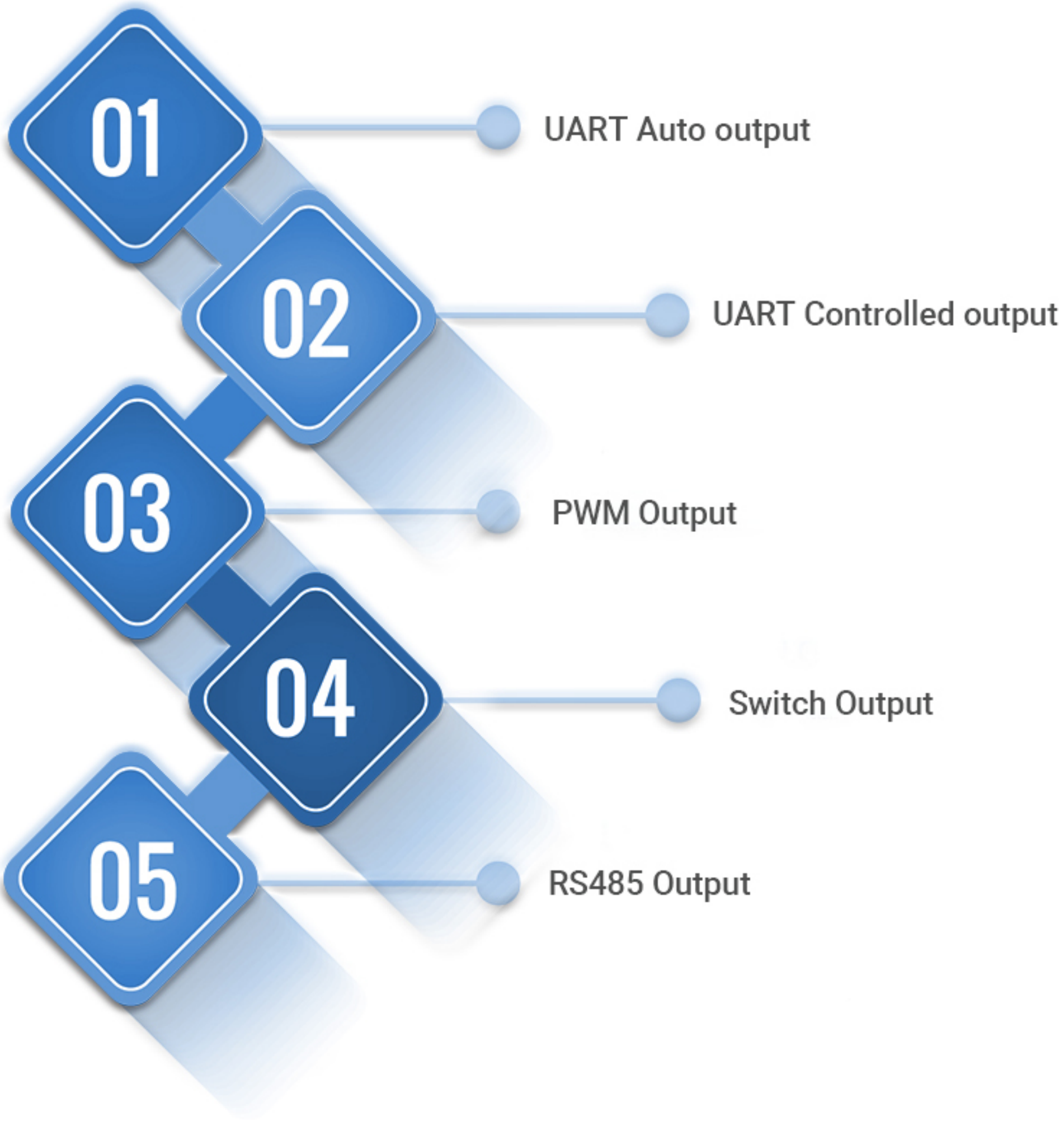
A02 Module Output Interface



1. UART Auto Output

(1) Pin definition

Pin No.	Mark	Pin description	Remark
①	VCC	Power input	
②	GND	GND	
③	RX	Processed value or Real time value output	(1)
④	TX	UART output	(1)

Remarks: The pin function corresponds to the output mode selected before ordering, and cannot coexist with the functions of other output modes

(2) Communication instruction

When the pin(RX)is suspended or the input high level, the module outputs processed value, and the data is more stable. The response time of is 100~500ms. When the pin(RX)is input low level, the module outputs real-time value. Response time of is 100ms.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	9600bps

(3) UART Output format

Data Frame	Description	Byte
Start Bit	0XFF OXFF	1byte
Data_H	High8 distance value	1byte
Data_L	Low8 distance value	1byte
SUM	Parity sum	1byte

(4) Example

Start Bit	Data_H	Data_L	SUM
0XFF	0X07	0XA1	0XA7

Remark: Parity sum only remain low8 value.

SUM =(start bit+ Data_H+ Data_L)&0x00FF

=(0XFF + 0X07 + 0XA1)&0x00FF

=0XA7

Distance value= Data_H*256+ Data_L=0X07A1;

Convert to decimal equal to 1953

Means current measurement distance value is 1953mm

2. UART Controlled Output

(1) Pin Definition

Pin No.	Mark	Pin description	Remark
①	VCC	Power input	
②	GND	GND	
③	RX	Trigger input	(1)
④	TX	UART output	(1)

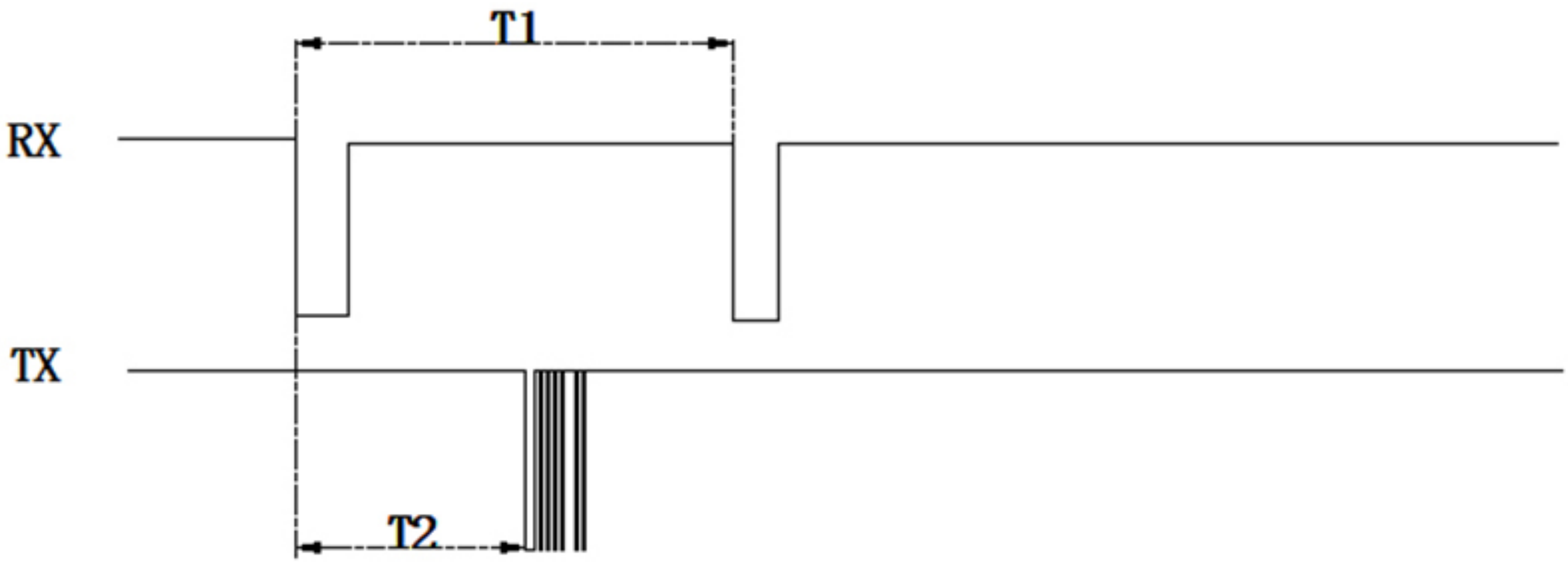
Remarks: The pin function corresponds to the output mode selected before ordering, and cannot coexist with the functions of other output modes.

(2) UART Communication instruction

The module will perform a distance detection after Pin(RX) receives a falling edge pulse or any one serial interface data. Pin(TX) will output a TTL level after detection is completed. The trigger period of the module must be greater than 70ms.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	9600bps

(3) Timing Diagram



Remark: T1 >70ms T2=45~60ms

(4) UART Output format

Data Frame	Description	Byte
Start Bit	0XFF OXFF	1byte
Data_H	High8 distance value	1byte
Data_L	Low8 distance value	1byte
SUM	Parity sum	1byte

(5) Example

Start Bit	Data_H	Data_L	SUM
0XFF	0X07	0XA1	0XA7

Remark: Parity sum only remain low8 value.

SUM =(start bit+ Data_H+ Data_L)&0x00FF

=(0XFF + 0X07 + 0XA1)&0x00FF

=0XA7

Distance value= Data_H*256+ Data_L=0X07A1;

Convert to decimal equal to 1953

Means current measurement distance value is 1953mm

3. PWM Output

(1) Pin Definition

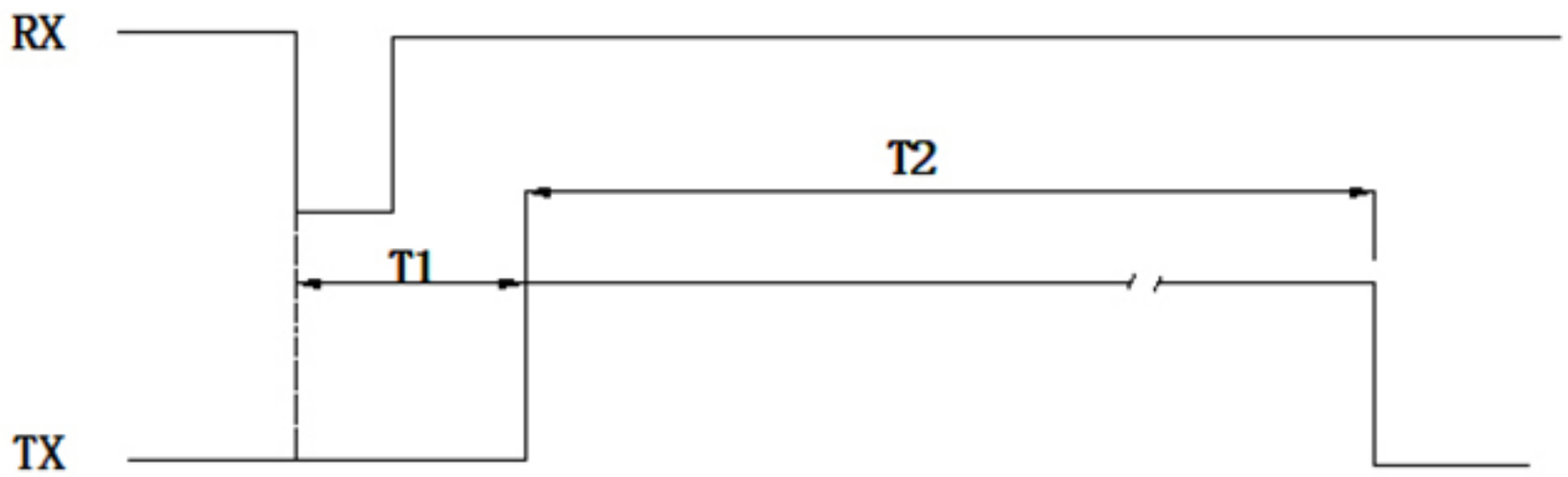
Pin No.	Mark	Pin description	Remark
①	VCC	Power input	
②	GND	GND	
③	RX	Trigger input	(1)
④	TX	PWM output	(1)

Remarks: The pin function corresponds to the output mode selected before ordering, and cannot coexist with the functions of other output modes.

(2) Instruction

When pin(RX) receives a trigger falling edge pulse, the module will start detecting, Pin(TX) will output a TTL level PWM high-level pulse width signal once. The period must be greater than 70ms. If the module does not detect an object, pin(TX) will output a fixed pulse width of about 35ms.

(3) Timing Diagram



Remark: T1=10～17ms； Flat object T2=0.18～35ms(PWM High level pulse width timing)

(4) Formula

Formula: S=T*V/2 (S is the distance value, T is duration time of PWM high-level pulse width, V is sound travel speed in the air)

Because of internal temperature compensation, V is directly calculated at speed of 348m/S at room temperature. The simplified formula is S= T/57.5 (unit of S in centimeters and us of time T)

For example: The duration time T of PWM high-level pulse width is 10000us, the S= T/57.5=10000/57.5 ≈173.9(cm), means 173.9cm distance value.

4. Switch Output

(1) Pin Definition

Pin No.	Mark	Pin description	Remark
①	VCC	Power input	
②	GND	GND	
③	RX	Switch negative output	(1)
④	TX	Switch positive output	(1)

Remarks: The pin function corresponds to the output mode selected before ordering, and cannot coexist with the functions of other output modes.

(2) Instruction

Factory setting a thresholds of 1.5 meter. The module performs distance measurement every 100ms. When the distance value less than threshold, the Pin(TX) output high level, Pin(RX) output low level. When the value greater than threshold, pin(TX) output low level and Pin(RX) output high level.
In order to improve stability, the factory defaults that when the distance value of the target is detected 3 times in a row is less than the set thresholds, it is determined that the detected target distance is less than the set thresholds. The distance value of the target detected 5 times in a row is greater than the set thresholds. It is determined that the detected target distance is greater than the set threshold value. The Pin(TX) of the module only outputs high and low level signals without driving capability

(3) Threshold value Setting

（1）Instruction

RX and TX leads as communication lines. Set the serial port according to the following table:

Interface	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	9600bps

The setting is only valid during the power-on of the module (within 400ms), the interval is 100ms, the command is sent repeatedly until the module responds.

(2) Modify threshold value format

Sensor module as slave. Customer device as master.

Master request:

Name	Frame header	Command Code	Data_H	Data_L	Checksum
Byte	0XFB	0X05	1Byte	1Byte	1Byte

Slave response:

Name	Frame header	Command Code	Data_H	Data_L	Status bit	Checksum
Byte	0XFB	0X85	1Byte	1Byte	Success：0X00 Failed：0X01	1Byte

Remark：Checksum=(Frame header+Command Code+Data_H+Data_L+Status bit)&0x00FF

Eg1:

Master :FB 05 03 E8 EB（Checksum=(0XFB+0X05+0X03+0XE8)&0X00FF=0XEB）

Slave： FB 85 03 E8 00 6B

Setting successes, Switch distance value is 1000mm

Remark: Threshold value range 3-450cm.

(3) Modify switch polarity data format

Sensor module as slave. Customer device as master.

Master request:

Name	Frame header	Command Code	Reserve	Output polarity	Checksum
Byte	0XFB	0X06	0X00	High level：0X01 Low Level：0X00	1Byte

Slave response:

Name	Frame header	Command Code	Reserve	Output polarity	Status bit	Checksum
Byte	0XFB	0X86	0X00	High level：0X01 Low Level：0X00	Success：0X00 Failed：0X01	1Byte

Remark：Checksum=(Frame header+Command Code+Data_H+Data_L+Status bit)&0x00FF

Eg1:

Master :FB 06 00 01 02（Checksum=(0XFB+0X06+0X00+0X01)&0X00FF=0X02）

Slave： FB 86 00 01 00 82

Setting successes, When the module is set to detect an object, the TX lead outputs high level, and the RX lead outputs low level

Eg2:

Master :FB 06 00 00 01 （Checksum=(0XFB+0X06+0X00+0X00)&0X00FF=0X01）

Slave： FB 86 00 00 00 81

Setting successes,When the module is set to detect an object, the "TX" lead outputs low level and the "RX" lead outputs high level.

5. RS485 Output

(1) Pin definition

Pin No.	Mark	Pin description	Remark
①	VCC	Power input	
②	GND	GND	
③	B	RS485 Inverting input	(1)
④	A	RS485 Non-inverting input	(1)

Remarks: The pin function corresponds to the output mode selected before ordering, and cannot coexist with the functions of other output modes.

(2) RS485 interface specification

Interface	Data Bit	Stop Bit	Parity Bit	Baud Rate
RS485 level	8	1	No	9600bps

(3) RS485 Modbus Protocol specification

Mode	Parity	Sensor Address	Read function code	Write function code
Modbus-RTU	CRC-16/MODBUS	Settable default 0x01	0x03	0x06

(4) RS485 Modbus protocol format

Sensor module as slave. Customer device as master.

Master request(Read):

Name	Address	Function code 0x03	Register address	Registers qty	CRC16 Parity
(Byte) Length(Byte)	1	1	2	2	2

Slave response(Read):

Name	Address	Function code 0x03	Response byte	Data zone	CRC16 Parity
(Byte) Length(Byte)	1	1	1	N	2

Master request(write):

Name	Address	Function code 0x06	Register address	Data zone	CRC16 Parity
(Byte) Length(Byte)	1	1	2	2	2

Slave response(write):

Name	Address	Function code 0x06	Register address	Data zone	CRC16 Parity
(Byte) Length(Byte)	1	1	2	2	2

(5) RS485 Modbus Register

Status	Register Address	Register Function	Type of Data	Description	Remark
Read-only	0x0100	Processing value	Unsigned, 16bit	Start the distance measurement after receiving the command code, output distance value which processed by the algorithm. unit mm, response time is 500ms.	
Read-only	0x0101	Real-time value	Unsigned, 16bit	Start the distance measurement after receiving the command code, output real time value. Unit is mm, response time is about 100ms.	

Read-only	0x0102	Tempera ture	Unsigned, 16bit	Unit is 0.1℃, resolution is 0.5℃, response time is about 100ms	
Read-only	0x0200	Slave address	Unsigned, 16bit	Range: 0x01~0xFE, default 0x01, 0xFF is broadcast address	
Read-write	0x0201	Baud rate	Unsigned, 16bit	The seting takes effect immediately. It will take effect immediately after setting, and the baud rate corresponding to the register value is as follows. 0x0001:2400bps 0x0002:4800bps 0x0003:9600bps 0x0004:14400bps 0x0005:19200bps 0x0006:38400bps 0x0007:57600bps 0x0008:76800bps 0x0009:115200bps	

(6) RS485 Modbus Example

Example 1: Read processing value data
Master:01 03 01 00 00 01 85 F6
Salve: 01 03 02 02 F2 38 A1
Description: The sensor address is 0x01, processing distance value is 0x02F2, converts to decimal is equal to 754mm.

Example 2: Read real time distance value
Master:01 03 01 01 00 01 D4 36
Slave:01 03 02 02 EF F8 A8
Description:The sensor address is 0x01, real time value is 0x02EF, coverts to decimal is equal to 751mm.

Example: Read temperature data
Master: 01 03 01 02 00 01 24 36
Slave: 01 03 02 01 2C B8 09
Description: The sensor address is 0x01, real temperature is 0x012C, converts to decimal is equal to 30.0℃.

Example 4: Modify slave address
Master:01 06 02 00 00 05 48 71
Slave:01 06 02 00 00 05 48 71
Description: The sensor address is changed from 0x01 to 0x05.