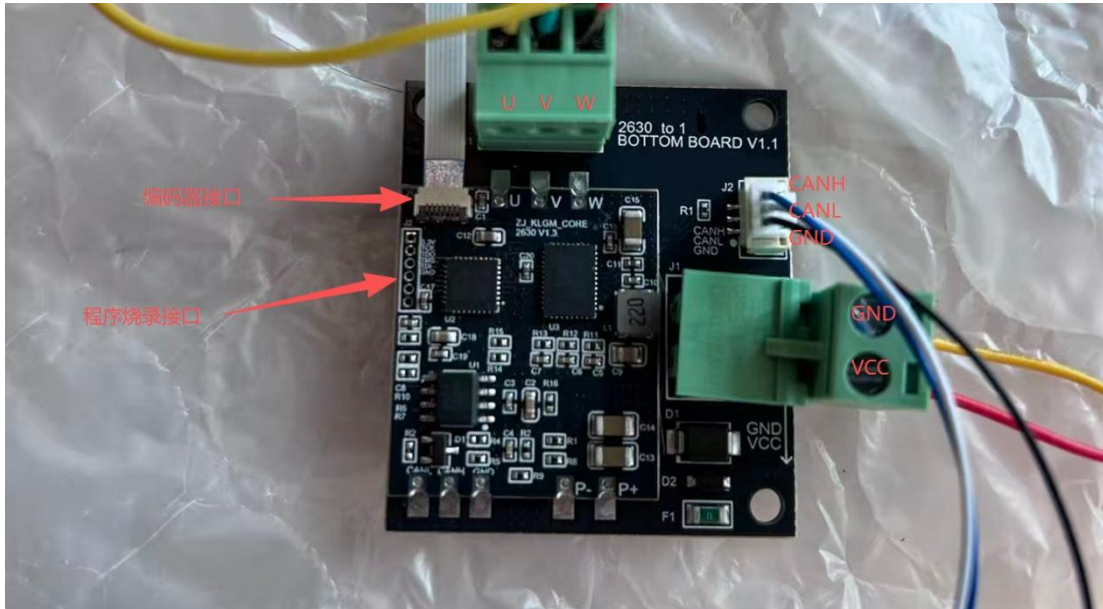


User Manual for External Drive (16-20mm)

1: Interface Definition



The default power supply voltage is 12V, with a range of 10-18V.

2: Canfd Configuration

Iso Canfd

Arbitration zone port rate: 1M 80%

Data field baud rate: 4M 80%

Note: For CAN protocol, both the transmitter and receiver must connect a 120-ohm terminal matching resistor to ensure signal quality.

3: Communication Protocol

Three modes are currently supported. The system defaults to MIT mode upon power-on and can be switched via motor control commands. During mode switching, a stop command must be sent to the motor.

- 1) Speed mode controls motor speed by sending the specified speed through the MIT mode.
- 2) Position mode controls motor position by sending commands through the MIT mode, specifying the target position.
- 3) Mit pattern

Send in 3.1 Mit Mode

Direction: Host machine sends

Canid: Standard frame 0x702

DLC: Data length 12 bytes

Current loop bandwidth: 1000 Hz

data :

Data0	Motor position code value = (s32)((((u32)data3 <<24) ((u32)data2 <<16) ((u32)data1 <<8) data0)) -0x80000000;
Data1	
Data2	
Data3	The motor position angle = motor position code value / 2097152 * 360 degrees. This position is a multi-turn location with a 21-bit encoder, where one full rotation of 360 degrees corresponds to 2,097,152 encoder pulses. The maximum range of motor position code values is -0x7CFFFFFF to 0x7CFFFFFF.
Data4	Speed code value = (s16)((((u16)data5 <<8) ((u16)data4)) -0x8000); Speed = speed code value / 10 rpm. Speed code value range: -30000 to 30000
Data5	
Data6	Valid only in MIT mode; other modes have their own fixed parameters. Kp, position loop ratio coefficient $Kp = 0.00001 * ((u16)data7 << 8) ((u16)data6)$. We recommend setting the initial debugging value to 0.008, as higher values may cause excessive oscillation. In the physical model, the input unit is rad and the output unit is A. Assuming the proportion coefficient at this point is kact, the relationship is given by $Kp = kact * 0.001115$.
Data7	
Data8	Valid only in MIT mode; other modes have their own fixed parameters. Kd, speed loop proportional coefficient $Kd = 0.01 * ((u16)data9 << 8) ((u16)data8)$. We recommend setting the initial debugging value to 1, as higher values may cause excessive oscillation. In the physical model, the input unit is rad/s and the output unit is A. Assuming the proportion coefficient at this time is kact, the relationship is $Kd = kact * 85.636$.
Data9	
Data10	Feedforward current code value = (s16)((((u16)data11 <<8) ((u16)data10) - 0x8000). Feedforward current value = current code value × 11 / 4096 A.
Data11	

example :

position mode :

01 00 01 80 00 80 C8 00 28 00 00

80 //Set position code value = 65537

Speed = 0

Kp = 0.002

Kd = 0.4

Current = 0

Current mode:

01 00 01 80 00 80 00 00 00 00 C8 80

Set position code value = 65537, speed = 0

Kp = 0

Kd = 0

Current code value = 200

3.2 Mit Mode Reply

For each frame sent in MIT mode, the controller returns a frame direction in MIT mode: The motor controller responds.

Canid: Standard frame 0x500

DLC: Data length 12 bytes

Data0	Canid, data0 = 0x02, data1 = 0x07
Data1	
Data2	Motor position code value = (s32)(((u32)data5 <<24) ((u32)data4 <<16) ((u32)data3 <<8) data2)) -0x80000000);
Data3	
Data4	The motor position angle = motor position code value / 2097152 * 360 degrees. <small>This position is a multi-turn location with a 21-bit encoder, where one full rotation of 360 degrees corresponds to 2,097,152 encoder pulses.</small>
Data5	
Data6	Speed code value = (s16)(((u16)data7 <<8) ((u16)data6)) -0x8000); Speed = speed code value / 10 rpm.
Data7	
Data8	Current code value = (s16)(((u16)data9 <<8) ((u16)data8) -0x8000). Current value = Current code value × 11 / 4096 A.
Data9	
Data10	0x00
Data11	0x00

3.3 Motor Status

Direction: The motor controller sends data, transmitting one frame every 20ms.

Canid: Standard frame 0x501

DLC: Data length 20 bytes

Data0	Canid, data0 = 0x02, data1 = 0x07
Data1	
Data2	Motor position code value = (s32)(((u32)data5 <<24) ((u32)data4 <<16) ((u32)data3 <<8) data2)) -0x80000000);
Data3	
Data4	The motor position angle = motor position code value / 2097152 * 360 degrees. <small>This position is a multi-turn location with a 21-bit encoder, where one full rotation of 360 degrees corresponds to 2,097,152 encoder pulses.</small>
Data5	
Data6	Speed code value = (s16)(((u16)data7 <<8) ((u16)data6)) -0x8000); Speed = speed code value / 10 rpm.
Data7	
Data8	Current code value = (s16)(((u16)data9 <<8) ((u16)data8) -0x8000)

Data9	Current value = current code value * 11 / 4096 A.
Data10	Bus voltage value = (float)(((u16)data11 <<8) ((u16)data1-0x8000)) / 10 V
Data11	
Data12	Fault condition Fault = (((u32)data15 << 24) ((u32)data14 << 16) ((u32)data13 << 8) data12)) Bit0: Drive chip failure Bit1: Overvoltage fault, bus voltage exceeds 18V Bit2: Under-voltage fault, bus voltage below 8V Bit3: Overcurrent fault, motor power exceeded limit within 10 seconds Bit4: Encoder failure
Data13	
Data14	
Data15	
Data16	Motor status 0: Initialize 1: Current calibration 2: Encoder zero point calibration 3: Stop 4: Run 5: Error
Data17	Encoder zero-point calibration status 0: Idle 1: calibration 2: Completed 3: Error
Data18	Current motor mode 0x00: MIT pattern 0x01: Speed mode 0x02: Position Mode
Data19	0x00

3.4 Electric Machine Control

Direction: Host machine sends

Canid: Standard frame 0x701

DLC: Data length 8 bytes

Data0	0x01: Motor operation 0x00: Motor stopped Note: To control the motor in MIT mode, first send a command to start the motor.
Data1	0x01: Set the current motor position to point 0 for position control. Others: No effect
Data2	Set motor mode To change the motor mode, you must stop the motor (set data0 to 0X00) for the change to take effect. 0x00: MIT mode

	0x01: Speed mode 0x02: Position Mode
Data3	0x00
Data4	0x00
Data5	0x00
Data6	0x00
Data7	0x00

3.5 Motor Calibration

3.5.1: Calibration Instructions

The drive board must first complete calibration after receiving the motor encoder signals; otherwise, it cannot operate normally.

If the motor fails to rotate after calibration is completed and commands are sent, you can swap the wire sequences of u and w, recalibrate, and then run the motor. (The issue arises because the encoder's data increment direction conflicts with the motor's forward rotation direction in the program, preventing operation. Reversing the wire sequences resolves this problem.)

Direction: Host machine sends

Canid: Standard frame 0x7ff

DLC: Data length 8 bytes

Data0	0x55
Data1	0xaa
Data2	0cc
Data3	0x33
Data4	0x77
Data5	0x11
Data6	0xFF
Data7	0x00

After sending, the motor completes calibration approximately 10 seconds later. Return the calibration results.

3.5.1: Calibration Results

Direction: The motor controller sends

Canid: Standard frame 0x7fe

DLC: Data length 8 bytes

Data0	0x02: Motor calibration completed 0x03: Motor calibration error
Data1	0x00
Data2	0x00

Data3	0x00
Data4	0x00
Data5	0x00
Data6	0x00
Data7	0x00

4: Command Indication

<input checked="" type="checkbox"/>	0001	发送	00000702	标准 数据 FDBRS 12	0	01 00 00 80 00 80 C8 00 28 00 00 80
<input type="checkbox"/>	0002	发送	00000702	标准 数据 FDBRS 12	10000	01 00 01 80 00 80 00 00 00 00 C8 80
<input checked="" type="checkbox"/>	0003	发送	00000701	标准 数据 FDBRS 8	20000	01 00 00 00 00 00 00 00
<input type="checkbox"/>	0004	发送	00000701	标准 数据 FDBRS 8	30000	00 01 00 00 00 00 00 00
<input type="checkbox"/>	0005	发送	00000701	标准 数据 FDBRS 8	40000	00 00 00 00 00 00 00 00
<input type="checkbox"/>	0006	发送	000007FF	标准 数据 FDBRS 8	50000	55 AA CC 33 77 11 FF 00
<input type="checkbox"/>	0007	发送	00000701	标准 数据 FDBRS 8	60000	00 00 01 00 00 00 00 00
<input type="checkbox"/>	0008	发送	00000701	标准 数据 FDBRS 8	70000	00 00 02 00 00 00 00 00
<input type="checkbox"/>	0009	发送	00000702	标准 数据 FDBRS 12	80000	01 00 00 90 20 CE 00 00 00 00 80

0001: Set the location in MIT mode

0002: Set current in MIT mode

0003: Motor operation command

0004: The motor sets the current position to point 0, stops, and enters MIT mode.

0005: The motor stops and enters MIT mode

0006: Calibration instruction

0007: The motor stops and enters speed mode

0008: The motor stops and enters position mode

0009: Used to set position and speed in position mode and speed mode. The current speed is 2000 rpm, and the position is 0x10000001.

1) mit pattern

position control :

Send 0005 – 0003 – 0001.

current-controlled :

Send 0005 – 0003 – 0002.

2) Speed mode

Send 0007 – 0003 – 0009, the motor operates at 2000 rpm.

3) position mode

Send 0008 – 0003 – 0009 to position the motor at 0x10000001.

4) calibration

Send 0005 – 0006, then wait 10 seconds for calibration to complete.