

700 Model AC DRIVE

User Manual

Sensorless current/flux vector control



Version No. 2.0

SUITABLE MODEL : THREE PHASE 200V~240V/380V~460V CLASS

Preface

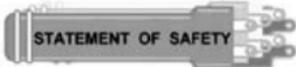
As industries are demanding more of their processes to be automated today in increasing their productivities, more ac drives with improved and enhanced features and capability are commercially used in many of the processes' applications.

Based on our many years of experience, professionalism and knowledge in drives technology and manufacturing, we are constantly committed in our continuous research to develop new product of the latest technology and high quality to meet the changing market requirement.

The LS700 Series current flux vector ac drive (open loop) is the fruit of our years of concerted research efforts which incorporate the most advanced IGBT Module design and silent operation to yield the optimum efficiency and economic benefits.

This manual contains detailed instructions on the installation (including operation, maintenance, inspection, and service), peripheral wirings, specifications, parameters setup, and gives the complete description and technical operation of the product.

This manual also details the various product types and ranges, the features and enhanced capability, and the full operation with the contents from the easy to the difficult. To help complete the installation setup in a systematic and efficient way, a summary process flowchart is given in the "Test run" section to enable the complicated setup procedures to be skipped while saving time in working out the proper installation.



STATEMENT OF SAFETY

- ◆ Read this manual before installation, wiring, operation, maintenance, inspection, and repair, and follow the appropriate instructions. For any doubts, please consult us, or local dealers.
- ◆ To prevent any personal injury or property loss due to unexpected accident, comply strictly to the warnings, cautions, danger marks and the prompts following those marks.
- ◆ Put this manual at a place where handy access is allowed for the operators to refer to.



DESCRIPTION OF MARKS



CAUTION

To warn that any act of omission to the instructions following this mark may cause personal injury.



WARNING

To warn that any act of omission to the instructions following this mark may cause personal injury and property loss.



INHIBIT

To warn that any act of omission or violation against the instructions following this mark may cause personal injury and property loss.

- ◆ This product has been treated with strict QC and provided with reinforced packing materials prior to its shipment ex-factory to ensure it is free of any unexpected impact or damage during the shipment.
- ◆ Operators referred in this manual include: qualified technicians of service and installation, those who are familiar with technologies involved, and well-disciplined operating employees.



CAUTIONS

- ◆ Each ac drive has been set to the basic ex-factory parameter values unless otherwise necessary; please do not change any internally set parameter value. Confirm first the safe allowable range of the motor or the mechanical system before operation or in case that the output frequency must be set to exceed 60 Hz before making the required parameter changes.
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- ◆ Only qualified technician is allowed to operate the ac drive. The qualified technician to this purpose is referred to one who is familiar with the internal construction, installation procedure, operating method, and service steps of the ac drive; and who also knows how to practise safety measures to prevent any occurrence of hazard and/or accident.
 - ◆ Before installing the ac drive, please check the environment of the installation site to see if it is suitable for the installation. If yes, firmly secure the ac drive onto a flat concrete wall or vertical metal plate and properly shield it from any impact of foreign objects during its operation that may damage the ac drive.
 - ◆ When installing multiple ac drives in the same control panel, additional cooling fans must be mounted to ensure that the incoming air temperature of these ac drives will not rise too high to affect its operation.
 - ◆ Check all the wires connected to each terminal blocks are firmly secured, and all grounding terminals on the ac drive and motor are properly earthed.
 - ◆ Before operating, always verify if the voltage of the power supply complies with the rated voltage of the ac drive; and check for correct wiring to any brake controller or brake resistance, if provided.
 - ◆ Since the dc bus voltage of the main circuit inside the ac drive is as high as up to 565 VDC (400V Class) / 283 VDC (200V Class), never use your hands to directly touch any internal circuit of the ac drive to avoid electric shock. Also, do not remove the protection lid when the circuits are energized. Before performing any service or inspection job, make sure to disconnect the power supply first, wait until the “CHARGE” indicator goes off, and then use a multi-meter to verify there is no VDC between the N and P terminals.
 - ◆ Terminals inside the ac drive may still carry dangerous voltage even the ac drive stops; so never use hands to touch the terminal block of the ac drive directly. To perform any wiring inspection and service routines, always wait for five minutes or longer after the power supply is turned off and after the “CHARGE” indicator goes off.
 - ◆ If the use of ac drive is not desired for an extended period of time, be sure to disconnect the power supply to the ac drive and perform the necessary measures to protect it against dust and moisture, so as to avoid unnecessary replacement of parts when using the ac drive in future.
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I Installation

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I -Installation-

Receiving

First-time Use

Please confirm the following matters prior to installation to protect your rights and interests.

1. Are the descriptions and specifications of the received product the same as your order?
2. Is the content of nameplate of the product according to the specifications that you have ordered?

Any breakage ?

Check the appearance for any damage to the product, such as ingress of water, damaged package or dents on the product during transportation.

Are there any loosened lids/screws?

Use a screwdriver to confirm their tightness if necessary.



WARNING

Upon receiving Series 700 ac drive, please check it for correct voltage, specifications, and capacity. Any mistake in the voltage class may lead to a burnt-out of the drive, and personal injury or fire hazard in serious case.

Precautions with regard to installation site

Installation Site



INHIBIT

Please keep the ac drive away from the places where the following substances or situations may be easily encountered:

- Inflammable materials, e.g., wood;
- Dust, metal powder, and oil stain;
- Radioactive substance, and EMI;
- Corrosive gases, liquids, water leakage, and high humidity;
- Vibration when installed on a machine vulnerable to vibration;
- Where exposed to direct sunshine, or at an ambient temperature lower than -10 °C or higher than 45 °C ; and
- High attitude of 1000m or higher above sea level.



WARNING

Avoid installing or placing the ac drive in any of the foregoing locations for such adverse circumstances may leave the ac drive open to failure, damage, deterioration, or even fire accident.

Temperature & Humidity

Installation type	Ambient temperature	Ambient Humidity
Closed Wall Mounting	-10 ~ +40°C	Below 95% RH (non-condensation)
In-Panel Mounting	-10 ~ +45°C	Below 95% RH (non-condensation)

*The above mentioned temperature and humidity are provided as reference only for your environmental assessment of installation.

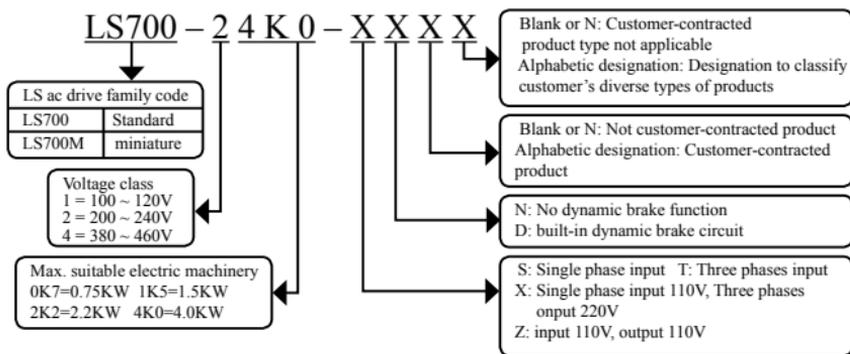
I -Installation-

Content of nameplate

Found on one side of the ac drive, the nameplate contains model, specification, protection class and other information as described below.

Model No.	→	MODEL : LS700-24K0-XXXX (VER 1.01)
Input Spec.	→	INPUT : AC 3Ph 200~240V 50/60Hz
Output Spec.	→	OUTPUT : AC 3Ph 0~240V 4.2KVA 16.0A cont 24.0A int 4.0KW 5Hp
Protection Class	→	PANEL. : IP20 NEMA 1
Manufacturing Series No.	→	S/NO :

Description of Model on the Nameplate of the Drive: (MODEL)

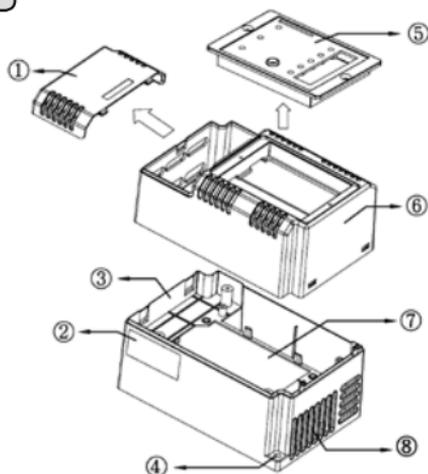


◆ Model No., specifications and power of ac drive

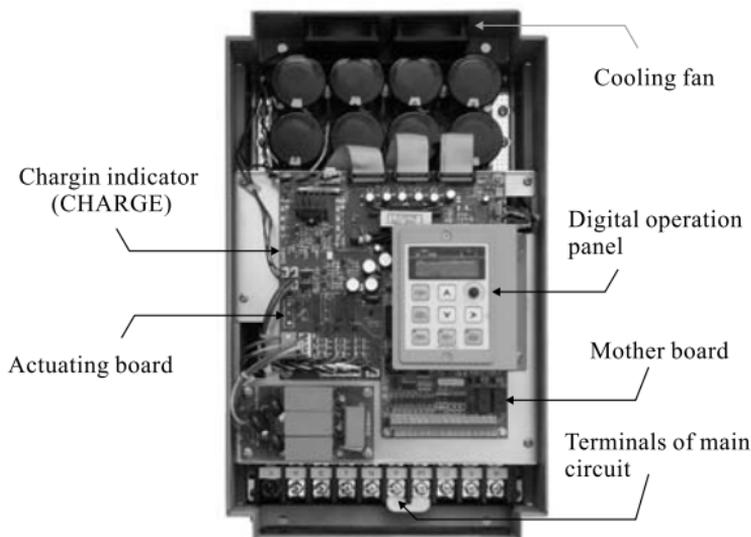
Model No. specifications	Power	Model No. specifications	Power
0K2	0.4KW	015	15KW
0K4	0.4KW	018	18KW
0K7	0.75KW	022	22KW
1K5	1.5KW	030	30KW
2K2	2.2KW	037	37KW
4K0	4.0KW	045	45KW
5K5	5.5KW	055	55KW
7K5	7.5KW	075	75KW
011	11KW		

Parts identification

- ① Terminal Block Lid
- ② Specification Nameplate
- ③ AC Drive Base
- ④ Setscrew Hole
- ⑤ Keyboard Panel
- ⑥ AC Drive Lid
- ⑦ Heat Sink Location
- ⑧ Heat Sink Vent



High horsepower control box layout



I -Installation-

Removing the AC drive lid

0.5HP ~5.0HP



Step 1: Have one thumb slightly push the locking buckle.



Step 2: Push to lift the lid and remove the terminal lid.



Step 3: To remove the lid for service, have both thumbs press LH & RH locking buckles to unbuckle the lid.



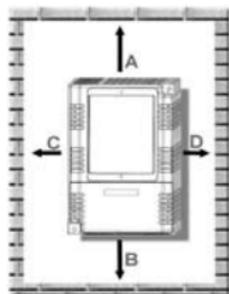
Step 4: Hold and pull upward to remove the entire lid.

Mounting direction and space

To maintain a good cooling air circulation, the ac drive must be secured in vertical position with sufficient clearance left to its surroundings, abutted components and baffles. Whereas cooling fans are mounted at the base of the ac drive, sufficient space shall be maintained to facilitate the air ventilation.

Cautionary points for installations:

- (1) For application at an ambient temperature of 40°C or higher, install the ac drive at a well ventilated place or enhance the cooling device for external environment.
- (2) Instant generation of high temperature may take place if an additional brake resistor is equipped to the ac drive; please select carefully the installation site for the brake resistor, or mount additional fans to help heat dissipation.
- (3) Installation site should be well ventilated and kept far away from inflammables.
- (4) Determine the minimum clearance between the body of the ac drive and the wall according to the model of the ac drive and the number of horsepower. °



CAUTION

After turning off the power supply, wait five minutes or longer for the complete discharge of the internal capacitor before opening the lid.

Direction and safe distance LS700 capacity	A	B	C	D
Below 2.2kw	Above \geq 100 mm	Above \geq 100 mm	Above \geq 50 mm	Above \geq 50 mm
4.0kw ~ 11kw	Above \geq 120 mm	Above \geq 120 mm	Above \geq 50 mm	Above \geq 50 mm
15kw ~ 22kw	Above \geq 150 mm	Above \geq 150 mm	Above \geq 100 mm	Above \geq 100 mm
30kw ~ 37kw	Above \geq 200 mm	Above \geq 200 mm	Above \geq 150 mm	Above \geq 150 mm
45kw ~ 75kw	Above \geq 300 mm	Above \geq 300 mm	Above \geq 200 mm	Above \geq 200 mm

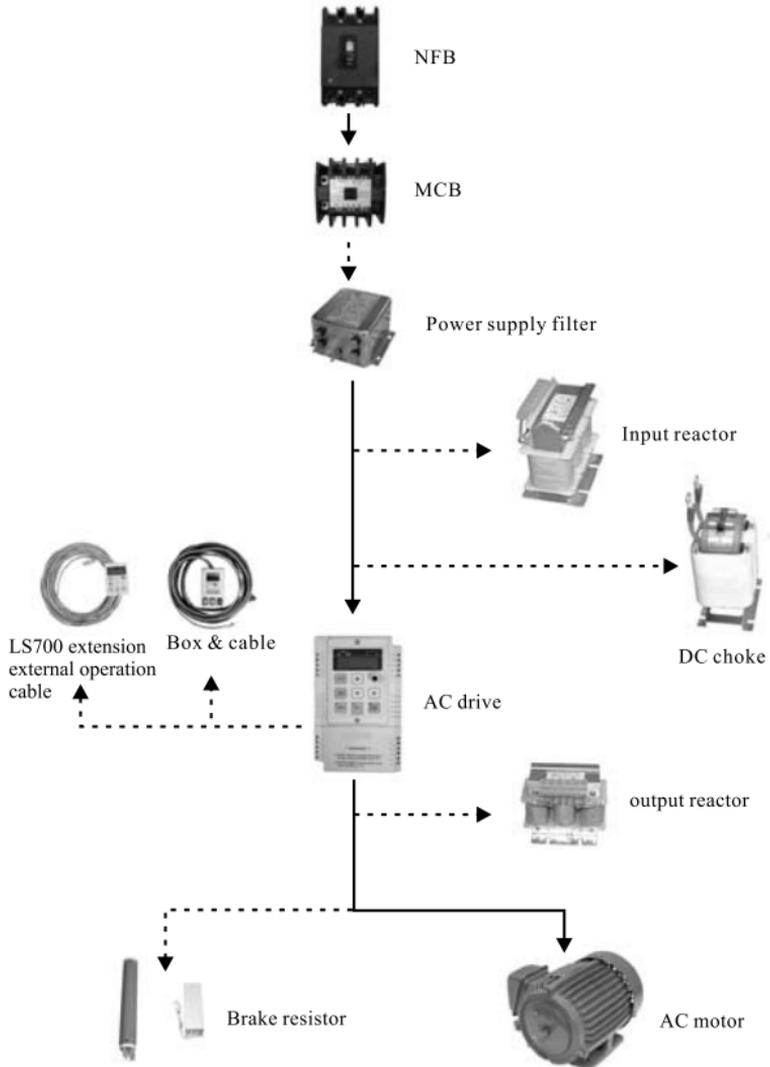
Functions and maintenance of cooling fan

- ◆ There is a cooling fan mounted inside the ac drive and will be triggered its running when temperature of ac drive reaches up to 40°C after operation. A temperature rise to reach 85°C due to a heavy & full load or a too-high environment temperature will trip an over temperature protection (Err17).
- ◆ Regular cleaning and maintenance is necessary to ensure the heat sink of cooling fan when mounted at a place with worse environmental conditions, such as power, dust, oil sludge and cotton fibers, etc. are not blocked.

II Wiring

- ◆ Schematic View of Peripheral Configuration 2-1
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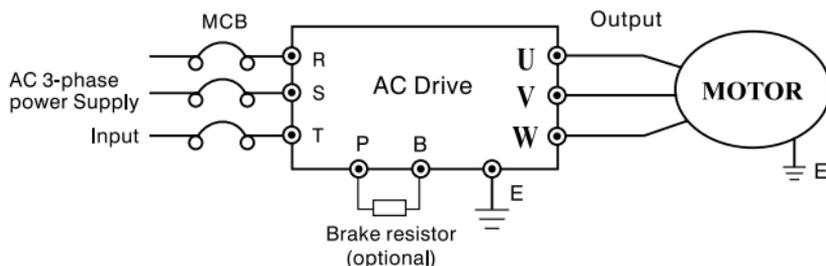
Schematic view of peripheral configuration



Wiring method

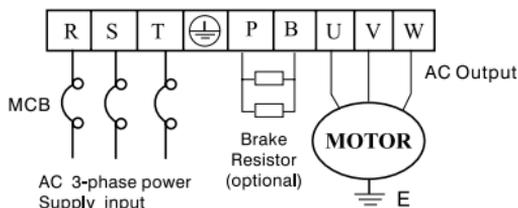
3-Phase Main Circuit Wiring Diagram

(LS700-20K2、LS700-20K4、LS700-20K7、LS700-21K5、LS700-22K2、
 LS700-24K0、LS700-25K5、LS700-27K5、LS700-2011)
 (LS700-40K7、LS700-41K5、LS700-42K2、LS700-44K0、LS700-45K5、
 LS700-47K5、LS700-4011)



- (1) A brake circuit is provided up to 15HP for 3-phase Series 200V and 400V. User shall refer to P. 8-1 for selecting correct resistance and wattage.
- (2) Each ac drive and motor casing must be properly grounded to prevent electric shock.

3-Phase power supply terminal block (0.4KW/0.5HP~11KW/15HP)

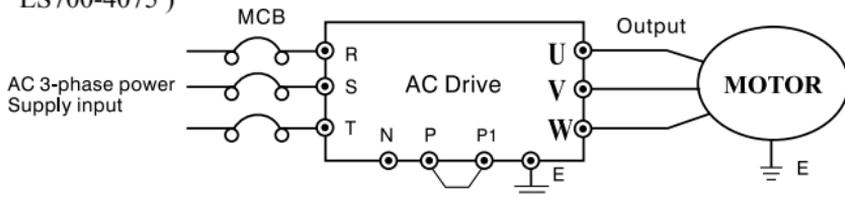


Symbol	Description
R.S.T	Connecting the AC 3-phase power supply input
P.B	Can be connected to brake resistor, additional mounting of brake unit is not necessary for embedded circuit
U.V.W	Output to connect 3-phase motor terminals
or	Grounding terminal

II -Wiring-

3-Phase Main Circuit Wiring Diagram

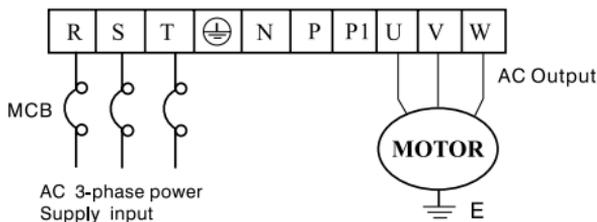
(LS700-2015、LS700-2018、LS700-2022、LS700-2030、LS700-2037、LS700-2045、LS700-2055、LS700-2075、LS700-4015、LS700-4018、LS700-4022、LS700-4030、LS700-4037、LS700-4045、LS700-4055、LS700-4075)



CAUTION

- (1) No brake circuit is provided for 3p Series 200V and 400V of 20HP or greater. User shall refer to P. 8-1 for selecting correct resistance and wattage of brake unit.
- (2) Each ac drive must be properly grounded to prevent electric shock.

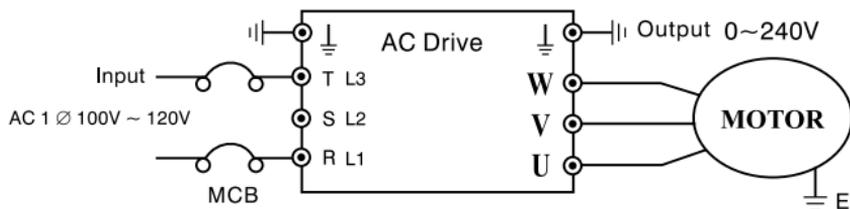
3-phase power supply terminal block (15KW/20HP~75KW/100HP)



Symbol	Description
R. S. T	Connecting the 3-phase power supply input
P1. N	P1(+), N(-) terminals can be connected to external brake unit, but direct connection to brake resistor is not acceptable.
P. P1	For connecting DC reactor
⊕ 或 ⊖	Grounding terminal
U. V. W	Connecting 3-phase motor output terminals

Single-Phase Main Circuit Wiring Diagram

Single phase input 115V – (LS700M-20K2-SX 、LS700M-20K4-SX 、LS700M-20K7-SX)



CAUTION

- (1) Single phase 115V no brake circuit is provided .
- (2) Each ac drive must be properly grounded to prevent electric shock.
- (3) Connecting the AC 115V single phase power supply input L1 、L3, don't connecting to terminal L2

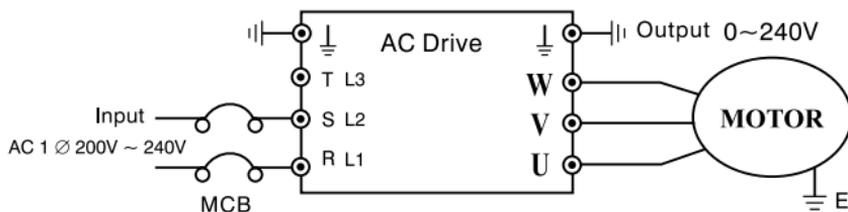
115V Single phase series (SX)

Model No. specifications LS700M-1□□□-SX		0K2	0K4	0K7
Output	MAX. motor is suitable the output (KW)	0.2	0.4	0.75
	MAX. motor is suitable output horsepower (HP)	0.25	0.5	1
	Output rated capacity (KVA)	0.6	1.0	1.6
	Output rated current (A)	1.6	2.5	4.5
	Output frequency range (HZ)	0.01 ~ 240HZ		
	Overload capacity	Rated current 150%, 1 Min		
	MAX. Output voltage	Is equal to the input two time of voltages		
Input	Phase • Voltage • Frequency	Single phase • 100V~120Vac • 50/60HZ		
	Allow voltage variance	Voltage: ±10%		
	Allow frequency variance	Frequency: ±5%		
	Input current (A)	6	9	17

II -Wiring-

Single-Phase Main Circuit Wiring Diagram

Single phase input 230V — (LS700M-20K2-S 、 LS700M-20K4-S 、
LS700M-20K7-S 、 LS700M-21K5-S)



CAUTION

- (1) Single phase 200V ~ 240V no brake circuit is provided .
- (2) Each ac drive must be properly grounded to prevent electric shock.
- (3) Connecting the AC 230V single phase power supply to input L1 、 L2, don't connecting to terminal L3

220V Single phase series (S)

Model No. specifications LS700M-2□□□-S		0K2	0K4	0K7	1K5
Output	MAX. motor is suitable the output (KW)	0.2	0.4	0.75	1.5
	MAX. motor is suitable output horsepower (HP)	0.25	0.5	1	2
	Output rated capacity (KVA)	0.6	1.0	1.6	2.9
	Output rated current (A)	1.6	2.5	4.5	7.5
	Output frequency range (HZ)	0.01 ~ 240HZ			
	Overload capacity	Rated current 150%, 1 Min			
MAX. Output voltage		Three phase corresponds to input voltage			
Input	Phase • Voltage • Frequency	Single phase • 200V~240Vac • 50/60HZ			
	Allow voltage variance	Voltage: ±10%			
	Allow frequency variance	Frequency: ±5%			
	Input current (A)	4.9	6.5	9.7	15.7

Cautionary Points

(1) Wiring of the main circuit

1. Make sure that the connections of power supply for input terminals R.S.T, and output terminals U.V. W (to be connected to the motor) are correct; any wrong connection will lead to a serious damage of the ac drive.
2. Never connect any power factor capacitor, or LC, RC noise filters to the output side of the ac drive.
3. Keep the wirings of main circuit to the ac drive far away from signal cable of the control systems (e.g., PLC, electronic signal system) to avoid interference.

(2) Ground wires

1. Connect the ground terminal \oplus in the third type grounding method ($\leq 10\Omega$).
2. Avoid sharing the grounding electrodes and ground wires with other power facilities including the welding machine and dynamo-machines. Keep the ground wire away from the power cable of large capacity equipment as far as possible.

(3) Circuit breaker for wiring the main circuit – EM (Electromagnetic) contactor

To protect the circuit, a NFB, or an additional EM contactor must be mounted between the AC power supply of main circuit and the LS700 input terminals R.S.T. at the power supply side.

* Use of electric leakage circuit breaker :

1. When an exclusive leakage breaker switch for the ac drive is used, please select to set an induced current of 30mA or greater for each ac drive.
2. If a general leakage breaker switch is used, please select to set an induced current of 200mA or greater and a time duration of more than 0.1s for each ac drive.

(4) Surge absorber

Any windings for the peripheral devices of ac drive, e.g., EM contact, relay, solenoid valve, etc., must be connected in parallel with the surge absorber to prevent the noise interference.

Please refer to the table below for selecting the surge absorber :

Voltage	Where needed	Specifications of surge absorber
220V	Windings of large capacity other than relay	AC250V 0.5uf 200 Ω
	Control relay	AC250V 0.1uf 100 Ω
380V	Ditto	AC500V 0.5uf 220 Ω

Wire gauge cross-reference table for main circuit and control circuit



- ⊙ Before wiring, please confirm that the voltage of power supply conforms to the rated input voltage of the ac drive.
- ⊙ Please follow the regulations set forth in Electric Codes to select the specifications of terminal screws and the size of wire diameter and firmly fasten them.
- ⊙ Wiring the input terminals (3p/R.S.T) of power supply side will not cause any phase sequence problem, but wiring the u, v, w terminals at output side may encounter a phase sequence problem and affect the rotational direction of motor; just switch any two of the three wires to fix the problem.



- ⊙ The wiring operation for the ac drive must be done only after the power supply is cut off for operation safety.
- ⊙ Please mount a no-fuse MCB (Molded Case Breaker) at the power supply input side to turn on/off the power supply and protect the input end of the ac drive.
- ⊙ Properly connect the ground wire to avoid possible electric shock or fire disaster.

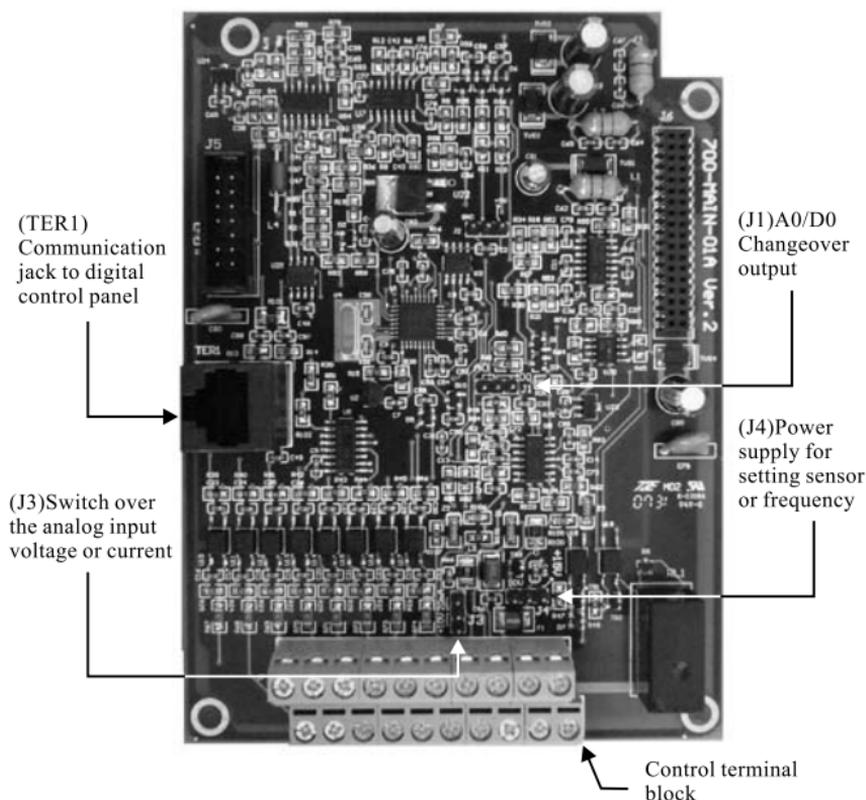
Table (1) 200V ~ 240V

Descriptions	20K2	20K4	20K7	21K5	22K2	24K0	25K5	27K5	2011	2015	2018	2022	2030	2037	2045	2055	2075
Capacity kw/HP-200V	0.2 / 0.25	0.4 / 0.5	0.75 / 1	1.5 / 2	2.2 / 3	4.0 / 5	5.5 / 7.5	7.5 / 10	11 / 15	15 / 20	18.5 / 25	22 / 30	30 / 40	37 / 50	45 / 60	55 / 75	75 / 100
3-phase MCB rated current (A)	5	5	10	15	20	30	50	60	75	125	150	175	225	250	400	400	400
Power wire gauge (mm ²)	2.0			3.5			5.5	8.0	14	22	30	38	50	60	80	100	100
main circuit screws	M4						M5		M6			M8		M10			
Wire gauge of control circuit(mm ²)	0.5 mm ² ~ 1.25 mm ²																

Table (2) 380V ~ 460V

Descriptions	40K7	41K5	42K2	44K0	45K5	47K5	4011	4015	4018	4022	4030	4037	4045	4055	4075
Capacity kw/HP-400V	0.75 / 1	1.5 / 2	2.2 / 3	4.0 / 5	5.5 / 7.5	7.5 / 10	11 / 15	15 / 20	18.5 / 25	22 / 30	30 / 40	37 / 50	45 / 60	55 / 75	75 / 100
3-phase MCB rated current (A)	5	10	15	20	30		50	60	100		125	150	175	200	225
Power wire gauge (mm ²)	2.0			3.5	5.5		8.0		14		22	38		5	
Main circuit screw	M4				M5		M6			M8		M10			
Wire gauge of control circuit (mm ²)	0.5 mm ² ~ 1.25 mm ²														

Location of control terminal block



LS700 Control panel (Motherboard)

- ※ Please see P2-9 for the function description of the jumpers (J1, J3, J4).
Please see P2-7, P2-8 and P2-9 for the function description of the control terminal block.

II -Wiring-

◆ LS700 Specification of communication connector for digital operation panel



1. RJ45 : A short connector as shown in the left photo shall be used instead of the general-purpose communication connector available in the market.

◆ Control terminal block

LS700 Wiring locations and sequence for LS700 control terminals are as follows:

Di1	Di3	Di5	Di7	COM	Do	Ai1	Ao	E	Tc
Di2	Di4	Di6	Di8	COM	Ai2	+10V	AVG	Ta	Tb

LS700M Wiring locations and sequence for LS700M control terminals are as follows:

Di1	Di3	Di5	COM	Do	Ai1	Ao	E	Tc
Di2	Di4	Di6	COM	Ai2	+10V	AVG	Ta	Tb

※ Please use a thin flat or cross-head (#101) screwdriver to unscrew the terminal screws on the terminal block, then route the wires from the wiring opening below the terminal block to connect respective terminals and firmly fasten the terminal screws. (Please refer to P2-8 for precautions when wiring the terminal block).

Wiring connection of control circuit terminals

Cautions for wiring the control circuit



WARNING

Shielded & meshed wire shall be applied and grounded to connect the control circuit and terminal block. Improper wiring will cause serious interference, make operation abnormal and result in accident, personal injury and property loss.

- ✓ For safety concerns, select suitable specifications of wire gauges for wiring connection in accordance with the Electric Code.
- ✓ For overseas customers, please follow the national regulations relevant to power wiring connection locally.
- ✓ Control circuit wiring: Wire to connect the control circuit wirings after separating the main circuit wiring from other power cables; if interlacing the wiring connection is necessary, please make it in a cross connection of 90 degrees.
- ✓ Communication cables for all I/O control signals or remote digital operation panel must be separated from power cables of large current (power supply, motor, brake) as far as possible, and shall never be installed with these power cables in the same cable tray.
- ✓ As long as the indicating lamp of digital operation panel is on, never attempt to connect or remove any cable.
- ✓ Make sure to firmly fasten the screws of main circuit terminals to avoid the sparks generated by slackened screw due to vibration.
- ✓ Please refer to the specification table below for the distance between the input and output wiring of power supply to the ac drive.

Conditions	Wiring standard length	Wiring length limit
Distance from power supply system → to power supply side of ac drive	Within 2~30m	Within 30~300m
Distance from output side of ac drive → to ac generator wire-connecting side	Within 2~25m	Within 25~200m
Method to extend the wiring length	Additional mounting of input/output reactors is recommended	Additional mounting of input/output reactors is compulsory.



WARNING

Long power cable will produce parasitic capacitance at the electric machinery and the grounds of power cable (low potential end) to generate high voltage surge and directly damage the ac drive.

Functional description of control circuit terminals

Terminal mark	Designated function	Descriptions	Attribute	
Multifunctional input terminals	Di1	Forward rotation command	Di1-COM ON for forward rotation running, and OFF for stop	Action
	Di2	Backward rotation command	Di2-COM ON for backward rotation running, and OFF for stop	Action
	Di3	Input at external failure (NC)	External fault signal ON trips the ac drive to stop.	Action
	Di4	Failure reset	Di4 ON releases the status imposed and maintained by the circuit protection action against failure.	Action
	Di5	Multistage rpm command 1	To take binary 2 Bit to execute 4-stage rpm control when enabled.	Action
	Di6	Multistage rpm command 2		Action
	Di7	Inching operation	To execute inching frequency operation when enabled ON.	Action
	Di8	Self stopping	When activated ON, ac drive stops outputting voltage immediately.	Action
	COM	Common terminal for digital input/output	Common terminal for multifunctional input/output terminals.	Common point
Analog frequency setup	+10V	+15V power supply for sensor	Power supply outputs DC+15V (maximum current 30mA) for sensor	Note 1
		+10V power supply for setting up frequency	Power supply outputs DC+10V for frequency setup (maximum current 10mA)	
	Note 1 To output +10V or +15V is determined by the J4 setting; +10V is default output set at ex-factory.			
	AVG	Common terminal for frequency setup	Common terminal of input signal (terminal Ai1, Ai2) for frequency setup.	Reference point
	Ai1	Analog voltage frequency command	Input impedance 30kΩ at input voltage DC 0~10V/or input impedance 500Ω at input current DC 0~20mA is determined by the J3 command selected from the voltage or current signal.	Signal source
Ai2	Analog voltage frequency command	Input impedance 30kΩ at input voltage DC 0~10V	Signal source	
Multifunction output terminals	AO	Analog output	Multifunctional analog output monitoring (DC 0~10V); common terminal is AVG.	Note 2
	DO	Frequency arrived	This contact will be enabled "ON" status when output frequency of ac drive reaches the frequency setting (F62).	
	Note 2 It can only have one choice, either AO or DO, as a synchronous setting output made by software and hardware J1. Software AO is to be established by parameters F50 ~ F52 while software DO is to be set up by parameter F62.			
	COM	Common terminal for signal input/output ¹	Common terminal for signals from multifunctional input/output terminals.	Common contact
	Ta	Output at failure (NC)	Contacts 1a and 1b will be enabled when triggered by the protection function against ac drive failure.	Contact
	Tb		* Ta-Tc is closed (ON) at failure.	Contact
	Tc		* Tb-Tc circuit is opened (OFF) at failure.	Contact
E	Terminal for grounding wire	Shrouded and shielded wire shall be exclusively used as grounding wire.	Grounding	

Description of grounding symbols

Symbols	Descriptions	
AVG ∇	Signal grounding end	Grounding end 0V of signal DC+10V
COM ▼		Grounding end 0V of signal DC+12V
⊕	Grounding pin of control box body is connected to E.	
E	Grounding pin of motor or shielded wire network wire.	
↗ or ⊕	Grounding pin of control box body is connected to E and ⊕	



CAUTION

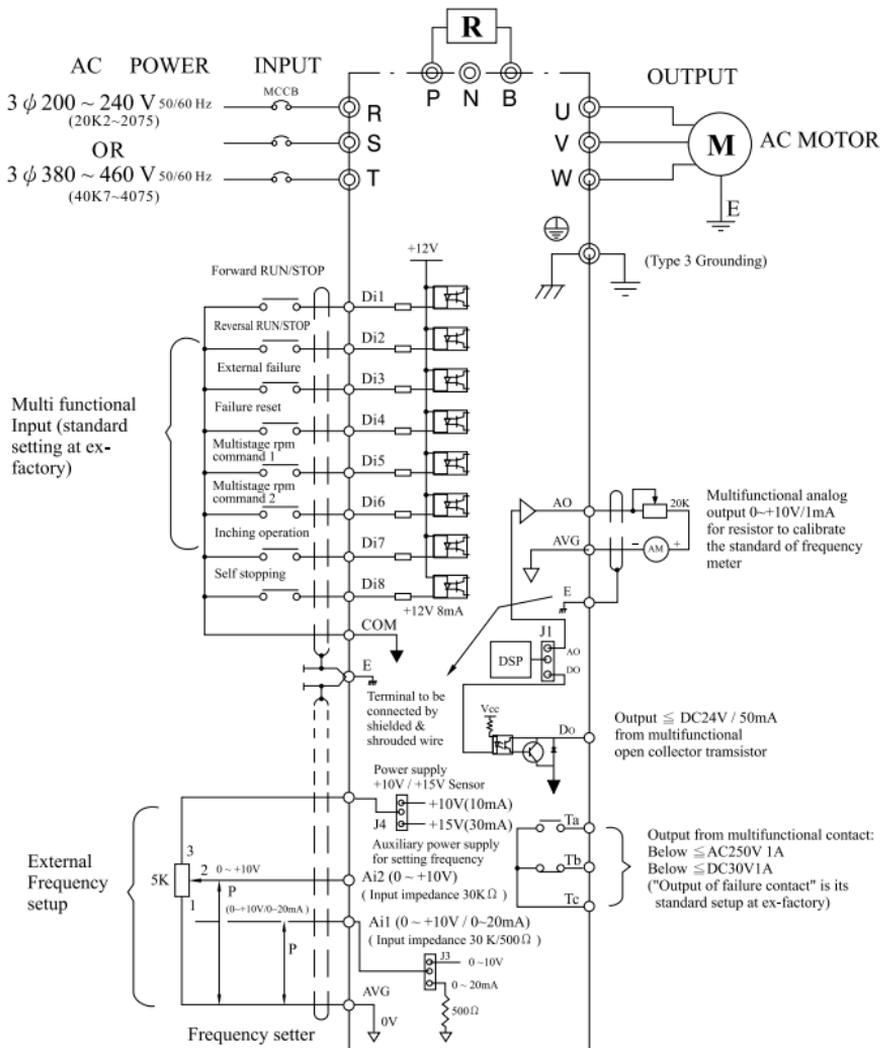


INHIBIT

Whereas the multifunctional input terminals are characterized as empty contacts, no signal source carrying voltage shall be input. Please pay attention to the foregoing introductions of each terminal and use them correctly; any improper use of them will damage the ac drive.

Control Circuit Wiring Diagram

Terminal Wiring for control circuit of ac drive

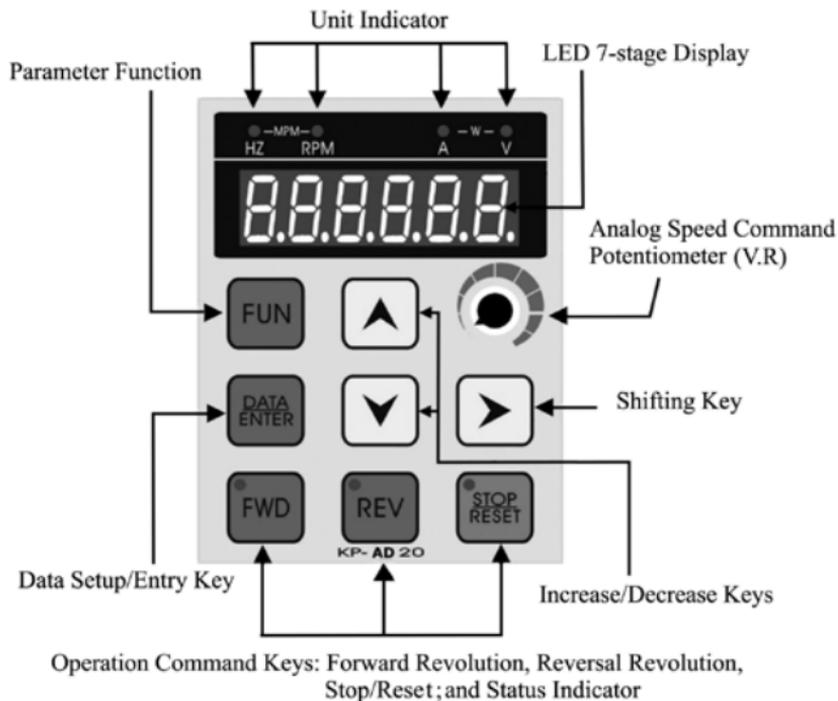


III Digital Operation panel

- ◆ Panel details 3-1
- ◆ Introduction of function keys 3-2
- ◆ Parameter setup mode 3-3
- ◆ Control mode 3-4
- ◆ Status check menus of digital input terminals . 3-5

III -Digital Operation Panel-

Panel Details



Function of digital operation panel

The operation panel is able to perform the functions of running, frequency setup, monitoring the running status, parameter setup and failure display, etc.

Introductio of function Keys

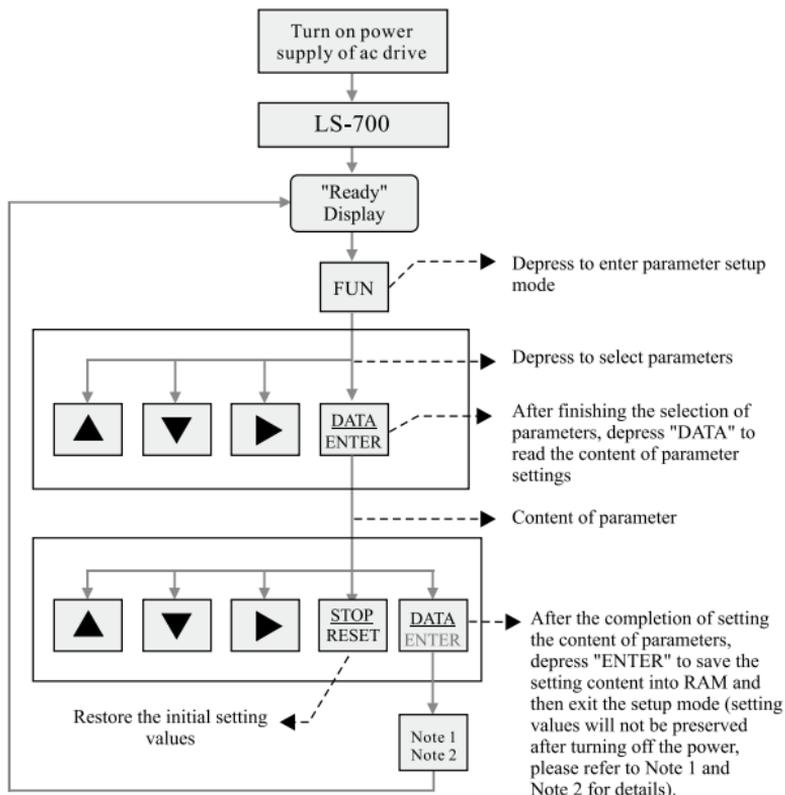
Classification	Pushbutton	Summary description of function
Control/ Parameter Key		Depress to enter into Parameter Function Mode.
		Under operation control mode with F8: rpm command source=0, proceed the frequency setup from digital operation panel.
		To read and write parameter settings.
		To confirm and enter data.
		Under operation control mode, depress to access monitoring of 15 running status values.
Shift/ Increase, Decrease Keys		To move the position of flashing cursor rightward to select the place for data entry.
		Depress to make an increment of numerical values for parametric encoding and setting values, etc.
		Depress to make an decrement of numerical values for parametric encoding and setting values, etc.
Operation Command Key		To execute an operation command in forward revolution and illuminate the LED indicator.
		To serve as a function key to execute stop running command when execution of forward revolution is disabled due to limitation of rotational direction.
		To execute an operation command in reversal revolution and illuminate the LED indicator.
		To serve as a function key to execute stop running command when execution of reversal revolution is disabled due to limitation of rotational direction.
		To execute the STOP running command. To reset the failure when encountered a failure; depress of this key in parameter setup mode will restore the original setting values.
RPM Command		F8: RPM control for operation panel Ai (V.R.) when RPM command source =1.

III -Digital Operation Panel-

Parameter setup mode

This mode is for changing the internal parameter settings. Use Increase/Decrease and Shift keys to change the parameter settings, and depress the ENTER/DATA pushbutton to save the data in RAM and exit the setup mode after the completion of changing parametric settings.

Flow process of parameter setup mode



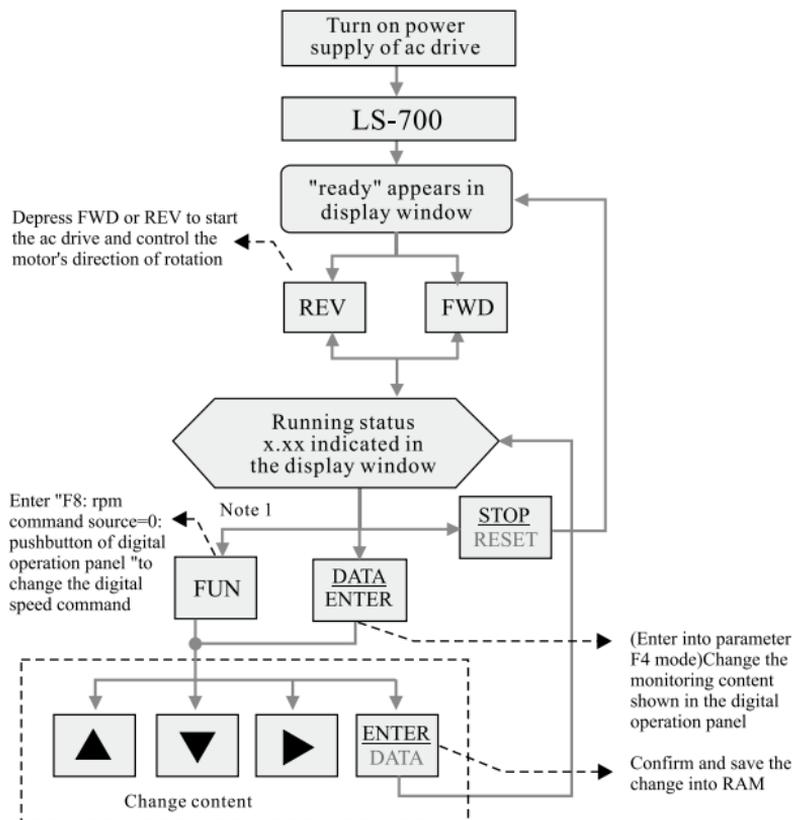
Note 1: For all the changed parameter settings that have been put into test run and meet their respectively intended requirement, please make sure to save these parameters into the EEPROM. Please select F0 (save the current parameters)=1 and save them into DSP (internal EEPROM) to avoid losing the parameter setting values.

Note 2: F0(save the current parameters)=0 : do not save, 1 : save to DSP.

Control mode

The flowchart of control mode for the digital operation panel is given below. This mode is to control the operation and display the frequency commands, output frequency, output current, output voltage, failure content, failure records, etc. For details of parameters, please see Appendix "Summary of Parameter Settings".

Flowchart of control mode for digital operation panel



Note 1 : If the rpm speed signal source is not under F8 (rpm command source)=0: digital operation panel mode, then the digital speed command will be ineffective.

III -Digital Operation Panel-

Status check menus of digital terminals

- ◆ Accessible from F4=14 : Din (display the status of the input values of the digital terminal)
- ◆ To check the display of digital input status, it can only be available when the ac drive is running.

Example No.	Digital total value	Di8	Di7	Di6	Di5	Di4	Di3	Di2	Di1	Digital terminals
		128	64	32	16	8	4	2	1	Digital bit value
1	0	OFF	Indicating value When enabled							
		X	X	X	X	X	X	X	X	
2	42	OFF	OFF	ON	OFF	ON	OFF	ON	OFF	Indicating value When enabled
		X	X	32	X	8	X	2	X	
3	87	OFF	ON	OFF	ON	OFF	ON	ON	ON	Indicating value When enabled
		X	64	X	16	X	4	2	1	
4	176	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	Indicating value When enabled
		128	X	32	16	X	X	X	X	
5	199	ON	ON	OFF	OFF	OFF	ON	ON	ON	Indicating value When enabled
		128	64	X	X	X	4	2	1	
6	216	ON	ON	OFF	ON	ON	OFF	OFF	OFF	Indicating value When enabled
		128	64	X	16	8	X	X	X	
7	222	ON	ON	OFF	ON	ON	ON	ON	OFF	Indicating value When enabled
		128	64	X	16	8	4	2	X	
8	255	ON	Indicating value When enabled							
		128	64	32	16	8	4	2	1	

- ◆ Digital total value is to check if Di1 ~ Di8 digital terminal blocks operate normally.

Example 1 : Digital total value is 0, terminals Di1 ~ Di8 → are all OFF ◦

Example 2 : Digital total value is 42, terminals Di2、Di4、Di6 → are ON state ◦

Example 3 : Digital total value is 87, terminals Di1、Di2、Di3、Di7、Di8 → are ON state ◦

Example 8 : Digital total value is 255, terminals Di1 ~ Di8 → are all ON ◦

* Take Example 2 for the calculation: Digital bit value of Di2 is 2, digital bit value of Di4 is 8 and digital bit value of Di6 is 32, therefore, the indication of digital total value is 2+8+32=42.

IV Test run

- ◆ **Test run operation 4-1**
- ◆ **Auto tuning 4-3**
- ◆ **Auto tuning flowchart 4-4**
- ◆ **Basic parameters setup 4-5**

Test run operation

#Pre-start service:

- ⊙ After the completion of wirings and before supplying the power for test run, please go through the following checkups:
 1. Check if wirings are correct.[input terminals R.S.T shall be wired to power supply while output terminals U.V.W shall be connected to 3-phase induction motor]. Phase reversal at input/output terminals is not allowed.
 2. Look around the interior and all the wiring terminal blocks inside the ac drive to see if there are any wire chips of leads; make sure to remove them thoroughly.
 3. Check if terminals and screws, etc. components are firmly and tightly fastened.
 4. Check if there is short-circuit or grounding among the terminals.
 5. Check if the voltage of the input power supply is the same as the rated voltage of the ac drive.

#Test run:

- ⊙ A factory default setting F83=1, that is, open loop V/F control mode, was made to the ac drive, selection of F83 control mode is available and detailed in P.5-18. F7=0 leaves the operation control method to digital operation panel while F8=1 functions as the rpm command source to control the potentiometer (V.R.) in operation panel. Before supplying power to perform the test run, please turn the knob of potentiometer (V.R.) fully counter-clockwise and then input the power supply. Please follow the following steps to perform the test run:
 1. Turn on the power.
 2. Verify the indicated status is “ready”.
 3. Enter into the operation control mode (Depress FWD to enter into forward rotation operation control).
 4. Input the rpm command (rotate slowly the potentiometer knob in operation panel clockwise and perform the test run within 10Hz)
 5. Depress STOP key to slow down and stop motor.

#Operation checklist

- ⊙ Check if motor runs smoothly.
- ⊙ Check if motor runs in correct direction of rotation.(Change any two of the U, V, and W phase lines at output side of ac drive to change the motor's direction of rotation.)
- ⊙ Check if motor vibrates abnormally.
- ⊙ Check if acceleration and deceleration are smooth.
- ⊙ Check if 3-phase load current is normal.(depress the DATA/ENTER pushbutton to access parameter F4=7; , i.e., the output current to monitor the output load currents from U, V, W respectively.)

#Fast operation control mode

- ⊙ There are several operation control methods applicable to the ac drive for the startup operation. You can use the following operation methods to simply and quickly start the ac drive.
- ⊙ There are two primary operation control parameters to start the operation of ac drive: one is the **F7: Operation Control Source** and the other one is **F8: rpm command source**. Please see the table below for description of operation.

Parameter function	Description of operation procedures	Ex-factory setting	Page No.
F7: Operation Control source			
0 : digital operation panel	Depress FWD key after "Ready" shown in the display window ↓ Enter into the forward-rotation operation mode	0	P5-3
	* Please pay attention to the motor's direction of rotation when performing the test run.*		P5-3
1 : digital input terminal	terminal Di1 /ON →FWD(indicator ON) Run → OFF/stop.		P5-11
F8 : rpm command source			
0 : digital operation panel	Depress the FUN key under running state to enter into the frequency-changing mode.	1	P5-3
1 : operation panel Ai input(V.R)	To perform the rpm control from the potentiometer (V.R.) in operation panel.		
2 : Ai1 input (+10V/20mA)	To perform the rpm control by inputting 0~+10V/0~20mA to analogy terminal Ai1.		
3 : Ai2 input (+10V)	To perform the rpm control by inputting 0~+10V to analogy terminal Ai2.		
4 : Ai1+Ai2	To perform the rpm control by making an addition operation of two analog signals from Ai1 and Ai2 analog terminals at the same time.		
5 : Ai1 - Ai2/MAX	To take the maximum value from two sets of analog signals, Ai1 and Ai2, to perform operation control.		
6 : Ai1 - Ai2/MIN	To take the minimum value from two sets of analog signals, Ai1 and Ai2, to perform operation control.		
7 : PID	To execute the external analog signals for PID feedback control.		
8 : Digital terminals for rpm acceleration or deceleration	To perform speed acceleration and deceleration control by inputting signals to digital input terminals.		

IV -Test Run-

Auto tuning

#Prerequisites

- ◎ If F83=2: sensorless flux vector, or 3: sensorless voltage vector control is selected as the control mode, auto tuning must be performed prior to the drive operation.
- ◎ Before executing the auto tuning function of parameters, it is necessary to establish the following parameters in accordance with the capacity data specified in the nameplate of motor: F78 : rated frequency, F79 : rated voltage(rms), F80 : rated current(rms), F81 : horse power rating (HP), F82 : number of poles of motor, etc.
* **Note: Set up the parameters to go with actual motor capacity.**
- ◎ Please select F7 (operation control source) = 0 : operation by digital operation panel when performing the auto tuning.
* **Note: dynamic parameter tuning: Run the motor at 40HZ pursuant to the FWD command for about one minute, then performing the detection for motor parameters with no-load or a load less than the medium load is available.**

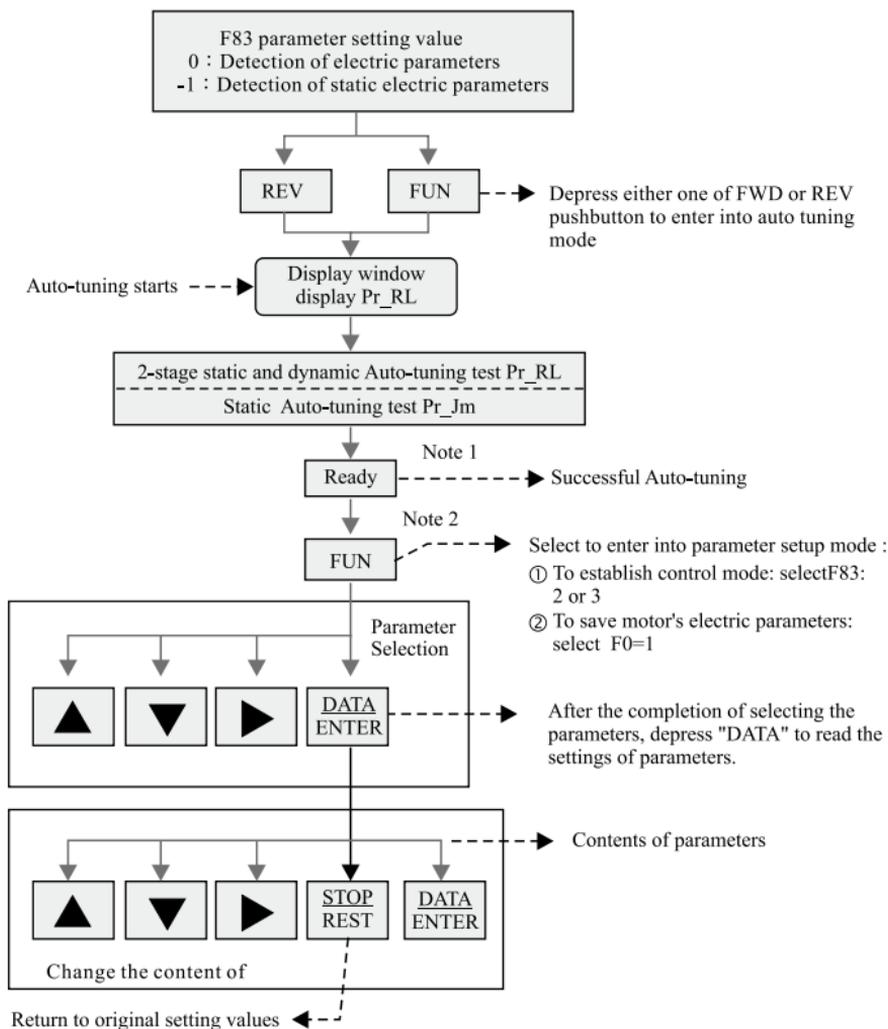


CAUTION

When performing the auto tuning, **make sure to disconnect the motor from the machine** and confirm that motor's running will not incur any danger.

#Parameter auto-tuning

- ◆ **Parameter tuning (F83)= -1 : static electric parameter detection** : This function is applicable to those machine & equipment with heavy load connected that can not be performed the dynamic parameter detection; however, it shall be accommodated with F88 (unloaded current of motor %) setup to be able to detect the motor's electric parameter groups (F84~F87) integrally at a lower accuracy in comparison with the 0: electric parameter detection.
- ◆ **Parameter tuning (F83)= 0 : electric parameter detection** : To perform the auto-tuning for static and dynamic parameters.
- ◆ **When performing the auto-tuning for electric parameters, the ac drive will continue to perform the functions of static parameters auto-tuning or static & dynamic parameters auto-tuning. Thus performing is able to automatically detect the electric characteristics of motor and set up the motor's electric parameter group, and then save the parameter settings in the software. Perform the auto-tuning according to the following steps:**
 1. Depress "FWD" or "REV" pushbutton to pop up a display of Pr-RL indicating that ac drive starts outputting DC current to motor to perform the parameter tuning of static mode for the first stage and parameter tuning of dynamic mode in relation to the rotational operation of motor for the second stage.
 2. If the auto-tuning has been successfully executed, the ac drive will automatically set up the electric characteristics of the motor to their corresponding parameters F84~F88.
 3. Change the control mode (F83) to one of the two control modes: 2: Sensorless flux vector Control or 3: sensorless Voltage Vector Control.
 4. Save electric parameters' settings into F0=1: Save to DSP (EEPROM) to avoid losing the electric parameters' settings after turning the power off.



Note 1 : Detection of electric parameters is completed.

Note 2 : ① Set up the relevant operation control mode from F83, and

② Set up F0=1 to save parameters.

IV -Test Run-

Basic parameter setup

Note 1 : N = Setting value varies with capacity of ac drive and motor.

Parameter code	Descriptions	Setting range	Unit	Ex-factory setting	Page No	
F7	Operation control source	0~1		0	P5-3	
0: digital operation panel		1: digital input terminal				
F8	rpm command source	0~8		1	P5-3	
0: digital operation panel (main speed)		3: Ai2	6: Ai1-Ai2 / MIN			
1: operation panel Ai (V.R)		4: Ai1+Ai2	7: PID			
2: Ai1		5: Ai1-Ai2 / MAX	8: digital terminals for acceleration & deceleration			
F9	Startup mode	0~1		0	P5-4	
0: started from 0 speed		1: DC braked and started from 0 speed				
F12	Stop mode	0~2		1	P5-4	
0: self stopping		1: dynamic stopping		2: dynamic + DC brake		
F15	Restriction of rotational direction	0~2		1	P5-5	
0: forward and reversal rotation		1: orward rotation only		2: reversal rotation only		
F16	Upper limit of frequency($\times F16 \leq F17$)	0.00~60.00	Hz	0	P5-5	
F17	Upper limit of frequency($\times F16 \geq F17$)	30.00~240.00	Hz	60.0	P5-5	
F27	Main speed (inching) acceleration time	0.1~600.0	Second	10.0	P5-7	
F28	Main speed (inching) deceleration time	0.1~600.0	Second	10.0	P5-7	
F54	Di1、Di2 setup	0~1		0	P5-11	
0: Di1(FWD/STOP)・Di2(REV/STOP)		1: Di1(RUN/STOP)・Di2(FWD/REV)				
F66	Stall prevention	0~1		0	P5-14	
0: disabled		1: enabled				
F67	Stall voltage setup	1.00~1.25	Vdc0	1.10	P5-14	
F68	Stall current setup	0.50~2.50	Pu	1.50	P5-14	
F69	Overload current level	1.01~2.50	Pu	1.50	P5-15	
F70	Overload allowable time	0.1~120.0	Second	60.0	P5-15	
if $\int (I^2 A(\text{pu}^{-1}) dt) (I^* \text{OL}^{-2-1}) \times \text{TOL}$						
F76	PWM carry frequency	2000~16000	Hz	5000	P5-17	
F77	RST input voltage (rms)	180~460	V	N ($\frac{1}{\sqrt{3}}$)	P5-17	
F78	Data on motor nameplate	Rated frequency	40.00~70.00	Hz	N ($\frac{1}{\sqrt{3}}$)	P5-17
F79		Rated voltage (rms)	180~460	V	N ($\frac{1}{\sqrt{3}}$)	P5-17
F80		Rated current (rms)	0.5~330.0	A	N ($\frac{1}{\sqrt{3}}$)	P5-17
F81		Horse power	0.20~100.00	Hp	N ($\frac{1}{\sqrt{3}}$)	P5-18
F82		Number of poles	2~16	Pole	N ($\frac{1}{\sqrt{3}}$)	P5-18
F83		Control mode setup	-1~3		1	P5-18
-1: Detection of static electric parameters 0: detection of electric parameters						
1: open loop scalar control (v/f) 3: sensor-less voltage vector control 2: sensor-less flux/vector control						

V Description of parameter functions

- ◆ Storing setup 5-1
- ◆ Display setup of operation panel .. 5-1
- ◆ Operation control parameters 5-3
- ◆ Rpm limit 5-5
- ◆ Multi-stage rpm command setup . 5-6
- ◆ Acceleration/deceleration time 5-7
- ◆ Analog input 5-8
- ◆ AO output 5-10
- ◆ Digital input 5-11
- ◆ Digital output 5-13
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- ◆ External PID 5-23
- ◆ Retrieval parameters 5-24
- ◆ Water pump function 5-25

V -Description of parameter functions-

Storing setup

Parameter	Description	Range	Unit	Ex-factory setting
F0	Save the current parameters	0~1		0

0 : do not save

1 : save to DSP — Save the changed set value of parameter to EEPROM of DSP.

- ※ **Caution** — The modified set values of parameters is saved in the DSP RAM memory and it is unable to retain the set values after turning off the power (POWER OFF); therefore, be sure to set up this parameter to **1: save to DSP** to save the changed values in EEPROM.

F1	Water pressure set value	0.0~10.0	Kg/cm2	2.0
----	--------------------------	----------	--------	-----

◆ **To set up the desired pressure.**

F2	Password entry to protect parameters	-32767~32767		0
F3	Reserved	-32767~32767		0

- ◆ If the drive has been enabled the constant-pressure function for the water pump, you can establish a combination of password to F2 parameter to protect the parameters. Setting this parameter is to avoid unauthorized service personnel from their inadvertently setting other parameter groups.
- ◆ Without an entry of password, the parameters can only be accessed up to parameter F4.

※The function of a constant-pressure water pump is only for unique and tailored-made model of machine.

Display setup of operation panel

F4	Select the variables to be displayed in operation panel	0~16		1
----	---	------	--	---

- ※ Operation panel has been equipped with 7-staged display window and LED lamps to monitor the running status data, 15 data in total, of ac drive during standby or operation.

-Description of parameter functions- IV

Set value	Function	Description of function	Related parameters
0	Set up frequency (HZ)	Set up the frequency of display..	
1	Reference frequency(HZ)	Monitor the reference value of output frequency.	
2	Frequency of output power supply(HZ)	Monitor the compensated value of output frequency.	F83=2
3	Predict speed (rpm)	Monitor the predicted rpm under sensor-less flux/vector control	
4	Vdc_0(V)	The initial DC voltage at DC bus of capacitor when POWER ON.	
5	Vdc(V)	Display the DC voltage of capacitor.	
6	Output voltage(rms)	Display the output voltage (U,V,W) of ac drive (rms)	
7	Output current(rms)	Display the total current of load for output (U,V,W) of ac drive to drive motor.	
8	Torque current command(A)	Data of torque current command in vector control mode	
9	Digital operation panel Ai1(%)	<ul style="list-style-type: none"> • Monitor the displayed percentage % of analog input voltage. • Monitor the noise voltage generated from the wiring as well and use this voltage to set up the bias voltage to avoid unnecessary noise interference. 	F8=1
10	Ai1(%)		F8=2
11	Ai2(%)		F8=3
12	PID(%)	Display the PID-controlled output value in %.	
13	Water pressure of water pump	Display the water pressure of water pump in kg/cm ²	
14	Input status of digital terminals	Able to monitor the control of digital input terminals and access a real-time numerical display of status during the standby and running modes (please see P3-5 for status monitoring).	F54~F60
15~16	Reserved	Reserved	

Parameter	Description	Range	Unit	Ex-factory setting
F5	Unit of speed display	0~1		0

- ◆ This parameter is to set up the display of output unit for running speed of ac drive in frequency (HZ)or revolutions per minutes (rpm) and show the display in the selected F4- function to select a status to be displayed in operation panel.

■ **0 : Frequency (HZ)**

■ **1 : Revolutions per minute (rpm)**

F6	Display of filter time	0~15		6
----	------------------------	------	--	---

- ◆ This function is able to filter out the variation of the low-bit display values so as to read the data of displayed status.
- ◆ Please do not set a long time to this parameter for it will affect the response speed in displaying the data.
- ◆ This function is to be performed by the built-in Low Pass Filter (LPF).

V -Description of parameter functions-

Operation control parameters

Parameter	Description	Range	Unit	Ex-factory setting
F7	Operation control source	0~1		0

- ※ Operation control command must be given first before starting the ac drive to initiate its operation. By then, you may select the operation control source from either digital operation panel or digital input terminals.
- 0 : digital operation panel – Digital operation panel shall control the ac drive's start of operation, forward rotation, reverse rotation and stop operation.
 - 1 : digital input terminals – Digital input terminals (F54) shall control the ac drive's start of operation, forward rotation, reverse rotation and stop operation.

F8	Rpm command source	0~8		1
----	--------------------	-----	--	---

- ◆ This parameter is the rpm command source for the drive motor of ac drive. The following nine options of rpm command sources are available for selection in accordance with the configured requirements of control system.
- ◆ When the following rpm command is executed for operation, input of inching command or multi-stage rpm command will have the priority to be executed and controlled.
- ◆ The sequence of priority for rpm command source is : inching > multi-stage > F8 rpm command source.
- 0 : digital operation panel (master speed) – to be set and controlled by the increase and decrease keys in digital operation panel.
- 1 : operation panel Ai input (V.R) – to be controlled by the DC 0~5V signal from potentiometer (V.R.) in operation panel.
- 2 : Ai1 input (+10V/20mA) – to be controlled by the input analog voltage signal DC 0~+10V (or DC 0~20mA) from analog input terminal Ai1.
- 3 : Ai2 input (+10V) – to be controlled by the input analog voltage signal DC 0~+10V from analog input terminal Ai2.
- 4 : Ai1+Ai2 – to be controlled by adding the two input signal values of input a analog voltage and analog voltage (or current) from both analog input terminals Ai1 and Ai2.
- 5 : Ai1 \ Ai2/MAX – to take the maximum value for operation control from two sets of analog signal input at both Ai1 and Ai2.
- 6 : Ai1 \ Ai2/MIN – to take the minimum value for operation control from two sets of analog signal input at both Ai1 and Ai2.
- 7 : PID(%) – to execute the external analog feedback signal and input it into the PID feedback control module. (Please select the source terminal of PID desired value and PID feedback value from parameter setup, i.e., the PID parameter group F101 ~ F108).
- 8 : Digital terminal for increase/decrease – to input signal to digital input terminal for controlling the increase / decrease of master speed

-Description of parameter functions- IV

Parameter	Description	Range	Unit	Ex-factory setting
F9	Start method	0~1		0

- **0 : Start from zero speed** – to start to run the ac drive from zero speed to the commanded rpm value
- **1 : DC-brake and start from zero speed** – When received a running command signal, the ac drive will perform a DC dynamic brake first to make sure the motor is stopped its idling; and then start its running from zero speed. Please see F10 and F11 for the parameter setup of DC brake before starting the running from zero speed.

F10	Braking duration before start	0~3000.0	Second	5.0
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- ◆ This parameter is to set up time duration of DC dynamic braking enabled when ac drive is started, ac drive will start its running only after the entered time duration elapsed. An entry of minimum value “0” to the duration will disable the pre-braking function.

※Parameter “F9=1: DC brake and start from zero speed” must be entered when DC brake function is desired prior to start.

F11	Brake voltage before start	0~20.00	%	3.0
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- ◆ This parameter is to set the percentage of the DC brake voltage output before the operation of the ac drive. A minimum set value, i.e., “0”, will deny the output brake energy, and will be regarded as a control to trigger a delay for the start of operation. F10 setting shall govern the time span of delay.

F12	Stop mode	0~2		1
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- ◆ To select an appropriate stop mode in accordance with the operational requirements of machine & equipment.
- 0 : coast-to-stop – An input of stop signal will trigger the ac drive to turn off its drive signal immediately and enable an open-circuit state between the ac drive and the motor so that motor can coast down from idling to stop.
- 1 : dynamic stop – Decelerate and stop the motor according to speed rate of the deceleration time.
- 2 : dynamic+DC brake – Slow down the speed according to the speed rate of deceleration time; action of DC brake is enabled when the output frequency is reduced to zero speed; thus the occurrence of coasting operation can be avoided after stopping the motor.

※**Note: Indication dc_dr (DC brake function)**

F13	Stopping & braking voltage	0~20.00	%	3.0
F14	Stopping & braking time	0~3000.0	Second	5.0

- ※**Do not enter a minimum value “0” to set up the stopping & braking time and the stopping & braking voltage; an entry of “0” will leave the time and braking energy inactive.**

V -Description of parameter functions-

Rpm limit

Parameter	Description	Range	Unit	Ex-factory setting
F15	Control of rotating direction	0~2		1

◆ Please use this parameter to select and restrict the rotating direction of motor when motor is restricted its rotating direction to forward or reverse direction required for the concern relevant to the operation of mechanical system.

■ 0 : Forward / reverse rotation available

■ 1 : Forward rotation only

■ 2 : Reversal rotation only



WARNING

※ **Warning** : The direction of rotation set to ac drive is not necessarily the same as the motor's direction of rotation. Each motor has different polarity, so please pay attention to the danger resulted from the reverse rotation..

F16	Lower limit of frequency	0.00~60.00	Hz	0.00
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※ **must satisfy the condition: $F16 \leq F17$**

F17	Upper limit of frequency	30.00~240.00	Hz	60.0
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※ **Must satisfy the condition: $F17 \geq F16$**

An appropriate setting of upper and lower frequency limit is able to truly protect your valuable mechanical system from damage caused by speeding or idling operation when received a wrong entry of speed command from the operator.

Multi-stage rpm command setup

terminal / stage →		Inching command	Multi-stage command 3	Multi-stage command 2	Multi-stage command 1	Setting range	Unit	Ex-factory setting
F18	Master	OFF	OFF	OFF	OFF	0~240.0HZ	HZ	5.00
F19	Stage 1	OFF	OFF	OFF	ON	0~240.0HZ	HZ	5.00
F20	Stage 2	OFF	OFF	ON	OFF	0~240.0HZ	HZ	10.00
F21	Stage 3	OFF	OFF	ON	ON	0~240.0HZ	HZ	20.00
F22	Stage 4	OFF	ON	OFF	OFF	0~240.0HZ	HZ	30.00
F23	Stage 5	OFF	ON	OFF	ON	0~240.0HZ	HZ	40.00
F24	Stage 6	OFF	ON	ON	OFF	0~240.0HZ	HZ	50.00
F25	Stage 7	OFF	ON	ON	ON	0~240.0HZ	HZ	60.00
F26	Inching	ON	✗	✗	✗	0~240.0HZ	HZ	5.00



※Warning — The inching operation has the top priority over any speed from the master through Stage 7 speed; it is unable to select any other speed for operation whenever the inching operation is being executed. The inching operation is a simplex command that has the preference to override any other rpm command sources for executing its operation.

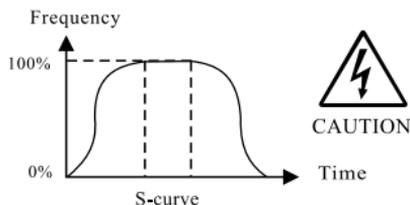
- ◆ ON and OFF shown in the table express the commands given to open or close the circuit at external terminals.
- ◆ Under the operation mode of multi-stage rpm, compilation to select the stage and rpm for operation (9 stages of speed the utmost) through the multi-functional input terminals (F55 ~ F60) is available while the compilation shall be made in a binary system of 3-bit (please see the table above).

V -Description of parameter functions-

Acceleration/deceleration time

Parameter	Description	Range	Unit	Ex-factory setting
F27	Master speed (inching) acceleration time	0.1~600.0	Second	10.0
F28	Master speed (inching) deceleration time	0.1~600.0	Second	10.0
F29	Acceleration time of stage 1	0.1~600.0	Second	10.0
F30	Deceleration time of stage 1	0.1~600.0	Second	10.0
F31	Acceleration time of stage 2	0.1~600.0	Second	10.0
F32	Deceleration time of stage 2	0.1~600.0	Second	10.0
F33	Acceleration time of stage 3	0.1~600.0	Second	10.0
F34	Deceleration time of stage 3	0.1~600.0	Second	10.0
F35	Acceleration time of stage 4	0.1~600.0	Second	10.0
F36	Deceleration time of stage 4	0.1~600.0	Second	10.0
F37	Acceleration time of stage 5	0.1~600.0	Second	10.0
F38	Deceleration time of stage 5	0.1~600.0	Second	10.0
F39	Acceleration time of stage 6	0.1~600.0	Second	10.0
F40	Deceleration time of stage 6	0.1~600.0	Second	10.0
F41	Acceleration time of stage 7	0.1~600.0	Second	10.0
F42	Deceleration time of stage 7	0.1~600.0	Second	10.0
F43	S-curve	0.0~100.0	%	0.0

- ◆ The long or short time duration set to acceleration or deceleration determines the increasing or decreasing rate of output frequency. F27: rated frequency is the reference frequency for the acceleration or deceleration time.
- ◆ The time duration of inching acceleration /deceleration is the same as the master speed's (F27, F28).
- ◆ Variation of setting in S-curve can effectively lessen the load and mitigate impact phenomenon received at start and stop of ac drive.
- ◆ Function of S-curve is only applicable to F8=0 : digital operation panel (master speed) and multi-stage rpm commands.



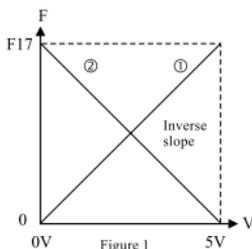
A shorter acceleration/deceleration time may lead to a danger of momentary over-current or over-voltage while an improper time tuning will result in a threat of trip, damage against the drive or a burnt-out of electric machinery.

-Description of parameter functions- IV

Analog input

Parameter	Description	Range	Unit	Ex-factory setting
F44	Ai : 0V input %	-300.00~300.00	%	0.00
F45	Ai : 5V input %	-300.00~300.00	%	100.00

- ◆ Parameters F44 and F45 are to define the Ai (V.R.) value of analog signal command for knob in the operation panel. The bias ratio corresponding to the Parameter F44/0V may be applied to set up a set of negative bias to avoid noise interference at 0V, or for the application by other control; Parameter F45/5V is a gain frequency with its maximum output value limited by the F17 upper-limited frequency. (Please see the following examples for six types of basic curve) :



※ Please refer to Figure 1 and see the description of parameters in the table below :

	Curve ① Figure 1	Curve ② Figure 1
F8 rpm command source	1 : Ai/(V.R)	1 : Ai/(V.R)
F15 Control of rotating direction	1 : forward rotation only	1 : forward rotation only
F17 Upper limit of frequency	60HZ	60HZ
F44 operation panel Ai:0V bias ration	0.0%	100%
F45 operation panel Ai:5V gain ratio	100%	0.0%

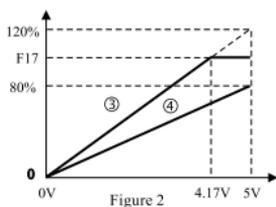


Figure 2 1. Ai maximum output frequency=(F17) upper limit of frequency * (F45) gain ratio.
2. If Ai maximum output frequency is higher than the set value of (F17) upper limit of frequency, then F17 set value will be taken as the maximum output value.

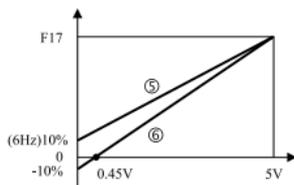


Figure 3 1. Frequency at bias=(F17) upper limit of frequency * (F44) bias ration (as shown in curve ⑤).
2. Voltage at bias=(Ai) 5V/ [(F44)10%+(F45) 100%] Note 1 * (F44)10% (as shown in curve ⑥)

Note 1: Operating bandwidth of analog

※ Please refer to the Figure 2 and Figure 3 and see the description of parameter along different curves in the table below :

	Curve ③	Curve ④	Curve ⑤	Curve ⑥
F8 rpm command source	1 : Ai/(V.R)	1 : Ai/(V.R)	1 : Ai/(V.R)	1 : Ai/(V.R)
F17 Upper limit of frequency	60HZ	60HZ	60HZ	60HZ
F44 operation panel Ai:0V bias ratio	0.0%	0.0%	10%	-10%
F45 operation panel Ai:5V gain ratio	120%	80%	100%	100%

V -Description of parameter functions-

Parameter	Description	Range	Unit	Ex-factory setting
F46	Ai1 : 0V input %	-300.00~300.00	%	0.00
F47	Ai1 : 10V input %	-300.00~300.00	%	100.00
F48	Ai2 : 0V input %	-300.00~300.00	%	0.00
F49	Ai2 : 10V input %	-300.00~300.00	%	100.00

- ◆ The functional commands of this parameter group are to define the frequency (gain frequency) corresponding to the maximum value (10V or 20mA) of analog signal while the output value of this gain frequency is restricted by the frequency of upper limit.
- ◆ Ai1 and Ai2 have the same mode of operation; however, 0~10V/0~20mA is selectable to Ai1 with operation selected by J3 while 0~10V is the only option for Ai2.

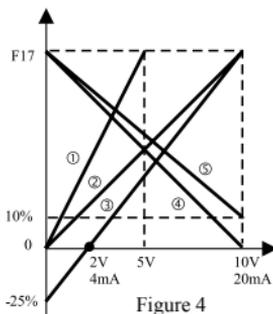


Figure 4

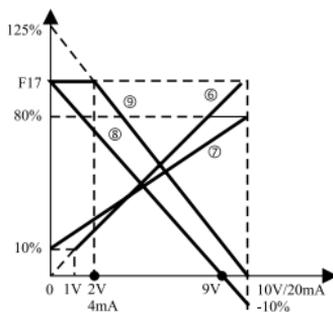


Figure 5

※ Please refer to Figure 4 and see the description of parameter along different curves in the table below :

	Curve ①	Curve ②	Curve ③	Curve ④	Curve ⑤
F8 rpm command source	3: Ai2/10V				
F17 frequency of upper limit	60HZ	60HZ	60HZ	60HZ	60HZ
F46、F48 0V(0mA) bias ratio	0.0%	0.0%	-25%	100%	100%
F47、F49 10V(20mA) gain ratio	200%	100%	100%	0.0%	10%

※ Please refer to Figure 5 and see the description of parameter along different curves in the table below :

	Curve ⑥	Curve ⑦	Curve ⑧	Curve ⑨
F8 rpm command source	3 : Ai2/10V	3 : Ai2/10V	3 : Ai2/10V	3 : Ai2/10V
F16 frequency of lower limit	6.0HZ	0.0HZ	0.0HZ	0.0HZ
F17 frequency of upper limit	60HZ	60HZ	60HZ	60HZ
F46、F48 0V(0mA) bias ratio	0.0%	10%	100%	125%
F47、F49 10V(20mA) gain ratio	100%	80%	-10%	0.0%

-Description of parameter functions- IV

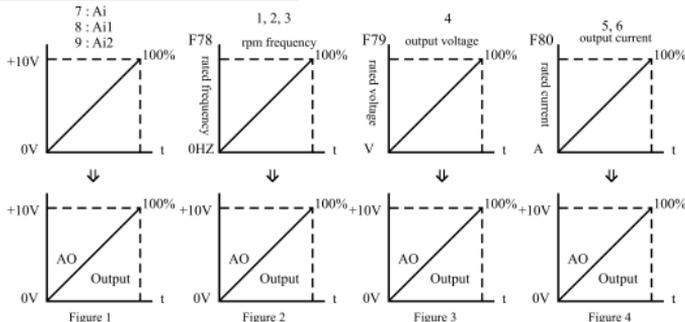
AO output

Parameter	Description	Range	Unit	Ex-factory setting
F50	A out function of analog variable	0~10		0
F51	A out : 0V corresponding value	-32767~32767		0
F52	A out : 10V corresponding value	-32767~32767		4096

- ◆ F50 : Both AO (Analog Output) and F62 : DO (Digital Output) are the output for a same I/O interface and only one function (AO or DO) of them is allowed to be output. When both functions are enabled at the same time, AO has preceding priority; however, hardware J1 functional selection must be established synchronously (please refer to P2-11 for the control circuit wiring diagram).
- ◆ AO output F52 : the smaller the corresponding value, the higher the gain will be. Please refer to the standard ex-factory settings listed in the table below for the output functions, corresponding values and reference standard settings.
- ◆ The following 10 functions of analog output are able to monitor the analog input(Ai) signal and the status value of control output (rpm, current, voltage) from ac drive.

(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point	(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point
0 : disabled	×	×	5 : output current (Figure 4)	8192	F80 parameter set value
1 : reference rpm (Figure 2)	4096	F78 parameter set value	6 : torque current command (Figure 4)	8192	F80 parameter set value
2 : predict rpm (Figure 2)	4096	F78 parameter set value	7 : Ai (Figure 1)	16384	100%
3 : frequency of power supply (Figure 2)	4096	F78 parameter set value	8 : Ai1 (Figure 1)	16384	100%
4 : output voltage (Figure 3)	2200 3800	220.0 V F79 parameter set value 380.0 V	9 : Ai2 (Figure 1)	16384	100%
			10 : PID	16384	100%

Example :



Description :

- In Figure 1, F50 set value is 7 for the input display of analog signal, F52 set value is 16384, reference standard point is 100%, and the highest corresponding value of AO analog signal output is DC+10V.
- In Figure 3, F50 set value is 4 for the display of output voltage, F52 set value is 2200, reference standard point is 220V, and the analog output signal AO is DC+10V.

V -Description of parameter functions-

Digital input

Parameter	Description	Range	Unit	Ex-factory setting
F53	Scan cycle of digital input	2~2000	0.1ms	10

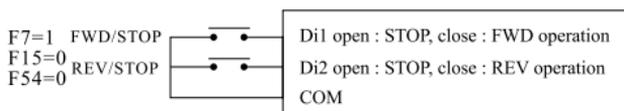
◆ This function is able to filter out the interference from the noise to the multi-function input terminals or get rid of the CUP malfunction caused by the resilience of switch, noise interference or switching ejection.

◆ scan time = set value × 0.1ms °

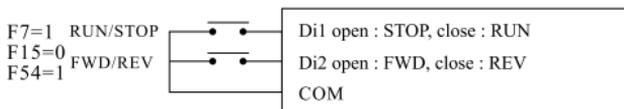
F54	Di1, Di2 setup	0~1		0
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◆ This function is to set up the Di1 and Di2 terminals only and correspond to two-way operation control only, the rest of multi-functions are out of the operation range of Di1 and Di2.

■ **0 : Di1(FWD/STOP), Di2(REV/STOP), 2-way control**



■ **1 : Di1(RUN/STOP), Di2(FWD/REV), 2-way control**



F55	Di3 setup	◆ Multifunction input terminals can be planned to set up their particular use as desired. To apply such functions, please peruse the functional instruction for their priority control and relevant description of functions. ◆ No fixed sequence is specified to set up the function for these six terminals; however, the set value of function for each terminal shall not be repeated except the set value "0: disabled".	0~9	1
F56	Di4 setup		0~9	2
F57	Di5 setup		0~9	6
F58	Di6 setup		0~9	7
F59	Di7 setup		0~9	9
F60	Di8 setup		0~9	3

■ **0 : Disabled** — This function is to disable the functional input terminal to avoid any malfunction caused by unknown reason.

■ **1 : Enabled at external failure (NC)** — b-contact for normal operation and a-contact for failure. An input of external failure will trip the ac drive and stop its output.

-Description of parameter functions- IV

- **2 : RESET** – When the ac drive tripped at failure, use this RESET command to release the failure-maintained state.



INHIBIT

Never operate the RESET command in a constantly energized (ON) state.

- **3 : coast-down stop** – After inputting the functional terminal signal, the ac drive will switch off its output, and let the motor run at idling state and coast down to stop.
- **4 : master speed increase** – To enter the frequency-increasing signal of master speed from multifunctional terminal while the increasing rate is to be determined by F27 and F53.
- **5 : master speed decrease** – To enter the frequency-decreasing signal of master speed from multifunctional terminal while the decreasing rate is to be determined by F28 and F53.
- ◆ These two sets of function mainly focus on the frequency of master speed as the external control can be set up through functional terminals; however, the control power of **F8 : rpm command source** must be set to **8 : digital terminal increases/ decreases**.

■ 6 : Multi-stage rpm command 1	Multi-stage rpm commands 1, 2 and 3 are formatted by binary system in 3-bit manner to configure eight stages of fixed speed for operation control.
■ 7 : Multi-stage rpm command 2	
■ 8 : Multi-stage rpm command 3	

- **9 : inching operation** – Once enabled, the inching command has the top priority over any rpm command; therefore it is unable to select any other speed for operation whenever the inching operation is being executed.

Multi-stage command terminals 8-stage speed	Din multi-stage command 3 $2^2 = 4$	Din multi-stage command 2 $2^1 = 2$	Din multi-stage command 1 $2^0 = 1$
Master speed	OFF	OFF	OFF
Stage 1 speed	OFF	OFF	ON
Stage 2 speed	OFF	ON	OFF
Stage 3 speed	OFF	ON	ON
Stage 4 speed	ON	OFF	OFF
Stage 5 speed	ON	OFF	ON
Stage 6 speed	ON	ON	OFF
Stage 7 speed	ON	ON	ON

(Table 1)

V-Description of parameter functions-

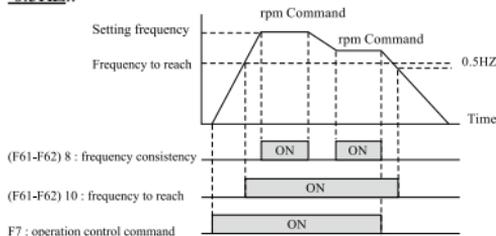
Digital output

Parameter	Description	Description	Range	Unit	Ex-factory setting
F61	Relay1 setup	◆ Multifunctional output terminal is programmable for setting control, no specific sequence is required.	0~10		1
F62	DO setup ※ To set up control power, please see F50 parameter for description.				10

- **0 : disabled**—to disable the function of the output terminal.
- **1 : enabled at failure(NC)**—DO outputs ON (close) signal when the ac drive detects an occurrence of failure condition.
- **2 : in operation**—DO outputs ON (close) signal when the ac drive enters into standby mode or is in operation.
- **3 : in zero speed**—DO outputs ON (close) signal when the ac drive stops or has an output frequency of 0.
- **4 : FWD**—DO outputs ON (close) signal when the ac drive is executing the FWD command.
- **5 : REV**—DO outputs ON (close) signal when the ac drive is executing the REV command.
- **6 : accelerating**—DO outputs ON (close) signal when the ac drive is accelerating toward the target command.
- **7 : decelerating**—DO outputs ON (close) signal when the ac drive is decelerating toward the target command.
- **8 : consistent frequency**—DO outputs ON (close) signal when the ac drive outputs a frequency consistent with the frequency set by rpm commands (master speed ~ speed at stage 7).
(This function is rather unsuitable for being applied to rpm command of analog signal).
- **9 : overload**—DO outputs ON (close) signal when the ac drive detects an overload output.
※ Overload = F80 rated current × F69 overload current level
- **10 : frequency to reach**—DO outputs ON (close) signal when the ac drive outputs a frequency \geq frequency to reach (F63).

Parameter	Description	Range	Unit	Ex-factory setting
F63	Frequency to reach	0.00~240.00	HZ	60.00

- ◆ The preset multifunctional output terminals will be maintained at **ON** state when output frequency \geq set value of **frequency to reach**, and switched to **OFF** state if the output frequency goes down below the **frequency to reach - 0.5HZ**.

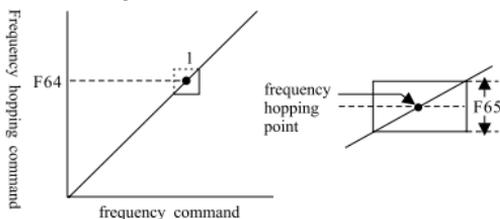


-Description of parameter functions- IV

Jumping frequency

Parameter	Description	Range	Unit	Ex-factory setting
F64	Frequency skip	0~240.00	HZ	0
F65	Skip bandwidth	0~10.0	HZ	0

- ◆ Functions of frequency skip and skip bandwidth are applied to prevent the resonant vibration taken place to the mechanical or motor at some frequencies. It is bound to passing through this resonant area during acceleration or deceleration; however, the program will not allow the operation to stay at this area.
- ◆ An entry of 0HZ to set up the skip bandwidth will disable the function of frequency skip.



Protection setup

F66	Stall prevention	0~1		0
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- **0 : disabled**— Function to prevent stall from over voltage and over current is disabled.
- **1 : enabled**— Function to prevent stall from over voltage and over current is enabled

F67	Stalling voltage setup	1.00~1.25	Vdc0	1.10
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- ◆ As a result from the inertia of motor load when the ac drive is executing the deceleration; the motor will regenerate energy into the interior of ac drive to increase the voltage at DC bus. Therefore, the ac drive will stop decelerating (output frequency paused from decreasing) once a voltage at DC bus detected higher than the set value and resume its executing the deceleration provided that the voltage at DC bus falls below the set value.
- ◆ Stalling voltage level = (F77)RST input voltage × 1.414 × (F67) stalling voltage setting
Example: Stalling voltage level = 220Vac × 1.414 × 1.10 = 342Vdc

F68	Stalling current setup	0.50~2.50	Pu	1.50
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- ◆ When performing the acceleration, the ac drive will stop accelerating (output frequency paused from increasing) once its rapidly risen output current exceeded the set value of stalling current level due to a too-fast acceleration or a too-big motor load, and resume the acceleration provided that the current falls below the set value.
- ◆ stalling current level = (F80) rated current of motor × (F68) gain of stalling current

Example: stalling current level = 4A × 1.5 times = 6.0A

※**Warning**— The upper limit of stalling current level shall never exceed two times of the rated value of ac drive.

V -Description of parameter functions-

Parameter	Description	Range	Unit	Ex-factory setting
F69	Over load current level	1.01~2.50	Pu	1.50
F70	Overload time allowable	0.1~120.0	Second	60.0

- ◆ When the rated capacity of ac drive is higher than motor's rated capacity, please input the motor's rated capacity into the parameters F78~F82 to avoid burning out the motor.
- ◆ This parameter provides a function of electronic thermal relay to protect the motor from overheating. This kind of protective characteristic has taken the protection against the low cooling ability encountered when motor is running at low speed into consideration.
- ◆ When the continuously loading current output from the ac drive exceeds the set value of overload current level, the timer for overload time allowable will be actuated.
- ◆ Overload Current Level = (F80) Motor Rated Current * (F69) overload current gain level
 $\ast \int (I/A(\text{pu})-1)dt \geq (I^*OL-1) \times TOL$, overload is overtime.

F71	Automatic Voltage Regulation (AVR)	0~1		0
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- **0 : disabled**—AVR function is disabled, output (U.V.W) voltage varies with the input voltage of power supply.
- **1 : enabled**—AVR function is enabled to output voltage.
- ◆ When the input voltage of power supply is higher than the maximum output voltage (U.V.W) of (F72) function, AVR function will be enabled automatically to regulate the voltage at the set value of F72; at this moment, the motor is able to output a steady torque and resistant to temperature rise and drastic increase of torque. However, when the input voltage of power supply is lower than the set value of F72, the output voltage will vary with the input voltage.
- ◆ AVR voltage = (F79) motor's rated voltage \times (F72) the maximum voltage

Example : (AVR voltage) 198Vac = (F79) 220Vac \times (F72) 0.9



INHIBIT

Never enable the AVR when the function = 2: sensor-less flux/vector control in (F83) control mode is selected.

Magnetic flux setup

F72	Maximum output voltage (U.V.W)	0.50~1.00	Pu	1.00
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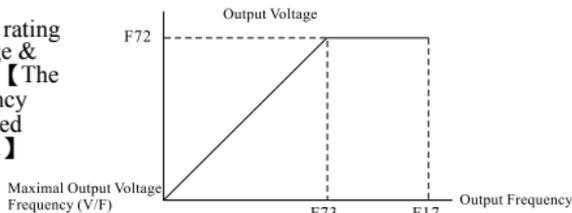
- ◆ The ac drive is able to receive an input voltage of AC 180V ~ 240V (or 380V ~ 460V) with its maximum output voltage set up by this parameter function to go with the motor's rated voltage.
 - ◆ Maximum output voltage = (F79) rated voltage \times F72(1.00 time) set value.
 - ◆ With the (F83) control mode selected to 1 : Open loop scalar control (V/F), 3 : sensor-less voltage vector control, set value 1.0 is the most ideal value to set up the maximum output voltage of F72.
- ※ **Caution**—If 2: sensor-less flux/vector control in (F83) control mode is selected, the maximum output voltage rate shall not be higher than 95% because the interior has to be performed a tuning for the control of magnetic field. If

-Description of parameter functions- IV

a set value is selected too big, the efficiency to compensate the magnetic field may be lost or tripping the machine may have taken place due to the disabled control of function. The optimum set value is ranging 0.90~0.95.

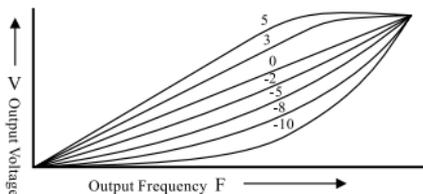
Parameter	Description	Range	Unit	Ex-factory setting
F73	V/F maximum voltage frequency	0.5~2.00	Pu	1.00

- ◆ Please follow the motor's rating to set up the output voltage & frequency of the ac drive. 【The maximum voltage frequency (1.00) shall take F78 : rated frequency as the standard.】



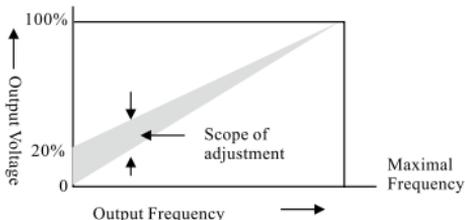
F74	V/F curve selection	-10~5		0
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- ◆ The relation of variation in terms of square decreasing, linear or square increasing between the output voltage and the output frequency is defined and established (as shown in the figure below).
- ◆ A set value 0 is for linear V/F curve to be applied to a constant torque load.
- ◆ A set value ranging -1~-10 is for square decreasing V/F curve to be applied to fan and pump, etc.
- ◆ A set value ranging 1~5 is for square increasing V/F curve.



F75	Voltage boosting value	0~0.200	Pu	0.020
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- ◆ This function provides a technique to take the advantage of V/F linear curve theory to boost the output voltage corresponding to 0HZ in an appropriate amount so that the low torque performance of the motor at low-speed range can be improved.
- ◆ Excessive boosting may lead to motor's over-current and may be more likely to actuate the functions (F68~F70) to restrict the output current. Therefore, with the "F4=7 display of output current" enabled, please confirm the output current while performing the adjustment so as to tune to an optimal value.
- ◆ Generally, 3HZ should be able to start the operation of motor under the V/F control mode in principle.



V -Description of parameter functions-

Ac drive parameters

Parameter	Description	Range	Unit	Ex-factory setting
F76	PWM carrier frequency	2000~16000	HZ	5000

- ◆ This parameter is able to set up the carrier frequency output from PWM.
- ◆ The set value of carrier frequency will affect the electromagnetic noise of the motor, the switching loss of the IGBT and the heat dissipation due to switching loss as stated in the table given below:

Carrier frequency	Motor noise	Switching loss	Heat dissipation	Torque	Harmonic rate
2KHz	High	Low	Low	High	Low
↕	↕	↕	↕	↕	↕
16KHZ	Low	High	High	Low	High

F77	RST input voltage (rms)	180~460	V	220
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- ◆ This parameter defines the standard input voltage from the mains power supply to the ac drive while the ac drive computes all working levels and protection levels relevant to voltage in accordance with this parameter.

Low voltage level = AC in \times 1.414 \times 70%

Over voltage level = AC in \times 1.414 \times 130%

Brake level = 360Vdc \pm 3% for AC 200V series, 720Vdc \pm 3% for AC 400V series,
Brake level is constant to the hardware.

Motor nameplate

F78	Rated frequency	40.00~70.00	HZ	N(Note 1)
F79	Rated voltage (rms)	180~460	V	N(Note 1, Note 2)
F80	Rated current (rms)	0.5~330.0	A	N(Note 1)

- ◆ The setup of rated voltage, rated current and rated frequency of the motor's windings as shown above sets the parameter functions of the ac drive to operate the motor.
(Note 1 : N= make different setup according to the actual motor capacity.)
(Note 2 : F79 : motor's rated voltage must \geq F77 \div 1.2)
- ◆ F78~F82 are parameter group for setting the parameters in motor nameplate; please enter the rated values from the motor nameplate as the set values.
- ◆ Motor parameters must be given for the application of vector control mode. Correct setting of parameters can obtain a better speed response curve and torque characteristic curve of motor.
- ◆ When applying an ac drive of high capacity to operate a motor of low capacity, the set value of F80 must satisfy the condition: F80>rated current of ac drive \div 9.

-Description of parameter functions- IV

Parameter	Description	Range	Unit	Ex-factory setting
F81	No. of HP	0.20~100.00	HP	N(Note 1)

- ◆ Motor's output rated power. (0.2HP = 150W), (1/4HP = 180W)

F82	No. of pole	2~16	Pole	N(Note 1)
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- ◆ Enter the motor's number of pole as the set value.
- ◆ The motor's rpm can be indicated correctly when performing the v/f control.
- ◆ When performing the vector control, the ac drive will take the set value of this parameter as the standard to undertake the calculation of speed vector control.

Control mode

F83	Control mode setup	-1~3		1
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■ **-1 : Static electric parameter detection** – This function is used for some mechanical equipment that have been coupled with heavy load and are unable to perform the detection of dynamic parameter. It must accommodate with the setting of parameter F88 (motor's no-load current %) so that the motor's electric parameter group (F84~F87) can be detected in full; the accuracy is lower than 0: electric parameter detection.

■ **0 : electric parameter detection** – This function is able to detect the electric characteristics of motor and enter the motor parameters into the electric parameter group F84~F88 automatically by performing the auto-tuning function for both the static and dynamic parameters.

(Dynamic parameter tuning: dynamic parameter tuning : Run the motor at 40HZ pursuant to the FWD command for about one minutes, then performing the detection for motor parameters with no-load or a load less than the available medium load.)

※ **Note: Display Pr RL (Detecting function)**

■ **1 : open loop scalar control (v/f)** – The ac drive outputs SVPWM waveform to motor.

■ **2 : sensor-less flux vector control** – It is a current-type sensor-less vector controller to use the current command and feedback current error for making a torque current compensation; the torque characteristic at low-speed area will be better than the voltage-type control and have a smaller rpm slip.

■ **3 : sensor-less voltage vector control** – It is a voltage-type sensor-less controller to apply the voltage command and feedback current signal to predict the magnetic flux of stator and slip for frequency compensation.

※ **The parameters F78~F82 of motor's nameplate to execute 0: electric parameter detection (Pr RL) must be firstly set if the control mode is set to 2: sensor-less flux/vector control or 3: sensor-less voltage vector control; after its successful execution, follow to set the 2: sensor-less flux/vector control or 3: sensor-less voltage vector control accordingly. (Please see P4-3).**

Prompt : The application of 2 : sensor-less flux/vector control mode must fall within the high-speed [approximately 90% ~ 120% of the motor's rated rpm] domain where the speed precision is essential. After the completion of electric parameter detection, please set up the following parameter groups:

1. F72 = 0.90~0.95
2. F76 = 6K~8K[carrier frequency]

V -Description of parameter functions-

Motor electric parameters

Parameter	Description	Range	Unit	Ex-factory setting
F84	Stator resistance	2250~32767	Pu:Q17	10000
F85	Rotor resistance	2250~32767	Pu:Q17	8000
F86	Stator inductance	6150~32767	Pu:Q13	18000
F87	Mutual inductance	6150~32767	Pu:Q13	17500
F88	No-load current (%)	10.00~80.00	%	40.00

※The motor's electric parameters in this parameter group can be detected by auto-tuning detection function set to F83 control mode— 0: auto-tuning detection functions for electric parameters.

If the auto-tuning fails, please manually enter the parameters F84, F85, F86, F87 and F88. Please obtain the set values of five parameters from the motor manufacturer— Rs: stator impedance, Rr: rotor impedance, Ls: stator inductance, Lm: mutual inductance and no-load current, and then compute the parameters of F84, F85, F86, F87 and F88 according to the rated values of motor.

Example: Motor manufacturer provides the data of parameters as follows: $R_s=0.3\Omega$
 $R_r=0.303\Omega$ $L_s=L_r=0.0477H$ $L_m=0.0456H$, Motor rated values: 220 V, 14 A,
 60 Hz, no-load current : 4.2A

Computation is as follow :

$$V_{base} = 220\sqrt{2}/\sqrt{3} = 179.63 \text{ (volt)}$$

$$I_{base} = 14\sqrt{2} = 19.8 \text{ (A)}$$

$$\omega_{base} = 2\pi \cdot 60 = 377 \text{ (rad/s)}$$

$$R_{base} = V_{base}/I_{base} = 9.07(\Omega)$$

$$L_{base} = R_{base}/\omega_{base} = 0.02406(H)$$

$$\bar{R}_s = \frac{R_s}{R_{base}} * 2^{17} = 0.0331 * 2^{17} = 4338 \dots\dots (F84)$$

$$\bar{R}_r = \frac{R_r}{R_{base}} * 2^{17} = 0.0334 * 2^{17} = 4378 \dots\dots (F85)$$

Computations are as follows:

$$\bar{L}_s = \bar{L}_r = \frac{L_s}{L_{base}} * 2^{13} = 1.9825 * 2^{13} = 16240 \dots\dots (F86)$$

$$\bar{L}_m = \frac{L_m}{L_{base}} * 2^{13} = 1.8953 * 2^{13} = 15526 \dots\dots (F87)$$

No-load current (%) = motor no-load current / motor rated current) \times 100
 = (4.2A / 14A) \times 100 = 30(%) (F88)

Note: 2^{13} and 2^{17} in the computing equations are constants in Q format, and shall not be changed.

($2^{13} = 8192$, $2^{17} = 131072$)

Motor electric parameters

Parameter	Description	Range	Unit	Ex-factory setting
F89	Bandwidth of magnetic flux prediction	1.00~30.00	HZ	4.0
F90	Bandwidth of speed prediction	1.00~30.00	HZ	6.0
F91	Slip compensation gain	10~200	%	85

- ◆ Increasing motor load will result in an increasing motor slip. Therefore, the functions of magnetic flux prediction, speed prediction and slip compensation gain are to overcome the changing load and to maintain the motor at a constant speed.

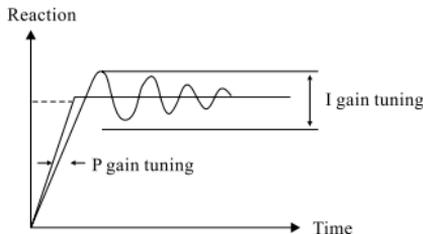
Controller

F92	Sensor-less speed control P gain	5~200	%	20
F93	Sensor-less speed control I gain	0~100.0	%	20.0

- ◆ Sensor-less speed PI control is to make an adjustment mainly focusing on the operation response of (F83) control mode = 2: sensor-less flux/vector control.
 - ◆ PI control: PI control is the combination of (P) Proportional Control and (I) Integral Control to make a response against thereof controlled values in accordance with the magnitude of deviation and change of time.
- ※ Please pay attention to the system reaction at the same time when tuning the parameters F92 and F93,

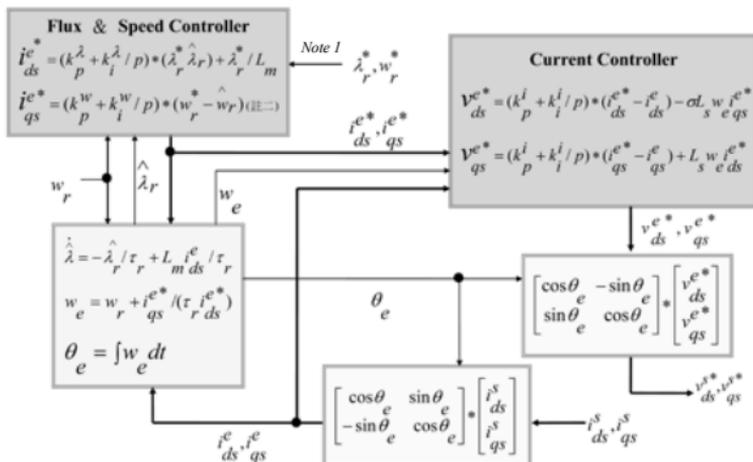
1. Gradually increase the set value of proportional gain (P) until it reaches the maximum value before the occurrence of oscillation.
2. Gradually increase the set value of integral time (I) until it reaches the maximum value before the occurrence of oscillation.

As shown in Figure 1 :



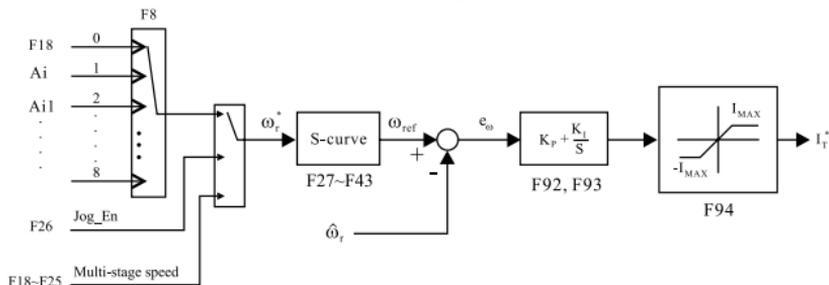
V -Description of parameter functions-

Magnetic field oriented control block chart



Note 1 : The formula to compute the current of magnetic field has been built in the software that can is unalterable.

Sensor-less vector speed PI control



Parameter	Description	Range	Unit	Ex-factory setting
F94	Torque current limit	0~125.0	%	100.0

- ◆ To set the torque current at the maximum load output from ac drive.
Torque current = Rated current of the ac drive (rms) × (F94) set value of torque current
- ◆ Torque current limit is provided only for the operation of F83=2 : Sensor-less flux / vector control.

※ **Caution :** The ac drive must match with the motor.

Failure record

Parameter	Description	Range	Unit	Ex-factory setting
F95	Current failure record	0~20		0
F96	Failure record of last time	0~20		0
F97	Failure record of last two times	0~20		0
F98	Failure record of last two times	0~20		0
F99	Clear the failure record	0~1		0

◆ Any failure event taken place during the operation of ac drive will be recorded in parameters F95 ~F98.

◆ Please use F99 to clear the failure content stored in the memory.

0 : do not clear 1 : clear

F100	Number of times to auto-reset the failure during operation	0~10		0
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◆ F100 (set value 0 is to disable the auto-reset function) will reset to release the failure taken place to trip the ac drive during the operation.

◆ The user can set up the number of times of auto-reset. When the number of times of failure is over the preset number of times, please use RESET pushbutton in the digital operation panel to clear it, or enable the digital input terminal 2: RESET to clear it; thus doing can zero the number of times of auto-reset.

◆ Default setting of duration is 6 seconds to auto-reset the failure. For an equipment with larger mechanical inertia, please refer to parameters F9 ~ F11 for functions to set a delay of time to start the operation.

◆ F100 auto-reset will not respond to the failure taken place during the standby (ready) state; please depress the RESET pushbutton to reset and clear it.

◆ If a failure taken place when operation control source is set to F7:0 digital operation panel, F100 will reset it automatically and restart the operation. If there is a safety concern, please cancel the F100 auto-reset function.

◆ If a failure taken place when operation control source is set to F7:1 digital input terminal, F100 will reset it automatically and operate the equipment under the current control mode.

Error code	Description of failure
Err 0	Communication of digital operation panel failed
Err 1	Over-voltage or over-current in standby state (hardware detection and protection)
Err 2	Over-voltage or over-current during acceleration (hardware detection and protection)
Err 3	Over-voltage or over-current during deceleration (hardware detection and protection)
Err 4	Over-voltage or over-current during speed regulation (hardware detection and protection)
Err 5	External failure
Err 6	DC over voltage (O.V)
Err 7	DC low voltage (L.V)

V -Description of parameter functions-

Error code	Description of failure
Err 8	Motor overload longer than the allowable time
Err 9	DI setting repeated
Err 10	Electric parameter detection malfunctioned
Err 11	Current between motor and ac drive not matched
Err 12	Voltage between motor and ac drive not matched
Err 13	Circuit opened at output side of U phase or current detector malfunctioned
Err 14	Circuit opened at output side of W phase or current detector malfunctioned
Err 15	Parameters stored in DSP locked and unalterable.
Err 16	Parameter out of range (Default)
Err 17	Over temperature or PF or PUF failure
Err 18 ~ Err20	reserved.

External PID

Parameter	Description	Range	Unit	Ex-factory setting
F101	PID mode	0~2		0

■ **0 : PID disabled**—PID control disabled.

■ **1 : Stop and reset PID value to 0**—Operation values of PID control will not be reserved if a STOP command is input while executing the PID control.

■ **2 : Stop and reserve PID value**—Operation values of PID control will be reserved if a STOP command is input while executing the PID control. Those PID reserved values will be the initial values of PID operation when receiving a START command again.

F102	Set value of PID command	0.00~100.00	%	50.00
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◆ Enter a constant target value of command for this parameter to undertake the control.

F103	PID feedback point	0~1		0
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◆ Select the input terminal to function as the detecting source of PID feedback point.

Set value	Function	Description
0	Ai1 input	<ul style="list-style-type: none"> Input terminal of analog signal command for external feedback value. Parameter F46~F49 will undertake the adjustment and setup for the gain and shift of analog signal command.
1	Ai2 input	

F104	Setup of input filter time D	0.05~10.00	second	0.20
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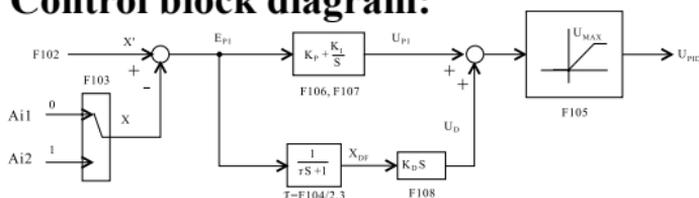
◆ D input is serially connected to a low-pass filter to filter out the high-frequency noise. Time constant $\tau = F104/2.3$

-Description of parameter functions- IV

Parameter	Description	Range	Unit	Ex-factory setting
F105	PID output limit	0.00~100.00	%	100.00
F106	Kp	10.00~300.00	%	150.00
F107	Ki	0.00~300.00	%	20.00
F108	Kd	0.00~300.00	%	5.00

- ◆ **Kp control** : To output a proportional operating value according to the degree in response to the deviation. Entry of a big gain will obtain a fast response, but a too-big gain will cause oscillation; entry of a small gain will obtain a slow response.
- ◆ **Ki control** : A responding ability to output an operating gain of integral deviation so that the feedback value and the target value can be identical and effective. An entry of big integral gain will obtain a fast response speed, but a too-big gain will cause oscillation.
- ◆ **Kd control** : To output an operating gain of differential deviation so as to respond to the drastic variation as soon as possible. Entry of a big differential gain will attenuate the oscillation induced by the occurrence of deviation. However, an entry of too-big differential gain will cause oscillation instead.

PID Control block diagram:



Retrieve parameters

F109	Retrieve parameter	0~1	0
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■ **0 : disabled**

- **1 : retrieve factory settings** – To retrieve the default ex-factory set values. (Parameters F77 ~ F82 are excluded from this retrieval function).

F110	Lock the EEPROM parameter	0~1	0
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- **0 : Memory available** – All set values of parameters can be saved in the EEPROM memory.

- **1 : Lock the parameters in DSP memory** – The changed set values of parameters can only be saved in the RAM memory of DSP, they can not be saved in the EEPROM memory of DSP.

V -Description of parameter functions-

- ※ After the EEPROM memory is restricted from data storage, all the changed set values of parameters can only be registered in the RAM memory of DSP. After turning off the power supply (POWER OFF), the parametric values in RAM are lost.

F111	Gain of indicated value Vdc (Read only)	50~300	X	145
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This parameter is to adjust the gain of DC-BUS voltage at both ends of capacitor. The result of the gain will be taken as one of the important parameters to indicate the (F4→5:Vdc) and the internal control operation.

Water pump function

- ※ Note: Water pump function is exclusively used for tailored-made model.

F112	Enable the water pump function	0~1		0
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■ **0 : disabled**

■ **1 : Enable** – To enable the constant-pressure control function of water pump (F113~F115), standby operation and waking-up function (F116~F118) and protective function for no-water operation of water pump (F119~F121).

F113	Sleep detection time	5~12000	Second	30
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- ◆ When pressure of water pump \geq F1 : set value of water pressure, function F113: sleep detection time will be enabled for detection.

F114	Sleep level	0.0~100.0	%	50.0
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- ◆ When the operating frequency goes below the F114: sleep level, pump will be reduced the speed to 0.0HZ and enter into standby status. (This function can save the water pump from running at ineffective area).

◆ Sleep frequency = F17 : set value of upper frequency \times F114 : sleep level %.

Example: Sleep frequency (30.00HZ) = F17: 60.00HZ \times F114: 50.00%

F115	Wake-up error	0.0~100.0	%	10.0
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- ◆ When pressure $<$ F115 : set value of wake-up error, ac drive starts to run.

◆ Wake-up pressure = F1 : set value of water pressure – (F1 : set value of water pressure \times F115 : set value of wake-up pressure error).

F116	Time of standby operation detection	0~12000	Second	900
F117	Standby operation time	0~12000	Second	60
F118	Standby operation frequency	0.0~240.0	HZ	0.00

- ◆ They are standby operation functions of water pump applicable to cope with the requirements of some special applications.

-Description of parameter functions- IV

- ◆ When pressure of water pump \geq F1 : set value of water pressure, the pump will enter into a constant-pressure standby state for an extended period of time, i.e., the time-counting of F116: standby operation detection time is enabled; when the time counting is up, F118: standby operation frequency and F117: standby operation time will be enabled to access a repeatedly cyclic control.
- ◆ Under a standby operation mode with pressure < wake-up error, standby operation mode will be disabled while normal constant-pressure control will be enabled.
- ◆ An entry of 0.0HZ to the F118 : standby operation frequency will disable the standby operation mode.

F119	Low water pressure (no water) detection level	0~100.0	%	3.0
F120	Time of low water pressure detection	0~12000	Second	20
F121	Time of no-water standby and restart	0~12000	Second	1200
F122	Water pump demonstration enlargement percentage	1.00~2.00		1.00

- ◆ When water pump is running at a water pressure < F119 : low water pressure detection level, the time counting of F120 : low water pressure detection time is enabled; when the time counting is up, F121 : no-water standby and restart time will be enabled; at this moment, the parameter F4: setup 13 : water pressure indication of water pump is able to indicate the countdown for the no-water standby and restart time together with an entry into a repeatedly cyclic control.
- ◆ The scope of no-water detection covers the water shortage at water source, rupture of water pipe or malfunction of pressure transmitter (open-circuit).

VI Protection and troubleshooting

- ◆ **Troubleshooting chart 6-1**
- ◆ **Most frequently used troubleshooting 6-3**

VI -Protection and troubleshooting-

Troubleshooting chart

- ◆ This chapter covers the displayed contents and the countermeasures relevant to the failure of ac drive, and the contents of problem and the solutions relevant to faulty conditions of motor.

<Table> Failure indication and remedy action

Displayed error code	Description	Possible causes	Remedy actions
Err 1	Over-voltage or over-current in standby state	<ul style="list-style-type: none">● Input voltage of power supply (R.S.T) was too high to cause the voltage at DC bus exceed the voltage detection level.● Phase-phase short-circuits or grounding short-circuit taken place to output wire.	<ul style="list-style-type: none">● Reduce the voltage to fall within the range of power supply specifications.● Please verify the output wire to remove any short-circuit.
Err 2	Over-voltage or over-current during acceleration	<ul style="list-style-type: none">● Started from motor's idling (easy to cause over-voltage or over-current).● Acceleration time too short (easy to cause over-current)	<ul style="list-style-type: none">● Please set F9=1 : DC brake and start from the start frequency● Extend the acceleration time appropriately.
Err 3	Over-voltage or over-current during deceleration	<ul style="list-style-type: none">● Deceleration time too short (easy to cause over-voltage or over-current)	<ul style="list-style-type: none">● Extend the deceleration time appropriately (setup shall comply with the deceleration time required by GD^2.)
Err 4	Over-voltage or over-current during speed regulation	<ul style="list-style-type: none">● Motor was driven to start by an external force● Drastic changing load	<ul style="list-style-type: none">● Correct the system and remove the source of external force.● Change the load smoothly.
Err 5	External failure	<ul style="list-style-type: none">● External failure signal input from digital input terminals (Di3-Di8)	<ul style="list-style-type: none">● Remove the cause of external failure.
Err 6	DC over voltage (O.V)	<ul style="list-style-type: none">● Input voltage of power supply (R.S.T) too high to exceed the DC protection level (F77 set value x 1.414x130%) or wrong F77 set value.● Deceleration time too short, motor's regenerative energy too big.	<ul style="list-style-type: none">● Lower the input voltage of power supply.● Examine the set value of parameter F77.● Extend the deceleration time, or connect the brake resistance (or brake controller).
Err 7	DC low voltage (L.V)	<ul style="list-style-type: none">● Voltage lower than the DC protection level (F77 set value x 1.414x130%) caused by momentary power outage● Loss of phase of input power supply or loosened wiring terminals.● Fluctuation too big for voltage of input power supply● Wrong setting of parameter F77.	<ul style="list-style-type: none">● Please examine for the cause and improve the quality of power supply.
Err 8	Motor overloaded longer than the allowable time	<ul style="list-style-type: none">● Motor's overload current exceeded the internal electronic set values (F69, F70).● V/F was set up the F72 : Maximum output voltage and F73 : Maximum voltage frequency too high or too low.● Setting of F75 voltage boosting value too big.	<ul style="list-style-type: none">● Please improve the motor load and check if parameters (F69 and F70) are correct.● Please reexamine the set values of parameters (F72 and F73) for V/F characteristics.● Please reexamine the set values.

-Protection and troubleshooting- IV

<Table> Failure indication and remedy action (Continued)

Displayed error code	Description	Possible causes	Remedy actions
Err 9	DI setting repeated	<ul style="list-style-type: none"> • Multifunctional input terminals Di3~Di8 were repeatedly set to an identical function (except the 0: disabled) 	<ul style="list-style-type: none"> • Please examine the set values of parameters F55~F60.
Err 10	Electric parameter detection malfunctioned	<ul style="list-style-type: none"> • Auto-tuning for motor's electric parameters failed. 	<ul style="list-style-type: none"> • Please check if the set values of parameters F78~F82 are correct. • Please make a manual calculation of motor data and enter them into motor electric parameter group (F84~F88).
Err 11	Current between motor and ac drive not matched	<ul style="list-style-type: none"> • F80 motor's rated current shall not be lower than nine times of rated current of ac drive. 	<ul style="list-style-type: none"> • Please change the motor capacity and examine the set value of parameter F80 (control and protection is not workable for a too-small motor capacity).
Err 12	Voltage between motor and ac drive not matched	<ul style="list-style-type: none"> • F79 motor's rated voltage shall not less than 1.2 times of (F77) input voltage of ac drive. 	<ul style="list-style-type: none"> • Please change the class of motor voltage and examine the parameters F77 and F79.
Err 13	Circuit opened at output side of U phase or CT malfunctioned	<ul style="list-style-type: none"> • The phase lines of U.V.W phase at output side of ac drive and the wirings of motor were not firmly fastened, or thereof circuits were opened. • Internal current transformer (C.T.) failed. 	<ul style="list-style-type: none"> • Please check the wiring loop and then perform the power resumption. • Send it back to factory for repair.
Err 14	Circuit opened at output side of W phase or CT malfunctioned		
Err 15	Parameters stored in DSP locked and unalterable	<ul style="list-style-type: none"> • Storage of parameters has been restricted, and further storage of new data is unattainable. 	<ul style="list-style-type: none"> • If storing new data is desired, please set up parameter F110=0 : Save.
Err 16	Parameter out of range (Default)	<ul style="list-style-type: none"> • EEPROM memory failed, no data, incomplete storage, set value of parameter out of range. 	<ul style="list-style-type: none"> • Please use parameter F109=1: retrieve the factory-set functions, and then proceed the setting for the parameter group of motor nameplate; or check the set values of parameters one by one for any value out of range. • If the foregoing steps are still in vain, please send it back to factory for repair.
Err 17	Temperature of heat sink too high	<ul style="list-style-type: none"> • Faulty operation of cooling fan • Ambient temperature too high 	<ul style="list-style-type: none"> • Change the cooling fan. • Increase the air change volume of environment.
	PF input power supply loss of phase or voltage too low	<ul style="list-style-type: none"> • Magnetic contactor not properly engaged. • Loosened wiring terminals of input power supply. • Fluctuation too big for voltage of input power supply 	<ul style="list-style-type: none"> • Check the cause, take remedy actions and restore power.
	PUF fuse blown	<ul style="list-style-type: none"> • IGBT module damaged and fuse blown due to short-circuit or grounding taken place at output side of ac drive. 	<ul style="list-style-type: none"> • Check the causes, take remedy actions and replace or repair the ac drive.
Err 18 ~ Err 20	Reserved	<ul style="list-style-type: none"> • Reserved 	<ul style="list-style-type: none"> • Reserved

VI -Protection and troubleshooting-

Most frequently used troubleshooting



INHIBIT

(Any person other than the dedicated keeper or qualified technician of this machine are not allowed to troubleshoot the following failures; failure to obey this statement will void the liability for any incident occurred to this machine.).

Motor fails to rotate ?

Symptom : Motor fails to start its running.

§ Terminals of R.S.T. power supply energized?

- Energize the power supply
- Disconnect the power supply and re-energize it

§ Output of voltage from output terminals

U.V.W confirmed ?

- Confirm the power supply
- Follow the operating procedure to operate it

§ Motor's rotating shaft jammed?

- Lessen the motor load
- Examine the mechanical structure
- Replace motor with a new one

§ Wrong wiring?

- Examine and repair the wiring loops

§ Protection functions enabled?

- Verify the displayed content in monitor

§ Incorrect setting to the operation keyboard ?

- Reconfirm the operating procedures once again

Ac drive trips when starting the motor ?

Symptom : An error code Err2 appears when starting or accelerating the motor (it may be caused by the enabled protection function of over-current, or a momentary output current in excess of 200% of rated current, or a damaged IGBT module).

§ Short of torque when started at heavy load?

- Change the parametric value for torque compensation

§ Acceleration time too short to match with the GD² of load?

- Extend the acceleration time

§ Starting frequency too low ?

- Increase the starting frequency

§ Protection function enabled?

- Confirm the display in the monitor

§ Ac drive started when motor is idling ?

- Set up the function: dc brake and start from zero frequency.

§ Incorrect setting to operation keyboard, electric leakage due to defective motor insulation?

- Confirm it again
- Replace it with a good motor, or remove the electric wire of output end and then re-supply the power to start it; if it still trips at Err2, then the ac does not trip at Err2, then the motor malfunctioned.

Ac drive trips when motor is decelerating?

Symptom : Err6 appears when decelerating the motor (Protective function of over-voltage enabled.)

.....

§ **The integral brake loop inside the ac drive failed to absorb the regenerative energy from motor during a sharp deceleration when the GD² of motor-driven load is too big?**

* **Over-voltage protection function will be enabled immediately when regenerative energy exceeds 400V (200~240V series) or 800V (380~460V series).**

→ Extend the deceleration time

→ Mount a dc brake resistance (optional) exclusive-use for external application below

→ Additional mounting of brake unit and resistance is necessary for application above 20HP

Trip during static operation ?

.....

◆ **Err7 appears during operation**

§ **Voltage of power supply Low?**

→ Review the capacity of power supply equipment and find out the cause to the low voltage; such as, check if the contacts of no-fuse-breaker of magnetic switch are in good condition.

◆ **Err6 appears during operation**

§ **Caused by load and motor or voltage of power supply?**

§ **Electric leakage due to bad motor insulation?**

→ Additionally mount a dc brake resistance (optional) exclusive-use for external application.

→ Remove the output wires, re-supply the power and start it; if it still trips at Err6, then the ac drive malfunctioned, if it does not trip at Err6, then the motor is troubled with electric leakage and shall be replaced with new one. .

VII Maintenance, inspection & testing

◆ Maintenance, inspection & testing	7-1
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VII -Maintenance, inspection & testing-

Maintenance, inspection & testing



CAUTION

Cautions

- A maintenance professional shall confirm the current status of power supply switch in person. In order to ensure the safety of operation, strictly keep the power switch from the reach of irrelevant personnel with an identification label hung on the switch.
- Within a short period of time right after disconnecting the power supply, there will be DC high voltage remained at the electrolytic capacitor of large capacity in the internal rectification loop of the ac drive. For this reason, please make sure to see if the [CHARGE] light is off before performing the substrate inspection.

Highlights of regular maintenance:

- **External terminals, components and screws :**
screws or connectors loosened ? → Redo mounting or fasten the screws.
- **Cooling fan :**
noise or abnormal vibration ? → Replace or clean the cooling fan.
- **Capacitors and parts :**
any discoloration, carbonization or strange odor ? → Send them back to factory for changing capacitors or components of the ac drive.
- **Heat sink fins and circuit boards :**
Deposited with dust or adhered with conductive iron chips or oil stain ? → Use a pressurized air gun to blow dry air to clean them. (Please do not use personal detergent for cleaning)

Routine check items Check if

Motor follows the preset actions to run ? any faulty sound or vibration during its running ?

Cooling fan mounted underneath the ac drive operates normally? Any abnormal heating condition ?

The output current detected by the monitor exceeds the normal value ?

The ambient temperature is normal ? the installation environment is normal ?

- ※ **Please truly follow the check items listed in this manual to conduct them item by item to ensure this product is always maintained at a normal state for a long time.**



CAUTION

The ac drive is comprised of variety of components and takes the advantage of these parts & components to maintain and develop its expected functions. Because of it is an electronic part that will be worn somewhat by the working environment and operator's habit of using it, therefore, in order to obtain a normal operation for a long time, a regular check and replacement of parts & components is strongly recommended.

VIII Selection of brake resistance and brake unit

- ◆ Selection of brake resistance and brake unit 8-1

VIII -Selection of brake resistance and brake unit-

Selection of brake resistance and brake unit



After the brake resistance's continuous discharging, a high ambient temperature will be formed to endanger the components around the brake resistance; therefore, please keep it away from the inflammables at a distance more than 2 meters and mount it at a well-ventilated place or mount an additional cooling fan for heat dissipation.

Ac drive							Specifications	
Voltage	Type specification	Capacity	Min. ohms	Min. wattage	Quantity of brake unit (set)	Braking torque	pecifications of externally mounted brake unit	
200V	LS-700	0.2	150	120	1	225	Built-in	
		0.4	150	120	1	225		
		0.75	150	120	1	130		
		1.50	100	200	1	130		
		2.20	60	250	1	120		
		3.70	40	300	1	120		
		5.50	25	1000	1	150		
		7.50	20	2000	1	150		
		11.00	13.6	2400	1	125		
		15.00	10.0	3000	1	125		LSBR-2015B
		18.50	8.0	4800	1	125	LSBR-2022B	
		22.00	6.8	4800	1	125	LSBR-2022B	
		30.00	10	3000	2	125	LSBR-2015B	
		37.00	10	3000	2	100	LSBR-2015B	
		45.00	6.8	4800	2	120	LSBR-2022B	
55.00	6.8	4800	2	100	LSBR-2022B			
75.00	6.8	4800	2	100	LSBR-2022B			
400V	LS-700	0.75	300	200	1	200	Built-in	
		1.50	300	200	1	200		
		2.20	150	300	1	130		
		3.70	100	500	1	130		
		5.50	80	800	1	150		
		7.50	60	1000	1	150		
		11.00	50	1040	1	135		
		15.00	40	1560	1	125		LSBR-4015B
		18.50	32	4800	1	125		LSBR-4030B
		22.00	27.2	4800	1	125		LSBR-4030B
		30.00	20	6000	1	125	LSBR-4030B	
		37.00	32	4800	2	125	LSBR-4030B	
		45.00	20	6000	2	135	LSBR-4030B	
		55.00	20	6000	2	135	LSBR-4030B	
		75.00	20	6000	2	135	LSBR-4030B	

IX Appendix

- ◆ **A: Summary of parameter settings**
- ◆ **B: Summary of Err codes and diagnostic descriptions**
- ◆ **C: Dimensional drawings of mechanism**

Appendix-A-Summary of parameter settings-

Summary list of LS-700 parameter

1	Parameter code	Description	Range	Unit	Ex-factory setting	Page No.
Storing setup	F 0	Save the current parameters	0 ~ 1		0	P5-1
	0 : do not save 1 : save to DSP					
	F 1	Water pressure set value	0.0 ~ 10.0	Kg/cm ²	2.0	P5-1
	F 2	Password entry	-32767 ~ 32767		0	
F 3	Reserved	-32767 ~ 32767		0		
Display setup of operation panel	F 4	Select the variables to be displayed in operation panel	0 ~ 16		1	P5-1
	0 : Set up frequency (Hz) 5 : Vdc (V) 10 : Ai1(V/mA)% 1 : Reference frequency (Hz) 6 : Output voltage (rms) 11 : Ai2(V)% 2 : Frequency of output power supply (Hz) 7 : Output current (rms) 12 : PID output(%) 3 : Predict rpm (Hz) 8 : Torque current command (A) 13 : Water pressure of water pump 4 : Vdc_0(V) 9 : Digital operation panelAi (V.R)% 14 : Input status of digital terminals 15~16 : Reserved					
	F 5	Unit of speed display	0 ~ 1		0	P5-2
	0 : Frequency(Hz) 1 : Revolutions per minute (rpm)					
Operation control parameters	F 6	Display of filter time	0 ~ 15		6	P5-2
	F 7	Operation control source	0 ~ 1		0	P5-3
	0 : digital operation panel 1 : digital input terminals					
	F 8	Rpm command source	0 ~ 8		1	P5-3
	0 : digital operation panel (master speed) 3 : Ai2 6 : Ai1, Ai2/MIN 1 : operation panel Ai (V.R) 4 : Ai1+Ai2 7 : PID 2 : Ai1 5 : Ai1, Ai2/MAX 8 : digital terminal for increasing/decreasing					
	F 9	Start method	0 ~ 1		0	P5-4
	0 : start from zero speed 1 : DC-brake and start from zero speed					
	F10	Braking duration before start	0 ~ 3000.0	Second	5.0	P5-4
	F11	Brake voltage before start	0 ~ 20.00	%	3.00	
	F12	Stop mode	0 ~ 2		1	
0 : coast-to-stop 1 : dynamic stop 2 : dynamic+DC brake						
F13	Stopping & braking voltage	0 ~ 20.00	%	3.00	P5-4	
F14	Stopping & braking time	0 ~ 3000.0	Second	5.0		
F15	Control of rotating direction	0 ~ 2		1	P5-5	
0 : Forward / reverse rotation available 1 : Forward rotation only 2 : Reverse rotation only						
rpm limit	F16	Lower limit of frequency	0.00 ~ 60.00	Hz	0.00	P5-5
	F17	Upper limit of frequency	30.00 ~ 240.00	Hz	60.0	
Multi-stage rpm command setup	F18	Master speed	0.00 ~ 240.00	Hz	5.00	P5-6
	F19	Stage 1 speed	0.00 ~ 240.00	Hz	5.00	
	F20	Stage 2 speed	0.00 ~ 240.00	Hz	10.0	
	F21	Stage 3 speed	0.00 ~ 240.00	Hz	20.0	
	F22	Stage 4 speed	0.00 ~ 240.00	Hz	30.0	
	F23	Stage 5 speed	0.00 ~ 240.00	Hz	40.0	
	F24	Stage 6 speed	0.00 ~ 240.00	Hz	50.0	
	F25	Stage 7 speed	0.00 ~ 240.00	Hz	60.0	
	F26	Inching speed (Note: Acceleration/ deceleration time is the same as master speed)	0.00 ~ 240.00	Hz	5.00	

-Summary of parameter settings- Appendix-A

No	Parameter code	Description	Range	Unit	Ex-factory setting	Page No																																									
Acceleration/deceleration time	F27	Master speed (inching) acceleration time	0.1 ~ 600.0	Second	10.0	P5-7																																									
	F28	Master speed (inching) deceleration time	0.1 ~ 600.0	Second	10.0																																										
	F29	Acceleration time of stage 1	0.1 ~ 600.0	Second	10.0																																										
	F30	Deceleration time of stage 1	0.1 ~ 600.0	Second	10.0																																										
	F31	Acceleration time of stage 2	0.1 ~ 600.0	Second	10.0																																										
	F32	Deceleration time of stage 2	0.1 ~ 600.0	Second	10.0																																										
	F33	Acceleration time of stage 3	0.1 ~ 600.0	Second	10.0																																										
	F34	Deceleration time of stage 3	0.1 ~ 600.0	Second	10.0																																										
	F35	Acceleration time of stage 4	0.1 ~ 600.0	Second	10.0																																										
	F36	Deceleration time of stage 4	0.1 ~ 600.0	Second	10.0																																										
	F37	Acceleration time of stage 5	0.1 ~ 600.0	Second	10.0																																										
	F38	Deceleration time of stage 5	0.1 ~ 600.0	Second	10.0																																										
	F39	Acceleration time of stage 6	0.1 ~ 600.0	Second	10.0																																										
	F40	Deceleration time of stage 6	0.1 ~ 600.0	Second	10.0																																										
	F41	Acceleration time of stage 7	0.1 ~ 600.0	Second	10.0																																										
F42	Deceleration time of stage 7	0.1 ~ 600.0	Second	10.0																																											
F43	S curve	0.0 ~ 100.0	%	0.0																																											
Analog input	F44	Ai:0V input %	-300.00 ~ 300.00	%	0.00	P5-8																																									
	F45	Ai:5V input %	-300.00 ~ 300.00	%	100.00																																										
	F46	Ai1:0V input %	-300.00 ~ 300.00	%	0.00																																										
	F47	Ai1:10V input %	-300.00 ~ 300.00	%	100.00	P5-9																																									
	F48	Ai2:0V input %	-300.00 ~ 300.00	%	0.00																																										
	F49	Ai2:10V input %	-300.00 ~ 300.00	%	100.00																																										
F50	A out function of analog variable	0 ~ 10		0	P5-10																																										
AO output	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 25%;">(F50) function of analog variable</th> <th style="width: 15%;">(F52)10V/ corresponding value</th> <th style="width: 15%;">Reference standard point</th> <th style="width: 25%;">(F50) function of analog variable</th> <th style="width: 15%;">(F52)10V/ corresponding value</th> <th style="width: 20%;">Reference standard point</th> </tr> </thead> <tbody> <tr> <td>0 : disabled</td> <td>X</td> <td>X</td> <td>5 : output current</td> <td>8192</td> <td>F80 parameter set value</td> </tr> <tr> <td>1 : reference rpm</td> <td>4096</td> <td>F78 parameter set value</td> <td>6 : torque current command</td> <td>8192</td> <td>F80 parameter set value</td> </tr> <tr> <td>2 : predict rpm</td> <td>4096</td> <td>F78 parameter set value</td> <td>7 : Ai</td> <td>16384</td> <td>100%</td> </tr> <tr> <td>3 : frequency of power supply</td> <td>4096</td> <td>F78 parameter set value</td> <td>8 : Ai</td> <td>16384</td> <td>100%</td> </tr> <tr> <td rowspan="2">4 : output voltage</td> <td>2200</td> <td>220.0 V</td> <td>9 : Ai2</td> <td>16384</td> <td>100%</td> </tr> <tr> <td>3800</td> <td>F79 parameter set value 380.0 V</td> <td>10 : PID</td> <td>16384</td> <td>100%</td> </tr> </tbody> </table>		(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point	(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point	0 : disabled	X	X	5 : output current	8192	F80 parameter set value	1 : reference rpm	4096	F78 parameter set value	6 : torque current command	8192	F80 parameter set value	2 : predict rpm	4096	F78 parameter set value	7 : Ai	16384	100%	3 : frequency of power supply	4096	F78 parameter set value	8 : Ai	16384	100%	4 : output voltage	2200	220.0 V	9 : Ai2	16384	100%	3800	F79 parameter set value 380.0 V	10 : PID	16384	100%				
	(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point	(F50) function of analog variable	(F52)10V/ corresponding value	Reference standard point																																									
	0 : disabled	X	X	5 : output current	8192	F80 parameter set value																																									
	1 : reference rpm	4096	F78 parameter set value	6 : torque current command	8192	F80 parameter set value																																									
	2 : predict rpm	4096	F78 parameter set value	7 : Ai	16384	100%																																									
	3 : frequency of power supply	4096	F78 parameter set value	8 : Ai	16384	100%																																									
	4 : output voltage	2200	220.0 V	9 : Ai2	16384	100%																																									
		3800	F79 parameter set value 380.0 V	10 : PID	16384	100%																																									
	F51	A out : 0V corresponding value	-32767 ~ 32767		0	P5-10																																									
	F52	A out : 10V corresponding value	-32767 ~ 32767		4096																																										
F53	Scan cycle of digital input	2 ~ 2000	0.1ms	10	P5-11																																										
F54	Di1, Di2setup	0 ~ 1		0																																											
Digital input	0 : Di1(FWD/STOP) ,Di2(REV/STOP)		1 : Di1(RUN/STOP) , Di2(FWD/REV)																																												
	F55	Di3 setup	0 ~ 9		1																																										
	F56	Di4 setup	0 ~ 9		2																																										
	F57	Di5 setup	0 ~ 9		6																																										
	F58	Di6 setup	0 ~ 9		7																																										
	F59	Di7 setup	0 ~ 9		9																																										
	F60	Di8 setup	0 ~ 9		3																																										
		0 : Disabled 1 : Enabled at external failure 2 : RESET	3 : coast-down stop 4 : master speed increases 5 : master speed decreases	6 : Multi-stage rpm command 1 7 : Multi-stage rpm command 2 8 : Multi-stage rpm command 3	9 : inching operation																																										

Appendix-A-Summary of parameter settings-

3	Parameter code	Description	Range	Unit	Ex-factory setting	Page No
Digital output	F61	Relay setup	0 ~ 10		1	P5-13
	F62	DO setup	0 ~ 10		10	
		0 : disabled 1 : enabled at failure 2 : in operation	3 : in zero speed 4 : FWD 5 : REV	6 : accelerating 7 : decelerating 8 : consistent frequency (constant speed)	9 : overload 10 : frequency to reach	
Jumping frequency	F63	Frequency to reach	0.00 ~ 240.00	Hz	60.00	P5-13
	F64	Frequency skip	0 ~ 240.00	Hz	0.00	P5-14
	F65	Skip bandwidth	0 ~ 10.00	Hz	0.00	
Protection setup	F66	Stall prevention	0 ~ 1		0	
		0 : disabled 1 : enabled				
	F67	Stalling voltage setup	1.00 ~ 1.25	Vdc0	1.10	P5-14
	F68	Stalling current setup	0.50 ~ 2.50	Pu	1.50	P5-15
	F69	Over load current level	1.01 ~ 2.50	Pu	1.50	
	F70	Overload time allowable	0.1 ~ 120.0	Second	60.0	
		If $\int (I^2 A(pu) - 1) dt \geq (I^* OL^2 - 1) \times TOL$, then overload is overtime.				
	F71	Automatic Voltage Regulation (AVR)	0 ~ 1		0	P5-15
	0 : disabled 1 : enabled					
Magnetic flux setup	F72	Maximum output voltage (U.V.W)	0.50 ~ 1.00	Pu	1.00	P5-15
	F73	V/F maximum voltage frequency	0.50 ~ 2.00	Pu	1.00	P5-16
	F74	V/F curve selection	-10 ~ 5		0	
	F75	V/F curve selection	0 ~ 0.200	Pu	0.020	
ac drive parameters	F76	PWM carrier frequency	2000 ~ 16000	Hz	5000	P5-17
	F77	RST input voltage (rms)	180 ~ 460	V	220	
Motor nameplate	F78	Rated frequency	40.00 ~ 70.00	Hz	60.00	P5-17
	F79	Rated voltage (rms)	180 ~ 460	V	220	
	F80	Rated current (rms)	0.5 ~ 330.0	A	3.4	
	F81	No. of HP	0.20 ~ 100.00	Hp	1.00	P5-18
	F82	No. of pole	2 ~ 16	Pole	4	
Control mode	F83	Control mode setup	-1 ~ 3		1	P5-18
	-1 : Static electric parameter detection 0 : electric parameter detection 1 : open loop scalar control (v/f) 2 : sensor-less flux vector control 3 : sensor-less voltage vector control					
Motor electric parameters	F84	Stator resistance	2250 ~ 32767	Pu:Q17	10000	P5-19
	F85	Stator resistance	2250 ~ 32767	Pu:Q17	8000	
	F86	Stator inductance	6150 ~ 32767	Pu:Q13	18000	
	F87	Mutual inductance	6150 ~ 32767	Pu:Q13	17500	
	F88	No-load current (%)	10.00 ~ 80.00	%	40.00	
Predictor	F89	Bandwidth of magnetic flux prediction	1.00 ~ 30.00	Hz	4.00	P5-20
	F90	Bandwidth of speed prediction	1.00 ~ 30.00	Hz	6.00	
	F91	Slip compensation gain	10 ~ 200	%	85	
Controller	F92	Sensor-less speed control P gain	5 ~ 200	%	20	P5-21
	F93	Sensor-less speed control I gain	0 ~ 100.0	%	20.0	
	F94	Torque current limit	0 ~ 125.0	%	100.0	

※ Note : Set up the parameters to go with the actual motor capacity.

-Summary of parameter settings- Appendix-A

4	Parameter code	Description	Range	Unit	Ex-factory setting	Page No	
Failure record	F95	Current failure record	0 ~ 20		0	P5-22	
	F96	Failure record of last time	0 ~ 20		0		
	F97	Failure record of last two times	0 ~ 20		0		
	F98	Failure record of last three times	0 ~ 20		0		
		0 : Communication of digital operation panel failed 1 : Over-voltage or over-current in standby state 2 : Over-voltage or over-current during acceleration 3 : Over-voltage or over-current during deceleration 4 : Over-voltage or over-current during speed regulation 5 : External failure 6 : DC over voltage (O.V) 7 : DC low voltage (L.V) 8 : Motor overload longer than the allowable time 9 : DI setting repeated		10 : Electric parameter detection malfunctioned 11 : Current between motor and ac drive not matched 12 : Voltage between motor and ac drive not matched 13 : Circuit opened at output side of U phase or current detector malfunctioned 14 : Circuit opened at output side of W phase or current detector malfunctioned 15 : Parameters stored in DSP locked and unalterable 16 : Parameter out of range (Default) 17 : Over temperature or PF or PUF failure 18 ~ 20:Reserved			
	F99	Clear the failure record	0 ~ 1		0	P5-22	
		0:do not clear 1:clear					
	F100	Number of times to auto-reset the failure during operation	0 ~ 10		0	P5-22	
	F101	PID mode	0 ~ 2		0	P5-23	
		0:PID disabled 1:Stop and reset PID value to 0 2:Stop and reserve PID value					
External PID	F102	Set value of PID command	0.00 ~ 100.00	%	50.00	P5-23	
	F103	PID feedback point	0 ~ 1		0		
		0: Ai1 1: Ai2					
	F104	Setup of input filter time D	0.05 ~ 10.00	Second	0.20	P5-23	
	F105	PID output limit	0.00 ~ 100.00	%	100.00	P5-24	
	F106	Kp	10.00 ~ 300.00	%	150.00		
	F107	Ki	0.00 ~ 300.00	%	20.00		
	F108	Kd	0.00 ~ 300.00	%	5.00		
	F109	Retrieve parameters	0 ~ 1		0		
		0:disabled 1:retrieval of factory settings					
Retrieval parameter	F110	Lock the EEPROM parameter	0 ~ 1		0	P5-24	
		0 : Memory available 1: lock the parameters in DSP memory					
	F111	Gain of indicated value Vdc (Read only)	50 ~ 300	X	145	P5-25	
※ Note : Water pump function is exclusively used for tailor-made model.							
Water pump function	F112	Enable the water pump function	0 ~ 1		0	P5-25	
		0 : Disable 1 : Enable					
	F113	Sleep detection time	5 ~ 12000	Second	30	P5-25	
	F114	Sleep level	0.0 ~ 100.0	%	50.0		
	F115	Wake-up error	0.0 ~ 100.0	%	10.0		
	F116	Time of standby operation detection	0 ~ 12000	Second	900		
	F117	Standby operation time	0 ~ 12000	Second	60		
	F118	Standby operation frequency	0.00 ~ 240.00	Hz	0.00		
	F119	Low water pressure (no water) detection level	0.0 ~ 100.0	%	3.0	P5-26	
	F120	Time of low water pressure detection	0 ~ 12000	Second	20		
	F121	Time of no-water standby and restart	0 ~ 12000	Second	1200		
	F122	Water pump demonstration enlargement percentage	1.00 ~ 2.00		1.00		

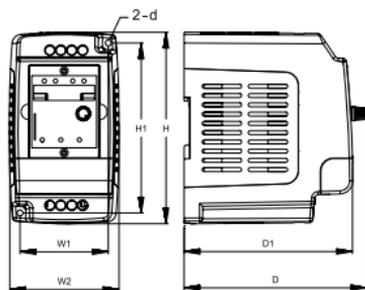
-B-Summary of Err codes and diagnostic descriptions-

Appendix B Summary of Err codes and diagnostic descriptions

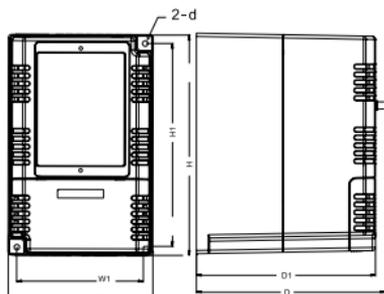
Error code	Description of failure
Err 0	Communication of digital operation panel failed
Err 1	Over-voltage or over-current in standby state (hardware detection and protection)
Err 2	Over-voltage or over-current during acceleration (hardware detection and protection)
Err 3	Over-voltage or over-current during deceleration (hardware detection and protection)
Err 4	Over-voltage or over-current during speed regulation (hardware detection and protection)
Err 5	External failure
Err 6	DC over voltage (O.V)
Err 7	DC low voltage (L.V)
Err 8	Motor overload longer than the allowable time
Err 9	DI setting repeated
Err 10	Electric parameter detection malfunctioned
Err 11	Current between motor and ac drive not matched
Err 12	Voltage between motor and ac drive not matched
Err 13	Circuit opened at output side of U phase or current detector malfunctioned
Err 14	Circuit opened at output side of W phase or current detector malfunctioned
Err 15	Parameters stored in DSP locked and unalterable.
Err 16	Parameter out of range (Default)
Err 17	Over temperature or PF or PUF failure
Err 18 ~ Err 20 reserved for failure signals	

-Dimensional drawings of mechanism-C-

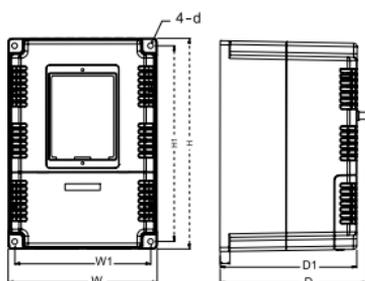
Roughing-in dimensions and mounting dimensions



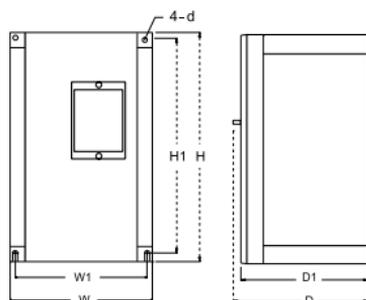
(Figure A)



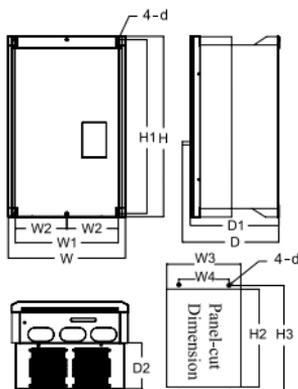
(Figure B)



(Figure C)

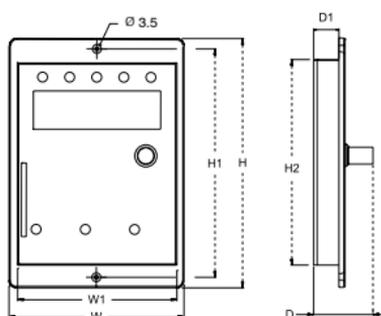


(Figure D)



(Figure E)

(Digital operation Panel KP-AD20)



(Figure F)

※ Dimensions shown in the figures above are for reference only. Please refer to the newest catalogue for the updated dimensions. We reserve the right to change the dimensions without notice.

-C-Dimensional drawings of mechanism- Roughing-in dimensions and mounting dimensions

200V class series

(HP)/(KW)	Dimensions(mm)							ψ	Semi-embedded Opens the hole • Fixed size (mm)					Figure NO
	W	H	D	W1	W2	H1	D1		d	W3	W4	H2	H3	
0.25 / 0.2	82.5	145	138	66.5	-	128.5	127.5	4.6	-	-	-	-	-	A
0.5 / 0.4														
1 / 0.75														
2 / 1.5	Traditional carriage bolt or Din Rail installment													
0.5 / 0.4	114	172	146	101	-	159	136	5.3	-	-	-	-	-	B
1 / 0.75														
2 / 1.5														
3 / 2.2	152	214	146	135.5	-	200	136	5.3	-	-	-	-	-	C
5 / 3.7														
7.5 / 5.5														
10 / 7.5	188	300	180	170	-	283	170	7	-	-	-	-	-	D
15 / 11														
20 / 15														
25 / 18	250	420	227	218	-	401	217	7	242	170	407	422	112	E
30 / 22														
40 / 30														
50 / 37	345	533	272	305	152.5	515	262	7	330	212	515	538	140	
60 / 45														
75 / 55														
100 / 75	70.9	102	25.8	-	-	93	15.8	3.5	65.3	-	84.5	-	-	F
KP-AD 20														

400V class series

(HP)/(KW)	Dimensions(mm)							ψ	Opens the hole • Fixed size (mm)					Figure NO
	W	H	D	W1	W2	H1	D1		d	W3	W4	H2	H3	
0.5 / 0.4	114	172	146	101	-	159	136	5.3	-	-	-	-	-	B
1 / 0.75														
2 / 1.5														
3 / 2.2	152	214	146	137.5	-	200	136	5.3	-	-	-	-	-	C
5 / 3.7														
7.5 / 5.5														
10 / 7.5	188	300	180	170	-	283	170	7	-	-	-	-	-	D
15 / 11														
20 / 15														
25 / 18	250	420	227	218	-	401	217	7	242	170	407	422	112	E
30 / 22														
40 / 30														
50 / 37	345	533	272	305	152.5	515	262	7	300	212	515	538	140	
60 / 45														
75 / 55														
100 / 75	70.9	102	25.8	-	-	93	15.8	3.5	65.3	-	84.5	-	-	F
KP-AD 20														