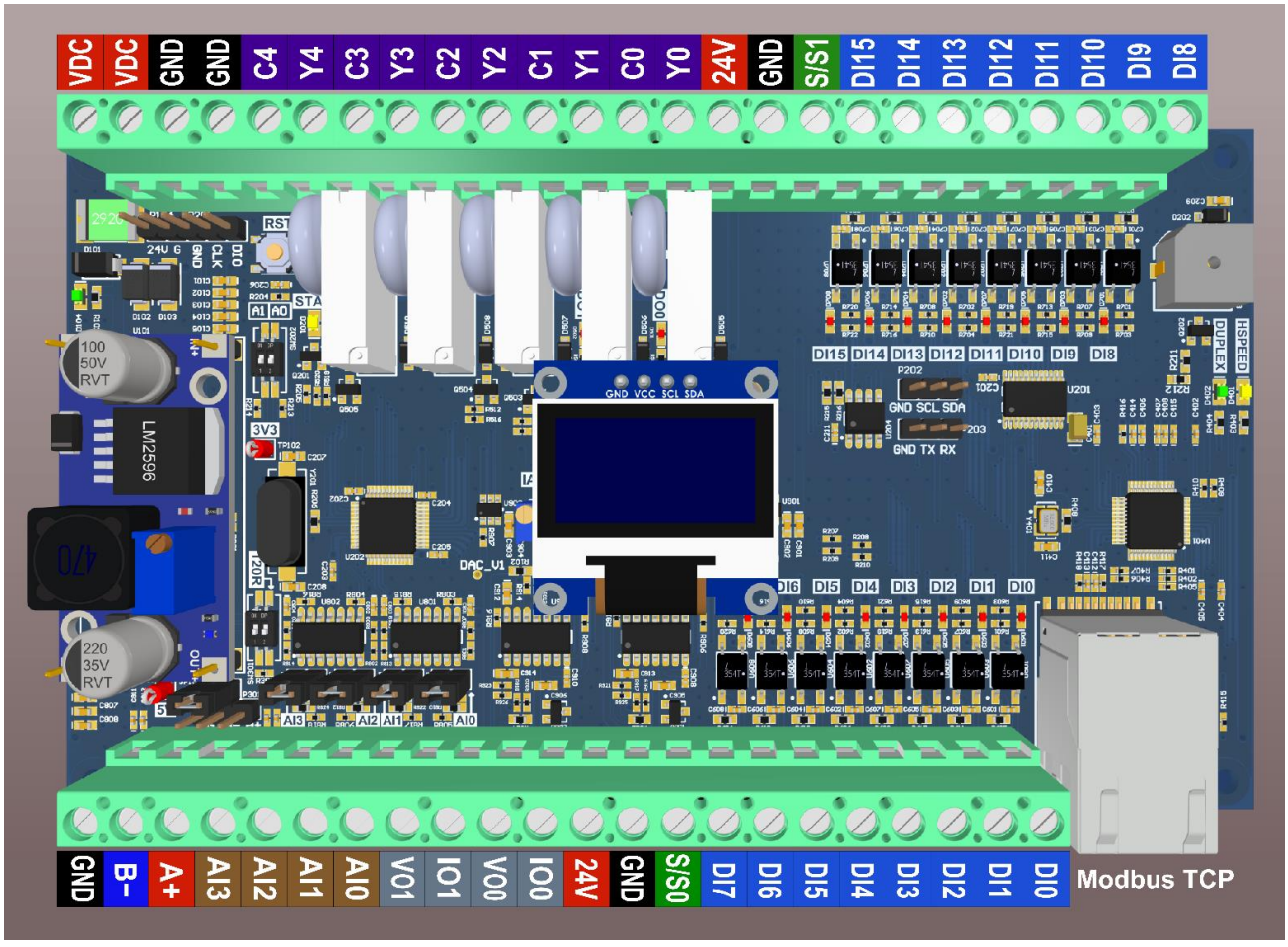
Modbus TCP/RTU Universal Remote I/O Module (5DO/16DI/2AO/4AI)

1. Design Specifications

- **Dual Interfaces for Modbus TCP and Modbus RTU**, usable individually or simultaneously.
- **Supports up to 9 clients connected simultaneously** (1 Modbus RTU and 8 Modbus TCP).
- **5-ch digital output of Omron slim power relays** with dry contact (NO) output.
  - **Maximum Resistive Load**: 5A@250VAC, 5A@30VDC.
  - **Maximum Inductive Load**: 2A@250VAC, 2A@30VDC.
- **Relay NO terminal equipped with a surge absorber**.
- **16-ch NPN/PNP opto-isolated digital inputs**.
- **128×64 pixel OLED display panel**, capable of showing real-time device settings and status.
- **2-ch of analog outputs** (0-10V and 4-20mA).
- **4-ch 12-bit analog inputs** (0-10V or 0-20mA).
- **Supports Modbus function codes** 01, 02, 03, 05, 06, 15, 16.
- **Configurable communication timeout reset** and **Keep-Alive packet transmission** to ensure stable communication connections.
- **Operating power supply**: **DC 24V**.
- **Dimensions**: **175 x 90 x 40 mm**, compatible with DIN35 rail mounting.

2. Input / Output Interface



Item	Terminal Name	Function Description
1	VDC	DC24V Supply. The device provides two VDC terminals. If one of the VDC terminals is used for power input, the other VDC terminal can be used to supply DC24V to other modules.
2	GND	Power Ground Terminal.
3	C4	Common Terminal (COM) of Digital Output DO4.
4	Y4	Normally Open (NO) Terminal of Digital Output DO4.
5	C3	Common Terminal (COM) of Digital Output DO3.
6	Y3	Normally Open (NO) Terminal of Digital Output DO3.
7	C2	Common Terminal (COM) of Digital Output DO2.
8	Y2	Normally Open (NO) Terminal of Digital Output DO2.
9	C1	Common Terminal (COM) of Digital Output DO1.
10	Y1	Normally Open (NO) Terminal of Digital Output DO1.
11	C0	Common Terminal (COM) of Digital Output DO0.
12	Y0	Normally Open (NO) Terminal of Digital Output DO0.
13	24V	DC 24V Output, used to connect with the S/S0 or S/S1 terminals to configure DI15 to DI0 as NPN type inputs. The 24V terminal is protected by an onboard chip fuse and should not be used as a power input for other modules.
14	DI15 ~ DI0	Digital Input Terminals, configurable with S/S terminals to detect digital inputs from NPN or PNP type sensors.
15	S/S1	Connecting S/S1 to DC24V: DI15 to DI8 are configured as NPN type inputs and will activate when connected to GND. Connecting S/S1 to GND: DI15 to DI8 are configured as PNP type inputs and will activate when connected to DC24V.
16	S/S0	Connecting S/S0 to DC24V: DI7 to DI0 are configured as NPN type inputs and will activate when connected to GND. Connecting S/S0 to GND: DI7 to DI0 are configured as PNP type inputs and will activate when connected to DC24V.
17	Modbus TCP	Modbus TCP Network Port.
18	IO0	Analog Current Output (4-20mA) Channel 0.
19	VO0	Analog Voltage Output (0-10V) Channel 0.
20	IO1	Analog Current Output (4-20mA) Channel 1.
21	VO1	Analog Voltage Output (0-10V) Channel 1.
22	AI0	Analog Input Channel 0, can accept inputs of 0-10V or 0-20mA (AI0 jumper must be connected first).
23	AI1	Analog Input Channel 1, can accept inputs of 0-10V or 0-20mA (AI1 jumper must be connected first).

Item	Terminal Name	Function Description
24	AI2	Analog Input Channel 2, can accept inputs of 0-10V or 0-20mA (AI2 jumper must be connected first).
25	AI3	Analog Input Channel 3, can accept inputs of 0-10V or 0-20mA (AI3 jumper must be connected first).
26	A+	A+ terminal of the RS-485 network, used for Modbus RTU connection.
27	B-	B- terminal of the RS-485 network, used for Modbus RTU connection.

3. Electrical characteristics

General	
Power Consumption	2.4 W at 24 VDC typical, 6 W at 24 VDC max.
Watchdog Timer	System WDT (3.0 second).
Terminal Blocks	Terminal spacing 5.0mm, wire stripping length 6-7mm, wire diameter range AWG24-AWG12, insulation material PA66, flame retardant grade UL94V-0.
Supported Protocols	Modbus TCP, Modbus RTU.

Digital Output	
Channels	5-ch of Omron slim power relays.
Contact Form	SPST-NO, Dry contact.
Rated Resistive Load	5 A at 250 VAC, 5 A at 30 VDC.
Rated Inductive Load	2 A at 250 VAC, 2A at 30 VDC.
Max. Switching Voltage	277 VAC max., 125 VDC max.
Max. Switching Current	5 A max.
Contact Resistance	100 mΩ max.
Operate Time	10 ms max.
Release Time	5 ms max.
Insulation Resistance	1000 MΩ min. (at 500 VDC).

Digital Input	
Channels	16-ch of LITEON bidirectional optical isolators.
Input Resistance	1.5 kΩ typ.
Rated Operating Current	±20 mA max.
Input Type	NPN or PNP Input
Isolation Voltage	3,750 Vrms.

Analog Output	
Channels	2-ch analog voltage output and 2-ch analog current output
Analog Voltage Output Range	0-10 V corresponds to 4-20mA.
Analog Current Output Range	4-20 mA corresponds to 0-10V.
Offset Error	0.02 % of FSR typ.
Gain Error	-0.1 % of FSR typ.
Integral Nonlinearity Error	±2 LSB typ.
Differential Nonlinearity Error	±0.2 LSB typ.

Analog Input	
Channels	4-ch analog voltage input or analog current input.
Analog Voltage Input Range	0-10 V.
Analog Voltage Input Impedance	1 MΩ typ.
Analog Current Input Range	0-20 mA.
Analog Current Input Impedance	500 Ω typ.
Offset Error	±1 LSB typ. ±1.5 LSB max.
Gain Error	±0.5 LSB typ. ±1.5 LSB max.
Integral Nonlinearity Error	±0.8 LSB typ. ±1.5 LSB max.
Differential Nonlinearity Error	±0.7 LSB typ. ±1 LSB max.

4. Modbus Register and Function Definitions

The device supports function codes 01, 02, 03, 05, 06, 15 and 16 for parameter setting and functional operations. Values are represented in the following formats: hexadecimal numbers are prefixed with "0x", binary numbers are prefixed with "0b", and all others are decimal.

0x2A (Hexadecimal) = 42 (Decimal)
0b10010010 (Binary) = 146 (Decimal)

4.1. Function Code 01

Modbus Function Code 01 is used to read the ON/OFF status of Digital Outputs (DO) of the device.

Item	Modbus Address	Data Address	Name	Function Description
1	1	0x0000	DO0	Read the status of Digital Output DO0 (0: OFF, 1: ON).
2	2	0x0001	DO1	Read the status of Digital Output DO1 (0: OFF, 1: ON).
3	3	0x0002	DO2	Read the status of Digital Output DO2 (0: OFF, 1: ON).
4	4	0x0003	DO3	Read the status of Digital Output DO3 (0: OFF, 1: ON).
5	5	0x0004	DO4	Read the status of Digital Output DO4 (0: OFF, 1: ON).

4.2. Function Code 02

Modbus Function Code 02 is used to read the ON/OFF status of Digital Inputs (DI) of the device.

Item	Modbus Address	Data Address	Name	Function Description
1	10001	0x0000	DI0	Read the status of Digital Input DI0 (0: OFF, 1: ON).
2	10002	0x0001	DI1	Read the status of Digital Input DI1 (0: OFF, 1: ON).
3	10003	0x0002	DI2	Read the status of Digital Input DI2 (0: OFF, 1: ON).
4	10004	0x0003	DI3	Read the status of Digital Input DI3 (0: OFF, 1: ON).
5	10005	0x0004	DI4	Read the status of Digital Input DI4 (0: OFF, 1: ON).
6	10006	0x0005	DI5	Read the status of Digital Input DI5 (0: OFF, 1: ON).
7	10007	0x0006	DI6	Read the status of Digital Input DI6 (0: OFF, 1: ON).
8	10008	0x0007	DI7	Read the status of Digital Input DI7 (0: OFF, 1: ON).
9	10009	0x0008	DI8	Read the status of Digital Input DI8 (0: OFF, 1: ON).
10	10010	0x0009	DI9	Read the status of Digital Input DI9 (0: OFF, 1: ON).
11	10011	0x000A	DI10	Read the status of Digital Input DI10 (0: OFF, 1: ON).
12	10012	0x000B	DI11	Read the status of Digital Input DI11 (0: OFF, 1: ON).
13	10013	0x000C	DI12	Read the status of Digital Input DI12 (0: OFF, 1: ON).
14	10014	0x000D	DI13	Read the status of Digital Input DI13 (0: OFF, 1: ON).
15	10015	0x000E	DI14	Read the status of Digital Input DI14 (0: OFF, 1: ON).
16	10016	0x000F	DI15	Read the status of Digital Input DI15 (0: OFF, 1: ON).

4.3. Function Code 03

Modbus Function Code 03 is used to read the contents of the holding registers of the device.

Item	Modbus Address	Data Address	Name	Function Description
1	40001	0x0000	Station Number	The Modbus station number. Default: 1
2	40002	0x0001	Baud Rate Index	The baud rate index of the Modbus RTU. 0: 9600 bps 1: 14400 bps 2: 19200 bps 3: 28800 bps 4: 38400 bps 5: 56000 bps 6: 57600 bps 7: 115200 bps (Default) 8: 128000 bps 9: 230400 bps 10: 256000 bps
3	40003	0x0002	IP Address 0	The IP address 0 of Modbus TCP. Default: 192
4	40004	0x0003	IP Address 1	The IP address 1 of Modbus TCP. Default: 168
5	40005	0x0004	IP Address 2	The IP address 2 of Modbus TCP. Default: 0
6	40006	0x0005	IP Address 3	The IP address 3 of Modbus TCP. Default: 200
7	40007	0x0006	Subnet Mask Address 0	The subnet mask address 0 of Modbus TCP. Default: 255
8	40008	0x0007	Subnet Mask Address 1	The subnet mask address 1 of Modbus TCP. Default: 255
9	40009	0x0008	Subnet Mask Address 2	The subnet mask address 2 of Modbus TCP. Default: 255
10	40010	0x0009	Subnet Mask Address 3	The subnet mask address 3 of Modbus TCP. Default: 0
11	40011	0x000A	Default Gateway 0	The default gateway address 0 of Modbus TCP. Default: 192
12	40012	0x000B	Default Gateway 1	The default gateway address 1 of Modbus TCP. Default: 168

Item	Modbus Address	Data Address	Name	Function Description
13	40013	0x000C	Default Gateway 2	The default gateway address 2 of Modbus TCP. Default: 0
14	40014	0x000D	Default Gateway 3	The default gateway address 3 of Modbus TCP. Default: 1
15	40015	0x000e	DNS Server 0	The DNS server address 0 of Modbus TCP. Default: 8
16	40016	0x000f	DNS Server 1	The DNS server address 1 of Modbus TCP. Default: 8
17	40017	0x0010	DNS Server 2	The DNS server address 2 of Modbus TCP. Default: 8
18	40018	0x0011	DNS Server 3	The DNS server address 3 of Modbus TCP. Default: 8
19	40019	0x0012	Network Port Number	The network port number of Modbus TCP. Default: 502
20	40020	0x0013	Reboot	N/A
21	40021	0x0014	OLED Display Mode	The current display mode of the OLED screen: 0: Carousel display mode. 1: AI0, AI1 analog signal display mode. 2: AI2, AI3 analog signal display mode. 3: AO0, AO1 analog signal display mode. 4: DI digital input display mode. 5: DO digital output display mode.
22	40022	0x0015	MAC0-MAC1	The MAC0-MAC1 address of the network card, expressed in hexadecimal.
23	40023	0x0016	MAC2-MAC3	The MAC2-MAC3 address of the network card, expressed in hexadecimal.
24	40024	0x0017	MAC4-MAC5	The MAC4-MAC5 address of the network card, expressed in hexadecimal.
25	40025	0x0018	No Communication Reboot Time	If there is no communication within the set time, the device will be forced to reboot. The setting unit is minutes; when set to 0, this feature is disabled. Default: 0
26	40026	0x0019	Keep-Alive time	Keep-Alive Network Packet Transmission Time The setting unit is 5-second. Default: 12

Item	Modbus Address	Data Address	Name	Function Description
27	40027	0x001a	Product Index Number	The product index number of the device.
28	40028	0x001b	Major Version Number	The major version number of the device.
29	40029	0x001c	Minor Version Number	The minor version number of the device.
30	40030	0x001d	Program Build Number	The program build number of the device.
31	40031	0x001e	Digital Output	The current status of the four digital outputs (DO4~DO0). The value is represented in binary format (prefixed with 0b), if the value is 0b00000101, it indicates that DO2 and DO0 are in the ON state.
32	40032	0x001f	PWM Cycle Time	The period time for DO3~DO0 in PWM mode. When A1 is low (L), the time unit is milliseconds (ms). When A1 is high (ON), the time unit is microseconds (us).
33	40033	0x0020	DO0 ON Time	The ON-time of DO0 in PWM mode. When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
34	40034	0x0021	DO1 ON Time	The ON-time of DO1 in PWM mode. When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
35	40035	0x0022	DO2 ON Time	The ON-time of DO2 in PWM mode. When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
36	40036	0x0023	DO3 ON Time	The ON-time of DO3 in PWM mode. When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
37	40037	0x0024	DO4 ON Time	The ON-time of DO4 in PWM mode. When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
38	40038	0x0025	DO5 ON Time	N/A
39	40039	0x0026	DO6 ON Time	N/A
40	40040	0x0027	DO7 ON Time	N/A

Item	Modbus Address	Data Address	Name	Function Description
41	40041	0x0028	Buzzer	The current status of the device's buzzer: 1: Buzzer ON 0: Buzzer OFF
42	40042	0x0029	Digital Input	The status of the 16 digital inputs (DI15~DI0) of the device. The value is represented in binary format (prefixed with 0b), if the read value is 0b00110001, it indicates that DI5, DI4, and DI0 are in the ON state.
43	40043	0x002a	DI0 Count Value	N/A
44	40044	0x002b	DI1 Count Value	N/A
45	40045	0x002c	DI2 Count Value	N/A
46	40046	0x002d	DI3 Count Value	N/A
47	40047	0x002e	DI4 Count Value	N/A
48	40048	0x002f	DI5 Count Value	N/A
49	40049	0x0030	DI6 Count Value	N/A
50	40050	0x0031	DI7 Count Value	N/A

Item	Modbus Address	Data Address	Name	Function Description
51	40051	0x0032	Motor Speed Measurement Cycle Time	N/A
52	40052	0x0033	Pulse Number per Motor Revolution	N/A
53	40053	0x0034	DI0 RPM	N/A
54	40054	0x0035	DI1 RPM	N/A
55	40055	0x0036	DI2 RPM	N/A
56	40056	0x0037	DI3 RPM	N/A
57	40057	0x0038	DI4 RPM	N/A
58	40058	0x0039	DI5 RPM	N/A
59	40059	0x003a	DI6 RPM	N/A
60	40060	0x003b	DI7 RPM	N/A
61	40061	0x003c	Analog Input Signal Type	The signal measurement modes for AI3 to AI0. Bits 3 to 0 correspond to the measurement modes of AI3 to AI0, respectively. For example, a read value of 0b00001010 indicates that AI3 and AI1 are currently in current measurement mode, while AI2 and AI0 are in voltage measurement mode. 0: The voltage measurement mode. [Unit: V] 1: The current measurement mode. [Unit: mA]
62	40062	0x003d	N/A	N/A
63	40063	0x003e	AI0	The analog conversion value of AI0. The value ÷ 1000, gives the measured analog value.
64	40064	0x003f	AI1	The analog conversion value of AI1. The value ÷ 1000, gives the measured analog value.
65	40065	0x0040	AI2	The analog conversion value of AI2. The value ÷ 1000, gives the measured analog value.
66	40066	0x0041	AI3	The analog conversion value of AI3. The value ÷ 1000, gives the measured analog value.

Item	Modbus Address	Data Address	Name	Function Description
67	40067	0x0042	AI4	N/A
68	40068	0x0043	AI5	N/A
69	40069	0x0044	AI6	N/A
70	40070	0x0045	AI7	N/A
71	40071	0x0046	Analog Output Signal Type	The analog output signal mode for AO1~AO0. Bit1 and Bit0 correspond to the signal setting mode for AO1 and AO0, respectively. For example, a reading of 0b00000010 indicates that AO1 is set to current mode, while AO0 is set to voltage mode. 0: The voltage setting mode. [Unit: V] 1: The current setting mode. [Unit: mA]
72	40072	0x0047	N/A	N/A
73	40073	0x0048	AO0	The analog output setting value for AO0. The value ÷ 1000, gives the current set analog output value.
74	40074	0x0049	AO1	The analog output setting value for AO1. The value ÷ 1000, gives the current set analog output value.
75	40075	0x004a	AO2	N/A
76	40076	0x004b	AO3	N/A
77	40077	0x004c	AO4	N/A
78	40078	0x004d	AO5	N/A
79	40079	0x004e	AO6	N/A
80	40080	0x004f	AO7	N/A

4.4. Function Code 05

Modbus Function Code 05 is used to set the ON/OFF status of digital outputs (DO) on the device.

Item	Modbus Address	Data Address	Name	Function Description
1	1	0x0000	DO0	Set the Digital Output DO0 (0: OFF, 1: ON).
2	2	0x0001	DO1	Set the Digital Output DO1 (0: OFF, 1: ON).
3	3	0x0002	DO2	Set the Digital Output DO2 (0: OFF, 1: ON).
4	4	0x0003	DO3	Set the Digital Output DO3 (0: OFF, 1: ON).
5	5	0x0004	DO4	Set the Digital Output DO4 (0: OFF, 1: ON).

4.5. Function Code 06

Function Code 06 is used to set a single holding register value.

Item	Modbus Address	Data Address	Name	Function Description
1	40001	0x0000	Station Number	Set the Modbus station number. Setting Range: 1~247
2	40002	0x0001	Baud Rate Index	Set the baud rate index of the Modbus RTU. 0: 9600 bps 1: 14400 bps 2: 19200 bps 3: 28800 bps 4: 38400 bps 5: 56000 bps 6: 57600 bps 7: 115200 bps 8: 128000 bps 9: 230400 bps 10: 256000 bps
3	40003	0x0002	IP Address 0	Set the IP address 0 of Modbus TCP. Setting Range: 0~255
4	40004	0x0003	IP Address 1	Set the IP address 1 of Modbus TCP. Setting Range: 0~255
5	40005	0x0004	IP Address 2	Set the IP address 2 of Modbus TCP. Setting Range: 0~255
6	40006	0x0005	IP Address 3	Set the IP address 3 of Modbus TCP. Setting Range: 0~255
7	40007	0x0006	Subnet Mask Address 0	Set the subnet mask address 0 of Modbus TCP. Setting Range: 0~255
8	40008	0x0007	Subnet Mask Address 1	Set the subnet mask address 1 of Modbus TCP. Setting Range: 0~255
9	40009	0x0008	Subnet Mask Address 2	Set the subnet mask address 2 of Modbus TCP. Setting Range: 0~255
10	40010	0x0009	Subnet Mask Address 3	Set the subnet mask address 3 of Modbus TCP. Setting Range: 0~255
11	40011	0x000A	Default Gateway 0	Set the default gateway address 0 of Modbus TCP. Setting Range: 0~255
12	40012	0x000B	Default Gateway 1	Set the default gateway address 1 of Modbus TCP. Setting Range: 0~255

Item	Modbus Address	Data Address	Name	Function Description
13	40013	0x000C	Default Gateway 2	Set the default gateway address 2 of Modbus TCP. Setting Range: 0~255
14	40014	0x000D	Default Gateway 3	Set the default gateway address 3 of Modbus TCP. Setting Range: 0~255
15	40015	0x000e	DNS Server 0	Set the DNS server address 0 of Modbus TCP. Setting Range: 0~255
16	40016	0x000f	DNS Server 1	Set the DNS server address 1 of Modbus TCP. Setting Range: 0~255
17	40017	0x0010	DNS Server 2	Set the DNS server address 2 of Modbus TCP. Setting Range: 0~255
18	40018	0x0011	DNS Server 3	Set the DNS server address 3 of Modbus TCP. Setting Range: 0~255
19	40019	0x0012	Network Port Number	Set the network port number of Modbus TCP. Setting Range: 0~65535
20	40020	0x0013	Reboot	Setting a value greater than 0 will cause the built-in watchdog timer (WDT) to force a reboot of the device. After setting the network parameters for Modbus TCP, you can use the reboot function to apply the settings.
21	40021	0x0014	OLED Display Mode	Set the current display mode of the OLED screen: 0: Carousel display mode. 1: AI0, AI1 analog signal display mode. 2: AI2, AI3 analog signal display mode. 3: AO0, AO1 analog signal display mode. 4: DI digital input display mode. 5: DO digital output display mode.
22	40022	0x0015	MAC0-MAC1	Set the MAC0-MAC1 address of the network card, expressed in hexadecimal. **Note: Changing the factory MAC0, MAC1, and MAC2 may cause the network equipment to fail to operate normally.**
23	40023	0x0016	MAC2-MAC3	Set the MAC2-MAC3 address of the network card, expressed in hexadecimal.
24	40024	0x0017	MAC4-MAC5	Set the MAC4-MAC5 address of the network card, expressed in hexadecimal.

Item	Modbus Address	Data Address	Name	Function Description
25	40025	0x0018	No Communication Reboot Time	Set the no communication reboot time. If there is no communication within the set time, the device will be forced to reboot. The setting unit is minutes; when set to 0, this feature is disabled. Setting Range: 0~65535
26	40026	0x0019	Keep-Alive time	Set the Keep-Alive Network Packet Transmission Time The setting unit is 5-second. Setting Range: 0~255
27	40027	0x001a	Product Index Number	N/A
28	40028	0x001b	Major Version Number	N/A
29	40029	0x001c	Minor Version Number	N/A
30	40030	0x001d	Program Build Number	N/A
31	40031	0x001e	Digital Output	Set the status of the four digital outputs (DO4~DO0). The value is represented in binary format (prefixed with 0b), if the value is 0b00000101, it indicates that DO2 and DO0 are in the ON state.
32	40032	0x001f	PWM Period Time	The period time for DO4~DO0 in PWM mode. (Setting Range: 10~65535) When A1 is low (L), the time unit is milliseconds (ms). When A1 is high (ON), the time unit is microseconds (us).
33	40033	0x0020	DO0 ON Time	The ON-time of DO0 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
34	40034	0x0021	DO1 ON Time	The ON-time of DO1 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).

Item	Modbus Address	Data Address	Name	Function Description
35	40035	0x0022	DO2 ON Time	The ON-time of DO2 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
36	40036	0x0023	DO3 ON Time	The ON-time of DO3 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
37	40037	0x0024	DO4 ON Time	The ON-time of DO4 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
38	40038	0x0025	DO5 ON Time	N/A
39	40039	0x0026	DO6 ON Time	N/A
40	40040	0x0027	DO7 ON Time	N/A

Item	Modbus Address	Data Address	Name	Function Description
41	40041	0x0028	Buzzer	Set the status of the device's buzzer: 1: Buzzer ON 0: Buzzer OFF
42	40042	0x0029	Digital Input	N/A
43	40043	0x002a	DI0 Count Value	N/A
44	40044	0x002b	DI1 Count Value	N/A
45	40045	0x002c	DI2 Count Value	N/A
46	40046	0x002d	DI3 Count Value	N/A
47	40047	0x002e	DI4 Count Value	N/A
48	40048	0x002f	DI5 Count Value	N/A
49	40049	0x0030	DI6 Count Value	N/A
50	40050	0x0031	DI7 Count Value	N/A
51	40051	0x0032	Motor Speed Measurement Cycle Time	N/A
52	40052	0x0033	Pulse Number per Motor Revolution	N/A
53	40053	0x0034	DI0 RPM	N/A
54	40054	0x0035	DI1 RPM	N/A
55	40055	0x0036	DI2 RPM	N/A
56	40056	0x0037	DI3 RPM	N/A
57	40057	0x0038	DI4 RPM	N/A
58	40058	0x0039	DI5 RPM	N/A
59	40059	0x003a	DI6 RPM	N/A
60	40060	0x003b	DI7 RPM	N/A

Item	Modbus Address	Data Address	Name	Function Description
61	40061	0x003c	Analog Input Signal Type	Set the signal measurement modes for AI3 to AI0. Bits 3 to 0 correspond to the measurement modes of AI3 to AI0, respectively. For example, writing 0b00001010 means that AI3 and AI1 are currently in current measurement mode, while AI2 and AI0 are in voltage measurement mode. 0: The voltage measurement mode. [Unit: V] 1: The current measurement mode. [Unit: mA]
62	40062	0x003d	N/A	N/A
63	40063	0x003e	AI0	N/A
64	40064	0x003f	AI1	N/A
65	40065	0x0040	AI2	N/A
66	40066	0x0041	AI3	N/A
67	40067	0x0042	AI4	N/A
68	40068	0x0043	AI5	N/A
69	40069	0x0044	AI6	N/A
70	40070	0x0045	AI7	N/A
71	40071	0x0046	Analog Output Signal Type	Set the analog output signal mode for AO1~AO0. Bit1 and Bit0 correspond to the signal setting mode for AO1 and AO0, respectively. For example, writing 0b00000010 means that AO1 is set to current setting mode, while AO0 is set to voltage setting mode. 0: The voltage setting mode. [Unit: V] 1: The current setting mode. [Unit: mA]
72	40072	0x0047	N/A	N/A
73	40073	0x0048	AO0	Set the analog output setting value for AO0. The value ÷ 1000, gives the current set analog output value.
74	40074	0x0049	AO1	Set the analog output setting value for AO1. The value ÷ 1000, gives the current set analog output value.
75	40075	0x004a	AO2	N/A
76	40076	0x004b	AO3	N/A
77	40077	0x004c	AO4	N/A
78	40078	0x004d	AO5	N/A
79	40079	0x004e	AO6	N/A
80	40080	0x004f	AO7	N/A

4.6. Function Code 15

The Modbus Function Code 15 is used to set the status of a series of digital outputs.

Item	Modbus Address	Data Address	Name	Function Description
1	1	0x0000	DO0	Set the Digital Output DO0 (0: OFF, 1: ON).
2	2	0x0001	DO1	Set the Digital Output DO1 (0: OFF, 1: ON).
3	3	0x0002	DO2	Set the Digital Output DO2 (0: OFF, 1: ON).
4	4	0x0003	DO3	Set the Digital Output DO3 (0: OFF, 1: ON).
5	5	0x0004	DO4	Set the Digital Output DO4 (0: OFF, 1: ON).

4.7. Function Code 16

Function code 16 is used to set a series of holding register values.

Item	Modbus Address	Data Address	Name	Function Description
1	40001	0x0000	Station Number	Set the Modbus station number. Setting Range: 1~247
2	40002	0x0001	Baud Rate Index	Set the baud rate index of the Modbus RTU. 0: 9600 bps 1: 14400 bps 2: 19200 bps 3: 28800 bps 4: 38400 bps 5: 56000 bps 6: 57600 bps 7: 115200 bps 8: 128000 bps 9: 230400 bps 10: 256000 bps
3	40003	0x0002	IP Address 0	Set the IP address 0 of Modbus TCP. Setting Range: 0~255
4	40004	0x0003	IP Address 1	Set the IP address 1 of Modbus TCP. Setting Range: 0~255
5	40005	0x0004	IP Address 2	Set the IP address 2 of Modbus TCP. Setting Range: 0~255
6	40006	0x0005	IP Address 3	Set the IP address 3 of Modbus TCP. Setting Range: 0~255

Item	Modbus Address	Data Address	Name	Function Description
7	40007	0x0006	Subnet Mask Address 0	Set the subnet mask address 0 of Modbus TCP. Setting Range: 0~255
8	40008	0x0007	Subnet Mask Address 1	Set the subnet mask address 1 of Modbus TCP. Setting Range: 0~255
9	40009	0x0008	Subnet Mask Address 2	Set the subnet mask address 2 of Modbus TCP. Setting Range: 0~255
10	40010	0x0009	Subnet Mask Address 3	Set the subnet mask address 3 of Modbus TCP. Setting Range: 0~255
11	40011	0x000A	Default Gateway 0	Set the default gateway address 0 of Modbus TCP. Setting Range: 0~255
12	40012	0x000B	Default Gateway 1	Set the default gateway address 1 of Modbus TCP. Setting Range: 0~255
13	40013	0x000C	Default Gateway 2	Set the default gateway address 2 of Modbus TCP. Setting Range: 0~255
14	40014	0x000D	Default Gateway 3	Set the default gateway address 3 of Modbus TCP. Setting Range: 0~255
15	40015	0x000e	DNS Server 0	Set the DNS server address 0 of Modbus TCP. Setting Range: 0~255
16	40016	0x000f	DNS Server 1	Set the DNS server address 1 of Modbus TCP. Setting Range: 0~255
17	40017	0x0010	DNS Server 2	Set the DNS server address 2 of Modbus TCP. Setting Range: 0~255
18	40018	0x0011	DNS Server 3	Set the DNS server address 3 of Modbus TCP. Setting Range: 0~255
19	40019	0x0012	Network Port Number	Set the network port number of Modbus TCP. Setting Range: 0~65535
20	40020	0x0013	Reboot	Setting a value greater than 0 will cause the built-in watchdog timer (WDT) to force a reboot of the device. After setting the network parameters for Modbus TCP, you can use the reboot function to apply the settings.

Item	Modbus Address	Data Address	Name	Function Description
21	40021	0x0014	OLED Display Mode	Set the current display mode of the OLED screen: 0: Carousel display mode. 1: AI0, AI1 analog signal display mode. 2: AI2, AI3 analog signal display mode. 3: AO0, AO1 analog signal display mode. 4: DI digital input display mode. 5: DO digital output display mode.
22	40022	0x0015	MAC0-MAC1	Set the MAC0-MAC1 address of the network card, expressed in hexadecimal. **Note: Changing the factory MAC0, MAC1, and MAC2 may cause the network equipment to fail to operate normally.**
23	40023	0x0016	MAC2-MAC3	Set the MAC2-MAC3 address of the network card, expressed in hexadecimal.
24	40024	0x0017	MAC4-MAC5	Set the MAC4-MAC5 address of the network card, expressed in hexadecimal.
25	40025	0x0018	No Communication Reboot Time	Set the no communication reboot time. If there is no communication within the set time, the device will be forced to reboot. The setting unit is minutes; when set to 0, this feature is disabled. Setting Range: 0~65535
26	40026	0x0019	Keep-Alive time	Set the Keep-Alive Network Packet Transmission Time The setting unit is 5-second. Setting Range: 0~255
27	40027	0x001a	Product Index Number	N/A
28	40028	0x001b	Major Version Number	N/A
29	40029	0x001c	Minor Version Number	N/A
30	40030	0x001d	Program Build Number	N/A

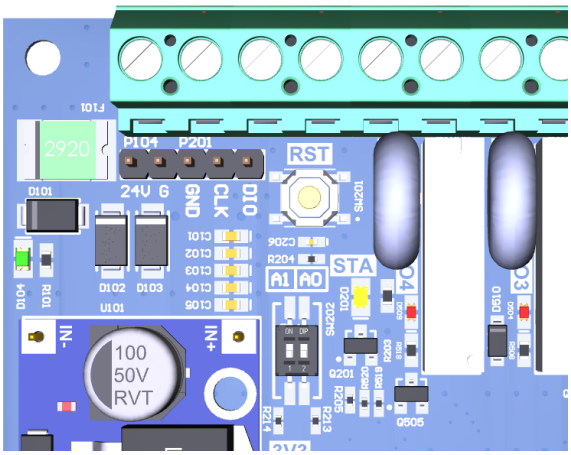
Item	Modbus Address	Data Address	Name	Function Description
31	40031	0x001e	Digital Output	Set the status of the four digital outputs (DO4~DO0). The value is represented in binary format (prefixed with 0b), if the value is 0b00000101, it indicates that DO2 and DO0 are in the ON state.
32	40032	0x001f	PWM Period Time	The period time for DO4~DO0 in PWM mode. (Setting Range: 10~65535) When A1 is low (L), the time unit is milliseconds (ms). When A1 is high (ON), the time unit is microseconds (us).
33	40033	0x0020	DO0 ON Time	The ON-time of DO0 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
34	40034	0x0021	DO1 ON Time	The ON-time of DO1 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
35	40035	0x0022	DO2 ON Time	The ON-time of DO2 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
36	40036	0x0023	DO3 ON Time	The ON-time of DO3 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
37	40037	0x0024	DO4 ON Time	The ON-time of DO4 in PWM mode. (Setting Range: 0~65535) When A1 is L, the time unit is milliseconds (ms). When A1 is H (ON), the time unit is microseconds (us).
38	40038	0x0025	DO5 ON Time	N/A
39	40039	0x0026	DO6 ON Time	N/A
40	40040	0x0027	DO7 ON Time	N/A

Item	Modbus Address	Data Address	Name	Function Description
41	40041	0x0028	Buzzer	Set the status of the device's buzzer: 1: Buzzer ON 0: Buzzer OFF
42	40042	0x0029	Digital Input	N/A
43	40043	0x002a	DI0 Count Value	N/A
44	40044	0x002b	DI1 Count Value	N/A
45	40045	0x002c	DI2 Count Value	N/A
46	40046	0x002d	DI3 Count Value	N/A
47	40047	0x002e	DI4 Count Value	N/A
48	40048	0x002f	DI5 Count Value	N/A
49	40049	0x0030	DI6 Count Value	N/A
50	40050	0x0031	DI7 Count Value	N/A
51	40051	0x0032	Motor Speed Measurement Cycle Time	N/A
52	40052	0x0033	Pulse Number per Motor Revolution	N/A
53	40053	0x0034	DI0 RPM	N/A
54	40054	0x0035	DI1 RPM	N/A
55	40055	0x0036	DI2 RPM	N/A
56	40056	0x0037	DI3 RPM	N/A
57	40057	0x0038	DI4 RPM	N/A
58	40058	0x0039	DI5 RPM	N/A
59	40059	0x003a	DI6 RPM	N/A
60	40060	0x003b	DI7 RPM	N/A

Item	Modbus Address	Data Address	Name	Function Description
61	40061	0x003c	Analog Input Signal Type	Set the signal measurement modes for AI3 to AI0. Bits 3 to 0 correspond to the measurement modes of AI3 to AI0, respectively. For example, writing 0b00001010 means that AI3 and AI1 are currently in current measurement mode, while AI2 and AI0 are in voltage measurement mode. 0: The voltage measurement mode. [Unit: V] 1: The current measurement mode. [Unit: mA]
62	40062	0x003d	N/A	N/A
63	40063	0x003e	AI0	N/A
64	40064	0x003f	AI1	N/A
65	40065	0x0040	AI2	N/A
66	40066	0x0041	AI3	N/A
67	40067	0x0042	AI4	N/A
68	40068	0x0043	AI5	N/A
69	40069	0x0044	AI6	N/A
70	40070	0x0045	AI7	N/A
71	40071	0x0046	Analog Output Signal Type	Set the analog output signal mode for AO1~AO0. Bit1 and Bit0 correspond to the signal setting mode for AO1 and AO0, respectively. For example, writing 0b00000010 means that AO1 is set to current setting mode, while AO0 is set to voltage setting mode. 0: The voltage setting mode. [Unit: V] 1: The current setting mode. [Unit: mA]
72	40072	0x0047	N/A	N/A
73	40073	0x0048	AO0	Set the analog output setting value for AO0. The value ÷ 1000, gives the current set analog output value.
74	40074	0x0049	AO1	Set the analog output setting value for AO1. The value ÷ 1000, gives the current set analog output value.
75	40075	0x004a	AO2	N/A
76	40076	0x004b	AO3	N/A
77	40077	0x004c	AO4	N/A
78	40078	0x004d	AO5	N/A
79	40079	0x004e	AO6	N/A
80	40080	0x004f	AO7	N/A

5. Pulse-Width Modulation (PWM)

The DO4~DO0 of this device can be set to output in PWM mode. Below is an example using DO0 to explain the setup process:



As shown in the figure, when the A1 dip switch (SW202) is set to the ON position, the time unit for PWM is in microseconds (us). Conversely, if the A1 dip switch is in the down position (OFF), the time unit is in milliseconds (ms).

To generate a PWM signal with a period of 100ms and an on-time of 40ms on DO0, follow these steps:

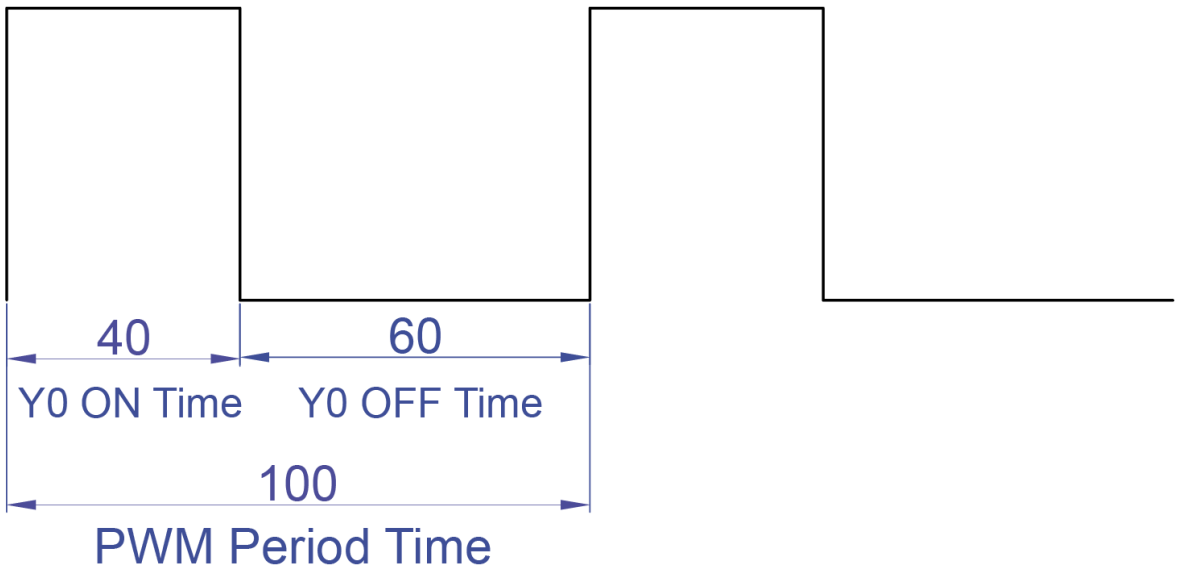
(1) Set the A1 dip switch to the down position (OFF) to set the time unit to milliseconds (ms).

(2) Use function code 06 to set the 『PWM Period Time (40032)』 to 100.

(3) Use function code 06 to set the 『DO0 ON Time (40033)』 to 40.

(4) Use function code 05 or 06 or 15 to set the state of DO0 to on (ON).

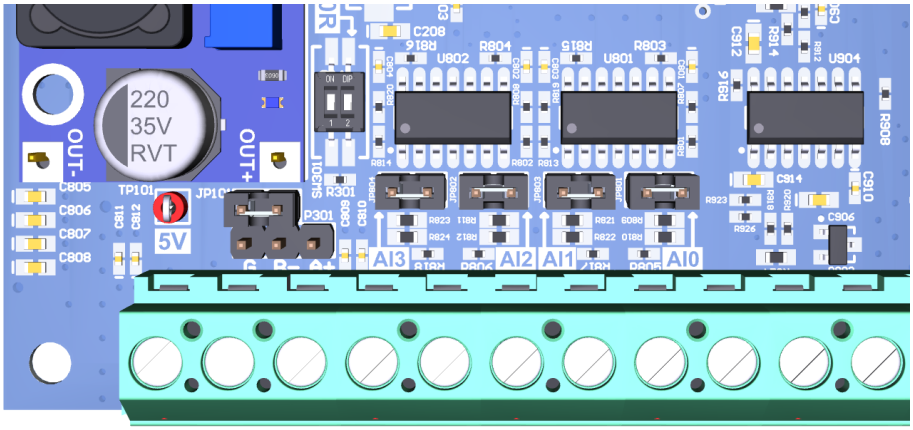
(5) DO0 will toggle between the ON and OFF states according to the configured on-time and period time until the DO0 state is set to OFF.



Note 1: If the conduction time of DO3 ~ DO0 is greater than or equal to the PWM cycle time, it means that DO3 ~ DO0 are used as general digital outputs at this time.

Note 2: If the PWM cycle time is too short (the frequency is too high), the relay will not have enough time to react.

6. Analog Input Voltage/Current Measurement Mode



The device includes 4 analog input channels (AI3 to AI0) capable of measuring 0-10V or 0-20mA. The following example demonstrates the setup process using AI0.

6.1. Voltage measurement setting process

(1) Remove the jumper labeled by AI0 in the above diagram.

(2) Use function code 06 to set 『Analog Input Signal Type (40061)』 to 0x0000.

(3) Connect a 0-10V voltage input signal to the AI0 terminal.

(4) Use function code 03 to read 『AI0 (40063)』. The read value divided by 1000 is the analog voltage measured by AI0 (unit: V).

6.2. Current measurement setting process

(1) Attach the jumper labeled by AI0 in the above diagram.

(2) Use function code 06 to set 『Analog Input Signal Type (40061)』 to 0x0001.

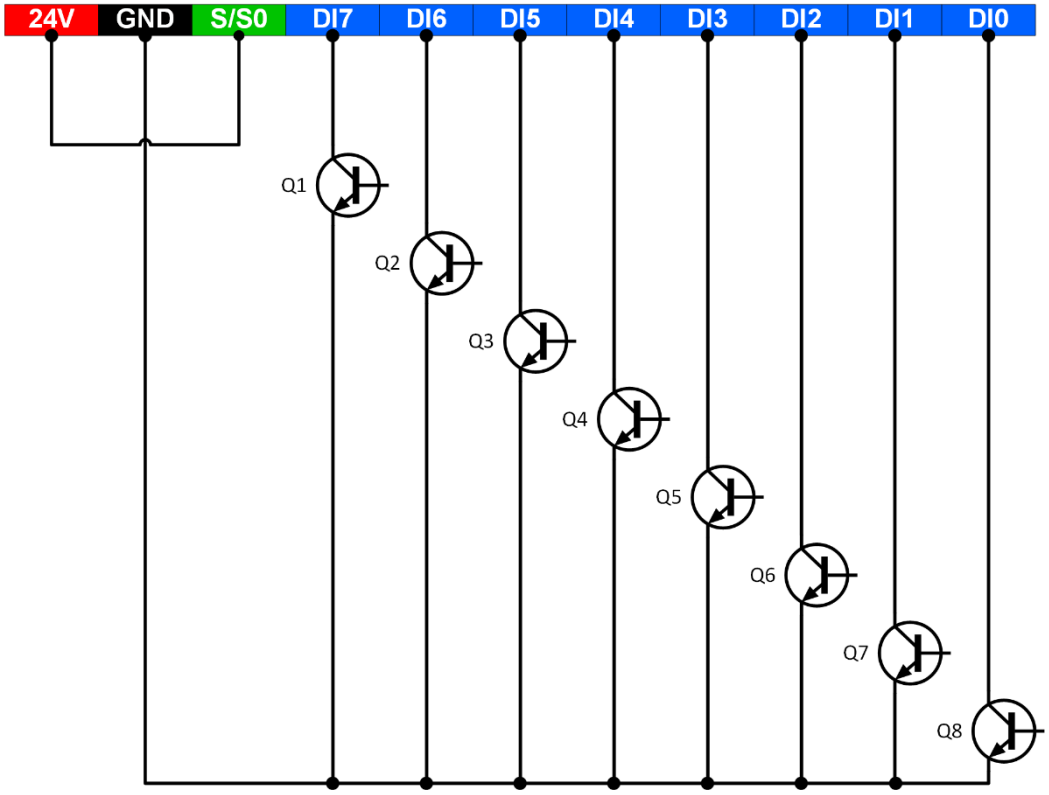
(3) Connect a 0-20mA current input signal to the AI0 terminal.

(4) Use function code 03 to read 『AI0 (40063)』. The read value divided by 1000 is the analog current measured by AI0 (unit: mA).

7. Digital Input

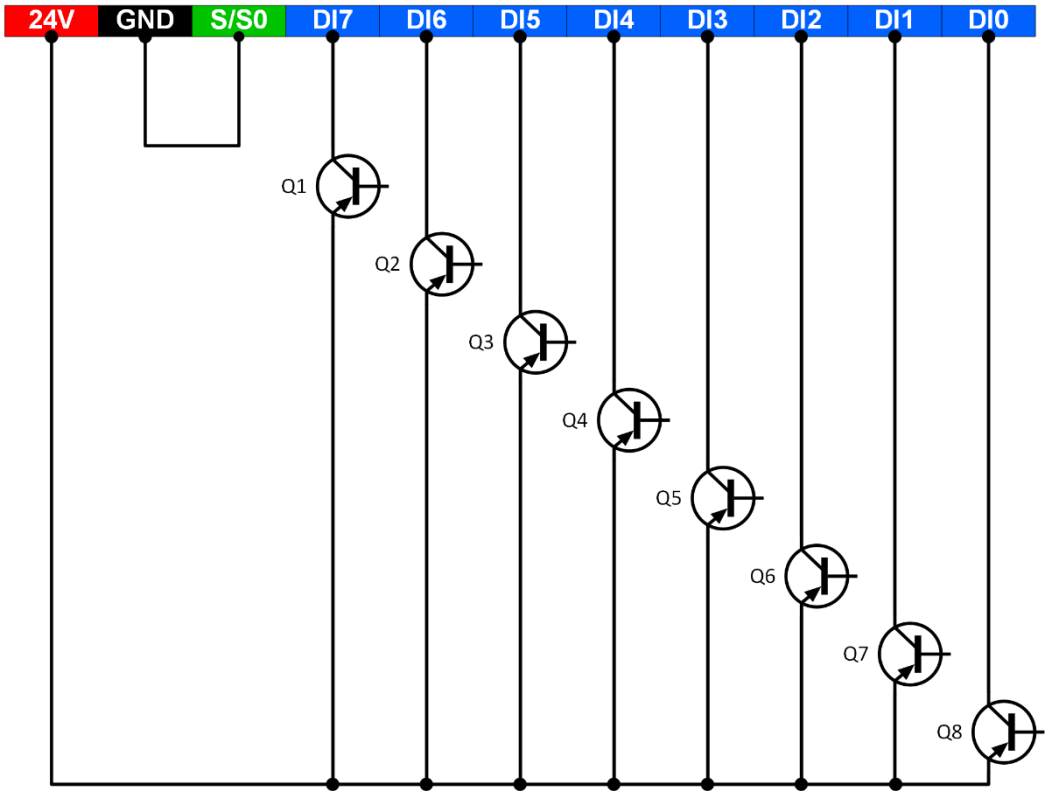
The device provides 16 digital inputs. S/S0 is the common terminal for DI7-DI0, and S/S1 is the common terminal for DI15-DI8. Depending on usage requirements, it can be configured as either NPN or PNP input. The following explains the wiring methods for both input types using DI7~DI0 as an example.

7.1. NPN (Sinking) Input



The above diagram shows the wiring method for the device using NPN-type input. Connect the S/S0 terminal of the device to the 24V terminal. Connect DI7~DI0 to the output of NPN-type sensors, and connect the ground terminal of the sensors to the ground terminal (GND) of the device (common ground), completing the wiring for NPN-type input. At this point, use function code 03 to read 『Digital Input (40042)』 to obtain the current status of the 16 digital inputs.

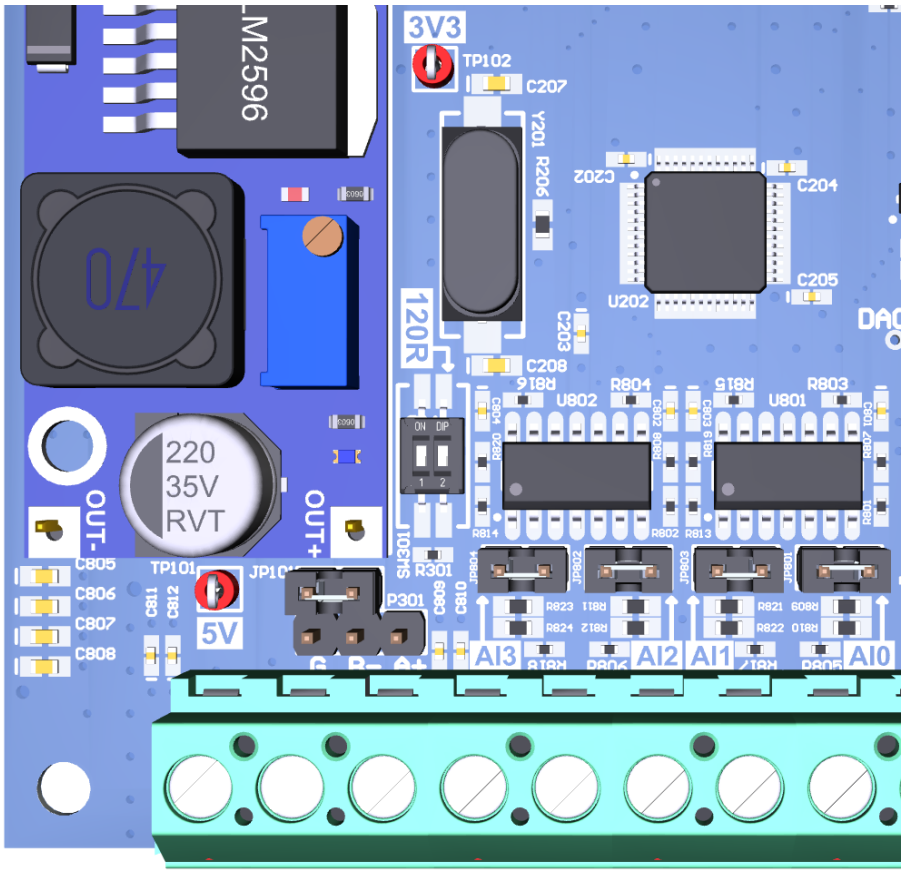
7.2. PNP (Sourcing) Input



The above diagram shows the wiring method for the device using PNP-type input. Connect the S/S0 terminal of the device to the ground terminal (GND) of the device. Connect DI7~DI0 to the output of PNP-type sensors, and connect the emitter terminal of the sensors to the 24V terminal of the device, completing the wiring for PNP-type input. At this point, use function code 03 to read 『Digital Input (40042)』 to obtain the current status of the 16 digital inputs.

8. Modbus RTU Termination Resistor Setup

The physical layer of a Modbus RTU network is the RS-485 interface. If this device is installed at the end of an RS-485 communication network, to avoid communication packet errors caused by signal reflection, the termination resistor needs to be set by toggling both dip switches (SW301) to the「ON」position.



9. ESG Sustainability and Customized Remote I/O Modules for DO/DI/AO/AI Points

With the rise of the global ESG (Environmental, Social, Governance) movement, governments worldwide are enacting regulations that require businesses to reduce carbon emissions annually and comply with various oversight measures.

Remote I/O modules are essential components in factory automation. However, most commercially available remote I/O modules come with fixed I/O points, making them unsuitable for industries with varying I/O requirements. As a result, companies often have to purchase modules with more points than needed, leading to wasted I/O points, higher power consumption, and increased carbon emissions.

Our laboratory offers customizable remote I/O modules with varying numbers of DO/DI/AO/AI points tailored to meet specific industry needs. Once the minimum order quantity is met, we can design and produce these modules. This customization not only significantly reduces procurement costs for businesses but also lowers carbon emissions, contributing to ESG goals.

10. Update History

版本	修改內容
V1.0.0	KH-Modbus-5002MR comes out.
V1.0.1	Added Function Code 16.
V1.0.2	Added Function Code 15.
V2.0.0	Add a set of digital output DO4 and set the IAO output range to 4~20mA.
V2.0.1	Passed CE certification and joined CE Marking.