Wireless Ultrasonic Distance Sensor with Temperature Sensor

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R718X
User Manual

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1. Introduction

The R718X is a LoRaWAN Class A device and it is compatible with LoRaWAN protocol. R718X has a built-in ultrasonic ranging sensor that can detect the distance from the sensor to the detected object (for example: detect the height of garbage in the waste bin). R718X also has the temperature detection function, it can detect the temperature of the waste bin. R718X would send out the detected data through wireless network.

LoRa Wireless Technology:

LoRa is a wireless communication technology famous for its long-distance transmission and low power consumption. Compared with other communication methods, LoRa spread spectrum modulation technique greatly extend the communication distance. It can be widely used in any use case that requires long-distance and low-data wireless communications. For example, automatic meter reading, building automation equipment, wireless security systems, industrial monitoring. It has features like small size, low power consumption, long transmission distance, strong 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. Main Features

- Apply SX1276 wireless communication module

- 2 sections ER14505 3.6V Lithium AA battery

- Temperature detection

- Distance detection

- The base is attached with a magnet that can be attached to a ferromagnetic material object

- Protection level: Main body IP65

- Compatible with LoRaWAN^{TM} 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

  Battery Life:

  - Please refer to web: http://www.netvox.com.tw/electric/electric_calc.html

  - At this website, users can find battery lifetime for variety models at different configurations.

    1. Actual range may vary depending on environment.

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

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 for 20 times.
Power off	Remove Batteries.
Note:	1. Remove and insert the battery; the device is at off state by default. 2. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components. 3. Five 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. The green indicator stays on for 5 seconds: success The green indicator remains off: fail
Had joined the network	Turn on the device to search the previous network. The green indicator stays on for 5 seconds: success The green indicator remains off: fail

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

The device will immediately send a version packet report along with an uplink packet including status,distance, temperature, fill level of percentage.

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

Default Setting:

MaxTime: Max Interval = 15 min = 900s

MinTime: Max Interval = 15 min = 900s

BatteryChange = 0x01 (0.1v)

DistanceChange = 0x012C (300mm)

TemperatureChange = 0x0A (1°C)

OnDistanceThreshold = 0x01F4 (500mm)

FillMaxDistance = 0x07D0 (2000mm)

Data packet:

a. **When used in waste bin detection:** Distance, Temperature, FillLevel;

Status=0 (Invalid)

b. **When used in parking detection:** Status, Distance, Temperature;

FillLevel=0 (Invalid)

Note:

(1) The device report interval will be programmed based on the default firmware which may vary.

(2) The interval between two reports must be the minimum time.

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

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

Data report configuration and sending period are as following:

Min Interval (Unit: second)	Max Interval (Unit: second)	Reportable Change	Current Change≥ Reportable Change	Current Change＜ Reportable Change
Any number between 1~65535	Any number between 1~65535	Can not be 0.	Report per Min Interval	Report per Max Interval

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					
R718X	0x34	0x01	Battery (1Byte, unit:0.1V)	Status(1Byte) 0x01_On 0x00_Off	Distance (2Bytes) Unit:1mm)	Temperature (Signed 2Bytes) unit:0.1°C	FillLevel (1Byte,Unit:1%)	Angleof Inclination (1Byte) Signed Value,Unit:1° *DONT SUPPORT FROM 2021.10.01

Ex.

Uplink: 013401220001F400FD5A00

Byte	Value	Attribute	Result	Resolution
1st	01	Version		-
2nd	34	DeviceType		-
3rd	01	ReportType		-
4th	22	Battery	3.4v	22(HEX)=34(DEC),34*0.1v=3.4v
5th	00	Status		-
6th~7th	01F4	Distance	500mm	01F4(HEX)=500(DEC),500*1mm=500mm
8th~9th	00FD	Temperature	25.3℃	00FD(HEX)=253(DEC),253*0.1℃=25.3℃
10th	5A	FillLevel	90%	5A(HEX)=90(DEC),90*1%=90%
11th	00	Angleof Inclination		-

5.2 Example of data configuration

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				
ConfigReport Req		0x01		MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	BatteryChange (1byte Unit:0.1v)	DistanceChange (2byte Unit:1mm)	Temperature Change (2byte Unit:0.1℃)
ConfigReport Rsp		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)	Temperature Change (2byte Unit:0.1℃)
SetOnDistanceTh resholdRreq		0x03		OnDistanceThreshold (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetOnDistanceTh resholdRrsp		0x83		Status (0x00_success)			Reserved (8Bytes,Fixed 0x00)	
GetOnDistanceTh resholdRreq		0x04		Reserved (9Bytes,Fixed 0x00)				
GetOnDistanceTh resholdRrsp	R718X	0x84	0x34	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)	
SetDeadZone DistanceReq		0x0B		DeadZoneDistance (2byte Unit:1mm)			Reserved (7Bytes,Fixed 0x00)	
SetDeadZone DistanceRsp		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)	

Set Report Time

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

TemperatureChange=2°C

Downlink: 0134003C003C0101F40014　　　　003C(H_{ex}) = 60(D_{ec}), 01F4(H_{ex}) = 500(D_{ec}), 14(H_{ex}) = 20(D_{ec})

Device returns:

8134000000000000000000 (Configuration is successful)

8134010000000000000000 (Configuration failed)

(2) Read device parameters

Downlink: 0234000000000000000000

Device returns:

8234003C003C0101F40014 (current device parameters)

Set Total Height of The Container

(3) Setting the total height of the container, FillMaxDistance = 5000mm

Downlink: 0534138800000000000000　　　　1388(H_{ex}) = 5000(D_{ec}),

Device returns:

8534000000000000000000 (Configuration is successful)

8534010000000000000000 (Configuration failed)

(4) Read the total height of the container (FillMaxDistance)

Downlink:0634000000000000000000

Device returns:

8634138800000000000000 (Device current parameter)

Switch the Mode

If the mode of the device is waste bin detection, switch it to parking detection.

(5) Set FillMaxDistance to 0

Downlink： 0534000000000000000000

Device returns：

8534000000000000000000

(6) Read FillMaxDistance, and check whether it is set successfully.

Downlink： 0634000000000000000000

Device returns：

8634000000000000000000

Set Distance Threshold

(7) Set OnDistanceThreshold to the appropriate value

　　Downlink：　033401F400000000000000　　// 01F4 (H_{ex}) = 500 (D_{ec})

　　Device returns：

　　　　8334000000000000000000

(8) Read OnDistanceThreshold, and check whether it is set successfully.

　　Downlink：　043400000000000000000000

　　Device returns：

　　　　833401F400000000000000

* The mode switches via setting the value of FillMaxDistance and OnDistanceThreshold.

If the current mode of the device is waste bin detection, it can be switched to the parking detection by setting FillMaxDistance

to 0 first, and then setting OnDistanceThreshold.

Conversely, the current mode of the device is parking detection, it can be switched to the waste bin detection by setting

OnDistanceThreshold to 0 first, and then setting FillMaxDistance.

Set Dead Zone Distance 　 --- 　Support after data code 20211220 (include)

(9) SetDeadZoneDistance

　　Downlink：　0B3400C800000000000000　　// set the device detection dead band to 200mm, 00C8 (H_{ex}) = 200 (D_{ec})

　　Device returns：

　　　　8B34000000000000000000

(10)　GetDeadZoneDistance, and check whether it is set successfully.

　　Downlink：　0C3400000000000000000000　　// Obtain the device detection dead zone distance of 200mm

　　Device returns：

　　　　8C3400C800000000000000

* Keep the last set value when restoring the factory setting

5.3 Example of Temperature/Distance Sensor calibration

Port:0x0E

Description	CmdID	SensorType	PayLoad(Fix =9 Bytes)				
SetGlobal CalibrateReq	0x01	0x01 0x36	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

Temperature 0x01

Distance 0x36

(1) Set the **distance** calibration:

   If the distance between the device and detected object the R718X detects is 490mm and the actual distance is 500mm, it means

   the calibration we want to make is +10mm.

   SensorType =0x36, Channel 1= 00, Multiplier = 000A, Divisor = 0000, DeltValue=0001

   Downlink：013600000A000000010000

   Response：

           8136000000000000000000（Configuration success）

(2) Check whether the setting in (1) calibration

   Downlink：023600000000000000000000

   Response：

           823600000A000000010000 (Current configuration)

(3) Set the **temperature** calibration:

   If the temperature the R718X detects is 26° and the actual temperature is 27°, it means the calibration we want to make is +1°.

   SensorType =0x01 ,Channel 2= 01, Multiplier = 000A, Divisor = 0000, DeltValue=0001

   Downlink：010101000A000000010000

   Response：

           8101010000000000000000（Configuration success）

(4) Check whether the setting in (3) calibration

Downlink：020101000000000000000000

Response：

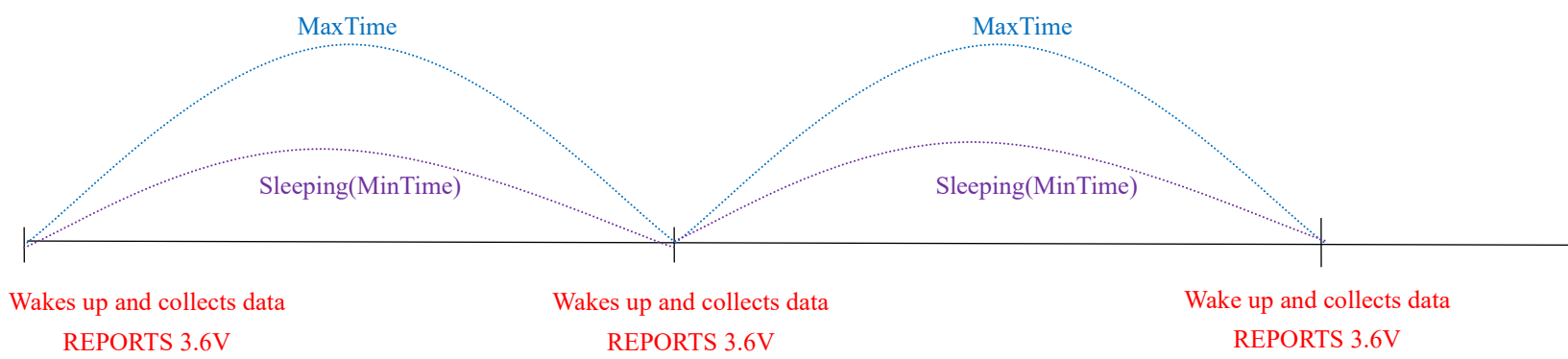   820101000A000000010000（Current configuration）

Note:

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

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

3. The choices of the Channel would be 00-03 Channel

4. With different sensor type, it is forbidden to use that same Channel number.

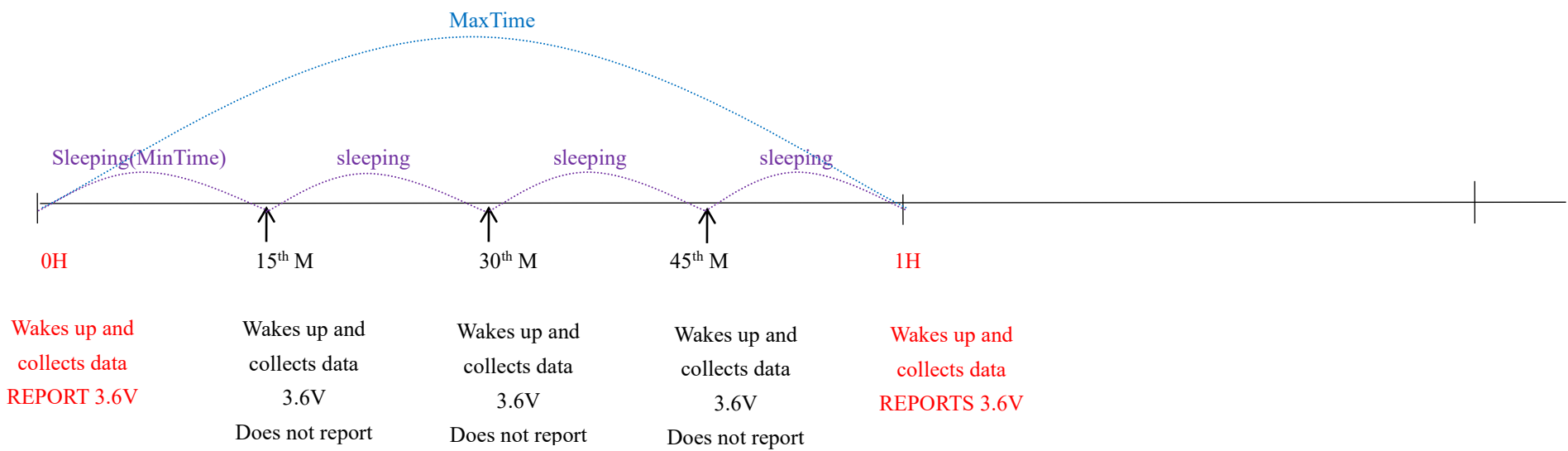5. This universal calibration supports calibration of positive and negative numbers.

5.4 Example for MinTime/MaxTime logic

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

| MaxTime | | MaxTime |
| Sleeping(MinTime) | | Sleeping(MinTime) |

Wakes up and collects data   Wakes up and collects data   Wake up and collects data
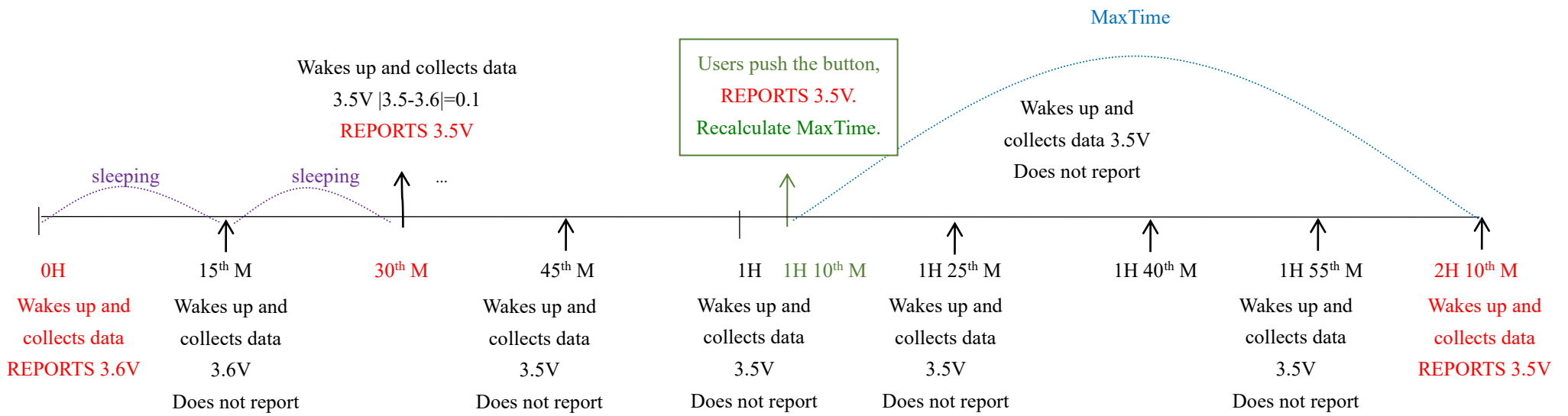REPORTS 3.6V   REPORTS 3.6V   REPORTS 3.6V

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.

MaxTime

Sleeping(MinTime)   sleeping   sleeping   sleeping

0H   15th M   30th M   45th M   1H

| Wakes up and collects data REPORT 3.6V | Wakes up and collects data 3.6V Does not report | Wakes up and collects data 3.6V Does not report | Wakes up and collects data 3.6V Does not report | Wakes up and collects data REPORTS 3.6V |

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

MaxTime

Wakes up and collects data
3.5V |3.5-3.6|=0.1
REPORTS 3.5V

Users push the button,
REPORTS 3.5V.
Recalculate MaxTime.

Wakes up and
collects data 3.5V
Does not report

sleeping   sleeping   ...

| 0H | 15th M | 30th M | 45th M | 1H | 1H 10th M | 1H 25th M | 1H 40th M | 1H 55th M | 2H 10th M |

0H
Wakes up and
collects data
REPORTS 3.6V

15th M
Wakes up and
collects data
3.6V
Does not report

45th M
Wakes up and
collects data
3.5V
Does not report

1H
Wakes up and
collects data
3.5V
Does not report

1H 25th M
Wakes up and
collects data
3.5V
Does not report

1H 55th M
Wakes up and
collects data
3.5V
Does not report

2H 10th M
Wakes up and
collects data
REPORTS 3.5V

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 setting 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 scenario

In the use case of detecting the garbage in waste bin, the device should be installed on the top of the waste bin.

After the device is installed and powered, turn on the device and it will detect the distance between the device and the garbage as well as the percentage of the garbage in the waste bin.

H means the height of the waste bin (this value can be set with the payload command; the "fillmaxdistance" in payload means H)

D means the distance between the device and the garbage (this value is "distance" in uplinks)

L means the garbage (this value can be calculated by the "distance" in uplink and "fillmaxdistance" in payload)

    Calculation: L = fillmaxdistacnce - distance

d represents the DeadZoneDeistance set by the equipment (the distance that cannot be detected by the actual equipment)

FillLevel means the percentage of the garbage in the waste bin.

The value of the total depth of the water tank / trash can can be set according to the specific scene through instructions; DeadZoneDeistance can be set according to the actual use scenario.
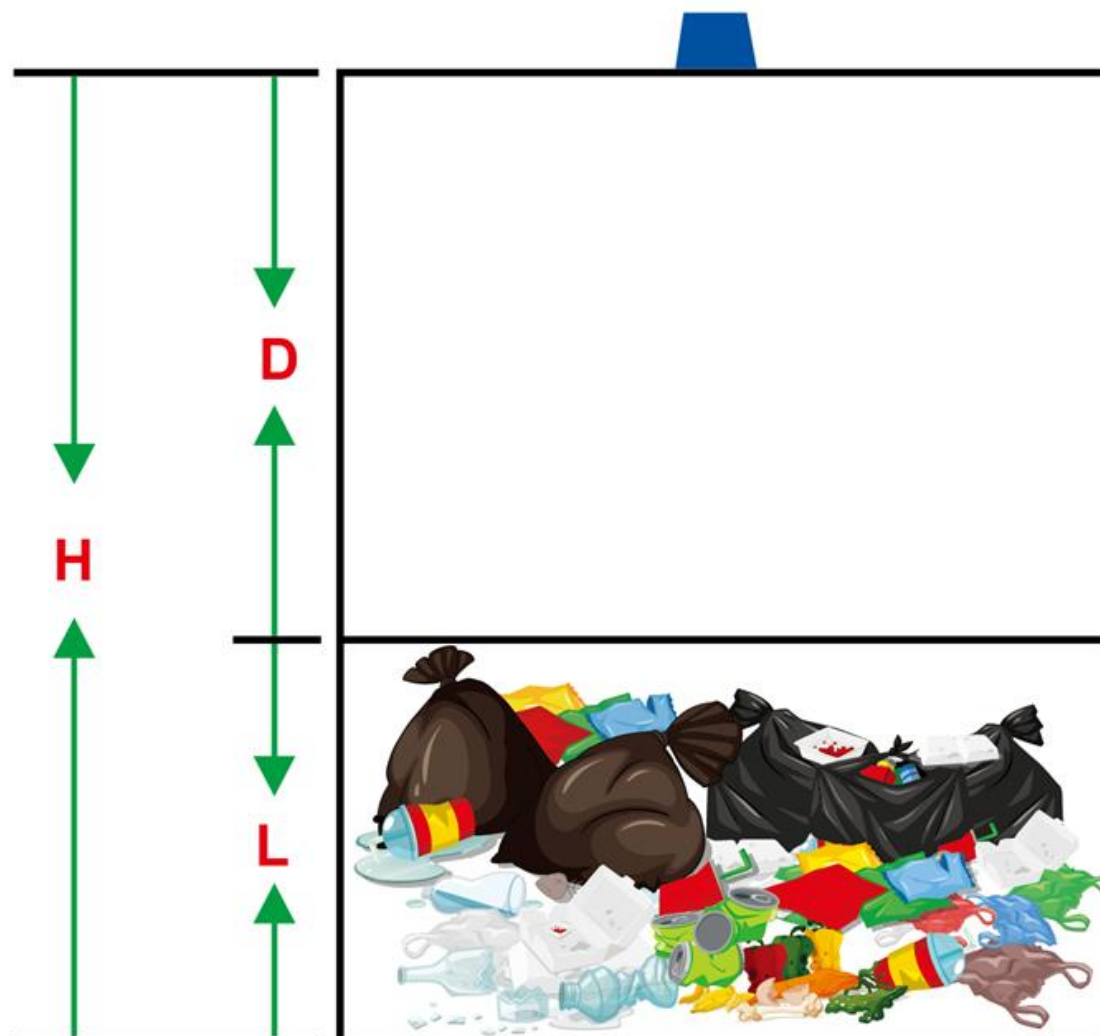
Illustration 1.

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

Illustration 2.

The calculation method of water level percentage of deadzonedeistance can be set
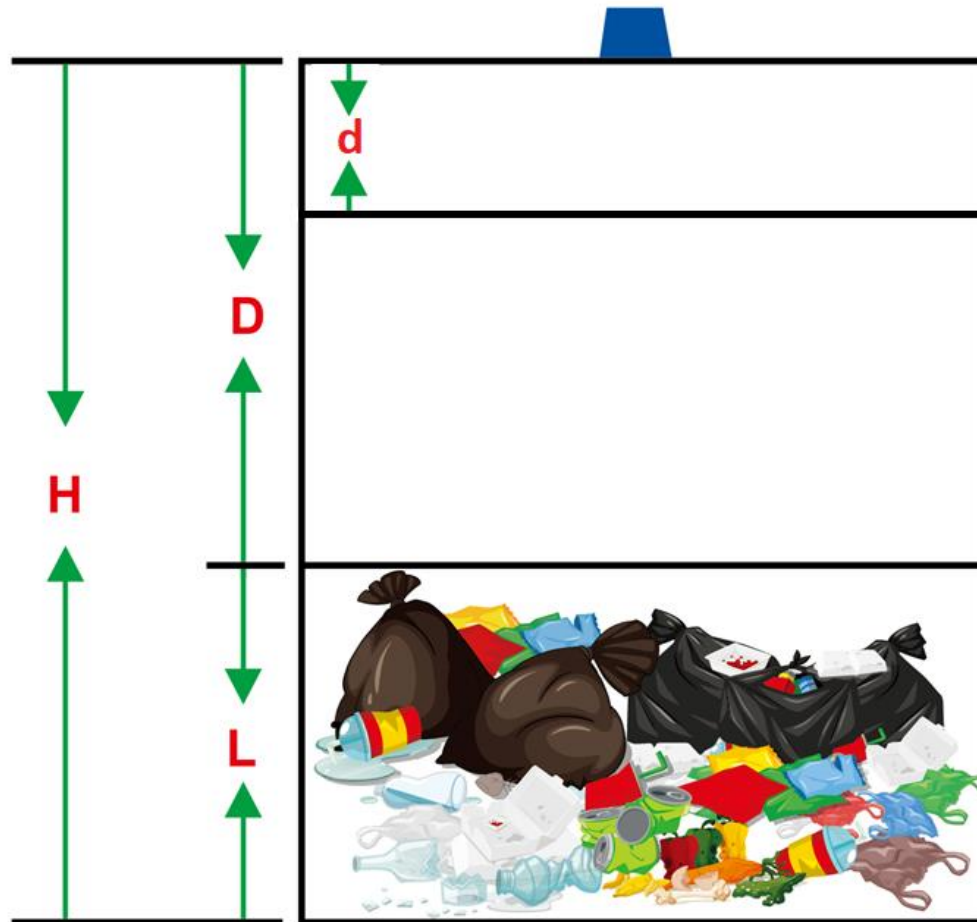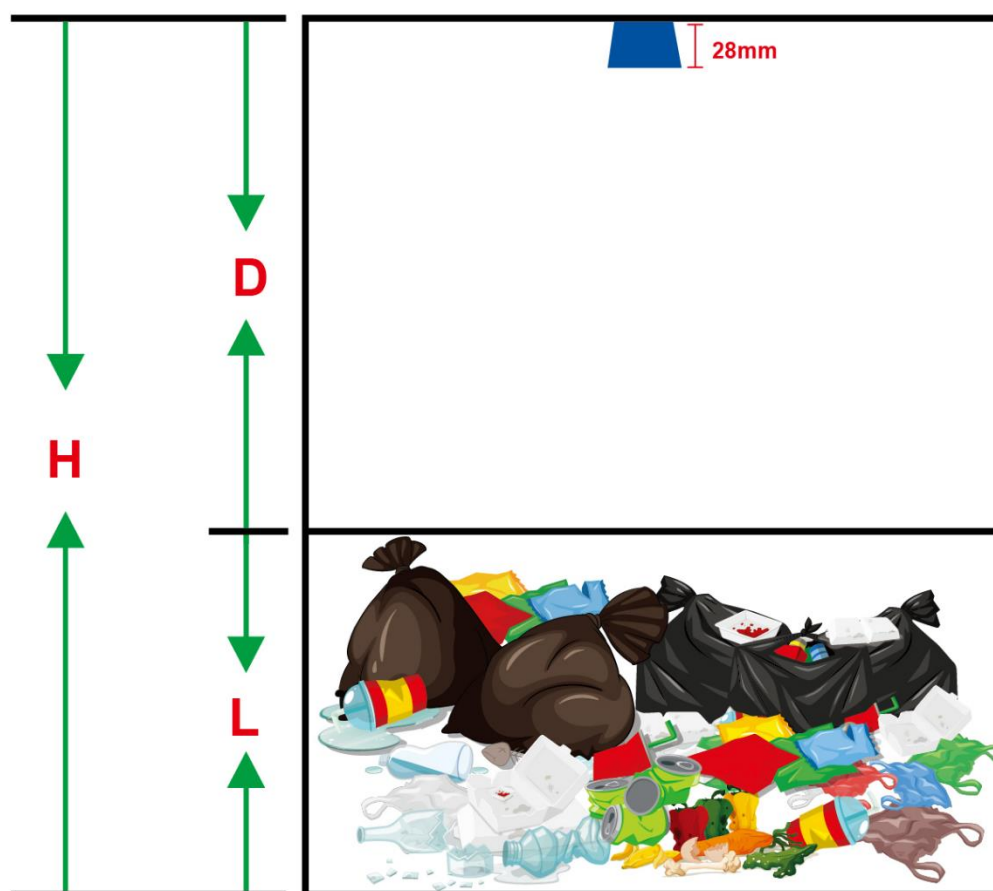
FillLevel = ((H - D) / H-d) * 100%

Illustration 3.

If the R718X is installed as the following way, then the measured distance needs to add the height of the device itself which is
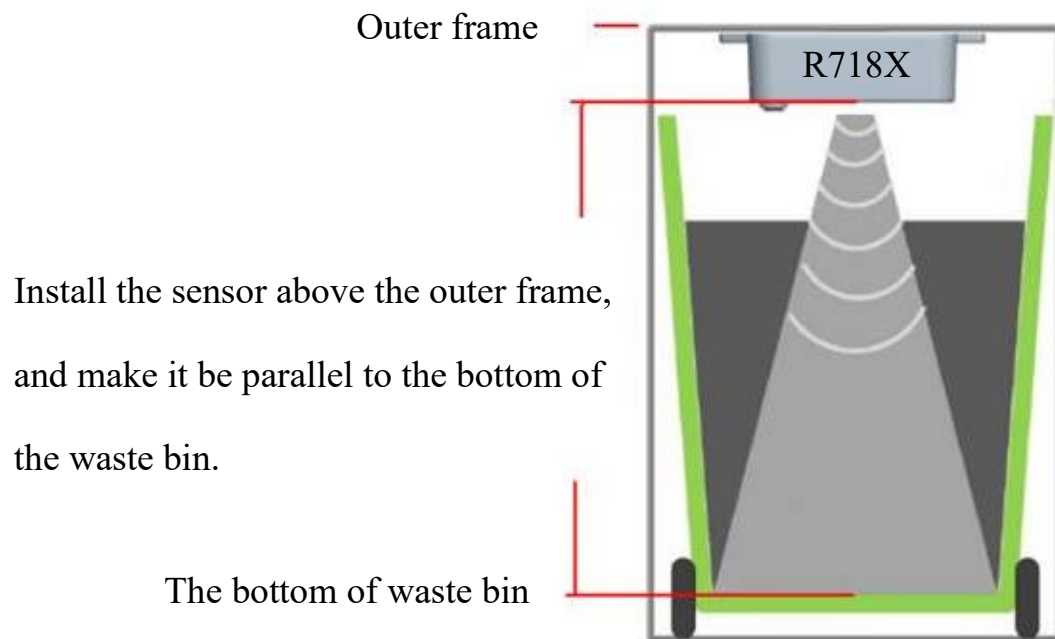
28mm.

Note:

    (1) The default value of OnDistanceThreshold is 500mm, and the default value of FillMaxDistance is 2000mm.

    (2) The detecting range of the device is 200mm~3500mm.

7. Installation

7.1 The waste bin with frame

Outer frame

R718X

Install the sensor above the outer frame, and make it be parallel to the bottom of the waste bin.

The bottom of waste bin

7.2 The waste bin without the frame but an upper cover

The waste bin without the frame but an upper cover needs to be drilled out the required mounting holes in the cover, and then install the sensor on the cover. User should find and make sure the installation location that is parallel to the bottom of the waste bin. Namely, the detecting direction is perpendicular to the bottom of the waste bin.

Horizontal Plane

7.3 Plastic Bucket Test of R718X

Probe position

| The probe offset center point 7cm | The probe offset center point 5 cm | The probe is offset to the right 5.5 cm |

7.4 Installation

Use screws and locking nuts to fix the device, as the figure for reference.

M4 Locking Nut

M4 Gasket

M4*20 Machine Screw

1. After finding the installation position, use the tool to drill 2 holes in the upper cover.

   M4 screws can be inserted into the hole.
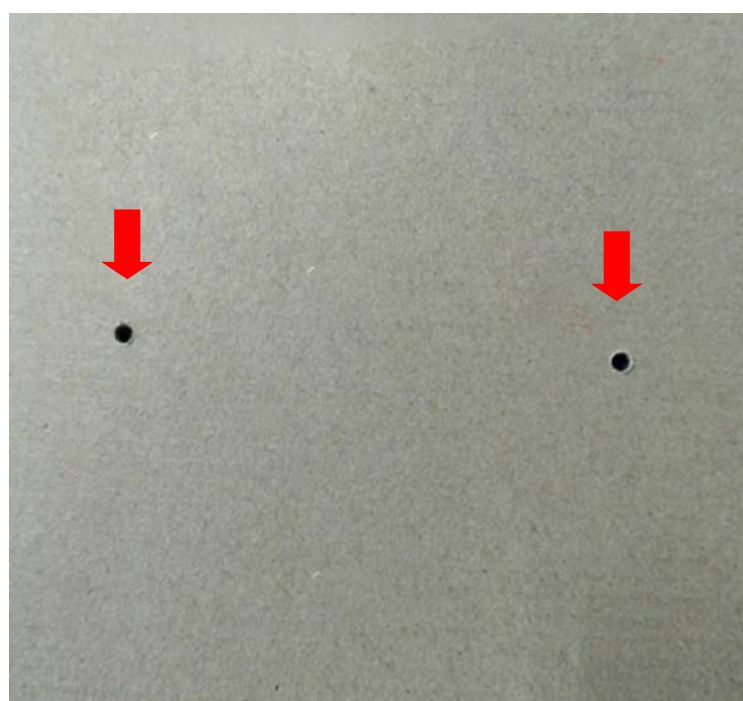
2. Insert the screw with the gasket into the hole to install the device.
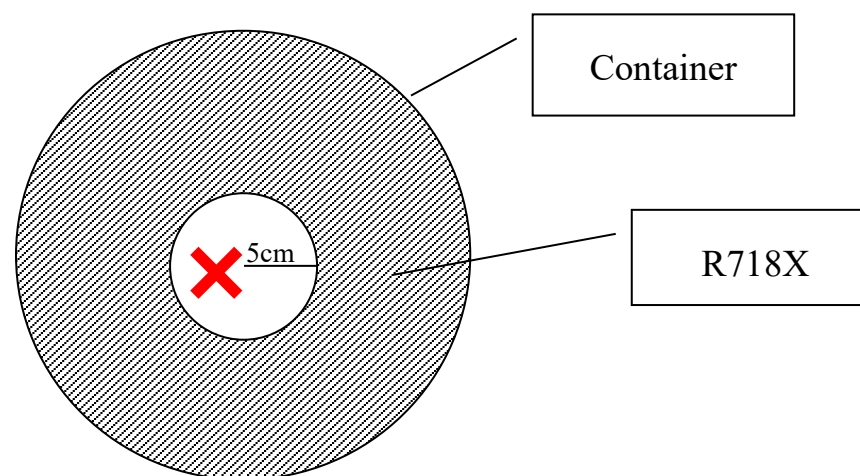
3. Use a tool to tighten the locking nut.

Note:

　　1.The installation location **can not** be at the center of the cover.

　　Suggest that installing the sensor should be outside the area of the circle with radius 5cm from the center of the cover.

　　If the ultrasonic sensor is installed in the center, the ultrasonic signal will generate gain which will affect the

　　measurement result

　　2.Please do not disassemble the device unless it is required to replace the batteries.

　　Do not touch the waterproof gasket, LED indicator light, function keys when replacing the batteries.

　　Please use suitable screwdriver to tighten the screws.

　(if using an electric screwdriver, it is recommended to set the torque as 4kgf) to ensure the device is impermeable.

　　When disassembling and assembling the equipment, it is recommended to understand the internal structure of the equipment

　　first to avoid equipment damage.

8. 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:

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.

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.

9. 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 excessive heat condition. High temperature 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, detergents or strong detergents.

• Do not apply the device with paint. Smudges might block in 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.