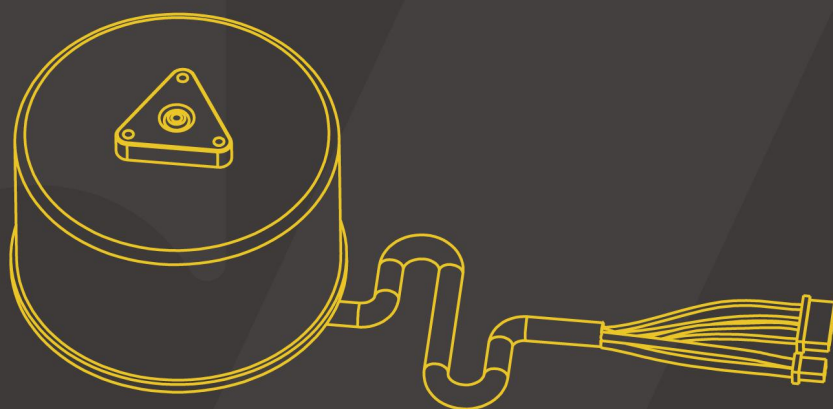


# **M6<sup>1C</sup>** **111** **User Manual**

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# Content

Disclaimer.....	3
Safety Precautions.....	4
Production Introduction.....	5
Production Features.....	5
Product List.....	6
Motor Driver Interface and Cable Instruction.....	7
Installation Guidelines.....	8
M0601C_111 Motor Driver Instruction.....	9
Communication Method.....	9
Communication Protocol.....	9
Protection.....	13
Firmware Update.....	14
Motor Parameter.....	15

## ◆ Disclaimer

Thank you for purchasing the M series permanent magnetic synchronous motor (hereinafter referred to as "motor") from Dongguan Direct Drive Technology Co., Ltd. (hereinafter referred to as Direct Drive Tech). This manual has been published to guide the use of this product.

Before starting operation, please be sure to read through this manual carefully and follow the relevant instructions to avoid injury or damage. By using this product, you are deemed to have accepted all the terms and contents of the specification and all relevant documents of this product. You promise to use this product only for legitimate purposes and take full responsibility for the possible consequences of using this product. Direct Drive Tech shall not be responsible for any damage, injury, or legal liability caused by the direct or indirect use of this product.

This product and its specification are copyrighted by Direct Drive Tech Co., Ltd. It is not allowed to reproduce in any form without permission.

Direct Drive Tech Co., Ltd. reserves the right for the modification and final interpretation of this product and all documents of its specification, and Direct Drive Tech may modify the information of this specification without prior notice when it obtains new information, knowledge, or experience.

## ◆ Safety Precautions

1. Before starting operation, make sure whether the working voltage is the one specified in this manual.
2. Make sure the motor is used within the specified ambient temperature range.
3. Avoid soaking the motor in water. Failure to do this may result in abnormal operation or damage to the motor.
4. Before starting operation, be sure to correctly and securely perform the cable to avoid loose contact.
5. Before starting operation, refer to the installation guidelines to make sure the motor is installed correctly and securely.
6. Before starting operation, refer to the installation guidelines to make sure the external output part of the motor is installed correctly and securely.
7. During operation, avoid damaging the cables. Failure to do this may result in abnormal operation or damage to the motor.
8. During operation, do not touch the rotating parts of the motor. This may result in injury.
9. When the motor produces high torque output with heat generation, do not touch the motor. This may result in scald.
10. Do not disassemble the motor without permission. This may result in abnormal operation or damage to the motor and bring protentional safety hazards.

## ◆ Introduction

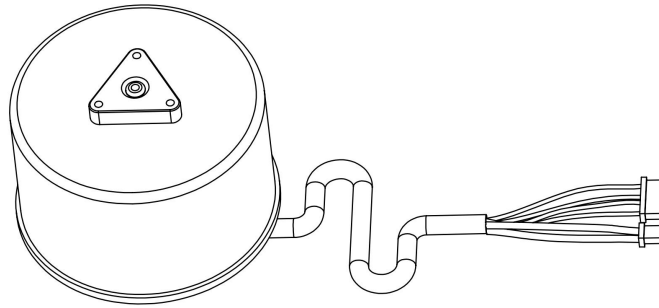
M6 series motor is an independently developed product by Direct Drive Technology Co., Ltd. This product is a highly reliable permanent magnet synchronous motor, integrating external rotor BLDC motors, encoder, and servo system based on the concept of integration development. It has compact structure, ease of installation, stability in operation, small size and large torque, which is especially suitable for the following direct drive fields: robotics, : robots, AGVs, automation equipment, warehousing logistics, etc. By optimizing the number of poles and wedges, wedge shape, air gap, permanent magnet materials, etc., the motor can ensure larger torque output, less torque fluctuations, and provides high-performance direct drive application solutions. The motor driver embeds the field-oriented control (FOC) algorithm. Together with the high-precision sensor, the motor achieves great control accuracy and nice mute effect. The drive has a complete and reliable motor OBD monitoring and protection mechanism to ensure the safe and reliable operation of the motor.

## ◆ Product Features

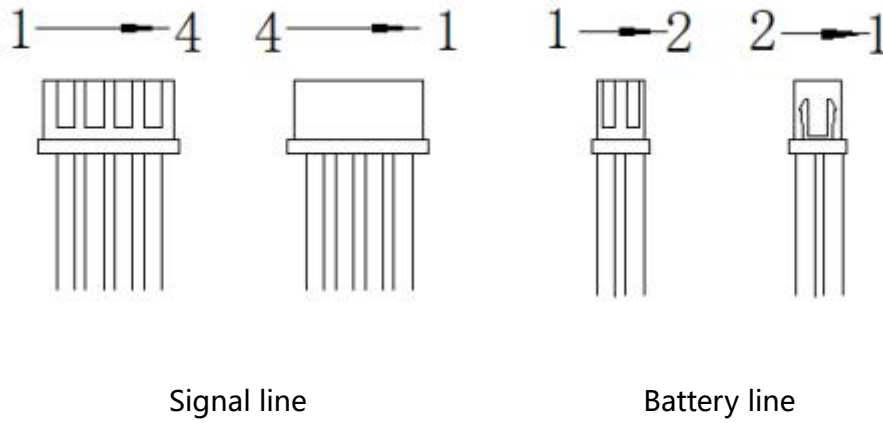
1. Integrated design of motor and motor driver.
2. 485 communication mode supported.
3. Special design in structure allows the sensor to measure the overall temperature of motor.
4. Angle, velocity, current, fault value and other information of the motor can be obtained through communication.
5. Equipped with hall sensing and protections.
6. Electrical brake supported.

## ◆ Product List

### Motor Assembly



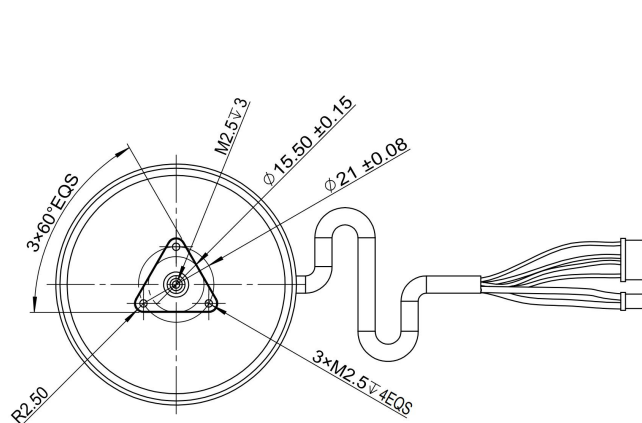
## ◆ Motor Driver Interface and Cable Instructions



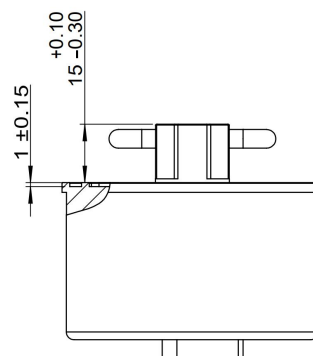
Type	Index	Name	Label	Description
Signal Cable (ZH1.5*4P)	1	GND	Signal Ground	Connected to Power Negative
	2	A	DATA+	485 bus A
	3	B	DATA-	485 bus B
	4	/		Reserved
Power Cable (XH2.54*2P)	1	VCC	Power Positive	Maximum 24 VDC input
	2	GND	Power Negative	

## ◆ Installation Guidelines

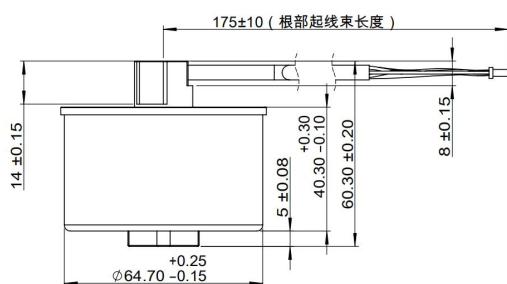
Please refer to the size and position of the motor mounting holes to install the motor on the custom device.



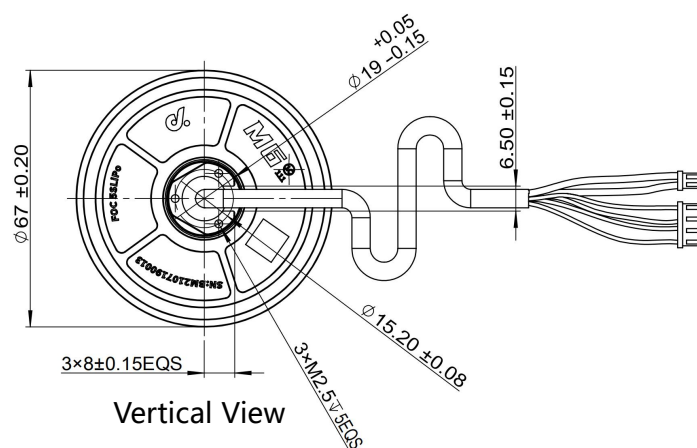
Bottom View



Side View



Front View



Vertical View

The screw hole on the rotor is M2.5, 4mm depth. The central axis hole is M2.5( $\phi$ 2.5). The hexagon's side is 24mm long, and 5mm high.

The installation hole on the stator is M2.5 ( $\phi$ 2.5), 5mm depth, distributed at the  $\phi$ 15.2 circle and the 8mm flat position.

Please choose proper screws for installation.



## ◆ M0601C\_111 Motor Driver Instructions

1. The motor can communicate with the computer with a USB To 485 tool.  
Firmware update is possible through the computer.
2. The motor driver follows the user input through current loop or velocity loop.

## ◆ Communication Method

### 485 Bus Communication

Follow the protocol, send corresponding messages through the 485 to control the motor.

## ◆ Communication Protocol

**Baud rate:** 115200      **Data bit:** 8bit      **Stop bit:** 1bit      **Parity check:** none

**Data length:** 10 字节

method: polling

maximum frequency: 500 Hz

**Current Mode:** -32767~32767 correspond to 0~8A, INT16

**Velocity Mode:** -330~330 rpm, INT16

**Angle Mode:** 0~32767 correspond to 0°~360°, UINT16

Operation steps:

- ① Set the motor ID (save in FLASH when power off)
- ② Set motor mode (current loop, velocity loop, angle loop, default in velocity loop)
- ③ Send the set value

## 1、Spin the motor

Command										
Date field	DAT A [0]	DAT A [1]	DATA [2]	DATA [3]	DAT A [4]	DAT A [5]	DA TA [6]	DAT A [7]	DATA [8]	DA TA [9]
Descri-ption	ID	0x64	Velocity/Current/Angle loop set, high 8 bits	Velocity/Current/Angle loop set, high 8 bits	0	0	Ac cel eration	Brak e	0	CR C8
Feedback										
Date field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DAT A [6]	DATA [7]	DATA [8]	DAT A [9]
Descri-ption	ID	mode	Current High 8 bits	Current Low 8 bit	Veloc ity High 8 bits	Veloc ity Low 8 bits	An gle Hig h 8 bits	An gl e Low 8 bits	Fault value	CRC 8

**Acceleration:** Valid in velocity loop. unity: RPM/0.1ms. When set to 0, it would be the default value

**Brake:** Valid in velocity loop when the value is 0XFF. Brake won' t work at other values.

## 2、Obtain other feedback

Command										
Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Description	ID	0x74	0	0	0	0	0	0	0	CRC8
feedback										
Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Description	ID	mode	Current High 8 bits	Current Low 8 bit	Velocity High 8 bits	Velocity Low 8 bits	Stator temperature	Angle in 8 bits	Fault value	CRC8

**Angle in 8 bits:** 0~256 corresponds to 0~360°

**Stator temperature :** unity : °C

**Fault value :**

Fault value	BIT7	BIT6	BIT5	BIT4	BIT3	BIT2	BIT1	BIT0
Description	Reserved	Reserved	Reserved	Over heat	Stall	Phase Over current	Bus over current	Sensor Fault

E.g.: 0x02 or 0b00000010 corresponds to Bus over current.

**CRC8:**

Use CRC-8\Maxim algorithm to validate the value from DATA[0] to DATA[]

CRC-8\Maxim:  $x^8 + x^5 + x^4 + 1$

### 3、 Mode switching:

Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Descr -ption	ID	0xA0	0	0	0	0	0	0	0	Mode

mode:

0x01 : Current loop

0x02 : Velocity loop

0x03 : Angle loop

Only when the velocity is lower than 10 rpm that switching to angle loop is available.

### 4、 ID setting

Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Descr -ption	0xAA	0x55	0x53	ID	0	0	0	0	0	0

Note: When setting the ID, please make sure that the bus has only one motor.

ID setting is allowed once every power reset.

The ID will be changed after 5 times repeating the ID setting command.

## 5、ID check:

Command										
Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Descr-ption	0XC8	0x64	0	0	0	0	0	0	0	CRC8
Feedback										
Data field	DATA [0]	DATA [1]	DATA [2]	DATA [3]	DATA [4]	DATA [5]	DATA [6]	DATA [7]	DATA [8]	DATA [9]
Descr-ption	ID	mode	Current High 8 bits	Current Low 8 bit	Velocity High 8 bits	Velocity Low 8 bits	Stator temperature	Angle in 8 bits	Fault value	CRC8

Note: When checking the ID, please make sure that the bus has only one motor.

## ◆ Protection

- 1、Bus current protection threshold: Approximately 3A, motor power off, and recover after 5 seconds.
- 2、Over temperature threshold: Approximately 80°C, recover if the temperature is 5°C lower than the threshold.
- 3、Phase current protection threshold: Approximately 4.6A, motor power off, and recover after 5 seconds.
- 4、Stall protection: motor power off after five seconds of stalling, and recover after 5 seconds.

## ◆ Firmware update

The motor can connect the PC with USB To 485 tool. Firmware update is available on DDT TOOL software.

## ◆ Motor Parameters

### Motor parameters with M6 built-in drive

Unload velocity	200±10rpm
Unload current	≤0.25A
Rated velocity	115rpm
Rated torque	0.96Nm
Rated current	1.25A
Maximum efficiency	≥60%
Stall torque	2.0Nm
Stall current	≤2.7A
Rated voltage	18VDC
Torque constant	0.75Nm/A (在额定转速下测得)
Velocity constant	11.1rpm/V
Ambient temperature	-20℃~45℃
Motor weight	485g
Encoder resolution	4096
Absolute accuracy	1024
Noise level	≤50dB
Ingress Protection Ratine	IP54

Note: The parameters are tested under 18VDC.



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