Wireless Temperature and Humidity Sensor with Thermocouple Sensor

R718CKAB_R718CTAB_R718CNAB User Manual

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1. Introduction

R718CKAB

The temperature/humidity sensor and K-type thermocouple can detect the temperature, humidity, and an object's surface temperature. The temperature measurement range of R718CK is -40°C to +375°C. R718CK has the features of good linearity, larger thermal electromotive force, high sensitivity, and stability. It should not be used in sulfuric environments, reducing, oxidizing, vacuum atmospheres, or weak oxidizing atmospheres.

R718CTAB

The temperature/humidity sensor and T-type thermocouple can detect the temperature, humidity, and an object's surface temperature. The temperature measuring range of R718CT is -40°C to +125°C but it works more stably in the range of -40°C to 0°C.

R718CNAB

The temperature/humidity sensor and N-type thermocouple can detect the temperature, humidity, and an object's surface temperature. The temperature measuring range of R718CK is -40°C to +800°C, which is wider than other types of thermocouples.

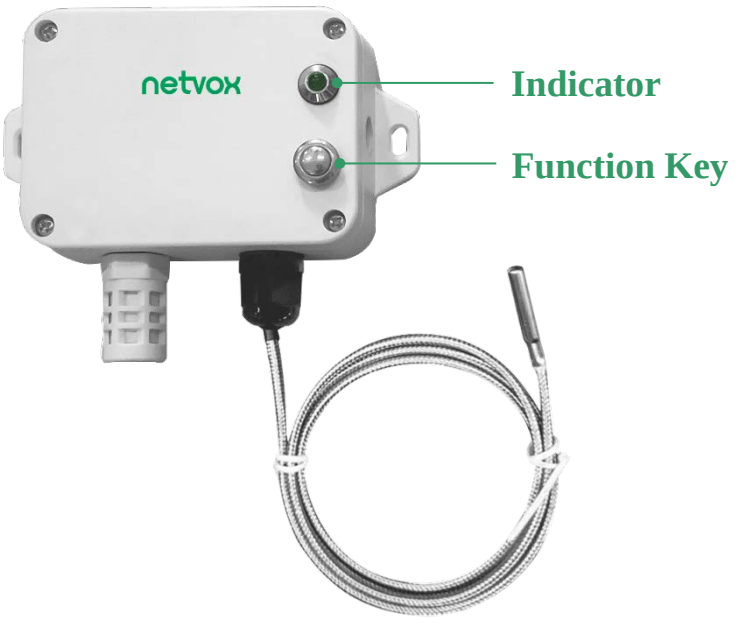
LoRa Wireless Technology

LoRa is a wireless communication technology that adopts techniques such as long-distance communication and low power consumption. Compared with other communication methods, LoRa spread-spectrum modulation techniques greatly expand the communication distance. It is used in long-distance and low-data wireless communications like automatic meter reading, building automation equipment, wireless security systems, and industrial monitoring control system. The features include small size, low power consumption, long transmission distance, and anti-interference ability.

LoRaWAN

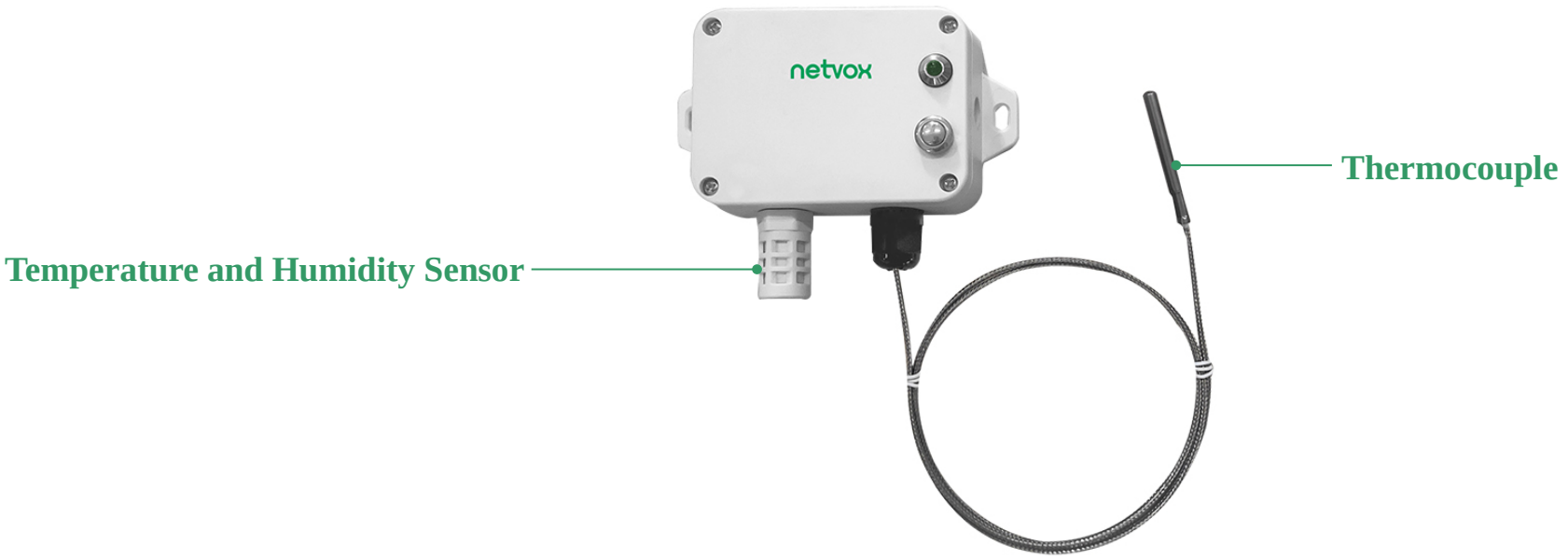
LoRaWAN built LoRa’s end-to-end standards and techniques, ensuring interoperability between devices and gateways from different manufacturers.

2. Appearance



R718CKAB

R718CTAB



R718CNAB

3. Features

- SX1276 wireless communication module
- 2 ER14505 battery in parallel (AA size 3.6V for each battery)
- IP65 rating
- Magnetic base
- Thermocouple detection
- Temperature and Humidity detection
- Compatible with LoRaWAN™ Class A device
- Frequency hopping spread spectrum
- Support third-party platforms: Actility/ThingPark, TTN, MyDevices/Cayenne
- Low-power design for longer battery life

Note: Please visit http://www.netvox.com.tw/electric/electric_calc.html for battery life calculation and other detailed information.

4. Set up Instructions

On/Off

Power on	Insert batteries. (User may need a screwdriver to open the battery cover.)
Turn on	Press and hold the function key for 3 seconds until the green indicator flashes.
Turn off (Factory resetting)	Press and hold the function key for 5 seconds until the green indicator flashes 20 times.
Power off	Remove Batteries.
Note	1. When user removes and inserts the battery; the device should be off by default. 2. 5 seconds after power on, the device will be in engineering test mode. 3. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components.

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 (without factory resetting)	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	Please check the device verification information on the gateway or consult your platform server provider.

Function Key

Press and hold for 5 seconds	Reset to factory setting/Turn off The green indicator flashes 20 times: Success The green indicator remains off: Fail
Press once	The device is in the network: the green indicator flashes once and sends a report. The device is not in the network: the green indicator remains off

Sleeping Mode

The device is on and in the network	Sleeping period: Min Interval. When the reportchange exceeds the setting value or the state changes, the device will send a data report based on the Min Interval.

Low Voltage Warning

Low Voltage	3.2 V

5. Data Report

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

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

Default:

Max Interval: 0x0384 (900s)

Min Interval: 0x0384 (900s) (Automatically checking the current voltage every Min Interval)

BatteryChange: 0x01 (0.1V)

TemperatureChange:0x01 (1°C)

AirTemperatureChange: 0x01 (1℃)

AirHumidChange: 0x01 (1%)

Note:

1. The interval of the data reports might vary due to the firmware.
2. The interval between two reports must be the minimum time.
3. Please check 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	Cannot 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)

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 01C4000A0B202005200000, 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				
R718CKAB R718CTAB R718CNAB	0xC4 0xC5 0xCE	0x01	Battery (1 byte) unit:0.1V	Temperature (Signed 2 bytes) unit: 0.1°C	AirTemperature (Signed 2 bytes) unit:0.01°C	AirHumidity (2 bytes) unit: 0.01%	ThresholdAlarm (1 byte) Bit0_LowTemperatureAlarm Bit1_HighTemperatureAlarm Bit2_LowAirTemperatureAlarm Bit3_HighAirTemperatureAlarm Bit4_LowAirHumidityAlarm Bit5_HighAirHumidityAlarm Bit6-7:Reserved

Example of Uplink: 01C40124028A0B0E1A9001

1st byte (01): Version

2nd byte (C4): DeviceType 0xC4－R718CKAB

3rd byte (01): ReportType

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

5th 6th byte (028A): Temperature－65°C, 028A(HEX)=650(DEC),650*0.1°C =65.0°C

7th 8th byte (0B0E): Air Temperature－28.3°C, 0B0E(HEX)=2830(DEC),2830*0.01°C =28.30°C

9th 10th byte (1A90): Air Humidity－68%, 1A90(HEX)=6800(DEC),6800*0.01%=68.00%

11th byte (01): Threshold Alarm－Low Temperature Alarm, Bit 0 =1

0000 0001

5.2 Example of ConfigureCmd

FPort: 0x07

Bytes	1	1	Var (Fix = 9 Bytes)
	CmdID	DeviceType	NetvoxPayLoadData

CmdID– 1 byte

DeviceType– 1 byte – Device Type of Device

NetvoxPayLoadData– var bytes (Max = 9bytes)

Description	**Device**	**Cmd ID**	**Device Type**	**NetvoxPayLoadData**						
Config ReportReq	R718CKAB R718CTAB R718CNAB	0x01	0xC4 0xC5 0xCE	MinTime (2 bytes) Unit: s	MaxTime (2 bytes) Unit: s	Battery Change (1 byte) Unit: 0.1v	Temperature Change (1 byte) Unit: 1℃	AirTemperature Change (1 byte) Unit: 1℃	AirHumid Change (1 byte) Unit: 1%	Reserved (1 byte) Fixed 0x00
Config ReportRsp		0x81		Status (0x00_success)		Reserved (8 Bytes, Fixed 0x00)				
ReadConfig ReportReq		0x02		Reserved (9 Bytes, Fixed 0x00)						
ReadConfig ReportRsp		0x82		MinTime (2 bytes) Unit: s	MaxTime (2 bytes) Unit: s	Battery Change (1 byte) Unit: 0.1v	Temperature Change (1 byte) Unit: 1℃	AirTemperature Change (1 byte) Unit: 1℃	AirHumid Change (1 byte) Unit: 1%	Reserved (1 byte) Fixed 0x00

(1) Configure R718CKAB report parameters:

MinTime = 1min (0x3c), MaxTime = 1min (0x3c), BatteryChange = 0.1v (0x01), TemperatureChange = 5℃ (0x05), AirTemperatureChange=5℃ (0x05), AirHumidChange=5% (0x05)

Downlink: 01C4003C003C0105050500

Response: 81C400000000000000000 (Configuration success)

81C401000000000000000000 (Configuration failure)

(2) Read Configuration:

Downlink: 02C40000000000000000

Response: 82C4003C003C0105050500 (Current configuration)

5.3 Example of GlobalCalibrateCmd

FPort: 0x0E

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

Sensor Type - byte

0x01_Temperature Sensor (Thermocouple temperature & air temperature)

0x02_Humidity Sensor

※Unit:

Thermocouple temperature: 0.1°C

Air temperature: 0.01°C

Air humidity: 0.01%

Channel - byte

0x00_ Thermocouple Temperature

0x01_Air Temperature

0x02_ Air Humidity

(1) Calibrate the R718CKAB thermocouple temperature sensor by increasing 10℃

Sensor type: 0x01 Channel: 0x00, Multiplier: 0x0001, Divisor: 0x001, DeltValue: 0x0064

Downlink: 0101000001000100640000 // 0064 Hex = 100 Dec, 100*0.1°C=10°C

Response: 8101000000000000000000 // Configuration success

8101000100000000000000 // Configuration failure

(2) Read Configuration:

Downlink: 0201000000000000000000

Response: 8201000001000100640000 // Current configuration

5.4 Set/GetSensorAlarmThresholdCmd

Fport: 0x10

Note: The threshold value could be configured by users.

If the sensor shows 0xFFFFFFFF, the high / low threshold function is disabled.

CmdDescriptor	CmdID (1 byte)	Payload (10 bytes)			
SetSensorAlarmThresholdReq	0x01	Channel (1 byte) 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3, etc.)	SensorType (1 byte) 0x00_Disable ALL Sensor threshold. 0x01_Temperature, 0x02_Humidity,	SensorHigh Threshold (4 bytes)	SensorLow Threshold (4 bytes)
SetSensorAlarmThresholdRsp	0x81	Status (0x00_success)	Reserved (9 bytes, Fixed 0x00)		
GetSensorAlarmThresholdReq	0x02	Channel (1 byte, 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3, etc.)	SensorType (1 byte) 0x00_Disable ALL Sensor threshold. 0x01_Temperature, 0x02_Humidity,	Reserved (8 bytes, Fixed 0x00)	
GetSensorAlarmThresholdRsp	0x82	Channel (1 byte) 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3, etc.)	SensorType (1 byte) 0x00_Disable ALL Sensor threshold. 0x01_Temperature, 0x02_Humidity,	SensorHigh Threshold (4 bytes)	SensorLow Threshold (4 bytes)

Channel - 1byte

0x00_ Thermocouple Temperature

0x01_Air Temperature

0x02_ Air Humidity

※ Unit:

Thermocouple temperature: 0.1°C

Air temperature: 0.01°C

Air humidity: 0.01%

(1) Set the high threshold to 40.5°C and the low threshold to 10.5°C.

Downlink: 0100010000019500000069 // 195Hex=405Dec,405*0.1°C=40.5°C; 69Hex=105Dec,105*0.1°C=10.5°C.

Response: 8100000000000000000000 // Configuration success

(2) GetSensorAlarmThresholdReq

Downlink: 0200010000000000000000

Response: 8200010000019500000069

(3) Disable all sensor thresholds. (Configure the Sensor Type to 0)

Downlink: 0100000000000000000000

Response: 8100000000000000000000

5.5 Example of NetvoxLoRaWANRejoin

(NetvoxLoRaWANRejoin command is to check if the device is still in the network. If the device is disconnected, it will automatically rejoin back to the network.)

Fport: 0x20

CmdDescriptor	CmdID (1 byte)	Payload (5 bytes)	
SetNetvoxLoRaWANRejoinReq	0x01	RejoinCheckPeriod (4 bytes, Unit: 1s 0XFFFFFFFF Disable NetvoxLoRaWANRejoinFunction)	RejoinThreshold (1 byte)
SetNetvoxLoRaWANRejoinRsp	0x81	Status (1 byte, 0x00_success)	Reserved (4 bytes, Fixed 0x00)
GetNetvoxLoRaWANRejoinReq	0x02	Reserved (5 Bytes, Fixed 0x00)	
GetNetvoxLoRaWANRejoinRsp	0x82	RejoinCheckPeriod (4 bytes, Unit:1s)	RejoinThreshold (1 byte)

(1) Configure parameters

RejoinCheckPeriod = 60min (0x00000E10); RejoinThreshold = 3 times (0x03)

Downlink: 0100000E1003

Response: 810000000000 (configuration succeed)

810100000000 (configuration fail)

(2) Read configuration

Downlink: 020000000000

Response: 8200000E1003

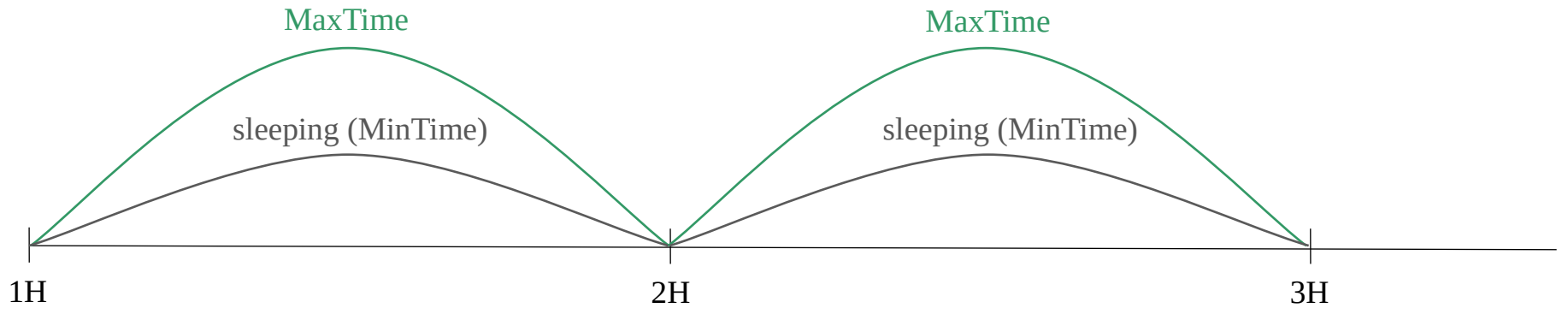
Note: a. Set RejoinCheckThreshold as 0xFFFFFFFF to stop the device from rejoining the network.

b. The last configuration would be kept as user reset the device back to the factory setting.

c. Default setting: RejoinCheckPeriod = 2 (hr) and RejoinThreshold = 3 (times)

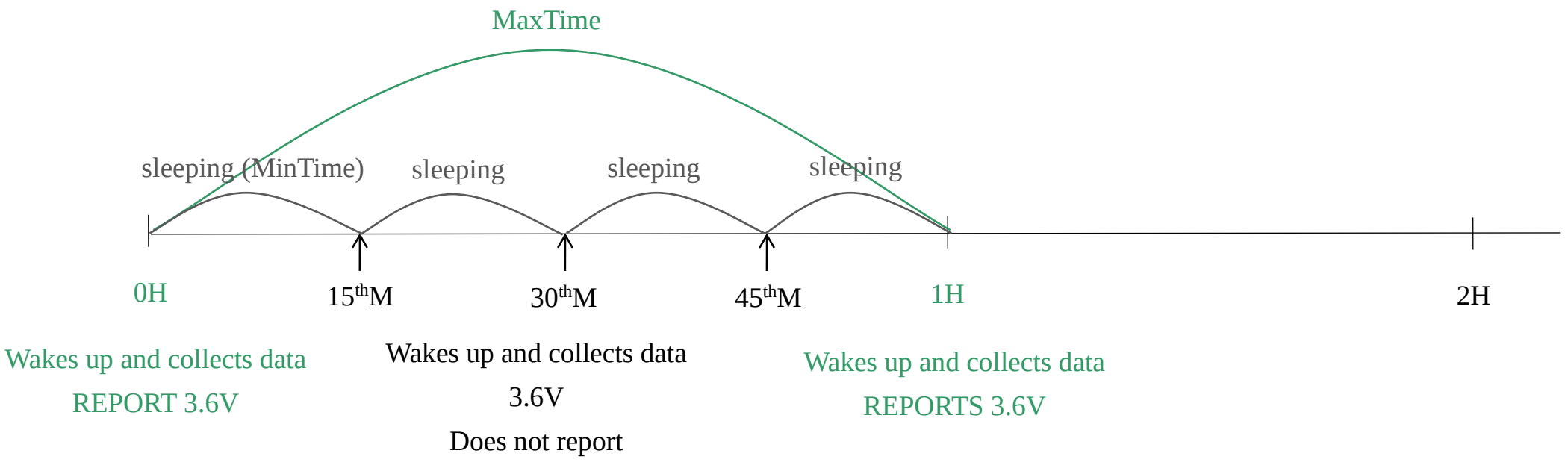
5.5 Example for MinTime/MaxTime logic

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

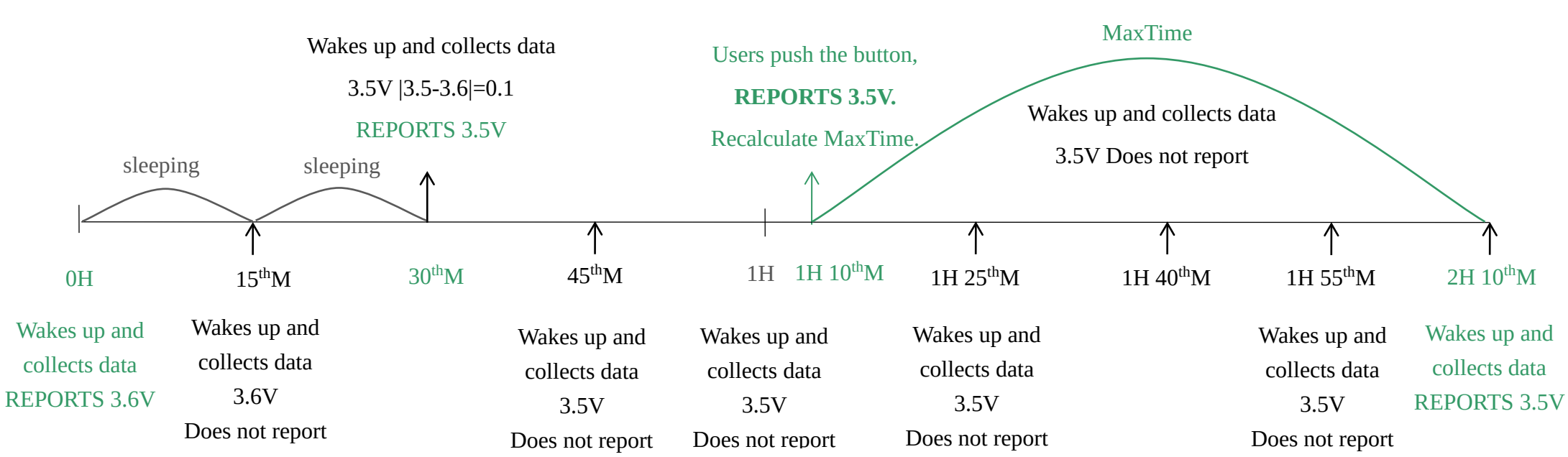


Note: MaxTime=MinTime. Data will only be report according to MaxTime (MinTime) duration regardless BatteryVoltageChange value.

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.



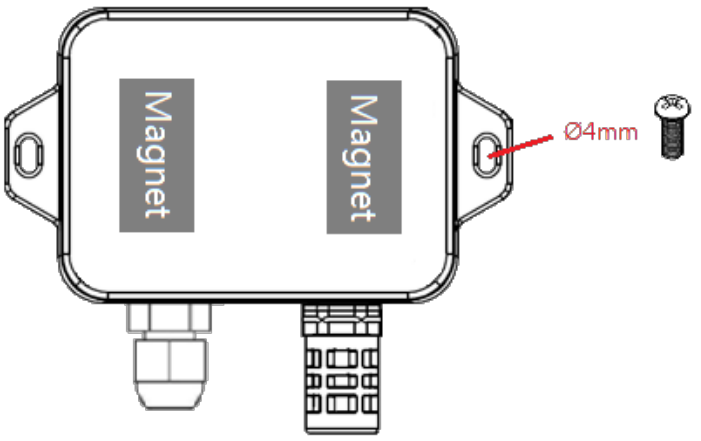
Note:

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.

6. Installation

1. The Wireless Temperature and Humidity Sensor with Thermocouple Sensor (R718CXAB) has a built-in magnet. 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.



Screw hole diameter: Ø4mm

2. When R718CXAB is compared with the last reported values, the temperature / air temperature change is exceeded 1°C (default), it will report values at the MinTime interval.

   If does not exceeded 1°C (default), it will report values at the MaxTime interval.

3. Do not put the whole stainless probe into the liquid.

   Sinking the probe into the liquid could damage the sealing compound and thus cause the liquid to get inside the PCB.

Applications:

- Oven
- Industrial control equipment
- Semiconductor industry

Note:

(1) 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) Do not sink the probe into chemical solutions, such as alcohol, ketone, ester, acid, and alkali.

(3) Please do not disassemble the device unless it is required to replace the batteries.

(4) 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. 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 How to tell 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 Instructions

Kindly pay attention to the following 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 a dusty or dirty environment. It might damage its detachable parts and electronic components.
- Do not store the device under extremely hot conditions. 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, moisture that forms inside the device will damage 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 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 operating properly, please take it to the nearest authorized service facility for repair.

9. Precautions for Outdoor Installation

According to the Enclosure Protection Class (IP code), the device is compliant to GB 4208-2008 standard, which is equivalent to IEC 60529:2001 degrees of protection provided by enclosures (IP Code).

IP Standard Test Method:

IP65: spray the device in all directions under 12.5L/min water flow for 3min, and the internal electronic function is normal.

IP65 is dustproof and able to prevent damage caused by water from nozzles in all directions from invading electrical appliances. It can be used in general indoor and sheltered outdoor environments. Installation in extreme weather conditions or direct exposure to sunlight and rain could damage the components of the device. Users may need to install the device under an awning (fig. 1) or face the side with an LED and function key downwards (fig. 2) to prevent malfunction.

IP67: the device is immersed in 1m deep water for 30 minutes, and the internal electronic function is normal.

Fig 1. Install under an awning

Fig 2. Install with LED and function key faced downwards