A17 Module Output Interface

01 Pulse Width Output(PWM)

02 UART Auto output

03 UART Controlled output

04 RS485 Controlled output

05 Modbus protocol

This module support PWM processing value, UART Auto, UART Controlled and RS485 output interfaces. Model no. Correspond to output interface, Pls refer to page (5) .

1. PWM processing value output

PWM processing value connector is simple, flexible connect to analog or digital circuit.

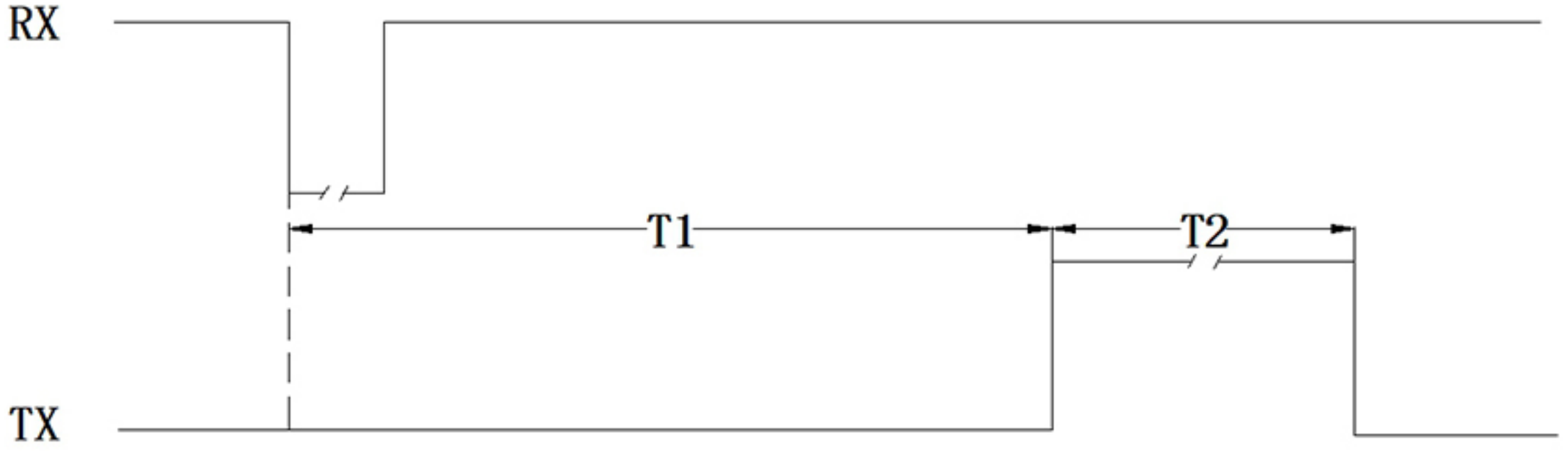
(1) Pin definition

Pin No.	Mark	Pin description	Remark
③	RX	Signal input	
④	TX	PWM processing value output	

(2) Instruction

When Pin 3(RX) receives a falling edge pulse, the module will be awakened from sleep mode and start working, running 5-15 times detection. After the detection is completed, pin4(TX) will output a high-level pulse width signal, the high-level duration of pin4(TX) corresponds to the distance between the detection target and the module. The period must be greater than 2.5s, Pin4(TX) will output a fixed 80ms pulse width if module does not detect an object.

(3) Timing Diagram



Remark: T1=0.9s~2.5s T2=1.4ms~80ms (Timing of PWM High-level pulse width).Suggest timing between 10us and 2ms of RX falling edge 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≈174(cm), means 174cm distance value.

2. UART Auto Output

UART auto output mode outputs measured distance value according to UART communication format. This mode does not require an external trigger signal. Every 5 to 15 times measured distance value output through Pin(TX). The response time is 0.9s~2.5s (working cycle and response time can be customized and developed according to customer needs). This output mode can reduce quantity of SCM I/O port, only one I/O port is needed.

(1) Pin Definition

Pin No.	Mark	Pin description	Remark
③	RX	Free	
④	TX	UART output	

(2) UART Instruction

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL	8	1		9600bps

(3) UART Output format

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

(4) Example of UART Output

Start Bit	Data_H	Data_L	SUM
0XFF	0X01	0XA1	0XA1

Remark: Parity sum only remain low8 value.

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

=(0XFF + 0X01 + 0XA1)&0x00FF

=0XA1

Distance value= Data_H*256+ Data_L=0X01A1:

Convert to decimal equal to 417

Means current measurement distance value is 417cm

3. UART Controlled Output

UART controlled mode outputs measured distance value according to UART communication format.When pin(RX) receives a falling edge pulse, the module will perform 5 to 15 measurements, measured distance value output through pin(TX) after completed. The cycle must be greater than 2.5s.

This output mode can control the measurement cycle and reduce power consumption. It is recommended to use with battery power supply.

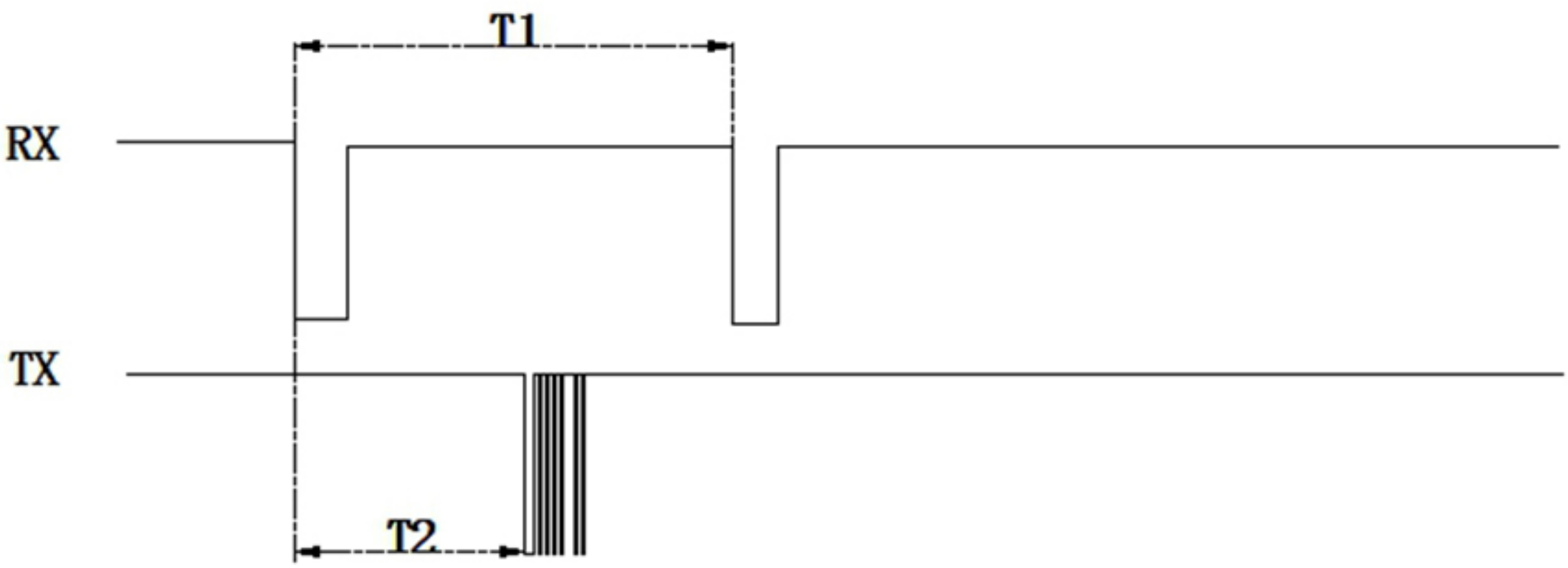
(1) Pin Definition

Pin No.	Mark	Pin description	Remark
③	RX	Trigger signal input	
④	TX	UART output	

(2) UART Instruction

UART	Data Bit	Stop Bit	Parity Bit	Baud Rate
TTL level	8	1		9600bps

(3) Timing Diagram



Remark : T1>2.5s； T2=0.9~2.5s.

Suggest timing between 10us and 2ms of RX falling edge pulse width

(4) UART output format

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

(5) Example of UART Output

Start Bit	Data_H	Data_L	SUM
0XFF	0X01	0XA1	0XA1

Remark: Parity sum only remain low8 value.

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

=(0XFF + 0X01 + 0XA1)&0x00FF

=0XA1

Distance value= Data_H*256+ Data_L=0X01A1；

Convert to decimal equal to 417

Means current measurement distance value is 417cm

4. RS485 Controlled output

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	RS485 Pin B	
④	TX	RS485 Pin A	

(2) RS485 interface specification

Interface	Data Bit	Stop Bit	Parity Bit	Baud Rate
RS485	8	1		9600bps

(3) RS485 Protocol

Refer to Modbus protocol

5. Modbus Protocol

This module supports Modbus protocol, which is convenient for users to read and set internal parameters.

(1) Modbus protocol specification

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

(2) 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

(3) Modbus Register

Status	Register Address	Register Function	Type of Data	Description	Remark
Read-only	0x0100	Processing value	Unsigned, 16bit	0.9s~2.5s Measurement start after received instruction, output distance value after multiple measurements filtering process. Unit mm, 0.9s-2.5s response time	
Read-only	0x0101	Real-time value	Unsigned, 16bit	The module start measuring after received instruction, directly output real time value, unit mm 100ms response time.	
Read-only	0x0102	Environm-ent temp.	Unsigned, 16bit	Unit is 0.1℃, 0.5℃ resolution, 100ms response time.	
Read-write	0x0200	slaver address	Unsigned, 16bit	Range:0x00~0xFE, default 0x01, 0xFF as the 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, 0x09-115200, 0x0A-128000	
Read-write	0x0210	Blind zone value	Unsigned, 16bit	Ignore objects echo within the value, only measuring distance beyond the value. Ranging:25-100cm, Default 25cm	affect stability within blind zone
Read-write	0x0211	Level of filter	Unsigned, 16bit	Ranging: 0-5 levels, default value is 4. Among them, level 0 does not filter the steps,the first object will be selected as the effective echo. Level 5 has the highest intensity, will ignored the most steps echoes. Measured object required high echo amplitude.	The higher the filtering level, the actual well surface may be ignored and need to be adjusted according to actual measurement.
Read-write	0x0212	Sensor excitation	Unsigned, 16bit	Ranging: 5-15 level, default is 10 level. The bigger value,the ultrasonic wave signal is strong. Pls modify carefully.	Will affect blind zone,measuring accuracy and angle.
Read-write	0x0213	Narrow angle switch	Unsigned, 16bit	Ranging: 0-1, default is 0. 0: normal measuring angle, 1:change to narrow angle, suitable for application with limited space.	Refer to Beam pattern

Note: (1) Register data is high byte first and low byte last.

(2) Under UART controlled mode, sensor is in dormant state until it is triggered. The first frame of serial command data will be ignored and it only serves to wake up the sensor. It needs to send command again within 500ms to respond.

(4) Xample of Modbus communication

(1) Read

Example 1: Read process value data
Master:01 03 01 00 00 01 85 F6
Slaver:01 03 02 02 F2 38 A1
Instruction: Sensor address is 0x01, process distance value is 0x02F2, convert to decimal is 754mm.

Example 2: Read real time data
Master：01 03 01 01 00 01 D4 36
Slave：01 03 02 02 EF F8 A8
Instruction：Sensor address is 0x01，real time distance value is 0x02EF,convert to decimal is 751 mm.

Example 3: Read temperature data
Master：01 03 01 02 00 01 24 36
Slave：01 03 02 01 2C B8 09
Instruction: Sensor address is 0x01, real time temperature value is 0x012C, convert to decimal is 30.0℃.

Example 4: Read step filter level parameters.
Master：01 03 02 11 00 01 D5 B7
Slave：01 03 02 00 04 B9 87
Instruction：Sensor address is 0x01，step filter level is 4.

(2) Write

Example: Modify slave address
Master：01 06 02 00 00 05 48 71
Slave：01 06 02 00 00 05 48 71
Instruction：Sensor address changed from 0x01 to 0x05.

Example 2: Modify step filer level parameters
Master：01 06 02 11 00 03 98 76
Slave：01 06 02 11 00 03 98 76
Instruction：Sensor address is 0x01，step filter level parameters changed to level3.