R01 Module Output Interface

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1. UART automatic output description

(1) Output pin definition

PIN #	PIN name	PIN description	Remarks
①	VCC	Power input	
②	GND	Ground	
③	RX	Processing value and real-time value output selection, communication receiving	(1)
④	TX	UART output	(1)

Remarks: (1) Lead wire, pin function and output mode of product model correspond one-to-one, and cannot coexist with other output modes.

(2) UART communication description

The module automatic output interval is 100ms, ranging work and output once, can be set by modbus instruction, range of 30~10000ms, see modbus protocol section for more details.
When the input lead "RX" is suspended or input high level is triggered, the module outputs according to the processing value after 1~3 filtering, the data is more stable, and the ranging response time is 1~3 times. For example, the default ranging response under100ms output interval is 100-300 ms.
When the "RX" inputs the low level, the module outputs according to the real-time value, and the ranging response is consistent with the output interval. The default is 100ms.
Note: When the output interval is more than1000ms, the fixed output by real-time value. "RX" level detection is detected only valid within 800ms of power, and no level detection will be done after.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	115200bps

(3) UART Output format

Frame data	Description	Byte
Frame header	Fixed to 0XFF	1byte
Data_H	High 8 bits of distance data	1byte
Data_L	Low 8 bits of distance data	1byte
SUM	Communication checksum	1byte

(4) UART output example

Frame header	Data_H	Data_L	SUM
0XFF	0X07	0XA1	0XA7

Note:

The checksum only retains the lower 8 bits of the accumulated value;

SUM =(Frame header+ Data_H+ Data_L)&0x00FF

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

=0XA7;

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

Converted to decimal is equal to 1953;

2. Description of UART controlled output

(1) Definition of output leads

PIN #	PIN name	PIN description	Remarks
①	VCC	Power input	
②	GND	Ground	
③	RX	Trigger input	(1)
④	TX	UART output	(1)

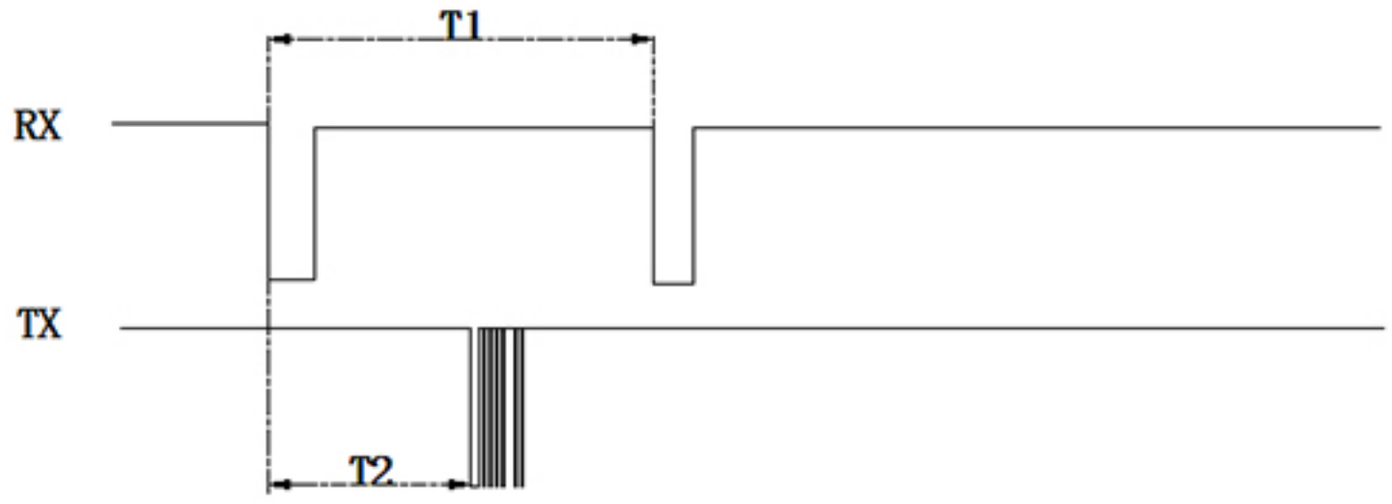
Remarks: (1) Lead wire, pin function and output mode of product model correspond one-to-one, and cannot coexist with other output modes.

(2) UART communication description

When the trigger input lead "RX" receives the modbus ranging instruction, the module operation will be triggered, and the output lead "TX" will output a measurement data. The trigger cycle of the module recommended ≥50ms(real-time value). See the modbus protocol section for more details.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	115200bps

(3) Timing Diagram



Note: T1 ＞T2+8ms； T2=19～38ms(real-time value),T2=19～38ms(Processing value).

3. Description of switch output

(1) Definition of output leads

PIN #	PIN name	PIN description	Remarks
①	VCC	Power input	
②	GND	Ground	
③	RX	Processing value and real-time value output selection□Communication receiving	(1)
④	TX	Switch output	(1)

Remarks: (1) Lead wire, pin function and output mode of product model correspond one-to-one, and cannot coexist with other output modes.

(2) Job description

The module will set a threshold value at the factory, the default is 1.5 meters.The factory default output polarity is a positive output (0x01). The module performs distance measurement every 100ms. To improve stability, when the module RX lead is suspended or the high level is input , the module outputs according to the processing value. If the target distance is less than the threshold value for 15 consecutive times, the TX lead output is high level, that is, the response time is about 1.5S; If the target distance is greater than the threshold value for 25 consecutive times, that is, the holding time is about 2.5s. When the RX lead is input at low level, the module outputs it at real-time values, with a response time of about 0.3s and a retention time of about 0.5s.Both the threshold and the output polarity parameters can be set, if the output polarity is positive output(0x01),when the detected distance value of the target is less than the set threshold value, the output is at a high level,when the detected distance value is greater than the set threshold, the output is at a low level. With a negative output(0x00), the level logic is reserved.

Note:RX lead level detection is only effective within 800ms of power-up,and no level detection will be done after that. The module TX lead only outputs high and low level signals and has no driving capability. If there are special requirements that need to change threshold or other settings, special instructions are required when purchasing.

(3) Set the threshold value and output polarity

(1)Communication line connection

Connect the RX and TX of the module leads to the TXD and RXD of the host side,serial port communication is available.

(2)Communication serial port setting

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1	No	115200bps

Only set valid during the module power on (within 800ms after the power on), 100 ms interval, the instructions are repeatedly sent, until the module responds.

(3)Modify the threshold data format

The user machine is the host equipment, and this module is the slave equipment.
Host sent:

Name	Frame header	Command Code	High threshold values	Low threshold values	Checksum
Byte	Fixed to 0XFB	Fixed to 0X05	1Byte	1Byte	1Byte

Slave respond:

Name	Frame header	Command Code	High threshold values	Low threshold values	Status bit	Checksum
Byte	Fixed to 0XFB	Fixed to 0X85	1 byte	1Byte	Success: 0X00 Failed: 0X01	1Byte

Note: checksum = (frame header + command code + High threshold values + Low threshold values + Status bit) & 0x00FF

Example 1:
Host： FB 05 03 E8 EB(checksum=(0XFB+0X05+0X03+0XE8)&0X00FF=0XEB)
Slave： FB 85 03 E8 00 6B
Indicates that the setting is successful, set the switch distance to1000mm.
Threshold setting range： 20～4000mm。

(4)Modify the switch volume polarity data format

The user machine is the host equipment, and this module is the slave equipment.
Host sent:

Name	Frame header	Command Code	Hold	Output polarity	Checksum
Byte	Fixed to 0XFB	Fixed to 0X06	0X00	0x00： negative output, Output low level below threshold0x01: positive output, Output high level below threshold	

Slave response：

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

Note：checksum = (frame header + command code + output polarity + status bit)&0x00FF

Example 1：

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

Slave： FB 86 00 01 00 82

Indicate that the setting is successful, when the module is set to detect an object, the"TX" lead output high level, and the "RX" lead output low level.

Example 2：

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

Slave： FB 86 00 00 00 81

Indicate that the setting is successful, when the module is set to detect an object, the"TX" lead output low level, and the "RX" lead output high level.

4.Modbus protocol description

Switch output only supports the serial port Modbus protocol withion 800ms. UART automatic、UART controlled output mode does not have this limitation, sustainable communication after power-up. IIC mode is not support this protocol.

(1). The Modbus protocol parameters

Model	Check	Sensor address	Read the function code	Write the function code
Modbus-RTU	CRC-16/MODBUS	Setable, default 0x01	0x03	0x06

(2). The Modbus protocol format

The user machine is the host machine equipment, and this module is the slave equipment.

Host sent(read)：

Name	Device address	Function code0x03	Register address	Register number	CRC16 check
Length(Byte)	1	1	2	2	2

Slave response(read)：

Name	Device address	Function code0x03	Return bytes number	Data field	CRC16 check
Length(Byte)	1	1	1	N	2

Host sent(write)：

Name	Device address	Function code 0x06	Register address	Data field	CRC16 check
Length(Byte)	1	1	2	2	2

Slave response(write)：

Name	Device address	Function code 0x06	Register address	Data field	CRC16 check
Length(Byte)	1	1	2	2	2

(3). The Modbus register

Register data for high bytes in front and low bytes in back.The values prefixed with "0x" are hexadecimal, and the others are decimal.

（1） Modbus register table 1

Authority	address	function	Data type	Instruction
Read-only	0x0100	Processing value	Unsigned int, 16bit	Start raging after receiving instruction, output distance value after the algorithm processing unit: mm， response time is about 170～260ms
Read-only	0x0101	Processing value	Unsigned int, 16bit	After receiving the instruction, the module starts raging once, and outputs the real-time distance value, unit: mm, response time is about 19～38ms

（2）)Modbus register table 2

Authority	address	function	Data type	Instruction
Read-write	0x0200	Slave address	Unsigned int, 16bit	range: 0x01～0xFE (default 0x01)， 0xFF is the broadcast address

Read-write	0x0201	Baud rate	Unsigned int, 16bit	Serial port baud rate(default 115200), unit: bps, effective immediately after setting, baud rate corresponding to register value is as follows: 0x0002:4800, 0x0003:9600, 0x0004:14400, 0x0005:19200, 0x0006:38400, 0x0007:57600, 0x0008:76800, 0x0009:115200
Read-write	0x0203	Ranging output cycle	Unsigned int, 16bit	Automatic ranging output period, only the UART automatic output is valid, in unit ms, the range of 30~10000ms (default 100ms). The resolution is set to 10ms, and when the value is not a multiple of 10, the single digit value is ignored, such as setting 43ms, then the actual range output period is 40ms
Read-write	0x0205	Switch output polarity	Unsigned int, 16bit	Only the switch mode is valid; 0x00： negative output, less than the threshold value and output low 0x01： positive output, less than the threshold value and output high(default)
Read-write	0x0205	Set the switch threshold value	Unsigned int, 16bit	Set the switch threshold value,unit： mm, range： 20～4000mm(default 1500mm)

(4). Modbus communication example

Example 1： read the processing data
Host： 01 03 01 00 00 01 85 F6
Slave： 01 03 02 02 F2 38 A1
instruction： The sensor address is 0x01, The processing distance value is 0x02F2, Convert to a decimal into 754mm

Example2:read the real-time data
Host :01 03 01 01 00 01 D4 36
Slave :01 03 02 02 EF F8 A8
instruction:The sensor address is 0x01，The real-time distance value is 0x02EF，Convert to a decimal into 751mm

Example 3:modify the slave address
Host :01 06 02 00 00 05 48 71
Slave :01 06 02 00 00 05 48 71
instruction:The sensor address was modified from 0x01 to 0x05.

Example 4:read the baud rate
Host :01 03 02 01 00 01 D4 72
Slave:01 03 02 00 03 F8 45
instruction:Read the port rate, the read baud rate is，9600bps

Example 5:set the baud rate
Host :01 06 02 01 00 03 99 B3
Slave :01 06 02 01 00 03 99 B3
instruction:set the baud rate to 9600bps

Example 6: Read the ranging output period
Host: 01 03 02 03 00 01 75 B2
Slave: 01 03 02 00 28 B8 5A
Description: The read ranging output period is 40ms

Example 7: Set the ranging output period
Host: 01 06 02 03 00 64 79 99
Slave: 01 06 02 03 00 64 79 99
Description: Set the ranging output period to 100ms

5. IIC Output Description

(1).Definition of output leads

PIN #	PIN name	PIN description	Remarks
①	VCC	Power input	
②	GND	Ground	
③	RX	IIC clock line SCK	
④	TX	IIC data wire SDA	

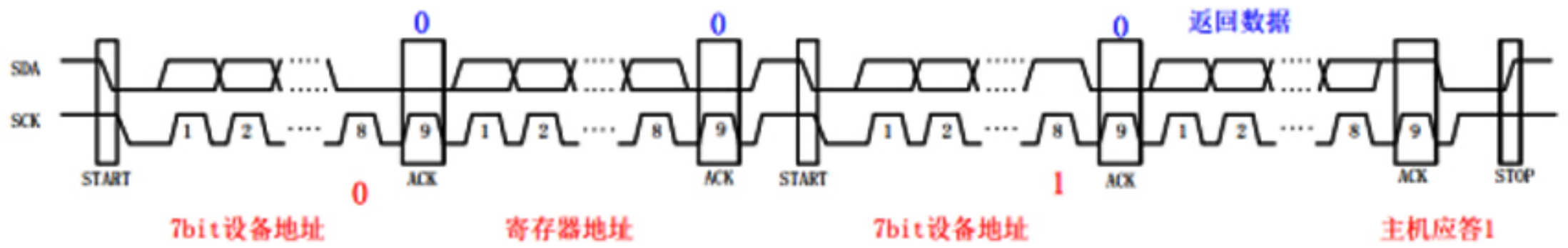
(2).IIC module parameters

This module is a slave equipment and supports multiple parallel connections. Communication line SDA and SCK need the user externally parallels the pull-up resistor, the recommended size range is: 3K～10K
Communication level: equal to VCC
Communication rate: 10～100kbit/s
Broadcast address : 0x00
Default address : 0xE8
The 8-bit slave address described in this paper is obtained from the 7-bit address, for example, the corresponding 7-bit address of 0xE8 is expressed as 0x74.
Users can modify the address to any one of the 20 addresses： 0xD0, 0xD2, 0xD4, 0xD6, 0xD8, 0xDA, 0xDC, 0xDE, 0xE0, 0xE2, 0xE4, 0xE6, 0xE8, 0xEA, 0xEC, 0xEE, 0xF8, 0xFA, 0xFC, 0xFE

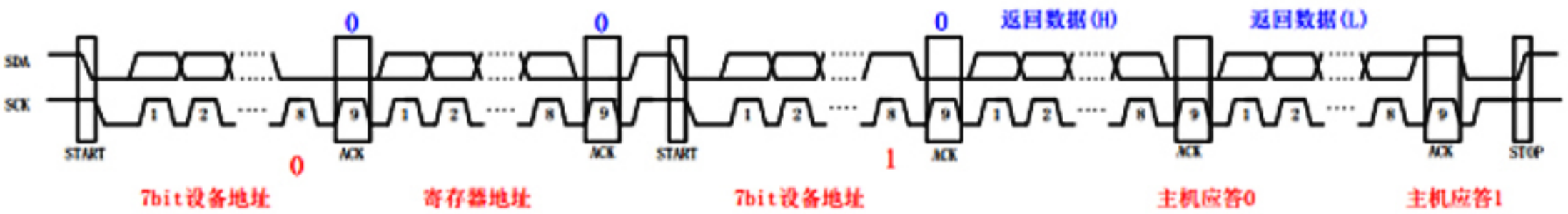
(3).IIC timing diagram

(1)read 1 byte of data

Note :The blue part above the sequence is the signal generated by the slave, and the red part below the sequence is the signal generated by the host



(2)read two bytes of data, high eight in the anterior and lower eight in the posterior



(3)write 1 byte of data

(4).IIC register

Register data for high bytes in front and low bytes in back.

(1)IIC register table 1

Authority	address	function	Data type	Instruction
Read-only	0x00～0x01	Program version identification	Unsigned int, 16bit	Module software version number identification
Read-only	0x02～0x03	Distance value	Unsigned int, 16bit	Output the real-time distance value, unit:mm； It is recommended that the distance value be read above the trigger ranging after delaying the corresponding time,the premature reading will obtain the 0xFFFF value
read-write	0x05	Slave address	Unsigned int, 8bit	8-bit slave device address, default 0xE8,0x00 is broadcast address; any one of the 20 set addresses can be written into ： 0xD0, 0xD2, 0xD4, 0xD6, 0xD8, 0xDA, 0xDC, 0xDE, 0xE0, 0xE2, 0xE4, 0xE6, 0xE8, 0xEA, 0xEC, 0xEE, 0xF8, 0xFA, 0xFC, 0xFE

Note:0x05 register parameters can be saved after setting

(2)IIC register table 2， control instruction

Authority	address	function	Data type	Instruction
Write-only	0x10	0xBD	Trigger the range once	After receiving the instruction, the module immediately distances once for about 19~38ms, returning the mm unit distance value. After triggering the ranging, it is recommended to delay by more than 40ms before reading the real-time distance value, and the premature reading will obtain the 0xFFFF value
Write-only	0x10	0x5A+0xA5		The slave module restart immediately after receiving the instructions

(5).Communication example

Example 1： Read the module software version number, the operation step is:

Address (write)	0x00	Address (read)	0x00	0x01

The module is identified by the software version number as 0x0001.

Example 2： Trigger the module ranging, and read the real-time distance value, the operation step is:

① Send the trigger ranging instructions：

Address (write)	0x10	0xB0

②Delay wait for 40ms

③Read the distance value

Address (write)	0x02	Address (read)	0x04	0xE9

The real-time distance value is 0x04E9 .convert to a decimal into 1257mm

Example 3： Host modifies the module IIC address, the operation step is:

Original address 0xE8(write)	0x05	New address 0xD0

The module is changed from original address 0xE8 to new address 0xD0, saved and takes effect.