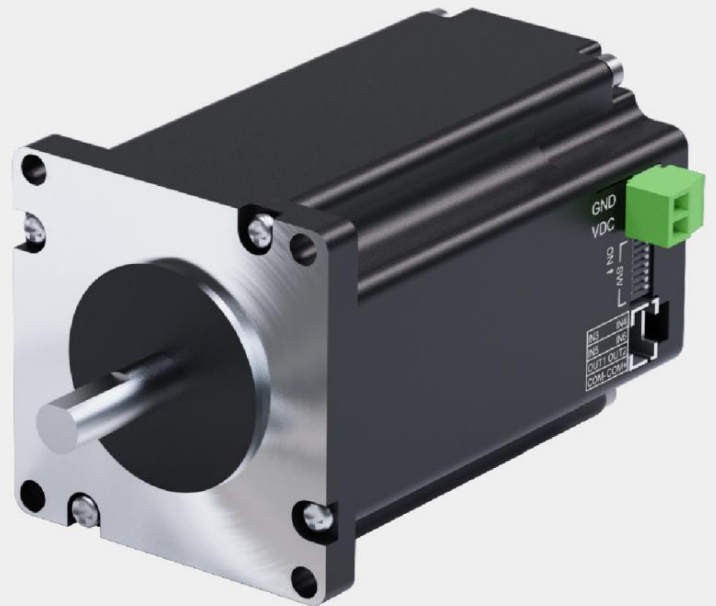




IR86, IT86 Integrated Stepper Motor User Manual

Shenzhen Rtelligent Technology Co.,Ltd

ADDRESS: 2-6F, A Building, Ruitech Industrial Park,
Xingyu Road No.23, Xixiang Street, Bao an District,
Shenzhen,Guang Dong Province, China

PHONE/WHATSAPP: +86 138 2653 6186

OFFICE DIRECT LINE: +86 755 27440012

EMAIL: info@rtelligent.cn

WEBSITE: www.rtelligentglobal.com

Contents

Manual version change record	- 1 -
Contents	- 2 -
1 Product Features	- 5 -
1.1 Naming Rules.....	- 6 -
2 Installation.....	- 7 -
2.1 Installation Requirements	- 7 -
2.2 Installation dimensions	- 7 -
2.2.1 IT86AM45-D1440-xxV-x.....	- 7 -
2.2.2 IT86AM85-D1440-xxV-x.....	- 7 -
3 Ports, wiring and Settings	- 8 -
3.1 Port Function Instructions.....	- 8 -
3.2 Power supply.....	- 9 -
3.3 Input and output signal connections	- 9 -
3.3.1 Input signal NPN single-ended common anode connection	- 9 -
3.3.2 Output signal connection	- 10 -
3.4 RS485 dip setting.....	- 11 -
3.4.1 Communication format	- 11 -
3.4.2 From the station address [SW1-5]	- 11 -
3.4.3 Baud rate [SW6~7]	- 12 -
3.4.4 Direction Settings [SW8].....	- 12 -
3.4.5 Terminal matching resistor	- 12 -
3.5 Status, alarm indicator lights.....	- 12 -
4 Communication Protocol	- 14 -
4.1 Modbus/RTU configuration.....	- 14 -
4.2 Detailed Explanation of Registers	- 15 -
4.2.1 Driver flag registers [0 to 1].....	- 15 -

4.2.2 Input/Output status registers [2-7]	19 -
4.2.3 Motor current position, speed-related registers [8-16]	25 -
4.2.4 Driver control mode Settings [17-23]	26 -
4.2.5 Open-loop operating parameters [24-29].....	28 -
4.2.6 Motor and current loop parameters [30-39].....	29 -
4.2.7 Closed-loop motor parameters [40-49]	30 -
4.2.8 Output port parameters [50 ~ 59].....	31 -
4.2.9 Input port parameters [60-69]	33 -
4.2.10 PP, PV mode motion parameters [70-79]	34 -
4.2.11 HM homing parameters [80-89]	35 -
4.2.12 Auxiliary function registers [90-99]	36 -
4.2.13 Lock axle time [105,106]	37 -
4.2.14 Current, subdivision parameters [110 to 114].....	37 -
4.2.15 Phase loss detection [115,116].....	37 -
4.2.16 Locked-rotor detection [117-119].....	38 -
4.2.17 Low-speed resonance [120~129]	39 -
4.2.18 Closed-loop control parameters [130 to 159]	40 -
4.2.19 Torque mode parameter Settings [180-184]	40 -
4.2.20 Speedometer parameter Settings [205-220].....	41 -
4.2.21 Position table parameter Settings [224 ~ 254]	42 -
5 Instructions for motion control applications	43 -
5.1 Pulse control mode.....	43 -
5.2 Communication control mode.....	43 -
5.2.1 PP position control mode	45 -
5.2.2 PV Speed control mode	46 -
5.2.3 HM returns to zero	46 -
5.2.3.1 It automatically returns to zero upon power-on.....	46 -
5.2.3.2 Communication triggers zeroing.....	47 -
5.2.3.3 I/O triggers homing.....	47 -

5.3 Default IO control mode 1: start-stop + Direction.....	- 48 -
5.4 Preset IO control mode 2: Forward + Reverse	- 49 -
5.5 Preset IO control mode 3: Speedometer mode	- 50 -
5.6 Preset IO control mode 4: Position Table mode	- 52 -
5.7 Preset IO control mode 5: Speed-torque mode	- 53 -
5.8 homing mode	- 55 -
5.8.1 Method 17:	- 55 -
5.8.2 Method 18:	- 55 -
5.8.3 Method 19:	- 55 -
5.8.4 Method 20:	- 56 -
5.8.5 Method 21:	- 57 -
5.8.6 Method 22:	- 57 -
5.8.7 Method 23	- 58 -
5.8.8 Method 24	- 58 -
5.8.9 Method 25:	- 59 -
5.8.10 Method 26:	- 59 -
5.8.11 Method 27	- 60 -
5.8.12 Method 28:	- 60 -
5.8.13 Method 29:	- 61 -
5.8.14 Method 30:	- 61 -
5.8.15 Method 35:	- 62 -
6 Appendix A Function Code Message Format.....	- 63 -
7 Appendix B Abnormal Responses and Code for Modbus/RTU	- 68 -
8 Appendix C Modbus/RTU 16-bit CRC Check Routine	- 69 -

1 Product Features

1. Drive, control, motor integrated smart stepper motor.
 2. Operating voltage: 24 to 50VDC
 3. Full loop: 4096 lines (16,384 Counts) encoder feedback.
 4. Pulse control modes: pulse + direction, dual pulse, orthogonal pulse
 5. Communication control mode: RS485/Modbus/RTU
 6. Communication Settings: 5-bit dials -- 31-axis addresses; 2-bit dials -- 4 baud rates
 7. Motion direction setting: Set the motor running direction with a 1-bit dip
 8. Maximum phase current output: 5.0A/ phase (sinusoidal peak)
 9. Digital I/O port:
 - 4-channel photoelectrically isolated digital signal input: 5V or 24V single-ended input, common anode connection
 - 2 optically isolated outputs: collector open
- Note: Product models with signal levels of 5V and 24V are different. See the naming rules for details.

1.1 Naming Rules

IT 42 AM 06 – D 08 24 – 5V – M

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

① Series name IR: Integral open loop series IT: Integral closed loop series	② Motor base 20mm、28mm、42mm、 57mm、60mm、86mm	③ Motor version
④ Motor torque 06: 0.6N·m	⑤ Motor shaft type D: Single flat K: Keyed G: Plain shaft	⑥ Shaft diameter Unit: mm
⑦ Shaft length Unit: mm	⑧ IO signal level 5V、24V	⑨ Communication interface M: Modbus - RS485 C: Can – CanOpen E: EtherCAT

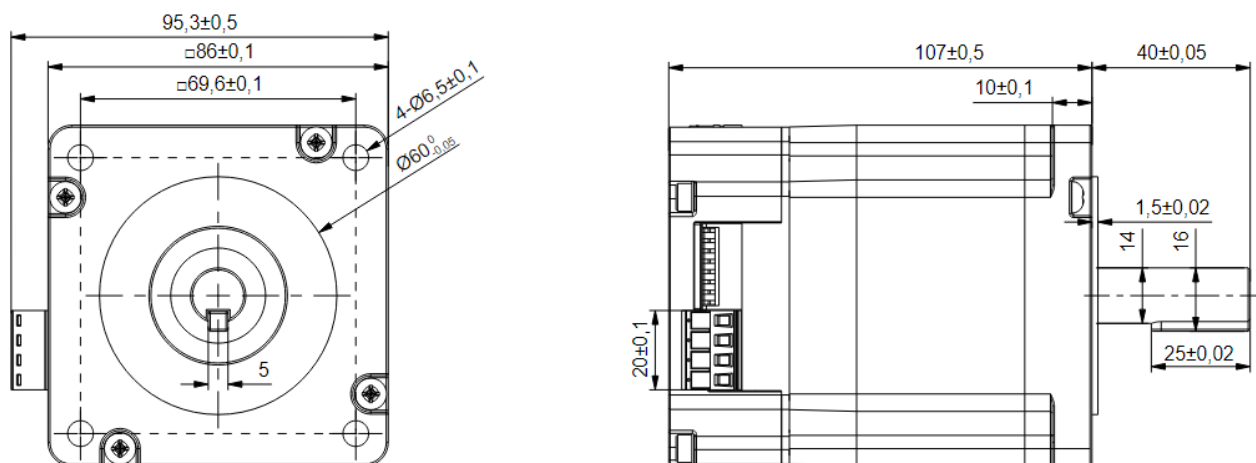
2 Installation

2.1 Installation Requirements

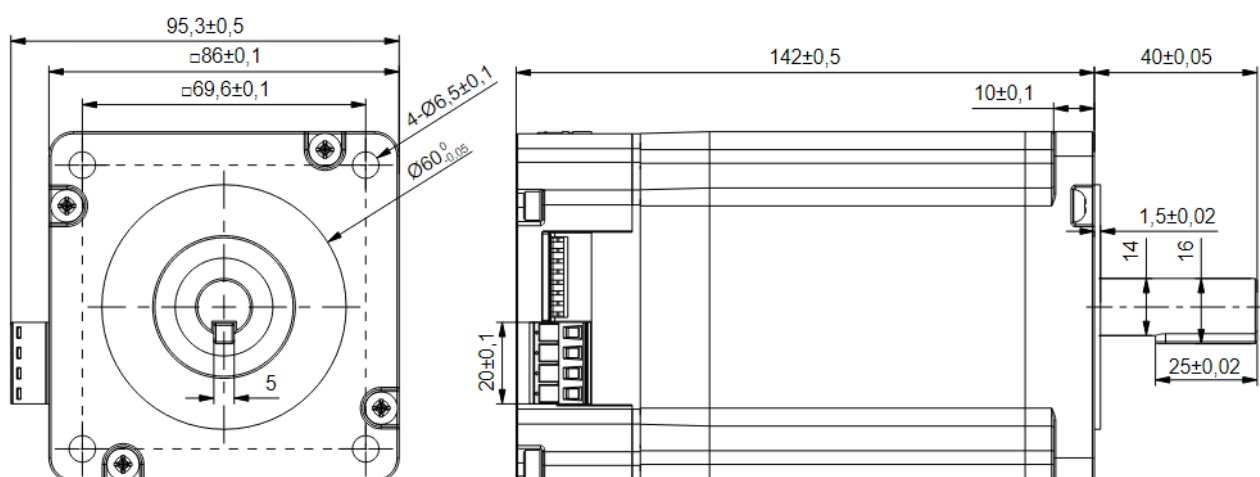
The integrated stepper motor contains precise position detection devices inside and should avoid excessive axial knocking on the motor shaft.

2.2 Installation dimensions

2.2.1 IT86AM45-D1440-xxV-x



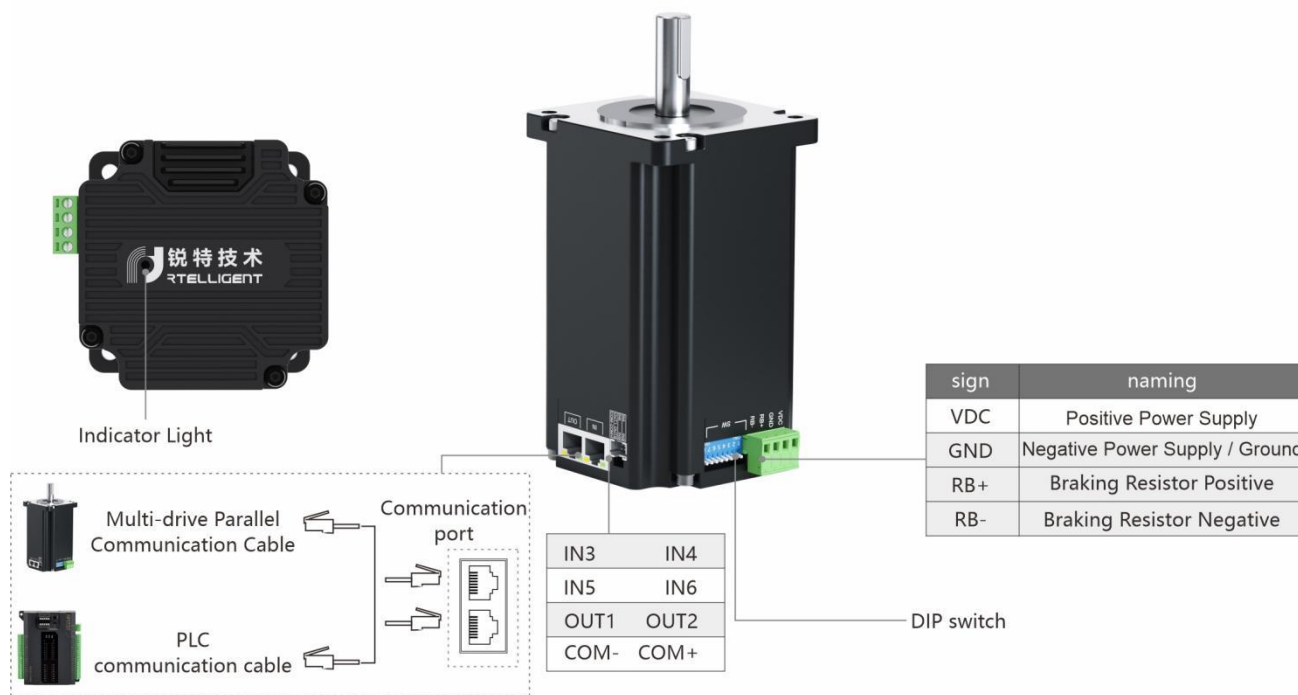
2.2.2 IT86AM85-D1440-xxV-x



3 Ports, wiring and Settings

3.1 Port Function Instructions

• Series 86



Number	Component Name	Instructions
①	Status indicator light	LED lights are used to show the operating status and fault status of the drive
②	RS485 interface	RS485 interface with isolation
③	Control signal interface	4 inputs, 2 outputs
④	Dip switch	Set the address, baud rate and motor running direction of the 485 communication
⑤	Power interface	24 to 50V DC power supply, note polarity

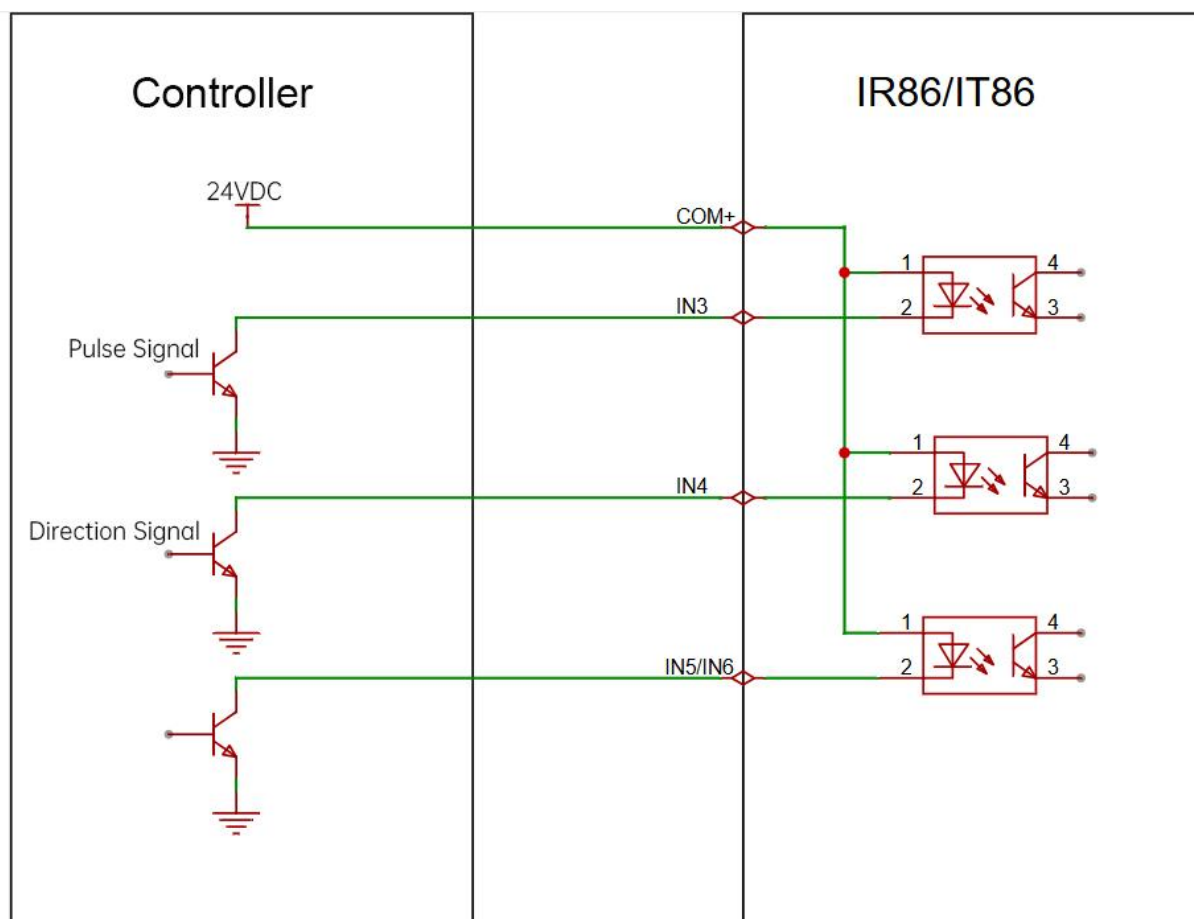
3.2 Power supply

Identification	Name	Notes
VDC	Positive power supply	The working voltage range of the product is: 24 to 50VDC. The polarity of the power supply must not be reversed and the voltage must not exceed 50V, otherwise the product will be damaged.
GND	Power supply negative terminal	

3.3 Input and output signal connections

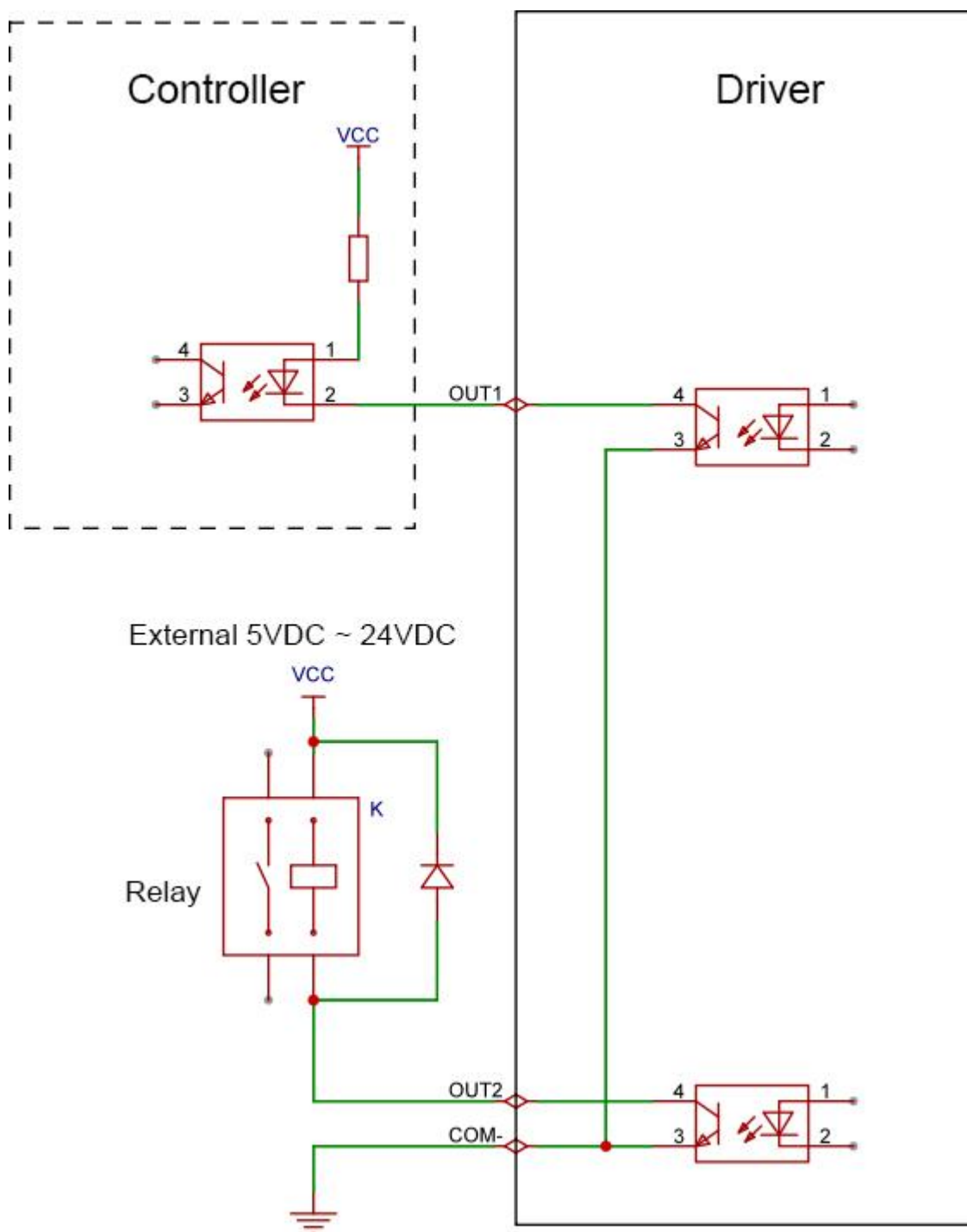
3.3.1 Input signal NPN single-ended common anode connection

The four input signals of the IT86 are IN3, IN4, IN5, IN6, and the wiring diagram is as follows:



3.3.2 Output signal connection

The output ports of the IR86/IT86 series are photoelectrically isolated and collector open output, with a maximum current of no more than 150mA per output. The wiring diagram is as follows:



3.4 RS485 dip setting

3.4.1 Communication format

1. Baud rate: Consistent with the slave
2. Data bits: 8 data bits
3. Stop bit: 1 stop bit
4. Check bit: No check bit

3.4.2 From the station address [SW1-5]

In the same network, each slave has a unique address.

Slave ID	SW1	SW2	SW3	SW4	SW5
Default	ON	ON	ON	ON	ON
1	OFF	ON	ON	ON	ON
2	ON	OFF	ON	ON	ON
3	OFF	OFF	ON	ON	ON
4	ON	ON	OFF	ON	ON
.....					
30	ON	OFF	OFF	OFF	OFF
31	OFF	OFF	OFF	OFF	OFF

ON = 0, OFF = 1

The slave address = $SW1 + SW2 \times 2 + SW3 \times 4 + SW4 \times 8 + SW5 \times 16$

3.4.3 Baud rate [SW6~7]

Master and slave stations must be set to the same baud rate.

BDR	SW6	SW7
9600	ON	ON
19200	OFF	ON
38400	ON	OFF
115200	OFF	OFF

3.4.4 Direction Settings [SW8]

The motor's running direction can be changed by setting the ON or OFF status of the SW8 without changing the driving-related Settings. The factory default is OFF.

3.4.5 Terminal matching resistor

A 120-ohm terminal resistor can be installed at the end depending on the situation, which is usually not necessary for short distances.

3.5 Status, alarm indicator lights

- ◆ The integrated motor contains an integrated red-green indicator light for showing status and errors.
- ◆ When the motor is enabled, the green indicator light flashes slowly, and when the green light remains on, the motor is not enabled.
- ◆ If an error occurs when the red light LED flashes, the error is displayed by the combination of red and green light flashes as follows:

LED status		Drive status
	Green light on all the time	The driver is not enabled
	Green light flashing	The driver is working properly
	1 green, 1 red	Driver overcurrent
	1 green, 2 red	Driver input power overvoltage

	1 Green, 3 red	There is a voltage error inside the driver
	1 Green, 4 red	Encoder out-of-tolerance alarm
	1 Green, 6 red	Parameter verification error
	1 green, 7 red	Motor phase loss alarm

4 Communication Protocol

4.1 Modbus/RTU configuration

1. IR/IT series products currently support the following Modbus function codes:
 - (1) 0x03: Read hold register
 - (2) 0x06: Write to a single register
 - (3) 0x10: Write multiple registers
2. MODBUS registers start with 0, while in touch screens, PLCS, register addresses are typically represented as type 400x and start with 1. So: PLC address = MODBUS address + 1
3. Register operation type:
 - (1) R-read-only
 - (2) W- Write only
 - (3) R/W- Readable/writable
4. Data type:
 - (1) SHORT —— 16bit
 - (2) LONG —— 32bit
5. MODBUS defaults a register to 16 bits. Two consecutive registers make up a 32-bit data, with the lower 16-bit data coming first and the higher 16-bit data following;

4.2 Detailed Explanation of Registers

4.2.1 Driver flag registers [0 -1]

1. Alarm flag register [0]

Defines all the alarm flags of the drive. MODBUS address: 0

15				11	10	9	8
Reserved							ECDE1
R-0				R-0			
7	6	5	4	3	2	1	0
POSE	MPE	MEM	OT	UV	OV	OC	IVE
R-0	R-0	R-0	R-0	R-0	R-0	R-0	R-0

BIT	Name	Description
9~15	Reserved	Reads always return 0
8	ECDE1	Encoder failure 0: The encoder signal is normal 1: Abnormal encoder signal
7	POSE	Tracking error alarm 0: No tracking error alarm 1: A tracking error alarm occurs and the motor cannot follow the encoder properly. The possible effects of a tracking error alarm are as follows: ① Position out-of-tolerance alarm threshold; ② Wiring of the encoder; ③ Wiring of the motor; ④ Whether the setting of parameters such as speed and acceleration is reasonable.

6	MPE	Motor phase loss alarm 0: Missing phase alarm 1: A phase loss alarm occurs When a phase loss alarm occurs, the driver cannot normally detect the current in the motor winding. ① Check the motor wiring and motor type.
5	MEM	Parameter verification error 0: Parameter verification correct 1: Incorrect parameter verification.
4	OT	Over-temperature warning sign 0: Driver temperature is normal 1: The internal components of the driver are overheating
3	UV	Low voltage warning sign 0: No undervoltage alarm 1: Driver undervoltage occurs
2	OV	Overvoltage warning sign 0: No overvoltage alarm 1: Overvoltage occurs in the driver If the driver experiences overvoltage, the following tests need to be conducted: ① Check the input power supply; ② Check the pump-up voltage as the motor decelerates
1	OC	Overcurrent warning sign 0: No overcurrent alarm 1: An overcurrent alarm occurred on the drive The driver has an overcurrent alarm. Possible causes are as follows: ① Short circuit in the motor winding; ② Excessive current set by the driver causes the motor to burn out; ③ Internal components of the driver are damaged

0	IVE	Internal voltage error alarm sign 0: No internal voltage error 1: Internal voltage error The driver gives an internal voltage error alarm, which is usually caused by damage to the internal components of the driver.
---	-----	--

2. Drive status register [1]

It defines some status flags inside the drive. MODBUS address: 1

15				11	10	9	8
Reserved				TC	POW	NL	PL
R-0							
7	6	5	4	3	2	1	0
CLAMP	ARRSPD	RDY	HOME	MOV	INPOS	ALM	ENA
R-0	R-0	R-0	R-1	R-0	R-0	R-0	R-1

BIT	Name	Description
12~15	Reserved	Reads always return 0
11	TC	Torque arrival state 0: The torque has not reached the set value 1: The torque reaches the set value
10	STALL	Stall detection 0: The motor operates normally in open-loop operation 1: The motor gets stuck during open-loop operation
9	NL	Negative limit active status 0: Not in the negative limit position 1: In negative limit position
8	PL	Positive limit active status 0: Not in the positive limit position 1: In the positive limit position

7	CLAMP	Motor mechanical brake status 0: The brake is not open, mechanically locking the motor shaft The brake has been opened and the motor can run
6	ARRSPD	Is the motor running at the set speed 0: Speed not reached 1: Speed has arrived In internal pulse command mode, used to indicate whether the motor has reached the set speed.
5	RDY	Drive ready sign 0: Not ready 1: Ready Usually when the drive is enabled, it is ready. But it takes 100ms for the motor to get ready during the transition from non-enabled to enabled. In addition, automatic parameter identification upon power-on and current step tests can cause the motor to be in an unready state.
4	HOME	Homing flag 0: Homing is not completed 1: Homing is completed
3	MOV	Motor motion mark 0: Motor stop status 1: The motor is running When the motor is in operation, it cannot respond to new motion instructions and can only respond to stop instructions.
2	INPOS	The motor positioning completion mark in closed-loop mode 0: Positioning not completed 1: Positioning completed
1	ALM	Driver alarm sign 0: No driver alarm 1: The drive has an alarm. Please check the status of the register REG_ALMCODE (address 0)
0	ENA	Drive enable flag 0: The drive is not enabled 1: The drive is enabled By default, the drive is enabled when powered on

4.2.2 Input/Output status registers [2-7]

1. Input port value register [2]

Used to indicate the value of the current input port. Since the input port is optically isolated, for ease of understanding, the status of the input port is indicated by whether the optocoupler is on or not in the text. MODBUS address: 2

15							8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved		IN6	IN5	IN4	IN3	IN2	IN1
R-0		R-0	R-0	R-0	R-0	R-0	R-0

BIT	Name	Description
6~15	Reserved	Reads always return 0
5	IN6	The level status of input port IN6 0: Input port 6 is not conducting 1: Input port 6 is on
4	IN5	Level status of input port IN5 0: Input port 5 is not conducting 1: Input port 5 is on
3	IN4	Level status of input port IN4 0: Input port 4 is not conducting 1: Input port 14 is on
2	IN3	Level status of input port IN3 0: Input port 3 is not conducting 1: Input port 3 is on
1	IN2	Level status of input port IN2 0: Input port 2 is not conducting 1: Input port 2 is on

0	IN1	Level status of input port IN1 0: Input port 1 is not conducting 1: Input port 1 is on
---	-----	--

2. Value of the current output port [3]

Output port value register. MODBUS address: 3

15							8
Reserved							
R-0							
7			4	3	2	1	0
Reserved				OUT4	OUT3	OUT2	OUT1
R-0				R-0	R-0	R-0	R-0

BIT	Name	Description
4~15	Reserved	The read always returns 0
3	OUT4	Output port 4(used by other products) level status 0: Output port 4 is not conducting 1: Output port 4 is on
2	OUT3	Level status of output port 3(used by other products) 0: Output port 3 is not conducting 1: Output port 3 is on
1	OUT2	Level status of output port 2 0: Output port 2 is not conducting 1: Output port 2 is on
0	OUT1	Level status of output port 1 0: Output port 1 is not conducting 1: Output port 1 is on

3. The input port is on along the latch register [4]

Each time a port changes from off to on, the driver latches the edge of the change. MODBUS address:
4

15							8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved		IN6	IN5	IN4	IN3	IN2	IN1
R-0		R-0	R-0	R-0	R-0	R-0	R-0

BIT	Name	Description
6~15	Reserved	Reads always return 0
5	IN6	Input port IN6 is on along the latch flag 0: No overconduction edge occurs at input port 6 A conduction edge occurred at input port 6
4	IN5	Input port IN5 conduction edge latch flag 0: No overconduction edge occurs at input port 5 1: A conduction edge occurs at input port 5
3	IN4	Input port IN4 conduction edge latch flag 0: No overconduction edge occurs at input port 4 1: A conduction edge occurs at input port 4
2	IN3	Input port IN3 conduction edge latch flag 0: No overconduction edge occurs on input port 3 1: A conduction edge occurs at input port 3
1	IN2	Input port IN2 conduction edge latch flag 0: No overconduction edge occurs at input port 2 1: A conduction edge occurs at input port 2
0	IN1	Input port IN1 conduction edge latch flag 0: No overconduction edge occurs at input port 1 1: A conduction edge occurs at input port 1

4. The input port turn-off edge latch register [5]

Each time a port changes from on to off, the driver latches this change edge. MODBUS address: 5

15							8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved		IN6	IN5	IN4	IN3	IN2	IN1
R-0		R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

BIT	Name	Description
6~15	Reserved	The read always returns 0
5	IN6	Input port IN6 turns off along the latch flag 0: No pass-off edge occurs at input port 6 1: A cut-off edge occurred at input port 6
4	IN5	Input port IN5 turn-off edge latch flag 0: No pass-off edge occurs at input port 5 1: A cut-off edge occurred at input port 5
3	IN4	Input port IN4 off edge latch flag There is no pass-through edge on input port 4 1: A cut-off edge occurred at input port 4
2	IN3	Input port IN3 off edge latch flag 0: No pass-off edge occurs at input port 3 1: A cut-off edge occurred at input port 3
1	IN2	Input port IN2 off edge latch flag 0: No pass-off edge occurs at input port 2 1: A cut-off edge occurred at input port 2
0	IN1	The IN1 input port is off along the latch flag 0: No pass-off edge occurs at input port 1 1: A cut-off edge occurred at input port 1

5. Input port conduction edge clears register [6]

The conduction edge flag used to clear the latch. MODBUS address: 6

15							8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved		IN6	IN5	IN4	IN3	IN2	IN1
R-0		R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

BIT	Name	Description
6~15	Reserved	Reads always return 0
5	IN6	Clear the conduction of IN6 along the latch status flag 0: No effect 1: Clear the conduction along the latch flag on port IN6
4	IN5	Clear the conduction edge latch status flag of IN5 0: No effect 1: Clear the conduction along the latch flag on port IN5
3	IN4	Clear the conduction edge latch status flag of IN4 0: No effect 1: Clear the conduction along the latch flag on port IN4
2	IN3	Clear the conduction edge latch status flag of IN3 0: No effect 1: Clear the conduction of the IN3 port along the latch flag
1	IN2	Clear the conduction of IN2 along the latch status flag 0: No effect 1: Clear the conduction along the latch flag on port IN2
0	IN1	Clear the conduction edge latch status flag of IN1 0: No effect 1: Clear the conduction of the IN1 port along the latch flag

6. Input port off edge clear register [7]

The turn-off edge flag used to clear the latch. MODBUS address: 7

15							8
Reserved							
R-0							
7	6	5	4	3	2	1	0
Reserved		IN6	IN5	IN4	IN3	IN2	IN1
R-0		R/W-0	R/W-0	R/W-0	R/W-0	R/W-0	R/W-0

BIT	Name	Description
6~15	Reserved	Reads always return 0
5	IN6	Clear IN6 off along the latch status flag 0: No effect 1: Clear the turn-off edge latch flag on port IN6
4	IN5	Clear the turn-off edge latch status flag of IN5 0: No effect 1: Clear the turn-off edge latch flag on port IN5
3	IN4	Clear the turn-off edge latch status flag of IN4 0: No effect 1: Clear the turn-off edge latch flag on port IN4
2	IN3	Clear the off edge latch status flag of IN3 0: No effect 1: Clear the turn-off edge latch flag on port IN3
1	IN2	Clear the turn-off edge latch status flag of IN2 0: No effect 1: Clear the turn-off edge latch flag on port IN2
0	IN1	Clear the turn-off edge latch status flag of IN1 0: No effect 1: Clear the turn-off edge latch flag on port IN1

4.2.3 Motor current position, speed-related registers [8-16]

MODBUS address	Attributes	Default values	Range	Description
8	R	0	[0,65535]	In internal pulse mode, current absolute position, 16 bits lower
9	R	0	[0,65535]	In internal pulse mode, current absolute position, 16 bits high
10	R	0	[-3000,3000]	Current instruction speed, signed 16-bit data Unit: RPM
11	R	-	[0,100]	Current busbar voltage value Unit: mV
12	R	0	[0,65535]	In closed-loop mode, motor tracking error, low 16 bits Unit: Encoder resolution
13	R	0	[0,65535]	In closed-loop mode, motor tracking error, up to 16 bits
14	R	0	[0,65535]	External pulse counter, low 16 bits
15	R	0	[0,65535]	External pulse counter, 16 bits high
16	R/W	0	[0,1]	Clear the external pulse counter Writing 0 has no effect and reading always returns 0 Writing 1 will clear the external pulse counter, and register 14, 15 values become 0. Then this register will become 0.

4.2.4 Driver control mode Settings [17-23]

MODBUS address	Attributes	Default values	Range	Description
17	R/W	0	[0, 1]	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse instructions
18	R/W	0	[0, 6]	0: Waiting status The driver will resume the bit wait state after it has processed any control instructions received. 1: Fixed-length forward rotation In relative position mode, the motor runs forward based on register parameters 70 to 74. In absolute position mode, the operating status is determined based on the current position and the absolute positions set at 70 to 74. 2: Fixed-length reversal In relative position mode, the motor runs in reverse according to register parameters 70 to 74. In absolute position mode, the operating state is determined based on the current position and the absolute position set by 70-74. 3: Speed mode, continuous forward rotation The motor runs forward acceleration based on registers 75 and 77 4: Speed mode, continuous reverse rotation The motor runs in reverse acceleration based on registers 75 and 77 6: Deceleration stop In position mode, the motor decelerates and stops based on register 71 In speed mode, the motor decelerates and stops based on register 76 9: Trigger to homing This register works only when the value of the internal pulse mode register 20 is 0

19	R/W	0	[0, 2]	External pulse instruction mode setting register 0: PUL+DIR mode: PUL is the pulse input port, and DIR is the direction input port 1: Reserved 2: CW+CCW mode: PUL is the CW input signal, DIR is the CCW input signal 3: Orthogonal Input mode
20	R/W	0	[0, 5)	Preset application selection in internal pulse mode 0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table 25: Preset IO control Mode 5: Speed-torque mode
21	R/W	0	[0, 1]	Motor type setting register 0: Two-phase stepper motor 1: Three-phase stepper motor 2: Five-phase stepper motor The IR/IT series is a two-phase motor. Do not perform any other Settings
22	R/W	0	[0, 2]	Motor operation mode setting register 0: Open-loop operation 1: Servo operation
23	R	0	[0, 1]	Motor direction reverse setting register 0: Default running direction 1: Reverse the running direction of the motor Since the direction of the IR/IT series is set via SW8, this register is used to display the current setting

4.2.5 Open-loop operating parameters [24-29]

MODBUS address	Attributes	Default values	Range	Description
24	R	4000	[200,65535]	Show the segmentation when the drive is running Unit: Pulses/revolutions
25	R	1500	[0,6000]	Show the maximum current the driver is running, Unit: mA
26	R/W	50	[0,100]	Standby current percentage Set the percentage of the current relative to the operating current when the driver enters standby mode in open-loop operation mode. Unit: %
27	R/W	500	[10,65535]	Standby time Settings Set the time the drive enters standby mode after the pulse stops for a certain period of time when the drive is in open-loop operation. Unit: ms
28	R/W	512	[1,1024]	Pulse instruction filter For smoothing pulse instructions (including internal and external pulses), filtering time = set value * 50us
29	Reserved	-	-	-

4.2.6 Motor and current loop parameters [30-39]

MODBUS address	Attributes	Default value	Range	Description
30	R/W	0	[0,1]	Automatic PI enable function The driver has built-in parameter recognition and gain optimization algorithms. It usually works well. This feature can be disabled if the customer requires optimization. 0: Do not use the automatic PI feature 1: Use the Auto PI function
31	R	-	[100,65535]	Automatically recognized resistance values Read the motor winding resistance value automatically recognized by the driver. Unit: mOhm
32	R	-	[1,65535]	Automatically recognized inductance value Read the motor winding inductance value automatically recognized by the driver. Unit: mH
33	R/W	1000	[100,10000]	User-set resistance value The user-set resistance value does not take effect when the automatic PI function is disabled. Unit: mOhm
34	R/W	1	[1,10]	Inductance values set by the user The inductance value set by the user does not take effect when the automatic PI function is disabled. Unit: mH
35	R/W	200	[0,1000]	Motor torque constant The parameters are only valid when the motor control mode is servo Mode Two

36	R/W	1000	[200,1000 0]	Current loop proportional gain KP in the current loop PI algorithm. ILOOPKP is automatically generated when auto-PI is enabled, and users can modify ILOOPKP when auto-PI is not enabled.
37	R/W	200	[0,2000]	Current loop integral gain KI in the current loop PI algorithm. ILOOPKI is automatically generated when auto-PI is enabled, and users can modify ILOOPKI when auto-PI is not enabled
38	R/W	256	[0,1024]	KC in the current loop PI algorithm.
39	R/W	50	-	Motor pole pairs

4.2.7 Closed-loop motor parameters [40-49]

MODBUS address	Attribute	Default values	Range	Description
40	R/W	16384	[256,65535]	Encoder resolution: 4096 wire magnetic encoding The driver is capable of receiving quadrature encoder input signals and performing 4x frequency processing. Encoder resolution = encoder lines X 4
41	R/W	2000	[100,65535]	Locate the completed detection mode 0: Immediate mode, at any time if the position error is less than the value set in register 42 and persists for the time set in 43, it is considered to be in place 1: Instruction Stop mode The error is judged only after the motor motion instruction stops for more than the time set in register 44.
42	R/W	10	[1,65535]	Positioning completion accuracy Unit: Encoder resolution

43	R/W	50	[1,65535]	Location completion duration Set the duration after the motor enters the completion accuracy. Duration = set value X 50us
44	R/W	100	[1,65535]	Locate the time when the start of the test is completed Set the time after the driver stops receiving pulses, and then begin to determine whether the positioning is complete. Set time = set value X 50us
45	R/W	16384	[0,65535]	Out-of-tolerance alarm threshold, low 16 bits
46	R/W	0	[0,65535]	Out-of-tolerance alarm threshold, 16 bits high Cancel the out-of-tolerance alarm when both registers 45 and 46 are 0.
47	R/W	0	[0,1]	Encoder signals A and B are switched Motors from other manufacturers can be matched without changing the wiring of the motor and encoder.
48	R	0	[0,65535]	Encoder single-turn count value
49	-	-	-	-

4.2.8 Output port parameters [50 ~ 59]

The IR86/IT86 product features two output ports.

15							8
Reserved							
R/W-0							
7	6	5	4	3			0
Reserved			Polarity	Features			
R-0			R/W-0	R/W-0			

BIT	Name	Description
5~15	Reserved	Reads always return 0
4	Polarity	The polarity of the output port 0: Normally closed 1: Normally open (default value)
0~3	Features	Output port function selection 0: Normal output, User control 1: Alarm output, OUT1 default value 2: Brake signal output 3: In place signal output 4: Speed Arrival output, OUT2 default value 5: homing to complete the output 6: The drive is ready to output 7: Motor stop state output 8: Positive limit output 9: Negative limit output 10: Power indication output 11: Torque Arrives output Others: The input port has no function and only serves as a regular input port

MODBUS address	Attributes	Default values	Range	Description
50	R/W	1	[0,11]	Output port 1 sets the register
51	R/W	4	[0,11]	Output port 2 sets the register
52	R/W	0	[0,11]	Reserved
53	R/W	0	[0,11]	Reserve

4.2.9 Input port parameters [60-69]

The IR86/IT86 product contains four input ports, each set in the same way.

15							8
Reserved							
R/W-0							
7	6	5	4				0
Reserved		Polarity	Features				
R-0		R/W-0	R/W-0				

BIT	Name	Description
6~15	Reserved	Reads always return 0
5	Polarity	The effective level of the input port 0: Normally closed 1: Normally open (default value)
0~4	Features	Input port function selection 0: Pulse input 1: Direction input 2: Quadrature encoder A phase input 3: Quadrature encoder B phase input 4: Motor offline 5: Clear the fault 6: Emergency stop 7: Jog forward/start/stop 8: Jog reverse/Direction 9: Forward limit input 10: Reverse limit input 11: Zero point signal 12: Start back to zero 13: Reverse the running direction of the motor 14: Multi-speed control 0

		15: Multi-speed control 1 16: Multi-speed control 2 17: Multi-speed control 3 18: Multi-position control 0 19: Multi-segment position control 1 20: Multi-segment position control 2 21: Multi-segment position control 3 22: USER1 23: USER2 24: USER3 25: USER4 26: USER5 27: USER6 28: USER7 29: USER8 30: USER9 31: USER10 Others: The input port has no function and only serves as a regular input port
--	--	---

MODBUS address	Attributes	Default values	Range	Description
60	R/W	--	[0, 31]	Reserved
61	R/W	--	[0, 31]	Reserved
62	R/W	32	[0, 31]	Input Port 1 Setting register (IN3)
63	R/W	33	[0, 31]	Input Port 2 Setting register (IN4)
64	R/W	36	[0, 31]	Input Port 3 Setting register (IN5)
65	R/W	39	[0, 31]	Input Port 4 Setting register (IN6)

4.2.10 PP, PV mode motion parameters [70-79]

MODBUS address	Attributes	Default value	Range	Description
70	R/W	200	[10,1000]	Acceleration of a point in motion, unit: R/S^2

71	R/W	200	[10,1000]	Deceleration when a point is in motion, in R/S^2
72	R/W	300	[0,3000]	Maximum speed at which a point moves, unit: RPM
73	R/W	2000	[-16777216, 16777216]	Running pulse instructions for point movement, unit: number of pulses P73 is the low 16-bit data, and P74 is the high 16-bit data.
74				
75	R/W	60	[10,1000]	Point acceleration, unit: R/S^2
76	R/W	60	[10,1000]	Point motion deceleration, unit: R/S^2
77	R/W	300	[0,3000]	Jog speed, unit: RPM
78	R/W	0	[0, 1]	Absolute motion (ABS)/relative motion (INC) Settings
79	W	0	1	Write 1 Clear position counter (Registers 8, 9)

Registers 73 and 74 make up a 32-bit signed register.

In incremental operation mode, the absolute values of 73 and 74 represent the running distance, and write 1 or 2 to register 18 to control whether the motor is running forward or backward.

In absolute position mode, the signed data composed of 73 and 74 represents the target position, and the motor runs to the set distance by writing 1 to 18.

4.2.11 HM homing parameters [80-89]

MODBU address	Attributes	Default values	Range	Description
80	R/W	200	[1,3000]	homing speed Unit: RPM
81	R/W	40	[1,3000]	homing low speed Unit: RPM
82	R/W	100	[0,1000]	Acceleration back to zero
83	R/W	0	[-32768, 32767]	Zero offset
84	R/W	0	[0, 3]	Zero offset mode Settings
85	R/W	0	[17,35]	homing mode selection

86	R/W	0	[0,1000]	Stop abruptly to slow down
87	R/W	50	[0,1000]	The stop time of the homing process Unit: ms During the homing process, the driver will detect the status of the sensor and perform the corresponding deceleration and stop action. After the motor stops, after a set period of time, it will further act according to the homing method.
88	R/W	5000	[0,65535]	Homing timeout Unit: ms After triggering the Homing, if the Homing is still not completed after the set timeout period, the motor will decelerate and stop. Wait for the user's next trigger.
89	R/W	0	[0, 1]	Power-on auto-Homing enable 0: Prohibit resetting to zero after power-on 1: Homing after the drive is powered on

4.2.12 Auxiliary function registers [90-99]

MODBU address	Attributes	Default value	Range	Description
90	R/W	0	[0, 1]	0: Writing 0 is invalid, and reading returns 0 1: Write 1 to save the current parameter
91	R/W	0	[0, 1]	0: Writing 0 is invalid, and reading returns 0 1: Writing 1 will restore the factory Settings
92	-	-	-	The manufacturer Reserveds the use, and the user is prohibited from writing data
93	R	-	-	Drive ID number
94	R	-	-	Drive version number
95	R	-	-	-

4.2.13 Lock axle time [105,106]

When the stepper motor is initially powered on, the position is in a random position. The initial position between the stator and rotor of the motor needs to be determined by locking the shaft. Locking the shaft through a current ramp can reduce vibration when the motor is powered on and enabled.

MODBU address	Attributes	Default values	Range	Description
105	R/W	16000	0655 [35]	Lock shaft ramp time, in 62.5us
106	R/W	4000	0655 [35]	Lock shaft duration, in 62.5us

4.2.14 Current, subdivision parameters [110 - 114]

MODBU address	Attribute	Default values	Range	Description
110	R/W	1500	[0,1500]	Units mA; The maximum current for IR86/IT86 is 6000; In open-loop mode, this register is used to set the current for open-loop operation mode; In closed-loop mode, this register is used to set the maximum current for open-loop operation mode;
111	R/W	4000	[200,65535]	Set the pulse required for the motor to run one revolution.
112	Reserved			
113	R/W	30	[0,100]	Current compensation percentage
114	R/W	30	[0,100]	Current loop gain compensation percentage

4.2.15 Phase loss detection [115,116]

A phase loss refers to an abnormality in the stepper motor winding, such as a broken motor winding wire.

The IR/IT series contains the connection between the motor winding and the drive circuit board. Through the current detection circuit, it monitors whether the motor winding feeds back the corresponding current to monitor the status of the motor winding. When a phase loss alarm occurs, the driver shuts off the power output and the motor is in a free state.

In some cases, a phase loss cannot be detected. For example, when the driver is powered on for the first time, the current reference value of the B-phase winding is zero. If the B-phase winding breaks, the current detected by the driver is also zero, at which point the driver cannot give an alarm signal. If

a command is sent to make the motor run for more than two full steps, the driver can determine the phase loss status of the B-phase winding

MODBU address	Attribute	Default values	Range	Description
115	R/W	0	[0, 1]	Phase loss detection is enabled 0 -- Disable phase loss detection 1--Enable the phase loss detection function
116	R/W	50	[0,1500]	Phase loss detection current threshold: mA

4.2.16 Locked-rotor detection [117-119]

The IR/IT series can operate in open-loop mode, with sensorless locked-rotor detection built into the drive. Locked rotor refers to the situation where a stepper motor fails to rotate properly due to external causes, which can lead to overloading of the stepper motor, even burnout and damage to the mechanical components of the equipment.

The IR/IT series collects the current feedback of the motor in real time, estimates the load torque change of the motor through the observer, and then determines whether the motor is locked. Once the motor is locked, corresponding protective measures can be taken.

Using sensorless technology for locked rotor detection, the accuracy of the detection depends on the identification of motor parameters and the correct setting of relevant observer parameters. The default parameter identification of the driver is usually competent for this task, and when misjudgment occurs in actual test applications, the user can disable this function.

When a locked rotor is detected, even if the controller is still sending instructions to the driver, the driver will stop running, but the motor will be locked in full flow state while the red alarm indicator light remains on and the alarm output port outputs an alarm signal. When the user stops sending pulses, the driver will automatically clear the alarm status and respond to subsequent command signals.

The relevant registers are as follows:

MODBU address	Attribute	Default values	Range	Description
117	R/W	0	[0,1000]	Locked rotor detection enabled 0 -- Disable the locked rotor detection function 1 -- Enable the blocking detection function
118	R/W	180	[0,3000]	Blockage detection starting speed: RPM

119	R/W	2	[0,65535]	Locked-rotor detection position error alarm threshold
-----	-----	---	-----------	---

4.2.17 Low-speed resonance [120~129]

IR/IT series, in response to the problem of low-speed resonance in two-phase stepper motors operating in open-loop mode, provides a harmonic injection algorithm that can effectively reduce motor resonance.

Typically, the first resonance point speed V1 of a two-phase stepper motor is around 60RPM, and the second resonance point speed V2 is around 120RPM. The specific resonance speed of the motor is directly related to the motor's inertia, current, etc. It is necessary to test to discover the resonance point under different conditions.

The velocity relationship between the two resonance points is as follows:

$$V2 = 2 \times V1$$

To debug the resonance, the following steps need to be completed:

The first step is to identify two resonance points and determine the velocity range of the resonance region. You can use either an external pulse or an internal pulse to identify the first resonance point by comparison and then maintain the current velocity.

The second step is to adjust the amplitude and phase of the first resonance point so that the motor resonance is significantly reduced

Step 3: Run the motor at the second resonance point and maintain the current speed

Step 4: Adjust the amplitude and phase of the second resonance point so that the motor resonance is significantly reduced

MODBU address	Attribute	Default values	Range	Description
120	R/W	0	[0,1500]	First resonance point amplitude
121		0	[0,1024]	First resonance point phase
122		0		Reserved
123		0	[0,1500]	The amplitude of the second resonance point
124		0	[0,1024]	Second resonance point phase
125		0		Reserved
126		0	[0,600]	Velocity begins at the first vibration point
127		0	[0,600]	The velocity ends at the first vibration point

128		0	[0,600]	Velocity begins at the second vibration point
129		0	[0,600]	Velocity ends at the second vibration point

4.2.18 Closed-loop control parameters [130 to 159]

MODBU address	Attribute	Default values	Scope	Description
130	R/W	300	[1,5000]	First-order velocity filter bandwidth
131		900	[1,5000]	Second-order velocity filtering bandwidth
132		2000	[1,5000]	Acceleration filter bandwidth
133 ~ 149				Reserved
150		3500	[500,2000 0]	Position ring Kp
151		0	[0,65535]	Position ring Kd
152		40	[10,500]	Velocity loop Kp
153		100	[0,600]	Velocity loop KI
154		0	[0,65535]	Acceleration feedforward
155		3000	[0,5000]	Position loop output filter bandwidth
156		3000	[0,5000]	Position ring differential output filter bandwidth
157		500	[0,5000]	Speed loop output filter bandwidth
158		80	[0,100]	First-order velocity feedback proportion
159		Reserved	Reserved	Preserve

Rigid adjustment of position tracking can be achieved by adjusting the parameters of the position loop and the speed loop.

4.2.19 Torque mode parameter Settings [180-184]

MODBU address	Attribute	Default values	Range	Description
180	R/W	6000	[0,1000]	Torque corresponds to the magnitude of current, unit: MA
181	R	0	[0,1]	Torque reaches the marker position

				0-Not reached 1-Arrived
182	R/W	1000	[0,65535]	Torque holding time, unit: ms
183	R/W	0	[0,2]	Mode selection after torque arrives 0-Free mode 1-Position lock axis 2-Torque mode
184	R	0	[0,1500]	Torque corresponds to the magnitude of the feedback current, unit: MA

4.2.20 Speedometer parameter Settings [205-220]

MODBUS address	Attribute	Default values	Range	Description
205	R/W	0	[- 3000300 0]	Speed Table 1, unit: RPM
206	R/W	20		Speed Table 2, unit: RPM
207	R/W	30		Speed Table 3, unit: RPM
208	R/W	50		Speed Table 4, unit: RPM
209	R/W	60		Speed Table 5, unit: RPM
210	R/W	80		Speed Table 6, unit: RPM
211	R/W	100		Speed Table 7, unit: RPM
212	R/W	150		Speed Table 8, unit: RPM
213	R/W	200		Speed Table 9, unit: RPM
214	R/W	250		Speed Table 10, unit: RPM
215	R/W	300		Speed Table 11, unit: RPM
216	R/W	400		Speed Table12, unit: RPM
217	R/W	500		Speed Table 13, unit: RPM
218	R/W	600		Speed Table 14, unit: RPM
219	R/W	700		Speed Table15, unit: RPM
220	R/W	800		Speed Table 16, unit: RPM

4.2.21 Position table parameter Settings [224 ~ 254]

MODBUS address	Attribute	Default values	Range	Description
224	R/W	0	[-1073741824, 1073741824]	Position Table 1, unit: Pulse
226	R/W	0		Position Table 2, Unit: Pulse
228	R/W	0		Position Table 3, Unit: Pulse
230	R/W	0		Position Table 4, Unit: Pulse
232	R/W	0		Position Table 5, Unit: Pulse
234	R/W	0		Position Table 6, Unit: Pulse
236	R/W	0		Position Table 7, Unit: Pulse
238	R/W	0		Position Table 8, Unit: Pulse
240	R/W	0		Position Table 9, unit: Pulse
242	R/W	0		Position Table 10, Unit: Pulse
244	R/W	0		Position Table 11, unit: Pulse
246	R/W	0		Position Table 12, unit: Pulse
248	R/W	0		Position Table 13, Unit: Pulse
250	R/W	0		Position Table 14, unit: Pulse
252	R/W	0		Position Table 15, unit: Pulse
254	R/W	0		Position Table 16, unit: Pulse

5 Instructions for motion control applications

5.1 Pulse control mode

The IR86/IT86 series is controlled by default with pulse + direction from the factory. The relevant register Settings are as follows:

Steps	Register address	Units	value	Parameter Description
1	17	---	1	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse command 1: External pulse instructions
2	19	---	0	External pulse instruction mode sets the register 0: PUL+DIR mode: PUL is the pulse input port and DIR is the direction input port 1: Reserved 2: CW+CCW mode: PUL is the CW input signal, DIR is the CCW input signal 3: Orthogonal Input mode
3	110	mA	1500mA	The driving current has been synthesized by default. Users can further optimize on this basis.
4	111	Pulse/rev	4000	By default, use 4000 pulses/revolutions for control.

Refer to the specific wiring.

5.2 Communication control mode

In this mode, users can communicate to make the motor perform homing, positioning, and speed regulation movements.

Parameter Settings for communication control mode:

Steps	Register address	Units	value	Parameter Description
1	17	---	0	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse instructions
2	20	---	0	Preset application selection in internal pulse mode

				0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table
3	18	---		0: Waiting state. Upon receiving any control instructions, the driver will resume the bit waiting state after processing them. 1: Fixed-length forward rotation. In relative position mode, the motor runs forward based on register parameters 70 to 74. In absolute position mode, the operating state is determined based on the current position and the absolute position set by 70-74. 2: Fixed-length reversal. In relative position mode, the motor runs in reverse according to register parameters 70 to 74. In absolute position mode, the operating state is determined based on the current position and the absolute position set by 70-74. 3: Speed mode, continuous forward rotation. The motor runs forward acceleration based on registers 75 and 77 4: Speed mode, continuous reverse rotation. The motor runs in reverse acceleration based on registers 75 and 77 6: Deceleration stop. In position mode, the motor decelerates and stops based on register 71 In speed mode, the motor decelerates and stops based on register 76 9: Trigger to homing This register works only when the value of the internal pulse mode register 20 is 0

5.2.1 PP position control mode

The IR/IT series has the function of communicating to control the motor to run a specified pulse stroke. The specific modes and parameters to be set are as follows (register addresses are decimal unless otherwise specified or specified) :

- (1) Set the value of register address 17 (select internal pulse mode) to 0 (Select internal pulse mode to use communication control);
- (2) Set the value of Register address 20 (default application selection in internal pulse mode) to 0 (Communication control, responding to instructions at register address 18);
- (3) Set the functions of the digital input/output ports according to the application requirements and the actual terminal blocks;
- (4) Set motion parameters:

Address	Units	Parameter Description
70	R/S ²	Acceleration of the position mode
71	R/S ²	Deceleration of the position mode
72	RPM	Speed of position mode
73	Command pulses	The number of instruction pulses in position mode, low 16-bit register
74	Instruction pulses	Number of instruction pulses in position mode, high 16-bit register
78	R/S ²	Set location running mode: 0: Incremental 1: Absolute
79	-	Write 1 and clear the position counter (registers 8, 9)

- (5) Communication given run instruction: Start point movement by writing values 1(fixed-length forward rotation) and 2(fixed-length reverse rotation) to register 18 (for detailed description of this register, see register 18 in "[Driver Control Mode Settings \[17-23\]](#)");
 - (6) If you need to stop during operation, you can do so by writing a value of 6 to register 18 (deceleration stop, deceleration is set to register 71).
- ◆ Note: When the acceleration (register 70), deceleration (register 71), and speed (register 72) are changed while the motor is running, the driver does not immediately respond to these Settings and needs to be triggered by writing the corresponding command to register 18 again.

5.2.2 PV Speed control mode

The IR/IT series features the ability to control the motor's point operation via communication. The specific modes and parameters to be set are as follows (register addresses are decimal unless otherwise specified or stated) :

- (1) Set the value of register address 20(default application selection in internal pulse mode) to 0(communication control, responding to instructions from register address 18);
- (2) Set the functions of the digital input/output ports according to the application requirements and the actual terminal blocks;
- (3) Set motion parameters:

Address	Units	Parameter Description
75	R/S ²	Acceleration of point motion
76	R/S ²	Deceleration of point motion
77	RPM	Jog the speed of motion

- (4) Communication gives running instructions: Start point motion by writing values 3(continuous forward rotation) and 4(continuous reverse rotation) to register 18 (for details of this register, see register 18 in ["Driver Control Mode Settings \[17-23\]"](#));
- (5) If you need to stop during operation, you can do so by writing a value of 6 to register 18 (deceleration stop, deceleration set to register 76).

◆ Note:

- (1) The motor is in operation and only responds to stop commands (deceleration stop or emergency stop). If you need to change the motor's running direction by command, you need to send a stop command and wait for the motor to stop before sending a start signal in the opposite direction.
- (2) The speed (register 77) can be changed while the motor is running, and the driver will respond immediately, that is, the motor will run immediately at the set speed value without the need to stop and restart to respond.

5.2.3 HM homing

The IR/IT series of integrated stepper motor products have three working modes: power-on automatic homing, communication-triggered homing, and IO-triggered homing, and support [17 to 30, 35 return to origin](#) as defined in CANOPEN

5.2.3.1 It automatically homing upon power-on

First set the homing parameters 80 to 85, homing high and low speed, acceleration, offset, and mode. Set the power-on enable of register 89 to 1 and save the restart so that the homing mode at address 85 is triggered each time the motor is powered on.

80	HM High speed	200	0	RPM	0	65535	
81	HM Low speed	40	0	PRM	0	65535	RW
82	HM acceleration	100	0	r/s^2	0	65535	RW
83	HM position offset	0	0	Pulse	- 32768	32767	RW
85	offset HM mode emergency stop	17	17	-	0	35	RW
86	deceleration	500	0	r/s^2	0	65535	RW
87	HM IO waiting time	50	0	ms	0	65535	RW
88	HM Timeout time	10000	0	ms	0	65535	RW
89	The HM is powered on	0	0	-	0	1	RW

5.2.3.2 Communication triggers zeroing

Set the mode of register 20 to communication control, and also configure the homing parameters 80 to 85. Write the value 9 to register 18, and it will trigger a homing mode with the parameters you set.

17	Instruction Source	0- Internal pulse	1	-	0	1	RW
18	Internal communication Control instructions	0	0	-	0	65535	RW
19	Pulse mode	0- Pulse rising edge	0	-	0	1	RW
20	Internal application patterns	0- Communication control	2	-	0	65535	RW
21	Motor type	0- Two-phase	0	-	0	1	RW
22	Control methods	1- servo mode 1	0	-	0	3	RW
23	Running direction	1- Invert	0	-	0	1	RW
24	Current Segmentation	4000	4000	-	200	65535	R
25	Current standby current percentage	2000	0	-	∞	65535	RW
26		0%	70	%	1	100	RW
27	Standby time	500	1000	ms	-	65535	RW

5.2.3.3 I/O triggers homing

At this point, it doesn't matter what mode register 20 is set to. It's better to configure registers 80-85, homing parameters, modes, etc. first, enter motion control, select IN input channel as start HM, and select the triggered limit signal or origin signal for the other channel, and choose positive limit or negative limit depending on the homing mode set. Each time it starts (12- start to zero), it will be triggered once

For example: When the homing mode 17 is selected, the start homing will trigger the stop when IN3 touches the rising edge of the negative limit switch signal and then turns forward to touch the falling edge.

Always open

Always closed

IN1: 7- Jog forward rotation/start/stop

IN2: 12- Start HM10- Reverse limit input

IN3:

IN4:

IN5: 11- Zero point signal input 12- Start HM15- Multi-speed control 1

IN6:

OUT1: 1- Fault alarm

OUT2: 4- Speed arrival

OUT3: 0- Normal output

OUT4:

OUT5: 0- normal output 0- normal output 0- normal output

OUT6:

5.3 Default IO control mode 1: start-stop + Direction

The IR/IT series can control the operation of the motor using two IN ports through this mode. One of the IN terminals is used to control the start/stop of the motor, and one IN terminal is used to control the running direction of the motor. The specific Settings are as follows:

Steps	Register address	Units	value	Parameter Description
1	17	---	0	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse command
2	20	---	2	Preset application selection in internal pulse mode 0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table 25: Preset IO control Mode 5: Speed-torque mode
3	62	---	39	The IN3 port is set to "39- point forward/start-stop", always open; Set to 7 when normally closed;
	63	---	40	The IN4 port is set to "40- jog reverse/direction", normally open; Set to 8 when normally closed;
4	75	R/S^2	60	Acceleration of point motion
	76	R/S^2	60	Deceleration in point motion
5	205	RPM	100	The speed at which the motor is running

- ◆ Acceleration (register 75), deceleration (register 76), and speed (register 205) can be dynamically changed while the motor is running, and the driver responds immediately to these Settings.
- ◆ The direction signal can be switched while the motor is running, at which point the motor will decelerate and stop at the deceleration set in register 76, and then accelerate in the opposite direction to the set speed.

Under the above register Settings, the COM port is connected to 24V to control the states of PUL-, DIR-, EN-, which can control the operation of the motor:

IN3 level	IN4 level	IN5 level	Motor status
/	/	0V	Offline
0V	24V	24V	Forward rotation
0V	0V		Reverse
24V	24V		Not turning
24V	0V		Do not rotate

5.4 Preset IO control mode 2: Forward + Reverse

The IR/IT series can control the operation of the motor using two IN ports through this mode. One of the IN terminals is used to control the start/stop of the motor, and one IN terminal is used to control the running direction of the motor. The specific Settings are as follows:

Steps	Register address	Units	value	Parameter Description
1	17	---	0	The instruction mode setting register sets the source of the pulse instructions of the drive 0: Internal pulse instructions 1: External pulse instructions
2	20	---	3	Preset application selection in internal pulse mode 0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table 25: Preset IO control Mode 5: Speed-torque mode
3	62	---	39	The IN3 port is set to "39-- point forward/start-stop", always open; Set it to 7 when it is normally closed;

	63	---	40	Set the IN4 port to "40-- dot reverse/direction", normally open; Set to 8 when normally closed;
4	75	R/S^2	60	The acceleration of point motion
	76	R/S^2	60	Deceleration of point motion
5	205	RPM	100	The speed at which the motor is running

- ◆ Acceleration (register 75), deceleration (register 76), and speed (register 205) can be dynamically changed while the motor is running, and the driver responds immediately to these Settings.
- ◆ The direction signal can be switched while the motor is running, at which point the motor will decelerate and stop at the deceleration set in register 76 and then accelerate in the opposite direction to the set speed.

Under the above register Settings, the COM port is connected to 24V to control the states of PUL-, DIR-, EN-, which can control the operation of the motor:

IN3 level	IN4 level	IN5 level	Motor status
/	/	0V	Offline
0V	24V	24V	Forward rotation
24V	0V		Reverse
24V	24V		Not turning
0V	0V		Do not rotate

5.5 Preset IO control mode 3: Speedometer mode

The IR/IT series can control up to 16 speeds through 4 IO. The first speed is usually set to 0, indicating that the motor stops when there is no signal input. The relevant register Settings are as follows:

Steps	Register address	Units	value	Parameter Description
1	17	---	0	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse instructions
2	20	---	4	Preset application selection in internal pulse mode

				0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table 25: Preset IO control Mode 5: Speed-torque mode
3	62	---	46	The IN3 port is set to "46 - multi-speed 0", always open; Set to 14 when normally closed;
	63		47	The IN4 port is set to "47 - multi-speed 1", always open; Set to 15 when normally closed;
	64		48	The IN5 port is set to "48 - multi-speed 2", always open; Set to 16 when normally closed;
	65		49	The IN6 port is set to "49 - multi-speed 3", always open; Set to 17 when normally closed;
4	75	R/S^2	60	Acceleration of point motion
	76	R/S^2	60	Deceleration of point motion
5	205	RPM	0	Speedometer 1
	206		200	Speedometer 2
	207		-200	Speedometer 3
	208		300	Speedometer 4
	209		-300	Speedometer 5
	210		400	Speedometer 6
	211		-400	Speedometer 7
	212		500	Speedometer 8

◆ The values in the speedometer registers are signed 16-bit data, which can be used to make the motor run forward and reverse by setting the positive and negative values of the speed.

5.6 Preset IO control mode 4: Position Table mode

The IR/IT series can control 16 positions through up to 4 I/S, and the relevant register Settings are as follow:

Steps	Register address	Units	value	Parameter Description
1	17	---	0	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse instructions
2	20	---	5	Preset application selection in internal pulse mode 0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode One: Start/Stop + direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO control mode Four: Position table 25: Preset IO control Mode 5: Speed-torque mode
3	62	---	50	The IN3 port is set to "50 - multi-segment position 0", always open; Set to 18 when normally closed;
	63		51	The IN4 port is set to "51 - multi-segment position 1", normally open; Set to 19 when normally closed;
	64		52	The IN5 port is set to "52 - multi-segment position 2", normally open; Set to 20 when normally closed;
	65		53	The IN6 port is set to "53 - multi-segment position 3", normally open; Set to 21 when normally closed;
	70	R/S^2	200	Acceleration of point motion

4	71	R/S^2	200	Deceleration of point motion
	72	RPM	300	Point movement speed
5	224	Pulse	0	Position Table 1
	226		200	Position Table 2
	228		-200	Position Table 3
	230		300	Position Table 4
	232		-300	Position Table 5
	234		400	Position Table 6
	236		-400	Position Table 7
	238		500	Position Table 8

The values in the speedometer register are signed 16-bit data, which can be used to enable the forward and reverse rotation of the motor by setting the positive and negative values of the position.

5.7 Preset IO control mode 5: Speed-torque mode

The IR/IT series can control forward and reverse rotation in torque mode with 2 I/s, and the relevant register Settings are as follows:

Steps	Register address	Units	value	Parameter description
1	17	---	0	Instruction mode set register, set the pulse instruction source of the drive 0: Internal pulse instructions 1: External pulse instructions
2	20	---	25	Preset application selection in internal pulse mode 0: Communication Control: Respond to instructions in Register 18 1: Reserved, Do not use 2: Preset IO control mode 1: Start-stop + Direction 3: Preset IO control Mode 2: Forward + Reverse 4: Preset IO Control Mode 3: Speedometer 5: Preset IO Control Mode 4: Position Table

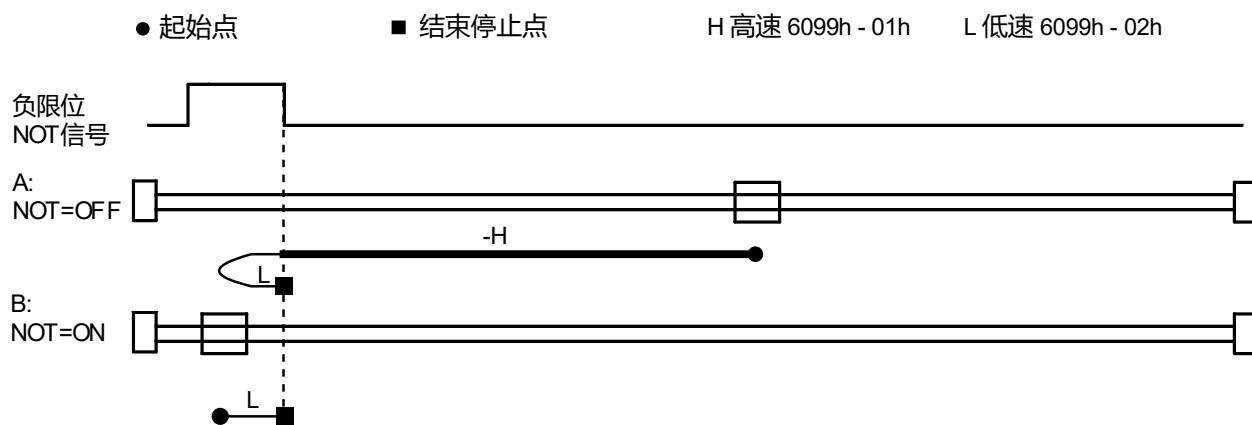
				25: Preset IO control Mode 5: Speed-torque mode
3	62	---	39	The IN3 port is set to "39 - point motion forward rotation", always open; Set to 7 when normally closed;
	63		40	The IN4 port is set to "40 - dot reverse", normally open; Set to 8 when normally closed;
4	75	R/S^2	60	Acceleration of point motion
	76	R/S^2	60	Deceleration of point motion
	77	RPM	300	Jog the speed of motion
5	180	mA	1000	Set the torque corresponding to the magnitude of the current
	181	--	--	Torque reaches the marker position 0- Not reached 1- Arrived
	182	ms	1000	Torque holding time
	183	--	1	Mode selection after torque arrives 0-Free mode 1-Position lock axis 2-Torque mode
	184	mA	--	Torque corresponds to the magnitude of the feedback current

- ◆ When the torque reaches mode 0, the motor is in an unenabled state. Re-enabling requires triggering one IO forward and reverse rotation , and the flag bit of the 181 register will be reset to zero; When the mode is 1, the motor is enabled after the torque is reached.

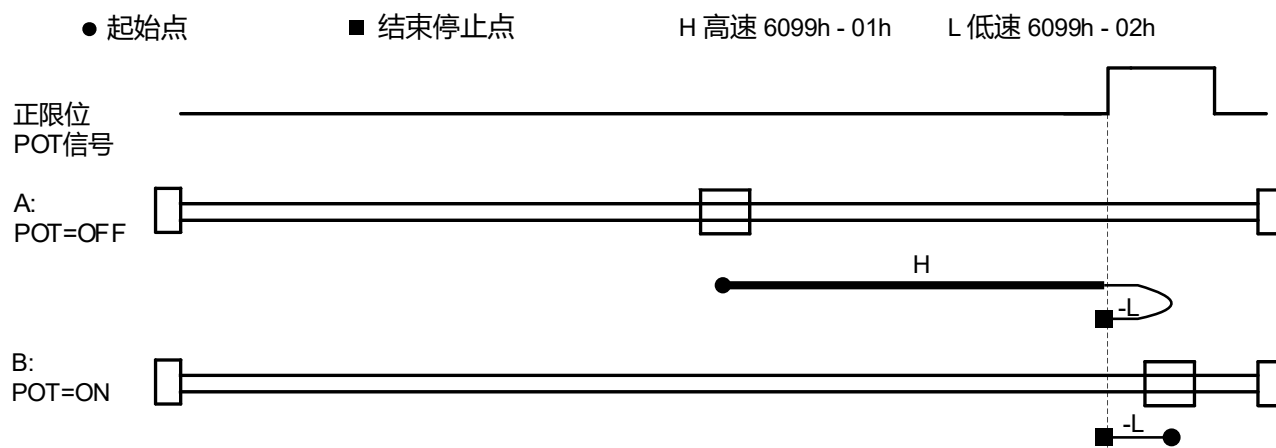
5.8 Homing mode

The IR/IT series of integrated stepper motor products have three working modes: power-on automatic homing, communication trigger homing, IO trigger homing, and support the homing mode defined in CANOPEN 17-30, 35. The specific process of the homing method is described as follows.

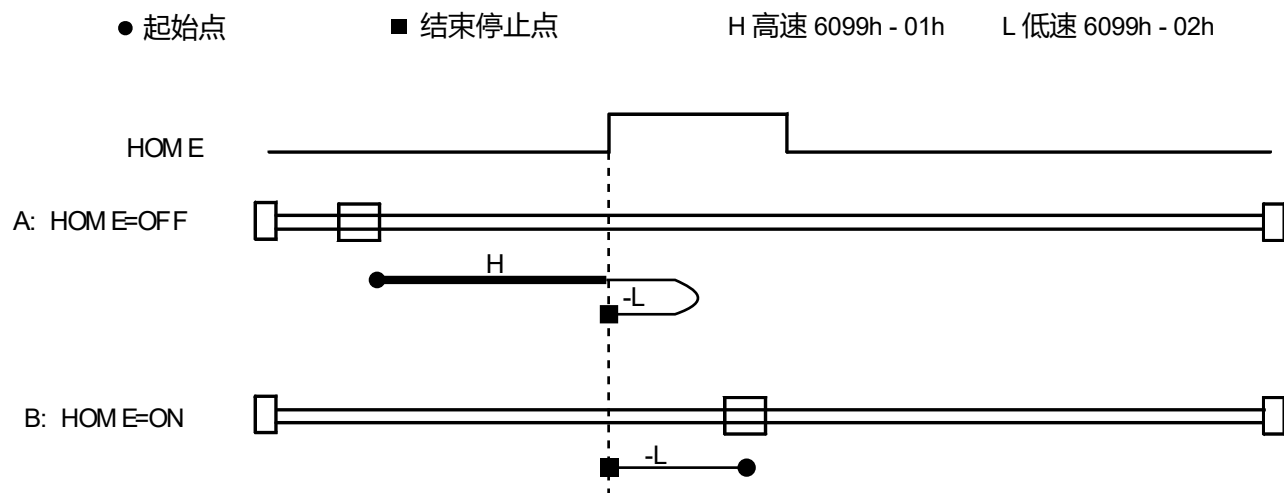
5.8.1 Method 17:



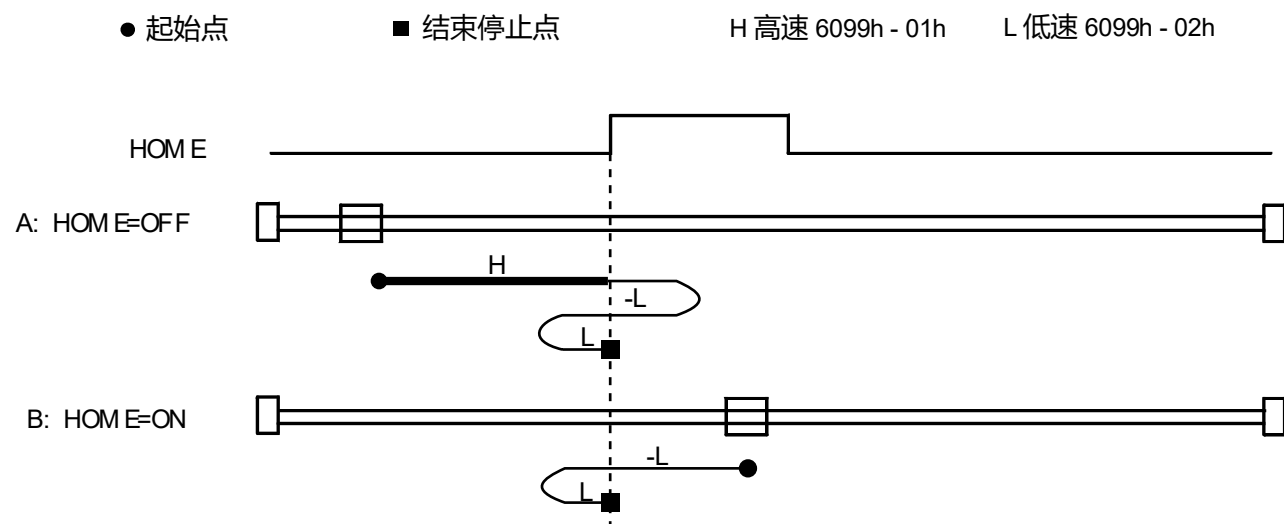
5.8.2 Method 18:



5.8.3 Method 19:

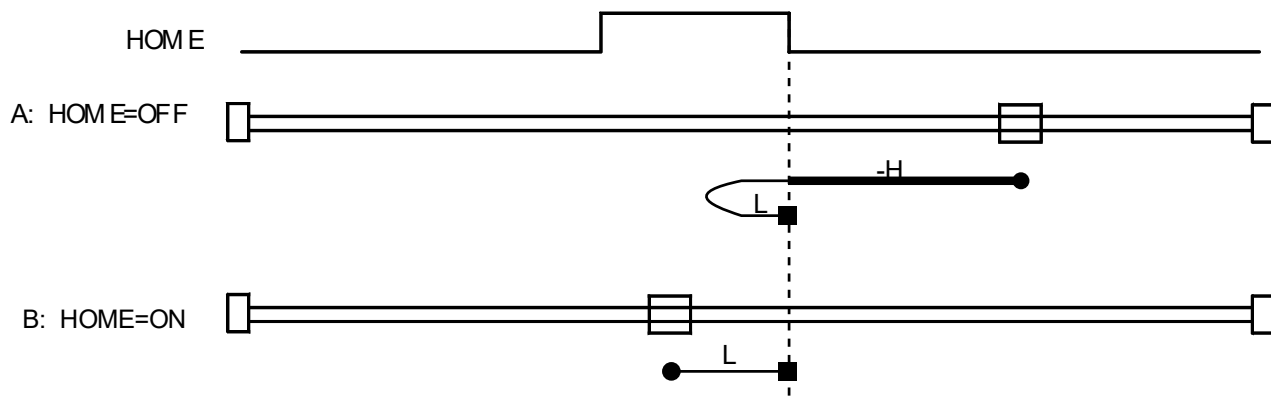


5.8.4 Method 20:



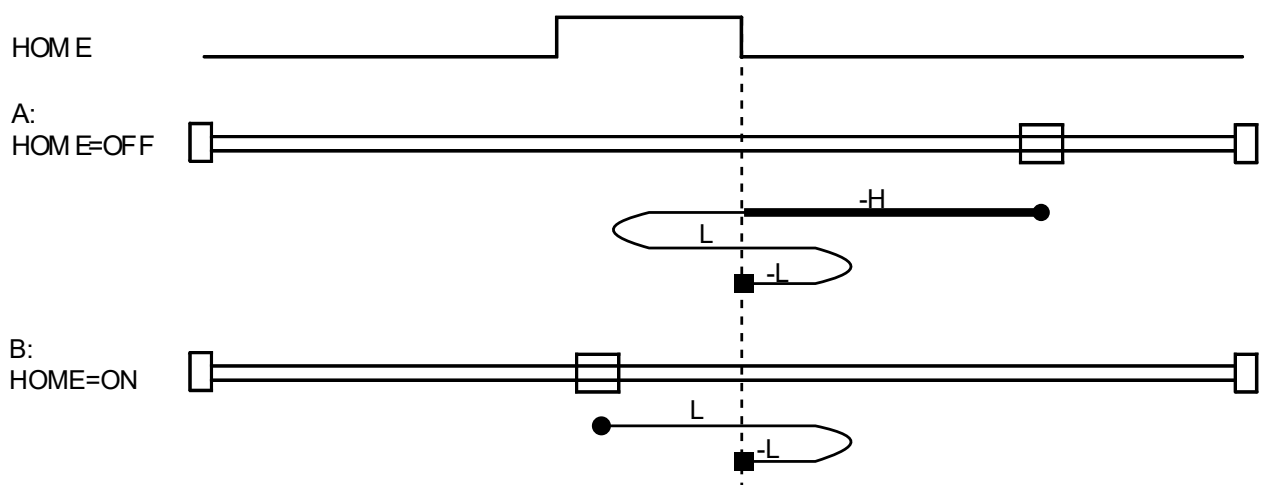
5.8.5 Method 21:

● 起始点 ■ 结束停止点 H 高速 6099h - 01h L 低速 6099h - 02h

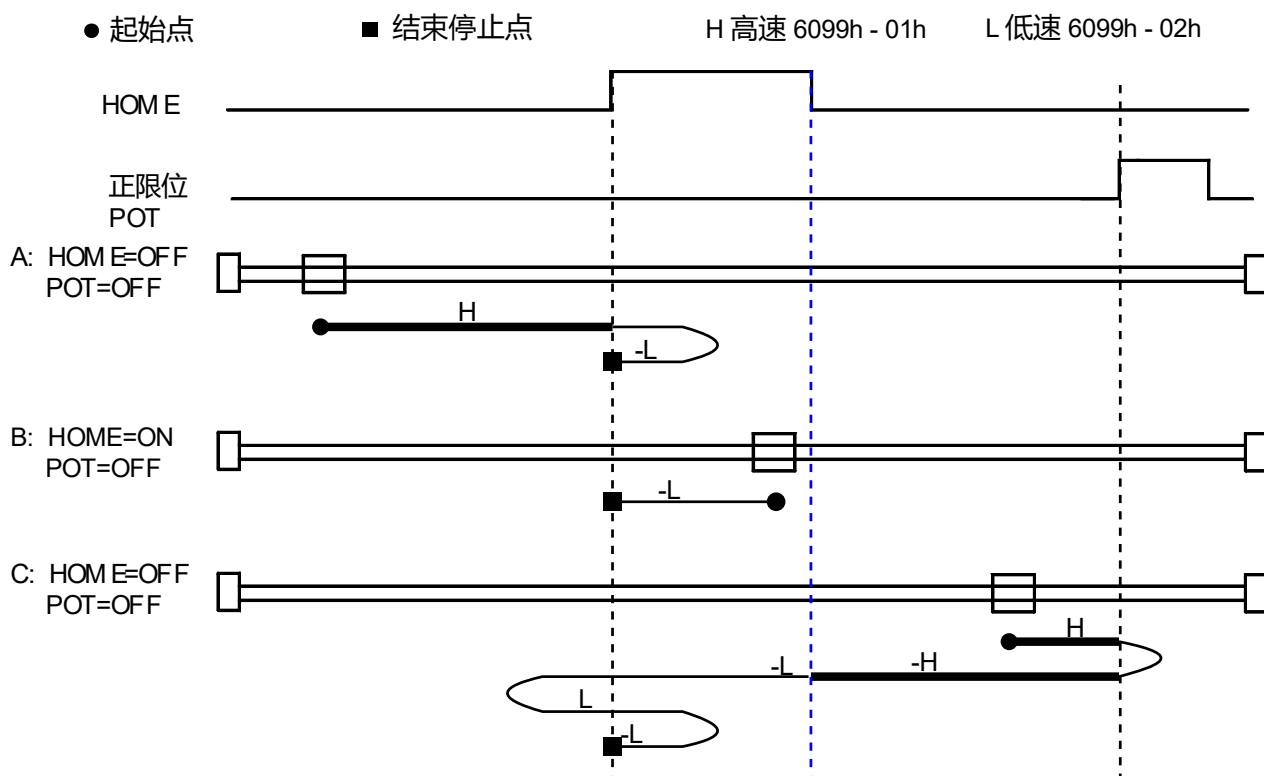


5.8.6 Method 22:

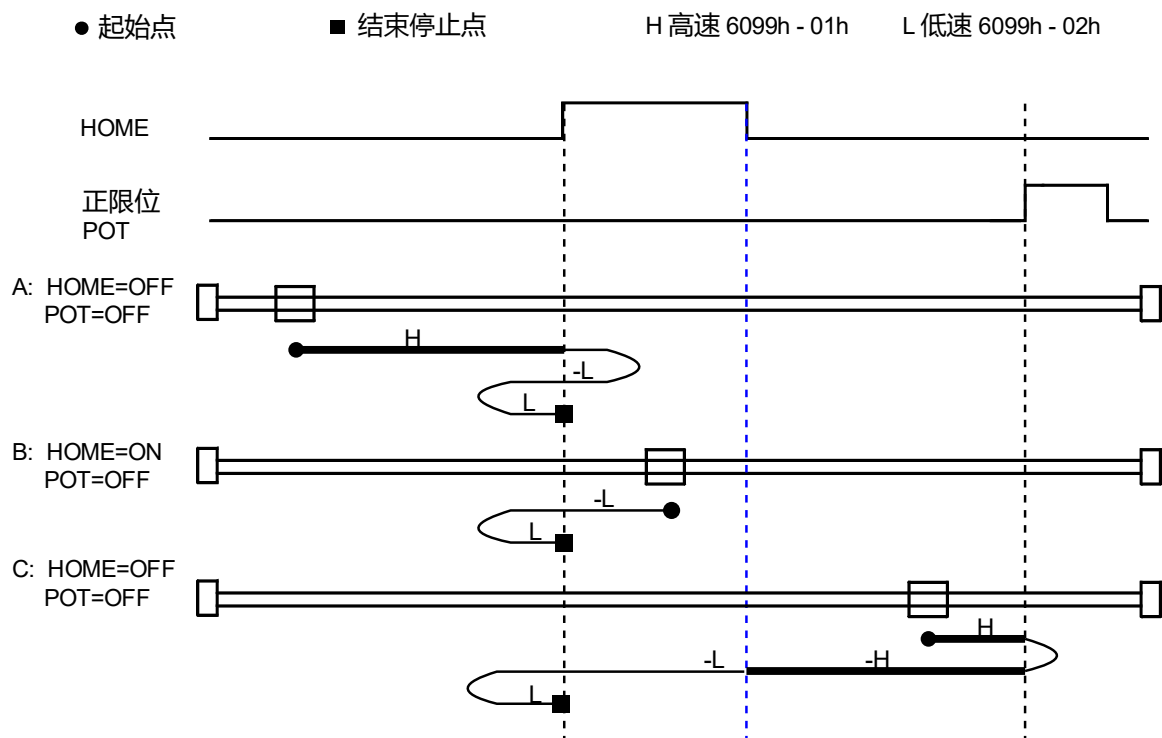
● 起始点 ■ 结束停止点 H 高速 6099h - 01h L 低速 6099h - 02h



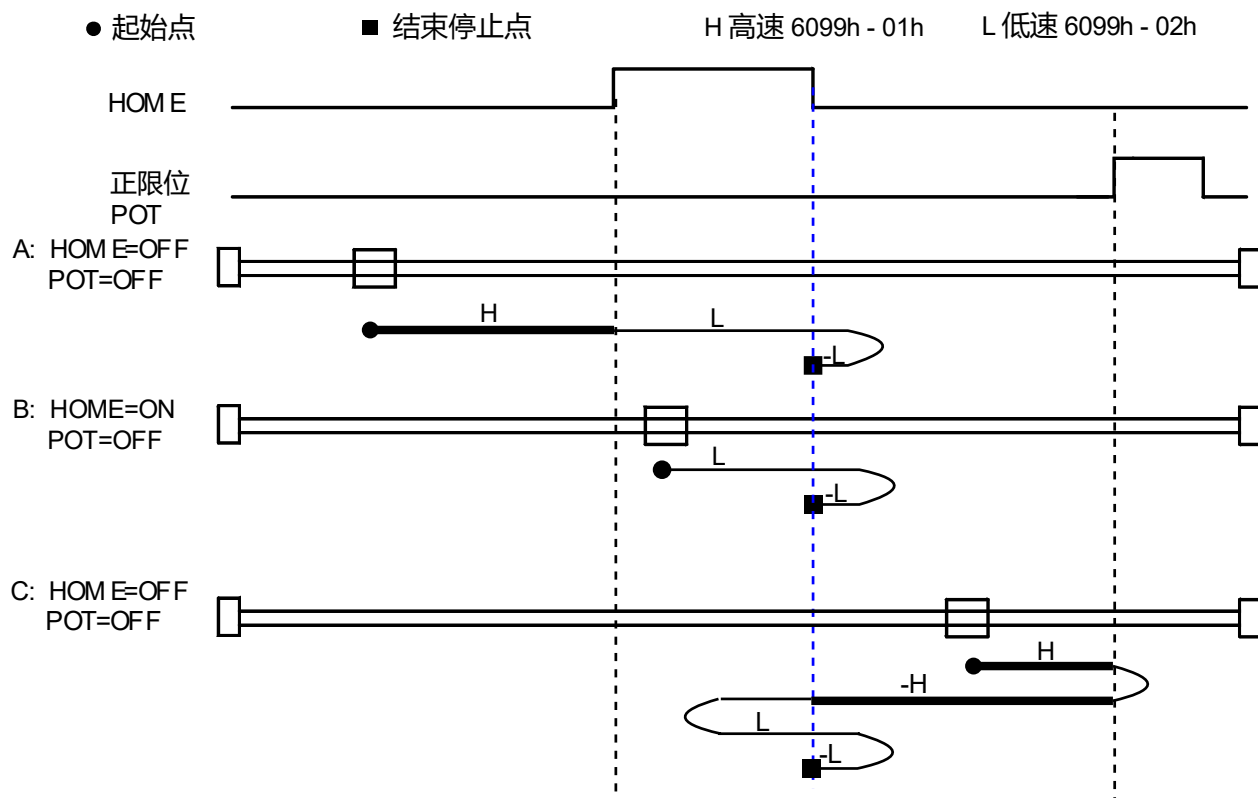
5.8.7 Method 23



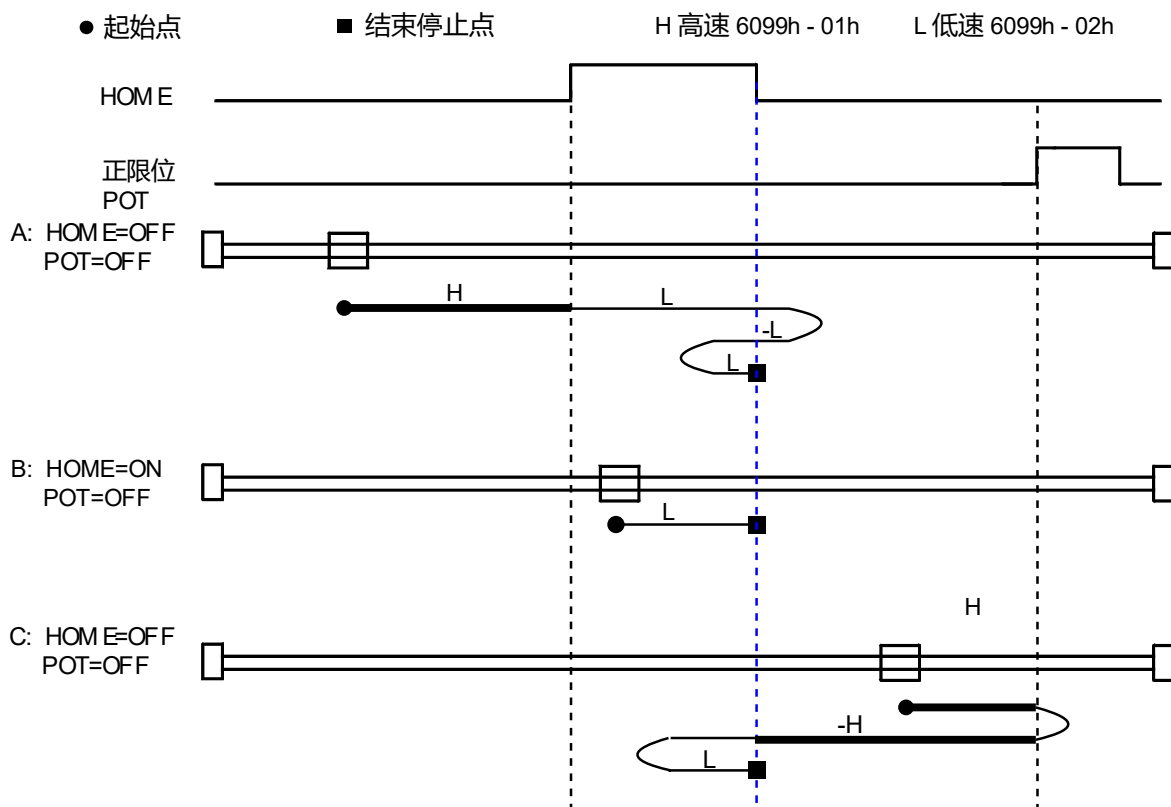
5.8.8 Method 24



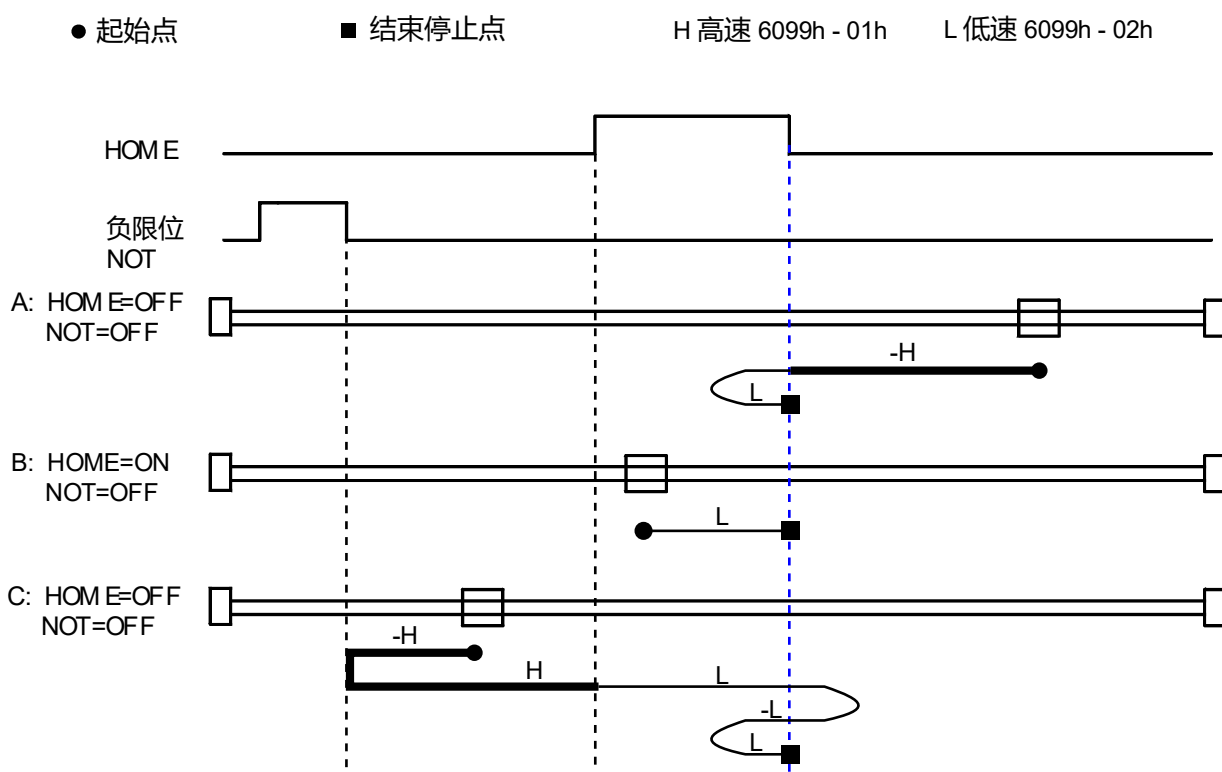
5.8.9 Method 25:



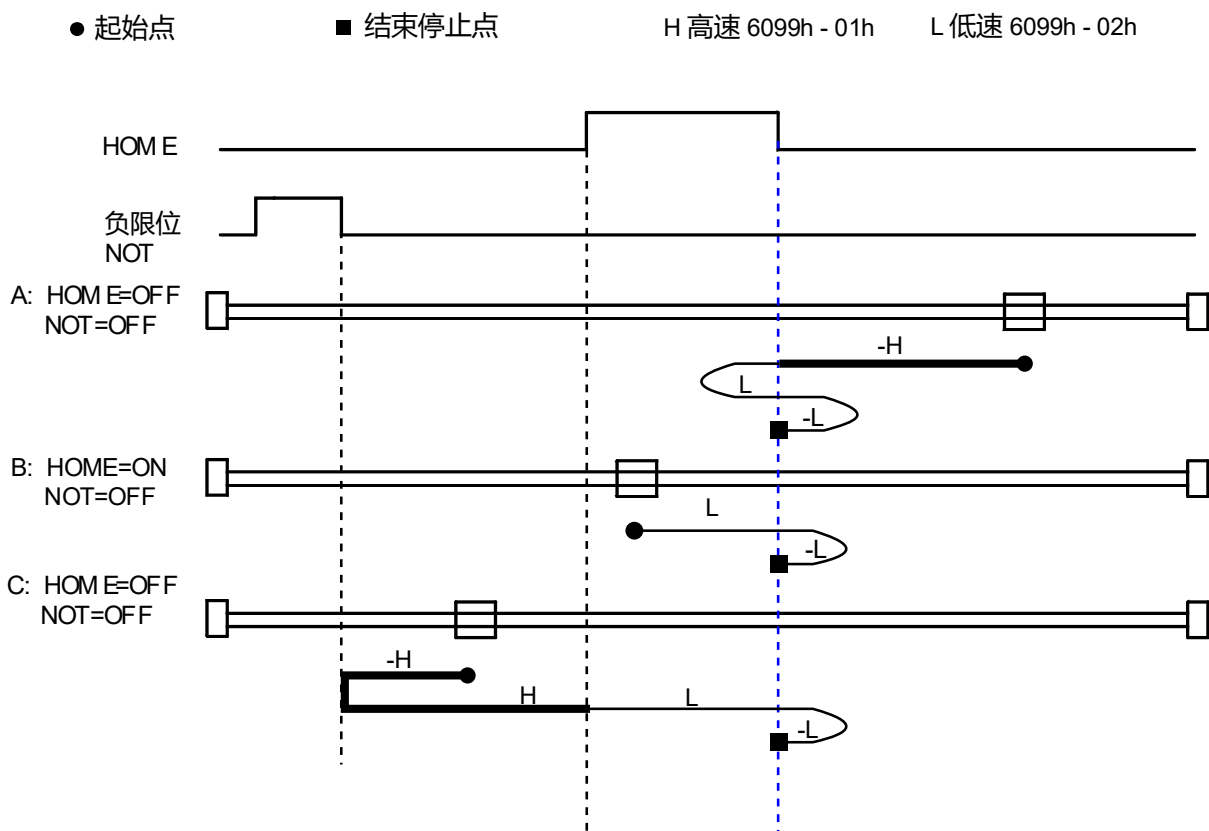
5.8.10 Method 26:



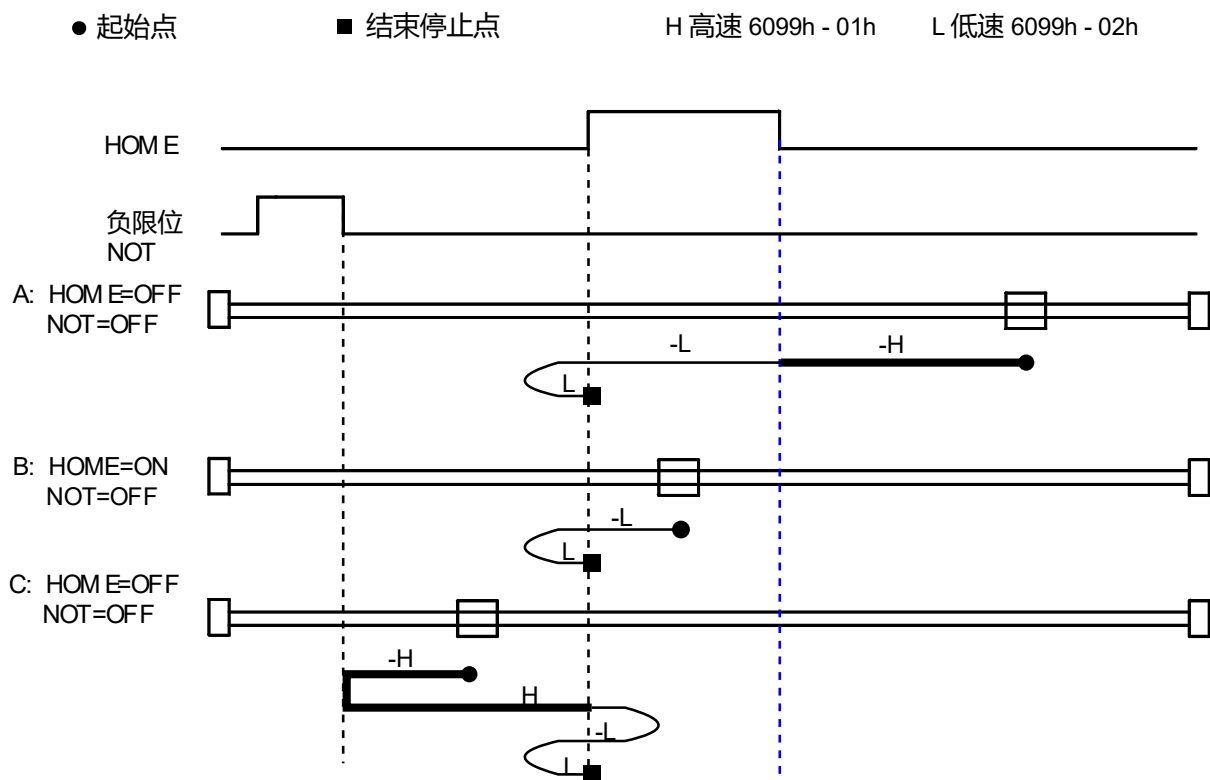
5.8.11 Method 27



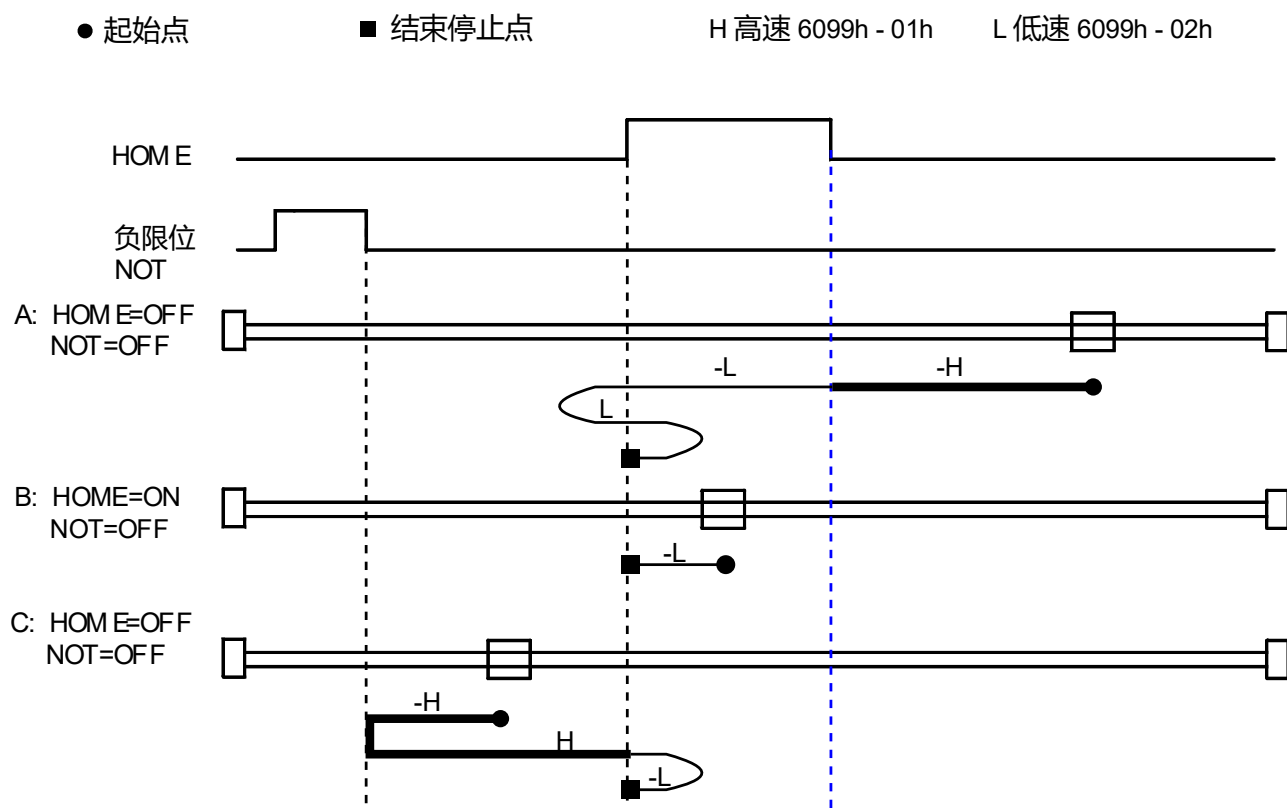
5.8.12 Method 28:



5.8.13 Method 29:



5.8.14 Method 30:



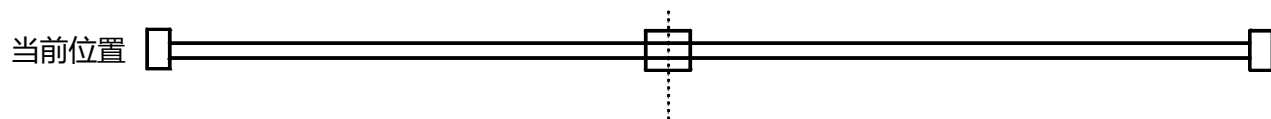
5.8.15 Method 35:

● 起始点

■ 结束停止点

→ 高速 6 00 9h-0 1h

→ 低速 6 00 9h-0 1h



6 Appendix A Function Code Message Format

1. Function 03 Read Hold registers

Query message:

QUERY	Example(Hex)
Field Name	
Slave address	01
Feature Code	03
The starting address is 8 bits high	00
8 bits lower of the starting address	00
The data length is 8 bits high	00
Data length 8 bits low	05
CRC check the lower 8 bits	85
CRC check the high 8 bits	C9

Response message:

RESPONSE	Example(Hex)
Field Name	
Slave address	01
Feature Code	03
Number of bytes returned	0A
Data high (Register 40001)	00
Low data (Register 40001)	00
High data (Register 40002)	00
Low data (Register 40002)	01
High data (Register 40003)	00
Low data (Register 40003)	00
High data (Register 40004)	00
Low data (Register 40004)	03
High data (Register 40005)	FF
Low data (Register 40005)	FF
CRC check 8 bits low	C5
CRC check the high 8 bits	C6

2. Function 06 Write to a single register:

Query message: 01 06 00 12 00 00 29 CF

QUERY	Example(Hex)
Field Name	
Slave address	01
Feature Code	06
The address is 8 bits high	00
The address is 8 digits lower	12
Data 8 bits high	00
Data 8 bits low	00
CRC check the lower 8 bits	29
CRC check the high 8 bits	CF

Response message:

QUERY	Example(Hex)
Field Name	
Slave address	01
Feature Code	06
The address is 8 bits high	00
Address 8 bits low	12
Data 8 bits high	00
Data 8 bits low	00
CRC check the lower 8 bits	29
CRC check the high 8 bits	CF

3. Function 16(10 HEX) write to multiple registers:

Query message: 01 10 00 4B 00 04 08 00 64 00 64 02 58 01 F4 86 EC

QUERY	Example(Hex)
Field Name	
Slave address	01
Feature Code	10
The starting address is 8 bits high	00
8 bits lower of the starting address	4B
The data length is 8 bits high	00
Data length 8 bits low	04
Byte count	08
High data (Register 40076)	00
Low data (Register 40076)	64
High data (Register 40077)	00
Low data (Register 40077)	64
High data (Register 40078)	02
Low data (Register 40078)	58
High data (Register 40079)	01
Low data (Register 40079)	F4
CRC check 8 bits low	86
CRC check the high 8 bits	EC

Response message:

QUERY	Example(Hex)
Field Name	
Slave address	01
Function code	10
The starting address is 8 bits high	00
8 bits lower of the starting address	4B
The data length is 8 bits high	00
Data length 8 bits low	04
CRC check the lower 8 bits	B1
CRC check the high 8 bits	DC

7 Appendix B Abnormal Responses and Code for Modbus/RTU

NT60 driver response and code in case of communication failure

// exception code

#define ILLEGAL_FUNCTION 0x01

#define ILLEGAL_DATA_ADD 0x02

#define ILLEGAL_DATA_VAL 0x03

#define DEVICEFAIL 0x04

8 Appendix C Modbus/RTU 16-bit CRC Check Routine

CRC routines are written in the C language specification to facilitate user porting to various platforms. The CRC_Checksum.c file contains two functions for calculating CRC.

Use the computed CRC:

```
unsigned short CalcCRCbyAlgorithm(unsigned char* pDataBuffer, unsigned long usDataLen)
```

```
{
```

```
    /* Use the Modbus algorithm as detailed in the Watlow comms guide */
```

```
    const unsigned short POLYNOMIAL = 0xA001;
```

```
    unsigned short wCrc;
```

```
    int iByte, iBit;
```

```
    /* Initialize CRC */
```

```
    wCrc = 0xFFFF;
```

```
    for (iByte = 0; iByte < usDataLen; iByte++)
```

```
    {
```

```
        /* Exclusive-OR the byte with the CRC */
```

```
        wCrc ^= *(pDataBuffer + iByte);
```

```
        /* Loop through all 8 data bits */
```

```
        for (iBit = 0; iBit <= 7; iBit++)
```

```
        {
```

```
            /* If the LSB is 1, shift the CRC and XOR the polynomial mask with the CRC */
```

```
            /* Note - the bit test is performed before the rotation, so can't move the << here */
```

```
            if (wCrc & 0x0001)
```

```
    {  
        wCrc >>= 1;  
        wCrc ^= POLYNOMIAL;  
    }  
    else  
    {  
        /* Just rotate it */  
        wCrc >>= 1;  
    }  
}
```

```
    return wCrc;
```

```
}
```

Calculate CRC using table lookup:

```
/* Table Of CRC Values */
```

```
const unsigned short TABLE_CRC16[] =
```

```
{  
    0x0000, 0xC0C1, 0xC181, 0x0140, 0xC301, 0x03C0, 0x0280, 0xC241,  
    0xC601, 0x06C0, 0x0780, 0xC741, 0x0500, 0xC5C1, 0xC481, 0x0440,  
    0xCC01, 0x0CC0, 0x0D80, 0xCD41, 0x0F00, 0xCFC1, 0xCE81, 0x0E40,  
    0x0A00, 0xCAC1, 0xCB81, 0x0B40, 0xC901, 0x09C0, 0x0880, 0xC841,  
    0xD801, 0x18C0, 0x1980, 0xD941, 0x1B00, 0xDBC1, 0xDA81, 0x1A40,  
    0x1E00, 0xDEC1, 0xDF81, 0x1F40, 0xDD01, 0x1DC0, 0x1C80, 0xDC41,  
    0x1400, 0xD4C1, 0xD581, 0x1540, 0xD701, 0x17C0, 0x1680, 0xD641,  
    0xD201, 0x12C0, 0x1380, 0xD341, 0x1100, 0xD1C1, 0xD081, 0x1040,  
    0xF001, 0x30C0, 0x3180, 0xF141, 0x3300, 0xF3C1, 0xF281, 0x3240,  
    0x3600, 0xF6C1, 0xF781, 0x3740, 0xF501, 0x35C0, 0x3480, 0xF441,  
    0x3C00, 0xFCC1, 0xFD81, 0x3D40, 0xFF01, 0x3FC0, 0x3E80, 0xFE41,  
    0xFA01, 0x3AC0, 0x3B80, 0xFB41, 0x3900, 0xF9C1, 0xF881, 0x3840,
```

0x2800, 0xE8C1, 0xE981, 0x2940, 0xEB01, 0x2BC0, 0x2A80, 0xEA41,
0xEE01, 0x2EC0, 0x2F80, 0xEF41, 0x2D00, 0xEDC1, 0xEC81, 0x2C40,
0xE401, 0x24C0, 0x2580, 0xE541, 0x2700, 0xE7C1, 0xE681, 0x2640,
0x2200, 0xE2C1, 0xE381, 0x2340, 0xE101, 0x21C0, 0x2080, 0xE041,
0xA001, 0x60C0, 0x6180, 0xA141, 0x6300, 0xA3C1, 0xA281, 0x6240,
0x6600, 0xA6C1, 0xA781, 0x6740, 0xA501, 0x65C0, 0x6480, 0xA441,
0x6C00, 0xACC1, 0xAD81, 0x6D40, 0xAF01, 0x6FC0, 0x6E80, 0xAE41,
0xAA01, 0x6AC0, 0x6B80, 0xAB41, 0x6900, 0xA9C1, 0xA881, 0x6840,
0x7800, 0xB8C1, 0xB981, 0x7940, 0xBB01, 0x7BC0, 0x7A80, 0xBA41,
0xBE01, 0x7EC0, 0x7F80, 0xBF41, 0x7D00, 0xBDC1, 0xBC81, 0x7C40,
0xB401, 0x74C0, 0x7580, 0xB541, 0x7700, 0xB7C1, 0xB681, 0x7640,
0x7200, 0xB2C1, 0xB381, 0x7340, 0xB101, 0x71C0, 0x7080, 0xB041,
0x5000, 0x90C1, 0x9181, 0x5140, 0x9301, 0x53C0, 0x5280, 0x9241,
0x9601, 0x56C0, 0x5780, 0x9741, 0x5500, 0x95C1, 0x9481, 0x5440,
0x9C01, 0x5CC0, 0x5D80, 0x9D41, 0x5F00, 0x9FC1, 0x9E81, 0x5E40,
0x5A00, 0x9AC1, 0x9B81, 0x5B40, 0x9901, 0x59C0, 0x5880, 0x9841,
0x8801, 0x48C0, 0x4980, 0x8941, 0x4B00, 0x8BC1, 0x8A81, 0x4A40,
0x4E00, 0x8EC1, 0x8F81, 0x4F40, 0x8D01, 0x4DC0, 0x4C80, 0x8C41,
0x4400, 0x84C1, 0x8581, 0x4540, 0x8701, 0x47C0, 0x4680, 0x8641,
0x8201, 0x42C0, 0x4380, 0x8341, 0x4100, 0x81C1, 0x8081, 0x4040

};

unsigned short CalcCRC_TAB(unsigned char* pDataBuffer, unsigned long usDataLen)

```
{  
    unsigned char nTemp;  
    unsigned short wCRCWord = 0xFFFF;  
  
    while (usDataLen--)  
    {  
        nTemp = wCRCWord ^ *(pDataBuffer++);
```

```
wCRCWord >>= 8;
wCRCWord ^= TABLE_CRC16[nTemp];
}

return wCRCWord;
}
```

SUPPORTS

**Shenzhen Rtelligent
Technology Co.,Ltd**

www.rtelligentglobal.com

ADDRESS: 2-6F, A BUILDING, RUI TECH
INDUSTRIAL PARK, XINGYU ROAD NO.23,
XIXIANG STREET, BAO AN DISTRICT,
SHENZHEN, GUANG DONG PROVINCE, CHINA

PHONE/WHATSAPP: +86 13826536186

OFFICE DIRECT LINE: +86 755 27440012

EMAIL: info@rtelligent.cn



To become the Innovation Engine of Motion Control