

USER'S MANUAL

WeatherFront

REALM[®]
AGRICULTURE



Revision Sheet

Release No.	Date	Revision Description
Rev. A	07/16/2019	Release



Table of Contents

1	General	4
1.1	System Overview	4
1.2	Features	4
1.3	Acronyms and Abbreviations.....	5
1.4	Important FCC and IC Compliance Information	5
1.5	ESD Warning.....	5
1.6	Device Use Information	5
1.6.1	Installation Packet Series	5
1.6.2	User Input	6
1.6.3	Indicator Description	6
1.6.4	Antenna Orientation.....	7
1.6.5	Weather Station Power Connection	7
1.7	Cloud Data Services.....	8
1.8	Points of Contact	8
1.8.1	Installation User Interface.....	8
1.8.2	Obtaining a Login.....	8
1.8.3	Obtaining Help.....	8
2	Installation.....	9

1 GENERAL

1.1 System Overview

The WeatherFront monitors and reports temperature, humidity, barometric pressure, windspeed, wind direction, rainfall, and optionally, solar radiation, ultraviolet radiation, and leaf wetness. It is used in three different models: a Weather Station Gateway, a LoRa Weather Station, and a Cellular Weather Station. As a LoRa Weather Station it reports weather data through a Data Gateway via LoRa radio. As Weather Station Gateway or Cellular Weather Station it reports weather data via cellular modem. As a Weather Station Gateway, it is also capable of serving as the link between end devices and the cloud data server in the Internet of Things (IoT) for agriculture. As a gateway it listens for LoRa data packets from end devices and periodically makes a cellular data connection to forward the accumulated end device packets to a server along with its own data packets. It also acknowledges packets from end devices. And it holds downlink packets from the server for end devices and sends them to the device after the next uplink packet from that device in lieu of an acknowledge.

1.2 Features

The WeatherFront includes the following features:

- Six RJ11 connectors for external sensors
- A barometric pressure sensor
- Low power microcontroller
- Low power, long range radio for communication with end devices or a Data Gateway
- Cellular data modem (optional)
- GPS receiver for device location
- Non-volatile memory for configurable settings
- Non-volatile memory for uplink and downlink packet queues
- Red-green-blue LED status and cellular RSSI indicators
- Accelerometer for user input
- Solar charged LiFePO4 41 W-Hr battery pack
- Powered by a 10 W Solar Panel

1.3 Acronyms and Abbreviations

Term	Description
API	Application Interface
FCC	Federal Communications Commission
GPS	Global Positioning System
Hr	Hour
ID	Unique Identification Number
IoT	Internet of Things
LED	Light Emitting Diode
LiFePO4	Lithium Iron Phosphate
QR	Quick Response
RSSI	Received Signal Strength Indication
s	Seconds
URL	Universal Resource Locator
UTC	Universal Time Coordinated
V	Volts
W	Watt

1.4 Important FCC and IC Compliance Information

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

This product meets the applicable FCC Part 15 rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

To limit RF exposure, please ensure 8 inches (20 cm) of separation from the transmitter antennas at all times.

1.5 ESD Warning

The WeatherFront half of the enclosure must be unlatched from the back half of the enclosure to connect the various sensors. Care should be taken not to touch the circuit board inside the WeatherFront as the circuit is susceptible to damage from ESD.

1.6 Device Use Information

1.6.1 Installation Packet Series

After booting the WeatherFront turns on its GPS receiver to acquire time and location. This is indicated with short cyan flashes every two seconds. IT MUST BE ABLE TO RECEIVE FROM GPS SATELLITES TO FUNCTION CORRECTLY. The WeatherFront will automatically send a series of packets after it is powered up by connecting it to the solar panel. It sends a version packet, a status packet, a modem info packet, configuration packets, a location packet, and various weather packets.

In the LoRa Weather Station it sends these packets via LoRa radio. Each transmission is indicated by a magenta-green or magenta-red indicator blink; green means an acknowledge was received by a Data Gateway and red means it was not. Unacknowledged packets are save in a queue and tried again later.

In the Cellular Weather Station and Weather Station Gateway it sends these packets via cellular modem. Solid green indicates it is connecting to a tower. Blinking green indicates it is transferring data to/from the server. After acquiring location, it sends the location packet and then goes to sleep.

The Weather Station Gateway keeps its radio on, in receive mode, while it is sleeping. When a radio packet is received it queues the packet and goes back to sleep. A magenta-green blink indicates it received a radio packet and sent an acknowledge.

1.6.2 User Input

To achieve a long battery life, the WeatherFront sleeps most of the time. It will periodically transmit data to the cloud via cellular connection or to a Data Gateway via LoRa radio. It is set up to detect a double tap – two taps, one immediately following the other. This will wake up the device if it is asleep. A white flash of the status indicator signals a double tap detection. This can be used to wake the WeatherFront and verify it is powered and running if it is sleeping.

1.6.3 Indicator Description

The WeatherFront has two red-green-blue LED indicators: one for status (right) and one for cellular RSSI (left). The table below gives the meaning of colors and flashes on the status LED.

Color	Flash Timing	Meaning
Green	0.1 s flash every 2 s	Battery good
Yellow	0.1 s flash every 2 s	Battery low
Cyan	0.1 s flash every 2 s	GPS enabled
White	Once	Double tap detected
Magenta-Green	Once	Weather Station Gateway: Radio packet received and sent acknowledge
Magenta-Green	Once	LoRa Weather Station: Radio packet sent and acknowledge received
Magenta-Red	Once	LoRa Weather Station: Radio packet sent and no acknowledge
Green	On	Cellular Weather Station and Weather Station Gateway: Attempting to connect to a cellular tower
Green	0.5 s flash every 1 s	Cellular Weather Station and Weather Station Gateway: Cellular connection made, transferring data
RBGRBG	Rapid and repeating	Bootloader running
RYGY	Rapid and repeating	Booting Firmware

The RSSI LED indicator changes color to indicate cellular signal strength.

Color	Meaning
Off	Modem is sleeping or powered down
Red	Very poor signal strength – relocate Weather Station to improve cellular reception
Yellow	Poor signal strength – relocate Weather Station to improve cellular reception if possible
Green	Okay signal strength
Cyan	Good signal strength
White	Excellent signal strength

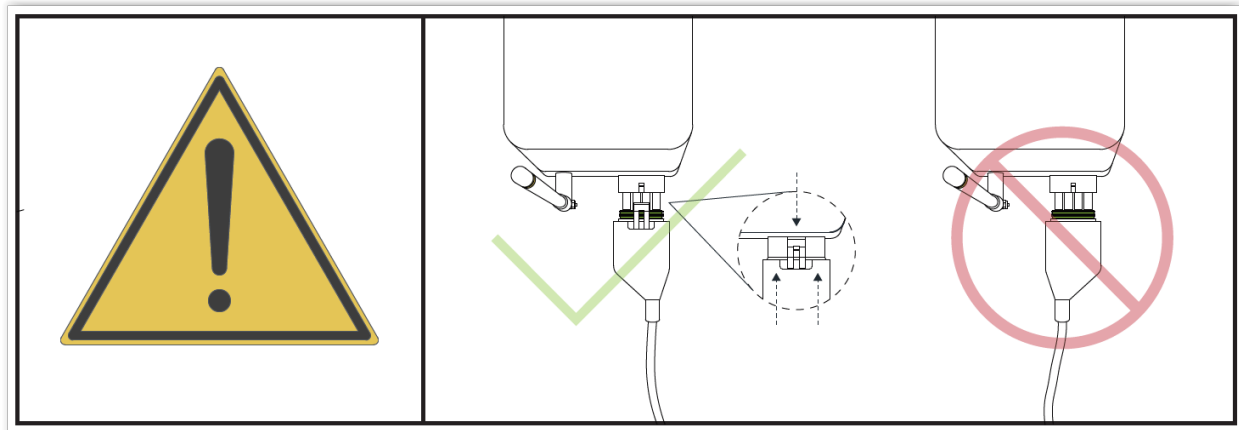
1.6.4 Antenna Orientation

The LoRa antenna extends from the bottom of the WeatherFront. It should be set straight, pointing down.

1.6.5 Weather Station Power Connection

Plugging the Solar Panel into the WeatherFront will power the Weather Station up from its internal battery pack even if there is no sunlight to charge the battery. The WeatherFront can run through several heavily overcast days in a row when fully charged. It can be fully charged in less than one sunny day assuming the Solar Panel is oriented for good solar reception. However, due to battery shipping regulations, the WeatherFront ships with approximately 30% battery charge. It will need at least one full sun day for the battery level indication to sync with the actual battery level (full charge).

Care should be taken not to plug the Solar Panel connector into the receptacle upside down as this may damage the WeatherFront.





1.7 Cloud Data Services

Data from RealmFive IoT devices is stored on data servers in the cloud. The data is accessible to customers through an API allowing customer integration into their own applications and websites. Device data is also accessible through app.realmfive.com which is intended to aid installers with configuration and verification of device operation. Both require credentials for access. See the following section for information on how to obtain credentials.

1.8 Points of Contact

1.8.1 Installation User Interface

RealmFive's installer interface is at app.realmfive.com. A login username and password are required to access this website. Access to this website is needed to verify device installation. Please contact your administrator at least 24 hours prior to installation time to get your login set up if you do not have one.

1.8.2 Obtaining a Login

A login username and password may be obtained by emailing your administrator with the following information:

FIRST NAME
LAST NAME
PHONE NUMBER
ORGANIZATION

Your username will be your email address. You will be sent a temporary password which must be changed the first time you log in.

To log in, go to app.realmfive.com, or simply scan the QR code on a device, and enter your username and password.

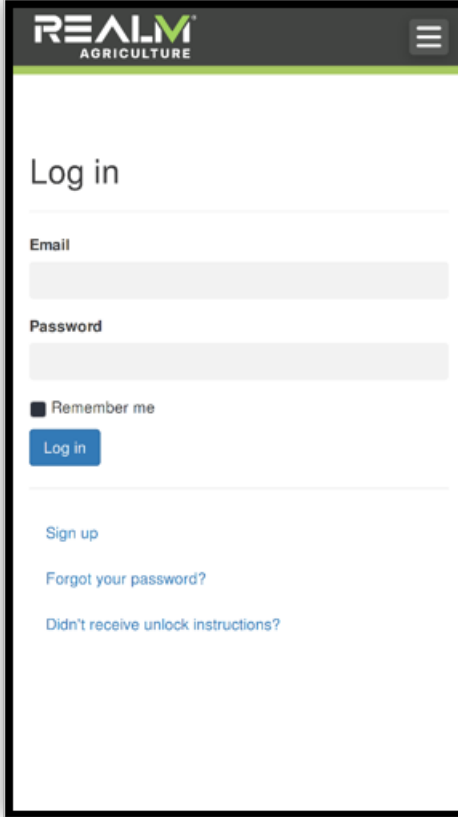
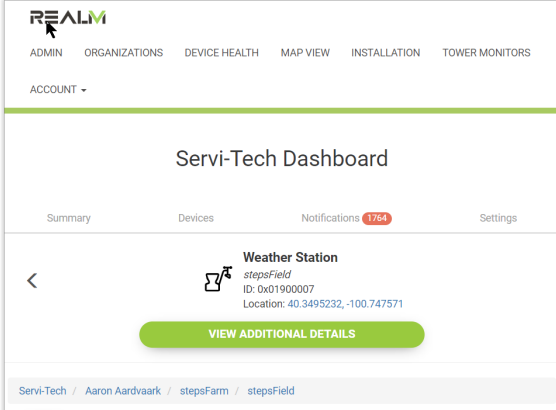
1.8.3 Obtaining Help

Questions and problems can also be submitted via the help desk or chat link within the app. A guide to common user tasks and frequently asked questions can be found under "Support" at app.realmfive.com. More immediate help can be obtained through a live chat under "Support" at app.realmfive.com.

2 INSTALLATION

The Weather Station Gateway should be installed before the end devices that will communicate with the Weather Station Gateway.

WeatherFront		
2.1	Prior to mounting the WeatherFront, scan QR code on the side via smart phone. The QR code contain the URL of the webpage for that specific device. Scanning with any generic QR code scanner should take you to page for the device.	

2.2	If you have not logged in to the website before, the login page will appear first. Log in to RealmFive's browser-based installation app. See Section 1.8.2 for how to obtain credentials.	
2.3	All received devices should already be provisioned to your organization. The installer will need to assign each device to the grower and field. This is done by tapping on the  in the upper right corner and selecting Organization. Then navigating to or adding the grower and field as necessary. And finally tapping Add New Device and scanning the QR code or typing the ID.	

2.4	If using the vertical mount tripod kit assemble per the tripod kit installation instructions. Start with a single section of pipe to mount the weather station on. If more height is desire once the weather station and solar panel are mounted, additional sections of pipe may be added below the original section of pipe.	
2.5	Attach Solar Panel to the mounting bracket.	<insert picture of solar panel mounted to solar panel bracket>

2.6

Attach rain bucket portion and the solar panel on opposite sides of the pole with a single U-bolt. Point the solar panel south. Tighten the nuts on the U-bolt.



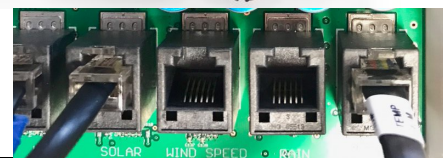
2.7

Assemble the anemometer and mount it to the pole pointing exactly south, above the solar panel by tightening the nuts on the U-bolt.



2.8

Remove the rubber plug and feed the sensor cables through the hole provided in the back half of the enclosure so they are in the correct order to mate with the correct RJ11 receptacle. Plug each cable in to the correct receptacle. Replace the rubber plug over the cables so it blocks ingress of rain and dust.



2.9

Attach the WeatherFront to the back half of the enclosure. Pull it down to latch it in place.

Plug the solar panel cable into the WeatherFront with the latch chip on the front side as shown. This will turn the Weather Station on. The status LED on the right will flash multi-colored when first turns on.

it will turn on its GPS receiver to acquire time and location. A short cyan blink every two seconds indicates GPS is on.

When it acquires time from GPS it will send a series of packets to verify its functionality. See section **Error! Reference source not found.** for a description of the installation series.

On the Weather Station Gateway or the Cellular Weather Station it will initiate a cellular connection to send the packets. Solid green on the status LED indicates it is connecting to a cell tower. 50% blinking green indicates it is communicating over cellular.

The left LED indicates RSSI. The installation should be relocated if this indicator stays red while connecting to cellular. Yellow indicates a poor signal. Green, cyan, or white are okay to excellent respectively.

On the Weather Station Gateway it will also start listening for packets from end devices that are within range. A magenta->green blink on the status LED indicates a radio packet was received.

On the LoRa Weather Station it will send the packets via LoRa radio. A magenta->green blink indicates a radio packet was sent and an acknowledge was received from the gateway.

Note that several status LED indications can sometimes go on at the same time.



	Once the Weather Station sends its install packets, the Weather Station's app web page should show new data from the device For the Weather Station Gateway or the Cellular Weather Station the signal strength number is the RSSI of the cellular connection. If the RSSI is less than -115, consider moving the Weather Station installation higher or closer to a cell tower. For the LoRa Weather Station the signal strength number is the RSSI of the LoRa radio signal to the Data Gateway. If the RSSI is less than -115 consider relocation it higher or closer to the gateway. More details about the device can be obtained by clicking the arrow to the right.	REALM ADMIN ORGANIZATIONS DEVICE HEALTH MAP VIEW INSTALLATION TOWER MONITORS ACCOUNT Servi-Tech Dashboard Summary Devices Notifications 1750 Settings Weather Station stepsField ID: 0x01900007 Location: 40.3495232, -100.747571 VIEW ADDITIONAL DETAILS Servi-Tech / Aaron Aardvaak / stepsFarm / stepsField Modem Info <pre>{ "type": "CDMA2000", "imei": "353613071008931", "lccid": "9914000004706337140", "ip_addr": "100.90.99.97", "operator": "Verizon", "phone_number": "+14024328943", "xbee_fw_version": "180C", "xbee_hw_version": "4040", "modem_fw_version": "23.00.004 (MBA-00040)"}</pre> Jul 8 - Jul 15, 2019 Week Battery Health <table><thead><tr><th>Date</th><th>Volts</th></tr></thead><tbody><tr><td>Jul 8</td><td>6.50</td></tr><tr><td>Jul 9</td><td>6.50</td></tr><tr><td>Jul 10</td><td>6.60</td></tr><tr><td>Jul 11</td><td>6.65</td></tr><tr><td>Jul 12</td><td>6.70</td></tr><tr><td>Jul 13</td><td>7.10</td></tr><tr><td>Jul 14</td><td>7.15</td></tr><tr><td>Jul 15</td><td>7.15</td></tr></tbody></table> RSSI - SNR <table><thead><tr><th>Date</th><th>RSSI (dBm)</th><th>SNR</th></tr></thead><tbody><tr><td>Jul 8 - Jul 10</td><td>-115</td><td>0</td></tr><tr><td>Jul 11</td><td>-110</td><td>25</td></tr><tr><td>Jul 12 - Jul 15</td><td>-110</td><td>25</td></tr></tbody></table> Transmission Delay <table><thead><tr><th>Date</th><th>Seconds</th></tr></thead><tbody><tr><td>Jul 8 - Jul 10</td><td>0</td></tr><tr><td>Jul 11</td><td>500</td></tr><tr><td>Jul 12</td><td>500</td></tr><tr><td>Jul 13</td><td>500</td></tr><tr><td>Jul 14</td><td>500</td></tr><tr><td>Jul 15</td><td>500</td></tr></tbody></table> <tr><td>2.11</td><td>Verify each type of weather reading looks correct.</td><td><insert picture of weather data in the RDS App></td></tr>	Date	Volts	Jul 8	6.50	Jul 9	6.50	Jul 10	6.60	Jul 11	6.65	Jul 12	6.70	Jul 13	7.10	Jul 14	7.15	Jul 15	7.15	Date	RSSI (dBm)	SNR	Jul 8 - Jul 10	-115	0	Jul 11	-110	25	Jul 12 - Jul 15	-110	25	Date	Seconds	Jul 8 - Jul 10	0	Jul 11	500	Jul 12	500	Jul 13	500	Jul 14	500	Jul 15	500	2.11	Verify each type of weather reading looks correct.	<insert picture of weather data in the RDS App>
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