LENSAIL

User Guide
LS680 Series AC Drive
Closed Loop Pressure and Flow Control

A00

Data code 200921001

Preface

Thank you for purchasing the LS680 series servo drive developed and manufactured by Lensail.

The LS680 is a servo drive developed for high-performance vector control of permanent magnet synchronous motor (PMSM). Using the high-performance vector control technology, it optimizes the process control of injection molding machine, including the control on injection speed and pressure holding precision as well as the stability control upon working with the injection molding machine controller. It also provides monitoring software and communication buses and supports multiple encoder types, realizing flexible function combinations and stable performance.

The LS680 is mainly applied to such industries as plastic molding, pipe extrusion, shoes making, rubber production, and metal die casting. It features better hydraulic control performance, faster pressure and speed responses, lower steady-state pressure fluctuation and smaller size.

Lensail dedicates to continuous product upgrade. The user guide will be updated with the product. Visit Lensail's official website (www.lensail.com) to download the latest document.

Introduction

§ Features

The LS680 series servo drive features:

1) Smaller size and higher power density

For models of the same power, the drive size reduces by at least 40% on average.

2) Wide voltage range

Rated input: three-phase 380–480 VAC

Voltage fluctuation range: -15% to +10%

3) Built-in DC reactor

A built-in DC reactor is provided for models of 30 kW or above, simplifying installation.

4) Improved built-in braking unit and braking protection functions

A built-in braking unit is configured for models of 75 kW or below (external braking unit for models of 90 kW or above). The braking circuit is equipped with various protection functions, including regenerative resistor short circuit, braking circuit overcurrent, braking transistor overload, and braking transistor short circuit.

5) Longer service life of the bus capacitor

The bus capacitor can serve for a longer time due to better configurations.

6) Fan drive circuit protection

The fan drive circuit generates a protection when the fan is unexpectedly short-circuited due to blocking or damage.

7) Better drive protection functions

The full series of servo drives are equipped with protections against output short circuit to ground and pre-charge relay (contactor) close fault.

8) Optimized EMC solution

A complete set of solution can be provided based on actual application requirements and certification requirements.

9) Matching with 23-bit absolute encoder and support for "auto-tuning free" function (intelligent identification of motor parameters, with auto-tuning not required when setting up the motor).

The LS680 can work with a 23-bit absolute encoder, achieving a resolution of up to 8 million pulses per revolution (PPR). It also supports motor parameter packing to perform the "auto-tuning free" function, simplifying the use of software.

◆ The "auto-tuning free" function is available only to servo systems configured with ESMG/ISMGx-xxxxxxx-A3xxxx series motor with a 23-bit absolute encoder.

§ Unpacking

Upon unpacking, check the following items:

- Whether the nameplate model and ratings of the servo drive (with certificate of conformity) in the packaging box are consistent with your order.
- Whether the product is damaged during transportation. If you find anything omission or damage, contact Lensail or your supplier immediately.

§ First-time Use

Read this user guide carefully if you use this product for the first time. For any problem concerning the functions or performances, contact the technicians of Lensail for help.

§ Standards Compliance

The following table lists the certifications and standards that the product may comply with. For details about the acquired certificates, see the certification marks on the product nameplate.

Certification	Certification Mark	Directive		Standard

§ Guide Downloading

Visit Lensail's official website (www.lensail.com) to download the latest version of the user guide.

Contents

Safety Information and Precautions

This guide is packaged together with the product. It contains basic information for quick start of the drive. For safety and more information, please refer to IS580 Servo Drive Advanced User Guide, which can be Downloaded on website: https://www.lensail.com.

■ Electrical Safety

Extreme care must be taken at all times when working with the servo drive or within the area of the servo drive. The voltages used in the servo drive can cause severe electrical shock or burns and is potentially lethal. Only authorized and qualified personnel should be allowed to work on servo drives.

■ Machine/System Design and Safety of Personnel

Machine/system design, installation, commissioning startups and maintenance must be carried out by personnel who have the necessary training and experience. They must read this safety information and the contents of this manual. If incorrectly installed, the servo drive may present a safety hazard.

The servo drive uses high voltages and currents (including DC), carries a high level of stored electrical energy in the DC bus capacitors even after power OFF. These high voltages are potentially lethal.

The servo drive is NOT intended to be used for safety related applications/functions. The electronic “STOP & START” control circuits within the servo drive must not be relied upon for the safety of personnel. Such control circuits do not isolate mains power voltages from the output of the servo drive. The mains power supply must be disconnected by an electrical safety isolation device before accessing the internal parts of the servo drive.

Safety risk assessments of the machine or process system which uses an servo drive must be undertaken by the user and or by their systems integrator/designer. In particular the safety assessment/design must take into consideration the consequences of the servo drive failing or tripping out during normal operation and whether this leads to a safe stop position without damaging machine, adjacent equipment and machine operators/users. This responsibility lies with the user or their machine/process system integrator.

System integrator/designer must ensure the complete system is safe and designed according to the relevant safety standards. Lensail Technology and Authorized Distributors can provide recommendations related to the servo drive to ensure long term safe operation.

The installer of the AC Drive is responsible for complying with all relevant regulations for wiring, circuit fuse protection, earthing, accident prevention and electromagnetic (EMC regulations). In particular fault discrimination for preventing fire risk and solid earthing practices must be adhered to for electrical safety (also for good EMC practice). Within the European Union, all machinery in which this product is used must comply with required directives.

■ Electrical Installation - Safety

Electrical shock risk is always present within an servo drive including the output cable leading to the motor terminals. Where dynamic brake resistors are fitted external to the servo drive, care must be taken with regards to live contact with the brake resistors, terminals which are at high DC voltage and potentially lethal. Cables from the servo drive to the dynamic brake resistors should be double insulated as DC voltages are typically 600 to 700 VDC.

Mains power supply isolation switch should be fitted to the servo drive. The mains power supply must be disconnected via the isolation switch before any cover of the servo drive can be removed or before any servicing work is undertaken stored charge in the DC bus capacitors of the PWM servo drive is potentially lethal after the AC supply has been disconnected. The AC supply must be isolated at least 10 minutes before any work can be undertaken as the stored charge will have been discharged through the internal bleed resistor fitted across the DC bus capacitors.

Whenever possible, it is good practice to check DC bus voltage with a VDC meter before accessing the servo drive bridge. Where the servo drive input is connected to the mains supply with a plug and socket, then upon disconnecting the plug and socket, be aware that the plug pins may be exposed and internally connected to DC bus capacitors (via the internal bridge rectifier in reversed bias). Wait 10 minutes to allow stored charge in the DC bus capacitors to be dissipated by the bleed resistors before commencing work on the servo drive.

■ Electrical Shock Hazard

Ensure the protective earthing conductor complies with technical standards and local safety regulations. Because the leakage current exceeds 3.5 mA in all models, IEC 61800-5-1 states that either the power supply must be automatically disconnected in case of discontinuity of the protective earthing conductor or a protective earthing conductor with a cross-section of at least 10 mm^2 (Cu) or 16 mm2 (Al) must be used. Failure to comply may result in death or serious injury.

When using an earth leakage circuit breaker, use a residual current operated protective device (RCD) of type B (breaker which can detect both AC and DC). Leakage current can cause unprotected components to operate incorrectly. If this is a problem, lower the carrier frequency, replace the components in question with parts protected against harmonic current, or increase the sensitivity amperage of the leakage breaker to at least 200 mA per drive.

Factors in determining leakage current:

- Size of the AC drive
- AC drive carrier frequency
- Motor cable type and length
- EMI/RFI filter

■ Approvals

Certification marks on the product nameplate indicate compliance with the corresponding certificates and standards.

Certification	Mark	Directives		Standard

1 Product Information

1.1 Nameplate and Designation Rule

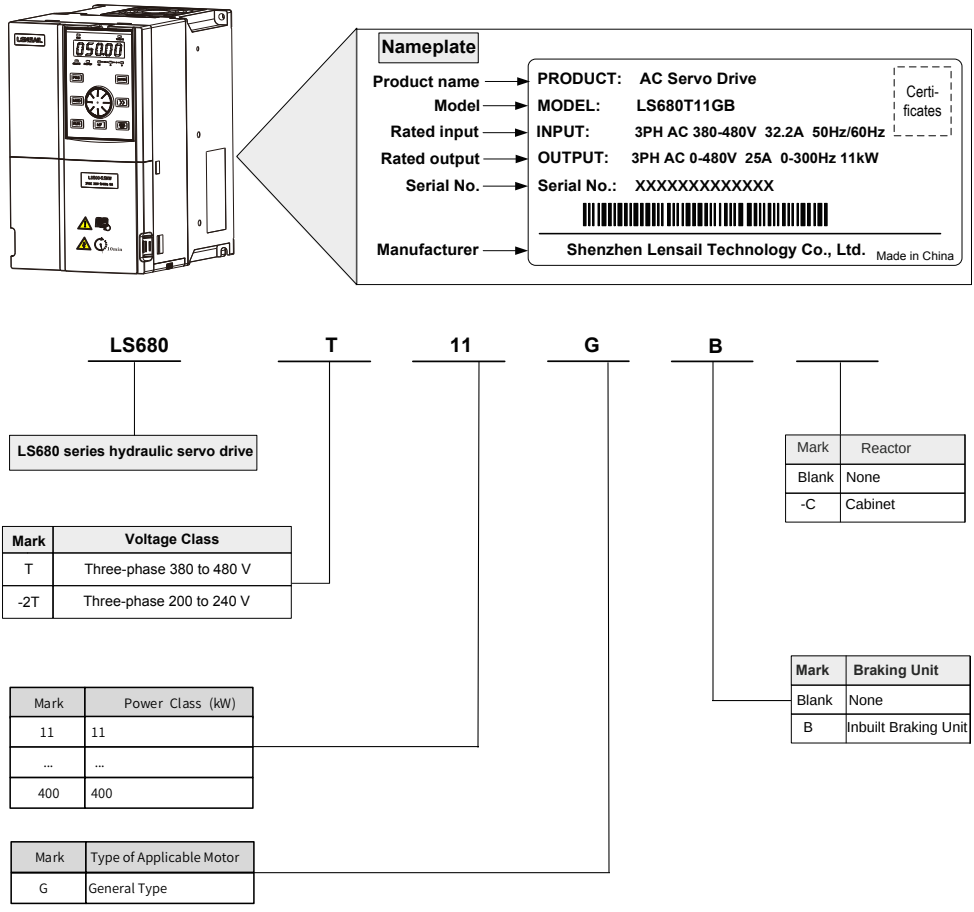
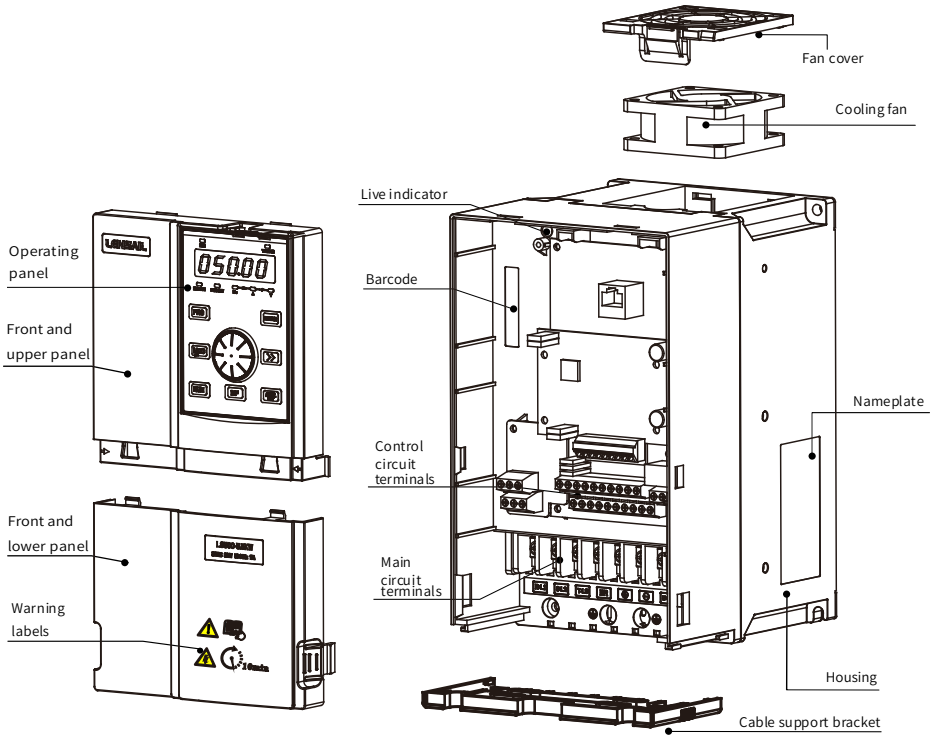


Figure 1-1 Nameplate and ordering code

1.2 Components

The AC drive has either a plastic housing (three-phase 380 V, 11 to 18.5 kW models and three-phase 220 V, 5.5 to 7.5 kW models used as an example) or a sheet metal housing (200 to 400 kW models used as an example), depending on the voltage and power class, as shown in the following figures.



Warning Label		Description
⚠	📖	CAUTION! Read the user guide carefully before installation or operation.
⚠	10min	DANGER! Do not remove the front cover while the power is on or within 10 minutes after the power is turned off.

Figure 1-2 Product parts (LS680T11GB to LS680T18.5GB, LS680-2T5.5GB to LS680-2T7.5GB)

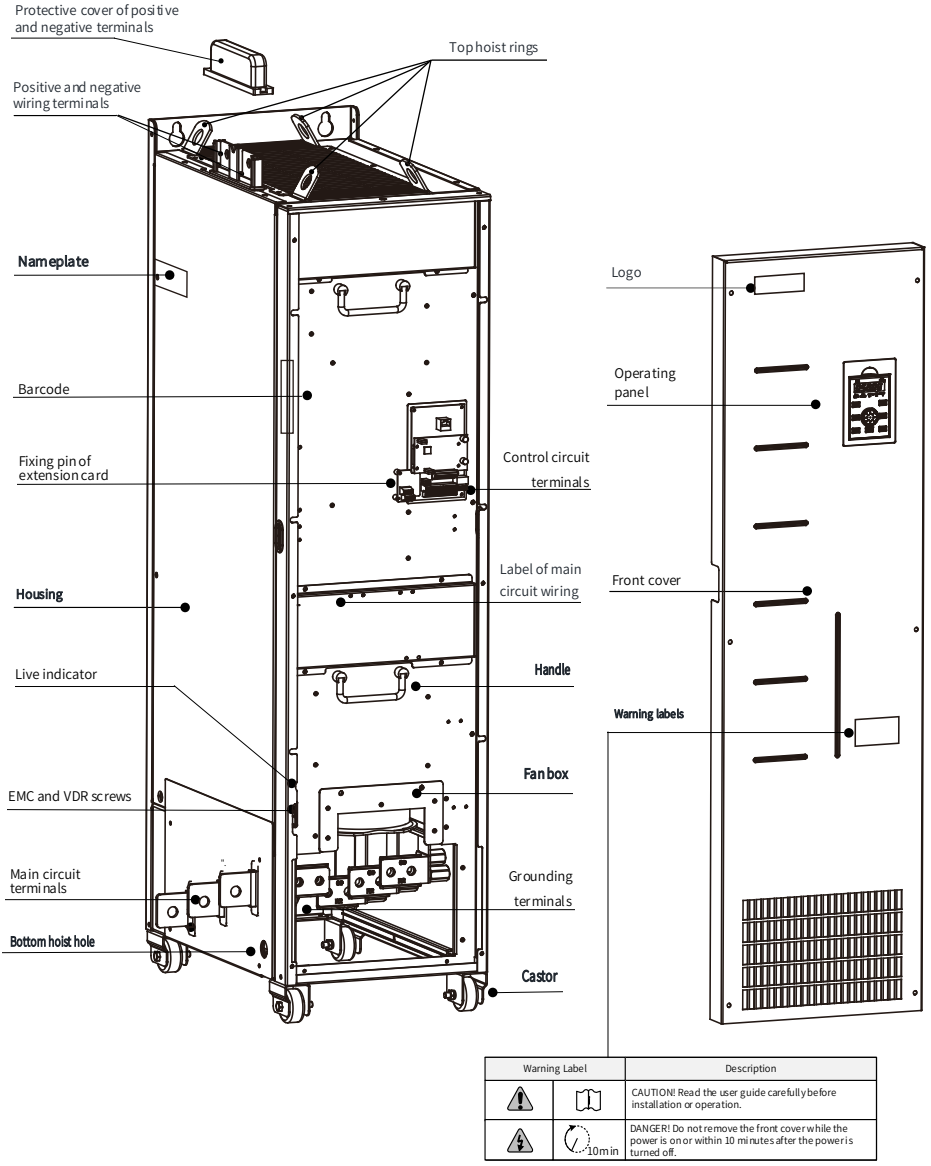


Figure 1-3 Product parts (LS680T200G-C to LS680T400G-C)

1.3 Technical Data

Table 1-1 Models and technical data (three phase 380–480 V)

Item			Specification											
LS680TXXG(B)			11	15	18	22	30	37	45	55	75	90	110	132
Output	Applicable	(kW)	11	15	18	22	30	37	45	55	75	90	110	132
	Motor	(HP)	15	20	25	30	40	50	60	75	100	125	150	180
	Rated output current(A)		25	32	37	45	60	75	91	112	150	176	210	253
	Output voltage		0 to input voltage											
	Maximum output frequency		300Hz (editable through a parameter)											
	Carrier frequency		2kHz to 8kHz (Automatically adjusted according to the load characteristics)											
	Overload capacity		150% for 60s with rated current											
Input	Rated input current (A)		32.2	41.3	49.5	57	59	69	89	106	139	164	196	240
	Rated voltage/frequency		AC : three phase 380V to 480V , 50/60Hz											
	Allowed voltage fluctuation		-15 to 10% , actually allowed range : AC 323V to 528V											
	Allowed frequency fluctuation		±5%											
	Power capacity (kVA)		33.4	42.8	45	54	52	63	81	97	127	150	179	220
Thermal design	Thermal power consumption (kW)		0.355	0.454	0.478	0.551	0.694	0.815	1.01	1.21	1.57	1.81	2.14	2.85
	Air flow (CFM)		40	42	51.9	57.4	118.5	118.5	122.2	122.2	218.6	287.2	354.2	547

Item			Specification							
LS680TXXG(B)			160	200	220	250	280	315	355	400
Output	Applicable	(kW)	160	200	220	250	280	315	355	400
	Motor	(HP)	220	275	300	340	380	430	485	545
	Rated output current(A)		304	377	426	465	520	585	650	725
	Output voltage		0 to input voltage							
	Maximum output frequency		300Hz (editable through a parameter)							
	Carrier frequency		2kHz to 8kHz							
			Automatically adjusted according to the load characteristics							
	Overload capacity		150% for 60s with rated current (LS680T400G : 130% for 60s with the rated current)							
Input	Rated input current (A)		287	365	410	441	495	565	617	687
	Rated voltage/frequency		AC : three phase 380V to 480V , 50/60Hz							
	Allowed voltage fluctuation		-15 to 10% , actually allowed range : AC 323V to 528V							
	Allowed frequency fluctuation		±5%							
	Power capacity (kVA)		263	334	375	404	453	517	565	629

Item		Specification							
Thermal design	Thermal power consumption (kW)	3.56	4.15	4.55	5.06	5.33	5.69	6.31	6.91
	Air flow (CFM)	627	638.4	722.5	789.4	882	645	860	860

Table 1-2 Models and technical data (three phase 200–240 V)

Item			Specification										
LS680-2TXXG(B)			5.5	7.5	11	15	18	22	30	37	45	55	75
Output	Applicable	(kW)	5.5	7.5	11	15	18	22	30	37	45	55	75
	Motor	(HP)	7.5	10	15	20	25	30	40	50	60	75	100
	Rated output current(A)		25	32	45	60	75	91	112	150	176	210	304
	Output voltage		0 to input voltage										
	Maximum output frequency		300Hz (editable through a parameter)										
	Carrier frequency		2kHz to 8kHz (Automatically adjusted according to the load characteristics)										
	Overload capacity		150% for 60s with rated current										
Input	Rated input current (A)		32.2	41.3	57	59	69	89	106	139	164	196	287
	Rated voltage/frequency		AC : three phase 200V to 240V , 50/60Hz										
	Allowed voltage fluctuation		-15 to 10% , actually allowed range : AC 170V to 264V										
	Allowed frequency fluctuation		±5%										
	Power capacity (kVA)		15.0	20	25	26	32	41	49	64	75	90	132
Thermal design	Thermal power consumption (kW)		0.4	0.5	0.73	0.91	1.08	1.36	1.62	1.66	1.8	2.3	3.2
	Air flow (CFM)		40	42	57.4	118.5	118.5	122.2	122.2	218.6	287.2	354.2	547

Table 1-3 Technial specifications

Item		Specification	
Basic functions	Input frequency resolution	Digital setting: 0.01 Hz Analog setting: Max. frequency x 0.025%	
	Control mode	Sensorless vector control (SVC), feedback vector control (FVC), and voltage/frequency (V/f) control	
	Startup torque	SVC: 0.25 Hz/150% FVC: 0 Hz/180%	
	Speed range	1:200 (SVC)	1:1000 (FVC)
	Speed stability accuracy	±0.5% (SVC)	±0.02% (FVC)
	Torque control accuracy	FVC: ±3% SVC: ±5% above 10 Hz	
	Torque boost	Automatic torque boost Manual torque boost: 0.1% to 30.0%	
	V/f curve	Linear	
	Acceleration/ Deceleration curve	Linear or S-curve acceleration/deceleration mode Four groups of acceleration/deceleration time within the range of 0.0s to 6500.0s can be set	
	DC injection braking	Braking start frequency: 0.00 Hz to max. frequency Braking time: 0.0s to 36.0s Injection braking current: 0.0% to 100.0%	
	Built-in proportional–integral–derivative (PID)	Implements the PID function in the closed-loop control.	
	Automatic voltage regulation (AVR)	Keeps a constant output voltage automatically when the mains voltage changes.	
	Overvoltage/ Overcurrent stall control	Automatically limits the current and voltage during running to avoid frequent tripping caused by overvoltage/ overcurrent.	
Features	Fast current limit	Avoids frequent overcurrent of the servo drive.	
	Multiple field buses	Supports three field buses: Modbus RTU, CANopen and PROFIBUS-DP	
	Motor overtemperature protection	Supports KTY and PTC temperature protections.	
	Multiple encoder types	Supports the resolver and 23-bit absolute encoder	
	Powerful software tool	Supports parameter operations and provides a virtual oscilloscope that allows you to monitor the status of the servo drive.	

Item		Specification
Running	RUN command source	Supports the following command sources and allows different methods of switching between them: Operating panel Terminal I/O control Serial communication
	Frequency reference setting channel	Supports up to 10 frequency reference setting channels, including digital setting, analog voltage reference, analog current reference, pulse reference, and communication reference. Allows different methods of switching between these channels.
	Input terminals	Standard: Five digital input (DI) terminals Three analog input (AI) terminals, two of which support only 0–10 V voltage input and the other one supports 0–10 V voltage input or 0–20 mA current input.
	Output terminals	Standard: One digital output (DO) terminal Two relay output terminals Two analog output (AO) terminals that support 0–20 mA current output or 0–10 V voltage output.
Display and panel operations	LED display	Displays parameters.
	Key locking and function selection	Keys on the control panel can be locked partially or electronically to prevent accidental operation.
Protection functions	Phase loss protection	Input/Output phase loss protection
	Instantaneous overcurrent protection	The servo drive stops when the instantaneous current exceeds 250% of the rated output current.
	Overvoltage protection	The servo drive stops when the DC voltage of the main circuit is above 820 V.
	Undervoltage protection	The servo drive stops when the DC voltage of the main circuit is below 350 V.
	Overtemperature protection	Protection is triggered when inverter bridge overtemperature occurs.
	Overload protection	The servo drive stops after running at 150% rated current for 60s.
	Overcurrent protection	The servo drive stops when the current exceeds 2.5 times rated current.
	Braking protection	Braking unit overload protection and regenerative resistor short circuit protection
	Short circuit protection	Output interphase short circuit protection and protection against output short circuit to ground

Item		Specification
Environment	Operating location	Indoor, free from direct sunlight, dust, corrosive or combustible gases, oil mist, vapor, drip, or salt
	Altitude	1000 m or below, de-rated by 1% for each 100 m higher if the altitude exceeds 1000 m Max. altitude: 3000 m
	Ambient temperature	-10°C to +40°C, de-rated by 1.5% for each 1°C higher if the ambient temperature exceeds 40°C Max. temperature: 50°C
	Humidity	Below 95% RH, without condensation
	Vibration	< 5.9 m/s^2 (1 g)
	Storage temperature	-20°C to +60°C

1.4 Outline and Dimensions

1.4.1 LS680T11GB to LS680T18GB and LS680-2T5.5GB to LS680-2T55G

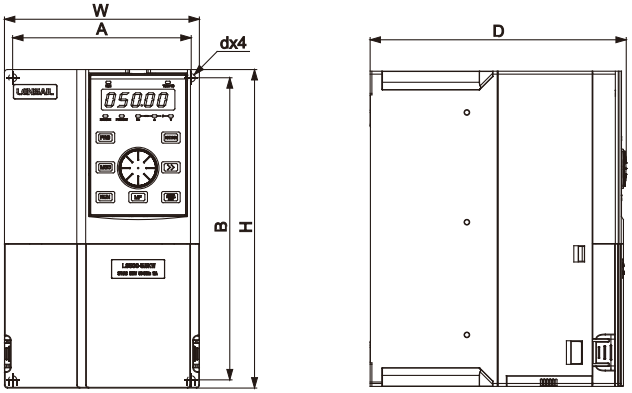


Figure 1-4 Outline and mounting dimensions of LS680T11GB to LS680T18GB, and LS680-2T5.5GB to LS680-2T7.5GB

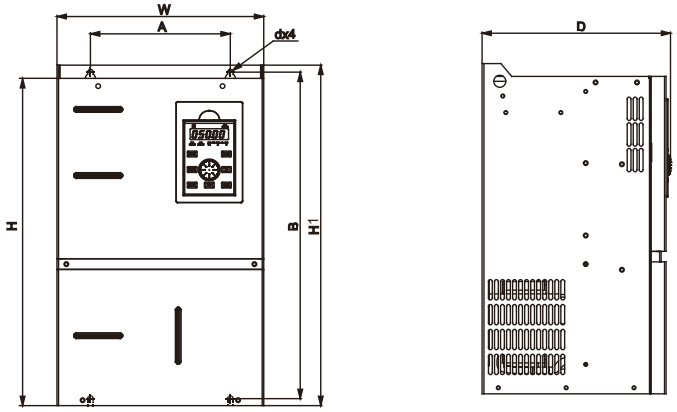


Figure 1-5 Outline and mounting dimensions of models with sheet metal structure (LS680T22GB to LS680T400G, LS680-2T11GB to LS680-2T55G)

Table 1-4 Outline and mounting hole dimensions of LS680T11GB to LS680T400G and LS680-2T5.5G to LS680-2T75G

Model	Hole Dimensions (mm)		Overall Dimensions (mm)				Hole Diameter (mm)
	A	B	H	H1	W	D	d
LS680T11GB	168	269	280	-	180	179	Φ6
LS680T15GB							
LS680T18GB							
LS680T22GB	145	327	328	345	226	220	Φ7
LS680T30GB							
LS680T37GB	180	420	420	438	266	250	Φ7
LS680T45GB							
LS680T55GB	245	523	525	542	300	275	Φ10
LS680T75GB							
LS680T93G	270	560	554	580	338	315	Φ10
LS680T110G							
LS680T132G	320	705	704	745	400	315	Φ10
LS680T160G							

Model	Hole Dimensions (mm)		Overall Dimensions (mm)				Hole Diameter (mm)
	A	B	H	H1	W	D	d
LS680T200G	320	750	740	780	425	335	Φ13
LS680T220G							
LS680T250G	350	800	795	835	475	355	Φ14
LS680T280G							
LS680T315G	500	995	990	1030	625	355	Φ14
LS680T400G							

Table 1-5 Mounting hole dimensions of LS680-2T5.5GB to LS680-2T75G (three phase 200–240 V)

Model	Hole Dimensions (mm)		Overall Dimensions (mm)				Hole Diameter (mm)
	A	B	H	H1	W	D	d
LS680-2T5.5GB	120	203	214	-	131	173	Φ5.5
LS680-2T7.5GB	168	269	280	-	180	179	Φ6
LS680-2T11GB							
LS680-2T15GB	145	327	328	345	226	220	Φ7
LS680-2T18GB							
LS680-2T22GB	180	420	420	438	266	250	Φ7
LS680-2T30GB							
LS680-2T37GB	245	523	525	542	300	275	Φ10
LS680-2T45G							
LS680-2T55G	270	560	554	580	338	315	Φ10
LS680-2T75G	320	705	704	745	400	315	Φ10

1.4.2 LS680T200G-C to LS680T400G-C

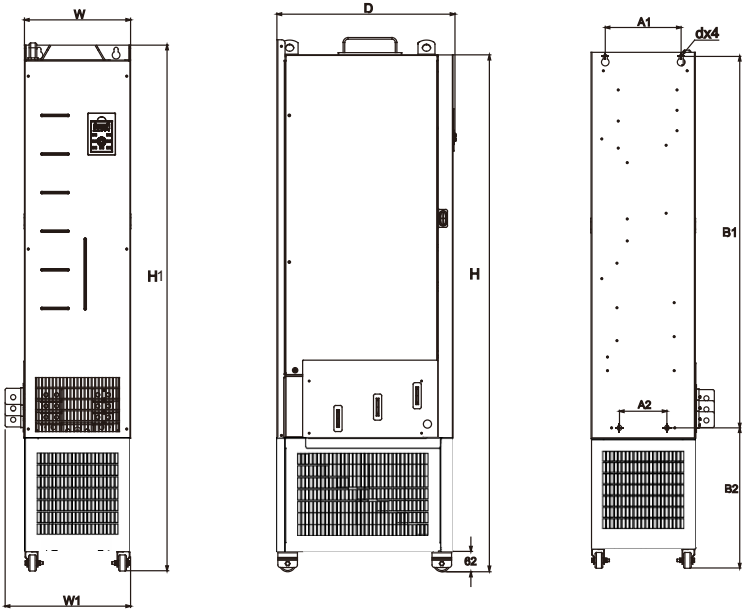


Figure 1-6 Outline and mounting dimensions of models with sheet metal structure (LS680T200G-C to LS680T400G-C)

Table 1-6 Outline and mounting hole dimensions of LS680T200G-C to LS680T400G-C

Model	Hole Dimensions (mm)				Overall Dimensions (mm)					Hole Diameter (mm)
	A1	A2	B1	B2	H	H1	W	W1	D	d
LS680T200G-C	240	150	1035	86	1086	1134	300	360	505	Φ13
LS680T220G-C										
LS680T250G-C	240	185	1175	96	1238	1284	330	390	545	Φ13
LS680T280G-C										
LS680T315G-C	240	200	1280	101	1355	1405	340	400	545	Φ16
LS680T350G-C										
LS680T400G-C										

2 System Connection

2.1 Connection of Peripherals

When using the LS680 to control the hydraulic system with PMSM, install peripherals on both the input and output sides of the servo drive to ensure system's safety and stability. The structure of systems with three-phase 380–480 V servo drive of 11 kW or above is as follows.

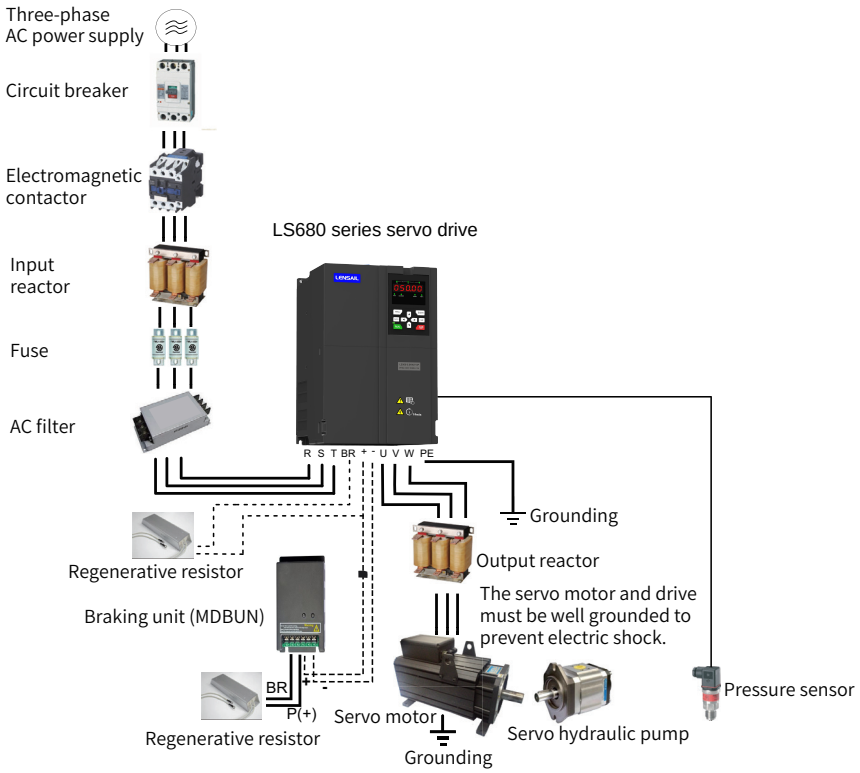


Figure 2-1 Electrical system configuration with LS680

NOTE

◆ The preceding figure is just a connection diagram of peripherals and cannot be used as a guide for peripheral selection.

2.2 Usage of Peripherals

Table 2-1 Usage description of electrical peripherals

Name	Installation Position	Function Description
Circuit breaker	Between the power supply and the drive input side	Short circuit breaker: Cuts off the power supply when an overcurrent occurs on downstream devices to prevent accidents.
		RCD: Provides protection against potential high leakage current during running of the drive to prevent an electric shock or even a fire. Select a proper RCD according to the field situation.
(Electromagnetic) Contactor	Between the air switch and the drive input side	◆ Do not power on or power off the drive frequently by switching the contactor on and off (the time interval cannot be less than 1 h). ◆ Do not use the contactor to directly start/ stop the drive.
Input reactor	On the drive input side	◆ Improves the power factor of the input side. ◆ Eliminates high harmonics of the input side effectively to prevent other devices from being damaged due to the distortion of the voltage waveform. ◆ Eliminates the input current unbalance caused by inter-phase unbalance.
Fuse	Between the power supply and the drive input side	Prvents accidents in case of short circuit and protect downstream semiconductor components.
AC filter	On the drive input side	◆ Reduces the external conduction and radiation interference generated by the drive. ◆ Decreases the conduction interference flowing from the power supply to the drive and improves the anti-interference capacity of the drive.
Regenerative resistor	Models of 75 kW or below	For models of 75 kW or below, use a regenerative resistor to absorb regenerative energy during motor deceleration.
Braking unit	Models of 90 kW or above	For models of 90 kW or above, use the braking unit MDBUN provided by Lensail and the recommended regenerative energy to absorb regenerative energy during motor deceleration.

Name	Installation Position	Function Description
Output reactor (du/dt filter)	Between the drive output side and the motor (close to the drive side)	The output side of the servo drive usually has many high harmonics. When the distance between the motor and the drive is too long, large distributed capacitance exists in the circuit. Certain harmonics may cause resonance in the circuit, which will: ◆ degrade the motor insulation performance, causing damage to the motor in the long run. ◆ generate large leakage current, causing frequent drive protection trips. If the distance between the drive and the motor is greater than 50 m, install an AC output reactor.
Output ferrite core	On the drive output side (close to the drive side)	Reduces the bearing current.
Host controller system	Part of control signals from the host controller is connected to the drive	◆ Controls the drive. ◆ Sends various references to the drive. ◆ Exchanges information with the drive.
Servo motor	On the drive output side	Selects an appropriate motor according to the recommendation.
Servo hydraulic pump	Connected to the servo motor	Provides the hydraulic system with flow and pressure.
Pressure sensor	Installed in the oil outlet circuit, with feedback signals connected to the drive	Provides hydraulic circuits with pressure feedback analog signals.
DC reactor	Built-in DC reactor is offered for models of 30 kW or above	◆ Improves the power factor of the input side. ◆ Increases the efficiency and thermal stability of the servo drive. ◆ Eliminates the impact of high harmonics of the input side on the servo drive, reducing the external conduction and radiation interference.

NOTE

◆ Do not install the capacitor or SPD on the drive output side. Failure to comply will cause faults of the drive or damage to the capacitor and SPD.
◆ Harmonics exist in the input/output (main circuits) of the drive, which may interfere with the communication device connected to the drive. Therefore, install an AC input filter to minimize interference.

2.3 Selection of Cables, Breakers, and Contactors

Table 2-3 Cable selection (three phase 380–480 V)

Model	RST/UVW		Ground Cable		Terminal Width of the AC Drive (mm)	Screw
	Recommended Cable(mm^2) <1>	Recommended Lug Model	Recommended Cable(mm^2) <1>	Recommended Lug Model		
Three Phase 380V~480V , 50/60Hz						
LS680T11GB	3 x 6	TNR5.5-5	6	TNR5.5-5	14.3	M5
LS680T15GB	3 x 10	TNR8-5	10	TNR8-5	14.3	M5
LS680T18GB	3 x 10	GTNR10-6	10	GTNR10-6	15	M6
LS680T22GB	3 x 16	GTNR16-6	16	GTNR16-6	15	M6
LS680T30GB	3 x 16	GTNR16-6	16	GTNR16-6	18	M6
LS680T37G(B)	3 x 25	GTNR25-6	16	GTNR16-6	18	M6
LS680T45G(B)	3 x 35	GTNR35-8	16	GTNR16-8	26.8	M8
LS680T55G(B)	3 x 50	GTNR50-8	25	GTNR25-8	26.8	M8
LS680T75G(B)	3 x 70	GTNR70-12	35	GTNR35-12	30.6	M12
LS680T90G	3 x 95	GTNR95-12	50	GTNR50-12	30.6	M12
LS680T110G	3 x 120	GTNR120-12	70	GTNR70-12	30.6	M12
LS680T132G	3 x 150	BC150-12	95	BC95-12	*	M12
LS680T160G	3 x 185	BC185-12	95	BC95-12	*	M12
LS680T200G(-C)	2 x (3 x 95)	BC95-12	95	BC95-12	*	M12
LS680T220G(-C)	2 x (3 x 120)	BC120-12	120	BC120-12	*	M12
LS680T250G(-C)	2 x (3 x 120)	BC120-12	120	BC120-12	*	M12
LS680T280G(-C)	2 x (3 x 150)	BC150-12	150	BC150-12	*	M12
LS680T315G(-C)	2 x (3 x 185)	BC185-16	185	BC185-16	*	M16
LS680T355G(-C)	2 x (3 x 185)	BC185-16	185	BC185-16	*	M16
LS680T400G(-C)	2 x (3 x 240)	BC240-16	240	BC240-16	*	M16

Table 2-4 Cable selection (Three phase 380–480 V) (Comply with UL certification)

Model	RST/UVW		Ground Cable		Terminal Width of the AC Drive (mm)	Screw
	Recommended Cable (AWG/mil)<2>	Recommended Lug Model	Recommended Cable (AWG/mil)<2>	Recommended Lug Model		
Three Phase 380V~480V , 50/60Hz						
LS680T11GB	8	TLK10-5	2*8	TLK10-5	12	M5
LS680T15GB	6	TLK16-5	6	TLK16-5	12	M5
LS680T18GB	6	TLK16-6	6	TLK16-6	12	M6
LS680T22GB	4	TLK25-6	4	TLK25-6	14	M6
LS680T30GB	4	TLK25-6	4	TLK25-6	14	M6
LS680T37G(B)	3	TLK35-6	4	TLK25-6	14	M6
LS680T45G(B)	2	TLK35-8	4	TLK25-8	16	M8
LS680T55G(B)	1/0	TLK70-8	3	TLK35-8	17	M8
LS680T75G(B)	3/0	TLK95-12	1	TLK50-12	23	M12
LS680T90G	4/0	TLK120-12	1/0	TLK70-12	23	M12
LS680T110G	300	SQNBS180-12	3/0	TLK95-12	26	M12
LS680T132G	400	TLK240-12	4/0	TLK120-12	28	M12
LS680T160G	500	TLK300-12	250	TLK150-12	31	M12
LS680T200G(-C)	4×1	TLK50-12	2×1	TLK50-12	23	M12
LS680T220G(-C)	4×1/0	TLK70-12	2×1/0	TLK70-12	23	M12
LS680T250G(-C)	4×1/0	TLK70-12	2×1/0	TLK70-12	23	M12
LS680T280G(-C)	4×2/0	TLK70-12	2×2/0	TLK70-12	23	M12
LS680T315G(-C)	4×3/0	TLK95-12	2×3/0	TLK95-12	26	M16
LS680T355G(-C)	4×4/0	TLK120-12	2×4/0	TLK120-12	28	M16
LS680T400G(-C)	4×4/0	TLK120-12	2×4/0	TLK120-12	28	M16

Table 2-5 Cable selection (three phase 200–240 V)

Model	RST/UVW		Ground Cable		Terminal Width of the AC Drive (mm)	Screw
	Recommended Cable(mm^2) <1>	Recommended Lug Model	Recommended Cable(mm^2) <1>	Recommended Lug Model		
Three Phase 380V~480V，50/60Hz						
LS680-2T5.5GB	3 x 6	TNR5.5-5	6	TNR5.5-5	10.2	M4
LS680-2T7.5GB	3 x 10	TNR8-5	10	TNR8-5	14.3	M5
LS680-2T11GB	3 x 16	GTNR16-6	16	GTNR16-6	15	M6
LS680-2T15G(B)	3 x 16	GTNR16-6	16	GTNR16-6	18	M6
LS680-2T18G(B)	3 x 25	GTNR25-6	16	GTNR16-6	18	M6
LS680-2T22G(B)	3 x 35	GTNR35-8	16	GTNR16-8	26.8	M8
LS680-2T30G(B)	3 x 50	GTNR50-8	25	GTNR25-8	26.8	M8
LS680-2T37G(B)	3 x 70	GTNR70-12	35	GTNR35-12	30.6	M12
LS680-2T45G	3 x 95	GTNR95-12	50	GTNR50-12	30.6	M12
LS680-2T55G	3 x 120	GTNR120-12	70	GTNR70-12	30.6	M12

NOTE

[1] Suitable for the Chinese standard. "3 x 10" indicates one three-conductor cable, and "2 x (3 x 95)" indicates two three-conductor cables.

[2] Suitable for the American standard. "5" indicates 5AWG, "1/0" indicates 0AWG, "2/0" indicates 00AWG, "3/0" indicates 000AWG, "4/0" indicates 0000AWG, and "2 x 250" indicates two 250 Kcmil cables.

[3] The preceding recommended lugs are the TNR, GTNR and BC series lugs of Suzhou Weizheng. The lugs with UL certifications are KST's TLK and SQNBS series lugs.

Table 2-6 Contactor and breaker selection (three phase 380–480 V)

Servo Drive Model	Recommended Fuse Bussmann (with UL Certification)		Recommended Contactor	Recommended Breaker
	Rated Current (A)	Model	Rated Current (A)	Rated Current (A)
Three Phase 380V~480V，50/60Hz				
LS680T11GB	60	FWP-60B	38	50
LS680T15GB	70	FWH-70B	50	63
LS680T18GB	80	FWH-80B	65	63
LS680T22GB	100	FWH-100B	65	80
LS680T30GB	100	FWH-100B	65	80
LS680T37G(B)	125	FWH-125B	80	100
LS680T45G(B)	150	FWH-150B	95	160
LS680T55G(B)	200	FWH-200B	115	160
LS680T75G(B)	250	FWH-250A	150	250
LS680T90G	275	FWH-275A	170	250
LS680T110G	325	FWH-325A	205	250
LS680T132G	400	FWH-400A	245	400
LS680T160G	500	FWH-500A	300	400
LS680T200G(-C)	600	FWH-600A	410	500
LS680T220G(-C)	700	FWH-700A	410	630
LS680T250G(-C)	800	FWH-800A	475	630
LS680T280G(-C)	800	FWH-800A	620	800
LS680T315G(-C)	1000	170M5016	620	800
LS680T355G(-C)	1000	170M5016	620	800
LS680T400G(-C)	1400	170M6017	800	1000

Table 2-7 Contactor and breaker selection (three phase 200–240 V)

Servo Drive Model	Recommended Fuse Bussmann (with UL Certification)		Recommended Contactor	Recommended Breaker
	Rated Current (A)	Model	Rated Current (A)	Rated Current (A)
Three Phase 380V~480V , 50/60Hz				
LS680-2T5.5GB	60	FWP-60B	38	50
LS680-2T7.5GB	70	FWH-70B	50	63
LS680-2T11GB	100	FWH-100B	65	80
LS680-2T15G(B)	100	FWH-100B	65	80
LS680-2T18G(B)	125	FWH-125B	80	100
LS680-2T22G(B)	150	FWH-150B	95	160
LS680-2T30G(B)	200	FWH-200B	115	160
LS680-2T37G(B)	250	FWH-250A	150	250
LS680-2T45G	275	FWH-275A	170	250
LS680-2T55G	325	FWH-325A	205	250

2.4 Selection of the AC Output Reactor

Whether to install an AC output reactor on the power output side is dependent on actual situations. Cable connecting the AC drive and motor cannot be too long. Otherwise, capacitance enlarges and thus high-harmonics current may be easily generated. To avoid these problems, install an AC output reactor close to the AC drive if the cable length is equal to or larger than the values listed in the following table.

Table 2-8 Cable length limit with the output reactor configured (three phase 380–480 V)

Servo Drive Power (kW)	Rated Voltage (V)	Minimum Cable Length with Output Reactor Configured (m)	Servo Drive Power (kW)	Rated Voltage (V)	Minimum Cable Length with Output Reactor Configured (m)
11	200 ~ 500	110	18	200 ~ 500	135
15	200 ~ 500	125	≧ 22	200 ~ 500	150

Table 2-9 Cable length limit with the output reactor configured (three phase 200–240 V)

Servo Drive Power (kW)	Rated Voltage (V)	Minimum Cable Length with Output Reactor	Servo Drive Power (kW)	Rated Voltage (V)	Minimum Cable Length with Output Reactor
5.5	200 ~ 500	110	≧ 11	200 ~ 500	150
7.5	200 ~ 500	125			

Table 2-10 Recommended models of the AC output reactor (three phase 380–480 V)

Servo Drive Model	Servo Output Reactor Model (Lensail)	Servo Drive Model	Servo Output Reactor Model (Lensail)
LS680T11GB	LS500-OCL-30-0.23-4T-1%	LS680T55G(B)	LS500-OCL-150-0.047-4T-1%
LS680T15GB	LS500-OCL-40-0.18-4T-1%	LS680T75G(B)	LS500-OCL-200-0.035-4T-1%
LS680T18GB	LS500-OCL-50-0.14-4T-1%	LS680T90G	LS500-OCL-250-0.028-4T-1%
LS680T22GB	LS500-OCL-60-0.12-4T-1%	LS680T110G	LS500-OCL-250-0.028-4T-1%
LS680T30GB	LS500-OCL-80-0.087-4T-1%	LS680T132G	LS500-OCL-330-0.021-4T-1%
LS680T37G(B)	LS500-OCL-90-0.078-4T-1%	LS680T160G	LS500-OCL-330-0.021-4T-1%
LS680T45G(B)	LS500-OCL-120-0.058-4T-1%		

Table 2-11 Recommended models of the AC output reactor (three phase 200–240 V)

Servo Drive Model	AC Output Reactor Model (Lensail)	AC Drive Model	AC Output Reactor Model (Lensail)
LS680-2T5.5GB	LS500-OCL-30-0.23-4T-1%	LS680-2T30G(B)	LS500-OCL-150-0.047-4T-1%
LS680-2T7.5GB	LS500-OCL-40-0.18-4T-1%	LS680-2T37G(B)	LS500-OCL-200-0.035-4T-1%
LS680-2T11G(B)	LS500-OCL-60-0.12-4T-1%	LS680-2T45G	LS500-OCL-250-0.028-4T-1%
LS680-2T15G(B)	LS500-OCL-80-0.087-4T-1%	LS680-2T55G	LS500-OCL-250-0.028-4T-1%
LS680-2T18G(B)	LS500-OCL-90-0.078-4T-1%		
LS680-2T22G(B)	LS500-OCL-120-0.058-4T-1%		

2.5 Selection of Braking Components

Table 2-12 Braking component selection (three phase 380–480 V)

Servo Drive Model	Applicable Motor Kw	Braking Unit		125% Braking Torque (10% ED, Max. 10 s)		Remarks	Minimum Braking Resistance (Ω)
		Model	QTY	Recommended Braking Resistor	QTY		
LS680T11GB	11	Built-in (Standard)		2200W 50Ω	1	Servo Drive models ending with letter "B"	20
LS680T15GB	15			3000W 38Ω	1		20
LS680T18GB	18			4000W 32Ω	1		24
LS680T22GB	22			4500W 27Ω	1		24
LS680T30GB	30			6000W 20Ω	1		19.2
LS680T37G(B)	37	Built-in (Optional)		7000W 16Ω	1	Servo Drive models ending with letter "B"	14.8
LS680T45G(B)	45			9000W 13Ω	1		12.8
LS680T55G(B)	55			11000W 10.5Ω	1		9.6
LS680T75G(B)	75			15000W 7.7Ω	1		6.8
LS680T90G	90	LS500BUN-60-T	2	9000W 10.0Ω	2	Input Voltage≤ 440Vac	9.3×2
	90	LS500BUN-60-5T	2	9000W 12.8Ω	2	Input Voltage >440Vac	10.5×2
LS680T110G	110	LS500BUN-60-T	2	11000W 9.4Ω	2	Input Voltage≤ 440Vac	9.3×2
	110	LS500BUN-60-5T	2	11000W 10.5Ω	2	Input Voltage >440Vac	10.5×2
LS680T132G	132	LS500BUN-90-T	2	13000W 6.8Ω	2	Input Voltage≤ 440Vac	6.2×2
	132	LS500BUN-90-5T	2	13000W 8.8Ω	2	Input Voltage >440Vac	7.0×2
LS680T160G	160	LS500BUN-90-T	2	16000W 6.3Ω	2	Input Voltage≤ 440Vac	6.2×2
	160	LS500BUN-90-5T	2	16000W 7.2Ω	2	Input Voltage>440Vac	7.0×2
LS680T200G(-C)	200	LS500BU-200-B	2	19000W 4.5Ω	2	Input Voltage≤ 440Vac	2.5×2
	200	LS500BU-200-C	2	19000W 5.8Ω	2	Input Voltage >440Vac	3.0×2
LS680T220G(-C)	220	LS500BU-200-B	2	21000W 4.1Ω	2	Input Voltage≤ 440Vac	2.5×2
	220	LS500BU-200-C	2	21000W 5.3Ω	2	Input Voltage>440Vac	3.0×2
LS680T250G(-C)	250	LS500BU-200-B	2	24000W 3.6Ω	2	Input Voltage≤ 440Vac	2.5×2
	250	LS500BU-200-C	2	24000W 4.6Ω	2	Input Voltage>440Vac	3.0×2
LS680T280G(-C)	280	LS500BU-200-B	2	27000W 3.2Ω	2	Input Voltage≤ 440Vac	2.5×2
	280	LS500BU-200-C	2	27000W 4.1Ω	2	Input Voltage>440Vac	3.0×2
LS680T315G(-C)	315	LS500BU-200-B	3	20000W 4.3Ω	3	Input Voltage≤ 440Vac	2.5×3
	315	LS500BU-200-C	3	20000W 5.5Ω	3	Input Voltage >440Vac	3.0×3
LS680T355G(-C)	355	LS500BU-200-B	3	23000W 3.8Ω	3	Input Voltage≤ 440Vac	2.5×3
	355	LS500BU-200-C	3	23000W 4.9Ω	3	Input Voltage >440Vac	3.0×3
LS680T400G(-C)	400	LS500BU-200-B	3	26000W 3.4Ω	3	Input Voltage≤ 440Vac	2.5×3
	400	LS500BU-200-C	3	26000W 4.3Ω	3	Input Voltage >440Vac	3.0×3

Table 2-13 Braking component selection (three phase 200–240 V)

Servo Drive Model	Applicable Motor Kw	Braking Unit		125% Braking Torque (10% ED, Max. 10 s)		Remarks	Minimum Braking Resistance (Ω)
		Model	QTY	Recommended Braking Resistor	QTY		
LS680-2T5.5GB	5.5			1300W 22Ω	1		10
LS680-2T7.5GB	7.5			1700W 16Ω	1		10
LS680-2T11GB	11			2300W 12Ω	1		12
LS680-2T15G (B)	15			3000W 9Ω	1		9
LS680-2T18G (B)	18			3900W 7Ω	1		7
LS680-2T22G (B)	22	Built-in (Optional)		4600W 6Ω	1	AC Drive models ending with letter "B"	6
LS680-2T30G(B)	30			5500W 5Ω	1		5
LS680-2T37G(B)	37			6800W 4Ω	1		4
LS680-2T45G	45	LS500BUN-60-2T	2	5000W 5.4Ω	2	-	4.9
LS680-2T55G	55	LS500BUN-60-2T	2	6000W 4.4Ω	2	-	4

NOTE

- The minimum braking resistance in the preceding table supports the operating condition with ED of 10% and the longest time for single braking of 10s.
- The default initial braking voltage for built-in braking units is 760 V and 350 V when the input voltage is 380 to 480 VAC and 200 to 240 V, respectively.
- The default initial braking voltage is 670 V for LS500BUN-60-T, LS500BUN-90-T, and LS500BU-200-B when the input voltage is lower than or equal to 440 VAC, and 760 V for LS500BUN-60-5T, LS500BUN-90-5T, and LS500BU-200-C when the input voltage is above 440 VAC. The resistance of the braking resistor can be adjusted with the initial braking voltage.
- The preceding table is for reference only. You can select the resistance and power of the braking resistor as required (the resistance cannot be lower than the reference value while the power may be higher than the reference value). Selection of the braking resistor model is determined by the generation power of motors and is also related to the system inertia, deceleration time and potential energy load. For systems with high inertia, and/or short deceleration time, and/or frequent braking, select a braking resistor with higher power and lower resistance.

3 Installation and Wiring

3.1 Installation

3.1.1 Installation Environment

1) Ambient temperature: The ambient temperature substantially affects the service life of the servo drive. Do not operate the servo drive outside the allowable ambient temperature (-10°C to +50°C).

2) Install the servo drive on the surface of a nonflammable object. Ensure that there is sufficient space around for heat dissipation because a large amount of heat will be generated during the operation of the servo drive. Install the servo drive vertically on the support by using the screws.

3) Install the servo drive in a place without strong vibration. The vibration cannot exceed 1 g. Keep the servo drive away from devices such as punch presses.

4) Install the servo drive in a place free from direct sunlight, high humidity, and condensation.

5) Install the servo drive in a place free from corrosive, flammable, and explosive gases.

6) Install the servo drive in a place free from oil dirt and dust.

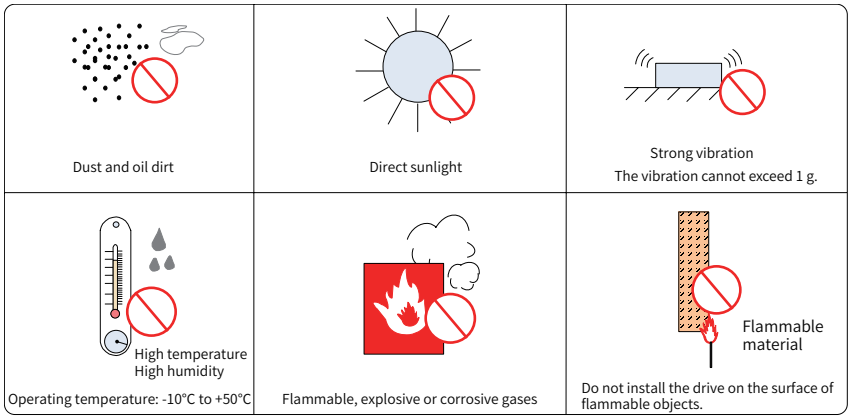


Figure 3-1 Requirements for the installation environment

7) The servo drive must be installed in a cabinet which is used in a final system with a fireproof enclosure providing both electrical and mechanical protections. The installation must conform to local laws and regulations and related IEC requirements.

3.1.2 Backplate Mounting and Through-Hole Mounting

1) Backplate mounting

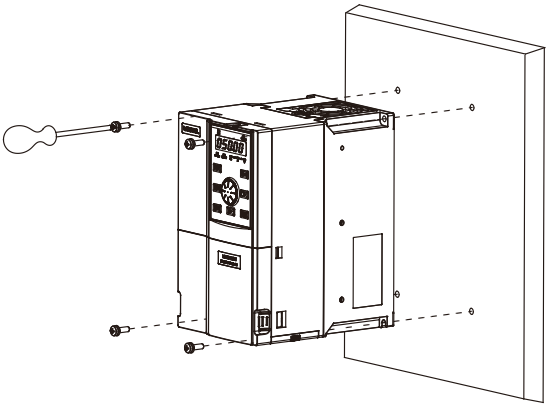


Figure 3-2 Backplate mounting of LS680T11GB to LS680T18GB and LS680-2T5.5GB to LS680-2T7.5G(B)

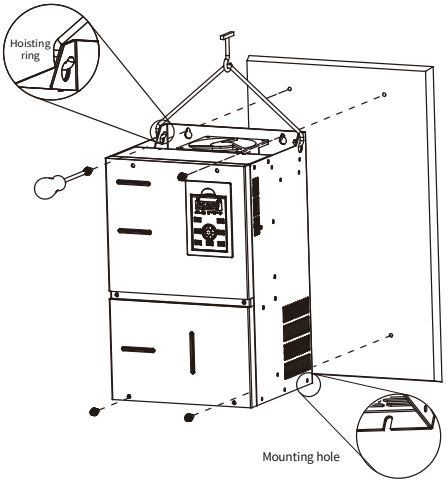


Figure 3-3 Backplate mounting of LS680T22GB to LS680T400G and LS680-2T11GB to LS680-2T75G

NOTE

- In this mode, do not just secure two screws on the top of the AC drive; otherwise, the AC drive may fall off or be damaged due to the unbalanced effect on the fixed part during long-time running.

2) Through-hole mountin

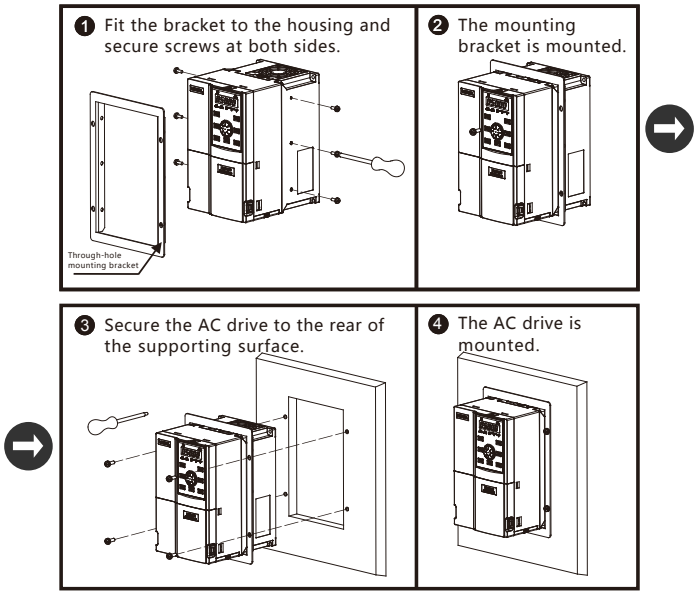


Figure 3-4 Through-hole mounting of LS680T11GB to LS680T18GB and LS680-2T5.5GB to LS680-2T7.5GB

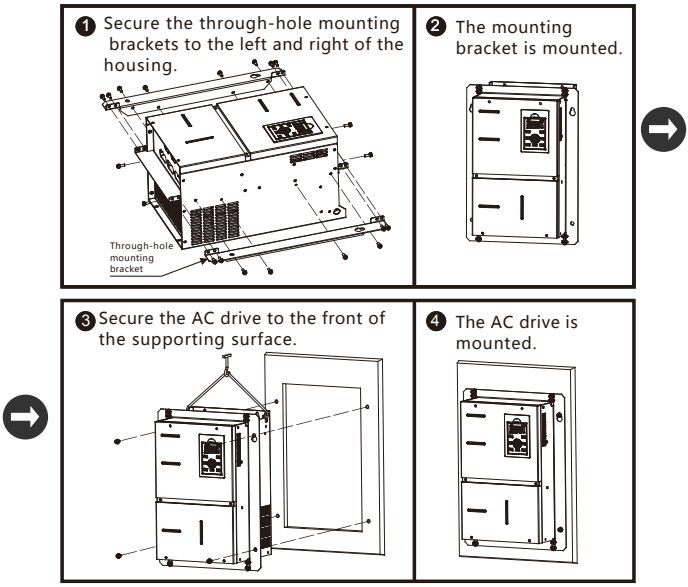


Figure 3-5 Through-hole mounting of LS680T22GB to LS680T160G and LS680-2T22GB to LS680-2T75G

3) Through-hole mounting brackets

Table 3-1 Through-hole mounting bracket models (three phase 380–480 V)

Through-hole Mounting Bracket Model	Servo Drive Model	Through-hole Mounting Bracket Model	Servo Drive Model
LS500-AZJ-A1T3	LS680T11GB	LS500-AZJ-A1T6	LS680T55G(B)
	LS680T15GB		LS680T75G(B)
	LS680T18GB	LS500-AZJ-A1T7	LS680T90G
LS500-AZJ-A1T4	LS680T22GB		LS680T110G
	LS680T30GB	LS500-AZJ-A1T8	LS680T132G
LS500-AZJ-A1T5	LS680T37G(B)		LS680T160G
	LS680T45G(B)		

Table 3-2 Through-hole mounting bracket models (three phase 200–240 V)

Through-hole Mounting Bracket Model	Servo Drive Model	Through-hole Mounting Bracket Model	Servo Drive Model
LS500-AZJ-A1T2	LS680-2T5.5GB	LS500-AZJ-A1T6	LS680-2T22G(B)
LS500-AZJ-A1T3	LS680-2T7.5GB		LS680-2T30G(B)
LS500-AZJ-A1T4	LS680-2T11GB	LS500-AZJ-A1T7	LS680-2T37G(B)
LS500-AZJ-A1T5	LS680-2T15G(B)		LS680-2T45G
	LS680-2T18G(B)		LS680-2T55G

3.1.3 Mounting in the Cabinet

1) Ventilation

Only one AC drive of models LS680T200G-C to LS680T400G-C can be mounted in a cabinet and ventilation space must be considered. Follow the following guidance for specific model and application scenarios.

■ Direct discharging cabinet (without fans on the top)

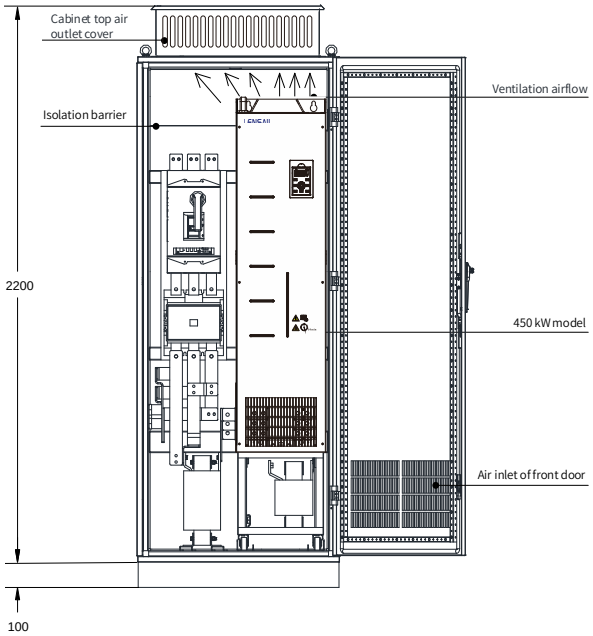


Figure 3-6 Direct discharging cabinet

Table 3-3 Specification of the direct discharging cabinet

Servo Drive Model	Quantity of Fans	Total Air Volume (CFM)	Effective Area of Cabinet Top Air Inlet (mm^2)	Effective Area of Cabinet Top Air Outlet (mm^2)
LS680T132G	2	541	31809	50894
LS680T160G	2	620	31809	50894
LS680T200G(-C)	2	586	31809	50894
LS680T220G(-C)	2	722	31809	50894
LS680T250G(-C)	3	789	47713	76341
LS680T280G(-C)	3	882	47713	76341
LS680T315G(-C)	3	644	47713	76341
LS680T355G(-C)	3	796	47713	76341
LS680T400G(-C)	3	796	47713	76341

Note:

1. CFM=0.0283 m3 /min.
2. "Effective Area" indicates the through-hole area.

■ Cabinet with fans on the top

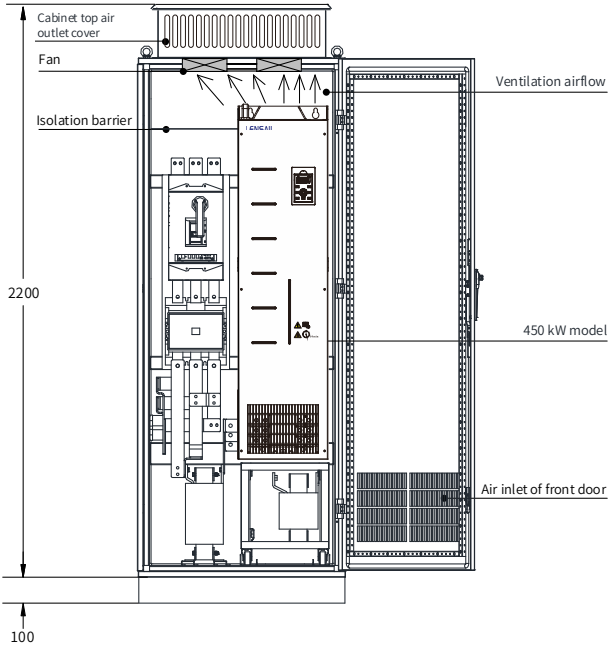


Figure 3-7 Cabinet with fans on the top

Table 3-4 Specification of the cabinet with fans on the top

Servo Drive Model	Quantity of Fans	Total Air Volume (CFM)	Effective Area of Cabinet Top Air Inlet (mm^2)	Max. Air Volume Required by the Top Fan (CFM)	Effective Area of Cabinet Top Air Outlet (mm^2)
LS680T132G	2	541	31809	649	S = 0.942 x N x (Dout2 - DHUB2) In the preceding formula, N indicates the number of top fans, Dout indicates the diameter of the top fan, and DHUB indicates the diameter of the top fan center HUB.
LS680T160G	2	620	31809	744	
LS680T200G(-C)	2	586	31809	703	
LS680T220G(-C)	2	722	31809	866	
LS680T250G(-C)	3	789	47713	947	
LS680T280G(-C)	3	882	47713	1058	
LS680T315G(-C)	3	644	47713	773	
LS680T355G(-C)	3	796	47713	955	
LS680T400G(-C)	3	796	47713	955	

Note:

1. CFM=0.0283 m3 /min.
2. "Effective Area" indicates the through-hole area.

3.2 Wiring

3.2.1 Standard Wiring Diagram

As shown in the following figure, the wiring part marked by the double-headed arrow in 11 to 75 kW/5.5 to 37 kW models is different from that in 90 to 400 kW/45 to 75 kW models.

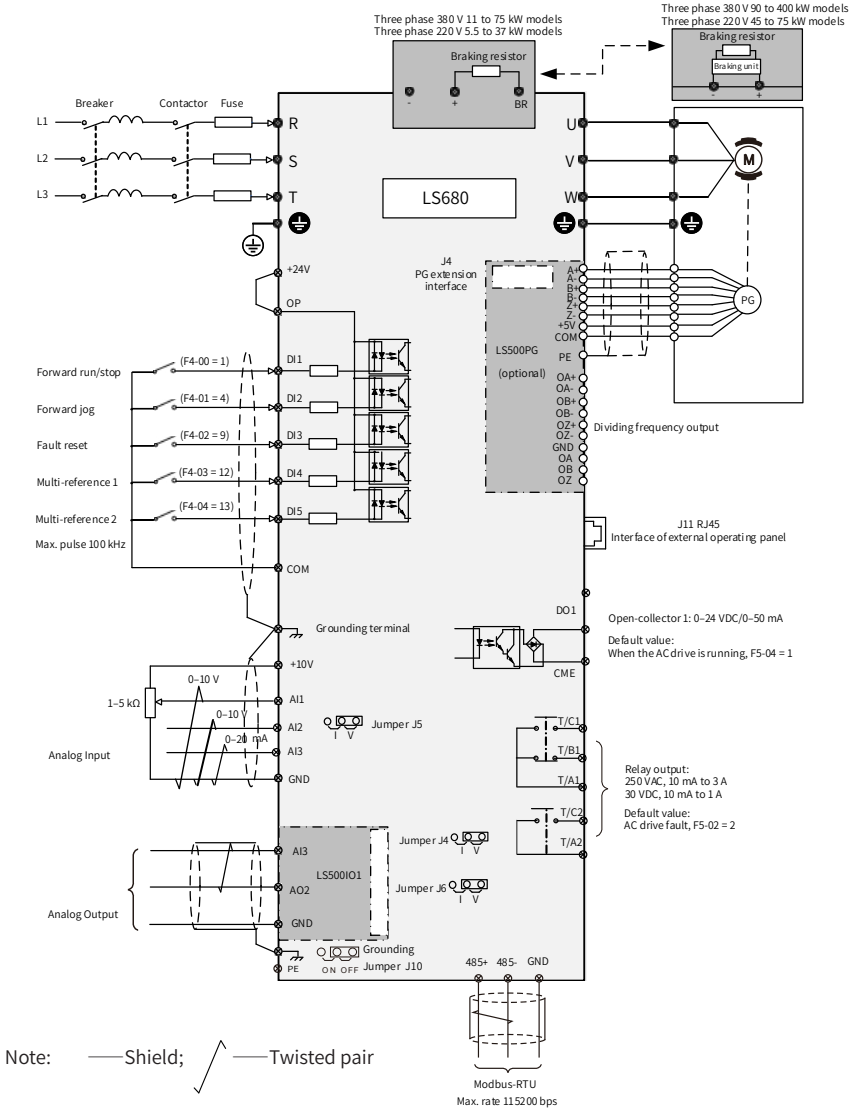


Figure 3-8 Typical wiring

3.2.2 Main Circuit Terminals

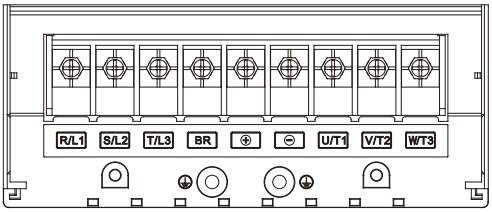


Figure 3-9 Terminal arrangement in LS5680T11GB to LS680T18GB and LS680-2T5.5GB to LS680-2T7.5GB

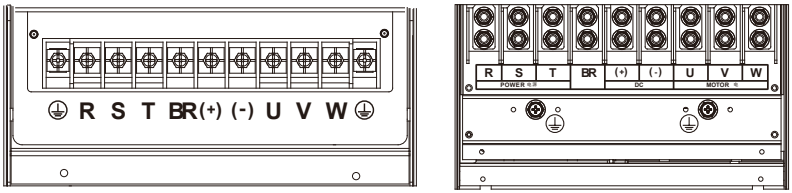


Figure 3-10 Terminal arrangement in LS680T22GB to LS680T110G and LS680-2T11GB to LS680-2T55G

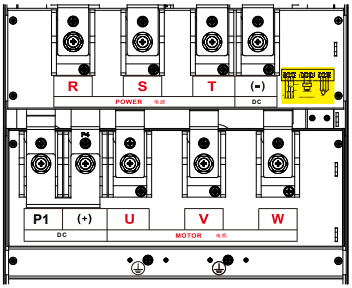
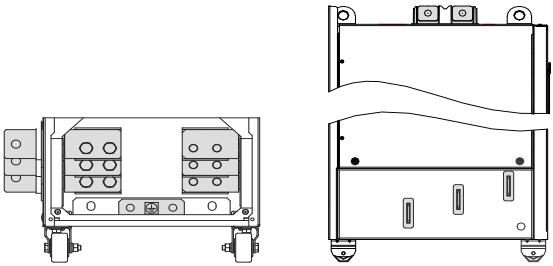


Figure 3-11 Terminal arrangement in LS680T132G to LS680T400G



(Front view) (Side view)

Figure 3-12 Terminal arrangement in LS680T200G-C to LS680T400G-C

Table 3-5 Description of main circuit terminals

Terminal	Name	Description
R、S、T	Three-phase power supply input terminals	Connected to AC input three-phase power supply
(+) 、 (-)	DC bus opsitive and negative terminals.	Common DC bus input, connected to the external braking unit for AC drives of 90 kW and above
(+) 、BR	Braking resistor connection terminals	Connected to the external braking resistor for AC drive of 75kW and below
U、V、W	AC drive output terminals	Connected to a three-phase motor
⏚	Grounding (PE) terminal	Grounging connection

3.2.3 Control Circuit Terminals

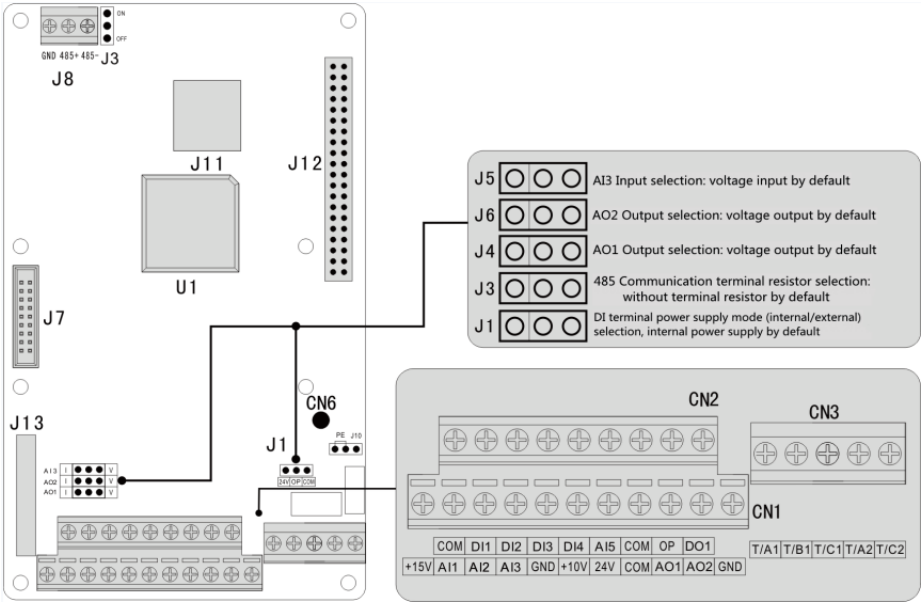


Figure 3-13 Control circuit terminal arrangement

Table 3-6 Function description of control board terminals

Type	Terminal Mark	Terminal Name	Description
Power Supply	10V-GND	+ 10V Power supply	Provides +10 V power supply to an external unit. Its maximum output current is 10 mA. Generally used to supply an external potentiometer of 1 to 5 kΩ
	15V-GND	+ 15V Power supply	Provides 15 V power supply, generally for an external pressure sensor
	OP	Input terminal for external power supply	Connected to +24 V by default. When DI1 to DI5 need to be driven by external signals, OP must be disconnected from + 24 V and connected to an external power
Analog input	AI1-GND	Analog input 1	1) Voltage range of inputs: 0 to 10 VDC 2) Input impedance: 22Ω
	AI2-GND	Analog input 2	1) Input voltage: 0–10 VDC 2) Input impedance: 22 kΩ
	AI3-GND	Analog input 3	1) Input range: 0–10 VDC/0–20 mA, determined by jumper J5 on the control board 2) Input impedance: 22 kΩ (voltage input) or 500 Ω (current input)
Digital input	DI1- COM	Digital input 1	1) Photocoupler isolation input, with the input frequency less than 100 Hz; Either an internal or an external power supply, determined by jumper J1 on the control board. 2) Input impedance: 1.39 kΩ 3) Voltage range upon active level input: 9–30 V
	DI2- COM	Digital input 2	
	DI3- COM	Digital input 3	
	DI4- COM	Digital input 4	
	DI5- COM	Digital input 5	
Analog output	AO1-GND	Analog output 1	Either a voltage or a current output, determined by jumper J4 on the control board, with the load resistance less than 500 Ω. ◆ Output voltage: 0–10 V ◆ Output current: 0–20 mA
	AO2-GND	Analog output 2	Either a voltage or a current output, determined by jumper J6 on the control board, with the load resistance less than 500 Ω. ◆ Output voltage: 0–10 V ◆ Output current: 0–20 mA
Digital output	DO1-COM	Digital output 1	◆ Photocoupler isolation and bipolar open collector output ◆ Output voltage: 0–24 V ◆ Output current: 0–50 mA Note: DO1 only supports the external power supply. When the external power supply is used, check whether the power ground can be connected to the COM terminal.

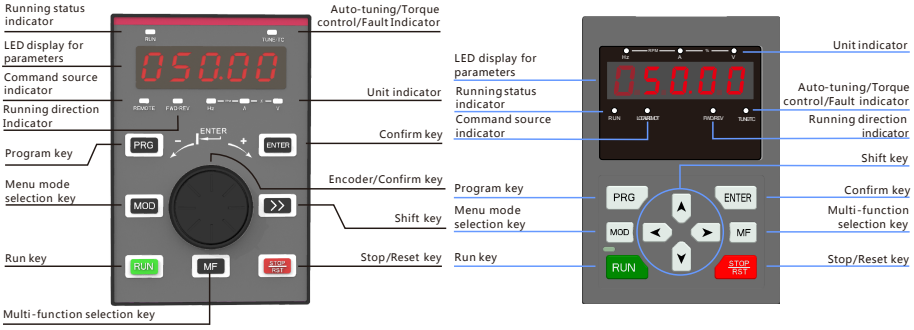
Type	Terminal Mark	Terminal Name	Description
Relay output	T/A1-T/B1	Normally-closed (NC) terminal	Contact driving capacity: 250 VAC, 3 A, Cos Φ = 0.4 30 VDC, 1 A
	T/A1-T/C1	Normally-open (NO) terminal	
	T/A2-T/C2	Normally-open (NO) terminal	
Auxiliary interfaces	J13	Extension card interface	28-core terminal, used for connection with various optional cards, such as bus cards
	J7	PG card interface	Support resolver encoder, high-performance tuning-free encoder and ABZ encoder
	J11	External operating panel interface	Connected to an external operating panel
Jumper [1]	J1	DI signal drive selection terminal	Used to select the power supply (internal/external) to drive DI signals, internal 24 V power supply by default
	J3	485 terminal resistor selection	ON means with 500Ω terminal resistor , OFF means without terminal resistor , without terminal resistor by default
	J4	AO1 output selection	Either a voltage or a current output. Voltage output by default
	J5	AI3 input selection	Either a voltage or a current input. Voltage input by default
	J6	AO2 output selection	Either a voltage or a current output. Voltage output by default
485 Communication (J8)	485+	RS485 positive communication signal	485+ Communication differential signal positive terminal
	485-	RS485 negative communication signal	485- Communication differential signal negative terminal
	GND	RS485 communication signal ground	485 communication signal ground

[1] For the position of jumpers J1, J3,J4, J5, J6 and J8 on the control board, see "Figure 3-8 Layout of control board terminals" on page 36.

4 Panel Operations

4.1 Introduction

The LED operating panel allows you to set and modify parameters, monitor system status, and start or stop the AC drive. For details, see "4 Panel Operation" in 210315001 LS500 Series AC Drive Advanced User Guide.



Shuttle panel　　Silicone panel

Figure 4-1 Details of the operating panel

4.2 Keys on the Operating Panel

Table 4-1 Function of keys on the operating panel

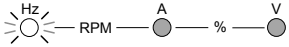
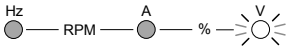
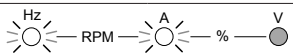
Key	Name	Function
PRG	Programming	Enter or exit Level 1 menu
ENTER	Enter	Push the encoder knob or Enter key: enter each level of menu interface and confirm displayed parameter setting
ENTER Encoder	Increment	Increase the displayed value when rotate the encoder knob clockwise
ENTER Encoder	Decrement	Decrease the displayed value when rotate the encoder knob counterclockwise
>>	Shift	Select the displayed parameter in the STOP or RUNNING status. Select the digit to be modified when modifying a parameter value.
	Increment, Decrease	Increase the data or parameter　Decrease the data or parameter
	Shift	Select the displayed parameter in the STOP or RUNNING status
		Select the digit to be modified when modifying a parameter value. (Remark: backup key)
RUN	RUN	Start the AC drive when using the operating panel control mode

Key	Name	Function
STOP RST	Stop/Reset	Stop the AC drive when the AC drive is in the RUNNING status. Perform a reset operation when the AC drive is in the FAULT status.
M F	Multifunction	Perform a function switchover as defined by the setting of F7-01 (MF.K key function selection).
MOD	Menu mode selection	Switch over between menu modes as defined by the setting of FP-03 (Selection of individualized parameter display).

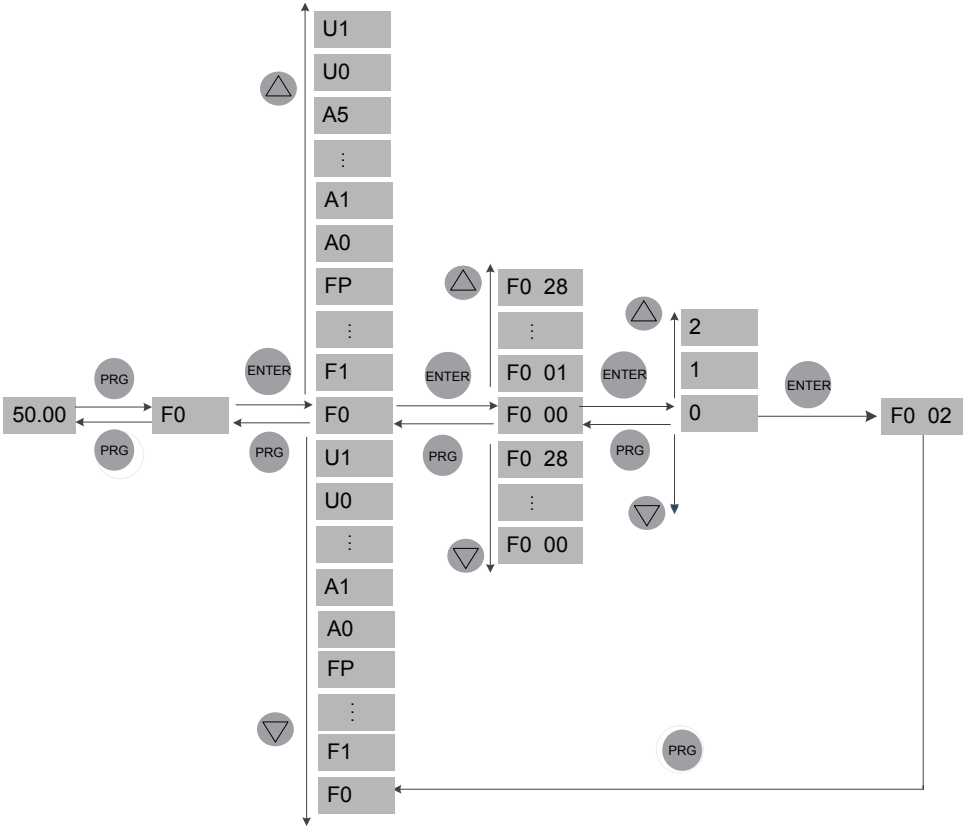
4.3 Indicators on the Operating Panel

 indicates that the light turns on,  indicates that the light turns off, and  indicates that the light flashes.

Table 4-2 Indicators on the operating panel

State		Indication
RUN Running status indicators	 RUN	OFF indicates the STOP status.
	 RUN	ON indicates the RUNNING status.
LOCAL/REMOT Running command indicators	 LOCAL/ REMOT	OFF indicates under operating panel control.
	 LOCAL/ REMOT	ON indicates under terminal control.
	 LOCAL/ REMOT	FLASHING indicates under serial communication control.
FWD/REV Forward and reverse rotation indicators	 FWD/ REV	OFF indicates forward motor rotation.
	 FWD/ REV	ON indicates reverse motor rotation.
TUNE/TC Auto-tuning, torque control and fault indicators	 TUNE/ TC	OFF indicates that the AC drive is normal.
	 TUNE/ TC	ON indicates the torque control mode.
	 TUNE/TC	FLASHING SLOWLY (once a second) indicates auto-tuning status.
	 TUNE/TC	FLASHING QUICKLY (four times a second) indicates a fault condition.
 Hz RPM A % V		Hz for frequency
 Hz RPM A % V		A for current
 Hz RPM A % V		V for voltage
 Hz RPM A % V		RPM for motor speed
 Hz RPM A % V		Percentage

4.4 Operations of Parameters



■ Parameter arrangement

Function Code Group	Description
F0 to FF	Basic control parameters
A0 to A5	Hydraulic control parameters
U0 to U1	Status monitoring

5. Troublesshooting

5.1 Fault Alarms and Solutions

The following faults may occur during the use of the servo drive. Perform simple fault analyses according to the following solutions. (You need not pay attention to the fault subcode if it is not provided.)

Table 5-1 Fault list

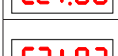
Fault	Panel Display	Possible Cause	Solution
Detection circuit fault	E0 1.00	The current detection circuit is damaged, causing too large current zero-drift at stop.	Check the current detection circuit.
Overcurrent during acceleration	E02.00	The drive output circuit is grounded or short-circuited.	Eliminate external faults.
		The braking transistor is short-circuited.	Power off the servo drive, remove the regenerative resistor, and power on the servo drive again. ◆ If no fault is reported, it indicates that the braking circuit is abnormal. The cause may be that the resistance between the regenerative resistor cable and the enclosure of the servo drive is too small (short circuit). In this case, replace the regenerative resistor. ◆ If the fault persists, it indicates that the braking transistor circuit is normal but the motor control loop is abnormal. Check whether the overcurrent is caused by other reasons.
		The control mode is SVC or FVC, and motor auto-tuning is not performed.	Set motor parameters according to the nameplate and perform motor auto-tuning.
		The acceleration time is too short.	Increase the acceleration time.
		The rotating motor is started.	Select the motor speed tracking restart or start the motor after it stops.
		The servo drive suffers external interference.	View historical fault records. If the current is significantly smaller than the overcurreth threshold when the fault occurs, find the interference source. If no external interference exists, the drive board, Hall sensor, Hall cables or the control board may be faulty.

Fault	Panel Display	Possible Cause	Solution
Overcurrent during deceleration	E03.00	The drive output circuit is grounded or short-circuited.	Eliminate external faults. Check whether short circuite or open circuit exists in the motor.
		The braking transistor is short-circuited.	Power off the servo drive, remove the regenerative resistor, and power on the servo drive again. ◆ If no fault is reported, it indicates that the braking circuit is abnormal. The cause may be that the resistance between the regenerative resistor cable and the enclosure of the servo drive is too small (short circuit). In this case, replace the regenerative resistor. ◆ If the fault persists, it indicates that the braking transistor circuit is normal but the motor control loop is abnormal. Check whether the overcurrent is caused by other reasons.
		The control mode is SVC or FVC, and motor auto-tuning is not performed.	Set motor parameters according to the nameplate and perform motor auto-tuning.
		The deceleration time is too short.	Increase the deceleration time.
		The servo drive suffers external interference.	View historical fault records. If the current is significantly smaller than the overcurreth threshold when the fault occurs, find the interference source. If no external interference exists, the drive board, Hall sensor, Hall cables or the control board may be faulty.

Fault	Panel Display	Possible Cause	Solution
Overcurrent at constant speed	E04.00	The drive output circuit is grounded or short-circuited.	Eliminate external faults. Check whether short circuite or open circuit exists in the motor.
		The braking transistor is short-circuited.	Power off the servo drive, remove the regenerative resistor, and power on the servo drive again. ◆ If no fault is reported, it indicates that the braking circuit is abnormal. The cause may be that the resistance between the regenerative resistor cable and the enclosure of the servo drive is too small (short circuit). In this case, replace the regenerative resistor. ◆ If the fault persists, it indicates that the braking transistor circuit is normal but the motor control loop is abnormal. Check whether the overcurrent is caused by other reasons.
		The control mode is SVC or FVC, but motor auto-tuning is not performed.	Set motor parameters according to the nameplate and perform motor auto-tuning.
		The deceleration time is too short.	If the running current exceeds the rated motor current or the rated output current of the servo drive during stable running, select a drive of larger power class.
		The servo drive suffers external interference.	View historical fault records. If the current is significantly smaller than the overcurreth threshold when the fault occurs, find the interference source. If no external interference exists, the drive board, Hall sensor, Hall cables or the control board may be faulty.
Overvoltage during acceleration	E05.00	The input voltage is too high.	Adjust the input voltage to the normal range.
		An external force drives the motor during acceleration.	Cancel the external force or install a regenerative resistor.
		The braking unit and regenerative resistor are not installed.	Install a braking unit and regenerative resistor.
		The acceleration time is too short.	Increase the acceleration time.

Fault	Panel Display	Possible Cause	Solution
Overvoltage during deceleration	E06.00	The input voltage is too high.	Adjust the input voltage to the normal range.
		An external force drives the motor during deceleration.	Cancel the external force or install a regenerative resistor.
		The deceleration time is too short.	Increase the deceleration time.
		The braking unit and regenerative resistor are not installed.	Install a braking unit and regenerative resistor.
		The motor is short-circuited to ground.	The short circuit to ground causes a booster circuit, which may result in overvoltage. Check whether short circuit to ground exists in the drive output cables or the motor.
Overvoltage at constant speed	E07.00	The input voltage is too high.	Adjust the input voltage to the normal range.
		An external force drives the motor during running at a constant speed.	Cancel the external force or install a regenerative resistor.
Pre-charge resistor fault	E08.00	The pre-charge resistor is frequently off and on in a short period.	Power off the servo drive and consult the technical personnel of Lensail.
Undervoltage	E09.01	The input voltage of the servo drive exceed the specified range.	Adjust the voltage to the normal range.
		The bus voltage is abnormal.	Consult the technical personnel of Lensail.
		The rectifier bridge, pre-charge resistor, drive board or control board is abnormal.	Consult the technical personnel of Lensail.
	E09.09	The program cannot run long time after power-on.	Check the input voltage and bus voltage, or consult the technical personnel of Lensail.
Drive overload	E10.00	The load is too heavy or locked-rotor occurs on the motor.	Reduce the load and check the motor and mechanical conditions.
		The power class of the servo drive is too small.	Select a drive of larger power class.
	E10.01	The encoder is faulty.	Set A1-05 (Detection time of PG card disconnection protection) to a proper value (2s) to enable the encoder check.

Fault	Panel Display	Possible Cause	Solution
Input phase loss	E12.00	Three-phase power input phase loss exists.	Check and eliminate external faults.
		The drive board, lightning protection board, main control board (MCB) or rectifier bridge is abnormal.	Consult the technical personnel of Lensail.
Output phase loss	E13.00	The motor is faulty.	Check whether an open circuit exists in the motor.
		The cable connecting the drive and the motor is abnormal.	Eliminate external faults.
		The three-phase output of the servo drive is unbalanced during motor running.	Check whether the motor three-phase winding is anormal. If yes, eliminate the fault.
		The drive board or IGBT module is abnormal.	Consult the technical personnel of Lensail.
IGBT overheat	E14.00	The ambient temperature is too high	Reduce the ambient temperature.
		The air filter is blocked.	Clean the air filter.
		The fan is damaged.	Replace the damaged fan.
		The thermistor is damaged.	Replace the damaged thermistor.
		The IGBT is damaged.	Replace the damaged IGBT.
External input fault	E15.00	Input the external fault signal using the DI terminal.	Eliminate external faults and confirm whether restart is allowed (view F8-18). Reset and run the servo drive.
		The STOP key is pressed in the terminal/ communication control mode or in a stall state.	Reset and run the servo drive.
Communication fault	E16.03	The host controller does not work properly.	Check the wiring of the host controller.
		The communication cable is abnormal.	Check the connection of communication cables.
		The communication expansion card type (F0-28) is set incorrectly.	Set the communication expansion card type correctly.
		The communication parameters in group FD are set incorrectly.	Set the communication parameters correctly.
		If the fault still persists after all the preceding solutions have been done, restore the default settings.	

Fault	Panel Display	Possible Cause	Solution
Contactor fault		The drive board or power board is abnormal.	Replace the drive board or power board.
		The contactor is faulty.	Replace the contactor.
		The lightning protection board is abnormal.	Replace the lightning protection board.
		An external interference.	Eliminate the external interference.
Current detection fault		The zero drift or temperature drift of the UVW current detection circuit is too large.	Consult the technical personnel of Lensail. (The Hall sensor, Hall cables, the drive board, the wiring between the drive board and the control board, or the control board is abnormal.)
Motor auto-tuning fault		The initial pole position angle auto-tuning of the synchronous motor is abnormal.	Check whether the motor inductance is too large, or the motor is disconnected.
		The pole position auto-tuning of the synchronous motor is abnormal.	Check the current detection circuit or the motor winding.
Encoder fault		The encoder direction detection is incorrect.	Check the pulse signal and motor parameter settings.
		The encoder angle verification is incorrect.	Check the encoder PPR and motor parameters settings.
EEPROM reading/writing fault		Parameter writing error	◆ Decrease the parameter modification frequency if the EEPROM reading/writing is too frequent. ◆ Replace the PCB if the board is damaged.
		Parameter reading error	
		Parameter writing/reading delay error	
		The quantity of parameters to be stored exceeds range.	
		Parameter writing error occurs at power-on.	
		Parameter reading error occurs at power-on.	
		At power-on, the quantity of parameters to be stored exceeds range.	

Fault	Panel Display	Possible Cause	Solution
Motor short circuit to ground		The motor is short-circuited to ground.	Check whether the motor is short-circuited to ground. If yes, replace motor cables or the motor. If the fault still persists after replacement, consult the technical personnel of Lensail.
		Before the servo drive is powered on, the motor is rotating under the drive of an external force.	Power on the servo drive after the motor stops.
Output inter-phase short circuit		There is an output inter-phase short circuit.	Check whether the UVW three-phase output of the servo drive is short-circuited.
EEPROM address error		The EEPROM address exceeds the specified range, or identical physical addresses occur.	Power off the servo drive and consult the technical personnel of Lensail.
Running time reached		The running time reaches the set value.	◆ Set F8-17 (Set running time) to a non-zero value. ◆ Set F7-09 (Accumulative running time) to a value larger than F8-17 (Set running time). ◆ Set F8-23 (Action selection when accumulative running time is reached) to 1. (For the selection of stop mode when the running time is reached, see "Figure 6-3 Running time reached (E26.00)".)
Business running time reached		The business running time is reached.	Check if FA-08 [Accumulative business running time (hour)] is equal to or larger than any of FA-01 (Timed 1st running time), FA-03 (Timed 2nd running time), FA-05 (Timed 3rd running time), and FA-07 (Timed 4th running time). If yes, ask for the running time protection passwords (FA-00, FA-02, FA-04, FA-06) from the manufacturer, and increase the value of FA-01 (Timed 1st running time), FA-03 (Timed 2nd running time), FA-05 (Timed 3rd running time), and FA-07 (Timed 4th running time).

Fault	Panel Display	Possible Cause	Solution
Output load loss	E30.00	There is an output load loss.	Check the working condition of the load.
Pulse-by-pulse current limit fault		The drive output circuit is grounded or short-circuited.	Eliminate external faults.
	E40.00	The load is too heavy or locked-rotor occurs on the motor.	Reduce the load, and check the motor and mechanical conditions.
		The power class of the servo drive is too small.	Select a drive of larger power class.
CAN communication fault	E42.01	The communication cable is disconnected.	◆ Check whether the communication cable is in good contact. ◆ Check whether the cable shield is connected properly and whether the communication cable is too long. ◆ Check the load rate of the CAN bus.
	E42.02	The communication suffers severe interference (receiving error)	
	E42.03	The communication is never online after power-on.	◆ Check whether CANH and CANL are connected incorrectly. ◆ Check whether parameters (A2-00 and A2-01) are set incorrectly and whether the communication cable is faulty. Eliminate these problems one by one.
	E42.04	There is an expansion card fault (extension protocol card not supported temporarily).	Power off the servo drive, consult the technical personnel of Lensail, and replace the expansion card.
	E42.07	CANopen protocol abnormal	Power off the servo drive and consult the technical personnel of Lensail.
	E42.11	CANopen communication timeout	Power off the servo drive and consult the technical personnel of Lensail.
	E42.12	PDO length does not match the mapping.	Power off the servo drive and consult the technical personnel of Lensail.

Fault	Panel Display	Possible Cause	Solution
Encoder fault during motor auto-tuning	E43.00	The encoder parameters are set improperly.	Set the encoder parameters properly.
		The motor auto-tuning is not performed.	Perform motor auto-tuning.
		Motor overspeed detection parameters (F9-67 and F9-68) are set improperly.	Set F9-67 and F9-68 properly according to actual conditions.
Excessive speed deviation	E44.00	The speed deviation is too large.	Check whether the installation and wiring of the encoder and the motor power cable are loose. Check whether the servo drive works normally after the PG card is replaced.
	E44.01	The drive parameters are set incorrectly.	Increase the value of F2-10 (Torque upper limit).
	E44.02	The encoder is faulty.	◆ Power off the servo drive and replace the PG card. ◆ Consult the technical personnel of Lensail.
	E44.03	The drive parameters are set incorrectly or the encoder is faulty.	◆ Power off the servo drive and replace the PG card. ◆ Increase the value of F2-10 (Torque upper limit). ◆ Consult the technical personnel of Lensail.

Fault	Panel Display	Possible Cause	Solution
Motor overtemperature		The PTC protection is enabled when the motor overheats.	Handle this problem according to "Figure 6-2 Motor overtemperature (E45.00)".
		The temperature sensor cable is disconnected or not connected.	Check whether the motor temperature sensor cable is disconnected.
		The PTC thermistor is short-circuited or connected reversely.	◆ Check whether short circuit occurs on the motor temperature sensor. ◆ Check whether terminals PTCP and PTCN are connected reversely.
		The KTY protection is enabled when the motor overheats.	Handle this problem according to "Figure 6-2 Motor overtemperature (E45.00)".
		The PTC cable is disconnected.	Set F9-16 (Motor overtemperature protection) to 2 and enable both PTC and KTY protections. Check whether the PTC cable is disconnected.
		The KTY cable is disconnected.	Set F9-16 (Motor overtemperature protection) to 2 and and enable both PTC and KTY protections. Check whether the KTY cable is disconnected.

Fault	Panel Display	Possible Cause	Solution
Pressure sensor fault		The pressure sensor is faulty.	Check whether the connection of the pressure sensor is loose and the power supply and the output are normal.
		The load is too heavy (the motor or hydraulic pump is stuck).	◆ Stop the servo drive and rotate the motor manually to check whether the motor can rotate. ◆ Check whether F2-10 (Torque upper limit) is set to a proper value. ◆ Check whether dynamic motor auto-tuning is normal.
		The zero drift of the pressure sensor is faulty.	◆ Ensure that the pressure measured by the pressure sensor is zero. ◆ Ensure that the pressure sensor is connected correctly (whether the values of AI3 and U0-32 measured by the multimeter are consistent). ◆ Ensure that parameters F4-28 (AI3 minimum input) to F4-31 (Corresponding value of AI3 maximum input) are set correctly.
		The measuring range of the pressure sensor exceeds the upper and lower limits.	Check whether the measuring range of the pressure sensor is smaller than A3-55 (Lower pressure deviation limit during pressure relief when the valve is closing) or larger than A3-56 (Upper torque limit in zero torque mode).
Slave pump fault in multi-pump confluence mode		The slave pump is faulty in the multi-pump confluence mode.	See "Appendix C Multi-Pump Mode of the Injection Molding Machine".
Station number conflict		There is a conflict between station numbers.	See "Appendix C Multi-Pump Mode of the Injection Molding Machine".

Fault	Panel Display	Possible Cause	Solution
Encoder fault	E49.01	◆ The encoder cable is disconnected or not connected. ◆ The encoder type is set incorrectly.	◆ Check whether the PG card connector becomes loose. ◆ Check whether the PG card cable is connected correctly. ◆ Check the PG card and encoder types and whether A1-00 (PG card type) is set properly.
	E49.02	Encoder interference exists.	Use the shielded cable as the encoder cable, and separate the encoder cable from the power cable. Ground the PG card and connect and disconnect it for several times.
Multi-master fault in multi-pump mode	E52.00	Multiple masters are used together in the multi-pump mode.	See "Appendix C Multi-Pump Mode of the Injection Molding Machine".
Parameter restoring fault	E58.00	Parameters are not stored before restoring.	Set the parameters correctly, and then store them. (Input the password set in FP-04 and set FP-05 to 1 to store parameters.)
Back EMF fault during auto-tuning	E59.00	The motor back EMF is too low during dynamic auto-tuning.	Check whether parameters in group F1 are set correctly, and replace the motor with a new one of the same type to test whether the motor is demagnetized.
Overtime working of braking transistor	E6 1.00	The braking transistor works overtime.	Check whether the bus voltage is higher than the braking voltage for a long time and whether the braking protection time set previously is too short.
	E6 1.01	The regenerative resistor is not connected or disconnected.	Check whether the regenerative resistor is in good connection and enable the regenerative resistor detection by setting F8-26.
Reverse running time reached	E63.00	In the oil pressure mode, the reverse running time exceeds the value set in A4-09 (Protection time for long-time pressure relief during reverse rotation).	Check whether the flow falling time and oil cooling reference falling time set previously are too short.
The pressure sensor voltage exceeds the allowable range.	E65.00	The AI3 voltage is larger than A3-57 or smaller than A3-58.	Check whether Ai3 is connected correctly.
Regenerative resistor fault	E66.01	The regenerative resistor is not connected or disconnected.	◆ Check the wiring of the regenerative resistor. ◆ If no regenerative resistor is required, set F8-26 to 0.
	E66.02	The resistance of the regenerative resistor is too small.	Select a regenerative resistor with proper resistance.

Fault	Panel Display	Possible Cause	Solution
Parameter initialization abnormal	E67.00	Parameter initialization is abnormal at power-on.	Power off the servo drive and consult the technical personnel of Lensail.
Motor rotor locked	E69.00	The UVW phases are incorrect.	◆ After power-off, adjust the motor cables to ensure that UVW cables of the servo drive are connected to those of the motor in correct sequence. ◆ Set A1-09 ("Auto-tuning free" function) to 0 to disable the "auto-tuning free" function and perform auto-tuning again.
"Auto-tuning free" fault	E70.00	Parameters related to "auto-tuning free" function are set incorrectly.	Check the following items: ◆ whether A1-09 ("Auto-tuning free" function) is set correctly. ◆ whether the motor is a synchronous motor. ◆ whether the encoder is a 23-bit absolute encoder. ◆ whether the control mode is FVC.
	E70.01	SPI communication cable used for "auto-tuning free" function is disconnected.	Check whether the communication cable of the PG card is connected incompletely or disconnected.
	E70.02	RS485 communication cable used for "auto-tuning free" function is disconnected.	Check whether the cable between the PG card and the encoder is connected incompletely or discon-nected.
	E70.03	Motor parameters are set incorrectly.	Set A1-09 ("Auto-tuning free" function) to 0 to disable the "auto-tuning free" function and perform auto-tuning again. If the fault still exists, consult the technical personnel of Lensail.
	E70.05	The "auto-tuning free" function is disabled.	Set A1-09 ("Auto-tuning free" function) to 1 to enable the "auto-tuning free" function. Then, set A1-10 to a proper value.
Feedback speed abnormal	E71.00	There is an alarm when the frequency deviation exceeds the rated motor frequency.	The solutions are the same as those of E69.00.
Encoder direction abnormal in the "auto-tuning free" mode	E73.00	In the "auto-tuning free" mode, the UVW wiring is abnormal, or the encoder direction is manually modified to the reverse direction (A1-03 is set to 1).	Connect the UVW cables correctly or prohibit the modification of the encoder direction in the "au-to-tuning free" mode.

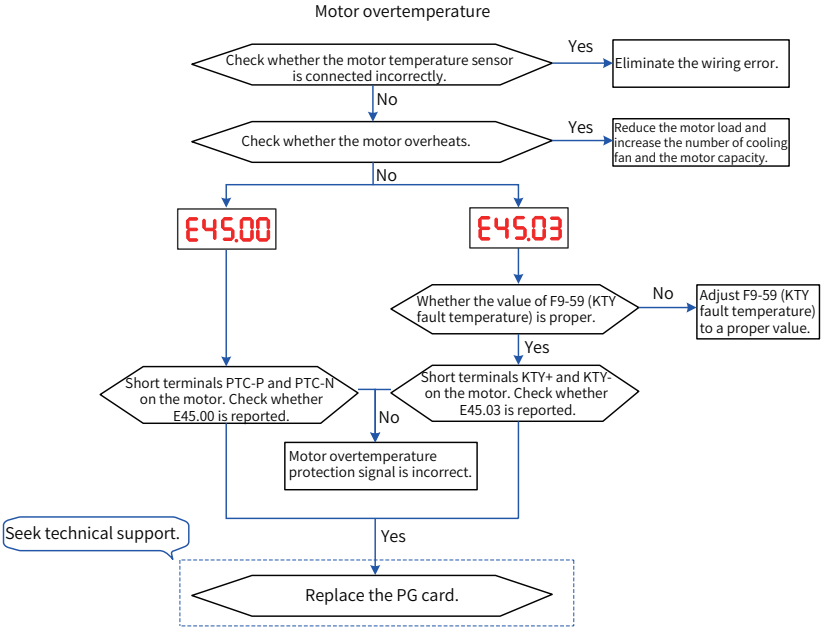


Figure 6-2 Motor overtemperature (E45.00)

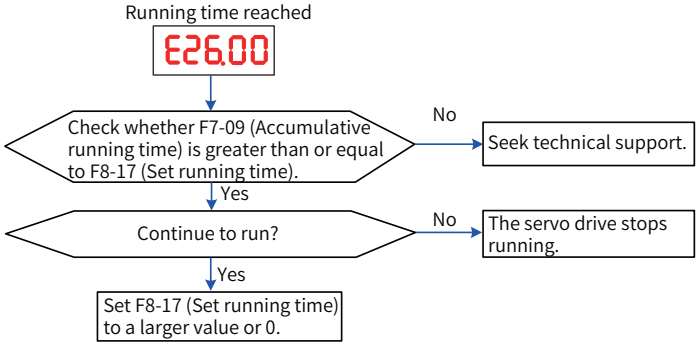
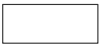


Figure 6-3 Running time reached (E26.00)

5.2 Common Faults and Solutions

No.	Fault Symptom	Possible Cause	Solution
1	There is no display at power-on. 	There is no mains voltage or the mains voltage is too low.	◆ Check the power supply.
		The switched-mode power supply on the drive board is faulty.	◆ Check the bus voltage.
		The cable between the control board and the drive board and that between the control board and the operating panel is broken.	◆ Re-connect the 8-core and 40-core cables.
		The pre-charge resistor of the servo drive is damaged.	◆ Consult the technical personnel of Lensail.
		The control board or operating panel is faulty.	
		The rectifier bridge is damaged.	
2	"HC" is displayed at power-on. 	The cable between the drive board and the control board is in poor contact.	◆ Re-connect the 8-core and 40-core cables.
		Components on the control board are damaged.	◆ Consult the technical personnel of Lensail.
		The motor or motor cable is short-circuited to the ground.	
		The Hall sensor is damaged.	
		The mains voltage is too low.	
3	The display is normal at power-on. But after the running starts, "HC" is displayed and the drive stops running immediately. 	The cooling fan is damaged or blocked.	◆ Replace the fan.
		A short circuit exists in the wiring of external control terminals.	◆ Eliminate the external short circuit fault.

No.	Fault Symptom	Possible Cause	Solution
4	The motor does not rotate after the servo drive starts running.	The motor wiring is abnormal.	◆ Check whether the wiring between the servo drive and the motor is normal.
		The motor parameters are set incorrectly.	◆ Restore the factory parameters and reset parameter groups properly. ◆ Check whether the encoder parameters and rated motor parameters (such as rate motor frequency and rated motor speed) are set correctly. ◆ Check whether F0-01 (Control mode) and F0-02 (Command source) are set correctly. ◆ In the V/f control mode, modify F3-01 (Torque boost) under heavy-load start.
		The cable connecting the drive board and the control board is in poor contact.	◆ Re-connect the cable connecting the drive board and the control board and ensure a secure connection.
		The drive board is faulty.	◆ Consult the technical personnel of Lensail.
5	DI terminals are disabled.	The parameters are set incorrectly.	◆ Check and reset parameters in group F4.
		The external signal is incorrect.	◆ Re-connect the external signal cable.
		Jumper J1 is connected incorrectly.	◆ Check whether jumper J1 is connected correctly according to the wiring diagram.
		The control board is faulty.	◆ Consult the technical personnel of Lensail.
6	The motor speed cannot rise in the FVC mode.	The encoder is faulty.	◆ Replace the encoder and check the wiring.
		The encoder is connected incorrectly or in poor contact.	◆ Replace the PG card.
		The PG card is faulty.	◆ Consult the technical personnel of Lensail.
		The drive board is faulty.	

No.	Fault Symptom	Possible Cause	Solution
7	The servo drive reports overcurrent and overvoltage frequently.	The motor parameters are set improperly.	◆ Reset the motor parameters or perform motor auto-tuning again.
		The acceleration/deceleration time is improper.	◆ Set a proper acceleration/deceleration time.
		The load fluctuates.	◆ Consult the technical personnel of Lensail.
8	The motor coasts to stop or the motor brake is inactive during deceleration or deceleration to stop.	The encoder cable is disconnected, or the overvoltage stall protection is enabled.	◆ Check the encoder wiring in the FVC mode (F0-01 = 1). ◆ If a regenerative resistor is configured, disable the overvoltage stall protection function by setting F3-23 (V/f voltage limit enabled) to 0.
9	The pre-charge resistor is damaged.	◆ The drain wire of the regenerative resistor is connected to the metal enclosure (that is, short-circuited to the ground). ◆ The braking transistor is damaged. ◆ The short circuit occurs due to the damage of the bus capacitor. ◆ The negative bus (Bus-) is short-circuited to the ground.	◆ Increase the insulation of the drain wire of the regenerative resistor by taking such measures as winding the electric tape cloth. ◆ Replace the braking transistor. ◆ Replace the bus capacitor. ◆ Eliminate the short circuit fault.

6 Maintenance

6.1 Routine Maintenance

Check the following items daily to ensure normal running and prevent damage to the AC drive. Copy this checklist and sign the "Checked" column after each inspection.

Inspection Item	Inspection Points	Solutions	Checked
Motor	Inspect whether the abnormal sounds and vibration occur on the motor.	◆ Check whether the mechanical connection is normal. ◆ Check whether output phase loss occurs on the motor. ◆ Check whether retaining screws of the motor are tightened.	
Fan	Inspect whether the cooling fan of the AC drive and motor work abnormally.	◆ Check running of the cooling fan of the AC drive. ◆ Check whether the cooling fan of the motor is normal. ◆ Check whether the ventilation is clogged. ◆ Check whether the ambient temperature is within the permissible range.	
Installation environment	Inspect whether the cabinet and cable duct are abnormal.	◆ Check input and output cables for damaged insulation. ◆ Check for vibration of hanging bracket. ◆ Check whether ground bars and terminals become loose or get corroded.	
Load	Inspect whether the running current of the AC drive exceeds the rated current of the AC drive and motor for a certain period.	◆ Check whether motor parameters are set properly. ◆ Check whether the motor is overloaded. ◆ Check whether the mechanical vibration is severe (allowed range: < 1 g).	
Input voltage	Inspect whether the power voltage of the main and control circuits is within the allowed range.	◆ Check that the input voltage is within the allowed range. ◆ Check whether start of heavy load exists.	

6.2 Periodic Inspection

Inspection Item	Inspection Point	Solution	Checked
General	Inspect for wastes, dirt, and dust on the surface of the AC drive.	◆ Check whether the cabinet of the AC drive is powered off. ◆ Use a vacuum cleaner to suck up wastes and dust to prevent direct touching. ◆ Wipe stubborn stains with alcohol and wait until the alcohol evaporates.	
Cables	Inspect power cables and connections for discoloration. Inspect wiring insulation for aging or wear.	◆ Replace cracked cables. ◆ Replace damaged terminals.	
Peripheral devices such as relay and contactor	Check whether the contactor is loose or abnormal noise exists during operation. Check whether short-circuit, water stain, expansion, or cracking occurs on peripheral devices.	◆ Replace abnormal peripheral devices.	
Ventilation	Inspect whether ventilation and heatsink are clogged. Check whether the fan is damaged.	◆ Clean the ventilation. ◆ Replace the fan.	
Control circuit	Inspect for control components in poor contact. Inspect for loose terminal screws. Inspect for control cables with cracked insulation.	◆ Clear away foreign matters on the surface of control cables and terminals. ◆ Replace damaged or corroded control cables.	

6.3 Replacement of Wear Parts

6.3.1 Service Life of Wear Parts

The service life of fans and electrolytic DC bus capacitors is related to the operating environment and maintenance status. The general service life is listed as follows.

Component	Service Life [1]
Fan	⩾ 5 years
Electrolytic capacitor	⩾ 5 years

[1] You can determine when to replace these parts according to the actual operating time.

- Ambient temperature: 40°C
- Load rate: 80%
- Operating rate: 24 hours per day

6.3.2 Replacing Cooling Fans

1) Possible damage causes: bearing worn and blade aging

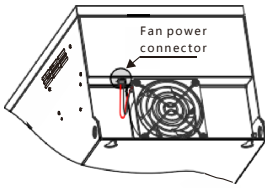
2) Judging criteria: whether there is crack on the blade; whether there is abnormal vibration noise upon startup; whether the blade runs abnormally

3) Replacement notes:

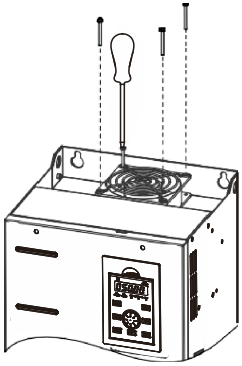
- To remove the cooling fan, decompress the fan cover hook and pull the cover out.
- After replacing the fan, check that the air flow direction is upright.

Removing the Fan (LS680T22G to LS680T450G)

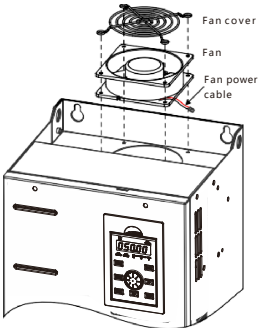
① Disconnect the fan power cable connector from the AC drive. (Top view)



② Remove the four screws from the fan cover using a screwdriver.



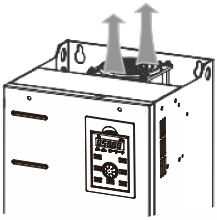
③ Remove the fan and fan cover from the AC drive.



Installing the Fan (LS680T22G to LS680T400G)

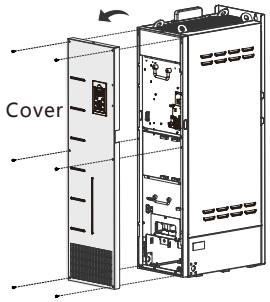
① Install the fan in a reverse procedure to removal. Pay attention to the direction of the fan.
② Install the fan and fan cover on the AC drive. Note that the mounting holes are aligned, as shown in figure 3 of the removal procedure.
③ After the replacement is completed, check that the air flow direction is upright.

Note that the airflow direction is upright.

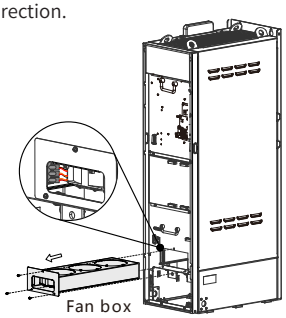


Removing the Fan (LS680T200G-C to LS680400G-C)

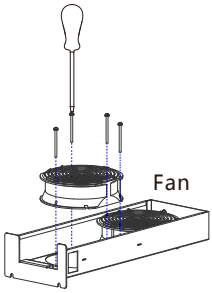
①Remove the six screws on the cover. Then, hold the cover with both hands and lift it up in the arrow direction shown below to remove the cover.



② Disconnect the fan power cable connectors from the AC drive. Each fan has a power cable connector.
③ Remove screws from the fan box and draw the fan box out in the arrow direction.

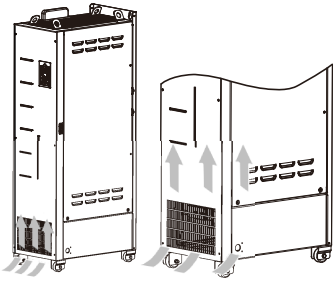


④ Loosen screws from each fan cover and remove the fan.



Installing the Fan (LS680T200G-C to LS680T400G-C)

① Install the fan in a reverse procedure to removal. Pay attention to the direction of the fan.
② Align the fan box to the rail and push it into the AC drive.
③ Connect the fan power cable connectors before fixing the fan box. After the replacement is completed, check that the air flow direction is upright.



7.4 Storage

For storage of the AC drive, pay attention to the following three aspects:

1) Pack the AC drive with the original packing box provided by Lensail.

2) Do not expose the AC drive to moisture, high temperature or outdoor direct sunlight for a long time.

3) The electrolytic capacitor will deteriorate after being stored for a long time. Therefore, the AC drive must be switched on once every 6 months, each time lasting at least 5 hours. Ensure to increase the input voltage gradually to the rated value by using a voltage regulator. Contact professionals for technical support if necessary.

A. Parameter List

A.1 Introduction

Groups F and A include basic and hydraulic function parameters. Group U includes the monitoring function parameters and extension card communication parameters.

The parameter description tables in this chapter use the following symbols. The symbols in the parameter table are described as follows:

Symbol	Meaning
☆	It is possible to modify the parameter with the drive in the stop or in the run status.
★	It is not possible to modify the parameter with the drive in the run status.
•	The parameter is the actual measured value and cannot be modified.
*	The parameter is a factory parameter and can be set only by the manufacturer.

A.2 Hydraulic Control and Basic Control Parameter List

Para. No.	Para. Name	Setting Range	Unit	Default	Property
Group A0: Flux Weakening Control					
A0-00	Flux weakening method selection	0: by calculation 1: auto adjusted	1	1	★
A0-01	Flux weakening current factor	0 to 500	1	5	☆
A0-02	Pm motor flux weakening depth	0 to 50	%	5	☆
A0-03	Factor of pm motor max. output torque	20 to 300	%	100	☆
A0-04	Factor of pm motor field current	40 to 200	%	100	☆
Group A1: PG Card					
A1-00	PG card type selection	0: resolver 1: reserved 2: ABZ encoder	1	0	★
A1-02	Encoder installation angle	0.0 to 359.9	°	0	☆
A1-03	Speed feedback direction	0: same 1: reverse	1	-	★
A1-04	Number of resolver pole-pairs	1 to 50	1	Model dependent	★
A1-05	Resolver fault detection time	0.000 to 60.000	Sec	2.000	☆
A1-06	Encoder resolution	0 to 65535	1	1024	★
A1-08	Speed sensor interference counts	0 to 60000	1	0	☆
Group A2: CAN Communication					
A2-00	Baud rate	0: 20 1: 50 2: 125 3: 250 4: 500 5: 1024	kHz	4	☆
A2-01	CANLink address	1 to 64	1	1	☆
A2-02	CANLink continuous communication time	0.1 to 600.0	sec	0.3	☆
A2-03	CANLink multi-pump mode selection	0: broadcast 1: multi masters	1	0	☆
A2-04	CANLink slave address 1	0 to 65535	1	0	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
A2-05	CANLink slave address 2	0 to 65535	1	0	☆
A2-06	CANLink slave address 3	0 to 65535	1	0	☆
A2-07	CANLink slave address 4	0 to 65535	1	0	☆
A2-09	Can protocol selection in speed control mode	0: original 1: CANOpen 2: CANLink	1	0	★
Group A3: Basic Hydraulic Control					
A3-00	Pressure control mode	0: non-hydraulic 1: hydraulic control mode 1 by can 2: hydraulic control mode 2 by AI 3: can hydraulic control mode 4: EST mode(original) 5: EST mode(new) 6: CANOpen mode 7: CANLink3.0 mode	1	0	★
A3-01	Max. Motor speed	1 to 30000	rpm	2000	★
A3-02	System pressure	0.0 to A3-03	kg/cm^2	175.0	☆
A3-03	Max. Pressure	A3-02 to 500.0	kg/cm^2	250.0	☆
A3-04	Pressure command acceleration time 1	0 to 2000	ms	20	☆
A3-05	Pressure loop proportional gain kp 1	0.0 to 800.0		210.0	☆
A3-06	Pressure loop integral time ti 1	0.001 to 10.000	S	0.100	☆
A3-07	Pressure loop differential time td 1	0.000 to 1.000	S	0.000	☆
A3-08	Max. Reverse motor speed	0.0 to 100.0	%	10.0	☆
A3-09	Minimum flow	0.0% to 50.0%	%	0.5	☆
A3-10	Minimum pressure	0.0 to 50.0 kg/cm^2	kg/cm^2	0.5	☆
A3-11	Pressure loop proportional gain kp 2	0.0 to 800.0	0.1	210.0	☆
A3-12	Pressure loop integral time ti 2	0.001s to 10.000s	S	0.100	☆
A3-13	Pressure loop differential time td 2	0.000s to 1.000s	S	0.000	☆
A3-14	Pressure loop proportional gain kp 3	0.0 to 800.0	0.1	210.0	☆
A3-15	Pressure loop integral time ti 3	0.001s to 10.000s	S	0.100	☆
A3-16	Pressure loop differential time td 3	0.000s to 1.000s	0.001s	0.000	☆
A3-17	Pressure loop proportional gain kp 4	0.0 to 800.0	0.1	210.0	☆
A3-18	Pressure loop integral time ti 4	0.001s to 10.000s	0.001s	0.100	☆
A3-19	Pressure loop differential time td 4	0.000s to 1.000s	0.001s	0.000	★
A3-20	AI zero drift self-adjusting enable	0: disable 1: enable	1	0	☆
A3-21	Pressure sensor fault detection time	0.001s to 60.000s	0.001s	0.500	☆
A3-22	Max. flow in pressure control state	0.0% to 100.0%	0.1%	10.0	☆
A3-23	Min. Pressure in pressure control state	0.0% to 100.0%	0.1%	60.0	☆
A3-24	Output delay in pressure control state	0.001s to 10.000s	0.001s	0.100s	☆
A3-25	Pressure command s-curve acceleration filter time 1	0.001s to 1.000s	0.001s	0.030s	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
A3-26	Pressure command s-curve deceleration filter time 1	0.001s to 1.000s	0.001s	0.030s	☆
A3-27	Overshoot suppression detection factor 1	0 to 2000	1	200	☆
A3-28	Overshoot suppression factor 1	0 to 3.000	0.001	0.200	☆
A3-29	Pressure loop gain factor	0.20 to 5.00	0.01	1.00	☆
A3-30	Max. torque during switch from pressure control to flow control state	50.0% to 250.0%	0.1%	160.0%	☆
A3-31	Pressure command delay time 1	0.000s to 0.500s	0.001s	0.000s	☆
A3-32	Slave drive min. Input	0.0% to A3-34	0.1%	0.0%	☆
A3-33	Slave drive min. Input frequency.	-100.0% to 100.0%	0.1%	0.0%	☆
A3-34	Slave drive mid-point input	A3-32 to A3-36	0.1%	0.0%	☆
A3-35	Slave drive mid-point input frequency.	-100.0% to 100.0%	0.1%	0.0%	☆
A3-36	Slave drive max. Input	A3-34 to 100.0%	0.1%	100.0%	☆
A3-37	Slave drive max. Input frequency.	-100.0% to 100.0%	0.1%	100.0%	☆
A3-38	Multi-pump host check whether to enable slave pump	0: slave enable forbidden 1: slave enable permitted	1	0	☆
A3-39	Multi-pump confluence mode pressure holding gain	20 to 800	1	100	☆
A3-40	Multi-pump injection state acceptable pressure error during gain decrease	0.0 to 50.0 kg	0.1kg	5.0kg	☆
A3-41	Multi-pump injection state acceptable min. Flow during gain decrease	0 to 30000 rpm	1 rpm	0 rpm	☆
A3-42	Multi-pump injection state flow detection time during gain decrease	0.200 to 2.000s	0.001s	0.400s	☆
A3-43	Multi-pump CANLink state pressure error threshold to Disable slave pump	0 to 50.0 kg	0.1 kg	5.0 kg	☆
A3-44	Multi-pump CANLink state min. flow to Disable slave pump	-100.0% to 100.0%	0.1%	0.0%	☆
A3-45	Withdrew speed command slave pump delays to stop	0.100 to 5.000s	0.001s	1.000s	☆
A3-46	Withdrew speed command slave pump deceleration time	0.001 to 5.000s	0.001s	0.200s	☆
A3-47	Valve decompression enable delay	0.001 to 5.000s	0.001s	0.100s	☆
A3-48	Valve decompression Disable delay	0.001 to 5.000s	0.001s	0.100s	☆
A3-49	Pressure error lower threshold for valve decompression enable	0.0 to A3-02 (system pressure)	0.1 kg	0.0 kg	☆
A3-50	Pressure command lower threshold for valve decompression enable	0.0 to A3-02 (system pressure)	0.1 kg	0.0 kg	☆
A3-51	Current lower threshold for pressure sensor fault detection	20 to 300%	1%	100%	☆
A3-52	Speed upper threshold for pressure sensor fault detection	20 to 100%	1%	50.0%	☆
A3-53	Deceleration time of second set high flow	0.000 to 5.000s	0.001s	0.100s	☆
A3-54	Threshold of second set high flow	0 to 100.0%	0.1%	100.0%	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
A3-55	Pressure difference of stop valve pressure relief	0.0 to A3-02	0.1 V	0.0	☆
A3-56	Torque lower limit in zero torque mode	0.0 to 250.0	0.1	0.0	☆
A3-57	Upper threshold of pressure sensor fault	A3-58 to 11.000 V	0.001 V	10.000 V	☆
A3-58	Lower threshold of pressure sensor fault	0.000 V to A3-57	0.001 V	0 V	☆
A3-59	Judging time of voltage exceeding limit of pressure sensor	0.000s to 60.000s	0.001s	0s	☆
A3-60	Output signal selection of pressure sensor	0: 0 to 10 V/4 to 20 mA (need check the jumper) 1: 1 to 5 V 2: 1 to 6 V 3: 1 to 10 V 4: 0.25 to 10.25 V	1	0	☆
Group A4: Hydraulic Advanced					
A4-00	Current filter	0.000s to 5.000s	0.001s	0.005s	☆
A4-01	Speed filter	0.000s to 5.000s	0.001s	0.010s	☆
A4-02	Pressure command deceleration time 1	0.001s to 2.000s	0.001s	0.020s	☆
A4-03	Flow command acceleration time 1	0 to 5.000s	0.001s	0.100	☆
A4-04	Flow command deceleration time 1	0 to 5.000s	0.001s	0.100	☆
A4-06	Flow leakage compensation	0.0% to 50.0%	0.1%	0.0%	☆
A4-08	Reverse decompression min. pressure	0.0 kg/cm^2 to A3-02	0.1 kg/cm^2	0.0 kg/cm^2	☆
A4-09	Reverse decompression protection time	0.0s to 500.0s	0.1s	0.000s	☆
A4-10	Pressure command s-curve acceleration filter time 2	0.001s to 1.000s	0.001s	0.030s	☆
A4-11	Pressure command s-curve deceleration filter time 2	0.001s to 1.000s	0.001s	0.030s	☆
A4-12	Flow command acceleration time 2	0.001 to 5.000s	0.001s	0.100	☆
A4-13	Flow command deceleration time 2	0.001 to 5.000s	0.001s	0.100	☆
A4-14	Pressure command acceleration time 2	0.001 to 2.000s	0.001s	0.020s	☆
A4-15	Pressure command deceleration time 2	0.001 to 2.000s	0.001s	0.020s	☆
A4-16	Overshoot suppression detection factor 2	1 to 2000	1	200	☆
A4-17	Overshoot suppression factor 2	0.001 to 3.000s	0.001s	0.200s	☆
A4-18	Pressure command delay time 2	0.000s to 0.500s	0.001s	0.000s	☆
A4-22	Pressure error threshold for pressure suppression Disabling	0 to A3-02	0.1 kg	10.0 kg	☆
A4-23	Pressure error threshold for integral limitation	0 to A3-02	0.1 kg	45.0 kg	☆
A4-24	Integral limitation mode selection	0 to 1	1	0	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
A4-25	Increase of pressure loop max. Output	0 to 50.0	0.1s	2. 0	☆
A4-26	Pressure control PID switching mode selection	0: original algorithm 1: algorithm 1 2: algorithm 2 3: algorithm 3	1	3	★
A4-33	Integral factor 1 of algorithm 3	0 to 1.00	0.01	0.08	☆
A4-34	Integral factor 2 of algorithm 3	0 to 1.00	0.01	0.08	☆
A4-35	Integral factor 3 of algorithm 3	0 to 1.00	0.01	0.08	☆
A4-36	Integral factor 4 of algorithm 3	0 to 1.00	0.01	0.08	☆
Group F0: Basic Control					
F0-00	G/p selection	1: g 2: p	1	1	•
F0-01	Control mode	0: SVC 1: Closed loop vector control 2: V/F	1	1	★
F0-02	Command source selection	0: keypad 1: terminals 2: communication	1	0	☆
F0-03	Main frequency source x selection	0: Digital setting (non-retentive at power down) 1: Digital setting (retentive at power down) 2: AI1 3: AI2 4: AI3 5 to 8: reserved 9: communication	1	0	★
F0-08	Preset frequency	0.00 to F0-10	0.01 Hz	50.00 Hz	☆
F0-09	Running direction	0: same 1: reverse	1	0	★
F0-10	Max. frequency	50.00 to 300.00 Hz	0.01 Hz	200.00 Hz	★
F0-11	Frequency upper limit source	0: F0-12 1: AI1 2: AI2 3: AI3 4: reserve 5: communication	1	0	★
F0-12	Frequency upper limit	F0-14 to F0-10	Hz	200.00	☆
F0-13	Frequency upper limit offset	0.00 to F0-10	Hz	0.00	☆
F0-14	Frequency lower limit	0.00 to F0-12	Hz	0.00	☆
F0-15	Carrier frequency	1 to 8.0	kHz	Model dependent	☆
F0-16	Carrier frequency auto adjusting selection	0: Disable 1: enable	1	1	☆
F0-17	Acceleration time 1	0.0s to 6500.0s	0.1s	20.0s	☆
F0-18	Deceleration time 1	0.0s to 6500.0s	0.1s	20.0s	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
Group F1: Motor Parameters					
F1-00	Motor type selection	0: induction motor 1: frequency variable induction motor 2: PMSM	1	2	★
F1-01	Rated power	0.4 to 1000.0 kW	0.1 kW	Model dependent	★
F1-02	Rated voltage	0 to 480 V	1 V	Model dependent	★
F1-03	Rated current	0.0 to 6500.0 A	0.1 A	Model dependent	★
F1-04	Rated frequency	0.00 Hz to F0-10	0.01 Hz	Model dependent	★
F1-05	Rated rotating speed	0 to 30000 rpm	1 rmp	Model dependent	★
F1-11	D-axis inductance	0 to 65.535 mH	0.001 mh	Model dependent	★
F1-12	Q-axis inductance	0 to 65.535 mG	0.001 mh	Model dependent	★
F1-13	Stator resistance	0 to 65.535	0.001 Ω	Model dependent	★
F1-14	Motor manufacturer selection	0: none 1: manual motor angle input (A1-02) 2: reserved 3: Motor 4: PHASE motor 5: HAI TIAN motor	1	0	☆
F1-15	Back-EMF	0 to 65535 V	1 V	Model dependent	★
F1-16	Motor auto-tuning method selection	0: no auto-tuning 1: no-load static 2: no-load dynamic, reverse running fast 3: with-load static 4: with-load dynamic, reverse running fast 5: no-load dynamic, forward running fast 6: no-load dynamic and short time, forward running fast	1	0	★
Group F2: Vector Control					
F2-00	Speed loop proportional gain kp1	1 to 400	1	60	☆
F2-01	Speed loop integral gain ki1	0.01s to 10.00s	0.01s	0.3s	☆
F2-02	Switching frequency 1 for speed loop gains	0.00 Hz to F2-05	0.01 Hz	5.00 Hz	☆
F2-03	Speed loop proportional gain kp2	1 to 400	1	60	☆
F2-04	Speed loop integral gain ki1	0.01s to 10.00s	0.01s	0.3s	☆
F2-05	Switching frequency 2 for speed loop gains	F2-02 to F0-10	0.01 Hz	10.00 Hz	☆
F2-07	Speed loop filter time	0.5 to 10.0 ms	0.1 ms	1.0 ms	☆
F2-08	Torque upper limit enable	0: speed control 1: torque control	0	0	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F2-09	Torque upper limit source selection	0: F2-10 1: AI1 2: AI2 3: AI3 4: reserved 5: communication	0	0	☆
F2-10	Torque upper limit	0.0% to 250.0%	0.1%	200.0%	☆
F2-29	Back EMF compensation	0: disable 1: enable	1	0	★
Group F3: V/F Control					
F3-00	V/F curve setting	0: linear V/F 1: multi-point V/F 2: square V/F 3: 1.2-power V/F 4: 1.4-power V/F 6: 1.6-power V/F 8: 1.8-power V/F 9: reserved 10: V/F complete separation 11: V/F half separation	0	0	★
F3-01	Torque boost	0.0% to 30.0%	0.1%	1.0%	☆
F3-02	Cut-off frequency of torque boost	0.00 Hz to F0-10	0.01 Hz	50.00 Hz	★
F3-03	Multi-point V/F frequency 1	0.00 Hz to F3-05	0.01 Hz	0.00 Hz	★
F3-04	Multi-point V/F voltage 1	0.0% to 100.0%	0.1%	0.0%	★
F3-05	Multi-point V/F frequency 2	0.00 Hz to F3-07	0.01 Hz	0.00 Hz	★
F3-06	Multi-point V/F voltage 2	0.0% to 100.0%	0.1%	0.0%	★
F3-07	Multi-point V/F frequency 3	0.00 Hz to F1-04	0.01 Hz	0.00 Hz	★
F3-08	Multi-point V/F voltage 3	0.0% to 100.0%	0.1%	0.0%	★
F3-09	V/F slip compensation	0.0% to 200.0%	0.1%	0.0%	☆
F3-10	V/F over-excitation gain	0 to 200	1	64	☆
F3-11	V/F oscillation suppression gain	0 to 100	1	40	☆
F3-12	V/F oscillation suppression mode selection	0 to 3	1	3	★
F3-13	Voltage source for V/F separation	0 to 8	1	0	★
F3-14	Digital setting of voltage for V/F separation	0 to F1-02	0	0	★
F3-15	Voltage rise time of V/F separation	0 to 1000.0	0.1	0	☆
F3-16	Voltage decline time of V/F separation	0 to 1000.0	0.1	0	★
F3-17	Stop mode selection for V/F separation	0 to 1	1	0	★
F3-18	Current limit level	0 to 200	1	130	★
F3-19	Current limit selection	0 to 1	1	1	☆
F3-20	Current limit gain	0 to 100	1	20	☆
F3-21	Compensation factor of speed multiplying current limit level	50 to 200	1	50	★
F3-22	Voltage limit	650.0 to 800.0 V	0.1 V	780.0 V	★

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F3-23	Voltage limit selection	0 to 1	1	1	★
F3-24	Frequency gain for voltage limit	0 to 100	1	30	☆
F3-25	Voltage gain for voltage limit	0 to 100	1	30	☆
F3-26	Frequency rise threshold during voltage limit	0 to 50	1	5	★
F3-27	Slip compensation time constant	0.1 to 10.0	0.1	0.5	☆
F3-28	Auto frequency boost enable	0 to 1	1	0	★
F3-29	Minimum torque current	10 to 100	1	50	★
F3-30	Maximum torque current	10 to 100	1	20	★
F3-31	Auto frequency boost kp	0 to 100	1	50	☆
F3-32	Auto frequency boost kp	0 to 100	1	50	☆
F3-33	Online torque compensation gain	80 to 150	1	100	★
Group F4: Input Terminals					
F4-00	DI1 function selection	0: no function 1: Forward run (FWD) (oil pump enable) 2: Reverse run (REV) 3: 3 wire control 4: jog forward 5: jog reverse 6 to 7: reserved 8: coast to stop 9: fault reset 10: reserved 11: external fault(normally open) 12 to 17: reserved 18 frequency source switch 19 to 32: reserved 33: external fault(normally closed) 34 to 38: reserved 39: switch from frequency source x to preset frequency 40: switch from frequency source y to preset frequency 41 to 47: reserved 48: PID selection 1 49: PID selection 2 50: can communication enable 51: slave pump enable 52: switch from pressure mode to speed mode (torque upper limit = AI1/max. voltage x A3-30) 53: slave pump address selection 1 54: slave pump address selection 2 55: switch from injection to pressure holding 56: error reset(except overcurrent) 57: switch from pressure mode to speed mode (torque upper limit = F2-10)	1	1	★
F4-01	DI2 function selection		1	48	★
F4-02	DI3 function selection		1	53	★
F4-03	DI4 function selection		1	9	★
F4-04	DI5 function selection		1	50	★
F4-05	Reserved		1	0	★
F4-06	Reserved		1	0	★
F4-07	Reserved		1	0	★
F4-15	DI filter time	1 to 10	1	4	☆
F4-18	AI1 min. Input	-11.00 to 11.00 V	0.01 V	0.02 V	☆
F4-19	AI1 min. Input frequency	-100.0% to 100.0%	0.1%	0.0%	☆
F4-20	AI1 max. Input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
F4-21	AI1 max. Input frequency	-100.0% to 100.0%	0.1%	100.0%	☆
F4-22	AI1 filter time	0.000s to 10.000s	0.001s	0.01s	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F4-23	AI2 min. Input	-11.00 to 11.00 V	0.01 V	0.02 V	☆
F4-24	AI2 min. Inp frequency	-100.0% to 100.0%	0.1%	0.0%	☆
F4-25	AI2 max. Input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
F4-26	AI2 max. Input frequency	-100.0% to 100.0%	0.1%	100.0%	☆
F4-27	AI2 filter time	0.000s to 10.000s	0.001s	0.005s	☆
F4-28	AI3 min. Input	-11.00 to 11.00 V	0.01 V	0.02 V	☆
F4-29	AI3 min. Input frequency	-100.0% to 100.0%	0.1%	0.0%	☆
F4-30	AI3 max. Input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
F4-31	AI3 max. Input frequency	-100.0% to 100.0%	0.1%	100.0%	☆
F4-32	AI3 filter time	0.000s to 10.000s	0.001s	0.000s	☆
F4-43	AI1 Display value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-44	AI1 measured value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-45	AI1 Display value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F4-46	AI1 measured value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F4-47	AI2 Display value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-48	AI2 measured value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-49	AI2 Display value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F4-50	AI2 measured value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F4-51	AI3 Display value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-52	AI3 measured value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F4-53	AI3 Display value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F4-54	AI3 measured value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
Group F5: Output Terminals					
F5-01	T/a1-t/b1-t/c1 function selection	0: no function 1: drive is running 2: fault output 3 to 5: reserved 6: motor overload warning 7: drive overload warning 8 to 11: reserved 12: time is out 13 to 14: reserved 15: drive is ready 16: abs AI1 value is bigger than abs AI2 value after correction 17 to 19: reserved 20: communication control 21 to 22: reserved 23: Displacement switch of dual displacements piston pump (normally open) 24: pressure control (normally close) 25: slave pump warning 26: Displacement switch of dual Displacements piston pump (normally open) 27: DC bus voltage established 28: business preset running time out 29: business preset running time less than 24 hours 30: maximum reverse speed 31: warning 32: KTY temperature reached	1	2	☆
F5-02	T/a2-t/c2 function selection		1	23	☆
F5-03	DO1 function selection		1	24	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F5-10	AO1 function selection	0: running frequency 1: frequency reference 2: output current 3: output torque 4: output power 5: output voltage 6: reserved 7: AI1 8: AI2 9: AI3 10: feedback speed 11: feedback pressure 14: by communication control 12 to 16: reserved	1	10	☆
F5-11	AO2 function selection		1	11	☆
F5-14	AO1 offset factor	-100.0% to 100.0%	0.1%	0.0%	☆
F5-15	AO1 gain	-10.00 to 10.00	0.01	1.00	☆
F5-16	AO2 offset factor	-100.0% to 100.0%	0.1%	0.0%	☆
F5-17	AO2 gain	-10.00 to 10.00	0.01	1.00	☆
F5-23	AO1 measured value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F5-24	AO1 calculated value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F5-25	AO1 measured value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F5-26	AO1 calculated value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F5-27	AO2 measured value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F5-28	AO2 calculated value 1	-9.999 to 9.999 V	0.001 V	2.000 V	☆
F5-29	AO2 measured value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
F5-30	AO2 calculated value 2	-9.999 to 9.999 V	0.001 V	8.000 V	☆
Group F6: Stopping					
F6-10	Stopping mode	0: deceleration to stop 1: coast to stop	1	0	☆
Group F7: Keypad and Display					
F7-02	The function of stop/reset key on keypad	0: only the key can stop motor 1: in terminal control, the key can stop motor 2.in terminal control, the key can reset fault 3: in terminal control, the key can stop motor and reset fault	1	2	☆
F7-06	Load linear speed display factor	0.0001 to 6.5000	0.0001	1.0000	☆
F7-07	IGBT temperature	-1000°C to 1000°C	1°C		●
F7-09	Total running time	0 to 65535 h	1 h	-	●
F7-10	Firmware version 1	-	-	-	●
F7-11	Firmware version 2	-	-	-	●
F7-12	Temporary firmware version 1	-	-	-	●
F7-13	Temporary firmware version 2	-	-	-	●

Para. No.	Para. Name	Setting Range	Unit	Default	Property
Group F8: Auxiliary Functions					
F8-17	Preset running time	0 to 65000 h	1 h	0 h	☆
F8-18	Protection enable upon startup	0: Disable 1: enable	1	0	☆
F8-22	Ground fault detection enable upon power on	0: Disable 1: enable	1	1	☆
F8-23	Selection for reactions of preset running time out	0: Disable 1: enable	1	0	☆
F8-24	Undervoltage level(the voltage of input)	148.5 to 321.7 V	0.1 V	247.5 V	☆
F8-25	Braking operation duration limit	0.0s to 3600.0s	0.1s	5.0s	☆
F8-26	Braking resistor protection	0: Disable 1: enable	1	1	☆
F8-27	Output ground fault protection upon starting	0: Disable 1: enable	1	0	☆
F8-28	Output phase loss protection upon starting	0: Disable 1: enable	1	1	☆
F8-29	Braking resistor overload protection	0: Disable 1: enable	0 to 1	1	☆
Group F9: Protection and Fault					
F9-00	Motor overload protection	0: disable 1: enable	1	0	☆
F9-01	Motor overload protection factor	0.20 to 10.00	0.01	2.00	☆
F9-08	Braking level	700 to 800 V	1 V	750 V	☆
F9-12	Input phase loss detection enable	0: disable 1: enable	1	1	☆
F9-13	Output phase loss detection enable	0: Disable 1: enable	1	1	☆
F9-14	Speed error protection threshold	0.50 to 50.00 Hz	0.01 Hz	10.00 Hz	☆
F9-15	Speed error protection time	0.0s to 20.0s	0.1s	10.0s	☆
F9-16	Motor temperature protection enable	0: Disable 1: enable	1	1	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F9-18	The third last fault	0: no fault 1: reserved 2: overcurrent (E02) 3: overcurrent (E03) 4: overcurrent (E04) 5: overvoltage (E05) 6: overvoltage (E06) 7: overvoltage (E07) 8: reserved 9: undervoltage (E09) 10: drive overload (E10) 12: input phase loss (E12) 13: output phase loss (E13) 14: heatsink overheat (E14) 15: external fault (E15) 16: modbus fault (E16) 17: contactor fault (E17) 18: current sensing fault (E18) 19: motor tuning fault (E19) 20: reserved (E20) 21: EEPROM fault (E21) 22: reserved (E22) 23: ground fault (E23) 24 to 25: reserved 26: time is out (E26) 27: bussiness time is out (E27) 28 to 39: reserved 40: multi times overcurrent (E40) 41: reserved 42: can communication fault (E42) 43: resolver tuning fault (E43) 44: speed error protection fault (E44) 45: motor overheat (E45) 46: pump sensor fault (E46) 47: slave fault warning (E47) 48: can address conficting (E48) 49: resolver loose wiring (E49) 52: multi masters fault (E52) 58: user parameter restore fault (E58) 59: back EMF error (E59) 61: braking overtime (E61) 62: braking IGBT fault (E62) 63: reverse running time out (E63) 66: braking resistor fault (E66) 67: function code initialization fault (E67)	1	-	●
F9-19	The second last fault		1	-	●
F9-20	The last fault		1	-	●
F9-21	Frequency upon the last fault	-	-	-	●
F9-22	Current upon the last fault	-	-	-	●
F9-23	Bus voltage upon the last fault	-	-	-	●
F9-24	DI status upon the last fault	-	-	-	●
F9-25	DO status upon the last fault	-	-	-	●
F9-26	The subtype of the last fault	-	-	-	●
F9-30	Frequency upon the second last fault	-	-	-	●
F9-31	Current upon the second last fault	-	-	-	●
F9-32	Bus voltage upon the second last fault	-	-	-	●
F9-33	DI status upon the second last fault	-	-	-	●
F9-34	DO status upon the second last fault	-	-	-	●

Para. No.	Para. Name	Setting Range	Unit	Default	Property
F9-35	The subtype of the second last fault	-	-	-	●
F9-39	Frequency upon the third last fault	-	-	-	●
F9-40	Current upon the third last fault	-	-	-	●
F9-41	Bus voltage upon the third last fault	-	-	-	●
F9-42	DI status upon the third last fault	-	-	-	●
F9-43	DO status upon the third last fault	-	-	-	●
F9-44	The subtype of the third last fault	-	-	-	●
F9-48	KTY temperature reached	0 to 300.0	0.1	0	☆
F9-58	KTY temperature	-40.0 to 300.0	0.1	-	●
F9-59	KTY overheat fault threshold	-40.0 to 300.0	0.1	130.0	☆
Group FA: Business Countdown Function					
FA-00	Password of first countdown setting	0 to 65535	1	0	☆
FA-01	First countdown	0 to 65535 h	1 h	0	☆
FA-02	Password of second countdown setting	0 to 65535	1	0	☆
FA-03	Second countdown	0 to 65535 h	1 h	0	☆
FA-04	Password of third countdown setting	0 to 65535	1	0	☆
FA-05	Third countdown	0 to 65535 h	1 h	0	☆
FA-06	Password of forth countdown setting	0 to 65535	1	0	☆
FA-07	Forth countdown	0 to 65535 h	1 h	0	☆
FA-08	Business running time in total(hour)	0 to 65535 h	1 h	0	●
FA-09	Business running time in total(second)	0s to 3600s	1s	0	●
Group FB Optimization					
FB-04	Overcurrent prevention enable	0: Disable 1: enable	1	1	★
Group FC: Multi-point Calibration					
FC-00	Multi-point AI calibration enable	0: no calibration 1: AI1 enable 2: AI2 enable 3: AI1 and AI2 enable	0	0	★
FC-01	Minimum AI1 input	-11.00 to 11.00 V	0.01 V	0.02 V	☆
FC-02	Correspondent value of minimum AI1 input	-100.0% to 100.0%	0.1%	0.0%	☆
FC-03	AI1 point 1 input	-11.00 to 11.00 V	0.01 V	1.00 V	☆
FC-04	Correspondent value of AI1 point 1 input	-100.0% to 100.0%	0.1%	10.0%	☆
FC-05	AI1 point 2 input	-11.00 to 11.00 V	0.01 V	2.00 V	☆
FC-06	Correspondent value of AI1 point 2 input	-100.0% to 100.0%	0.1%	20.0%	☆
FC-07	AI1 point 3 input	-11.00 to 11.00 V	0.01 V	3.00 V	☆
FC-08	Correspondent value of AI1 point 3 input	-100.0% to 100.0%	0.1%	30.0%	☆
FC-09	AI1 point 4 input	-11.00 to 11.00 V	0.01 V	4.00 V	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
FC-10	Correspondent value of AI1 point 4 input	-100.0% to 100.0%	0.1%	40.0%	☆
FC-11	AI1 point 5 input	-11.00 to 11.00 V	0.01 V	5.00 V	☆
FC-12	Correspondent value of AI1 point 5 input	-100.0% to 100.0%	0.1%	50.0%	☆
FC-13	AI1 point 6 input	-11.00 to 11.00 V	0.01 V	6.00 V	☆
FC-14	Correspondent value of AI1 point 6 input	-100.0% to 100.0%	0.1%	60.0%	☆
FC-15	AI1 point 7 input	-11.00 to 11.00 V	0.01 V	7.00 V	☆
FC-16	Correspondent value of AI1 point 7 input	-100.0% to 100.0%	0.1%	70.0%	☆
FC-17	AI1 point 8 input	-11.00 to 11.00 V	0.01 V	8.00 V	☆
FC-18	Correspondent value of AI1 point 8 input	-100.0% to 100.0%	0.1%	80.0%	☆
FC-19	AI1 point 9 input	-11.00 to 11.00 V	0.01 V	9.00 V	☆
FC-20	Correspondent value of AI1 point 9 input	-100.0% to 100.0%	0.1%	90.0%	☆
FC-21	AI1 point 10 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-22	Correspondent value of AI1 point 10 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-23	AI1 point 11 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-24	Correspondent value of AI1 point 11 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-25	AI1 point 12 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-26	Correspondent value of AI1 point 12 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-27	AI1 point 13 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-28	Correspondent value of AI1 point 13 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-29	AI1 point 14 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-30	Correspondent value of AI1 point 14 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-31	AI1 point 15 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-32	Correspondent value of AI1 point 15 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-33	AI1 point 16 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-34	Correspondent value of AI1 point 16 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-35	AI1 point 17 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-36	Correspondent value of AI1 point 17 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-37	Maximum AI1 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-38	Correspondent value of maximum AI1 input	-100.0% to 100.0%	0.1%	100.0%	☆
FC-39	Minimum AI1 input	-11.00 to 11.00 V	0.01 V	0.02v	☆
FC-40	Correspondent value of minimum AI2 input	-100.0% to 100.0%	0.1%	0.0%	☆
FC-41	AI2 point 1 input	-11.00 to 11.00 V	0.01 V	1.00v	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
FC-42	Correspondent value of AI2 point 1 input	-100.0% to 100.0%	0.1%	10.0%	☆
FC-43	AI2 point 2 input	-11.00 to 11.00 V	0.01 V	2.00v	☆
FC-44	Correspondent value of AI2 point 2 input	-100.0% to 100.0%	0.1%	20.0%	☆
FC-45	AI2 point 3 input	-11.00 to 11.00 V	0.01 V	3.00v	☆
FC-46	Correspondent value of AI2 point 3 input	-100.0% to 100.0%	0.1%	30.0%	☆
FC-47	AI2 point 4 input	-11.00 to 11.00 V	0.01 V	4.00v	☆
FC-48	Correspondent value of AI2 point 4 input	-100.0% to 100.0%	0.1%	40.0%	☆
FC-49	AI2 point 5 input	-11.00 to 11.00 V	0.01 V	5.00v	☆
FC-50	Correspondent value of AI2 point 5 input	-100.0% to 100.0%	0.1%	50.0%	☆
FC-51	AI2 point 6 input	-11.00 to 11.00 V	0.01 V	6.00v	☆
FC-52	Correspondent value of AI2 point 6 input	-100.0% to 100.0%	0.1%	60.0%	☆
FC-53	AI2 point 7 input	-11.00 to 11.00 V	0.01 V	7.00v	☆
FC-54	Correspondent value of AI2 point 7 input	-100.0% to 100.0%	0.1%	70.0%	☆
FC-55	AI2 point 8 input	-11.00 to 11.00 V	0.01 V	8.00v	☆
FC-56	Correspondent value of AI2 point 8 input	-100.0% to 100.0%	0.1%	80.0%	☆
FC-57	AI2 point 9 input	-11.00 to 11.00 V	0.01 V	9.00v	☆
FC-58	Correspondent value of AI2 point 9 input	-100.0% to 100.0%	0.1%	90.0%	☆
FC-59	Maximum AI2 input	-11.00 to 11.00 V	0.01 V	10.00 V	☆
FC-60	Correspondent value of maximum AI2 input	-100.0% to 100.0%	0.1%	100.0%	☆
Group FD: Bus communication and PC Software Setting					
FD-00	Baud rate	0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	1	5	☆
FD-01	Data format symbol	0: no parity check (8-n-2) 1: even parity check 2: odd parity check 3: no parity check (8-n-1)	1	0	☆
FD-02	Local address	0 to 247	1	1	☆
FD-03	Response delay	0 to 20 ms	1 ms	2 ms	☆
FD-04	Communication timeout	0.0s to 60.0s	0.1s	0.0s	☆
FD-30	PC software communication enable	0: Disable 1: enable	1	0.0	☆
FD-31	Channel 1 selection	0 to 999	1	10	☆

Para. No.	Para. Name	Setting Range	Unit	Default	Property
FD-32	Channel 1 selection	0 to 999	1	10	☆
FD-33	Channel 1 selection	0 to 999	1	10	☆
FD-34	Channel 1 selection	0 to 999	1	10	☆
FD-35	Sampling period	0 to 65535	1	1	☆
FD-36	Object of trigger a	0 to 999	1	1	☆
FD-37	Condition of trigger a	0 to 2	1	0	☆
FD-38	Level of trigger a	0 to 65535	1	0	☆
FD-39	Object of trigger b	0 to 999	1	1	☆
FD-40	Condition of trigger b	0 to 2	1	0	☆
FD-41	Level of trigger b	0 to 65535	1	0	☆
FD-42	Switch of trigger a/b	0: a 1: b	1	0	☆
FD-43	Carrier period of data saving	0 to 65535	1	0	★
FD-44	Fault code	0 to 65535	1	0	★
FD-45	Setting value of data saving	0 to 2	1	0	☆
FD-46	Data retrieve area selection	0: ram 1: flash	1	0	☆
FD-47	Flash rewritten selection	0 to 1	1	1	☆
Group FE: User-defined Parameters					
FE-00	User-defined parameter 0	F0.00 to FP.xx A0.00 to A4.xx U0.00 to U1.xx	-	-	☆
FE-01	User-defined parameter 1		-	-	☆
FE-02	User-defined parameter 2		-	-	☆
FE-03	User-defined parameter 3		-	-	☆
FE-04	User-defined parameter 4		-	-	☆
FE-05	User-defined parameter 5		-	-	☆
FE-06	User-defined parameter 6		-	-	☆
FE-07	User-defined parameter 7		-	-	☆
FE-08	User-defined parameter 8		-	-	☆
FE-09	User-defined parameter 9		-	-	☆
FE-10	User-defined parameter 10		-	-	☆
FE-11	User-defined parameter 11		-	-	☆
FE-12	User-defined parameter 12		-	-	☆
FE-13	User-defined parameter 13		-	-	☆
FE-14	User-defined parameter 14		-	-	☆
FE-15	User-defined parameter 15		-	-	☆
Group FP: Password and Parameter Operation					
FP-00	User password	0 to 65535	1	0	☆
FP-01	Parameter initialization	0: no operation 1: restore factory parameters 2: clear records 3: restore back-up user parameter 4: restore factory parameters except A2-01 5: restore factory parameters except FA and FP	1	0	★

Para. No.	Para. Name	Setting Range	Unit	Default	Property
FP-02	Motor model number	0 to 65535	1	0	★
FP-04	User parameter password	0 to 65535	1	0	☆
FP-05	Back up user parameters	0: no operation 1: back up	1	0	★
FP-06	Bilingual (EN/CH) HMI specification	0 to 65535	1	0	☆
Group AF: Communication Process Data (Visible onlu in CANopen)					
AF-00	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-02	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-04	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-06	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-08	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-10	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-12	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-14	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-16	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-18	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-20	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-22	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-24	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-26	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-28	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-30	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-32	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-34	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-36	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-38	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-40	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-42	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-44	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-46	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-48	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-50	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-52	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-54	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-56	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-58	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-60	Communication process data	0 to 0xffffffff	1	H.0000	☆
AF-62	Communication process data	0 to 0xffffffff	1	H.0000	☆

A.3 Monitoring Parameter List

Para. No.	Para. Name	Setting range	Unit
Group U0: Drive Status Monitoring			
U0-00	Running frequency	-650.00 to 650.00	0.01 Hz
U0-01	Frequency reference	-650.00 to 650.00	0.01 Hz
U0-02	DC bus voltage	0.0 to 1000.0 V	0.1 V
U0-03	Output voltage	0 V to F02.03	1 V
U0-04	Output current	0.1 to 6553.5 A	0.1 A
U0-05	Output power	0.4 to 1000.0 kW	0.1 kW
U0-06	Output torque	0% to 200%	0.1
U0-07	Basic DI/DO status	-	-
U0-08	Extended DI/DO status	-	-
U0-09	AI1 voltage(after correction)	-10.00 to 10.000 V	0.001 V
U0-10	AI2 voltage(after correction)	-10.00 to 10.000 V	0.001 V
U0-11	AI3 voltage(after correction)	-10.00 to 10.000 V	0.001 V
U0-12	Resolver mechanical angle	1 to 4096	1
U0-13	Reserved	-	-
U0-14	Motor speed	-9999 to 32767 rpm	1
U0-15 to U0-18	Reserved	-	-
U0-19	Speed reference	-9999 to 32767 rpm	1rmp
U0-20	Frequency feedback of motor (q15 format)	0 to 65535	1
U0-21 to U0-24	Reserved	-	-
U0-25	Overload value in total	0 to 36000	1.0
U0-28	Current upon overcurrent fault	0.01 to 655.35 A	0.01 A
U0-29	Overcurrent fault type	1: hardware 2: firmware	1
U0-30	AI1 voltage(before correction)	-10.000 to 10.000 V	0.001 V
U0-31	AI2 voltage(before correction)	-10.000 to 10.000 V	0.001 V
U0-32	AI3 voltage(before correction)	-10.000 to 10.000 V	0.001 V
U0-33	Reserved	-	-
U0-34	AO1 voltage	0.000 to 10.000 V	0.001 V
U0-35	AO2 voltage	0.000 to 10.000 V	0.001 V
U0-36	Motor e-angle	0.0° to 359.9°	0.1°
U0-37	Pressure command	0.0 kg/cm^2 to A3-02	0.1 kg/cm^2
U0-38	Pressure feedback	0.0 kg/cm^2 to A3-02	0.1kg/cm^2
U0-39	Speed command	-9999 to 30000 rpm	1 rmp
U0-40	Speed feedback	-9999 to 30000 rpm	1 rmp
U0-41	Motor speed feedback	0 to 65535	1
U0-42	Resolver interference status	0 to 65535	1
U0-43	Reserved	-	-
U0-44	Reserved	-	-
U0-45	Motor KTY temperature	-40.0°C to 200.0 °C	-
U0-46	Received can frames	0 to 65535	1
U0-47	Faulty frames of can sending	0 to 65535	1
U0-48	Faulty frames of can receiving	0 to 65535	1

Para. No.	Para. Name	Setting range	Unit
U0-49	Off-line times of can bus	0 to 65535	1
U0-55	Extension card type	0 to 65535	1
U0-56	Extension card firmware version	0 to 65535	1
Group U1: Hydraulic Pressure Monitoring			
U1-00	Electrical angle	0.0° to 359.9°	0.1°
U1-01	Pressure command	0.0 kg/cm^2 to A3-02	0.1
U1-02	Pressure feedback	0.0 kg/cm^2 to A3-02	0.1
U1-03	Motor speed feedback	-9999 to 30000 rpm	1 rmp
U1-04	AI1 voltage	-9.999 to 9.999 V	0.001 V
U1-05	AI2 voltage	-9.999 to 9.999 V	0.001 V
U1-06	AI3 voltage	-9.999 to 9.999 V	0.001 V
U1-07	AI1 zero drift	-9.99 to 9.99 V	0.01 V
U1-08	AI2 zero drift	-9.99 to 9.99 V	0.01 V
U1-09	AI3 zero drift	-9.99 to 9.99 V	0.01 V
U1-10	Flow command	0.00 Hz to F0-10	0.01 Hz
U1-11	Resolver signal interference extent	0 to 1000 (off-line)	1
U1-12	Pressure command from host computer	0.0 kg/cm^2 to A3-02	0.1
U1-13	CANLink communication interference extent	0 to 128 (off-line)	1

Appendix B Modbus Communication Protocol

The LS680 provides a RS485 communication interface and supports Modbus RTU communication protocol. Through the Modbus communication protocol, you can implement the centralized control of the drive, such as setting the running commands, modifying or reading parameters, and reading the running status and fault information, by using a computer or programmable logic controller (PLC).

This protocol defines the content and format of messages transmitted through serial communication, including the master polling (or broadcasting) format and the master coding method (parameter No. for the action, transmission data, and error check). The slave uses the same structure in the response, including action confirmation, data returning, and error check. If an error occurs when the slave receives a message, or the slave cannot complete the action required by the master, the slave returns a fault message (response) to the master.

B.1 Application Method

As a slave, the servo drive is connected to a "single-master multi-slave" PC/PLC control network with RS485 bus.

B.2 Bus Structure

1) Hardware interface

An RS485 expansion card MD38TX1 is required for the drive.

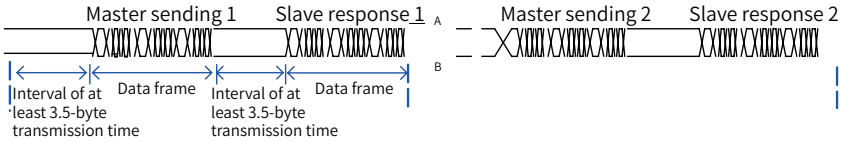
2) Topological structure

The system consists of a single master and multiple slaves. Each device in the network has a unique slave address. Among them, a device (usually a PC, PLC or HMI) serves as the master and initiates communication to read or write parameters of the slaves. Other devices serve as slaves and respond to query or communication operations from the master. Only one device is allowed to transmit data at the same moment, and other devices receive data.

The address range of slaves is 1 to 247. The value "0" is a broadcasting communication address. A slave must have a unique address in the network.

3) Communication transmission mode

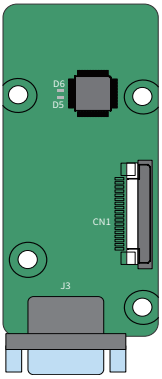
The asynchronous serial and half-duplex transmission mode is used. In the process of asynchronous serial communication, data is sent frame by frame in the form of message. In Modbus RTU protocol, an interval of at least 3.5-byte transmission time marks the end of the previous message. A new message starts to be sent after this interval.



The built-in communication protocol of the LS680 is the Modbus RTU slave communication protocol, which allows the drive to provide data to respond to a "query/command" from the master or execute the action according to "query/command" from the master.

The master can be a PC, an industrial control device, or a PLC. It can communicate with a single slave or send broadcast messages to all slaves. When the master communicates with a single slave, the slave needs to return a message (response) to the "query/command" from the master, but it does not need to return a response to a broadcast message sent by the master.

1 Resolver PG card (LS500PG4)



Specifications of the LS500PG4	
User interface	DB9 female
Cable specification	> 22AWG
Resolution	12-bit
Excitation frequency	10 kHz
VRMS	7 V
VP-P	3.15 ± 27%
Range of frequency-division	Without frequency-division function
Load capacity	175 mA
Input impedance	0.5 transformation ratio: 5.9 kΩ 0.286 transformation ratio: 9.4 kΩ

Table C-1 Function description of LS500PG4 terminals

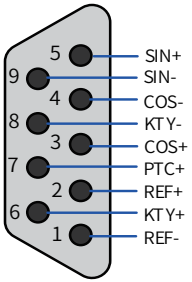
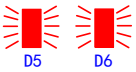
Terminal	Pin No.	Pin Definition	Function Description	Terminal Layout
J3	1	REF-	Resolver excitation negative	
	2	REF+	Resolver excitation positive	
	3	COS+	Resolver feedback COS positive	
	4	COS-	Resolver feedback COS negative	
	5	SIN+	Resolver feedback SIN positive	
	6	KTY+	KTY resistance positive	
	7	PTC+	PTC resistance positive	
	8	KTY-	KTY/PTC resistance negative	
	9	SIN-	Resolver feedback SIN negative	
CN1	18-pin flexible flat cable (FFC) interface, connected to jumper J2 on the control board of the servo drive			

Table C-2 Status description of LS500PG4 indicators

Fault Indicator	Status	Possible Cause and Solution
	Normal	No
	Phase-locked loop (PPL) loss of lock	The phase lag of the resolver is too large.
	The signal SIN/COS amplitude exceeds the upper limit	Possible cause: There is an interference. Solution: Ground the motor well and connect the grounding terminal on the PG card to the PE terminal of the servo drive.

Fault Indicator	Status	Possible Cause and Solution
	The signal SIN/COS amplitude is too small.	Possible cause: The DB9 connector is not connected or incorrectly connected, or the cable is disconnected. Solution: If the preceding situation does not occur, check whether the resolver matches the LS500PG4.
◆ Note: For some PG cards, D3 is the same as D5 and D2 is the same as D6.		

NOTE

- ◆ The resolver must meet the parameter requirements of the LS500PG4, and the excitation input DC resistance must be larger than 17 Ω (measured by a multimeter). Otherwise, the S58-PG-B1 cannot work properly.
- ◆ Do not select a resolver with more than four pole-pairs. Otherwise, the LS500PG4 will be overloaded.

Revision History

Date	Version	Change Description
Sep. 2020	A01	Related firmware version

Shenzhen Lensail Technology Co., Ltd.
Add.:603A, 6th Floor, Building 3, C0FC0 Business Park, Xin'an Street, Bao'an District, Shenzhen, P.R. China
Tel: +86-755-8667 7286
Fax: +86-755-8621 9066
https: //www.lensail.com

Factory Add.: 3rd Floor, Building C, Xixiang Haoye Industrial Park, No.162 Fengtang Avenue, Fuhai Street, Baoan District, Shenzhen, P.R. China
Tel: +86-755-8667 7286
Fax: +86-755-8621 9066
https: //www.lensail.com

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