650 Model CT/VT SERIES AC DRIVE APPLICATION MANUAL

Voltage vector control universal inverter

Version NO：1.24

Suitable Model: Single-phase/3-phase power supply 200V/400V Class
Overload capacity:
CT：150%, 60 seconds (Suitable for Extruder, Conveyor and General machines,etc.)
VT：120%, 60 seconds (Suitable for Cooling fan, Air blower, Water pump, etc.)

Preface

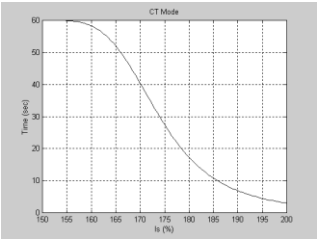
More and more applications of ac drive are commercially used nowadays as automated process operation becomes popular. Based on our professional commitments by focusing on “provision of modern technologies and promotion of industrial upgrades”, we attach this manual to our high performance ac drive. This manual contains detailed instructions on installation (including operation, maintenance, inspection, and repair), peripheral wirings, specifications, and parameter setup process, and gives you complete description of types and technical operation of the product. In addition, please peruse the safety information and precautions of product prior to its use.

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.

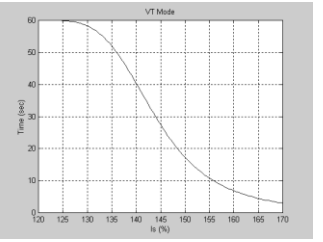
Thank you for having our LS650 Series voltage vector ac drive, one is the fruit of our years of concerted research efforts which incorporate the most advanced IGBT Module design and silent operation to yield the optimum efficiency and economic benefits.

Overloading ability Err9

CT Series : (150%, 60S) (175%, 27.5S) (200%, 3S)



VT Series : (120%, 60S) (145%, 27.5S) (170%, 3S)



STATEMENT OF SAFETY

- Please be sure to peruse this manual prior to the installation, wiring, operation, maintenance, inspection, and repair, and follow the appropriate instructions publisher in this manual to use the product. For any doubts, please consult us, or your local dealers.

- To prevent any personal injury or property loss due to unexpected accident, please strictly abide by the marks of cautions, warning and inhibit and the prompts following those marks published in this manual.

- Keep this manual at a place where handy access is allowed for the operators to refer to.

DESCRIPTION OF MARKS

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

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

Inhibit mark — 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 undertaken a stringent QC and provided with reinforced packing materials prior to its ex-factory to ensure and reduce the possibilities of 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

- Unless otherwise specified, the 650 Series or LS650 Series mentioned in this Manual means the LSCT650 and LSVT650.

- Each ac drive has been established the default settings prior to its ex-factory; unless otherwise necessary; please do not arbitrarily change any internal set values of parameters. Confirm first the safety tolerance range of the motor or the mechanical system prior to the operation or before setting a required output frequency over 60 Hz.

- 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 practice safety measures to prevent any occurrence of hazard and/or accident.

- Before installing the ac drive, please first look around the environment of the installation site to see if it is suitable for installation. If yes, please firmly fix the ac drive onto a flat concrete wall or a wall made of vertical metal plate with shield properly mounted to keep it from any impact of foreign objects that may damage the ac drive during its operation.

- When installed inside a control panel, please mount additional cooling fans to the ac drive so as to ensure that the incoming air temperature to the ac drives will not rise too high to affect its operation.

- Please check if all the wires connected to each terminal block are firmly secured, and all the grounding terminals on the ac drive and motor are properly earthed.

- Before operation, please always verify if the voltage of the power supply is in line with the rated voltage of the ac drive; and check if the wirings for additional mounting of brake controller or brake resistance, if any, are corrected.

- 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); therefore, in order to prevent any critical accidents relevant to the electric shock from taking place, never use your hands to directly touch any internal circuits of the ac drive; meanwhile, do not remove the protection cover when the circuits are electrified. 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 the future.

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I Installation

Receiving

Thank you for purchasing our 650 Model AC DRIVE. To protect your right and interests, please confirm the following receiving inspection prior to the installation and use of ac drive.

Are the descriptions and specifications of the received product the same as your order?
Please check if the contents in the nameplate side-attached to the product are in line with the purchased specifications.

Any breakage ?
Please check the appearance of product for any damage due to transportation, such as ingression of water, damaged package or dents on the product.

Are there any loosened lids/screws?
Use a screwdriver to confirm their tightness if necessary.

WARNING

Upon receiving Series 650 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 ac drive, and personal injury or fire hazard in serious case.

Precautions with regard to installation site

Installation Site

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 ^{o}C or higher than 45 ^{o}C site.
- 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.

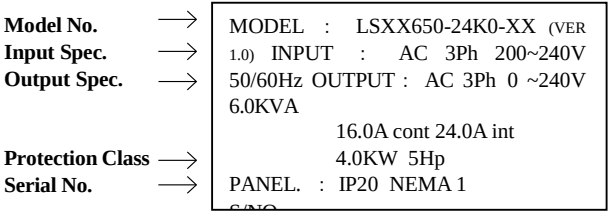
Temperature & Humidity

Installation type	Ambient temperature	Ambient Humidity
Closed Wall Mounting	-10 ~ +40^{o}C	Below 95% RH (non-condensable)
In-Panel Mounting	-10 ~ +45^{o}C	Below 95% RH (non-condensable)

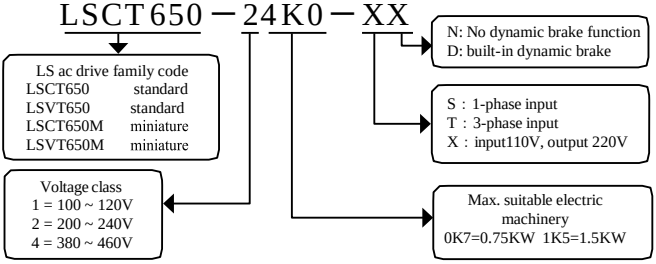
∗ The above mentioned temperatures and humidity are provided as reference only for your environmental assessment of installation.

Content of nameplate

The nameplate right-sided to the ac drive contains the model, specifications, protection class and other information as described below.



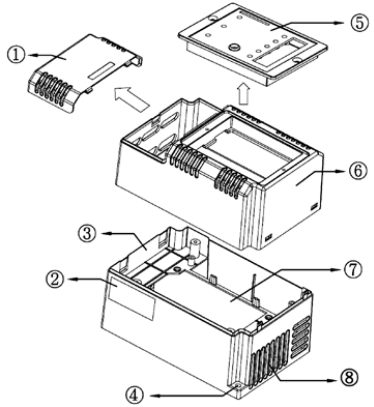
Model number details: (MODEL)



♦ **Reference model number, specifications and power**

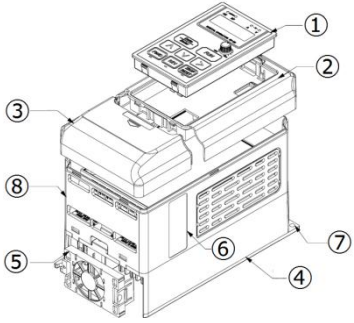
Model No.	Power	Model No.	Power	Model No.	Power
0K2	0.2KW	011	11KW	075	75KW
0K4	0.4KW	015	15KW	090	90KW
0K7	0.75KW	018	18.5KW	110	110KW
1K5	1.5KW	022	22KW	132	132KW
2K2	2.2KW	030	30KW	160	160KW
4K0	4.0KW	037	37KW	185	185KW
5K5	5.5KW	045	45KW	220	220KW
7K5	7.5KW	055	55KW	260(VT series)	260KW

Parts identification



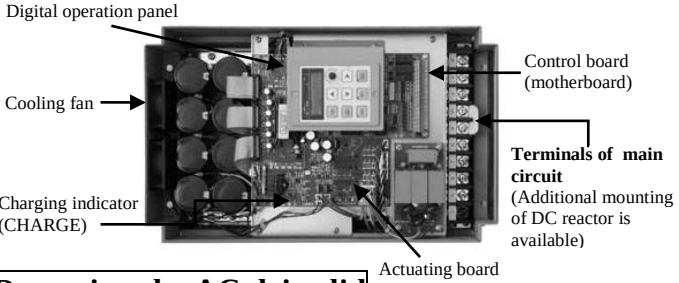
① Terminal Block Lid
② Specification Nameplate
③ AC Drive Base
④ Setscrew Hole Keyboard
⑤ Panel
⑥ AC Drive Lid
⑦ Heat Sink Location
⑧ Heat Sink Vent

LS900

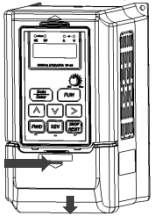
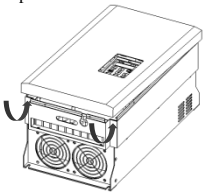
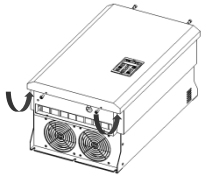


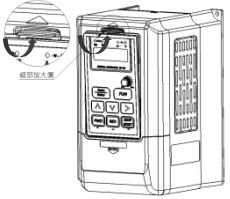
①Keyboard Panel
②Top lid of AC drive
③Top lid of terminal block
④Heat sink location
⑤Cooling fan
⑥Specification Nameplate
⑦Setscrew holes
⑧Intermediate plastic box

High horsepower control box layout



Removing the AC drive lid

0.5HP～5HP Press where arrow shown and pull down lid. 	5HP～25HP Press where both arrows shown and pull up. 
25HP～40HP Pull up where arrow shown and push up the cover. 	40HP～300HP 1. Loosen screws in the front and rear. 2. Pull up where arrows shown and push up the cover. 

Control Box Take – Out	Install Control Box
Pull where arrow shown and take Control Box out. 	1. Insert Control Box where figure shown. 2. Press and push into main box. 

0.5HP~5.0HP

Step 1: Use a thumb to gently push the locking buckle.

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

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

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

7.5HP~30HP

Step 1: Take and hold the PULL UP and push the panel up.

Step 2: Remove the panel.

40HP~300HP

Step 1: Unscrew to remove four screws first.

Step 2: Carefully remove the panel.

Step 3: Finish the removal of panel.

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.

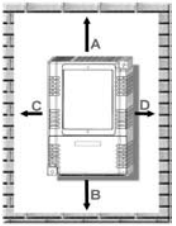
Cautionary points for installations:

(1) For application at an ambient temperature over 40°C, please install the ac drive at a well ventilated place or reinforce the cooling device for external environment.

(2) Momentary 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 ac drive and the horsepower.

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



The minimum clearance for in-panel mounting (please see reference diagram and table)

Direction / Clearance / LS650 capacity	A	B	C	D
Below 2.2kw	≧100 mm	≧100 mm	≧50 mm	≧50 mm
4.0kw ~ 11kw	≧120 mm	≧120 mm	≧50 mm	≧50 mm
15kw ~ 22kw	≧150 mm	≧150 mm	≧100 mm	≧100 mm
30kw ~ 37kw	≧200 mm	≧200 mm	≧150 mm	≧150 mm
45kw ~ 75kw	≧300 mm	≧300 mm	≧200 mm	≧200 mm
90kw ~ 260kw	≧400 mm	≧400 mm	≧250 mm	≧250 mm

Functions and maintenance of cooling fan

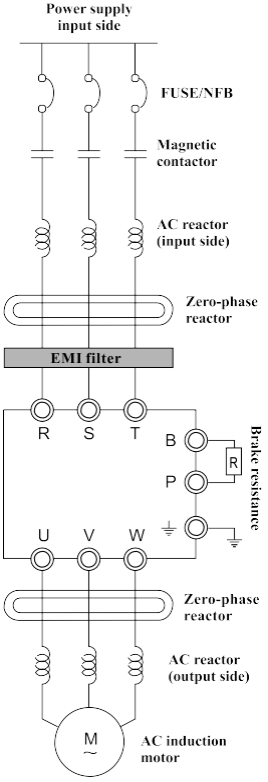
- There is a cooling fan mounted inside the ac drive that can be triggered its running when temperature of ac drive reaches up to 45°C (±5°C)after operation. A temperature rise to reach 85°C (±5°C)due to a heavy & full load or a too-high ambient temperature will trip an over temperature protection (Err10).
- Regular cleaning and maintenance is necessary to ensure the function of cooling fan and thereof heat sink when operating the ac drive at a place with worse environmental conditions, such as the powder, dust, oil sludge and cotton fibers, etc.

II Wiring

Schematic view of peripheral configuration

3-phase 200V/400V family

System wiring diagram for model below 20HP (including)
(For peripheral machines, please select them according to the need)

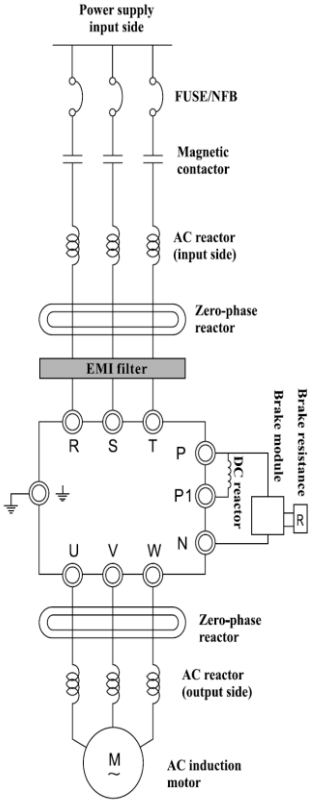


Power supply input side	Please follow the rated power supply specifications from the operation instruction manual to install the power supply (Please see Appendix A P9-1).
FUSE/NFB	There may be a higher input current when turning on the power supply. Please select an appropriate no-fuse breaker or fuse.
Magnetic contactor	When mounted a magnetic contactor (MC) at the power supply side, please do not use this MC to make a frequent ON and OFF operations to avoid failing the ac drive. The number of time to switch ON/OFF MC shall be one time in 30 minutes the utmost.
AC reactor (input side)	When connected to a power supply transformer with a higher capacity (above 600KVA) or switching over to phase capacitance may be desired, a current higher than the peak value will inrush into the input power supply circuit and damage the ac drive; therefore, additional mounting of AC reactor is recommended to improve the power while the wiring distance shall be within 10m.
Zero-phase reactor	Fitted to attenuate the low-frequency interference; especially for the locale with audio frequency device together with interference from the input & output sides reduced as well. The effective range is AM frequency channel 10MHz.
EMI filter	Can be applied to weaken the interference from electromagnetic waves.
Brake resistance	Mounted to shorten the deceleration time for motor. Please see the details in Chapter 8.
AC reactor (output side)	When wired from the output side to motor, the wiring length of motor will affect the magnitude of voltage back wave. An additional mounting of AC reactor is recommended when the wiring length of motor is longer than 20 meters (the closer the wiring length to the ac drive side, the better the effect will be).

3-phase 200V/400V family

System wiring diagram for model above 25HP (including)

(For peripheral machines, please select them according to the need)



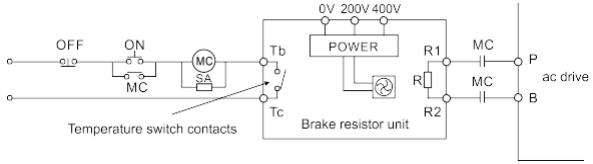
Power supply input side	Please follow the rated power supply specifications from the operation instruction manual to install the power supply (Please see Appendix A P9-1).
FUSE/NFB	There may be a higher input current when turning on the power supply. Please select an appropriate no-fuse breaker or fuse.
Magnetic contactor	When mounted a magnetic contactor (MC) at the power supply side, please do not use this MC to make a frequent ON and OFF operations to avoid failing the ac drive. The number of time to switch ON/OFF MC shall be one time in 30 minutes the utmost.
AC reactor (input side)	When connected to a power supply transformer with a higher capacity (above 600KVA) or switching over to phase capacitance may be desired, a current higher than the peak value will inrush into the input power supply circuit and damage the ac drive; therefore, additional mounting of AC reactor is recommended to improve the power while the wiring distance shall be within 10m.
Zero-phase reactor	Fitted to attenuate the low-frequency interference; especially for the locale with audio frequency device together with interference from the input & output sides reduced as well. The effective range is AM frequency channel 10MHz.
EMI filter	Can be applied to weaken the interference from electromagnetic waves.
Brake resistance And brake module	Mounted to shorten the deceleration time for motor. Please see the details in Chapter 8.
AC reactor (output side)	When wired from the output side to motor, the wiring length of motor will affect the magnitude of voltage back wave. An additional mounting of AC reactor is recommended when the wiring length of motor is longer than 20 meters (the closer the wiring length to the ac drive side, the better the effect will be).

Mounting the brake control circuits

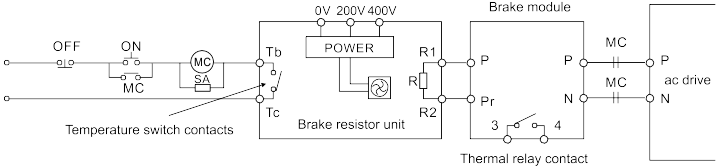
Mounting the brake resistor for overheating protection

To mount the brake resistor (Model No.: LSDR, please see P8-3) onto ac drive for overheating protection.

0.4KW~18KW Ac Drive(200V class/400V class)

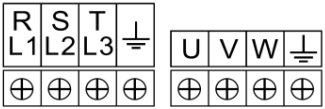


22KW~260KW Ac Drive (200V class/400V class)

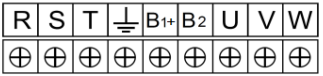


Main circuit terminal block

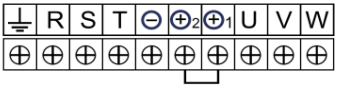
◆0.25KW~1.5KW (LS650M)



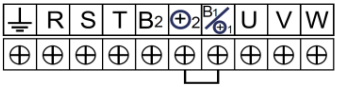
◆0.4KW~11KW(200V/400V series)



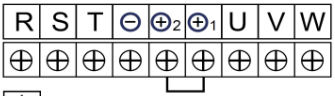
◆15KW~30KW (200V series)
15KW~37KW (400V series)



◆15KW~30KW(200V series with BRAKE)
15KW~37KW(400V series with BRAKE)

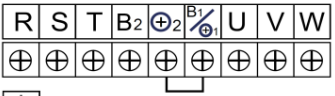


◆37KW~55KW(200V series)
45KW~75KW(400V series)



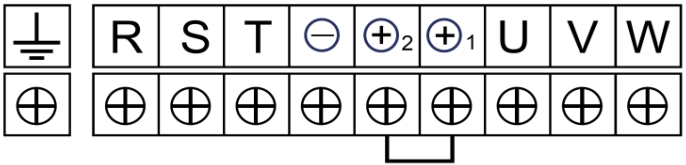
Grounding terminal is located at exterior of cabinet

◆37KW~55KW(200V series with BRAKE)
45KW~75KW(400V series with BRAKE)



Grounding terminal is located at exterior of cabinet

◆75KW~110KW(200V series)
90KW~260KW(400V series)

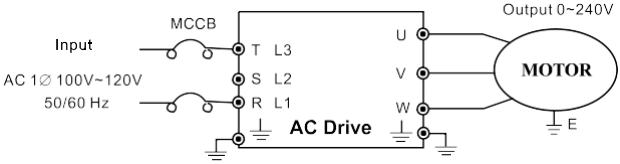


Grounding terminal is located at left lower corner of terminal block

Wiring Method

1-Phase Main Circuit Wiring Diagram (100-120V)

1-phase input voltage 115V — (LS650M-10K2-SX、LS650M-10K4-SX、LS650M-10K7-SX)



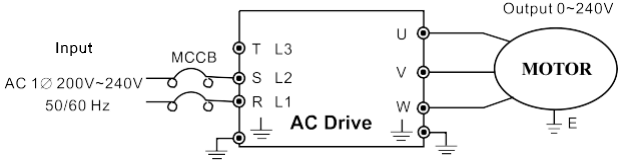
CAUTION

(1) Every ac drive and motor casing must be well grounded to protect from being struck by lighting and electric-shocked to the human body.
(2) Please wire the 1-phase input voltage 115V to L1 and L3 positions, do not wire it to L2 position.

Type specifications LS□□650M-1□□□-SX		0K2	0K4	0K7
Output specifications	Applicable motor capacity(KW)	0.2	0.4	0.75
	Applicable max. motor horsepower (HP)	0.25	0.5	1
	Output capacity (KVA)	0.6	1.2	1.7
	Continuously rated current (A)	1.6	3.2	4.5
	Rated output frequency	0.01 ~ 300.00Hz		
	Overload capacity	CT series: rated current 150%,60 Second		
	MAX. Output voltage	2-fold 1-phase input voltage		
Input specifications	Input voltage / frequency	1-phase 100V~120Vac • 50/60Hz		
	Allowable voltage fluctuating rate	Voltage: ±10%		
	Allowable frequency fluctuating rate	Frequency: ±5%		
	Input current (A)	6	9	17

1-Phase Main Circuit Wiring Diagram (200-240V)

1-phase input voltage 230V — (LS650M-20K2-S、LS650M-20K4-S、LS650M-20K7-S、LS650M-21K5-S)



CAUTION

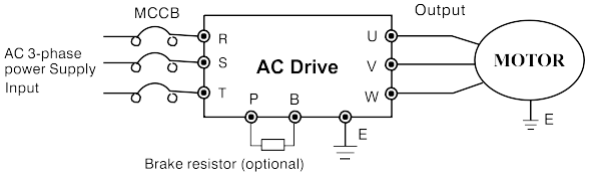
(1) Every ac drive and motor casing must be well grounded to protect from being struck by lighting and electric-shocked to the human body.
(2) Please wire the 1-phase input voltage 230V to L1 and L2 positions, do not wire it to L3 position.

Type specifications LS□□650M-2□□□-S		0K2	0K4	0K7	1K5
Output specifications	Applicable motor capacity (KW)	0.2	0.4	0.75	1.5
	Applicable max. motor horsepower (HP)	0.25	0.5	1	2
	Output capacity (KVA)	0.6	1.2	1.7	2.7
	Continuously rated current (A)	1.6	3.2	4.5	7.0
	Rated output frequency	0.01 ~ 300.00Hz			
	Overload capability	CT series: rated current 150%, 60 Second VT series: rated current 120%, 60 Second			
	MAX. Output voltage	3-phase corresponding input voltage			
Input specifications	Input voltage/frequency	1-phase 200V~240Vac • 50/60Hz			
	Allowable voltage fluctuating rate	Voltage: ±10%			
	Allowable frequency fluctuating rate	Frequency: ±5%			
	Input current (A)	4.9	6.5	9.7	15.7

3-Phase Main Circuit Wiring Diagram -1

（LS650-20K4、LS650-20K7、LS650-21K5、LS650-22K2、LS650-24K0、LS650-25K5、LS650-27K5、LS650-2011)

（LS650-40K7、LS650-41K5、LS650-42K2、LS650-44K0、LS650-45K5、LS650-47K5、LS650-4011)

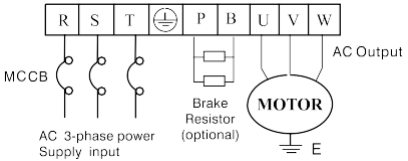


CAUTION

(1) Units in 3-phase 200V and 400V series with a horsepower up to 15HP are fitted a brake circuit. Please see P8-3 for selecting the correct resistance and the watt number.

(2) Every ac drive and motor casing must be well grounded to protect from being struck by lighting and electric-shocked to the human body.

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

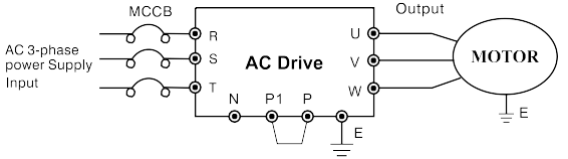


Symbols	Descriptions
R.S.T	To be connected to 3-phase power supply input
P.B	Can be connected to brake resistor; circuit has been embedded, additional mounting of brake unit is unnecessary.
U.V.W	To be connected to 3-phase motor output terminals
⏚ or ⏚	Grounding terminal

3-Phase Main Circuit Wiring Diagram -2

(LS650-2015、LS650-2018、LS650-2022、LS650-2030、LS650-2037、LS650-2045、LS650-2055、LS650-2075、LS650-2090、LS650-2110)

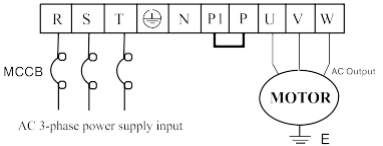
(LS650-4015、LS650-4018、LS650-4022、LS650-4030、LS650-4037、LS650-4045、LS650-4055、LS650-4075、LS650-4090、LS650-4110、LS650-4132、LS650-4160、LS650-4185、LS650-4220、LS650-4260)



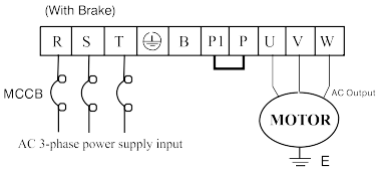
CAUTION

(1) Units in 3-phase 200V and 400V series with a horsepower above 20HP are not fitted the brake circuit. Please see P8-1 for selecting the correct resistance and the watt number.
(2) The brake circuit of 20HP~75HP can be customized and fabricated inside the ac drive.
(3) Every ac drive and motor casing must be well grounded to protect from being struck by lighting and electric-shocked to the human body.

3-phase power supply terminal block (Please see P2-4 for detailed descriptions)



(With Brake)



Symbols	Descriptions
R. S. T	To be connected to a AC 3-phase power supply input
P. N	P (+) and N (-) terminals can be externally connected to the brake unit, but they can not be connected to brake resistor directly.
P1. P	To be connected to DC reactor.
B. P	Can be connected to brake resistor, circuit has been embedded, additional mounting of brake unit is unnecessary.
⏚ or ⏚	Grounding terminal
U. V. W	To be connected to 3-phase motor output terminals

Cautionary points

(1) Main circuit wiring

1. The input terminals R.S.T, to the power supply and the output terminals U.V. W to the motor shall not be wrongly connected, otherwise, the ac drive will be seriously damaged.
2. The output side of ac drive shall not be applied the power capacitor, LC, RC noise filter, etc. elements.
3. The main circuit wiring shall be kept away the signal cables from other control equipment (e.g., PLC, electroweak signal system) to avoid the bad interference.
4. Please firmly fasten the screws on main circuit terminals to avoid any production of sparkling due to vibration-loosened screws.
5. The specifications for the distance between the power supply input and output in ac drive are described in the table below.

	standard wiring length	Limit of wiring length
Distance from power supply system →to power supply side of ac drive	Within 2~30 meters	Within 30~300 meters
Output side of ac drive →Junction side of AC electric machinery	Within 2~25 meters	Within 25~200meters
Remedy action to a too-long wiring problem	Additional mounting of input & output reactors is recommended.	Additional mounting of input & output reactors is a must.

If the power line is too long, a parasitic capacitance will be produced from the electric machinery and power lines to the ground (lower potential side) that lead to a generation of high-voltage surge to destroy the voltage-withstanding insulation of ac drive and motor.

(2) Grounding wires

1. For the purpose of safety and reducing the noise, please apply the third grounding type ⏚ to 200V series and special grounding type ⏚ to 400V series. (Grounding impedance below 10Ω)。
2. Be sure to avoid using a common grounding electrode and grounding wires with the other power facilities including the welding machine and dynamo-machines and try to keep the grounding wire away from the power cable of large capacity equipment as far as possible.

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

To protect the circuit, a NFB, or an additional EMI contactor must be mounted between the AC power supply of main circuit and the 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 unit of 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 action more than 0.1 second for each unit of ac drive,

(4) Surge absorber

Any coils for the peripheral devises of ac drive, e.g., EMI contactor, 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
200V	Coils of large capacity other than relay	AC250V 0.5uf 200Ω
	Control relay	AC250V 0.1uf 100Ω
400V	Ditto	AC500V 0.5uf 220Ω

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

CAUTION

◎ 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 (3Ø/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.

WARNING

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

Table (I) 200V~240V

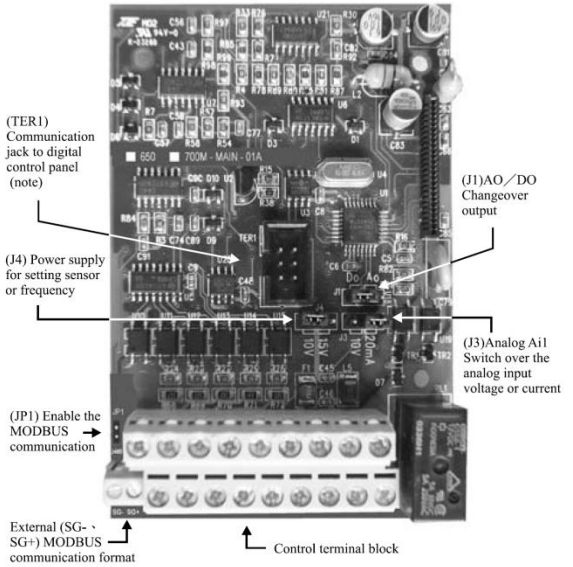
Specifications / Descriptions	20K2	20K4	20K7	21K5	22K2	24K0	25K5	27K5	2011	2015	2018	2022	2030	2037	2045	2055	2075	2090	2110
Capacity KW/HP	0.2 / 0.25	0.4 / 0.5	0.75 / 1	1.5 / 2	2.2 / 3	4.0 / 5	5.5 / 7.5	7.5 / 10	11 / 15	15 / 20	18.5 / 25	22 / 30	30 / 40	37 / 50	45 / 60	55 / 75	75 / 100	90 / 125	110 / 150
3-phase MCCB rated current(A)	5	5	10	15	20	30	50	60	75	125	150	175	225	250	300	400	450	500	550
Power line wire gauge (mm^2)	2.0					3.5	5.5	8.0	14	30			50	60	80	100		150	
Main circuit screws	M4							M5		M6	M8			M10		M12			
Wire gauge for control loop (mm^2)	0.5 mm^2 ~ 1.25 mm^2																		

Table (II) 380V~460V

Specifications / Descriptions	40K7	41K5	42K2	44K0	45K5	47K5	4011	4015	4018	4022	4030	4037	4045	4055	4075	4090	4110	4132	4160	4185	4220	VT 4260
Capacity KW/HP	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	90 / 125	110 / 150	132 / 175	160 / 200	185 / 250	220 / 300	260 / 350
3-phase MCCB rated current(A)	5	10	15	20	30		50	60	100		125	150	175	200	225	250	275	300	350	400	450	530
Power line wire gauge (mm^2)	2.0			3.5		5.5		8.0		14	22	38		50	60	100				120		
Main circuit screws	M4						M5		M6			M8			M10		M12					
Wire gauge for control loop (mm^2)	0.5 mm^2 ~ 1.25 mm^2																					

Location of control terminal block

LS650M Control board (Motherboard)

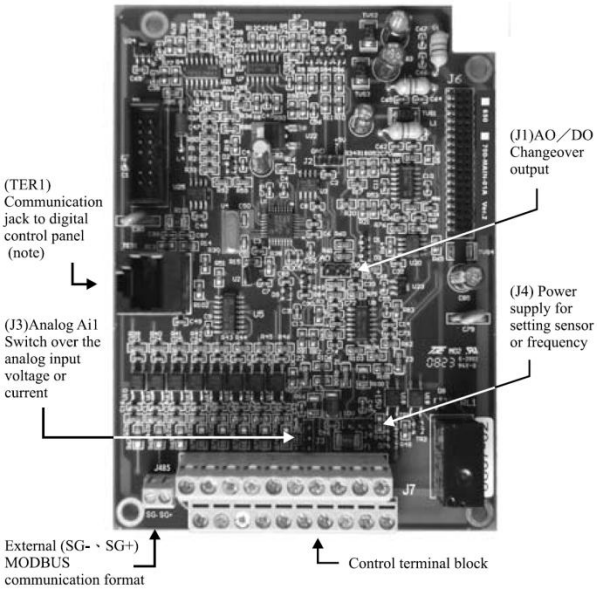


※ When enabling MODBUS communication is desired, it is necessary to set up F73(Di8：15 MODBUS communication) first and insert the JP1.

※ Caution：(Note) the RS-485 communication format is internally exclusive for digital operation panel and different from the external (SG-、SG+) MODBUS communication format; connecting both of them at the same time for operation is not allowed; only one format can be enabled for use.

※ Please see P2-16 for functional descriptions of (J1、J3、J4), and P2-14 ~ P2-18 for functional descriptions of control terminal block.

LS650 Control board (Motherboard)



※ When enabling MODBUS communication is desired, it is necessary to set up F73(Di8：15 MODBUS communication) first and connect the Di8 to COM.

※ Caution：(Note) the RS-485 communication format is internally exclusive for digital operation panel and different from the external (SG-、SG+) MODBUS communication format; connecting both of them at the same time for operation is not allowed; only one format can be enabled for use.

※ Please see P2-16 for functional descriptions of (J1、J3、J4), and P2-14 ~ P2-18 for functional descriptions of control terminal block.

◆ LS650M Specification of communication connector to the digital operation panel

1. LS650M exclusive communication connector as shown in the left picture.

◆ LS650 Specification of communication connector for digital operation panel

2. 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

LS650M control terminals – wiring addresses and sequence are shown follows:

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

LS650 control terminals – wiring addresses and sequence are shown follows:

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

※ Please use slender type "－" or "＋" (#101 screwdriver) screwdriver to unscrew the terminal screws on the terminal block, then route the wire from the wiring opening below the terminal block to connect respective terminal and firmly fasten the terminal screws. (Please refer to P2-15 for cautionary points when wiring the terminal block is desired)

Wiring connection of control circuit terminals

Cautions for wiring the control circuit

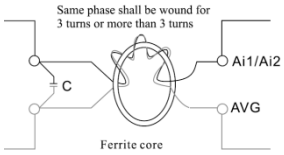
WARNING

Shielded & meshed wires shall be applied and grounded to wire the control circuit and connect terminal block with the mesh wires grounded. 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 gages 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 cable electricity wires; 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 editor must be separated from power cables of large current (power supply, motor, brake) as far as possible, and shall never be configured 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.

Analog input terminals (Ai1, Ai2, AVG)

- ☑ Connecting to a weak analog signal is easily interfered by external noise, therefore, the wiring length for connection shall not be too long (less than 20m is recommended), and a shielding wire shall be used. Moreover, the peripheral meshed wires to the shield wires shall be well grounded; for a bigger induced noise, connection to AVG terminal can access a better effect.



- ☑ When connecting the external analog signal output is desired, an error action may taken place due to the interference produced from the analog signal output and the AC motor actuator; when encountered such a situation, connecting the external analog output side to a capacitor and a ferrite core can inhibit the noise. Such a connection is shown in the right figure:

Digital input terminals (Di1~Di8, COM)

- ☑ Multifunctional input terminals are characterized as dry contact that cannot be input any signal carrying voltage; when inputting signal to contacts for control, in order to prevent the occurrence of bad contact, contacts with high reliability in contacting the weak signal shall be used.

Do output (Do, DCM)

- ☑ When enabling the control relay is desired, a surge absorber or a flywheel diode shall be connected in parallel to both ends of exciting coil while attention shall be made to the correctness of polarity for connection.

Summary descriptions for function of control terminals

* The following summary chart describes the standard setting at ex-factory for each control terminal.

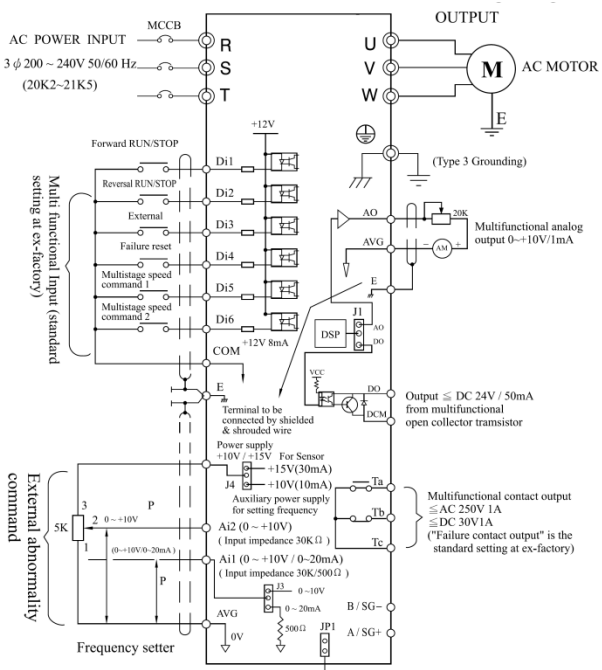
Terminal mark		Designated function	Descriptions
Multifunctional input terminals	Di1	FWD Command	Di1-COM ON for FWD running, and OFF for stop
	Di2	REV Command	Di2-COM ON for REV running, and OFF for stop
	Di3	Enabled at external failure input (NC)	Enabled by an external failure signal ON to trip the ac drive to stop.
	Di4	Failure reset	Di4 ON releases the status locked by the circuit protection action against failure.
	Di5	Multistage speed command 1	Multistage speeds command 1 and 2 take the binary 2 Bit to execute 4-stage speeds control when enabled. To take binary 2 Bit to execute 4-stage rpm control when enabled.
	Di6	Multistage speed command 2	
	Di7	Inching operation	To execute the inching frequency operation when enabled ON. LS650M has no interfaces for Di7 and Di8. (In MODBUS communication mode, the Di8 is replaced by JP1)
	Di8	Free Run	When enabled (ON) a stop command, ac drive stops outputting voltage immediately that leaves the motor to a free running and stop.
	COM	Common terminal for digital input	Common terminal for multifunctional input terminals
Analog frequency setup	+10V	+15V Sensor power supply	Power supply outputs DC+15V (maximum current 30mA) for sensor use.
		+10V frequency signal setter power supply	Power supply outputs DC+10V (maximum current 10mA) for frequency setter use.
	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 standard potential terminal for frequency setup input signal (terminals Ai1、Ai2、AO).
	Ai1	Analog voltage or current signals command	Input voltage DC 0~10V, input impedance 30KΩ or input current DC 0~20mA; input impedance 500Ω, input voltage or current signal shall be selected by J3.
	Ai2	Analog voltage signal command	Input voltage DC 0~10V, input impedance 30KΩ.
Multifunctional output terminals	AO	Analog output	Multifunctional analog output monitoring (DC 0~10V); reference standard potential terminal is AVG.
	DO	Frequency to reach	This contact will be enabled “ON” status when output frequency reaches the frequency setting (F76).
	Note 2：It can only have one choice, either AO or DO, as the a synchronous setting out made by software and hardware J1. Software AO is to be established by parameters F63~F65 while software Do is to be set up by parameter F75.		
	DCM	Common terminal for DO output	Common terminal for the signal of multifunctional output terminals
	Ta	Output at failure	Contacts 1a and 1b will be enabled when triggered by the protection function against ac drive failure.
	Tb		* Ta-Tc is (ON) at failure. (contact is closed)
	Tc		* Tb-Tc is (OFF) at failure. (contact is open)
	E	Terminal for grounding wire	Shrouded and shielded wires shall be exclusively used as the grounding wires.

INHIBIT

Multifunctional input terminals are dry-type contact that shall not be input any voltage-carrying signal source; please peruse the introduction of function to each terminal and use them correctly; any improper use may damage the ac drive.

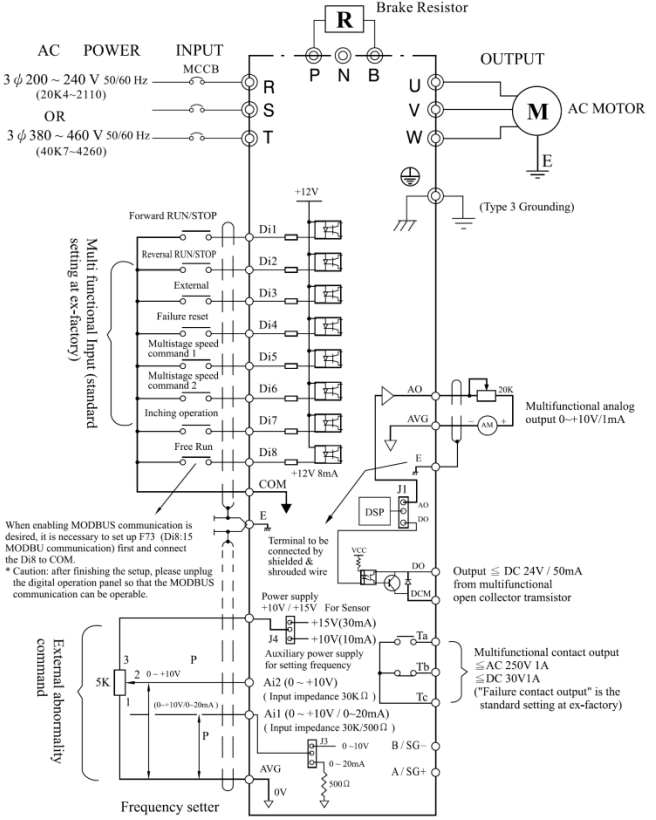
Wiring diagram of control circuit terminal block

LS650M control circuit terminal block wiring diagram

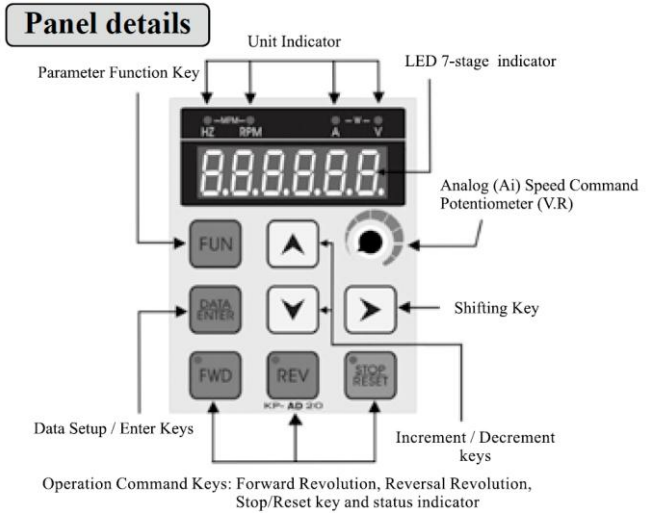


symbols	descriptions	
AVG ☆	signal grounding side	signal DC+10V grounding side 0V ◦
COM ▼		signal DC+12V grounding side 0V ◦
⏚	The grounding pin of cabinet body is connected to E for turn-on	
E	Grounding pin to motor or shielding wires & meshed wires.	
⏚ or ⏚	The grounding pin of cabinet body is connected to E and ⏚ for turn on.	

LS650 control circuit terminal block wiring diagram



III Digital Operation panel

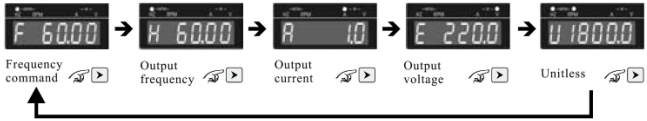


Functions of digital operation panel

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

Quick & cyclic display functions during operation

Each press of key from digital operation panel is able to cyclically display the functions in the following order: Frequency command → Output frequency → Output current → Output voltage → Unitless.



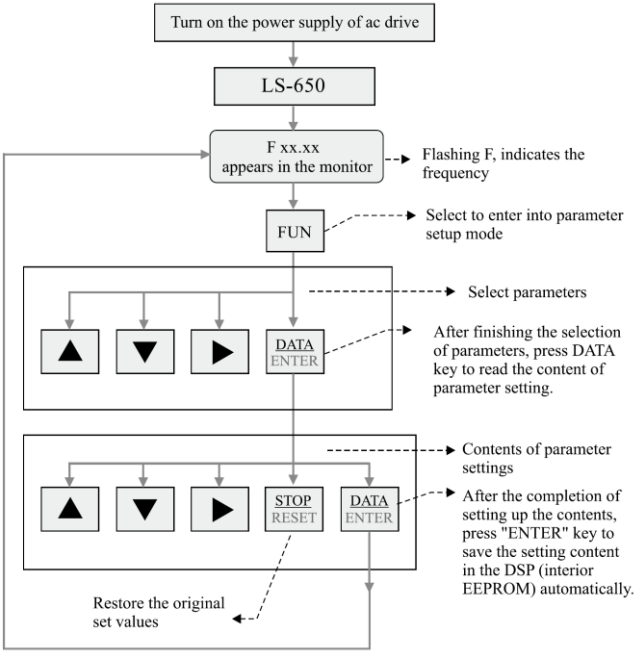
Introduction of function keys

Classific-ation	Keys	Summary descriptions of functions
Parameter / Data keys	FUN	Press to enter into the parameter function mode.
	DATA ENTER	To read and write the set values of parameters.
		To confirm and enter data, and save the data at DSP (interior of EEPROM) automatically.
Shift, increment, decrement keys	➤	To shift the position of flashing cursor rightward to select the data for entry.
		*** Each depress of right-shift key will enable a cyclic display during the operation.** F: Frequency command → H: Output frequency → A: Output current → U: Unitless ← E: Output voltage ←
	▲	Depress to increase the numerical values for parametric encoding and set values, etc.
		To perform the frequency setting under operation control mode by setting the F8: Frequency command source =0 to the digital operation panel.
	▼	Depress to decrease the numerical values for parametric encoding and set values, etc.
		To enter into F4 to monitor variety of displays under the operation control mode.
Operation command keys	FWD	To give an operation command to the operation panel for executing a Forward revolution and turning on the LED lamp for indication.
		To serve as a function key to execute the stop running command when setting the revolving direction is not limited to the FWD command.
	REV	To give an operation command to the operation panel for executing a Reversal revolution and turning on the LED lamp for indication.
		To serve as a function key to execute the stop running command when setting the revolving direction is not limited to the REV command.
	STOP RESET	To execute the STOP running command.
		To serve as an anomaly-reset key when encountered an anomaly; press to retrieve the original set values during the parameter setup mode.
Speed command		Speed control for operation panel Ai (V.R) when F8 : Frequency command source = 1

Parameter setup mode

This mode is for changing the set values of internal parameters. Please use the Increment, decrement, and shift keys to change the parameter settings, and press the ENTER/DATA key to save the changed data in DSP (interior EEPROM) automatically and exit the setup mode. For more details of parameters, please see the “Summary of parameter settings” in the Appendix.

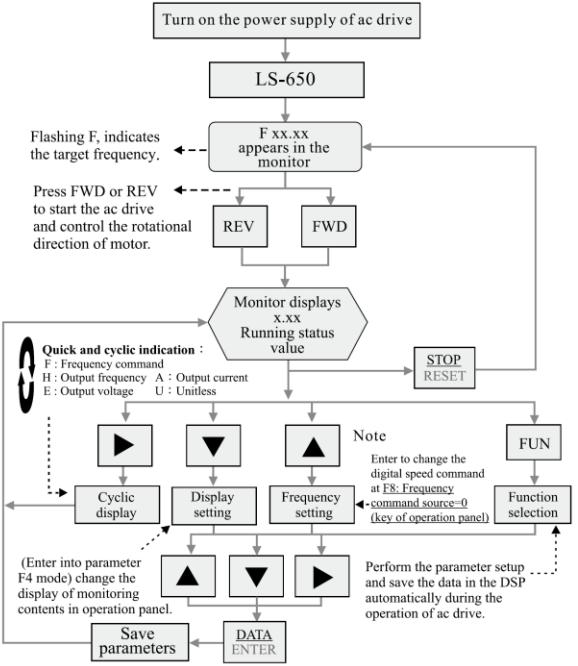
Flow process for parameter setup mode



Control mode

The following flowchart is the flow process of control mode for the digital operation panel that describes control modes to control the operation and display the frequency commands, output frequency, output current, output voltage, failure content, failure records, etc.

Flow process for the control mode of digital operation panel



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

Status check menus of digital input terminals

◆Accessible from the F4=11: Din (display the input status values from digital terminals)

To check the display of status values for digital terminals is available only when running the ac drive.

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	OFF	OFF	OFF	OFF	OFF	OFF	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	ON	ON	ON	ON	ON	ON	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 at ON state.

Example 3 : Digital total value is 87, terminals Di1、Di2、Di3、Di5、Di7→are at ON state.

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

*** Take the Example 2 for a trial 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

Verification of application :

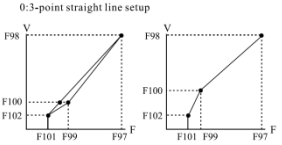
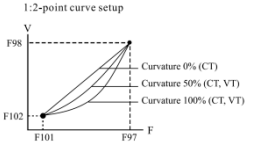
※ Before using the ac drive, please verify the user's machine and thereof applications:

- CT(150%,60 seconds)：Extruder, conveyor and general machines, etc.
- VT(120%,60 seconds)：Cooling fan, air blower and water pump, etc.

Parameters and applications indirect impact against the performance control.

Parameter (code)	Applications
CT/VT selection	To select the max. torque and the overload capacity (CT)150% and (VT)120%
Acceleration / deceleration time (F35~F50)	To adjust the acceleration / deceleration time
S-curve characteristics (F51~F52)	To protect the impact from taking place when starting to accelerate / decelerate the speed.
Jumping frequency (F77~F79)	To avoid the harmonic vibration during the mechanical operation.
Analog filtration time(F58、F62)	To prevent a drastic fluctuation of analog input signal from taking place due to a generation of noise.
Stall protection (F80~F85)	To protect the motor from stall or Err 6 (faulty overvoltage) when carrying a heavy load or performing a sharp acceleration / deceleration; generally, no change is needed when the initial values are effective.

Characteristics of CT and VT：

CT/may establish the V/F curve	CT • VT/may establish the V/F curve
	
CT characteristic – An overload capacity is needed to cope with the adjustable rpm & torque in order to reduce the frictional load and gravitational load.	VT characteristic – The torque load is lessened along with the reduction of rpm.

Cautionary points for setup:

※ In VT mode, the ac drive can be operative only along the 2-point curve with a curvature ranging 30% ~ 100% at an overload of 120%, 60 seconds together with the following parametric range limited:

(1) F 97 ≧ 50.00 Hz or 60.00Hz
(2) F 98 ≦ 200.0V or 220.0V / 380.0V or 440.0V
(3) F 101 ≦ 2.00 Hz,
(4) F 102 ≦ 8.5V or 9.5V / 17.0V or 19.0V
(5) F 103 ≧ 30.0%, limitation will be enabled when exceeding the range with Err=16 warning displayed at the same time.

IV-Test Run-

Pre-start checkups:

◎ 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. [The input terminals R.S.T shall be wired to power supply while the 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 condition among the terminals?
5. Check if the voltage of the input power supply is the same as the rated voltage of the ac drive.
   200V class: Single/3-phase AC200 ~ 240V 50/60Hz
   400V class: 3-phase AC380 ~ 460V 50/60Hz

Test run

◎ A factory default setting, an open loop V/F control mode, was made to the ac drive to set F7=0 that leaves the operation control method to digital operation panel and F8=1 that takes the frequency 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.) counter-clockwise to the end position and then input the power supply. Please perform the test run in accordance with the following steps:

1. Turn on the power supply.
2. Verify the indicating status is shown the target frequency.
3. Enter into the operation control mode (Press the FWD key to enter into the operation control for forward rotation).
4. Input the speed command (rotate slowly the potentiometer knob in operation panel clockwise and perform the test run within 10Hz)
5. Press STOP key to slow down and stop the motor.

Operation checklist:

◎ Check if motor runs in correct direction of rotation. (Interchange any two of the phase lines to change the motor's direction of rotation.)
◎ Check if motor runs smoothly?
◎ Check if motor vibrates abnormally?
◎ Check if acceleration and deceleration are smooth?
◎ Check if output load current is normal? (Press the ▼ key to access parameter F4=2: output current, or ➤ right-shift cyclic key to monitor the output load currents.)

Basic parameters setup

Parameter code	Description	Setting range	Unit	Ex-factory setting	Page No.
F4	Selection of variables to be shown in the operation panel	0~17		1	P5-1
0：Frequency command (F) 1：Output frequency(H) 2：Output current(A) 3：Output voltage (V) 4：Unitless(U) 5：Normal voltage at DC side(Vdc)	6：Voltage at DC side before startup(Vdc) 7：Digital operation panel Ai(V.R)% 8：Ai1(V/mA)% 9：Ai2(V)% 10：PID output (%) 11：Input status value at digital terminals			12：Water pressure of water pump 13：Cycle No., Stage No. 14：Software version(1.24) 15：Software Status(0:corrected) 16：Cumulative running time (days) 17: Cumulative running time (mins)	
F7	Operation control source	0~1		0	P5-3
0：Digital operation panel or MODBUS communication　1：Digital input terminal					
F8	Frequency command source	0~8		1	P5-3
0：Digital operation panel (main speed) 1：Operation panel Ai (V.R) 2：Ai1	3：Ai2 4：Ai1+Ai2 5：Ai1、Ai2／MAX			6：Ai1、Ai2／MIN 7：PID 8：Digital terminal for acceleration & deceleration	
F11	Stop mode	0~2		1	P5-4
0：Free run	1：Dynamic shutdown			2：Dynamic +DC brake	
F14	Constraint of rotational direction	0~3		1	P5-5
0：Forward & backward rotation 1：Forward rotation only	2：Backward rotation only 3：Backward rotation available for negative bias				
F15	Lower limit of frequency (※F15≦F16)	0.00~300.00	Hz	0.00	P5-5
F16	Upper limit of frequency (※F15≦F16)	0.00~300.00	Hz	60.0 / 50.0	P5-5
F17	Selection for Min. output frequency	0~1		0	P5-6
0：Can be zero speed	1：To set the Min. output frequency (F101)				
F35	Main speed, inching acceleration time	0.0~30000.0	Sec	10.0	P5-7
F36	Main speed, inching deceleration time	0.0~30000.0	Sec	10.0	P5-7
F67	Di1、Di2 setup	0~2		0	P5-14
0：Di1(FWD/STOP)，Di2(REV/STOP)　1：Di1(RUN/STOP)，Di2(FWD/REV) 2：3-wire shutdown: Di3 (FWD/REV), Di2(Stop), Di1(Running), disable F68 setup automatically at the same time.					
F80	Stall protection setup	0~128		7	P5-19
bit7：CT / VT mode switch(128) bit5：Start magnetic brake function (32) bit2：Protection function F83	bit6：Enable Ai1 break detection (64) bit4：AVR Voltage-regulating function bit1：Protection function F82			bit3：Protection function F84 bit0：Protection function F81	
F81	Stall voltage setup for deceleration	330.0~400.0 660.0~800.0	Vdc	380.0 760.0	P5-20
F82	Stall voltage setup for acceleration	30.0~200.0	%	170.0	
F83	Stall current setup for operation	30.0~190.0	%	160.0	P5-21
F84	Current level for electronic thermal relay	1.01~2.00	F90	1.50	
F85	Acting time for electronic thermal relay	0.1~120.0	Sec	60.0	
$\int (I^2_{(pu)} - 1)\,dt \,/\, (I^2_{OL} - 1) \times T_{OL}$					
F88	Rated frequency	40.00~70.00	Hz	60.00 / 50.00	P5-21
F89	RST input voltage (rms)	150.0~255.0 300.0~510.0	Vac	220.0 / 200.0 440.0 / 380.0	
F90	Rated current (rms)	0.1~(F95×1.3)	A	F95	
F93	PWM switchover frequency	1000~16000	Hz	5000	P5-23

Fast operation control mode

Fast operation control mode

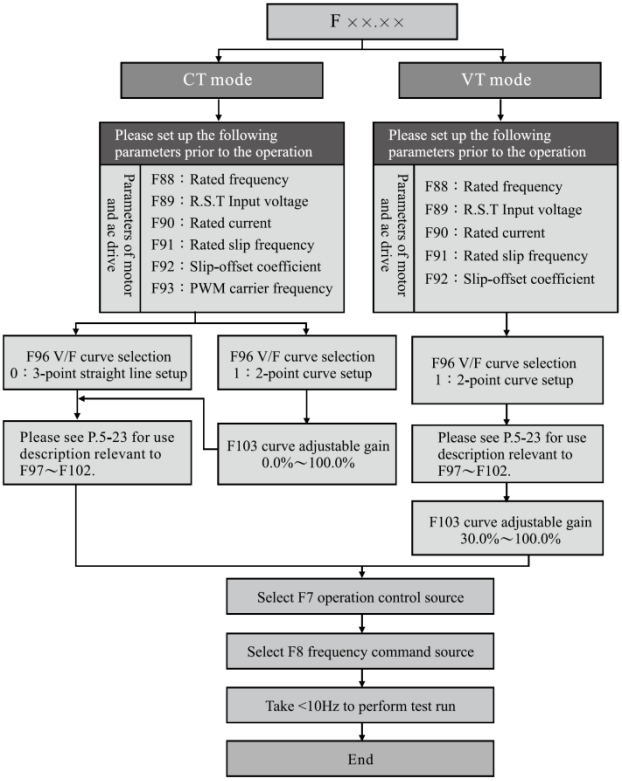
◎ There are several operation control methods applicable to the ac drive for thereof startup operation. You can use the following operation methods to simply and quickly start the ac drive.

◎ There are two primary operation control parameters to start the operation of ac drive: The first one is the F7: Operation Control Source and the other one is F8: Frequency command source. Please see the table below for description of operation.

Parameter functions	Description of operating procedures	Ex-factory setting	Page No.
F7 : Operation control source			
0 : Digital operation panel (Or MODBUS communication)	Press [FWD] key after the display of F xx.xx ↓ Enter into the FWD operation mode	0	P5-3
	∗ Please pay attention to the forward & backward rotating direction of motor when performing the test run. ∗		
1 : Digital input terminal	Terminal Di1 /ON → FWD (Indicator ON) operation →OFF/Stop.		P5-3 P5-14
F8 : Frequency command source			
0 : Digital operation pane	Frequency changing mode is accessible by pressing the ▲ key during the operating state.	1	P5-3
1 : Operation panel Ai inputV.R)	To perform the speed control from the (V.R) potentiometer from the operation panel.		
2 : Ai1 input (+10V/20mA)	To perform the speed control by inputting 0~+10V/0~20mA to analog Ai1 terminal.		
3 : Ai2 input (+10V)	To perform the speed control by inputting 0~+10V to analog Ai2 terminal.		
4 : Ai1+Ai2	To perform the speed 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 the operation control.		
6 : Ai1、Ai2/MIN	To take the minimum value from two sets of analog signals, Ai1 and Ai2, to perform the operation control.		
7 : PID	To execute the external analog signals for PID feedback control.		
8 : Digital terminals for speed acceleration or deceleration	To perform speed acceleration and deceleration control by inputting signals to the digital input terminals.		

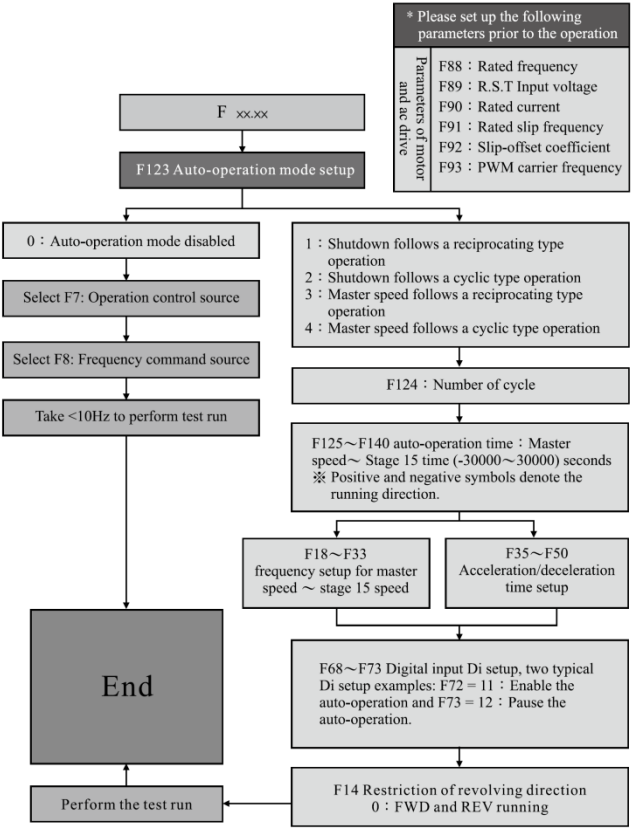
Control mode setup

- ◆ LS650 is categorized to a simple V/F voltage vector control in possession of slip-offsetting function and V/F curve setting.
- ◆ LS650 has been setup a CT mode or VT mode according to the need of user at ex-factory.



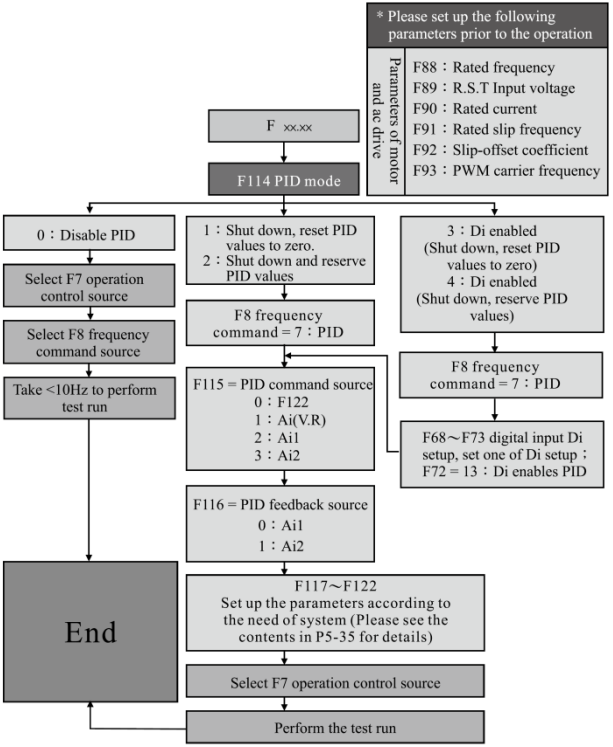
Parameter setup for auto-operation control

◆The auto-operation mode will leave the functions of F7: Operation control source and F8: Frequency control source inoperative when enabled because its priority is higher than any other frequency commands.



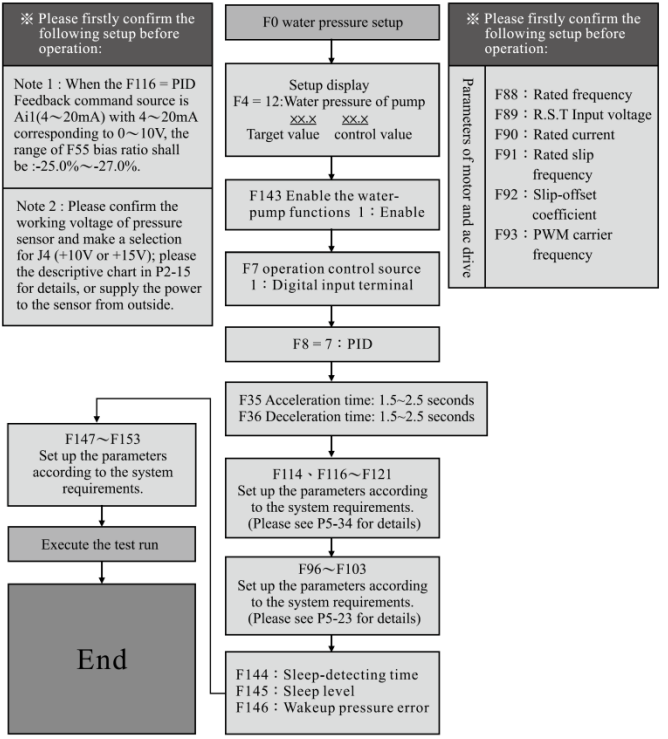
Multifunctional PID setup

- ◆ A PID control technology is introduced to apply the advanced digital coding technology by combining , tuning and consisting of three aspects of P (Proportion), I (Integration) and D (Differential).
- ◆ When PID control module is in use; generally, both acceleration & deceleration times of F35 and F36 are set less than 2.0 seconds.



Setting the functions of constant-pressure water pump (Sleep PID control)

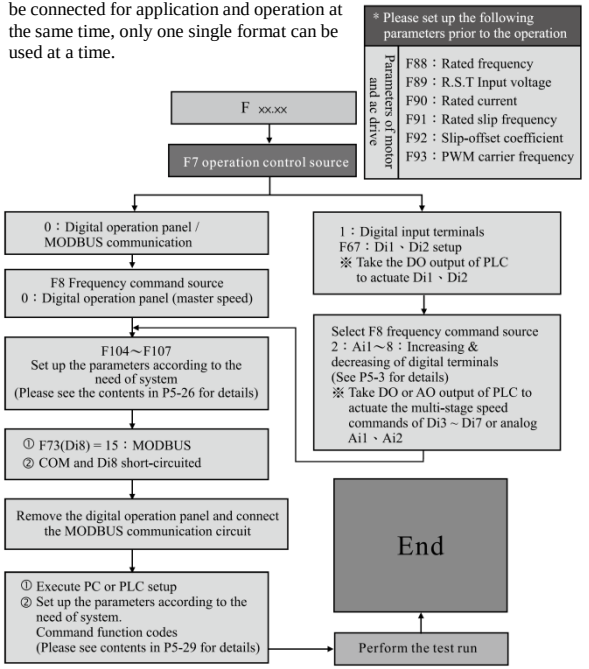
- ◆ A comparison between the feedback signal of sensor and the set value will be made according to the variation of system pressure to control the output frequency, perform the constant-pressure function, and control the functions to stop working at no water consumption, make up water for water leakage and stop working when running out of water running out of water.
- ◆ When using the PID control module, the typical setting of F35 & F36 for acceleration & deceleration time are less than 2.0 seconds.



MODBUS communication setup

- ◆ Ac drive and PC or PLC is serially connected for communication so that remote monitoring is accessible to the user.
- ◆ When MODBUS is enabled to LS650M, it is necessary to set F73(Di8: 15 MODBUS communication) and insert the JP1 (JP1 is a function of Di8) (Note 1)
- ◆ When MODBUS is enabled to LS650, it is necessary to set F73(Di8: 15 MODBUS communication) and connect Di8 to COM. (Note 1)

※ (Note 1)：The digital operation panel is configured an internally exclusive RS-485 communication format; and when performing the external (SG-, SG+) MODBUS communication control in different communication format is desired, they cannot be connected for application and operation at the same time, only one single format can be used at a time.



V Description of parameter functions

Water pump setup

「○」 **Signify that setting the function during operation is executable.**

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F0	Water pressure set values	0.0~10.0	Kg/cm2	2.0

♦ To set up the target pressure value.

×	F1	Setup to activate terminal after restoring the power supply	0~1		0

■ 0 : Direct activate – When set F7 (operation control source) = 1 : digital input terminal for control, the operation control terminal (Di1 or Di2) will be normal close (ON) while the ac drive will be activated to run after inputting the power supply or restoring the power supply.

■ 1 : Command terminal reset and then activate – When set F7 (operation control source) = 1 : digital input terminal for control, the operation control terminal (Di1 or Di2) will be normal close (ON) while the command terminal shall be re-activated (off→ON), then the ac drive follow to run after inputting the power supply or restoring the power supply.

Display setup of operation panel

○	F4	Select the variables to be displayed in operation panel	0~17		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 the standby or operation modes.

Set value	Functions	Description of function	Related parameters
0	Frequency command(F)	Display the frequency set value.	
1	Output frequency(H)	Display the output frequency.	
2	Output current(A)	Display the load of current output (U,V,W) to drive motor.	
3	Output voltage(E)	Display the output voltage (U,V,W) (rms)	
4	Unitless (U)	To monitor the functions of motor rpm or machine rpm, etc.	F5
5	Normal voltage at DC side(Vdc)	Display the DC voltage of capacitor running on capacitor.	
6	Voltage at DC side before startup (Vdc)	The DC voltage at DC bus of capacitor before startup.	

Set value	Functions	Description of function	Related parameters
7	Digital operation panel Ai(%)	● Able to display the percentage % of analog input voltage. ● Able to monitor the noise voltage generated from the wiring and use this voltage to set up the bias voltage to avoid unnecessary noise interference.	F8=1
8	Ai1(V/mA)%		F8=2
9	Ai2(V)%		F8=3
10	PID(%)	Display the PID-controlled output value in %.	
11	Input status value at 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).	F67~F73
12	Water pressure of water pump	Display the water pressure of water pump in kg/cm². Display method: (Target value) xx.x xx.x (Control value)	F0
13	Number of cycles, number of stages	To display the travel designated to the number of cycle and the number of stage from automatic operation mode. ● Display the number of cycle in a decimal system (0~9) ● Display the number of stage in a hexadecimal system. (0123456789AbcdEF)	F124 F125~F140
14	Software version	To display the version number of software.	
15	Software status	Read only, 0: Software Normal, 1: Software flaws	
16	Cumulative running time (days)	Unit: Days, range: 0~30000	
17	Cumulative running time (mins)	Unit: Mins, range: 0~1440.0	

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
○	F5	Unitless display of folds	0.01~300.00		30.00

- This function can be applied to monitor the motor RPM or machine (gear ratio output) RPM.
- To display the F4=4: Unitless (U) indicating value according to the user-set frequency × (F5) folds of display.

○	F6	Display of filtration time	0~15		6

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

Operation control parameters

Changeable during operation	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 can select the operation control source from either digital operation panel or digital input terminals.**

- **0:Digital operation panel** – The digital operation panel shall control the ac drive's start of operation, forward rotation, reversal rotation and stop of operation; or a MODBUS communication protocol system shall be applied to execute the serial communication control (the use of F73:Di8-15 terminals are needed to turn on the MODBUS **sys**tem).
- **1:Digital input terminals** – Digital input terminals (F67) shall control the ac drive's start of operation, forward rotation, reversal rotation and stop of operation.

×	F8	Frequency command source	0~8		1

- This parameter is the frequency command source for the drive motor of ac drive. The following nine options of frequency command sources and (F123) auto operation mode are available for selection in accordance with the configurative requirements of control system.
- The sequence of priority for frequency command source is: **Auto operation> Inching>Di enables Ai1>Speed of designated stage>F8 frequency command source.**
  - **0 : Digital operation panel (main speed)** – To be set and controlled by the increment and decrement keys in digital operation panel.
  - 1**: Operation panel Ai input (V.R)** – To be controlled by the DC 0~5V signal from Voltage Regulator (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 analog voltage and analog voltage (or current) from both analog input terminals Ai1 and Ai2. (Setting the function of F14:3, the negative bias is able to make a reversal rotation, control by addition & subtraction is available)
  - 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 F114 ~ F122). (When set to enable the function of F11=3: Reversal revolution is available at negative bias, performing the negative PID% control is available.)
- 8**: Digital terminal for increasing/decreasing** – To input signal to digital input terminal for controlling the increasing / decreasing of master speed.

×	F9	Braking duration before start	0.0~120.0	Second	0.0

- 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.

×	F10	Braking current before start	0.0~100.0	%	30.0

- This parameter is to set the percentage of the DC braking current 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. F9 setting shall govern the time span of delay, and the braking current percentage shall be based on the (F95) rated current of ac drive.

×	F11	Stop mode	0~2		1

- To select an appropriate stop mode in accordance with the operational requirements of machine & equipment.
  - **0 : Free run 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 free run 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; DC brake action is enabled when the output frequency is reduced to zero speed; thus the occurrence of coasting operation phenomenon can be avoided after stopping the motor.

×	F12	Stopping & braking time	0.0~120.0	Second	0.0
×	F13	Stopping & braking current	0.0~100.0	%	30.0

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

Speed limit

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F14	Restriction of rotating direction	0~3		1

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

0 : Forward / Reversal rotation available **1 : Forward rotation only**
2 : Reversal rotation only **3 : Reversal rotation at negative bias available**

- When the **3 : Reversal rotation at negative bias available** is selected, there are six types of analog input signal status at parameter F8: Frequency command source available to set up the negative bias frequency. When the analog input signal value is working on the bandwidth of negative bias frequency, the motor is rotating in reversal direction for operation; and the motor will rotate in forward direction when the signal value is working on the positive frequency bandwidth. [For details of analog signal shifting setup, please see each shifting parameter group (F53, F55, F59) of analog signal]
- Select 3: Reversal revolution is available at negative bias, F8 = 4: Ai1 + Ai2 addition & subtraction for operational control is available, and F8 = 7: PID% is taken to perform negative PID% control.

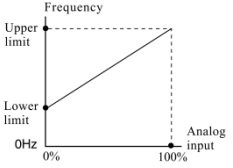
WARNING

*** 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 that may be resulted from the reversal rotation.

×	F15	Lower limit of frequency	0.00~300.00	Hz	0.00	
×	F16	Upper limit of frequency	0.00~300.00	Hz	60.00	50.00

- **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.**

* The operating range for the analog input frequency command and PID frequency command shall be 0% corresponding to the (F15) lower limit of frequency and 100% corresponding to the(F16) upper limit of frequency.
* Must satisfy the condition F16≥F15



Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F17	To select the minimum output frequency	0~1		0

- **0 : For zero fast** – when set value F15<F101 and input frequency command <F101 set value, the output frequency is a zero speed; if the set value F15 ≥F101 with the operation command enabled, then the F15 set value will be enabled for operation.
- **1 : For F101 lowest output frequency hypothesis** – when set value F15< F101, input frequency command <F101 set value, take the F101 set value to output for operation.

* When F15≥F101, the frequency of lower limit will be output as the minimum output frequency for performing the operation.

Multi-stage speed frequency command setup

multi-stage speed command terminals			Multi-stage command 4	Multi-stage command 3	Multi-stage command 2	Multi-stage command 1	Setting range	Unit	Ex-factory setting
○	F18	Master speed	OFF	OFF	OFF	OFF	0.00~300.00Hz	Hz	5.00
○	F19	Speed at stage1	OFF	OFF	OFF	ON	0.00~300.00Hz	Hz	5.00
○	F20	Speed at stage2	OFF	OFF	ON	OFF	0.00~300.00Hz	Hz	10.00
○	F21	Speed at stage3	OFF	OFF	ON	ON	0.00~300.00Hz	Hz	15.00
○	F22	Speed at stage4	OFF	ON	OFF	OFF	0.00~300.00Hz	Hz	20.00
○	F23	Speed at stage5	OFF	ON	OFF	ON	0.00~300.00Hz	Hz	30.00
○	F24	Speed at stage6	OFF	ON	ON	OFF	0.00~300.00Hz	Hz	40.00
○	F25	Speed at stage7	OFF	ON	ON	ON	0.00~300.00Hz	Hz	50.00
○	F26	Speed at stage8	ON	OFF	OFF	OFF	0.00~300.00Hz	Hz	0.00
○	F27	Speed at stage9	ON	OFF	OFF	ON	0.00~300.00Hz	Hz	0.00
○	F28	Speed at stage10	ON	OFF	ON	OFF	0.00~300.00Hz	Hz	0.00
○	F29	Speed at stage11	ON	OFF	ON	ON	0.00~300.00Hz	Hz	0.00
○	F30	Speed at stage12	ON	ON	OFF	OFF	0.00~300.00Hz	Hz	0.00
○	F31	Speed at stage13	ON	ON	OFF	ON	0.00~300.00Hz	Hz	0.00
○	F32	Speed at stage14	ON	ON	ON	OFF	0.00~300.00Hz	Hz	0.00
○	F33	Speed at stage15	ON	ON	ON	ON	0.00~300.00Hz	Hz	0.00

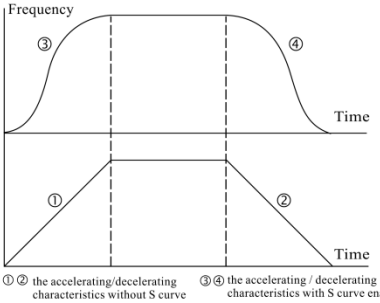
- ON and OFF shown in the table express the commands given to open (OFF) or close (ON) the circuit at external terminals.
- Under the operation mode of multi-stage rpm, compilation to select the stage and rpm for operation (16 stages of speed the utmost) through the multi-functional input terminals (F68 ~ F73) is available while the compilation shall be made in a binary system of 4-bit (please see the table above).

○	F34	Inching speed	0.00~300.00Hz	Hz	6.00

Acceleration/deceleration time

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
O	F35	Master speed (inching) /with No stage 8 speed of acceleration time	0.0~30000.0	Second	10.0
O	F36	Master speed (inching) /with No stage 8 speed of deceleration time	0.0~30000.0	Second	10.0
O	F37	Acceleration time of stage 1,9	0.0~30000.0	Second	10.0
O	F38	Deceleration time of stage 1,9	0.0~30000.0	Second	10.0
O	F39	Acceleration time of stage 2,10	0.0~30000.0	Second	10.0
O	F40	Deceleration time of stage 2,10	0.0~30000.0	Second	10.0
O	F41	Acceleration time of stage 3,11	0.0~30000.0	Second	10.0
O	F42	Deceleration time of stage 3,11	0.0~30000.0	Second	10.0
O	F43	Acceleration time of stage 4,12	0.0~30000.0	Second	10.0
O	F44	Deceleration time of stage 4,12	0.0~30000.0	Second	10.0
O	F45	Acceleration time of stage 5,13	0.0~30000.0	Second	10.0
O	F46	Deceleration time of stage 5,13	0.0~30000.0	Second	10.0
O	F47	Acceleration time of stage 6,14	0.0~30000.0	Second	10.0
O	F48	Deceleration time of stage 6,14	0.0~30000.0	Second	10.0
O	F49	Acceleration time of stage 7,15	0.0~30000.0	Second	10.0
O	F50	Deceleration time of stage 7,15	0.0~30000.0	Second	10.0
×	F51	Acceleration S curve	0.0~100.0	%	0.0
×	F52	Deceleration 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. F88: rated frequency is the reference frequency for the acceleration or deceleration time.
- Variation of setting in S-curve can effectively lessen the load and mitigate the 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.



Technical explanations: in the left figure, we can clearly learn the original set values when function of S-curve is enabled, and the acceleration and the deceleration time will increase along with the increase of set values.

CAUTION

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.

Analog input

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F53	Ai : 0V input bias %	-300.00~300.00	%	0.00
×	F54	Ai : 5V input gain %	-300.00~300.00	%	100.00

♦ Parameters F53 and F54 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 F53/0V 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 F54/5V is a gain frequency with its maximum output value limited by the F16 upper-limited frequency. (Please see the following examples for six types of basic curve).

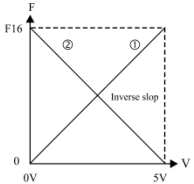


Figure 1

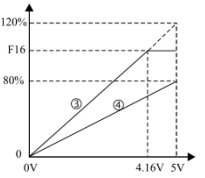


Figure 2

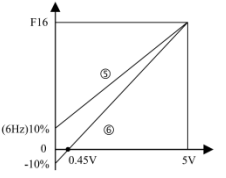


Figure 3

* Please refer to Figure 1, 2 & 3 and see the description of parameters in the table below :

	Curve ①	Curve ②	Curve ③	Curve ④	Curve ⑤	Curve ⑥
F8 frequency command source	1:Ai/(V.R)	1:Ai/(V.R)	1:Ai/(V.R)	1:Ai/(V.R)	1:Ai/(V.R)	1:Ai/(V.R)
F16 Upper limit of frequency	60Hz	60Hz	60Hz	60Hz	60Hz	60Hz
F53 operation panel Ai: 0V bias ration	0.0%	100%	0.0%	0.0%	10%	-10%
F54 operation panel Ai: 5V gain ratio	100%	0.0%	120%	80%	100%	100%

- Ai max. output frequency = (F16) frequency of upper limit × (F54) gain ratio.
- Frequency at positive bias = (F16) frequency of upper limit × (F53) bias ratio.
  For example: curve ⑤ = 60Hz ×10%=6Hz
- Negative bias voltage = [5V(Ai) ÷ (F53 bias ratio + F54 gain ratio)] × F53 bias ratio
  For example: curve ⑥ = [5V(Ai) ÷ (10% + 100%)] × 10% = 0.45V (positive and negative symbol shall be ignored for operation)

◆ Operating voltage (V) = $\dfrac{\text{The max. voltage} \times \text{The max. operating frequency}}{\text{The upper limit of frequency} \times \text{gain ratio}}$

Ex. : Curve ③ $\dfrac{5V \times 60Hz}{60Hz \times 120\%} = 4.16V$

Ex. : Curve ④ $\dfrac{5V \times 48Hz}{60Hz \times 80\%} = 5V$

◆ Gain ratio $= \dfrac{\text{The max. voltage} \times \text{The max. operating}}{\text{The upper limit of frequency} \times \text{operating voltage}}$

Ex. : Curve③ $\dfrac{5V \times 60Hz}{60Hz \times 4.16V} = 120\%$

Ex. : Curve④ $\dfrac{5V \times 48Hz}{60Hz \times 5V} = 80\%$

V -Description of parameter functions-

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F55	Ai1:0V Input bias %	-300.00~300.00	%	0.00
×	F56	Ai1:10V Input gain %	-300.00~300.00	%	100.00
×	F57	Ai1: Insensitive area (Dead Band)	0.00~85.00	%	0.00
×	F58	Ai1: Filtration time setup	0.01~5.00	Second	0.30
×	F59	Ai2:0V Input bias %	-300.00~300.00	%	0.00
×	F60	Ai2:10V Input gain %	-300.00~300.00	%	100.00
×	F61	Ai2: Insensitive area (Dead Band)	0.00~85.00	%	0.00
×	F62	Ai2: Filtration time setup	0.01~5.00	Second	0.30

- The functional commands of this parametric 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.
- F57 insensitive band voltage setup can effectively keep away the noise interference at 0V, but fail the actuator to stop operation correctly that leads to motor swinging operation between forward and reversal rotations.

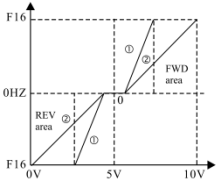


Figure 1

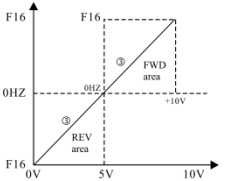


Figure 2

* Please refer to figures above and see the description of parameters along different curves in the table below

	Curve ①	Curve ②	Curve ③
F8 Frequency command source	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V
F14 Restriction of rotating direction	3: REV available at bias	3: REV available at bias	3: REV available at bias
F16 Upper limit of frequency	60Hz	60Hz	60Hz
F55 0V: bias ratio	-200%	-100%	-100%
F56 10V: gain ratio	200%	100%	100%
F57 Insensitive band	10%	10%	0%
F58 Filtration time setup	0.30 Second	0.30 Second	0.30 Second

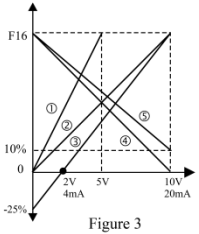


Figure 3

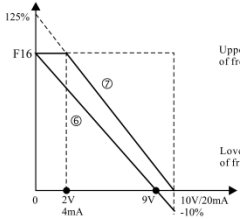


Figure 4

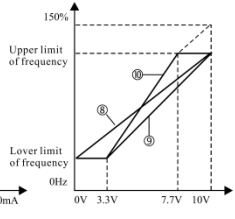


Figure 5

* Please refer to Figure 3 and see the description of parameters along different curves in the table below :

	Curve ①	Curve ②	Curve ③	Curve ④	Curve ⑤
F8 Frequency command source	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V
F16 Upper limit of frequency	60Hz	60Hz	60Hz	60Hz	60Hz
F55, F59 0V(0 mA): bias ratio	0.0%	0.0%	-25%	100%	100%
F56, F60 10V(20 mA): gain ratio	200%	100%	100%	0.0%	10%

* Please refer to Figure 4 and Figure 5 and see the description of parameters along different curves in the table below :

	Curve ⑥	Curve ⑦	Curve ⑧	Curve ⑨	Curve ⑩
F8 Frequency command source	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V	2:Ai1/10V
F15 Lower limit of frequency	0.0Hz	0.0Hz	20Hz	20Hz	20Hz
F16 Upper limit of frequency	60Hz	60Hz	60Hz	60Hz	60Hz
F55, F59 0V(0 mA): bias ratio	100%	125%	0.0%	-50%	-75.18%
F56, F60 10V(20 mA): gain ratio	-10%	0.0%	100%	100%	150%

- Negative bias ratio = lower limit of frequency ÷ [(upper limit of frequency – lower limit of frequency) ÷ gain ratio]
- Negative bias voltage = [10V ÷ (negative bias ratio + gain ratio)] × negative bias ratio
- Frequency voltage = [upper limit of frequency × (gain ratio + negative bias ratio)] ÷ 10V (positive, negative symbols are not for operation)
- Operating voltage (V) = upper limit of frequency ÷ frequency voltage
- Upper limit of frequency / full voltage = increased voltage + negative bias voltage

Descriptions :

Curve ⑨ Negative bias ratio = 20Hz ÷[(60.0Hz - 20.0Hz) ÷100%] = - 50%
Negative bias voltage = [10V ÷(50% + 100%)] ×50% = 3.33V
Frequency voltage = [60Hz ×(100% + 50%)] ÷10V = 90Hz ÷10V = 9 Hz/V
Operating voltage (V) = 60Hz ÷9 Hz/V = 6.66V
Upper limit of frequency / full voltage = 6.66V + 3.33V = 9.99V

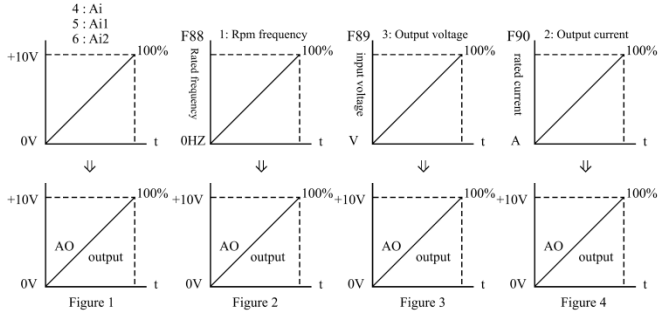
Curve ⑩ Negative bias ratio = 20Hz ÷[(60.0Hz - 20.0Hz) ÷150%] = - 75.18%
Negative bias voltage = [10V ÷(75.18% + 150%)]× 75.18% = 3.33V
Frequency voltage = [60Hz ×(150% + 75.18%)] ÷10V = 135.1Hz ÷10V
= 13.51 Hz/V
Operating voltage (V) = 60Hz ÷13.51 Hz/V = 4.44V
Upper limit of frequency / full voltage = 4.44V + 3.33V = 7.77V

AO output

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
○	F63	AO out function of analog variable	0~7		0
○	F64	AO out : 0V corresponding value	-32767~32767		0
○	F65	AO out : 10V corresponding value	-32767~32767		4096

- F63 : Both AO (Analog Output) and F75 : 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 P2-17 for the control circuit wiring diagram).
- **When enabled the F63:AO analog output, please set F75=0 to disable the DO output (Both sets cannot be used at the same time)**.
- AO output F65 : 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 8 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.

F63 Function of analog variable	F65 10V/ Corresponding value	Reference standard point	F63 Function of analog variable	F65 10V/ Corresponding value	Reference standard point
0 : Disabled	X	X	4 : Ai(Figure 1)	16384	Ai ×(F53, F54)
1 : Rpm or frequency (Figure 2)	4096	F88 Parameter set value	5 : Ai1(Figure 1)	16384	Ai1 ×(F55, F56)
2 : Output current (Figure 4)	8192	F95 Parameter set value	6 : Ai2(Figure 1)	16384	Ai2 ×(F59, F60)
3 : Output voltage (Figure 3)	2200 3800	220.0 V F89 Parameter set value 380.0 V	7 : PID	16384	100%



Description : ① In Figure 1, F63 set value is 4 for the display of input analog signal, F65 set value is 16384, reference standard point is Ai × (F53, F54 gain value), and the highest corresponding value of AO analog signal output is DC+10V.

② In Figure 3, F63 set value is 3 for the display of output voltage, F65 set value is 2200, reference standard point is 220V, and the analog output signal AO is DC+10V.

Digital input

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F66	Scan cycle of digital input	10~2000	0.1ms	10

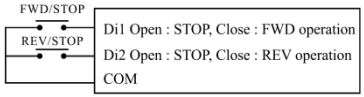
- This function is able to filter out the interference from the noise to the multi-function input terminals or get rid of the CUP malfunction caused by the resilience of switch. due to noise interference or switching ejection.
- Scan time = set value ×0.1ms

×	F67	Di1, Di2 setup	0~2		0

- 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.

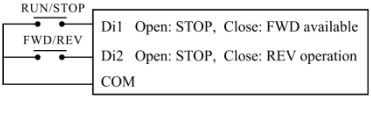
■ **0 : Di1(FWD/STOP), Di2(REV/STOP)**, 2-way control

F7 (Operation control source) =1 (Digital input terminal)
F14 (Restriction of rotating direction)= 0 (FWD/REV available)
F67 (Dil, Di2) =0



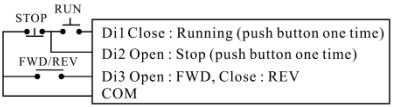
■ **1 : Di1(RUN/STOP), Di2(FWD/REV)**, 2-way control

F7 (Operation control source) =1 (Digital input terminal)
F14 (Restriction of rotating direction)=0 (FWD/REV available)
F67 (Dil, Di2) =1



■ **2 : 3-wire stop:Di3(FWD/REV), Di2(STOP), Di1(RUN), and F68 setup is disabled automatically at the same time.**

F7 (Operation control source) =1 (Digital input terminal)
F14 (Restriction of rotating direction)=0 (FWD/REV available)
F67 (Dil, Di2) =2



×	F68	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".	0~14	1
×	F69	Di4 setup		0~14	2
×	F70	Di5 setup		0~14	6
×	F71	Di6 setup		0~14	7
×	F72	Di7 setup		0~14	10
×	F73	Di8 setup		0~15	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** – An input of external failure will trip the ac drive and stop its output.
- 2**: RESET** – When the ac drive tripped at failure, use this RESET command to release the failure-maintained state.

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

- 3**: Free run stop** – After inputting the functional terminal signal, the ac drive will switch off its output, and let the motor run at idling state and free running down to stop.
- 4**: Master speed increases** – To enter the frequency-increasing signal of master speed from multifunctional terminal, for a F35 set value ≥ 20 seconds, F35 set value will be taken to perform the acceleration for increasing the master speed; and for a F35 set value < 20 seconds, the duration of 20 seconds will be taken to perform the acceleration for increasing the master speed.
- 5**: Master speed decreases** – To enter the frequency-decreasing signal of master speed from multifunctional terminal, for a F36 set value ≥ 20 seconds, F36 set value will be taken to perform the deceleration for decreasing the master speed; and for a F36 set value < 20 seconds, the duration of 20 seconds will be taken to perform the deceleration for decreasing the master speed.

♦ These two sets of function mainly focusing on the frequency of master speed as the external control can be set up through functional terminals; however, the control power of F8: frequency command source must be set to 8: digital terminal increases/decreases.

6 : Multi-stage speed command 1	Multi-stage speed commands 1, 2, 3, and 4 are formatted by binary system in 4-bit manner to compile 16 stages of speed for operation control.
7 : Multi-stage speed command 2	
8 : Multi-stage speed command 3	
9 : Multi-stage speed command 4	

- 10**: Inching operation** – Once enabled, the inching command has the second priority following the command to enable the auto operation. .
- 11 **: Enable auto operation** – Once enabled and confirmed, it has the top priority over any rpm command; therefore, it is unable to select any other speed for operation whenever the execution of auto operation is enabled.
- 12**: Pause auto operation** – When selected the programmable auto operation function, ac drive will start to execute the procedural operation according to the preset 16-stage speed frequency after enabling the functional terminals; during the operation, the pause terminal can be enabled to interrupt the operation procedure temporarily and carry on the execution of operation procedure after restoring from the interruption. If the auto operation terminal is disabled and enabled again, the operation procedure will be started from the Home point.
- 13**: Di enables PID** – Once selected to enable the Di, then PID function is controlled by Di external terminals.
- 14**: Di enables Ai1** – When enabling the Di is selected, Ai1 shall be the frequency command source compulsorily.

* When enabled this function, Ai1 shall not be received other functional setup for applications. (For example: the setup of F8, F115 and F116 relevant to Ai1).

* Priority sequence: Auto operation > Jog frequency > Di enables Ai1 > multi-stage speed > F8: frequency command source.

- 15**: MODBUS** – This function is set up by F73 (Di8) only and enabled by Di8.

Multi-stage command terminals / 16-stage speed	Din multi-stage command 4, $2^3 = 8$	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	OFF
Stage 1 speed	OFF	OFF	OFF	ON
Stage 2 speed	OFF	OFF	ON	OFF
Stage 3 speed	OFF	OFF	ON	ON
Stage 4 speed	OFF	ON	OFF	OFF
Stage 5 speed	OFF	ON	OFF	ON
Stage 6 speed	OFF	ON	ON	OFF
Stage 7 speed	OFF	ON	ON	ON
Stage 8 speed	ON	OFF	OFF	OFF
Stage 9 speed	ON	OFF	OFF	ON
Stage 10 speed	ON	OFF	ON	OFF
Stage 11 speed	ON	OFF	ON	ON
Stage 12 speed	ON	ON	OFF	OFF
Stage 13 speed	ON	ON	OFF	ON
Stage 14 speed	ON	ON	ON	OFF
Stage 15 speed	ON	ON	ON	ON

(Table 1)

Digital (Do) output

Changeable during operation	Parameter	Description		Range	Unit	Ex-factory setting
×	F74	Relay1 setup	♦ Multifunctional output terminal is programmable for setting control, no specific sequence is required.	0~10		1
×	F75	DO setup * To set up control power, please see F63 parameter for description. (P5-12)	♦ **When enabled the F75: DO output, please set F63=0 to disable the AO output (Both sets cannot be used at the same time).**			10

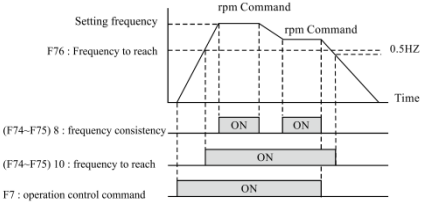
- **0 : Disabled** ─ To disable the functional state of functional output terminal.
- 1**: Enabled at failure(NC)** ─ Contact will be enabled a "ON(close)" state when the ac drive detects an occurrence of failure condition.
- 2**: In operation** ─ Contact will be enabled a "ON(close)" state when the ac drive enters into a standby mode or is in operation.
- 3**: In zero speed** ─ Contact will be enabled a "ON(close)" state when the ac drive stops or has an output frequency of 0.
- 4**: FWD** ─ Output ON signal when the ac drive is executing the FWD command and outputting a frequency > 0Hz.
- 5**: REV** ─ Output ON signal when the ac drive is executing the REV command and outputting a frequency > 0Hz.
- 6**: Accelerating** ─ Output ON signal when the ac drive is accelerating toward the target command.
- 7**: Decelerating** ─ Output ON signal when the ac drive is decelerating toward the target command.
- 8**: Consistent frequency** ─ Contact will be enabled an "ON (close)" state when the ac drive outputs a frequency consistent with the frequency set by rpm commands (master speed ~ speed at stage 15). (This function is rather unsuitable for being applied to rpm command of analog signal).。
- 9**: Overload pre-alarm** ─ contact will be enabled an "ON (close)" state when the ac drive detects an overload output; ac drive is still continuous to run with the (F85) electronic thermal relay enabled for time counting (unloading can be processed at this moment)

※ Overload = F90 (motor) rated current×(F84) current level of electronic thermal relay %

- 10**: Frequency to reach** ─ Contact will be enabled an "ON (close)" state when the ac drive outputs a frequency≧ frequency to reach (F76).

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting	
×	F76	Frequency to reach	0.00~300.00	Hz	60.00	50.00

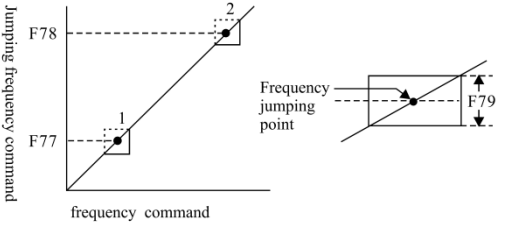
- The preset multifunctional output terminals will be maintained at ON state when output frequency ≥ set value of frequency to reach, and switched to OFF state if the output frequency goes down below the frequency to reach – 0.5Hz..



Jumping frequency

×	F77	Jumping frequency 1	0.00~300.00	Hz	0.00
×	F78	Reserved			0
×	F79	Jumping bandwidth	0.00~10.00	Hz	0.00

- Functions of jumping frequency and jumping bandwidth are applied to prevent the resonant vibration taken place to the mechanical or motor at some certain frequencies. It is bound to pass 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 jumping bandwidth will disable the function of frequency jumping.



Motor protection setup

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F80	Stall Protection setup	0~128		7

- **bit0 : Protection function F81** – To enable the function for stalling voltage protection during deceleration.
- **bit1 : Protection function F82** – To enable the function for stalling current protection during acceleration.
- **bit2 : Protection function F83** – To enable the function for stalling current protection during operation.
- **bit3 : Protection function F84** – To enable the function electronic thermal relay.
- **bit4 : AVR voltage-regulating function** – To enable the AVR function for output voltage (U.V.W.).
- **bit5 : Start magnetic brake function (32)** – During deceleration, can be assist braking function, smaller horsepower was better.
- **bit6 : Enable Ai1 break detection (64)** – Enable detection signal line disconnection function
- **bit7 : CT / VT mode switch(128)** – Enable transform CT/VT function, CT mode=150%/60 sec, VT mode=120%/60 sec

※When parameter setting VT mode, auto change F96=1, over load from 150%/60sec modify become 120%/60sec, and also all need suitable following condition;

(1)F97≧50.00Hz(2)F98≦220.0/440.0

(3)F101≦2.00Hz(4)F102≦11.0/2.0V

(5)F103≧30.0%, If out of range, a warning is displayed Err16

(6)When if bit5, bit6, bit7 three functions are enabled, you must set the value of 32 + 64 + 128 = 224

*** Digital increment tables**

Set values	AVR 2^4=16	F84 2^3=8	F83 2^2=4	F82 2^1=2	F81 2^0=1	Set values	AVR 2^4=16	F84 2^3=8	F83 2^2=4	F82 2^1=2	F81 2^0=1
0	×	×	×	×	×	16	○	×	×	×	×
1	×	×	×	×	○	17	○	×	×	×	○
2	×	×	×	○	×	18	○	×	×	○	×
3	×	×	×	○	○	19	○	×	×	○	○
4	×	×	○	×	×	20	○	×	○	×	×
5	×	×	○	×	○	21	○	×	○	×	○

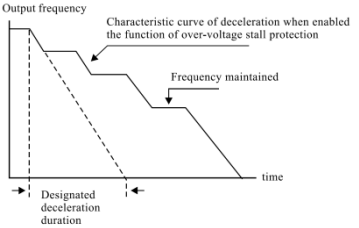
6	×	×	○	○	×	22	○	×	○	○	×
7	×	×	○	○	○	23	○	×	○	○	○
8	×	○	×	×	×	24	○	○	×	×	×
9	×	○	×	×	○	25	○	○	×	×	○
10	×	○	×	○	×	26	○	○	×	○	×
11	×	○	×	○	○	27	○	○	×	○	○
12	×	○	○	×	×	28	○	○	○	×	×
13	×	○	○	×	○	29	○	○	○	×	○
14	×	○	○	○	×	30	○	○	○	○	×
15	×	○	○	○	○	31	○	○	○	○	○

* ○ : protection function enabled

×: protection function disabled, no protection function when set value is 0.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F81	Setup for stalling voltage during deceleration	330.0~400.0 660.0~800.0	Vdc	380.0 760.0

- 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 heighten 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.

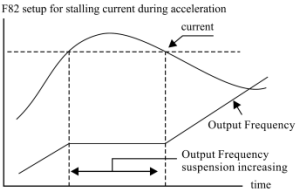


×	F82	Setup for stalling current during acceleration	30.0~200.0	%	170.0
×	F83	Setup for stalling current during operation	30.0~190.0	%	160.0

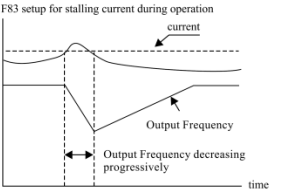
- When performing the acceleration or operation, the ac drive will stop accelerating (output frequency is paused from increasing) due to a too-fast acceleration or too-big motor load that leads to a quick rise of output current from ac drive to exceed the set value of stalling current level; ac drive will resume its acceleration provided that the current is lower than the set value..
- Stalling current level during acceleration= (F95) rated current of ac drive ×(F82) stalling current percentage
- Stalling current level during operation= (F95) rated current of ac drive ×(F83)

stalling current percentage

Example : stalling current level =4A ×170% = 6.8A



Function for stalling current protection during acceleration



Function for stalling current protection during operation

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F84	Current level of electronic thermal relay	1.01~2.00	F90	1.50
×	F85	Acting duration of electronic thermal relay	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 F88、F90 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 short 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 (F90) motor rated current , the timer for acting duration of electronic thermal relay will be actuated.

  *** $\int(I^2A(pu)-1)dt \geq (I*OL\ 2\ 1)\times TOL$, overload is overtime.**

○	F86	Output current restriction	30.0~200.0	%	180.0

- When output current exceeds the set value, ac drive will reduce the output voltage quickly to protect the over-current from tripping the ac drive; and a F83 set value less than F86 set value by more than 20% is the most ideal condition.

○	F87	Oscillation-inhibit gain	0.0~100.0	%	15.0

- When operating in some frequency bandwidth, the electric machine will produce current oscillation; then adjustment of this parametric set value can effectively correct this condition. The current oscillating bandwidth for a motor with higher horsepower will appear at a lower frequency bandwidth; therefore, it is advised to duly increase the set value. However, an excessive setting may easily produce an over-excited current, please make a suitable adjustment.

Motor nameplate and Drive parameter setting

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting	
×	F88	Rated frequency	40.00~70.00	Hz	60.00	50.00
×	F89	R.S.T Output voltage (rms)	150.0~255.0 300.0~510.0	V	220.0 440.0	200.0 380.0
×	F90	Rated current(rms)	0.1~(F95 ×1.3)	A	F95(Note)	

- F88、F90 is a parametric group for the rated values in motor nameplate and all be set in accordance with the rated values in motor nameplate; the ac drive will perform the functions of operation control, motor overload protection, etc. according to this parameter group.

*** Note: When F141 is resumed to its factory setting value, F90 will be resumed to a value the same as the F95 rated value.**

- F89 : R.S.T input voltage setup shall be the actual input voltage of the ac drive.

  Low voltage level = Vdc < 200V (200 Series) / Vdc < 400 V (400V Series).

  Over voltage level = Vdc > 414V (200 Series) / Vdc < 827 V (400V Series).

  Brake level = 360 Vdc ±3% for AC 200V Series,

  720 Vdc ±3% for AC 400V Series,

  Brake level is constant to the hardware.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F91	Rated slip frequency	0.00~10.0	Hz	4.00
○	F92	Slip compensation factor	0.0~200.0	%	50.0

- When the ac drive is driving the electric motor, an increase of motor load will increase the slip; so this parameter is to set up the compensation frequency to reduce the slip so that the operating rpm at rated current of the electric motor can further approach the synchronous rpm. the functions of slip frequency and the compensation factor are to overcome the load variation and control the motor at a constant speed as well.
- The rated slip of motor can be obtained from the following computation according to the data from the motor nameplate:

$$F91 = 60 - \frac{\text{Motor rpm} \times \text{motor's pole number (p)}}{120}$$

Example:

$$F91 = 60 - \frac{1720(RPM) \times 4(P)}{120} = 2.6(Hz)$$

$$F92 = F91 \times 90\%(Note) = 2.34(Hz)$$

* Note : The unit for the set value of upper limit for slip compensation function is %, please set 90% as the slip compensation factor; for a motor with a slightly bad performance, it is advised to adjust the slip compensation factor higher.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F93	PWM carrier frequency	1000~16000	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	Thermal runaway	Torque	Harmonic rate
1KHz	High	Low	Low	High	Low
↕	↕	↕	↕	↕	↕
16KHz	Low	High	High	Low	High

×	F94	Vdc gain(read only)	50~300	Fold	140

- This parameter is to tune the gain of DC-BUS at both ends of capacitor while the result will be displayed (F4 = 5 : Vdc) and taken as one of the important parameters for internal control operation.

×	F95	Rated current of ac drive (read only)	1.0~1000.0	A	5.0

- This parameter is to display the rated current of ac drive while the rated current to this ac drive has been set at ex-factory.

V/F curve setup

×	F96	V/F curve selection	0~1		0

- **0 : 3-point straight line setup** – A mode to be applied to general applications, the same as a transportation system moving along a straight line; no matter the rpm will be, the loading torque is always constant.
- **1 : 2-point curve setup** – A mode to be applied to a torque with proportional load; such as the cooling fan, pump, etc.

×	F97	Max. voltage frequency setup	0.10~300.00	Hz	60.00	50.00
×	F98	Highest output voltage setup	0.1~255.0 0.2~510.0	V	220.0	190.0
					440.0	380.0

- The set values of F97 and F98, the maximum output frequency and the voltage shall be the set values of rated frequency and voltage set in the motor's nameplate.
- A F97 set value less than the rated frequency of electric machine may possibly result in an over-current output from the ac drive that may damage the electric machine or trigger the over-current protection of ac drive; and a F97 set value higher than the rated frequency of electric machine may possibly lead to a short torque output from the electric machine.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting	
×	F99	Selective setup for intermediate frequency	0.10~300.00	Hz	3.00	2.50
×	F100	Selective setup for intermediate voltage	0.0~255.0 0.0~510.0	V	12.5 25.0	10.8 21.6
×	F101	Min. output frequency setup	0.10~20.00	Hz	1.50	1.25
×	F102	Min. voltage setup	0.0~50.0 0.0~100.0	V	7.0 14.0	6.0 12.1

- The set values of F99~F102 shall be based on the following basic calculation in accordance with the motor's rated voltage and frequency :
  220V (rated voltage) ÷ 60Hz (rated frequency) = 3.67 V/Hz

  Reference value for setting the intermediate voltage :
  3.67 × F99 (intermediate frequency is to take 3Hz as the basis) × Voltage-boosting rate%
  Ex. : F99 = 3Hz, Voltage-boosting rate 150% **(Max. rate shall not exceed 180%)**
  3.67 × 3Hz × 150% = 16.5V

  Reference value for setting the minimum voltage :
  3.67 × F101 (the minimum frequency is to take 1.5Hz as the basis) × voltage-boosting rate %
  Ex. : F101 = 1.5Hz, voltage-boosting rate 175% **(Max. rate shall not exceed 200%)**
  3.67 × 1.5Hz × 175% = 9.6V
- **Since the rated capacity varies with different motors, please see Appendix B (P10-1) for the ex-factory set values.**
- **Selection of high start torque (Figure 3) shall be applied only to a place where the wiring length from output side to the motor side is longer than 150m or a place having a bigger voltage drop (Normally this curve shall not be selected).**
- F102 – Minimum voltage setup, is the Boost function; when an output of low rpm and high torque is needed, please adjust to increase the F102 set value stepwise and confirm the motor current.

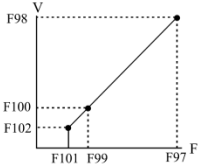


Figure 1
(General application)

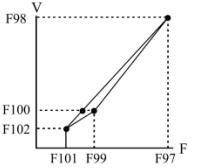


Figure 2
(FAN, water pump machines)

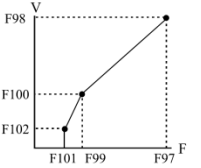
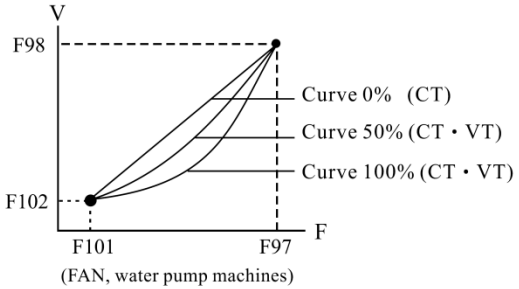


Figure 3
(high start torque)

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F103	Curve adjustment gain	0.0~100.0	%	30.0



(FAN, water pump machines)

* The user is requested to make the adjustment carefully without setting the value too big.
* VT mode can only operate 2-point V/F curve control with a gain value (F103) operating within 30%~100%.
* When setting the V/F curves, please follow their respective application to set up the curves under the conditions: F97>F99>F101, F98>F100>F102.
* VT mode restricts the following parameter ranges :
  (1) F97 ≥ 50.00 Hz or 60.00Hz
  (2) F98 ≤ 200.0V or 220.0V / 380.0V or 440.0V (3)
  F101 ≤ 2.00 Hz
  (4) F102 ≤ 8.5V or 9.5V / 17.0V or 19.0V
  (5) F103 ≥ 30.0%, restriction will be enabled with Err = 16 warning indication when exceeding the range.
* Please see Appendix B for ex-factory set values. (P10-1)

Communication setup

×	F104	RS485 communication address	1~254		1

♦ The legal communication addresses of ac drive is ranging 1~254 that stands for the communication address of ac drive in the communication network; also, the Master device (PC or PLC serves as the Master unit) can perform a remote monitoring according to the communication addresses designated to each ac drive.

Caution : There shall be no two (or more than two) ac drives having the identical communication address in the same communication network.

×	F105	Data transfer rate	0~4		2

■ **0 : 2400** ■ **1 : 4800** ■ **2 : 9600** ■ **3 : 19200** ■ **4 : 38400**

♦ 2400 Bps Bits per second 2400 / 8 = 300 Bytes/Second
Transfer rate is related to the length and quality of transmission cable; if a long transmission cable is selected, it is advised to select a lower transfer rate so as to obtain a higher transfer quality and stability. If an ac drive with a faster responding speed is desired, in addition to adjust a higher transfer rate, it is advised to adjust the F107 communication response delay time as well.

×	F106	Communication data format	0~3		0

■ 0 : 8, N, 1 RTU (1 start bit + 8 data bits + 1 stop bit)
■ 1 : 8, E, 1 RTU (1 start bit + 8 data bits + 1 Even bit + 1 stop bit)
■ 2 : 8, O, 1 RTU (1 start bit + 8 data bits + 1 Odd bit + 1 stop bit)
■ 3 : 8, N, 2 RTU (1 start bit + 8 data bits + 2 stop bit)

×	F107	Communication response delay time	3~50	ms	5

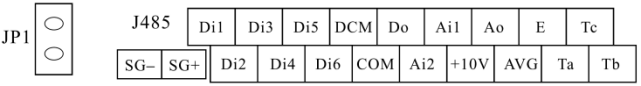
* The responding time of ac drive is the delay time for ac drive to send out the response signal after receiving the command signal from the Master device; because of that responding time of each Master device varies with the time interval from one packet to the next packet; therefore, if a responding time of ac drive is set too short to go with the responding time of Master device, then a phenomenon to have the responding signal overlapped with the command signal in the communication network may take place. Thus, the responding time of ac drive shall be set up according to different responding time of master devices.

×	F108	Receiving failure response	0~8		0

■ **0 : Receiving normal**
■ **1 : Function code error**
■ **2 : CRCL error**
■ **3: CRCH error**
■ **4: Packet-receiving time over 0.2 second**
■ **5: Set parameter unchangeable during operation**
■ **6: Parameter code error**
■ **7: Parameter value out of range**
■ **8 : Locked parameter, unchangeable set values (except F4,F18,,F142)**

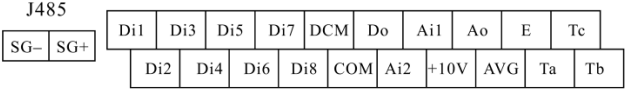
MODBUS communication

LS650M Series :



* When enabling the MODBUS communication is desired, it is necessary to set up the F73 (Di8 : 15 MODBUS communication) and insert the JP1 (JP1 is for Di8 function). (Note 1)

LS650 Series :



* When enabling the MODBUS communication is desired, it is necessary to set up the F73 (Di8 : 15 MODBUS communication) and connect the Di8 to COM. (Note 1)
* (Note 1) : The RS-485 is the internally exclusive communication format for digital operation panel; and a different communication format shall be applied to the external (SG-, SG+) MODBUS communication monitoring; do not connect them at the same time for operation; only single format is allowed to be enabled.

♦ Communication procedures between RS485 MODBUS and PLC

(1) First, take the digital operation panel to set up the F73 = 15 : MODBUS (Set Di8 terminal to MODBUS function and leave this terminal open-circuited).

(2) Again take the digital operation panel to set up the communication mode parameters (F104~F107) as follows :

F104 : Communication address of ac drive (1~254)

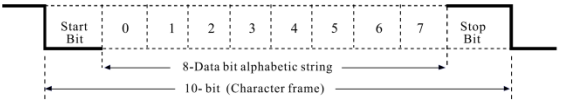
Caution : The legal communication addresses are ranging from 1 to 254; if the communication address is set to 0, it means to perform broadcasting to all motor actuator. Under such a mode, the motor actuator will not respond any message to the master device.

F105 : PC transfer rate (0~4)

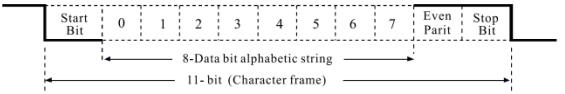
0 : 2400, 1 : 4800, 2 : 9600, 3 : 19200, 4 : 38400

F106 : Communication data format (0~3)

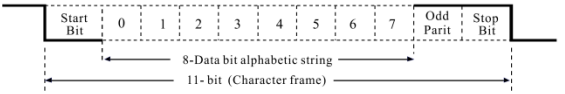
0 : (8 , N , 1) RTU (1 Start bit + 8 data bits + 1 stop bit)



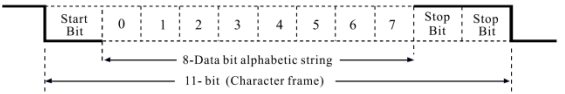
1 : (8 , E , 2) RTU (1 Start bit + 8 data bits + 1 Even bit + 1 stop bit)



2 : (8 , O , 2) RTU (1 Start bit + 8 data bits + 1 Odd bit + 1 stop bit)



3 : (8 , N , 2) RTU (1 Start bit + 8 data bits + 2 stop bit)



F107: Responding time of ac drive (3~50ms)

(3) When taking the RS485 MODBUS communication to control the ac drive is desired, please set up the F7 = Operation control source to 0 (Digital operation panel) or MODBUS communication, and the F8 = frequency command source to 0(Digital operation panel). The rest of mode setups are for operation-monitoring functions. (Digital operation panel is configured in digital data format).

(4) Please disconnect the digital operation panel from the ac drive, and set the F73 (Di8:15 MODBUS communication) to (LS650) and connect the Di8 and COM (The insertion of JP1 is necessary to LS650M)

(5) When communication has no response, just read the receiving failure code (F108) to find out the causes.

- **0 : Receiving normal**
- **1 : Function code error**
- **2 : CRCL error**
- **3: CRCH error**
- **4: Packet-receiving time over 0.2 second**
- **5 : Set parameter unchangeable during operation**
- **6 : Parameter code error**
- **7 : Parameter value out of range**
- **8 : Locked parameter, unchangeable set values (except F4,F18,F142)**

Communication data structure (the data contents are 16-bit numbered format)

i. Keep the no-input-signal state ≥ 10ms
ii. D1 : Communication address
iii. D2 : Functional code
iv. D3 : Data 1 Content (H)
v. D4 : Data 1 Content (L)
vi. D5 : Data 2 Content (H)
vii. D6 : Data 2 Content (L)
viii. D7 : Check code (CRCL)
ix. D8 : Check code (CRCH)
x. Keep the no-input-signal state ≥ 10ms

(6) **Command function code** :

03H : To read the parameters set to and displayed by ac drive
06H : To write in the operation parameters of ac drive and set up parameters
08H : Loop detection

1. [03H] To read the parameters set to ac drive (D2=03H, D3=00H)

A. PC calls :		B. Ac drive responds :	
D1: Communication address	(00~FFh)	D1: Communication address	(00~FFh)
D2: Function code	(03h)	D2: Function code	(03h)
D3: #th set parameter (H)	(00h)	D2: Number of byte for parameter content 2*(0nh)	
D4: #th set parameter (L)	(00~D2h)	D3: Content of set parameter 1(H)	(00~FFh)
D5: Number of data entry (H)	(00h)	D4: Content of set parameter 1(L)	(00~FFh)
D6: Number of data entry (L)	(0nh)	……	
D7: CRCL		……	
D8: CRCH		Dm-3: Content of set parameter n(H)	(00~FFh)
		Dm-2: Content of set parameter n(L)	(00~FFh)
		Dm-1: CRCL	
		Dm: CRCH	
*** Number of data entry n = 1~12**		*** m = 5 + 2 * n**	

Ex. : To read the set values of parameters from the ac drive (F18 Note 1, F19)
Responding data : F18=60.00Hz, F19=5.00Hz Note 2

* Note 1 : F18=0012h, Number of data entry: 2 entries
Note 2 : Responding data will be displayed without decimal points, so 60.00Hz=6000=1770h, 5.00Hz=500=01F4h

Calling commands at PC side are as follows:		Responding data from ac drive are as follows:	
Communication address	01h	Communication address	01h
Functional code	03h	Functional code	03h
18th set parameter (H)	00h	Number of data entry	04h
18th set parameter (L)	12h	Contents of F18 parameter (H)	17h
No. of data entry (H)	00h	Contents of F18 parameter (L)	70h
No. of data entry (L)	02h	Contents of F19 parameter (H)	01h
		Contents of F19 parameter (L)	F4h
CRCL	64h	CRCL	FEh
CRCH	0Eh	CRCH	4Bh

2. [03H] To read the parameters operation displayed by ac drive (D2=03H, D3=21H)

Ex. : To read the indicating values from the operation of ac drive (2101h, Note 1, output frequency) (Responding data : 60.00 Hz Note 2)

* Note 1 : 2101h=8449, Number of data entry: 1 entries

Note 2 : Responding data will be displayed without decimal points, so 60.00Hz=6000=1770h

Calling commands at PC side are as follows:		Responding data from ac drive are as follows:	
Communication address	01h	Communication address	01h
Functional code	03h	Functional code	03h
Read the indicating parameter (H)	21h	Number of data entry	02h
Read the indicating parameter (L)	01h	Operation-indicating value (H)	17h
No. of data entry (H)	00h	Operation-indicating value (L)	70h
No. of data entry (L)	01h	……	
CRCL	DFh	CRCL	B6h
CRCH	F6h	CRCH	50h

2100h: Frequency command(F); 2101h: Output power supply frequency(H); 2102h: Output current(A);
2103h: Output voltage (E); 2104h: Unitless(H); 2105h: Unitless(L);
2106h: Normal voltage at DC side (Vdc); 2107h: Voltage at DC side before startup (Vdc); 2108h: Reserved;
2109h: Ai1(%); 210ah: Ai2(%); 210bh: PID(%);
210ch: Input status at digital terminal; 210dh: ERR; 210eh: Reserved;

Response-display parameters :	Data format in expression	Response-display parameters :	Data format in expression
0 : Set frequency (F)	×××.××(F)	8 : Digital operation panel Ai (%)	×××.×
1 : Output frequency (H)	×××.××(H)	9 : Ai1(%)	×××.×
2 : Output current (A)	×××.×(A)	10 : Ai2 (%)	×××.×
3 : Output voltage (E)	×××.×(E)	11 : PID (%)	××××
4 : Unit less (H)	××××.×(H)	12 : Input status at digital terminal	Di8 ~ Di1
5 : Unit less (L)	××××.×(L)	* Digital input display is expressed in bit method and the max. display value is 255. (for detailed introduction, please see P.3-5 for details).	
* (2^{15}=65535) is displayed in unitless word (L); for a displayed value that exceeds (>65535), it will be displayed in unitless word (H) (2^{31}); they are differentiated by two words (H, L) for display.		13 : (ERR) 1 ~ 17	××
6 : Normal voltage at DC side (Vdc)	×××.×	* Error display message will be indicated in number only, please see P5-26 for details.	
7 : Voltage at DC side before startup (Vdc)	×××.×	* To display the content with decimal points, the first digit of demical point will be divided by 10 and the second digit will be divided by 100.	

* Note: (-) denotes a reversal running direction.*

3. [06H] To write in the set parameters of ac drive (D2=06H, D3=00H)

A. PC calls :		Ac drive responds :	
D1: Communication address	(00~FEh)	D1: Communication address	(00~FEh)
D2: Function code	(06h)	D2: Function code	(06h)
D3: #th set parameter (H)	(00h)	D3: #th set parameter (H)	(00h)
D4: #th set parameter (L)	(00~D2h)	D4: #th set parameter (L)	(00~D2h)
D5: Write-in content of parameter (H)	(00~FFh)	D5: Write-in content of parameter (H)	(00~FFh)
D6: Write-in content of parameter (L)	(00~FFh)	D6: Write-in content of parameter (L)	(00~FFh)
D7: CRCL		D7: CRCL	
D8: CRCH		D8: CRCH	

4. [06H] To write in the operation parameters of ac drive (D2=06H, D3=20H, D4=00H)

A. PC calls :		B. Ac drive responds :	
D1: Communication address	(00~FFh)	D1: Communication address	(00~FEh)
D2: Function code	(06h)	D2: Function code	(06h)
D3: #th operating parameter (H)	(20h)	D3: #th operating parameter (H)	(20h) D4:
D4: #th operating parameter (L)	(00h)	#th operating parameter (L)	(00h)
D5: Write-in content of parameter (H)	(00h)	D5: Write-in content of parameter (H)	(00h)
D6: Write-in content of parameter (L)	(00~05h)	D6: Write-in content of parameter (L)	(00~05h)
D7: CRCL		D7: CRCL	
D8: CRCH		D8: CRCH	
2000h(D6 operation control): 0: Stop 1: FWD 2:REV 3: Inching FWD 4: Inching REV 5: Failure reset			
F18 : (Master speed command)			

Ex. : ① Writing to enable the ac drive to perform setup in 50.00Hz
② Writing to enable the ac drive to perform the running command 2000h: 1, FWD running

* Note 1 : F18=0012h, 50.00Hz=5000=1388h
Note 2 : Running command=2000h=8192, FWD rotation=0001h

Calling commands at PC side are as follows:	①50Hz	②FWD running	Responding data from ac drive are as follows:	①50Hz	②FWD running
Communication address	01h	01h	Communication address	01h	01h
Functional code	06h	06h	Functional code	06h	06h
18th set parameter (H)	00h	20h	18th set parameter (H)	00h	20h
18th set parameter (L)	12h	00h	18th set parameter (L)	12h	00h
No. of data entry (H)	13h	00h	Contents of set parameter (H)	13h	00h
No. of data entry (L)	88h	01h	Contents of set parameter (L)	88h	01h
CRCL	24h	43h	CRCL	24h	43h
CRCH	99h	CAh	CRCH	99h	CAh

5.[08H] Loop detection (D2=08H)

(7) 08H : Loop detection	
A. PC calls : D1: Communication address (00~FEh) D2: Function code (08h) D3: Test content of parameter (1) (00~FFh) D4: Test content of parameter (2) (00~FFh) D5: Test content of parameter (3) (00~FFh) D6: Test content of parameter (4) (00~FFh) D7: CRCL D8: CRCH	B. Ac drive responds : D1: Communication address (00~FEh) D2: Function code (08h) D3: Test content of parameter (1) (00~FFh) D4: Test content of parameter (2) (00~FFh) D5: Test content of parameter (3) (00~FFh) D6: Test content of parameter (4) (00~FFh) D7: CRCL D8: CRCH

Ex. : Loop testing commands

Calling commands at PC side are as follows :		Responding data from ac drive are as follows :	
Communication address	01h	Communication address	01h
Functional code	08h	Functional code	08h
Content of test parameter (1)	01h	Content of test parameter (1)	01h
Content of test parameter (2)	02h	Content of test parameter (2)	02h
Content of test parameter (3)	03h	Content of test parameter (3)	03h
Content of test parameter (4)	04h	Content of test parameter (4)	04h
CRCL	41h	CRCL	41h
CRCH	04h	CRCH	04h

CRC production steps :

1. CRC = 0FFFFh
2. CRC = (CRC) XOR (D1)
3. Determine if CRC's BIT0 is 1?
   Yes : CRC = (CRC >>1) XOR (0A001h)
   No : CRC = CRC >> 1
   * >>1 : right-shift for one digit input 0 to higher bits.
4. Again, repeat the step 3 for 7 times (that is, the step 3 shall be executed 8 times in total)
5. Download the data of next entry D2.
6. Repeat steps 2~4
7. Repeat steps 5 and 6 until all the data (D1~D6) have been executed; and then the final value is the CRC value.
8. D7 is the low 8-bit CRC while D8 is the high 8-bit CRC..

Failure record

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F109	Current failure record	0~24		0
×	F110	Failure record of last time	0~24		0
×	F111	Failure record of last two times	0~24		0
×	F112	Failure record of last three times	0~24		0
×	F113	Number of failure-auto reset time during operation	0~10		0

- F113 (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.; in case there are safety concerns, please cancel the F113 auto reset function.
- 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 ~ F10 for functions to set a delay of time to start the operation.
- F113 auto-reset will not respond to the failure taken place during the standby state F xx.xx, please press the RESET pushbutton to reset and clear it.
- If the operation control source is set to F7:0 Digital operation panel, then F113 will auto reset and restart the operation when a failure taken place; when any failure phenomena taken place during the operation of ac drive, F113 will automatically reset and remove the failure (auto reset disabled when set 0); in case there are safety concerns, please cancel the F113 auto reset function.
- If the operation control source is set to F7:1 Digital input terminal, then F113 will auto reset and operate under the current control mode when a failure taken place.

Error code	Descriptions
Err 0	Communication of digital operation panel failed
Err 1	Over-current during standby state (hardware detection and protection)
Err 2	Over-current during acceleration (hardware detection and protection)
Err 3	Over-current during deceleration (hardware detection and protection)
Err 4	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) during operation

Error code	Descriptions
Err 8	Electronic thermal relay activated
Err 9	AC drive overloaded longer than the allowable time duration (150%, 60 seconds/CT, 120%, 60 seconds/VT)
Err 10	Over temperature, or PF or PUF malfunction
Err 11	DSP-saved parameters are locked and unable to change them.
Err 12	Parameter setup error 0 (Out of range)
Err 13	Parameter setup error 1 (Di repeated setting)
Err 14	Parameter setup error 2 (F101>F99>F97,F15>F16)
Err 15	Parameter setup error 3 (F90>F95×1.3)
Err 16	VT parameter setup error (F97,F98,F101,F102,F103)
Err 17	Program code error
Err 18	Signal disconnection
Err 21	Over-voltage during standby state (hardware detection and protection)
Err 22	Over-voltage during acceleration (hardware detection and protection)
Err 23	Over-voltage during deceleration (hardware detection and protection)
Err 24	Over-voltage during speed regulation (hardware detection and protection)
Err 19 ～ Err 20 reserved for failure signals.	

External PID

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F114	PID mode	0~4		0

- **0 : PID disabled** – PID control disabled.
- **1: Stop and reset PID value to Zero** – 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.
- **3: Di enabled (Stop and reset PID value to zero)** – 13: Enable PID function can be set up from any one terminal of the external terminals Di (F68 ~ F73); and operation values of PID control will not be reserved if a STOP command is input while executing the PID control.
- **4: Di enabled (Stop and reserve PID values)** – 13: Enable PID function can be set up from any one terminal of the external terminals Di (F68 ~ F73); and

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.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F115	PID command source	0~3		0

■ **0 : F122 PID command value setup** ■ **1 : Ai(V.R)** ■ **2 : Ai1** ■ **3 : Ai2**

×	F116	PID feedback source	0~1		0

⧫ Select the input terminal to function as the detecting source of PID feedback point.

Set value	Function	Description
0	Ai1 input	⧫ Input terminal of analog signal command for external feedback value. ⧫ Parameter F55~F62 will undertake the adjustment and setup for the gain and shift of analog signal commands.
1	Ai2 input	

○	F117	Setup of input filtration time D	0.05~10.00	Second	0.20

⧫ D input is serially connected to a low-pass filter to filter out the high-frequency noise. Time constant τ = F117/2.3.

○	F118	PID output limit	0.00~100.00	%	100.00
○	F119	Kp	1.00~300.00	%	100.00
○	F120	Ki	0.00~300.00	%	25.00
○	F121	Kd	0.00~300.00	%	2.00
○	F122	PID command value setup	0.00~100.00	%	50.00

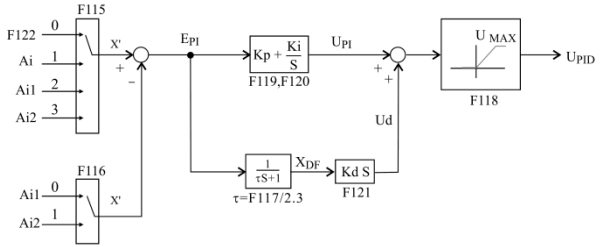
⧫ Kp control : To adjust an output of proportional operating magnitude according to the deviation of response. Entry of a big gain will obtain a fast response, but a too-big gain will cause oscillation; entry of a small gain will obtain a slow response.

⧫ Ki control : To adjust an operating gain of output 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 adjust an operating gain of differential deviation so as to respond 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 command value setup control is to set a parameter as the constant command target value to proceed the control.

PID Control block diagram :



Auto operation function

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F123	Auto operation mode	0~4		0

■ **0 : Auto operation mode disabled** – Automatic operation is inoperative.

■ 1**: Stop follows a reciprocating operation** – To perform a reciprocating Operation from master speed to stage 15 speed.

◎ **Reciprocating operation** – To run from the master speed→ stage 1 stage speed…15 speed →stage 15 speed →stage 14 speed…master speed → master speed …, etc.; that is, running from forward sequence to backward sequence as one cycle for 32 speeds in total and the operation follows to run reciprocally and continuously. The number of cycle can be set by F124 while the number of cycle and the stage speed can be displayed in the 7-stage display screen; after the number of time of operation cycles are over, the operation stops automatically.

■ 2**: Stop follows a cyclic operation** – To perform the automatic operation from the master speed to the stage 15 speed in a clockwise manner.

◎ **Cyclic operation** – Master speed→ stage 1 speed…stage 15 speed→ master speed→ stage 15 speed…, etc. in a clockwise manner; 16 speeds in total for one cycle, and operation follows to run cyclically and continuously. The number of cycle can be set by F124 while the number of cycle and the stage speed can be displayed in the 7-stage display screen; after the number of time of operation cycles are over, the operation stops automatically.

■ 3**: Master speed follows a reciprocating operation** – The executing method is the same as the 1 : Reciprocating operation, but, operation will be running at master speed instead after the number of operation cycles are over.

■ 4**: Master speed follows a cyclic operation** – the executing method is the same as the 2 : Cyclic operation, but, operation will be running at master speed instead after the number of operation cycles are over.

Caution : After enabling the auto operation setup, the multi-function input terminal 11: auto operation and 12: pause auto operation shall govern. Its priority is superior to other rpm commands; therefore, selection of command to run at other speed is not available once the auto operation is enabled. (set values 1~4 are for enabling the auto operation).

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F124	Number of cycles	1~3000	time	1

◎ The number of running cycle needed for auto operation.

×	F125	Auto operation mode master speed time	-30000~30000	Second	1
×	F126	Auto operation mode stage 1 time	-30000~30000	Second	0
×	F127	Auto operation mode stage 2 time	-30000~30000	Second	0
×	F128	Auto operation mode stage 3 time	-30000~30000	Second	0
×	F129	Auto operation mode stage 4 time	-30000~30000	Second	0
×	F130	Auto operation mode stage 5 time	-30000~30000	Second	0
×	F131	Auto operation mode stage 6 time	-30000~30000	Second	0
×	F132	Auto operation mode stage 7 time	-30000~30000	Second	0
×	F133	Auto operation mode stage 8 time	-30000~30000	Second	0
×	F134	Auto operation mode stage 9 time	-30000~30000	Second	0
×	F135	Auto operation mode stage 10 time	-30000~30000	Second	0
×	F136	Auto operation mode stage 11 time	-30000~30000	Second	0
×	F137	Auto operation mode stage 12 time	-30000~30000	Second	0
×	F138	Auto operation mode stage 13 time	-30000~30000	Second	0
×	F139	Auto operation mode stage 14 time	-30000~30000	Second	0
×	F140	Auto operation mode stage 15 time	-30000~30000	Second	0

◎ To set up the time and direction of operation for each stage. The setup of negative number of seconds is for performing the REV running and the counting time while the positive number of seconds are for performing the FWD running and counting time. If controlling the FWD and REV operation is desired, please see F14 setup for details.

◎ When setting up the auto operation stage & speed, the speed for any one stage can be set to 0Hz frequency as the time-counting stop function; or when running at any one of the stage speed frequency is not desired, just set there of running time to zero to skip it and perform the next stage speed frequency; for descriptions of stage, speed and running speed frequency, please see parameter setup F18 ~ F33.

*** The positive & negative signs shown in F125~F140 denote the running direction.**

Retrieval parameters

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F141	Retrieval parameters	0~6		0

■ 0 : Not recalled

■ 1: 220V/440V,60Hz factory settings – Retrieve the original 220V/440V,60Hz ex-factory settings.

■ 2: 220V/400V,50Hz factory settings – Retrieve the original 220V/440V,50Hz ex-factory settings

■ 3: 200V/380V,60Hz factory settings – Retrieve the original 200V/380V,60Hz ex-factory settings

■ 4: 200V/380V,50Hz factory settings – Retrieve the original 200V/380V,50Hz ex-factory settings

※ Parameters F94, F95, F109~F112 are excluded from this retrieval function.

■ 5: Clearance of failure records – ♦ Any faulty phenomena taken place during the operation of ac drive will be recorded in the parameters F109 ~ F112.
♦Enable the function of F141 : 5 clearance of failure records to clear the contents of failures saved in the memory.

■ 6： All called back parameters (read-only) —This item permissions must be original factory execution

○	F142	Lock the functional parameters	0~1		0

■ **0 : Changeable** – All set values of parameters can be saved in the EEPROM memory of DSP.

■ **1 : Functional parameters locked** – This function is able to lock most of the contents of parameters; the contents are unchangeable and for display only.

* Parameters F4, F18 are exempted from this restriction of locking the functional parameters, they are changeable.

Water pump function

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F143	Enable the water pump function	0~1		0

■ **0 : Disable**

■ **1 : Enable** – To enable the constant-pressure control function of water pump (F144~F146), standby operation and warming-up function (F147~F149) and protective function for no-water operation of water pump (F150~F152).

×	F144	Sleep-detecting time	5~30000	Second	30

- When pressure of water pump ≥ F0: set value of water pressure, function F144: sleep-detecting time will be enabled for detection.

×	F145	Sleep level	0.0~100.0	%	50.0

- When the operating frequency goes below the F145: sleep level, pump will be reduced the speed to 0.0Hz and enter into a standby status. (This function can save the water pump from running at ineffective area).
- Sleep frequency = F16 : set value of upper frequency limit × F145 : sleep level %. Example: Sleep frequency (30.00Hz) = F16 : 60.00Hz × F145 : 50.00%

×	F146	Wake-up pressure error	0.0~100.0	%	15.0

- When pressure < F146 : set value of wake-up error, ac drive is enabled to start to run.
- Wake-up pressure = F0 : set value of water pressure – (F0 : set value of water pressure × F146 : set value of wake-up pressure error).

×	F147	Time for detection of standby operation	0~30000	Second	900
×	F148	Standby operation time	0~30000	Second	60
×	F149	Standby operation frequency	0.00~300.00	Hz	0.00

- They are standby operation functions of water pump applicable to cope with the requirements of some special places.
- When pressure of water pump ≥ F0 : 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 F147: Time for detection of standby operation is enabled; when the time counting is up, F149: standby operation frequency and F148: standby operation time will be enabled to access a repeatedly cyclic control.

- Under a standby operation mode with a 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 F149 : standby operation frequency will disable the standby operation mode.

Changeable during operation	Parameter	Description	Range	Unit	Ex-factory setting
×	F150	Low water pressure (no water) detection level	0.0~100.0	%	8.0
×	F151	Time of low water pressure detection	0~12000	Second	60
×	F152	Time of no-water standby and restart	0~30000	Second	1200

- When water pump is running at a water pressure < F150 : low water pressure detection level, the time counting of F151 : low water pressure detection time is enabled; when the time counting is up, F152 : no-water standby and restart time will be enabled; at this moment, the parameter F4: setup 12: 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 supply side, rupture of water pipe or malfunction of pressure detector (open-circuit).

×	F153	Pressure sensor rated value	1.0~99.9	Kg/c㎠	10.0

- When leaving the plant take pressure Sensor 10.0kg/c㎠ - (0.0~10.0Vdc or 4~20mA) as the datum.
- 1Bar = 1.02 kg- c㎠
  1.0kg- c㎠=0.98Bar

×	F154	Ai1 Pulse wave frequency instruction	0.0~1000.0	ms	0.0

- 0.0~9.9:Ai1 pulse wave frequency pattern expiration ─ When F154 below pulse wave number setting value 10.0ms, the Ai1 analogy input pulse wave frequency does not start.
- 10.0~1000.0:Ai1 pulse wave frequency pattern start ─ When establishes this function, the Ai1 analogy input frequency instruction origin compulsion carries out the frequency revolution by the PWM pulse wave number.

※ When uses this function, must be establish F4 = 2：Ai1 first, (for example PLC and so on) meets the pulse wave out-port to frequency changer post Ai1, the AVG position, then inputs F154 above 10.0ms the setting value (pulse wave cycle not to be smaller than 10.0ms).

※ Pulse wave signal accurate position: above 2.5V is below Hi, 2.5V is Lo. (MAX input voltage 10V)

※ Equivalent input analogy voltage $\overline{V}_{in}$ = setting value of the 0V correspondence to the F55, $\overline{V}_{in}$ = setting value of the 10V correspondence to the F56, F57, F58 the function hypothesis and the analogy signal input function is the same, may also prevent the miscellaneous news disturbance.

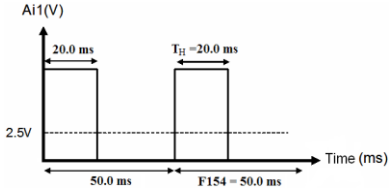
Example：F4 = 2：Ai1, F16 = 60.00Hz, F55=0.00%, F56=100.00%, F57=0.00%, F154=50.0ms, if time TH = 20ms, the output frequency computation is as follows：

Equivalent input analogy voltage：$\overline{V}_{in} = 10V \times \frac{T_H}{F154} = 10V \times \frac{20.0\ ms}{50.0\ ms} = 4V$

Corresponding frequency percentage：

$$A_{i1}(\%) = F55 + \frac{\overline{V}_{in}}{10V} \times (F56 - F55) = 0.00\% + \frac{4V}{10V} \times (100.00\% - 0.00\%) = 40.00\%$$

Output frequency：$F_e = \frac{A_{I1}(\%)}{100.00\%} \times F16 = \frac{40.00\%}{100.00\%} \times 60.00Hz = 24.00Hz$



×	F155	Cumulative running time(Days)	0~30000	Day	0

∗When you press the start key FWD or REV, immediately began to calculate, the total unit count in days

×	F156	Cumulative running time(Min)	0~1440.0	Min	0

∗When you press the start key FWD or REV, immediately began to calculate, the total unit count in Minutes

VI Protection and troubleshooting

Troubleshooting chart

♦ This Chapter covers the diagnostics and remedy actions relevant to the failure of ac drive, and the analysis of problem and solutions relevant to the faulty phenomena of motor.

<Table> Failure indication and remedy action

Displayed error code	Description	Possible causes	Remedy actions
Err 1	Over-current during standby state (hardware detection and protection)	● Phase-phase short-circuits or grounding short-circuit taken place to output wire.	● Please verify the output wire to remove any short-circuited phenomena.
Err 2	Over-current during acceleration (hardware detection and protection)	● Started from motor's idling (easy to cause over-voltage or over-current). ● Acceleration time too short (easy to cause over-current) ● Any leakage due to poor insulation of the motor	● Please set F9, F10 for braking time and braking current ● Extend the acceleration time appropriately. ● Check motor isolation or change new one.
Err 3	Over-current during deceleration (hardware detection and	● Deceleration time too short (easy to cause over-voltage or over-current)	●Extend the deceleration time appropriately (setup shall comply with the deceleration time required by GD^2.)
Err 4	Over-current during speed regulation (hardware	● Motor was driven to start by an external force ● Drastic changing load	● Correct the system and remove the source of external force. ● Change the load smoothly.
Err 5	External failure	● External failure signal input from digital input terminals (Di3~Di8)	● Remove the cause of external failure.
Err 6	DC over voltage (O.V) during operation	● Input voltage of power supply (R.S.T) too high to exceed the DC protection level ● Deceleration time too short, motor's regenerative energy too big. (Input 200Vac: O.V 414Vdc/ 400V: O.V 827Vdc)	● Lower the input voltage of power supply. ● Extend the deceleration time, or connect the brake resistance (or brake controller).
Err 7	DC low voltage (L.V) during operation	● Momentary power outage left the voltage lower than the DC protection level (200V: L.V 200Vdc/ 400V: L.V 400Vdc) ● Voltage of input power supply too low.	● Please examine for the cause and improve the quality of power supply.
Err 8	Electronic thermal relay enabled	● Loading current of motor exceeded the internal electronic thermal set values (F84, F85 and F90) ● F102:Min.output voltage and F101: Min voltage / frequency were set too high in the V/F setup.	● Please correct the motor load and check the parameters (F84, F85 and F90) for correctness. ● Please re-examine the set values of parameters (F101 and F102) for V/F characteristic ● Adjust the F90: rated current of motor a little bit higher.

Displayed error code	Description	Possible causes	Remedy actions
Err 9	AC drive overloaded longer than the allowable time (150%, 60 seconds/CT) (120%, 60 seconds/VT)	● CT mode: ac drive is loaded a current over the rated current by 150% for 60 seconds. ● VT mode: ac drive is loaded a current over the rated current by 120% for 60 seconds.	● Please examine if the value exceeds the rated value in F95. CT: (150%, 60 seconds), (175%, 27.5 seconds), (200%, 3 seconds) VT: (120%, 60 seconds), (145%, 27.5 seconds), (170%, 3 seconds)
Err 10	Temperature of heat sink too high	● Faulty operation of cooling fan ● Ambient temperature too high	● Change the cooling fan. ● Increase the air-changing volume of environment.
	PF input power supply under phase or voltage too low	● Wiring obstructer or magnetic contactor defectively enabled. ● Loosened wiring terminals of input power supply. ● Fluctuation too big for voltage of input power supply	● Check the cause, take remedy actions and restore power. ● When inputs owes, and the output current surpasses the motor nominal current above 50% time jumps Err10.
	PUF fuse blown	● IGBT module damaged and fuse was further blown due to short-circuit or grounding taken place at output side of ac drive.	● Check the causes, take remedy actions and replace or repair the ac drive.
Err 11	Parameters stored in DSP locked and unchangeable	● Storage of parameters has been restricted, and further modification to the new data is unattainable.	● If modifying the new data is desired, please set up the parameter F142=0 : changeable.
Err 12	Parametric setting error 0 (Default 1)	● EEPROM memory failure, incomplete storage, set value of parameter out of range.	● Please use parameter F141=1: parameter initialization, retrieve the factory-set functions, and then proceed the setting for the parameter group of motor; 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 13	Parametric setting error 1 (Di setting repeated)	● Multifunctional input terminals Di3 ~Di8 were repeatedly set to an identical function (except the 0: disabled)	● Please examine the set values of parameters F68~F73 for any repeated settings...
Err 14	Parametric setting error 2	● Incorrect set value of parameter is caused by the following reasons: ①(F101>F99>F97) ②(F15>F16)	● Please check the following two points of conditions for setting the standard value of parameter: ①(F101<F99<F97) ②(F15<F16)
Err 15	Parametric setting error 3	● Incorrect set value of parameter is caused by: (F90 × 1.3 >F95)	● Please check the following condition for setting the standard value of parameter: (F90 × 1.3≤F95)
Err 16	Parametric setting error 4	● Incorrect set value of parameter is caused by the following five reasons: ①F97<50.0Hz, or 60.0Hz ②F98>220.0/440.0V ③F101>2.00Hz ④F102>8.5V, 9.5V, 17.0V or 19.0V ⑤F103<30%	● Please check the following ex-factory set values of parameters: ①F97≥60.0Hz, or 50.0Hz ②F98≤190V, 220V, 380V, or 440V ③F101≤60.0 Hz/1.5Hz, or 50.0Hz/1.25Hz ④F102≤8.5V, 9.5V, 17.0V or 19.0V ⑤VT curve≥30%
Err 17	Program code error	● DSP processor failure	● Check the causes, take remedy actions and replace the ac drive or return it to factory for repair.

Displayed error code	Description	Possible causes	Remedy actions
Err 18	Signal disconnection	● Signal wire unlocked ● Signal disconnection	Check the signal and lock Replacement one new wire
Err 21	Over-voltage during standby state (hardware detection and protection)	● Input voltage of power supply (R.S.T.) was too high to cause the voltage at DC bus exceed the voltage detection level.	●Reduce the voltage to fall within the range of power supply specifications.
Err 22	Over-voltage during acceleration (hardware detection and protection)	● Started from motor's idling (easy to cause over-voltage or over-current). ● Motor leakage	● Please set F9, F10 for braking time and braking current ● Check motor isolation or change new one.
Err 23	Over-voltage during deceleration (hardware detection and protection)	● Deceleration time too short (easy to cause over-voltage or over-current)	● Extend the deceleration time appropriately (setup shall comply with the deceleration time required by GD^2.)
Err 24	Over-voltage during speed regulation (hardware detection and protection)	● Motor was driven to start by an external force ● Drastic changing of load	● Correct the system and remove the source of external force. ● Change the load smoothly.

Most frequently used troubleshooting

INHIBIT

(Any person other than a professional undertaker or a qualified technician of this machine is 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 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 GD^2 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 GD^2 of motor-driven load is too big?

＊Over-voltage protection function will be enabled immediately when regenerative energy exceeds 414V (200~240V series) or 827V (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 short 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

Points of attention for maintenance, inspection & testing

- 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 capacitorsor components of the ac drive.
- **Heat sink fins and circuit boards :**
  Deposited with dust or adhered with them. conductive iron chips or oil stain ? → Use a pressurized air gun to blow dry air to clean

Routine check items

- 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.**

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 unit

After the brake resistance's continuous discharging, a high ambient temperature will be formed to endanger the articles 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	Applicable motor capacity HP	Applicable motor capacity KW	Equivalent resistance specification W/Ω	Brake torque (10%ED) %	Equivalent Min resistance value (Ω)	Brake resistor (Module)	Brake resistor / SET	Specifications of externally mounted brake unit	Brake Unit / SET
200V	0.5	0.4	150W/150Ω	225	75Ω			Included	
	1	0.75	150W/150Ω	150	75Ω				
	2	1.5	300W/100Ω	125	39Ω				
	3	2.2	500W/60Ω	140	30Ω				
	5	3.7	800W/40Ω	125	27Ω				
	7.5	5.5	1200W/25Ω	135	18Ω	DR1K5W-24	1		
	10	7.5	1500W/20Ω	125	10Ω	DR1K5W-20	1		
	15	11	2200W/13.6Ω	125	10Ω	DR3K1W-12	1		
	20△	15	3000W/10Ω	125	6.6Ω	DR3K1W-10	1	LSBR-2015B	1
	25△	18.5	3700W/8Ω	125	6.6Ω	DR4K6W-8	1	LSBR-2022B	1
	30△	22	4400W/6.8Ω	125	3.3Ω	DR4K6W-6.6	1	LSBR-2022B	1
	40△	30	6000W/5Ω	125	3.3Ω	DR6K2W-5	1	LSBR-2015B	2
	50△	37	7400W/4Ω	125	3.3Ω	DR4K6W-8	2	LSBR-2022B	2
	60△	45	9000W/3.3Ω	125	2.5Ω	DR4K6W-6.6	2	LSBR-2022B	2
	75△	55	11000W/2.7Ω	125	2.5Ω	DR6K2W-5	2	LSBR-2022B	3
	100	75	15000W/2Ω	125		DR6K2W-6	3	LSBR-2022B	4
	125	90	18000W/1.6Ω	125		DR6K2W-5	3	LSBR-2022B	4 or 5
	150	110	22000W/1.3Ω	125		DR6K2W-5	4	LSBR-2022B	5

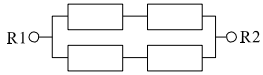
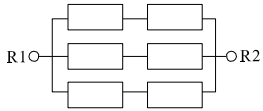
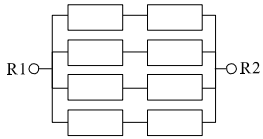
△: An additional brake circuit can be fitted into the ac drive when placing the purchase order.

Ac drive						Specifications			
Voltage	Applicable motor capacity		Equivalent resistance specification W/Ω	Brake torque (10%ED) %	Equivalent Min resistance value (Ω)	Brake resistor (Module)	Brake resistor / SET	Specifications of externally mounted brake unit	Brake Unit / SET
	HP	KW							
400V	1	0.75	150W/300Ω	200	150Ω			Included	
	2	1.5	300W/300Ω	155	150Ω				
	3	2.2	500W/150Ω	175	72Ω				
	5	3.7	800W100Ω	170	72Ω				
	7.5	5.5	1200W/80Ω	155	40Ω	DR1K5W-80	1		
	10	7.5	1500W/60Ω	155	40Ω	DR1K5W-60	1		
	15	11	2200W/50Ω	135	40Ω	DR3K1W-47	1		
	20△	15	3000W/40Ω	125	20Ω	DR3K1W-40	1	LSBR-4015B	1
	25△	18.5	3700W/32Ω	125	20Ω	DR4K6W-31.3	1	LSBR-4030B	1
	30△	22	4400W/27.2Ω	125	20Ω	DR4K6W-26.6	1	LSBR-4030B	1
	40△	30	6000W/20Ω	125	14.3Ω	DR6K2W-20	1	LSBR-4030B	1
	50△	37	7400W/16Ω	125	14.3Ω	DR4K6W-31.3	2	LSBR-4030B	2
	60△	45	9000W/13.3Ω	125	10Ω	DR4K6W-26.6	2	LSBR-4030B	2
	75△	55	11000W/10Ω	125	6.6Ω	DR6K2W-20	2	LSBR-4030B	2
	100	75	15000W/8Ω	125	6.6Ω	DR6K2W-23.5	3	LSBR-4030B	3
	125	90	18000W/6.6Ω	125		DR6K2W-20	3	LSBR-4030B	3
	150	110	22000W/5.4Ω	125		DR6K2W-20	4	LSBR-4030B	4
	175	132	26400W/4.5Ω	125		DR6K2W-20	4	LSBR-4030B	5
	200	160	32000W/3.7Ω	125		DR6K2W-20	5	LSBR-4030B	6
	250	185	37000W/3.2Ω	125		DR6K2W-20	6	LSBR-4030B	7
	300	220	44000W/2.7Ω	125		DR6K2W-20	8	LSBR-4030B	8
	350	260	52000W/2.3Ω	125		DR6K2W-20	9	LSBR-4030B	9

△: An additional brake circuit can be fitted into the ac drive when placing the purchase order.

Selection of brake resistance

♦ DR brake resistance specifications

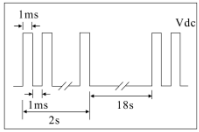
Model NO.		Model	Connection
DR1K5W-R		Figure A	
R	16Ω		
	20Ω		
	24Ω		
	60Ω		
	80Ω		
DR3K1W-R		Figure B	
R	8Ω		
	10Ω		
	12Ω		
	30Ω		
	40Ω		
	47Ω		
DR4K6W-R		Figure B / Figure C	
R	5.3Ω		
	6.6Ω		
	8Ω		
	20Ω		
	26.6Ω		
	31.3Ω		
DR6K2W-R		Figure C	
R	4Ω		
	5Ω		
	6Ω		
	15Ω		
	20Ω		
	23.5Ω		

♦ **Description of model number**

DR 3K1W - 10

- Brake resistance module
- Rated power (W)
- Resistance (Ω)

Brake cyclic curve



Brake power conditions :

1. Duty/Cycle :1ma/2ms
2. Brake time：2s
3. Rest time：18s

Work frequency (ED%) :

$ED\% = \frac{2s}{20s} \times 100\% = 10\%$

◆ Dimensions of Brake resis

Figure A

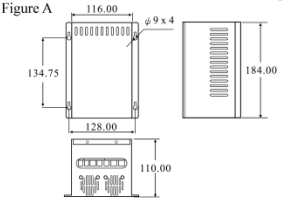


Figure B

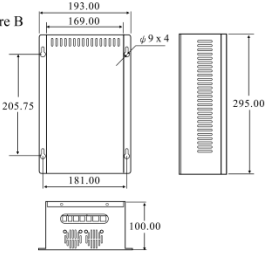


Figure C

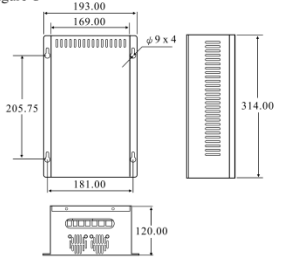
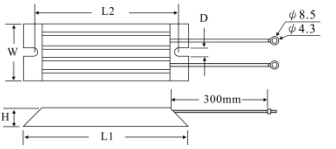


Figure D



Model No.	Dimensions (mm) ±3%					Resistance range (Ω)	Model No.	Dimensions (mm) ±3%					Resistance range (Ω)
	L1	L2	H	D	W			L1	L2	H	D	W	
SDR80W	140	125	20	5.2	40	0.1~10K	SDR300W	215	200	30	5.2	60	0.5~30K
SDR100W	165	150	20	5.2	40	0.1~10K	SDR400W	265	250	30	5.2	60	0.5~30K
SDR120W	190	175	20	5.2	40	0.15~15K	SDR500W	335	320	30	5.2	60	0.5~30K
SDR150W	215	200	20	5.2	40	0.15~15K	SDR600W	335	320	30	5.2	60	1~50K
SDR200W	165	150	30	5.2	60	0.3~20K	SDR800W	400	385	40	5.2	80	1~50K

NOTE

1. Please select the resistance (ohms), watts and the frequency of application (ED %) specified by the Company.
2. A precaution toward the safety and inflammability around the peripheral environment shall be made when installing the brake resistance.
3. For an application with more than two sets of brake unit, please pay attention to the equivalent resistance after installing these brake units in parallel connection that shall not be lower than the equivalent minimum resistance of each ac drive. When using the brake unit is desired, please peruse the operation instruction of brake unit and connect the wirings accordingly.

IX Appendix

Appendix-A-Standard specifications-

200V Series specifications

Model LS650-2□□□			0k4	0k7	1k5	2k2	4k0	5k5	7k5	011	015	018	022	030	037	045	055	075	090	110
Applicable motor power KW		CT	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110
		VT	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	110
Power Input	Rated current(A)	CT	5.1	6.3	9.7	14	20.5	28	37	53	80	91	110	135	162	182	220	290	338	440
		VT	6.4	7.9	12	17.5	26	35	46.5	67	100	113	138	170	205	230	280	370	432	550
Power output	Rated capacity (KVA)	CT	1.4	1.9	2.8	3.8	6.6	9.5	12.9	19	26	31	38	49	62	72	87	114	133	173
		VT	1.7	2.3	3.5	4.7	8.3	11.9	16.1	23	32	38	47	61	78	90	109	142	166	216
	Rated current(A)	CT	3.7	5	7.5	10	17.5	25	34	50	68	82	100	130	165	190	230	300	350	455
		VT	4.6	6.2	9.3	12.5	21.8	31.2	42.5	62.5	85	102	125	162	206	237	287	375	437	568
	Overload ability of ac drive		(CT) Heavy load : Output rated current 150% 60sec (constant torque) , Switch frequency 1~16kH (Setting by F93) (VT) Light load : Output rated current 120% 60 秒(Variable torque), Switch frequency 1~5kHz (Setting by F93) (When applied to the reciprocating of the load, the need to reduce the rating)																	
	Carrier frequency		1~16kHz (Setting by F93)																	
	Max. output voltage		3P/ 220~240V (corresponding input voltage)																	
	Max. frequency output		300Hz (Setting by F18~F34)																	
Power range	Rated voltage Rated frequency		AC : 3P/200~240V 50/60Hz DC : 270~340V																	
	Tolerance for voltage fluctuation		-15% ~ +10% (170V~264V)																	
	Tolerance for frequency fluctuation		±8% (47Hz~64.8Hz)																	
Harmonic filter accessories		DC reactor	Option																	
Brake function		Brake circuit	Built-in										Option						Option(added brake unit)	

400V Series specifications

型號 LS650-4□□□			0k7	1k5	2k2	4k0	5k5	7k5	011	015	018	022	030	037	045	055	075	090	110	132	160	185	220	260
Applicable motor power KW		CT	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	185	220	260
		VT	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	185	220	260	260
Power Input	Rated current(A)	CT	5.1	6.9	10.5	15	17.9	20	27.5	41.8	45.5	52.5	71.5	85.4	111	137	174	192	218	256	291	360	410	482
		VT	6.3	8.5	13	18.5	22.3	24.9	34.5	52.5	57	66.5	90	107	139	171	218	250	275	320	365	450	512	605
Power output	Rated capacity (KVA)	CT,	2.8	3.8	5.7	7.6	10.6	13.3	19	29	32	38	51	62	76	99	125	152	175	209	228	266	346	407
		VT	3.5	4.7	7.1	9.5	13.3	16.6	23	36	41	47	64	77	95	123	157	190	219	261	285	333	433	509
	Rated current(A)	CT	3.7	5	7.5	10	14	17.5	25	38	43	50	68	82	100	130	165	200	230	275	300	350	455	535
		VT,	4.6	6.2	9.3	12.5	17.5	21.8	31.2	47.5	53.7	62.5	85	102	125	162	206	250	287	343	375	437	568	669
	Overload ability of ac drive		(CT) Heavy load : Output rated current 150% 60sec (constant torque) , Switch frequency 1~16kH (Setting by F93) (VT) Light load : Output rated current 120% 60 秒(Variable torque) , Switch frequency 1~5kHz (Setting by F93) (When applied to the reciprocating of the load, the need to reduce the rating)																					
	Carrier frequency		1~16kHz (Setting by F93)																					
	Max. output voltage		3P/ 220~240V (corresponding input voltage)																					
	Max. frequency output		300Hz (Setting by F18~F34)																					
Power range	Rated voltage Rated frequency		AC : 三相 380~480V 50/60Hz																					
	Tolerance for voltage fluctuation		-15% ~ +10% (323V~560V)																					
	Tolerance for frequency fluctuation		±8% (47Hz~64.8Hz)																					
Harmonic filter accessories		DC reactor	Option																					
Brake function		Brake circuit	Built-in										Brake function						Brake circuit					

Common characteristics

Control	Control method	Sine wave SVPWM 3-phase modulation, switching frequency 1 K~16KHz, V/F voltage vector control
	Max. output frequency	0.00~300.00Hz
	Frequency precision (temperature fluctuation)	Digital signal: ±0.1%(-10 ℃~+40 ℃), analog signal: ±0.1%(25 ℃±10 ℃)
	Precision for frequency setup	Digital signal: 0.01Hz(0.01~300.00Hz), analog signal: 0.06/60.00Hz
	Precision for speed regulation	Voltage sensor-less vector : ± 1.0 %, V/F : ± 3.0% ~ 5.0%
	Acceleration / deceleration time	0.0~3000.0(seconds), 8-stage individual & independent setup of acceleration /deceleration time duration.
	V/F curve	CT : 3-point straight line setup, CT/VT : 2-point curve setup
	Control functions	15 display functions, 9 rpm command sources, upper & lower frequency setup, AVR function, S-curve, multiplexing input, output terminal control, 16 preset stages for speed regulation, Jumping frequency, slip compensation, PID function, exclusive PID for water pump, functional setup for intelligent water pump, DC brake at on/off, simple PLC for operation control, MODBUS communication, Auto operation function.
	Signal for frequency setup	DC 0~10V, 0~20mA
	Brake torque	20% approximately, 125% with brake controller mounted.
	Additional control functions	Digital operation panel, RS-485, speed regulation, PID control, multi-stage speed control, water pump functions, etc.
Protection functions	Motor protection	Protected by an integral type electronic thermal-activated relay
	Over-current protection	CT : Exceeding the rated current by 200% for 3 seconds will trigger the over-current protection to stop motor automatically. VT : Exceeding the rated current by 170% for 3 seconds will trigger the over-current protection to stop motor automatically.
	Overload ability of ac drive	CT : 150%,60 Second / VT : 120%,60 Second
	Over-voltage protection	Over-voltage level : Vdc > 414V(200~240V Series) / Vdc > 827V(380~460V Series)
	Low-voltage protection	Low-voltage level : Vdc < 200V(200~240V Series) / Vdc < 400V(380~460V Series)
	Power supply protection	Under phase protection for input power supply (equipped for ac drive with a power above 5.5KW), under phase protection for output (equipped for ac drive with a power above 0.4KW)
	Superheating heat radiation fins	Thermal coupler protection 85 ℃±5 ℃
	Stall protection	To protect the device from stall during acceleration/deceleration and operation.
	Grounding protection	To protect electronic circuits.
	Charging indication	Charging indicator will be turned "ON" when the DC voltage of main circuit is over 50V.
	Place used	Indoor places free of corrosion or dusts.
Environment conditions	Ambient temperature	-10 ℃~+40 ℃(Lock wall-mounting model), -10 ℃~+50 ℃(open model) free of freezing condition
	Storage temperature (Note 1)	-20 ℃~+60 ℃
	Humidity	Below 95%RH (no condensation condition)
	Vibration	1G below 20Hz, 0.2G during 20~50Hz

*** Note 1 : A too high storage temperature may damage the capacitor of main circuit.**

Horse powe	KW	20K4	20K7	21K5	22K2	24K0	25K5	27K5	2011	2015
	HP	0.5	1.0	2.0	3.0	5.0	7.5	10	15	20
Parameters of motor and ac drive	F88	Ex-factory set value of frequency is 50Hz or 60Hz; the rated frequency (40Hz~70Hz) of motor shall be observed when changing the frequency is desired.								
	F89	Ex-factory set value of voltage is 200V or 220V, the rated voltage (150V~255V) of motor shall be observed when changing the voltage is desired.								
	F90	2.0A	3.5A	6.0A	8.2A	15A	20A	27A	38A	50A
	F93	5000	5000	5000	5000	5000	5000	5000	5000	5000
	F94	134	134	134	134	134	135	135	135	138
	F95	3.2A	4.5A	7.0A	10A	17A	25A	33A	46A	62A
V/F curve setup	F96	0 : 3-point straight line setup (F97~F102) 1 : 2-point curve setup (F97, F98, F101, F102), curve gain setup F103 * Please set up the curve according to the application when setting the V/F curve with a prerequisite: F97 > F99 > F101, F98 > F100 > F102.								
	F97(Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
	F98(V)	190/220	190/220	190/220	190/220	190/220	190/220	190/220	190/220	190/220
	F99(Hz)	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00
	F100(V)	15.0/16.5	15.0/16.5	15.0/16.5	15.0/16.5	15.0/16.5	13.0/14.5	13.0/14.5	13.0/14.5	13.0/14.5
	F101(Hz)	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50
	F102(V)	8.5 / 9.5	8.5 / 9.5	8.5 / 9.5	8.5 / 9.5	8.5 / 9.5	7.0 / 7.5	7.0 / 7.5	7.0 / 7.5	7.0 / 7.5
	F103	0.0% : Straight line						0.1% ~ 100% : 3-time curve		
		* In VT mode, F96 = 1 will be set automatically while the overload protection will be modified from 150% to 120%, 60 seconds with the following ranges of parameters limited : (1) F97 ≥ 50.00 Hz or 60.00Hz (4) F102 ≤ 8.5V/200V or 9.5V/220V (2) F98 ≥ 190.0V or 220.0V (5) F103 ≥ 30.0%, will be limited with Err-16 warning (3) F101≤ 2.00 Hz displayed when exceeding the limit.								

Horse power	KW	2018	2022	2030	2037	2045	2055	2075	2090	2110
	HP	25	30	40	50	60	75	100	125	150
Parameters of motor and ac drive	F88	Ex-factory set value of frequency is 50Hz or 60Hz; the rated frequency (40Hz~70Hz) of motor shall be observed when changing the frequency is desired.								
	F89	Ex-factory set value of voltage is 200V or 220V, the rated voltage (150V~255V) of motor shall be observed when changing the voltage is desired.								
	F90	62A	75A	97A	128A	150A	187A	235A	300A	355A
	F93	5000	5000	5000	5000	5000	3000	3000	3000	2000
	F94	138	138	138	138	138	138	138	138	138
	F95	76A	90A	120A	150A	180A	215A	300A	350A	425A
V/F curve setup	F96	0 : 3-point straight line setup (F97~F102) 1 : 2-point curve setup (F97, F98, F101, F102), curve gain setup F103 * Please set up the curve according to the application when setting the V/F curve with a prerequisite: F97 > F 99 > F101, F98 > F100 > F102.								
	F97(Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
	F98(V)	190/220	190/220	190/220	190/220	190/220	190/220	190/220	190/220	190/220
	F99(Hz)	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00	2.50/3.00
	F100(V)	11.0/12.5	11.0/12.5	11.0/12.5	11.0/12.5	10.0/11.5	10.0/11.5	10.0/11.5	10.0/11.5	10.0/11.5
	F101(Hz)	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50	1.25/1.50
	F102(V)	6.0/7.0	6.0/7.0	6.0/7.0	6.0/7.0	5.0/6.0	5.0/6.0	5.0/6.0	5.0/6.0	5.0/6.0
	F103	0.0% : Straight line						0.1% ~ 100% : 3-time curve		
		* In VT mode, F96 = 1 will be set automatically while the overload protection will be modified from 150% to 120%, 60 seconds with the following ranges of parameters limited : (1) F97 ≥ 50.00 Hz or 60.00Hz (4) F102 ≤ 8.5V/200V or 9.5V/220V (2) F98 ≥ 190.0V or 220.0V (5) F103 ≥ 30.0%, will be limited with Err-16 warning (3) F101≤ 2.00 Hz displayed when exceeding the limit.								

Horse power	KW	40K7	41K5	42K2	44K0	45K5	47K5	4011	4015	4018	4022	4030
	HP	1	2	3	5	7.5	10	15	20	25	30	40
Parameters of motor and ac drive	F88	Ex-factory set value of frequency is 50Hz or 60Hz; the rated frequency (40Hz~70Hz) of motor shall be observed when changing the frequency is desired.										
	F89	Ex-factory set value of voltage is 380V or 440V, the rated voltage (300V~510V) of motor shall be observed when changing the voltage is desired.										
	F90	1.9A	3.7A	5.3A	8.2A	12A	15A	22A	28A	36A	44A	58A
	F93	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000	5000
	F94	269	269	269	269	269	269	269	277	277	277	277
	F95	3.2A	4.5A	7.0A	9.0A	12.5A	17A	25A	32A	40A	46A	62A
V/F curve setup	F96	0 : 3-point straight line setup (F97~F102) 1 : 2-point curve setup (F97, F98, F101, F102), curve gain setup F103 * Please set up the curve according to the application when setting the V/F curve with a prerequisite: F97 > F99 > F101, F98 > F100 > F102.										
	F97(Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
	F98(V)	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440
	F99(Hz)	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0
	F100(V)	28.5/33	28.5/33	28.5/33	28.5/33	25.5/29	25.5/29	25.5/29	25.5/29	21.5/25	21.5/25	21.5/25
	F101(Hz)	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5
	F102(V)	17 / 19	17 / 19	17 / 19	17 / 19	14 / 15	14 / 15	14 / 15	14 / 15	12/14	12/14	12/14
	F103	0.0% : Straight line							0.1% ~ 100% : 3-time curve			
		* In VT mode, F96 = 1 will be set automatically while the overload protection will be modified from 150% to 120%, 60 seconds with the following ranges of parameters limited : (1) F97 ≥ 50.00 Hz or 60.00Hz (2) F98 ≤ 380.0V or 440.0V (3) F101≤ 2.00 Hz (4) F102 ≤ 17.0V/380V or 19.0V/440V (5) F103 ≥ 30.0%, will be limited with Err-16 warning displayed when exceeding the limit.										

Horse powe	KW	4037	4045	4055	4075	4090	4110	4132	4160	4185	4220	4260(VT)
	HP	50	60	75	100	125	150	175	200	250	300	350
Parameters of motor and ac drive	F88	Ex-factory set value of frequency is 50Hz or 60Hz; the rated frequency (40Hz~70Hz) of motor shall be observed when changing the frequency is desired.										
	F89	Ex-factory set value of voltage is 380V or 440V, the rated voltage (300V~510V) of motor shall be observed when changing the voltage is desired.										
	F90	72A	84A	108A	135A	165A	210A	260A	290A	340A	385A	480A
	F93	5000	5000	4000	4000	3000	3000	3000	3000	2000	2000	2000
	F94	277	277	277	277	277	277	277	277	277	277	277
	F95	75A	90A	115A	150A	180A	216A	275A	300A	350A	450A	520A
V/F curve setup	F96	0 : 3-point straight line setup (F97~F102) 1 : 2-point curve setup (F97, F98, F101, F102), curve gain setup F103 * Please set up the curve according to the application when setting the V/F curve with a prerequisite: F97 > F99 > F101, F98 > F100 > F102.										
	F97(Hz)	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60	50/60
	F98(V)	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440	380/440
	F99(Hz)	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0	2.5/3.0
	F100(V)	21.5/25	19.5/23	19.5/23	19.5/23	19.5/23	19.5/23	17.5/21	17.5/21	17.5/21	17.5/21	17.5/21
	F101(Hz)	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5	1.25/1.5
	F102(V)	12/14	10/12	10/12	10/12	10/12	10/12	8.0/10	8.0/10	8.0/10	8.0/10	8.0/10
	F103	0.0% : Straight line							0.1% ~ 100% : 3-time curve			
		In VT mode, F96 = 1 will be set automatically while the overload protection will be modified from 150% to 120%, 60 seconds with the following ranges of parameters limited : (1) F97 ≥ 50.00 Hz or 60.00Hz (2) F98 ≤ 380.0V or 440.0V (3) F101≤ 2.00 Hz (4) F102 ≤ 17.0V/380V or 19.0V/440V (5) F103 ≥ 30.0%, will be limited with Err-16 warning displayed when exceeding the limit.										

Appendix-C -Summary of parameter settings-

1	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value	Page No.
water pump setup	×	F0	Water pressure set value	0.0~10.0	Kg/cm^2	2.0	P5-1
	×	F1	Setup to activate terminal after restoring the power supply	0~1		0	
	0 : Direct activate 1 : Command terminal reset and then activate						
	×	F2	Reserved	-32767~32767		0	P5-1
	×	F3	Reserved	-32767~32767		0	
Display setup for operation panel	○	F4	Select the variables to be displayed in operation panel	0~17		1	
	0 : Frequency command (F) 1 : Output frequency (H) 2 : Output current (A) 3 : Output voltage (E) 4 : Unitless (U) 5 : Normal voltage at DC side (Vdc) 6 : Voltage at DC side before startup (Vdc) 7 : Digital operation panel Ai(V.R)% 8 : Ai1(V/mA)% 9 : Ai2(V)% 10 : PID output (%) 11 : Input status values of digital terminals 12 : Water pressure of water pump 13 : Number of cycle, number of stage 14 : Software version 15 : Software status 16 : Cumulative running time (days) 17 : Cumulative running time (mins)						
	○	F5	Unitless indication of magnification	0.01~300.00		30.00	P5-2
	○	F6	Indication of filtration duration	0~15		6	
Operation control parameters	×	F7	Operation control source	0~1		0	P5-3
	0 : Digital operation panel or MODBUS communication 1 : Digital input terminal						
	×	F8	Frequency command source	0~8		1	P5-3
	0 : Digital operation panel (main speed) 1: Operation panel Ai(V.R) 2: Ai1 3 : Ai2 4 : Ai1+Ai2 5 : Ai1, Ai2 / MAX 6 : Ai1, Ai2 / MIN 7 : PID 8 : Digital terminals for progressive acceleration or deceleration						
	×	F9	Braking time before start up	0.0~120.0	Second	0.0	P5-4
	×	F10	Braking current before start up	0.0~100.0	%	30.0	
	×	F11	Shutdown mode	0~2		1	
	0 : Free-Run 1 : Dynamic shutdown 2 : Dynamic + DC brake						
	×	F12	Braking time for shutdown	0.0~120.0	Second	0.0	P5-4
	×	F13	Braking current for shutdown	0.0~100.0	%	30.0	
RPM restriction	×	F14	To restrict the rotating direction	0~3		1	P5-5
	0 : For FWD or REV 1 : For FWD only 2 : For REV only 3 : REV at bias is available.						
	×	F15	Lower limit of frequency (F16≥F15)	0.00~300.00	Hz	0.00	P5-5
	×	F16	Upper limit of frequency	0.00~300.00	Hz	60.00 50.00	
	×	F17	To select the minimum output frequency	0~1		0	P5-6
	0 : Can be zero speed 1 : Minimum output frequency setup (F101)						
	○	F18	Main speed	0.00~300.00	Hz	5.00	P5-6
	○	F19	Stage 1 speed	0.00~300.00	Hz	5.00	

2	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value	Page No.
Multi-stage speed frequency command setup	○	F20	Stage 2 speed	0.00~300.00	Hz	10.00	P5-6
	○	F21	Stage 3 speed	0.00~300.00	Hz	15.00	
	○	F22	Stage 4 speed	0.00~300.00	Hz	20.00	
	○	F23	Stage 5 speed	0.00~300.00	Hz	30.00	
	○	F24	Stage 6 speed	0.00~300.00	Hz	40.00	
	○	F25	Stage 7 speed	0.00~300.00	Hz	50.00	
	○	F26	Stage 8 speed	0.00~300.00	Hz	0.00	
	○	F27	Stage 9 speed	0.00~300.00	Hz	0.00	
	○	F28	Stage 10 speed	0.00~300.00	Hz	0.00	
	○	F29	Stage 11 speed	0.00~300.00	Hz	0.00	
	○	F30	Stage 12 speed	0.00~300.00	Hz	0.00	
	○	F31	Stage 13 speed	0.00~300.00	Hz	0.00	
	○	F32	Stage 14 speed	0.00~300.00	Hz	0.00	
	○	F33	Stage 15 speed	0.00~300.00	Hz	0.00	
	○	F34	Inching speed	0.00~300.00	Hz	6.00	
Acceleration / deceleration time	○	F35	Master speed (inching) acceleration time/ With Acceleration time by speed at stage 8	0.0~30000.0	Second	10.0	P5-7
	○	F36	Master speed (inching) deceleration time/ With deceleration time by speed at stage 8	0.0~30000.0	Second	10.0	
	○	F37	Acceleration time of stage 1,9	0.0~30000.0	Second	10.0	
	○	F38	Deceleration time of stage 1,9	0.0~30000.0	Second	10.0	
	○	F39	Acceleration time of stage 2,10	0.0~30000.0	Second	10.0	
	○	F40	Deceleration time of stage 2,10	0.0~30000.0	Second	10.0	
	○	F41	Acceleration time of stage 3,11	0.0~30000.0	Second	10.0	
	○	F42	Deceleration time of stage 3,11	0.0~30000.0	Second	10.0	
	○	F43	Acceleration time of stage 4,12	0.0~30000.0	Second	10.0	
	○	F44	Deceleration time of stage 4,12	0.0~30000.0	Second	10.0	
	○	F45	Acceleration time of stage 5,13	0.0~30000.0	Second	10.0	
	○	F46	Deceleration time of stage 5,13	0.0~30000.0	Second	10.0	
	○	F47	Acceleration time of stage 6,14	0.0~30000.0	Second	10.0	
	○	F48	Deceleration time of stage 6,14	0.0~30000.0	Second	10.0	
	○	F49	Acceleration time of stage 7,15	0.0~30000.0	Second	10.0	
	○	F50	Deceleration time of stage 7,15	0.0~30000.0	Second	10.0	
	○	F51	Acceleration S curve	0.0~100.0	%	0.0	
	○	F52	Deceleration S curve	0.0~100.0	%	0.0	

Appendix-C -Summary of parameter settings-

3	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value	Page No.
Analog input	×	F53	Ai : 0V Input bias %	-300.00~300.00	%	0.00	P5-8
	×	F54	Ai : 5V Input gain %	-300.00~300.00	%	100.00	
	×	F55	Ai1 : 0V Input bias %	-300.00~300.00	%	0.00	
	×	F56	Ai1 : 10V Input gain %	-300.00~300.00	%	100.00	
	×	F57	Ai1 Insensitive area (Dead Band)	0.00~85.00	%	0.00	
	×	F58	Ai1 Filtration time setup	0.01~5.00	Second	0.30	P5-10
	×	F59	Ai2 : 0V Input bias %	-300.00~300.00	%	0.00	
	×	F60	Ai2 : 10V Input gain %	-300.00~300.00	%	100.00	
	×	F61	Ai2 Insensitive area (Dead Band)	0.00~85.00	%	0.00	
	×	F62	Ai2 Filtration time setup	0.01~5.00	Second	0.30	
Analog (AO) output	○	F63	A out function of analog variable	0~7		0	P5-12

F63 function of analog variable	F65 10V/ corresponding value	Reference standard point	F63 function of analog variable	F65 10V/ corresponding value	Reference standard point
0 : Disabled	×	×	4 : Ai	16384	Ai ×(F53, F54)
1 : Rpm frequency	4096	F88 parameter set value	5 : Ai1	16384	Ai1 ×(F55, F56)
2 : Output current	8192	F95 parameter set value	6 : Ai2	16384	Ai2 ×(F59, F60)
3 : Output voltage	2200 3800	220.0 V F89 parameter set value 380.0 V	7 : PID	16384	100%

	○	F64	A out : 0V Corresponding value	-32767~32767		0	P5-12
	○	F65	A out : 10V Corresponding value	-32767~32767		4096	
	×	F66	Scanning cycle of digital input	10~2000	0.1ms	10	P5-14
	×	F67	Di1 , Di2 setup	0~2		0	

0 : Di1(FWD/Stop) ,Di2(REV/Stop) 1 : Di1(Run/Stop) , Di2(FWD/REV)
2 : 3-wire shutdown: Di3 (FWD/REV), Di2 (Stop), Di1 (Run), automatically disable the F68 setup at the same time.

Digital input	×	F68	Di3 setup	0~14		1	P5-15
	×	F69	Di4 setup	0~14		2	
	×	F70	Di5 setup	0~14		6	
	×	F71	Di6 setup	0~14		7	
	×	F72	Di7 setup	0~14		10	
	×	F73	Di8 setup	0~15		3	

4	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value		Page No.
Digital input	0：Disabled 1：Enabled by external failure 2：RESET 3：Free-Run		4：Stepwise acceleration of main speed 5：Stepwise deceleration of main speed 6：Multi-stage speed command 1 7：Multi-stage speed command 2	8：Multi-stage speed command 3 9：Multi-stage speed command 4 10：Inching operation 11：Start the automatic operation		12：Pause the automatic operation 13：Di activate the PID 14：Di activate the Ai1 15：MODBUS(can be set by Di8 only)		
Digital (Do) output	×	F74	Relay setup	0~10		1		P5-17
	×	F75	DO setup	0~10		10		
	0 : Disabled 1 : Faulty output 2 : In operation		3 : In zero speed 4 : Forward rotation 5 : Reversal rotation	6 : In acceleration 7 : In deceleration 8 : Frequency consistency (in constant speed)		9 : Overload prognostication 10 : Frequency to reach		
Jumping frequency	×	F76	Frequency to reach	0.00~300.00	Hz	60.00	50.00	P5-18
	×	F77	Jumping frequency 1	0.00~300.00	Hz	0.00		
	×	F78	Reserved			0		P5-18
	×	F79	Jumping bandwidth	0.00~10.00	Hz	0.00		
	×	F80	Stall protection setup	0~128		7		P5-19
Motor protection setup	bit7 : CT / VT mode switch(128) bit5 : Start magnetic brake function (32) bit2 : Protection function F83		bit6 : Enable Ai1 break detection (64) bit4 : AVR voltage-regulating function bit1 : Protection function F82			bit3 : Protection function F84 bit0 : Protection function F81		
	×	F81	Stalling voltage setup for deceleration	330.0~400.0 660.0~800.0	V	380.0 760.0		P5-20
	×	F82	Stalling current setup for acceleration	30.0~200.0	%	170.0		
	×	F83	Stalling current setup for operation	30.0~190.0	%	160.0		
	×	F84	Current level of electronic thermal relay	1.01~2.00	F90	1.50		P5-21
	×	F85	Acting time of electronic thermal relay	0.1~120.0	Second	60.0		
	If $\int(I^2A(pu)-1)dt \geq (I*OL^2-1)\times TOL$, then electronic thermal relay is triggered.							
	○	F86	Output current restriction	30.0~200.0	%	180.0		P5-21
	○	F87	Oscillation-inhibit gain	0.0~100.0	%	15.0		
Parameters of motor and ac drive	×	F88	Rated frequency(rms)	40.00~70.00	Hz	60.00	50.00	P5-21
	×	F89	Rated voltage(rms)	150.0~255.0 300.0~510.0	V	220.0 440.0	200.0 380.0	
	×	F90	Rated current	0.1~(F95×1.3)	A	F95		P5-22
	×	F91	Rated slip frequency	0.00~10.00	Hz	4.00		
	○	F92	Slip compensation factor	0.0~200.0	%	50.0		
	×	F93	PWM carrier frequency	1000~16000	Hz	5000		
	×	F94	Vdc indicating value gain (read only)	50~300	Pu	140		P5-23
	×	F95	Rated current of ac drive (read only)	1.0~1000.0	A	5.0		

5	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value		Page No.
V/F curve setup	×	F96	V/F curve selection	0~1		0		P5-23
	0：3-point straight line setup 1：2-point curve setup							
	×	F97	Max. voltage / frequency setup	0.10~300.00	Hz	60.00	50.00	P5-23
	×	F98	Highest output voltage setup	0.1~255.0	V	220.0	190.0	
				0.2~510.0		440.0	380.0	
	×	F99	Highest output voltage setup	0.10~300.00	Hz	3.00	2.50	P5-24
	×	F100	Intermediate voltage setup	0.0~255.0	V	12.5	10.8	
				0.0~510.0		25.0	21.6	
	×	F101	Min. output voltage / frequency setup	0.00~20.00	Hz	1.50	1.25	
	×	F102	Min. voltage setup	0.0~50.0	V	7.0	6.0	
				0.0~100.0		14.0	12.1	
	×	F103	Curve modulating gain	0.0~100.0	%	30.0		P5-25
	0.0%：Straight line 100.0%：3-time curve							
Communication setup	×	F104	RS-485 Communication address	1~254		1		P5-26
	×	F105	Data transmission speed	0~4		2		
	0：2400 1：4800 2：9600 3：19200 4：38400							
	×	F106	Communication information format	0~3		0		P5-26
	0：8,N,1 RTU (1 start bit + 8 data bits + 1 stop bit) 1：8,E,1 RTU (1 start bit + 8 data bits + 1 Even bit + 1 stop bit) 2：8,O,1 RTU (1 start bit + 8 data bits + 1 Odd bit + 1 stop bit) 3：8,N,2 RTU (1 start bit + 8 data bits + 2 stop bit)							
	×	F107	Communication-responding delay time	3~50	ms	5		P5-26
	×	F108	Feedback of receiving failure	0~8		0		
	0：Normal receiving 1：Functional code error 2：CRCL error 3：CRCH error		4：Packet-receiving time over 0.2 sec 5：Modify the set parameters that are unchangeable during operation 6：Parameter code error			7：Parameter value exceeds range 8：The set parameters are unchangeable when locked (except F4,F18,F142)		
Failure record	×	F109	Current failure record	0~20		0		P5-33
	×	F110	Failure record of last time	0~20		0		
	×	F111	Failure record of last two times	0~20		0		
	×	F112	Failure record of last three times	0~24		0		
	0：Communication failure of digital operation panel 1：Over-current during standby state (hardware detection and protection) 2：Over-current during acceleration (hardware detection and protection) 3：Over-current during deceleration (hardware detection and protection) 4：Over-current during speed regulation (hardware detection and protection)			5：External failure 6：DC over voltage (O.V) 7：Low DC voltage during operation (L.V) 8：Electronic thermal relay enabled 9：AC drive overload (150%, 60 sec/CT, 120%,60 sec/VT) 10：Over temperature or PF or PUF malfunction 11：Parameters saved in DSP are locked and unchangeable. 12：Parametric setting error 0(Parameters are out of range) 13：Parametric setting error 1(Di repeated setting)				

6	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value	Page No.
Failure record	14：Parametric setting error 2(F101>F99>F97, F15>F16) 15：Parametric setting error 3(F90>F95×1.3) 16：VT parametric setting error (F97, F98, F101, F102, F103) 17 : Program code error 18 : Signal disconnection 19～20：Reserved for failure signals 21 : Over-voltage in standby state 22 : Over-voltage during acceleration 23 : Over-voltage during deceleration 24 : Over-voltage during speed rgulation						
	×	F113	Number of times to auto-reset the failure during operation	0~10		0	P5-33
External PID	×	F114	PID mode	0~4		0	P5-34
	0 : Disable PID 1 : Shutdown reset PID value to zero. 2 : Reserve the PID value at shutdown 3 : Di enable (shutdown, reset PID value to zero) 4 : Di enable (Reserve the PID value at shutdown)						
	×	F115	PID Command point	0~3		0	P5-35
	0：F122　1：Ai(V.R)　2：Ai1　3：Ai2						
	×	F116	PID feedback point	0~1		0	P5-35
	0：Ai1　1：Ai2						
	○	F117	PID feedback point	0.05~10.00	Second	0.20	P5-35
	○	F118	PID output limit	0.00~100.00	%	100.00	
	○	F119	Kp	1.00~300.00	%	100.00	
	○	F120	Ki	0.00~300.00	%	25.00	
	○	F121	Kd	0.00~300.00	%	2.00	
	○	F122	PID command value setup	0.00~100.00	%	50.00	
Automatic operation	×	F123	Automatic operation mode	0~4		0	P5-36
	0 : Automatic operation mode disabled 1 : Shutdown after reciprocating operation 2 : Shutdown after cyclic operation 3 : Main speed after reciprocating operation 4 : Main speed after cyclic operation						
	×	F124	Number of times of cycle	1~30000	Times	1	P5-37
	×	F125	Time of automatic operation mode at stage 0	-30000~30000	Second	1	
	×	F126	Time of automatic operation mode at stage 1	-30000~30000	Second	0	
	×	F127	Time of automatic operation mode at stage 2	-30000~30000	Second	0	
	×	F128	Time of automatic operation mode at stage 3	-30000~30000	Second	0	
	×	F129	Time of automatic operation mode at stage 4	-30000~30000	Second	0	
	×	F130	Time of automatic operation mode at stage 5	-30000~30000	Second	0	
	×	F131	Time of automatic operation mode at stage 6	-30000~30000	Second	0	
	×	F132	Time of automatic operation mode at stage 7	-30000~30000	Second	0	
	×	F133	Time of automatic operation mode at stage 8	-30000~30000	Second	0	
	×	F134	Time of automatic operation mode at stage 9	-30000~30000	Second	0	

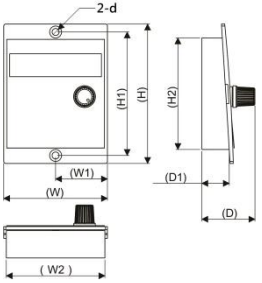
Appendix-C -Summary of parameter settings-

7	Changeable during operation	Parameter code	Descriptions	Setting range	Unit	Ex-factory set value	Page No.
Automatic operation	×	F135	Time of automatic operation mode at stage 10	-30000~30000	Second	0	P5-37
	×	F136	Time of automatic operation mode at stage 11	-30000~30000	Second	0	
	×	F137	Time of automatic operation mode at stage 12	-30000~30000	Second	0	
	×	F138	Time of automatic operation mode at stage 13	-30000~30000	Second	0	
	×	F139	Time of automatic operation mode at stage 14	-30000~30000	Second	0	
	×	F140	Time of automatic operation mode at stage 15	-30000~30000	Second	0	
	*** The positive and negative symbols used in F125~F140 signify the operating direction.**						
Retrieval parameters	×	F141	Retrieve parameters	0~6		0	P5-38
	0 : Not recalled 1 : 220V/440V,60Hz retrieval of factory setting 2 : 220V/440V,50Hz retrieval of factory setting 3 : 200V/380V,60Hz retrieval of factory setting			4 : 200V/380V,50Hz retrieval of factory setting 5 : Clear the Failure record 6 : All called back parameters (read-only)			
	○	F142	To lock the functional parameters	0~1		0	P5-38
	0 : Changeable 1 : Functional parameters locked (※ except Parameters F4 and F18)						
Water pump	×	F143	Enable the water pump function	0~1		0	P5-39
	0 : Disable 1 : Enable						
	×	F144	Sleep detection time	5~30000	Second	30	P5-39
	×	F145	Sleep level	0.0~100.0	%	50.0	
	×	F146	Wake-up pressure error	0.0~100.0	%	15.0	
	×	F147	Time of standby operation detection	0~30000	Second	900	
	×	F148	Standby operation time	0~30000	Second	60	
	×	F149	Standby operation frequency	0.00~300.00	Hz	0.00	P5-40
	×	F150	Low water pressure (no water) detection level	0.0~100.0	%	8.0	
	×	F151	Time of low water pressure detection	0~12000	Second	60	
	×	F152	Time of no-water standby and restart	0~30000	Second	1200	
	×	F153	Water pump indicates the magnification.	1.0~99.9	kg/cm2	10.0	
	×	F154	Ai1 Pulse wave frequency instruction	0.0~1000.0	ms	0.0	P5-41
	×	F155	Cumulative running time(Days)	0~30000	Day	0	P5-41
	×	F156	Cumulative running time(Min)	0~1440.0	Min	0	

Error code	Descriptions
Err 0	Communication of digital operation panel failed
Err 1	Over-current during standby state (hardware detection and protection)
Err 2	Over-current during acceleration (hardware detection and protection)
Err 3	Over-current during deceleration (hardware detection and protection)
Err 4	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) during operation
Err 8	Electronic thermal relay activated
Err 9	AC drive overloaded longer than the allowable time duration (150%, 60 seconds/CT, 120%, 60 seconds/VT)
Err 10	Over temperature, or PF or PUF malfunction
Err 11	DSP-saved parameters are locked and unable to change them.
Err 12	Parameter setup error 0 (Out of range)
Err 13	Parameter setup error 1 (Di repeated setting)
Err 14	Parameter setup error 2 (F101>F99>F97,F15>F16)
Err 15	Parameter setup error 3 (F90>F95×1.3)
Err 16	VT parameter setup error (F97,F98,F101,F102,F103)
Err 17	Program code error
Err 18	Signal disconnection
Err 21	Over-voltage during standby state (hardware detection and protection)
Err 22	Over-voltage during acceleration (hardware detection and protection)
Err 23	Over-voltage during deceleration (hardware detection and protection)
Err 24	Over-voltage during speed regulation (hardware detection and protection)
Err 19 ～ Err 20 reserved for failure signals.	

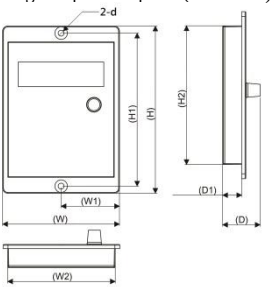
Appendix-E-Dimensional drawings of mechanism-

Digital operation panel (KP-700M)

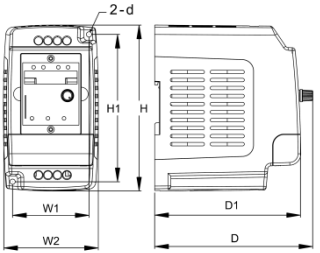


(Figure A-1)

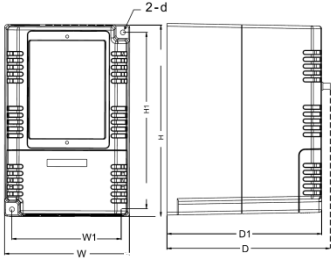
Digital operation panel (KP-AD20)



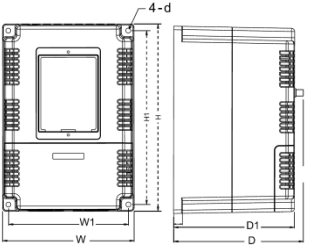
(Figure A-2)



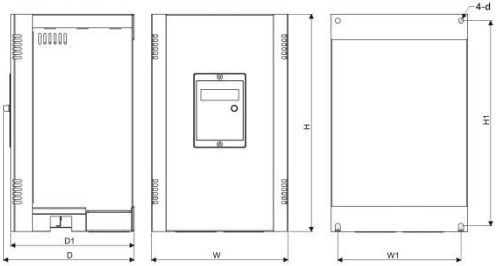
(Figure B)



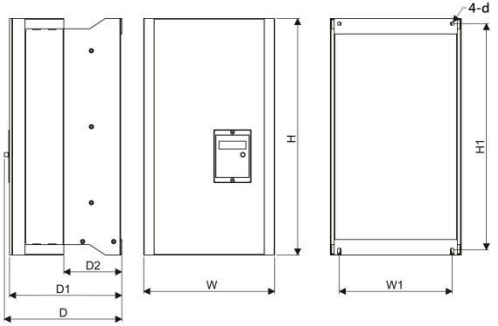
(Figure C)



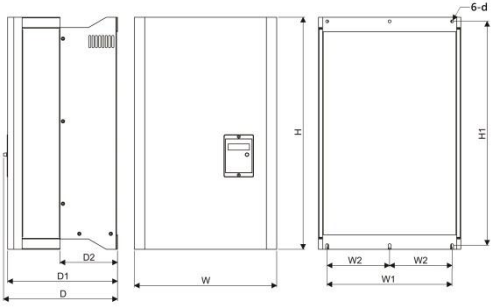
(Figure D)



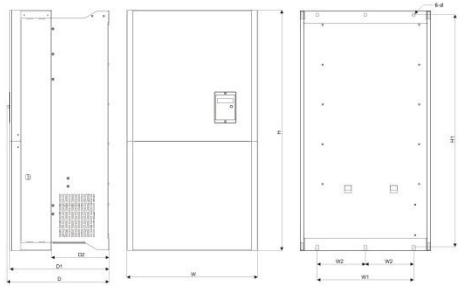
(Figure E)



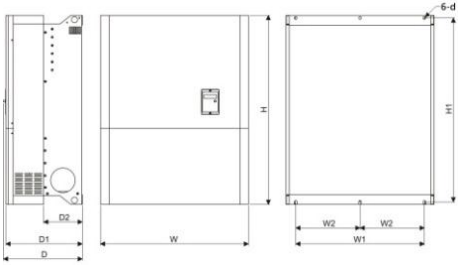
(Figure F)



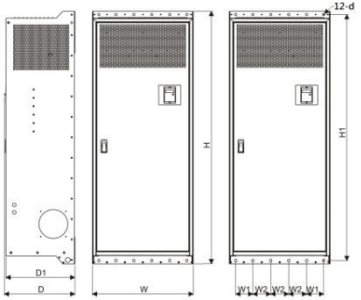
(Figure G)



(Figure H)



(Figure I)



(Figure J)

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

200V class series

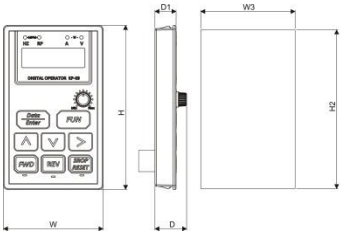
Applicable motor capacity	Roughing-in dimensions (mm)			Constant dimensions(mm)				ψ	Holing, constant dimensions (mm)					Drawing No.
(HP)／(KW)	W	H	D	W1	W2	H1	D1	d	W3	W4	H2	H3	D2	
KP-700M	52	70	27	26	49.4	62	14	3.5	—	—	56	—	—	A-1
KP-AD20	71	101.6	23	35.5	65.5	93	11.6	3.6	—	—	84.5	—	—	A-2
0.25 / 0.2 0.5 / 0.4 1 / 0.75 2 / 1.5	82.5	145	138	66.5	—	128.5	127.5	4.6	—	—	—	—	—	B
0.5 / 0.4 1 / 0.75 2 / 1.5	114	172	146	101	—	159	136	5.3	—	—	—	—	—	C
3 / 2.2 5 / 4.0	152	214	146	137.5	—	200	136	5.3	—	—	—	—	—	D
7.5 / 5.5 10 / 7.5 15 / 11	188	300	180	170	—	283	170	7	—	—	—	—	—	E
20 / 15 25 / 18.5 30 / 22 40 / 30	253	458	227	218	—	438	217	7	—	—	—	—	112	F
50 / 37 60 / 45 75 / 55	345	563	276	303	151	543	266	7	—	—	—	—	139	G
100 / 75	430	790	336	317	158	763	326	11	—	—	—	—	189	H
125 / 90 150 / 110	604	770	322	525	262	750	312	11	—	—	—	—	158	I

400V class series

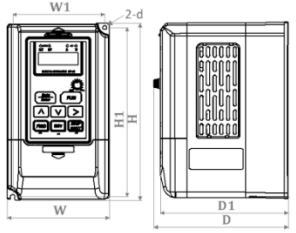
Applicable motor capacity (HP)／(KW)	Roughing-in dimensions (mm)			Constant dimensions(mm)				ψ	Holing, constant dimensions (mm)					Drawing No.
	W	H	D	W1	W2	H1	D1	d	W3	W4	H2	H3	D2	
KP-700M	52	70	27	26	49.4	62	14	3.5	—	—	56	—	—	A-1
KP-AD20	71	101.6	23	35.5	65.5	93	11.6	3.6	—	—	84.5	—	—	A-2
0.5 / 0.4														
1 / 0.75	114	172	146	101	—	159	136	5.3	—	—	—	—	—	C
2 / 1.5														
3 / 2.2	152	214	146	137.5	—	200	136	5.3	—	—	—	—	—	D
5 / 4.0														
7.5 / 5.5														
10 / 7.5	188	300	180	170	—	283	170	7	—	—	—	—	—	E
15 / 11														
20 / 15														
20 / 15														
25 / 18.5														
30 / 22	253	458	227	218	—	438	217	7	—	—	—	—	112	F
40 / 30														
50 / 37														
60 / 45														
75 / 55	345	563	276	303	151	543	266	7	—	—	—	—	139	G
100 / 75														
125 / 90														
150 / 110	430	790	336	317	158	763	326	11	—	—	—	—	189	H
175 / 132														
200 / 160														
250 / 185	604	770	322	525	262	750	312	11	—	—	—	—	158	I
300 / 220														
350 / 260														
375 / 280	612	1532	428	104	109	1493	418	14	—	—	—	—	—	J
425 / 315														

-Dimensional drawings of mechanism- Appendix-E

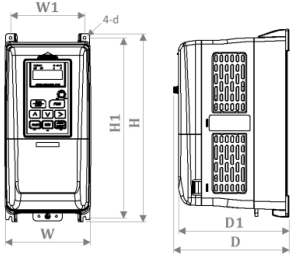
LS900 Dimensional



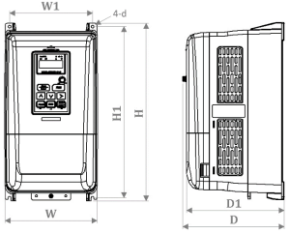
(KP-AD09)



(LS900 Figure A)



(LS900 Figure B)



(LS900 Figure C)

220V (KW)	0.75	1.5	2.2	3.7	5.5	7.5	11	15
220V (HP)	1	2	3	5	7.5	10	15	20
Frame Size	A			B		C		

400V(KW)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5
400V (HP)	1	2	3	5	7.5	10	15	20	25
Frame Size	A			B			C		

Drawing No.	Roughing-in dimensions (mm)			Constant dimensions(mm)				ϕ	Holing, constant dimensions (mm)				
	W	H	D	W1	W2	H1	D1	d	W3	W4	H2	H3	D2
KP-AD 09	70.7	116.7	22.5	—	—	—	15	—	67	—	113	—	—
A	114.5	198.5	150.8	103	—	190	143.5	4.8	—	—	—	—	—
B	129	286	176	113	—	274	169	4.5	—	—	—	—	—
C	175	335	193	158	—	323	186	5.5	—	—	—	—	—

*The company reserves the right to modify the models and specifications without notice.