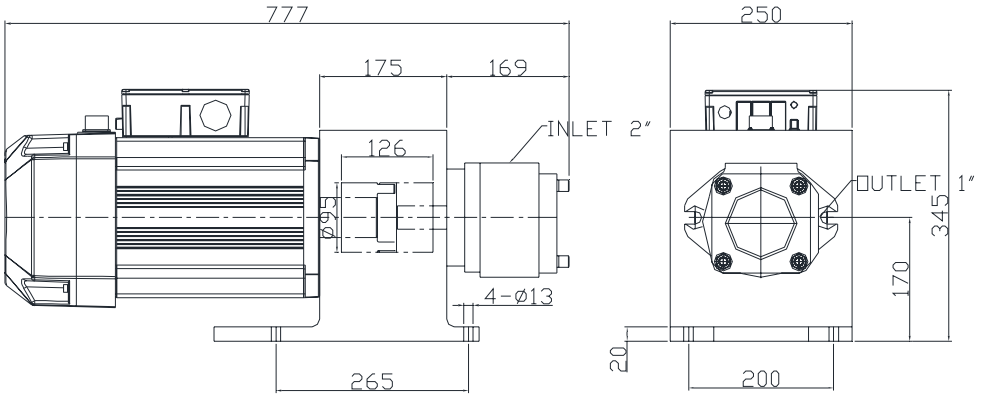
1 Servo controller VFD300VL43B16GA



Unit: mm[inch]

Frame	W	W1	H	H1	D	S1
D	255.0 [10.04]	226.0 [8.90]	403.8 [15.90]	384.0 [15.12]	168.0 [6.61]	8.5 [0.33]

2 Servo oil pump HSP-064-150-43A



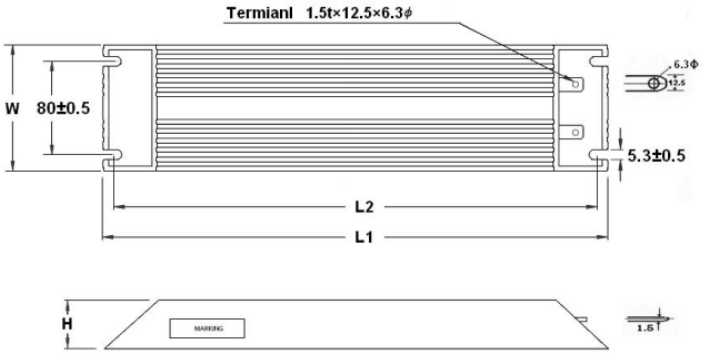
Component	Model Number	Quantity
Motor	ECMA-KR221FPS	1
Oil pump	EIPC5-064RA23	1
Pressure sensor	WIKA A-10	1

3 Accessories Kit HESP-160-G-N-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※Braking resistor	BR1K0W014	1

Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

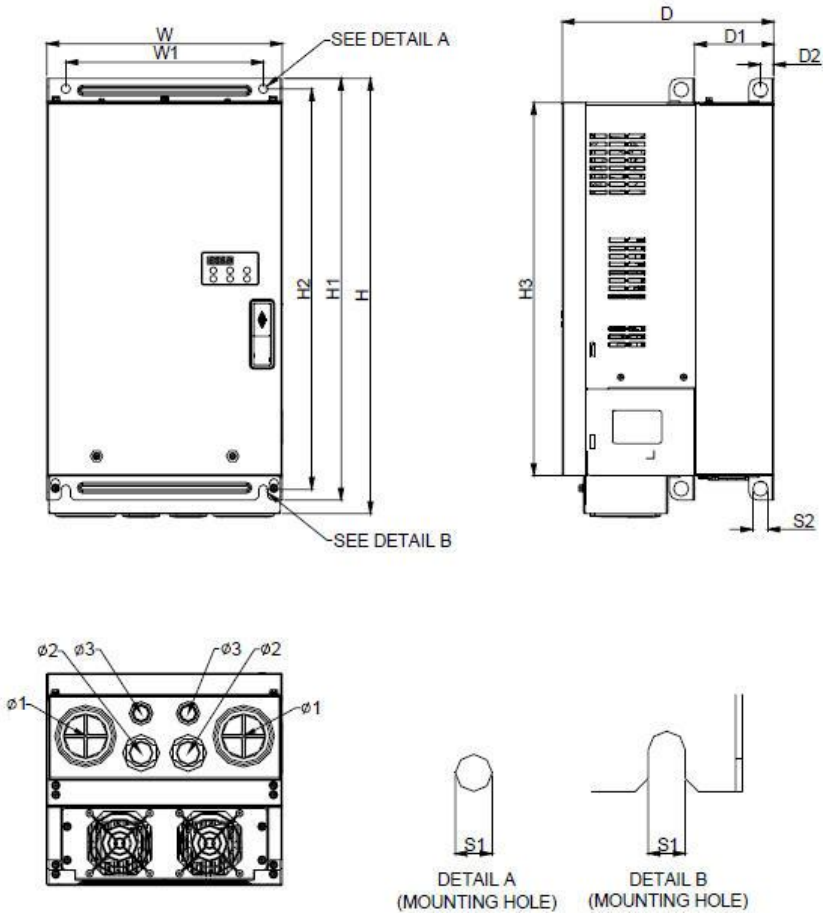
※Braking resistor1000W 14Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	W ± 0.5	H ± 0.5
MH 1000 W	400	385	100	50

HES160H43A

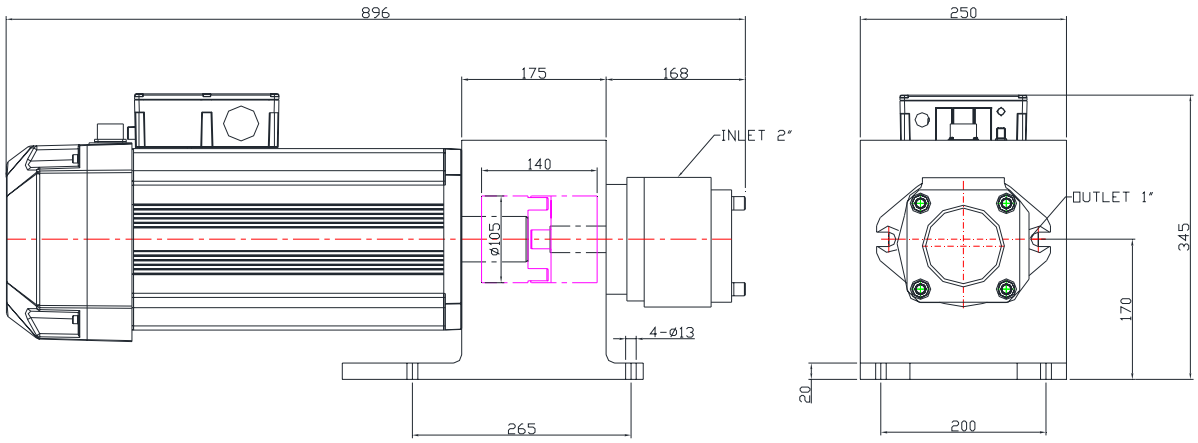
1 Servo controller VFD370VL43B16HA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	H3	D	D1	D2	S1	S2	Ø1	Ø2	Ø3
E0	280.0 [11.02]	235.0 [9.25]	516.0 [20.31]	500.0 [19.69]	475.0 [18.70]	442.0 [17.40]	251.7 [9.91]	94.2 [3.71]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]	62.7 [2.47]	34.0 [1.34]	22.0 [0.87]

2 Servo oil pump HSP-064-200-43A



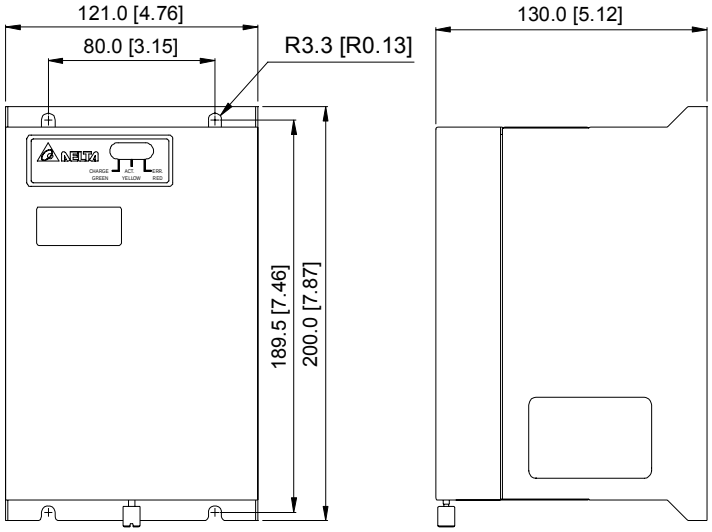
Component	Model Number	Quantity
Motor	ECMA-KR222APS	1
Oil pump	EIPC5-064RA23	1
Pressure sensor	WIKA A-10	1

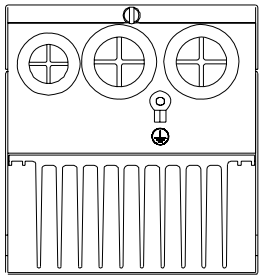
3 Accessories Kit HESP-160-H-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR1K5W013	1

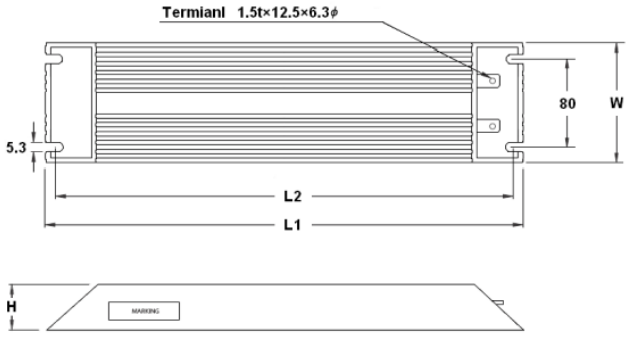
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-4045





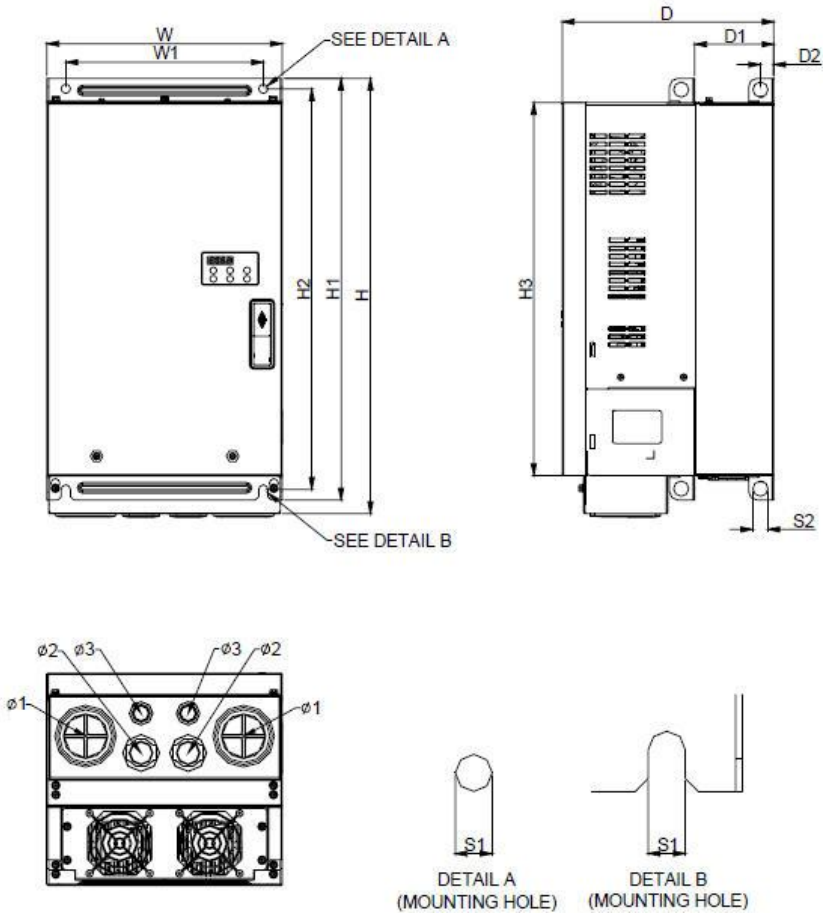
※2 Braking resistor 1500W 13Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	H ± 1	W ± 1
MH 1500 W	550	535	50	100

HES200G43A

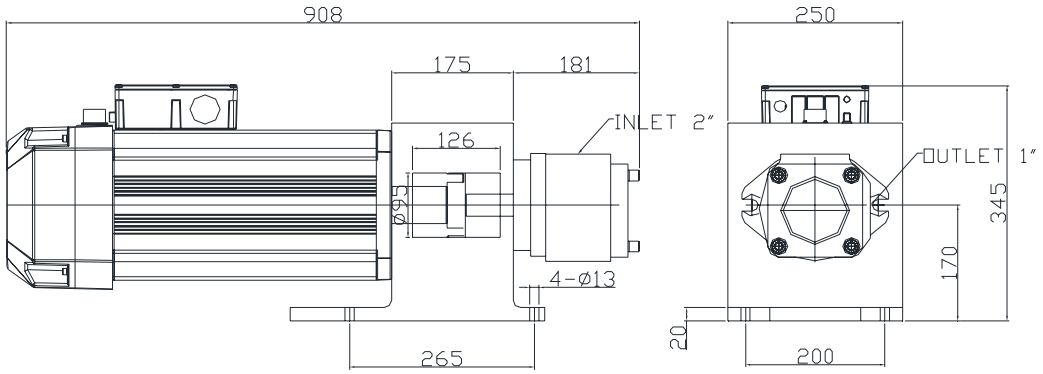
1 Servo controller VFD370VL43B20GA



Unit: mm[inch]

Frame	W	W1	H	H1	H2	H3	D	D1	D2	S1	S2	Ø1	Ø2	Ø3
E0	280.0 [11.02]	235.0 [9.25]	516.0 [20.31]	500.0 [19.69]	475.0 [18.70]	442.0 [17.40]	251.7 [9.91]	94.2 [3.71]	16.0 [0.63]	11.0 [0.43]	18.0 [0.71]	62.7 [2.47]	34.0 [1.34]	22.0 [0.87]

2 Servo oil pump HSP-080-200-43A



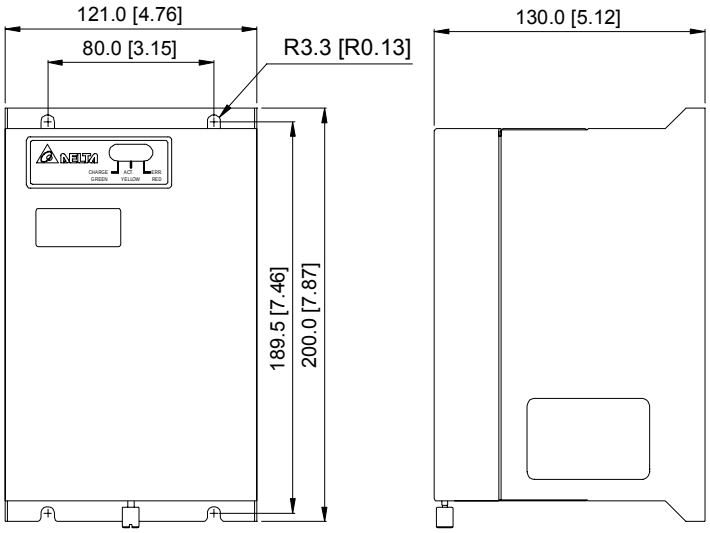
Component	Model Number	Quantity
Motor	ECMA-KR222APS	1
Oil pump	EIPC5-080-RA23-10	1
Pressure sensor	WIKA A-10	1

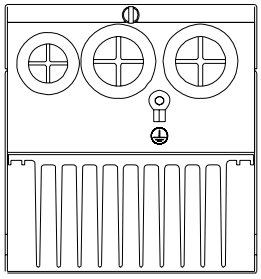
3 Accessories Kit HESP-200-G-B-43

Component	Model Number	Quantity
PG card	EMVJ-PG02R	1
※1 Braking unit	VFDB-4045	1
※2 Braking resistor	BR1K5W013	1

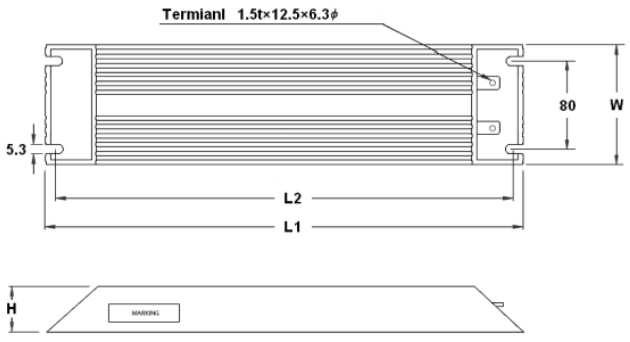
Coding device cable 5m*1	Magnetic ring of power cable*3	Sensor clamp*1
		

※1 Braking unit VFDB-4045





※2 Braking resistor 1500W 13Ω Unit: min



TYPE	L1 ± 2	L2 ± 2	H ± 1	W ± 1
MH 1500 W	550	535	50	100

Appendix B Optional Accessories

- ☑ This VFD-VL AC motor drive has gone through rigorous quality control tests at the factory before shipment. If the package is damaged during shipping, please contact your dealer.
- ☑ All accessories manufactured by us are to be used exclusively in the Hybrid Servo Controllers made by us. Please do not purchase accessories with unknown manufacturing information and use them on our Hybrid Servo Controllers to avoid the risk of malfunction.

B-1 Non-fuse Circuit Breaker Chart

UL certification: Per UL 508, paragraph 45.8.4, part a.

The rated current of the breaker shall be within 2 to 4 times rated input current of hybrid servo Controller.

Hybrid Servo Controller.

3-phase	
Model Number	Recommended Input Current (A)
VFD055VL23A-J	50
VFD055VL43A-J	30
VFD075VL23A-J	60
VFD075VL43A-J	40
VFD110VL23A-J	100
VFD110VL43A-J	50
VFD150VL23A-J	125
VFD150VL43A-J	60
VFD185VL23A-J	150
VFD185VL43A-J	75

3-phase	
Model Number	Recommended Input Current (A)
VFD220VL23A-J	175
VFD220VL43A-J	100
VFD300VL23A-J	225
VFD300VL43A-J	125
VFD370VL23A-J	250
VFD370VL43A-J	150
VFD450VL43A-J	175
VFD550VL43A-J	250
VFD750VL43A-J	300

Smaller fuses than those shown in the table are permitted.

230V Model Number	Input Current I (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD055VL23A-J	25	50	JJN-50
VFD075VL23A-J	31	60	JJN-60
VFD110VL23A-J	47	100	JJN-100
VFD150VL23A-J	60	125	JJN-125
VFD185VL23A-J	80	150	JJN-150
VFD220VL23A-J	90	175	JJN-175
VFD300VL23A-J	106	225	JJN-225
VFD370VL23A-J	126	250	JJN-250

460V Model Number	Input Current I (A)	Line Fuse	
		I (A)	Bussmann P/N
VFD055VL43A-J	14	30	JJN-30
VFD075VL43A-J	18	40	JJN-40
VFD110VL43A-J	24	50	JJN-50
VFD150VL43A-J	31	60	JJN-60
VFD185VL43A-J	39	75	JJN-70
VFD220VL43A-J	47	100	JJN-100
VFD300VL43A-J	56	125	JJN-125
VFD370VL43A-J	67	150	JJN-150
VFD450VL43A-J	87	175	JJN-175
VFD550VL43A-J	101	250	JJN-250
VFD750VL43A-J	122	300	JJN-300

B-2 Reactor

B-2-1 AC Input Reactor Recommended Value

460V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	12	18	2.5	4.2
7.5	10	18	27	1.5	2.5
11	15	25	37.5	1.2	2
15	20	35	52.5	0.8	1.2
18.5	25	35	52.5	0.8	1.2
22	30	45	67.5	0.7	1.2
30	40	55	82.5	0.5	0.85
37	50	80	120	0.4	0.7
45	60	80	120	0.4	0.7
55	75	100	150	0.3	0.45
75	100	130	195	0.2	0.3

230V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	25	37.5	0.5	1.2
7.5	10	35	52.5	0.4	0.8
11	15	55	82.5	0.25	0.5
15	20	80	120	0.2	0.4
18.5	25	80	120	0.2	0.4
22	30	100	150	0.15	0.3
30	40	130	195	0.1	0.2
37	50	160	240	0.075	0.15

460V, 50/60Hz, 3-phase

kW	HP	Fundamental Amps	Maximum Continuous Amps	Inductance（mh）	
				3% Impedance	5% Impedance
5.5	7.5	18	27	1.5	2.5
7.5	10	18	27	1.5	2.5
11	15	25	37.5	1.2	2
15	20	35	52.5	0.8	1.2
18.5	25	45	67.5	0.7	1.2
22	30	45	67.5	0.7	1.2
30	40	80	120	0.4	0.7
37	50	80	120	0.4	0.7
45	60	100	150	0.3	0.45
55	75	130	195	0.2	0.3
75	100	160	240	0.15	0.23

Applications for AC Reactor

Connected in input circuit

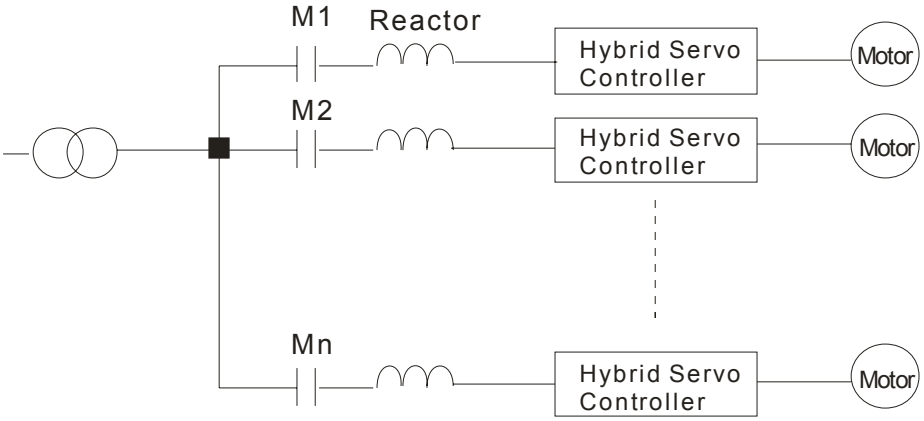
Application 1

When more than one drive is connected to the same power, one of them is ON during operation.

Question

When applying to one of the Hybrid Servo Controller, the charge current of capacity may cause voltage ripple. The Hybrid Servo Controller may damage when over current occurs during operation.

Correct wiring



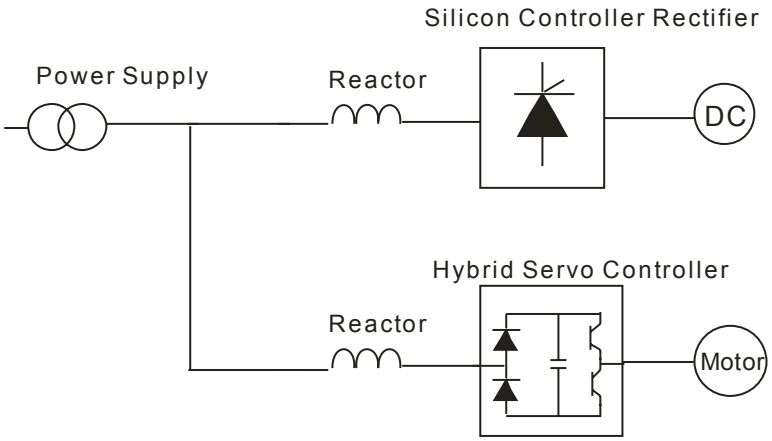
Application 2

Silicon rectifier and Hybrid Servo Controller is connected to the same power.

Question

Surges will be generated at the instant of silicon rectifier switching on/off. These surges may damage the mains circuit.

Correct wiring



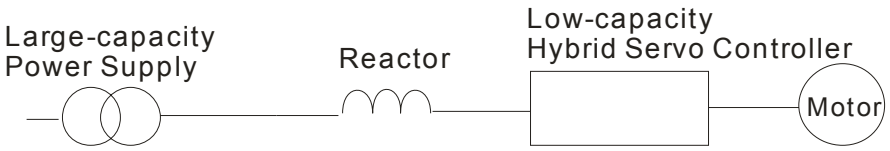
Application 3

Used to improve the input power factor, to reduce harmonics and provide protection from AC line disturbances. (Surges, switching spikes, short interruptions, etc.). AC line reactor should be installed when the power supply capacity is 500kVA or more and exceeds 6 times the inverter capacity, or the mains wiring distance $\leq$10m.

Question

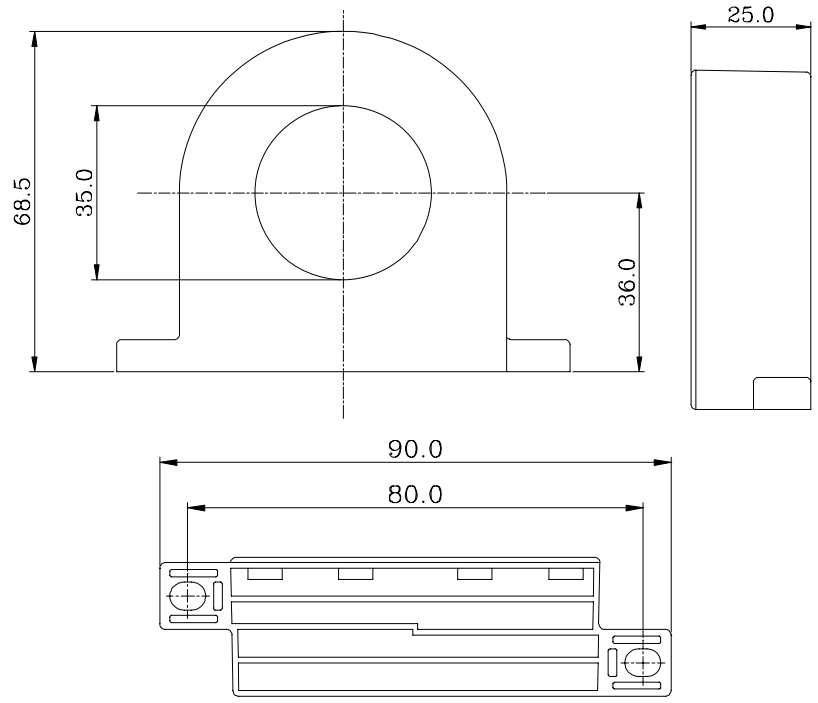
When power capacity is too large, line impedance will be small and the charge current will be too large. That may damage Hybrid Servo Controller due to higher rectifier temperature.

Correct wiring



B-2-2 Zero Phase Reactor

RF220X00A UNIT: mm(inch)



Cable type (Note)	Recommended Wire Size (mm^2)			Qty.	Wiring Method
	AWG	mm^2	Nominal (mm^2)		
Single-core	≤10	≤5.3	≤5.5	1	Figure A
	≤2	≤33.6	≤38	3	Figure B
Three-core	≤12	≤3.3	≤3.5	1	Figure A
	≤1	≤42.4	≤50	3	Figure B

NOTE

600V insulated power cable

1. The above table is for reference only. Please choose cables with suitable types and diameters, so that the cable must be of the right size to pass through the center of the reactor.
2. Please do not cross the ground wire. Only the motor wire or the power cable is to be threaded.
3. When long motor output cable I used, the zero-phase reactor may be needed to minimize the effect of radiation.

Figure A

Each wire must be wrapped at least three times when it threads the zero phase reactor, with the reactor placed as close to the Hybrid Servo Controller as possible.

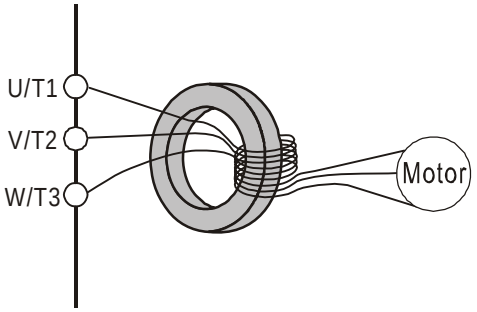
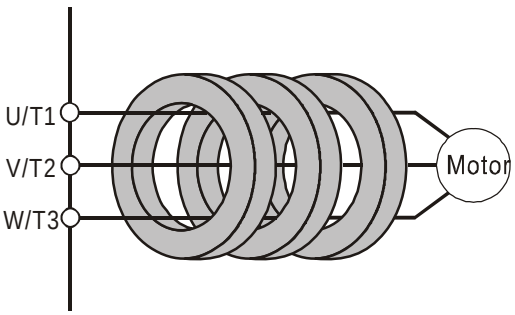


Figure B

Please thread the wire directly through the three zero phase reactors aligned in parallel.



B-2-3 DC Reactor

230V DC Choke

Input Voltage	kW	HP	DC Amps	Inductance（mh）
230Vac 50/60Hz 3-Phase	5.5	7.5	32	0.85
	7.5	10	40	0.75
	11	15	62	Built-in
	15	20	92	Built-in
	18.5	25	110	Built-in
	22	30	125	Built-in
	30	40	-	Built-in
	37	50	-	Built-in

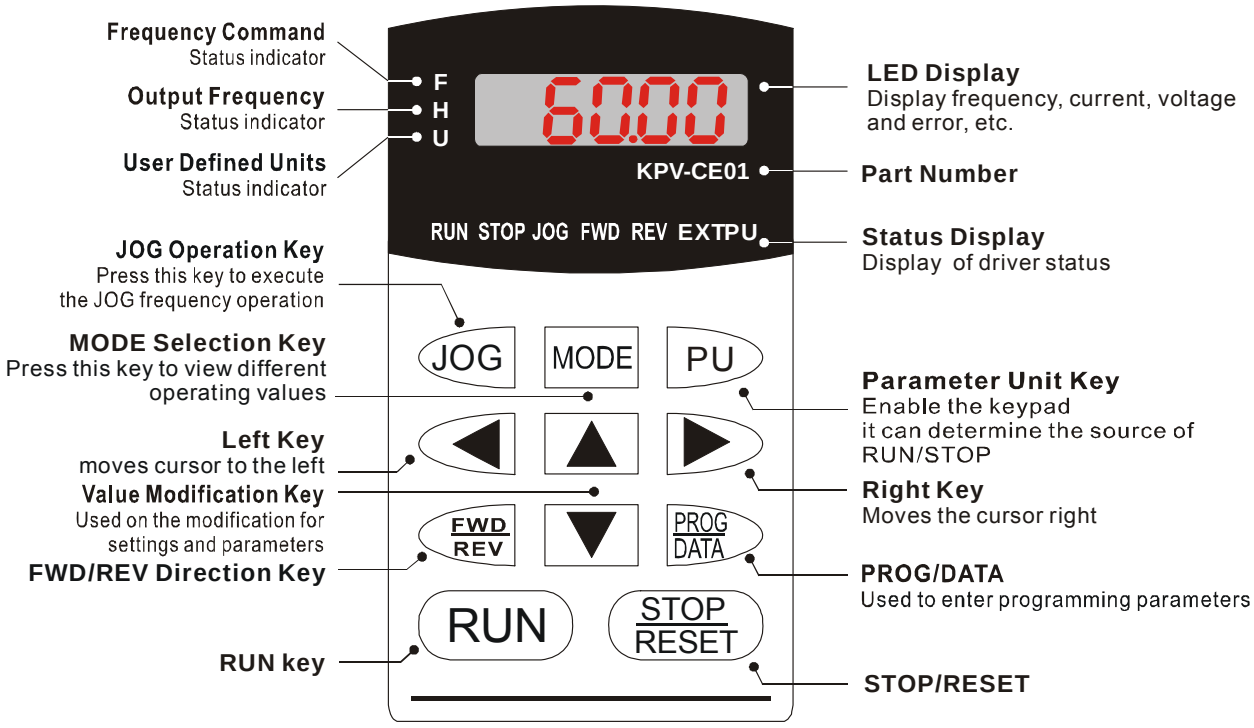
460V DC Choke

Input Voltage	kW	HP	DC Amps	Inductance（mh）
460Vac 50/60Hz 3-Phase	5.5	7.5	18	3.75
	7.5	10	25	4.00
	11	15	32	Built-in
	15	20	50	Built-in
	18.5	25	62	Built-in
	22	30	80	Built-in
	30	40	92	Built-in
	37	50	110	Built-in
	45	60	125	Built-in
	55	75	200	Built-in
	75	100	240	Built-in

B-3 Digital Keypad KPV-CE01

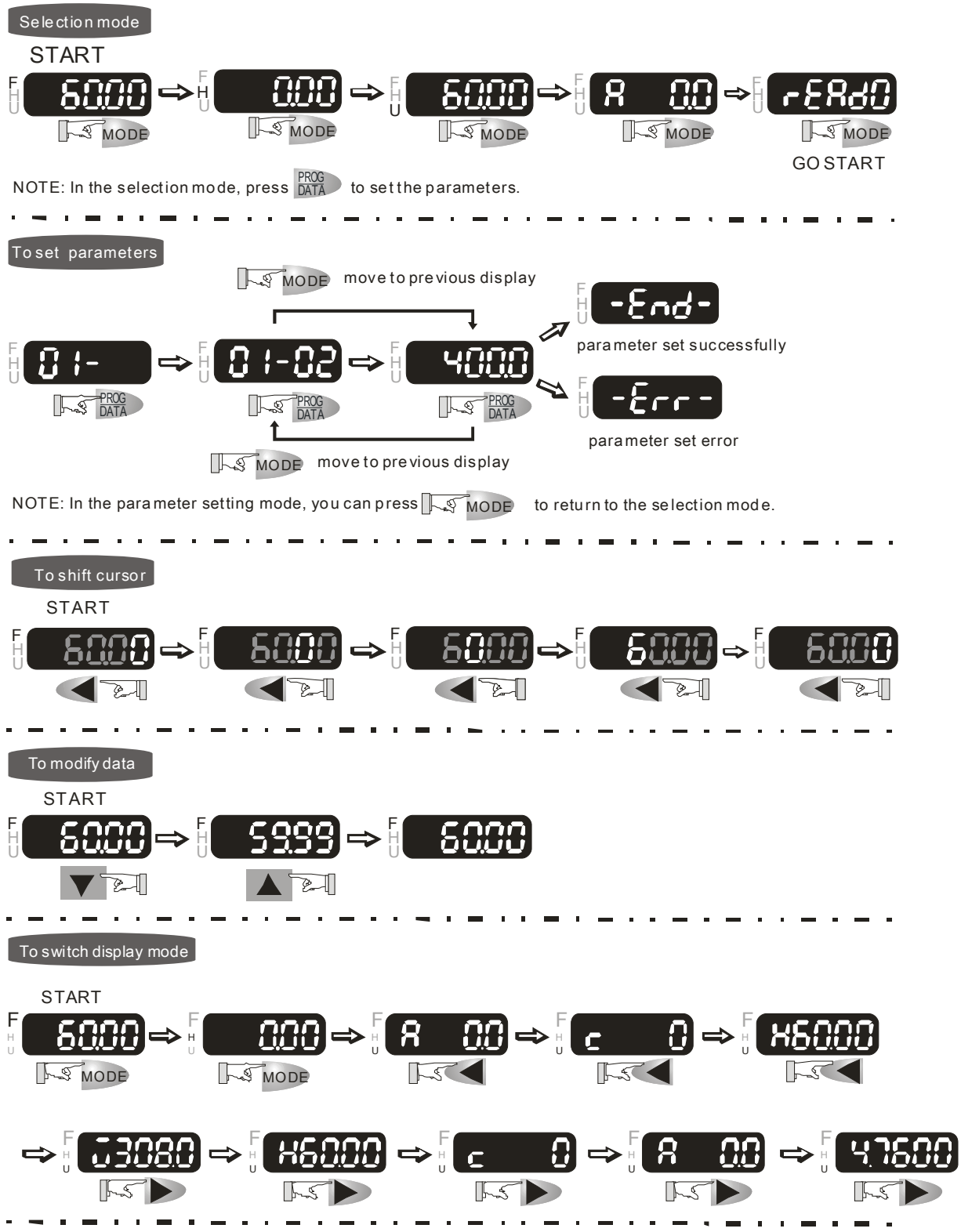
The digital keypad is the display of VFD-VJ series. The following keypad appearance is only for reference and please see the product for actual appearance.

Description of the Digital Keypad KPV-CE01



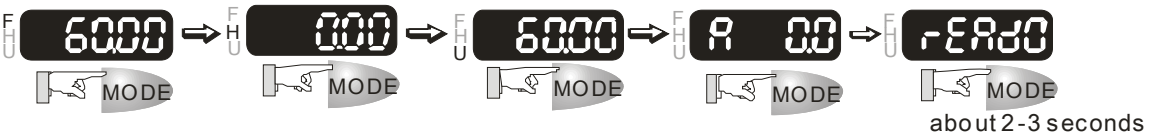
Display Message	Description
F 60.00	Displays the drive Master frequency.
H 50.00	Displays the actual output frequency present at terminals U/T1, V/T2, and W/T3.
U 1800.0	User defined unit (where U = F x Pr.00-05)
A 5.0	Displays the load current
c 20	The counter value (C).
01-00	Displays the selected parameter.
10	Displays the actual stored value of the selected parameter.
EF	External Fault.
-End-	Display “End” for approximately 1 second if input has been accepted. After a parameter value has been set, the new value is automatically stored in memory.
-Err-	Display “Err”, if the input is invalid.

How to Operate the Digital Keypad KPV-CE01



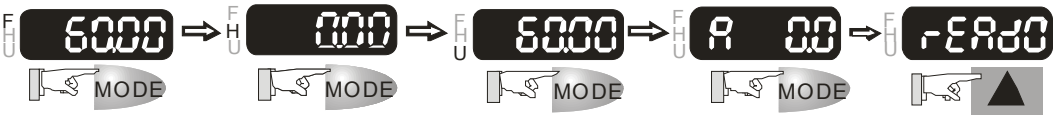
To copy parameters 1

Copy parameters from the Drive to the KPV-CE01



start blinking

It will display "End" to indicate that the first parameter is saved, then return to "rEAd0".



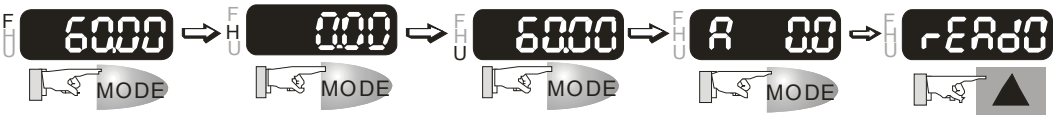
about 2-3 seconds

start blinking

It will display "End" to indicate that the second parameter is saved, then return to "rEAd1".

To copy parameters 2

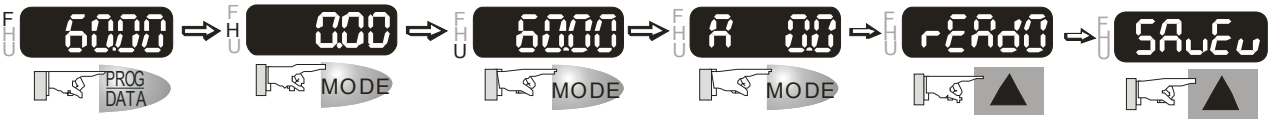
Copy parameters from the KPV-CE01 to the Drive



about 2-3 seconds

start blinking

It will display "End" to indicate that the first parameter is saved, then return to "SAvEv".



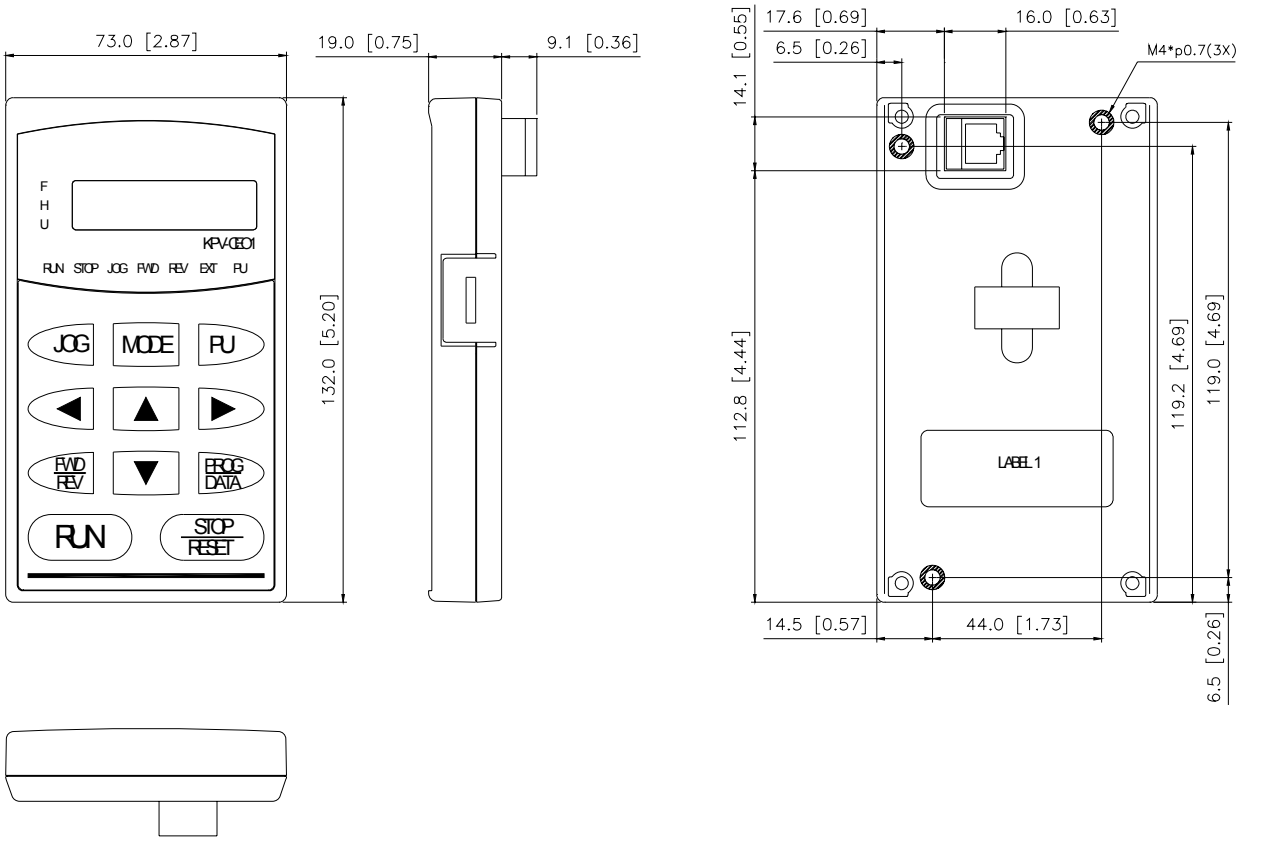
about 2-3 seconds

start blinking

It will display "End" to indicate that the second parameter is saved, then return to "SAvEv".

Dimension of the Digital Keypad (KPV-CE01)

Unit: mm [inch]



Reference Table for the LCD Display of the Digital Keypad

Number	0	1	2	3	4	5	6	7	8	9
LCD	0	1	2	3	4	5	6	7	8	9
English Alphabet	A	b	Cc	d	E	F	G	Hh	I	Jj
LCD	A	b	C c	d	E	F	G	H h	I	J j
English Alphabet	K	L	n	Oo	P	q	r	S	Tt	U
LCD	K	L	n	O o	P	q	r	S	T t	U
English Alphabet	v	Y	Z							
LCD	v	y	Z							

B-4 Communication Card

EMVJ-MF01

Terminal	Description
⏚	Ground
SG-	RS485 connection points
SG+	
GND	Common Signal Terminal
POWER	Power Light
Tx	When the light is on, it is set as master
Rx	When the light is on, a message sent from the master is received

NOTE

1） Use shielded twisted-pair cables for wiring to prevent voltage coupling and eliminate electrical noise and interference.

2） The shield of shielded twisted-pair cables should be connected to the SHIELD end ⏚.

B-5 EMI Filter

Driver	Filter Model No.	Web link of references
VFD055VL23A-J VFD075VL23A-J VFD150VL43A-J	KMF336A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF336A Three Phase Industrial Mains Filters - High Performance 36 Amps
VFD110VL23A-J VFD185VL43A-J VFD220VL43A-J	KMF350A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF350 Three Phase Industrial Mains Filters - General Purpose 50 Amps
VFD150VL23A-J VFD300VL43A-J VFD370VL43A-J	KMF370A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF370A Three Phase Industrial Mains Filters - High Performance 70 Amps
VFD185VL23A-J VFD220VL23A-J VFD450VL43A-J	KMF3100A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF3100A Three Phase Industrial Mains Filters - High Performance 100 Amps
VFD300VL23A-J VFD370VL23A-J VFD550VL43A-J VFD750VL43A-J	KMF3150A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF3150A Three Phase Industrial Mains Filters - High Performance 150 Amps
VFD055VL43A-J	KMF318A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF318 Three Phase Industrial Mains Filters - General Purpose 18 Amps
VFD075VL43A-J VFD110VL43A-J	KMF325A	http://www.dem-uk.com/roxburgh/products/emc_emi_industrial_filters/ KMF325A Three Phase Industrial Mains Filters - High Performance 25 Amps

EMI Filter Installation

All electrical equipment, including drives, will generate high-frequency/low-frequency noise and will interfere with peripheral equipment by radiation or conduction when in operation. By using an EMI filter with correct installation, much interference can be eliminated. It is recommended to use DELTA EMI filter to have the best interference elimination performance.

We assure that it can comply with following rules when drive and EMI filter are installed and wired according to user manual:

1. EN61000-6-4
2. EN61800-3: 1996
3. EN55011 (1991) Class A Group 1

General precaution

1. EMI filter and drive should be installed on the same metal plate. It is recommended to install the drive on the filter.
2. Please wire as short as possible. Metal plate should be grounded. The cover of EMI filter and drive or grounding should be fixed on the metal plate and the contact area should be as large as possible.

Choose suitable motor cable and precautions

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

1. Use the cable with shielding (double shielding is the best). The shielding on both ends of the motor cable should be grounded with the minimum length and maximum contact area.
2. Remove any paint on metal saddle for good ground contact with the plate and shielding as shown in figure 1.
3. The shielding net of motor cable and the plate must be connected correctly. The shielding net on the two ends of motor cable should be fixes by the metal saddle and the plate. See figure 2 for correct connection.

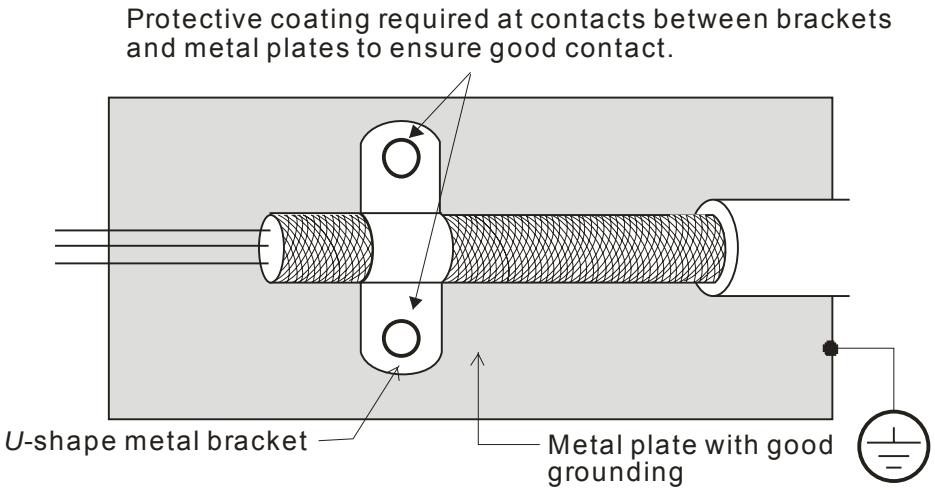


Figure 1

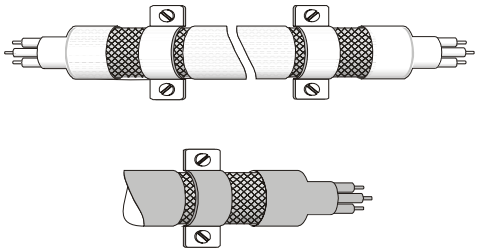


Figure 2

The length of motor cable

When motor is driven by a drive of PWM type, the motor terminals will experience surge voltages easily due to components conversion of 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 drive. The length of the cable between drive and motor should be as short as possible (10 to 20 m or less).

For models 7.5hp/5.5kW and above:

Insulation level of motor	1000V	1300V	1600V
460Vac input voltage	66 ft (20m)	328 ft (100m)	1312 ft (400m)
230Vac input voltage	1312 ft (400m)	1312 ft (400m)	1312 ft (400m)

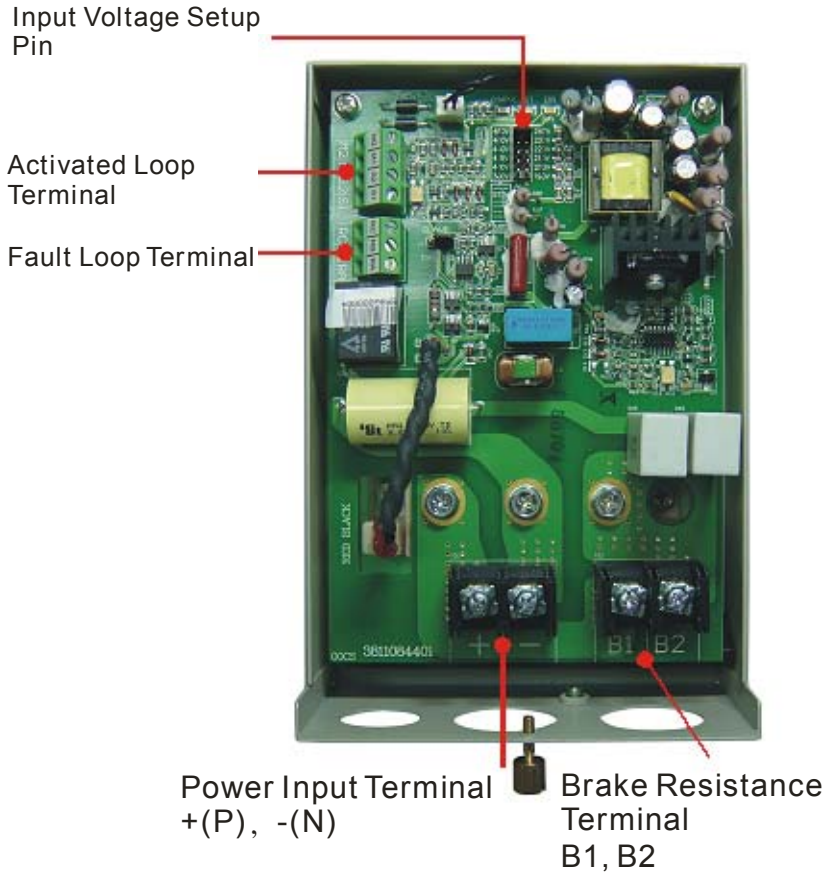
If the length is too long, the stray capacitance between cables will increase and may cause leakage current. It will activate the protection of over current, increase leakage current or not insure the correction of current display. The worst case is that drive may damage.
To drive the 460V series motor, if there is one relay installed between the Hybrid Servo Controller and motor to protect the motor from over-heating, the relay might malfunction even if the length of the wire is below 50 meters. Thus, a filter for output current shall be added (optional for purchase).

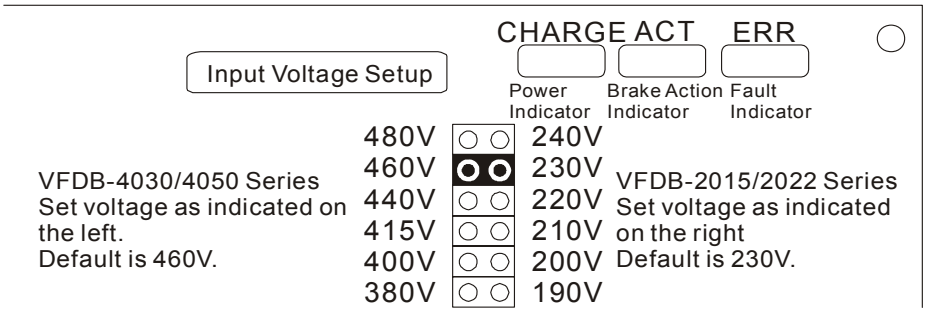
NOTE:

- ☑ When a thermal O/L relay protected by motor is used between Hybrid Servo Controller 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 a filter.
- ☑ Never connect phase lead capacitors or surge absorbers to the output terminals of the Hybrid Servo Controller.

B-6 Brake Unit

Individual Parts and Function Explanation





Input voltage setting for VFDB-2015/2022/4030/4045

The Voltage Settings

1. Adjust Voltage: The + (P) and – (N) sides of the hydraulic servo motor controller are the DC power source of the control unit. Therefore, after wiring and before operation, it is very important to set the voltage of the control unit according to the input voltage of the hydraulic servo motor controller. This setting will affect the state of activation voltage of the control unit. The following table shows the state address of individual voltage actions.

Voltage: 230 VAC	Braking Start-up voltage DC Bus (+(P), -(N)) Voltage	Voltage: 230 VAC	Braking Start-up voltage DC Bus (+(P), -(N)) Voltage
190Vac	330Vdc	380Vac	660Vdc
200Vac	345Vdc	400Vac	690Vdc
210Vac	360Vdc	415Vac	720Vdc
220Vac	380Vdc	440Vac	760Vdc
230Vac	400Vdc	460Vac	800Vdc
240Vac	415Vdc	480Vac	830Vdc

Table 1: The Selection of Power Voltage and Operation Potential of PN DC Voltage

Terminal Wire Gauge

Circuit	Terminal Mark		Wire Gauge AWG (mm^2)	Screw	Torque
Power Input Circuit	+ (P)、- (N)		10~12AWG (3.5~5.5mm^2)	M4	18 kgf-cm (15.6 in-lbf)
Braking Resistor	B1、B2		10~12AWG (3.5~5.5mm^2)	M4	18 kgf-cm (15.6 in-lbf)
SLAVE Circuit	Output	M1、M2	20~18AWG (0.25~0.75mm^2) (with shielded wires)	M2	4 kgf-cm (3 in-lbf)
	Input	S1、S2			
Fault Circuit	RA、RB、RC		20~18AWG (0.25~0.75mm^2)	M2	4 kgf-cm (3 in-lbf)

Specifications

Voltage Class		230V Series		460V Series	
Model VFDB-		2015	2022	4030	4045
Max. Motor Capacity (kW)		15	22	30	45
Output Rating	Max. Discharge Current (A) 10%ED	40	60	40	60
	Continuous Discharge Current (A)	15	20	15	18
	Braking Start-up Voltage (DC)	330/345/360/380/ 400/415±3V		660/690/720/760/ 800/830±6V	
Input Rating	DC Voltage	200~400VDC		400~800VDC	
Min. Equivalent Resistor for Each Braking Unit		10Ω	6.8Ω	20Ω	13.6Ω
Protection	Heat Sink Overheat	Temperature over +95℃ (203°F)			
	Alarm Output	Relay contact 5A120Vac/28Vdc(RA.RB.RC)			
	Power Charge Display	Blackout until bus (+~-) voltage is below 50VDC			
Environment	Installation Location	Indoor (no corrosive gases, metallic dust)			
	Operating Temperature	-10℃~+50℃ (14°F to 122°F)			
	Storage Temperature	-20℃~+60℃ (-4°F to 140°F)			
	Humidity	90% Non-condensing			
	Vibration	20Hz 以下 9.8m/S^2(1G)、20~50Hz 2m/S^2(0.2G)			
Mechanical Configuration		Wall-mounted enclosed type IP50			