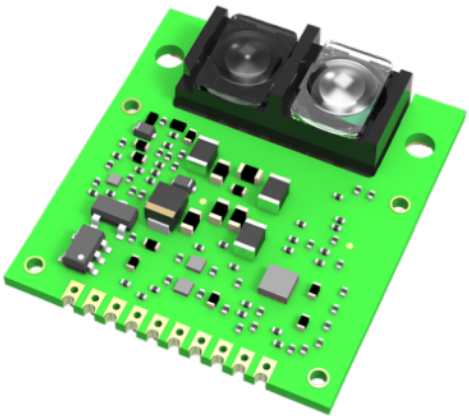
iPin–DRB222

MiniLidar — iTOF Laser Distance Measurement Module

Description



iPin-DRB222 MiniLidar is a miniaturized, long range, precise, easy to use, single point laser distance measurement / sensing module. It utilizes i-TOF laser light phase shift detection technology for obtaining the distance, which is featured in long distance accurate measurement.

Specially designed short focal length optics allows the sensor to have the thinnest structure as its kind. The module is good for integrated with mobile devices such as handheld computers, industrial tablet, etc. Visible red laser light is convenient for installing the sensor.

Features

1. Max range up to 20m
2. Max operable ambient light up to 3kLux
3. Sensor height 6mm only
4. Typical accuracy tolerance ±3mm
5. Class II laser eye safety rating

Applications

1. Distance measurement
2. Robotics
3. Automation and control
4. Security surveillance
5. Displacement sensing

Technical Specifications

1. Absolute Maximum Ratings

Description	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply voltage	VDD	–0.3	5	5.5	V	
Storage temperature range	T_{stor}	–25	—	60	°C	
Operating temperature range	T_{op}	–20	—	50	°C	a
Ambient light illumination	Ev	—	—	3000	Lux	

(a) Operating the product outside the max rated ambient temperature range may compromise its reliability.

2. Recommended Operating Conditions

Description	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply voltage	VDD	3.8	5	5.5	V	
UART signal level	V_s	—	3.3	—	V	
Storage temperature range	T_{stor}	–20	—	50	°C	
Operating temperature range	T_{op}	0	25	40	°C	
Ambient light illumination	Ev	—	—	500	Lux	
Target remission	Rm	18	90	—	%	

3. Electrical and Optical Characteristics (T_c = 25°C)

Description	Meas. Mode	Sym.	Min.	Typ.	Max.	Unit	Notes
Average power consumption (UART type)		P_{aw}	—	0.26	—	W	a
Average power consumption (USB type)			—	0.38	—	W	
Standby power consumption (UART type)		P_{sb}	—	0.20	—	W	b
Standby power consumption (USB type)			—	0.32	—	W	
Laser emission wavelength		λ	650	655	660	nm	
Laser beam FOV angle			—	0.12	0.15	deg	
Detector FOV angle			—	2.64	—	deg	
Measurement range	C0, D	d_{m0}	0.1	—	3	m	c
	C1	d_{m1}	0.1	—	10	m	
	A, B, C2	d_{m2}	0.1	—	20	m	
Distance resolution		d_{res}	—	1	—	mm	
Distance tolerance(d)	C0	Δd_{m0}	—	5	—	mm	
	C1	Δd_{m1}	—	5	—	mm	
	A, B, C2	Δd_{m2}	—	3	—	mm	
	D	Δd_{m4}	—	12	—	mm	
Measurement time	A, B, C2	t_m	—	1.5	—	sec	e
Measurement frequency	C0	f_{m0}	20	30	—	Hz	f
	C1	f_{m1}	—	8	—	Hz	
	D	f_{m4}	—	110	—	Hz	

(a) Under measurement mode C0.
(b) Laser is off in standby status.
(c) Under typical recommended operating conditions. dm0, dm1 and dm2 are preset by measurement mode commands.
(d) This is a 95% confidence level (2σ) tolerance at a distance less than 5m. For distance over 5m, an extra tolerance deterioration need to be added on the typical value, assuming under the stationary, recommended operating conditions.
(e) This is a typical time needed for a single shot measurement under the measurement mode A and B.
(f) The frequency of continuous measurements is defined under mode C0 in the typical recommended operating conditions and the target moving speed under 250cm/s.

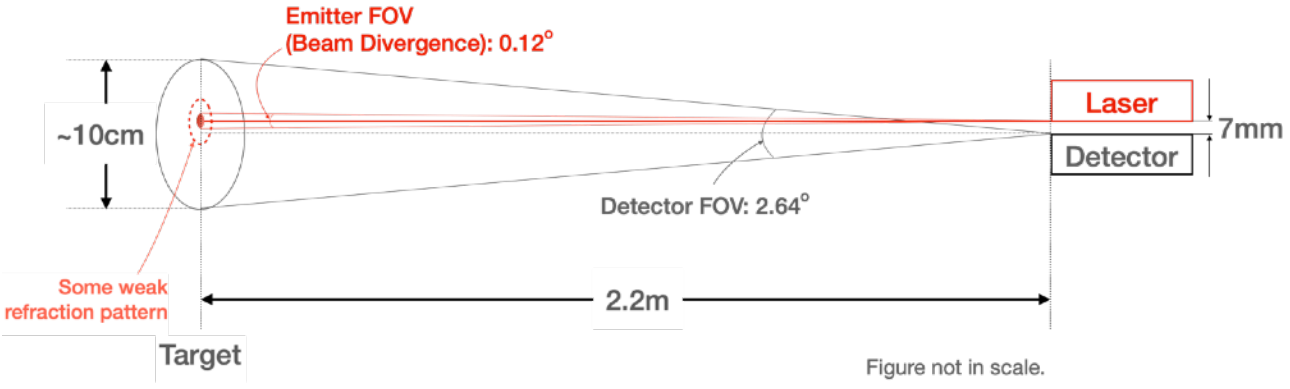
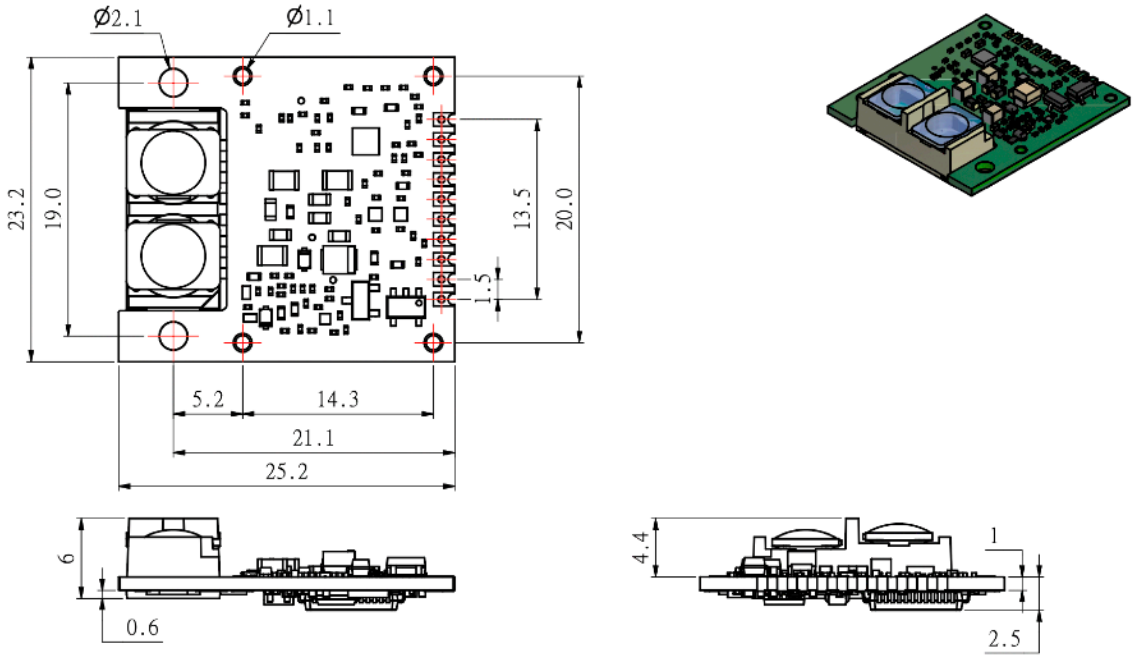


Figure not in scale.

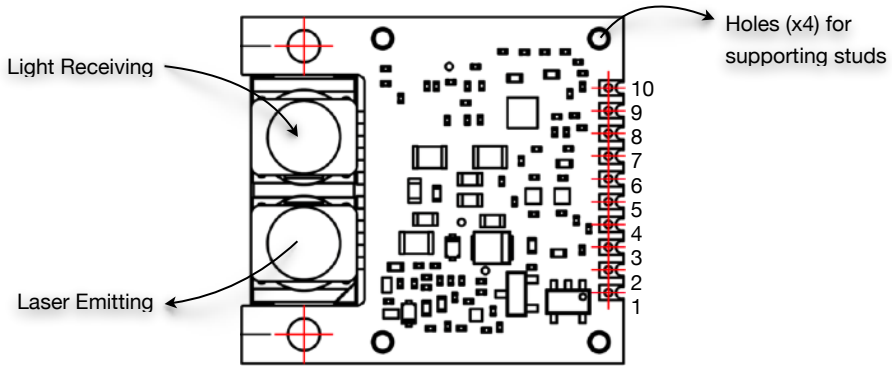
4. Mechanical Outline

4.1. Module Weight: 2.6 gram

4.2. Dimensions



4.3. Pinout Definitions



Pinout #	Symbol	Definitions
1	UART_RX	Module receives (data input)
2	UART_TX	Module Transmits (data output)
3	GND	Electric ground
4	VDD	Supply voltage
5	EN	Module power enable pin; Set to high (1V~5.3V) to turn on; Set to low (<0.35V) to turn off.
6~10	NC	Not connected

5. Serial Port Communication Protocols

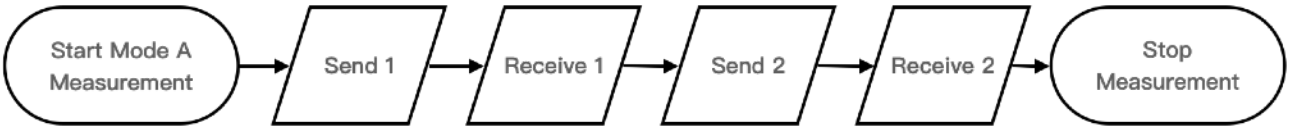
5.1. Data Communication Protocol

Default baud rate	115200
Data bit	8
Stop bit	1
Parity check	None

5.2. Command Sending (to module) and Data Receiving (from module) in the Normal Condition

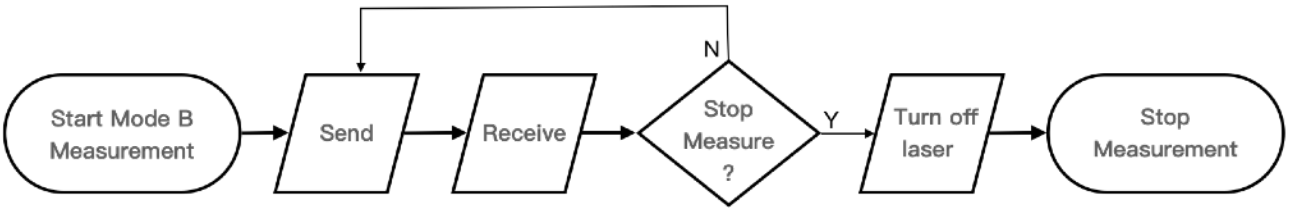
5.2.1. Measurement mode A (Single-shot, max range = d_{m2})

CMD Sequence	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Note
Send 1	0xCD	0x01	0x03	0x04					Turn on laser
Receive 1	0xFA	0x00	0x01	0x01					Acknowledgement packet
Send 2	0xCD	0x01	0x05	0x06					Start mode A measurement
Receive 2	0xFA	0x00	0x05	0xZZ	0xYY	0x00	0x00	Cksum	Data O/P
Note	Header	Data length from Byte 3~ Cksum		Measurement result = 0x0000YYZZ (mm) (little–endian)				Sum of Byte1~6	**Auto Laser Off**



5.2.2. Measurement mode B (Retained, max range = d_{m2})

CMD Sequence	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Note
Send	0xCD	0x01	0x06	0x07					Start mode B measurement
Receive	0xFA	0x00	0x05	0xZZ	0xYY	0x00	0x00	Cksum	Data O/P
Note	Header	Data length from Byte 3~ Cksum		Measurement result = 0x0000YYZZ (mm) (little–endian)				Sum of Byte1~6	



5.2.3. Measurement mode type C0~C2[a] (Synchronized)

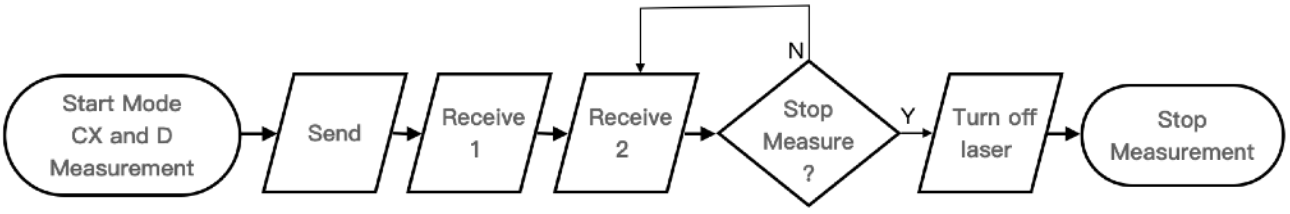
CMD Seq.	Byte # 0	1	2[a]	3	4	5	6	7	8	9	10	11	12	13	14	15
Send	0xCD	0x04	0xXX[a]	T_S: (big–endian) Epoch time on sending command In milliseconds represented as uint64								Cksum 1~10	Start mode CX measurement			
Receive 1	0xFA	0x00	0x01	0x01	(Acknowledgement Packet, appears only once, followed by Receive 2)											
Receive 2	0xFA	0x00	0x0D	0xZZ	0xYY	0x00	0x00									Cksum
Note	Header	Data length from Byte 3~ Cksum		(little-endian) Normal meas. result = 0x0000YYZZ (mm) Failed meas. result = 0x7FFFFFFF				T_R: (little–endian) Epoch time on receiving the distance result. In milliseconds. Represented as uint64								Byte 1~14

Byte 2 in "Send" command:

Measurement mode	Byte 2	Measurement Range	Measurement Frequency
C0	0x00	d_{m0}	f_{m0}
C1	0x01	d_{m1}	f_{m1}
C2	0x02	d_{m2}	f_{m2}

5.2.4. Measurement mode D (Burst, max range = d_{m0})

CMD Sequence	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Note
Send	0xCD	0x01	0x0A	0x0B	Start mode D measurement				
Receive 1	0xFA	0x00	0x01	0x01	(Acknowledgement Packet, appears only once, followed by Receive 2)				
Receive 2	0xFA	0x00	0x05	0xZZ	0xYY	0x00	0x00	Cksum	Data O/P
Note	Header	Data length from Byte 3~ Cksum		Measurement result = 0x0000YYZZ (mm) (little–endian)				Sum of Byte1~6	



5.2.5. Turn off laser

	Byte 0	Byte 1	Byte 2	Byte 3
Send	0xCD	0x01	**0x04**	0x05
Receive	0xFA	0x00	0x01	0x01

5.2.6. Request firmware version

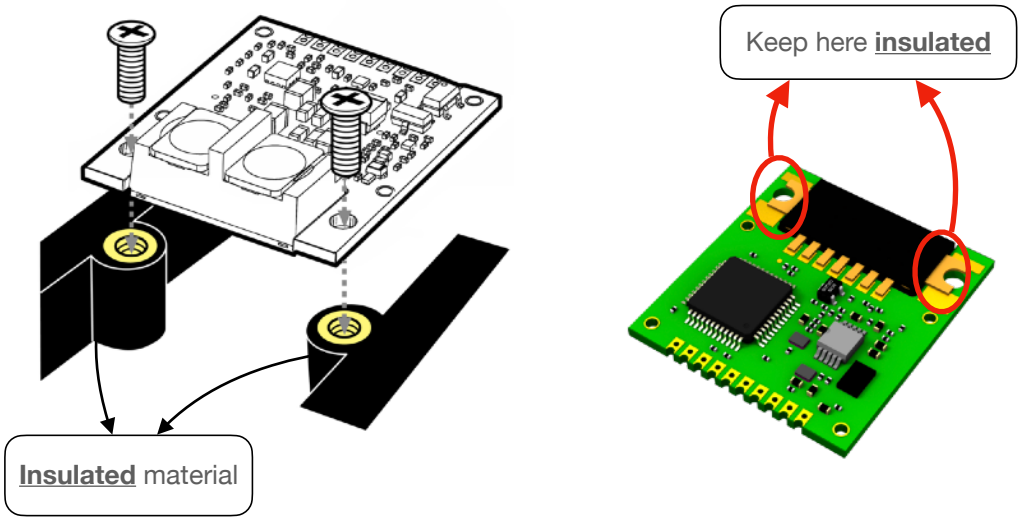
	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
Send	0xCD	0x01	**0x02**	0x03						
Receive	0xFA	0x00	0x07	0xPP	0xQQ	0xRR	0xXX	0xYY	0xZZ	Cksum
Note	Header	Data length from Byte 3~ Cksum		Firmware Version= 0xPPQQRRXXYYZZ						Sum of Byte1~8

5.3. Error codes received from the sensor in abnormal conditions

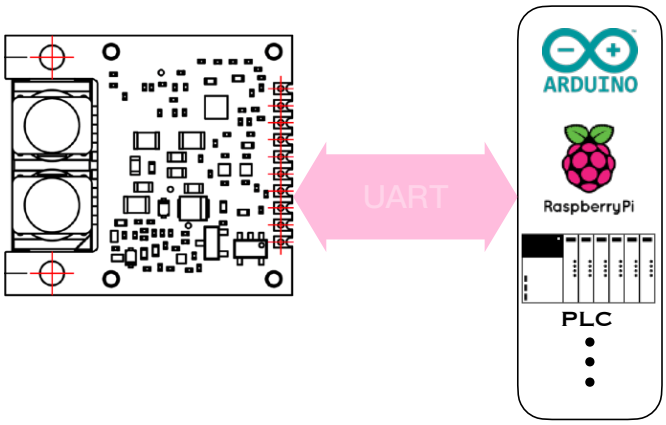
Format	Byte 0	Byte 1	Definitions
Explanation	**0x0E** Header	0x81	Checksum error
		0x82	Command not found
		0x83	The measured distance is out of max range.
		0x84	The parameters following command is out of permitted range
		0x85	Laser not turned on before measurement.
		0x89	Low SNR
		0x8B	Wrong command header, or header with wrong address

Install the Module

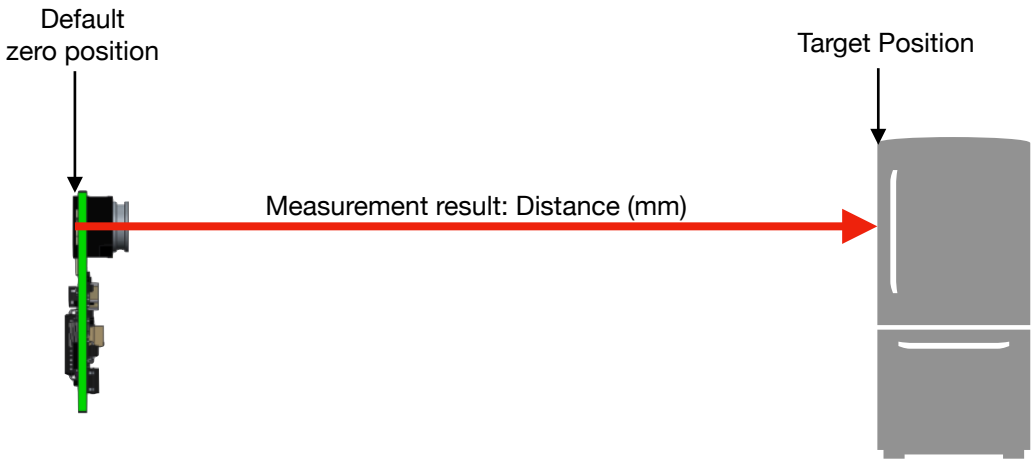
1. Fix the module to an **electrically insulated** base. Refer to the figures below.



2. Connecting the interface wires of UART ports between the module and the master.



3. Definition of zero position and distance:



4. Mobile computer integration design guide

4.1. Place the laser measure module as close to the camera lens as possible; this is helpful to maintain the laser spot in the center area of the picture, even when the target is close to the phone.

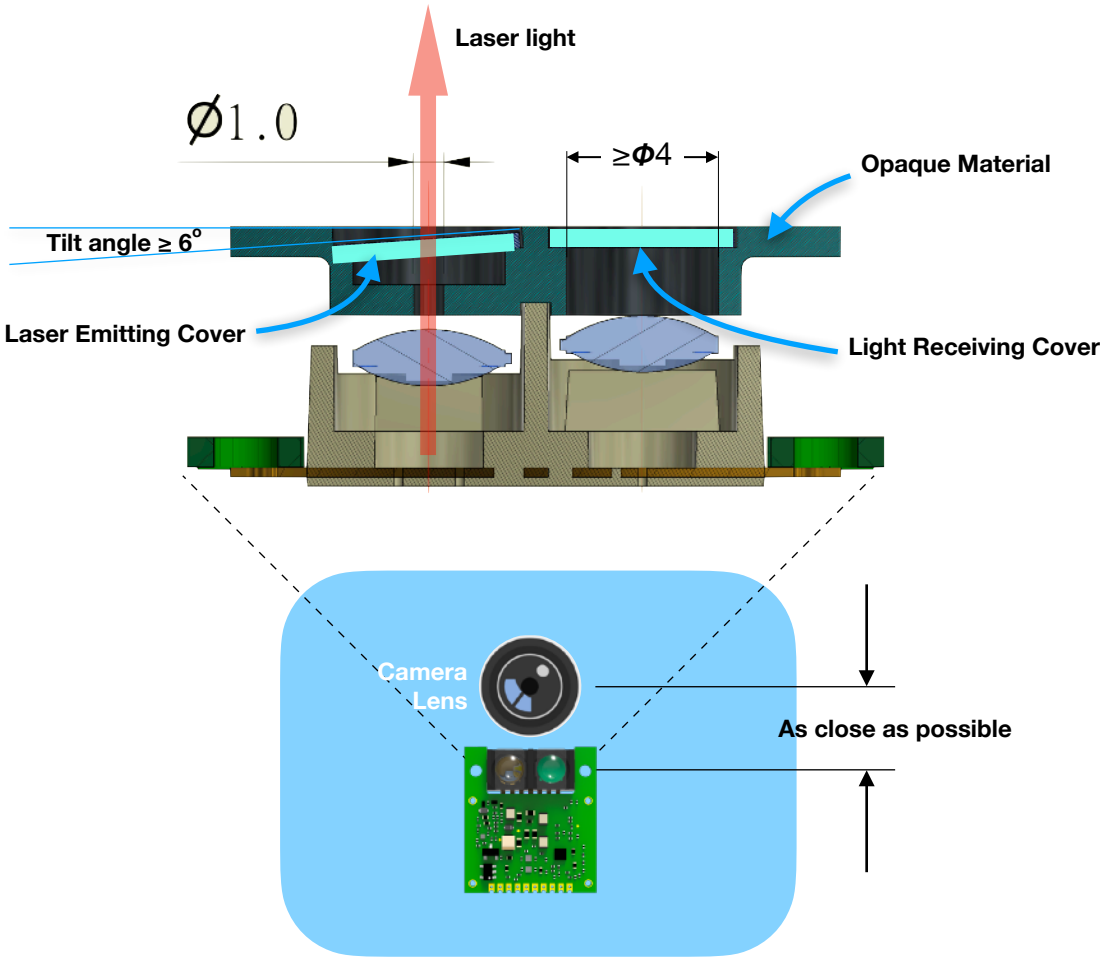
4.2. Select high transmittance (T > 96% preferred) and hard-coated covers for both emitting and receiving sides, in case the dust/water-proof protection needed.

4.3. Place the emitting side cover in a tilt angle ≥ 6° to preventing dual laser spots due to multiple reflections.

4.4. A 1.0 mm diameter of the laser emitting aperture is recommended to have a better circular laser spot.

4.5. A minimum 4.0mm diameter of the light receiving aperture is required otherwise the measurement performance maybe compromised.

4.6. Emitting cover and receiving cover should be separated by opaque material to avoid the laser light leakage to the receiver side.



Precautions

1. Do not stare directly into the laser beam by human eye since it may cause eye damage.
2. The transparent cover on laser measure is an optical element. Do not contaminate the optical cover by soil, oil or chemicals.
3. Avoid any mechanical impact to prevent from malfunction or measurement deviations.

Revision History

No.	Date	Changes	Page	FW ver.
1		Original ver. 1.0.0		FW-v2.9d
2		Update to ver. 1.1.0 1. Define power consumptions instead of current consumptions. 2. Pinout Definitions: #5 Power Enable Pins 3. Correct the mode A, B and C0~2 receiving byte 3~6 format as “little-endian”. 4. Combine commands “5.2.6~8” 5. Remove commands “5.2.9 and 5.2.10”. 6. Add “Install the module/ 3. Mobile computer integration design guide/ 3.5 A minimum 4.0mm diameter of the light receiving aperture is required otherwise the measurement performance maybe compromised.	2 3 5 6 7 8	FW-v2.9d
3	Mar. 23, 2023	Updated to ver. 1.7.0 1. Renew the figure of module (Add the black aperture on the emitting side lens. 2. Define Measurement Mode D and its performance spec.	1 3, 7	
4	May 08, 2023	Updated to ver. 1.7.2 1. Add the laser optical power. 2. Modify typical f_{m4} to 110Hz 3. Modify 4. Outline Drawing to 4. Mechanical Outline, and add 4.1 Weight of the module.	3 3 4	
5	May 25, 2023	Update to ver. 1.7.3 1. Change the Measurement Range minimum to 0.1m 2. Add the typical Measurement Freq. f_{m1} to be 8 Hz 3. Change the typical Measurement Freq. f_{m4} to be 110Hz	3 3 3	
6	Jul. 17, 2023	Update to ver. 1.7.4 1. Add typical Laser/Detector FOV angle 2. Add figure for FOV explanation 3. Move “Turn on Laser” command to mode A exclusively. 4. Add flow chart for measurement commands.	3 3 7 7	

* Wiseome reserves the right to make the document change without prior notice.