Wireless 2-Gang Temperature Sensor

R718B2 Series
User Manual

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1. Introduction

R718B2 series is a Wireless 2-Gang Resistance Temperature Detector for Netvox ClassA type devices based on the LoRaWAN open protocol and is compatible with the LoRaWAN protocol. It connects two external resistance temperature detectors (PT1000) to measure the temperature.

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

Probe

Round Head Needle Magnetic Clamp Patch

R718B2 series

R718B220 - Round head probe

-70° to 200°C

R718B221 - Needle probe

-70° to 375°C

R718B240 - Round head probe

-40° to 375°C

R718B241 - Needle probe

-40° to 375°C

R718B250 -Round head probe

-40° to 500°C

R718B251 - Needle probe

-40° to 500°C

R718B222 - Magnetic probe

-50° to 180°C

R718BC2 - Clamp probe

-50° to 150°C

R718BP2 - Patch probe

-50° to 150°C

3. Features

- SX1276 LoRa wireless communication module
- 2 x ER14505 lithium batteries in parallel
- PT1000 Platinum resistance temperature sensor detection
- Magnetic base
- IP65/IP67 (main body)
- 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

Note: Please visit http://www.netvox.com.tw/electric/electric_calc.html for more information about battery lifespan.

4. Setup Instructions

On/Off

Power on	Insert batteries. (Users 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 once.
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. Remove and insert the battery; the device is off by default. 2. The on/off interval should be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components. 3. 5 seconds after powering 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 (without factory resetting)	Turn on the device to search the previous network. 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	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 the 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 with an uplink packet including temperature1, temperature2, threshold alarm and battery voltage. It 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 (10°C)

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

b. The interval between two reports must be the minimum time.

c. 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 follows:

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 = 8 bytes)

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 0114000A0B202005200000, 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**				
R718B2 series	0x14	0x00	SoftwareVersion (1 byte) e.g. 0x0A—V1.0	HardwareVersion (1 byte)	DateCode (4 bytes, e.g.0x20170503)	Reserved (2 bytes, fixed 0x00)	
		0x01	Battery (1 byte) unit: 0.1V	Temperature 1 (Signed 2 bytes) unit: 0.1°C	Temperature 2 (Signed 2 bytes) unit:0.1°C	ThresholdAlarm (1Byte) Bit0_ LowTemperature1Alarm, Bit1_ HighTemperature1Alarm, Bit2_ LowTemperature2Alarm, Bit3_ HighTemperature2Alarm, Bit4-7 Reserved	Reserved (2 bytes) fixed 0x00

Note:

The default threshold alarm is disabled. If you need to enable it, please refer to section 5.3 Set/GetSensorAlarmThresholdCmd.

Example 1 of Uplink: 0114012401090102020000

1st byte (01): Version

2nd byte (14): DeviceType 0x14－R718B2 series

3rd byte (01): ReportType

4th byte (24): Battery－3.6V, 24 (H_{ex}) = 36 (D_{ec}), 36*0.1V=3.6V

5th6th byte (0109): Temperature－26.5°C, 0109 (H_{ex}) = 265 (D_{ec}), 265*0.1°C = 26.5°C

7th8th byte (0102): Temperature－25.8°C, 0102 (H_{ex}) = 258 (D_{ec}), 258* 0.1°C = 25.8°C

9th byte (02): ThresholdAlarm－High Temperature1 Alarm

0000 0010, bit1=1

10th11th byte (0000): Reserved

Example 2 of Uplink: 011401A0FF39FF36040000

1st byte (01): Version

2ndbyte (14): DeviceType 0x14－R718B2 series

3rd byte (01): ReportType

4th byte (A0): Battery－3.2V (Low battery), A0 (H_{ex}) = 32 (D_{ec}), 32* 0.1V = 3.2V //When bit7 is 1, it represents low battery.

5th6th byte (FF39): Temperature－-19.9ºC , 0x10000-0xFF39 = 0xC7 (H_{ex}), 0xC7 (H_{ex}) = 199 (D_{ec}), -199x0.1°C= -19.9°C

7th8th byte (FF36): Temperature－-20.2 °C, 0x10000-0xFF36 = 0xCA (H_{ex}), 0Xca (H_{ex}) = 202 (D_{ec}), -202* 0.1°C = -20.2°C

9th byte (04): ThresholdAlarm－Low Temperature2 Alarm

0000 0100, bit2=1

10th11th byte (0000): Reserved

5.2 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**				
ConfigReport Req	R718B2 series	0x01	0x14	MinTime (2 bytes, unit: s)	MaxTime (2 bytes, unit: s)	BatteryChange (1 byte, unit: 0.1v)	Temperature Change (2 bytes, unit: 0.1℃)	Reserved (2 bytes, fixed 0x00)
ConfigReport Rsp		0x81		Status (0x00_success)		Reserved (8 bytes, fixed 0x00)		
ReadConfigReportReq		0x02		Reserved (9 bytes, fixed 0x00)				
ReadConfigReportRsp		0x82		MinTime (2 bytes, unit: s)	MaxTime (2bytes, unit: s)	BatteryChange (1 byte, unit: 0.1v)	Temperature Change (2 bytes, unit: 0.1℃)	Reserved (2 bytes, fixed 0x00)

(1) Configure device parameters

MinTime = 0x003C (1 min), MaxTime = 0x003C (1 min), BatteryChange = 0x01 (0.1V), Temperaturechange = 0x0064 (10℃)

Downlink: 0114003C003C0100640000

Response: 8114000000000000000000 (configuration successful)

8114010000000000000000 (configuration failed)

(2) Read device parameters

Downlink: 0214000000000000000000

Response: 8214003C003C0100640000 (current parameters)

5.3 Set/GetSensorAlarmThresholdCmd

FPort: 0x10

Remain the last configuration when the device is reset back to factory setting.

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 SensorthresholdSet 0x01_Temperature)	SensorHighThreshold (4 bytes, unit: 0.1°C)	SensorLowThreshold (4 bytes, unit: 0.1°C)
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 SensorthresholdSet 0x01_Temperature)	Reserved (8 bytes, Fixed 0x00)	
GetSensorAlarmThresholdRsp	0x82	Channel (1 byte, 0x00_Channel1, 0x01_Chanel2, 0x02_Channel3,etc.)	SensorType (1 byte, 0x00_Disable ALL SensorthresholdSet 0x01_Temperature)	SensorHighThreshold (2 bytes, unit: 0.1°C)	SensorLowThreshold (2 bytes, unit: 0.1°C)

Default: Temperature1 = Channel 0x00, Temperature2 = Channel 0x01

(1) SetSensorAlarmThresholdReq

Configure Channel = 0x00 (Temperature1), HighThreshold = 0x0000012C (30°C), and LowThreshold = 0x00000064 (10°C)

Downlink: 0100010000012C00000064

Response: 810000000000000000000

(2) GetSensorAlarmThresholdReq

Downlink: 020001000000000000000

Response: 8200010000012C00000064

(3) Clear all thresholds (Set SensorType = 0)

Downlink: 010000000000000000000

Response: 810000000000000000000

5.4 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 = 0x00000E10 (60min); RejoinThreshold = 0x03 (3 times)

Downlink: 0100000E1003

Response: 810000000000 (configuration succeed)

810100000000 (configuration fail)

(2) Read configuration

Downlink: 020000000000

Response: 8200000E1003

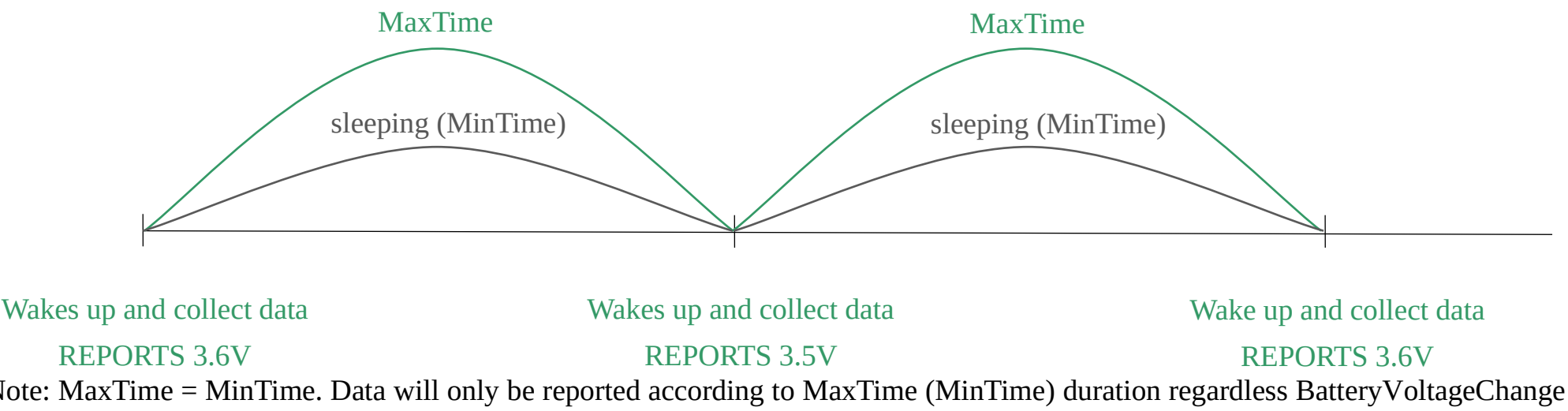
Note: a. Set RejoinCheckThreshold as 0xFFFFFFFF to stop the device from rejoining the network.

b. The last configuration would be kept as the device is factory reset.

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

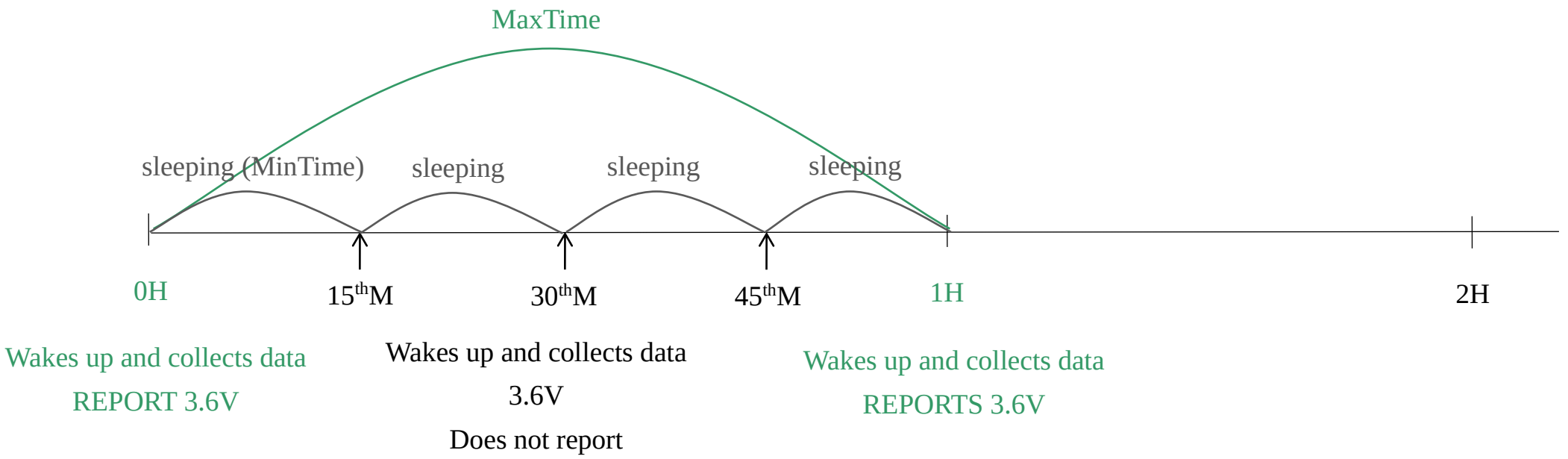
5.5 Example for MinTime/MaxTime logic

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

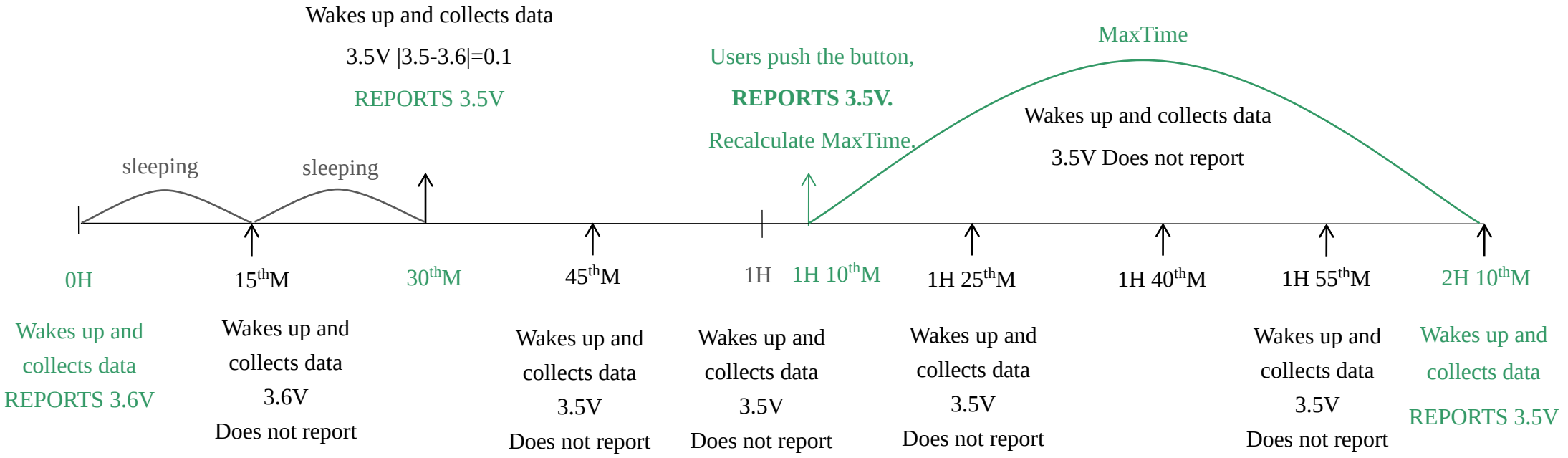


Note: MaxTime = MinTime. Data will only be reported according to MaxTime (MinTime) duration regardless BatteryVoltageChange value.

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.

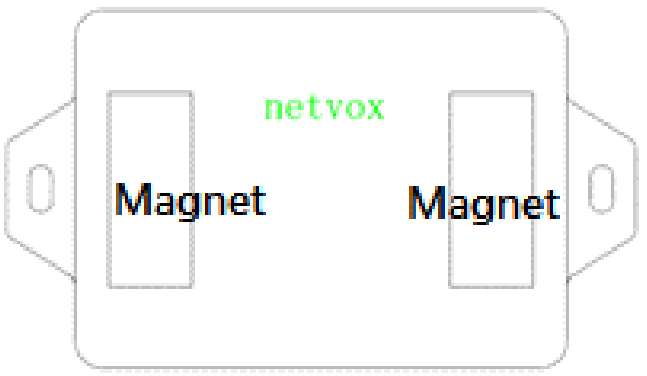
(4) Whenever the device sends a report, no matter resulting from data variation, button pushed or MaxTime interval, another cycle of MinTime/MaxTime calculation is started.

6. Installation

1. The Wireless 2-Gang Temperature Sensor (R718B2 series) has a built-in magnet.

   When installed, it can be attached to the surface of an iron object. To make the installation more secure, please use screws (purchased) to fix the unit.

   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 R718B2 is compared with the last reported values, the temperature change exceeds 0.1°C (default), it will report values at the MinTime interval. If the temperature change does not exceed 0.1°C (default), it will report values at the MaxTime interval.

R718B2 series is suitable for the below scenarios:

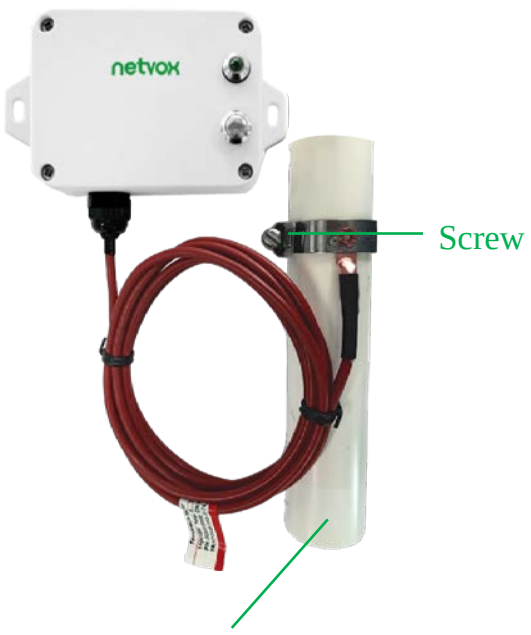
- Oven
- Industrial control equipment
- Semiconductor industry

3. Put only 30mm of the 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.

Note: Do not sink the probe into chemical solutions, such as alcohol, ketone, ester, acid, and alkali.

▼ R718BC2

3.1 When installing R718BC2, user needs to fix the clamp probe on the surface of a tube and tighten the screw with a slotted screwdriver.



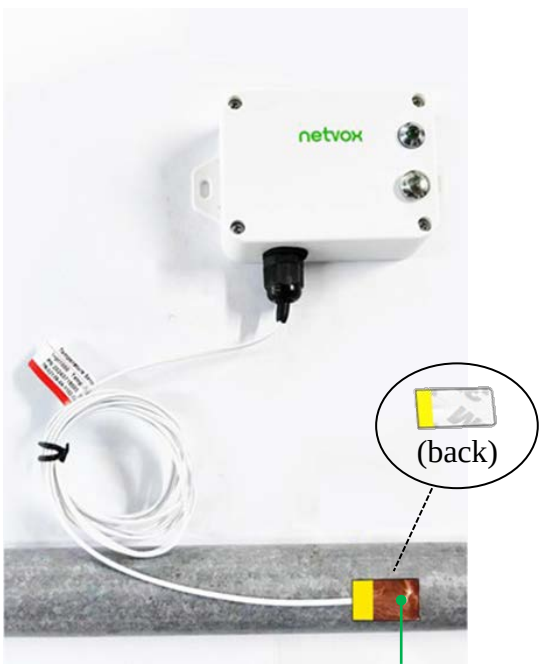
▼ R718BP2

3.2 When installing R718BP2, user needs to …

a. Remove the liner of the doubled-sided tape on the back of the patch probe.

b. Put the patch probe on the surface of an object.

c. Fix the patch probe with PTFE tape.



Note:

a. Please do not disassemble the device unless the batteries are required to be replaced.

b. Do not touch the waterproof gasket, LED indicator light, or function keys when replacing the batteries. Please use a 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 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 reactions 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.

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. Relevant Products

Model		Temperature Range	Wire Material	Wire Length	Probe Type	Probe Material	Probe Dimension	Probe IP Rating
R718B120	One-gang	-70° to 200°C	PTFE + silicone	2m	Round head	316 stainless steel	Ø5mm*30mm	IP67
R718B220	Two-gang							
R718B121	One-gang				Needle		Ø5mm*150mm	
R718B221	Two-gang							
R718B122	One-gang	-50° to 180°C			Magnetic	NdFeB magnet + stainless steel spring	Ø15mm	
R718B222	Two-gang							
R718B140	One-gang	-40° to 375°C	Braided Fiberglass		Round head	316 stainless steel	Ø5mm*30mm	IP50
R718B240	Two-gang							
R718B141	One-gang				Needle		Ø5mm*150mm	
R718B241	Two-gang							
R718B150	One-gang	-40° to 500°C			Round head		Ø5mm*30mm	
R718B250	Two-gang							
R718B151	One-gang				Needle		Ø5mm*150mm	
R718B251	Two-gang							
R718BC	One-gang	-50° to 150°C	PTFE + silicone		Clamp		Range: Ø21 to 38mm	IP67
R718BC2	Two-gang							
R718BP	One-gang	-50° to 150°C	PTFE		Patch	Copper	15mm x 20mm	IP65
R718BP2	Two-gang							

9. 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, thus corroding 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, moisture inside the device will damage the board when the temperature rises.
- 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.

10. 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.