A01 Module Output Interface

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1. Specification

Item	UART Auto	UART Controlled	PWM Auto	PWM Controlled	Switch Output	RS485	Unit	Remarks
Static current	-	≤10	-	≤10	-	-	uA	
Operating cycle	100~500	Controlled	250	Controlled	100	Controlled	ms	
Output interface	UART	UART	PWM	PWM	TTL Switch	RS485	-	
Accuracy of flat object	±(1+S*0.3%)						cm	
Temperature compensation	Support							

Remark:

(1) The UART automatic working cycle of A01A series and A01B series modules is 100ms, the PWM automatic output working cycle is 250ms, and the UART automatic output working cycle of A01C series modules is 500ms.

(2) Under normal temperature, the measured object is a 50cm*60cm flat carton, S represents the measuring distance, and the detection direction should be as perpendicular to the measured object as possible.

2. UART Auto Output

(1) Pin Definition

Pin No.	Mark	Description	Remarks
1	VCC	Power input	
2	GND	GND	
3	RX	Processing value and 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

Pin(RX) is floating or input high level under UART auto output mode(A01A and A01B series), the module outputs processed value, the data is more stable, and the response time is 300～500ms. when pin(RX) input low level, The module outputs real-time value, the response time is 100ms. (The module only detects the level of pin(RX) when it is powered on. When using the real-time value output, it is recommended to connect pin(RX) to the low level before supplying power to the module)

Pin(RX) is empty when A01C series module is UART automatic output mode, The module is an intelligent algorithm processing value output, response time is 500ms.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL Level	8	1	N/A	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	0X01	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

Converts to decimal is equal to 1953, means current measurement distance value is 1953mm.

3. UART Controlled Output

(1) Pin Definition

Pin No.	Mark	Description	Remarks
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.

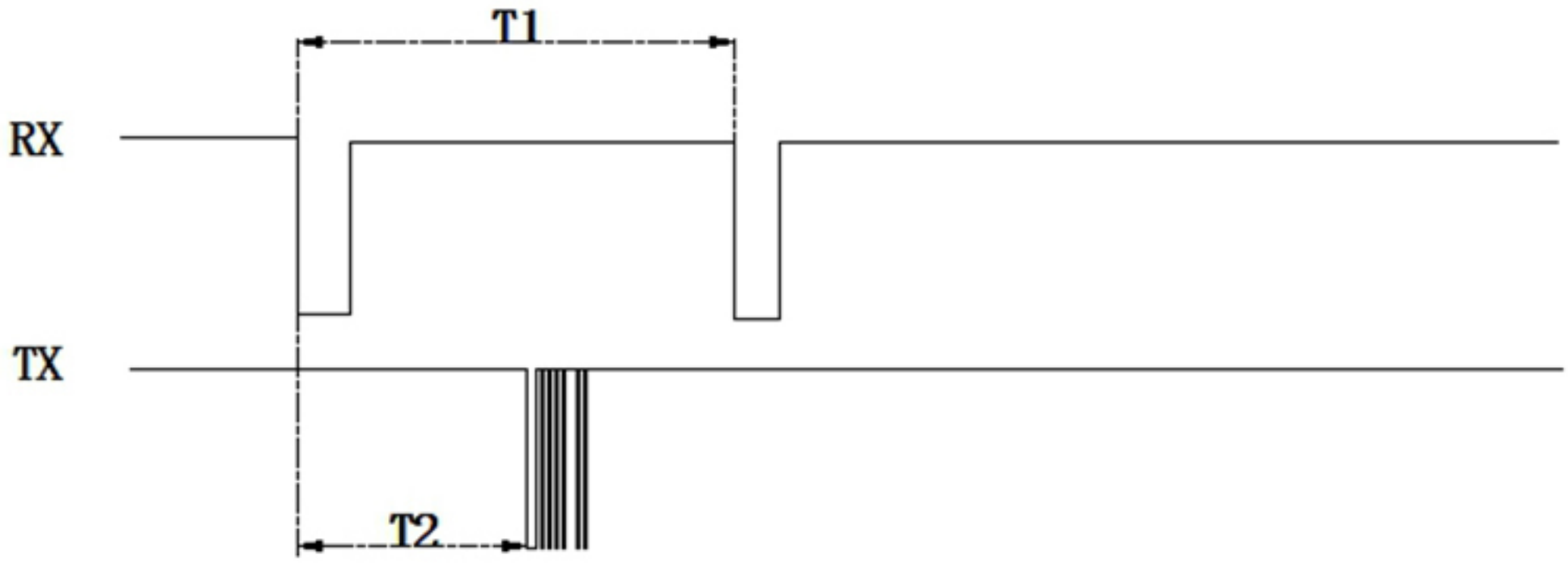
(2) UART Communication instruction

UART controlled mode outputs measured distance value according to UART communication format.When pin(RX) receives a falling edge pulse, the module will perform a measurements, measured distance value output through pin(TX) after completed. This output mode can control the measurement cycle and reduce power consumption.

The trigger cycle of A01A series and A01B series modules must be greater than 70ms. The UART controlled output mode of A01C series modules is intelligent algorithm processing value output, the response time is 500ms, and the trigger period should be greater than or equal to 500ms.

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL Level	8	1	N/A	9600bps

(3) Timing Diagram



Remark: A01A and A01B series: T1 ＞70ms, T2=50～60ms A01C series T1≥500ms,T2≈500ms

(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

Converts to decimal equal to 1953, means current measurement distance value is 1953mm

4. PWM Auto output

(1) Pin Definition

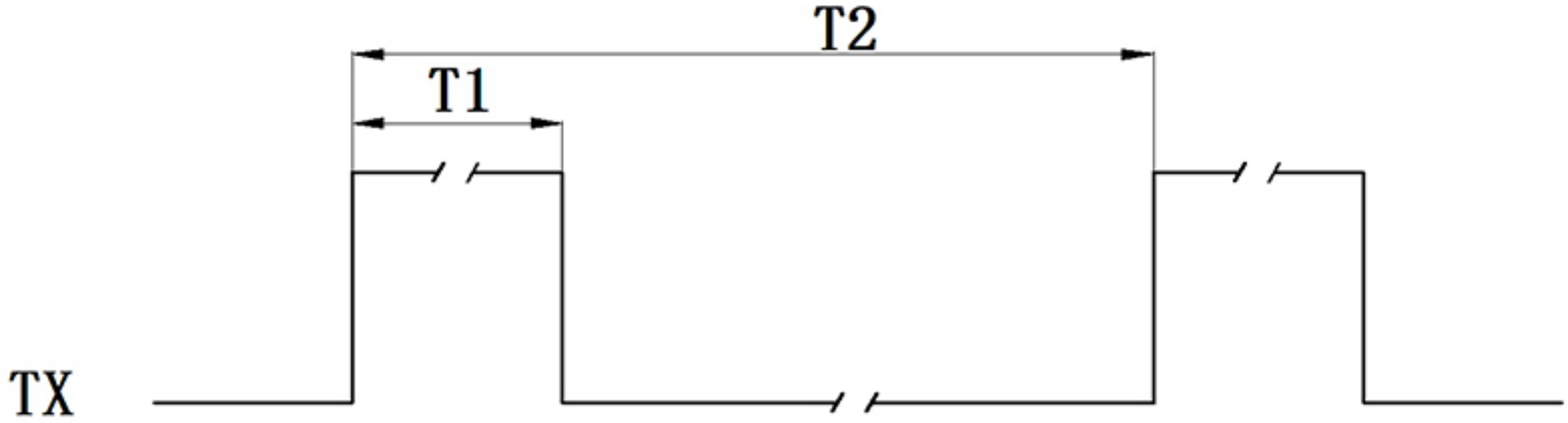
Pin No.	Mark	Description	Remarks
1	VCC	Power input	
2	GND	GND	
3	RX	Empty	(1)
4	TX	PWM output	(1)

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

(2) Instruction

A01A series and A01B series module PWM automatic output mode carries out distance measurement every 250ms, and converts the distance value detected by the module into PWM high-level pulse width output by pin(TX). If no object is detected, pin(TX) will output a fixed pulse width of about 45ms.
The PWM pulse width of the module has temperature compensation, and the distance measurement is more accurate in different temperature environments.

(3) Timing Diagram



Remark: A01A and A01B series module Auto output: T1=1.4～45ms； T2=250ms

(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)
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(T2)of PWM high-level pulse width is 10000us, the S= T/57.5=10000/57.5≈173.9(cm), means 173.9cm distance value.

5. PWM Controlled output

(1) Pin Definition

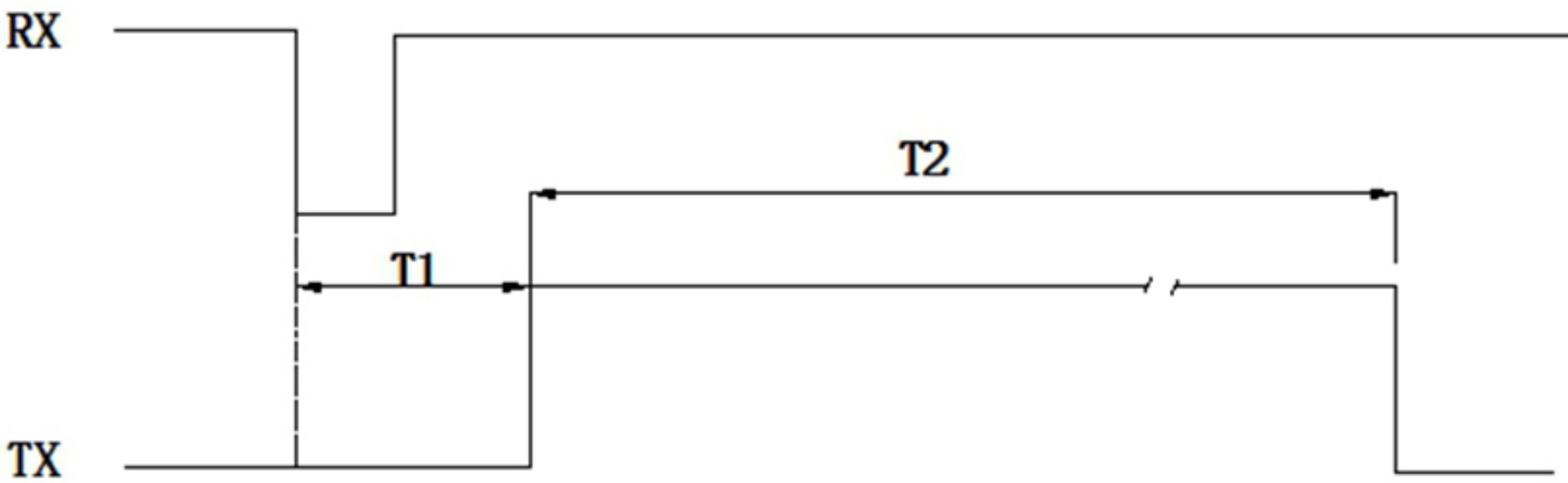
Pin No.	Mark	Description	Remarks
1	VCC	Power input	
2	GND	GND	
3	RX	Trigger input	(1)
4	TX	PWM output	(1)

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

(2) PWM instruction

Pin(RX) receives a falling edge pulse or any serial interface data, the module running a detection, pin TX output a TTL level PWM high level pulse width signal, the trigger period must greater than 70ms.

(3) Timing Diagram



Remark: T1=1～8ms； T2=1.4～45ms （Timing of PWM High-level pulse width）

(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(T2)of PWM high-level pulse width is 10000us, the S= T/57.5=10000/57.5≈173.9(cm), means 173.9cm distance value.

6. Switch output

(1) Pin Definition

Pin No.	Mark	Description	Remarks
1	VCC	Power input	
2	GND	GND	
3	RX	Processing value or real time value output	(1)
4	TX	Switch 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. When the value greater than threshold, pin(TX) output low level.

In order to improve stability, when pin(RX) of the module is floating or input high level, the module will output processed value, the data will be more stable. The response time is 1.5s and the delay time is 2.5s. when pin(RX) is input low power, the module outputs real-time value, the response time is 0.3s, and the delay time is 0.5s. The pin(TX) of the module only outputs high and low level signals and has no drive capability.

(3) Threshold value Setting

In order to allow users to flexibly adjust the threshold value, the module adds the function of modifying the threshold value through serial interface commands.

Interface	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL Level	8	1	N/A	9600bps

(4) Modify threshold value format

Data Frame	Description	Byte
Start Bit	0XFB 0XFB	1byte
Command Code	0X05 0X05	1byte
Data_H	High8 distance value	1byte
Data_L	Low8 distance value	1byte
SUM	Parity sum	1byte

(5) Example

Start Bit	Command Code	Data_H	Data_L	SUM
0XFB	0X05	0X03	0XE8	0XEB

Remark: Parity sum only remain low 8 value.

Master: FB 05 03 E8 EB

Slave: FB 85 03 E8 00 6B

Setting successes, Switch distance value is 1000mm

Remark: Threshold value range 25-750cm.

(6) Switch polarity data format

Data Frame	Description	Byte
Start Bit	0XFB 0XFB	1byte
Command Code	0X06 0X06	1byte
Data_H	High8 distance value	1byte
Data_L	Low8 distance value	1byte
SUM	Parity sum	1byte

(7) Switch polarity modifying example

Start Bit	Command Code	Data_H	Data_L	SUM
0XFB	0X06	0X00	0X01	0X02

Remark: Parity sum only remain low8 value.

Master：FB 06 00 01 02

Slave：FB 86 00 01 00 82

Means modifying successes, the switch polarity set to positive output.

Master：FB 06 00 00 01

Slave：FB 86 00 00 00 81

Means modifying successes, the switch polarity set to negative output.

7. RS485 Output

(1) Pin definition

Pin No.	Mark	Description	Remarks
1	VCC	Power input	
2	GND	GND	

3	RX/B	RS485 Inverting input(B)	(1)
4	TX/A	RS485 Non-inverting input(A)	(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	N/A	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	Default 0x03, 9600bps; 0x01-2400, 0x02-4800, 0x03-9600, 0x04-14400, 0x05-19200, 0x06-38400, 0x07-57600, 0x08-76800	

Remarks: The register data is the high byte first and the low byte last.

(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 3: 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.

Example 5: Modify baud rate
Master:05 06 02 01 00 01 19 F6
Slave:05 06 02 01 00 01 19 F6
Description: The sensor address is 0x05, baud rate changed to 0x01, e.g. 2400bps