Wireless Top-Mounted Ultrasonic Level Sensor

R718PE01
User Manual

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1. Introduction

R718PE01 series device is netvox Class A type device based on LoRaWAN open protocol. R718PE01 is a wireless communication device that can be used for liquid level / material level detection. This device is connected with ultrasonic sensor, which can detect its current liquid level / material level. The detection angle of R718PE01 is about 20 °, which has a stronger transmission signal and is more suitable for the detection of objects such as grain heaps and sand. And transmit the detected data to other devices through wireless network for display. It adopts sx1276 wireless communication module. The device is compatible with LoRaWAN protocol.

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, industrial monitoring. 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

The distance detected by the sensor is calculated from the plane

3. Main Feature

- Apply SX1276 wireless communication module
- 2 sections ER14505 3.6V AA size batteries parallel power supply
- Material level detection/ liquid level detection
- Host Body Protection Level: IP65 / IP67 (optional), Ultrasonic Probe Protection Level: IP67
- 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 platform: Actility / ThingPark, TTN, MyDevices/Cayenne
- Low power consumption and long battery life

Note: Battery life is determined by the sensor reporting frequency and other variables, please refer to http://www.netvox.com.tw/electric/electric_calc.html. On this website, users can find battery life time for varied models at different configurations.

4. Set up Instruction

On/Off

Power on	Insert batteries. (users may need a screwdriver to open)
Turn on	Press and hold the function key for 3 seconds till the green indicator flashes once.
Turn off (Restore to factory setting)	Press and hold the function key for 5 seconds till green indicator flashes 20 times.
Power off	Remove Batteries.
Note:	1. Remove and insert the battery; the device is at off state by default. Turn on the device to use again. 2. On/off interval is suggested to be about 10 seconds 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	Suggest to 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 reportchange 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 configuring.

Default Setting

Maximum time: 900s (15min)

Minimum time:900s (15min)

Battery Voltage Change - 0x01 (Unit:0.1v, 0.1V)

Distance Change - 0x012C (Unit:1mm, 300mm)

Data packet:

a. When used in level / material level detection:

   R718PE01 reports Battery voltage, Distance, Fill Level ; Status=0 (Invalid)

b. When used in parking detection:

   R718PE01 reports Battery voltage, Status, Distance ; Fill Level=0 (Invalid)

Note:

1. The cycle of the device sending the data report is according to the default.
2. The interval between two reports must be the MinTime.
3. 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 – Device Type 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)

Device	Device Type	Report Type	NetvoxPayLoadData				
R718PE01	0xB1	0x01	Battery (1Byte, unit:0.1V)	Status (1Byte,0x01_On 0x00_Off)	Distance (2Bytes,Unit:1mm)	FillLevel (1Byte,Unit:1%)	Reserved (3Bytes,fixed 0x00)

Fport:6 reported data: 01 B1 01 24 00 0190 14 000000 (when FillMaxDistance = 2000mm & DeadZoneDistance= 0mm)

Report is battery = 24 (3.6V), status =0x00 (liquid level / material level detection times off, parking space detection no car alarm off), distance =0x0190 (400mm), FillLevel= 0x14 (20%)

Ex. Uplink: 01B1012400019014000000

Byte	Value	Attribute	Result	Resolution
1st	01	Version	1	-
2nd	B1	DeviceType	B1	-
3rd	01	ReportType	1	-
4th	24	Battery	3.6v	24(HEX)=36(DEC),36*0.1v=3.6v
5th	00	Status	off	-
6th~7th	0190	Distance	400mm	0190(HEX)=400(DEC),400*1mm=400mm
8th	14	FillLevel	20%	14(HEX)=20(DEC),20*1%=20%
9th~11th	000000	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				
Config ReportReq	R718PE01	0x01	0xB1	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2byte)
Config		0x81		Status			Reserved	

ReportRsp				(0x00_success)				(8Bytes,Fixed 0x00)	
ReadConfig ReportReq		0x02		Reserved (9Bytes,Fixed 0x00)					
ReadConfig ReportRsp		0x82		MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byteUnit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2byte)	
SetOnDistance ThresholdRreq		0x03		OnDistanceThreshold (2byte Unit: 1mm)			Reserved (7Bytes, Fixed 0x00)		
SetOnDistance ThresholdRrsp		0x83		Status (0x00_success)			Reserved (8Bytes, Fixed 0x00)		
GetOnDistance ThresholdRreq		0x04		Reserved (9Bytes, Fixed 0x00)					
GetOnDistance ThresholdRrsp		0x84		OnDistanceThreshold (2byte Unit: 1mm)			Reserved (7Bytes, Fixed 0x00)		
SetFillMax DistanceReq		0x05		FillMaxDistance (2byte Unit: 1mm)			Reserved (7Bytes, Fixed 0x00)		
SetFillMax DistanceRsp		0x85		Status (0x00_success)			Reserved (8Bytes, Fixed 0x00)		
GetFillMax DistanceReq		0x06		Reserved (9Bytes, Fixed 0x00)					
GetFillMax DistanceRsp		0x86		FillMaxDistance (2byte Unit: 1mm)			Reserved (7Bytes, Fixed 0x00)		
SetDeadZoneD istanceReq		0x0B		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)		
SetDeadZoneD istanceRsp		0x8B		Status(0x00_success)			Reserved (8Bytes,Fixed 0x00)		
GetDeadZone DistanceReq		0x0C		Reserved (9Bytes,Fixed 0x00)					
GetDeadZone DistanceReq		0x8C		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)		

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

Downlink: 01B1003C003C0101F40000

Device Return:

81B1000000000000000000 (configuration success)

81B10100000000000000 (configuration failure)

(2) Read the device parameter

Downlink: 02B10000000000000000

Device Return:

82B1003C003C0101F40000 (device current parameter)

(3) Configure the device parameter FillMaxDistance = 5000mm

Downlink: 05B11388000000000000

Device returns:

85B10000000000000000 (configuration success)

85B10100000000000000 (configuration failure)

(4) Read device parameter FillMaxDistance

Downlink: 06B10000000000000000

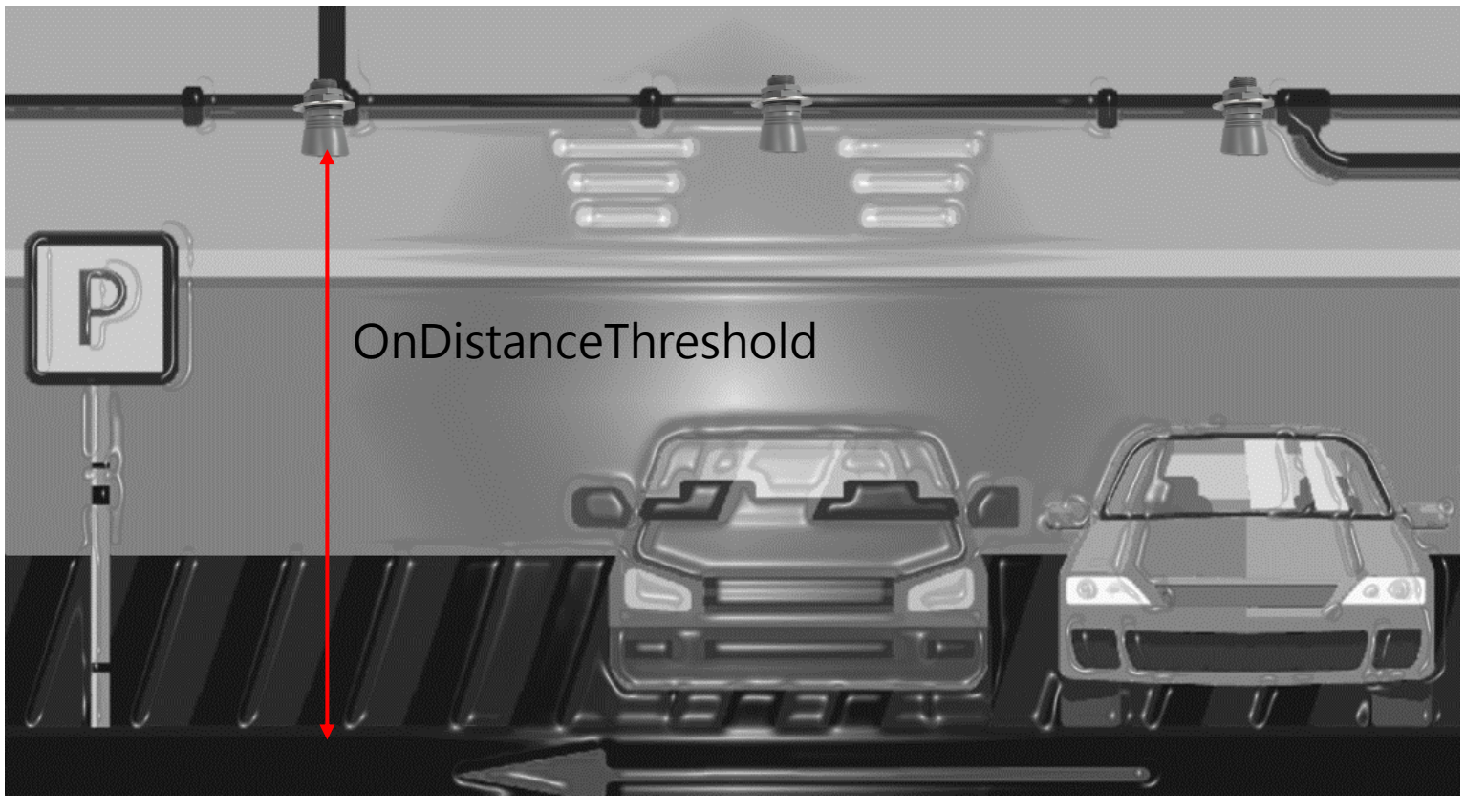
Device returns:

86B11388000000000000 (device current parameter)

5.3 Example of Switching Mode

Switching mode is achieved by setting the values of FillMaxDistance and OnDistanceThreshold.

If the current device is used as material level detection, to switch it to parking space detection, first set FillMaxDistance to 0, and then set OnDistanceThreshold. On the contrary, if the current device is used as parking space detection and wants to switch it to material level detection, first set OnDistanceThreshold to 0, and then set FillMaxDistance.



If the current device is used as material level detection, switch it to parking space detection

(1) Set FillMaxDistance =0

Downlink: 05B1000000000000000000

Device returns:

85B1000000000000000000

(2) Read FillMixDistance, confirm whether it has been set successfully

Downlink: 06B1000000000000000000

Device returns:

86B1000000000000000000

(3) Set OnDistanceThreshold= 500mm

Downlink: 03B101F400000000000000

Device returns:

83B1000000000000000000

(4) Read OnDistanceThreshold, confirm whether it has been set successfully

Downlink: 04B1000000000000000000

Device returns:

83B101F400000000000000

5.4 Example of DeadZoneDistance

(1) SetDeadZoneDistance:

Downlink: 0BB100FA00000000000000 //set the device detection dead zone distance to 250mm

Device returns:

8BB1000000000000000000

(2) GetDeadZoneDistance:

Downlink: 0CB1000000000000000000

Device returns:

8CB100FA00000000000000 //set the device detection dead zone distance to 250mm

Note: Keep the last set value when restoring the factory setting

5.5 Example of General Calibration Configuration

FPort：0x0E

Description	**Cmd ID**	**Sensor Type**	**PayLoad(Fix =9 Bytes)**				
SetGlobal CalibrateReq	0x01	0x36 Distance Sensor	Channel (1Byte) 0_Channel1 1_Channel2,etc	Multiplier (2bytes,Unsigned)	Divisor (2bytes,Unsigned)	DeltValue (2bytes,Signed)	Reserved (2Bytes, Fixed 0x00)
SetGlobal CalibrateRsp	0x81		Channel (1Byte) 0_Channel1 1_Channel2,etc	Status (1Byte,0x00_success)	Reserved (7Bytes,Fixed 0x00)		
GetGlobal CalibrateReq	0x02		Channel (1Byte) 0_Channel1 1_Channel2,etc	Reserved (8Bytes,Fixed 0x00)			
GetGlobal CalibrateRsp	0x82		Channel (1Byte) 0_Channel1 1_Channel2,etc	Multiplier (2bytes,Unsigned)	Divisor (2bytes,Unsigned)	DeltValue (2bytes,Signed)	Reserved (2Bytes, Fixed 0x00)
ClearGlobal CalibrateReq	0x03	Reserved (10Bytes,Fixed 0x00)					
ClearGlobal CalibrateRsp	0x83	Status (1Byte,0x00_success)	Reserved (9Bytes,Fixed 0x00)				

SensorType = 0x36，channel = 0x00 (The current channel fixed value of the device is 00)

(1) Assuming the reported original Distance value is 1000mm, the Calibration is increased by 100mm, and the reported value is 1100mm

SetGlobalCalibrateReq:Calibration is increased by 100mm，Multiplier =0x0001，Divisor = 0x0001，DeltValue = 0x0064

Downlink: 0136000001000100640000

Device returns: 8136000000000000000000

GetGlobalCalibrateReq：

Downlink: 0236000000000000000000

Device returns: 8236000001000100640000

(2) Assuming the reported original Distance value is 1000mm, the Calibration is reduced by 100mm， and the reported value is 900mm

SetGlobalCalibrateReq：Calibration is reduced by 100mm， Multiplier =0x0001， Divisor = 0x0001， DeltValue = 0xFF9C

Downlink: 01360000010001FF9C0000

Device returns: 8136000000000000000000

GetGlobalCalibrateReq：

Downlink：02360000000000000000

Device returns：82360000010001FF9C0000

(3) Clear the calibration value: the reported value is restored to 1000mm

ClearGlobalCalibrateReq：

Downlink: 03000000000000000000

Device returns: 83000000000000000000

Note:

1. When Multiplier is not 1, Calibration value = DeltValue*Multiplier.

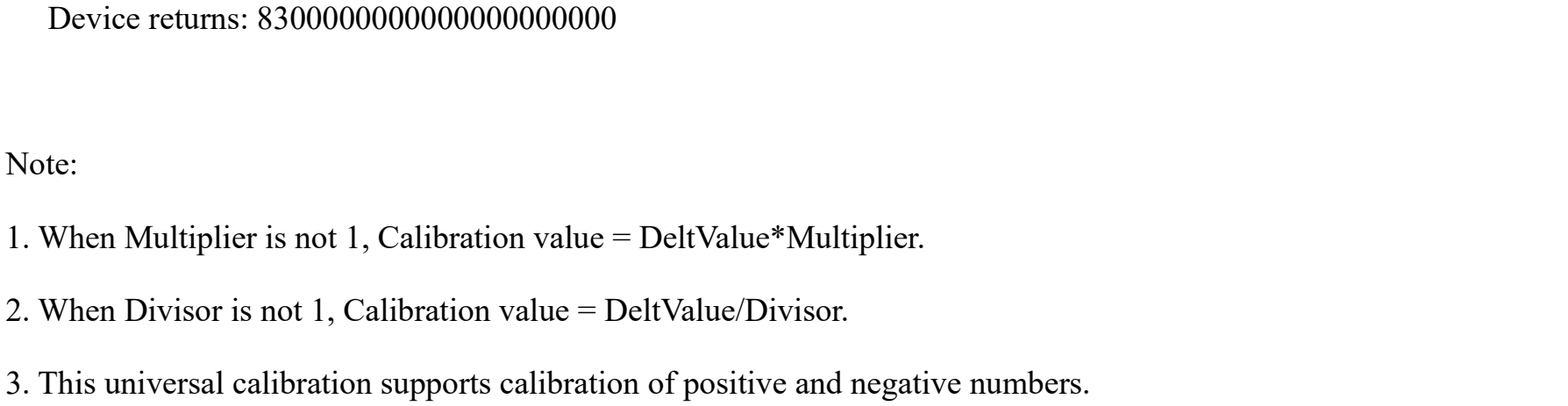
2. When Divisor is not 1, Calibration value = DeltValue/Divisor.

3. This universal calibration supports calibration of positive and negative numbers.

4. Negative values use the 2's complement

5.6 Example for MinTime/MaxTime logic

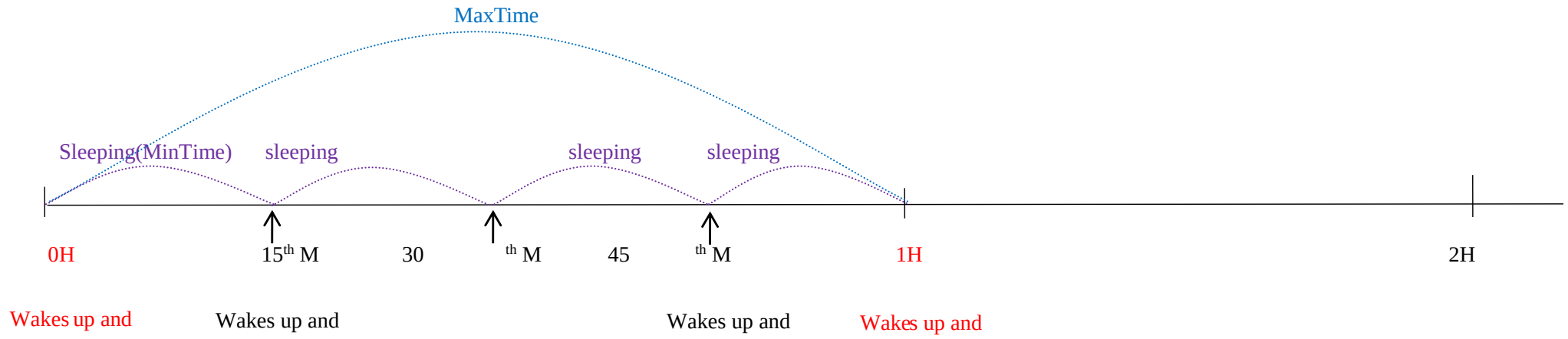
Example#1 based on MinTime = 1 Hour, MaxTime= 1 Hour, Reportable Change i.e. BatteryVoltageChange=0.1V



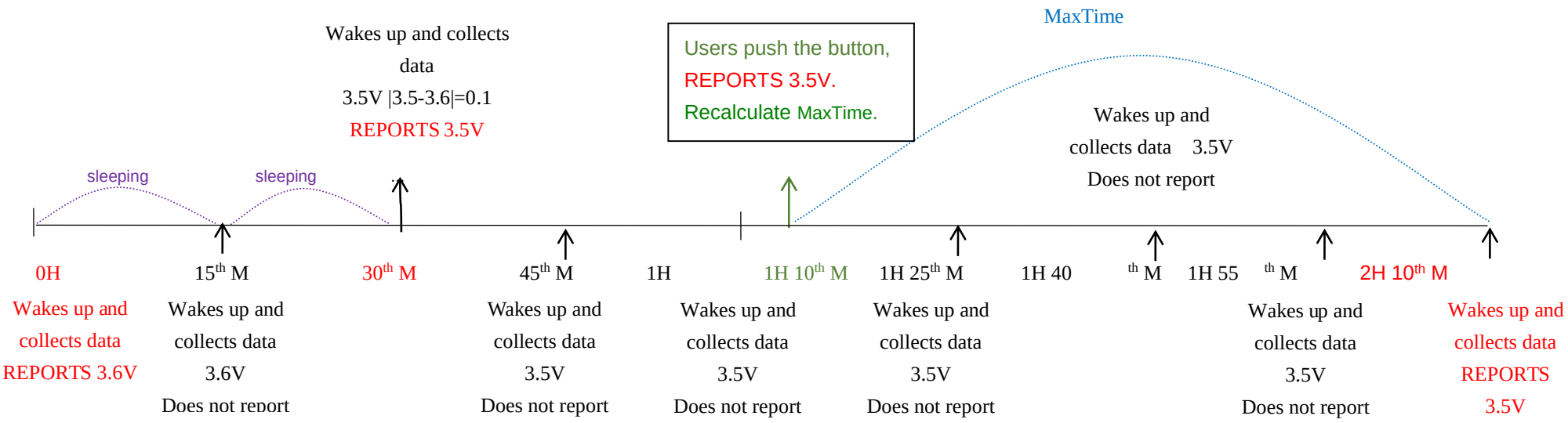
Note:

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



Notes :

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. 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.

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%

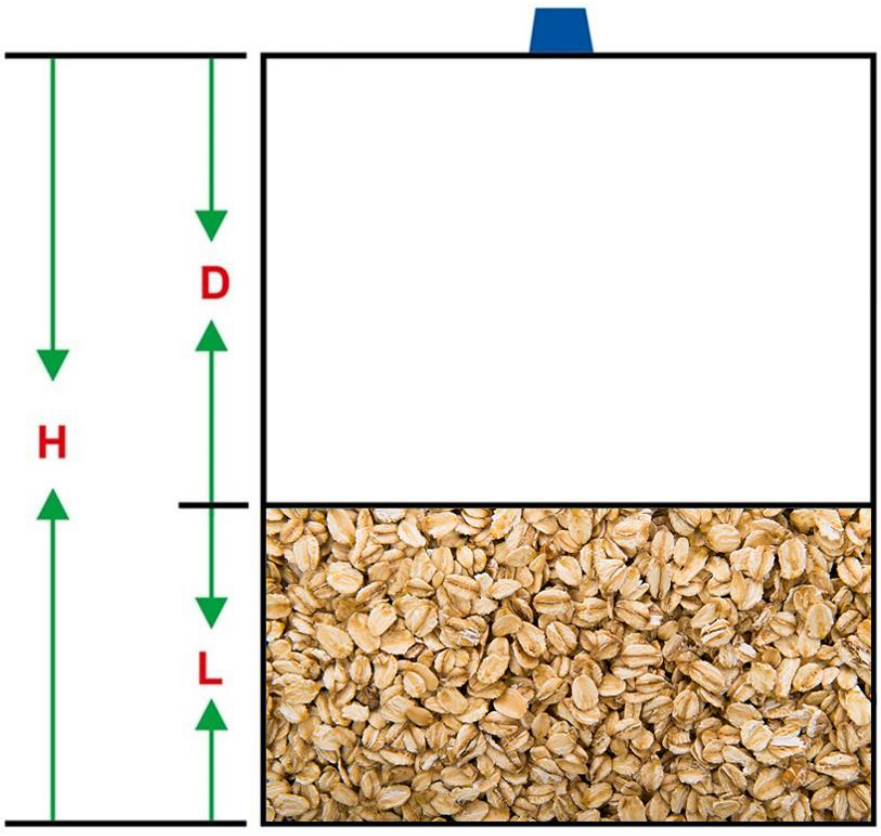
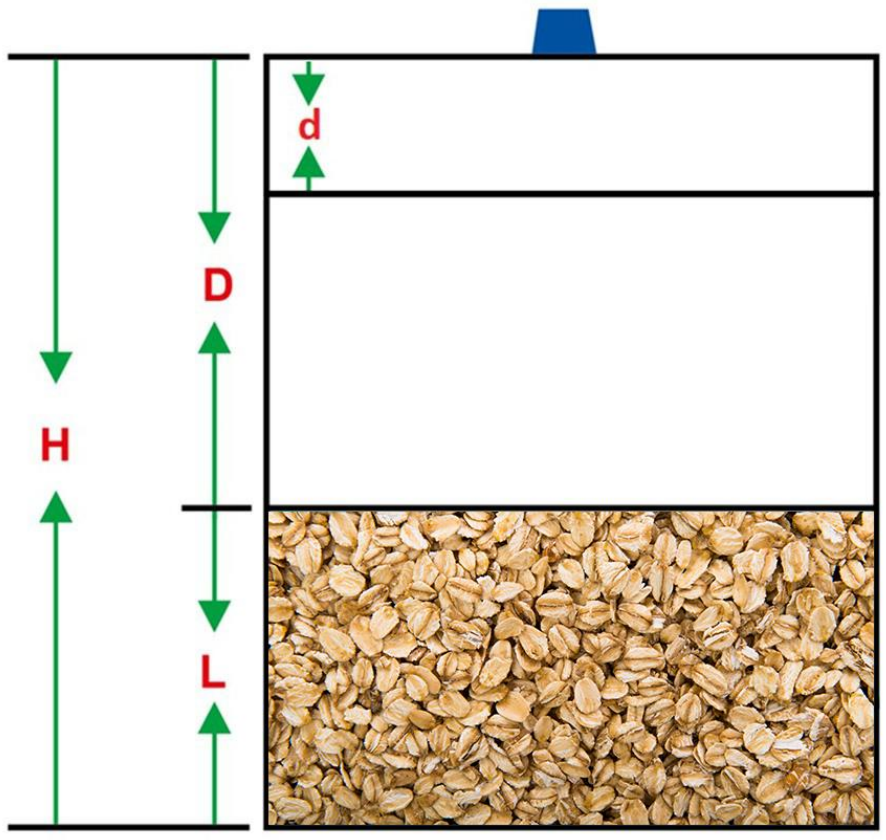


Illustration 2

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

The calculate method of material level percentage of DeadZoneDistance can be set



Note:

(1) The detecting range of the device is 250mm~8000mm

(2) When the device is used as level / material level detection, the detected distance (Distance) and the percentage of material level (FillLevel) are reported. Otherwise, the parking status (Status) is not reported (in this case, Status is 0 by default).

(3) When the device is used as parking space detection, it will report the detected distance (Distance) and the parking status (Status) (with car, report “on”; without car, report “off”), but FillLevel is not reported. (At this time, FillLevel defaults 0.)

(4) When Distance ≤ OnDistanceThreshold, the status is reported as on, so OnDistanceThreshold is recommended to be set to be less than the distance under the condition of no vehicle

7. Installation

The actual installation position of the ultrasonic sensor can be installed at the middle position of the top of the container or at the flat position of the top of the container to ensure that the ultrasonic detection direction is perpendicular to the plane of the tested object to ensure the accuracy of measurement.

When the measured object is in peak or valley shape, the data returned by the device is the position distance value that meets the detection requirements of the ultrasonic sensor within the measurement range.

In addition, the following formula can be used to calculate whether the container is applicable:

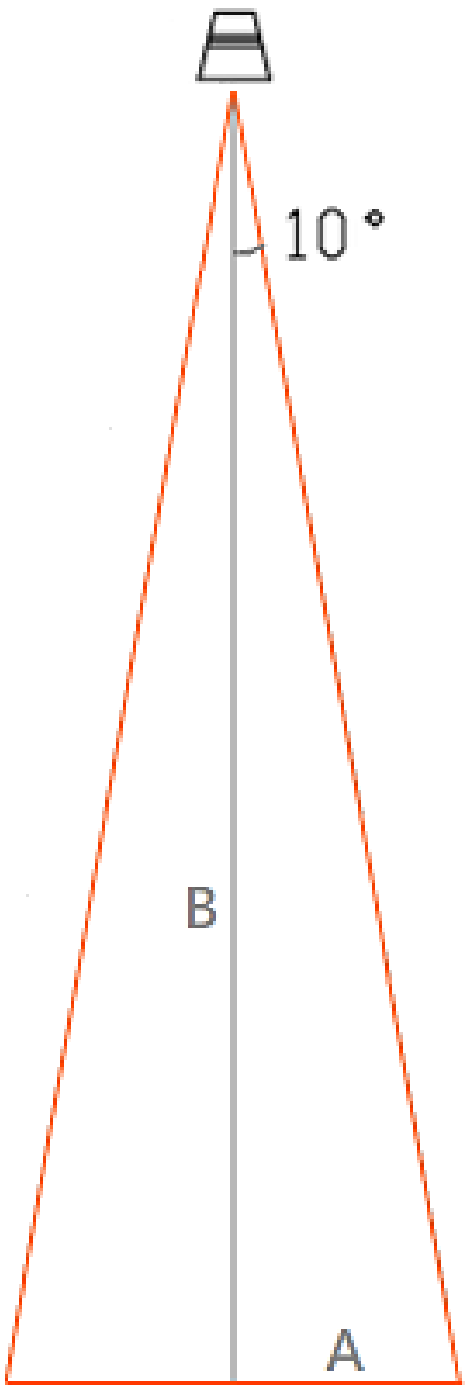
A is the radius of the container

B is the height of the container

Calculate **tan10 ° =A / B** according to the Pythagorean theorem

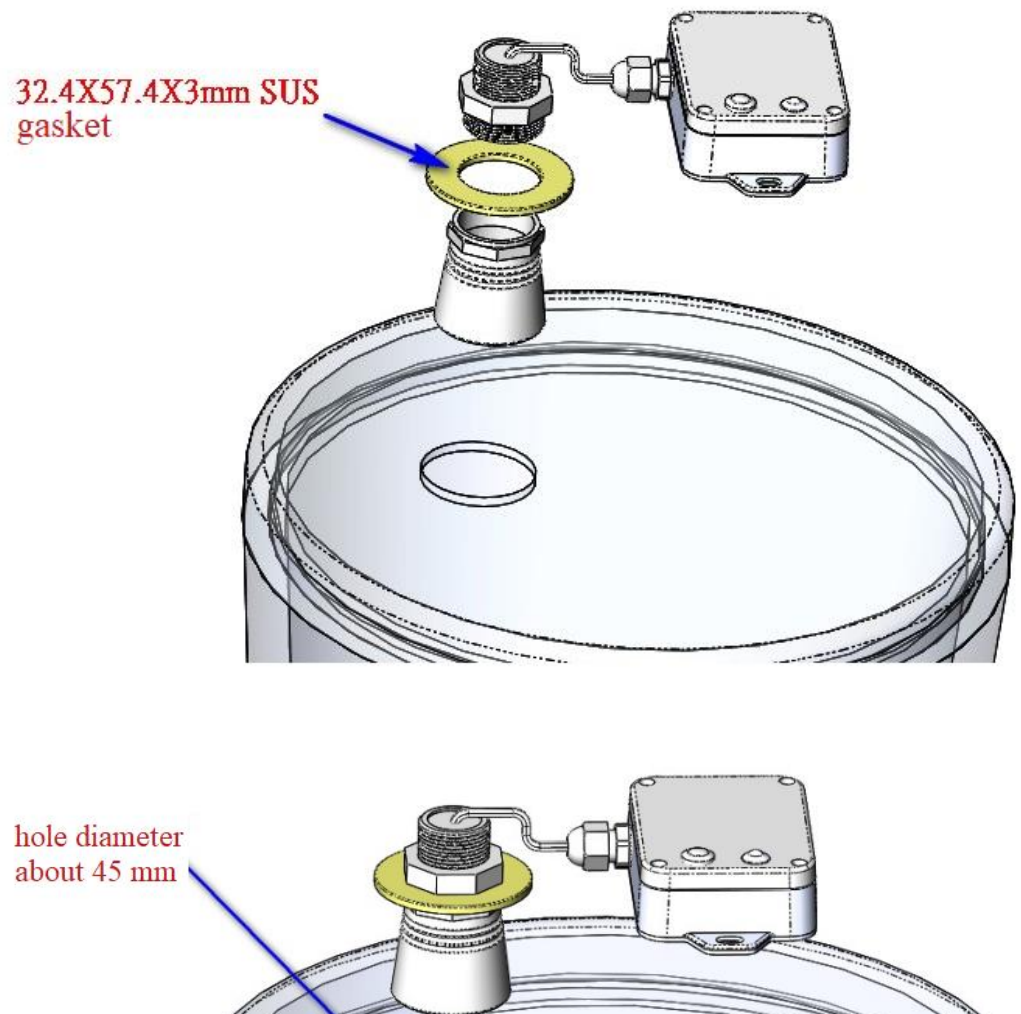
tan10°	A	B
0.1763	5.29	30
	8.82	50
	17.63	100
	26.45	150
	35.26	200
	44.08	250
	52.89	300
	61.71	350
	70.52	400
	79.34	450
	88.15	500
	96.97	550
	105.78	600
	114.60	650
	123.41	700
	132.23	750
	141.04	800

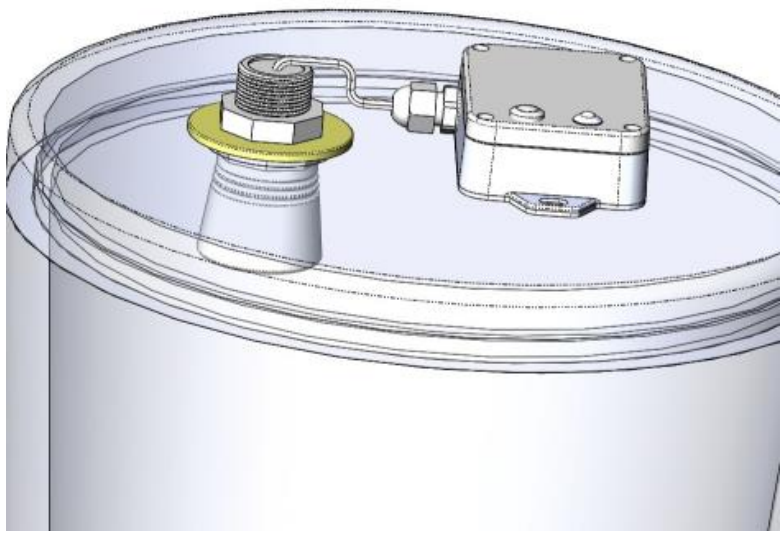
Reference Form Unit: cm



Installation method for reference

Open a hole about 45mm on the top of the container of the level to be measured, extend the probe of the lower half of the washer into the hole, and then fix it. The schematic diagram is as follows:





Installation precautions

1. The installation position of the ultrasonic probe is required to be perpendicular to the center of the plane of the measured object. When the plane of the measured object is small, if the installation position deviates from its center, it will have a great impact on the test results.
2. The installation site should be as far away as possible from the device that produces strong electromagnetic interference.

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 the 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 Instruction

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

• Do not use or store in dusty or dirty areas. This way can damage its detachable parts and electronic components.

• Do not store in an excessive heat place. High temperatures can shorten the life of electronic devices, destroy batteries, and deform or melt some plastic parts.

• Do not store in excessively cold places. 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. Treating equipment roughly can destroy internal circuit boards and delicate structures.

• Do not wash with strong chemicals, detergents, or strong detergents.

• Do not paint the device. Smudges can make debris block detachable parts and affect normal operation.

• Do not throw the battery into the fire to prevent the battery from exploding. Damaged batteries may also explode.

All the above suggestions apply equally to your device, batteries, and accessories.

If any device is not operating properly, please take it to the nearest authorized service facility for repair.