Wireless PM2.5 / Temperature / Humidity Sensor

User Manual

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1. Introduction

RA0716_R72616_RA0716Y is a Class A type device based on the LoRaWAN open protocol of Netvox and is compatible with the LoRaWAN protocol.

RA0716_R72616_RA0716Y can be connected with the sensor of the temperature and humidity and PM2.5. The values collected by the sensor are reported to the corresponding gateway.

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

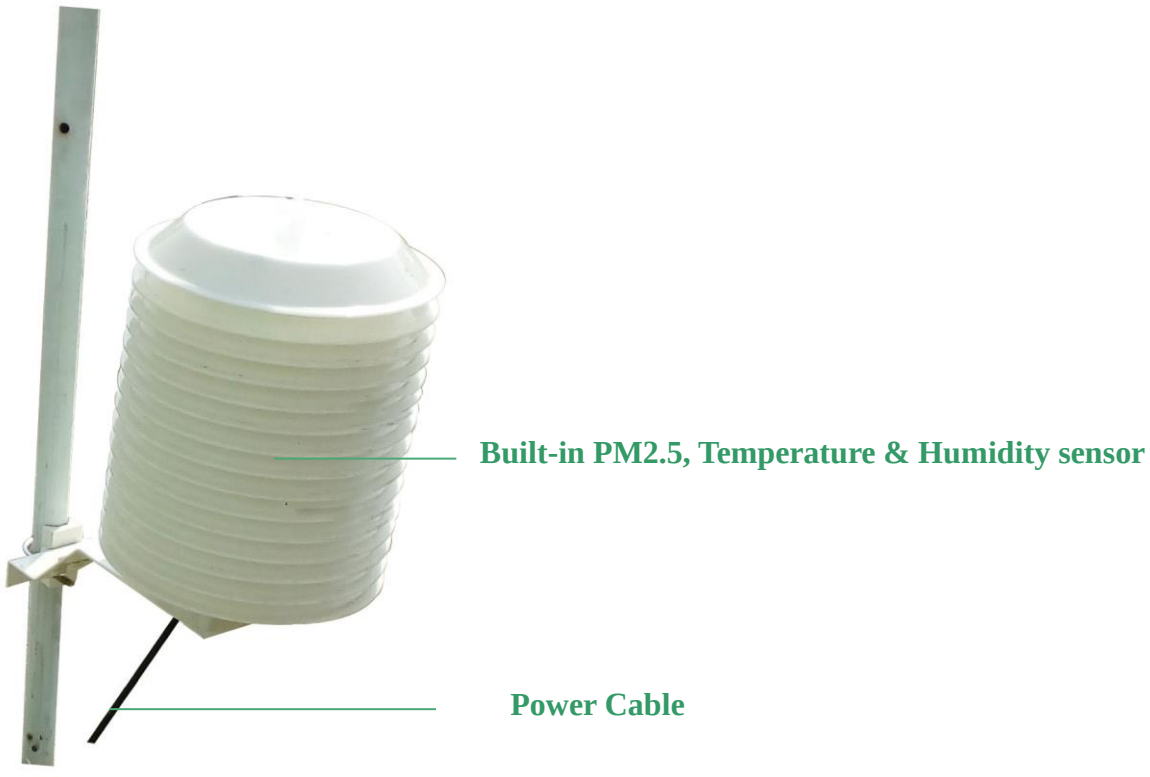
LoRaWAN uses LoRa technology to define end-to-end standard specifications to ensure interoperability between devices and gateways from different manufacturers.

2. Appearance

RA0716

R72616

RA0716Y



3. Features

- Compatible with LoRaWAN
- RA0716 and RA0716Y applies DC 12V adapters
- R72616 applies solar and rechargeable lithium batteries
- Simple operation and setting
- PM2.5, temperature and humidity detection
- SX1276 wireless communication module

4. Setup Instructions

On/Off

Power On	RA0716 and RA0716Y are connected to DC 12V adapter. R72616 applies solar power and rechargeable lithium batteries.
Turn On	Connect with power to turn on.
Factory Resetting	Press and hold the function key for 5 seconds, and the green indicator flashes 20 times: Succes
Power Off	Disconnect from the power supply.
Note	1. The engineering test requires programming a separate engineering testing software. 2. The interval between on and off should be 10 seconds long to avoid the interference of capacitor inductance and other energy storage components.

Network Joining

Never Joined the Network	<u>Turn on the device to search the network</u> The green indicator keeps on for 5 seconds: Success The green indicator remains off: Fail
Had joined the network (Not restore to factory setting)	<u>Turn on the device to search the previous network</u> The green indicator keeps on for 5 seconds: Success The green indicator remains off: Fail
Fail to Join the Network	1. To save power, please remove the batteries when the device is not used. 2. Please check the device registration information on the gateway or consult your platform server provider if the device fails to join the network.

Function Key

Press and Hold for 5 Seconds	Factory Reset / 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 the device sends a data report The device is not in the network: the green indicator remains off

Low Voltage Threshold

Low Voltage Threshold	10.5 V

5. Data Report

After power on, the device will immediately send a version packet report and the data report including the temperature, humidity, PM2.5 and voltage. The device sends data according to the default configuration before any other configuration.

Default Setting:

ReportMaxTime

RA0716_ RA0716Y: 0x0384 (900s)

R72616: 0x708 (1800s)

ReportMaxTime must be greater than ReportType count *ReportMinTime + 10

EU8686: ReportMinTime: 0x0078(120s); ReportMaxTime: 0x172 (370s)

ReportMinTime: 0x001E (30s)

ReportChange: 0

ReportType count = 1 (When the ThresholdAlarm is set, the ReportType Count = 2.)

Note:

(1) The cycle of the device sending the data report is according to the default.

(2) The interval between two reports must be the MaxTime.

(3) ReportChange is not supported by RA0716_R72616_RA0716Y (Invalid configuration). The data report is sent according to ReportMaxTime as a cycle (the first data report is the start to the end of a cycle).

(4) The device also supports the TxPeriod cycle configuration instructions of Cayenne. Therefore, the device can perform the report according to the TxPeriod cycle. The sspecific report cycle is ReportMaxTime or TxPeriod depending on which report cycle was configured last time.

(5) It would take 35 seconds for the sensor to sample and process the collected value after pressing the button.

Please refer Netvox LoRaWAN Application Command document and Netvox Lora Command Resolver http://cmddoc.netvoxcloud.com/cmddoc to resolve uplink data.

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 to the devicetype

NetvoxPayLoadData—Fixed bytes (Fixed = 8 bytes)

Tips

1. Battery Voltage:

(a) The voltage value is bit 0 ~ bit 6, bit 7=0 is normal voltage, and bit 7=1 is low voltage.

Battery=0xE9, binary=1110 1001, if bit 7= 1, it means low voltage.

The actual voltage is 0110 1001 = 0x69 = 105, 105*0.1v =10.5v.

(b) If the battery is equal to 0x00, it means that the device is powered by a DC power supply.

2. Version Packet:

When Report Type=0x00 is the version packet, such as 0135000D04202101060000, the firmware version is 2021.01.06.

3. Data Packet:

When Report Type=0x01 is data packet.

(If the device data exceeds 11 bytes or there are shared data packets, the Report Type will have different values.)

4. Signed Value:

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

Device	Device Type	Report Type	NetvoxPayLoadData				
RA0716 R72616 RA0716Y	0x35 0x36 0x37	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 (Signed 2 bytes, unit: 0.01°C)	Humidity (2 bytes, unit: 0.01%)	PM2.5 (2 bytes, unit: 1ug/m^3)	Reserved (1 byte, fixed 0x00)
		0x12	Battery (1 byte, unit:0.1V)	ThresholdAlarm (7 bytes, Bit0_LowPM2.5Alarm (ug/m3), Bit1_HighPM2.5Alarm (ug/m3), Bit36_LowTemperatureAlarm, Bit37_HighTemperatureAlarm, Bit38_LowHumidityAlarm, Bit39_HighHumidityAlarm, Bit52-55: Reserved)		

Example of Uplink1: 013501000AB61196000700

1st byte (01): Version

2nd byte (35): DeviceType — RA0716

3rd byte (01): ReportType

4th byte (00): Battery — 0V (DC power supply)

5th–6th byte (0AB6): Temperature — 27.42℃ 0AB6 (HEX) = 2742 (DEC), 2742* 0.01℃ = 27.42℃

7th–8th byte (1196): Humidity — 45.02% 1196 (HEX) = 4502 (DEC), 4502* 0.01% = 45.02%

9th–10th byte (0007): PM2.5 — 7ug/m3 0007 (HEX) = 7 (DEC), 7* 1ug/m^3 =7 ug/m^3

11th byte (00): Reserved

Example of Uplink2: 0135120000000000000001

1st byte (01): Version

2nd byte (35): DeviceType — RA0716

3rd byte (12): ReportType

4th byte (00): Battery — 0V (DC power supply)

5th–11th byte (00000000000001): ThresholdAlarm

Bit0: LowPM2.5Alarm — 1 (alarm)

Bit1: HighPM2.5Alarm — 0 (noalarm)

Bit2–51 — 0 (noalarm)

Bit52-55: Reserved

Note: Please visit http://cmddoc.netvoxcloud.com/cmddoc for detailed uplink data.

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	Cmd ID	DeviceType	NetvoxPayLoadData		
ConfigReportReq	RA0716 R72616 RA0716Y	0x01	0x35 0x36 0x37	MinTime (2 bytes, Unit: s)	MaxTime (2 bytes, Unit: s)	Reserved (5 bytes, Fixed 0x00)
ConfigReportRsp		0x81		Status (0x00_success)	Reserved (8 bytes, Fixed 0x00)	
ReadConfigReportReq		0x02		Reserved (9 Bytes, Fixed 0x00)		
ReadConfigReportRsp		0x82		MinTime (2 bytes, Unit: s)	MaxTime (2 bytes, Unit: s)	Reserved (5 bytes, Fixed 0x00)

(1) Configure RA0716 device parameter MinTime = 30s, MaxTime = 120s

Response: 813500000000000000000 (configuration success)

813501000000000000000 (configuration failure)

(2) Read RA0716 device parameter

Downlink: 023500000000000000000

Response: 8235001E00780000000000 (device current parameter)

Note:

a. ReportMaxTime > Report count* ReportMinTime + 10

b. EU868 device: MinTime ≥ 120s; MaxTime ≥ 370s

5.3 Example of GlobalCalibrateCmd

Fport: 0x0E

Description	Cmd ID	SensorType	PayLoad (Fix = 9 bytes)				
SetGlobal CalibrateReq	0x01	0x01_Temperature Sensor 0x02_Humidity Sensor 0x04_PM2.5 Sensor	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)				

0x01_Temperature Sensor, channel = 0x00; 0x02_Humidity Sensor, channel = 0x01; 0x04_PM2.5 Sensor, channel = 0x02

(1) SetGlobalCalibrateReq

Temperature increased by 10℃ (25.1℃ → 35.1℃)

Multiplier = 0x0001, Divisor = 0x0001, and DeltValue = 0x03E8

Downlink: 01010000010000103E80000

Response: 810100000000000000000

(2) GetGlobalCalibrateReq

Downlink: 020100000000000000000

Response: 82010000010000103E80000

(3) SetGlobalCalibrateReq

Temperature decreased by 10℃ (25.1℃ → 15.1℃)

Multiplier =0x0001, Divisor = 0x0001, and DeltValue = 0xFC18

Downlink: 01010000010001FC180000

Response: 8101000000000000000000

(4) GetGlobalCalibrateReq

Downlink: 0201000000000000000000

Response: 82010000010001FC180000

(5) ClearGlobalCalibrateReq

Downlink: 0300000000000000000000

Response: 8300000000000000000000

5.4 Set/GetSensorAlarmThresholdCmd

Fport: 0x10

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, 0x02_Humidity, 0x06_PM2.5)	SensorHighThreshold (4 bytes, unit: ℃; %; ug/m^3)	SensorLowThreshold (4 bytes, unit: ℃; %; ug/m^3)
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, 0x02_Humidity, 0x06_PM2.5)	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, 0x02_Humidity, 0x06_PM2.5)	SensorHighThreshold (4 bytes, unit: ℃; %; ug/m^3)	SensorLowThreshold (4 bytes, unit: ℃; %; ug/m^3)

0x01_Temperature Sensor, channel = 0x00; 0x02_Humidity Sensor, channel = 0x01; 0x06_PM2.5 Sensor, channel = 0x02

Configure temperature HighThreshold = 30℃, LowThreshold = 10℃

(1) SetSensorAlarmThresholdReq

When the HighThreshold or LowThresholdAlarm is triggered, the device reports the data packet of reporttype = 0x12.

Downlink: 01000100000BB8000003E8

Response: 810000000000000000000000

(2) GetSensorAlarmThresholdReq

Downlink: 0200010000000000000000

Response: 82000100000BB8000003E8

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

Downlink: 0100000000000000000000

Response: 8100000000000000000000

Note:

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

b. Set SensorHigh/LowThreshold as 0xFFFFFFFF to disable threshold.

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)

6. Installation

1. **RA0716** does not have the waterproof function. After the device completes joining the network, please place it properly.

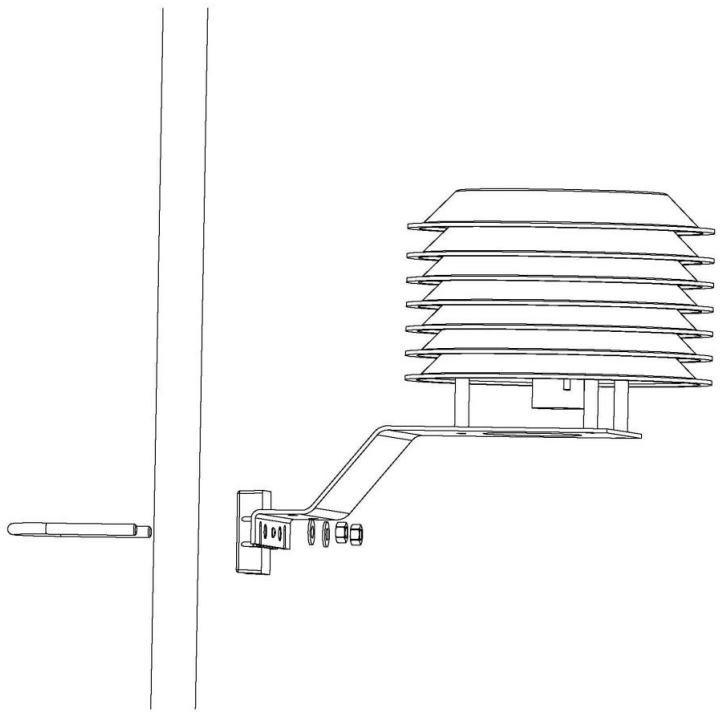
2. **R72616** has a waterproof function. After the device completes joining the network, please place it outdoors.

(1) In the installed position, loosen the U-shaped screw, the mating washer and the nut at the bottom of R72616, and then make the U-shaped screw pass through the appropriate size cylinder and fix it on the fixing strut flap of R72616. Install the washer and the nut in order and lock the nut till R72616 body is stable and does not shake.

(2) At the upper side of the fixed position of R72616, loosen the two U-shaped screws, the mating washer and nut on the side of the solar panel. Make the U-shaped screw pass through the appropriate size cylinder and fix them on the main bracket of the solar panel and install the washer and the nut in sequence. Lock nut till the solar panel is stable and does not shake.

(3) After adjusting the angle of the solar panel completely, lock the nut.

(4) Connect the top waterproof cable of R72616 with the wiring of the solar panel and lock it tight.



(5) Rechargeable lithium battery

R72616 has a battery pack inside. Users can buy and install rechargeable 18650 lithium battery, a total of 3 sections, voltage 3.7V/ every single rechargeable lithium battery, recommended capacity 5000mah. The installation of rechargeable lithium battery steps are as follows:

1: Remove the four screws around battery cover.

2: Insert three 18650 lithium batteries. (Please make sure the positive and negative level of the battery)

3: Press the activation button on the battery pack for the first time.

4: After activation, close the battery cover and lock the screws around battery cover.

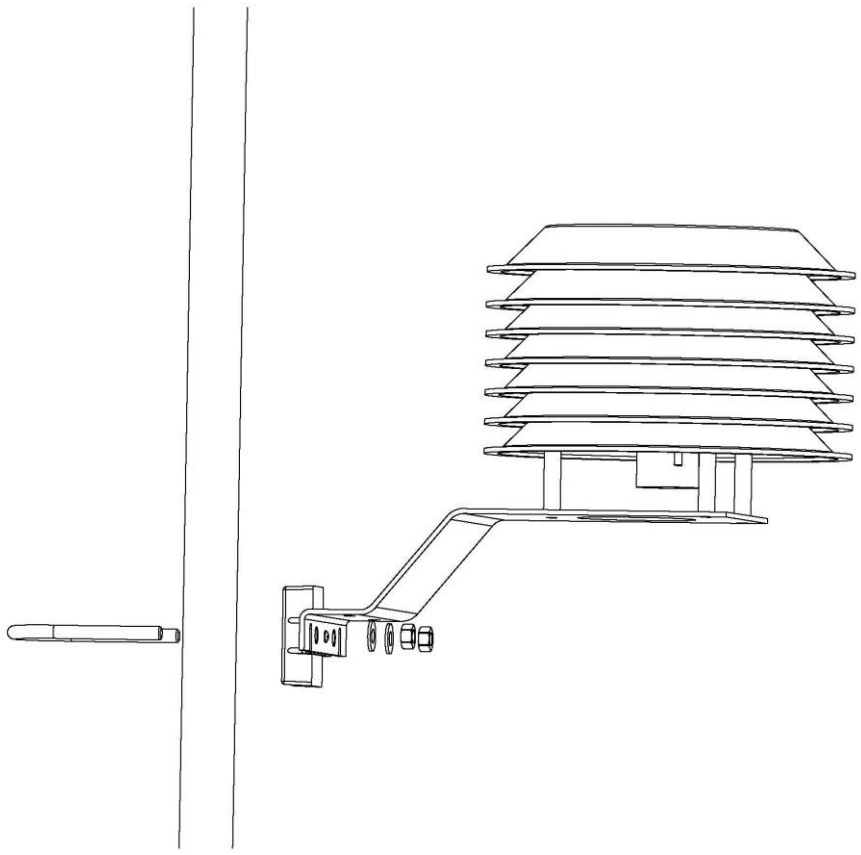
Fig. Rechargeable Lithium Battery

3. **RA0716Y** is waterproof and can be placed outdoors after the device completes joining the network..

(1) In the installed position, loosen the U-shaped screw, the mating washer and the nut at the bottom of RA0716Y, and then make the U-shaped screw pass through the appropriate size cylinder and fix it on the fixing strut flap of RA0716Y. Install the washer and the nut in order and lock the nut till RA0716Y body is stable and does not shake.

(2) Loosen the M5 nut at the bottom of the RA0716Y matte and take the matte together with the screw.

(3) Make the DC adaptor pass through the central hole of the bottom cover of RA0716Y and insert it into the RA0716Y DC socket, and then put the mating screw to the original position and lock the M5 nut tight.



7. 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.