

BL02A Operation Manual for

Brushless Controller of Power Wheelchair

I. Introduction

The controller adjusts the forward, backward and turning of the wheelchair by independently controlling the positive and reverse rotation, and speed of 2 brushless motors.

Major functions of controller:

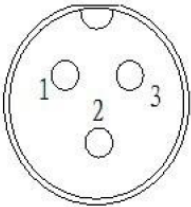
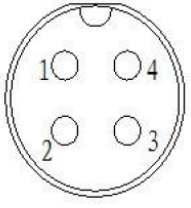
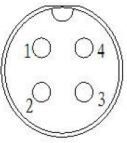
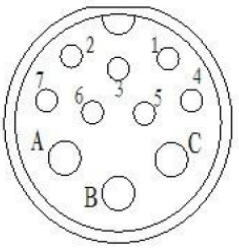
- Control of motor direction and speed;
- Control of alarm buzzer;
- Control of motor safety brake;
- Indication of battery level and charging;
- Failure detection and alarming.
- USB charging port
- Linear Actuator drive control (Optional)

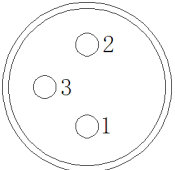
The controller has a built-in micro-controller which controls working logics by programming. the wheelchair is always under control on different roads.

The controller includes two modules: Joystick and Motor driver controller.



II. Controller Wiring

Description of Controller Connector			
Graphic representation	Description	Pins	Functions
	Battery Connector (without Linear Actuator)	1	Battery+
		2	Battery-
		3	Reserved pin
	Battery Connector (with Linear Actuator)	1	Battery+
		2	Battery-
		3	Linear actuator drive1
		4	Linear actuator drive2
	Header, connected to Joystick	1	Sign receiving
		2	Sign sending
		3	Power out
		4	GND
	Motor connector, the same for the left and right motors, connected to the brushless motors	1	safety brake return
		2	safety brake drive
		3	Hall power
		4	Hall phase A
		5	Hall phase B
		6	Hall phase B
		7	Hall ground
		8	Motor phase A
		9	Motor phase B
		10	Motor phase C

Description of Operation Controller Port			
Graphic representation	Description	Pins	Functions
	Charger Connector	1	Positive
		2	Negative
		3	Charging indication control pin, charger terminal to GND

III. Description of Joystick Operation



Port name	Function description
Charging port	Connects with battery charger
USB Charging port	Output 5V,charges the portable devices like phone
Joystick	Controls the wheelchair's forwarding, back warding and turning

Power display	Indicates the power level the green LEDs. The more LEDs are on, the higher the power level is.
Power on/off	Controls the wheelchair's turning on/off
Accelerate	Increases the speed of wheelchair
Speed display	Indicates the wheelchair's current speed
Decelerate	Decreases the speed of wheelchair
Horn	Sounds the horn

IV. Basic Functions of Controller

4.1 Turn-on/Turn-off

Press the power switch, the controller will be turned on for self-checking: the power level indicators and speed indicators will light up for 2 seconds and then go out. At the non-charging mode, if the self-checking is passed, the buzzer makes a short beep and then the controller goes into the normal operation mode. If the self-checking fails, the buzzer makes a long beep for 5 seconds and then the controller goes into the error mode. For the specific error types, please refer to 5 Troubleshooting of Controller. At the charging mode, the power level indicators will light up one by one, indicating that the controller is being charged.

At the ON state, press the power switch, and then all the indicators will go out and the system will be turned off.

4.2 Basic Operation for Driving

By pushing forward the joystick, the wheelchair moves forward; at this time the controller release the safety brake and drive the motor to make the wheelchair move forward. The farther the joystick is pushed, the faster the wheelchair moves. Similarly by pulling back the joystick, the wheelchair moves backward; and by pushing it left or right, the wheelchair turns.

When the joystick is released, the driver applies a braking force to the motor and release the safety brake after the wheelchair stops, so that the motor is locked and the wheelchair does not roll.

In the following 3 cases, the control handle is unable to control wheelchair movement.

1 The wheelchair is being charged; 2 the battery level is low; 3 there's a failure

4.3 Speed Adjustment

The max. speed of the wheelchair can be controlled through the speed-up button and slow-down button. The speed indicators indicate the max. current speed. Speed can be controlled among 5 levels. By pressing the speed-up button, the speed goes up by a level; when the speed is at the 5th level, it will not go up any more; by pressing the slow-down button, the speed goes down by a level; when the speed is at the 1st level, it will not go down any more. During speed adjustment, the buzzer makes a short beep for indication.

4.4 Battery Level Indication

The battery level indicators indicate battery level. The more indicators are on, the higher the batter level is. When the battery almost runs out, only one indicator is on. If the battery level goes on dropping, this indicator will flash, and the buzzer will make intermittent alarms to indicate that the battery needs to be charged. When the battery level is lower than the min. level for normal operation, the final indicator flashes

quickly and the buzzer makes an alarm, meaning that the wheelchair is not allowed to move any more.

4.5 Battery Charging

The battery can be charged through a special charger. To charge the battery, the charger shall be connected to the charging port and to mains supply at the other end. For the charging state, please see the indicators on the charger. At the charging state, the controller can be turned on or off, and when it is on, it indicates the charging state. At the charging state, the control handle is ineffective and the wheelchair cannot move.

4.6 Buzzer Alarm

Press the horn button and the buzzer beeps for indication. Release the horn button and the buzzer stops beeping immediately. Press and hold the horn button, and the buzzer beeps for 10 seconds and then stops.

When the wheelchair is reversing, a buzzer sounds to alert the user.

4.7 Lock function

When the speed plus button and the speed minus button are simultaneously pressed in the power-on state, the wheelchair is switched between the locked mode and the normal mode; and the mode of the wheelchair does not change after the power is turned off or outage. In the lock mode, the speed indicator does not light at all, and the handle cannot control the wheelchair. The change function is used to prevent the wheelchair from being mishandled by others.

4.8 USB Charging port

USB charging port can supply 5V power, charging mobile phone, IPAD and other portable devices. The maximum charging current can be 2.1A and the accurate charging current is determined by the access devices. The protocol chip into the charging port can achieve the maximum charging current with portable device. Regardless of the power on or off, the external portable devices can be charged. Through the data line or charging cable, connect the device and charging port.

4.9 Linear Actuator drive (Elevating seat function)

The controller can control the linear actuator, and the function can be used for wheelchair Elevating seat and etc. Long press the "+" button for 2S and the linear actuator starts to working. Press and hold the "-" button for 2S, the linear actuator starts to contracting. After the button is released, the linear actuator stops immediately. The function can only be used when the wheelchair is in a stopped state. The

wheelchair motors or wheelchair Hall fault do not affect the function of the linear actuator.

4.10 Power on self-test function

After the controller is powered on, conduct self-test first. If the self-test fails, an error will be reported, and the wheelchair cannot move. The self-test items include upper and lower control communication function, motor Hall state, safety break state, whether the joystick is faulty and whether it is at zero. See the Troubleshooting of Controller section for specific fault types.

4.11 Braking function

The controller is matched with the motor and has the functions of electronic braking and safety brake. In downhill or other similar situations, the controller generates the electronic braking function through the motor to limit the speed of the wheelchair. During parking, the electronic braking function also enables the wheelchair to stop quickly. In the parking state, the safety brake release locks the motor to realize the parking function. When the wheelchair wants to travel, the safety brake is engaged and released, and the wheelchair can move.

4.12 Energy recovery

When the electronic brake works, the motor works in the power generation mode and charges the battery through internal rectification of the controller to realize energy recovery.

V. Troubleshooting of Controller

The controller is provided with the failure detection function and detects failure at any state. When it detects a failure, it goes into the failure mode after the buzzer makes a long beep for 5 seconds. At the failure mode, all the battery level LEDs flash, and the speed LEDs indicate the failure type. At the failure mode, there's no response to the operations of the control handle and buttons, and only the power switch is effective.

See the following table for the relationship between failure types and indicators:

Speed Indicators	Failure Type	Failure Cause	Troubleshooting Method
10010 	Failure of safety brake of left motor	Brake switch of safety brake of left motor not closed	Close the brake switch of safety brake of left motor
		Error of safety brake wiring of left motor	Check that the motor connector is reliably connected
		Failure of safety brake or Motor driver controller failure	Contact the manufacturer for repair
10001 	Failure of safety brake of right motor	Brake switch of safety brake of right motor not closed	Close the brake switch of safety brake of right motor
		Error of safety brake wiring of right motor	Check that the motor connector is reliably connected
		Failure of safety brake or Motor driver controller failure	Contact the manufacturer for repair
10100 	Hall failure of left motor	Motor wiring error	Check that the motor connector is reliably connected
		Hall of motor or Motor driver controller failure	Contact the manufacturer for repair
10011 	Hall failure of right motor	Motor wiring error	Check that the motor connector is reliably connected
		Hall of motor or Motor driver controller failure	Contact the manufacturer for repair
00011 	Over-current of left motor	Over-current resulted from excessive wheelchair resistance	The system recovers itself after the handle is release

		Motor or Motor driver controller failure	Contact the manufacturer for repair
00001 	Over-current of right motor	Over-current resulted from excessive wheelchair resistance	The system recovers itself after the handle is release
		Motor or Motor driver controller failure	Contact the manufacturer for repair
00101 	Failure of handle zero point	Handle not at zero point during power-on self check	Turn off and on again
		Failure of Joystick	Contact the manufacturer for repair
00110 	Handle failure	Failure of Joystick	Contact the manufacturer for repair
00010 	Communication failure	Controller wiring error	Check that wiring is correct and reliable
01110 	Communication failure	Controller wiring error	Check that wiring is correct and reliable
11001 	Right motor pre-drive fault	Controller internal fault	Contact the manufacturer for repair
11011 	Left motor pre-drive fault	Controller internal fault	Contact the manufacturer for repair
10101 	Linear actuator short	Linear actuator short circuit or controller internal drive failure	Check the connector of linear actuator Contact the manufacturer for repair
11111 	Linear actuator not in initial position (only with linear actuator)	Linear actuator not in initial position, the Elevating seat in up	Long press “-” to control the linear actuator to initial position
		Wheelchair without linear actuator, mis-enable the linear actuator alarm function	Disable alarm function through configuration

11100 	Over battery voltage	Downhill energy recovery battery overcharging leads to high voltage, not a fault	Switch on/off recovery, Do not charge the battery full when going downhill for a long time
		Wrong battery or incorrect battery connection	Using the correct battery
		Fault in the detection circuit of motor control module	Contact the manufacturer for repair

VI. Controller Parameter Configuration

In order to meet the needs of different users on individualized setting of control parameters, the controller can be subject to individualized configuration of partial parameters through the buttons.

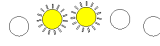
At the OFF state, press the speed-up button and slow-down button at the same time, then press the power switch to turn it on, and the controller will go into the parameter configuration mode.

At the parameter configuration mode, the speed LEDs indicate the types of parameters to be configured, and the battery level LEDs indicate the value of the current parameter. Each parameter has 8 different values. The horn button is used to switch the parameter type. By pressing the horn button once, the parameter is switched to the next one. The speed-up button and slow-down button are used to change parameter values. By pressing the speed-up button, the parameter value is 1 higher; by pressing the slow-down button, it is 1 lower. Each parameter has a range from 1 to 8, among which 5 is the default value. The number of the battery level LEDs which are lighting up represents the value of the current parameter.

The parameter value shall be stored immediately after it is changed. The changed value will take effect when the controller is turned on the next time.

Parameter Table

Parameter Number	Speed LEDs (for indicating parameter type)	Parameter Name	Parameter Default Value	Parameter Description
0		Max. forwarding speed	5	The max. forwarding speed of the wheelchair. The higher the value is, the higher the speed is.
1		Max. reversing speed	5	The max. reversing speed of the wheelchair. The higher the value is, the higher the speed is.
2		Turning speed	5	The max. turning speed of the wheelchair. The higher the value is, the larger the turn is.
3		Acceleration speed 1	5	Max. acceleration speed at a high speed above 5km/h. The higher the value is, the higher the acceleration speed is.
4		Acceleration speed 2	5	Max. acceleration speed at a medium speed between

				2-5km/h. The higher the value is, the higher the acceleration speed is.
5		Acceleration speed 3	5	Max. acceleration speed at a low speed below 2km/h. The higher the value is, the higher the acceleration speed is.
6		Deceleration speed 1	5	Max. deceleration speed at a high speed above 5km/h. The higher the value is, the higher the deceleration speed is.
7		Deceleration speed 2	5	Max. deceleration speed at a medium speed between 2-5km/h. The higher the value is, the higher the deceleration speed is.
8		Deceleration speed 3	5	Max. deceleration speed at a low speed below 2km/h. The higher the value is, the higher the deceleration speed is.
9		Turning speed at low speed	5	Turning speed when the wheelchair travels at a low speed. The higher the value is, the faster it turns.
10		down slope speed limit	5	Speed limit corresponding to motor adjustment 5: 8 pole pairs to motor 6: 4 pole pairs to motor others have no speed limit
11		Turning acceleration speed	5	Max. acceleration speed when the wheelchair turns. The higher the value is, the more sensitively it turns.
12		Turn-back acceleration speed	5	Max. turn-back acceleration speed. The higher the value is, the more sensitively it turns back.
13		Alarm setting for safety brake failure	5	1-5 an alarm is made in case of safety brake failure 6-8 no alarm is made in case of safety brake failure
14		Direction of left motor	5	1-5 normal 6-8 reverse

15		Direction of right motor	5	1-5 normal 6-8 reverse
16		Adjustment the speed of left motor	5	Fine tune of left motor speed. The higher the value is, the higher the left motor speed is.
17		Adjustment the speed of right motor	5	Fine tune of right motor speed. The higher the value is, the higher the right motor speed is.
18		Safety brake enable delay time	5	Control of safety brake delay time. The higher the value is, the more it delays.
19		Linear actuator not in initial position alarm	5	1-5 function disable 6-8 function enable
20		Reversing warning volume	1	Reversing warning volume, 1 is mute, 8 is max
21		Horn volum	8	Horn volum, 1 is mute, 8 is max
22		Key warning volume	5	Key, warning, trouble shooting volume, 1 is mute, 8 is max
23		Locking function config	5	1-5 function enable 6-8 function disable
24		Battery Type	1	Select the type of battery to ensure the correct display of power level. 1, lithium manganate battery 2, ternary lithium battery

At the configuration mode, by pressing and holding both the speed-up button and slow-down button for at least 10 seconds, the buzzer makes a long beep, indicating that all the configuration data is restored to the default values.

VII.Specification of Controller

Name of parameter	parameter values	Remark
Operating voltage range	23~30.5V	24V battery powered, the wheelchair can not move if the voltage exceed the range
Shutdown current	Less than 1 mA	At shut-down state, USB devices not in charging
Standby current	Less than 70 mA	At power-on state, USB devices not in charging
Motor drive current	20A	each motor
Safety brake driver	Max 1A	The actual current is determined

current		by the safety brake
USB charger current	Max 2.1A	The actual current is determined by the charge device
USB charger voltage	4.8~5.2V	Divider 2 DCP, BC1.2 DCP YD/T 1591-2009
Linear actuator output current	5A(voltage is same as battery)	Only for version with linear actuator
Operating temperature range	-25~50℃	
Storage temperature range	-30~70℃	
Operating humidity range	20%~80%	
Operating pressure range	860~1060 kPa	
Waterproofing grade	IPX4	
Motor PWM Drive Frequency	20kHz	
Maximum charging current	6A	
EMC	ISO 7176-21:2009 EN 60601-1-2:2015 IEC 60601-1-2:2014	Test with A08 motor, met the experimental requirements.

VIII.Modification record

Modification date	version	Content
February 2017	V1.0	Increase USB charging function
June 2017	V1.1	Increase the reversing warning configuration
December 2018	V1.2	Increase the function of pole Increase the fault displaying
April 2019	V1.3	P8 Increase the volume adjuster
August 2021	V2.0	Correct the name of safety break and linear actuator VII.Specification of Controller update add 4.10~4.12 add Linear actuator not in initial position alarm and config add locking function config Factory address change Other minor changes
September 2021	V2.01	Config parameter 21(Horn volume) picture corrected
October 2022	V2.1	Section 6, add Config parameter 10 and 24
August 2023	V2.2	Add Over Voltage detect