

## Product introduction

### Summary

Ultrasonic range detection module (DIC\_1) is designed to support one to four waterproof ultrasonic sensors and comes with 4 ready-to-use sensors. The module can also support different -range and angle needs with alternate sensors. Typical applications include parking management, obstacle avoidance and detection for UAV or robotics, etc.

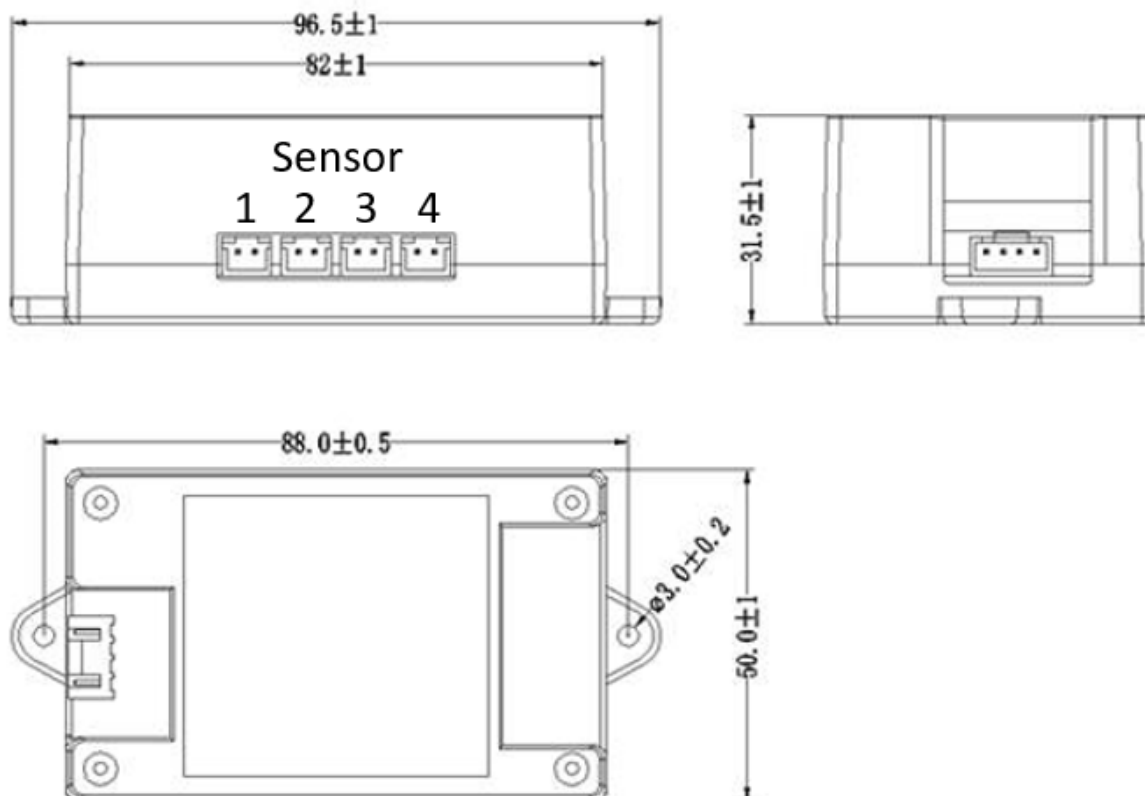
### Device Characteristics

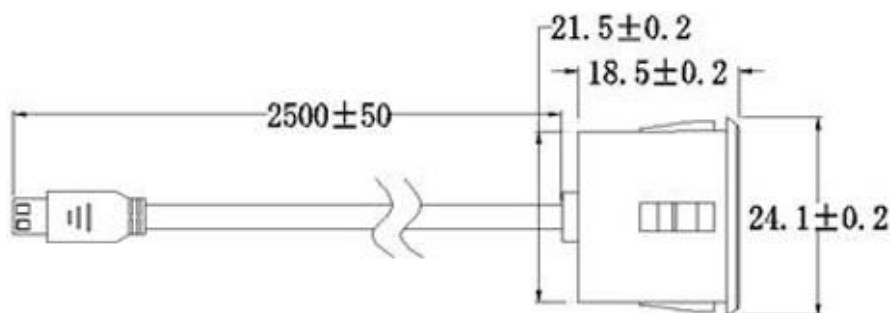
Description	Value	Unit
Input voltage	9~ 36	V <sub>DC</sub>
Average current <sup>1, 2</sup>	≤ 25, ≤ 35, ≤ 45	mA
Maximum current <sup>1</sup>	400	mA
Detection range <sup>3</sup>	25~ 450	cm
Cycling time	300	ms
Response time <sup>4</sup>	300~1500, 70~210, 1000	ms
Measurement accuracy <sup>5</sup>	(1+D*0.3%)	cm
Detection angle <sup>6</sup>	60	°
ESD <sup>7</sup>	±4 / ±8	KV

Notes:

1. Average current consumption based on 12V input, 300ms cycle time at room temperature.
2. Average current consumption is ≤ 25mA for UART, ≤ 35mA for RS485, and ≤ 45mA for relay output.
3. Based on detection of 50\*60cm plate at room temperature.
4. Response time is 300~1500ms for UART, 70~210ms for RS485, and 1000ms for relay.
5. Same test condition as note 3. In the value (1+D\*0.3%), D is the distance to the detected object.
6. Based on detection of Ø7.5\*1000cm cylindrical tube at room temperature.
7. In accordance with IEC61000-4-2

### Dimensions



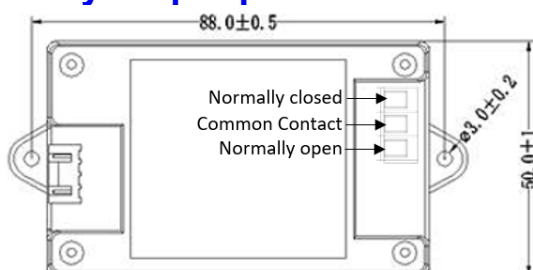


### Pin definition

Only one output mode is actively at a time. Refer to the model selection for the desired part name.

Pin name	Pin description
VCC	Module power positive input pin
TX/A	UART output or RS485 data +
RX/B	UART RSVD or RS485 data -
GND	Module power negative input pin

### Relay output pin definition



### Absolute Maximum Ratings

### Environmental Condition Ratings

Description	Min	Typical	Max	Unit
Storage temperature	-25	25	80	°C
Storage humidity		65%	90%	RH
working temperature	-15	25	60	°C
Working humidity		65%	80%	RH

Notes:

1. when the ambient temperature is 0-39 °C, the maximum humidity is 90% (no condensation)
2. when the ambient temperature is 40-50 °C, the highest humidity is the highest in nature under the current temperature (no condensation)

### Electrical Ratings

Parameter	Specifications			Unit
	Min	Typical	Max	
Input voltage	9	12	36	V
Input ripple			50	mV
Input noise			100	mV

## Output format

### UART

#### Frame Format

Data bits	Stop bit	Parity check	Baud rate
8	1	None	9600

#### UART Data Packet Structure

Frame data	Description	Length
Header	Fixed to 0xff	1byte
Data_1H	High 8 bits of distance data from sensor 1	1byte
Data_1L	Lower 8 bits of distance data from sensor 1	1byte
Data_2H	High 8 bits of distance data from sensor 2	1byte
Data_2L	Lower 8 bits of distance data from sensor 2	1byte
Data_3H	High 8 bits of distance data from sensor 3	1byte
Data_3L	Lower 8 bits of distance data from sensor 3	1byte
Data_4H	High 8 bits of distance data from sensor 4	1byte
Data_4L	Lower 8 bits of distance data from sensor 4	1byte
Checksum	Communication checksums	1byte

#### UART Output Example

0x FF 03 E8 07 D0 07 A1 0D EA 60

0xFF: Header

0x03 E8: Sensor 1 distance output. Distance is 1000mm.

0x07 D0: Sensor 2 distance output. Distance is 2000mm.

0x07 A1: Sensor 3 distance output. Distance is 1953mm.

0x0D EA: Sensor 4 distance output. Distance is 3562mm.

0x60: Checksum=(0xFF+0x03+0xE8+0x07+0xD0+0x07+0xA1+0x0D+0xEA) & 0x00FF=0x60

### RS485

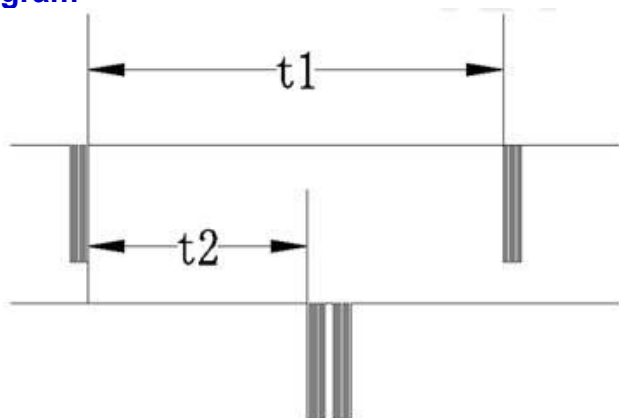
RS485 support features half duplex communication with Pro-Wave protocol.

#### Frame Format

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

### Pro-Wave protocol

#### Timing Diagram



Note: When the op code is 0x01, T1 ≥ 250ms; T2 = 200 ~ 210ms.

For op codes 0x10-0x13, T1 ≥ 90ms; T2 = 65-75ms.

### Opcode and Data Packet Structure

Description	Op code	Notes
Report measurement from all sensors	0x01	Cycle time $\geq$ 250ms
Report measurement from sensor 1	0x10	Cycle time $\geq$ 90ms
Report measurement from sensor 2	0x11	
Report measurement from sensor 3	0x12	
Report measurement from sensor 4	0x13	
Update salve address	0x03	
Broadcast address	0xFF	

Notes: For op code 0x01, cycle time must be  $\geq$  250ms. For op codes 0x10~0x13, cycle time must be  $\geq$  90ms. The module will ignore all instructions during operation.

Frame data	Description	Length
Header	Fixed to 0x55AA	2byte
Slave Address	The default address is 0x01	1byte
Control word	Control instruction signature	1byte
Data_1H	High 8 bits of distance data from sensor 1	1byte
Data_1L	Lower 8 bits of distance data from sensor 1	1byte
Data_2H	High 8 bits of distance data from sensor 2	1byte
Data_2L	Lower 8 bits of distance data from sensor 2	1byte
Data_3H	High 8 bits of distance data from sensor 3	1byte
Data_3L	Lower 8 bits of distance data from sensor 3	1byte
Data_4H	High 8 bits of distance data from sensor 4	1byte
Data_4L	Lower 8 bits of distance data from sensor 4	1byte
Checksum	Communication checksums	1byte

### Operation Example: Op Code 0x01 (Report Measurements From All Sensors)

	Header	Addr	Op Code	Data	Checksum
Master	0X55AA	0X01	0X01	NA	Checksum
Slave	0X55AA	0X01	0X01	Data	Checksum

Master sends: 0x55AA 0x01 0x01 0x01

0x55AA: Header

0x01: Address

0x01: Op code

0x01: Checksum  $= (0x55 + 0xAA + 0x01 + 0x01) \& 0x00FF = 0x01$ .

DIC\_1 returns: 0X55AA 0x01 0x01 0x03E8 0x07D0 0x07A1 0x0DEA 0x60

0x55AA: Header

0x01: Address

0x01: Op code

0x03E8: Sensor 1 reported measured distance of 1000mm

0x07D0: Sensor 2 reported measured distance of 2000mm

0x07A1: Sensor 3 reported measured distance of 1953mm

0x0DEA: Sensor 4 reported measured distance of 3562mm

0x:60: Checksum

### Operation Example: Op Code 0x10 (Report Measurements From Sensor 1)

Master sends: 0x55AA 0x01 0x10 0x10

0x55AA: Header

0x01: Address  
 0x10: Op code  
 0x01: Checksum = (0x55+0xAA+0x01+0x10) &0x00FF = 0x10

DIC\_1 returns: 0x55AA 0x01 0x10 0x07A1 0xB8  
 0x55AA: Header  
 0x01: Address  
 0x10: Op code  
 0x07A1: Sensor 1 reported measured distance of 1953mm  
 0x:60: Checksum= (0x55+0xAA+0x01+0x10+0x07+0xA1) &0x00FF=0xB8

### Operation Example: Op Code 0x03 (Update DIC\_1 Slave Address)

Master sends: 0x55AA 0x05 0x03 0x07  
 0x55AA: Header  
 0x05: Address to be changed to.  
 0x03: Op code  
 0x01: Checksum = (0x55+0xAA+0x05+0x03) &0x00FF = 0x07

DIC\_1 returns: 0x55AA 0x05 0x03 07

### Relay

If any of the probes detected object within the predefined range, the relay's normally closed port and common will be open; and normally open port and common will close. Default open and close time will hold for 1 second.

### Detection Range Setting Steps

Default detection range is set to be 100cm. Valid range is 25~450cm. To set the range, follow the steps below.

1. Place a flat plat at the desired distance from sensor 4.
2. Press and hold the button for 3 seconds until the module LED is constantly on. Flashing LED indicates that the setting has failed.

### Model Selection

There are three output formats of this series of ranging module. Users can choose the corresponding model according to the actual application.

Part Number	Output mode
DIC_1U	UART
DIC_18	RS485
DIC_1R	Relay

### Reliability Tests

Test items	Test environment
High temp environmental test	60°C , 85%RH , 5V <sub>IN</sub> for 72hrs
Low temp environmental test	-20°C , 5V <sub>IN</sub> for 72hrs
High temp storage	80°C , 80%RH for 72hrs
Low temp storage	-30°C 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.

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



### Revision History

Date	Version	Description
11/01/2019	1.0	Initial Pro-Wave release.



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