A15 Module Output Interface

01 Pulse Width Output(PWM)

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1. PWM output

PWM output interface with simple connector, flexible connect to analog or digital circuit.

(1) Pin definition

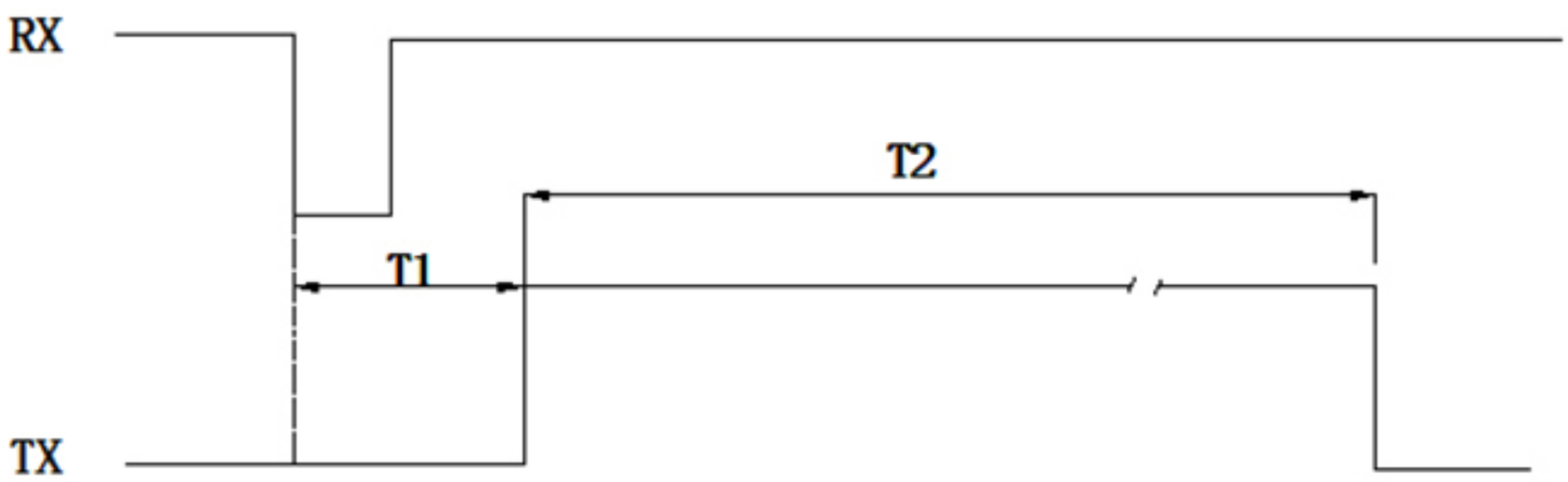
Pin No.	Mark	Pin Description	Remark
③	RX	Trigger Signal input	
④	TX	PWM value output	

Remark: The output high-level voltage of RX TX is 3V,the max allowable input voltage is 5V.

(2) Instruction

The module responds to the signal and outputs a high-level pulse width signal on the PIN(TX) after Pin(RX) receives a falling edge pulse, starts detection at the same time. the Pin(TX) will be set to low level after the target signal is detected, The high level duration of the pin(TX) corresponds to the distance between the detection target and the module. This cycle period of the module must be greater than 150ms. If the module does not detect an object, the pin(TX) will output a fixed pulse width of about 35ms.

(3) Timing Diagram



Remark: T1≈100ms T2=1～35ms（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, the 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(T3) of PWM high-level pulse width is 10000us, the S= T/57.5=10000/57.5≈173.9(cm), means 173.9cm distance value.

2. UART Auto Output

UART auto output mode outputs measured distance value(Hexadecimal) according to UART communication format. This mode does not require an external trigger signal. Pin(TX) output distance value by every 100ms, only one I/O port is needed

(1) Pin definition

Pin No.	Mark	Pin Description	Remark
③	RX	UART Receiving	
④	TX	UART output	

Remark: The output high-level voltage of RX TX is 3V,the max allowable input voltage is 5V.

(2) UART Instruction

Interface	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 0XFF	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

3. UART Controlled Output

UART controlled mode outputs measured distance value(Hexadecimal) according to UART communication format.When pin(RX) receives a falling edge pulse, the module will perform a measurement, measured distance value output through pin(TX) after completed. Such output method can set measuring cycle to drop power consumption.

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	Trigger Signal input	
④	TX	UART output	

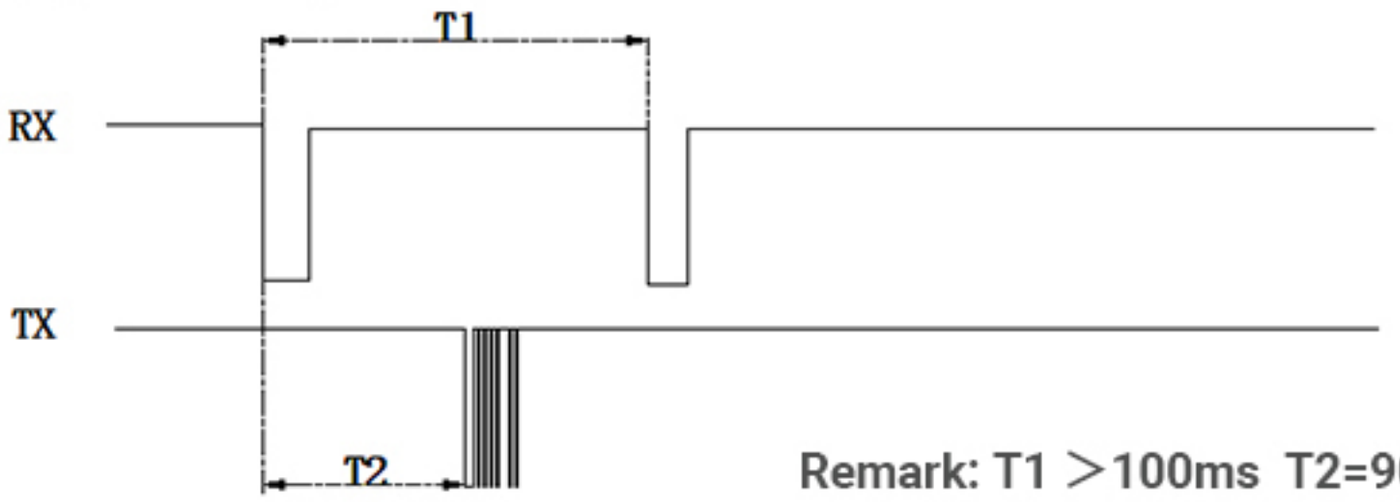
Remark: The output high-level voltage of RX TX is 3V,the max allowable input voltage is 5V.

(2) UART Instruction

The module will perform a distance detection after Pin(RX) receives a falling edge pulse. Pin(TX) will output a TTL level after detection is completed. The trigger period of the module must be greater than 100ms.

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

(3) Timing Diagram



Remark: T1 ＞100ms T2=90～100ms

(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

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

4. RS232 and RS485 Output

Using RS232 interface for data communication, it can work in two modes: automatic output mode and MODBUS controlled mode (the default is automatic output mode after power-on, after receiving MODBUS command, it can automatically switch to MODBUS controlled mode).Use RS485 interface for data communication, only work in MODBUS controlled mode.

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	RS232-RX/RS485 Pin B	
④	TX	RS232-TX/RS485 Pin A	

Note: The pin function setting followed customer's order, can't coexist with other output modes.

(2) Interface specification

Interface	Baud Rate	Data Bit	Stop Bit	Parity Bit
RS232/RS485	9600 bit/S	8	1	NO

(3) Automatic output instructions

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) For 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 is1953mm

5. Modbus Protocol

(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	Measurement start after received command, output distance value after multiple measurements filtering process. Unit mm, 100ms response time	

Read-only	0x0101	Real-time value	Unsigned, 16bit	The module start measuring after received command, directly output real time value, unit mm 50ms response time.	
Read-only	0x0102	Temperature	Unsigned, 16bit	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	

Note.:

Register data is high byte first and low byte last.

(4) Example

1. Read

Example 1:Read processed value data

Master:01 03 01 00 00 01 85 F6

Slave=: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 value data

Master：01 03 01 01 00 01 D4 36

Slave=：01 03 02 02 EF F8 A8

Instruction：Sensor address is0x01，real time distance value is 0x02EF,convert to decimal is 751mm

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.

6. Switch Output

The switch output interface is simple, the distance can be judged only by simple analog or digital.

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	Learning wire	
④	TX	Switch Output	

Note: Pin(TX)output high-level voltage as VCC, output low-level voltage is GND, and the maximum allowable input voltage of Pin(RX) is VCC.

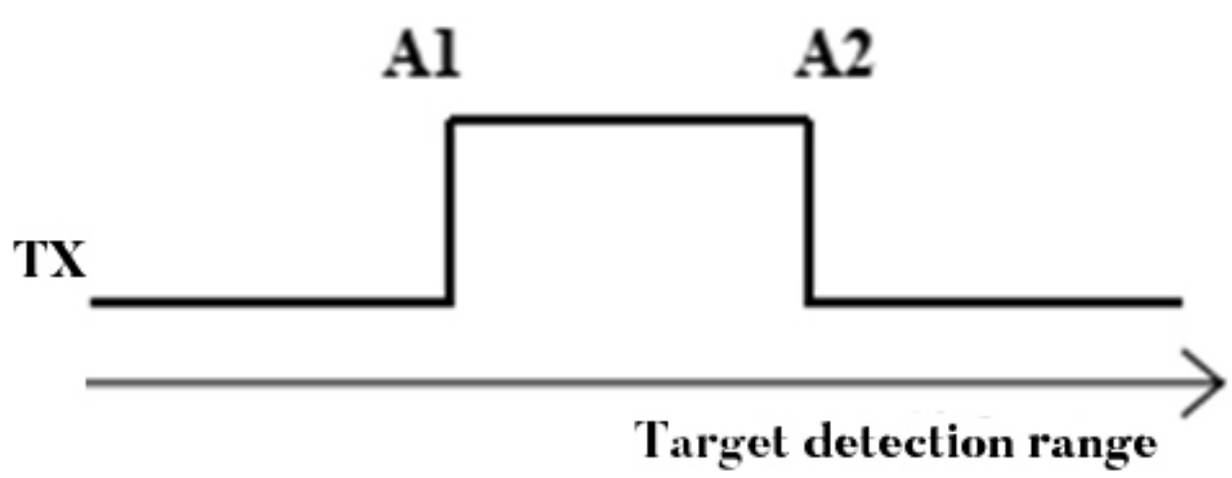
(2) Instruction

The response time of the module is about 100ms. According to the values of points A1 and A2, the Pin(TX)output switching high and low level signals, and the maximum drive capacity is 50mA. The values of points A1 and A2 can be modified through the learning line.

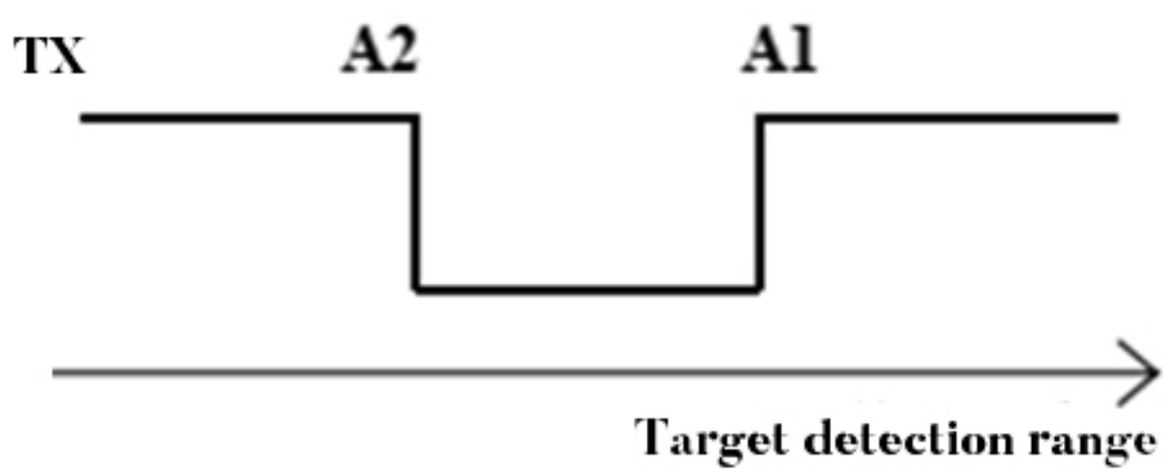
Factory default setting of the module is 150mm for A1 point and 2000mm for A2 point; the adjustable range is 150～2000mm.

According to points A1 and A2, there are the following 5 output modes.

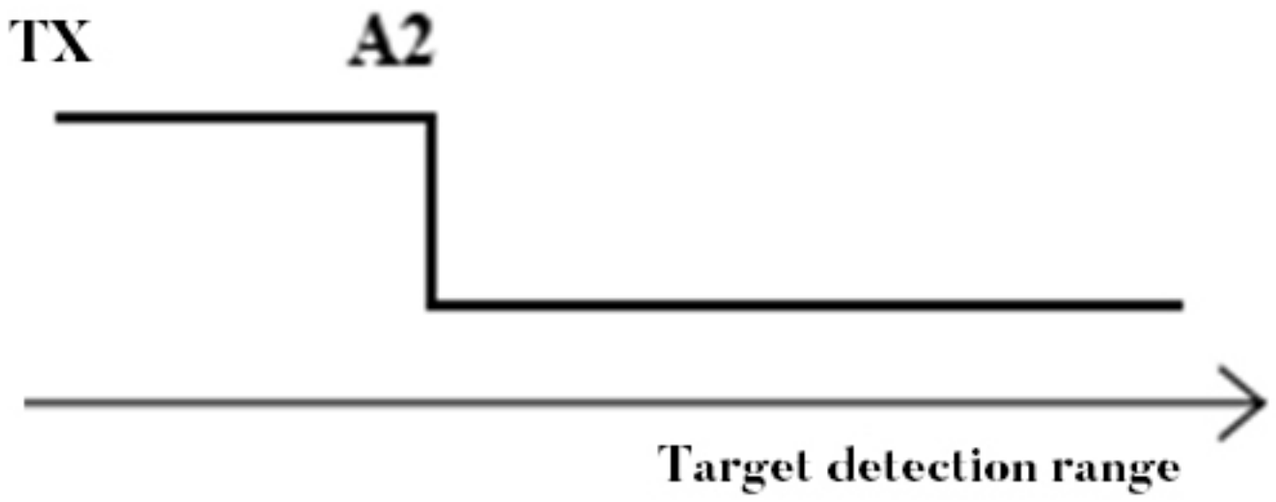
Window Mode A1<A2



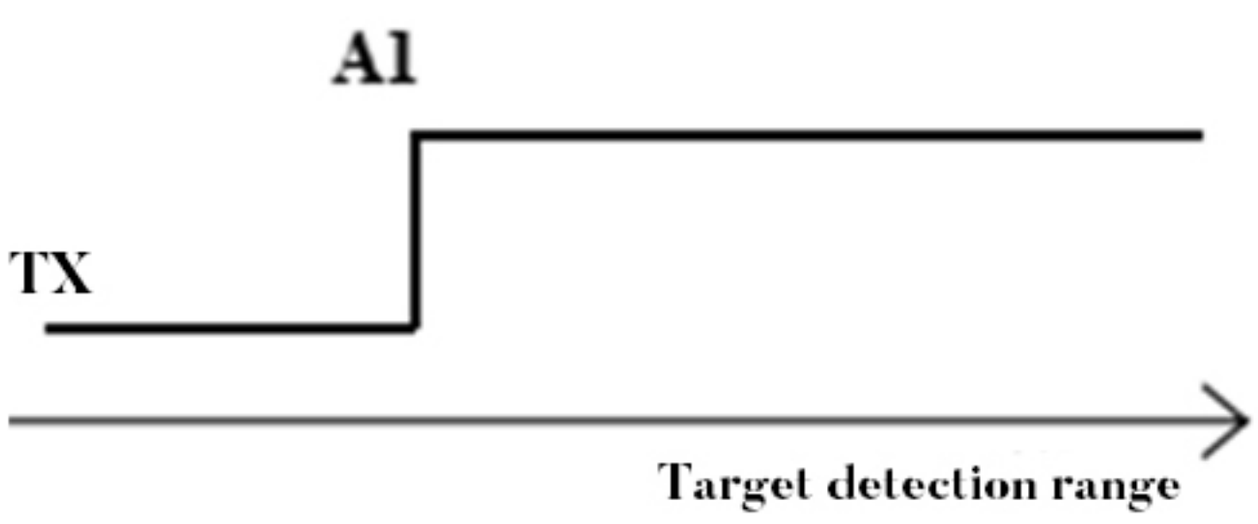
Window Mode A2<A1



Single point mode, A1 is infinite



Single point mode, A2 is infinite



A1 A2 are infinite, object is detected or not

When an object is detected, it outputs a high level, and if an object is not detected, it outputs a low level.

(3) Learning Wire settings

The settings within 5 minutes after power-on.

Set point A1:

① Place a flat object at the target distance.

② Connect the learning wire to GND, the module will enter the learning mode, when an object is detected, the blue light flashes. when it is not detected, the red light is always on, and the measured value is regarded as an infinite value.

③ Remove the learning line after maintaining this state for at least 3 seconds,the learning mode will be exited. If the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Set point A2:

① Place a flat object at the target distance

② Connect the learning line to VCC, the module will enter the learning mode. When an object is detected, the blue light flashes, when it is not detected, the red light is always on, and the measured value is regarded as an infinite value.

③ After maintaining this state for at least 3 seconds, remove the learning line, and the learning mode will be exited. If the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Note: Try not to set the target distance in the blind zone to ensure the stability of the system's ranging output. During learning, when the red light is on, the measured value will be regarded as an infinite value. If you exit the learning mode at this time, the measured value will be saved as an infinite value.

7. Analog Voltage output

The user can achieve distance measurement with only one I/O port, collect analog voltage value which output by the module, and the formula is converted into a distance value.

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	Learning wire	
④	TX	Analog voltage output	

Note: The maximum input voltage allowed by the Pin(RX) is VCC. The analog voltage output range can be 0～10V or 0～5V version.

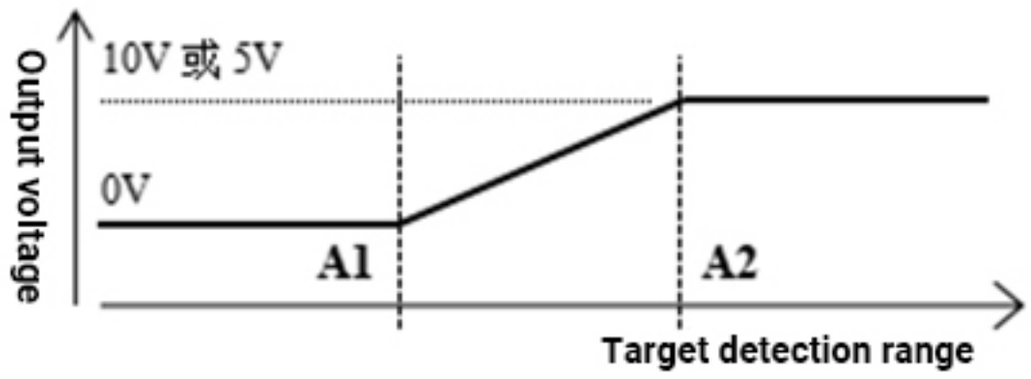
(2) Instruction

The response time of the module is about 100ms. According to the value of A1 and A2, the analog voltage signal is linearly output through the Pin(TX).

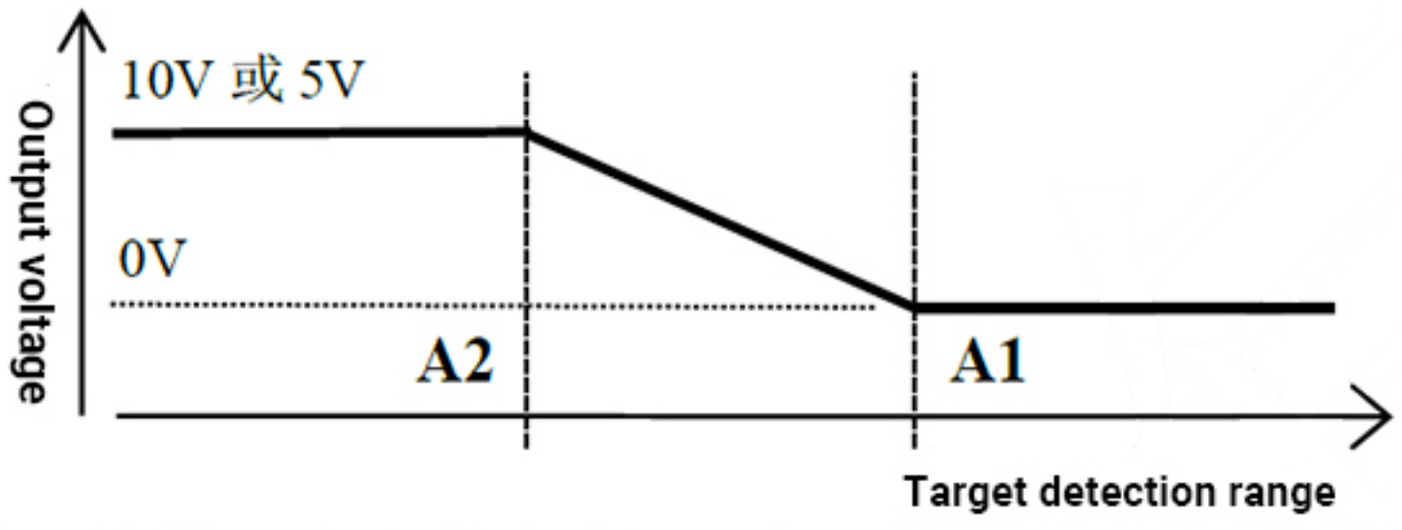
The factory default setting of the module is 150mm for A1 point and 2000mm for A2 point, the adjustable range is 150～2000mm.

According to points A1 and A2, there are two output modes as following.

Linear rising mode, A1<A2.



Linear dropping mode,A2<A1



Remark: The resistive load of the analog voltage output is ≤10mA.

(3) Learning wire Setup

The settings within 5 minutes after power-on.

Set point A1:

① Place a flat object at the target distance.

② Connect the learning line to GND, the module will enter the learning mode. When an object is detected, the blue light flashes, when it is not detected, the red light is always on, and the measured value is regarded as an invalid value.

③ After maintaining this state for at least 3 seconds, disconnect the learning line, the learning mode will be exited. if the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Set point A2:

① Place a flat object at the target distance.

② Connect the learning line to VCC, the module will enter the learning mode, When an object is detected, the blue light flashes, when it is not detected, the red light is always on, and the measured value is regarded as an invalid value.

③ Disconnect the learning line after maintaining this state for at least 3 seconds, the learning mode will be exited. If the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Note: Try not to set the target distance in the blind zone to ensure the stability of the system's ranging output. During learning, when the red light is on, the measured value will be invalid. If you exit the learning mode at this time, the learning will fail.

(4) Formula

output version conversion formula: S=U*(A2-A1)/10000+A1

output version conversion formula: S=U*(A2-A1)/5000+A1

Where S is the distance value, U represents the output voltage value, unit: mV.

For example: The output range of the module is 0～10V, point A1 is 150mm, point A2 is 2000mm, when the output lead voltage value is 1500mV

Substitute into the formula: S=1500*(2000-150)/10000+150=428mm

That is: the distance measured by the current sensor is 428mm.

8. Analog Current output

The user can achieve distance measurement with only one I/O port, collect analog current value which output by the module, and the formula is converted into a distance value.

(1) Pin Definition

Pin No.	Mark	Pin Description	Remark
③	RX	Learning wire	
④	TX	Analog current output	4～20mA

Note: The maximum input voltage allowed by the Pin(RX) is VCC.

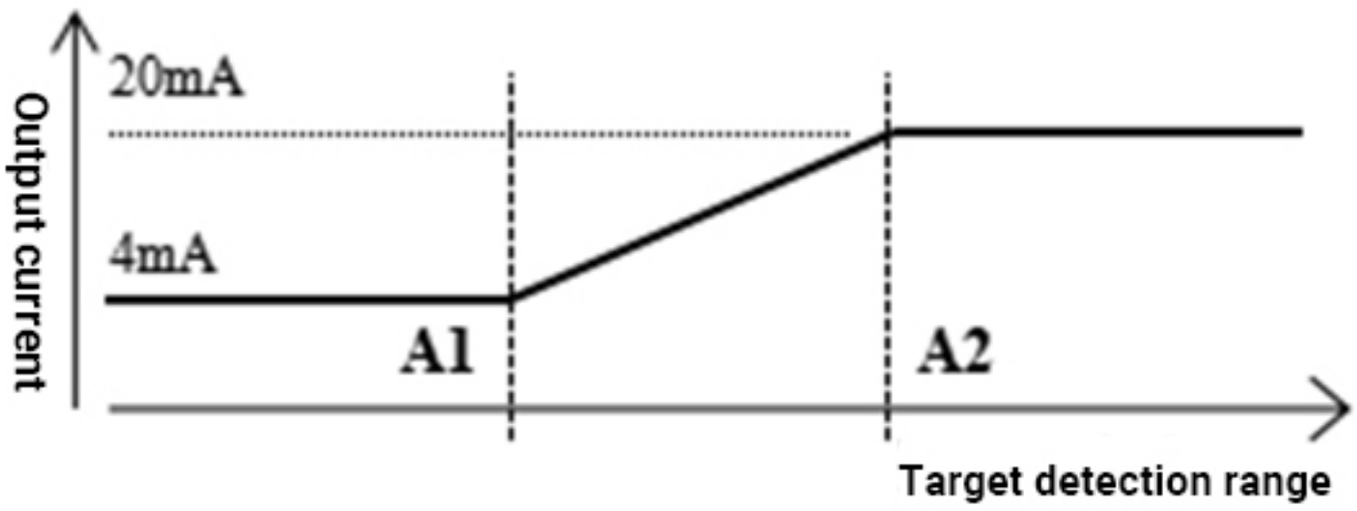
(2) Instruction

The module measures the distance every 30ms, distance value is obtained by filtering the three times data ,therefore, the response time is about 100ms. According to the value of A1 and A2, the analog current signal is linearly output through pin(TX).

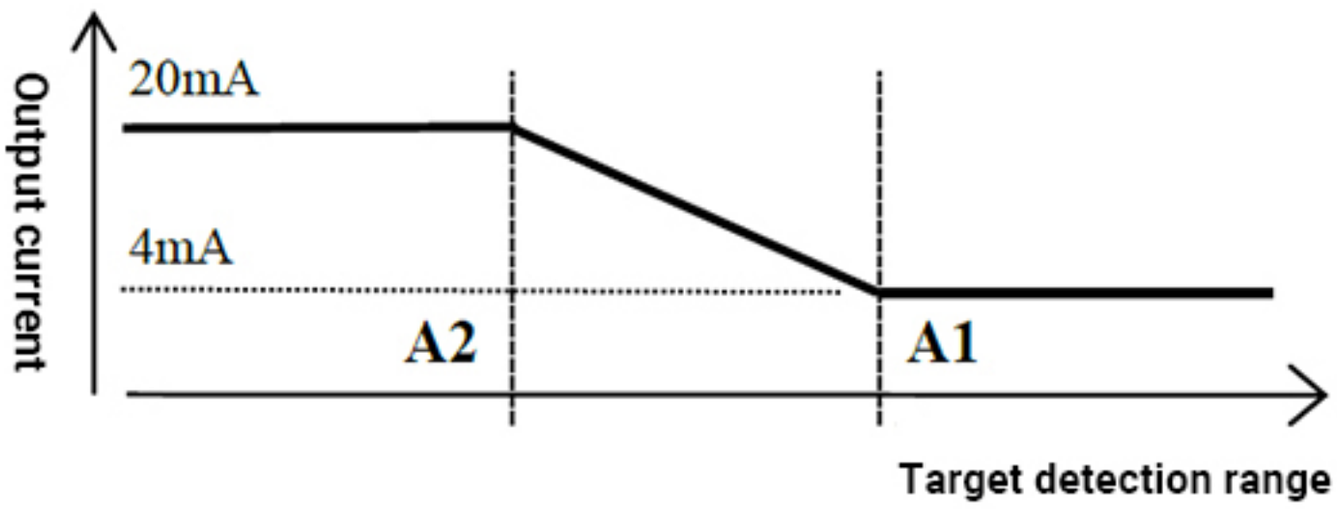
The factory default setting of the module is 150mm for A1 point and 2000mm for A2 point; the adjustable range is 150～2000mm.

According to points A1 and A2, there are two output modes as following.

Linear rising mode, A1<A2



Linear dropping mode.A2<A1



Remark: The resistive load of the analog current output is ≤300Ω.

(3) Learning wire setup

The settings valid within 5 minutes after power-on.

Set point A1:

① Place a flat object at the target distance.

② Connect the learning line to GND, the module will enter the learning mode. When an object is detected, the blue light flashes, when it is not detected, the red light is always on, and the measured value is regarded as an invalid value.

③ After maintaining this state for at least 3 seconds, disconnect the learning line, the learning mode will be exited. if the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Set point A2:

① Place a flat object at the target distance.

② Connect the learning line to VCC, the module will enter the learning mode, When an object is detected, the blue light flashes, when it is not detected, the red light is always on, and the measured value is regarded as an invalid value.

③ Disconnect the learning line after maintaining this state for at least 3 seconds, the learning mode will be exited. If the blue light is always on for 1 second, the setting value is saved successfully, and if the red light is on for 1 second, the setting has failed.

Note: Try not to set the target distance in the blind zone to ensure the stability of the system's ranging output. During learning, when the red light is on, the measured value will be invalid. If you exit the learning mode at this time, the learning will fail.

(4) Formula

Formula: S=(I-4)*(A2-A1)/16+A1

Where S is the distance value, and I is the output current value in mA.

For example: Module A1 point is 150mm, A2 point is 2000mm, when the output current value is 10mA.

Substitute into the formula: S=(10-4)*(2000-150)/16+150=844mm

That is: the distance value measured is 844mm.