

Electric Motorcycle Motor Controller Specifications

MC2K-72H120
MC2K-72H180



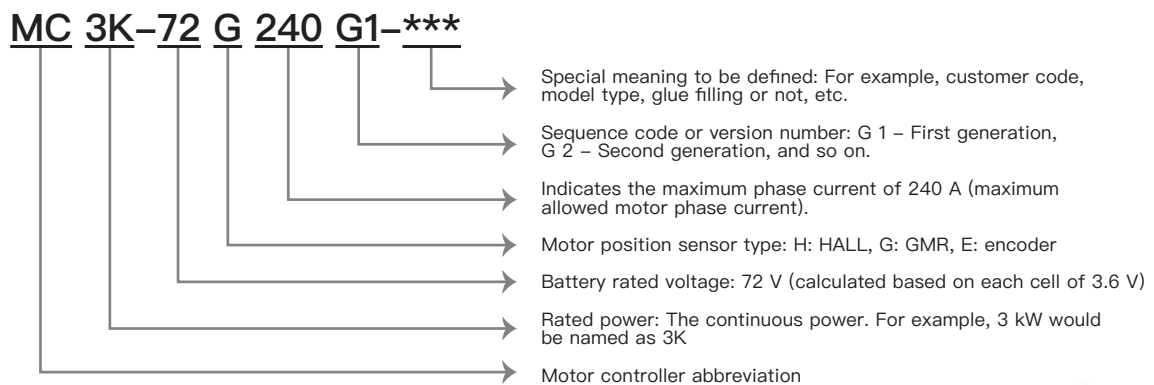
Table of Contents

1 Product Basic Information	1
1.1 Naming Instructions.....	1
1.2 Scope of Application.....	1
1.3 Product Introduction	2
1.4 Product Dimensions	3
1.5 Product Weight.....	3
2 Function Description	4
2.1 Motorcycle Functions	4
2.2 Safety Protection Features	5
3 Electrical Specifications	6
3.1 Controller Technical Specifications	6
3.2 Working Boundary	7
3.3 Electrical Safety.....	9
4 Electrical Connection and Interface Definition	9
4.1 Electrical Structure Block Diagram.....	10
4.2 Signal Harness Definition	10
4.3 Power Harness Definition	14
5 Product Environmental Adaptation Specifications.....	15
5.1 Ambient Temperature Range.....	15
5.2 Product Ambient Adaptation.....	15
6 Product Installation.....	16

6.1 Controller Installation Precautions	16
6.2 Wiring Harness Installation Precautions	16

1 Product Basic Information

1.1 Naming Instructions



Note:

- ① Rated power measurement conditions: ambient temperature $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, natural cooling. For example, 5.5 kW would be named 6K0, and 15 kW would be named 15K0.
- ② Maximum phase current measurement conditions: Ambient temperature $23^{\circ}\text{C} \pm 5^{\circ}\text{C}$, natural cooling. 240 A indicates the maximum phase current capability of 240 A sustained for 1 minute. This value may vary depending on the motor and usage scenario.

1.2 Scope of Application

These Product Specifications provide relevant technical information about the electric motorcycle controller of Shenzhen Hobbywing Technology Co., Ltd. (referred to as “HOBBYWING”), including function safety descriptions, allowed operating conditions, technical boundary conditions, interface technical conditions of other modules, and related installation and usage precautions.

The HOBBYWING electric motorcycle controller will operate only under the conditions specified in these Product Specifications. HOBBYWING is not liable for usage outside the scope of this document. HOBBYWING is responsible for failures caused by design, production, or transportation issues but is not liable for failures caused by other parts of the entire system. Customers are advised to include precautions in the motorcycle manual where the HOBBYWING controller is installed, and pay attention to the following safety items:

- 1) Ensure that the handle does not send incorrect speed control signals when the motorcycle is operating.
- 2) Ensure that the electric brake signal sent to the controller is reliable.

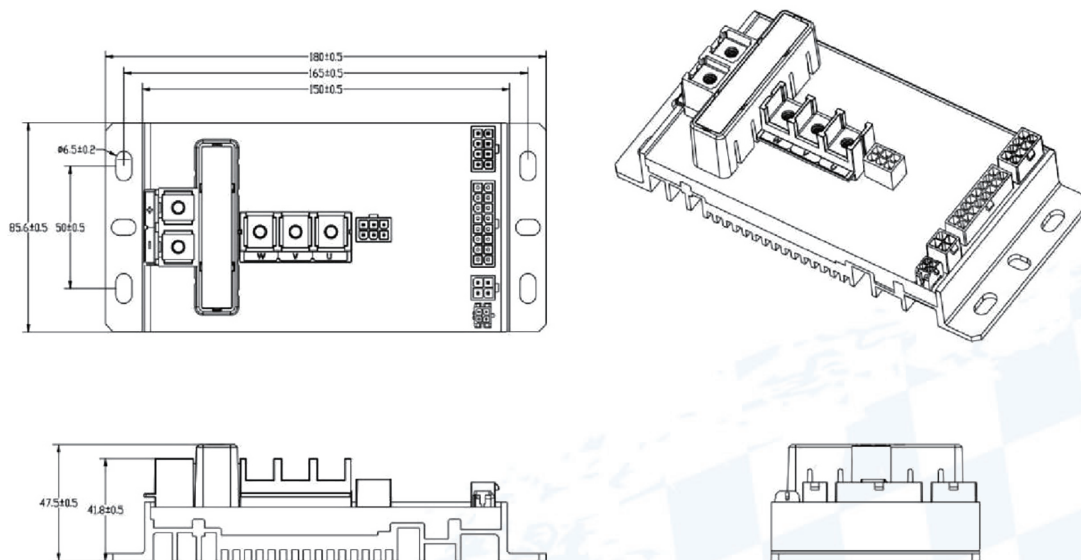
- 3) Ensure that the mechanical brake provides sufficient braking force.
- 4) The controller's surface temperature may rise significantly when the motorcycle is in heavy load conditions. Users should be informed to take protective measures when touching high-temperature controllers or installation areas to avoid burns.
- 5) If the operating voltage exceeds the specified 36V safe voltage, users should be informed not to directly touch the live parts of the controller (connectors) to avoid electric shock..

1.3 Product Introduction

This product features a 32-bit ARM high-speed MCU as the main control chip and a highly reliable automotive-grade software architecture and FOC algorithm, which guarantees seamless propulsion delivery, minimal noise, and exceptional acceleration. The deeply tuned software significantly boosts the overall propulsion efficiency, ensures a long endurance, and supports propulsion adjustment in various personalized driving experiences. Its comprehensive protection functions (such as voltage, current, temperature, short-circuit, and stall protection), power-on self-check features, and IP67-rated protection ensure reliable operation of the propulsion system. Functions such as switch between three operating modes, EABS braking, TCS, limp mode, cruise control, boost acceleration, and auxiliary push mode, greatly enhance the driving experience and safety. Additionally, the product boasts OTA upgrade, black box fault tracking, and motor self-learning features. It supports multiple communication interfaces and encoder types, allowing for good compatibility and quick fault analysis capabilities. Established in 2005, HOBBYWING has been dedicated to the UAV industry for over 20 years, earning a reputation for reliable, aerospace-grade quality control.

1.4 Product Dimensions

Controller Dimensions: (180 × 86 × 47.5 mm)



1.5 Product Weight

Controller Weight: approx. 500 g

2 Function Description

2.1 Motorcycle Functions

The basic functions of the motorcycle are defined as follows (which can be adjusted according to customer needs):

Seq. No.	Motorcycle Functions	Function Description
1	Stepless speed regulation	Adjusts motorcycle speed based on handle input (1.2 V – 3.8 V).
2	Gear (Three-gears)	Detects the gear level to determine whether to switch between high, medium, or low modes.
3	Parking	Detects the P-gear level change to determine whether it is effective. If not, the motorcycle cannot start.
4	Braking	Detects brake level signal changes to determine whether to enable braking (including high- and low-brake modes).
5	Reversing	Enables the reversing mode via a combination key.
6	Pushing	Enables the pushing mode via a combination key.
7	Side stand	Detects the side stand level to determine whether to enable this function. The motorcycle cannot start if the level is ineffective.
8	Cruise control	Starts the cruise mode via a combination key and exits the cruise mode using the throttle or brake.
9	Seat cushion detecting	Detects the seat cushion level to start this function.
10	Anti-theft	Detects the anti-theft lock signal to enable the security mode. When the motorcycle is stationary, directly lock it. When the motorcycle is running, stop and then lock it.
11	One-key repairing	Enables this function via a combination key in case of a handle or brake fault.
12	TCS	Prevents wheel slippage to enhance motorcycle stability and safety.
13	EPB (Electrical Park Brake)	Enables the auxiliary parking mode via a combination key when the motorcycle is stopped on a slope.
14	Self-learning	Allows the controller to adapt to all operating motor parameters.
15	Regenerative Braking	Enables the controller to enter the brake feedback state by releasing the throttle or using the brake.

2.2 Safety Protection Features

Through software, this product detects various faults, including handle faults, brake faults, position sensor faults, over-voltage / under-voltage faults, over-current faults, stall faults, controller overheating faults, motor overheating faults, etc.

Seq. No.	Safety Protection Functions	Function Descriptions
1	Over-voltage protection	If the battery voltage is too high, the controller will cut off the motor output.
2	Under-voltage protection	If the battery voltage drops below the soft under-voltage threshold, current limiting begins to decrease until reaching the minimal value.
3	Under-voltage protection	If the battery voltage is too low, the controller will cut off the motor output.
4	Over-current protection (Motor phase short-circuit)	Prevents the controller from damage due to a motor phase short circuit. Note: This protection only applies to short circuits between any two phases of the motor or between a phase and the positive terminal of the power supply, and does not apply to phase line-to-ground short circuits.
5	Over-temperature protection	The controller has over-temperature protection to prevent damage from excessive heat.
6	Phase loss protection	Supports phase loss detection during the motorcycle's zero-speed state.
7	Stall protection	If the motor is stalled, the controller will cut off the output within 2 seconds.
8	Sensor fault	If one or more motor position signals fail, the controller will cut off the output.
9	Throttle fault	In case of an open circuit or short circuit between any two wires of the handle, the controller will stop driving the motor.
10	Startup lock	If the handle is not at zero position (> 1.2 V) when powered on, the controller cannot drive the motor until the handle is reset to zero and twisted again.

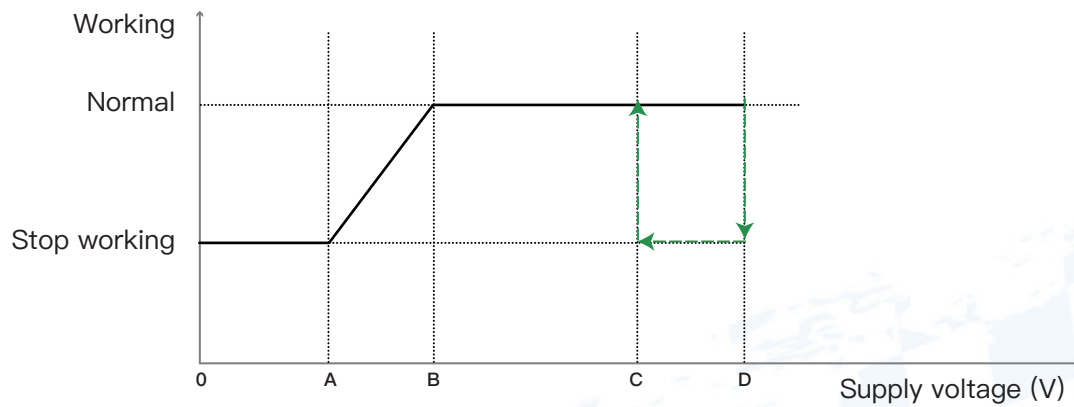
3 Electrical Specifications

3.1 Controller Technical Specifications

Model Specifications	MC2K-72H120	MC2K-72H180
Maximum bus current	40 A	60 A
Maximum phase current (amplitude)	120 A	180 A
Rated bus voltage	48 V, 60 V, 72 V	48 V, 60 V, 72 V
Rated power	1.5 kW	2 kW
Peak power	2.5 kW	4 kW
Full voltage max boundary	See Table 1 Controller Power Supply Boundary Conditions	
Motor sensor	H: HALL G: GMR	
Control method	FOC	
Communication method	CAN/RS485 / UART / One-wire / Bluetooth	
Maximum controller efficiency	98%	
Cooling mode	Natural air cooling	
Operating ambient temperature	-25°C ~ 60°C	
Humidity range	0% ~ 95% RH	
Protection rating	IP 67	

3.2 Working Boundary

Table 1 Controller Power Supply Boundary Conditions (Note: Specifications with * may vary according to the customer's technical specifications.)



Battery voltage	A	B	C	D
48 V	35 V*	40 V*	56 V*	58 V*
60 V	48 V*	53 V*	70 V*	72 V*
72 V	58 V*	62 V*	84 V*	86 V*

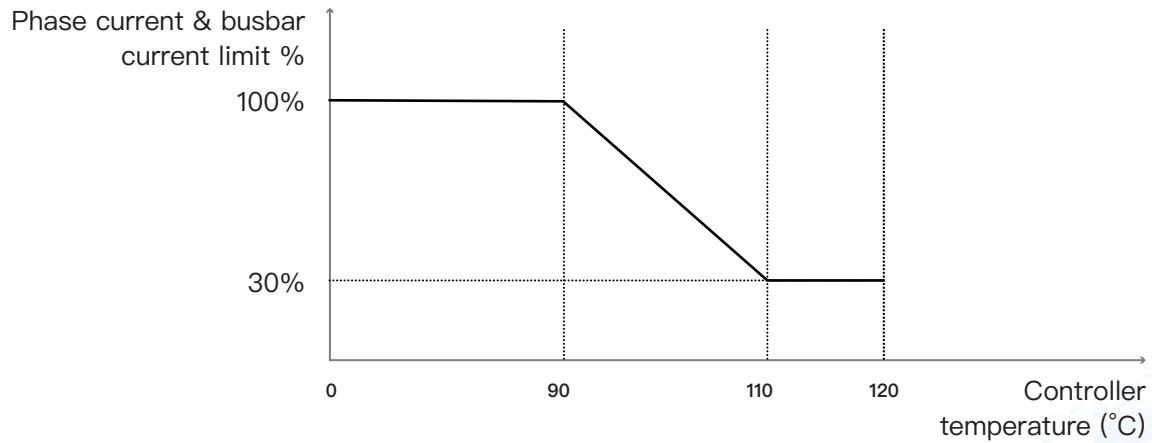
Table 2 Under-voltage / Over-voltage Protection Boundary Conditions (Note: Specifications with * may vary according to the customer's technical specifications.)

Battery voltage	48 V	60 V	72 V
Under-voltage protection voltage	35 V*	48 V*	58 V*
Over-voltage protection voltage	58 V*	72 V*	86 V*

Table 3 Rated Current / Peak Current Boundary Conditions (Note: Specifications in the table may vary according to the customer's technical specifications.)

Specification Series	Performance Specifications	Boundary Description
MC2K-72H120	Rated current	23°C ± 5°C, natural cooling, bus current 25 A , phase current 40 A , continuous running for 30 minutes .
	Peak current	23°C ± 5°C, natural cooling, bus current 40 A , phase current 120 A , continuous running for 1 minute .
MC2K-72H180	Rated current	23°C ± 5°C, natural cooling, bus current 35 A , phase current 60 A , continuous running for 30 minutes .
	Peak current	23°C ± 5°C, natural cooling, bus current 60 A , phase current 180 A , continuous running for 1 minute .

Fig. 1 Busbar Current and Phase Current Temperature Boundary (Note: Specifications in the figure may vary according to the customer's technical specifications.)



3.3 Electrical Safety

Seq. No.	Test Items	Test Conditions / Requirements
1	Insulation resistance test	Connect the positive output terminal to the power input / output, and the negative output terminal to the signal output terminal or ground (enclosure). Apply DC 500 V for 1 minute. The insulation resistance between the propulsion terminal and the signal terminal as well as the shell should be $> 1 \text{ M}\Omega$. The controller functions normally after the test.
2	Insulation strength test	Apply DC 1500 V between the controller's conductors under test and the protective ground circuit for 1 minute. During the test, leakage current should be $\leq 10 \text{ mA}$, and there should be no breakdown or flashover. The controller functions normally after the test.

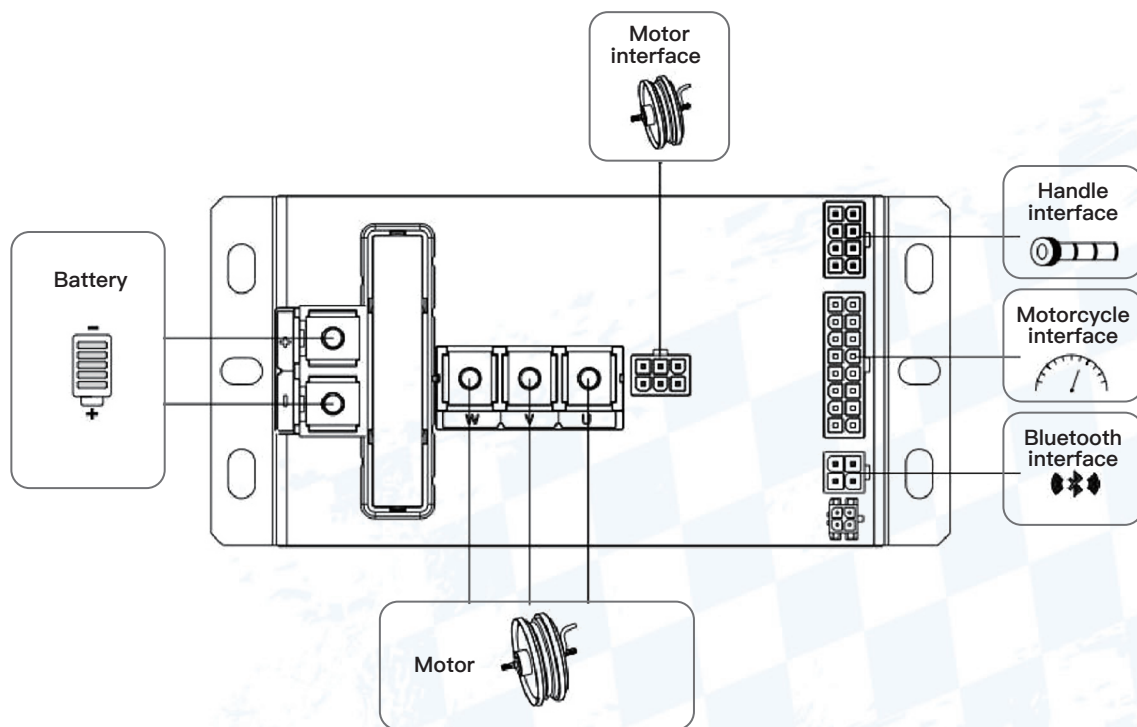
4 Electrical Connection and Interface Definition

There are two types of wires for controller connection: signal harness and power harness.

The signal harness is attached to the controller's control port via its connector to achieve the signal connection.

The power harness is connected to the controller's power terminal via the wiring terminal to ensure that the controller receives power from the battery, and to enable the controller to regulate the power output to the motor.

4.1 Electrical Structure Block Diagram

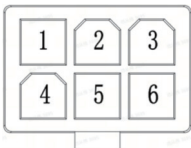
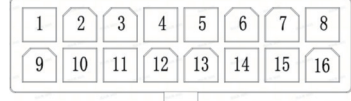


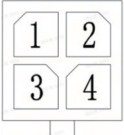
4.2 Signal Harness Definition

Control port model: 6-16-8 PIN female, adaptable control line plug model: Zhejiang ZEET ZTA 31006-6P-A, ZTA 31006-8 P-A, and ZTA 31006-16 P-A. In addition, a 4 PIN external Bluetooth port (corresponding plug model: ZTA 31006-4 P-A) and a 4 PIN debug port are reserved.

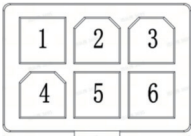
Two types of port definitions are provided to meet different customer requirements.

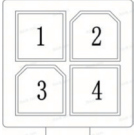
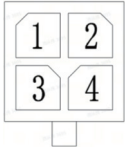
Type I (HW9662 KZ1):

	Pin	Pin Type	Pin Function
 5559-6P	1	HALL Yellow	HALL A
	2	HALL Green	HALL B
	3	HALL Blue	HALL C
	4	GND (Ground)	GND
	5	Input	Motor Temperature Sensor Input
	6	Power	Hall Power
 5559-8P	1	Communication	TX / CANH / RS485A
	2	Input	Anti-theft (Motor Locking)
	3	Output	Voice / Alarm
	4	GND	GND
	5	Communication	RX / CANL / RS485B
	6	Power	ACC
	7	Power	Battery Positive – VBUS
	8	Output	Wheel Rotation Signal
 5559-16P	1	Power	ACC
	2	Input	Side Stand Signal
	3	Output	One – wire
	4	Input	High Brake
	5	Input	Voltage Selection
	6	Input	P (Park Gear)
	7	Input	Throttle Signal
	8	Power	Side Stand Power
	9	Input	Magnetic Encoder PWM (Pulse Width Modulation)
	10	GND	GND
	11	Input / Output	Reverse
	12	Input / Output	Low Brake / Soft – Hard Start / Left Turn Signal Ctrl
	13	Input / Output	Gear – / Tail Light Ctrl
	14	Input / Output	Gear + / Right Turn Signal Ctrl
	15	GND	Throttle GND
	16	Power	Throttle Power

 5559-4P	1	Power	Bluetooth Power
	2	Communication	Bluetooth RX
	3	Communication	Bluetooth TX
	4	GND	Bluetooth GND
	1	Programming	CLK
	2	GND	GND
	3	Programming	DIO
	4	Power	3.3 V

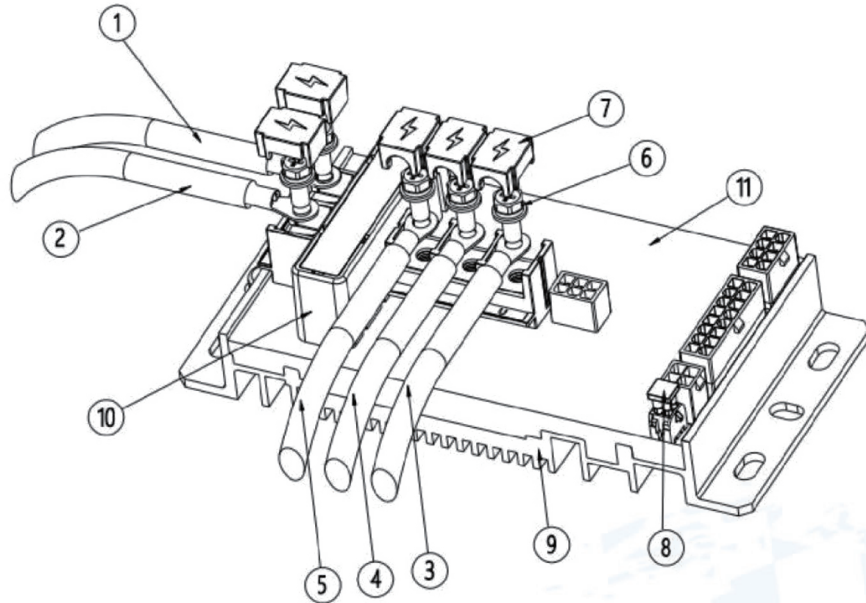
Type II (HW9662 KZ3):

	Pin	Pin Type	Pin Function
 5559-6P	1	Power	Hall Power
	2	Input	Motor Temperature Sensor Input
	3	GND	GND
	4	HALL Blue	HALL C
	5	HALL Green	HALL B
	6	HALL Yellow	HALL A
 5559-8P	1	Input	Magnetic Encoder PWM (Pulse Width Modulation)
	2	Input	Voltage Selection
	3	Input	Side Stand Signal
	4	Power	Throttle Power
	5	Power	ACC
	6	Input	High Brake
	7	Input	Throttle Signal
	8	GND	GND

 5559-16P	1	Input	Reverse
	2	Input	Button Three – speed
	3	Input	Turbo Power
	4	Output	Voice / Alarm
	5	Input	Cruise Control
	6	Communication	RX / CANL / 485B
	7	Output	Wheel Rotation Signal
	8	Input	Anti – theft (Motor Locking)
	9	Input	P Gear
	10	Input	Gear +
	11	Input	Gear –
	12	Output	One – wire
	13	Input	Low Brake
	14	Power	Side Stand Power
	15	GND	GND
	16	Communication	TX / CANH / 485A
 5559-4P	1	Power	Bluetooth Power
	2	Communication	Bluetooth RX
	3	Communication	Bluetooth TX
	4	GND	Bluetooth GND
	1	Programming	CLK
	2	GND	GND
	3	Programming	DIO
	4	Power	3.3 V

4.3 Power Harness Definition

The terminal wiring definitions for the power terminal are shown in the following diagram:



Seq. No.	Terminal Wiring	Material	Quantity	Installation Torque (N·m) / Specifications
1	Power negative SC16-5 terminal		1	3.5 ~ 4.5
2	Power positive SC16-5 terminal		1	3.5 ~ 4.5
3	U-phase wire SC16-5 terminal		1	3.5 ~ 4.5
4	V-phase wire SC16-5 terminal		1	3.5 ~ 4.5
5	W-phase wire SC16-5 terminal		1	3.5 ~ 4.5
6	Wiring terminal fixing screw	35 K carbon steel / natural color / grade 8.8	5	Triple combination outer hexagonal inner cross M5 * 12
7	Silicone cover for wiring terminal	Silicone rubber / 60 A	5	
8	Silicone cover for the commissioning terminal	Silicone rubber / 60 A	1	
9	Aluminum base	AL6063 / natural color	1	
10	Capacitor cover	PC / V0 fireproof	2	
11	Potting adhesive	Polyurethane/black		Hardness 85 A / V0 fireproof

5 Product Environmental Adaptation Specifications

5.1 Ambient Temperature Range

Operating ambient temperature range: $-25^{\circ}\text{C} \sim 60^{\circ}\text{C}$

Ambient temperature range for long-term storage: $-10^{\circ}\text{C} \sim 40^{\circ}\text{C}$

Adaptive temperature range for storage environment: $-40^{\circ}\text{C} \sim 85^{\circ}\text{C}$

5.2 Product Ambient Adaptation

Seq. No.	Test Items	Test Conditions / Requirements														
1	Low-temperature storage test	Place the controller in a temperature control box (– 40°C) for 24 h, which can work normally after being restored to the room temperature.														
2	High-temperature storage test	Place the controller in a temperature control box (85°C) for 48 h, which can work normally after being restored to the room temperature.														
3	Constant-temperature and humidity test	Place the controller in an environment with a temperature of 40°C ± 2°C and relative humidity of 93 ± 5%, and keep 48 h under constant humidity. After being tested and restored to the room temperature, the controller should function normally in all aspects without significant appearance abnormalities.														
4	Vibration test	Sweep frequency vibration: Frequency: 10 ~ 25 Hz; amplitude: double amplitude 1.2 mm; frequency: 25 ~ 500 Hz, acceleration: 30 m / s². Vibration time at each of the 3 direction (X, Y, and Z): 8 h. Random vibration: Vibration time at each of the 3 direction (X, Y, and Z): 8 h. Random vibration: Conduct each axial test for 8 h, and the root mean square (r.m.s.) of acceleration should be 27.8 m / s². The PDS and frequency relationship: <table><tr><th>Frequency Hz</th><th>PDS (m / s²) 2 / Hz</th></tr><tr><td>10</td><td>20</td></tr><tr><td>55</td><td>6.5</td></tr><tr><td>180</td><td>0.25</td></tr><tr><td>300</td><td>0.25</td></tr><tr><td>360</td><td>0.14</td></tr><tr><td>1000</td><td>0.14</td></tr></table> After the test, there should be no deformation, breakage (crack) and other issues on the shell. The devices and fixing screws should not loose. The controller should work normally during and after the test.	Frequency Hz	PDS (m / s ²) 2 / Hz	10	20	55	6.5	180	0.25	300	0.25	360	0.14	1000	0.14
Frequency Hz	PDS (m / s ²) 2 / Hz															
10	20															
55	6.5															
180	0.25															
300	0.25															
360	0.14															
1000	0.14															

6 Product Installation

6.1 Controller Installation Precautions

- 1) The installation area should be flat, free of foreign matters, like burrs and welding residue.
- 2) The heat dissipation surface must have good air circulation to improve the controller's cooling effect and maximize its performance.
- 3) Ensure that the wires do not interfere with the motorcycle after installation, to avoid wear and short circuits, which could lead to functionality issues.
- 4) The controller should be fixed using bolts (M6 recommended), with a torque range of 3.5 N·m to 4.5 N·m.
- 5) The connector should be plugged and unplugged less than 20 times during the controller's lifecycle, to avoid increasing contact resistance, which can lead to excessive temperature rise.
- 6) The controller's power terminals should be fixed with bolts, and the torque range must be controlled to ensure the terminals are securely tightened. Otherwise, poor contact and overheating may occur.
- 7) The controller's control terminals should be firmly and fully inserted into the controller socket. Otherwise, they may loosen, leading to poor contact and functionality issues.

6.2 Wiring Harness Installation Precautions

- 1) Different colored wires and anti-mistake connectors on the wiring harness are designed to prevent wiring errors, which could prevent the controller from functioning properly.
- 2) High-temperature wires should not be bundled with other wires to prevent insulation layer damage due to heat, which could cause short circuits.
- 3) Ensure the battery wiring is correct to avoid reversing polarity or incorrect connection of the battery wire to the phase wire.
- 4) Ensure the motor wiring is correct to avoid short circuits or open circuits in the phase wires.
- 5) Ensure correct controller wiring. Make sure that the phase wires and power wires are connected according to specifications. Otherwise, the motor may not work properly and could damage the controller.
- 6) After assembling the wiring harness, install the controller's silicone dust plugs.



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