Wireless Multifunctional CO2 Sensor

R718UBD Series
User Manual

Table of Content

1. Introduction

R718UBD all-in-one series is a ClassA type of netvox based on LoRaWAN open protocol, which can support a variety of combined detection devices composed of temperature and humidity, CO2, vibration, atmospheric pressure, illumination, TVOC and dust, 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 R718UBD all-in-one is shown in the following table:

UBD represents the basic function CO2 of DC power supply

"1" represents temperature and humidity,
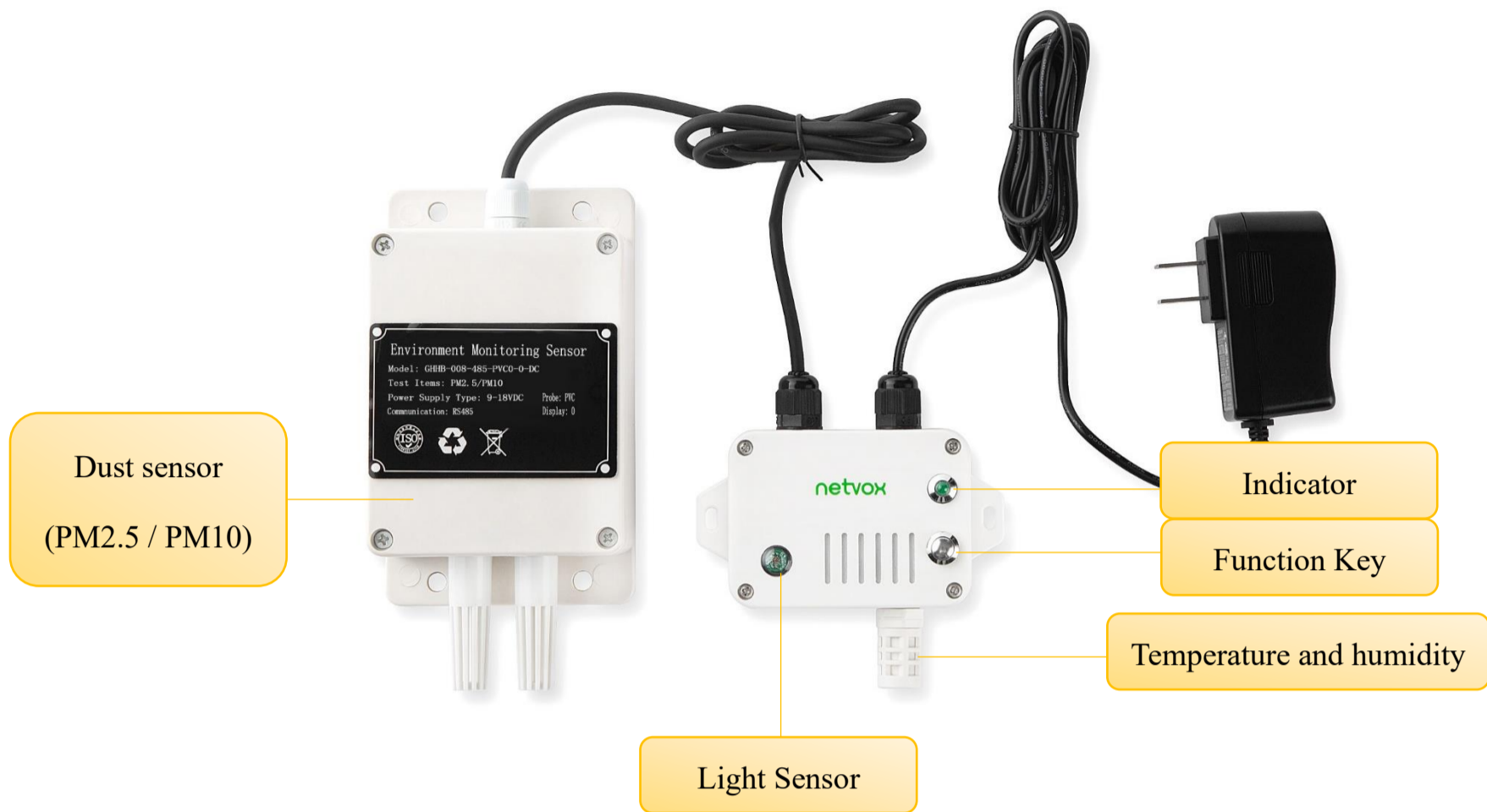
"2" represents vibration

"3" represents air pressure

"5" represents light

"6" represents TVOC

"7" represents PM2.5/10

Device Model	Product functions
R718UBD	CO2
R718UBD1	CO2, temperature and humidity
R718UBD12	CO2, temperature and humidity, vibration
R718UBD123	CO2, temperature and humidity, vibration, air pressure
R718UBD23	CO2, vibration, air pressure
R718UBD25	CO2, vibration, light
R718UBD125	CO2, temperature and humidity, vibration, light
R718UBD235	CO2, vibration, air pressure, light
R718UBD1235	CO2, temperature and humidity, vibration, air pressure, light
R718UBD126	CO2, temperature and humidity, vibration, TVOC
R718UBD1236	CO2, temperature and humidity, vibration, air pressure, TVOC
R718UBD127	CO2, temperature and humidity, vibration, PM2.5/10
R718UBD1237	CO2, temperature and humidity, vibration, air pressure, PM2.5/10
R718UBD12357	CO2, temperature and humidity, vibration, air pressure, light, PM2.5/10
R718UBD1257	CO2, temperature and humidity, vibration, light, PM2.5/10
R718UBD256	CO2, vibration, light, TVOC
R718UBD257	CO2, vibration, light, PM2.5/10
R718UBD236	CO2, vibration, air pressure, TVOC
R718UBD237	CO2, vibration, air pressure, PM2.5/10
R718UBD2356	CO2, vibration, air pressure, light, TVOC
R718UBD2357	CO2, vibration, air pressure, light, PM2.5/10

2. Appearance

Dust sensor (PM2.5 / PM10)

Environment Monitoring Sensor
Model: GHBB-OO8-485-PVCO-O-DC
Test Items: PM2.5/PM10
Power Supply Type: 9-18VDC   Probe: PVC
Communication: RS485   Display: 0

netvox

Indicator

Function Key

Temperature and humidity

Light Sensor

3. Main Feature

- Apply SX1276 wireless communication module

- DC 12V power supply

- It can detect temperature and humidity, CO_2, vibration, atmospheric pressure, illumination, TVOC and dust

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

- Host Body Protection Level: IP65

- Compatible with LoRaWAN^{TM} Class A

- Frequency Hopping Spread Spectrum (FHSS) technology

- Available third-party platform: Actility / ThingPark, TTN, MyDevices/Cayenne

4. Set up Instruction

On/Off

Power on	Power on
Restore to factory setting	Press and hold the function key for 5 seconds till green indicator flashes 20 times.
Power off	Remove adapter
Note:	1. On/off interval is suggested to be about 10 seconds to avoid the interference of capacitor inductance and other energy storage components. 2. 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 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.

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   // The interval between multiple data packets

Max interval = 900s

Report count=1, R718UBD, R718UBD1, R718UBD12

Report count=2, R718UBD123, R718UBD23, R718UBD25, R718UBD125, R718UBD235, R718UBD 1235

     R718UBD126, R718UBD127

Report count=3, R718UBD1236, R718UBD1237, R718UBD12357, R718UBD1257, R718UBD256, R718UBD257,

     R718UBD236, R718UBD237

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. CO2 data will be unstable due to transportation relations, long storage time and other factors.

 If the CO2 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)	Sending interval of multiple data packets	Report cycle
Not 0	Mintime * reportcount ~ 65535	By Min Time Report	Report by Max Time

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				
R718UBD	0xBB	0x01	Battery (1Byte) unit:0.1V)	Temperature (Signed 2Bytes) unit:0.01°C	Humidity (2Bytes) unit:0.01%	CO2 (2Bytes) unit:1ppm	ShockEvent (1Byte) 0x00_NoShock 0x01_ Shock
		0x02	Battery (1Byte, unit:0.1V)		AirPressure (4Bytes,unit:0.01hPa)		illuminance (3Bytes,unit:1Lux)
		0x03	Battery (1Byte) unit:0.1V	PM2.5 (2Bytes) Unit:1 ug/m^3	PM10 (2Bytes) Unit: 1ug/m^3	TVOC (2Bytes) Unit:1ppb	Reserved (1Byte) fixed 0x00

R718UBD12357 report example:

Report data 1: 01BB0100097A151F020C01

        1st byte (01): Version

        2nd byte (BB): DeviceType 0xBB － R718UBD Series

        3rd byte (01): ReportType

        4th byte (00): Battery－0x00 means is powered by DC power source

        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): Shock Event－1 , Shock

Report data 2: 01BB02000001870F000032

        1st byte (01): Version

        2nd byte (BB): DeviceType 0xBB － R718UBD Series

3rd byte (02): ReportType

4th byte (00): Battery－0x00 means is powered by DC power source

5th～8th byte (0001870F): AirPressure－1001.11hPa,1870F(HEX)=100111(DEC),100111*0.01hPa=1001.11hPa

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

Report data 3: 01BB030000110011FFFF00

1st byte (01): Version

2nd byte (BB): DeviceType 0xBB － R718UBD Series

3rd byte (03): ReportType

4th byte (00): Battery－0x00 means is powered by DC power source

5th 6th byte (0011):PM2.5－17ug/m^3, 11(HEX)=17(DEC)

7th 8th byte (0011): PM10－17ug/m^3, 11(HEX)=17(DEC)

9th 10th byte (FFFF): TVOC

11th byte (00): Reserved

Note:

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

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	Report type	NetvoxPayloadData		
Config ReportReq	R718UBD	0x01	0xBB	MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	Reserved (2Bytes,Fixed 0x00)
Config ReportRsp		0x81		Status (0x00_suBBess)		Reserved (8Bytes,Fixed 0x00)
ReadConfig ReportReq		0x02		Reserved (9Bytes,Fixed 0x00)		
ReadConfig ReportRsp		0x82		MinTime (2bytes Unit:s)	MaxTime (2bytes Unit:s)	Reserved (2Bytes,Fixed 0x00)

Calibrate CO2Req		0x03		CalibrateType (1Byte) 0x01_TargetCalibrate 0x02_ZeroCalibrate 0x03_BackgroudCalibrate 0x04_ABCCalibrate	CalibratePoint (2Bytes,Unit:1ppm) Only valid in targetCalibrateType	Reserved (6Bytes,Fixed 0x00)
Calibrate CO2Rsp		0x83		Status (0x00_suBBess)	Reserved (8Bytes,Fixed 0x00)	
SetShockSensor SensitivityReq		0x04		ShockSensorSensitivity (1Byte)	Reserved (8Bytes,Fixed 0x00)	
SetShockSensor SensitivityRsp		0x84		Status (0x00_success)	Reserved (8Bytes,Fixed 0x00)	
GetShockSensor SensitivityReq		0x05		Reserved (9Bytes,Fixed 0x00)		
GetShockSensor SensitivityRsp		0x85		ShockSensorSensitivity (1Byte)	Reserved (8Bytes,Fixed 0x00)	

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

    Downlink: 01BB012C03840000000000   //12C(Hex)=300(Dec), 384(Hex)=900(Dec)

    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

Description	Cmd ID	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	0x03		Reserved 10Bytes,Fixed 0x00				

CalibrateReq			
ClearGlobal CalibrateRsp	0x83	Status (1Byte,0x00_success)	Reserved (9Bytes,Fixed 0x00)

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

Sensor	**Sensor Type**	**Channel**
Temperature	0x01	0x03
Humidity	0x02	0x04
Light	0x03	0x05
PM2.5	0x04	0x01
PM10		0x02
CO2	0x06	0x00
Air Press	0x35	0x06
TVOC	0x40	0x07

(1) Assume that the reported original value of CO2 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: 010600000100010064 0000

Device return:810600<u>00</u>0000000000000000　　(configuration successful)

　　　　　810600<u>01</u>00000000000000　　(configuration failed)

(2) GetGlobalCalibrateReq：

Downlink:020600000000000000000000

Device return:820600000100010064 0000

(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:810600000000000000000000

(4) GetGlobalCalibrateReq:

Downlink:020600000000000000000000

Device return:82060000010001FF9C0000

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

Downlink: 030000000000000000000000

Device return:830000000000000000000000

6. Installation

The waterproof breathable film inside the product is waterproof but <u>not waterproof against steam</u>. Therefore, in order to prevent water vapor from condensing inside the body, it should not be used in high humidity and steam environments.

6-1 Precautions for use of dust sensor

- The sensor is made of water-resistant, dust-proof, and impact resistant materials. However, precision instruments need to be carefully used and maintained to avoid impact and use in harsh environments such as corrosive liquids or gases.
- The air inlet of the sensor shall not be blocked or polluted.
- The electrolyte leakage will cause damage. Do not disassemble the sensor at will.
- Do not use it when the shell is damaged or deformed.
- The sensor shall avoid contact with organic solvents (including silicone rubber and other adhesives), coatings, agents, and fuel oils.
- It is not recommended to use non-standard methods to test the sensor, and vertical air intake must be avoided. For example, put the sensor directly on the concentrated ammonia, spray cigarettes towards the sensor, approach the sensor after the lighter is lit, exhale towards the sensor, and close the sensor to alcohol. Because the regional concentration can be as high as tens of thousands of ppm when liquid ammonia or alcohol volatilizes, and the carbon dioxide concentration in human breath can be as high as 40000 ppm, which will damage the sensor.
- After being used for a long time in a high-concentration gas environment (it is prohibited to store and use it in a high-concentration acid gas for a long time), it is slow to recover to the initial state.
- When the sensor is stored, the working electrode and the reference electrode should be in a short circuit state.
- The sensor is not allowed to be hot-plugged. The sensor must be plugged in after the power is turned off, otherwise, the sensor may be damaged or abnormal phenomena may occur.
- Please pay attention to whether there are requirements for limiting the use of wireless communication devices in this situation. If there are such restrictions, please do not use this device. For example, during aircraft flight and landing, gas stations, gas stations or other places with flammable and explosive materials.

6-2. Precautions for use of TVOC sensor

- The installation place shall be far away from chemical corrosion environment.
- The sensor and wire shall be far away from high-voltage electricity, heat source, etc.
- The sensor belongs to precision instrument and should be stored in a dry, ventilated and normal temperature indoor environment.
- The sensor is a precision device. Please do not disassemble it when using it to avoid product damage.

6-3 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)

7. 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.