Lidar Material Level Detection Sensor

R718PE02D
User Manual

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1. Introduction

R718PE02D is a wireless communication device for Netvox Class C device based on LoRaWAN open protocol. It is a wireless communication device for the material level detection industry that uses LiDAR radar for single-point ranging. Based on the ToF (Time of Flight) schematic, the R718PE02D provides stable, accurate, and reliable ranging performance by optimizing the optical system and built-in algorithms. It is not easily affected by the surface state of the detected object, and the ranging performance can reach up to 25m. The product is equipped with a unique dust-removal wiper structure. The radar-driven dust-removal wiper can complete the dust removal operation of the optical mirror, so it can maintain the accuracy of distance measurement in an environment with severe dust pollution and dust accumulation. The R718PE02D body and the LiDAR sensor communicate through the UART serial communication and transmit the detected data to other devices for display through the wireless network. It adopts a wireless communication method that conforms to the LoRaTM protocol standard.

LoRa Wireless Technology:

LoRa is a wireless communication technology dedicated to long distance and low power consumption. Compared with other communication methods, LoRa spread spectrum modulation method greatly increases to expand the communication distance. Widely used in long-distance, low-data wireless communications. For example, automatic meter reading, building automation equipment, wireless security systems, and industrial monitoring. The main features include small size, low power consumption, transmission distance, anti-interference ability, and so on.

LoRaWAN:

LoRaWAN uses LoRa technology to define end-to-end standard specifications to ensure interoperability between devices and gateways from different manufacturers.

2. Appearance

3. Features

- SX1276 wireless communication module
- Powered by 5V DC
- IP30 rating
- Lidar material level detection with dust removal wiper
- Compatible with LoRaWAN™ Class C device
- Frequency hopping spread spectrum technology
- Configuration parameters can be configured through third-party software platforms, data can be read and alarms can be set via SMS text and email (optional)
- Available third-party platforms: Actility/ThingPark, TTN, MyDevices/Cayenne

4. Set up Instruction

4.1 On/Off

Power on	5V DC power supply
Turn on	Connect the power supply
Turn off	Disconnect the power supply
Restart	Press the function key for 5 seconds until the green indicator flashes once. Release the function key and the indicator will flash 10 times.
Back to factory setting	Press the function key for 10 seconds until the green indicator flashes 20 times
Note	1. When user disconnects the power supply; the device should be off by default. 2. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components. 3. 10 seconds after power on, the device will be in engineering test mode.

4.2 Network Joining

Never joined the network	Turn on the device to search the network to join. The green indicator remains on for 5 seconds: Success The green indicator remains off: Fail
Had joined the network (without factory resetting)	Turn on the device to search the previous network to join. The green indicator remains on for 5 seconds: Success The green indicator remains off: Fail
Fail to join the Network	Check the device verification information on the gateway or consult your platform server provider.

4.3 Function Key

Press and hold for 5 seconds	Restart The green indicator flashes 10 times: Success The green indicator remains off: Fail
Press and hold for 10 seconds	Factory resetting and restart The green indicator flashes 20 times: Success The green indicator remains off: Fail
Press once	The device is in the network: green indicator flashes once and sends a report The device is not in the network: green indicator remains off

4.4 Sleeping Mode

The device is on and in the network	Sleeping period: Min Interval When the report change exceeds setting value or the state changes, the device would send a data report according to Min Interval.
The device is on but not in the network	Disconnect the power supply when the device is not in use. Check the device verification information on the gateway

5 Data Report

After power on, the device will immediately send a version packet report and an attribute packet report.

The device sends data according to the default configuration before any other configuration.

Default:

Max Interval = 0x0384 (900s)

Min Interval = 0x0384 (900s) (detect the material level and voltage at every Min Interval)

reportchange: batteryvoltagechange ---- 0x01 (0.1V)

distancechange ---- 0x012C (300mm)

The interval of the data reports might vary due to the firmware.

R718PE02D default Max Interval = 15min and Min Interval = 15min. (The intervals could be set based on customers' demands.)

R718PE02D reports the distance between sensor and material, the percentage of the material level, and the ranging range.

Note: 1. The dust removal wiper will automatically wipe once when the device report cycle is reached or when the button is pressed.

2. The blind zone distance of the sensor is ≤ 0.1m.

Please refer to the Netvox LoRaWAN Application Command and http://www.netvox.com.cn:8888/cmddoc for devices' data analysis.

Tips

1. **Battery Voltage:**

   If the battery is equal to 0x00, it means that the device is powered by a DC power supply.

2. **Version Packet:**

   When Report Type=0x00 is the version packet, such as 01D5000A00201705030000, the firmware version is 2017.05.03.

3. **Data Packet:**

   When Report Type=0x01 is data packet; If the device data exceeds 11 bytes or there are shared data packets, the Report Type will have different values.

5.1 Example of ReportDataCmd

FPort: 0x06

Bytes	1	1	1	Var(Fix=8 Bytes)
	Version	DeviceType	ReportType	NetvoxPayLoadData

Version– 1 Byte –0x01——the Version of NetvoxLoRaWAN Application Command Version

DeviceType– 1 Byte – DeviceType of Device

The DeviceType is listed in Netvox LoRaWAN Application DeviceType doc

ReportType – 1 Byte –the presentation of the NetvoxPayLoadData, according the DeviceType

NetvoxPayLoadData– Var (Fixed =8bytes)

Device	Devive Type	Report Type	NetvoxPayloadData					
R718PE02D	0xD5	0x00	SoftwareVersion(1 Byte) Eg.0x0A-V1.0	HardwareVersion (1 Byte)	DateCode(4 Byte) eg 0x20170503	Reserved (2 Byte)		
		0x01	Battery (1Byte, unit:0.1V)	Status (1Byte,0x01_On 0x00_Off)	Distance (2Bytes, Unit:1mm)	FillLevel (1Byte,Unit:1%)	SensorStrength (2Bytes)	CapBattery (1Byte, unit:0.1V) Only the battery version is supported)
		0x02	Battery (1Byte, unit:0.1V)	ThresholdAlarm(1Byte, Bit0_Low Distance Alarm, Bit1_High Distance Alarm, Bit2_ Low FillLevel Alarm, Bit3_ High FillLevel Alarm, Bit4-7:Reserved)		Reserved(6Bytes,fixed 0x00)		

Example of Uplink1: 01D50100000C1226105700 (FillMaxDistance: 2000mm, DeadZoneDistance: 0mm)

1st byte (01): Version

2nd byte (D5): DeviceType 0xD5 — R718PE02D

3rd byte (01): ReportType

4th byte (00): DC power supply

5th byte (00): Status — OFF

6th-7th byte (0C12): Distance – 3090mm 0C12(Hex) = 3090(Dec), 3090*1mm = 3090mm

8th byte (26): FillLevel – 38% 26(Hex) = 38 (Dec), 38*1% = 38%

9th – 10th byte (1057): SensorStrength – 1057(Hex) = 4183 (Dec)

11th byte (00): Reserved

Example of uplink2: 01D5020001000000000000

1st byte (01): Version

2nd byte (D5): DeviceType 0xD5 — R718PE02D

3rd byte (02): ReportType

4th byte (00): DC power supply

5th byte (01): ThresholdAlarm 3090mm < 4000mm (LowThreshold) //0x01 = 0000 0001 (bin)

Bit 0 = 1

6th-11th byte (000000000000): Reserved

5.2 Example of ConfigureCmd

Fport: 0x07

Bytes	1	1	Var (Fix =9 Bytes)
	CmdID	DeviceType	NetvoxPayLoadData

CmdID– 1 byte

DeviceType– 1 byte – Device Type of Device

NetvoxPayLoadData– Var bytes (Max=9bytes)

Description	Device	CmdID	Device Type	NetvoxPayLoadData				
ConfigReportReq	R718PE02D	0x01	0xD5	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2Bytes, Fixed0x00)
ConfigReportRsp		0x81		Status(0x00_success)			Reserved (8Bytes,Fixed 0x00)	
ReadConfigReportReq		0x02		Reserved (9Bytes,Fixed 0x00)				

ReadConfigReportRsp		0x82		MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2Bytes,Fixed0x00)
SetOnDistanceThresholdRreq		0x03		OnDistanceThreshold(2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetOnDistanceThresholdRrsp		0x83		Status(0x00_success)			Reserved (8Bytes,Fixed 0x00)	
GetOnDistanceThresholdRreq		0x04		Reserved (9Bytes,Fixed 0x00)				
GetOnDistanceThresholdRrsp		0x84		OnDistanceThreshold(2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetFillMaxDistanceReq		0x05		FillMaxDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetFillMaxDistanceRsp		0x85		Status(0x00_success)			Reserved (8Bytes,Fixed 0x00)	
GetFillMaxDistanceReq		0x06		Reserved (9Bytes,Fixed 0x00)				
GetFillMaxDistanceRsp		0x86		FillMaxDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetDeadZoneDistanceReq(REMAIN Lastconfig when resetfac)		0x0B		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetDeadZoneDistanceRsp(REMAIN Lastconfig when resetfac)		0x8B		Status(0x00_success)				
GetDeadZoneDistanceReq		0x0C		Reserved (9Bytes,Fixed 0x00)				
GetDeadZoneDistanceRsp		0x8C		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	

(1) Configure R718PE02D report parameters:

MinTime = 1h (3600s, 0x0E10), MaxTime = 1h (3600s, 0x0E10), BatteryChange = 0v (0x00), DistanceChange = 500mm (0x01F4)

Downlink: 01D50E100E100001F40000

Response:

81D5000000000000000000 (configuration success)

81D5010000000000000000 (configuration failure)

(2) Read Configuration:

Downlink: 02D5000000000000000000

Response:

82D50E100E100001F40000 (device current parameter)

(3) Configure R718PE02D report parameter:

FillMaxDistance = 5000mm (0x1388)

Downlink: 05D5138800000000000000

Response:

85D5000000000000000000

(4) Read device parameter:

FillMaxDistance = 5000mm (0x1388)

Downlink: 06D5000000000000000000

Response:

86D5138800000000000000

(5) SetDeadZoneDistance：　　//When restoring factory settings, the last set value will be retained.

Downlink: 0BD5006400000000000000　　// Set the device detection dead zone distance to 100mm (0x64).

Response:

8BD5000000000000000000

(6) GetDeadZoneDistance：

Downlink: 0CD5000000000000000000

Response:

8CD5006400000000000000　　// Get the device detection dead zone distance of 100mm (0x64).

5.3 Example of General Calibration Configuration

FPort: 0x0E

<table>
<tr><td>Description</td><td>Cmd ID</td><td>SensorType</td><td colspan="5">PayLoad(Fix =9 Bytes)</td></tr>
<tr><td>SetGlobalCalibrateReq</td><td>0x01</td><td rowspan="5">See below</td><td>Channel (1Byte) 0_Channel1 1_Channel2,etc</td><td>Multiplier (2bytes, Unsigned)</td><td>Divisor (2bytes, Unsigned)</td><td>DeltValue (2bytes, Signed)</td><td>Reserved (2Bytes, Fixed 0x00)</td></tr>
<tr><td>SetGlobalCalibrateRsp</td><td>0x81</td><td colspan="2">Channel (1Byte) 0_Channel1 1_Channel2,etc</td><td colspan="2">Status(1Byte,0x00_success)</td><td>Reserved (7Bytes, Fixed 0x00)</td></tr>
<tr><td>GetGlobalCalibrateReq</td><td>0x02</td><td colspan="4">Channel (1Byte) 0_Channel1 1_Channel2,etc</td><td>Reserved (8Bytes, Fixed 0x00)</td></tr>
<tr><td>GetGlobalCalibrateRsp</td><td>0x82</td><td>Channel (1Byte) 0_Channel1 1_Channel2,etc</td><td>Multiplier (2bytes, Unsigned)</td><td>Divisor (2bytes, Unsigned)</td><td>DeltValue (2bytes, Signed)</td><td>Reserved (2Bytes, Fixed 0x00)</td></tr>
<tr><td>ClearGlobalCalibrateReq</td><td>0x03</td><td colspan="5">Reserved 10Bytes,Fixed 0x00)</td></tr>
<tr><td>ClearGlobalCalibrateRsp</td><td>0x83</td><td colspan="2">Status(1Byte,0x00_success)</td><td colspan="3">Reserved (9Bytes,Fixed 0x00)</td></tr>
</table>

SensorType = 0x36 Channel = 0x00 // The distance sensor channel fixed value of the device is 00

(When restoring factory settings, the last set value will be retained.)

Multiplier =0x0001 Divisor = 0x0001 DeltValue = 0x0064

Assuming that the original value of the uploaded Distance is 1000mm, and the calibration is increased by 100mm, the uploaded value is 1100mm.

(1) SetGlobalCalibrateReq:

Downlink: 0136000001000100640000

Response: 8136000000000000000000

(2) GetGlobalCalibrateReq：

Downlink: 0236000000000000000000

Response: 8236000001000100640000

Assuming that the original value of the uploaded Distance is 1000mm, and the calibration is reduced by 100mm, the uploaded value is 900mm

(3) SetGlobalCalibrateReq: Calibration reduced by 100mm, Multiplier =0x0001, Divisor = 0x0001, DeltValue = 0xFF9C

Downlink: 01360000010001FF9C0000

Response: 813600000000000000000

(4) GetGlobalCalibrateReq：

Downlink: 023600000000000000000

Response: 82360000010001FF9C0000

(5) Clear the calibration value: The uploaded value is back to 1000mm.

ClearGlobalCalibrateReq：

Downlink: 033000000000000000000

Response: 833000000000000000000

5.4 Set/GetSensorAlarmThresholdCmd

Fport:0x10

CmdDescriptor	CmdID (1Byte)	Payload (10Bytes)			
SetSensorAlarmThresholdReq	0x01	Channel (1Byte, 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3,etc)	SensorType (1Byte, 0x00_Disable ALL SensorthresholdSet 0x2F_ Distance, 0x30_ FillLevel,	SensorHighThreshold (4Bytes, Unit:same as reportdata in fport6, 0Xffffffff_DISALBLErHighThreshold)	SensorLowThreshold (4Bytes,Unit:same as reportdata in fport6, 0Xffffffff_DISALBLErHighThreshold)
SetSensorAlarmThresholdRsp	0x81	Status (0x00_success)	Reserved (9Bytes,Fixed 0x00)		
GetSensorAlarmThresholdReq	0x02	Channel (1Byte, 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3,etc)	SensorType (1Byte, Same as the SetSensorAlarmThresholdReq’s SensorType)	Reserved (8Bytes,Fixed 0x00)	
GetSensorAlarmThresholdRsp	0x82	Channel (1Byte, 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3,etc)	SensorType (1Byte, Same as the SetSensorAlarmThresholdReq’s SensorType)	SensorHighThreshold (4Bytes,Unit:same as reportdata in fport6, 0Xffffffff_DISALBLErHighThreshold)	SensorLowThreshold (4Bytes,Unit:same as reportdata in fport6, 0Xffffffff_DISALBLErHighThreshold)

Channel - 1 byte

0x00_Distance

0x01_FillLevel // When restoring factory settings, the last set value will be retained.

(1) SetSensorAlarmThresholdReq: (Set the Distance high threshold to 5m and the low threshold to 4m)

Downlink: 01002F0000138800000FA0 //1388Hex = 5000Dec, 5000*0.001m = 5m; FA0Hex = 4000Dec 4000*0.001m = 4m

Response: 810000000000000000000

(2) GetSensorAlarmThresholdReq：

Downlink: 02002F0000000000000000

Response: 82002F0000138800000FA0

(3) Clear all sensor thresholds. (Configure the Sensor Type to 0)

Downlink: 010000000000000000000

Response: 810000000000000000000

6. Application

In the case of detecting the material level of the barn, the device is installed on the top of the barn, and the device is powered on after fixing. The device collects the distance between the material level and the sensor and the percentage of the material level in the barn at regular intervals.

H: The height of the barn (this value can be set with the payload command; the “fillmaxdistance” in payload means H)

D: The distance between the device and the material (this value is “distance” in uplinks)

L: The material level (this value can be calculated by the “distance” in uplink and “fillmaxdistance” in payload)

Calculation: L = fillmaxdistacnce – distance

d: The DeadZoneDeistance set by the device (the distance that cannot be detected by the actual device)

FillLevel: The percentage of the material level in the barn. (Status = 0)

The value of the total height of the barn can be set through commands according to the specific scene.

Illustration 1

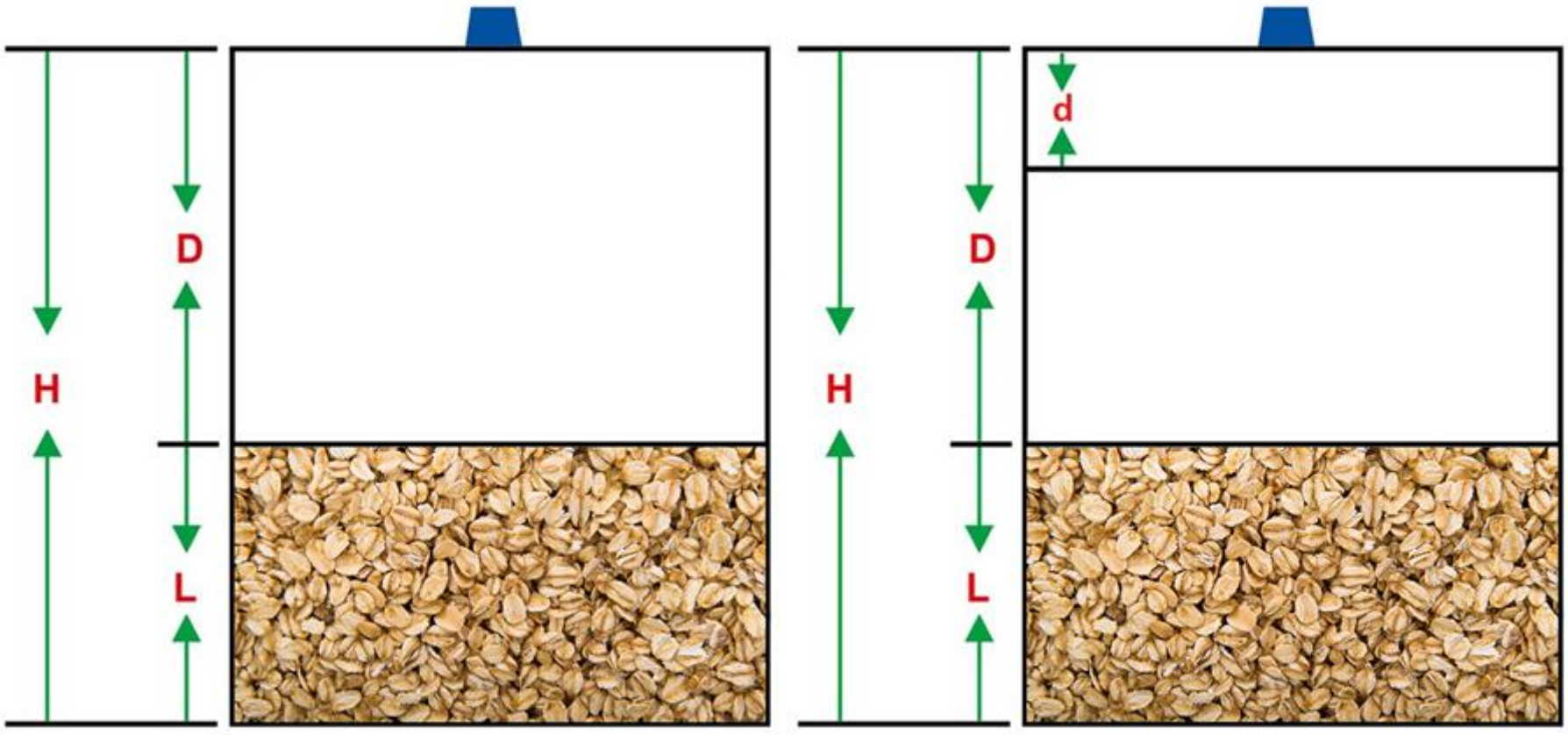
FillLevel = ((H - D) / H) * 100%

Illustration 2

FillLevel = ((H - D) / H-d) * 100%

The calculate method of material level percentage of

DeadZoneDistance can be set.



Note:

The ranging range of the device is:

90% reflectivity, 0Klux 0.1m~25m;

90% reflectivity, 100Klux 0.1m~25m;

10% reflectivity, 0Klux 0.1m~12m;

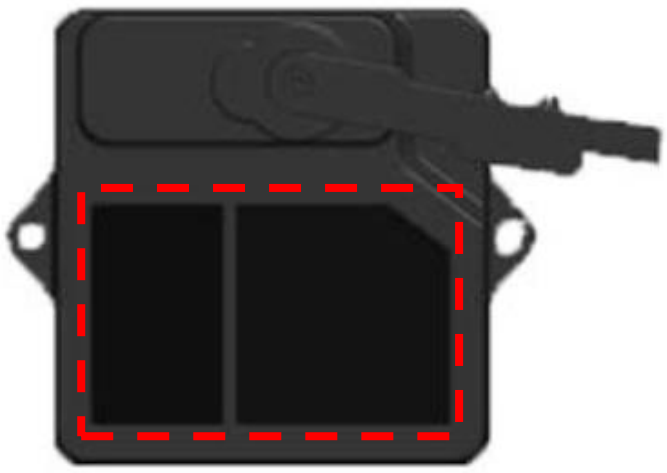
10% reflectivity, 100Klux 0.1m~12m

7. Installation

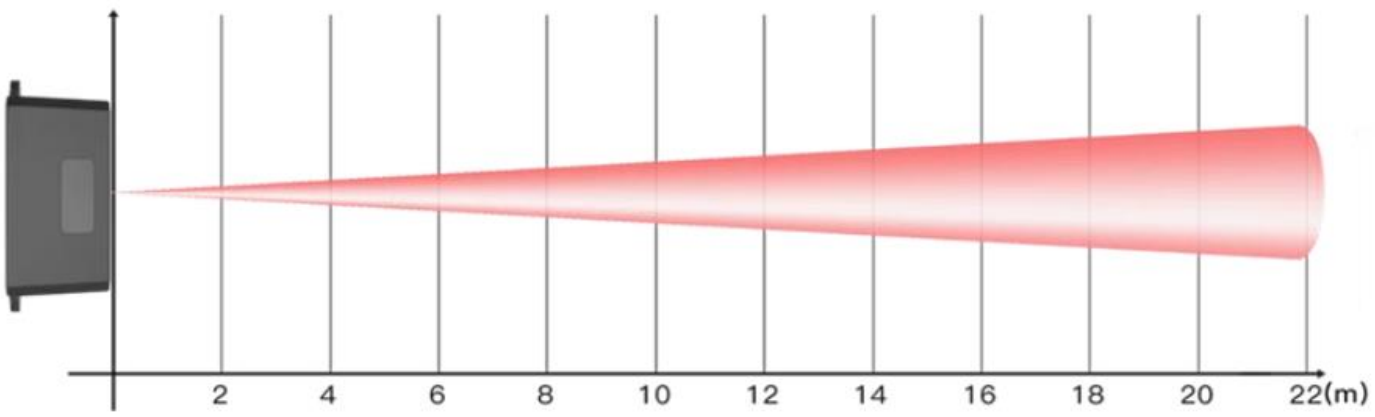
7.1 Precautions for sensor:

1. When installing the sensor, it is recommended to use M2.5 round head Phillips screws for installation.

   Please remove the protective film of the optical lens before use. The lens of front panel of LiDAR cannot be covered. Please keep it clean. The surface of optical lens is the ranging zero of LiDAR.



2. The detection angle of the sensor is 3°. At different distances, the size of light spot, namely the edge length of the detection range, is different.



The spot size at different distances

3. Side length of the detection range at different distances (the detection range is a square)

Distance (m)	1	2	3	4	5	6	7	8	9	10	15	20	22
Spot Size (cm)	5	10	16	21	26	31	37	42	47	52	79	105	115

Spot Size at Different Distances

Note: The side length of the detected target object should be greater than the side length of the detection range of the sensor. When the side length of the detected object is smaller than the side length of the detection range, the effective range of the radar will be reduced. When detecting a slope, the sensor can be placed in the middle of the slope.

4. Maintenance and Cleaning

- Before/after turning on the device, please check the exposed window mirror and check whether the optical components are dirty, if dirty, please clean it in time.
- The optical components should be cleaned regularly because the device will be placed and operated in a harsh environment.

- Before cleaning, please turn off the device first, and use a soft cloth to gently wipe the window in the same direction, avoiding repeated wiping back and forth, which may cause damage to the window mirror.
- Do not use alcohol to clean the window mirror as it may be damaged.
- Do not disassemble the dust-removal wiper, which may easily cause device failure.
- When the steering gear shaft is blocked by dust, the steering gear may be damaged due to increased resistance. It is recommended to clean the shaft regularly.

8. Important Maintenance Instruction

Kindly pay attention to the following in order to achieve the best maintenance of the product:

• Do not use or store the device in dusty or dirty environments to prevent damage to parts and electronic components.

• Do not store the device in high temperatures. This may shorten the lifespan of electronic components, damage batteries, and deform plastic parts.

• Do not store the device in cold temperatures. Moisture may damage circuit boards as the temperatures rise.

• Do not throw or cause other unnecessary shocks to the device. This may damage internal circuits and delicate components.

• Do not clean the device with strong chemicals, detergents, or strong detergents.

• Do not apply the device with paint. This may block detachable parts and cause malfunction.

The instructions are applied to your device, battery, and accessories.

If any device is not working properly or has been damaged, please send it to the nearest authorized service provider for service.