

Custom CAN communication protocol V3.10b2

Protocol version:

- Rev.3.01b0 – 2024.06.01: Initial version;
- Rev.3.02b0 – 2024.07.22: Optimized the system reset protocol;
- Rev.3.03b0 – 2024.08.01: Added commands for configuring position-loop and speed-loop PID parameters;
- Rev.3.04b0 – 2024.11.21: Added brake output control and the encoder fault code;
- Rev.3.05b0 – 2025.03.18: Corrected descriptive errors; added support for receiving and responding to commands addressed to (0x100 | Dev_addr); added periodic 0xAE status reporting when a fault is detected; improved the communication examples at the end of the document;
- Rev.3.05b1 – 2025.04.03: Optimized the document and corrected inaccurate descriptions;
- Rev.3.06b0 – 2025.04.23: Added MIT mode;
- Rev.3.07b0 – 2025.05.18: Expanded the description of the "set current position as origin" command and added command 0xA4;
- Rev.3.08b0 – 2025.09.19: Added the communication fault code and command 0xCD;
- Rev.3.08b1 – 2025.10.29: Added command 0xBA for reading or modifying the device address and improved the read/write descriptions of several command parameters;
- Rev.3.09b0 – 2026.03.31: Modified command 0xB0 by removing pole-pair count and reduction ratio from the response while retaining the torque constant; added the 0xDA trapezoidal-profile control command and the 0xDC position-filter control command; added commands 0xD0–0xD1 for configuring trapezoidal-profile parameters and commands 0xD5–0xD7 for configuring position-filter parameters;
- Rev.3.10b0 – 2026.05.22: Added command 0xEF for reading and modifying the maximum KP and KD values in MIT mode;
- Rev.3.10b1 – 2026.05.27: Corrected inaccurate descriptions of the MIT protocol;
- Rev.3.10b2 – 2026.06.09: Corrected errors in the command summary table, the 0xAE field type, and the communication examples;

Protocol Overview:

1. The CAN interface uses a default bit rate of 1 MHz and can be configured by the host computer to 1 MHz, 500 KHz, 250 KHz, 125 KHz, or 100 KHz. All CAN messages in this protocol use data frames with standard identifiers, and multi-byte fields use little-endian byte order. Special bit fields in the MIT protocol are packed as defined in the corresponding section.
2. The factory-default device address (Dev_addr) is 0x01. The host computer can set it to any value from 1 to 254. Two special addresses are defined: 0x00 is the broadcast address, for which all slave devices execute the command without responding; 255 (0xFF) is the common address, for which all slave devices execute the command and respond using their own device addresses as the response IDs.
3. To distinguish frames sent by the master controller from responses sent by slave devices, a slave device accepts commands addressed to both Dev_addr and (0x100 | Dev_addr). In either case, the slave device responds to the master controller using Dev_addr as the response frame ID. For example, if Dev_addr is 0x01 and the master controller sends a frame with ID 0x101, the slave device responds with frame ID 0x01. The frame ID can therefore be used to identify the communication direction on the CAN bus.
4. In addition, the current address of the device can be identified through the blinking pattern of driver board green LED:
Device address 1: [_ _ - _ - _]
Device address 2: [_ _ - _ - _ - _]
Device address 3: [_ _ - _ - _ - _ - _]

Data type description:

- 1u – 1 unsigned byte
- 1s – 1 signed byte
- 2u – 2 unsigned bytes (little-endian byte order)
- 2s – 2 signed bytes (little-endian byte order)
- 4u – 4 unsigned bytes (little-endian byte order)
- 4s – 4 signed bytes (little-endian byte order)
- 4f – Single-precision floating-point value (little-endian byte order)
- b – Number of bytes
- bit – Bit; a 1-byte field contains 8 bits

Supported Custom CAN Control Commands:

Category	Command code	Command function description
System	0x00	Reboot the slave device; after receiving this command, the slave device reboots immediately without responding to the master controller;
	0xA0	Read Boot, software, hardware, CAN protocol version;
	0xA1	Read the real-time Q-axis current;
	0xA2	Read the real-time rotational speed;
	0xA3	Read the real-time single-turn and multi-turn absolute positions;
	0xA4	Read the real-time temperature, Q-axis current, speed, and single-turn absolute position;
	0xAE	Read the real-time DC bus voltage, DC bus current, operating temperature, operating mode, and fault-code status; when a fault other than a communication fault is detected, the slave device reports the real-time status every 200 ms;
	0xAF	Clear faults;
Parameters	0xB0	Read the torque constant;
	0xB1	Set the current position as the origin;
	0xB2	Read or set the maximum rotational speed in position mode; the value is not retained after power-off;
	0xB3	Read or set the maximum Q-axis current in position or speed mode; the value is not retained after power-off;
	0xB4	Read or set the Q-axis current slope in Q-axis current-control mode; the value is not retained after power-off;
	0xB5	Read or set the acceleration in speed-control mode; the value is not retained after power-off;
	0xB6	Read or set the position-loop Kp; the value is not retained after power-off;
	0xB7	Read or set the position-loop Ki; the value is not retained after power-off;
	0xB8	Read or set the speed-loop Kp; the value is not retained after power-off;
	0xB9	Read or set the speed-loop Ki; the value is not retained after power-off;
	0xBA	Read or set the device address; a power cycle or reboot is required for a new address to take effect, and the value is retained after power-off;
Control	0xC0	Q-axis current control; (torque = torque constant * Q-axis current)
	0xC1	Velocity control;
	0xC2	Absolute value position control;
	0xC3	Relative position Control;
	0xC4	Motor returns to the specified origin at the shortest distance and does not rotate at an angle greater than 180°;
	0xCD	Read or configure CAN communication-timeout enable, duration, and action type; the values are not retained after power-off;
	0xCE	Brake Switch output control configure and status read;
	0xCF	Disable motor output; the motor enters an uncontrolled free state;
Control	0xD0	Read or set the acceleration for trapezoidal-profile control; the value is not retained after power-off;
	0xD1	Read or set the deceleration for trapezoidal-profile control; the value is not retained after power-off;

Category	Command code	Command function description
	0xD5	Read or set the position-filter bandwidth; the value is not retained after power-off;
	0xD6	Read or set the position-filter rotational inertia; the value is not retained after power-off;
	0xD7	Read or set the current feedforward limit in position-filter mode; the value is not retained after power-off;
	0xDA	Trapezoidal-profile position control;
	0xDC	Position-filter control;
MIT protocol	0xEF	Read or configure Pos_KP_Max and Vel_KD_Max for the MIT control command;
	0xF0	Read or configure Pos_Max, Vel_Max, and T_Max for the MIT control command;
	0xF1	Read the real-time position, speed, torque, and status in MIT mode;
		MIT control command with no command code; set the most significant bit, Bit[10], of the frame identifier (StdID) to 1;

- **Reboot the slave device; after receiving this command, the slave device reboots immediately without responding to the master controller; [Command code: 0x00]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x08
[0]	Command code	1u	0x00
[1]-[7]	With 7bytes data	7b	0xFF 0x00 0xFF 0x00 0xFF 0x00 0xFF

- **Read the Boot, firmware, hardware, and custom CAN protocol versions; [Command code: 0xA0]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xA0

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x08
[0]	Command code	1u	0xA0
[1]-[2]	Boot Software Version	2u	
[3]-[4]	Apply software version	2u	
[5]-[6]	Hardware version	2u	Driver board Hardware code;
[7]	CAN Custom Version	1u	Current custom CAN protocol version;

- **Read the real-time Q-axis current; [Command code: 0xA1]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xA1

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xA1
[1]-[4]	Q-axis current	4s	Unit: 0.001 A; (torque = torque constant * Q-axis current)

- **Read the real-time rotational speed; [Command code: 0xA2]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xA2

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xA2
[1]-[4]	Rotational speed	4s	Unit 0.01 Rpm;

- **Read the real-time single-turn and multi-turn absolute positions; [Command code: 0xA3]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01

Can frame	Field name	Bytes	Content description data
[0]	Command code	1u	0xA3

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x07
[0]	Command code	1u	0xA3
[1]-[2]	Single-turn absolute angle	2u	Angle° = value*(360/16384);
[3]-[6]	Multi-turn absolute angle	4s	Total Angle° = value*(360/16384);

- **Read the real-time temperature, Q-axis current, speed, and single-turn absolute position; [Command code: 0xA4]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xA4

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x08
[0]	Command code	1u	0xA4
[1]	Operating temperature	1u	Unit °C;
[2]-[3]	Q-axis current	2s	Q-axis current unit: 0.001 A; (torque = torque constant * Q-axis current)
[4]-[5]	Rotational speed	2s	Unit 0.01 Rpm;
[6]-[7]	Single-turn absolute angle	2u	Angle° = value*(360/16384);

- **Read the real-time DC bus voltage, DC bus current, operating temperature, operating mode, and fault-code status; when a fault other than a communication fault is detected, the slave device reports the real-time status every 200 ms; [Command code: 0xAE]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xAE

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data	
StdID	Device address	11bit	Dev_addr	
DLC	Frame Length		0x08	
[0]	Command code	1u	0xAE	
[1]-[2]	DC bus voltage	2u	(A) 0.01 V units;	
[3]-[4]	DC bus current	2u	Unit 0.01A;	
[5]	Operating temperature	1u	Unit °C;	
[6]	Operating mode	1u	0: Disabled state;	1: Voltage Control;
			2: Q-axis current control;	3: Velocity control;
			4: Position control;	
[7]	Fault code	1u	[Bit0]Voltagefault;	[Bit1]Currentfault;
			[Bit2]Temperature fault;	[Bit3]: Encoder fault;
			[Bit4]: Reserved;	[Bit5]: Communications fault;
			[Bit6]Hardware fault;	[Bit7]: Software fault;
			Bitn indicates bit n; Bit0 indicates 0 bit;	

- **Clear faults; [Command code: 0xAF]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xAF

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data	
StdID	Device address	11bit	Dev_addr	
DLC	Frame Length		0x02	
[0]	Command code	1u	0xAF	
[1]	Fault code	1u	[Bit0]Voltagefault;	[Bit1]Currentfault;
			[Bit2]Temperature fault;	[Bit3]: Encoder fault;
			[Bit4]: Reserved;	[Bit5]: Communications fault;
			[Bit6]Hardware fault;	[Bit7]: Software fault;
			Bitn indicates bit n; Bit0 indicates 0 bit;	

- **Read the torque constant; [Command code: 0xB0]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xB0

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x07
[0]	Command code	1u	0xB0
[1]		1u	This is empty, 0x00
[2]-[5]	Torque Constant	4f	Unit N.m/A;
[6]		1u	This is empty, 0x00

- **Set the current position as the origin; the single-turn absolute origin is stored on the drive board and retained after power-off; if the secondary encoder is enabled, this operation takes longer and the slave-device response is delayed by approximately 35 ms; [Command code: 0xB1]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xB1

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x03
[0]	Command code	1u	0xB1
[1]-[2]	Mechanical offset	2u	

- **Read or set the maximum rotational speed in position mode; the value is not retained after power-off; [Command code: 0xB2]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB2
[1]-[4]	Position Ring output limit	4u	The position mode is the largest velocity in 0.01 Rpm; when the DLC is 1 the content is empty;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB2
[1]-[4]	Position Ring output limit	4u	The position mode is the largest velocity in 0.01 Rpm;

- **Read or set the maximum Q-axis current in position or speed mode; the value is not retained after power-off; [Command code: 0xB3]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB3
[1]-[4]	Velocity Ring output limit	4u	Velocity/position mode Max. Q axis current in 0.001A; when DLC is 1 this content is empty;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB3
[1]-[4]	Velocity Ring output limit	4u	Velocity/position mode Max. Q axis current, unit 0.001A;

- **Read or set the Q-axis current slope in Q-axis current-control mode; the value is not retained after power-off; [Command code: 0xB4]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB4
[1]-[4]	Q-axis current slope	4u	Current Output rate in 0.001A/s; when DLC is 1 this content is empty;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB4
[1]-[4]	Q-axis current slope	4u	Current Output rate, in 0.001A/s;

- **Read or set the acceleration in speed-control mode; the value is not retained after power-off; [Command code: 0xB5]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB5
[1]-[4]	Acceleration	4u	In 0.01 Rpm/s; when DLC is 1 this is empty;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB5
[1]-[4]	Acceleration	4u	In 0.01 Rpm/s;

- **Read or set the position-loop Kp; the value is not retained after power-off; [Command code: 0xB6]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB6
[1]-[4]	Location Control Closed Ring Kp	4f	This is empty when the DLC is 1;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB6
[1]-[4]	Location Control Closed Ring Kp	4f	

- **Read or set the position-loop Ki; the value is not retained after power-off; [Command code: 0xB7]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB7
[1]-[4]	Position-loop Ki	4f	This is empty when the DLC is 1;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB7
[1]-[4]	Position-loop Ki	4f	

- **Read or set the speed-loop Kp; the value is not retained after power-off; [Command code: 0xB8]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB8
[1]-[4]	Speed Control Closed Ring Kp	4f	This is empty when the DLC is 1;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB8
[1]-[4]	Speed Control Closed Ring Kp	4f	

- **Read or set the speed-loop Ki; the value is not retained after power-off; [Command code: 0xB9]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xB9
[1]-[4]	Speed-loop Ki	4f	This is empty when the DLC is 1;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xB9
[1]-[4]	Speed-loop Ki	4f	

- **Read or set the device address; a power cycle or reboot is required for a new address to take effect, and the value is retained after power-off; [Command code: 0xBA]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x02, configure parameters]
[0]	Command code	1u	0xBA
[1]	Device address	1u	This is empty when the DLC is 1;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x02
[0]	Command code	1u	0xBA
[1]	Device address	1u	

- **Q-axis current control; [Command code: 0xC0]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x05
[0]	Command code	1u	0xC0
[1]-[4]	Q-axis current	4s	Unit: 0.001 A; (torque = Q-axis current * torque constant);

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA1;

- **Speed control; [Command code: 0xC1]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x05
[0]	Command code	1u	0xC1
[1]-[4]	Rotational speed	4s	In 0.01 Rpm;

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA2;

- **Absolute position control; [Command code: 0xC2]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x05
[0]	Command code	1u	0xC2
[1]-[4]	Absolute value position	4s	(B) motor Circle 16384Count;

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA3;

- **Relative position control; [Command code: 0xC3]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x05
[0]	Command code	1u	0xC3
[1]-[4]	Relative position	4s	(B) motor Circle 16384Count;

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA3;

- **Return to the origin along the shortest path; [Command code: 0xC4]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xC4

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA3;

- **Read or configure CAN communication-timeout enable, duration, and action type; the values are not retained after power-off; [Command code: 0xCD]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xCD
[1]	Enable	1u	0x00: Disabled; 0x01: Enabled; disabled by default;
[2]-[3]	Duration	2u	Units ms; default is 5000 ms;

Can frame	Field name	Bytes	Content description data
[4]	Action Type	1u	When timeout monitoring is enabled and the elapsed time exceeds the configured value, the slave device reports a communication fault and disables the motor. The following additional actions can be configured: [Bit0]: Communication fault code does not allow software clear; [Bit1]: Brake Switch off; Default 0x00, no additional action;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xCD
[1]	Enable	1u	0x00: Disabled; 0x01: Enabled;
[2]-[3]	Duration	2u	Unit: ms;
[4]	Action Type	1u	[Bit0]: Communication fault code does not allow software clear; [Bit1]: Brake Switch off;

- **Configure the brake-switch output or read its status; [Command code: 0xCE]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x02
[0]	Command code	1u	0xCE
[1]	Operation Type	1u	0x00: Switch off; 0x01: Closed; 0xFF: Read status;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x02
[0]	Command code	1u	0xCE
[1]	Action Type	1u	0x00: Switch off; 0x01: Closed;

- **Disable motor output; the motor enters an uncontrolled free state, which is also its power-on state; [Command code: 0xCF]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xCF

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xAE;

- **Read or set the acceleration for trapezoidal-profile control; the value is not retained after power-off; [Command code: 0xD0]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xD0
[1]-[4]	Trapezoidal-profile acceleration	4u	Unit 0.01rpm/s; empty when DLC is 1; default is 10rpm/s

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xD0
[1]-[4]	Trapezoidal-profile acceleration	4u	Unit 0.01rpm/s;

- **Read or set the deceleration for trapezoidal-profile control; the value is not retained after power-off; [Command code: 0xD1]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xD1
[1]-[4]	Trapezoidal-profile deceleration	4u	Unit 0.01rpm/s; empty when DLC is 1; default is 10rpm/s

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xD1
[1]-[4]	Trapezoidal-profile deceleration	4u	Unit 0.01rpm/s;

- **Read or set the position-filter bandwidth; the value is not retained after power-off; [Command code: 0xD5]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x03, configure parameters]
[0]	Command code	1u	0xD5
[1]-[2]	Filter Bandwidth	2u	Units Hz; this is empty when the DLC is 1; default 50 Hz;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x03
[0]	Command code	1u	0xD5
[1]-[2]	Filter Bandwidth	2u	Unit Hz;

- **Read or set the position-filter rotational inertia; the value is not retained after power-off; [Command code: 0xD6]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xD6
[1]-[4]	Position-filter rotational inertia	4f	Unit: Nm/(turn/s ²); 0 disables current feedforward. This field is empty when DLC is 1; default: 0.001 Nm/(turn/s ²);

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xD6
[1]-[4]	Position-filter rotational inertia	4f	Unit: Nm/(turn/s ²); 0 disables current feedforward;

- **Read or set the current feedforward limit in position-filter mode; the value is not retained after power-off; [Command code: 0xD7]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xD7
[1]-[4]	Maximum feedforward current in position-filter mode	4u	Unit 0.001A; empty when DLC is 1; default 1A;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xD7

Can frame	Field name	Bytes	Content description data
[1]-[4]	Maximum feedforward current in position-filter mode	4u	Unit 0.001A

- **Trapezoidal-profile position control; [Command code: 0xDA]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x06
[0]	Command code	1u	0xDA
[1]	Position Type	1u	[00: Absolute value position] [01: Relative value position]
[2]-[5]	Target position	4s	(B) motor Circle 16384Count;

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA3;

- **Position-filter control; [Command code: 0xDC]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x06
[0]	Command code	1u	0xDC
[1]	Position Type	1u	[00: Absolute value position] [01: Relative value position]
[2]-[5]	Target position	4s	(B) motor Circle 16384Count;

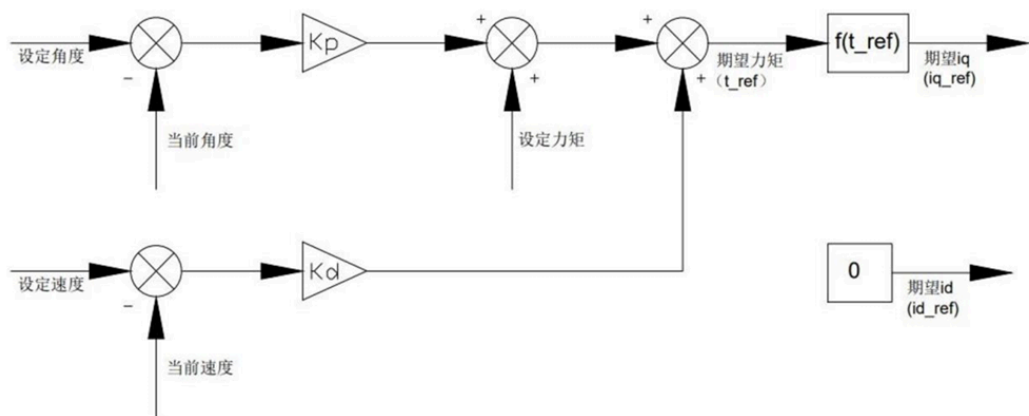
2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the response command code, the slave-device response is identical to the response for command 0xA3;

MIT Mode: MIT Protocol Control

To support motors with different specifications, the maximum position, speed, and torque values can be configured according to the actual motor parameters and application requirements. In the MIT protocol, position, speed, and torque use units different from those in the preceding sections:

1. Position unit: radians (rad), where 2π rad corresponds to 360° ;
2. Speed unit: radians per second (rad/s), where 2π rad/s corresponds to 60 revolutions per minute (Rpm);
3. Torque unit: newton-meter (Nm); configure the motor torque constant correctly using the host computer;

MIT mode logic diagram:



Detailed MIT protocol:

- Read or configure Pos_KP_Max and Vel_KD_Max for the MIT control command; data uses little-endian byte order; configured parameters are stored on the drive board and retained after power-off; **[Command code: 0xEF]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x05, configure parameters]
[0]	Command code	1u	0xEF
[1]-[2]	Pos_KP_Max	2u	Configure Pos_KP_Max for MIT mode; default: 500; maximum configurable value: 1000;

Can frame	Field name	Bytes	Content description data
[3]-[4]	Vel_KD_Max	2u	Configure Vel_KD_Max for MIT mode; default: 5; maximum configurable value: 100;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x05
[0]	Command code	1u	0xEF
[1]-[2]	Pos_KP_Max	2u	Pos_KP_Max for MIT mode; default: 500; maximum configurable value: 1000;
[3]-[4]	Vel_KD_Max	2u	Vel_KD_Max for MIT mode; default: 5; maximum configurable value: 100;

- **Read or configure Pos_Max, Vel_Max, and T_Max for the MIT control command; data uses little-endian byte order; configured parameters are stored on the drive board and retained after power-off; [Command code: 0xF0]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		[0x01, read parameters]、[0x07, configure parameters]
[0]	Command code	1u	0xF0
[1]-[2]	Pos_Max	2u	Configure Pos_Max for MIT mode in units of 0.1 rad; default: 955, corresponding to Pos_Max = 95.5 rad;
[3]-[4]	Vel_Max	2u	Configure Vel_Max for MIT mode in units of 0.01 rad/s; default: 4500, corresponding to Vel_Max = 45.00 rad/s;
[5]-[6]	T_Max	2u	Configure T_Max for MIT mode in units of 0.01 Nm; default: 1800, corresponding to T_Max = 18.00 Nm;

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x07
[0]	Command code	1u	0xF0
[1]-[2]	Pos_Max	2u	Pos_Max for MIT mode, in units of 0.1 rad;
[3]-[4]	Vel_Max	2u	Vel_Max for MIT mode, in units of 0.01 rad/s;

Can frame	Field name	Bytes	Content description data
[5]-[6]	T_Max	2u	T_Max for MIT mode, in units of 0.01 Nm;

- **Read the real-time position, speed, torque, and status in MIT mode; [Command code: 0xF1]**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr、(0x100 Dev_addr)、0x00、0xFF
DLC	Frame Length		0x01
[0]	Command code	1u	0xF1

2. The slave device (lower-level controller) responds to the master controller (host computer)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	Dev_addr
DLC	Frame Length		0x07
[0]	Command code	1u	0xF1
[1]	Mechanical position	16bit	Byte[1] contains the upper 8 bits and Byte[2] contains the lower 8 bits; [0~65535] maps to (-Pos_Max ~ Pos_Max);
[2]			
[3]	Mechanical velocity	12bit	Byte[3] contains the upper 8 bits and Byte[4]-Bit[7:4] contains the lower 4 bits; [0~4095] maps to (-Vel_Max ~ Vel_Max);
[4] Bit[7:4]			
[5]	Torque	12bit	Byte[4]-Bit[3:0] contains the upper 4 bits and Byte[5] contains the lower 8 bits; [0~4095] maps to (-T_Max ~ T_Max);
[6]	Status Information	1u	[Bit0]: 1 indicates MIT mode; [Bit1]: 1 indicates a system fault;

- **MIT control command; because this frame does not contain a command code, the master controller must set the most significant bit, Bit[10], of StdID to 1 so that the slave device can identify it as an MIT control frame. If Dev_addr is 1, set StdID to 0x401 or 0x501. After receiving the frame, the slave device immediately switches to MIT mode and executes the command. Send command 0xCF to exit MIT mode, or command 0xB1 to set the current position as the origin;**

1. The master controller (host computer) sends to the slave device (lower-level controller)

Can frame	Field name	Bytes	Content description data
StdID	Device address	11bit	(0x400 Dev_addr)、(0x400 (0x100 Dev_addr))、(0x400 0x00)、(0x400 0xFF)

Can frame		Field name	Bytes	Content description data
DLC		Frame Length		0x08
[0]		Target position	16bit	Byte[0] contains the upper 8 bits and Byte[1] contains the lower 8 bits; [0~65535] maps to (-Pos_Max ~ Pos_Max);
[1]				
[2]		Target velocity	12bit	Byte[2] contains the upper 8 bits and Byte[3]-Bit[7:4] contains the lower 4 bits; [0~4095] maps to (-Vel_Max ~ Vel_Max);
[3]	Bit[7:4]			
	Bit[3:0]	Position Gain Kp value	12bit	Byte[3]-Bit[3:0] contains the upper 4 bits and Byte[4] contains the lower 8 bits; [0~4095] maps to [0~Pos_KP_Max];
[4]				
[5]		Velocity Gain Kd	12bit	Byte[5] contains the upper 8 bits and Byte[6]-Bit[7:4] contains the lower 4 bits; [0~4095] maps to [0~Vel_KD_Max];
[6]	Bit[7:4]			
	Bit[3:0]	Target torque	12bit	Byte[6]-Bit[3:0] contains the upper 4 bits and Byte[7] contains the lower 8 bits; [0~4095] maps to (-T_Max ~ T_Max);
[7]				

2. The slave device (lower-level controller) responds to the master controller (host computer)
The slave-device response is identical to the response for command 0xF1;

The command format of the CAN protocol communication packet is as follows: (CAN messages use the data-frame format and standard-frame format, and bytes follow the little-endian format)

Can Communications Frame	Field name
StdID	Device address
DLC	Frame Length
Data[0]	Command code
Data[1]-Data[7]	Data Field

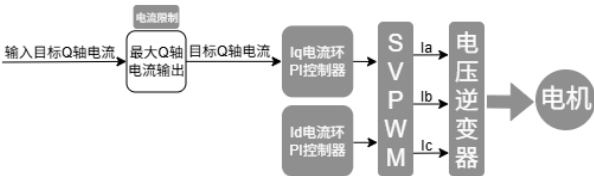
[0xAF] - Clear fault

Master-controller transmit data (HEX): AF; DLC is 1;		
AF		
Master-controller receive data (HEX): AF 00; DLC is 2;		
AF	00	

Parsing from 0xAF protocolMaster controller receiveData:

Received data fields	Corresponds to parameters value/mean
0x00	Fault code; 0x00 is no fault and other fault code view the above-mentioned manual [0xAF] command code;

[Command 0xC0] - Q-axis current control; the control block diagram is shown below:



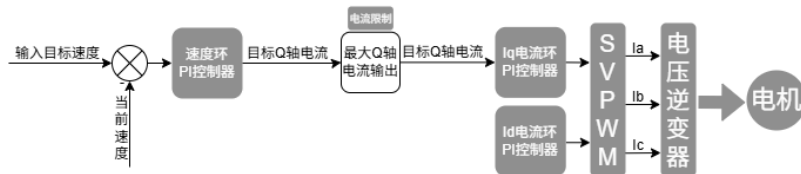
Target Q-axis current: 1 A. Assuming that the slave-device address is 1, the communication frames are as follows:

Master-controller transmit data (HEX): C0 E8 03 00 00; 0x000003E8 is 1000 in decimal, and 1000*0.001 = 1 A; DLC is 5;					
C0	E8	03	00	00	
Master-controller receive data (HEX): C0 F5 03 00 00; DLC is 5;					
C0	F5	03	00	00	

Parsing from 0xC0 protocolMaster controller receiveData:

Received data fields	Corresponds to parameters value/mean
0x000003F5	Current Q-axis current; 0x000003F5 is 1013 in decimal, and $1013 \times 0.001 = 1.013 \text{ A}$;

[Command 0xC1] - Speed control; the control block diagram is shown below:



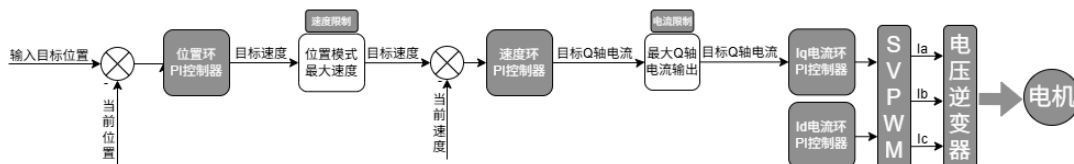
Target speed: 100 rpm. Assuming that the **slave-device address is 1**, the communication frames are as follows:

Master-controller transmit data (HEX): C1 10 27 00 00; 0x00002710 is 10000 in decimal, and $10000 \times 0.01 = 100 \text{ Rpm}$; DLC is 5;					
C1	10	27	00	00	
Master-controller receive data (HEX): C1 38 27 00 00; DLC is 5;					
C1	38	27	00	00	

Parsing under 0xC1 protocol**Master controller receive**Data:

Received data fields	Corresponds to parameters value/mean
0x00002738	Current velocity; 0x00002738 to 10040; $10040 \times 0.01 = 100.4 \text{ Rpm}$;

[Command 0xC2] - Absolute position control; the control block diagram is shown below:



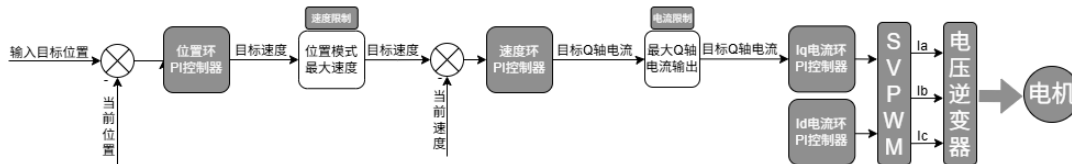
Target position: 16384 count. Assuming that the **slave-device address is 1**, the communication frames are as follows:

Master-controller transmit data (HEX): C2 00 40 00 00; 0x00004000 is 16384 in decimal, so the motor rotates to the 360° position; DLC is 5;							
C2	00	40	00	00			
Master-controller receive data (HEX): C2 00 00 00 00 00 00; DLC is 7;							
C2	00	00	00	00	00	00	

Parsing under 0xC2 protocol**Master controller receive**Data:

Received data fields	Corresponds to parameters value/mean
[1]-[2]:0x0000	Current single-turn absolute position; angle: 0°;
[3]-[6]:0x00000000	Current multi-turn absolute position; angle: 0°;

[Command 0xC3] - Relative position control; the control block diagram is shown below:



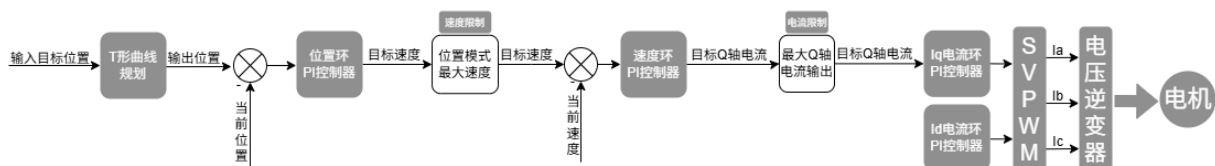
Rotation angle: 90°. Assuming that the **slave-device address is 1**, the communication frames are as follows:

Master-controller transmit data (HEX): C3 00 10 00 00; 0x00001000 is 4096 in decimal, and $4096 \times (360/16384) = 90^\circ$; DLC is 5;							
C3	00	10	00	00			
Master-controller receive data (HEX): C3 00 40 00 00 00 00; DLC is 7;							
C3	00	40	00	00	00	00	

Parsing under 0xC3 protocol**Master controller receive**Data:

Received data fields	Corresponds to parameters value/mean
[1]-[2]:0x4000	Current single-turn absolute position; 4000 is 16384 in decimal, and $16384 \times (360/16384) = 360^\circ$;
[3]-[6]:0x00004000	Current multi-turn absolute position; 4000 is 16384 in decimal, and $16384 \times (360/16384) = 360^\circ$;

[Command 0xDA] - Trapezoidal-profile position control; the control block diagram is shown below:



Rotation angle: 90°. Assuming that the **slave-device address is 1**, the communication frames are as follows:

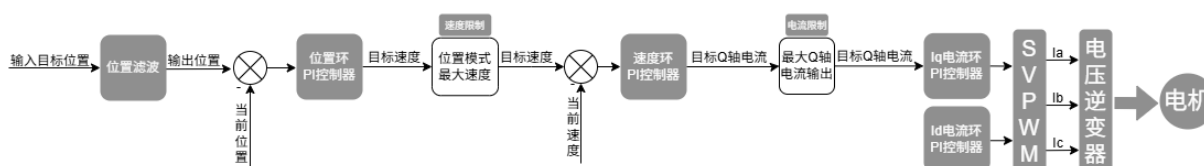
Master-controller transmit data (HEX): DA 00 00 10 00 00; 0x00001000 is 4096 in decimal, and 4096*(360/16384) = 90°; DLC is 6;						
DA	00	00	10	00	00	
	①	②				
Master-controller receive data (HEX): DA 00 40 00 00 00 00; DLC is 7;						

DA	00	40	00	00	00	00	
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Parsing from 0xDA protocol**Master controller send**Data:

Serial number	Transmitted data fields (HEX)	Corresponds to parameters value/mean
①	0x00	Absolute position Control;
②	0x00001000	0x00001000 is 4096 in decimal, and $4096^* (360/16384) = 90^{\circ}$;

[Command 0xDC] - Position-filter control; the control block diagram is shown below:



Rotation angle: 90° . Assuming that the **slave-device address is 1**, the communication frames are as follows:

Master-controller transmit data (HEX): DC 00 00 10 00 00; 0x00001000 is 4096 in decimal, and 4096*(360/16384) = 90°; DLC is 6;						
DC	00	00	10	00	00	
	①	②				
Master-controller receive data (HEX): DC 00 40 00 00 00 00; DLC is 7;						
DC	00	40	00	00	00	00

Parsing from 0xDC protocol**Master controller send**Data:

Serial number	Transmitted data fields (HEX)	Corresponds to parameters value/mean
①	0x00	Absolute position Control;
②	0x00001000	0x00001000 is 4096 in decimal, and $4096^* (360/16384) = 90^{\circ}$;

[0xCF] - Motor disable;

Master-controller transmit data (HEX): CF; DLC is 1;							
CF							
Slave-device response data (HEX): CF 7C 09 01 00 26 00 00; DLC is 8;							
CF	7C	09	01	00	26	00	00
	①		②		③	④	⑤

Parsing under 0xCF protocol**Master controller receive**Data:

Serial number	Received data fields (HEX)	Corresponds to parameters value/mean
①	0x097C	0x097C is 2428 in decimal; DC bus voltage = 2428*0.01 = 24.28 V;
②	0x0001	0x0001 is 1 in decimal; DC bus current = 1*0.01 = 0.01 A;
③	0x26	0x26 decimal 38 and motor 38°C;
④	0x00	Operating mode; 0x00 indicates the disabled state; see the preceding sections for details;
⑤	0x00	Fault code; 0x00 is no fault and see the above in the current manual for details;