LiDAR Material Level Detection Sensor

R718PE02
User Manual

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1. Introduction

R718PE02 is a wireless communication device for Netvox ClassA 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 R718PE02 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 R718PE02 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 LoRa™ protocol standard.

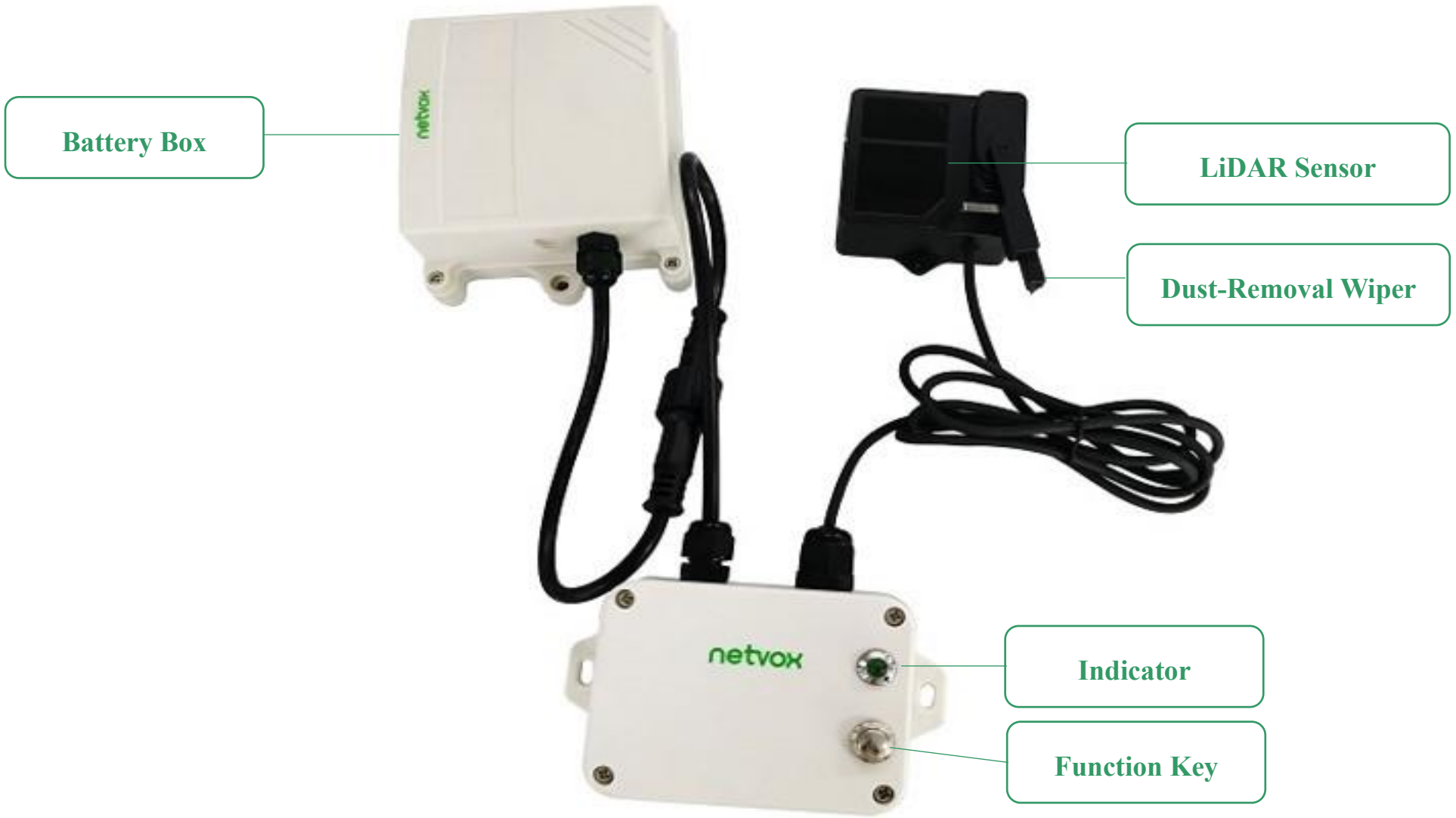
LoRa Wireless Technology

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
- 8 sections ER14505 (3.6V/ section) AA size batteries parallel power supply
- Main body: IP65/IP67 (optional); Sensor: IP5X
- Compatible with LoRaWAN™ Class A
- 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

Note: Please visit http://www.netvox.com.tw/electric/electric_calc.html for battery life calculation and other detailed information.

(1) The actual range may vary depending on the environment.

(2) Battery life is determined by sensor reporting frequency and other variables.

4. Set up Instructions

On/Off

Power on	Insert batteries. Note: User may need a screwdriver to open the battery cover.
Turn on	Press and hold the function key for 3 seconds until the green indicator flashes once. (1) It is recommended to turn on the device within half a year after receiving the device. If it exceeds half a year, it is recommended to turn on the device 2 to 3 hours later after installing the battery. (2) If the dust-removal wiper fails to operate or shuts down during operation after the device is turned on, please shut down the device first, install the batteries, and charge the supercapacitor for 2 to 3 hours.
Reset to factory setting & Turn off	Press and hold the function key for 5 seconds until the green indicator flashes 20 times.
Power off	Long press the function key to shut down and take out the batteries. Note: User may leave the batteries inside to charge the supercapacitor.
Note	(1) Remove and insert the batteries: The device is off state by default. Turn on the device to use again. (2) On/off intervals should be 10 seconds long to avoid the interference of capacitor inductance and other energy storage components. (3) 5 seconds after power on, the device will be in engineering test mode.

Network Joining

Never joined the network	Turn on the device to search the network to join. The green indicator stays on for 5 seconds: Success The green indicator remains off: Fail
Had joined the network (Not at factory setting)	Turn on the device to search the previous network to join. The green indicator stays on for 5 seconds: Success The green indicator remains off: Fail
Fail to Join the Network	Please check the device verification information on the gateway or consult your platform server provider.

Function Key

Press and hold for 5 seconds	Restore to factory setting / Turn off The green indicator flashes for 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

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: send a data report according to Min Interval.

Low Voltage Warning

Low Voltage	3.2V

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 Setting

Maxtime: 0x0E10 (3600s)

Mintime: 0x0E10 (3600s) // Every Min Interval will detect the material level and current-voltage one time.

Battery Voltage Change: 0x01 (0.1V)

Distance Change: 0x012C (300mm)

* When Mintime is not less than 1 hour, long press the function key to shut down the device.

LiDAR Sensor

R718PE02 reports the battery voltage, distance, fill level and sensor strength.

The dust removal wiper will automatically wipe once when the device report cycle is reached or when the button is pressed, so please do not operate it frequently.

LiDAR Sensor Signal Strength

Range: 0 and 65535 (0x0000 to 0xFFFF).

The strength of the signal will be affected by: (1) Distance and (2) Reflectivity of target material.

The farther the measurement distance or the lower the reflectivity is, the weaker the signal strength will be.

When the signal strength is less than 100, the "distance" display value does not guarantee accuracy.

Note:

1. It is recommended to turn on the device within half a year after receiving the device. If it exceeds half a year, it is recommended to turn on the device 2 to 3 hours later after installing the battery.
2. If the dust-removal wiper fails to operate or shuts down during operation after the device is turned on, it is recommended to shut down the device first, install the battery and charge the supercapacitor for 2 to 3 hours.
3. The blind zone distance of the sensor is ≤ 0.1m
4. The period for the device to send data is subject to the programming configuration. The time interval between 2 reports must be the minimum time.
5. Please refer Netvox LoRaWAN Application Command document and Netvox Lora Command Resolver http://cmddoc.netvoxcloud.com/cmddoc to resolve uplink data.

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– Fixed Bytes (Fixed =8bytes)

Tips

1. Battery Voltage:

The voltage value is bit 0 – bit 6, bit 7=0 is normal voltage, and bit 7=1 is low voltage.

Battery=0xA0, binary=1010 0000, if bit 7= 1, it means low voltage.

The actual voltage is 0010 0000 = 0x20 = 32, 32*0.1v =3.2v

2. Version Packet:

When Report Type=0x00 is the version packet, such as 01D5000A02202305250000, the firmware version is 2023.05.25.

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.

Device	Device Type	Report Type	NetvoxPayLoadData					
R718PE02	0xD5	0x00	SoftwareVersion (1Byte) Eg.0x0A—V1.0		HardwareVersion (1Byte)	DateCode (4Bytes, eg 0x20170503)		Reserved (2Bytes, fixed 0x00)
		0x01	Battery (1 byte) unit:0.1V	Status (1 byte) 0x00_Off 0x01_On	Distance (2 bytes) Unit:1mm	FillLevel (1 byte) Unit:1%	SensorStrength (2 bytes)	CapBattery (1Byte, unit:0.1V) Only the battery version is supported)
		0x02	Battery (1 byte, 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)	

Uplink1: 01D5019F000C1226105724 (when FillMaxDistance = 2000mm; DeadZoneDistance = 0mm)

1st byte (01): Version

2nd byte (D5): DeviceType — R718PE02

3rd byte (01) : ReportType

4th byte (9F): Battery — 3.1V (low voltage) 9F (HEX) = 31 (DEC), 31* 0.1V = 3.1V

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 — 4183 1057 (HEX) = 4183 (DEC)

11th byte (24): CapBattery — 3.6V 24 (HEX) = 36 (DEC), 36* 0.1V = 3.6V

Uplink2: 01D5029F01000000000000

1st byte (01): Version

2nd byte (D5): DeviceType — R718PE02

3rd byte (02): ReportType

4th byte (9F): Battery— 3.1V (low battery) 9F (HEX) = 31 (DEC), 31* 0.1V = 3.1V

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**	**Cmd ID**	**Device Type**	**NetvoxPayLoadData**				
ConfigReportReq	R718PE02	0x01	0xD5	MinTime (2 bytes Unit:s)	MaxTime (2 bytes Unit:s)	BatteryChange (1 byte) Unit:0.1v	DistanceChange (2 bytes) Unit:1mm	Reserved (2 bytes) Fixed0x00
ConfigReportRsp		0x81		Status (0x00_success)		Reserved (8 bytes, Fixed 0x00)		
ReadConfigReport Req		0x02		Reserved (9 bytes, Fixed 0x00)				
ReadConfigReport Rsp		0x82		MinTime (2 bytes Unit:s)	MaxTime (2 bytes Unit:s)	BatteryChange (1 byte) Unit:0.1v	DistanceChange (2 bytes) Unit:1mm	Reserved (2 bytes) Fixed0x00
SetOnDistanceThr esholdRreq		0x03		OnDistanceThreshold (2 bytes Unit:1mm)		Reserved (7 bytes, Fixed 0x00)		
SetOnDistanceThr esholdRrsp		0x83		Status (0x00_success)		Reserved (8 bytes, Fixed 0x00)		
GetOnDistanceThr esholdRreq		0x04		Reserved (9 bytes, Fixed 0x00)				
GetOnDistanceThr esholdRrsp		0x84		OnDistanceThreshold (2 bytes Unit:1mm)		Reserved (7 bytes, Fixed 0x00)		
SetFillMaxDistanc eReq		0x05		FillMaxDistance (2 bytes Unit:1mm)		Reserved (7 bytes, Fixed 0x00)		
SetFillMaxDistanc eRsp		0x85		Status (0x00_success)		Reserved (8 bytes, Fixed 0x00)		
GetFillMaxDistanc eReq		0x06		Reserved (9 bytes, Fixed 0x00)				

GetFillMaxDistanceRsp		0x86		FillMaxDistance (2 bytes Unit:1mm)	Reserved (7 bytes, Fixed 0x00)
SetDeadZoneDistanceReq (REMAIN Lastconfig when resetfac)		0x0B		DeadZoneDistance (2bytes Unit:1mm)	Reserved (7Bytes,Fixed 0x00)
SetDeadZoneDistanceRsp (REMAIN Lastconfig when resetfac)		0x8B		Status (0x00_success)	
GetDeadZoneDistanceReq		0x0C		Reserved (9Bytes,Fixed 0x00)	
GetDeadZoneDistanceReq		0x8C		DeadZoneDistance (2bytes,Unit:1mm)	Reserved (7Bytes,Fixed 0x00)

(1) Configure the device parameter MinTime = 1 hour, MaxTime = 1hour, BatteryChange = 0.1v, DistanceChange = 500mm

Downlink: 01D50E100E100101F40000

Response: 81D5000000000000000000 (configuration success)

81D5010000000000000000 (configuration failure)

(2) Read the device parameter

Downlink: 02D5000000000000000000

Response: 82D50E100E100101F40000 (device current parameter)

(3) Configure the device parameter FillMaxDistance = 5000mm

Downlink: 05D5138800000000000000

Response: 85D5000000000000000000 (configuration success)

(4) Read device parameter FillMaxDistance

Downlink: 06D5000000000000000000

Response: 86D5138800000000000000

(5) SetDeadZoneDistance // When reset to factory settings, the last value will be saved.

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

Response: 8BD5000000000000000000 (configuration success)

(6) GetDeadZoneDistance:

Downlink: 0CD5000000000000000000

Response: 8CD5006400000000000000 // Get the device detection dead zone distance of 100mm.

5.3 Example of General Calibration Configuration

FPort: 0x0E

Description	CmdID	Sensor Type	PayLoad(Fix =9 Bytes)				
SetGlobalCalibrateReq	0x01	0x36 Distance Sensor	Channel (1 byte) 0_Channel1 1_Channel2,etc	Multiplier (2 bytes) Unsigned	Divisor (2 bytes) Unsigned	DeltValue (2 bytes) Signed	Reserved (2 bytes) Fixed 0x00
SetGlobalCalibrateRsp	0x81		Channel (1 byte) 0_Channel1 1_Channel2,etc	Status (1 byte) 0x00_success	Reserved (7 bytes) Fixed 0x00		
GetGlobalCalibrateReq	0x02		Channel (1 byte) 0_Channel1 1_Channel2,etc	Reserved (8 bytes) Fixed 0x00			
GetGlobalCalibrateRsp	0x82		Channel (1 byte) 0_Channel1 1_Channel2,etc	Multiplier (2 bytes) Unsigned	Divisor (2 bytes) Unsigned	DeltValue (2 bytes) Signed	Reserved (2 bytes) Fixed 0x00
ClearGlobalCalibrateReq	0x03	Reserved (10 bytes, Fixed 0x00)					
ClearGlobalCalibrateRsp	0x83	Status (1 byte, 0x00_success)	Reserved (9 bytes, Fixed 0x00)				

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

(1) SetGlobalCalibrateReq: Calibration increased by 100mm, Multiplier =0x0001, Divisor = 0x0001, DeltValue = 0x0064

Downlink: 0136000001000100640000

Response: 8136000000000000000000

(2) GetGlobalCalibrateReq:

Downlink: 0236000000000000000000

Response: 8236000001000100640000

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

Downlink: 013600000100 01FF9C0000

Response: 8136000000000000000000

(4) GetGlobalCalibrateReq:

Downlink: 0236000000000000000000

Response: 82360000010001FF9C0000

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

Downlink: 0300000000000000000000

Response: 8300000000000000000000

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_DISALBLEHighThreshold)	SensorLowThreshold (4Bytes, Unit:same as reportdata in fport6, 0Xffffffff_DISALBLELowThreshold)
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_DISALBLEHighThreshold)	SensorLowThreshold (4Bytes, Unit: same as reportdata in fport6, 0Xffffffff_DISALBLELowThreshold)

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

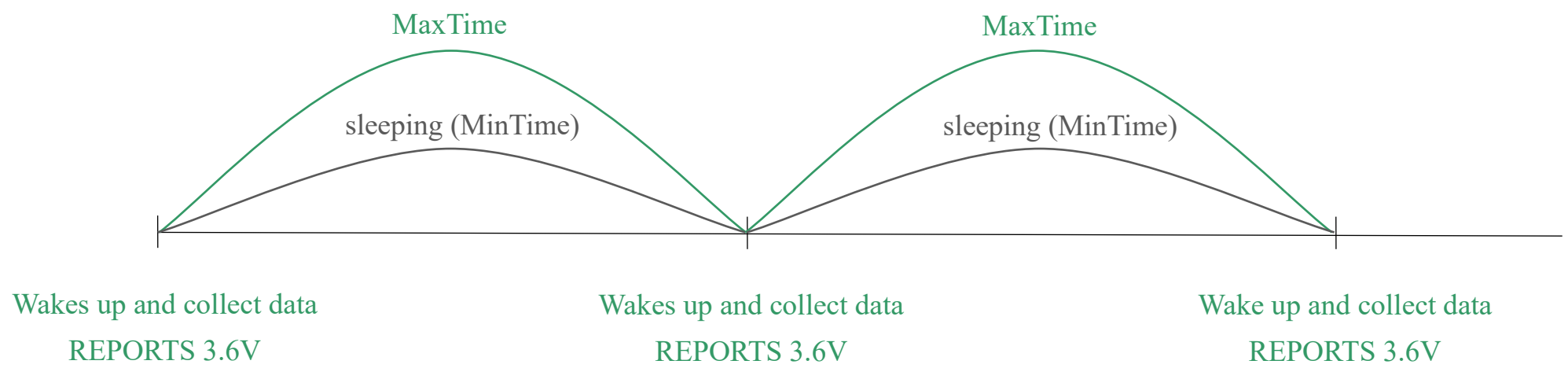
(3) Clear all sensor thresholds. (Configure the Sensor Type to 0)

Downlink: 010000000000000000000

Response: 810000000000000000000

5.5 Example for MinTime/MaxTime logic

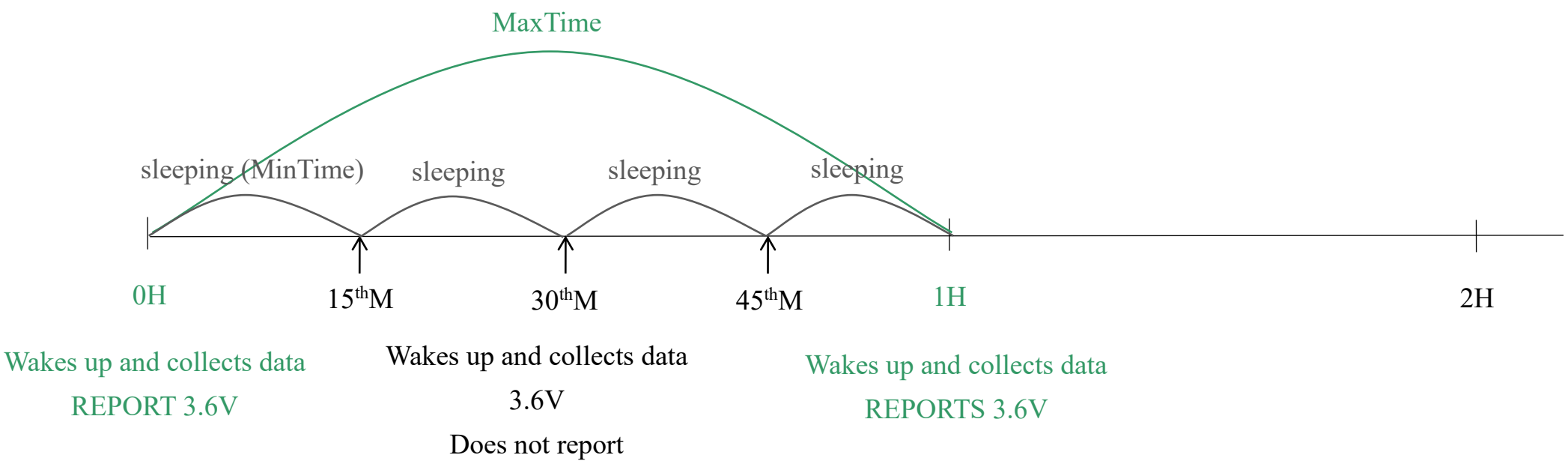
Example#1 based on MinTime = 1 Hour, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange=0.1V



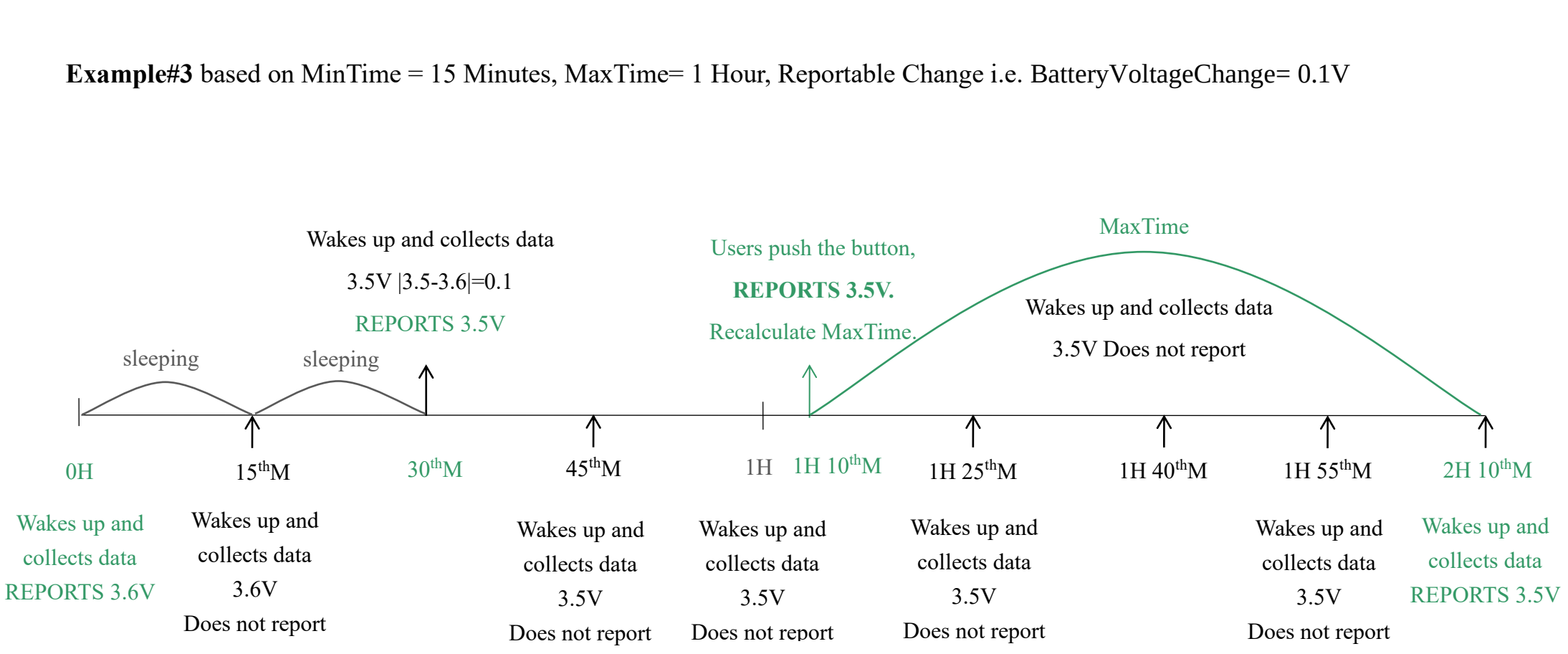
Note:

MaxTime=MinTime. Data will only be report according to MaxTime (MinTime) duration regardless BatteryVoltageChange value.

Example#2 based on MinTime = 15 Minutes, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange= 0.1V



Example#3 based on MinTime = 15 Minutes, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange= 0.1V



Note:

1) The device only wakes up and performs data sampling according to MinTime Interval. When it is on sleeping mode, it does not collect data.
2) The data collected is compared with the last data reported. If the data variation is greater than the ReportableChange value, the device reports according to MinTime interval. If the data variation is not greater than the last data reported, the device reports according to MaxTime interval.
3) We do not recommend to set the MinTime Interval value too low. If the MinTime Interval is too low, the device wakes up frequently and the battery will be drained soon.
4) Whenever the device sends a report, no matter resulting from data variation, button pushed or MaxTime interval, another cycle of MinTime/MaxTime calculation is started.

6. Applications

Barn

The device is installed on the top of the barn, and the device is powered on after fixing. It 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.

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%

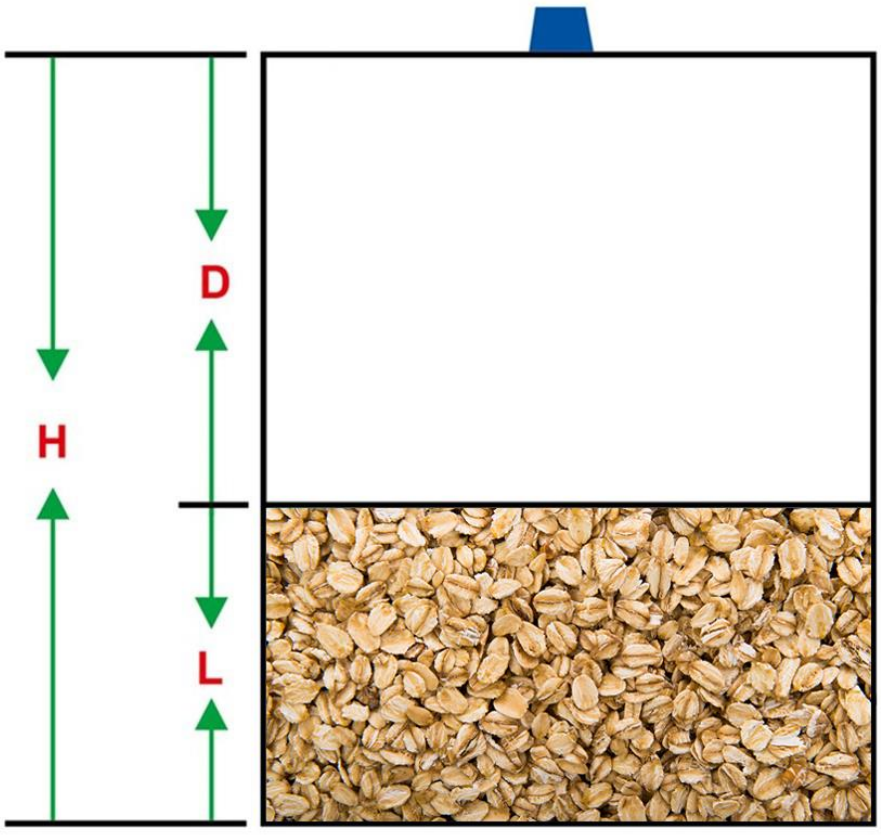
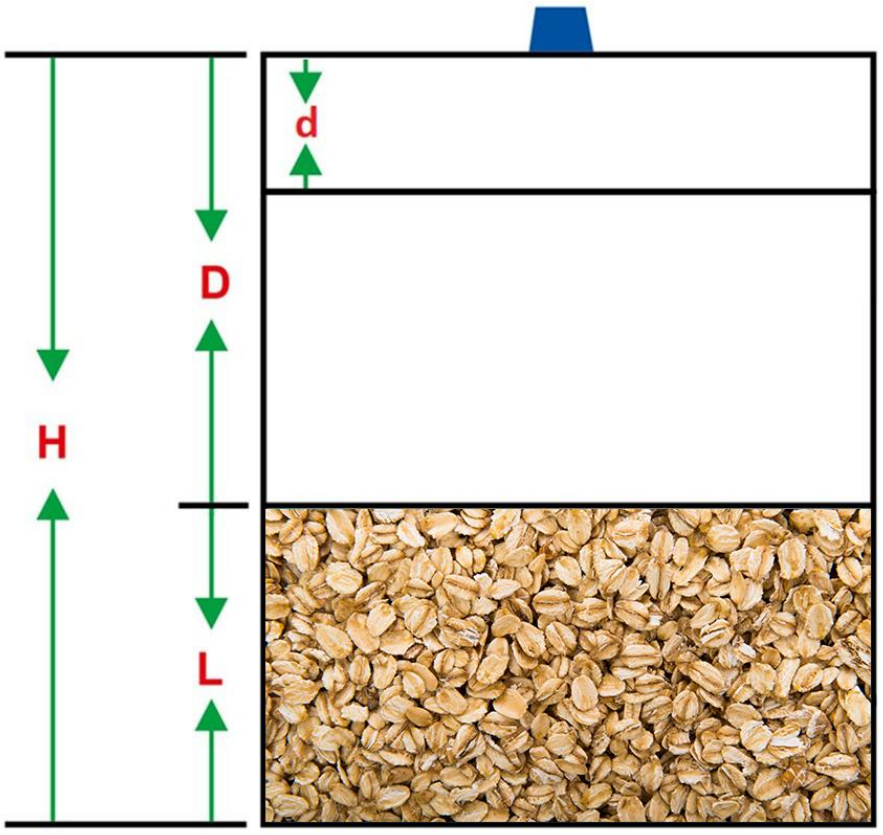


Illustration 2

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; 10% reflectivity, 0Klux 0.1m–12m;

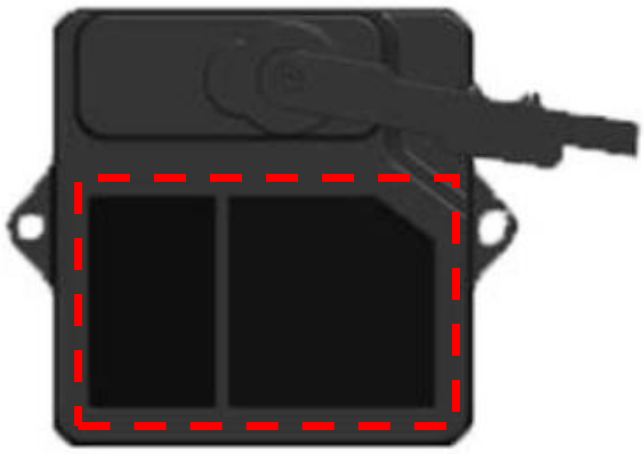
90% reflectivity, 100Klux 0.1m–25m; 10% reflectivity, 100Klux 0.1m–12m

7. Installation

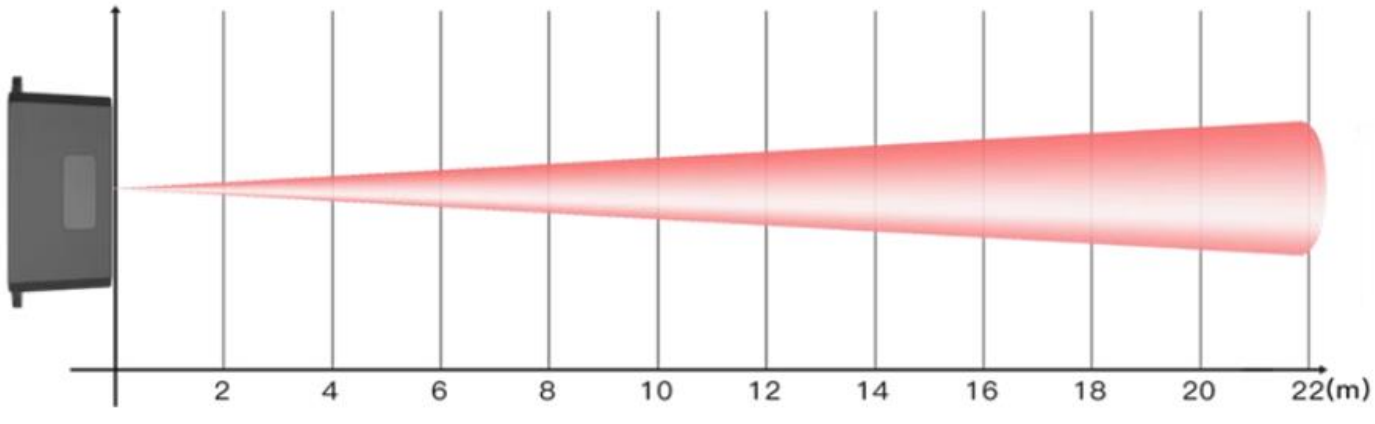
7.1 Precautions for sensor use

1. Please use M2.5 round head screws for installation.

2. Please remove the screen protector and keep the lens clean or it may cause false results. The LiDAR radar starts from the surface of the lens (that is Distance = 0m).



3. 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

4. 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 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.

7.2 Maintenance and Cleaning

- Before/after turning on the device, please check the exposed lens and check whether the optical components are dirty.
- The optical components should be cleaned regularly if the device was placed and operated in a harsh environment.
- The device should be off before cleaning. User may use a soft cloth to wipe the lens in one direction. Wiping the lens too hard or too many times may cause damage to it.
- Do not use alcohol to clean the lens as it may be damaged.
- Disassembling the dust-removal wiper may cause device failure.
- The steering gear should be cleaned to avoid damage or the increased resistance caused by dust.

7.3 Storage of Sensor

- The sensor shall be stored in an environment without exposure to corrosive gas or exceeding the storage temperature range (-30℃ to 80℃) and humidity (≤60%).
- Before storing the sensor, all switches and dust covers should be plugged or closed.
- The device should be tested before operation if it has been stored for over 3 months.
- Installation, connection, or maintenance without following the instructions could cause the malfunction of the device.

7.4 Reflectivity

- Detecting transparent objects like water would cause incorrect results.
- Detecting dark objects requires a closer distance, but the accuracy remains the same. The reflectivity of different dark objects are as follows:

	Materials	Reflectivity
1	Black foam rubber	2.4%
2	Black cloth	3%
3	Black rubber	4%
4	Coal (varies from coal to coal)	4–8%
5	Black car paint	5%
6	Black paper	10%
7	Opaque black plastic	14%
8	Clean rough board	20%
9	Translucent plastic bottles	62%
10	Packing case cardboard	68%
11	Clean pine	70%
12	Opaque white plastic	87%

13	White card	90%
14	Kodak standard whiteboard	100%
15	Unpolished white metal surface	130%
16	Shiny light metal surface	150%
17	Stainless steel	200%
18	Reflective board, reflective adhesive tape	>300%

8. Comparison between R718PE & R718PE01& R718PE02

Model	R718PE	R718PE01	R718PE02
Sensor type	Ultrasonic Level Sensor	Ultrasonic Level Sensor	LiDAR Material Level Detection Sensor
Measurement range	0.25-8m	0.25-8m	90% Reflectivity 0Klux，0.1-25m； 10% Reflectivity 0Klux，0.1-12m； 90% Reflectivity 100Klux，0.1-25m； 10% Reflectivity 0Klux，0.1-12m；
Measurement dead zone	0-0.25m	0-0.25m	0-0.1m
Detect angle	about 15°	about 20°	3º
Sensor probe waterproof level	IP67	IP67	IP5X Not waterproof
Application	Liquid-level detection	Plane and material level detection.	Material level detection.
Note	It is not suitable for scenarios where the liquid level fluctuates greatly or the measured object is uneven, nor is it suitable for high temperature, high pressure, and vacuum environments, and its performance is susceptible to electromagnetic interference and crosstalk.		Advantages: Accurate measurement, not affected by the surface state of the detected object, and can be used for slope measurement. Disadvantages: Susceptible to dust, and steam. Unable to measure transparent liquids.

9. Information about Battery Passivation

Many of Netvox devices are powered by 3.6V ER14505 Li-SOCl2 (lithium-thionyl chloride) batteries that offer many advantages including low self-discharge rate and high energy density. However, primary lithium batteries like Li-SOCl2 batteries will form a passivation layer as a reaction between the lithium anode and thionyl chloride if they are in storage for a long time or if the storage temperature is too high. This lithium chloride layer prevents rapid self-discharge caused by continuous reaction between lithium and thionyl chloride, but battery passivation may also lead to voltage delay when the batteries are put into operation, and our devices may not work correctly in this situation.

As a result, please make sure to source batteries from reliable vendors, and it is suggested that if the storage period is more than one month from the date of battery production, all the batteries should be activated. If encountering the situation of battery passivation, users can activate the battery to eliminate the battery hysteresis.

ER14505 Battery Passivation:

9.1 To determine whether a battery requires activation

Connect a new ER14505 battery to a resistor in parallel, and check the voltage of the circuit.

If the voltage is below 3.3V, it means the battery requires activation.

9.2 How to activate the battery

a. Connect a battery to a resistor in parallel

b. Keep the connection for 5~8 minutes

c. The voltage of the circuit should be ≧3.3, indicating successful activation.

Brand	Load Resistance	Activation Time	Activation Current
NHTONE	165 Ω	5 minutes	20mA
RAMWAY	67 Ω	8 minutes	50mA
EVE	67 Ω	8 minutes	50mA
SAFT	67 Ω	8 minutes	50mA

Note:

If you buy batteries from other than the above four manufacturers, then the battery activation time, activation current, and required load resistance shall be mainly subject to the announcement of each manufacturer.

10. Important Maintenance Instructions

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

- Keep the device dry. Rain, moisture, or any liquid might contain minerals and thus corrode electronic circuits. If the device gets wet, please dry it completely.
- Do not use or store the device in a dusty or dirty environment. It might damage its detachable parts and electronic components.
- Do not store the device under excessively hot conditions. High temperatures can shorten the life of electronic devices, destroy batteries, and deform or melt some plastic parts.
- Do not store the device in places that are too cold. Otherwise, when the temperature rises to normal temperature, moisture will form inside, which will destroy the board.
- Do not throw, knock, or shake the device. Rough handling of a device can destroy internal circuit boards and delicate structures.
- Do not clean the device with strong chemicals, detergents, or strong detergents.
- Do not apply the device with paint. Smudges might block the device and affect the operation.
- Do not throw the battery into the fire, or the battery will explode. Damaged batteries may also explode.

All of the above applies to your device, battery, and accessories. If any device is not working properly, please take it to the nearest authorized service facility for repair.

11. Precautions for Outdoor Installation

(1) In compliance with the Degrees of Protection Provided by Enclosures (IP Code): GB 4208-2008 and IEC 60529:2001

(2) IP Ratings

- IP65: Spray the device in all directions under 12.5L/min water flow for 3min, and the internal electronic function is normal.

  IP 65 is dust-proof and able to protect electrical appliances from water in every direction.

  The device can be used in general indoor environments and sheltered outdoor environments. It is not suitable for environments with high water pressure, high temperature, and high humidity, such as long-time direct sunlight outdoors and possible direct exposure to rainstorms. If it has to be installed in a harsh environment, it is recommended to add sunscreen and rainproof shields when installing.

- IP67: Immersed the device in 1-meter-deep water for 30min, and the internal electronic function is normal.

▲ Fig 1.

Installed the device face down (without exposing the LED and buttons)

▲ Fig 2. Installed the device under a rain shield