



# IoT Weather Station

Featuring LoRaWAN<sup>®</sup>

**WTS506**

User Guide



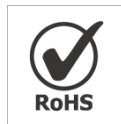
## Safety Precautions

Milesight will not shoulder responsibility for any loss or damage resulting from not following the instructions of this operating guide.

- ❖ The device must not be disassembled or remodeled in any way.
- ❖ In order to protect the security of the device, please change device password when first configuration. The default password is 123456.
- ❖ The device is not intended to be used as a reference sensor, and Milesight will not should responsibility for any damage which may result from inaccurate readings.
- ❖ Do not place the device close to objects with naked flames.
- ❖ Do not place the device where the temperature is below/above the operating range.
- ❖ Make sure electronic components do not drop out of the enclosure while opening.
- ❖ When installing the battery, please install it accurately, and do not install the reverse or wrong model.
- ❖ Make sure both batteries are newest when install, or battery life will be reduced.
- ❖ The device must never be subjected to shocks or impacts.

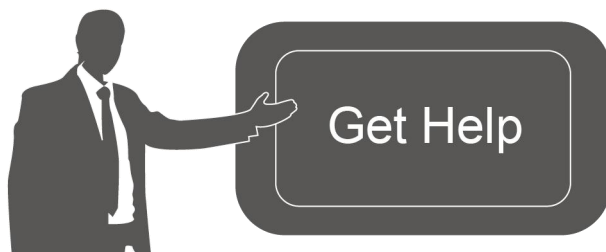
## Declaration of Conformity

WTS series is in conformity with the essential requirements and other relevant provisions of the CE, FCC, and RoHS.



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## Revision History

Date	Doc Version	Description
Oct.10, 2022	V 1.0	Initial version
Sept. 5, 2023	V 1.1	<ol style="list-style-type: none"><li>1. Add threshold alarm feature</li><li>2. Change rainfall related payload definition</li><li>3. Add maintenance note</li></ol>

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# 1. Product Introduction

## 1.1 Overview

IoT Weather Station (WTS Series) is an all-in-one LoRaWAN® weather monitoring system for various atmospheric conditions, such as temperature, humidity, wind speed, wind direction, barometric pressure and rainfall. Consisting of 3 main parts, WTS sensors, WTS Hub and solar panel, IoT Weather Station is designed to withstand the most challenging weather conditions and is easy to install in different scenarios to be widely used in meteorology, smart agriculture, smart building, etc.

Sensor data is transmitted using LoRaWAN® technology. Compliant with Milesight LoRaWAN® gateway and Milesight IoT Cloud solution, users can manage all sensor data and trigger other sensors or appliances easily via webpage or mobile App remotely.

## 1.2 Features

- Integrated with multiple sensors like humidity, temperature, barometric pressure, wind speed, wind direction, rainfall, etc.
- Waterproof, UV-proof and salt spray resistant enclosure for outdoor harsh environment applications
- High power solar powered with chargeable batteries backup
- Store locally more than 19,000 historical records and support retransmission to ensure no data miss
- Easy to carry and install
- Ultra-wide-distance wireless transmission up to the line of sight of 15 km in rural areas
- Equipped with NFC for easy and quick configuration
- Compliant with standard LoRaWAN® gateways and network servers
- Quick and easy management with Milesight IoT Cloud

## 2. Hardware Introduction

### 2.1 Packing List



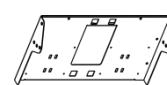
1 × WTS Sensor



1 × WTS Hub



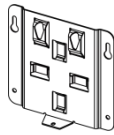
1 × Solar Panel  
(With Bracket)



1 × Solar Panel  
Mounting Bracket



1 x Sensor Cable



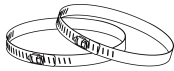
1 x WTS Hub  
Mounting Bracket



5 x Fixing Screws



4 x Solar Panel  
Screws Kits



2 x Hose Clamps



1 x Quick Start  
Guide



1 x Warranty Card



1 x Mounting  
Bracket



1 x Bent Pipe



3 x Hex Socket Cap  
Mounting Screws



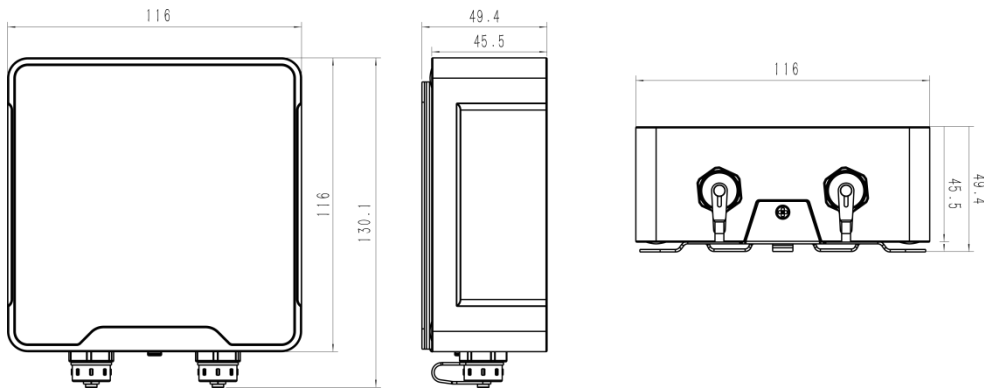
2 x Hose Clamps



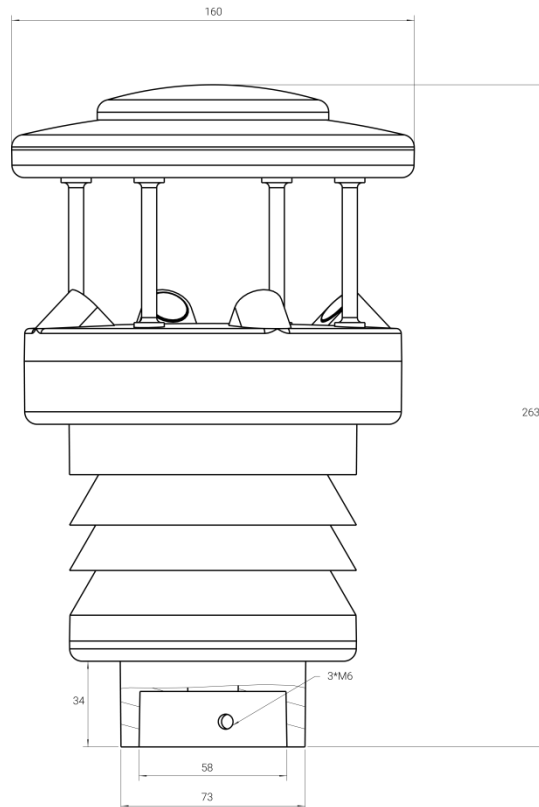
If any of the above items is missing or damaged, please contact your sales representative.

## 2.2 Dimensions(mm)

### WTS Hub



## WTS506



### 2.3 LED and Power Button

The LED indicator and power button are inside the WTS Hub device. Switch on/off and reset can also be configured via NFC.

Function	Action	LED Indication
Turn On	Press and hold the button for more than 3 seconds.	Off → On
Turn Off	Press and hold the button for more than 3 seconds.	On → Off
Reset	Press and hold the button for more than 10 seconds.	Blink 3 times.
Check On/Off Status	Quickly press the power button for within 3 seconds.	Light On: Device is on. Light Off: Device is off.

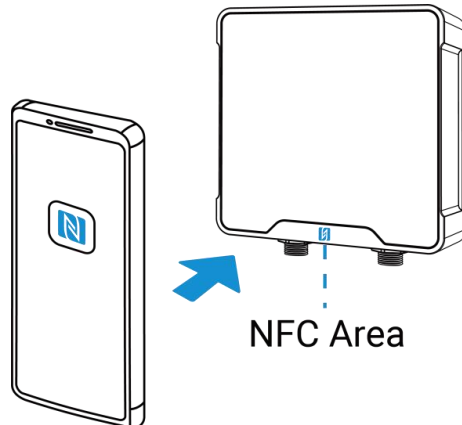
## 3. Operation Guide

### 3.1 NFC Configuration

WTS Hub can be configured via NFC. Before the configuration, please connect WTS Sensor to the right interface of WTS Hub via sensor cable to read and test.

1. Download and install “Milesight ToolBox” App from Google Play or Apple Store.

2. Enable NFC on the smartphone and open "Milesight ToolBox" App.
3. Attach the smartphone with NFC area to the device to read basic information.



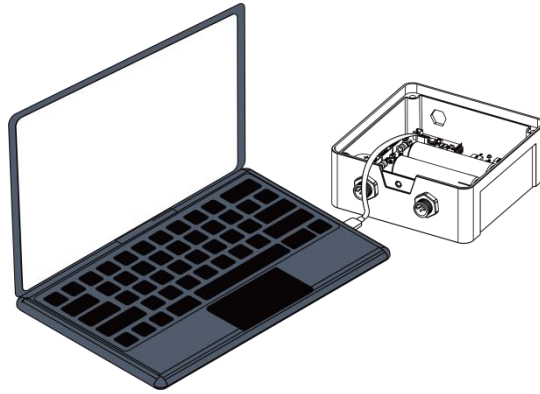
4. Basic information and settings of WTS Hub will be shown on ToolBox if it's recognized successfully. You can read and configure the device by tapping the buttons on the App. In order to protect the security of devices, password validation is required when configuring via unused phone . Default password is **123456**.

Status	Setting	Maintenance
SN	6454C32424650043	
Model	WTS506-915M	
Device EUI	24E124454C324246	
Firmware Version	V1.1-a3	
Hardware Version	V2.0	
Device Status	ON	<input checked="" type="checkbox"/>

**Note:**

- 1) Ensure the location of smartphone NFC area and it's recommended to take off phone case.
- 2) If the smartphone fails to read/write configurations via NFC, keep the phone away and back to try again.
- 3) WTS Hub can also be configured by dedicated NFC reader provided by Milesight IoT.
- 4) You can configure it via Type-C USB port inside the device by these steps: release the back panel of WTS Hub and connect the device to computer via Type-C port, run ToolBox PC software, select serial port as USB port and type as "General", then type password to login ToolBox and configure the device. (Default password: 123456)





## 3.2 LoRaWAN Settings

LoRaWAN settings is used for configuring the transmission parameters in LoRaWAN® network.

### Basic LoRaWAN Settings:

Configure join type, App EUI, App Key and other basic information. You can also keep all settings by default.

Device EUI	<input type="text" value="24E1244"/>
App EUI	<input type="text" value="24E124C0002A0001"/>
Application Port	<input type="text" value="85"/>
Working Mode:	<input type="text" value="Class A"/>
Join Type	<input type="text" value="OTAA"/>
Application Key	<input type="text" value="*****"/>
RX2 Date Rate	<input type="text" value="DR8 (SF12, 500k)"/>
RX2 Frequency	<input type="text" value="923300000"/>
Spread Factor	<input type="text" value="SF7-DR3"/>
Confirmed Mode	<input type="checkbox"/>
Rejoin Mode	<input checked="" type="checkbox"/>
Set the number of packets sent	<input type="text" value="32"/> packets
ADR Mode	<input checked="" type="checkbox"/>
TXPower	<input type="text" value="TXPower0-22 dBm"/>

Parameters	Description
Device EUI	Unique ID of the device which can also be found on the label.

App EUI	Default App EUI is 24E124C0002A0001.
Application Port	The port used for sending and receiving data, default port is 85.
Join Type	OTAA and ABP mode are available.
Application Key	Appkey for OTAA mode, default is 5572404C696E6B4C6F52613230313823.
Device Address	DevAddr for ABP mode, default is the 5 <sup>th</sup> to 12 <sup>th</sup> digits of SN.
Network Session Key	Nwkskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
Application Session Key	Appskey for ABP mode, default is 5572404C696E6B4C6F52613230313823.
LoRaWAN Version	V1.0.2, V1.0.3 are available.
RX2 Data Rate	RX2 data rate to receive downlinks.
RX2 Frequency	RX2 frequency to receive downlinks. Unit: Hz
Spread Factor	If ADR is disabled, the device will send data via this spread factor.
Confirmed Mode	If the device does not receive ACK packet from network server, it will resend data once.
Rejoin Mode	Reporting interval $\leq$ 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval or every double reporting interval to validate connectivity; If there is no response, the device will re-join the network. Reporting interval $>$ 35 mins: the device will send a specific number of LinkCheckReq MAC packets to the network server every reporting interval to validate connectivity; If there is no response, the device will re-join the network.
Set the number of packets sent	When the rejoin mode is enabled, set the number of LinkCheckReq packets to send. <b>Note:</b> the actual sending number is <b>Set the number of packet sent + 1</b> .
ADR Mode	Allow network server to adjust datarate of the device.
Tx Power	Transmit power of device.

**Note:**

- 1) Please contact sales for device EUI list if there are many units.
- 2) Please contact sales if you need random App keys before purchase.
- 3) Select OTAA mode if you use Milesight IoT Cloud to manage devices.
- 4) Only OTAA mode supports rejoin mode.

## LoRaWAN Frequency Settings:

Select supported frequency and select channels to send uplinks. Make sure the channels match the LoRaWAN® gateway.

Basic
Channel

Support Frequency : EU868

<input type="checkbox"/>	Index	Frequency/MHz	Max Datarate	Min Datarate
<input checked="" type="checkbox"/>	0	<input style="width: 80px;" type="text" value="868.1"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input checked="" type="checkbox"/>	1	<input style="width: 80px;" type="text" value="868.3"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input checked="" type="checkbox"/>	2	<input style="width: 80px;" type="text" value="868.5"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input type="checkbox"/>	3	<input style="width: 80px;" type="text" value="0"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input type="checkbox"/>	4	<input style="width: 80px;" type="text" value="0"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input type="checkbox"/>	5	<input style="width: 80px;" type="text" value="0"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>
<input type="checkbox"/>	6	<input style="width: 80px;" type="text" value="0"/>	<span style="border: 1px solid #ccc; padding: 2px;">5-SF7BW125</span>	<span style="border: 1px solid #ccc; padding: 2px;">0-SF12BW125</span>

If the frequency is one of CN470/AU915/US915, you can enter the index of the channel that you want to enable in the input box, making them separated by commas.

### Examples:

1, 40: Enabling Channel 1 and Channel 40

1-40: Enabling Channel 1 to Channel 40

1-40, 60: Enabling Channel 1 to Channel 40 and Channel 60

All: Enabling all channels

Null: Indicates that all channels are disabled

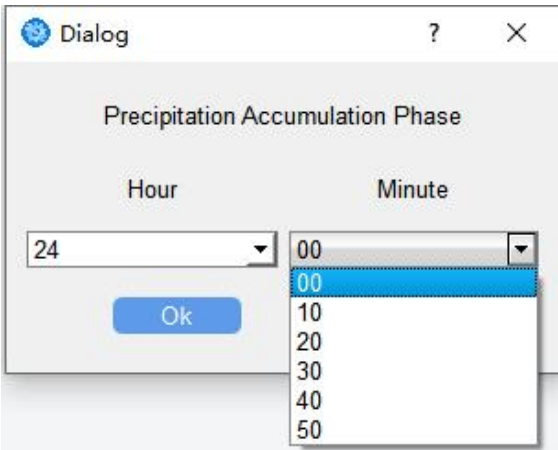
Support Frequency : AU915

Enabled Channel Index: 0-71

Channel Index	Frequency/MHz	Channel Spacing/MHz	BW/kHz
0 - 15	915.2 - 918.2	0.2	125
16 - 31	918.4 - 921.4	0.2	125
32 - 47	921.6 - 924.6	0.2	125
48 - 63	924.8 - 927.8	0.2	125
64 - 71	915.9 - 927.1	1.6	500

### 3.3 Basic Settings

Reporting Interval(min)	<input type="text" value="1"/>
Restoration of Power	<input type="text" value="Last Working Status"/>
Rainfall Accumulation Phase	<input type="text" value="24 hour 0 minutes"/>
Data Storage	<input checked="" type="checkbox"/>
Data Retransmission	<input checked="" type="checkbox"/>
Change Password	<input type="checkbox"/>

Parameters	Description
Reporting Interval	Reporting interval of transmitting weather data and battery level to network server. Default: 10 mins, Range: 1-1080 mins.
Restoration of Power	If the device loses power and returns to power supply, the device will be on or off according to this parameter.
Rainfall Accumulation Phase (WTS506 Only)	<p>After the rainfall accumulates up to this time range or up to 1000 mm, it will clear and re-count the accumulated rainfall value. There are two parameters to set the time range, range: 0~48 h</p> 
<a href="#">Data Storage</a>	Disable or enable reporting data storage locally.
<a href="#">Data Retransmission</a>	Disable or enable data retransmission.
Change Password	Change the password for ToolBox App to write the device and ToolBox software to configure this device.

### 3.4 Advanced Settings

#### 3.4.1 Threshold Settings

If the threshold is triggered, the device will upload the alarm packet once and collect the data at

the specified interval.

Temperature	<input checked="" type="checkbox"/>
Over	<input type="text" value="29.9"/> °C
Below	<input type="text" value="15"/> °C
Data Collecting Interval	<input type="text" value="10"/> min
Wind Speed	<input checked="" type="checkbox"/>
Over	<input type="text" value="0"/> m/s
Data Collecting Interval	<input type="text" value="10"/> min
Accumulated Rainfall	<input type="checkbox"/>
Barometric Pressure	<input type="checkbox"/>

### 3.4.2 Data Storage

WTS series supports storing more than 19,000 data records locally and exports data via ToolBox App or ToolBox software. The device will record the data according to reporting interval even not joining to network.

1. Sync the time via ToolBox or downlink commands.

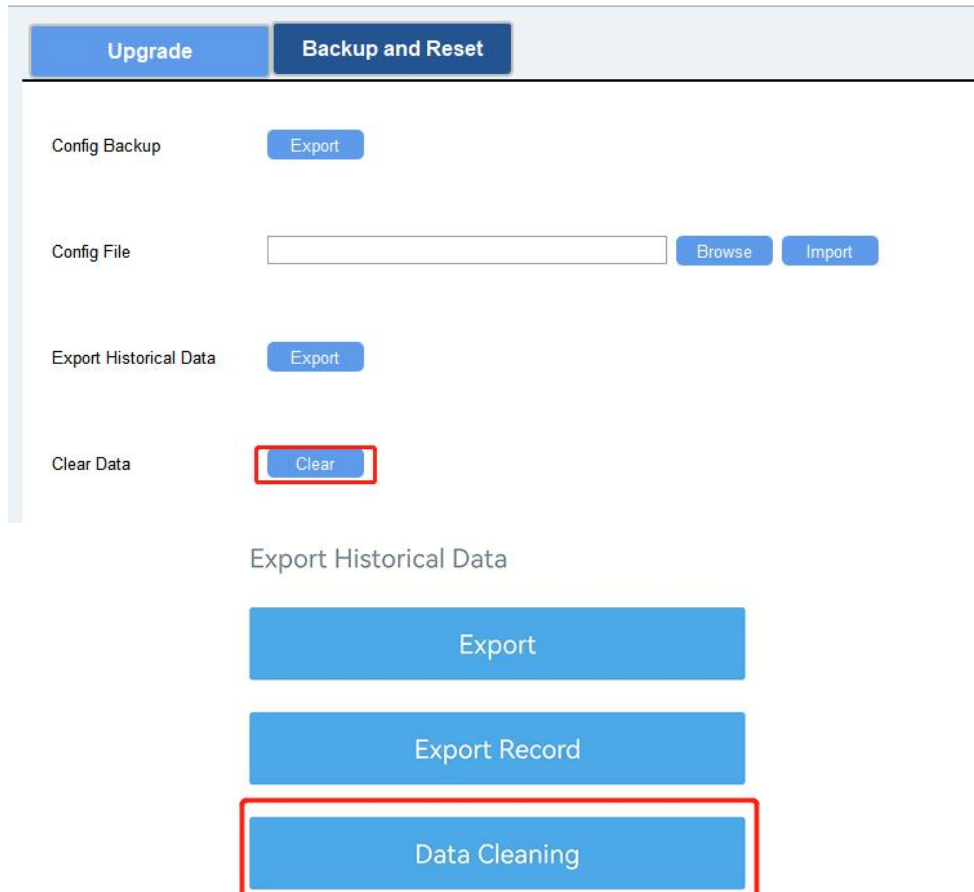
Channel Mask:	0003
Uplink Frame-counter:	86
Downlink Frame-counter:	0
Device Time:	2022-10-10 07:26:15 <input type="button" value="Sync"/>

Status	Setting	Maintenance
SN	6454C32424650043	
Model	WTS506-915M	
Device EUI	24E124454C324246	
Firmware Version	V1.1-a4	
Hardware Version	V2.0	
Device Status	ON <input checked="" type="checkbox"/>	
Join Status	De-activated	
RSSI/SNR	0/0	
Device Time	2022-10-10 14:54	<input type="button" value="Sync"/>

2. Enable data storage feature.
3. Go to **Maintenance > Basic** of ToolBox software or **Device > Maintenance** of ToolBox App, click **Export**, then select the data time period and click **Save** to export data.

**Note:** Toolbox App can only export last 14 days' data. If you need to export more data, please use ToolBox software.

4. Click **Clear** of ToolBox software or **Data Cleaning** of ToolBox App to clear all stored data if necessary.



### 3.4.3 Data Retransmission

WTS series supports data retransmission to ensure network sever can get all data even if network is down for some times. There are two ways to get the lost data:

- Network server sends downlink commands to enquire the historical data for specifying time range, refer section [Historical Data Enquiry](#);
- When network is down if no response from LinkCheckReq MAC packets for a period of time, the device will record the network disconnected time and re-transmit the lost data after device re-connects the network.

Here are the steps for data retransmission:

1. Enable data storage feature and data retransmission feature.

**Basic Settings**

Device Type: WTS506-915M

Reporting Interval(min): 1

Restoration of Power: Last Working Status

Rainfall Accumulation Phase: 24 hour 0 minutes

Data Storage

Data Retransmission

Change Password

Save

2. Enable rejoin mode feature and set the number of packets sent. Take below as example, the device will send LinkCheckReq MAC packets to the network server regularly to check if the network is disconnected; if there is no response for 4+1 times, the join status will change to de-active and the device will record a data lost time point (the time to join the network).

Rejoin Mode

Set the number of packets sent: 4 packets

3. After the network connected back, the device will send the lost data from the point in time when the data was lost according to the reporting interval.

**Note:**

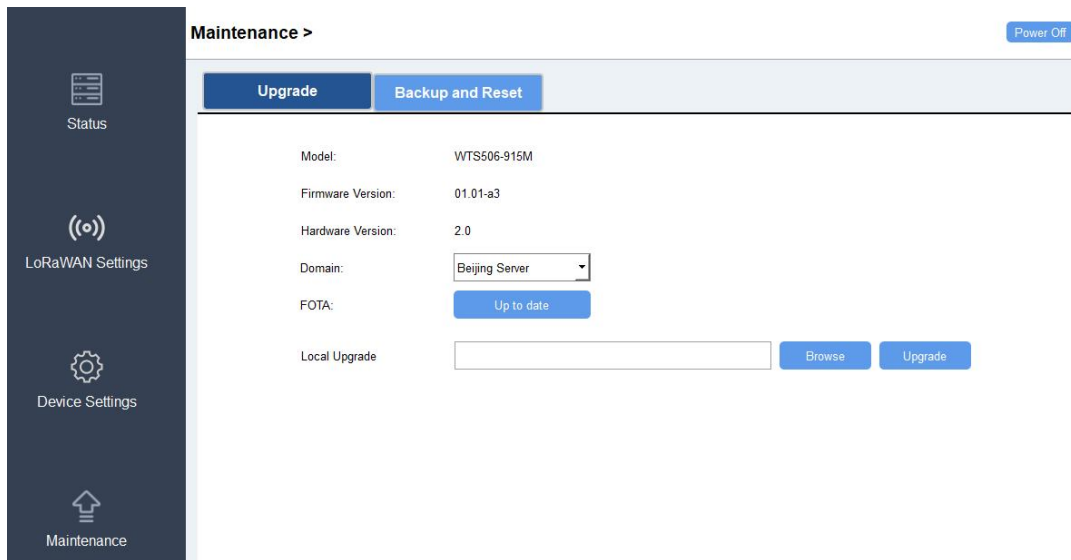
- 1) If the device is reboot or re-powered when data retransmission is not completed, the device will re-send all retransmission data again after device is reconnected to the network.
- 2) If the network is disconnected again during data retransmission, it will only send the latest disconnection data.
- 3) The retransmission data format is started with "20ce", please refer to section [Historical Data Enquiry](#).
- 4) Data retransmission will increase the uplinks and shorten the battery life.

## 3.5 Maintenance

### 3.5.1 Upgrade

**ToolBox Software:**

1. Download firmware from Milesight official website to your PC.
2. Click **Browse** to import the firmware and upgrade the firmware.

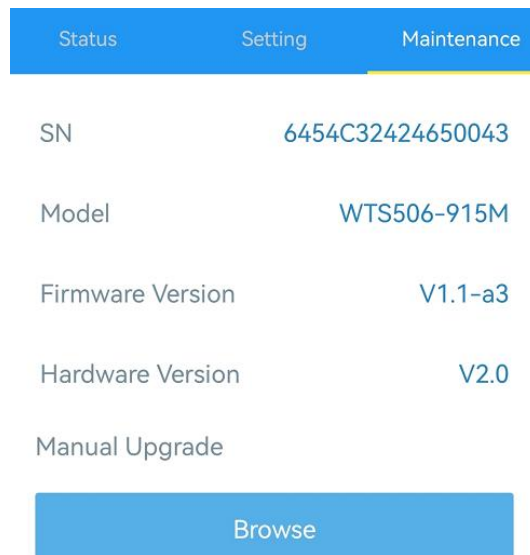


### ToolBox App:

1. Download firmware from Milesight official website to your smartphone.
2. Click **Browse** to import firmware and upgrade the device.

#### Note:

- 1) It is not supported to do any operation on ToolBox during upgrading.
- 2) Only Android version ToolBox App supports upgrade feature.



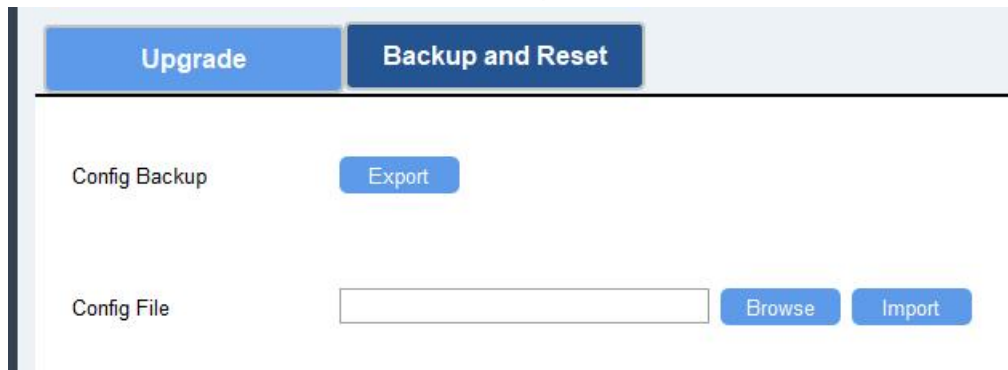
### 3.5.2 Backup

WTS Hub supports configure backup for easy and quick device configuration in bulk. Backup is allowed only for devices with the same model and LoRaWAN® frequency band. Please select one of following methods to backup device:



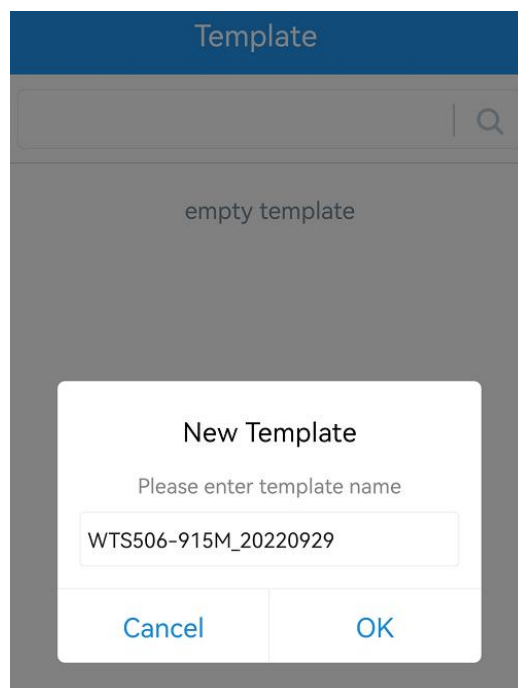
### ToolBox Software:

1. Go to **Maintenance > Backup and Reset**, click **Export** to save current configuration as json format backup file.
2. Click **Browse** to select backup file, then click **Import** to import the configurations.



### ToolBox App:

1. Go to **Template** page on the App and save current settings as a template. You can also edit the template file.
2. Select one template file which saved in the smartphone and click **Write**, then attach to another device to write configuration.



**Note:** Slide the template item left to edit or delete the template. Click the template to edit the configurations.

Template	
<input type="text"/>	<input type="text"/>
<input type="checkbox"/> EM500-UDL-868M_20201124 Last Modified Time: 2020-11-24 17:06:26	
<input type="checkbox"/> EM300-TH-915M_20210112 Last Modified Time: 2021-01-12 14:35:12	
<input type="checkbox"/> UC512-DI-868M_20210128 Last Modified Time: 2021-01-28 16:57:20	
<input type="checkbox"/> UC501-470M_20210201 Last Modified Time: 2021-02-01 11:29:43	
<input type="checkbox"/> M_20210208 Last Modified Time: 2021-02-08 16:44:37	<input type="button" value="Edit"/> <input type="button" value="Delete"/>

### 3.5.3 Reset to Factory Default

Please select one of following methods to reset device:

**Via Hardware:** Hold on power button (internal) of WTS Hub for more than 10s.

**Via ToolBox Software:** Go to **Maintenance > Backup and Reset** to click **Reset**.

Upgrade	Backup and Reset
Config Backup	<input type="button" value="Export"/>
Config File	<input type="text"/> <input type="button" value="Browse"/> <input type="button" value="Import"/>
Export Historical Data	<input type="button" value="Export"/>
Clear Data	<input type="button" value="Clear"/>
Restore Factory Defaults	<input type="button" value="Reset"/>

**Via ToolBox App:** Go to **Device > Maintenance** to click **Reset**, then attach smart phone with NFC area to WTS Hub to complete reset.

Status	Setting	Maintenance
SN	6454C32424650043	
Model	WTS506-915M	
Firmware Version	V1.1-a3	
Hardware Version	V2.0	
Manual Upgrade		
<a href="#">Browse</a>		
Restore Factory Default		
<a href="#">Reset</a>		

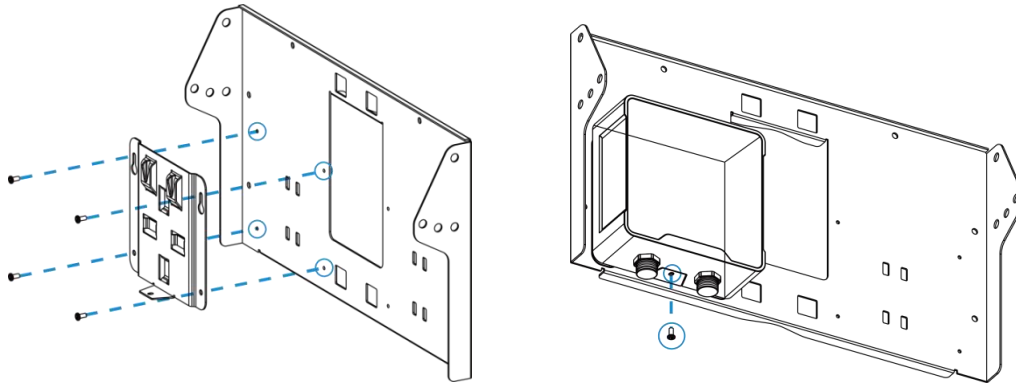
## 4. Installation and Maintenance

### 4.1 Installation Locations

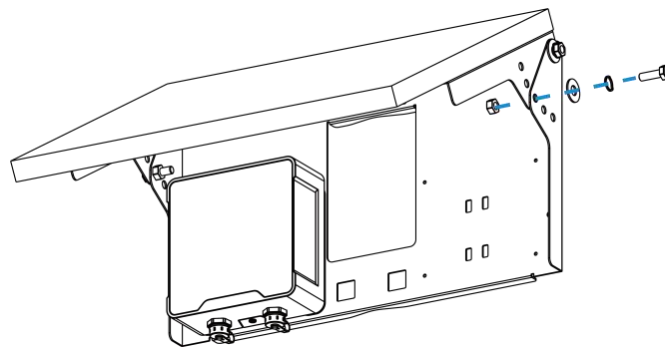
- Within the communication range of LoRaWAN® gateway.
- No high buildings or barriers (trees, telegraph poles) around; the distance between the IoT weather station and the nearest obstacle is preferably 10 times the height of the obstacle.
- Keep away from radars, transmitters and any other instruments which can generate electrical interference; keep a distance of more than 2 meters between sensor and radar.
- Keep away from heat sources like chimney, vents, etc.
- No fence plants (higher than 1m) around weather station within 10m.

### 4.2 Solar Panel and WTS Hub Installation

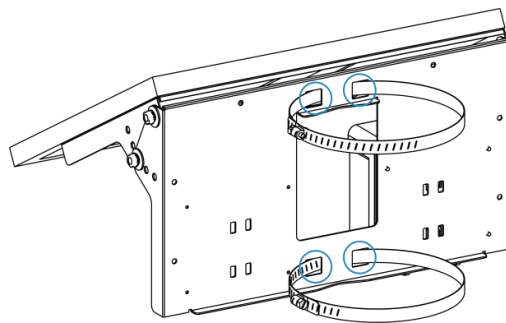
1. Fix the hub mounting bracket to the solar panel bracket with 4 fixing screws, the put the WTS Hub to the bracket fix the bottom of hub to the bracket with a fixing screw.



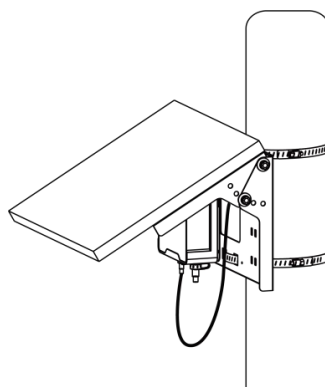
2. Adjust the angle of solar panel brackets (20°,40° or 60°is optional) according to the installation environment, then fix the two sides of bracket with screw kits.



3. Straighten the hose clamps and slide them through the rectangular rings in the solar panel's bracket, wrap the hose clamps around the pole. After that use a screwdriver to tighten the locking mechanism by turning it clockwise.

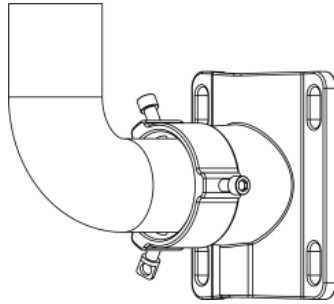


4. Connect the cable of solar panel to left interface of WTS Hub.

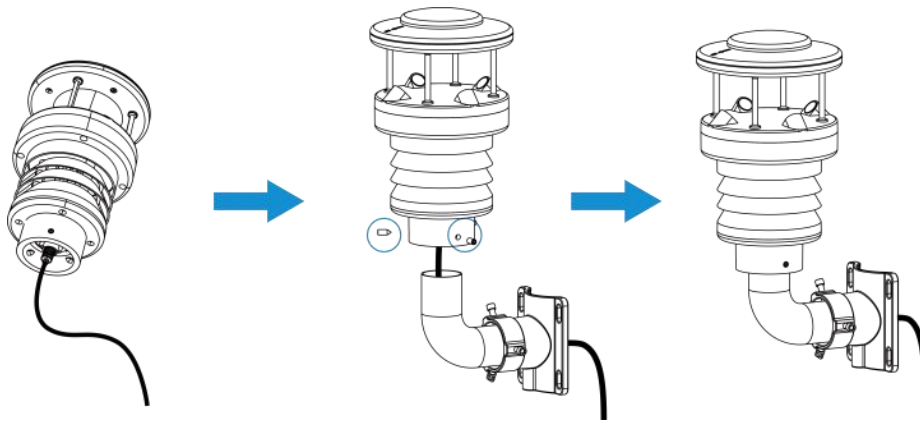


### 4.3 WTS506 Sensor Installation

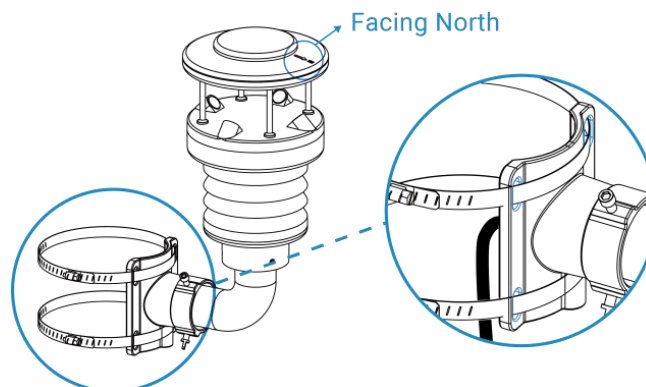
1. Connect the bent pipe to the mounting bracket, tighten the 2 hex socket cap screws with screwdriver and tighten the insurance screw by hand to ensure the two parts are fixed well.



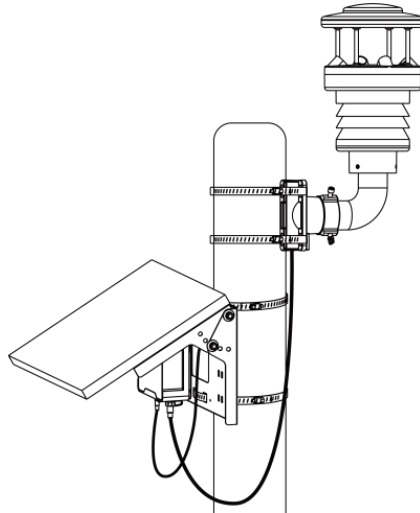
2. Connect one side of sensor cable to WTS Sensor and tighten the cable, pass the cable through the bent pipe and bracket, then connect the pipe to the bottom of sensor and fix both parts with 3 hex socket cap mounting screws.



3. Straighten the hose clamps and slide them through the rings in the bracket, wrap the hose clamps around the pole. After that use a screwdriver to tighten the locking mechanism by turning it clockwise. When installing, ensure the arrow on the sensor facing north according to a compass.



4. Connect the other side of sensor cable to the right interface of WTS Hub.



## 4.4 Maintenance

- To clean the device, wipe with a soft moistened cloth with soft detergents.
- When there is accumulated snow or ice on the surface of WTS sensor, wait for it to dissolve naturally and do not remove with tools forcibly.
- Do not destroy the surface of devices and solar panel.

## 5. Device Payload

All data are based on following format (HEX), the Data field should follow little-endian:

Channel1	Type1	Data1	Channel2	Type2	Data2	Channel 3	...
1 Byte	1 Byte	N Bytes	1 Byte	1 Byte	M Bytes	1 Byte	...

For decoder examples please find files on <https://github.com/Milesight-IoT/SensorDecoders>.

### 5.1 Basic Information

WTS series sensors report basic information of sensor whenever joining the network.

Channel	Type	Description
ff	0b (Power On)	Device is on
	01(Protocol Version)	01=>V1
	09 (Hardware Version)	01 40 => V1.4
	0a(Software Version)	01 14 => V1.14
	0f(Device Type)	00: Class A, 01: Class B, 02: Class C
	16(Device SN)	16 digits

Example:

ff0bff ff0101 ff166454c32424650043 ff090200 ff0a0101 ff0f00						
Channel	Type	Value	Channel	Type	Value	Value
ff	0b	0b	ff	01	01	ff
ff	09	166454c32424650043	ff	02	00	ff
ff	0a	0101	ff	0f	00	ff

ff	0b(Power on)	ff	ff	01 (Protocol Version)	01=V1
Channel	Type	Value	Channel	Type	Value
ff	16(Device SN)	6454c3242 4650043	ff	09 (Hardware version)	0200 (V2.0)
Channel	Type	Value	Channel	Type	Value
ff	0a (Software version)	0101 (V1.1)	ff	0f (Device Type)	00 (Class A)

## 5.2 Sensor Data

Item	Channel	Type	Description
Battery Level	01	75	UINT8, Unit: %
Temperature	03	67	INT16/10, Unit: °C
Humidity	04	68	UINT8/2, Unit: %RH
Wind Direction	05	84	UINT16/10, Unit: °
Barometric Pressure	06	73	UINT16/10, Unit: hPa
Wind Speed	07	92	UINT16/10, Unit: m/s
Rainfall	08	ec	5 Bytes <b>Byte 1-4:</b> Accumulated rainfall, UINT32/100, Unit: mm <b>Byte 5:</b> Frame counter, calculate the uplink amounts of every phase, range: 0~255 <b>Note:</b> 1) When the rainfall is cleared and start a new accumulation phase, the counter will be also cleared to 0; 2) When frame counter reaches 255 and not enter a new phase, it will always report 255.
Temperature Alarm	83	67	Temperature (2 Bytes) + Alarm Status(1 Byte) Alarm Status: 01=Threshold Alarm
Barometric Pressure Alarm	86	73	Pressure (2 Bytes) + Alarm Status(1 Byte) Alarm Status: 01=Threshold Alarm
Wind Speed Alarm	87	92	Wind Speed (2 Bytes) + Alarm Status(1 Byte) Alarm Status: 01=Threshold Alarm
Rainfall Alarm	88	ec	Rainfall (4 Bytes) + Frame Counter (1 Byte) + Alarm Status(1 Byte)

Alarm Status:01=Threshold Alarm
---------------------------------

**Example:**

## 1. Periodic packet

017564 03671001 046871 05844605 0673aa27 07929201 08ecc413000025					
Channel	Type	Value	Channel	Type	Value
01	75 (Battery)	64 => 100%	03	67 (Temperature)	10 01 => 01 10 = 272/10=27.2°C
Channel	Type	Value	Channel	Type	Value
04	68 (Humidity)	71=>113 Hum=113/2=56.5%	05	84 (Wind Direction)	46 05=> 05 46 = 1350/10=135°
Channel	Type	Value	Channel	Type	Value
06	73 (Barometric Pressure)	aa 27=>27 aa=10154/10=10 15.4 hPa	07	92(Wind Speed)	92 01 => 01 92 = 402/10= 40.2 m/s
Channel	Type	Value			
08	ec(Rainfall)	c4130000=>000 013 c4 =5060/100=50.6 mm Counter=25=>37			

## 2. Threshold alarm: report when reaching the threshold.

83 67 0001 01		
Channel	Type	Value
83	67 (Temperature)	00 01 => 01 00 = 255*0.1=25.5°C 01= Threshold Alarm

**5.3 Downlink Commands**

WTS series support downlink commands to configure the device. The application port is 85 by default.

Item	Channel	Type	Description
Reporting Interval	ff	03	2 Bytes, unit: s
Reboot		10	ff(Reserved)
Device Time		11	4 Bytes, unix timestamp
UTC Time Zone		17	INT16/10
Clear Data		27	01: Clear Historical Data 00: Clear Accumulated Rainfall



Restoration of Power		67	00: Off 01: On 02: Return to Previous Working State
Rainfall Accumulation Phase		6e	2 Bytes, unit: min
Data Storage		68	01: Enable, 00: Disable
Data Retransmission		69	01: Enable, 00: Disable
Retransmission Interval		6a	3 Bytes Byte 1: 00 Bytes 2-3: interval time, unit: s range: 30~1200s (600s by default)
Threshold Alarm-Temperature		06	9 Bytes, Temperature: CTRL(1B)+Min(2B)+Max(2B)+ 00000000(4B) CTRL: Bit0~Bit2: 001-below (minimum threshold) 010-over (maximum threshold) 011-within 100 -below or above Bit3~Bit5: 001 Bit6: 1=enable, 0=disable Bit7: 1
Threshold Alarm		06	9 Bytes, Wind Speed/Pressure: CTRL(1B)+0000+Max(2B)+ 00000000(4B) Rainfall: CTRL(1B)+0000+Max_Low(2B)+0000+Max_ High (2B) CTRL: Bit0~Bit2: 010-over (maximum threshold) Bit3~Bit5:

			010-wind speed 011-rainfall 100-pressure Bit6: 1=enable, 0=disable Bit7: 1
Collecting Interval		bb	3 Bytes, <b>Byte 1:</b> 01-temperature, 02-wind speed, 03-rainfall, 04-pressure <b>Byte 2-3:</b> collecting interval, unit: s

**Example:**

1. Set reporting interval as 20 minutes.

ff03b004		
Channel	Type	Value
ff	03 (Set Reporting Interval)	b0 04 => 04 b0 = 1200s= 20 minutes

2. Reboot the device.

ff10ff		
Channel	Type	Value
ff	10 (Reboot)	ff(Reserved)

3. Set time zone to GMT-4.

ff17d8ff		
Channel	Type	Value
ff	17 (Set Time Zone)	d8 ff => ffd8 = -40 = -4 * 10

4. Set the device time.

ff 11 3d 1c de 5d		
Channel	Type	Value
ff	11(Set Device Time)	3d 1c de 5d=>5d de 1c 3d=1574837309(Unix timestamp) =>2019/11/17 14:48:29

5. Set temperature threshold alarm.

ff06 cc 9600 2c01 00000000		
Channel	Type	Value
ff	06 (Threshold Alarm)	Ctrl: cc=>11 001 100 100=below or above, 001=temperature, 1=enable Min_value: 96 00=>00 96=15°C

		Max_value: 2c 01=>01 2c=30°C
--	--	------------------------------

6. Set rainfall threshold alarm: rainfall is over 995.35 mm.

ff06 5a 0000 cf84 0000 0100		
Channel	Type	Value
ff	06 (Threshold Alarm)	Ctrl: 5a=>01 011 010 010=above, 011=rainfall, 1=enable Max_value: cf 84 01 00=>00 01 84 cf=99535*0.01=995.35 mm

## 5.4 Historical Data Enquiry

WTS series support sending downlink commands to enquire historical data for specified time point or time range. Before that, ensure **the device time is correct and data storage feature was enabled to store the data.**

**Command format:**

Channel	Type	Description
fd	6b (Enquire data in time point)	4 Bytes, unix timestamp
fd	6c (Enquire data in time range)	Start time (4 bytes) + End time (4 bytes), Unix timestamp
fd	6d (Stop query data report)	ff
ff	6a (Report Interval)	3 Bytes, Byte 1: 01 Byte 2: interval time, unit: s, range: 30~1200s (60s by default)

**Reply format:**

Channel	Type	Description
fc	6b/6c	00: data enquiry success 01: time point or time range invalid 02: no data in this time or time range
21	ce (Historical Data)	Data time stamp (4 Bytes) + Temperature (2 Bytes) + Humidity (1 Byte) + Pressure (2 Bytes) + Wind Direction (2 Bytes) + Wind Speed (2 Bytes) + Rainfall (4 Bytes)

**Note:**

1. The device only uploads no more than 300 data records per range enquiry.
2. When enquiring the data in time point, it will upload the data which is closest to the search point within the reporting interval range. For example, if the device's reporting interval is 10

minutes and users send command to search for 17:00's data, if the device find there is data stored in 17:00, it will upload these data. If no, it will search for data between 16:50 to 17:10 and upload the data which is closest to 17:00.

**Example:**

1. Enquire historical data between 2022/10/10 14:45:00 to 2022-10-10 15:35:00.

fd6c c3291a63 b09a1a63		
Channel	Type	Value
fd	6c (Enquire data in time range)	Start time: 6cbf4363 => 6343bf6c = 1665384300 =2022/10/10 14:45:00 End time: 24cb4363 => 6343cb24 = 1665387300 =2022-10-10 15:35:00

Reply:

fc6c00		
Channel	Type	Value
fc	6c (Enquire data in time range)	00: data enquiry success

21ce 60c34363 0e01 64 8c27 c706 0400 10000000			
Channel	Type	Time Stamp	Value
21	ce (Historical Data)	56991a63 => 2022-10-10 15:31:52	Temperature: 0e 01=>01 0e=27°C Humidity: 64=>100=50% Barometric pressure: 8c 27=>27 8c=1012.4 hPa Wind Direction: c7 06=> 06 c7=173.5° Wind Speed: 0400=>0004=0.4m/s Rainfall: 10 00 00 00=>00 00 00 10=0.16 mm

-END-