Remote I/O Modules

- USER GUIDE FOR MODBUS REMOTE IO MODULE STHM-MBIO

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STHM-MBIO-MN-EN-01	JUN-2020

This document is applied for the following products

SKU	STHM-MBIO	**HW Ver.**	1.0	**FW Ver.**	1.0
Item Code	STHM-MBIO-4AI4DI4RL-NR	RS485/ModbusRTU Remote I/O Module, 4AI/DI, 4DI, 4xRelay, 1xPulse Output, Non-ROHS			

1. Functions Change Log

HW Ver.	FW Ver.	Release Date	Functions Change
1.0	1.0	JUN-2020	

2. Introduction

STHM-MBIO is Modbus RTU Remote IO Module to help PLC/SCADA/BMS and any IoTs gateway extend the number of I/O capabilities. STHM-MBIO has a simple but powerful design with 4 AI/DI, 4 DI, 4 Relay, 1 Pulse PWM output, 1 RS485 Master ModbusRTU and 2 RS485 Slave ModbusRTU allow them to connect to more devices such as sensors, meters, ... directly and easily. The module with advanced technology provide high stability and reliability, multiple functions and easy installation with DIN rail design. The module can be used in many applications such as machine monitoring, manufacture monitoring, environmental monitoring, smart farms, etc.

MODBUS RTU REMOTE I/O MODULE
STHM-MBIO

STHM-MBIO-H1.PNG

3. Specification

Digital Inputs	04 x Ports, opto-coupler, 4.7 kohms input resisrtance, 5000V rms isolation, Logic 0 (0-1VDC), Logic 1 (5-24VDC), Functions: logic status 0/1 or Pulse counting (32 bit counter with max 2kHz pulse)
Analog Inputs	04 x Ports, select between 0-10VDC input or 0-20mA input, 12 bit Resolution, can be configured as Digital input by DIP switch (max 10VDC input)
Relay Output	04 x Ports, electro-mechanical Relays, SPDT, contact rating 24VDC/2A or 250VAC/5A, LED indicators, Latch control enable
Pulse Output	01 x Ports, open-collector, opto-isolation, max 10mA and 80VDC, On/off control, Pulser (max 2.5Khz, max 65535 Pulses) or PWM (max 2.5Khz)
Communication	02 x ModbusRTU-Slave, 01 x ModbusRTU-Master, RS485, speed 9600 or 19200, LED indicator
Reset button	For resetting 02 x RS485 Slave port to default setting (9600, None parity, 8 bit)
Power supply	9..36VDC
Consumption	80mA @ 24VDC supply
Mounting type	DIN rail
Terminal Block	pitch 5.0mm, rating 300VAC, wire size 12-24AWG
Working temperature/humidity	0..60 degC / 95%RH non-condensing
Dimension	H87xW117xD42
Net weight	80 grams

4. Applications

MODBUS RTU REMOTE I/O MODULE
STHM-MBIO

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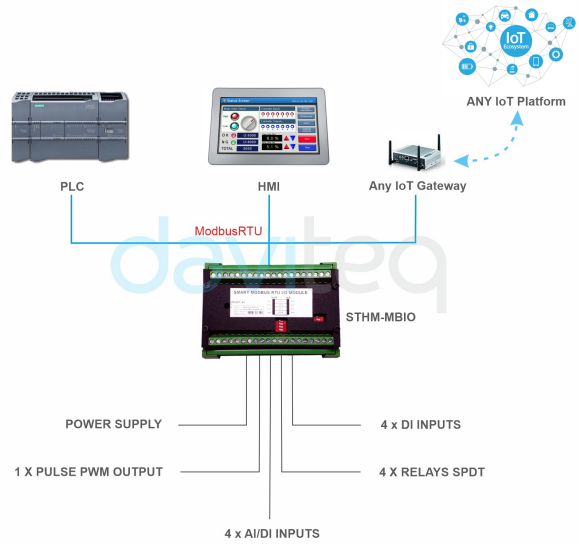
USING I/O MODULE for Any PLC, HMI or IoT Platform



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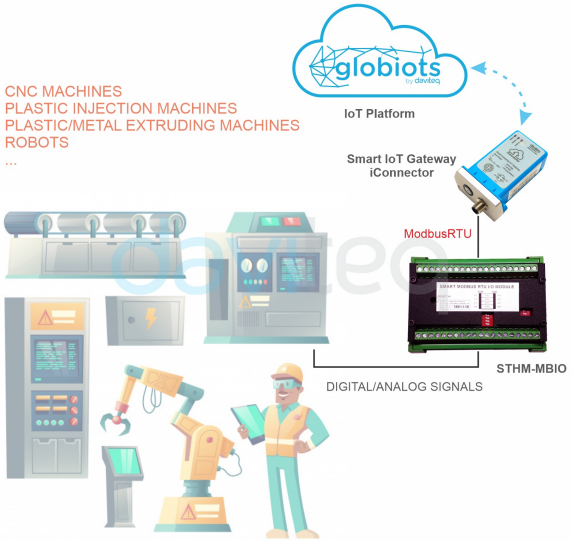
MANUFACTURING MONITORING



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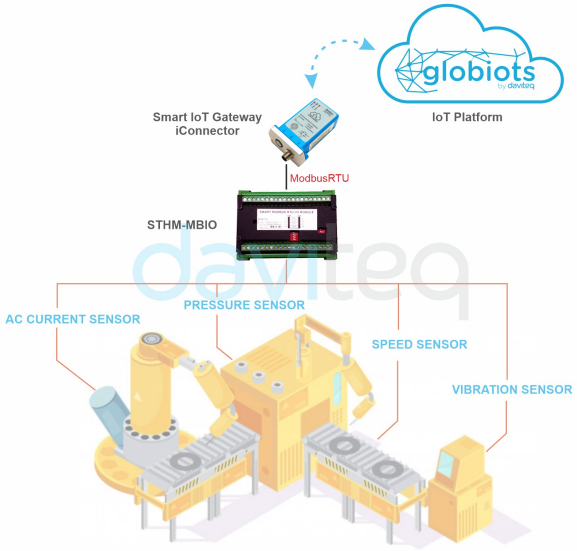
MACHINES / EQUIPMENTS CONDITION MONITORING



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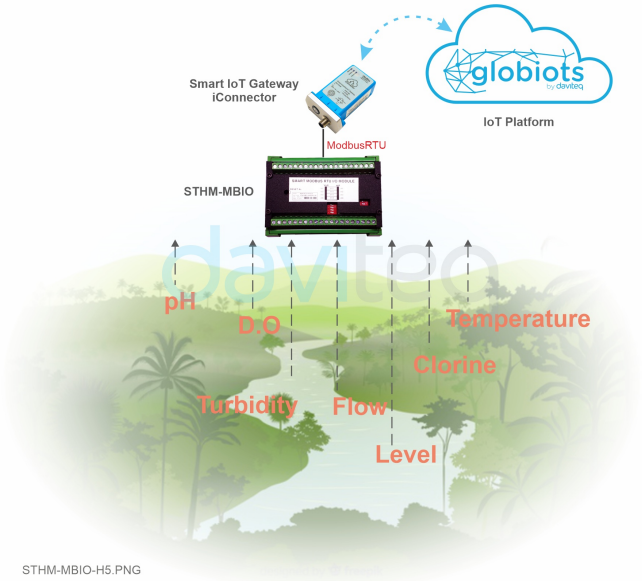
ENVINRONMENT MONITORING



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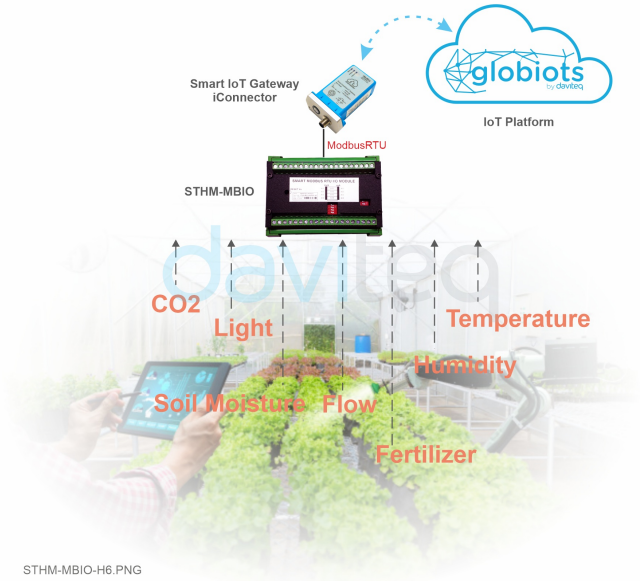
SMART AGRICULTURE / SMART FARM



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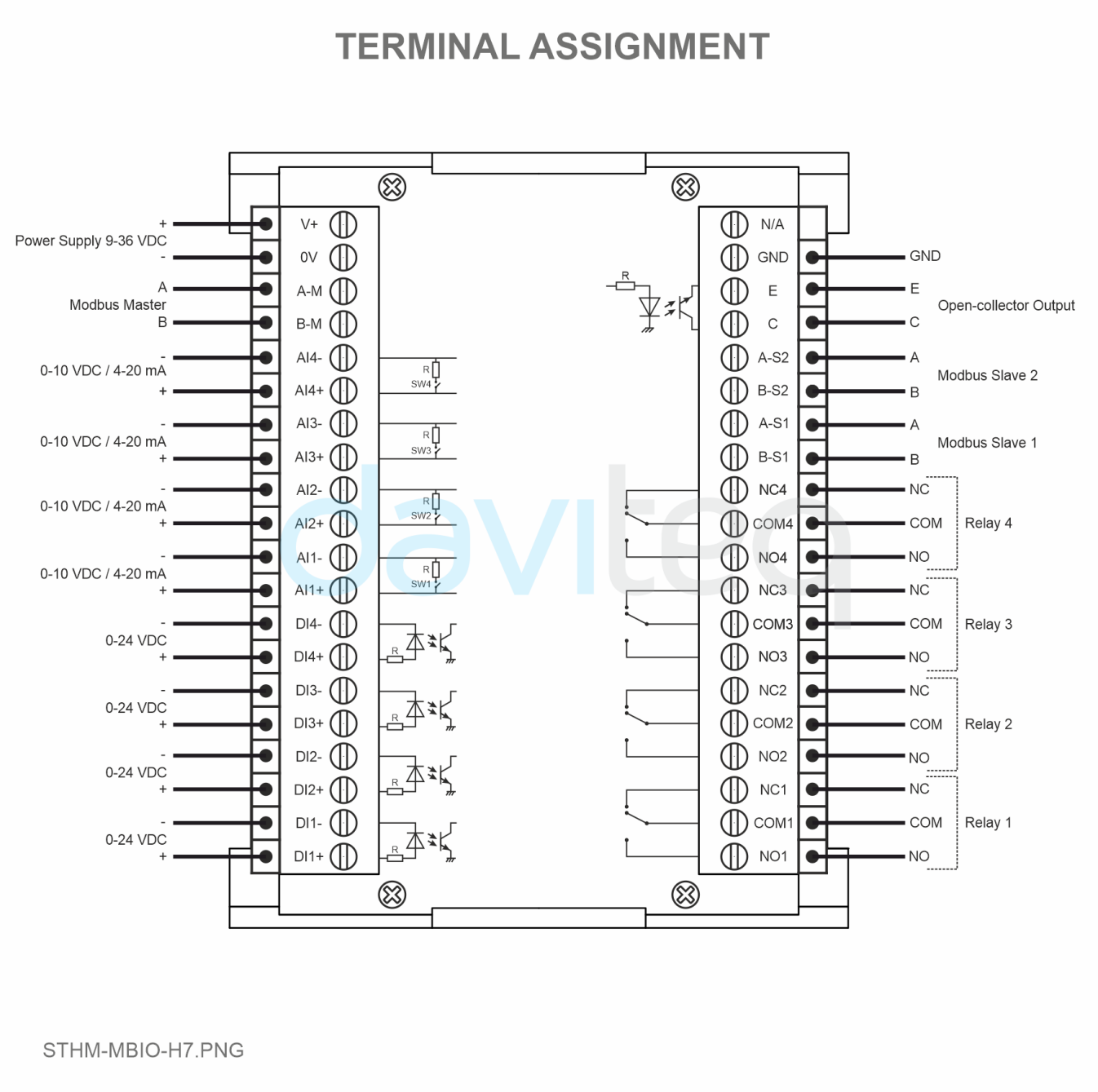
5. Operation Principle



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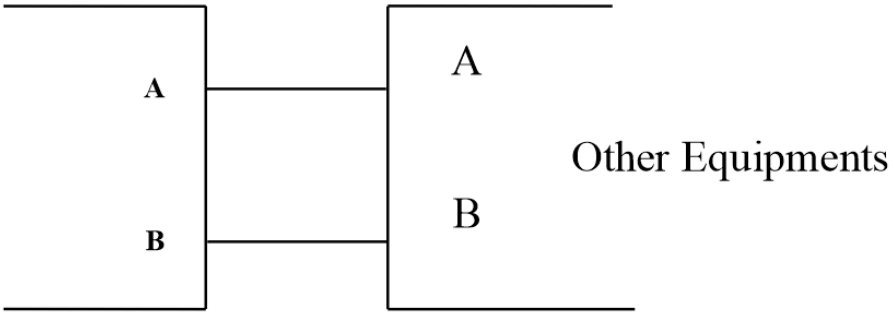
5.1 Modbus communication



02 x RS485/ModbusRTU-Slave

Protocol: Modbus RTU

Address: 1 - 247, 0 is the Broadcast address

Baud rate: 9600 , 19200

Parity: none, odd, even

Default configuration: Address: 1, Baudrate slave 1: 9600, Parity slave 1: none, Baudrate slave 2: 9600, Parity slave 2: none

Status indicator LED:

- Led on: modbus communication OK
- Led blinking: received data but modbus communication incorrect, due to wrong Modbus configuration: address, baudrate
- Led off: STHM-MBIO received no data, check the connection

Memmap resgisters

READ uses function 03, WRITE uses function 16

Modbus Register	Hex Addr	# of Registers	Description	Range	Default	Format	Properties	Comments
Data zone								
0	0	2	device info		IOMD	string	Read	
2	2	4	firmware version		1.0	string	Read	
6	6	2	hardware version		1.1	string	Read	
8	8	1	DI1___DI2: digital status	0-1		uint8	Read	H_byte: DI1 L_byte: DI2
9	9	1	DI3___DI4: digital status	0-1		uint8	Read	H_byte: DI3 L_byte: DI4
10	A	1	AI1___AI2: digital status	0-1		uint8	Read	H_byte: AI1 L_byte: AI2
11	B	1	AI3___AI4: digital status	0-1		uint8	Read	H_byte: AI3 L_byte: AI4
12	C	1	AI1: analog value			uint16	Read	
13	D	1	AI2: analog value			uint16	Read	
14	E	1	AI3: analog value			uint16	Read	
15	F	1	AI4: analog value			uint16	Read	
16	10	2	AI1: scaled value			float	Read	
18	12	2	AI2: scaled value			float	Read	
20	14	2	AI3: scaled value			float	Read	
22	16	2	AI4: scaled value			float	Read	
24	18	1	relay 1	0-1		uint16	Read/Write	

25	19	1	relay 2	0-1		uint16	Read/Write	
26	1A	1	relay 3	0-1		uint16	Read/Write	
27	1B	1	relay 4	0-1		uint16	Read/Write	
28	1C	1	open collector ctrl	0-3		uint16	Read/Write	0: off 1: on 2: pwm, generate pulse continuously 3: generate pulse , when there are enough pulses ctrl = 0
29	1D	1	spare					
30	1E	2	counter DI1			uint32	Read/Write	counter can write, erase
32	20	2	counter DI2			uint32	Read/Write	counter can write, erase
34	22	2	counter DI3			uint32	Read/Write	counter can write, erase
36	24	2	counter DI4			uint32	Read/Write	counter can write, erase
38	26	2	counter AI1			uint32	Read/Write	counter writable, erasable, max frequency 10Hz
40	28	2	counter AI2			uint32	Read/Write	counter writable, erasable, max frequency 10Hz
42	2A	2	counter AI3			uint32	Read/Write	counter writable, erasable, max frequency 10Hz
44	2C	2	counter AI4			uint32	Read/Write	counter writable, erasable, max frequency 10Hz
46	2E	2	DI1: time on			uint32	Read/Write	sec
48	30	2	DI2: time on			uint32	Read/Write	sec
50	32	2	DI3: time on			uint32	Read/Write	sec
52	34	2	DI4: time on			uint32	Read/Write	sec
54	36	2	AI1: time on			uint32	Read/Write	sec
56	38	2	AI2: time on			uint32	Read/Write	sec
58	3A	2	AI3: time on			uint32	Read/Write	sec
60	3C	2	AI4: time on			uint32	Read/Write	sec
62	3E	2	DI1: time off			uint32	Read/Write	sec
64	40	2	DI2: time off			uint32	Read/Write	sec
66	42	2	DI3: time off			uint32	Read/Write	sec
68	44	2	DI4: time off			uint32	Read/Write	sec

70	46	2	AI1: time off			uint32	Read/Write	sec
72	48	2	AI2: time off			uint32	Read/Write	sec
74	4A	2	AI3: time off			uint32	Read/Write	sec
76	4C	2	AI4: time off			uint32	Read/Write	sec
78	4E	50	spare					
128	80	2	none reset counter DI1			uint32	Read	counter cannot be written or erased
130	82	2	none reset counter DI2			uint32	Read	counter cannot be written or erased
132	84	2	none reset counter DI3			uint32	Read	counter cannot be written or erased
134	86	2	none reset counter DI4			uint32	Read	counter cannot be written or erased
136	88	2	none reset counter AI1			uint32	Read	counter cannot be written or erased, max frequency 10Hz
138	8A	2	none reset counter AI2			uint32	Read	counter cannot be written or erased, max frequency 10Hz
140	8C	2	none reset counter AI3			uint32	Read	counter cannot be written or erased, max frequency 10Hz
142	8E	2	none reset counter AI4			uint32	Read	counter cannot be written or erased, max frequency 10Hz
144	90	1	AI1: scaled value			uint16	Read	
145	91	1	AI2: scaled value			uint16	Read	
146	92	1	AI3: scaled value			uint16	Read	
147	93	1	AI4: scaled value			uint16	Read	
Configuration Zone								
256	100	1	modbus address slave	1-247	1	uint16	Read/Write	
257	101	1	modbus baudrate slave 1	0-1	0	uint16	Read/Write	0: 9600, 1: 19200
258	102	1	modbus parity slave 1	0-2	0	uint16	Read/Write	0: none, 1: odd, 2: even
259	103	9	serial number			string	Read/Write(	
268	10C	2	password for setting			uint32	Read/Write	
270	10E	1	counter DI1: filter time		500	uint16	Read/Write	x0.1ms

271	10F	1	counter DI2: filter time		500	uint16	Read/Write	x0.1ms
272	110	1	counter DI3: filter time		500	uint16	Read/Write	x0.1ms
273	111	1	counter DI4: filter time		500	uint16	Read/Write	x0.1ms
274	112	2	counter DI1: max number		1000000	uint32	Read/Write	
276	114	2	counter DI2: max number		1000000	uint32	Read/Write	
278	116	2	counter DI3: max number		1000000	uint32	Read/Write	
280	118	2	counter DI4: max number		1000000	uint32	Read/Write	
282	11A	1	counter DI: power on reset		0	uint16	Read/Write	bit 0: DI1 (0: not reset, 1: reset) bit 1: DI2 bit 2: DI3 bit 3: DI4
283	11B	1	counter AI1: threshold logic 0		500	uint16	Read/Write	
284	11C	1	counter AI1: threshold logic 1		1800	uint16	Read/Write	
285	11D	1	counter AI2: threshold logic 0		500	uint16	Read/Write	
286	11E	1	counter AI2: threshold logic 1		1800	uint16	Read/Write	
287	11F	1	counter AI3: threshold logic 0		500	uint16	Read/Write	
288	120	1	counter AI3: threshold logic 1		1800	uint16	Read/Write	
289	121	1	counter AI4: threshold logic 0		500	uint16	Read/Write	
290	122	1	counter AI4: threshold logic 1		1800	uint16	Read/Write	
291	123	2	counter AI1: max number		1000000	uint32	Read/Write	
293	125	2	counter AI2: max number		1000000	uint32	Read/Write	
295	127	2	counter AI3: max number		1000000	uint32	Read/Write	
297	129	2	counter AI4: max number		1000000	uint32	Read/Write	
299	12B	1	counter AI: power on reset		0	uint16	Read/Write	bit 0: AI1 (0: not reset, 1: reset) bit 1: AI2 bit 2: AI3 bit 3: AI4

300	12C	1	AI1: scale in 1			uint16	Read/Write	
301	12D	1	AI1: scale in 2			uint16	Read/Write	
302	12E	2	AI1: scale out 1			float	Read/Write	
304	130	2	AI1: scale out 2			float	Read/Write	
306	132	1	AI2: scale in 1			uint16	Read/Write	
307	133	1	AI2: scale in 2			uint16	Read/Write	
308	134	2	AI2: scale out 1			float	Read/Write	
310	136	2	AI2: scale out 2			float	Read/Write	
312	138	1	AI3: scale in 1			uint16	Read/Write	
313	139	1	AI3: scale in 2			uint16	Read/Write	
314	13A	2	AI3: scale out 1			float	Read/Write	
316	13C	2	AI3: scale out 2			float	Read/Write	
318	13E	1	AI4: scale in 1			uint16	Read/Write	
319	13F	1	AI4: scale in 2			uint16	Read/Write	
320	140	2	AI4: scale out 1			float	Read/Write	
322	142	2	AI4: scale out 2			float	Read/Write	
324	144	2	AI1: cut off		0	float	Read/Write	
326	146	2	AI2: cut off		0	float	Read/Write	
328	148	2	AI3: cut off		0	float	Read/Write	
330	14A	2	AI4: cut off		0	float	Read/Write	
332	14C	1	relay 1 default	0-2	0	uint16	Read/Write	0: off, 1: on, 2: old status
333	14D	1	relay 2 default	0-2	0	uint16	Read/Write	0: off, 1: on, 2: old status
334	14E	1	relay 3 default	0-2	0	uint16	Read/Write	0: off, 1: on, 2: old status

335	14F	1	relay 4 default	0-2	0	uint16	Read/Write	0: off, 1: on, 2: old status
336	150	1	modbus baudrate slave 2	0-1	0	uint16	Read/Write	0: 9600, 1: 19200
337	151	1	modbus parity slave 2	0-2	0	uint16	Read/Write	0: none, 1: odd, 2: even
338	152	24	spare					
362	16A	1	open collector: time on			uint16	Read/Write	x0.1 ms
363	16B	1	open collector: time cycle			uint16	Read/Write	x0.1 ms
364	16C	2	open collector: pulse number			uint32	Read/Write	

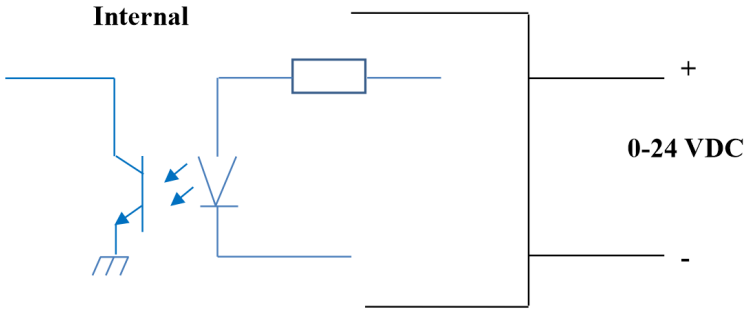
5.2 Reset Button

When holding the reset button for 4 seconds, STHM-MBIO will reset the default configuration to 02 x RS485 / Modbus RTU-Slave.

Default Modbus RTU Configuration:

- Address: 1
- Baud Rate: 9600
- Parity: none

5.3 Digital Input



Specification:

- 04 channels DI, isolated
- Input Resistance: 4.7 kΩ
- Isolation Voltage: 5000Vrms
- Logic level 0: 0-1V
- Logic level 1: 5-24V
- Function:
  - Read logic 0/1
  - Pulse Counter

5.3.1 Read the logical state 0/1

Logic value in Modbus Memory Map: 0-1

Registers to store logic values in the Modbus Memory Map:

- DI1__DI2: digital status: stores the logical state of channel 1 and channel 2.
  - H_byte: DI1

    - L_byte: DI2
- DI3__DI4: digital status: store the logical state of channel 3 and channel 4.
    - H_byte: DI3
    - L_byte: DI4

5.3.2 Pulse Counter

Counter value in Modbus Memory Map, when adding the number exceeds the threshold, it will automatically return: 0 - 4294967295 (32bits)

The register that stores Counter value in the Modbus Memory Map can be erased:

- Counter DI1: stores the logic state of channel 1
- Counter DI2: stores the logic state of channel 2
- Counter DI3: stores the logic state of channel 3
- Counter DI4: stores the logic state of channel 4

The register that stores Counter value in the Modbus Memory Map cannot be erased:

- None reset counter DI1: stores the logic state of channel 1
- None reset counter DI2: stores the logic state of channel 2
- None reset counter DI3: stores the logic state of channel 3
- None reset counter DI4: stores the logic state of channel 4

Configura max number:

- "counter DI1: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter DI2: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter DI3: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter DI4: max number" : Count limit of counter, when counting to max value, counter will return to 0

Pulse Counter Mode:

Low-speed pulse count less than 10Hz with filter, anti-jamming:

- Set register "counter DI1: filter time" = 500-2000: Channel 1 counts pulses less than 10Hz
- Set register "counter DI2: filter time" = 500-2000: Channel 2 counts pulses less than 10Hz
- Set register "counter DI3: filter time" = 500-2000: Channel 3 counts pulses less than 10Hz
- Set register "counter DI4: filter time" = 500-2000: Channel 4 counts pulses less than 10Hz

High-speed pulse count with max 2KHz frequency without filter:

- Set register "counter DI1: filter time" = 1: channel 1 counts pulses with Fmax = 2kHz
- Set register "counter DI2: filter time" = 1: channel 2 counts pulses with Fmax = 2kHz
- Set register "counter DI3: filter time" = 1: channel 3 counts pulses with Fmax = 2kHz
- Set register "counter DI4: filter time" = 1: channel 4 counts pulses with Fmax = 2kHz

5.3.3 Time on - Time off

Time on

DI1: time on = Total time DI1 at logic 1

DI2: time on = Total time DI2 at logic 1

DI3: time on = Total time DI3 at logic 1

DI4: time on = Total time DI4 at logic 1

Time off

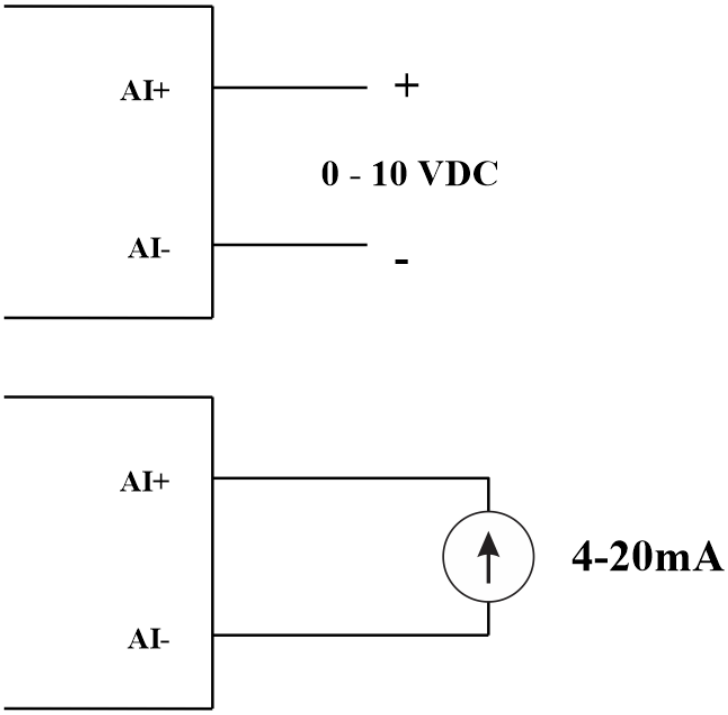
DI1: time off = Total time DI1 at logic 0

DI2: time off = Total time DI2 at logic 0

DI3: time off = Total time DI3 at logic 0

DI4: time off = Total time DI4 at logic 0

5.4 Analog Input



04 AI channels, no isolation

Use DIP SW to configure Analog input: 0-10V, 0-20mA

Value	Type of AI
0	0-10 V
1	0-20 mA

Input type:

- Measure voltage: 0-10V
- Measure current: 0-20mA
- The configuration for **AI** reads the same logical state as **DI**, but it is not isolated with a pulse range of **0-24V**

Input impedance:

- Measure voltage: 320 kΩ
- Measure the current: 499 Ω

5.4.1 Read the Analog value

Resolution 12 bits

Non-Linearity: 0.1%

Analog value in Modbus Memory Map: 0-3900

Analog value register in the Modbus Memory Map:

- AI1 analog value: store the Analog value of channel 1
- AI2 analog value: stores the Analog value of channel 2
- AI3 analog value: store the Analog value of channel 3
- AI4 analog value: store the Analog value of channel 4

5.4.2 AI configuration works as DI

No isolation

AI Configure AI to read the same logic state as DI with pulse amplitude from 0-24V

There are 2 counter threshold AIx: logic threshold 0 and counter AIx: threshold logic 1 in the modbus table: 0-4095

- Analog Analog value of AI <counter AIx: threshold logic 0: is considered Logic 0 status of AI
- Analog Analog value of AI> counter AIx: threshold logic 1: is considered to be Logic 1 state of AI
- Counter AIx: threshold logic 0 = <Analog value of AI <= counter AIx: threshold logic 1: is considered to be the constant logic state

Logic Logical status value of AI in Modbus Memory Map table: 0-1

The register stores logical values in Modbus Memory Map:

- AI1___AI2: digital status: stores the logical state of channel 1 and channel 2.
  - H_byte: AI1
  - L_byte: AI2
- AI3___AI4: digital status: stores the logical state of channel 1 and channel 2.
  - H_byte: AI3
  - L_byte: AI4

5.4.3 Pulse Counter AI max 10Hz

Counter value in Modbus Memory Map, when adding the number beyond the threshold, it will automatically return: 0 - 4294967295 (32bits)

The register that stores Counter value in the Modbus Memory Map can be erased:

- Counter AI1: stores the logic state of channel 1
- Counter AI2: stores the logic state of channel 2
- Counter AI3: stores the logic state of channel 3
- Counter AI4: stores the logic state of channel 4

The register that stores Counter value in the Modbus Memory Map cannot be erased:

- None reset counter AI1: stores the logic state of channel 1
- None reset counter AI2: stores the logic state of channel 2
- None reset counter AI3: stores the logic state of channel 3
- None reset counter AI4: stores the logic state of channel 4

Configura max number:

- "counter AI1: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter AI2: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter AI3: max number" : Count limit of counter, when counting to max value, counter will return to 0
- "counter AI4: max number" : Count limit of counter, when counting to max value, counter will return to 0

5.4.3 Time on - Time off

Time on

AI1: time on = Total time AI1 at logic 1

AI2: time on = Total time AI2 at logic 1

AI3: time on = Total time AI3 at logic 1

AI4: time on = Total time AI4 at logic 1

Time off

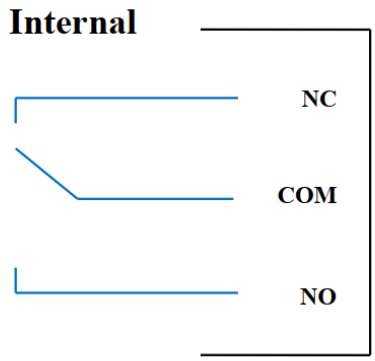
AI1: time off = Total time AI1 at logic 0

AI2: time off = Total time AI2 at logic 0

AI3: time off = Total time AI3 at logic 0

AI4: time off = Total time AI4 at logic 0

5.5 Relay



04 channel Relay SPDT NO / NC

Contact rating: 2A / 24VDC, 0.5A / 220VAC

There are status LEDs:

- Led on: Close Contact
- Led off: Open Contact

Set the "relay x" register in the Modbus Memory Map table to control Relay Close / Open Contact:

Relay	Set Relay Register	Status of relays
Channel 1	1	Close Contact
	0	Open Contact

Channel 2	1	Close Contact
	0	Open Contact
Channel 3	1	Close Contact
	0	Open Contact
Channel 4	1	Close Contact
	0	Open Contact

Relay has 2 modes:

- Latch Mode
- Normal Mode

5.5.1 Latch Mode of Relay

The relay will remember the previous Close / Open Contact status, when resetting or losing power:

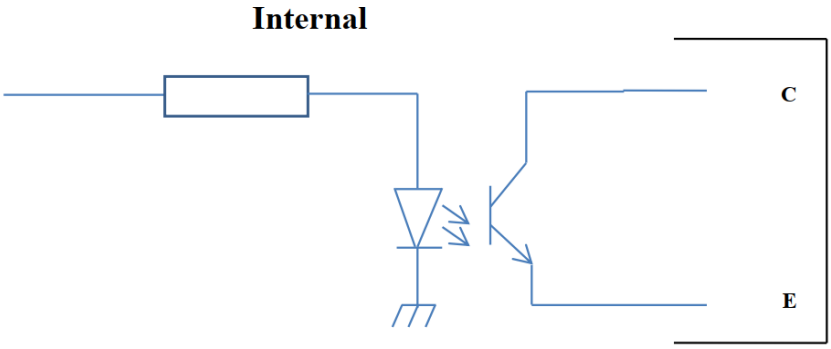
Relay Channel	Relay Register	Set Relay Register	Description
Channel 1	relay default 1	2	Relay channel 1 remembers the previous Close / Open Contact status
		0/1	Relay channel 1 status does not remember the Close / Open Contact
Channel 2	relay default 2	2	Relay channel 2 remembers the previous Close / Open Contact status
		0/1	Relay channel 2 status does not remember the Close / Open Contact
Channel 3	relay default 3	2	Relay channel 3 remembers the previous Close / Open Contact status
		0/1	Relay channel 3 status does not remember the Close / Open Contact
Channel 4	relay default 4	2	Relay channel 4 remembers the previous Close / Open Contact status
		0/1	Relay channel 4 status does not remember the Close / Open Contact

5.5.2 Normal Mode of Relay

Relay operates normally, do not remember the status of Close / Open Contact when power reset or power failure.
Relay status table when resetting the power as follows:

Register Default Relay	Status of relays when resetting power
0	Open Contact
1	Close Contact
2	Remember the previous state (Latch mode)

5.6 Pulse Output



01 isolated open-collector channel

Opto-coupler: Source current Imax = 10mA, Vceo = 80V

Functions: On / Off, pulse generator, PWM

5.6.1 On/Off Function

Set the Open-collector register in the Modbus Memory Map table:

- Set Open-collector register: 1 => Pulse Output**ON**
- Set Open-collector register: 0 => Pulse Output**OFF**

5.6.2 Pulse generator

Pulse output transmits a maximum of 65535 pulses, with Fmax 2.5kHz

Configure the following registers in the Modbus Memory Map table:

- Set register "open collector: pulse number": 0-65535 => Pulse Number = 65535: broadcast 65535 pulses
- Set register "open collector: time cycle": (0-65535) x0.1ms => Time Cycle = 4: Fmax 2.5kHz
- Set register "open collector: time on": (0-65535) x0.1ms => Time On: is the logic time 1 of the pulse
- Set the register "open collector ctrl" = 3 => configure the Pulse Output to generate a pulse and start to pulse, generate a sufficient number of pulses in the "open collector: pulse number" register => stop pulse generator and register " open collector ctrl ”= 0

5.6.3 PWM

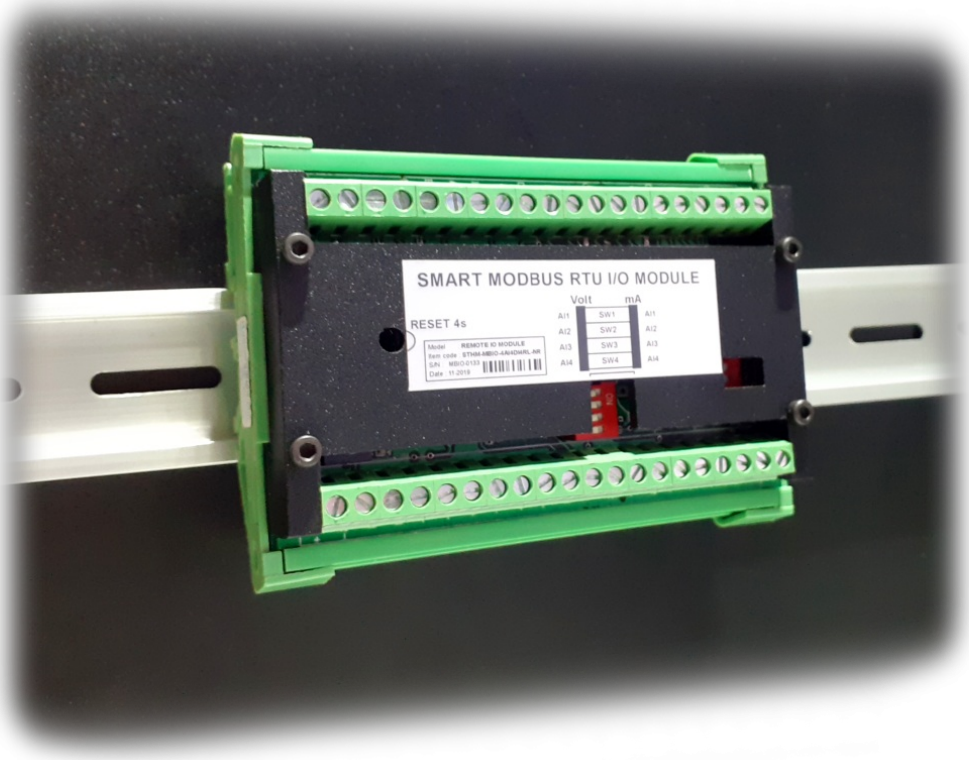
Max frequency 2.5kHz

Configure the following registers in the Modbus Memory Map table:

- Set the register "open collector ctrl" = 2 => configure Pulse Output PWM function
- Set register "open collector: time cycle": (0-65535) x0.1ms => Time Cycle = 4: Fmax 2.5kHz
- Set register "open collector: time on": (0-65535) x0.1ms => Time On: is the logic time 1 of the pulse

6. Installation

Mounting type: DIN rail



7. Troubleshooting

No.	Phenomena	Reason	Solutions
1	Modbus failed to communicate	Modbus LED Status: • LED is off: received no data • LED is blinking: the Modbus configuration is not the correct	• Check the connection • Check the Modbus configuration: Address, Baud Rate, Parity
2	Timeout Modbus	Noise appears on the line	Configure Baudrate 9600 and use a twisted pair cable with anti-jamming protection

8. Support contacts

Manufacturer
Daviteq Technologies Inc
No.11 Street 2G, Nam Hung Vuong Res., An Lac Ward, Binh Tan Dist., Ho Chi Minh City, Vietnam.
Tel: +84-28-6268.2523/4 (ext.122)
Email: info@daviteq.com | www.daviteq.com