SwitchDoc Labs

WeatherRack2 Installation

April 2021
Version 1.3

WeatherSense

Table of Contents

Introduction

Thank you for your purchase of the SwitchDoc Labs FT-020T WeatherRack2. The following user guide provides step by step instructions for installation, operation and troubleshooting.

Version 1.3 October 2020

Warnings

⚠️**Warning:** Any metal object may attract a lightning strike, including your weather station mounting pole. Never install the weather station in a storm.

⚠️ **Warning:** Installing your weather station in a high location may result in injury or death. Perform as much of the initial check out and operation.
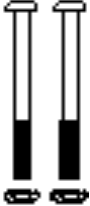
Getting Started

The FT-020T weather station consists a sensor array with Integrated Outdoor Transmitter and mounting hardware.   It also includes an F016TH Indoor Temperature and Humidity Sensor.

Parts List

The FT-020T WeatherRack2 and the F016TH T/H sensor consists of the following parts.

QTY	Item	Image
1	FT-020T WeatherRack2 Integrated Sensor Array Outdoor Transmitter Dimensions (LxHxW) : 330x150x280mm	
1	Thermo-hygrometer transmitter (F016TH) Dimensions (LxHxW): 114.5 x 50.0 x 19mm	

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QTY	Item	Image
1	Foot Mounting (with pole insert) Dimensions: 84x 152 x 216mm	
1	Mounting Bracket Back Plate (pole mount) Dimensions: 76 x 102 x 38mm	
1	Mounting Pole Dimensions: 76 x 76 x 25mm	
2	Pole mounting nuts (M3) / bolts Ø3)	
4	Pole mounting nuts (M5) / bolts (Ø5)	
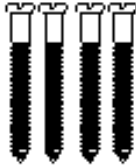
QTY	Item	Image
4	Tapping screws	

Figure 1

Recommended Tools

Precision screwdriver (for small Phillips screws)
Compass or GPS (for wind direction calibration)
Adjustable Wrench
Hammer and nail for hanging remote F016TH thermo-hygrometer transmitter.

Sensor Assembly Set Up

The following illustration shows FT-020T Sensor Array

UV and Light Sensor — Wind Cups
Rain Collector — Level Indicator
Solar Panel — Thermo-Hygrometer Radiation Shield
Wind Vane —
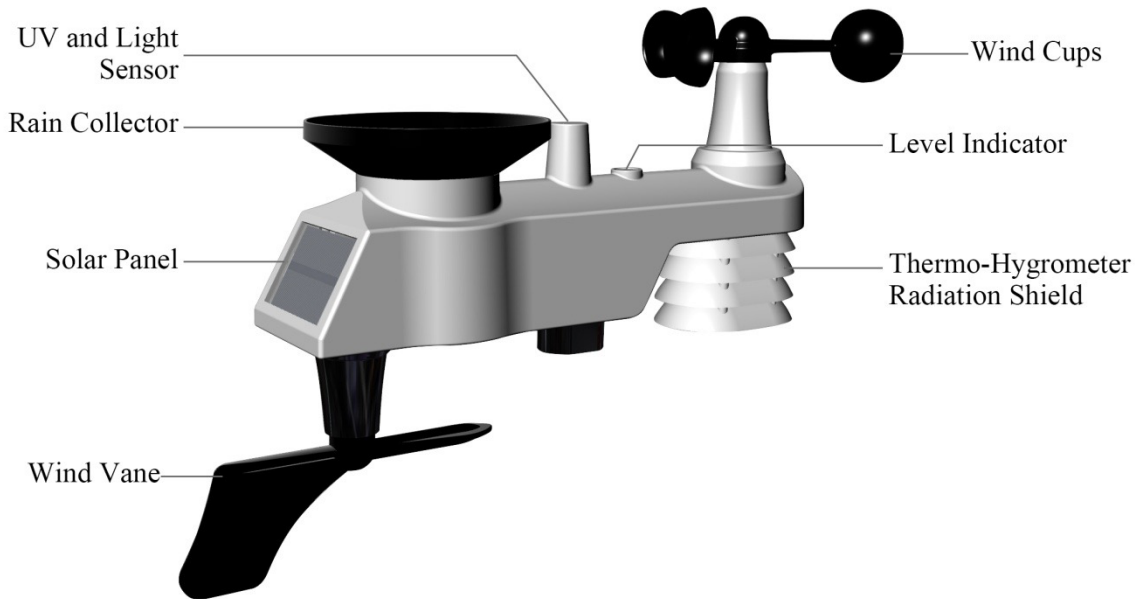
Figure 2

3.3.1 Insert batteries into the transmitter. Locate the battery door on the transmitter, push and open the battery compartment, as show in Figure 3.

Battery Door ⎯

LED and
RESET Button

Thermo-Hygro Sensor
(radiation shield removed)

Figure 3

Remove the battery door on the back of the sensor by removing the set screw, as shown in Figure 4.
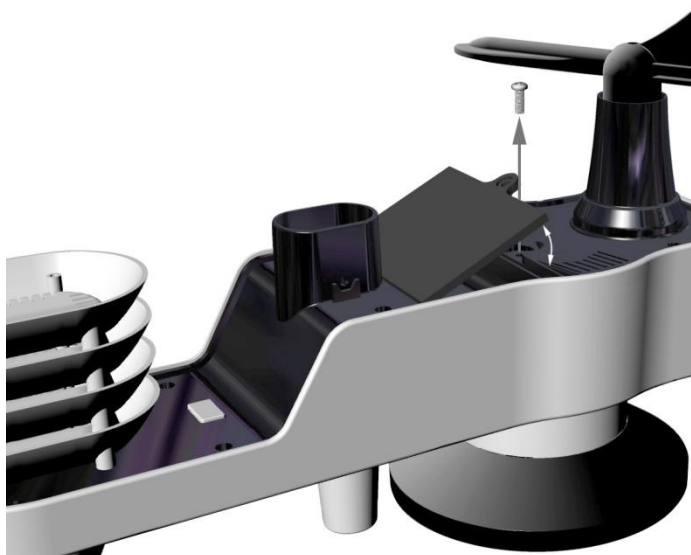
Figure 4

Inserting 3xAA batteries in the battery compartment, as shown in Figure 5.

Figure 5
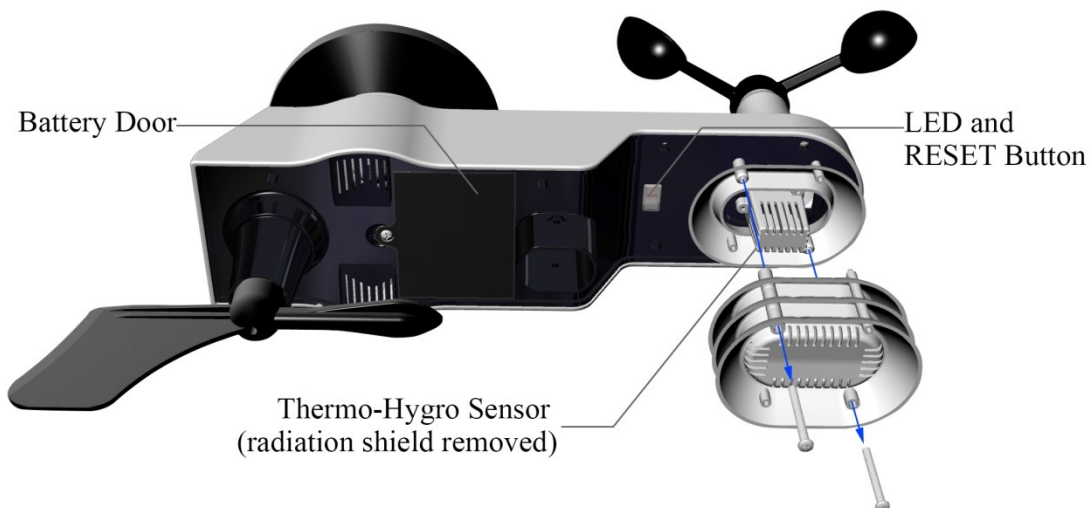
Close the battery door. Make sure the gasket (around the battery compartment) is properly seated in its trace prior to closing the door. Tighten the set screw.

📝 **Note:** Do not install the batteries backwards. You can permanently damage the sensors. The solar panel does not charge the batteries, so rechargeable batteries are not needed or recommended.

📝 **Note:** We recommend installing Lithium AA batteries for sensors.
The sensor LED indicator will light for 3 seconds, and then flash once per 16 seconds thereafter. Each time it flashes, the sensor is transmitting data.
Replace the battery door and push to tighten it.

📝 **Note:** If the sensor does not power up after inserting the batteries, press the reset button shown in Figure 6.

LED and RESET
Button
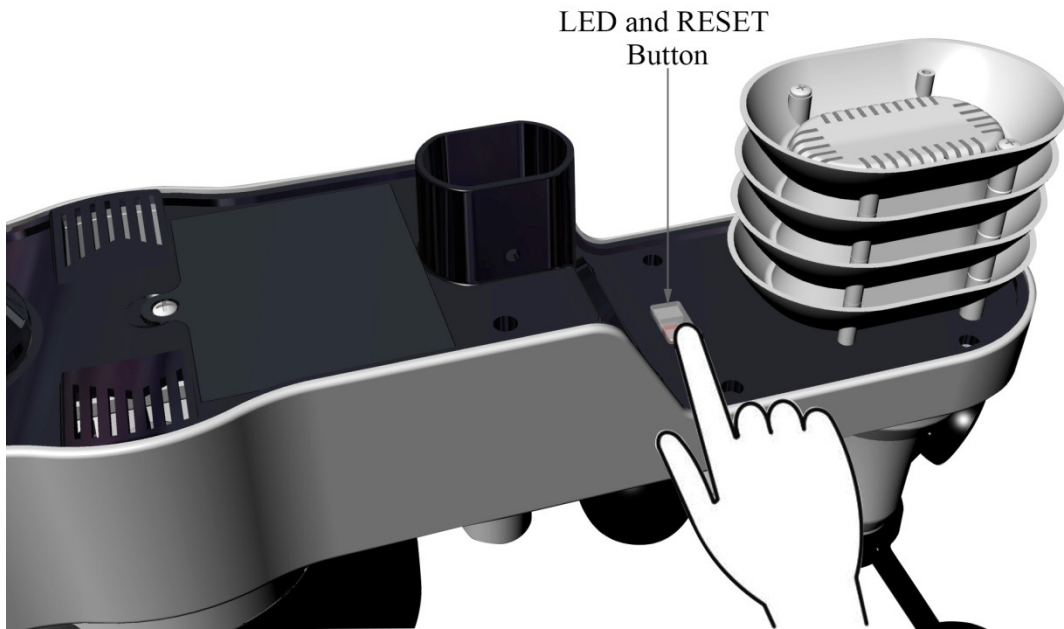
Figure 6

3.3.2Insert batteries into the FT016TH thermo-hygrometer transmitter. Remove the battery door on the back of the sensor by removing the set screw, as shown in Figure 7.   Your device may be more square than the illustration shown.
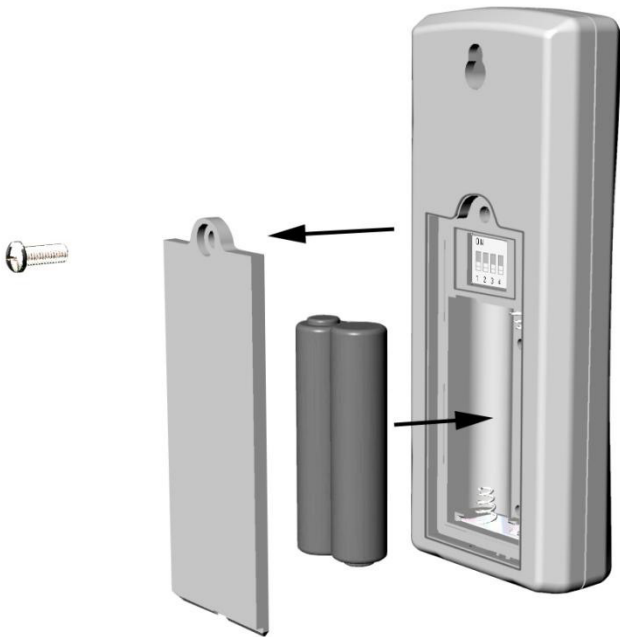
Figure 7

BEFORE inserting the batteries, locate the dip switches on the inside cover of the lid of the transmitter. Figure 8 displays all four switches in the OFF position (factory default setting).

Figure8

Channel Number: The FT-020T supports up to eight transmitters. To set each channel number (the default is Channel 1), change Dip Switches 1, 2 and 3, as referenced in Table 1.
Temperature Units of Measure: To change the transmitter display units of measure (°F vs. °C), change Dip Switch 4, as referenced in Table 1.

DIP SWITCH				FUNCTION
1	**2**	**3**	**4**	
DOWN	DOWN	DOWN	---	Channel 1
DOWN	DOWN	UP	---	Channel 2
DOWN	UP	DOWN	---	Channel 3
DOWN	UP	UP	---	Channel 4
UP	DOWN	DOWN	---	Channel 5
UP	DOWN	UP	---	Channel 6
UP	UP	DOWN	---	Channel 7
UP	UP	UP	---	Channel 8
---	---	---	DOWN	°F
---	---	---	UP	°C

Table 1

Insert two AAA batteries.
After inserting the batteries, the remote sensor LED indicator will light for 4 seconds, and then flash once per 60 seconds thereafter. Each time it flashes, the sensor is transmitting data.   The unit will always transmit the data in °F but the SwitchDoc Labs software always reports in metric units (°C).

Verify the correct channel number (CH) and temperature units of measure (°F vs. °C) are on the display, as shown in Figure 9.

Figure 9

(1) temperature
(2) temperature units (°F vs. °C)
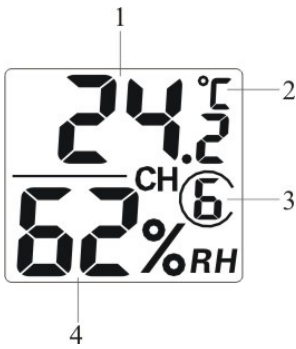(3) channel number
(4) relative humidity

Close the battery door. Make sure the gasket (around the battery compartment) is properly seated in its trace prior to closing the door. Tighten the set screw.

Weather Station Installation

Pre Installation Checkout Before installing your weather station in the permanent location, we recommend operating the weather station for one week in a temporary location with easy access. This will allow you to check out all of the functions, insure proper operation, and familiarize you with the weather station and calibration procedures. This will also allow you to test the wireless range of the weather station.

Site Survey

Perform a site survey before installing the weather station. Consider the following:

1. You must clean the rain gauge once per year and change the batteries every two years. Provide easy access to the weather station.

2. Avoid radiant heat transfer from buildings and structures. In general, install the sensor array at least 5' from any building, structure, ground, or roof top.

3. Avoid wind and rain obstructions. The rule of thumb is to install the sensor array at least four times the distance of the height of the tallest obstruction. For example, if the building is 6m tall, install 4 x 6m = 24m away. Use common sense. If the weather station is installed next to a tall building, the wind and rain will not be accurate.

4. Wireless Range. The radio communication between receiver and transmitter in an open field can reach a distance of up to 100 m, providing there are no interfering obstacles such as buildings, trees, vehicles, high voltage lines. Wireless signals will not penetrate metal buildings. Most applications will only reach 30m due to building obstructions, walls and interference.

5. Radio interference such as PCs, radios or TV sets can, in the worst case, entirely cut off radio communication. Please take this into consideration when choosing mounting locations.

Best Practices for Wireless Communication

Wireless communication is susceptible to interference, distance, walls and metal barriers. We recommend the following best practices for trouble free wireless communication.

1. **Electro-Magnetic Interference (EMI)**. Keep the sensors several feet away from computer monitors and TVs.

2. **Radio Frequency Interference (RFI).** If you have other 433 MHz devices and communication is intermittent, try turning off these other devices for troubleshooting purposes. You may need to relocate the transmitters or receivers to avoid intermittent communication.

3. **Line of Sight Rating.** This device is rated at 100 m line of sight (no interference, barriers or walls) but typically you will get 30 m maximum under most real-world installations, which include passing through barriers or walls.

4. **Metal Barriers.** Radio frequency will not pass through metal barriers such as aluminum siding. If you have metal siding, align the remote and receiver through a window to get a clear line of sight.

The following is a table of reception loss vs. the transmission medium. Each "wall"or obstruction decreases the transmission range by the factor shown below.

Medium	RF Signal Strength Reduction
Glass (untreated)	5-15%
Plastics	10-15%
Wood	10-40%
Brick	10-40%
Concrete	40-80%
Metal	90-100%

Final Installation of Sensors

Integrated outdoor transmitter installation.

The Wireless Weather Station can be used in both the Northern and Southern Hemispheres.

Prior to installation, you will need to calibrate the wind direction.

Northern Hemisphere (NOR).

The cardinal directions (N, S, E, W) molded on the body of the outdoor sensor are indicators for the Northern Hemisphere only.

There is a "S" indicator on the wind vane that indicates South, as shown in Figure 13. Align this "S" marker in the direction of South.

📝 **Note:** There are four alphabet letter of "N","E","S"and "W" around the wind direction, representing for the direction of North, East, South and West. Wind direction sensor has to be adjusted so that the directions on the sensor are matching with your real location. Permanent wind direction error will be introduced when the wind direction sensor is not positioned correctly during installation.

Northern Hemisphere
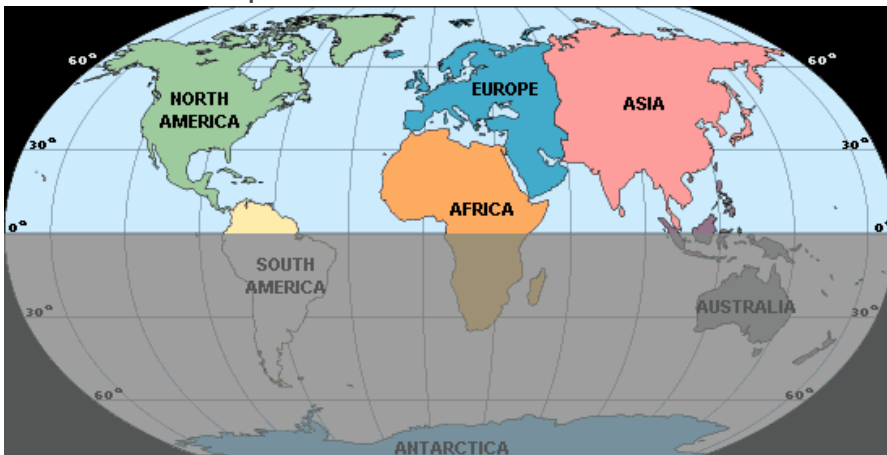
Southern Hemisphere

Figure 13

Southern Hemisphere (SOU).

For Southern Hemisphere installations, ignore these (N, S, E, W) and face **the solar panel to the North** (and in a sunny position) when it comes to installing the Integrated outdoor transmitter.

Step 1: Install the Integrated outdoor transmitter and face the solar panel North.

In the Southern Hemisphere, there will a permanent wind direction error (180º). Correct this in your software.

Fasten the integrated transmitter to mounting pole brackets with foot-mounting, two ¢ 3 bolts and M3 nuts , as shown in Figure 14
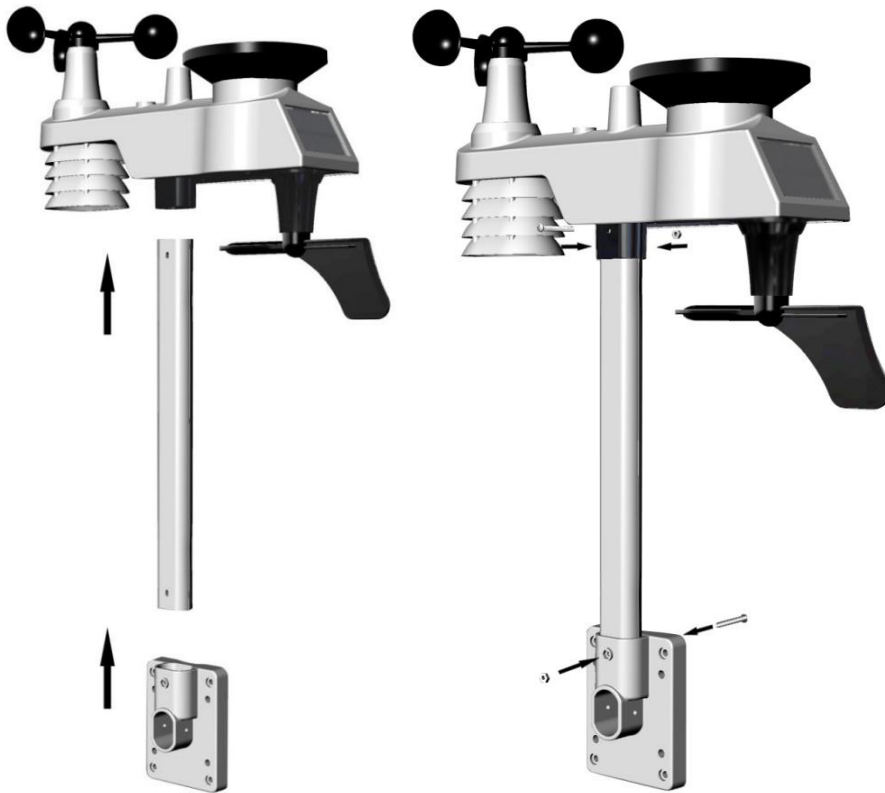

Figure 14

Tighten the mounting pole to your existing mounting pole with the four ¢ 5 Bolts and M5 Nuts assembly, or fix on the wall with four tapping screw, as shown in Figure15.
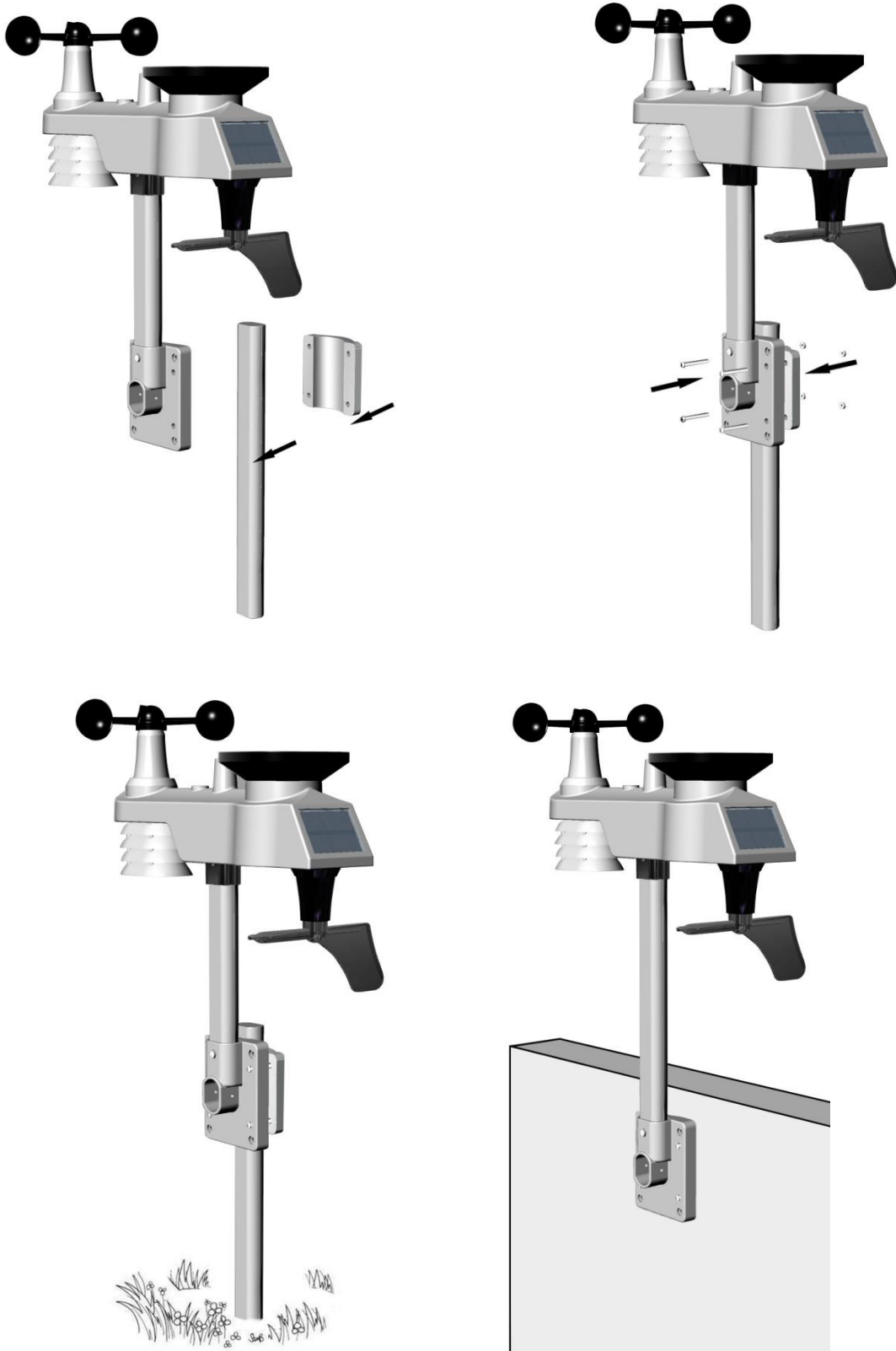
Figure 15

F016TH Indoor **Thermo-hygrometer Transmitter installation.** If you are mounting it outside, it is recommended you mount the F016TH Thermo-hygrometer sensor outside in a shaded area. A north facing wall is preferred because it is in the shade most of the day. Direct sunlight and radiant heat sources will result in inaccurate temperature readings. Although the sensor is water resistant, it is best to mount in a well protected area, such as under an eve. Use a screw or nail (not included) to affix the remote sensor to the wall, as shown in Figure 16. The F016TH is generally for use indoors.
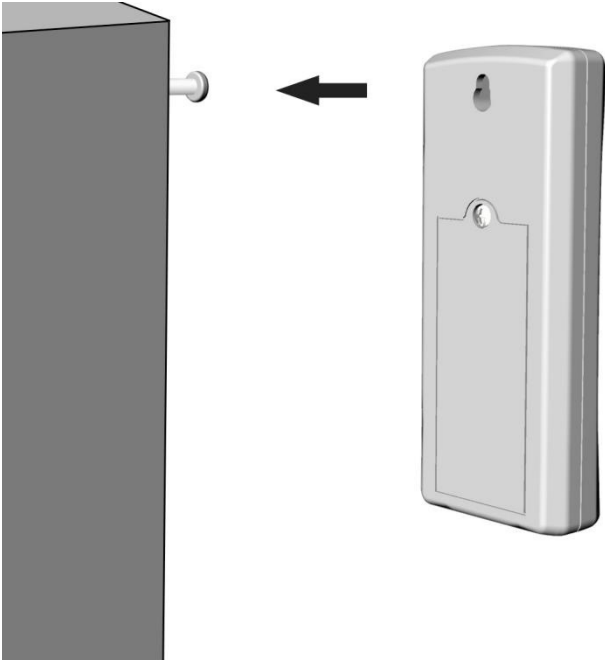
Figure 16

Low Battery Icon

A low battery indicator icon is shown in the display window for F016TH thermo-hygrometer sensor. When the low battery icon appears (the battery voltage is lower than 2.4V), replace the batteries in the sensor with fresh batteries. Be sure to never mix old and new batteries, and never mix battery types such as alkaline and lithium together.

Both the F016TH and the FT-020T Sensor Array report a low battery condition in the transmitted messages.

When the low battery data appears (the battery voltage is lower than 3.6V), replace the batteries in the sensor with fresh batteries. Be sure to never mix old and new batteries, and never mix battery types such as alkaline and lithium together.

Specifications

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Wireless Specifications

Line of sight wireless transmission (in open air): 100m.
Frequency: 433 MHz
F016TH Thermo-hygrometer Transmitter update interval: 60 seconds
FT-020T Sensor Array Integrated Outdoor transmitter interval: 16 seconds

Measurement Specifications

The following table provides specifications for the measured parameters.

Measurement	Range	Accuracy	Resolution
Outdoor Temperature (FT-020T)	-40 to 60 °C	± 1 °C	0.1 °C
Outdoor Humidity (FT-020T)	10 to 99%	± 5% (only guaranteed between 20 to 90%)	1 %
Sensors 1-8 Temperature (F016TH)	-40 to 60 °C	± 1 °C	0.1 °C
Sensors 1-8 Humidity (F016TH)	10 to 99%	± 5% (only guaranteed between 20 to 90%)	1 %
UV Index (FT-020T)	1 to 15+	± 1	± 1
Sunlight (FT-020T)	0 to 200klux	± 15%	± 15%
Rain (FT-020T)	0 to 9999mm	<15mm:±1 mm, 15mm to 9999mm:±7%	<1000mm (0.3mm) >1000mm (1mm)
Wind Direction (FT-020T)	0 - 360 º	± 10º (16 point compass)	± 1º (16 point compass)
Wind Speed (FT-020T)	0 to 50 m/s	2 m/s ~10 m/s: ±3m/s, 10m/s ~50 m/s: ±10% (whichever is greater)	0.1 m/s

WeatherRack2 Raw Data Description and Example Results from the Pi and Arduino

Here is an example of results coming in from the WeatherRack2 from the PythonTest Software:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherRack2 $ sudo python3 readWeatherSensors.py
Starting Wireless Read
```

```
{"time" : "2020-11-22 06:40:15", "model" : "SwitchDoc Labs FT020T AIO", "device" : 12,
"id" : 0, "batterylow" : 0, "avewindspeed" : 2, "gustwindspeed" : 3, "winddirection" :
18, "cumulativerain" : 180, "temperature" : 1011, "humidity" : 27, "light" : 1432, "uv" :
4, "mic" : "CRC"}
```

Data Descriptions:

- time: Time of Message Reception
- model: SwitchDoc Labs FT020T AIO
- device: Serial Number of the sensor - changed on powerup but can be used to discriminate from other similar sensors in the area
- batterylow: 0 if battery good, 1 if battery is getting low
- avewindspeed: Average Wind Speed in m/s *10
- gustwindspeed: Last Gust Speed in m/s *10
- winddirection: Wind Direction in degrees from 0-359.
- cumulativerain: Total rain since last reset or power off. in mm.*10
- temperature: outside temperature in F with 400 offset and *10 T = (value-400)/10.0
- humidity: Relative Humidity in %. light:
- Visible Sunlight in lux. uv: UV Index * 10 (meaning an uv index of 0.8 is in the example message above)

Temperature and Humidity Error Conditions
If the humidity level in Hex is 0xFF, this is an error

If the temperature level in Hex is 0x0FFF, this is an error

Clearly those are errors. Here are three more Errors from the temperature:
Valid range for temperature: (with 400 offset added)

-40.0F to 140.0F

Invalid value: 0X7FA
Below minimum: 0X7FC
Above maximum: 0X7FD

Valid Range for Humidity 10% -100%
Errors for Humidity:

Invalid humidity: 0x7A

From the Arduino Driver:

```
15:46:40.724 ->
15:46:40.800 -> MESSAGE_INDOORTH_GOOD
15:46:40.800 ->
15:46:40.800 -> IndoorTHMessage.messageid=8903
15:46:40.800 -> IndoorTHMessage.time=
15:46:40.800 -> IndoorTHMessage.device=147
15:46:40.800 -> IndoorTHMessage.modelnumber=5
15:46:40.800 -> IndoorTHMessage.channel=1
15:46:40.800 -> IndoorTHMessage.battery=0
15:46:40.800 -> IndoorTHMessage.temperature=25.67
15:46:40.800 -> IndoorTHMessage.humidity=38
15:46:40.800 -> IndoorTHMessage.CRC=0x70
15:46:40.800 ->
15:46:40.800 -> Headers Found=10510
15:46:40.800 -> WeatherRack2 Sensors Found=3362
15:46:40.800 -> Indoor T/H Found=5543
15:46:40.800 ->
15:46:45.806 -> ------------
15:46:53.848 ->
15:46:53.961 -> MESSAGE_WEATHERRACK2_GOOD
15:46:53.961 ->
15:46:53.961 -> currentWR2.messageid=8904
15:46:53.961 -> currentWR2.time=
15:46:53.961 -> currentWR2.device=12
15:46:53.961 -> currentWR2.modelnumber=0
15:46:53.961 -> weatherRack2.currentWR2.battery=0
15:46:53.998 -> currentWR2.avewindspeed=1.00
15:46:53.998 -> currentWR2.gustwindspeed=3.00
15:46:53.998 -> currentWR2.winddirection=245
15:46:53.998 -> currentWR2.cumulativerain=1455
15:46:53.998 -> currentWR2.temperature=27.44
15:46:53.998 -> currentWR2.humidity=29
15:46:53.998 -> currentWR2.light=20925
15:46:53.998 -> currentWR2.uv=11
15:46:53.998 -> currentWR2.CRC=0x60
15:46:53.998 ->
```

F016TH Sensor Data Description

Here is an example of results coming in from the F016TH (F007TH) from the PythonTest Software:

```
pi@SwitchDocLabs:~/SDL_Pi_WeatherRack2 $ sudo python3 readWeatherSensors.py
Starting Wireless Read
```

{"time" : "2020-07-09 10:54:16", "model" : "SwitchDoc Labs F007TH Thermo-Hygrometer", "device" : 233, "modelnumber" : 5, "channel" : 3, "battery" : "OK", "temperature_F" : 72.100, "humidity" : 45, "mic" : "CRC"}

This is the raw data: {"time" : "2020-07-09 10:54:16", "model" : "SwitchDoc Labs F007TH Thermo-Hygrometer", "device" : 233, "modelnumber" : 5, "channel" : 3, "battery" : "OK", "temperature_F" : 72.100, "humidity" : 45, "mic" : "CRC"}

- time: Time of Message Reception
- model: SwitchDoc Labs F007TH
- device: Serial Number of the sensor - changed on powerup but can be used to discriminate from other similar sensors in the area
- modelnumber: internal number indicating F007TH
- channel: channel number you have set
- batterylow: OK if battery good, LOW if battery is getting low
- temperature_F: Temperature in Fahrenheit
- humidity: Relative humidity in %

Power Consumption

F016TH Thermo-hygrometer Sensor : 2 x AAA alkaline batteries or Lithium batteries (not included

Integrated Outdoor Transmitter: 3xAA alkaline batteries or Lithium batteries (not included)

Minimum 12 months for FT-020T Sensor Array Integrated Outdoor Transmitter (use lithium batteries in cold weather climates less than -20 °C), The primary power source is the solar panel. The batteries provide backup power when there is limited solar energy

Minimum 12 months for F016TH sensors (use lithium batteries in cold weather climates less than -20 °C)

Maintenance
Clean the rain gauge of Integrated Outdoor Transmitter once every 3 months.

Unscrew the rain collector funnel by turning it 30°counter clockwise.
Gently remove the rain collector funnel.
Clean and remove any debris or insects.
Install the collector funnel after it has been cleaned and completely dried.

2.Remove

1.Counter Clockwise

Figure 52

Replace the FT-020T Sensor Array and F016TH thermo-hygrometer transmitter batteries once every 1-2 years

Troubleshooting Guide.

Problem: F016TH Temperature sensor reads too high in the daytime.

Solution: Make sure the F016TH thermo-hygrometer is mounted in a shaded area if outdoors . The preferred location is a north facing wall because it is in the shade most of the day.

Problem: Indoor and Outdoor Temperature do not agree

Solution: Allow up to one hour for the sensors to stabilize due to signal filtering. The indoor and outdoor temperature sensors should agree within 2 °C (the sensor accuracy is ± 1 °C).

Match the indoor and outdoor temperature to a known source.

Problem: Indoor and Outdoor Humidity do not agree

Solution: Allow up to one hour for the sensors to stabilize due to signal filtering. The indoor and outdoor humidity sensors should agree within 10 % (the sensor accuracy is ± 5 %).

Testing the WeatherSense Sensors

Proceed to the WeatherRack2 Testing Manual.

Disclaimer

SwitchDoc Labs, LLC takes no responsibility for any physical injuries and possession loss caused by those reasons which are not related to product quality, such as operating without following the operating manual and cautions, natural disasters, or force majeure.

SwitchDoc Labs, LLC has compiled and published this manual which covers the latest product description and specification.   The contents of this manual are subject to change without notice.