Operation Manual for Brushless Controller of Power Wheelchair

1. Introduction

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

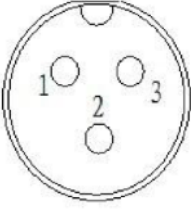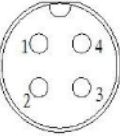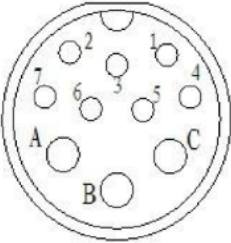Major functions of controller:

- Control of motor direction and speed
- Control of alarm buzzer
- Control of motor solenoid valve
- Indication of battery level and charging
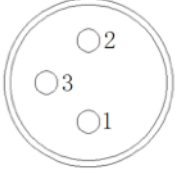- Failure detection and alarming

The controller has a built-in micro-controller which controls working logics by programming. Also, the closed-loop control technology is used to control motor speed, such that the wheelchair is always under control on different roads.

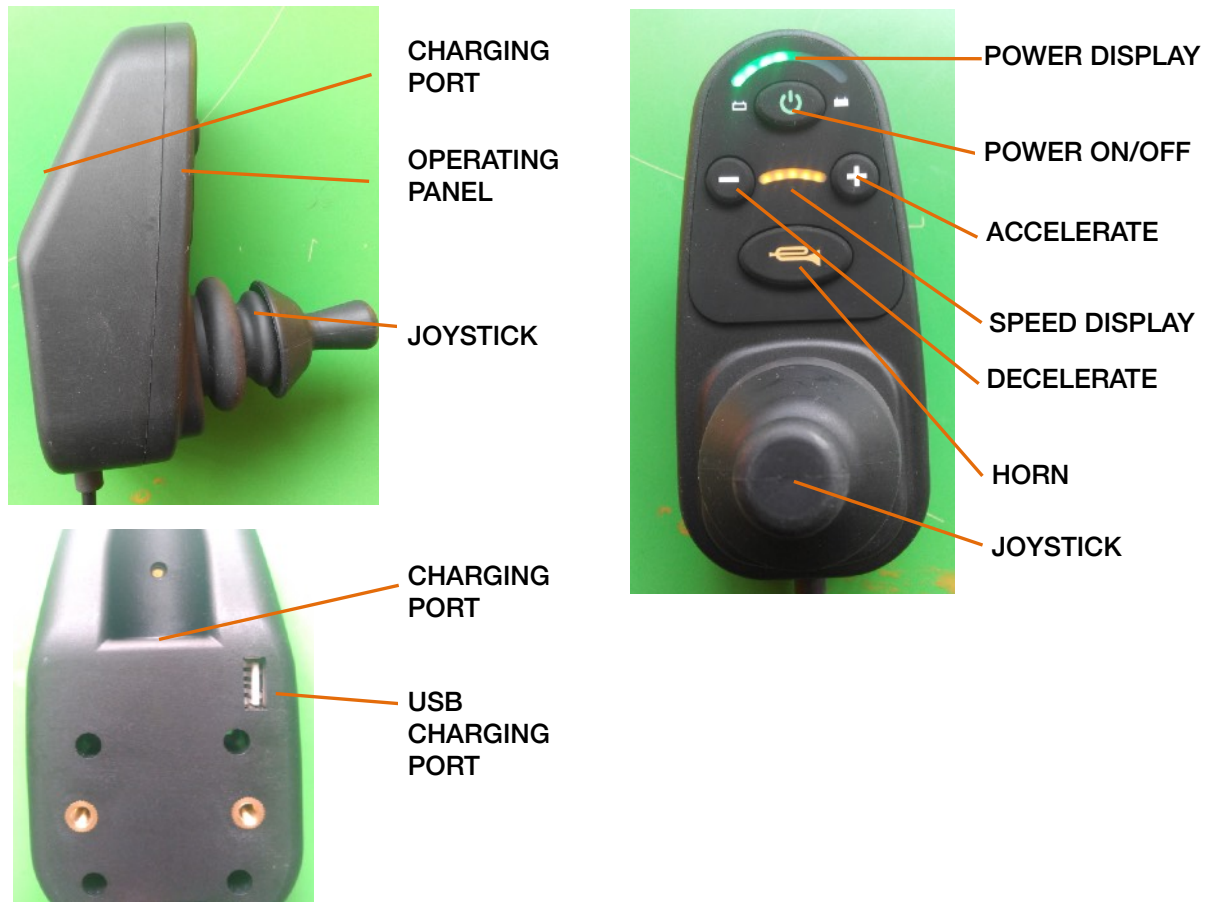The controller includes two modules: joystick and central processing unit.

JOYSTICK   CENTRAL PROCESSING UNIT

2. Controller Wiring

Description of Controller Port			
Graphic representation	**Description**	**Pins**	**Functions**
	Battery Connector	1	Positive pole
		2	Negative pole
		3	Reserved pin
	Header, connected to CPU	1	Signal receiving
		2	Signal sending
		3	Power
		4	Earth wire
	Motor connector, the same for the left and right motors, connected to the brushless motors	1	Electromagnetic valve area
		2	Electromagnetic valve power
		3	Hall power
		4	Hall phase A
		5	Hall phase B
		6	Hall phase B
		7	Hall area
		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	The control pin of charging indication, charger connecting area

3. Description of Joystick Operation

CHARGING PORT

OPERATING PANEL

JOYSTICK

CHARGING PORT

USB CHARGING PORT

POWER DISPLAY

POWER ON/OFF

ACCELERATE

SPEED DISPLAY

DECELERATE

HORN

JOYSTICK

Port name	Function description
Charging port	Connects to battery charger
USB Charging port	Output 5V, charges portable devices like phones
Joystick	Controls the wheelchair's direction of travel
Power display	Indicates the power level of the battery with green LEDs. The more LEDs are on, the higher the battery level.
Power on/off	Controls the wheelchair's power on/off
Accelerate	Increases the speed of wheelchair
Speed display	Indicates the wheelchair's current maximum speed setting
Decelerate	Decreases the speed of wheelchair
Horn	Sounds the horn

4. 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 opens the solenoid valve, releasing the brake and driving the motor to make the wheelchair move forward. The further 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 controls the solenoid valve to be released after the wheelchair stops, so that the motor is locked and the wheelchair does not roll.

In the following three cases, the joystick is unable to control wheelchair movement

• The wheelchair is being charge
• The power of battery is low
• There is a failure

4.3 Speed Adjustment

The max. speed of the wheelchair can be controlled through the Accelerate button and Decelerate button. The speed LED lights indicate the max. current speed. Speed can be controlled through 5 levels. By pressing the Accelerate 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 Decelerate 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. When the speed is at the extreme levels, i.e., the 1st or 5th level, the indicating sound is different from that at other levels.

4.4 Battery Level Display

The battery level lights indicate the battery level. The more lights are on, the higher the batter level is. When the battery almost runs out, only one lights is on. If the battery level goes on dropping, this lights 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 the supplied battery charger. Insert the charger cable into the charging port under the joystick and connect the charger to the outlet of the mains power supply. To check 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, the indicators are on. At the charging state, the joystick is ineffective and the wheelchair cannot move.

4.6 Buzzer Alarm

Pressing the horn button, the buzzer beeps for the driver to make their presence known. Release the horn button and the buzzer stops beeping immediately. Press and hold the horn button, the buzzer beeps for 10 seconds and then stops.

4.7 Locking Mode

At the power-on state, press the speed-up button (+) and the speed-down button (-) at the same time. The wheelchair can be changed between the lock mode and normal mode. In the lock mode, speed indicator light is not illuminated and the joystick cannot control the wheelchair. This mode will not change even when the wheelchair is turned off.

4.8 USB Charging port

USB charging port can supply 5V power charging for mobile phone, tablets and other portable devices.The maximum charging current is 2.1A and the accurate charging current is determined by the connected device.The protocol chip in the charging port can achieve the maximum charging current with the connected device. Regardless of the power on or off, the external portable devices can be charged.

5. Troubleshooting of Controller

The controller with the failure self-inspection function 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 LED lights flash, and the speed of the LED lights indicate the failure type. At the failure mode, there's no response to the operations of the joystick and buttons, but only the switch is effective.

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

Speed Indicators	Failure Type	Failure Cause	Troubleshooting Method
10010	Fault of Electromagnetic valve brake of left motor	Brake switch of Electromagnetic valve of left motor is not closed	Close the brake switch of Electromagnetic valve of left motor
		Error of Electromagnetic valve wiring of left motor	Check that the motor connector is reliably connected
		Fault of Electromagnetic valve brake or controller of left motor	Contact the manufacturer for repair
10001	Fault of Electromagnetic valve brake of right motor	Brake switch of Electromagnetic valve of right motor not closed	Close the brake switch of Electromagnetic valve of right motor
		Error of solenoid valve wiring of right motor	Check that the motor connector is reliably connected
		Failure of brake solenoid valve or controller of right motor	Contact the manufacturer for repair
10100	Hall fault of left motor	Motor wiring error	Check that the motor connector is reliably connected
		Hall or controller failure of motor	Contact the manufacturer for repair
10011	Hall fault of right motor	Motor wiring error	Check that the motor connector is reliably connected
		Hall fault of motor or controller fault	Contact the manufacturer for repair
00011	Over-current of left motor	Over-current resulted from excessive resistance to wheelchair	The system recovers itself after the joystick is release
		Motor or controller failure	Contact the manufacturer for repair
00001	Over-current of right motor	Over-current resulted from excessive resistance to wheelchair	The system recovers itself after the joystick is release
		Motor or controller fault	Contact the manufacturer for repair
00101	Fault of Joystick's null point	Joystick is not at null point during power-on self checking	Turn off/ on again
		Failure of joystick or CPU	Contact the manufacturer for repair

00110 ○✹✹○○	Joystick fault	Failure of joystick or CPU	Contact the manufacturer for repair
00010 ○✹○○○	Communication failure	Controller wiring error	Check whether that wiring is correct and reliable

6. Controller Parameter Configuration

In order to meet the needs of different users on individualized setting of control parameters, certain parameters can be configured using the joystick 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 representing the value of the current parameter.

The parameter value shall be stored immediately after it is changed. The changed value will take effective 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. forward 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	○☀○☀○	Preset parameter	5	Preset parameter of the wheelchair. The default value is 5, which is suitable for normal wheelchair control. The other values are reserved.
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 electromagnetic valve failure	5	1-5 an alarm is made in case of solenoid valve failure 6-8 no alarm is made in case of solenoid valve failure
14	○☀☀☀○	Turning of left motor	5	1-5 normal 6-8 reverse
15	☀☀☀☀○	Turning of right motor	5	1-5 normal 6-8 reverse
16	○○○○☀	Adjustment of direction and 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 of direction and speed of right motor	5	Fine tune of right motor speed. The higher the value is, the higher the right motor speed is.
18	○☀○○☀	Electromagnetic valve's delay	5	Adjust the delay time of Electromagnetic valve . The higher the value is, the more it delays.
19	☀☀○○☀	Adjustment of motor level	5	Adjustment of motor level. 1-5 4-level magnetic steel motor 6-8 8-level magnetic steel motor
20	○○☀○☀	Set reversing warning	5	1-5 There is warning when reversing; 6-8 No warning when reversing

Operation Manual for Brushless Motor Controller of Power Wheelchair   V2.3

21		Reversed	5	Reversed
22		Reversed	5	Reversed
23		Reversed	5	Reversed
24		Reversed	5	Reversed

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.

7. Specification of Controller

Name of Parameter	Parameter Values	Remark
Operating voltage range	23~30V	24V battery powered
Shutdown current	Less than 1 mA	At shut-down state, USB device is not charged
Standby current	Less than 70 mA	At power-on state, USB device is not charged
Motor drive current	20A	Each motor
Electromagnetic valve	Maximum 1A	The actual current is determined by electromagnetic valve
USB output current	Maximum 2.1A	The actual current is determined by charging device
USB out voltage	4.8~5.2V	

8. Modification record

Modification date	Version	Content
February 2017	V1.0	Introduced USB charging function
June 2017	V1.1	Introduced the reversing warning configuration

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