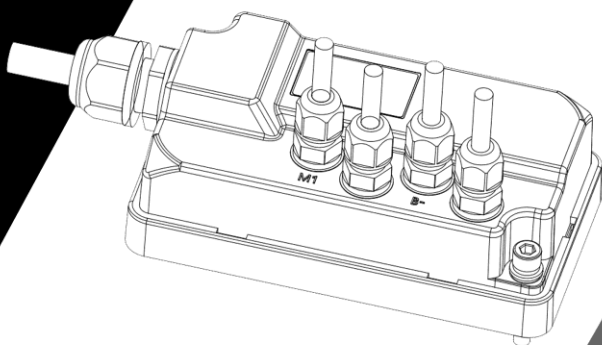


LC024025-BD (A3)

Brushed controller

Operation Manual



Safety Warnings

Security Matters

1. Precautions for use	
 DANGER	
	1. Never touch the inside of the drive with your hands. Otherwise, electric shock may occur.
	2. The ground terminal of the drive and motor must be grounded. Otherwise, electric shock may occur.
	3. Please do not damage the cable, or apply unnecessary stress, ballast, or pinch to the cable. Otherwise, it may cause malfunction, damage and electric shock.
	4. During operation, please do not touch the rotating part of the motor. Otherwise, it may be injured.
 CAUTION	
	1. Please use the motor and driver in the specified combination. Otherwise, fire and malfunction may occur.
	2. Please never use it in a place prone to splashing water, corrosive gas environment, flammable gas environment and combustible materials. Otherwise, fire and malfunction may occur.
	3. The temperature of the drive, motor and peripheral equipment is high, so please keep the distance. Otherwise, it is easy to burn.
	4. During the power-on process and for a period of time after the power is cut off, the heat sink, regenerative resistor, motor, etc. of the drive may be in a high temperature state, so please do not touch it.
	5. If the surface temperature of the motor in the final product exceeds 70°C during operation, please affix a label of "caution hot" on the final product.

2. Wiring precautions	
 CAUTION	
	The wiring must be correct and connected securely. Otherwise, accidents such as fire, breakdown, and injury may occur.
 PROHIBITION	
	1. Never connect power(24V) to the M1 and M2 terminals on the servo motor side. Otherwise, fire and malfunction may occur.
 INSTRUCTION	
	The ground wire is used to prevent an electric shock accident. For safety reasons, please install a ground wire.

3. Precautions during operation and running	
 CAUTION	
	1. Excessive adjustments and changes will cause unstable operation, please do not make it arbitrarily. Otherwise, it may be injured.
	2. During the trial operation, fix the servo motor and install it in the equipment after confirming the operation status while it is disconnected from the mechanical equipment. Otherwise, it may be injured.
	3. The self-holding brake is not a stopping device to ensure the safety of the equipment. Please install a safety stop device on the equipment side. Otherwise, accidents such as failure or injury may occur.
	4. When an alarm occurs, remove the cause, and after ensuring safety, reset the alarm before running. Otherwise, it may be injured.
	5. The motor may restart suddenly when the power is turned on after a momentary power failure, so please keep away from the equipment. (Please consider how to ensure personal safety when restarting during mechanical design).
	6. Please confirm that the power supply specifications are normal. Otherwise, it may cause fire, malfunction and injury.

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Chapter 1 Overview

1.1 Servo drive model description

<u>L</u>	<u>C</u>	<u>0</u>	<u>24</u>	<u>025</u>	-	<u>B</u>	<u>D</u>	<u>N</u>	<u>(***)</u>
1	2	3	4	5		6	7	8	9

- 1: Indicates the controller series: L series Riding low voltage servo driver;
- 2: Indicates the drive type, A: Universal Servo Drive; B: AGV dedicated; C:Forklift dedicated; D: Special for rollers; E: Yarn feeder drive and control integration.
- 3: Indicates the product extension bit, 0~9;
- 4: Indicates the maximum adaptable voltage level of this drive: 24: DC 24V; 36: DC 36V; 48: DC 48V; 60: DC 60V。
- 5: Indicates the rated output current level of this drive, in amperes (A);
- 6: Indicates the type of corresponding motor encoder. V: 2500ppr Incremental photoelectric or magnetic encoder; S: 2500ppr Line-saving incremental photoelectric encoder or magnetic encoder; A: 17-bit or 23-bit multi-turn absolute encoder; I: SPI bus encoder; H: Hall; B without encoder.
- 7: Indicates the characteristics of the motor, T: synchronous servo motor; D: brushed DC motor; B: brushless DC motor;
- 8: Indicates the communication function of the drive. R: RS-485 communication; N: CANopen communication; E: EtherCat communication; Default: no communication function.
- 9: Indicates that there are special features in the driver's software and hardware, and the default means no special features.

1.2 Features

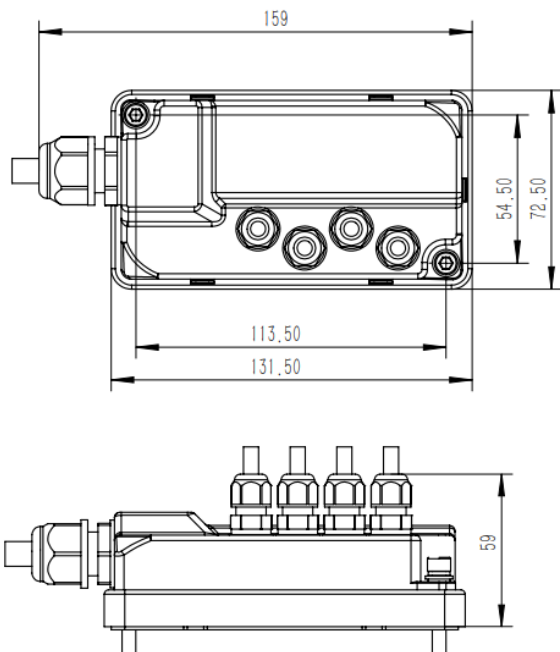
- Advanced speed adjustment. Precise speed is maintained over a variety of terrains, obstacles, curbs and ramps.
- Linearly reduces current to ensure smooth control without sudden power outages during undervoltage or overheating.
- Proprietary algorithms help prevent gearbox wear while providing smooth starts and reversals.
- Bringing the vehicle to a complete stop before applying the electromagnetic brake ensures a safe and secure stop in all conditions.
- The charger inhibit input prevents driving when a charger is connected.
- Navel switch input emergency reverse.
- An internal main relay provides safe de-energization.
- The transient overload function provides greatly improved performance under transient loads such as crossing from hillsides, thresholds, climbing obstacles, etc.

- ▶Changes in motor state are automatically compensated to ensure optimum drive performance at all times.
- ▶Provides two different programmable control modes (indoor/outdoor mode).
- ▶The power saving feature prevents the controller from draining the battery when the vehicle is inactive.
- ▶The indicator outputs the battery discharge status.
- ▶When the internal temperature of the controller exceeds 75° C, the phase current of the controller gradually decreases.
- ▶When the vehicle starts, the position of the accelerator should be below the set protection position, otherwise it will not be able to start.

Chapter 2 Controller and Motor Installation

2.1 Brushed controller installation dimensions

Unit: mm



LC024025-BD (A3) Installation Dimensions

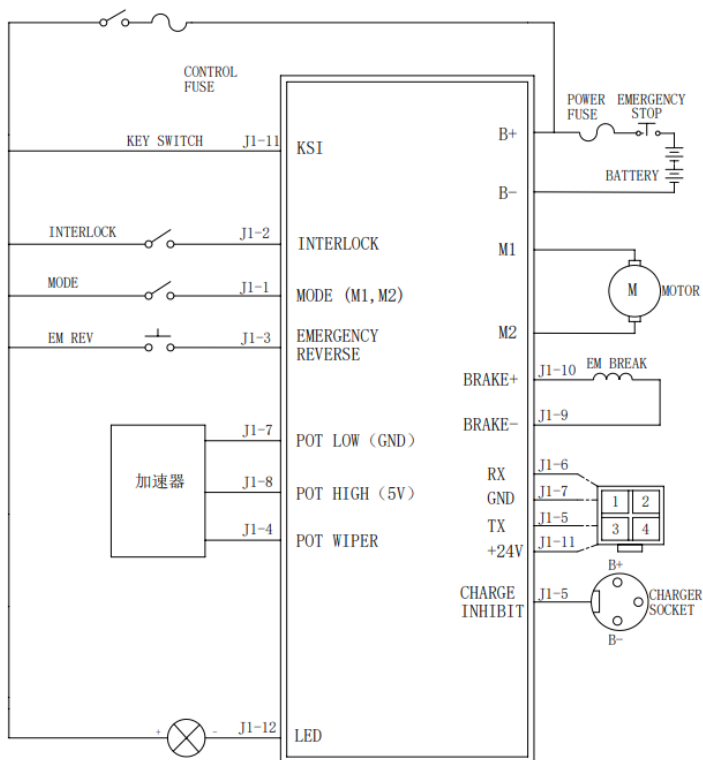
2.2 Power supply

Supply DC 24V to the servo controller;

Voltage: DC 17V ~ 34V.

※ If the given supply voltage exceeds the limit value, the DC controller will be damaged.

2.3 Wiring diagram



Chapter 3 Wiring and Detailed Instructions

3.1 Connector pin definition diagram



J1 (5569-10A)			
No.	Definition	No.	Definition
1	Mode selection input (24V)	6	RX
2	Interlock input (24V)	7	Accelerator power supply negative (GND)
3	Emergency reverse input (24V)	8	Accelerator power supply (+5V)
4	Accelerator wiper signal (0~5V)	9	Electric lock switch input (24V)
5	TX	10	Status indicator output

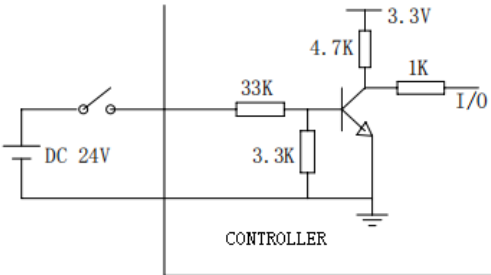
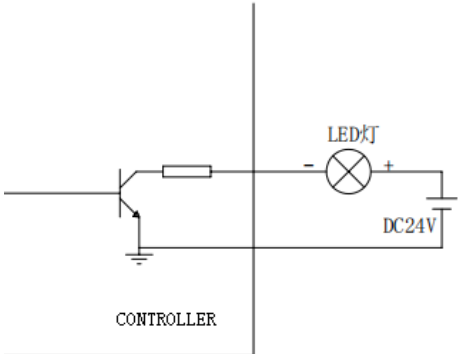
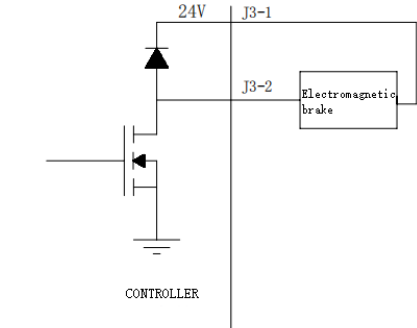
*Note: 1. The input terminals are all active high

2. The mode selects the default high-speed mode, and the high level is the half-speed mode

J2 (5569-2A)	
No.	Definition
1	Electric brake -
2	Electric brake + (24V)

3.2 Interface circuit

Signal name	Circuit
-------------	---------

Switch signal input (J1-1, J1-2, J1-3) <u>Interface</u> <u>Specifications</u> DC24V/1mA (every 1 point)	
Status indicator output <u>Interface</u> <u>Specifications</u> DC24V/70mA(Max)	
Electromagnetic brake control output <u>Interface</u> <u>Specifications</u> DC24V/1A(Max)	

Accelerator wiper signal input	
<u>Interface</u>	
<u>Specifications</u>	
0~5V	
input resistance	
5.1k Ω	

Chapter 4 Controller Parameter Description

4.1 Acceleration and deceleration parameters

Parameter Name	Range	Default	Explanation
Accel Speed	0.5s-8s	1.5s	Forward acceleration time, the larger the value, the slower the acceleration process
High Speed Decel	0.5s-8s	0.5s	Forward high speed deceleration time, the smaller the value, the faster the deceleration at high speed
Low Speed Decel	0.5s-8s	1.5s	Forward low speed deceleration time, the smaller the value, the faster the deceleration at low speed
Rev Accel Speed	0.5s-8s	1.5s	Reverse acceleration time, the larger the value, the slower the acceleration process
Rev High Speed Dec	0.5s-8s	0.5s	Reverse high speed deceleration time, the smaller the value, the faster the deceleration at high speed
Rev Low Speed Dec	0.5s-8s	1.5s	Reverse low speed deceleration time, the smaller the value, the faster the deceleration at low speed
E Accel Speed	0.5s-8s	0.5	Emergency reverse acceleration time, the larger the value, the slower the acceleration in reverse
E Stop Decel	0.5s-4s	0.5s	Emergency reverse deceleration time, the smaller the value, the faster the deceleration
Inhibit Decel	0.5s-4s	0.5s	Deceleration time when the interlock is in effect, the smaller the value, the faster the deceleration

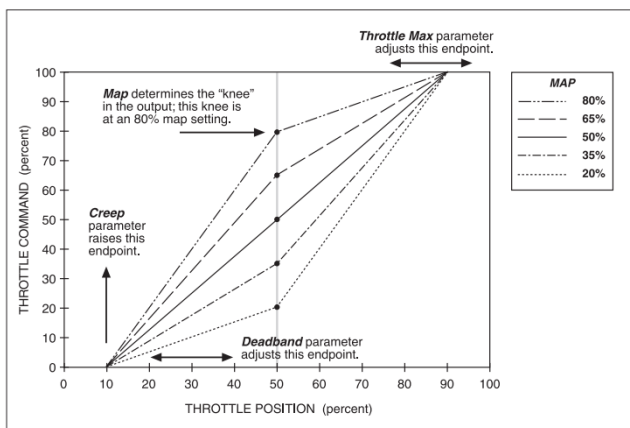
4.2 Current parameters

Parameter Name	Range	Default	Explanation
Motor Current Limit	20A-90A	90A	Drive output current limit, limit the rms value of motor current

4.3 Throttle adjustment parameters

Parameter Name	Range	Default	Explanation
Pot High	1.1-5.0V	2.0V	The maximum throttle voltage, the default is 2V, (Pot High- Pot Low) is the value when the throttle reaches 100%, for example: Pot Neutral=2V, Pot Low=0.5V, Pot High=2V, when the throttle input is greater than 4V or less than 0V, it can be to 100% throttle.
Pot Low	0-1.0V	0.5V	The minimum starting voltage, the default is 0.5V, if Pot Neutral=2V, Pot Low=0.5V, then the vehicle starts when the throttle is greater than 2.5V or less than 1.5V.
Pot Neutral	1.0-3.0V	2.0V	Throttle neutral voltage, default 2V, can be adjusted between 1V to 3V.
Pot High Err	4.0-5.0V	4.5V	The maximum allowable throttle voltage, the default is 4.5V, for example, Pot High Err=4.5V, when the throttle

			voltage is greater than 4.5V for 50ms, the HPD will alarm and cannot be recovered.
Pot Low Err	0-1.0V	0.5V	The minimum allowable throttle voltage, the default is 0.5V, for example, Pot Low Err=0.5V, when the throttle voltage is less than 0.5V for 50ms, the HPD will alarm and cannot be recovered.
Creep Speed	0%-20%	10%	Output speed corresponding to 0% throttle
Throttle Map	20%-80%	30%	Output value corresponding to 50% throttle
Throttle Max	60%-100 %	100%	Output value corresponding to 100% throttle
Neutral Dead-band	0%-10%	10%	Throttle dead zone, this area keeps the minimum output speed unchanged
Mode1 Max Speed	0%-100%	92%	Maximum speed in Mode 1
Mode1 Rev Max Speed	0%-100%	92%	Reverse maximum speed in Mode 1
Mode2 Max Speed	0%-100%	30%	Maximum speed in Mode 2
Mode2 Rev Max Speed	0%-100%	30%	Reverse maximum speed in Mode 2



4.4 IBD parameters

Parameter Name	Range	Default	Explanation
Full Voltage	24.0V-28.0V	25.1V	The upper voltage limit used by the battery percentage output
Empty Voltage	17.0V-24.0V	22.0V	The lower voltage limit used by the battery percentage

	0V		output
Discharge Factor	0.1-10.0	1.0	The set battery discharge rate, the larger the value, the faster the BDI output decline rate
Reset Voltage	24.0V-28.0V	25.4V	When the battery voltage is higher than the set value, the BDI output is reset to 100%
Start Charge Voltage	24.0V-28.0V	25.2V	When the charger is connected, charging starts when the voltage is higher than this value, BDI will increase according to the charging rate
Full Charge Voltage	24.0V-32.0V	28.2V	When the charger is connected, the charging is considered complete when the voltage is higher than this value, BDI output reset to 100%
Charge Factor	0.1-10.0	2.0	The set battery charging rate, the larger the value, the faster the BDI output increases during charging
Low BDI Level	0%-100%	10%	Low battery speed limit threshold, when the BDI output is less than the set value, it enters the low battery speed limit mode, and the speed limit value is Low BDI Max Speed
Low BDI Max Speed	10%-100%	15%	The maximum speed of the low battery speed limit, after entering the low battery mode, the maximum speed is limited to the set value.

4.5 Other parameters

Parameter Name	Range	Default	Explanation
EMBrake Fault Check	0-1	1	Do not check the electromagnetic brake fault Check electromagnetic brake failure
EMBrake Delay	0.1s-1s	0.8s	Delay time between zero speed command and electromagnetic brake braking
InterLock Fault Check	0-1	1	Do not check the interlock switch for faults Check for interlock switch failure
Lift Control Enable	0-1	0	Disable lift control function Enable lift control function (J1-9 as input, J1-3 as output)
Sleep Time	0-60Min	30	If the throttle is not moved for a long time, it will enter the sleep mode. When this parameter is equal to zero, it will not enter the sleep mode.
Motor Resistance	50mR-500mR	80mR	The set value of the motor internal resistance is the winding resistance value of the motor at room temperature.
Motor Res Auto Comp	0-1	1	0: Automatic measurement of motor internal resistance is disabled 1: Automatic measurement of motor internal resistance is turned on

			When the automatic measurement of motor internal resistance is turned on, the internal resistance of the motor will be automatically measured once every time the electromagnetic brake is released.
Set Default Par	0-1	0	1: Initialization parameters 0: no action

Note: 1) All parameters are effective immediately, no need to power off and restart.

2) All parameters are stored in the EEPROM after being modified by the handheld, and saved when power off.

Chapter 5 Servo Alarm

5.1 Alarm content

After the alarm is detected, there will be a flashing LED light in the vehicle system, and the fault of the brushed motor controller is displayed as follows:

error code (Handheld view)	LED blinks	fault name
5	(1,1) ■ ■	Over Current, Current overcurrent alarm
9	(1,2) ■ ■ ■	Over Temp, Drive temperature is too high
10	(1,4) ■ ■ ■ ■	Under Voltage, The driver supply voltage is too low
6	(1,5) ■ ■ ■ ■ ■	Over Voltage, Drive overvoltage
117	(2,2) ■ ■ ■	EMR, The emergency reverse button was pressed before power up
111	(2,3) ■ ■ ■ ■	MAIN_SHORT, Main relay short circuit
110	(2,4) ■ ■ ■ ■ ■	MAIN_DRI, Main relay drive circuit failure
116	(3,1) ■ ■ ■ ■	INTERLOCK, Interlock button was pressed before power up
100,101	(3,2) ■ ■ ■ ■	BRAKE, Electromagnetic brake is abnormal
+105	(3,3) ■ ■ ■ ■ ■	PRECHARGE, Precharge circuit failure
115	(3,5) ■ ■ ■ ■ ■ ■	HPD, The throttle is not in zero position before power-on or the throttle voltage exceeds the safe range
11	(4,1) ■ ■ ■ ■ ■	Current Sensor, Current sampling fault
65	(4,2) ■ ■ ■ ■ ■ ■	MOS, Damaged power device
4,13	(4,3) ■ ■ ■ ■ ■ ■	EEPROM,EEPROM storage failure
60	(4,4) ■ ■ ■ ■ ■ ■ ■	Motor Open, Motor wiring is open
69	(4,5) ■ ■ ■ ■ ■ ■ ■ ■	TEMP Sensor, temperature sensor failure
12	(5,1) ■ ■ ■ ■ ■ ■ ■	EMCY STOP, Detecting that the emergency stop button has been pressed
130	(5,2) ■ ■ ■ ■ ■ ■ ■ ■	SRO, The lift button was pressed before power up

*LED is always on: the LED indicator is always on when the power is on and there is no fault

*LED is always off: the controller is not powered on

Note: HPD, INTERLOCK, EMR faults can be reset (the HPD fault caused by the throttle voltage exceeding the safe range cannot be reset). The corresponding operations are: restore the throttle to zero state, put the interlock switch in the invalid position, and let the emergency reverse button is in an invalid location. All other fault recovery requires power off and restart.

5.2 Alarm interpretation and alarm handling methods

error code (Handheld view)	LED blinks	fault name
4/13	EEPROM	Memory failure Replace the drive
5	Over Current	The driver detects excessive current Check whether the motor phase line is short-circuited, restart after power failure
6	Over Voltage	The drive has detected excessive voltage Check whether the power supply voltage is normal, restart after power failure
9	Over Temp	Drive temperature exceeds 95 degrees Celsius The drive works continuously under high load, or the ambient temperature is too high, power off and restart
10	Under Voltage	Supply voltage below 17V Power supply battery undervoltage, restart after power failure
11	Current Sensor	Abnormal current sampling circuit Drive hardware failure, replace drive
12	EMCY STOP	It is detected that the emergency stop button is pressed during operation The emergency stop button is pressed and the drive is

		disconnected from the battery.
60	Motor Open	Motor is not connected Check whether the motor wiring is firm, restart after power off
65	MOS	MOS device damage The MOSFET is burned out or the drive circuit is faulty, replace the driver
69	TEMP Sensor	Temperature sensor disconnected or shorted Replace the drive
100	BRAKEON	Abnormal opening of electromagnetic brake Electromagnetic brake drive circuit failure, replace the drive
101	BRAKEOFF_ DIS	Electromagnetic brake closes abnormally The wiring of the electromagnetic brake is not reliable, or the drive circuit is faulty, power off and restart
105	PRECHARGE	Precharge circuit failure Replace the drive
110	MAIN DRI	Main relay drive circuit failure Replace the drive
111	MAIN SHORT	Main relay short circuit Replace the drive
115	HPD	HPD failure Before power on, the throttle is in the valid position, release the throttle and power on again
116	INTERLOCK	Interlock signal failure The interlock switch is in the valid position before power-on, and the reset lever is powered on again
117	EMR	EMR failure The emergency reverse button is in a valid position before

		power-on, release the emergency reverse button and power on again
130	SRO	SRO failure The lifting button is in the valid position before power-on, and walking will not be affected after the fault is reported, but the lifting function is prohibited. Power on again after releasing the lift button.

Note: HPD, INTERLOCK, EMR faults can be reset, and the corresponding operations are: restore the throttle to zero state, make the interlock switch in the invalid position, and make the emergency reverse button in the invalid position. All other fault recovery requires power off and restart.

