

# **Wireless Capacitive Proximity Sensor**

## **R718VB**

## **User Manual**

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## 1. Introduction

R718VB is to detect the level of toilet tank water, liquid hand soap, and liquid level of non-metallic pipes (pipe outside diameter:  $D \geq 11\text{MM}$ ). This device is connected to a non-contact capacitive sensor, which can be installed on the exterior of the container. Without direct contact, the sensor can detect the current level of water or liquid hand soap within the measurement range. The collected data could be transmitted to and displayed by other devices through the wireless network.

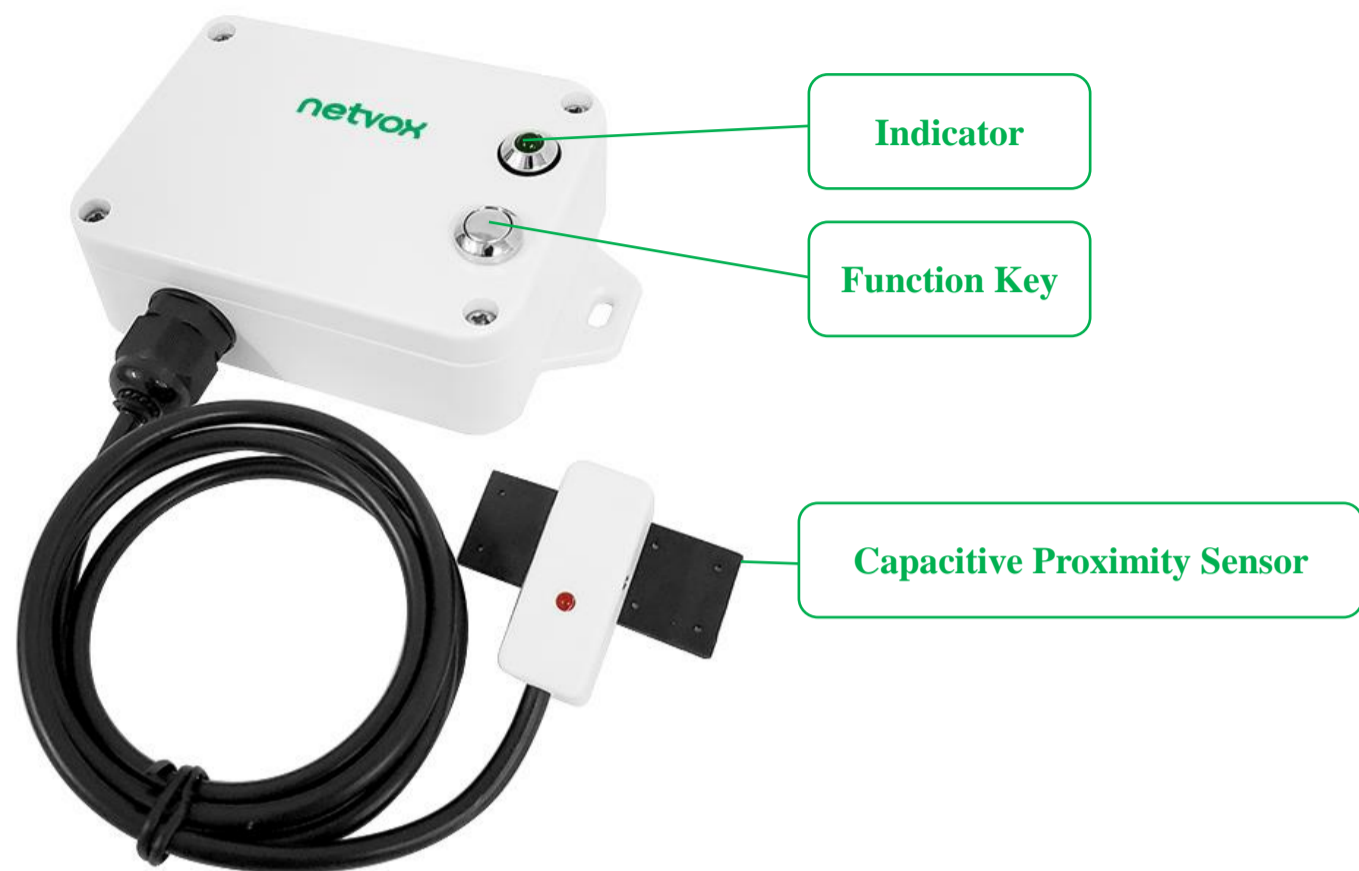
### **LoRa Wireless Technology**

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



## 3. Features

- Non-contact capacitive sensor
- 2 ER14505 battery AA SIZE (3.6V/section) in parallel
- SX1276 wireless communication module
- Main body: IP65/IP67 (optional); sensor probe: IP67
- Magnetic base
- LoRaWAN™ Class A compatible
- Frequency hopping spread spectrum technology
- Configuration parameters can be configured through third-party software platforms, data can be read and alerts can be set via SMS text and email (optional)
- Applicable to third-party platforms: 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](http://www.netvox.com.tw/electric/electric_calc.html). On this website, users can find various types of battery lifetime in different configurations.

## 4. Set up Instruction

### On/Off

Power on	Insert batteries. (Users may need a screwdriver to open battery case.)
Turn on	Press and hold the function key for 3 seconds until the green indicator flashes once.
Turn off (factory resetting)	Press and hold the function key for 5 seconds until the green indicator flashes for 20 times.
Power off	Remove Batteries.
Note	<ol style="list-style-type: none"> <li>1. Remove and insert the battery; the device is at off state by default. Please turn on the device to use again.</li> <li>2. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components.</li> <li>3. At 1<sup>st</sup> to 5<sup>th</sup> second after power on, the device will be in engineering test mode.</li> </ol>

### 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 yet restore to 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 (when the device is on)	<p>First two mins: wake up every 15 seconds to send request.</p> <p>After two mins: enter sleeping mode and wake up every 15 minutes to send request.</p> <p>Note: Suggest to remove batteries if the device is not used to save power.</p> <p>Suggest to check the device verification information on the gateway or consult your platform server provider.</p>

### 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: the green indicator flashes once and sends a report</p> <p>The device is not in the network: the 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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The device is on but not in the network	<p>First two mins: wake up every 15 seconds to send request.</p> <p>After two mins: enter sleeping mode and wake up every 15 minutes to send request.</p> <p>Note: Suggest to remove batteries if the device is not used.</p> <p>Suggest to check the device verification information on the gateway or consult your platform server provider.</p>
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### Low Voltage Warning

Low Voltage	3.2V
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## 6. Data Report

The device will immediately send a version packet report along with an uplink packet including liquid level status, battery voltage.

The device sends data in the default configuration before any configuration is done.

#### Default Setting:

Maximum time: 0x384 (15min)

Minimum time: 0x384 (15min) (Detect the current voltage value and liquid level status every Min Interval)

BatteryVoltageChange: 0x01 (0.1V)

#### R718VB detection status:

As the device detects liquid, the device would send a report of current status and battery voltage.

The threshold could be modified through sensitivity adjustment as the distance between liquid and sensor reaches the threshold.

When the device detects liquid level, status = 1; the device does not detect liquid level, status = 0

Under two conditions, the device will report the status of the detected liquid and the battery voltage at MinTime interval:

- a. When the liquid level changes from where the device can detect to where the device cannot detect. (1→0)
- b. When the liquid level changes from where the device cannot detect to where the device can detect. (0→1)

If none of the above conditions is met, the device will report at the MaxTime interval.

Please refer Netvox LoRaWAN Application Command document and Netvox Lora Command Resolver

<http://cmddoc.netvoxcloud.com/cmddoc> to resolve uplink data.

Note: The device send data cycle depends on real programming configuration according to the customer's inquiry.

The interval between two reports must be the minimum time.

## 6.1 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

**ReportType** – 1 byte - the presentation of the NetvoxPayLoadData, according the devicetype

**NetvoxPayLoadData**– Var (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 019F000A02202108130000, the firmware version is 2021.08.13.

#### 2. Data Packet:

When Report Type=0x01 is data packet.

Device	DeviceType	ReportType	NetvoxPayLoadData			
R718VB	0x9F	0x00	SoftwareVersion (1 Byte) Eg.0x0A-V1.0	HardwareVersion (1 Byte)	DateCode (4 Byte) eg 0x20170503	Reserved (2 Byte, fixed 0x00)
		0x01	Battery (1Byte, unit:0.1V)	Status (1Byte 0:off 1:on)	Reserved (6Bytes, fixed 0x00)	

Example of Uplink: 019F01240000000000000000

1st byte (01): Version

2nd byte (9F): DeviceType 0x9F – R718VB

3rd byte (01): ReportType

4th byte (24): Battery – 3.6v    24 Hex=36 Dec    36\*0.1v=3.6v

5th byte (00): Status

6th-11th byte (000000000000): Reserved

## 6.2 Example of Report Configuration

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	R718VB	0x01	0x9F	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byte Unit:0.1v)	Reserved (4Bytes, Fixed 0x00)
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)	Reserved (4Bytes, Fixed 0x00)

(1) Configure the device report parameters MinTime = 1min (003C), MaxTime = 1min (003C), BatteryChange = 0.1v (0x01)

Downlink: 019F003C003C0100000000

The device returns:

819F00000000000000000000 (configuration succeeded)

819F01000000000000000000 (configuration failed)

(2) Read the device configuration parameters

Downlink: 029F00000000000000000000

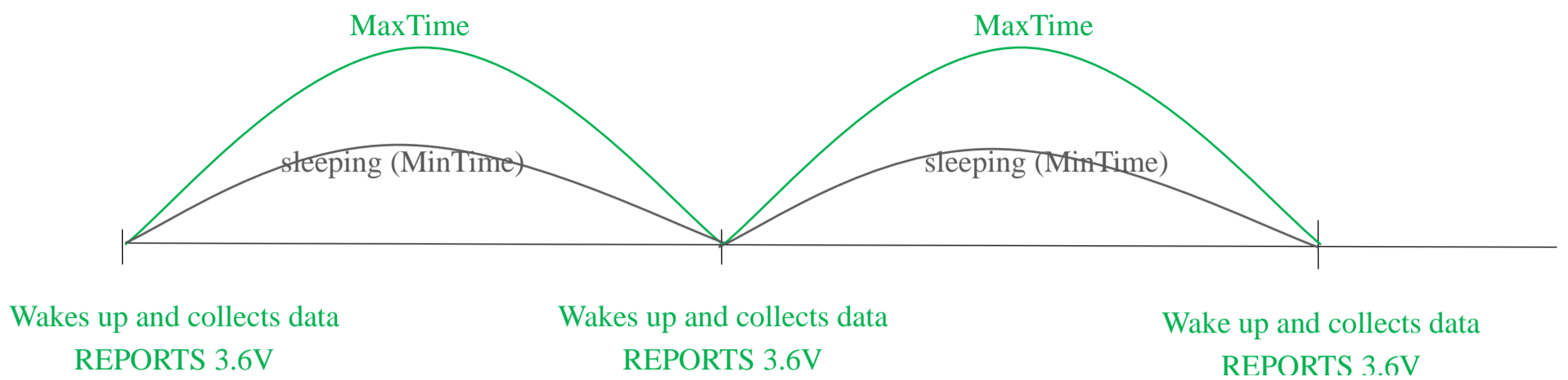
The device returns:

829F003C003C0100000000 (current configuration parameters)



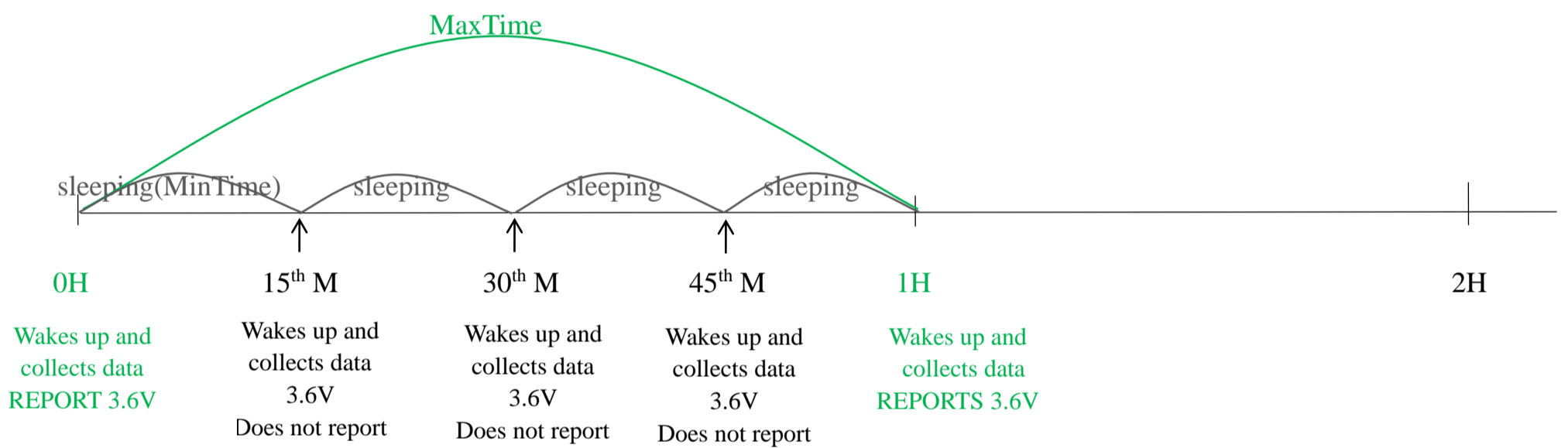
### 6.3 Example for MinTime/MaxTime logic

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

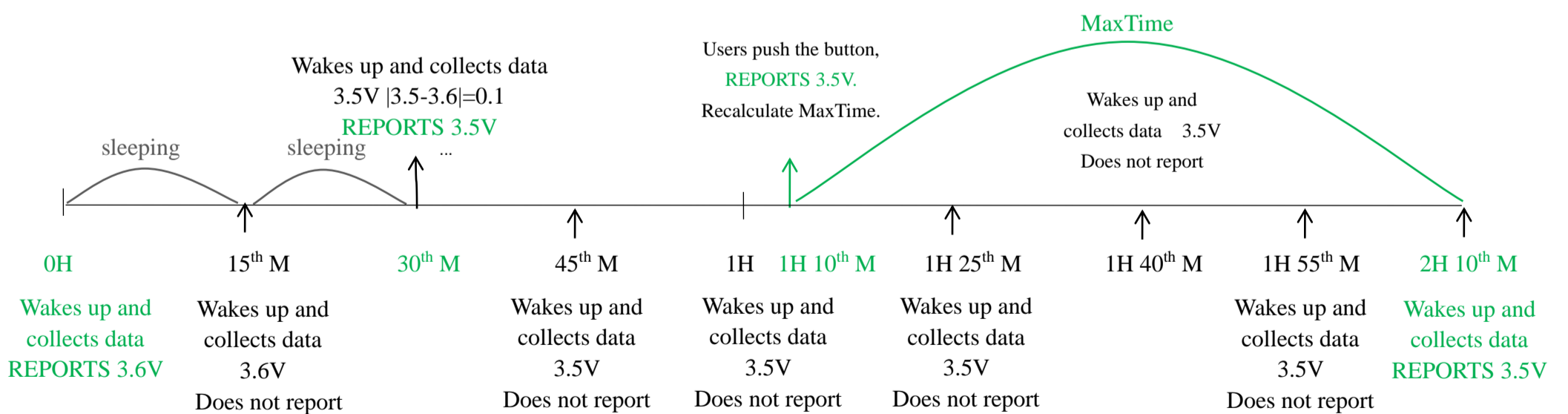


Note: MaxTime=MinTime. Data will only be report according to MaxTime (MinTime) duration regardless BatteryVoltageChange value.

**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 sleeping, 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.

## 7. Application

When the device is used to detect the water level of the toilet tank, please install the device at a desired level of the toilet tank.

Turn on the device after it is fixed to the toilet tank and powered. The device will detect the status regularly at the MinTime interval.

There are two conditions in which the device will report the status of the detected liquid and the battery voltage at MinTime interval:

- a. When the liquid level changes from where the device can detect to where the device cannot detect
- b. When the liquid level changes from where the device cannot detect to where the device can detect

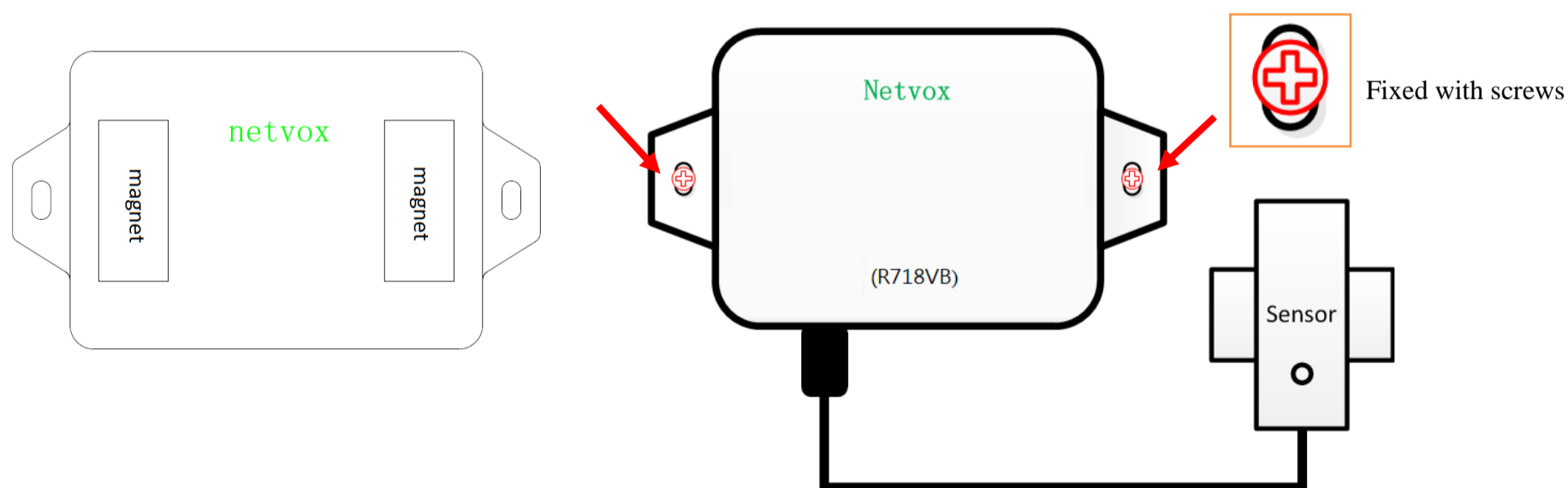
If none of the above conditions is met, the device will report at the MaxTime interval.

## 8. Installation

Wireless Capacitive Proximity Sensor (R718VB) has two magnets on the back. When using it, the back can attach to a ferromagnetic material, or the two ends can be fixed to the wall with screws (should be purchased)

Note:

Do not install the device in a metal shielded box or around electrical equipment or it may affect the wireless transmission of the device.



## 8.1 Measurement and liquid viscosity

### 8.1.1 What is dynamic viscosity?

Dynamic viscosity is the tangential force per unit area required to move one horizontal plane with respect to another plane - at an unit velocity - when maintaining an unit distance apart in the fluid.

### 8.1.2 Dynamic viscosity

A.  $< 10\text{mPa}\cdot\text{s}$  (the liquid can be measured)

B.  $10\text{mPa}\cdot\text{s} < \text{Dynamic viscosity} < 30\text{mPa}\cdot\text{s}$  (the results may be affected)

C.  $> 30\text{mPa}\cdot\text{s}$  (cannot be measured due to a large amount of liquid attached to the container wall)

Note: The viscosity decreases as the temperature rises. Liquid with high viscosity is easily affected by temperature. To get accurate result, please mind the liquid temperature while measuring.

### 8.1.3 Common substances

Substance	Viscosity (mPa·s)	Temperature (°C)
Benzene	0.604	25
Water	1.0016	20
Mercury	1.526	25
Whole milk	2.12	20
Olive oil	56.2	26

Reference source: <https://en.wikipedia.org/wiki/Viscosity>

## 8.2 Containers and installation instruction

1. Fix the probe by glue and tapes or held by tiny shelf on the outside of the container.
2. Avoid metal materials around the probe to get accurate result.
3. The place where the probe is installed should avoid the liquid and the flow path of the liquid.
4. There should be no silt or other debris inside the container where the lower probe is directly facing, so as not to affect the detection.
5. Containers made of non-metallic materials with flat surface, uniform thickness, tight material and good insulation performance; such as glass, plastic, non-absorbent ceramic, acrylic, rubber and other materials or their composite materials.

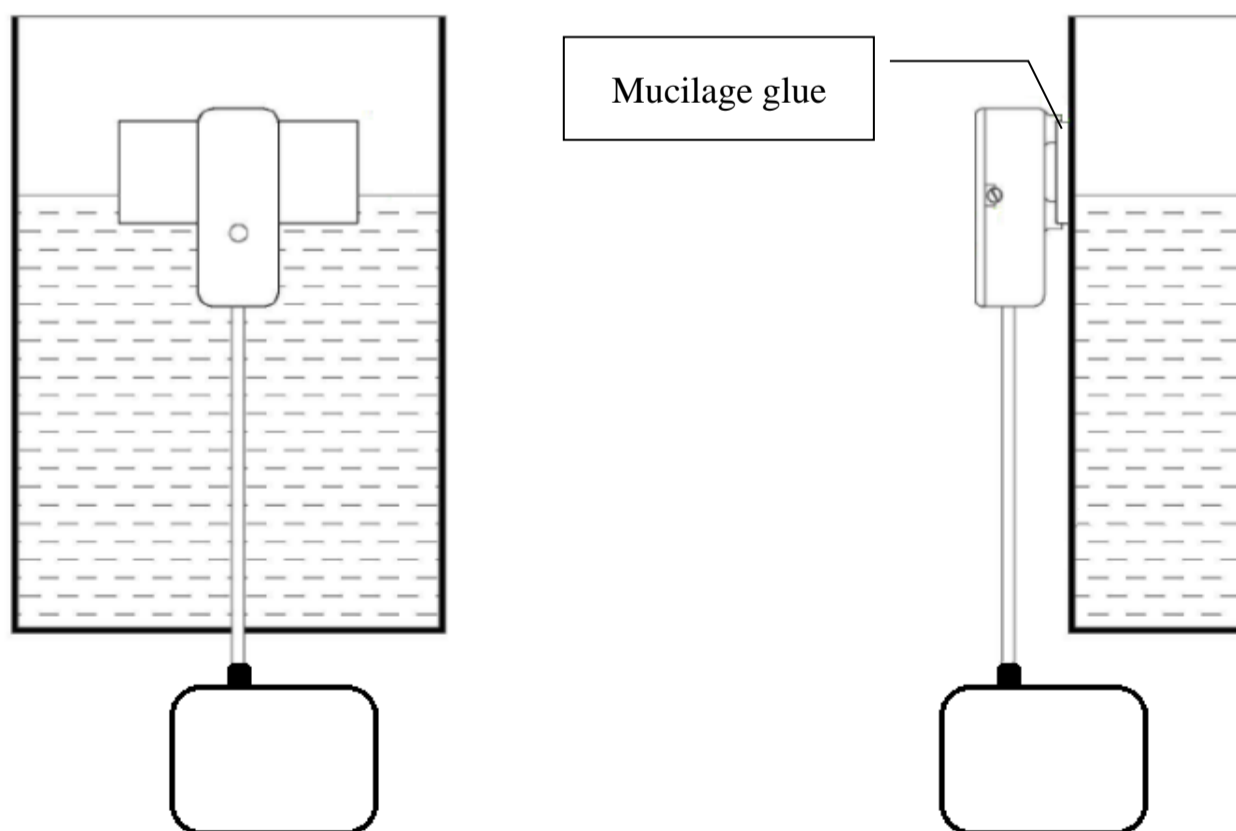
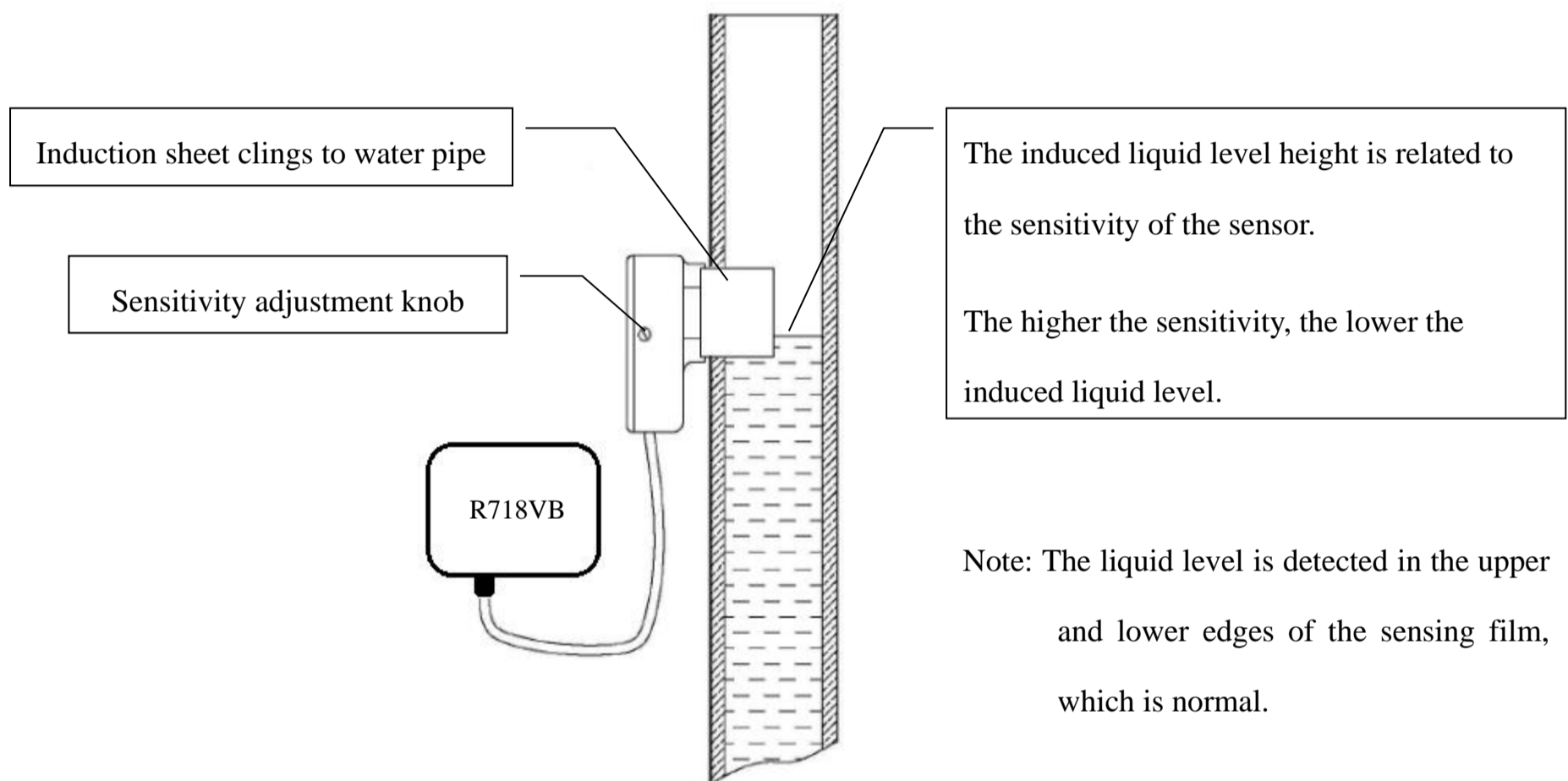
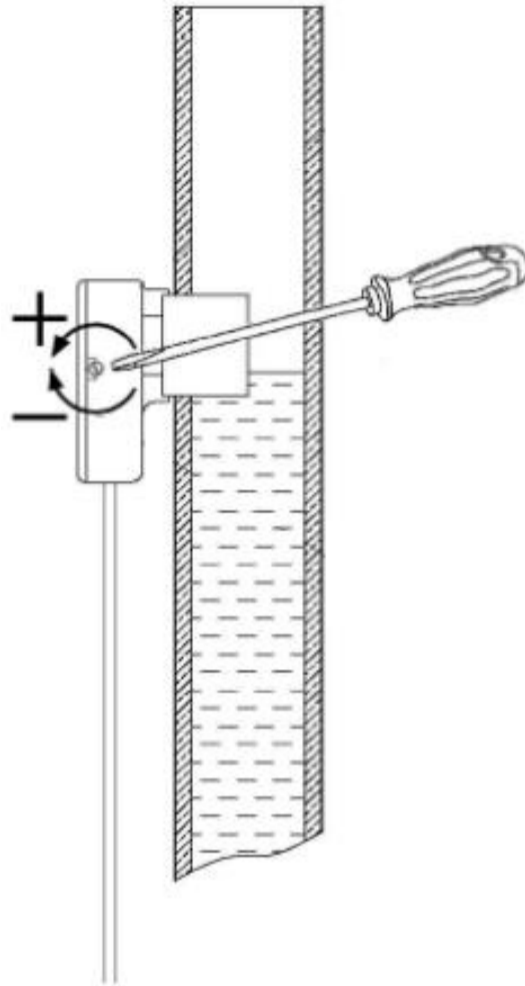


Figure 1. sensor installed on square or flat non-metallic container

### 8.3 Adjust sensitivity

1. Adjust the sensitivity knob with a small screwdriver,
2. Rotate counterclockwise to increase the sensitivity; clockwise to decrease the sensitivity  
(sensitivity from high to low 12 cycles in total.)



## 9. Information about Battery Passivation

Many of Netvox devices are powered by 3.6V ER14505 Li-SOCl<sub>2</sub> (lithium-thionyl chloride) batteries that offer many advantages including low self-discharge rate and high energy density. However, primary lithium batteries like Li-SOCl<sub>2</sub> 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  $\geq 3.3$ , indicating successful activation.

Brand	Load Resistance	Activation Time	Activation Current
NHTONE	165 $\Omega$	5 minutes	20mA
RAMWAY	67 $\Omega$	8 minutes	50mA
EVE	67 $\Omega$	8 minutes	50mA
SAFT	67 $\Omega$	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, 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 dusty or dirty environment. It might damage its detachable parts and electronic components.
- Do not store the device under excessively hot condition. 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 equipment can destroy internal circuit boards and delicate structures.
- Do not clean the device with strong chemicals or 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. Description of Waterproof Grade

1. According to Enclosure Protection Class, this standard is equivalent to IEC 60529:2001 Degrees of Protection Provided by Enclosures (IP Code).
2. The test method of IP65 waterproof grade is: spray the device in all directions under 12.5L/min water flow for 3min, and the internal electronic function is normal.

The test method of IP67 waterproof grade is: the device is immersed in 1m deep water for 30min, and the internal electronic function is normal.

IP65 is dust-proof and able to prevent damage caused by water from nozzles in all directions from invading electrical appliances. It can be used in general indoor environments and sheltered outdoor environments. It is not suitable to be used in environments with high water pressure, high temperature, high humidity, or long-time exposure to sunlight and rainstorm. If it is really necessary to install in harsh environments, it is recommended to add rain and sun shields.



Figure 1. Install the device upside down.



Figure 2. Install the device under the rain/sun shield.