User Manual of DYP-A01-V2.0

Waterproof Ultrasonic Distance Measuring Controller

一. Description:

Waterproof ultrasonic distance measuring controller of DYP-A01Y –V2.0 uses the integrated and enclosed waterproof ultrasonic transducer, which has a certain dust waterproof level, suitable for the wet and poor measurement occasion. It is with a special horn mouth, suitable for the larger testing range requirements. And it has different types of output mode, it's a commercial grade module with high-performance and high reliability.

二. Features:

1. Power Supply: DC3.3V to 5.0V;

2. Standby current can be below 10uA;

3. UART auto-output;

4. UART controlled output;

5. PWM auto-output;

6. PWM controlled output;

7. Digital output;

8. With integrated and enclosed waterproof ultrasonic transducer;

9. With temperature compensation;

10. Working Temperature: -15℃ to +60℃;

11. Storage Temperature: -25℃ to +80℃;

12. Measurement Accuracy: ±(1cm + S*0.3%) ,S is the measured value ;

13. Electrostatic protection design, the enclosure of sensor and the I/O PIN are added the electrostatic protection device, up to the standard of IEC61000-4-2;

三. Advantages:

1. With high degree of protection;

2. With strong anti-interference;

3. Data output, stable and reliable;

4. Lower power dissipation;

5. With strong anti - static ability;

6. High measurement accuracy；

7. Small size, easy installation;

8. With automatic output mode, release the user processor;

9. With controlled output mode, could minimize power consumption according to the actual application;

四. Applications:

1. Level distance measurement;

2. Liquid level measurement;

3. Parking management system;

4. Detect the objects close to and the existence of external objects;

5. Intelligent bin management system;

6. Robot obstacle avoidance、 automatic control;

7. Monitoring of water level in sewer and bottom hole;

五.Basic Parameters:

Items	(A01A serial)For plane distance measurement	(A01B serial)For human body measurement	(A01C serial)For rubbish measurement	Unit	Remarks
Working voltage	3.3-5.0	3.3-5.0	3.3-5.0	V	DC
Average working current	< 10	< 10	< 10	mA	(1)
Blind distance	≤28	≤28	≤28	cm	
The measuring range (without horn mouth)	28-450	28-450	28-450	cm	(2)
The measuring range (with horn mouth)	28-750	28-750	28-750	cm	(2)
Detection Angle (without horn mouth)	-	≈75	-	Degree	(3)
Detection Angle (with horn mouth)	≈40	≈65	-	Degree	(3)
Output modes	UART auto output UART controlled output PWM auto output PWM controlled output Digital Output	UART auto output UART controlled output PWM auto output PWM controlled output Digital Output	UART auto output PWM auto output	-	

Note:

1. Above measured typical data bases on the power supply is 5V and work cycle is 100ms, which is at room temperature;

2. At room temperature, the tested object is a 50cm*60cm plane carton, and the detection direction should be as vertical as possible to the tested object;

3. At room temperature, the tested object is φ7.5cm * 100cm white PVC pipe, which is with 100cm distance; Different measured distance there are also differences in measuring angles;

六. Wiring definition:
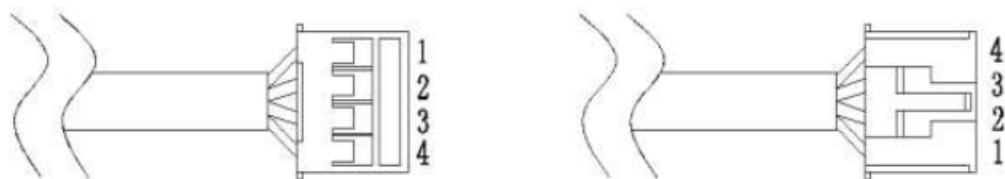
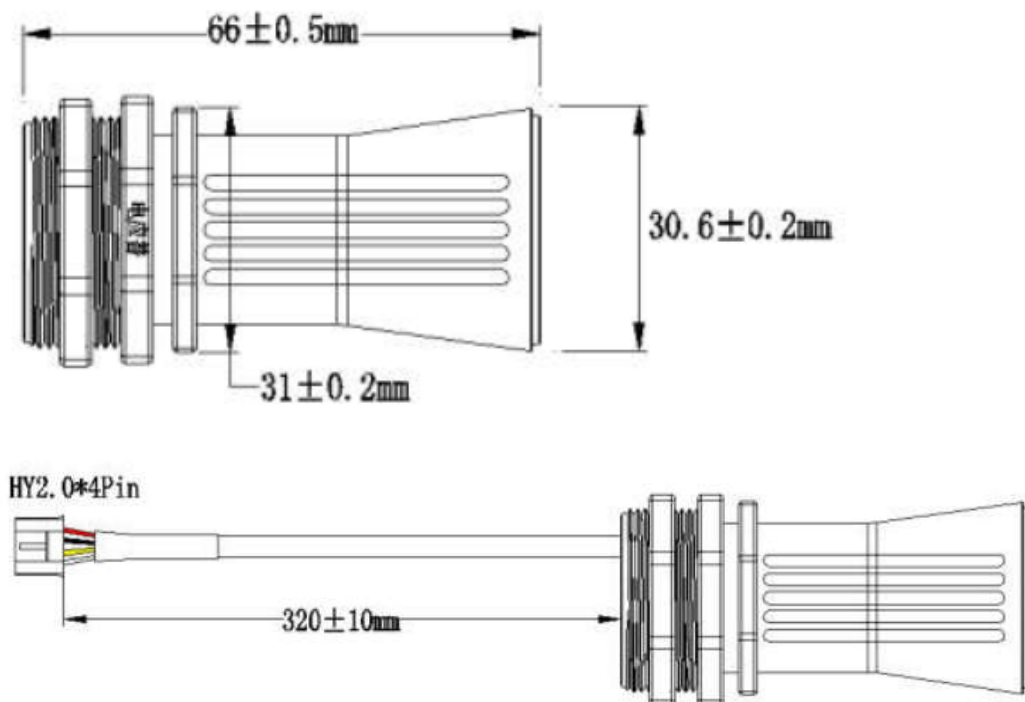| Wire number	Wire name	Wire description	Remarks
1	VCC	3.3-5V power supply access line	
2	GND	Power supply ground wire	
3	RX	Function wire	(1)
4	TX	Function wire	(1)

Remarks:

(1) The user shall choose the output mode as their practical use, the product cannot be compatible with two or more output modes at the same time.

七. Mechanical Features:

Without horn mouth:
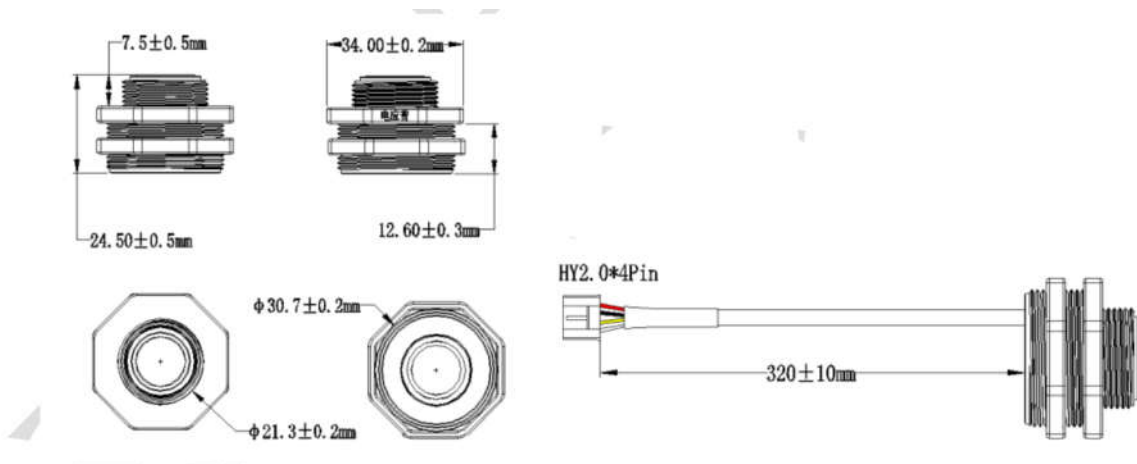
With horn mouth:

八. Module series description

According to different characteristics and advantages, modules are divided into three series

For A01A serial, mainly is for plane distance measurement;

For A01B serial, mainly is for human body measurement;

For A01C serial, mainly is for rubbish measurement;

1. The description of A01A:

For A01A serial, mainly is for plane distance measurement: it can be used for targeted measurement of planar objects with long distance and high precision; There are 5 output modes, they are UART auto output, UART controlled output, PWM auto output, PWM controlled output and digital output;

2. The description of A01B:

For A01B serial, mainly is for human body measurement: sensitive to human body detection, human target measurement more stable, the blind area to measure the stability of the object. It can measure the upper body stably within 200cm without horn mouth and 350cm with horn mouth; There are 5 output modes, they are UART auto output, UART controlled output, PWM auto output, PWM controlled output and digital output;

3. The description of A01C:

For A01C serial, mainly is for rubbish measurement: through the special algorithm intelligent filter bin borders and interference objects and accurately measure the overflowing state of garbage in the garbage box. There are 2 output modes, they are UART auto output and PWM auto output;

九. Output Format

1. Working parameters of output mode

Items	UART auto	UART controlled	PWM auto	PWM controlled	Digital output	Unit	Remarks
Standby current	-	≤10	-	≤10	-	uA	
Work cycle	100~500	Controlled	250~500	Controlled	100	ms	(1)
Output mode	UART serial port	UART serial port	PWM pulse width	PWM pulse width	TTL digital output	-	
Measurement accuracy of flat objects	± (1+S*0.3%)	± (1+S*0.3%)	± (1+S*0.3%)	± (1+S*0.3%)	± (1+S*0.3%)	cm	(2)
temperature compensation	compensation	compensation	compensation	compensation	compensation	-	

Remarks:

(1) Regarding A01A and A01B serials, the work cycle is 250ms for UART auto output and PWM auto output; And the work cycle is 500ms for UART auto output and PWM auto output regarding A01C serial.

(2) At room temperature, the tested object is a 50cm*60cm plane carton. S represents the measurement distance, and the detection direction should be as vertical as possible to the tested object

2. The instructions of UART auto output

(1) Output cable definition

No. of cables	Cable name	Cable description	Remarks
1	VCC	Power input cable 3.3V~5V	
2	GND	Power ground cable	
3	RX	Processing value and real time value output selection cable	(1) (2)
4	TX	UART output cable	(1)

Remarks:

(1) The function of the lead wire corresponds to the output mode of the product model and cannot coexist with the output mode of other products.

(2) For A01C serial module which "RX" cable is empty.

(2) Communication instructions of UART auto output

For UART auto output of A01A and A01B serials, when the lead wire "RX" is hung in air or input high level, sensor will output according to the processing value, which data is more stable and the response time is about 300-500ms; When the lead wire "RX" inputs low level, sensor will output according to the real-time value, and the response time is 100ms.

For UART auto output of A01C serial, when the lead wire "RX" is hung in air, which is intelligent algorithm processing value output, and the response time is 500ms.

UART	Data bits	Stop bit	Parity check	Baud rate
TTL level	8	1	None	9600bps

(3) Output Format of UART

Frame data	Instruction	Byte
Frame header	Fixed to 0xFF	1 byte
Data_H	High 8 bits of distance data	1 byte
Data_L	Low 8 bits of distance data	1 byte
SUM	Checksum of communication	1 byte

(4) Example of UART output

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

Note: the checksum retains the low 8 bits of accumulative value only;

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

$\quad$ = (0XFF + 0X07 + 0XA1) &0x00FF

$\quad$ = 0XA7

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

Convert to decimal is 1953;

Means the current measured distance value is 1953mm;

4. UART controlled output

(1) Output cable definition

| No. of cables	Cable name	Cable description	Remarks
1	VCC	Power input cable 3.3V~5V	
2	GND	Power ground cable	
3	RX	Trigger input cable	(1)
4	TX	UART output cable	(1)

Remarks:

(1)The function of the lead wire corresponds to the output mode of the product model and cannot coexist with the output mode of other products.

(2) Communication instructions of UART controlled output

When the cable "RX" receives a trigger pulse with falling edge or any serial port data, the module makes a measurement, the cable "TX" will output a measurement distance value when the measurement is finished every time. The output mode can control the measurement period and reduce the power consumption. The trigger period of the module must be greater than 70ms

UART	Data bits	Stop bit	Parity check	Baud rate
TTL level	8	1	None	9600bps

(3) Timing diagram of UART controlled output
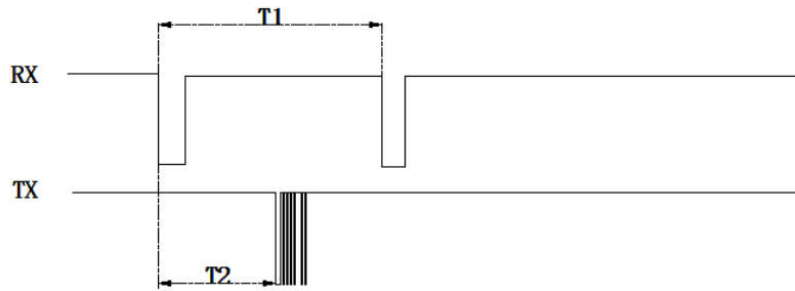
Note：T1 > 70ms, T2= 50~60ms;

(4) Output format of controlled UART

Frame data	Instruction	Byte
Frame header	Fixed to 0xFF	1 byte
Data_H	High 8 bits of distance data	1 byte
Data_L	Low 8 bits of distance data	1 byte
SUM	Checksum of communication	1 byte

(5) Example of controlled UART output

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

Note: the checksum retains the low 8 bits of accumulative value only;

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

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

= 0XA7

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

Convert to decimal is 1953;

Means the current measured distance value is 1953mm;

5.PWM auto output mode

(1) Output cable definition

No. of cables	Cable name	Cable description	Remarks
1	VCC	Power input cable 3.3V~5V	
2	GND	Power ground cable	
3	RX	Empty	(1)
4	TX	PWM output cable	(1)

Remarks: (1)The function of the lead wire corresponds to the output mode of the product model and cannot coexist with the output mode of other products.

(2) Working instructions of PWM auto output

For PWM auto output of A01A and A01B serials, ranging is performed once every 250ms, and the range value detected by the module is converted to PWM high level pulse width, which is output by the "TX" wire. If no object is detected, the "TX" lead outputs a fixed pulse width of about 45ms.

For PWM auto output of A01C serial, ranging is performed every 500ms. If no object is detected, the "TX" wire will output a fixed pulse width of about 15ms.

PWM pulse width has temperature compensation, ranging is more accurate in different temperature environment.

(1) Timing diagram of PWM auto output
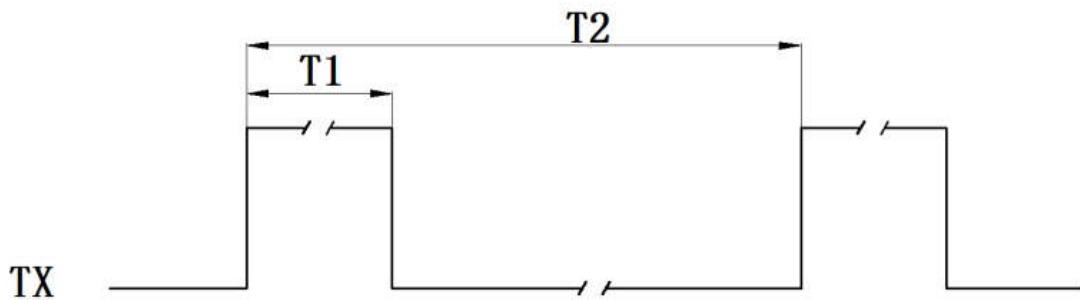
Note: For the PWM auto output of A01A and A02B serial: T1= 1.4~45ms; T2=250ms. For the PWM auto output of A01C: T1= 1.4~15ms; T2=500ms.

(2) Compute mode

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

The sound velocity V is 348M/S at room temperature, and the formula could be simplified to $S=T/57.5$ (now the unit of distance "S" is cm, unit of time "T" is us)

For example, when the output cable "TX", which time of PWM high level pulse width T3 is 10000us, and $S=T/57.5= 10000/57.5 \approx 173.9$(cm),means the current value of measured distance is 173.9cm.

6. PWM controlled output

(1) Output cable definition

| No. of cables	Cable name	Cable description	Remarks
1	VCC	Power input cable 3.3V~5V	
2	GND	Power ground cable	
3	RX	Trigger cable	(1)
4	TX	PWM output cable	(1)

Remarks: (1)The function of the lead wire corresponds to the output mode of the product model and cannot coexist with the output mode of other products.

(2) Working instructions of PWM auto output

The "RX" wire of the module receives a trigger pulse with falling edge or any serial port data, and the module will make a measurement once. The "TX" wire will output a TTL high level PWM pulse width signal, and the trigger period of the module must be greater than 70ms. If the module does not detect the object, the output wire "TX" will output a fixed pulse width of about 45ms.

(3) Timing diagram of PWM controlled output
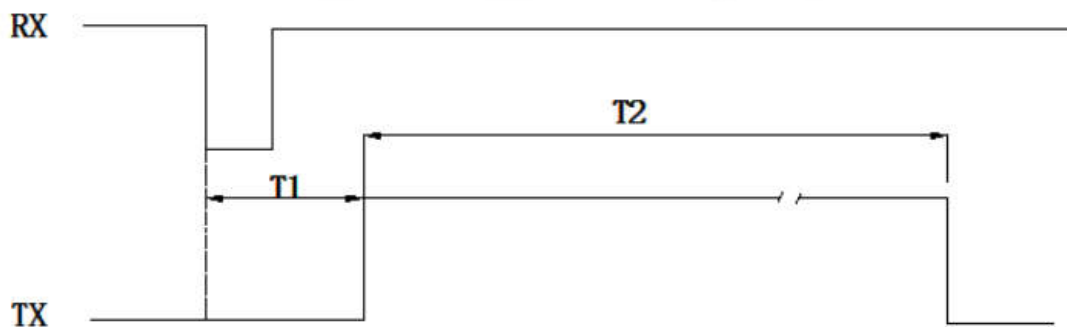
Note: T1= 1 ~ 8ms; T2= 1.4 ~ 45ms (the time of PWM high level pulse width);

(4) Compute mode

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

The sound velocity is 348m/s at room temperature, and the formula could be simplified to S=T/57.5 (now the unit of distance "S" is cm, unit of time "T" is us)

For example, when the output wire "TX", which time of PWM high level pulse width T3 is 10000us, and S=T/57.5= 10000/57.5≈ 173.9(cm),means the current value of measured distance is 173.9cm.

7. Digital output

(1) Output cable definition

No. of cables	Cable name	Cable description	Remarks
1	VCC	Power input cable 3.3V~5V	
2	GND	Power ground cable	
3	RX	Negative output wire of digital output	(1)
4	TX	Positive output wire of digital output	(1)

Remarks: (1)The function of the lead wire corresponds to the output mode of the product model and cannot coexist with the output mode of other products.

(2)The function instructions of digital output

The module factory will set a threshold value of 1.5m by default. The module conducts ranging every 100ms. When the detected target distance value is less

than the set threshold value, the "TX" wire outputs high level and the "RX" wire outputs low level. The current detected distance value is greater than the set threshold value, the "TX" wire outputs low level and the "RX" wire outputs high level. In order to improve the stability, the factory defaults to the threshold value set by the small residual of the detected target distance for 5 consecutive times to be the threshold value set by the small residual of the detected target distance. It is determined that the detected target distance is greater than the set threshold value for 10 times in a row. The lead of module "TX" and "RX" can only output high and low level signals without driving ability. If there are any special requirements to modify the threshold value or other settings, special instructions should be given at the time of purchase.

十. Limit Parameter

1. Rated Environmental Condition

Items	Min. Value	Typical Value	Max. Value	Unit	Remark
Storage Temperature	-25	25	80	℃	
Storage Humidity		65%	90%	RH	(1)
Working Temperature	-15	25	60	℃	
Working Humidity		65%	80%	RH	(1)

Notes:

A, When then environment temperature is in 0 to 39℃, the max. value of humidity is 90% (no condensation);

B, When the environment temperature is in 40℃ to 50℃, the max. value of humidity is the high humidity in the natural world under current temperature(no condensation);

2. Rated Electrical Condition

| Items | Specification | | | Unit | Remark |
	Min. Value	Typical Value	Max. Value		
Working Voltage	3.1	5.0	5.25	V	
Peak Current	50		75	mA	Peak to peak value
Input Ripple			50	mV	Peak to peak value
Input Noise			100	mV	Peak to peak value
ESD			±200K/±2K	V	(1)
ESD			±4K/±8K	V	(2)

Note:

4. For the electrostatic specifications of assemble lead, the contact electrostatic could not be more than ±200V, and the air electrostatic could not be more than ±2KV;

5. The shell of ultrasonic transducer and the lead wire meets the standard of IEC61000-4-2;
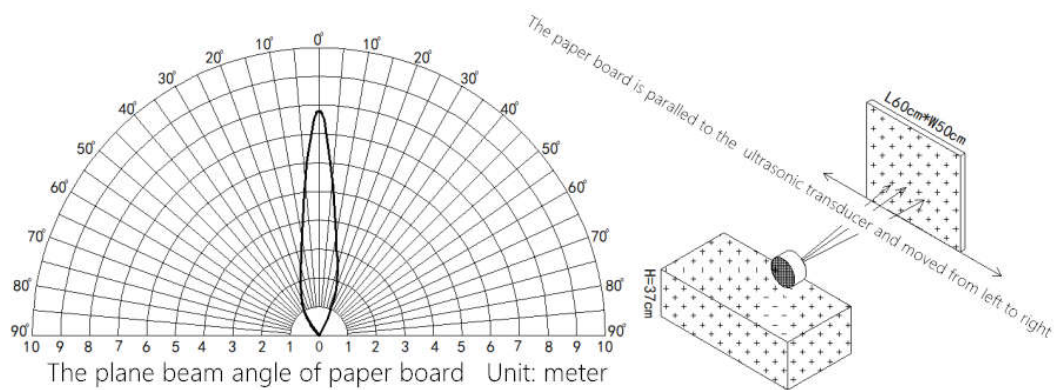
十一. The Effective Detection Range:

1. **The reference beam image of A01A serial:**

(1) The tested object is the white cylindrical tube, material is PVC, height is 100cm, diameter is 7.5cm:
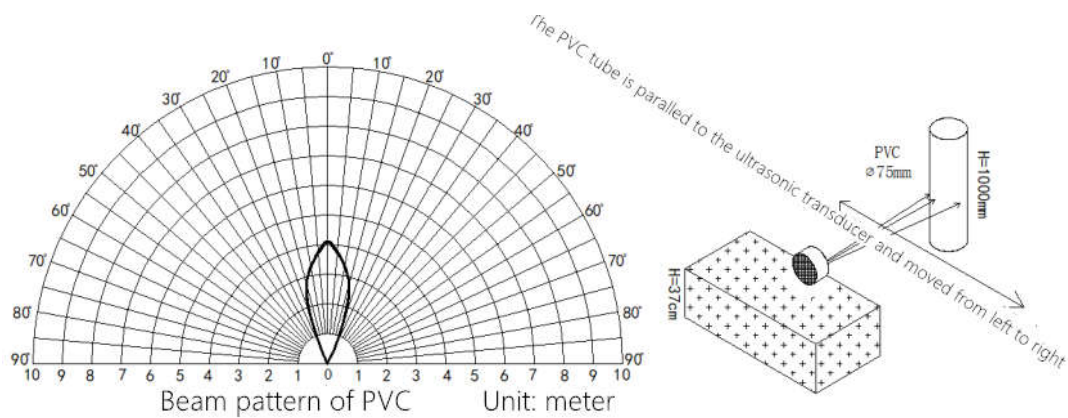
Beam pattern of PVC   Unit: meter

(2) The tested object is the corrugated case, perpendicular to 0° axle wire, length is 60cm, width is 50cm:

The plane beam angle of paper board   Unit: meter

2. **The reference beam image of A01B serial:**

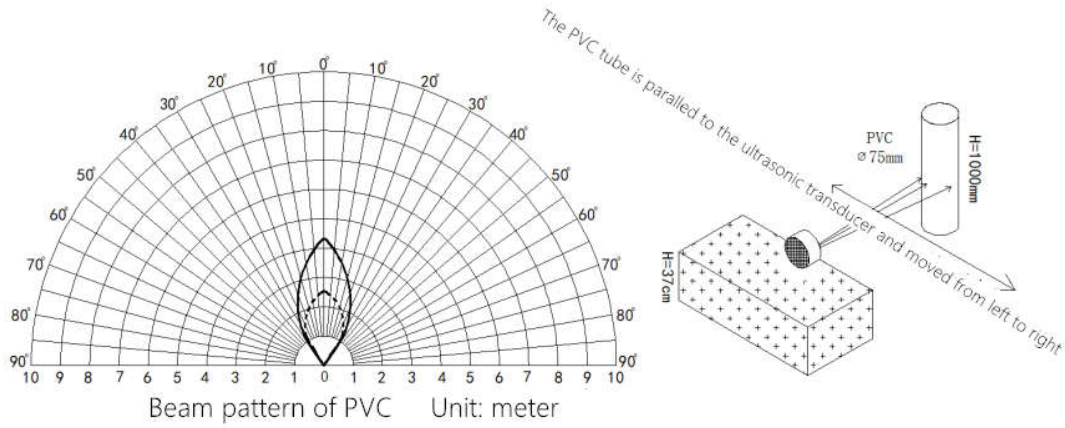(1) The tested object is the white cylindrical tube, material is PVC, height is 100cm, diameter is 75mm (The solid line is the data from the one with horn mouth, and the dotted line is the data from the one without horn mouth):

Beam pattern of PVC   Unit: meter

(2)The tested object is the corrugated case, perpendicular to 0° axle wire, length is 60cm, width is 50cm(The solid line is the data from the one with horn mouth, and the dotted line is the data from the one without horn mouth):

The plane beam angle of paper board   Unit: meter
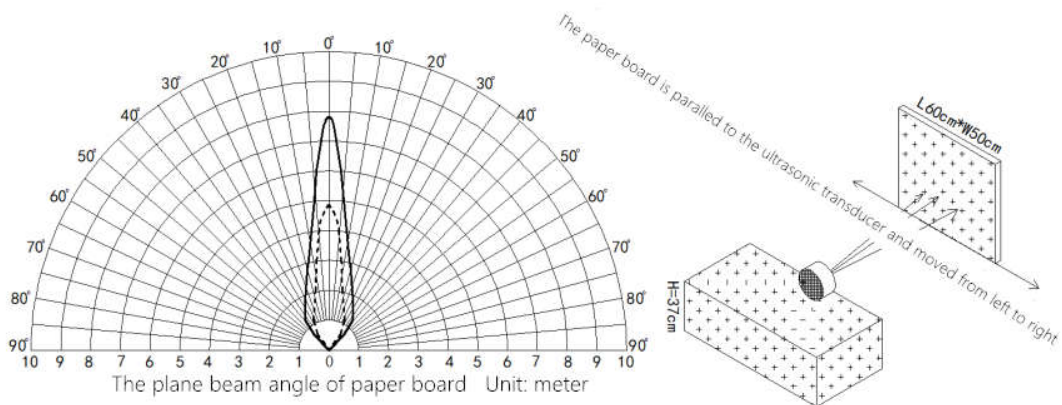
Note: Above testing data is from our company testing room, in practical application different installation and use environment, the final data will be some difference with ours, please refer to the actual application test.

十二. Instructions of model selection

This product can be divided into three series according to different application scenarios, and the output format is also divided into various. Users choose the corresponding model according to their actual application needs:

No.	Application	Features	Output mode	Item No.
A01A serial	For flat object measurement	1.Waterproof case + horn mouth; 2.The measuring range is 28cm to 750cm; 3.Distance measuring angle≈40°	UART auto output	DYP-A01ANYUB-V2.0
			UART controlled output	DYP-A01ANYTB-V2.0
			PWM auto output	DYP-A01ANYWB-V2.0
			PWM controlled output	DYP-A01ANYMB-V2.0
			Digital output	DYP-A01ANYGDB-V2.0
A01B serial	For human body measurement	1. Waterproof case； 2.The measuring range is 28cm to 450cm; 3.Distance measuring angle≈75°	UART auto output	DYP-A01BNYUW-V2.0
			UART controlled output	DYP-A01BNYTW-V2.0
			PWM auto output	DYP-A01BNYWW-V2.0
			PWM controlled output	DYP-A01BNYMW-V2.0
			Digital output	DYP-A01BNYGDW-V2.0
		1.Waterproof case+ horn mouth;； 2.The measuring range is 28cm to 750cm; 3. The upper body was measured stably within 350cm; 4.Distance measuring angle≈65°	UART auto output	DYP-A01BNYUB-V2.0
			UART controlled output	DYP-A01BNYTB-V2.0
			PWM auto output	DYP-A01BNYWB-V2.0
			PWM controlled output	DYP-A01BNYMB-V2.0
			Digital output	DYP-A01BNYGDB-V2.0
A01C serial	For rubbish measurement	1.Waterproof case+ horn mouth;； 2.The measuring range is 28cm to 250cm;	UART auto output	DYP-A01CNYUB-V2.0
			PWM auto output	DYP-A01CNYWB-V2.0

Note:

For the measuring range (flat object): at room temperature, the tested object is the corrugated case which is with 60cm(L) * 50cm (w).

For the distance measuring angle: at room temperature, which tested object is the white PVC tube withφ7.5cm*100cm and the sensor was placed on the 100cm;

十三. Reliability Test Condition:

Item	Test Items	Experiment Conditions	Sample Quantity	Remark
1	High temperature and humidity working	65℃,85%RH,power on@5V, 72hrs	3	
2	Low temperature working	-20℃, power on @5V, 72hrs	3	
3	High temperature and humidity storage	80℃,80% RH, storage, 72hrs	3	
4	Low temperature storage	-30℃, storage, 72hrs	3	
5	Vibration test	10-200Hz,15min.,2.0G,XYZ, three axial and each one is 0.5h	3	
6	Drop test	1.2m free fall, 5times@wooden floor	3	

Remark: After testing, the sensor passes the function test will be determined as ok, and the performance attenuation rate ≤10%.

十四、 Matters needing attention：

1) Pay attention to structural tolerances when designing, due to unreasonable structure design may cause transient abnormality of module function;

2) Pay attention to EMC evaluation when designing, due to unreasonable system design may cause transient abnormality of module function;

3) Involving the boundary application of product limit parameters, please contact with our FAE to confirm the matters needing attention;

4) We reserve the right to change this document, features updated without notice;

十五、 Package specification:

1) Default as our regular packing mode;

2) Packaging materials can be customized according to customer IQC standards;

3) Container transport way staggered LCL is required, at the same time, the outer edge of a single stack should be coated with reinforced corner plate to provide sufficient support;