DM-J4310-2EC V1.1 GEAR MOTOR USER MANUAL V1.0

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Most of the content is AI-translated. If you encounter any unclear sections, please contact me via Slack or email. My name is Liyan Liang, email: liang569@purdue.edu

DISCLAIMER

Thank you for purchasing the DM-J4310-2EC V1.1 gear motor from DAMIAO Technology (hereinafter referred to as "the motor"). Before using this product, please carefully read and follow all safety instructions provided in this document and by DAMIAO Technology. Failure to do so may result in injury, damage to the product or surrounding items.

By using this product, you acknowledge that you have read, understood, and accepted all terms and contents of this and related documents. You agree to use this product only for legitimate purposes and take full responsibility for its use and any consequences. DAMIAO Technology is not liable for any damage, injury, or legal responsibility resulting from direct or indirect use of this product.

PRECAUTIONS

1. Use the motor within the specified operating environment and winding temperature limits to avoid irreversible damage.
2. Prevent foreign objects from entering the rotor to avoid abnormal operation.
3. Check all components before use. Do not use if parts are missing, aged, or damaged.
4. Ensure correct wiring and secure installation.
5. Do not touch the rotor during operation. High torque output may cause heating—avoid burns.
6. Do not disassemble the motor yourself, as it may affect control precision or cause malfunction.

MOTOR FEATURES

- Dual encoders with single-turn absolute position output—no loss of position on power-off.
- Integrated motor and driver design—compact and highly integrated.
- Supports PC-based visual debugging and firmware upgrades.
- CAN bus feedback for speed, position, torque, and temperature.
- Dual temperature protection.
- Supports trapezoidal acceleration/deceleration in position mode.

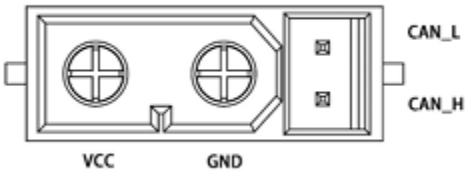
PACKAGE CONTENTS

- Motor (with driver) ×1
- Power cable (XT30(2+2)-F plug with CAN terminal) ×1

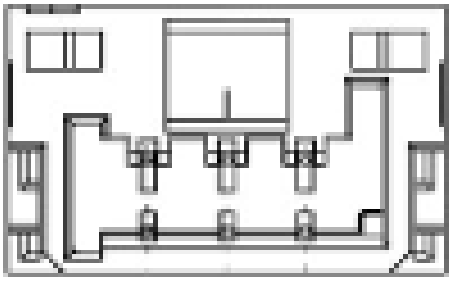
- Debugging serial signal cable (GH1.25-3pin) ×1

INTERFACES AND WIRING

- Power Interface 1 & 2 (with CAN terminal):
  - Connect to 24V power via XT30(2+2)-F plug.
  - CAN terminal connects to external control devices for command input and status feedback.
  - Either power interface can be used independently or in series for multiple motors.

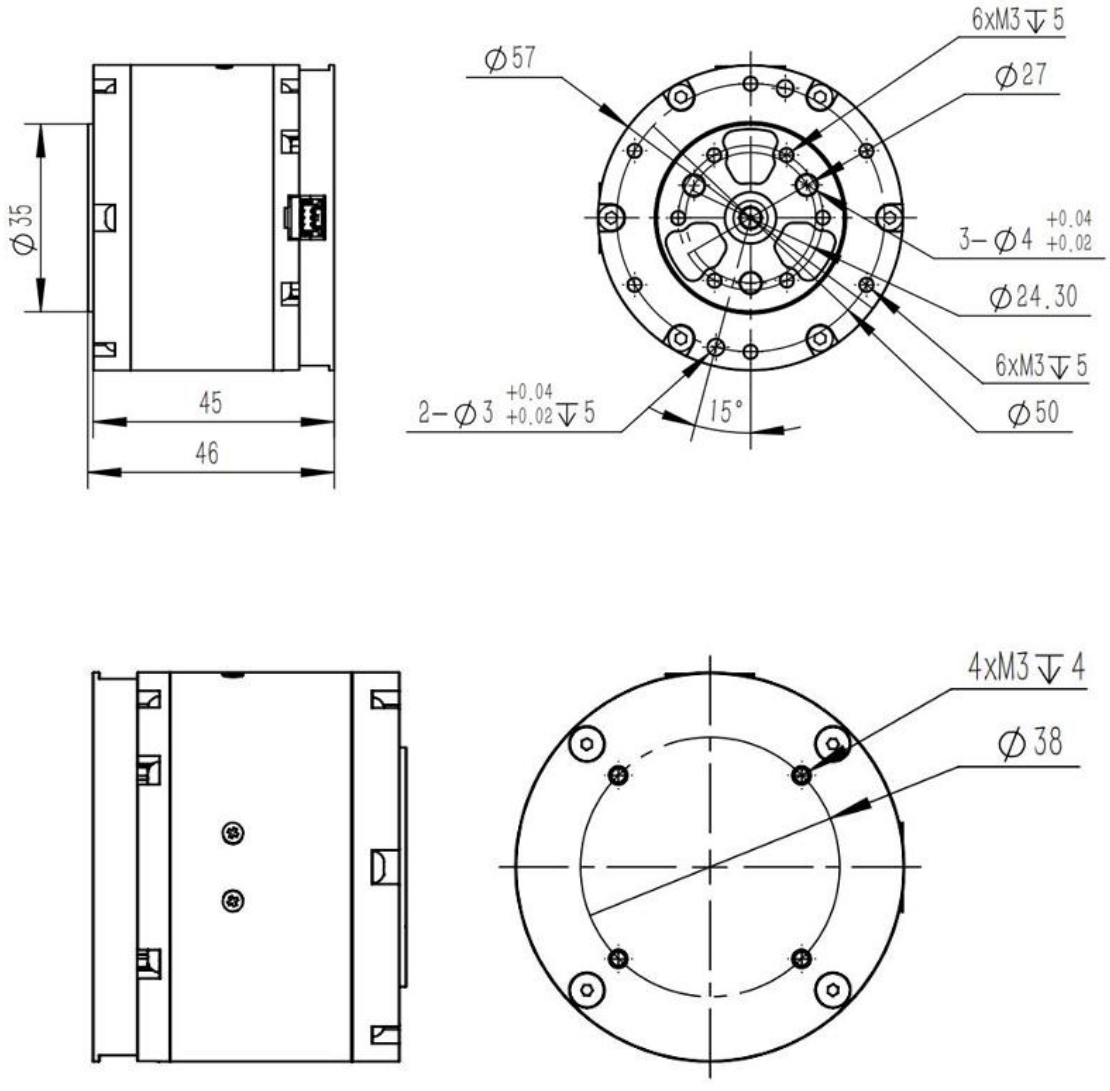


- Debug Serial Interface:
  - Connect to PC via GH1.25-3pin cable using USB-to-CAN or USB-to-Serial module.
  - Use DAMIAO Debug Assistant for parameter settings and firmware upgrades.



MOTOR DIMENSIONS & INSTALLATION

Refer to the mounting hole dimensions and positions for proper installation.



INDICATOR LIGHT STATUS

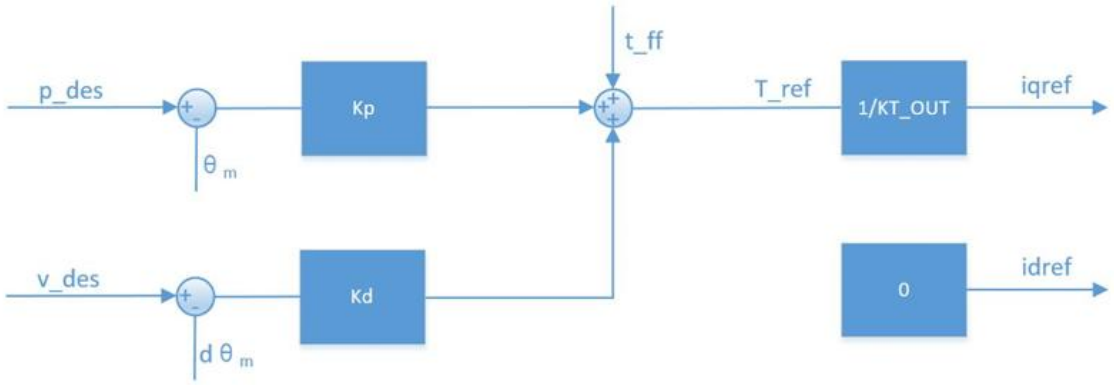
- Normal:
  - Green light steady: Enabled mode, normal operation
  - Red light steady: Disabled mode

- Error (Red light flashing):
  - 8: Overvoltage
  - 9: Undervoltage
  - A: Overcurrent
  - B: MOS overtemperature
  - C: Coil overtemperature
  - D: Communication loss
  - E: Overload
  - Use feedback frame or debug assistant to identify fault type.

OPERATING MODES

MIT MODE

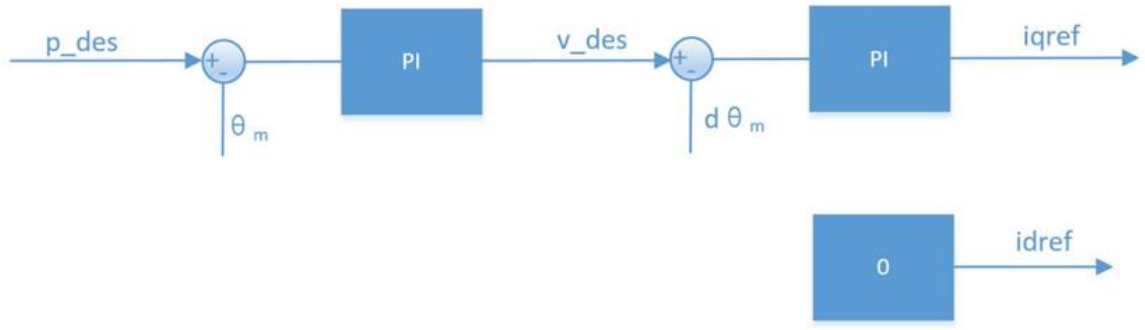
Compatible with original MIT mode. Allows flexible control range settings (P_MAX, V_MAX, T_MAX). CAN data is converted into control variables to compute torque for current loop input.



Derived modes:
- kp=0, kd≠0 → constant speed
- kp=0, kd=0 → torque control
- Note: kd must not be 0 during position control to avoid oscillation or loss of control.

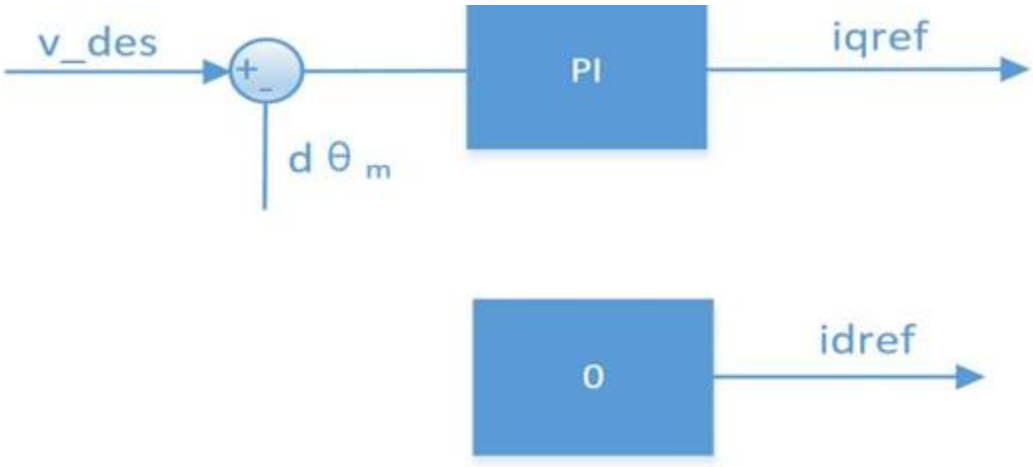
POSITION-SPEED MODE

Three-loop cascade control: position → speed → current.
- p_des: target position
- v_des: max speed during motion
- Acceleration/deceleration parameters configurable.
- Note: p_des in rad, v_des in rad/s, damping factor must be a positive non-zero float.



SPEED MODE

Motor runs at a stable set speed.



Note: The unit for v_des is rad/s, and its data type is float. To enable automatic parameter calculation via the debug assistant, set the damping factor to a non-zero positive number, typically between 2.0 and 10.0. An excessively low damping factor may cause velocity oscillations and significant overshoot, while an excessively high damping factor may result in prolonged rise times. The recommended setting is 4.0.

CAN COMMUNICATION

Control communication employs the standard CAN frame format with a fixed baud rate of 1Mbps. Frames are functionally categorized into receive frames and feedback frames. Receive frames contain received control data, enabling command control of the motor. Feedback frames transmit the motor's status data to the upper-level controller. Depending on the selected motor mode, the received frame format definition and frame IDs differ, but the feedback frame remains identical across all modes.

FEEDBACK FRAME FORMAT

The feedback frame ID is set by the debugging assistant (MasterID), with a default value of 0. It primarily provides motor position, speed, and torque information. Its frame format is defined as:

反馈报文	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[11:8]	T[7:0]	T_MOS	T_Rotor

- ID: Controller ID (low 8 bits of CAN_ID)
- ERR: Fault code
- POS: Position
- VEL: Speed
- T: Torque
- T_MOS: Driver MOS temperature (°C)
- T_Rotor: Coil temperature (°C)

Position, velocity, and torque are converted from floating-point data to signed fixed-point data using linear mapping relationships, with position represented by 16-bit data and velocity and torque both represented by 12-bit data.

MIT MODE CONTROL FRAME

控制报文	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
ID	p_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]

- Frame ID equals the set CANID value
- P_des: Position setpoint
- V_des: Velocity setpoint
- Kp: Position proportional gain
- Kd: Position derivative gain
- T_ff: Torque setpoint

All parameters follow the mapping relationships described in the previous section. The ranges for p_des, v_des, and t_ff can be configured via the debugging assistant, Kp ranges from [0, 500], and Kd ranges from [0, 5].

A standard CAN data frame is only 8 bytes long. MIT's control command format combines the five parameters—Position, Velocity, Kp, Kd, and Torque—bitwise within these 8 bytes. Specifically: Position occupies 2 bytes (16 bits), Velocity occupies 12 bits, Kp occupies 12 bits, and Kd occupies 12 bits.

POSITION-SPEED MODE CONTROL FRAME

控制报文	D[0]	D[1]	D[2]	D[3]	D[4]	D[5]	D[6]	D[7]
0x100+ID	p_des				v_des			

Frame ID is the set CANID value plus an offset of 0x100

- P_des: Position setpoint, floating-point type, LSB first, MSB last

- V_des: Velocity setpoint, floating-point type, LSB first, MSB last

The CANID for this command transmission is 0x100 + ID. The velocity setpoint represents the maximum speed during trapezoidal acceleration operation, i.e., the velocity value for the constant-speed segment.

SPEED MODE CONTROL FRAME

控制报文	D[0]	D[1]	D[2]	D[3]
0x200+ID	v_des			

- CAN ID = 0x200 + ID
- v_des as float (low byte first)

The CAN ID for sending commands here is 0x200 + ID.

USING DAMIAO DEBUG ASSISTANT

Using the Damo Technology USB-to-CAN debugging tool, connect the computer to the motor. Utilize the Damo Technology Assistant to configure motor parameters and perform firmware upgrades.

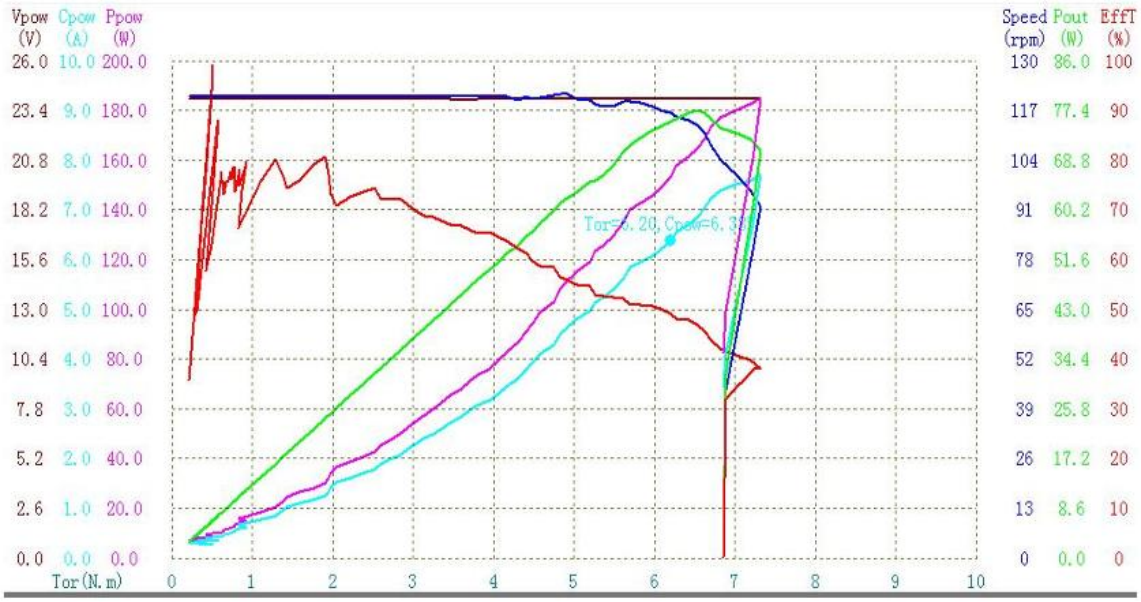
The motor debugging serial port connects to the PC via a GH1.25 3-pin cable. The CAN communication terminal in the motor's power interface connects to the

Connect the motor's power interface CAN terminal to the USB-to-CAN debugging tool via an XT30(2+2)-F plug cable. Use the Damo Technology Debugging Assistant to configure motor parameters and perform firmware upgrades.

After connecting the motor's serial port, CAN port, and power interface, open the Damo Technology Debugging Assistant on the computer. Select the corresponding serial device and open the serial port. Power the motor at this point; the serial port will print information, with ControlMode indicating the current drive mode.

MOTOR PERFORMANCE

Performance curve measured at a constant speed of 120 rpm and room temperature of 25°C:



SPECIFICATIONS

ELECTRICAL PARAMETERS

- Rated Voltage: 24V
- Rated Current: 2.5A
- Peak Current: 7.5A
- Rated Torque: 3NM
- Peak Torque: 7NM
- Rated Speed: 120rpm
- Max No-load Speed: 200rpm

MOTOR CHARACTERISTICS

- Gear Ratio: 10:1
- Pole Pairs: 14
- Phase Inductance: 340μH
- Phase Resistance: 650mΩ

STRUCTURE & WEIGHT

- Diameter: 56mm
- Height: 46mm
- Weight: ~300g
-

ENCODER

- Resolution: 14-bit
- Quantity: 2
- Type: Magnetic (single-turn)

COMMUNICATION

- Control Interface: CAN @ 1Mbps
- Tuning Interface: UART @ 921600bps

CONTROL MODES

- MIT Mode
- Speed Mode
- Position Mode

PROTECTION FEATURES

- Driver Overtemperature: 120°C
- Motor Overtemperature: ≤100°C
- Overvoltage: ≤32V
- Communication Loss
- Overcurrent: ≤9.8A
- Undervoltage: ≥15V