

Wireless Top Mounted Ultrasonic Liquid Level Sensor

R718PE User Manual

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1. Introduction

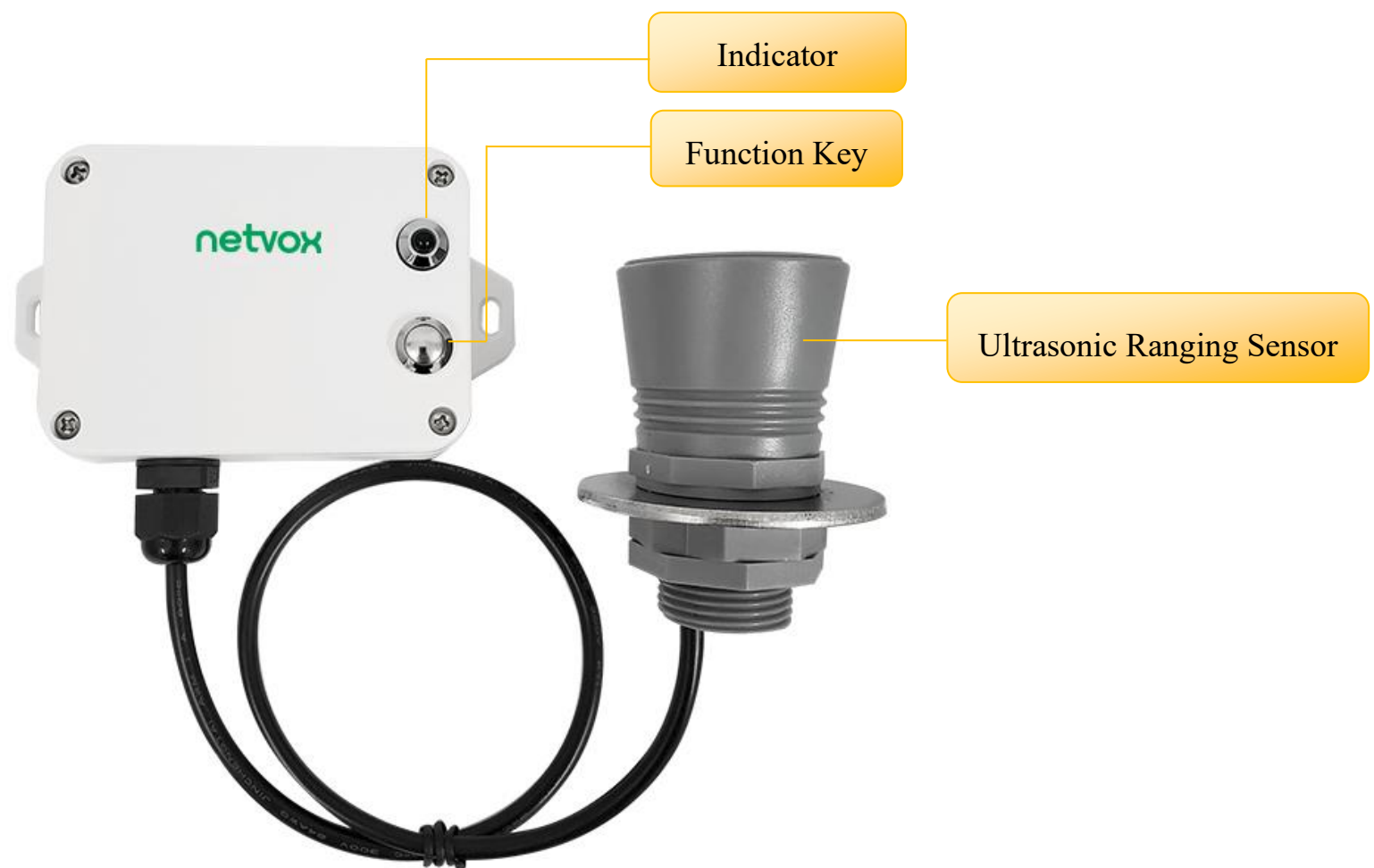
R718PE is a Class A device based on LoRaWAN open protocol of Netvox. R718PE is a wireless communication device that can detect liquid level and parking space. The device is connected to an ultrasonic sensor to detect its current liquid level or the status of parking space, and the detected data will be transmitted to other devices through the wireless network for display. The detection angle of R718PE is about 15°, which is suitable for distance detection in small space. It adopts SX1276 wireless communication module and 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. Features

- Apply SX1276 wireless communication module
- 2 sections ER14505 3.6V AA size batteries parallel power supply
- Liquid level detection/ parking space detection
- Main Unit 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 until the green indicator flashes once.
Turn off (Restore to factory setting)	Press and hold the function key for 5 seconds until green indicator flashes 20 times.
Power off	Remove Batteries.
Note:	<ol style="list-style-type: none"> 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	<p>Turn on the device to search the network to join.</p> <p>The green indicator stays on for 5 seconds: success</p> <p>The green indicator remains off: fail</p>
Had joined the network (not at factory setting)	<p>Turn on the device to search the previous network to join.</p> <p>The green indicator stays on for 5 seconds: success</p> <p>The green indicator remains off: fail</p>
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	<p>Restore to factory setting / Turn off</p> <p>The green indicator flashes for 20 times: success</p> <p>The green indicator remains off: fail</p>
Press once	<p>The device is in the network: green indicator flashes once and sends a report</p> <p>The device is not in the network: green indicator remains off</p>

Sleeping Mode

The device is on and in the network	<p>Sleeping period: Min Interval.</p> <p>When the reportchange exceeds setting value or the state changes: send a data report according to Min Interval.</p>
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Low Voltage Warning

Low Voltage	3.2V
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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: 0x0384 (900s)

Minimum time: 0x0384 (900s)

Battery Voltage Change - 0x01 (0.1V)

Distance Change - 0x012C (300mm)

Data packet:

a. When used in level / material level detection:

R718PE reports Battery voltage, Distance, Fill Level ; Status=0 (Invalid)

b. When used in parking detection:

R718PE 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 bytes –0x01—the Version of NetvoxLoRaWAN Application Command Version

DeviceType – 1 byte – Device Type of Device

The devicetype is listed in Netvox LoRaWAN Application Devicetype V1.9.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 to 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 01B1000A04202001060000, the firmware version is 2020.01.06

3. Data Packet:

When Report Type=0x01 is data packet.

Device	Device Type	Report Type	NetvoxPayLoadData				
R718PE	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)

Example of Uplink: 01B1019F00019014000000

1st byte (01): Version

2nd byte (B1): DeviceType

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

6th 7th byte (0190): Distance 400 mm, 0190 (HEX) = 400 (DEC), 400* 1 mm = 400 mm

8th byte (14): FillLevel 20%, 14 (HEX) = 20 (DEC), 20* 1% = 20%

9th – 11th byte (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					
				MinTime (2bytes Unit: s)	MaxTime (2bytes Unit: s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2byte)	
Config ReportReq	R718PE	0x01	0xB1	MinTime (2bytes Unit: s)	MaxTime (2bytes Unit: s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Reserved (2byte)	
Config ReportRsp		0x81		Status (0x00_success)	Reserved (8Bytes, Fixed 0x00)				
ReadConfig ReportReq		0x02		Reserved (9Bytes, Fixed 0x00)					
ReadConfig ReportRsp		0x82		MinTime (2bytes Unit: s)	MaxTime (2bytes Unit: s)	BatteryChange (1byte Unit: 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)		
SetDeadZoneDistanceReq		0x0B		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)		
SetDeadZoneDistanceRsp		0x8B		Status(0x00_success)			Reserved (8Bytes,Fixed 0x00)		
GetDeadZoneDistanceReq		0x0C		Reserved (9Bytes,Fixed 0x00)					
GetDeadZoneDistanceReq	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:

81B10000000000000000 (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

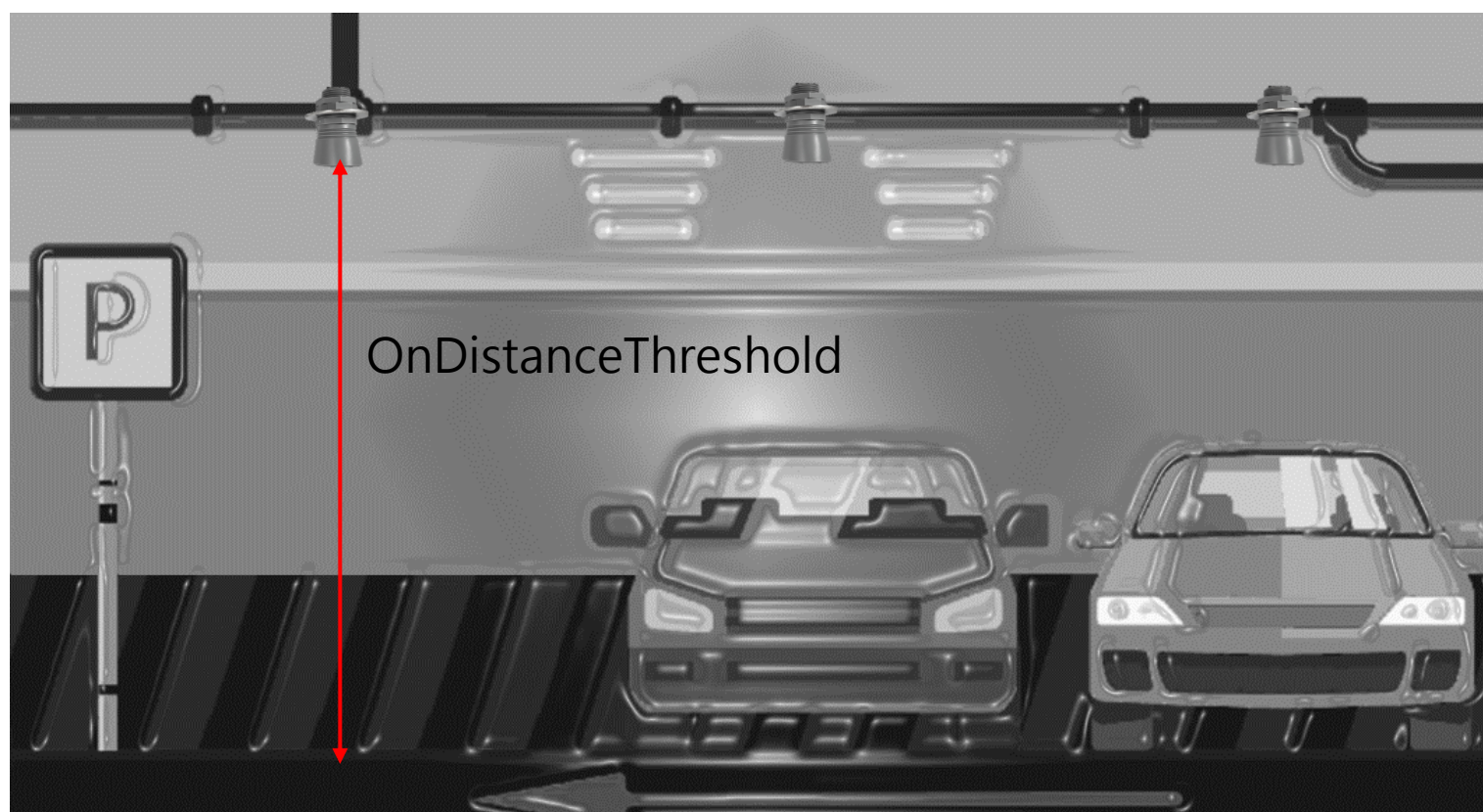
Device returns:

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 liquid 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 liquid level detection, first set OnDistanceThreshold to 0, and then set FillMaxDistance.



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

- a. Set FillMaxDistance =0

Downlink: 05B10000000000000000

Device returns:

85B10000000000000000

- b. Read FillMixDistance, confirm whether it has been set successfully

Downlink: 06B10000000000000000

Device returns:

86B10000000000000000

- c. Set OnDistanceThreshold= 500mm

Downlink: 03B101F4000000000000

Device returns:

83B10000000000000000

- d. Read OnDistanceThreshold, confirm whether it has been set successfully

Downlink: 04B10000000000000000

Device returns:

83B101F4000000000000

5.4 Example of DeadZoneDistance

SetDeadZoneDistance:

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

Device returns:

8BB100000000000000000000

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: 023600000000000000000000

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: 813600000000000000000000

GetGlobalCalibrateReq:

Downlink: 023600000000000000000000

Device returns: 82360000010001FF9C0000

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

ClearGlobalCalibrateReq:

Downlink: 030000000000000000000000

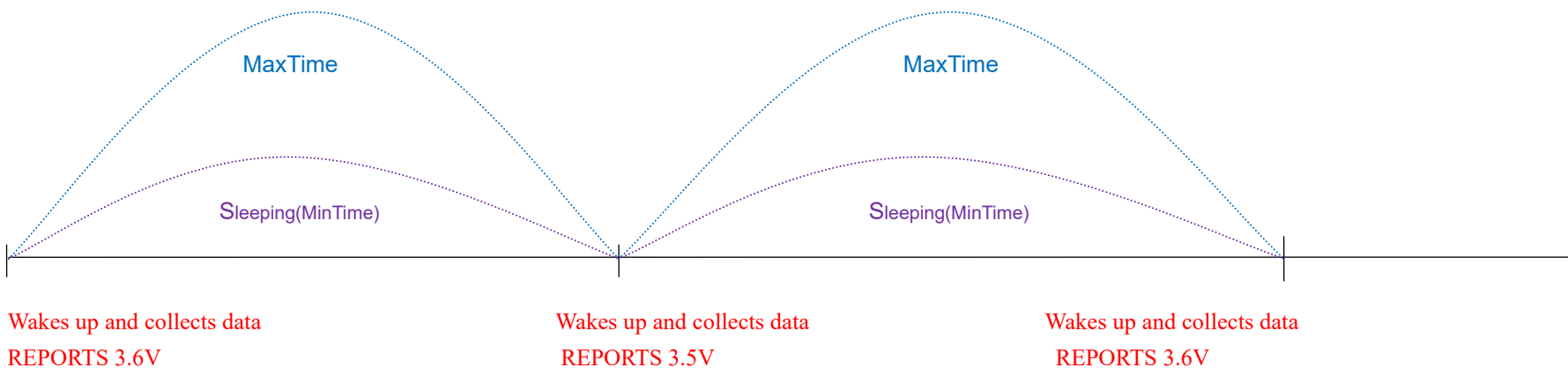
Device returns: 830000000000000000000000

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

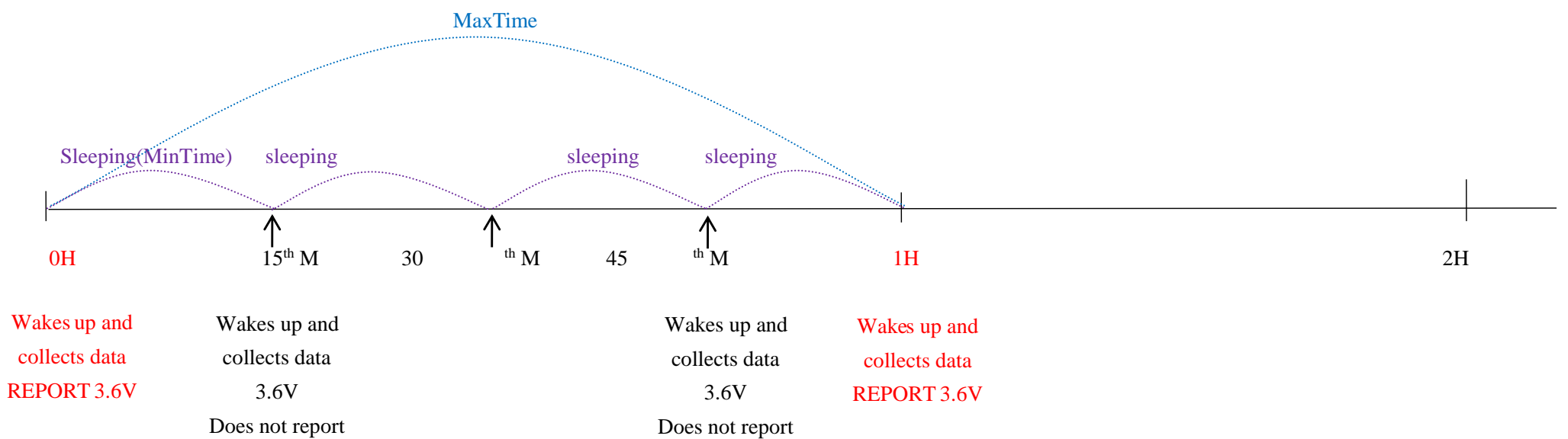
5.6 Example for MinTime/MaxTime logic

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

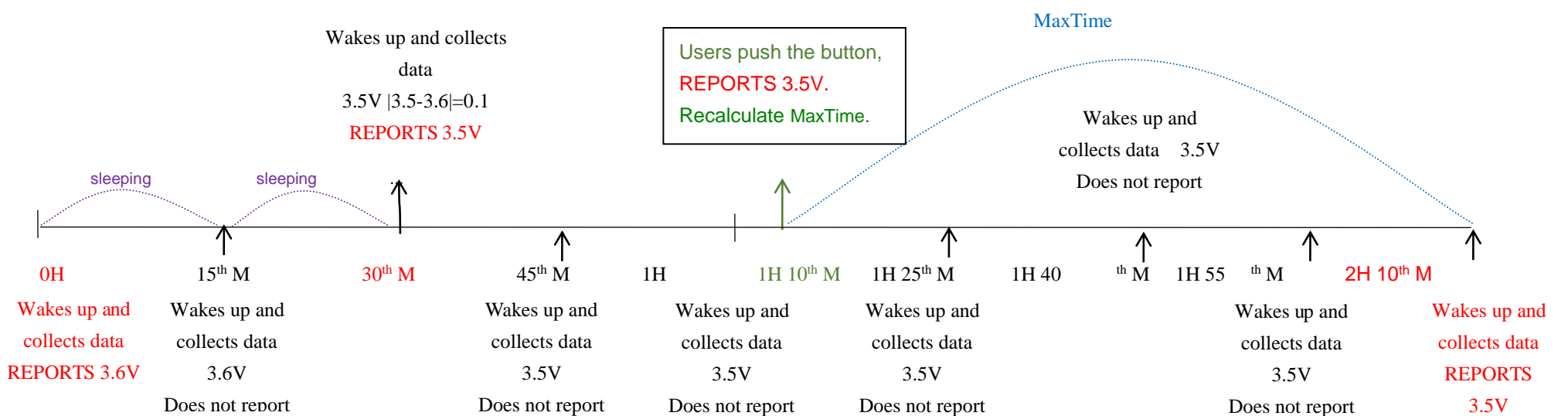


Note:
MaxTime=MinTime. Data will only be report according to MaxTime (MinTime) duration regardless BatteryVoltageChange value.

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. Applications

In the case of detecting the water level of a water tower/tank, install the device on the top of the water tower/tank and power on the device after the fixation is completed. The device collects the distance between the water level and the sensor and the percentage of the water level in the water tower/tank once in a while.

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

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

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

Calculation: $L = \text{fillmaxdistance} - \text{distance}$

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

FillLevel: the percentage of the water level in the water tank.

The value of the total height of the water tank / tower can be set through commands according to the specific scene.

Illustration 1

$$\text{FillLevel} = ((H - D) / H) * 100\%$$

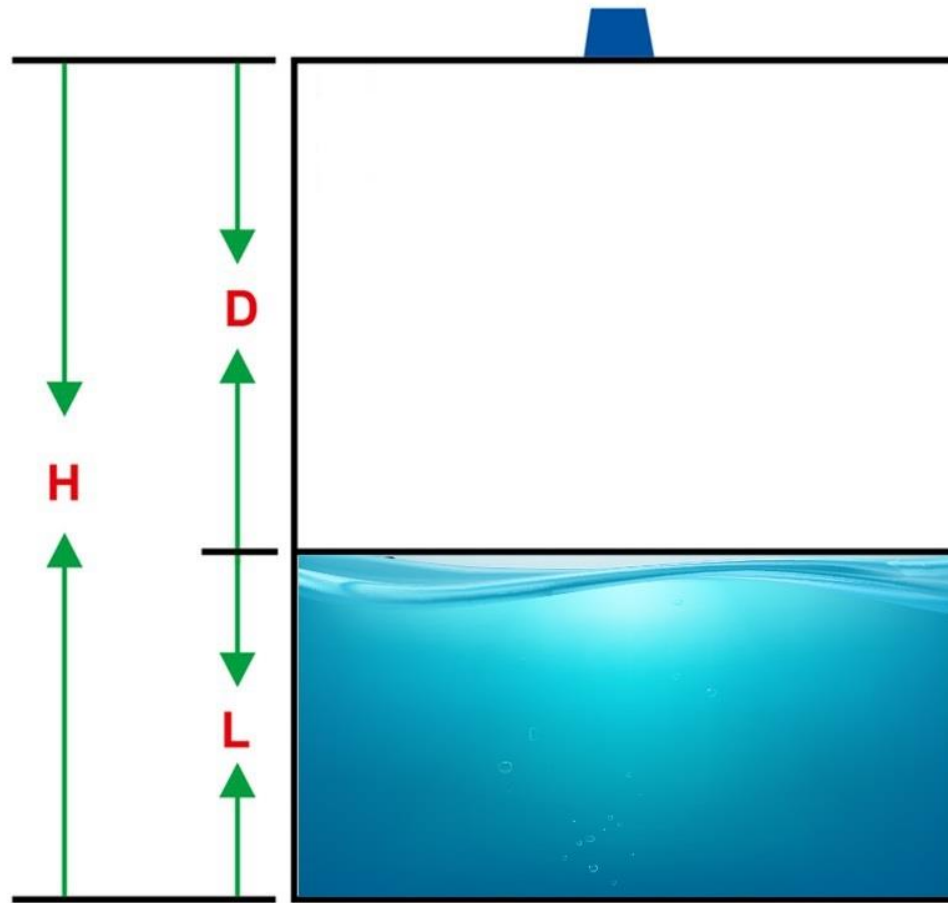
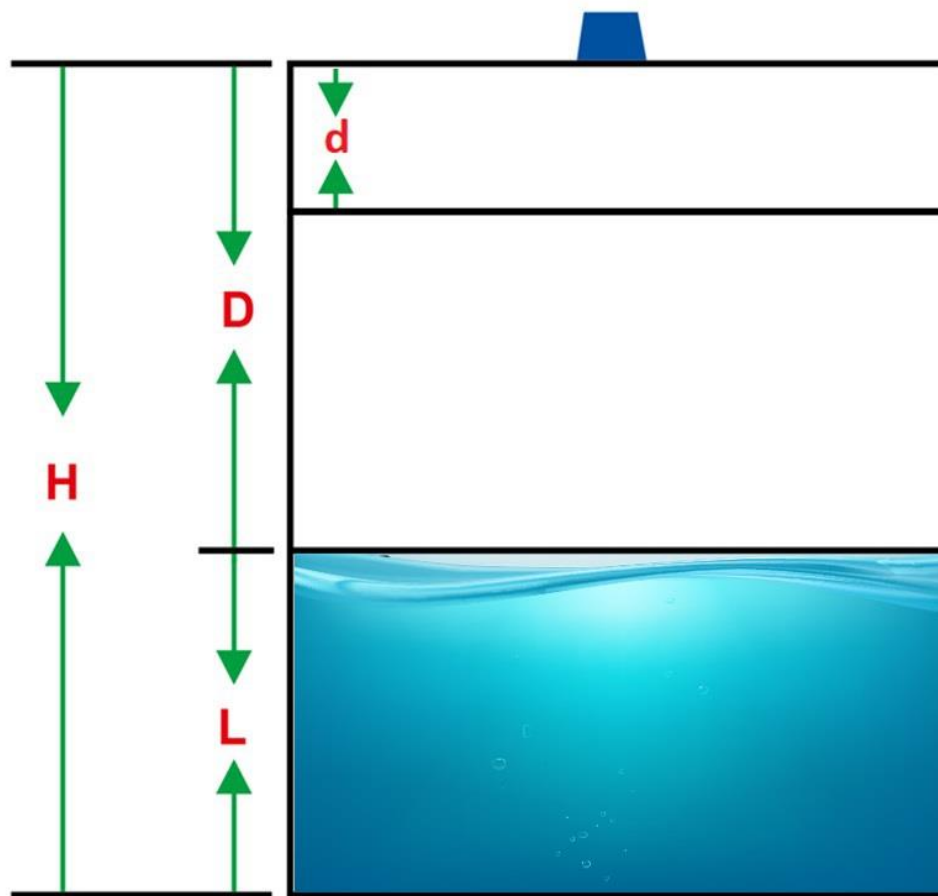


Illustration 2

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

$$\text{FillLevel} = ((H - D) / H-d) * 100\%$$



Note:

- (1) The detecting range of the device is **250mm~8000mm**
- (2) When the device is used as water level detection or trash can detection, the detected distance (Distance) and the percentage of water level or garbage (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 $\text{Distance} \leq \text{OnDistanceThreshold}$, 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

Installed in a container

Kindly note the illustration is only for reference.

1. The device can be installed in the middle or anywhere of the top of the container that is flat enough to ensure the ultrasonic detection direction will be vertical to the detected object, so the accuracy can be maintained.
2. When the use case is water tank, the diameter of the water tank is recommended to be larger than 60cm.
3. Customers can refer to the below formula to see if the container is suitable:

$$\tan 7.5^\circ = A / B$$

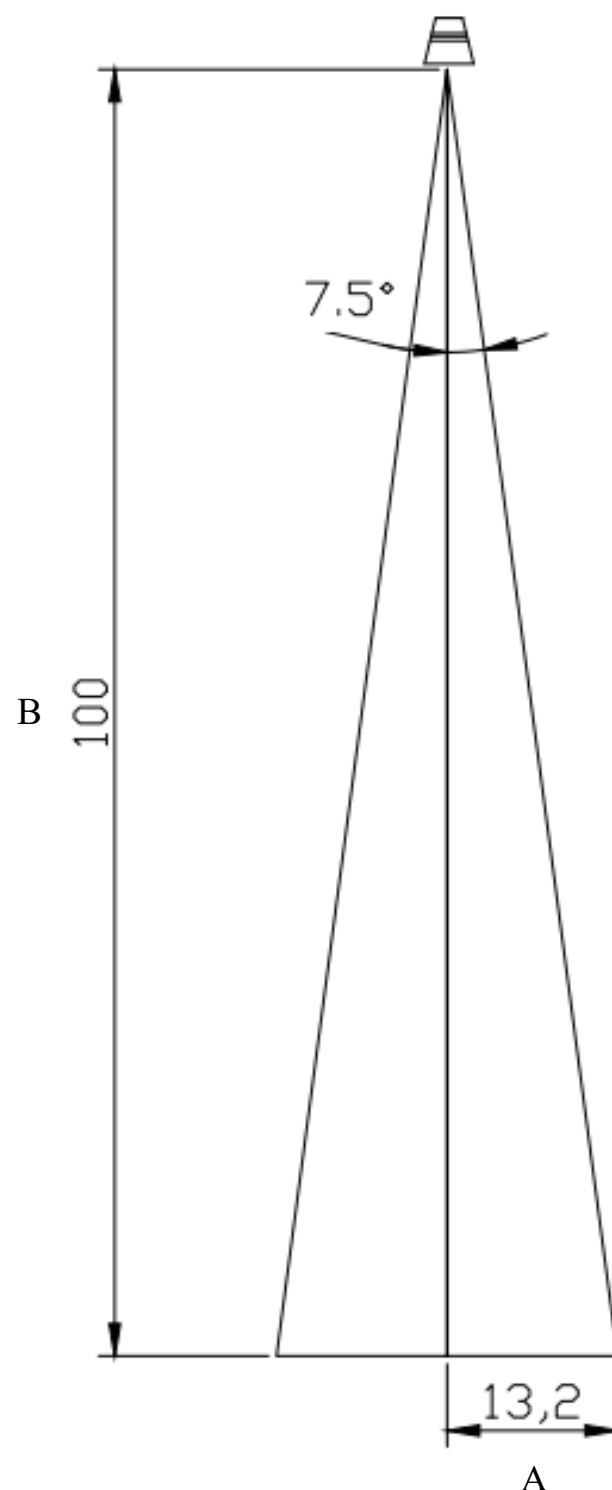
A is the radius of the container (water tank),

B is the height of the container (water tank);

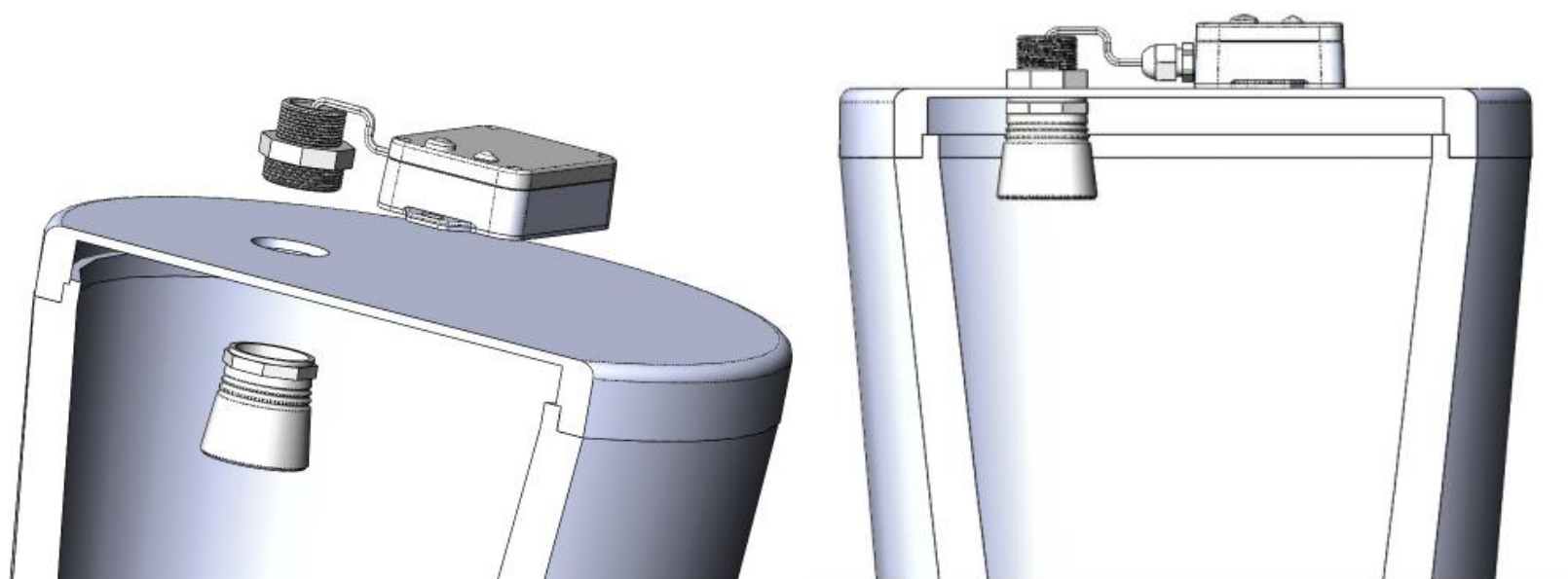
$\tan 7.5^\circ$	A	B
0.1316	3.9	30
	6.6	50
	13.2	100
	19.7	150
	26.3	200
	32.9	250
	39.5	300
	46.1	350
	52.6	400
	59.2	450
	65.8	500
	72.4	550
	79.0	600
	85.5	650
	92.1	700
98.7	750	
105.3	800	

Reference Form

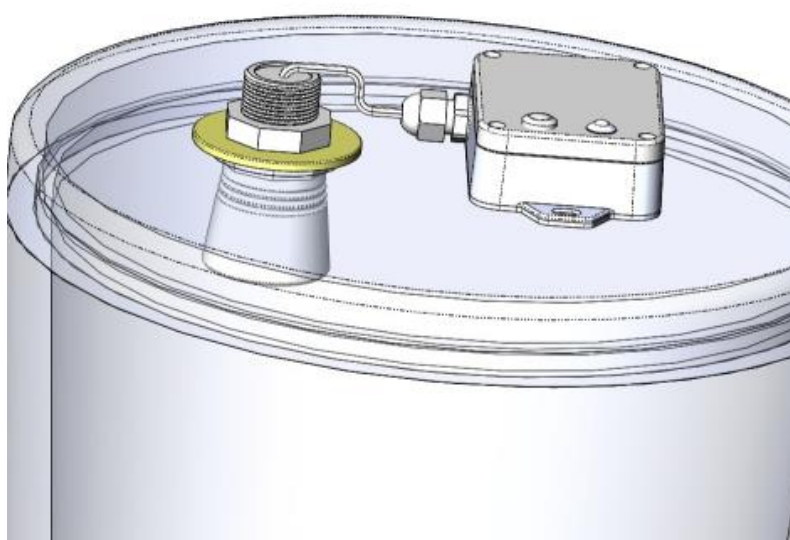
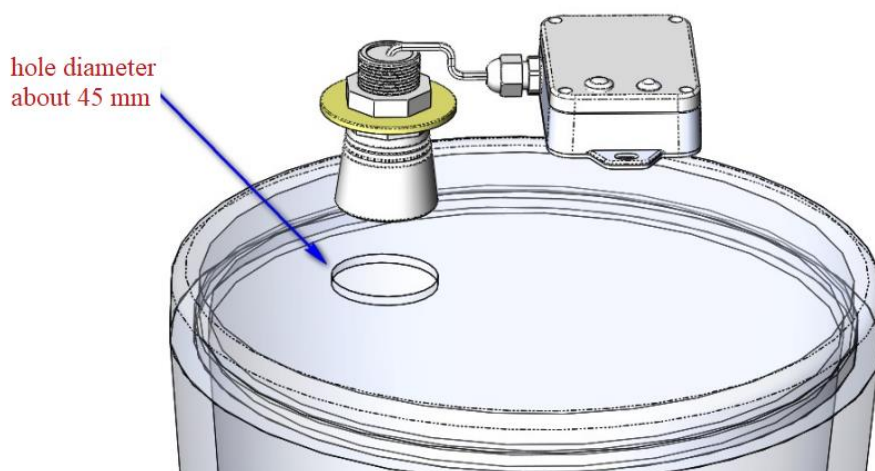
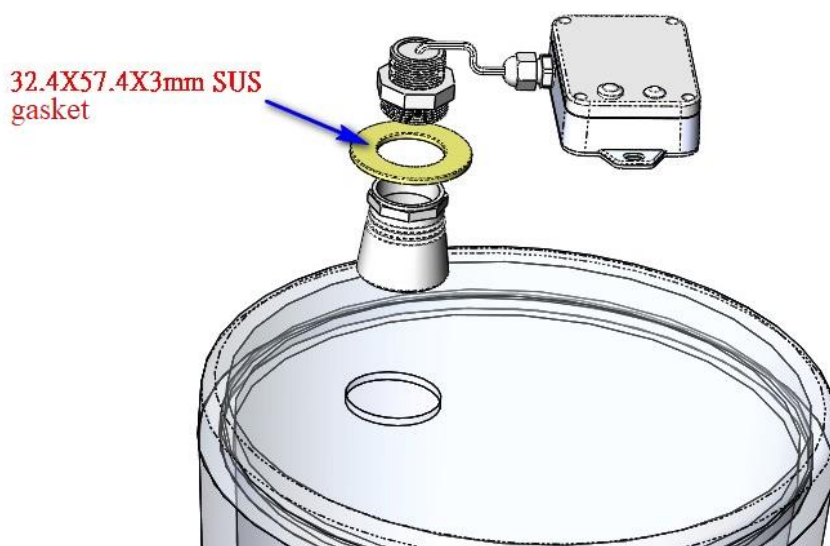
Unit: cm



4. If the top of the water tank can be opened, it is recommended to make a hole of diameter 32mm on the top of the water tank.



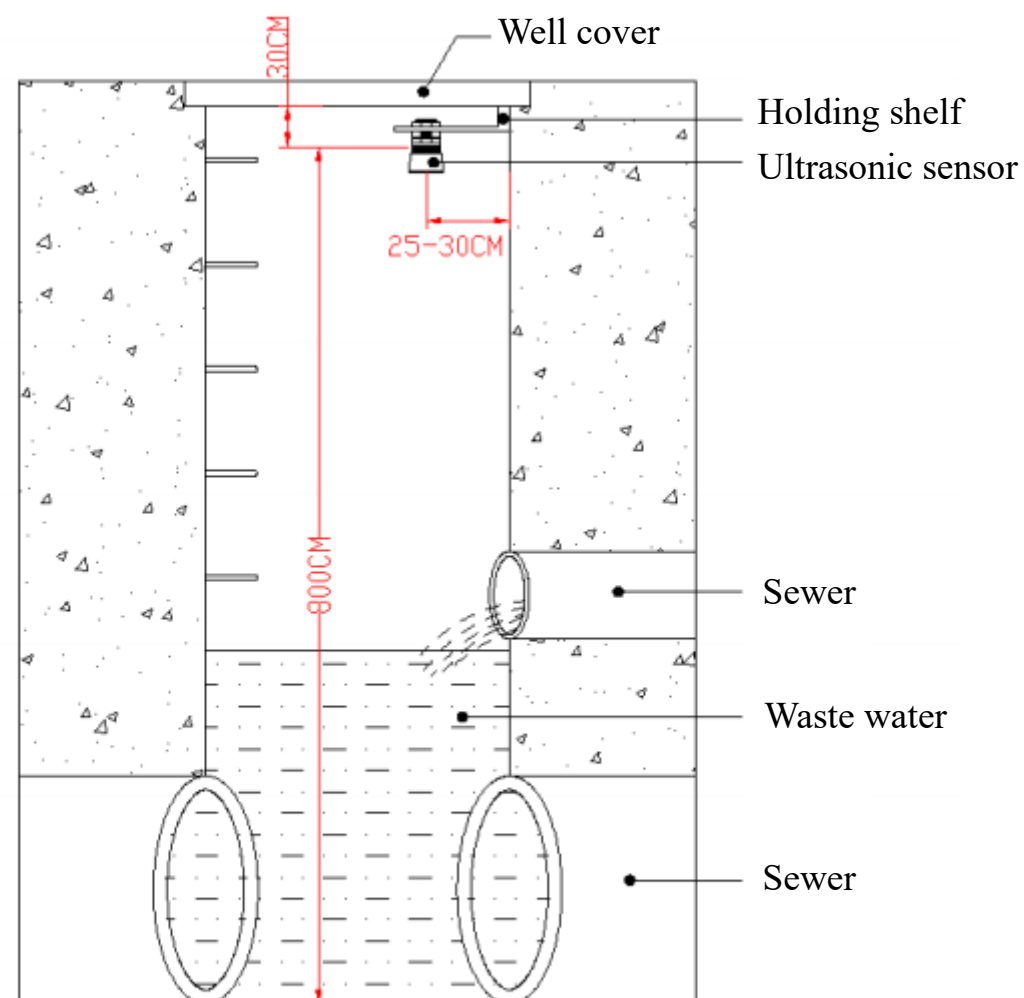
5. If the top of the water tank cannot be opened, the hole made on the top of the water tank is recommended to be 45mm diameter. It is recommended to add a gasket (size: 32.4*57.4*3mm) between the hole and the sensor.



6. The place directly below the ultrasonic probe should avoid to be put in some position to reduce the impact on measurement accuracy. For example, the position that the liquid level is violently fluctuating such as the water inlet and outlet, and the position that foam floats are easy to accumulate.
7. There should be no obstacles within the radiation range of the ultrasonic beam to avoid affecting the measurement. For example, when installing in a well, it should avoid escalators, water inlet and outlet pipes and other facilities in the well.
8. The installation site should be far away from the equipment that produces strong electromagnetic interference.
9. The user only needs to disassemble and assemble the new battery when installing it.

Please do not touch the waterproof adhesive strip, waterproof fixing head, waterproof LED light and waterproof bottom during the process of assembling the battery. After the installation of the battery, an electric screwdriver with a torque of 4kgf must be used to assemble the shell screws (if there is no electric screwdriver, please use a cross screwdriver with an appropriate screw to assemble and lock to ensure that the upper cover and the lower cover are assembled tightly), otherwise the air tightness after assembly will be affected. When disassembling and assembling the device, it is recommended to understand the internal structure of the device first to avoid device damage.

Installed in a well



If users would like to install the R718PE in a well, the device shall be fixed far from the ladder. The sensor should be vertical to the water surface and horizontal to the wall of the well. It should be installed 25 to 30 cm away from the wall of the well and less than 30 cm away from the well cover.

Cautions:

1. Please keep the chip surface clean. Make sure nothing blocks the ultrasonic sensor.
2. Please use a soft fabric to clean the chip in case it gets scratched.
3. Please keep the device away from strong acids or alkalis.
4. The probe should be kept still.
5. Please mind the lightning stroke if the device is used for outdoor purposes.
6. Please make sure the output current is stable during operation.

Note: If the device is used for horizontal measurements, it should be installed ≥ 30 cm away from the floor. (The distance could be > 30 cm if the floor is uneven.)

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°	3°
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.		<p>Advantages:</p> <p>Accurate measurement, not affected by the surface state of the detected object, and can be used for slope measurement.</p> <p>Disadvantages:</p> <p>Susceptible to dust, and steam. Unable to measure transparent liquids.</p>

9. Information about Battery Passivation

Many 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 Instruction

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

- Keep the device dry. Rain, moisture, and various liquids or water may contain minerals that can corrode electronic circuits. In case the device is wet, please dry it completely.
- 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.