

Custom RS485 Communication Protocol_V3.03b3

Protocol Version:

- Rev.3.01b0 – 2024.01.06: Initial release;
- Rev.3.01b1 – 2024.06.25: Added more communication frame examples;
- Rev.3.02b0 – 2024.11.21: Added support for Tamagawa RS485 encoders, a brake output control command, and an encoder fault code;
- Rev.3.02b1 – 2025.02.20: Corrected the command-code field in the 0x10 command table;
- Rev.3.02b2 – 2025.02.21: Corrected the second-encoder enable descriptions for commands 0x10 and 0x11;
- Rev.3.02b3 – 2025.03.28: Improved the communication examples;
- Rev.3.02b4 – 2025.04.24: Improved the document wording;
- Rev.3.03b0 – 2026.03.31: Added MIT protocol commands 0x30, 0x31, and 0x32; added position-velocity control command 0x25, trapezoidal-profile position control command 0x26, position-filter control command 0x27, and position-filter parameter command 0x17; added RS485 communication-timeout configuration command 0x2D; revised the read/write contents of user parameters (0x10 and 0x11) and motor hardware parameters (0x12 and 0x13);
- Rev.3.03b1 – 2026.05.22: Added position KP and velocity KD maximum-value settings to MIT parameter command 0x30;
- Rev.3.03b2 – 2026.05.27: Corrected inaccurate descriptions in the MIT protocol section;
- Rev.3.03b3 – 2026.06.09: Corrected data-length and CRC-check descriptions;

Protocol Overview:

1. The RS485 interface **defaults to a baud rate of 115200** (8 data bits, no parity, and 1 stop bit). The baud rate can be configured through the user-parameter interface of the host computer as 921600, 460800, 115200, 57600, 38400, 19200, or 9600. All multi-byte fields use **little-endian byte order**.
2. The product **defaults to device address 0x01**. The host computer can configure the device address in the range 1–254. Address 0 is the broadcast address: every slave executes the command but does not respond to the master. Address 255 (0xFF) is the common address: every slave responds to commands sent to this address. The master may use the common address when communicating with a single slave to obtain configuration parameters. The current device address can be identified from the flashing pattern of the green LED on the drive board. (Device address 1: [_ _ _ _ _]) (Device address 2: [_ _ _ _ _]) (Device address 3: [_ _ _ _ _]), etc.
3. The RS485 bus allows only one master, and slave devices on the same bus must not share an address. If multiple slaves use the same address, they will respond simultaneously when the master communicates with that address, which may cause bus contention and damage the control boards. **Therefore, before connecting multiple slaves to the same bus, configure a unique address for each slave through the host computer or the communication protocol.**

RS485 V3.x Communication Packet Format:

Field name	Byte count	Description
Protocol Header	1 byte	The protocol header is 0xAE for packets sent by the master and 0xAC for packets returned by a slave.
Packet sequence number	1 byte	The packet sequence number in a slave response must match the sequence number in the corresponding master request.
Device address	1 byte	The address range is 0x00–0xFF. Address 0x00 is the broadcast address, and 0xFF is the common address. Broadcast address: All slaves receive and execute the command, but do not respond to the master. Common address: All slaves receive and execute the command and respond to the master. Because of RS485 bus characteristics, the common address must not be used when multiple motors are connected to the same bus.
Command code	1 byte	Each command has a distinct command code.
Data Length	1 byte	[Data field] number of bytes (can be 0);
Data Field	0-248(Byte)	Command code with data;
CRC16 Check	2 bytes	The CRC16_MODBUS value calculated from the protocol header through the final byte of the data field. For the calculation, refer to the supplied C source code for CRC16_MODBUS.

Data Type Definitions:

- 1u – 1-byte unsigned integer
- 1s – 1-byte signed integer
- 2u – 2-byte unsigned integer (little-endian byte order)

- 2s – 2-byte signed integer (little-endian byte order)
- 4u – 4-byte unsigned integer (little-endian byte order)
- 4s – 4-byte signed integer (little-endian byte order)
- 4f – Single-precision floating-point value (little-endian byte order)
- Nb – Byte array containing N bytes

RS485 V3.x Protocol Control Commands:

Category	Command code	Command function description
System	0x00	Restart the slave. After receiving this command packet, the slave restarts immediately and does not respond to the master.
	0x0A	Read the bootloader, application software, hardware, RS485 protocol and CAN protocol versions, and the UID.
	0x0B	Read real-time data such as the single-turn absolute angle, multi-turn absolute angle, speed, and Q-axis current.
	0x0F	Clear faults.
Parameters	0x10	Read user parameters.
	0x11	Write and save user parameters.
	0x12	Read motor hardware parameters.
	0x13	Write and save motor hardware parameters.
	0x14	Read motion-control parameters.
	0x15	Write motion-control parameters without saving them.
	0x16	Write and save motion-control parameters.
	0x17	Read or configure position-filter control parameters. The parameters are not retained after power loss.
	0x1D	Set the current position as the origin.
	0x1E	Calibrate the encoder. The motor must be unloaded during calibration, and its rotation must not be obstructed.
	0x1F	Restore parameter defaults.
Control	0x20	Q-axis current control (torque = torque constant × Q-axis current).
	0x21	Speed control.
	0x22	Absolute-position control.
	0x23	Relative-position control.
	0x24	Return the motor to the specified origin by the shortest path, with a rotation angle no greater than 180°.
	0x25	Position-velocity control.
	0x26	Trapezoidal-profile position control.
	0x27	Position-filter control.
	0x2D	Read or configure the RS485 communication-timeout enable state, duration, and action type. The parameters are not retained after power loss.
	0x2E	Control the brake switch output.
	0x2F	Disable motor output; the motor enters the uncontrolled free state used after power-on.
MIT Protocol	0x30	Read or configure Pos_Max, Vel_Max, T_Max, Pos_KP_Max, and Vel_KD_Max for MIT motion control. The parameters are retained after power loss.
	0x31	Read real-time position, velocity, torque, and status information in MIT motion-control mode.
	0x32	MIT motion-control command.

- **Restart the slave; after receiving this command packet, the slave restarts immediately and does not respond to the master. [Command code: 0x00]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x00
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

- **Read the bootloader, software, hardware, RS485 protocol and CAN protocol versions, and the unique device identifier. [Command code: 0x0A]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0A
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0A
[4]	Data Length	1u	0x16
[5]-[6]	Boot software version	2u	
[7]-[8]	Apply software version	2u	
[9]-[10]	Hardware Model	2u	Driver board Hardware code;
[11]	RS485- Custom	1u	RS485-Customized protocol version;
[12]	RS485-Modbus	1u	RS485-Modbus protocol version; (0 not supported)
[13]	CAN - Custom	1u	CAN - Custom protocol version;
[14]	CAN-CanOpen	1u	CANopen protocol version; (0 not supported)
[15]-[26]	Unique UID Serial Number	12b	Unique Device Serial Number
[27]-[28]	CRC16 Check	2u	DATA[0]~DATA[26]Byte CRC16 Verify

- **Read real-time data (single-turn absolute angle, multi-turn absolute angle, speed, Q-axis current, bus voltage, bus current, operating temperature, operating state, motor state, and fault code); the single-turn resolution is 14 bits. [Command code: 0x0B]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0B
[4]	Data Length	1u	0x00

Serial number	Field name	Type	Content description
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0B
[4]	Data Length	1u	0x16
[5]-[6]	Single-turn absolute angle	2u	Angle (°) = value × (360/16384).
[7]-[10]	Multi-turn absolute angle	4s	Total angle (°) = value × (360/16384).
[11]-[14]	Mechanical speed	4s	Unit 0.01rpm;
[15]-[18]	Q-axis current	4s	Unit 0.001A; (torque=Qaxis current*Torque Constant)
[19]-[20]	Bus voltage	2u	Unit: 0.01 V;
[21]-[22]	Bus current	2u	Unit 0.01A; the value is invalid during encoder calibration;
[23]	Operating temperature	1u	Unit °C;
[24]	Run status	1u	0: Close status 1: Voltage Control 2: Q-axis current control 3: Velocity control 4: Position control
[25]	Motor status	1u	0: Disabled Other values: Enabled
[26]	Fault code	1u	[Bit0]Voltage fault [Bit1]Current fault [Bit2]Temperature fault [Bit3]Encoder fault [Bit6]Hardware fault [Bit7]: Software fault (Bit n represents bit n of the byte; Bit0 represents bit 0.)
[27]-[28]	CRC16 Check	2u	DATA[0]~DATA[26]Byte CRC16 Verify

- **Clear faults. [Command code: 0x0F]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0F
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x0F
[4]	Data Length	1u	0x01
[5]	Current fault	1u	[Bit0]Voltage fault [Bit1]Current fault [Bit2]Temperature fault [Bit3]Encoder fault [Bit6]Hardware fault [Bit7]: Software fault (Bit n represents bit n of the byte; Bit0 represents bit 0.)
[6]-[7]	CRC16 Check	2u	DATA[0]~DATA[5]Byte CRC16 Verify

- **Read user parameters. [Command code: 0x10]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE

Serial number	Field name	Type	Content description
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x10
[4]	Data Length	1u	0x02
[5]	Protocol version	1u	V1: 0x01; V2: 0x02; V3: 0x03. Different versions contain different content; each higher version includes all parameters from the lower versions. The protocol version can be identified from the cover or filename of this document: "Custom RS485 Communication Protocol_V3.0xbx" indicates V3; "Custom RS485 Communication Protocol_V2.0xbx" indicates V2.
[6]	Reserved	1u	
[7]-[8]	CRC16 Check	2u	DATA[0]~DATA[6]Byte CRC16 Verify

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

Version Distinction	Serial number	Field name	Type	Content description
	[0]	Protocol Header	1u	0xAC
	[1]	Packet sequence number	1u	0x00~0xFF
	[2]	Device address	1u	0x01~0xFE
	[3]	Command code	1u	0x10
	[4]	Data Length	1u	0x1C
V1/V2	[5]-[6]	Electrical angle offset	2u	Angle offset obtained by encoder calibration;
	[7]-[8]	Mechanical offset	2u	Angle offset obtained by setting the zero position;
	[9]-[10]	U-phase current offset	2u	Offset obtained by U-phase current calibration;
	[11]-[12]	V-phase current offset	2u	Offset obtained by V-phase current calibration;
	[13]-[14]	W-phase current offset	2u	Offset obtained by W-phase current calibration;
	[15]	Encoder Model	1u	0: AS504x_SPI 1: Ma7xx_SPI 2: MT6835_SPI 3: TLx5012_SSI 4: AS504x_PWM 5: Tamagawa

Version Distinction	Serial number	Field name	Type	Content description
				(This parameter is invalid for drive boards that use the onboard encoder.)
	[16]	Change direction encoder	1u	0: No change of direction Other: change of direction;
	[17]	Enable second encoder	1u	0: No enable Other: enable;
	[18]	Speed filter coefficient	1u	Value 1 ~ 100 indicates coefficient 0.01 ~ 1;
	[19]	Device address	1u	Address range 0x01~0xFE (1~254);
	[20]	RS485 baud rate	1u	0: 921600 1: 460800 2: 115200 3: 57600 4: 38400 5: 19200 6: 9600 (Default value 115200)
	[21]	CAN baud rate	1u	0: 1M 1: 500K 2: 250K 3: 125K 4: 100K (The default value is 1M);
	[22]	Functional Extension	1u	[bit0]Canopen function Other: set aside; Note: setting [Bitn] to 1 enables the corresponding function.
	[23]-[24]	Maximum bus voltage	2u	0.01 V in units
	[25]	Overvoltage fault delay	1u	An overvoltage fault is reported when the continuous overvoltage duration exceeds this value; unit: s.
	[26]-[27]	Maximum bus current	2u	Unit 0.01A
	[28]	Overcurrent fault delay	1u	An overcurrent fault is reported when the continuous overcurrent duration exceeds this value; unit: s.
	[29]	Maximum temperature	1u	Maximum temperature, in °C;
	[30]	Temperature fault duration	1u	Growing up in excess of the temperature at that time and reporting fault; units of seconds;
V3	[31]-[32]	Current-loop gain	2u	Unit: rad/s; a value of 0 selects the voltage loop.
	[33]-[34]	CRC16 Check	2u	DATA[0]~DATA[32]Byte CRC16 Verify

- **Write and save user parameters. [Command code: 0x11]**

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

Version Distinction	Serial number	Field name	Type	Content description
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Version Distinction	Serial number	Field name	Type	Content description
	[0]	Protocol Header	1u	0xAE
	[1]	Packet sequence number	1u	0x00~0xFF
	[2]	Device address	1u	0x01~0xFE
	[3]	Command code	1u	0x11
	[4]	Data Length	1u	0x12
V1/V2	[5]	Encoder Model	1u	0: AS504x_SPI 1: Ma7xx_SPI 2: MT6835_SPI 3: TLx5012_SSI 4: AS504x_PWM 5: Tamagawa (This parameter is invalid for drive boards that use the onboard encoder.)
	[6]	Change direction encoder	1u	0: No change of direction Other: change of direction;
	[7]	Enable second encoder	1u	0: No enable Other: enable;
	[8]	Speed filter coefficient	1u	Value 1 ~ 100 indicates coefficient 0.01 ~ 1;
	[9]	Device address	1u	Address range 0x01~0xFE (1~254);
	[10]	RS485 baud rate	1u	0: 921600 1: 460800 2: 115200 3: 57600 4: 38400 5: 19200 6: 9600 (Default value 115200)
	[11]	CAN baud rate	1u	0: 1M 1: 500K 2: 250K 3: 125K 4: 100K (The default value is 1M);
	[12]	Functional Extension	1u	[bit0]Canopen function Other: set aside; Note: setting [Bitn] to 1 enables the corresponding function.
	[13]-[14]	Maximum bus voltage	2u	0.01 V in units
	[15]	Overvoltage fault delay	1u	An overvoltage fault is reported when the continuous overvoltage duration exceeds this value; unit: s.
	[16]-[17]	Maximum bus current	2u	Unit 0.01A
	[18]	Overcurrent fault delay	1u	An overcurrent fault is reported when the continuous overcurrent duration exceeds this value; unit: s.
	[19]	Maximum temperature	1u	Maximum temperature, in °C;
	[20]	Temperature fault duration	1u	Growing up in excess of the temperature at that time and reporting fault; units of seconds;

Version Distinction	Serial number	Field name	Type	Content description
V3	[21]-[22]	Current-loop gain	2u	Unit: rad/s; a value of 0 selects the voltage loop.
	[23]-[24]	CRC16 Check	2u	DATA[0]~DATA[22]Byte CRC16 Verify

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

Except for command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x10 order;

- **Read motor hardware parameters. [Command code: 0x12]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x12
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Version Distinction	Serial number	Field name	Type	Content description
	[0]	Protocol Header	1u	0xAC
	[1]	Packet sequence number	1u	0x00~0xFF
	[2]	Device address	1u	0x01~0xFE
	[3]	Command code	1u	0x12
	[4]	Data Length	1u	0x21

Version Distinction	Serial number	Field name	Type	Content description
	[5] - [20]	Motor Name	Nb	Motor Name of ASCII character
	[21]	Number of motor pole pairs	1u	
	[22]-[25]	Phase resistance	4f	Resistance measured between two phases, divided by 2; unit: Ω .
	[26]-[29]	Phase inductance	4f	Inductance measured between two phases, divided by 2; unit: mH.
	[30]-[33]	Torque Constant	4f	Unit N.m/A;
	[34]	Reduction ratio	1u	Low 8 bits of the reduction-ratio numerator
V3	[35]		1u	High 8 bits of the reduction-ratio numerator
	[36]-[37]		2u	Reduction-ratio denominator
	[38]-[39]	CRC16 Check	2u	DATA[0]~DATA[37]Byte CRC16 Verify

- **Write and save motor hardware parameters. [Command code: 0x13]**

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

Version Distinction	Serial number	Field name	Type	Content description
	[0]	Protocol Header	1u	0xAE
	[1]	Packet sequence number	1u	0x00~0xFF
	[2]	Device address	1u	0x01~0xFE
	[3]	Command code	1u	0x13
	[4]	Data Length	1u	V1/V2: 0x1E V3: 0x21
V1/V2	[5] - [20]	Motor Name	Nb	Motor Name of ASCII character
	[21]	Number of motor pole pairs	1u	
	[22]-[25]	Phase resistance	4f	Resistance measured between two phases, divided by 2; unit: Ω .

Version Distinction	Serial number	Field name	Type	Content description
	[26]-[29]	Phase inductance	4f	Inductance measured between two phases, divided by 2; unit: mH.
	[30]-[33]	Torque Constant	4f	Unit N.m/A;
	[34]	Reduction ratio	1u	Low 8 bits of the reduction-ratio numerator
V3	[35]		1u	High 8 bits of the reduction-ratio numerator
	[36]-[37]		2u	Reduction-ratio denominator
	[38]-[39]	CRC16 Check	2u	DATA[0]~DATA[37]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with those of the 0x12 order;

- **Read motion-control parameters. [Command code: 0x14]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x14
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF

Serial number	Field name	Type	Content description
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x14
[4]	Data Length	1u	0x18
[5]-[8]	Position-loop Kp	4f	
[9]-[12]	Position-loop Ki	4f	
[13]-[16]	Position-loop output limit	4u	The position mode is the largest velocity in 0.01rpm;
[17]-[20]	Speed-loop Kp	4f	
[21]-[24]	Speed-loop Ki	4f	
[25]-[28]	Speed-loop output limit	4u	Velocity/position mode Max. Q axis current, unit 0.001A;
[29]-[30]	CRC16 Check	2u	DATA[0]~DATA[28]Byte CRC16 Verify

- **Write motion-control parameters without saving them. [Command code: 0x15]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x15
[4]	Data Length	1u	0x18
[5]-[8]	Position-loop Kp	4f	
[9]-[12]	Position-loop Ki	4f	
[13]-[16]	Position-loop output limit	4u	The position mode is the largest velocity in 0.01rpm;
[17]-[20]	Speed-loop Kp	4f	
[21]-[24]	Speed-loop Ki	4f	
[25]-[28]	Speed-loop output limit	4u	Velocity/position mode Max. Q axis current, unit 0.001A;
[29]-[30]	CRC16 Check	2u	DATA[0]~DATA[28]Byte CRC16 Verify

2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x14 order;

- **Write and save motion-control parameters. [Command code: 0x16]**

1. The master controller (host computer) sends to the slave device (lower-level controller) Except for the command code, the master request is identical to the command 0x15 request.
2. The slave device (lower-level controller) responds to the master controller (host computer)
Except for the command code, the slave response is identical to the command 0x14 response.

- **Read or configure position-filter control parameters; the parameters are not retained after power loss. [Command code: 0x17]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x17
[4]	Data Length	1u	[0x00, read parameters], [0x0A, configure parameters]
[5]-[6]	Position-filter bandwidth	2u	Position-filter bandwidth; unit: Hz; default: 50 Hz.
[7]-[10]	Position-filter rotational inertia	4f	Rotational inertia; unit: N·m/(turn/s ²). A value of 0 disables current feedforward; default: 0.001 N·m/(turn/s ²).
[11]-[14]	Position-filter current feedforward limit	4u	Maximum feedforward current in position-filter mode; unit: 0.001 A; default: 1 A.
[15]-[16]	CRC16 Check	2u	DATA[0]~DATA[14]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x17
[4]	Data Length	1u	0x0A
[5]-[6]	Position-filter bandwidth	2u	Position-filter bandwidth; unit: Hz.
[7]-[10]	Position-filter rotational inertia	4f	Rotational inertia; unit: N·m/(turn/s ²). A value of 0 disables current feedforward.

Serial number	Field name	Type	Content description
[11]-[14]	Position-filter current feedforward limit	4u	Maximum feedforward current in position-filter mode; unit: 0.001 A.
[15]-[16]	CRC16 Check	2u	DATA[0]~DATA[14]Byte CRC16 Verify

- **Set the current position as the origin. [Command code: 0x1D]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x1D
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x1D
[4]	Data Length	1u	0x02
[5]-[6]	Mechanical offset	2u	
[7]-[8]	CRC16 Check	2u	DATA[0]~DATA[6]Byte CRC16 Verify

- **Calibrate the encoder; for accurate calibration, the motor must be unloaded and its rotation must not be disturbed. Send command 0x2F to stop an encoder calibration in progress. [Command code: 0x1E]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x1E
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Restore parameters to their default values; the device address, encoder-calibration parameters, and motor hardware parameters remain unchanged. [Command code: 0x1F]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x1F
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x1F
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

- **Q-axis current control. [Command code: 0x20]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x20
[4]	Data Length	1u	0x08
[5]-[8]	Target Q axis current	4s	Unit 0.001A; torque = target current*Torque Constant;
[9]-[12]	Q-axis current slope	4u	0.001A/S; maximum slope at 0;
[13]-[14]	CRC16 Check	2u	DATA[0]~DATA[12]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Speed control. [Command code: 0x21]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x21
[4]	Data Length	1u	0x08
[5]-[8]	Target velocity	4s	In 0.01 rpm;
[9]-[12]	Acceleration	4u	Unit: 0.01 rpm/s; a value of 0 selects the maximum acceleration.
[13]-[14]	CRC16 Check	2u	DATA[0]~DATA[12]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Absolute-position control. [Command code: 0x22]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x22
[4]	Data Length	1u	0x04

Serial number	Field name	Type	Content description
[5]-[8]	Absolute value position	4s	In Count; in one circle 16384Count;
[9]-[10]	CRC16 Check	2u	DATA[0]~DATA[8]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Relative-position control. [Command code: 0x23]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x23
[4]	Data Length	1u	0x04
[5]-[8]	Relative bits position	4s	In Count; in one circle 16384Count;
[9]-[10]	CRC16 Check	2u	DATA[0]~DATA[8]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Return to the origin by the shortest path. [Command code: 0x24]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE

Serial number	Field name	Type	Content description
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x24
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Position-velocity control. [Command code: 0x25]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x25
[4]	Data Length	1u	0x09
[5]	Position Type	1u	[00: Absolute value position] [01: Relative value position]
[6]-[9]	Target position	4s	In Count; in one circle 16384Count;
[10]-[13]	Target velocity	4u	In 0.01 rpm
[14]-[15]	CRC16 Check	2u	DATA[0]~DATA[13]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Trapezoidal-profile position control. [Command code: 0x26]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x26
[4]	Data Length	1u	0x11
[5]	Position Type	1u	[00: Absolute value position] [01: Relative value position]
[6]-[9]	Target position	4s	In Count; in one circle 16384Count;
[10]-[13]	Maximum velocity	4u	In 0.01 rpm
[14]-[17]	Maximum acceleration	4u	In 0.01rpm/s
[18]-[21]	Maximum deceleration	4u	In 0.01rpm/s
[22]-[23]	CRC16 Check	2u	DATA[0]~DATA[21]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Position-filter control. [Command code: 0x27]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE

Serial number	Field name	Type	Content description
[3]	Command code	1u	0x27
[4]	Data Length	1u	0x09
[5]	Position Type	1u	[00: Absolute value position] [01: Relative value position]
[6]-[9]	Target position	4s	In Count; in one circle 16384Count;
[10]-[13]	Maximum velocity	4u	In 0.01 rpm;
[14]-[15]	CRC16 Check	2u	DATA[0]~DATA[13]Byte CRC16 Verify

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

Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

- **Read or configure the RS485 communication-timeout enable state, duration, and action type; the parameters are not retained after power loss. [Command code: 0x2D]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x2D
[4]	Data Length	1u	[0x00, read parameters], [0x04, configure parameters]
[5]	Communication timeout enable	1u	0x00: Disabled 0x01: Enabled; default: Disabled
[6]-[7]	Duration	2u	Unit: ms; default: 5000 ms.
[8]	Action Type	1u	When communication timeout is enabled and the timeout duration exceeds the configured value, the slave reports a communication fault and disables the motor. Optional additional actions: [Bit0]: the communication fault code cannot be cleared by software; [Bit1]: open the brake switch. The default value is 0x00, with no additional action.
[9]-[10]	CRC16 Check	2u	DATA[0]~DATA[8]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x2D
[4]	Data Length	1u	0x04
[5]	Communication timeout enable	1u	0x00: Disabled 0x01: Enabled
[6]-[7]	Duration	2u	Unit: ms.
[8]	Action Type	1u	[Bit0]: Communications fault code does not allow software clear;[Bit1]: Brake Switch off;
[9]-[10]	CRC16 Check	2u	DATA[0]~DATA[8]Byte CRC16 Verify

- **Brake switch output control. [Command code: 0x2E]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x2E
[4]	Data Length	1u	0x01
[5]	Operation Type	1u	0x00: Switch open 0x01: Switch closed 0xFF: Read status
[6]-[7]	CRC16 Check	2u	DATA[0]~DATA[5]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x2E
[4]	Data Length	1u	0x01
[5]	Operation Type	1u	0x00: Switch open 0x01: Switch closed
[6]-[7]	CRC16 Check	2u	DATA[0]~DATA[5]Byte CRC16 Verify

- **Disable the motor output (OFF). [Command code: 0x2F]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x2F
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

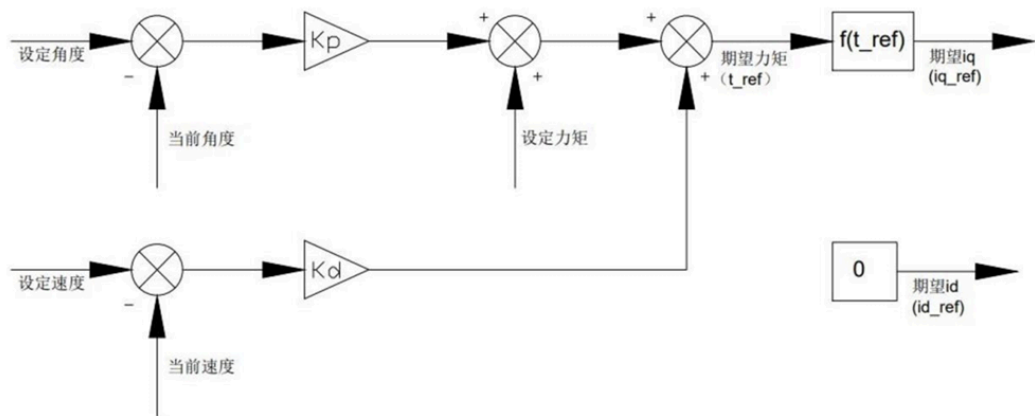
Except for the command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x0B command;

MIT Motion-Control Mode

To support motors with different specifications, the maximum position, velocity, and torque values can be configured according to the motor parameters and application requirements. Note that the units used in MIT motion-control mode differ from those used in the preceding sections:

- 1. Position unit: radian (rad), where 2π rad corresponds to 360° ;
- 2. Velocity unit: radians per second (rad/s), where 2π rad/s corresponds to 60 revolutions per minute (rpm);
- 3. Torque unit: newton-metre (N·m). The motor torque constant must be configured correctly through the host computer.

MIT Motion-Control Logic Diagram:



- Read or configure MIT motion-control parameters; the parameters are retained after power loss.
[Command code: 0x30]

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x30
[4]	Data Length	1u	[0x00, read parameters], [0x0A, configure parameters]

Serial number	Field name	Type	Content description
[5]-[6]	Pos_Max	2u	Configure the maximum position for MIT motion-control mode; unit: 0.1 rad; default: 95.5 rad.
[7]-[8]	Vel_Max	2u	Configure the maximum velocity for MIT motion-control mode; unit: 0.01 rad/s; default: 45 rad/s.
[9]-[10]	T_Max	2u	Configure the maximum torque for MIT motion-control mode; unit: 0.01 N·m; default: 18 N·m.
[11]-[12]	Pos_KP_Max	2u	Configure the maximum position KP for MIT motion-control mode; default: 500; maximum configurable value: 1000.
[13]-[14]	Vel_KD_Max	2u	Configure the maximum velocity KD for MIT motion-control mode; default: 5; maximum configurable value: 100.
[15]-[16]	CRC16 Check	2u	DATA[0]~DATA[14]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x30
[4]	Data Length	1u	0x0A
[5]-[6]	Pos_Max	2u	Configure the maximum position for MIT motion-control mode; unit: 0.1 rad.
[7]-[8]	Vel_Max	2u	Configure the maximum velocity for MIT motion-control mode; unit: 0.01 rad/s.
[9]-[10]	T_Max	2u	Configure the maximum torque for MIT motion-control mode; unit: 0.01 N·m.
[11]-[12]	Pos_KP_Max	2u	Configure the maximum position KP for MIT motion-control mode; default: 500; maximum configurable value: 1000.
[13]-[14]	Vel_KD_Max	2u	Configure the maximum velocity KD for MIT motion-control mode; default: 5; maximum configurable value: 100.
[15]-[16]	CRC16 Check	2u	DATA[0]~DATA[14]Byte CRC16 Verify

- **Read real-time position, velocity, torque, and status information in MIT motion-control mode. [Command code: 0x31]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x31
[4]	Data Length	1u	0x00
[5]-[6]	CRC16 Check	2u	DATA[0]~DATA[4]Byte CRC16 Verify

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAC
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x31
[4]	Data Length	1u	0x09
[5]	Mechanical position	16bit	[5] contains the high 8 bits and [6] contains the low 8 bits; [0~65535] maps to (-Pos_Max~Pos_Max).
[6]			
[7]	Mechanical speed	12bit	[7] contains the high 8 bits and Bit[7:4] of [8] contains the low 4 bits; [0~4095] maps to (-Vel_Max~Vel_Max).
[8]			
[9]	Torque	12bit	Bit[3:0] of [8] contains the high 4 bits and [9] contains the low 8 bits; [0~4095] maps to (-T_Max~T_Max).
[10]	Status Information	1u	[Bit0]: For 1 indicating that it is in control mode; [Bit1]: For 1 indicating that the system has fault; [Bit2~7]: Set aside
[11]	Operating temperature	1u	Unit °C;
[12]-[13]	Retention	2u	Reserved area, default 0;
[14]-[15]	CRC16 Check	2u	DATA[0]~DATA[13]Byte CRC16 Verify

- **MIT motion-control command. [Command code: 0x32]**

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

Serial number	Field name	Type	Content description
[0]	Protocol Header	1u	0xAE
[1]	Packet sequence number	1u	0x00~0xFF
[2]	Device address	1u	0x01~0xFE
[3]	Command code	1u	0x32
[4]	Data Length	1u	0x08
[5]	Target position	16bit	[5] contains the high 8 bits and [6] contains the low 8 bits; [0~65535] maps to (-Pos_Max~Pos_Max).
[6]			
[7]	Target velocity	12bit	[7] contains the high 8 bits and Bit[7:4] of [8] contains the low 4 bits; [0~4095] maps to (-Vel_Max~Vel_Max).
[8]			
[9]	Position Gain Kp value	12bit	Bit[3:0] of [8] contains the high 4 bits and [9] contains the low 8 bits; [0~4095] maps to [0~Pos_KP_Max].
[10]	Velocity Gain Kd	12bit	[10] contains the high 8 bits and Bit[7:4] of [11] contains the low 4 bits; [0~4095] maps to [0~Vel_KD_Max].
[11]			
[12]	Target torque	12bit	Bit[3:0] of [11] contains the high 4 bits and [12] contains the low 8 bits; [0~4095] maps to (-T_Max~T_Max).
[13]-[14]	CRC16 Check	2u	DATA[0]~DATA[12]Byte CRC16 Verify

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

Except for command code of response, the contents of the slave device response mainframe are consistent with the content of the 0x31 order;

Custom Communication Protocol Examples

Field name	Byte count	
Protocol Header	1 byte	The protocol header is 0xAE for packets sent by the master and 0xAC for packets returned by a slave.
Packet sequence number	1 byte	The packet sequence number in a slave response must match the sequence number in the corresponding master request.
Device address	1 byte	The address range is 0x00–0xFE; 0x00 is the broadcast address, and 0xFF is the common address. Broadcast address: every slave receives and executes the command but does not respond to the master. Common address: every slave receives and executes the command and responds to the master. Because RS485 is a shared bus, do not use the common address when multiple slaves are connected.
Command code	1 byte	Each command has a unique command code.
Data Length	1 byte	Number of bytes in the data field; may be 0.
Data Field	0-248(Bytes)	Command-specific data.
CRC16 Check	2 bytes	The CRC16_MODBUS value calculated from the protocol header through the data field. See the CRC16_MODBUS C reference implementation.

[0x0B command] — Read real-time data, including the single-turn absolute angle, multi-turn absolute angle, mechanical speed, and Q-axis current. Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0; data field empty																												
AE	00	01	0B	00	9B	28																						
Slave response frame (hex):																												
AC	00	01	0B	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	01	00	3B	DD
					①	②			③			④			⑤		⑥		⑦	⑧	⑨	⑩						

Parse the **slave response** data field according to command 0x0B:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Single-turn absolute angle	0x3927	14631	$14631 \times (360/16384) = 321.48^\circ$
②	Multi-turn absolute angle	0x00193927	1653031	$1653031 \times (360/16384) = 36321.48^\circ$
③	Mechanical speed	0x0000C81E	51230	$51230 \times 0.01 = 512.3\text{rpm}$
④	Q-axis current	0x00000019	25	$25 \times 0.001 = 0.025\text{A}$
⑤	Bus voltage	0x0C94(Hex)	3220	$3220 \times 0.01 = 32.2\text{V}$

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
⑥	Bus current	0x0004	4	4*0.01 = 0.04A
⑦	Operating temperature	0x24	36	36°C
⑧	Run status	0x03	3	Speed-control mode
⑨	Motor status	0x01	1	Enabled
⑩	Fault code	0x00	0	No fault

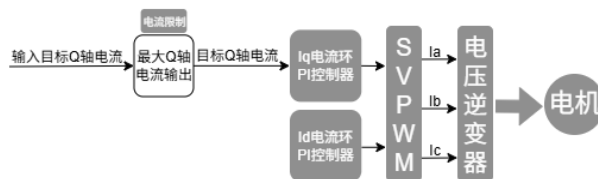
[0x0F command] — **Clear faults.** Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0; data field empty									
AE	00	01	0F	00	99	E8			
Slave response frame (hex):									
AC	00	01	0F	01	00	28	18		
					①				

Parse the **slave response** data field according to command 0x0F:

Serial number	Field name	Hex	Decoded value / meaning
①	Fault code	0x00	[Bit0]: Voltage fault; [Bit1]: Current fault; [Bit2]: Temperature fault; [Bit3]: Encoder fault; [Bit6]: Hardware fault; [Bit7]: Software fault. 0x00 indicates no fault.

[0x20 command] — **Q-axis current control.** The control block diagram is shown below:



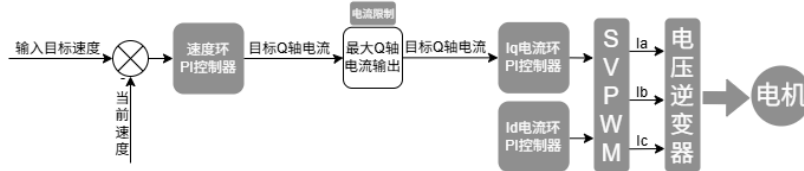
Set the target Q-axis current to 1 A. Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x08																												
AE	00	01	20	08	E8	03	00	00	00	00	00	00	CB	7C														
					①				②																			
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	20	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	AD	F3

Parse the **master request** data field according to command 0x20:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Q-axis current	0x000003E8	1000	Q-axis current = $1000 \times 0.001 = 1$ A.
②	Current slope	0x00000000	0	A value of 0 selects the maximum Q-axis current slope.

[0x21 command] — **Speed control.** The control block diagram is shown below:



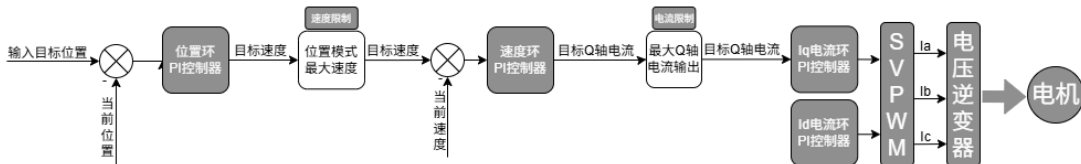
Set the target speed to 100 rpm. Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x08																												
AE	00	01	21	08	10	27	00	00	00	00	00	00	F0	59														
					①				②																			
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	21	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	F0	66

Parse the **master request** data field according to command 0x21:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Target speed	0x00002710	10000	$10000 \times 0.01 = 100$ rpm.
②	Acceleration	0x00000000	0	A value of 0 selects the maximum acceleration.

[0x22 command] — **Absolute-position control.** The control block diagram is shown below:



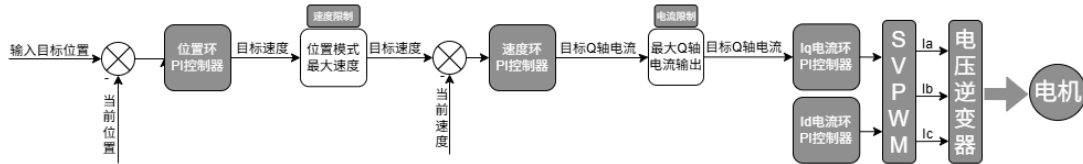
Set the target position to 16384 counts. Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x04																												
AE	00	01	22	04	00	40	00	00	58	C1																		
					①																							
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	22	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	14	99

Parse the **master request** data field according to command 0x22:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Absolute position	0x00004000	16384	$16384 \times (360/16384) = 360^\circ$; the motor moves to the multi-turn absolute position of 16384 counts.

[0x23 command] — **Relative-position control**. The control block diagram is shown below:



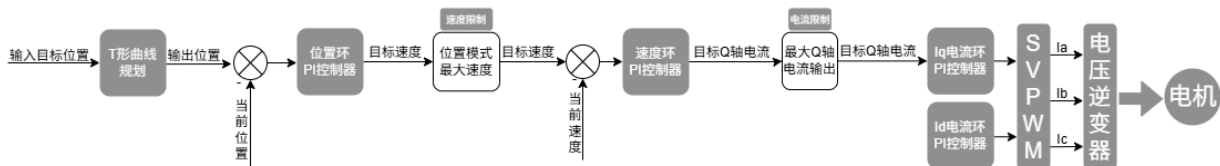
Set the relative rotation angle to 90° . Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x04																												
AE	00	01	23	04	00	10	00	00	59	01																		
					①																							
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	23	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	49	0C

Parse the **master request** data field according to command 0x23:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Relative position	0x00001000	4096	$4096 \times (360/16384) = 90^\circ$; the motor rotates 90° in the positive direction from its current position.

[0x26 command] — **Trapezoidal-profile absolute-position control**. The control block diagram is shown below:



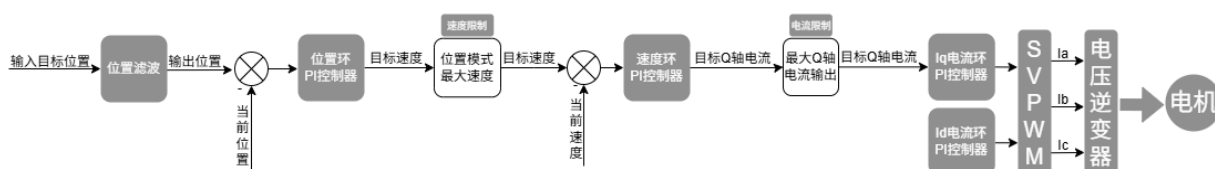
Set the target angle to 90° . Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x11																												
AE	00	01	26	11	00	00	10	00	00	E8	03	00	00	E8	03	00	00	E8	03	00	00	70	75					
					①	②				③				④				⑤										
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	26	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	66	4C

Parse the **master request** data field according to command 0x26:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Control mode	0x00	0	Absolute-position control
②	Target position	0x00001000	4096	$4096 \times (360/16384) = 90^\circ$; the motor moves to the multi-turn absolute position of 4096 counts.
③	Maximum speed	0x000003E8	1000	$1000 \times 0.01 = 10$ rpm; the maximum motor speed is 10 rpm.
④	Maximum acceleration	0x000003E8	1000	$1000 \times 0.01 = 10$ rpm/s; the maximum motor acceleration is 10 rpm/s.
⑤	Maximum deceleration	0x000003E8	1000	$1000 \times 0.01 = 10$ rpm/s; the maximum motor deceleration is 10 rpm/s.

[0x27 command] — Position-filter control. The control block diagram is shown below:



Set the target angle to 90° . Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0x09																												
AE	00	01	27	09	00	00	10	00	00	E8	03	00	00	4C	56													
					①	②				③																		
Slave response frame (hex): response data format is the same as for command 0x0B																												
AC	00	01	27	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	3B	D9

Parse the **master request** data field according to command 0x27:

Serial number	Field name	Hex	Decimal (Dec)	Decoded value / meaning
①	Control mode	0x00	0	Absolute-position control
②	Target position	0x00001000	4096	$4096 \times (360/16384) = 90^\circ$; the motor moves to the multi-turn absolute position of 4096 counts.
③	Maximum speed	0x000003E8	1000	$1000 \times 0.01 = 10$ rpm; the maximum motor speed is 10 rpm.

[0x2F command] — Disable the motor. Assuming slave address 1, the communication frames are as follows:

Master request frame (hex): data length 0; data field empty															
AE	00	01	2F	00	80	28									
Slave response frame (hex): response data format is the same as for command 0x0B															

AC	00	01	2F	16	27	39	27	39	19	00	1E	C8	00	00	19	00	00	00	94	0C	04	00	24	03	10	00	DC	33
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