Wireless Multifunctional CO2 Sensor

R718UBB Series
User Manual

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1. Introduction

R718UBB all-in-one series is a ClassA type testing device based on LoRaWAN open protocol of Netvox, which can support multiple combinations of temperature and humidity, CO_2, vibration, atmospheric pressure and illumination sensors, and is compatible with LoRaWAN 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 device, 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.

The specific model of R718UBB all-in-one is shown in the following table:

UBB represents the basic function of battery power CO_2

"1" represents temperature and humidity,

"2" represents vibration

"3" represents air pressure

"5" represents light

Device Model	Product functions
R718UBB	CO2
R718UBB1	CO2, temperature and humidity
R718UBB12	CO2, temperature and humidity, vibration
R718UBB123	CO2, temperature and humidity, vibration, air pressure
R718UBB23	CO2, vibration, air pressure
R718UBB25	CO2, vibration, light
R718UBB125	CO2, temperature and humidity, vibration, light
R718UBB235	CO2, vibration, air pressure, light
R718UBB1235	CO2, temperature and humidity, vibration, air pressure, light

2. Appearance

Indicator

Function Key

Light Sensor

Temperature and humidity

3. Main Feature

- Apply SX1276 wireless communication module

- 2 sections ER14505 3.6V Lithium AA size batteries

- Detectable CO2 concentration

- The base is attached with a magnet, which can be adsorbed on iron objects

- Host Body Protection Level: IP65

- Compatible with LoRaWAN™ Class A

- Frequency Hopping Spread Spectrum (FHSS) 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

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. On this website, users can find battery life time for varied 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 20 times.
Power off	Remove Batteries.
Note:	1. Remove and insert the battery; the device is at off state by default. Turn on the device to use again. 2. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components. 3. In the first 5 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 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 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 rapidly 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: Max Interval. When the reportchange exceeds setting value or the state changes: send a data report according to Max Interval.

Low Voltage Warning

Low Voltage	3.2V(after reporting low voltage, the device may still work, but the CO_2 data will be inaccurate. Please replace the battery in time)

5. Data Report

When the device is powered on, it will immediately send a version package report and then report the device data.

    Default setting:

        Min interval = 10s (subject to factory setting)

        Max interval = 15min (subject to factory setting)

        R718UBB,R718UBB1,R718UBB12 reportcount=1

        R718UBB123,R718UBB23,R718UBB25,R718UBB125,R718UBB235,R718UBB1235 reportcount=2

    Data detection:

        When the device is in a network state, the light flashes once after pressing the key, and then reads the data. When the time to return the corresponding data or configure is up, it will also detect and return the corresponding data information.

        (Note: The interval between multiple data packets is mintime)

    Note:

        1. Before any configuration, the device sends data according to the default configuration.

        2. Do not send any configuration before turn on the device.

        3. CO_2 data will be unstable due to transportation relations, long storage time and other factors.

           If the CO_2 value which customers test is inconsistent ,or there is large discrepancy of the primary standard,

           it can be recalibrated. For specific calibration methods,please refer to command 0x03 CalibrateType.

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

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

The report configuration and sending time are as follows:

Min Interval (Unit: s)	Max Interval (Unit: s)
Not 0	Mintime * reportcount ~ 65535

5.1 Example of ReportDataCmd

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)

			Battery (1Byte, unit:0.1V)	Temperature (Signed2Bytes,unit:0.01°C)	Humidity (2Bytes,unit:0.01%)	CO2 (2Byte ,1ppm)	ShockEvent (1Byte) 0x00_NoShock 0x01_ Shock
R718UBB	0xBB	0x01	Battery (1Byte, unit:0.1V)	Temperature (Signed2Bytes,unit:0.01°C)	Humidity (2Bytes,unit:0.01%)	CO2 (2Byte ,1ppm)	ShockEvent
		0x02	Battery (1Byte, unit:0.1V)	AirPressure (4Bytes,unit:0.01hPa)		Illuminance (3Bytes,unit:1Lux)	

R718UBB1235 report example:

Report data 1: 01BB0124097A151F020C01

1st byte (01): Version

2nd byte (BB): DeviceType 0xBB － R718UBB Series

3rd byte (01): ReportType

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

5th 6th byte (097A): Temperature－24.6°C ,097A(HEX)=2426(DEC),2426*0.01°C =24.26°C

7th 8th byte (151F): Humidity－54.07% , 151F(HEX)=5407(DEC),5407*0.01%=54.07%

9th 10th byte (020C): CO2－524ppm , 020C(HEX)=524(DEC),524*1ppm=524ppm

11th byte (01): ShockEvent－1 , Shock

Report data 2: 01BB02240001870F000032

1st byte (01): Version

2nd byte (BB): DeviceType 0xBB － R718UBB Series

3rd byte (02): ReportType

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

5th ～ 8th byte (0001870F): AirPressure－1001.11hPa, 0001870F(HEX)=100111(DEC),100111*0.01hPa=1001.11hPa

9th ~11th byte (000032): Illuminance－50 Lux , 000032(HEX)=50(DEC),50*1Lux=50Lux

Note:

        Unsupported sensor detection item data is 0xFF/0xFFFF/0xFFFFFF/0xFFFFFFFF

5.2 Example of ConfigureCmd

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)

ConfigReportReq		0x01	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	Reserved (2Bytes,Fixed 0x00)
ConfigReportRsp		0x81	Status (0x00_suBBess)	Reserved (8Bytes,Fixed 0x00)	
ReadConfigReportReq		0x02	Reserved (9Bytes,Fixed 0x00)		
ReadConfigReportRsp		0x82	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	Reserved (2Bytes,Fixed0x00)
CalibrateCO2Req	R718UBB	0x03	CalibrateType (1Byte, 0x01_TargetCalibrate, 0x02_ZeroCalibrate, 0x03_BackgroudCalibrate, 0x04_ABCCalibrate)	CalibratePoint (2Bytes, Unit:1ppm) Only valid in targetCalibrate Type	Reserved (6Bytes,Fixed 0x00)
CalibrateCO2Rsp		0x83	Status (0x00_success)	Reserved (8Bytes,Fixed 0x00)	
SetShockSensorSensitivityReq		0x04	ShockSensorSensitivity (1Byte)	Reserved (8Bytes,Fixed 0x00)	
SetShockSensorSensitivityRsp		0x84	Status (0x00_success)	Reserved (8Bytes,Fixed 0x00)	
GetShockSensorSensitivityReq		0x05	Reserved (9Bytes,Fixed 0x00)		
GetShockSensorSensitivityRsp		0x85	ShockSensorSensitivity (1Byte)	Reserved (8Bytes,Fixed 0x00)	

Note: The 0xBB column appears between DeviceType (R718UBB) and CmdID column in the original, applying to all rows.

(1) Configure the device parameter MinTime = 300s, MaxTime = 900s

    Downlink: 01BB012C03840000000000

    Device return:

          81BB000000000000000000 (configuration successful)

          81BB010000000000000000 (configuration failed)

(2) Read the device parameter

    Downlink: 02BB000000000000000000

    Device Return:

          82BB012C03840000000000 (device current parameter)

(3) Set CO2 calibration

    Downlink:

        03BB0103E8000000000000   // Select Target-calibrations

        (calibrate when the known CO2 concentration is 1000ppm (concentration optional))

        03BB020000000000000000   // Select Zero-calibrations

        (Calibration in an environment with a CO2 concentration of 0 ppm)

        03BB030000000000000000   // Select Background calibrations

        (calibration shall be carried out in a stable environment in fresh air, i.e. 400 ppm concentration)

        03BB040000000000000000   // Select ABC calibrations

        (self calibration is default when power on, and 8 days is a cycle of self calibration. The sensor must be exposed to

        fresh air at least once (well ventilated) for calibration)

    Device return:

        83BB000000000000000000 (configuration successful)

        // Successfully configured, (Target/Zero/Background/ABC-alignments)

        83BB010000000000000000 (configuration failed)

        //After calibration, the returned CO2 value is not within the error range

(4) SetShockSensorSensitivityReq:

    The effective range of the configuration is 0x01~0x14, and the vibration function is turned off when it is set to 0xFF

    Downlink: 04BB0A0000000000000000   //Set ShockSensorSensitivity = 10 (Dec)

    Device return:

        84BB000000000000000000 (device current parameter)

(5) GetShockSensorSensitivityReq:

    Downlink: 05BB000000000000000000

    Device return:

        85BB0A0000000000000000 (device current parameter)

5.3 Example of calibration configuration

FPort：0x0E

Description	CmdID	Sensor Type	PayLoad(Fix =9 Bytes)				
SetGlobal CalibrateReq	0x01	See below	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 - byte

The calibration <u>sensor type</u> corresponding to each sensortype:

0x01_Temperature Sensor, 0x02_Humidity Sensor, 0x03_Light Sensor, 0x06_CO2 Sensor, 0x35_Air PressSensor

The calibration <u>channel</u> corresponding to each sensortype:

CO_2=0x00, temperature=0x01, humanity=0x02, light=0x03, air press=0x04

(1) Assume that the reported original value of CO_2 is 500ppm, the calibration increases by 100ppm, and the reported value is 600ppm

SetGlobalCalibrateReq: Calibration increased by 100ppm，Multiplier =0x0001，Divisor = 0x0001，DeltValue = 0x0064

Downlink: 0106000001000100640000

Device return:8106000000000000000000000 (configuration successful)

8106000<u>01</u>00000000000000 (configuration failed)

(2) GetGlobalCalibrateReq：

Downlink:0206000000000000000000

Device return:8206000001000100640000

(3)Assume that the reported original CO2 value is 500ppm, the calibration is reduced by 100ppm, and the reported value is 400ppm

    SetGlobalCalibrateReq: Calibration reduction by 100ppm，Multiplier =0x0001，Divisor = 0x0001，DeltValue = 0xFF9C

   Downlink: 01060000010001FF9C0000

   Device return:81060000000000000000000

 (4) GetGlobalCalibrateReq:

   Downlink:02060000000000000000000

   Device return:82060000010001FF9C0000

 (5)ClearGlobalCalibrateReq (Clear calibration value: reported value returns to 500ppm)

   Downlink: 03000000000000000000000

   Device return:83000000000000000000000

6. 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:

6.1 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.

6.2 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.

7. Precautions for Outdoor Installation

According to Enclosure Protection Class

This standard is equivalent to IEC 60529:2001 Degrees of Protection Provided by Enclosures

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, dust-proof and to prevent damage caused by water from nozzles in all directions from invading electrical appliances. It can be used in general indoor environment and sheltered outdoor environment.

It is not suitable for use in environments with high water pressure, high temperature and high humidity, such as long time direct sunlight outdoors and possible direct exposure to rainstorm. If it is really necessary to install in harsh environments, it is recommended to add sunscreen and rainproof shields when installing.

Case I (face down with LED and buttons)   Case II (installed under the rain shield)

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 and various liquids or water may contain minerals that can corrode electronic circuits. In case the device is wet, please dry it completely.

• Do not use or store in dusty or dirty areas. This way can damage its detachable parts and electronic components.

• Do not store in excessive heat place. High temperatures can shorten the life of electronic devices, destroy batteries, and deform or melt some plastic parts.

• Do not store in excessive cold place. 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. Treating device roughly can destroy internal circuit boards and delicate structures.

• Do not wash with strong chemicals, detergents or strong detergents.

• Do not paint the device. Smudges can make debris block detachable parts up and affect normal operation.

• Do not throw the battery into the fire to prevent the battery from exploding. Damaged batteries may also explode.

All the above suggestions apply equally to your device, batteries and accessories.

If any device is not operating properly, please take it to the nearest authorized service facility for repairing.