

USER'S MANUAL

*Sensor Integration Device
for Watermark Probes*

REALM[®]
AGRICULTURE



Revision Sheet

Release No.	Date	Revision Description
Rev. A	04/24/2018	Release

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1 GENERAL

1.1 System Overview

The Sensor Integration Device for Watermark Probes (SID-WM) is an end device in the Internet of Things (IoT) for agriculture. Its job is to periodically read up to four Watermark soil moisture probes (model [200SS](#)) and a soil temperature probe (model [200TS](#)) and report the readings to the cloud via a Gateway device. The Gateway listens for packets from edge devices and periodically makes a cellular data connection to forward the accumulated edge device packets to a server along with its own packets. The Gateway acknowledges packets from edge devices. The Gateway also holds downlink packets from the server for edge devices and sends them to the device after the next uplink packet from the device in lieu of an acknowledge.

1.2 Features

The SID-WM includes the following features:

- Low power microcontroller
- Probe measurement circuit
- Low power, long range radio for communication to Gateway
- GPS receiver for device location
- Non-volatile memory for configurable read intervals
- Non-volatile memory for data storage when a Gateway is not available
- Red-green-blue LED status indicator
- Accelerometer for user input
- Sonalert to aid locating the device in crop
- Ultra-low power sleep enabling extended operating time from two AA batteries

1.3 Acronyms and Abbreviations

Term	Description
API	Application Interface
cB	Centi-Bars
cm	Centimeters
CPVC	Chlorinated Polyvinyl Chloride
FCC	Federal Communications Commission
GPS	Global Positioning System
ID	Unique Identification Number
IoT	Internet of Things
LED	Light Emitting Diode
QR	Quick Response
RSS	Radio Standards Specification
RSSI	Received Signal Strength Indicator
s	Seconds
URL	Universal Resource Locator
UTC	Universal Time Coordinated
V	Volts
'	Feet
"	Inches

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 User Information

1.5.1 Enclosure

The SID-WM has a lid that may be opened for access to the probe wire connections, wire release buttons and the LED indicator. The lid should always be snapped closed tightly when installation is complete, taking care to route the probe wires through the slot provided between the lid and the base. Failure to do so will allow moisture to enter the enclosure which will likely cause failure.

1.5.2 Installation Packet Series

The SID-WM will automatically send four data packets via radio to the Gateway after the batteries are installed. It sends a version packet, a status packet, a soil moisture packet, and a location packet. These packets are sent with a special “send-it-now” flag to make the Gateway forward them immediately instead of holding them until the next normal cellular connection.

After booting the SID-WM turns on its GPS receiver to acquire time and location. This is indicated with short cyan flashes every two seconds. It needs date and time to set its real time clock. It needs location to send the location packet. **IT MUST BE ABLE TO RECEIVE FROM GPS SATELLITES TO FUNCTION CORRECTLY.** After acquiring time and before location is acquired, it sends the version, status, and soil moisture radio packets. After acquiring location, it sends the location packet and then goes to sleep.

1.5.3 User Input

To achieve a long battery life, the SID-WM sleeps most of the time. It wakes up periodically to read the probes and to send radio packets. The default interval for reading soil moisture is every 30 minutes. The Data Gateway collects packets and forwards them to the server every 15 minutes.

The SID-WM also has an accelerometer sensor capable of detecting taps on the enclosure. 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 indicator signals a double tap detection. Four double taps in a row will cause it to turn on GPS and send the install sequence of packets again.

1.5.4 Indicator Description

The SID-WM has a red-green-blue LED indicator. The table below gives the meaning of colors and flashes.

Color	Flash Timing	Meaning
Green	0.1 s flash every 2 s	Battery good and functioning
Yellow (or Red)	0.1 s flash every 2 s	Battery low, replace battery immediately
Cyan	0.1 s flash every 2 s	GPS enabled
White	Once	Double tap detected
Magenta-Green	Once	Radio packet sent, acknowledge received
Magenta-Red	Once	Radio packet sent, no acknowledge received
RYGY	Rapid and repeating	Booting Firmware

1.5.5 Orientation

For maximum radio performance, the SID-WM should be oriented with the back or front edge of the enclosure pointed toward the Data Gateway.



1.6 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.

1.7 Points of Contact

1.7.1 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.

1.7.2 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.




1.7.3 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 SID-WM needs the Data Gateway to send in its data packets. Thus, the Data Gateway should be installed before the SID-WM.

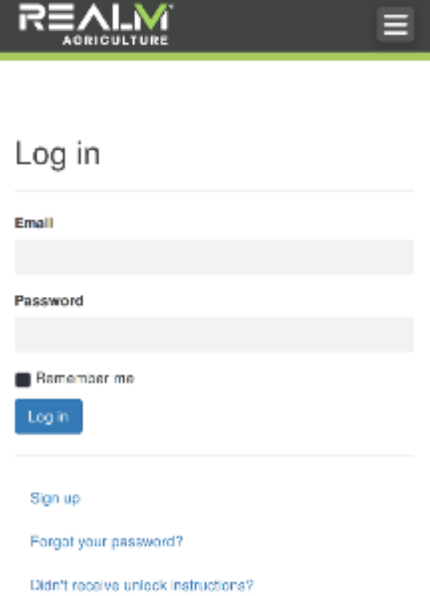
Sensor Integration Device		
2.1	<p>Install Watermark soil moisture and temperature probes in the ground at desired depths. Common practice is to utilize ¾" CPVC pipe.</p> <p>Soil moisture probes are typically installed at 6", 12", 24", and 36" depths. The temperature probe is typically installed 6 to 12" deep. A soil sampling tool is typically used to dig the hole for each probe.</p>	
2.2	<p>Install Sensor Integration Device on a 5' length of the same ¾" CPVC post as the probes by pushing and twisting.</p>	
2.3	<p>Push post assembly into the ground near the soil moisture probes so there is sufficient length of wire to reach soil moisture probes.</p> <p>Install the SID-WM as high as possible. Device wireless range will be best the higher the installation height. RealmFive recommends an installation height of approx. 4 feet off the ground.</p> <p>In corn, best results are achieved when the SID-WM is above the ear height.</p>	

<p>2.4</p>	<p>Open SID-WM lid and plug each set of Watermark soil moisture sensor wires into the respective connector holes on the SID-WM.</p> <p>The bottom surface of the device has holes that each wire can be pushed into. The molded-in numbers correlate to the numbers in the mobile installation app. Respective installed depths should be entered in the installation app.</p> <p>Insert a short piece of wire into any unfilled holes to prevent bugs from entering device.</p>	
<p>2.5</p>	<p>Up to (4) Watermark soil moisture probes can be added per SID-WM.</p> <p>Any solder ball or uneven solder that exist on the tinned wires should be cut off with side cutters to ease removal at the end of the season.</p>	
<p>2.6</p>	<p>Plug the 2 leads of the temperature probe into the corresponding temperature probe connector holes (marked with a 'T') on the SID-WM.</p> <p>Any solder ball or uneven solder that exist on the tinned wires should be cut off with side cutters to ease removal at the end of the season.</p>	

<p>2.7</p>	<p>Respective wires from Watermark soil moisture and temperature probes should be wire tied to CPVC post mount to prevent the wires from being accidentally pulled out of the SID-WM's internal board clips.</p>	 A photograph showing a white, square-shaped sensor mounted on a vertical CPVC post. The sensor is secured to the post with a white zip tie. Several colored wires (red, green, blue) are bundled together and attached to the bottom of the sensor. The background shows a field with a fence and trees under a cloudy sky.
<p>2.8</p>	<p>Tidy up Watermark wires by coiling them and zip tying them to CPVC post.</p> <p>Keep wires off the ground to reduce likelihood of damage from rodents or other animals.</p>	  Two photographs. The top one shows a person wearing a hat and a blue shirt kneeling in a field of dry crop residue, working on a sensor. A white pickup truck is visible in the background. The bottom one is a close-up of the sensor's base, showing the wires being secured to the CPVC post with a zip tie.

<p>2.9</p>	<p>Install (2) AA batteries.</p> <p>Realm recommends the use of Energizer Lithium Ultimate batteries for best performance on devices that are not label Alkaline Only.</p> <p>Devices labeled Alkaline only should use alkaline batteries. Their soil moisture reading will read slightly drier than they should when the series voltage is over 3.4 V. Energizer Lithium Ultimate batteries have a starting voltage close to 3.6 V. Note that the battery voltage will read higher when the temperature is warmer.</p> <p>Alkaline batteries will work in all devices and should last an entire growing season. Batteries should not be left in the device during the off season.</p> 
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<p>2.10</p>	<p>Once batteries are installed, device LED will repeatedly blink red-yellow-green-yellow as it boots. It will then blink cyan while it acquires time and location via GPS. While it is acquiring GPS it will also blink magenta-green or magenta-red indicating it is sending radio packets. Magenta-green means it received an acknowledge from the Gateway. Magenta-red means no acknowledge was received. If no acknowledge was received the device needs to be mounted higher or closer to the Data Gateway.</p>	
<p>2.11</p>	<p>Open device lid to expose the unique device QR code.</p> <p>Scan Sensor Integration Device QR code 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.</p> <p>Or go to app.realmfive.com/devices/0x3XXXXX where XXXXX is the balance of the ID as it appears on the label.</p>	

<p>2.12</p>	<p>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.</p> <p>See section 1.7 for credentials.</p>	
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2.13


Device app page for SID-WM should be displayed. The ID number in the upper right corner should correspond to the ID number on the Sensor Integration Device.

Scroll down to the bottom of the page

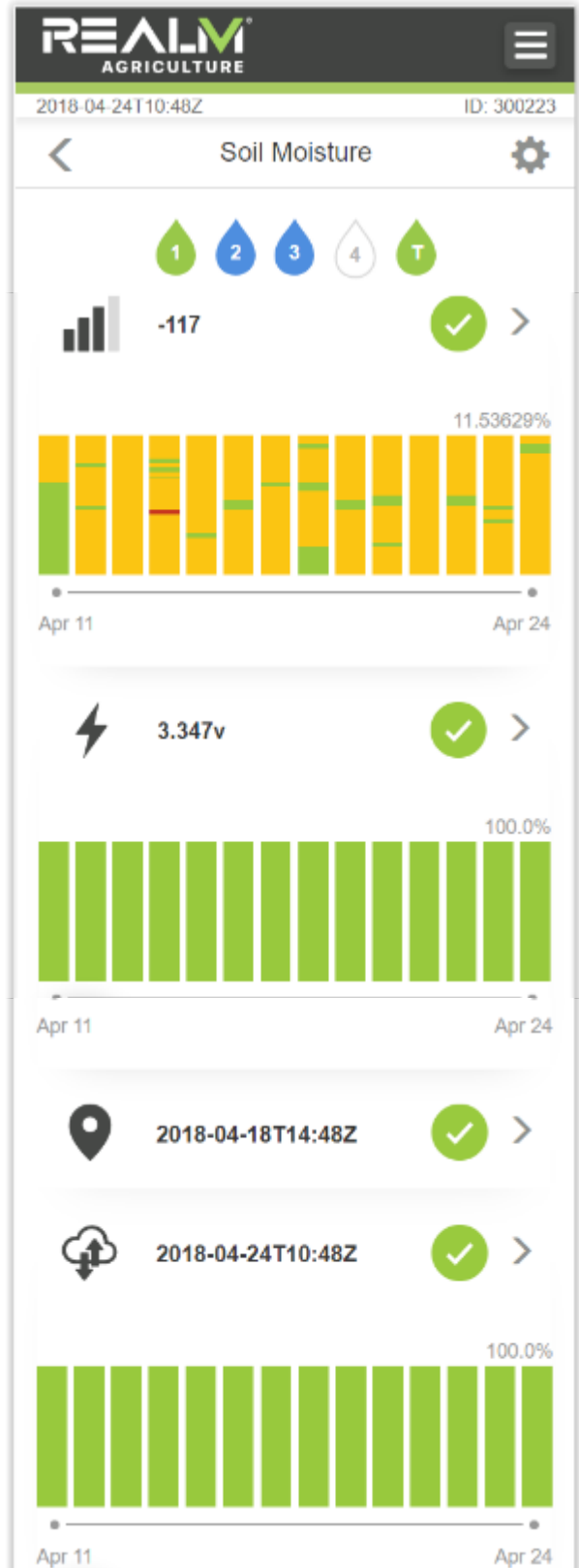
and check connectivity  to verify new packets have been received. The timestamp of the last packet received from the device is shown in UTC. Tapping on the time stamp will pop up the time since the packet was received.


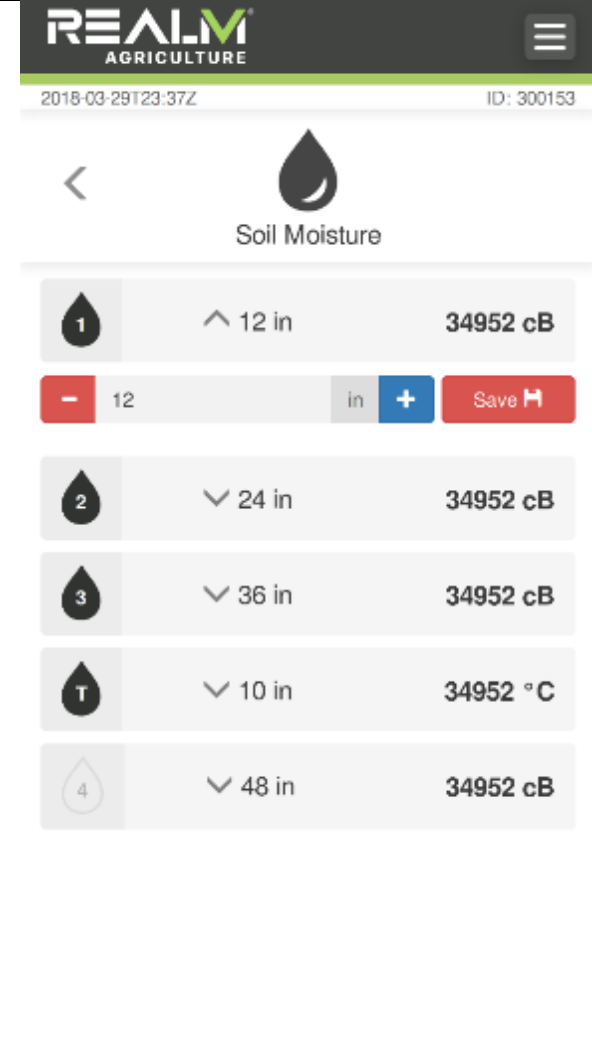
Check the RSSI. If the RSSI is lower than -115, consider mounting the SID-WM higher or relocating the device the device closer to the Data Gateway. This is true especially if crop is expected to grow above the height of the SID-WM.

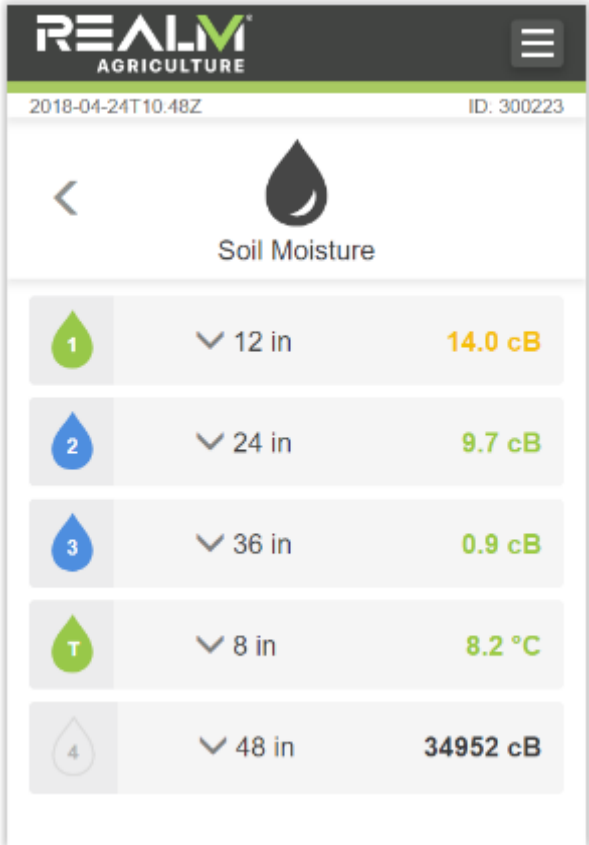

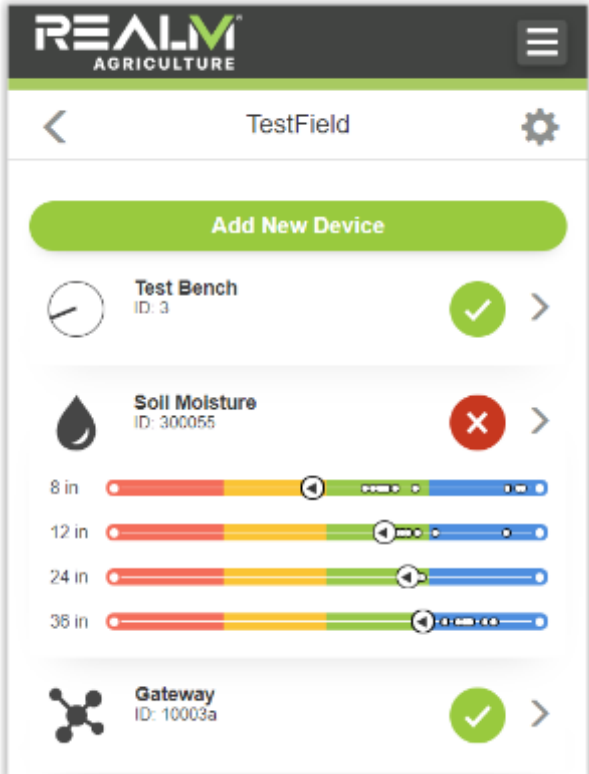
Check the battery voltage . Battery voltage should be above 3.0 V. Batteries need to be changed when the voltage gets below 2.7 V.


Check location . Verify a new location has been received by tapping the timestamp.

If desired, double tapping four times on the enclosure will cause the SID-WM to send the install series of packets again. Detection of the double tap is indicated by a white flash. It takes a few minutes for the packets to be sent and relayed by the Data Gateway.



<p>2.14</p>	<p>Scroll to the top and tap on the drops. Then click on the “Set Soil Moisture” button that appears. This will navigate to the Soil Moisture Setup page.</p>	
<p>2.15</p>	<p>Select +/- to increase or decrease the depth for that probe. Select “Save” to save the selected value.</p>	

<p>2.16</p>	<p>Device installation page for setting Watermark soil moisture probe depths or viewing most recent probe readings in cB.</p> <p>The colors to the drop icon distinguish whether the setup is working. In this example, the depths are set but the soil moisture and temperature probes are not hooked up. But the device is confirmed to be working and sending data to the cloud.</p> <p>Note: Probe reading show 34952 cB the probe wires are not connected. Check probe wires to make sure they are plugged in and are not damaged.</p>	
<p>2.17</p>	<p>All received devices should already be provisioned to each customer. 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.</p>	

2.18	Close the lid on the SID-WM, taking care to route the wires out the slot provided between the base and the lid. Do not cut the insulation on the wires by pinching the wires between the lid and the base.	
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