Operation Manual for

Brushless Controller of Freedom Powerchair

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.
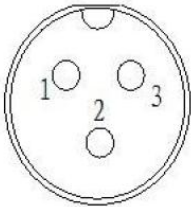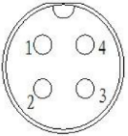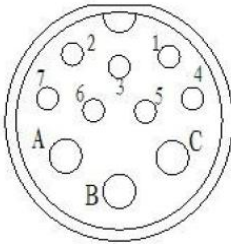
Major functions of controller:

➢ Control of motor direction and speed;

➢ Control of alarm buzzer;

➢ Control of motor solenoid valve;

➢ Indication of battery level and charging;

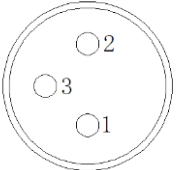➢ Failure detection and alarming.

➢ USB charging port

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

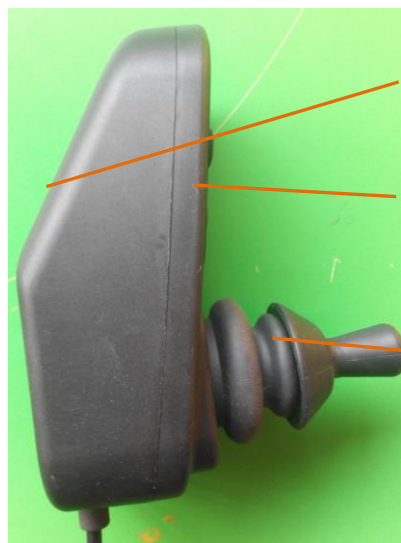The controller includes two modules: joystick and central processing unit.

II. 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	Sign receiving
		2	Sign sending
		3	Power
		4	Earth wire
	Motor connector, the same for the left and right motors, connected to the brushless motors	1	Solenoid valve ground
		2	Solenoid valve power
		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 earthed

III. Description of Joystick Operation

Charging port

Operating panel

Joystick
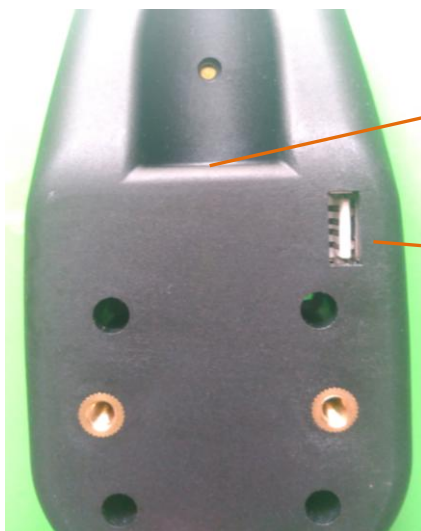
Power display

Power on/off

Accelerate

Speed display

Decelerate

Horn

Joystick

Charging port

USB Charging port

Port name	Function description
Charging port	Connects with 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
USB Charging port	Charging outlet

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 makes the solenoid valve be engaged to release the 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 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 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. 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 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.

4.8USB 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 Elevating seat function

The controller can control the actuator's motor, and the function can be used for wheelchair electric lifting and etc. Long press the "+" button for 2S and the actuator motor starts to working. Press and hold the "-" button for 2S,the strut actuator starts to

contracting. After the button is released, the actuator motor stops immediately. The propeller motor 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 actuator motor.

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 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 brake solenoid valve of left motor	Brake switch of solenoid valve of left motor not closed	Close the brake switch of solenoid valve of left motor
		Error of solenoid valve wiring of left motor	Check that the motor connector is reliably connected
		Failure of brake solenoid valve or controller of left motor	Contact the manufacturer for repair
10001	Failure of brake solenoid valve of right motor	Brake switch of solenoid valve of right motor not closed	Close the brake switch of solenoid 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 failure 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 ON ON OFF OFF ON	Hall failure of right motor	Motor wiring error	Check that the motor connector is reliably connected
		Hall or controller failure of motor	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 controller	Contact the

		failure	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 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 handle or controller	Contact the manufacturer for repair
00110 ○☀☀○○	Handle failure	Failure of handle or controller	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 ☀○☀○☀	Strut motor output line short circuit	Strut motor output line short circuit or internal drive failure	Check the connector of strut motor 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.
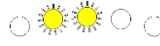
At the OFF state, press the speed-up button and slow-down button at the same time, then press the power switch to turn it on, and the controller will goes into the parameter configuration mode.

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 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. 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

No.	LED Indicator	Parameter	Value	Description
				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 solenoid 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	○☀○○☀	Solenoid valve delay time	5	Control of solenoid valve delay time. The higher the value is, the more it delays.
19	☀☀○○☀	Reversed	5	Reversed
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	☀☀☀○☀	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.

VII.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 deviceis not chargered
Standby current	Less than 70 mA	At power-on state，USB deviceis not chargered
Motor drive current	20A	each motor