

DAMIAO | 达妙科技

DM-G6220 Hollow Gimbal Motor

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Disclaimer

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Precautions

1. The motor must be operated strictly within the specified working environment and maximum allowable temperature range of the windings; otherwise, permanent irreversible damage may occur to the product.
2. Prevent foreign objects from entering the rotor, as this may cause abnormal operation.
3. Before use, check all components for integrity. If any parts are missing, aged, or damaged, stop using the device.
4. Ensure proper wiring and secure, correctly installed motor.
5. Do not touch the electronic rotor during operation to prevent accidents. The motor may overheat when delivering high torque, so take precautions to avoid burns.
6. Users must not disassemble the motor without authorization, as this may compromise its control accuracy or even cause malfunction.

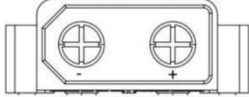
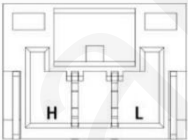
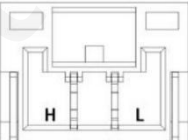
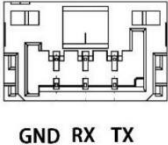
Motor Features

1. The motor features a hollow design for easier wiring and a lightweight body.
2. The motor and driver are integrated, which has compact structure and high integration degree.
3. Supports visual debugging on the host computer and firmware upgrades.
4. The CAN bus can be used to feedback the motor speed, position, torque, and temperature.

Package Contents

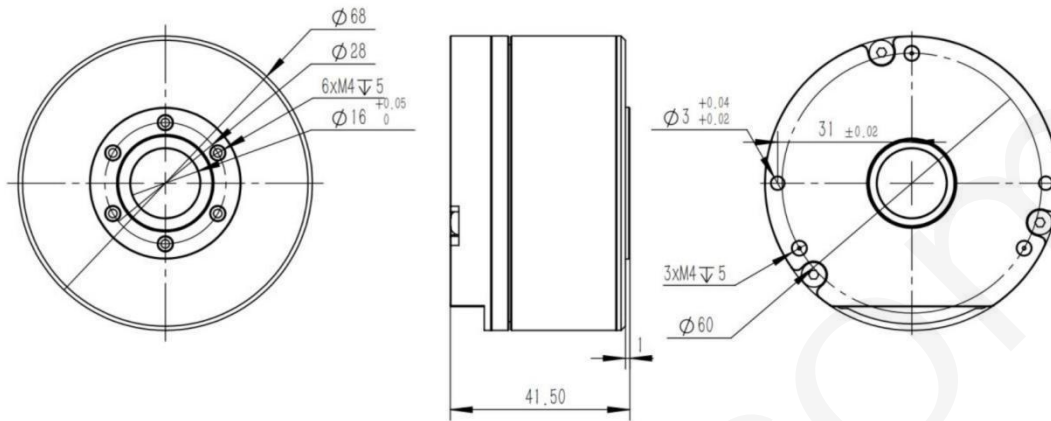
1. Motor (including drive) × 1
2. Power cable: XT30200mm power cable (1 unit)
3. CAN communication terminal: GH1.25 connector-2-pin (300mm, cross-face) × 1
4. Debugging the serial signal line: GH1.25 connector-3-pin (300mm, cross-face) × 1

Interface and Pinout Description

Specific Name-Number	Interface annotation	Explain
Power interface		The XT30 connects to the power supply via its orbital power supply cable, with a rated voltage of 24V to power the motor.
CAN Communication Terminal-1		The CAN communication terminal connects to external control devices, receiving CAN control commands and transmitting motor status information.
CAN Communication Terminal-1		The CAN communication terminal connects to external control devices, receiving CAN control commands and transmitting motor status information.
Debugging serial port		Connect the motor to the PC using the GH1.25 cable with 3-pin connector and a USB-to-CAN diagnostic tool (or a universal USB-to-serial module). Use Damiao Technology's diagnostic assistant to configure motor parameters and perform firmware upgrades.

Motor Dimensions and Installation

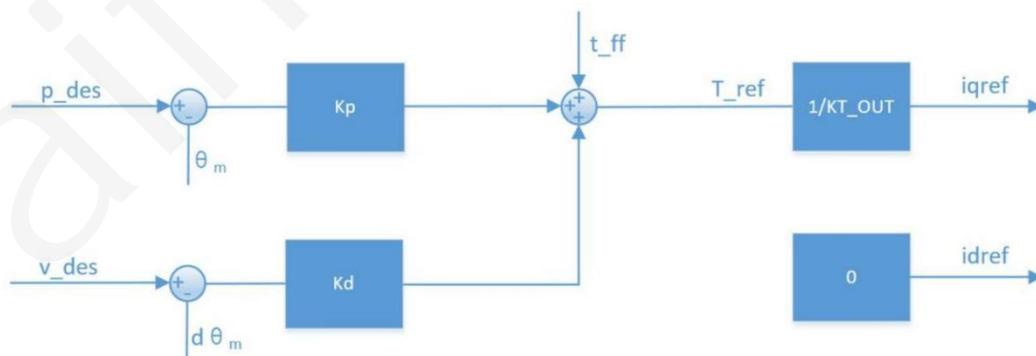
Refer to the motor mounting hole dimensions and positions to install the motor on the corresponding equipment.



Operating Modes

MIT Mode

The MIT mode is designed to be compatible with the original MIT mode, enabling seamless switching while allowing flexible control range settings (P_MAX , V_MAX , T_MAX). The electric controller converts received CAN data into control variables, calculates torque values, and provides current setpoints for the current loop. The current loop then adjusts according to its regulation rules to ultimately achieve the desired torque current. The control block diagram is shown below:

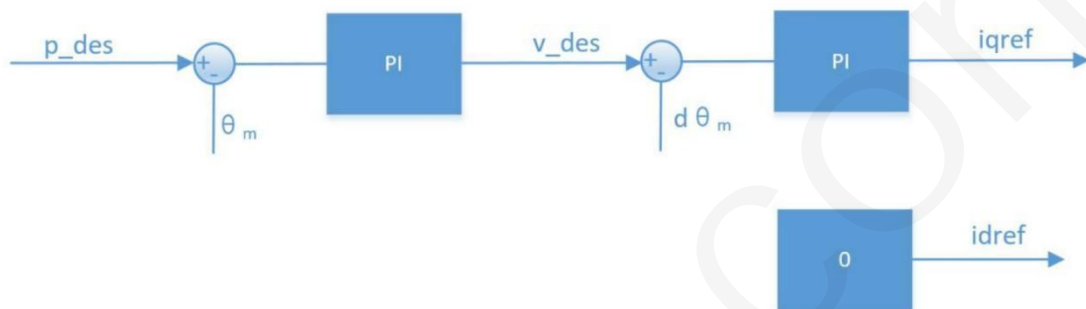


The MIT model can be adapted to various control configurations. For instance, when $k_p=0$ and $k_d \neq 0$, a constant-speed rotation can be achieved by setting v_des . Similarly, when $k_p=0$ and $k_d=0$, torque output can be controlled by setting t_ff .

Note: When controlling position, do not set k_d to 0, as this may cause motor oscillation or even loss of control.

Position-Speed Mode

The position cascade control mode employs a three-loop series control configuration. The outermost position loop provides the setpoint for the speed loop, while the speed loop's output serves as the setpoint for the inner current loop to regulate actual current output. The control block diagram is shown below.



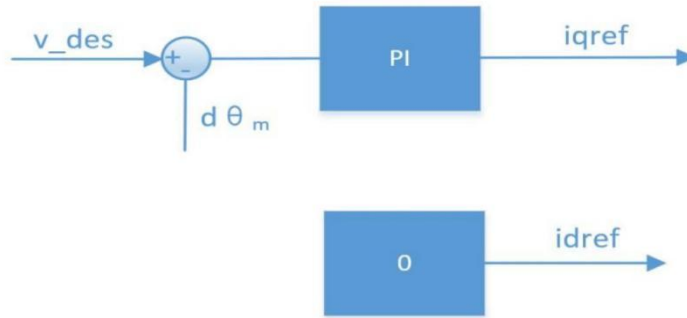
p_des is the target position for control, while v_des defines the maximum absolute speed during motion.

When the cascade mode is controlled using the parameters recommended by the debugging assistant, it achieves better control accuracy and a smoother process, though with longer response time. In addition to v_des , other configurable parameters include acceleration/deceleration settings. If additional oscillations occur during control, increasing acceleration/deceleration can mitigate them.

Note: p_des and v_des are measured in rad and rad/s respectively, with data type float. The damping factor must be set to a positive non-zero value. Refer to the speed mode precautions.

Speed Mode

The speed mode enables the motor to operate stably at the set speed, as shown in the control block diagram below.



Note: v_des is measured in rad/s and stored as a float. To enable the debugging assistant to automatically calculate parameters, set the damping factor to a non-zero positive value (typically 2.0–10.0). A low damping factor may cause speed oscillations and excessive overshoot, while a high damping factor may result in prolonged rise time. The recommended setting is 4.0.

Direction for Use

The control system employs CAN standard frame formats with a fixed baud rate of 1Mbps. Functionally, these frames are categorized into receiving frames and feedback frames. Receiving frames contain control data for motor command execution, while feedback frames transmit real-time status data from the motor to the upper-level controller. Although the specific frame formats and IDs vary depending on the selected motor mode, the feedback frames remain consistent across all operational modes.

Feedback Frame

The feedback frame ID is set by the debug assistant (Master ID), with a default value of 0. It primarily provides feedback on the motor's position, speed, and torque. The frame format is defined as:

Feedback message	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
MST_ID	ID ERR <<4	POS[15: 8]	POS[7: 0]	VEL[11: 4]	VEL[3:0] T[1 1:8]	T[7:0]	T_MO S	T_Roto r

among :

ID represents the controller ID, taking the lower 8 bits of CAN_ID

ERR indicates a status, corresponding to the following status type:

0-Disability;

1—Enable;

8—overpressure;

9-Under-voltage;

A— excess current ;

B—MOS overtemperature;

C-Motor coil overheating;

D-Communication loss;

E— overload ;

POS indicates the motor's position information

VEL indicates the motor speed information

T represents the torque information of the motor

T_MOS is the average temperature of the upper MOS, in °C

T_Rotor is the average temperature of the motor's internal coils, measured in °C

The position, speed and torque are converted to fixed-point data with sign by linear mapping, where the position is 16-bit, and the speed and torque are 12-bit.

Control Frame in MIT Mode

Control message	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
ID	p_desp_des [15:8]	p_des [7:0]	v_des [11:4]	v_des[3:0] Kp[11:8]	Kp [7:0]	Kd [11:4]	Kd[3:0] t_ff[11:8]	t_ff[7:0]

The frame ID equals the set CAN ID value P_des: position given

V_des: Speed given

Kp: Position Ratio Coefficient

Kd: Positional differential coefficient

T_ff: Torque setpoint

All parameters adhere to the mapping relationships specified in the previous section. The values of `p_des`, `v_des`, and `t_ff` can be configured via the debugging assistant, while `Kp` ranges from 0 to 500 and `Kd` ranges from 0 to 5.

A standard CAN data frame contains only 8 bytes. MIT's control command format encodes five parameters—Position, Velocity, `Kp`, `Kd`, and Torque—into 8 bytes using bit combinations. Specifically: Position occupies 2 bytes (16 bits), Velocity 12 bits, `Kp` 12 bits, and `Kd` 12 bits.

Control Frame in Position Velocity Mode

Control message	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x100+ID	p_des				v_des			

The frame ID is the set CAN ID value plus an offset of 0x100.

`P_des`: Position given, floating-point type, with the lower bit first and the higher bit last

`V_des`: Speed given, floating-point, lower bits first, higher bits last

The CAN ID for the command is 0x100+ID. The given speed is the maximum speed limit during motor operation, i.e., the speed value during the constant-speed phase.

Control Frame in Speed Mode

control message	D[0]	D[1]	D[2]	D[3]
0x200+ID	v_des			

The frame ID is the set CAN ID value plus an offset of 0x200.

`V_des`: A floating-point variable with fixed speed, where the lower bit is first and the higher bit is last. The CAN ID for this command is 0x200+ID.

Motor Debugging Procedure

Use Damiao Technology's USB-to-CAN debugging tool to connect the computer and motor, then configure motor parameters and upgrade firmware via Damiao Technology Assistant.

The motor's debugging serial port connects to the PC via a GH1.253-pin cable. The CAN communication terminal on the motor's power interface is linked to a USB-to-CAN debugging tool using an XT30 (2+2) F-type connector. The Damiao Technology Debug Assistant is employed to configure motor parameters and perform firmware upgrades.

After connecting the motor's serial port, CAN port, and power interface, launch the Damiao Technology Debug Assistant on your computer. Select the corresponding serial port device and enable the serial port. When powering the motor, the serial port will display information, with the Control Mode indicating the current driving mode.

Detailed debugging process reference: Debug Assistant User Manual (Dami Driver Control Protocol) V1.4.pdf

Download link :

<https://gitee.com/kit-miao/damiao/tree/master/%E5%85%B3%E8%8A%82%E7%94%B5%E6%9C%BA/%E6%8E%A7%E5%88%B6%E5%8D%8F%E8%AE%AE>

Characteristic Parameter

Use the motor properly according to the following parameters.

Motor Parameters	Rated voltage	24V
	Rted current	2.3A
	Peak point current	5.3A
	Rating torque	1.3NM
	Peak torque	2.7NM
	Rated speed	110rpm
	No-load maximum speed	300rpm;
Motor Characteristics	Reduction gear ratio	1: 1
	Number of pole-pairs	14
	Phase inductance	2900uh
	Phase resistance	3.5Ω
Structure and	External diameter	68mm
	Altitude	41.5mm

Weight	Motor weight	Approximately 493.5 grams
Encoder	Encoder type	magnetic compilation
Communication	Control interface	CAN@1Mbps
	Parameter passing interface	UART@921600bps
Control and protection	Control model	MIT pattern
		Speed mode
		position mode
	Protect	Enable over-temperature protection with a protection temperature of 120°C. The motor will exit the enable mode if overheated.
		Motor over-temperature protection. Set according to usage requirements, recommended not exceeding 100°C. The motor will exit the 'enabled mode' if over-temperature occurs.
		Motor overvoltage protection. Set according to usage requirements, recommended not to exceed 32V. Overvoltage will exit the 'enabled mode'.
		Communication loss protection. If no CAN commands are received within the set period, the system will automatically exit the enable mode.
		Motor overcurrent protection, configured according to usage requirements, recommended not to exceed 9.8A. Overcurrent will exit the 'enabled mode'.
		Motor under-voltage protection: If the power supply voltage drops below the set threshold, the system exits the enable mode. The minimum required voltage is 15V.