Product introduction
Summary

DHR_1 module is a high-performance ranging module featuring Pro-Wave's 500ES430 electrostatic transducer at its core. DHR_1 can detect plane object between 100mm and 8000mm, and can detect the human body between 100mm and 3000mm. The module also offers precise temperature output (UART/RS485 output models) and temperature compensation function (except PWM live output model). It is a high-performance and high reliability commercial functional module specially developed for height measurement.

Device Characteristics

| Description	Value	Unit
Input voltage	5~12	V_{DC}
Average current[1]	<10	mA
Peak current	≤100	mA
Detection Range[2]	100~8000	mm
Detection accuracy[3]	Refer to note 3	mm
Cycling Time[4]	Refer to note 4	ms
ESD[5]	±4 / ±8	KV

Notes:
1. Measured with 12V input and 500ms cycle time. For RS485 model, typical current is less than 25mA.
2. Data measured by detection of a 50cm * 60cm plate at room temperature. For human body, the detection range will be 100~3000 mm.
3. H is the distance measurement. For PWM model, the accuracy is $\pm(8+H*0.2\%)$. All other models: $\pm(5+H*0.2\%)$
4. Cycle time is >75 for PWM and >160 for PWM with processed value output.
5. In accordance with IEC61000-4-2

Dimensions

Unit in mm.
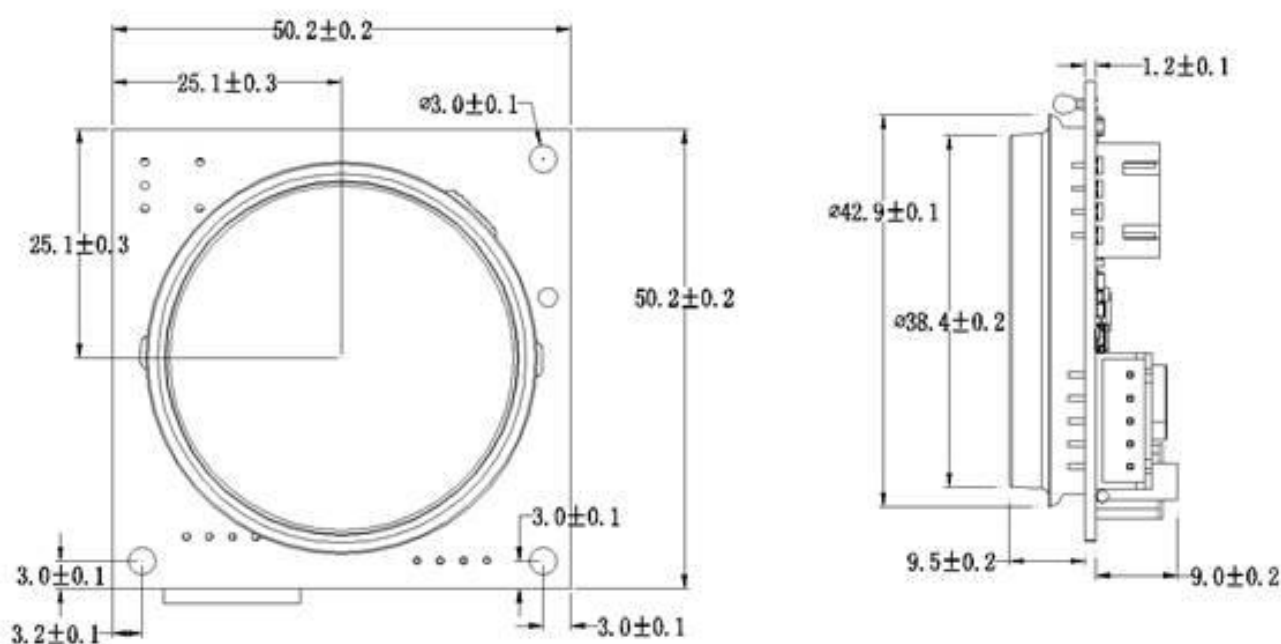
Pin definition
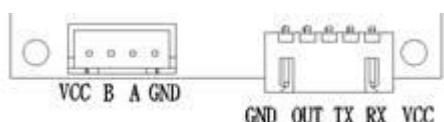
Name	Description
VCC	Power Input
RX	UART/PWM Input
TX	UART/PWM Output
OUT	Reserved
GND	Ground
A	RS485 data +
B	RS485 data -

Absolute Maximum Ratings
Environmental Condition Ratings

Description	Min	Max	Unit
Storage temperature	-20	65	℃
Storage humidity		90%	RH
Operation temperature	-10	50	℃
Operation humidity		80%	RH

Electrical Condition Ratings

Description	Max	Unit
Input voltage	12	V
Output current	100	mA
Input ripple	50	mV
Input noise	100	mV

Output format

Four output formats are supported: UART, RS485, PWM-Processed, and PWM-Live. Only one output format can be supported with each model. UART and RS485 support user input control and temperature reading. PWM-Live does not support temperature compensation.

UART / RS485

UART supports full duplex communication. RS485 supports half duplex communication with Pro-Wave protocol.

Frame format

Start bit	Data bits	Stop bit	Parity Check	Baud rate
1	8	1	None	9600

Operation Codes

Description	Op Code
Report real time distance value; unit: 1 mm	0x01
Report temperature; unit: 0.1℃	0x02
Update slave address	0x03
Report processed distance value; unit: 1 mm	0x05

Data Packet Structure

Frame Data	Description	Length
Header	0x55	1byte
Header	0xAA	1byte
Slave Address	0x01	1byte
Operation Codes	Control Command	1byte
Data_H	Upper byte of the data	1byte
Data_L	Lower byte of the data	1byte
Check Sum	Check Sum	1byte

Operation Example：Report temperature

	Header		Slave Addr	Op Code	Data		Checksum
Host	0x55	0XAA	0x01	0x02			0x02[1]
Slave	0x55	0XAA	0x01	0x02	0x01[2]	0x23	0x25

Notes:
1. Checksum = (Header + slave address + op code) & 0x00ff = (0x55+0xaa+0x01+0x02) &0x00ff =0x02
2. MSB in Data_H is used to denote positive or negative.
   Example (Data_H Data_L): 0x01 0x23 = + 29.1℃
   0x81 0x23 = - 29.1℃

Modify slave address from 0x01 (default) to 0x05

	Frame head		address	instructions	data		Checksum
Host	0x55	0XAA	05	0x03			0x07
Slave	0x55	0XAA	05	0x03			0x07

PWM

Two models are supported for PWM, processed output or live output. For processed output, DHR_1 samples the distance to the object five times, discards the first and last reading, and reports the average value of the readback values on TX. For live output, DHR_1 will simply report the value it reads.

Falling edge on "RX" will trigger a one-time operation from the module. A new trigger can be initiated after the cycle time of 160ms for processed output and 75ms for live output model. If no object is detected, output pulse width will be 65ms.

Timing diagram
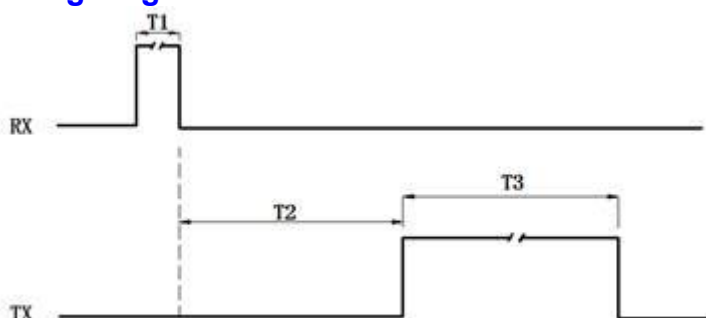
Note: For processed output: T1 = 0.1-5ms; T2 ≥ 75ms; T3 = 0.6-65ms
For live output: T1 = 0.1-10ms; T2 = 4.5-6.0ms; T3 = 0.55-65ms

Output Calculation Example

The pulse width on TX represents the time the DHR_1 took to detect an object. Distance to the object follows D = (v * t) / 2

D: Distance to the object

V: Velocity of sound speed. 343m/s or 0.343 mm/µs at room temperature.

T: Time the soundwave travel.

/2: Sound wave travels to the object and returns to the transducer; therefore, the distance needs to be divided by 2.

Assuming the width of the high pulse is 10,000µs, the equation is as follow.

D=(0.343mm/µs*10,000µs)/2 =1715mm

Model selection

Part Name	Feature
DHR_1U	UART
DHR_18	RS485
DHR_1V	PWM live output
DHR_1P	PWM process output

Reliability Tests

Test items	Test environment
High temp environmental test	60℃, 85%RH，5V$_{IN}$ for 72hrs
Low temp environmental test	-20℃, 5V$_{IN}$ for 72hrs
High temp storage	80℃, 80%RH for 72hrs
Low temp storage	-30℃ for 72hrs
Vibration test	10-200hz, 15min, 2.0g, on XYZ axes for 30 min
Drop test	1.2m free fall on wood surface, repeated 5 times.

Notes: 3 samples are tested for each test items with performance degradation less than 10%.

Revision History

Date	Version	Description
12/01/2019	1.0	Initial Pro-Wave release.

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