Wireless Temperature and Humidity Sensor for Low Temperature Environment with Data Storage

R718A01 User Manual

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1. Introduction

R718A01 can detect the temperature and humidity of the air, with the function of temperature and humidity data buffer, and transmit the detected data to the gateway for display through the wireless network, fully compatible with LoRa 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

Indicator

Function Key

Built-in temperature and humidity

3. Main Features

- Compatible with LoRaWAN protocol.

- 2 x ER14505 lithium batteries in parallel (AA size/3.6v)

- Capable to detect the temperature and humidity

- Capable to cache 50 records of temperature and humidity data

- Simple operation and installation

- IP rating: IP65

- Compatible with LoRaWAN™ Class A

- Frequency hopping spread spectrum

- Applicable to third-party platforms: 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 life time for variety 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 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. At 1st -5th second 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 registration 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

The device will immediately send a version packet report along with an uplink packet including temperature, humidity and battery voltage.

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

Default setting:

Max Interval: 0x0384 (900s)

Min Interval: 0x0384 (900s)

BatteryChange: 0x01 (0.1V)

TemperatureChange: 0x0064 (1°C)

HumidityChange: 0x0064 (1%)

Data Storage Function

1. R718A01 has the function of temperature and humidity data storage, and the upper limit of stored data is 50 packets (if more than 50 packets, the initially stored data will be overwritten. For example, the data in packet 51 covers packet 1, and the data in packet 52 covers packet 2, and so on)

2. Users read the data they want to find by issuing command "ReadBackUpDataReq"

3. When issuing the ReadBackUpDataReq command, the UplinkCounter is based on the serial number (Fcnt) on the network server. For example, if fcnt = 51 on the network server, downlink port 12, 0100000033　　*(33H$_{ex}$ = 51D$_{ec}$)

4. If the fcnt belongs to a non-temperature and humidity packet or there is no fcnt, reply no found.

5. Only the temperature and humidity data are stored, others such as battery power and time data are not stored.

Note:

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

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 Data Storage Function

FPort: 0x0C

Description	CmdID	PayLoad			
ReadBackUpDataReq	0x01	ResendUpLinkCounter(4bytes)			
ReadBackUpDataRsp	0x81	Resend (4bytes) UpLinkCounter	Status (1byte) 0x00_Found 0x01_NoFound	Temperature (Signed2Bytes,unit:0.01°C) When not found, it will be 0x0000	Humidity (2Bytes,unit:0.01%) When not found, it will be 0x0000

Ex1. Read Fcnt 1 data

Downlink: 0100000001

Respond: 8100000001000A721745　　// Temperature = 26.74°, Humidity = 59.57%

0A72 Hex = 2674Dec

1745 Hex = 5957Dec

Ex2. Read Fcnt 51 data

Downlink: 0100000033

Respond: 8100000033000A281770　　// Temperature = 26°, Humidity = 60%

0A28 Hex = 2600Dec

1770 Hex = 6000Dec

*At this time, if fcnt 1 is read again, the data will not be found because it has been overwritten by fcnt 51.

5.2 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)

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 010B000A0B202005200000, the firmware version is 2020.05.20

3. **Data Packet:**

   When Report Type=0x01 is data packet.

4. **Signed Value:**

   When the temperature is negative, 2's complement should be calculated.

Device	Device Type	Report Type	NetvoxPayLoadData			
R718A (R718A01	0x0B	0x00	SoftwareVersion (1Byte) Eg.0x0A—V1.0	HardwareVersion (1Byte)	DateCode (4Bytes,eg0x20170503)	Reserved (2Bytes,fixed 0x00)
		0x01	Battery (1Byte, unit:0.1V)	Temperature (Signed2Bytes, unit:0.01°C)	Humidity (2Bytes,unit:0.01%)	Reserved (3Bytes,fixed 0x00)

Example 1 of Uplink: 010B01220A52169E000000

   1st byte (01): Version

   2nd byte(0B): DeviceType 0x0B － R718A/R718A01

   3rd byte (01): ReportType

   4th byte(22): Battery － 3.4V, 22(H_{ex}) = 34(D_{ec}), 34x0.1v=3.4v

   5th6th byte (0A52): Temperature －26.42ºC , A52(H_{ex})=2642 (D_{ec}), 2642x0.01=26.42°

   7th8th byte (169E): Humidity － 57.9%, 169E(H_{ex})=5790(D_{ec}), 5790x0.01=57.9%

   9th-11th byte (000000): Reserved

Example 2 of Uplink: 010B019FFF391A9E000000

   1st byte (01): Version

   2nd byte (0B): DeviceType 0x0B － R718A/R718A01

   3rd byte (01): ReportType

   4th byte (9F): Battery － 3.1V, 1F(Hex) = 31(Dec), 31x0.1v=3.1v   // Low battery

5th 6th byte (FF39): Temperature — -1.99°C

$0x10000-0xFF39=0xC7$ (Hex) = 199(Dec) , 199x0.01=1.99°C

7th 8th byte (1A9E): Humidity — 68.14%, 1A9E(Hex)=6814(Dec), 6814x0.01=68.14%

9th -11th byte (000000): Reserved

5.3 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	R718A (R718A01)	0x01	0x0B	MinTime (2bytes Unit:s)	MaxTime (2bytesUnit:s)	BatteryChange (1byte Unit:0.1v)	TemperatureChange (2byte Unit:0.01°C)	HumidityChange (2byte Unit:0.01%)
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)	TemperatureChange (2byte Unit:0.01°C)	HumidityChange (2byte Unit:0.01%)

(1) Command Configuration:

MinTime = 1min、MaxTime = 1min、BatteryChange = 0.1v、TemperatureChange = 1°C、HumidityChange = 1%

Downlink：010B003C003C0100640064　　　003C(H_{ex}) = 60(D_{ec)},　64(H_{ex}) = 100(D_{ec})

Response：

810B000000000000000000 (Configuration success)

810B010000000000000000 (Configuration failure)

(2) Read Configuration:

Downlink：020B000000000000000000

Response：

820B003C003C0100640064（Current configuration）

5.4 Example of GlobalCalibrateCmd

FPort：0x0E

Description	CmdID	Sensor Type	PayLoad(Fix =9 Bytes)				
SetGlobal CalibrateReq	0x01		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)	

Sensor type:

0x01_Temperature Sensor   0x02_Humidity Sensor

(1) Assume that the reported original value of temperature is 27.15°C, the calibration reduces by 0.28°C, and the reported value is

26.87°C. (Sensor type=0x01, Channel 1 =0x00, Multiplier =0x0001, Divisor = 0x0001, DeltValue = 0xFFE4)

Downlink: 01010000010001FFE40000   // FFE4 Hex = -28 Dec, -28*0.01°C= -0.28°C

Device return:810100<u>00</u>0000000000000000   // Configuration successful

810100<u>01</u>00000000000000   // Configuration failed

(2) Assume that the reported original value of humidity is 49.98%, the calibration increases by 0.52%, and the reported value is 50.5%.

(Sensor type=0x02,Channel 2 =0x01, Multiplier =0x0001，Divisor = 0x0001，DeltValue = 0x0034)
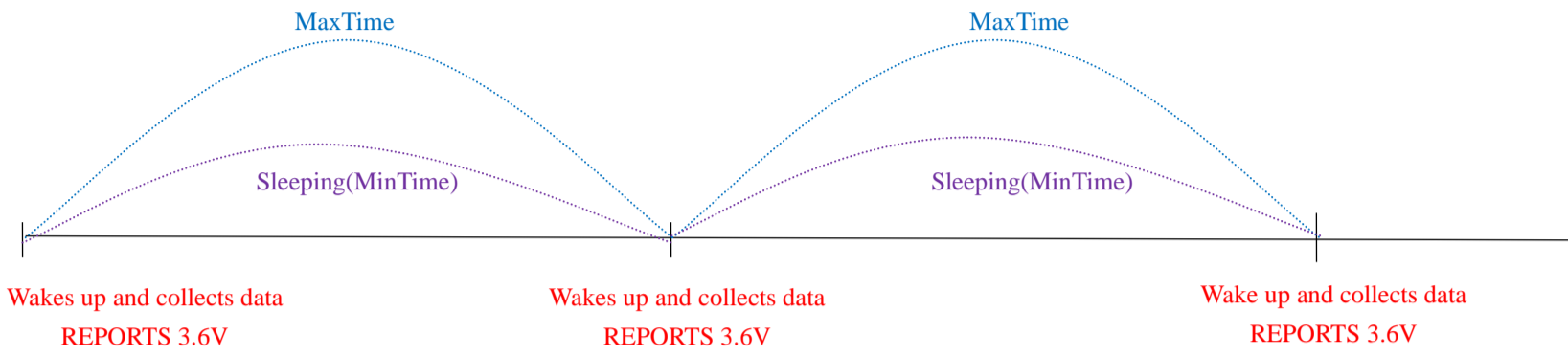
Downlink: 010201000100010034 0000   // 34 Hex= 52 Dec, 52*0.01%= 0.52%

Device return:810201<u>00</u>0000000000000000   // Configuration successful

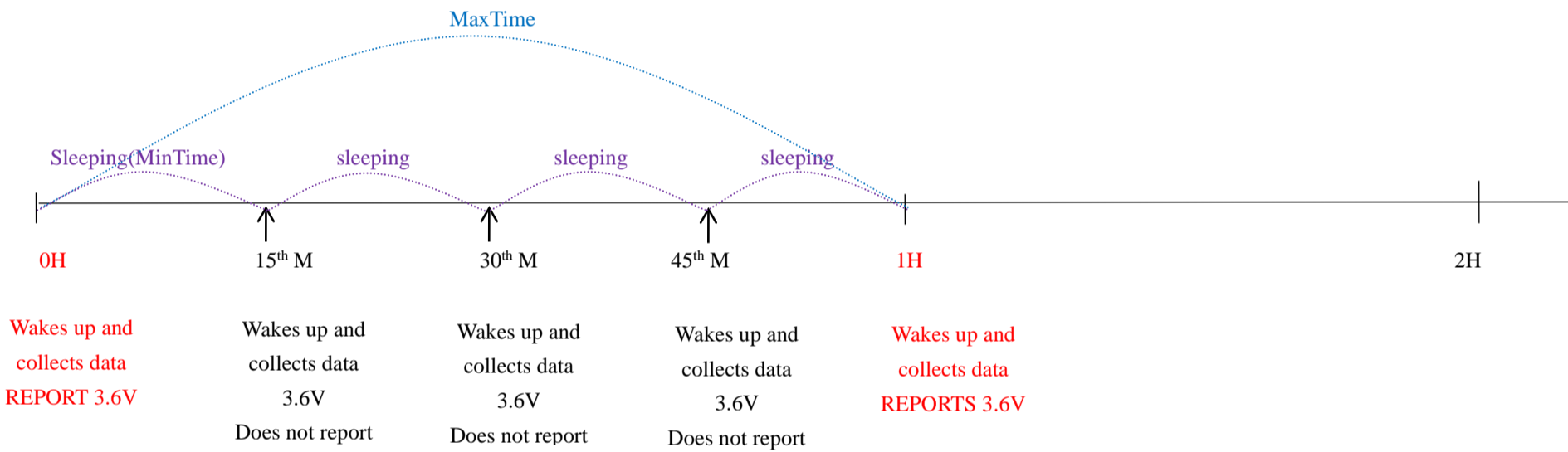810201<u>01</u>00000000000000   // Configuration failed

5.5 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
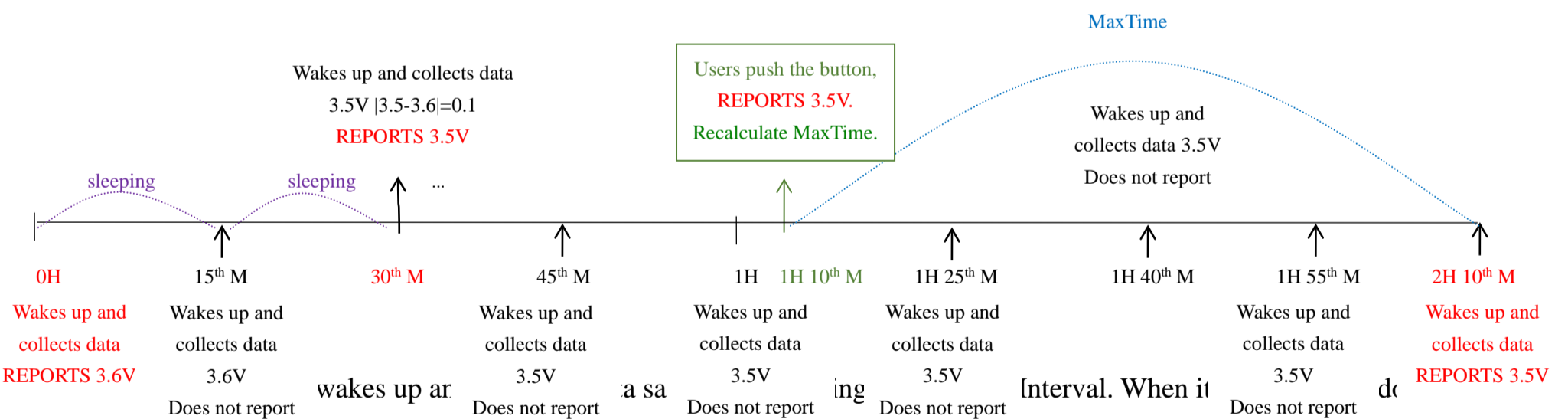REPORTS 3.6V REPORTS 3.6V REPORTS 3.6V

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 2H

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

Wakes up and collects data REPORTS 3.6V | Wakes up and collects data 3.6V Does not report | | Wakes up and collects data 3.5V Does not report | Wakes up and collects data 3.5V Does not report | Wakes up and collects data 3.5V Does not report | | Wakes up and collects data 3.5V Does not report | Wakes up and collects data REPORTS 3.5V

wakes up ar a sa ing Interval. When it d

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 <u>reported</u>. 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. Installation

The waterproof breathable membrane inside the product is not resistant to vapor.

To prevent water vapor from condensing inside the body, please do not use the product in high humidity and steam environment.

1.The Wireless Temperature and Humidity Sensor (R718A01) has a built-in magnet (see Figure 1 below). When installed, it can be attached to the surface of an object with iron which is convenient and quick.

To make the installation more secure, use screws (purchased) to secure the unit to a wall or other surface (see Figure 2 below).

Note:

Do not install the device in a metal shielded box or in an environment with other electrical equipment around it to avoid affecting the wireless transmission of the device.

2. When the temperature and humidity detected by R718A01 is compared with the last reported values, it will report current values when the temperature change exceed 1°C (default) or the humidity change exceed 1%(default).

3. Installation height recommendation:1-2 m

4. Installation ambient temperature: -40C° ~ 55°C

5. Installation direction recommendation: The output port (sensor) is facing down, and the LOGO is facing towards the person.
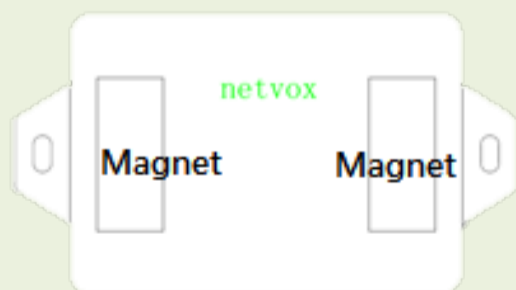
The figure shows the scene where the temperature and humidity sensor (R718A01) is applied in the refrigerator.

It can also be applied to the following scenarios:

- Restaurant (refrigerator or freezer)

- Shopping mall supermarket (freezer)

- Engine room

- Environmental monitoring

- Smart city and intelligent building

- Storage and transportation of food and medicine

- Flowers and other perishable foods

- Wall or logistics refrigerator

When it is necessary to detect temperature or humidity.

Battery installation steps

Please replace the battery by professionals! The device must use 2 sections of ER14505 battery (3.6v/section)

Please note that the positive and negative poles of the battery should not be installed reversely.
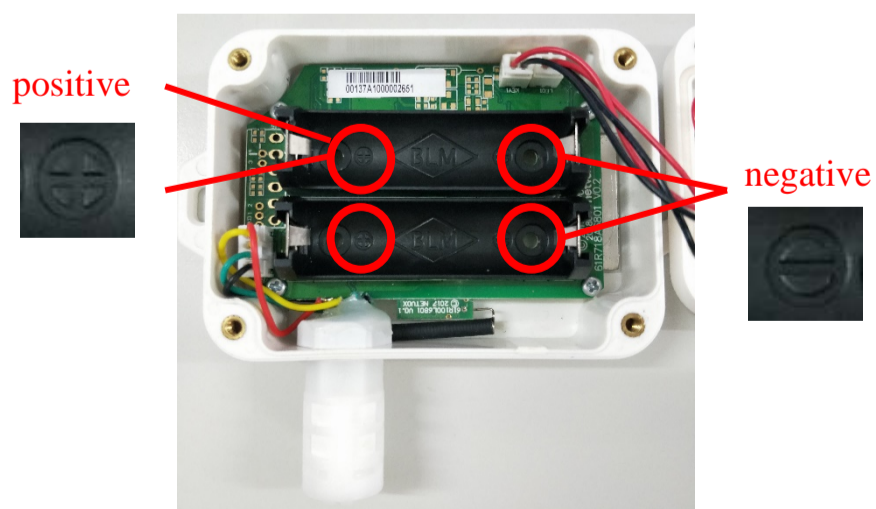
Step 1

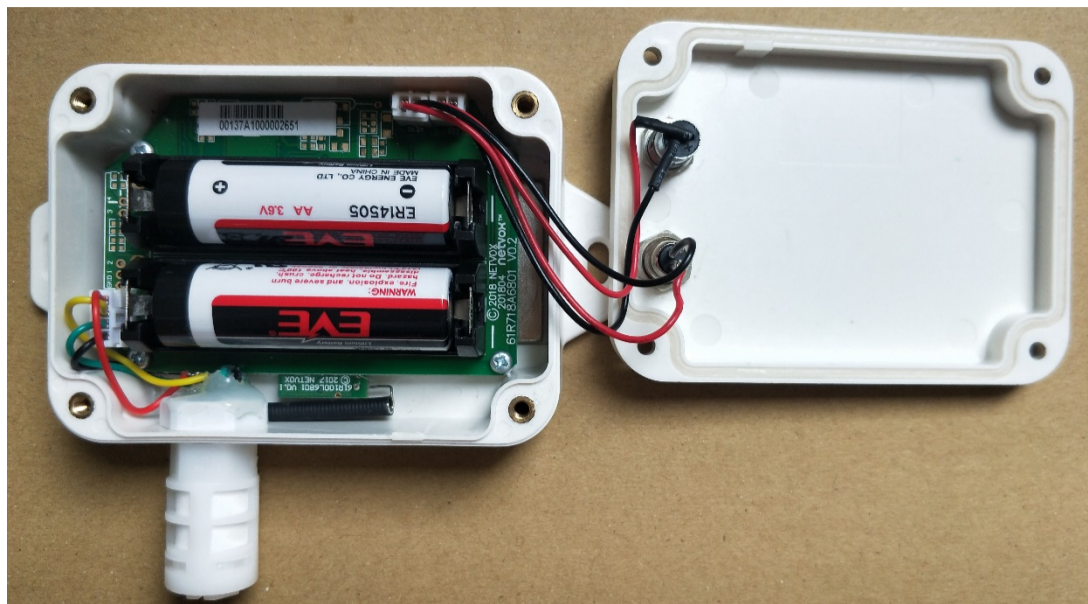Unscrew the four corners of the device with a screwdriver, as shown in the red circle below.

Step 2

Put the batteries into the battery bay of the device and note the positive and negative poles of the battery, please do not insert the

battery reversely.

Step 3

After inserting the batteries, put the lid back on and tighten the four screws.

Note:

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.

7. 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:

7.1 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.

7.2 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.

8. 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 hot condition. High temperature can shorten the life of electronic devices, destroy batteries, and deform or melt some plastic parts.

· Do not store the device under excessive cold condition. 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.