ALTA by MONNIT

Remote Monitoring for Business

ALTA Soil Moisture Sensor

USER GUIDE

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I. ABOUT THE WIRELESS SOIL MOISTURE SENSOR

The ALTA Soil Moisture Sensor measures soil moisture tension and soil temperature within the soil. It uses a resistive granular matrix element to measure the matric water potential (soil moisture tension) in the soil and a thermistor-based temperature element to measure temperature.

The sensor's moisture element is unique because it works similar to a plant's root by measuring water tension in its hydrophilic fabric-covered matrix material rather than the surrounding soil. You won't need to recalibrate it after each placement. And you can use the temperature element's reading for soil moisture temperature compensation, so you don't have to get different water readings if the soil temperature changes.

The ALTA Soil Moisture Sensor has a removable soil moisture/temperature lead and a single sensor base. The sensor works best when you bury the lead or soil probe within or very close to a plant or tree root system. The sensor also works well in most soil types.

The removable lead attaches to the sensor base via a threaded M8 6-pin connector. The sensor/radio base and at least five inches of the lead near the connector end should be installed above ground for best radio performance and to maintain sensor integrity. The higher the sensor base and radio antenna are from the ground, the better the radio will perform.

FEATURES: SOIL MOISTURE SENSOR

- Safe to use in both hot and freezing temperatures
- Reports matric potential (soil water tension) which is the best indicator of water availability in the soil.
- Moisture readings in centibar (cb) and kilopascal (kPa)
- Measures within a range of 0 to 240 cb or kPa
- Will not dissolve in soil
- Internally compensated for commonly found salinity levels
- Easy to install and use compared to traditional tensiometers
- Stainless steel electrodes
- No maintenance required
- Temperature readings in C/F.
- 5 foot (1.524 meter) removable lead

EXAMPLE APPLICATIONS

- Precision irrigation
- Agritech or agtech
- Landscaping
- Argonomy research
- Sports turf management
- Forestry
- Construction
- Mining
- Leak detection
- Environmental monitoring

II. ORDER OF OPERATIONS

It's important to understand the order of operations for activating your Soil Moisture Sensor. If performed out of sequence, your sensor may have trouble communicating with iMonnit Software. Please complete the steps below in the order indicated to make sure you set up the Soil Moisture Sensor correctly.

1. **Create iMonnit Account (If new user).**

2. **Register then connect/power on your gateway. Wait till it checks into iMonnit.**

3. **Register then power on sensor. Verify it checks into iMonnit. (See Setup and Installation section.)**
   We recommend powering the sensor on near the gateway then moving to the installation location, checking signal strength along the way.

4. **Configure sensor for use.**

5. **Install sensor in final location.**

Note: For information on setting up iMonnit and the gateway refer to the iMonnit User Guide and the gateways user guide.

Note: Device specific setup is covered in more detail in the following sections.

III. SETUP

If this is your first time using the iMonnit online portal, you will need to create a new account. If you have already created an account, start by logging in. For instructions on how to register and setup your iMonnit account, please consult the iMonnit User Guide.

STEP 1: ADD DEVICE

1. Add the sensor on iMonnit.

Add a sensor to your account by choosing **Sensors** in the main menu. Navigate to the **Add Sensor** button.

Desktop

Mobile

2. Find the device ID. See Figure 1.

The Device ID (ID) and Security Code (SC) are necessary to add a sensor. These can both be located on the label on the side of your device.

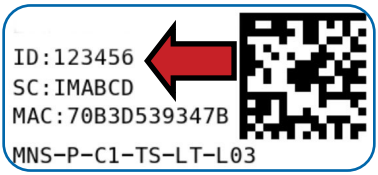

Figure 1

3. Adding your device. See Figure 2.

You will need to enter the Device ID and the Security Code from your Sensor in the corresponding text boxes. Use the camera on your smartphone to scan the QR code on your device. If you do not have a camera on your phone, or the system is not accepting the QR code, you may enter the Device ID and Security Code manually.

Figure 2

- The Device ID is a unique number located on each device label.
- Next, you'll be asked to enter the Security Code from your device. A security code consists of letters and must be entered in upper case (no numbers). It can also be found on the barcode label of your device.

When completed, select the **Add Device** button.

STEP 2: SETUP

Select your use case. See Figure 3.

Unlike most sensors, choosing a use case in Step 2 of adding this sensor does not give you the option to customize your settings. These will need to be adjusted in the settings tab for your device. See the **Settings View** section for instructions.

Select the **Skip** button when completed.

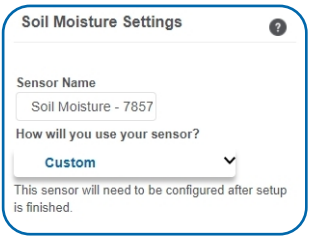

Figure 3

STEP 3: VALIDATION

Check your signal. See Figure 4.

The validation checklist will help you ensure your sensor is communicating with the gateway properly and you have a strong signal.

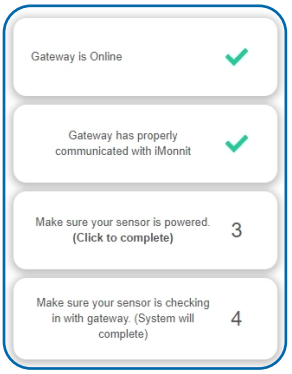

Figure 4

1. Gateway is Online: Ensure that the gateway is registered to iMonnit and is connected to power with antenna(s) or an Ethernet cable allowing it to communicate with the Internet.

2. Gateway has properly communicated with iMonnit: This step will autocomplete if the gateway is communicating with iMonnit. Press the button on the gateway to ensure the gateway has an updated sensor list and to speed up this process.

3. Make sure your sensor is powered: Attach the included antenna and switch on the sensor (see the **Powering Sensor On and Attach Antenna** sections for help in this area). Once you power the sensor on by flipping the switch, the sensor will communicate with the gateway every 30 seconds for the first few minutes.

4. Make sure your sensor is checking in with gateway: Checkpoint 4 will only complete when your sensor achieves a solid connection to the gateway. Press the action button on your Cellular Gateway or Ethernet Gateway to force communication.

Select the **Save** button when completed.

STEP 4: ACTIONS

Choose your actions. See Figure 5.

Actions are the alerts that will be sent to your phone or email in the event of an emergency. Low battery life and device inactivity are two of the most common actions to have enabled on your device. See the **Actions Overview** section for how to set actions for your sensor.

Select the **Done** button when completed.

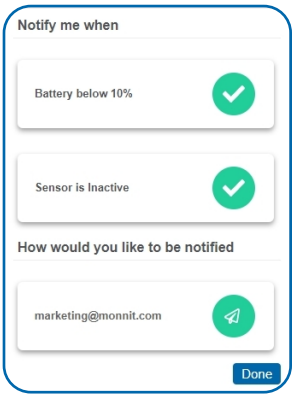

Figure 5

POWERING SENSOR ON AND INSTALLING ANTENNA

Attach Antenna

In order for the sensor to function properly, you will need to attach the included antenna. Simply screw the antenna onto the barrel connector on the top of he device. Make sure the antenna connection is snug, but do not over tighten. Refer to Antenna Orientation guide below for best radio performance.

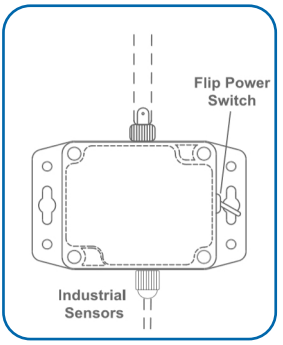

Figure 6

Powering Sensor On

The sensor comes pre-installed with an industrial grade 3.6V lithium battery sealed inside of the sensor housing.

To power the sensor on simply toggle the power switch to the "On" position.

Resetting Sensor

If the sensor needs to be reset for any reason, you can simply cycle the power by toggling the switch to the "Off" position and waiting 30 seconds before powering back on.

Storage

Always set the power switch to the "Off" before storing sensor to preserve battery life.

Antenna Orientation

In order to get the best performance out of your ALTA device, it is important to note proper antenna orientation and device positioning. Radio performance is best when device and gateway antenna are pointing in the same direction and installed on the same plane. For devices installed on the same horizontal plane this means the antenna should be pointed straight up. If devices are installed on the same vertical plane antenna should be aligned on the same horizontal plane and still pointing in the same direction. See Figure 16.

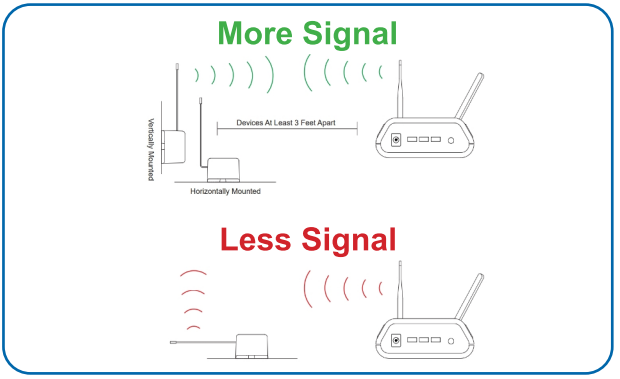

Figure 7

IV. SENSOR OVERVIEW AND INSTALLATION

IRRIGATION DESIGN USING THE SOIL MOISTURE SENSOR

Review the following diagrams to understand how to deploy the soil moisture sensors into your water operations.

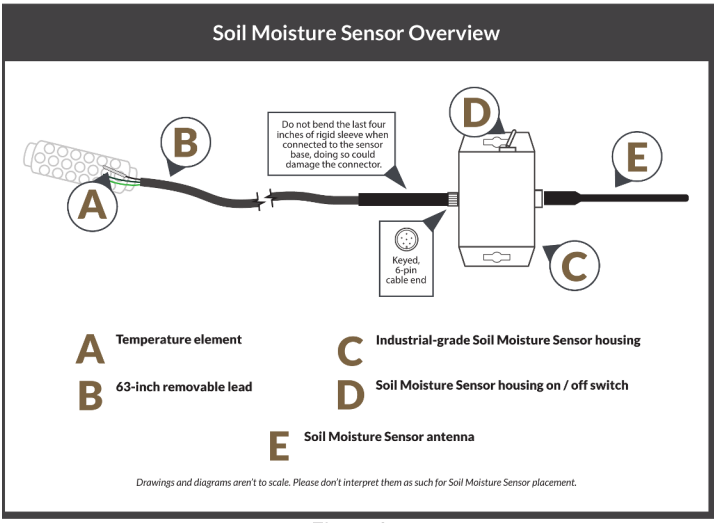

Figure 8

Preparing the Soil Moisture Sensor for Installation

To install the Soil Moisture Sensor, we recommend using the following supplies and tools (not sold with sensor).

Supplies:

- PVC pipe to insert the Soil Moisture Sensor's soil probe in the ground and on which to mount the Soil Moisture Sensor's housing.
  - 1/2" (13mm) Class 315 PVC (thin wall SDR 13.5), or
  - 3/4" (19mm) CPVC (SDR 11) pipe
- ABS to PVC transition cement
- A vinyl cap for the PVC pipe
- Three zip ties

Tools:

- Drill with 1/8" bit
- Hacksaw
- 7/8" rod or auger, 1" rod or auger for abrasive soils.

Please follow the instructions in the next section to prepare the Soil Moisture Sensor for installation.

Soil Moisture Lead Installation

The soil moisture lead is designed to be buried directly in the soil but we recommend using a PVC pipe and vinyl sealing cap as indicated in the following installation diagrams. If burying directly in the soil ensure the soil moisture element is buried completely and water cannot easily flow down the lead to the sensor. If the sensor is not buried well and water can flow down the lead, the sensor may become inadvertently saturated and provide high moisture or shorted readings. Before burying lead always perform **wetting process** first.

Wetting Process: Soak the sensors overnight in irrigation water. Always install a wet sensor. If time permits, slowly wet the sensor by partially submerging (no more than half way, 1 to 2") for 30 minutes in the morning and let dry until evening, wet for 30 minutes, let dry overnight, wet again for 30 minutes the next morning and let dry until evening. Soak over the next night and install WET. This will improve the sensor response in the first few irrigations.

Physical Installation: Make a sensor access hole to the desired depth with a 7/8" (22mm) O.D. rod/auger. Fill the bottom of the hole with a thick slurry made of soil removed from the hole and water, then firmly push the sensor down into the mud in the bottom of the hole. This will “grout in” the sensor to ensure maximum surface contact between the sensor surface and the surrounding soil. Alternately, the sensor can be firmly pushed to the bottom of the access hole as long as it is a tight enough fit to ensure adequate contact; a snug fit is absolutely necessary. A length of 1/2" Class 315 PVC (thin wall SDR 13.5) or 3/4" CPVC (SDR 11) pipe will fit snugly over the sensor’s collar and can be used to push in the sensor. A good snug fit in the soil is important. This PVC can be solvent welded to the sensor collar with a transition solvent PVC to ABS cement. If the PVC pipe is not left on the sensor (not-recommended), then backfill the hole so the sensor is buried (see Fig. 1). It is important that water doesn't run down the sensor lead and reach the sensing element directly so it is recommended to bury a small horizontal section of the lead (6 to 12" of lead under 3 to 6" of packed soil). If PVC is left on, then compact soil around the surface to seal off the hole (see Fig. 2). The PVC acts as a conduit for the sensor’s wires. Be sure to cap off or tape the top of the pipe, so surface water will not infiltrate to the sensor and give a false reading. Drill a small hole at the bottom of the pipe to allow any trapped water to drain away. Label each sensor lead to indicate sensor depth.

NOTE: It is important that sensor is located in active root system of the crop.

NOTE: Marking the installation with a "flag" will facilitate finding them later.

Installing in Course or Gravelly Soils: For very coarse or gravelly soils, an oversized hole (1" – 1.25" [25 mm - 32 mm]) may be needed to prevent abrasion damage to the sensor membrane. In this case, auger a hole to the desired depth and make a thick slurry with the soil and some water, as described above. Fill the hole with this slurry and then install the sensor.

Another method of installing sensors in difficult gravelly soils, or at deeper settings is to use a “stepped” installing tool (see Fig. 3). This makes an oversized hole for the upper portion and an exact size hole (sensor is 7/8" [22 mm] O.D.) for the lower portion where the sensor is located. The hole must be carefully backfilled and tamped down to prevent air pockets, which could allow water to channel down to the sensor.

Sensor Removal and Storage: If sensors are removed, clean and dry them. They can be stored indefinitely in a clean, dry location. Switch them off to save battery power. Always soak before re-installation.

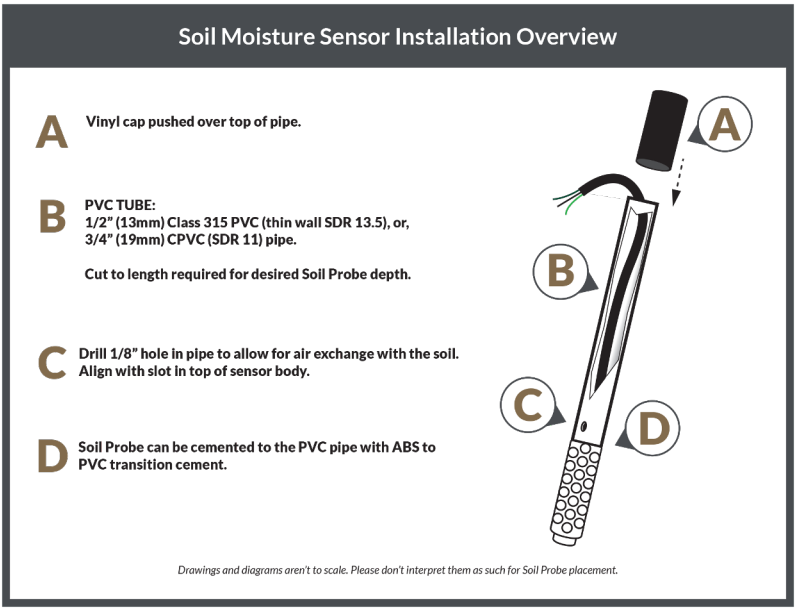

Figure 9

Mounting Soil Moisture Sensor Housing

We recommend installing the prepared soil probe with a PVC pipe into the ground and then attaching the sensor's housing to the PVC pipe. You have the following two options to mount the sensor's housing to the PVC pipe:

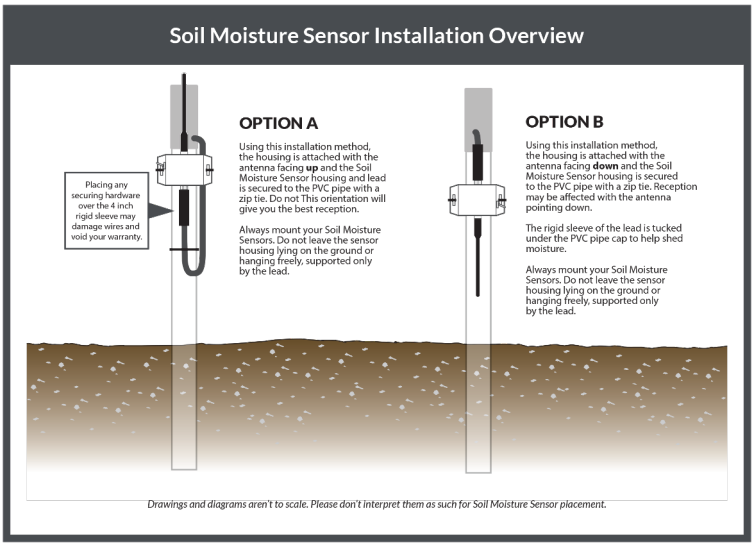

Figure 10

We highly recommend option A. Although not recommended, at your discretion, you may choose to mount the sensor's housing to a nearby post if the length of the lead allows.

See how to place the soil probe in orchards, row crops, center pivot, vines on drip, and greenhouse installations.

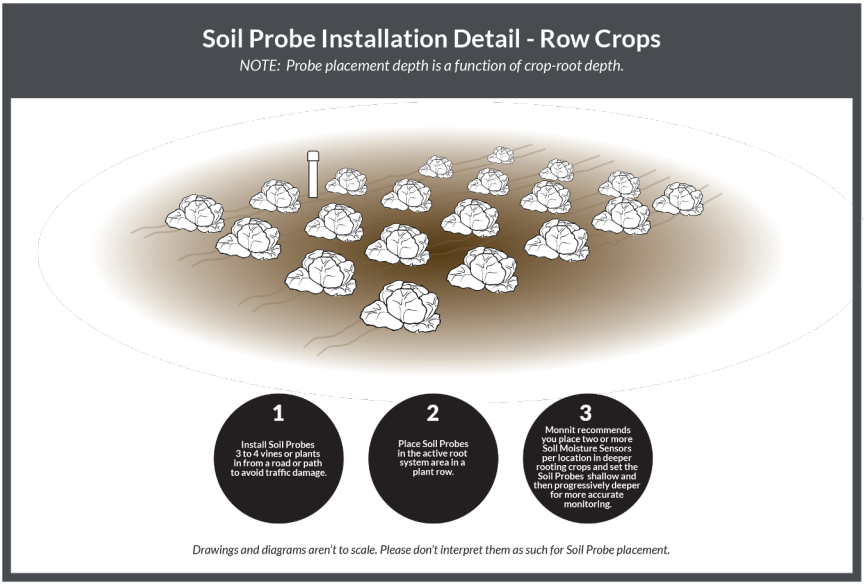

Figure 11

NOTE: The soil moisture sensor can be used in large pots, but is not well suited for small pots or for use in potting soil. Potting soil tends to be too loose for this sensor to work properly.

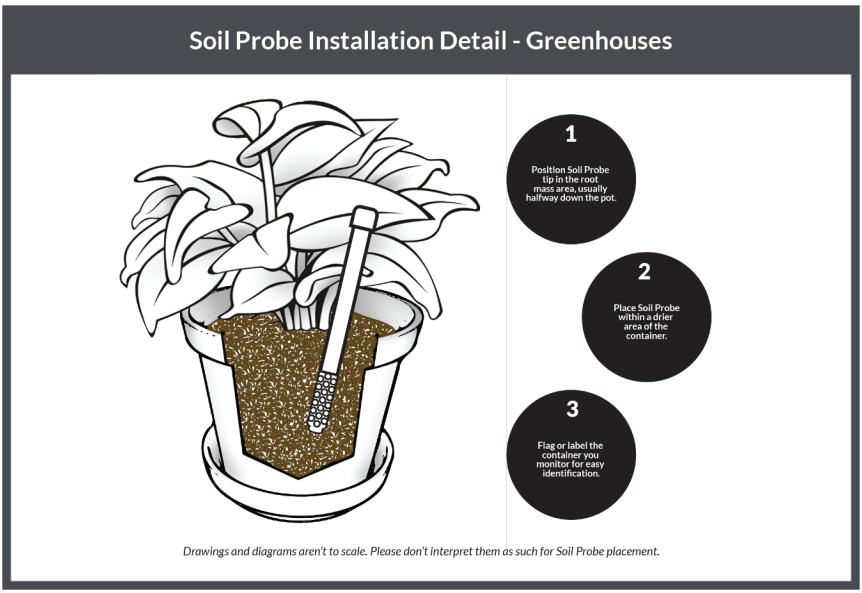

Figure 12

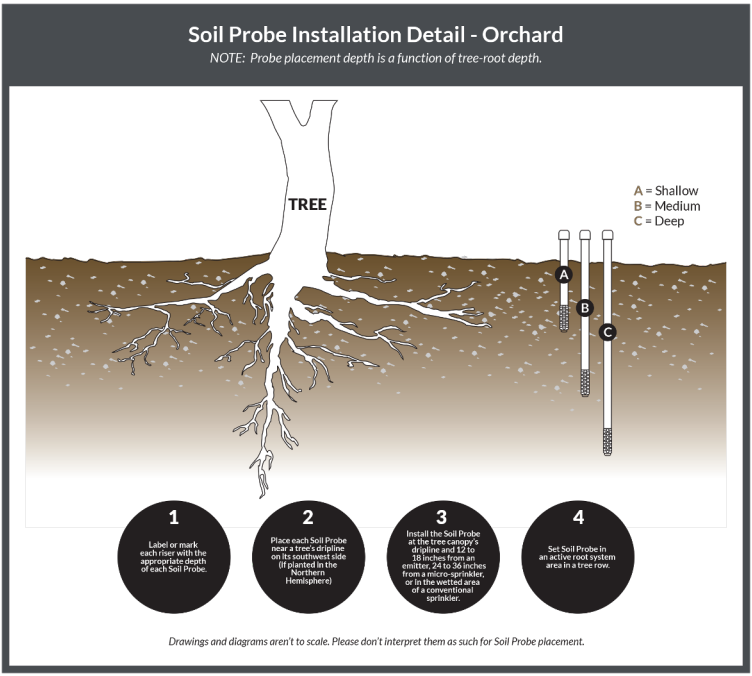

Figure 13

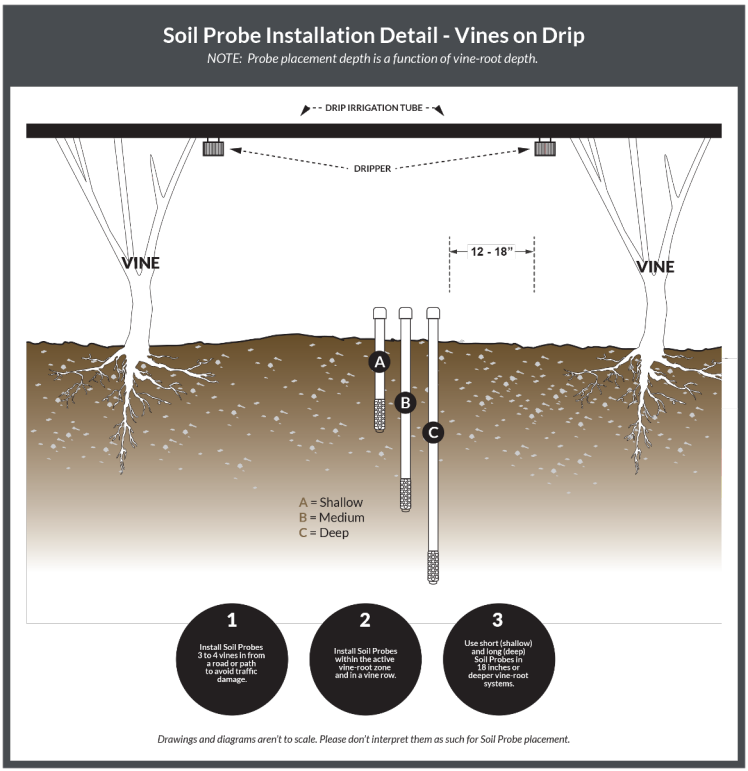

Figure 14

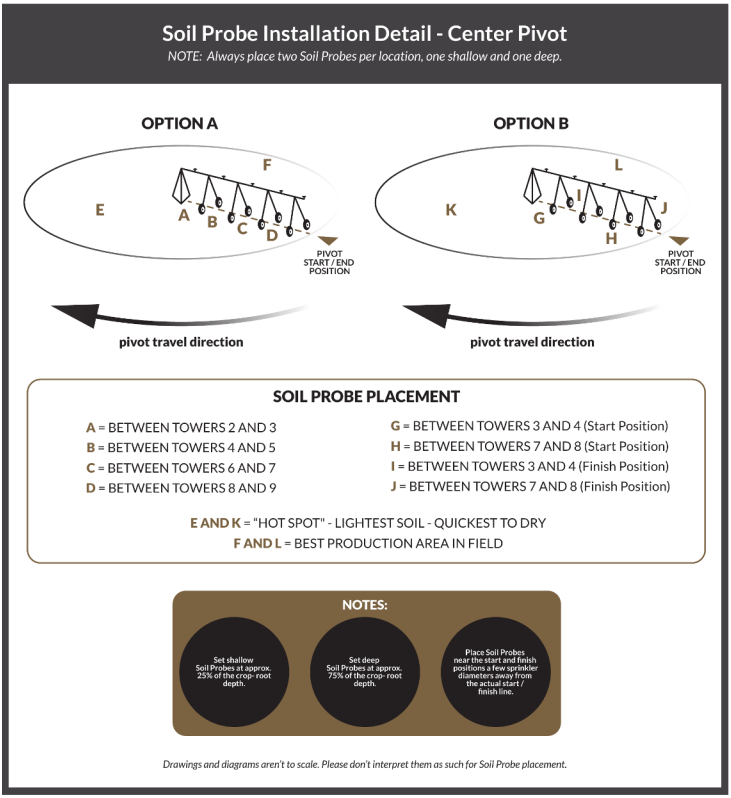
Soil Probe Installation Detail - Center Pivot
NOTE: Always place two Soil Probes per location, one shallow and one deep.
OPTION A
OPTION B
E
F
A
B
C
D
K
L
G
I
H
J
PIVOT START / END POSITION
PIVOT START / END POSITION
pivot travel direction
pivot travel direction
SOIL PROBE PLACEMENT
A = BETWEEN TOWERS 2 AND 3
B = BETWEEN TOWERS 4 AND 5
C = BETWEEN TOWERS 6 AND 7
D = BETWEEN TOWERS 8 AND 9
G = BETWEEN TOWERS 3 AND 4 (Start Position)
H = BETWEEN TOWERS 7 AND 8 (Start Position)
I = BETWEEN TOWERS 3 AND 4 (Finish Position)
J = BETWEEN TOWERS 7 AND 8 (Finish Position)
E AND K = "HOT SPOT" - LIGHTEST SOIL - QUICKEST TO DRY
F AND L = BEST PRODUCTION AREA IN FIELD
NOTES:
Set shallow Soil Probes at approx. 25% of the crop- root depth.
Set deep Soil Probes at approx. 75% of the crop- root depth.
Place Soil Probes near the start and finish positions a few sprinkler diameters away from the actual start / finish line.
Drawings and diagrams aren't to scale. Please don't interpret them as such for Soil Probe placement.

Figure 15

SUGGESTED PLACEMENT DEPTHS FOR SOIL PROBE

The following are suggested placement depths for various crops based on deep well drained soils. In lighter or shallow soils, place instrument accordingly or set them at an angle. With drip or trickle irrigation 12" and 24" depths are recommended.

CROP	SHALLOW INSTRUMENT (INCHES)	DEEP INSTRUMENT (INCHES)	FOR EXTRA DEPTH, SET AT (INCHES)	CROP	SHALLOW INSTRUMENT (INCHES)	DEEP INSTRUMENT (INCHES)	FOR EXTRA DEPTH, SET AT (INCHES)
ALFALFA	18-24	36-48		MELONS	18	36	
ALMONDS	24	48		MILO	24	48	
APPLES	20	40		MINT	12	24	
APRICOTS	24	48		MONTEREY PINES, FIRS	12	24	
ARTICHOKES	18	36		MUMS	4-6		
ASPARAGUS	18-24	36-48		MUSTARD	18	36	
AVOCADOS	12	24	36	NECTARINES	18	36	
BANANAS	12	24		OATS	18	36	
BARLEY	18	36		OKRA	18	36	
BEANS (bush)	10		18	OLIVES	24	48	
BEANS (Lima)	18	36		ONIONS	12		
BEANS (Pole)	18	36		PAPAYA	12	24	
BEETS (sugar)	18	36		PARSNIPS	18	36	
BEETS (table)	12-18	24-36		PEACHES	18	36	
BLUEBERRIES	12	24		PEANUTS	12	24	
BROCCOLI	12	20		PEARS	18	36	48
CABBAGE	12	20		PEAS	18	36	
CANAIGRE	18	36	48	PECANS	18	36	48
CANTALOUPE	18	36		PEPPERS	15	30	
CARNATIONS	4-6			PERMANENT PASTURES	8-15		24-30
CARROTS	12	24		PERSIMMONS	18	36	
CAULIFLOWER	12	24		PINEAPPLE	15	30	
CELERY	10	20		PISTACHIO NUTS	24	48	
CHARD	12	24		POMEGRANATES	18	36	
CHERRIES	24	48		POTATOES (Irish)	8-10	18	
CHRISTMAS TREE	12	24		POTATOES (sweet)	18	36	
CITRUS: Orange, Lemon, Grapefruit	18	36		PLUMS	24	48	
COFFEE	18-24	36-48		PRUNES	24	48	
CORN (sweet)	12	30		PUMPKIN	18	36	48
CORN (field)	18	36		RADISHES	12		
COTTON	18	36	48	RASPBERRIES	18	36	
CRANBERRIES	18	36		SORGHUM	18	36	
CUCUMBERS	18	36		SOY BEANS	18	36	
DATE PALM	24	48		SPINACH	12	24	
EGGPLANT	12	24		SQUASH (Summer)	15	30	
FIGS	18	36		STRAWBERRIES	6	12	
GARLIC	12	24		SUDAN GRASS	18-24	36-48	
GRAIN and FLAX	18	36		SUGAR CANE	18	36	
GRAPES	24	48		SUNFLOWERS	24	48	
HOPS	24	48		TEA	12	24	
JOJOBA	18	36		TOBACCO	8-15	30	
KIWI	18	36	48	TOMATOES	18	36	
LADINO CLOVER	10	20		TURNIPS	18	36	
LETTUCE	12			WALNUTS	24	48	
MACADAMIAS	12	24	36	WATERMELON	18	36	48
MAIZE	18	36		WHEAT, HAY	18	36	

Figure 16

Interpreting Soil Moisture Sensor Data

The Soil Moisture Sensor measures soil water status in centibars (cb) or kilopascals (kPa) of soil water tension. This value represents the energy a plant's root system uses to draw water from the soil. As you analyze and interpret your sensor readings, you gain a clearer view of what is happening with the soil moisture in your crop's root system.

Typically, two to three readings between irrigations are sufficient. Charting your readings will show precisely how quickly (or slowly) your soil moisture is being depleted. Our iMonnit Software can provide graphical displays of sensor data, so you know what's happening throughout your precision irrigation operations.

Use the following readings as general guidelines:

- 0-10 cb (kPa) = Saturated soil
- 10-30 cb (kPa) = Soil is adequately wet (except coarse sands, which are beginning to lose water)
- 30-60 cb (kPa) = Usual range for irrigation (most soils)
- 60-100 cb (kPa) = Usual range for irrigation in heavy clay
- 100-200 cb (kPa)[1] = Caution: soil is becoming dangerously dry for maximum production. Proceed with caution.

1: ALTA Soil Moisture Sensors read up to 240 cb (kPa).

Your situation may be unique because of differences in crops, soils, and climate. Perhaps the most crucial soil moisture reading is the difference between today's reading and that of three to five days ago. That is to say, how quickly is the reading going up?

A slow increase means the soil is drying out slowly. But a big jump means the soil is losing water very rapidly. A faster rate of increase means the crop is working harder to extract water from the soil and may start to stress. By analyzing such trends in the readings, you will determine when to irrigate. Displaying readings on a graph makes it easier to see the trends, thereby making interpretation easier.

Assessing Soil Moisture Thresholds

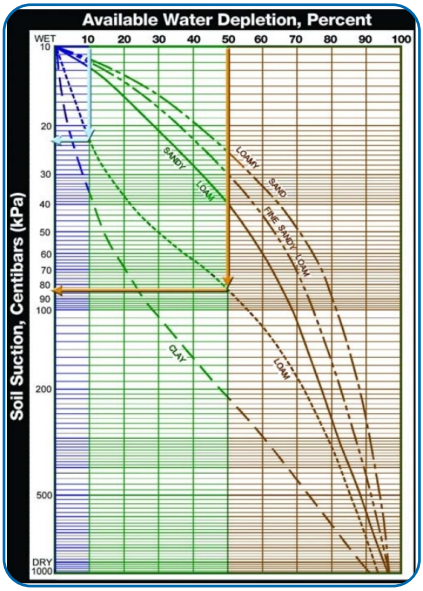

Figure 17

This graph[1] (Figure 17) can assist you in creating reference points for your site and application. These points help identify the boundaries within which you want to manage moisture availability for your crop. How wet and dry the soil should depend on soil type, crop, the plant's stage of development, and cultural practices for managing the field. A chart or graph like this can help guide you to select appropriate threshold levels.

1.Select the soil type(s) that most closely resembles that in your field.

2.Draw a vertical line from 10% available water depletion (represented by the blue/green boundary) down to the curve for your soil type and then horizontally over to the left axis labeled soil suction to obtain the wet reference value. This will help you determine the lower (wetter) threshold value.

3.Use this centibar / kPa value as the wet threshold. For example, for loam soil, this value would be 23 (as indicated by the blue arrow).

4.Draw a vertical line from 50% available water depletion (represented by the green/brown boundary) down to the curve for your soil type and then horizontally over to the left axis labeled soil suction to obtain the reference DRY value. This will determine the higher (drier) threshold value.

5.Use this centibar / kPa value as the dry threshold. For example, for loam soil, this value would be 84 (as indicated by the brown arrow).

1. Graph adapted from Agronomy No. 11, figure 30-2 Irrigation of Agricultural Lands American Society of Agronomy R.M. Hagan, H.R. Haise, T.W. Edminster, editors.

V. SENSOR OVERVIEW IN iMONNIT

Select **Sensors** from the main navigation menu on iMonnit to access the sensor overview page and begin making adjustments to your Soil Moisture Sensor, See Figure 18.

MENU SYSTEM

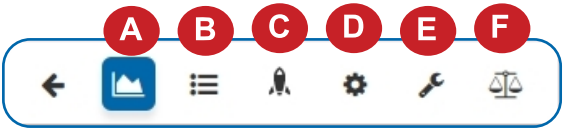

Figure 18

A. Details - Displays a graph of recent sensor data

B. History - List of all past heartbeats and readings

C. Actions - List of all actions attached to this sensor

D. Settings - Editable levels for your sensor

E. Calibrate - Set your sensor to deliver readings with greater accuracy

F. Scale - Change the scale of readings for your sensor

Directly under the tab bar is an overview of your sensor. This allows you to see the signal strength and the battery level of the selected sensor. A colored dot in the left corner of the sensor icon denotes its status.

- **Green** indicates the sensor is checking in and within user-defined safe parameters.
- **Red** indicates the sensor has met or exceeded a user-defined threshold or triggered event.
- **Gray** indicates that no sensor readings are being recorded, rendering the sensor inactive.
- **Yellow** indicates that the sensor reading is out of date, due to perhaps a missed heartbeat check-in.

Details View

The Details View will be the first page you see upon selecting which sensor you would like to modify. See Figure 19.

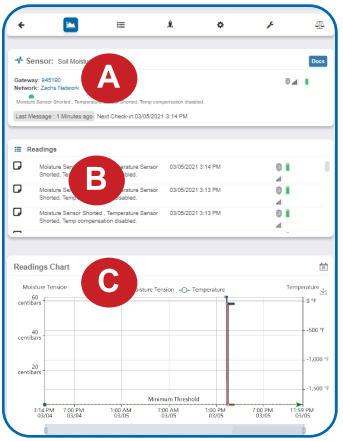

Figure 19

A. The sensor overview section will be above every page. This will consistently display the present reading, signal strength, battery level, and status.

B. The Recent Readings section below the chart shows your most recent data received by the sensor.

C. This graph charts how the sensor fluctuates throughout a set date range. To change the date range displayed in the graph, navigate up to the top of the Readings Chart section on the right-hand corner to change the from and/or to date.

Readings View

Selecting the **Readings Tab** within the tab bar allows you to view the sensor's data history as time stamped data.

- On the far right of the Sensor History Data is a cloud icon. ( ) Selecting this icon will export an Excel file for your sensor into your download folder.

Note: Make sure you have the date range for the data you need input in the "From" and "To" text boxes. This will be the previous day by default. Only the first 2,500 entries in the selected date range will be exported.

The data file will have the following fields:

MessageID: Unique identifier of the message in our database.

Sensor ID: If multiple sensors are exported, you can distinguish between the sensors using this number — even if the names are the same.

Sensor Name: The name you have given the sensor.

Date: The date the message was transmitted from the sensor.

Value: Data presented with transformations applied, but without additional labels.

Formatted Value: Data transformed and presented as it is shown in the monitoring portal.

Raw Data: Raw data as it is stored from the sensor.

Sensor State: Binary field represented as an integer containing information about the state of the sensor when the message was transmitted. (See "***Sensor State***" explained below.)

Alert Sent: Boolean indicating if this reading triggered a notification to be sent from the system.

Sensor State

The value presented here is generated from a single byte of stored data.
A byte consists of 8 bits of data that we read as Boolean (True (1) / False (0)) fields.

When broken into individual bits, the State byte contains the following information:
aaaabcde
STS: This value is specific to the sensor profile and is often used to indicate error states and other sensor conditions.
UNUSED: This sensor does not use these bits.
AWARE: Sensors become aware when critical sensor specific conditions are met. Going aware can cause the sensor to trigger and report before the heartbeat and cause the gateway to forward the data to the server immediately resulting in near immediate transmission of the data.
TEST: This bit is active when the sensor is first powered on or reset and remains active for the first 9 messages when using default configurations.

STS Specific Codes:
This sensor does not have any STS specific codes.

Settings View

To edit the operational settings for a sensor, choose the Sensor option in the main navigation menu and then select the Settings Tab to access the configuration page. See Figure 20.

A. Sensor Name is the unique name you give the sensor to easily identify it in a list along with any notifications.

B. Heartbeat Interval is how often the sensor communicates with the server if no activity is recorded.

C. Aware State Heartbeat is how often the sensor communicates with the server while in the Aware State.

D. Assessments per Heartbeat is how many times between heartbeats a sensor will check its measurements against its thresholds to determine whether it will enter an Aware State.

E. Minimum Threshold: Assessments below this value will cause the sensor to enter the Aware State.

F. Maximum Threshold: Assessments above this value will cause the sensor to enter the Aware State.

G. Moisture Aware State Buffer: prevents the sensor from bouncing between Standard Operation and Aware State when the assessments are very close to a threshold. For example, if a Maximum Threshold is set to 240 centibars and the buffer is 1 centibar, then once the sensor takes an assessment of 240.1 centibars it will remain in an Aware State until dropping to 239 centibars.

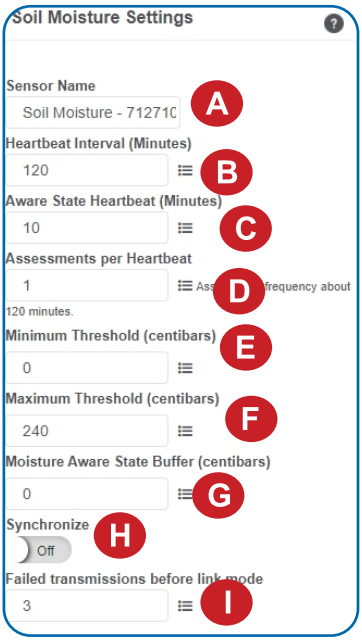

Figure 20

H. Synchronize: is a setting that in small sensor networks synchronizes communication. The default setting OFF allows the sensors to randomize their communications therefore maximizing communication robustness. Setting this will synchronize the communication of the sensors.

I. Failed transmissions before link mode is the number of transmissions the sensor sends without response from a gateway before it goes to battery saving link mode. In link mode, the sensor will scan for a new gateway and if not found will enter battery saving sleep mode for up to 60 minutes before trying to scan again. A lower number will allow sensors to find new gateways with fewer missed readings. Higher numbers will enable the sensor to remain with its current gateway in a noisy RF environment better. (Zero will cause the sensor to never join another gateway, to find a new gateway the battery will have to be cycled out of the sensor.)

Finish by selecting the **Save** button.

Note: Be sure to select the Save button anytime you make a change to any of the sensor parameters. All changes made to the sensor settings will be downloaded to the sensor on the next sensor heartbeat (check-in). Once a change has been made and saved, you will not be able to edit that sensor's configuration again until it has downloaded the new setting.

Calibrate View

You have the option of choosing Moisture Calibration or Temperature Calibration. To calibrate the sensor, ensure that the environment of the sensor and other calibration devices are stable.

Enter the actual (accurate) reading from the calibration device into the text field. If you need to change the unit of measurement you can do that here.

Press **Calibrate.**

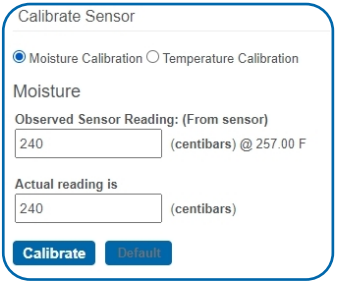

Figure 21

To ensure that the calibration command is received prior to the sensors next check-in, press the control button on the back of the gateway, once, to force communication (Cellular and Ethernet gateways).

After pressing the "Calibrate" button and choosing the gateway button, the server will send the command to calibrate the specified sensor to the gateway. When the sensor checks-in, it will send the pre-calibration reading to the gateway, then receive the calibration command and update it's configuration. When the process is completed, it will send a "Calibration Successful" message. The server will display the sensor's last pre-calibrated reading for this check-in, then all future readings from the sensor will be based on the new calibration setting.

It is important to note that after calibrating the sensor, the sensor reading returned to the server is based on pre-calibration settings. The new calibration settings will take effect on the next sensor heartbeat.

Note: If you would like to send the changes to the sensor right away, please remove the battery(s) for a full 60 seconds, then re-insert the battery(s). This forces the communication from the sensor to the gateway and this the message to make a change from the gateway back to the sensor. (If the sensors are industrial sensors, turn the sensor off for a full minute, rather than removing the battery).

Creating a Calibration Certificate

Creating a sensor calibration certificate will mask the calibration tab from those who should not have permissions to adjust these settings. Permissions for self-certifying a calibration must be enabled in user permissions.

Directly below the calibrate button is the selection to "Create Calibration Certificate.

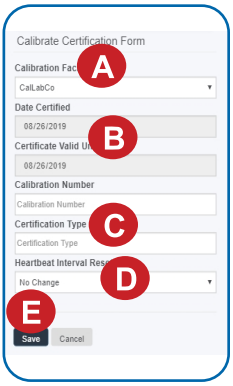

Figure 22

A. The **Calibration Facility Field** will be filled. Select the dropdown menu to change your facility.

B. The **"Certificate Valid Until"** field must be set one day after the date contained in the "Date Certified" field.

C. "**Calibration Number**" and "Calibration Type" are unique values to your certificate.

D. If necessary, you can reset the heartbeat interval here to 10 minutes, 60 minutes, or 120 minutes. By default, this will be set to no change.

E. Choose the "**Save**" button before moving on.

When the new certificate is accepted, the Calibration tab will change to a Certificate tab.

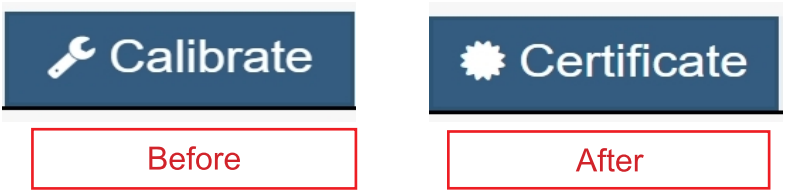

Figure 23

You will still be able to edit the certificate by choosing the Certificate Tab and navigating down to "Edit Calibration Certificate."

The tab will revert back to "Calibrate" after the period for the certificate ends.

Scale View

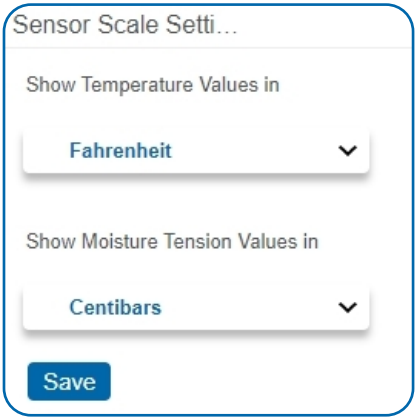

Figure 24

Select the scale tab to change your temperature and moisture tension values.

Choose the text box to trigger a pop-up window allowing you to change the scale. Select the scale you prefer and push “Set.”

Press the “Save” button to complete your adjustment.

Changing units here will also change units on the sensor physical display. Units changed locally on the sensor itself will not be change this setting in iMonnit.

VI. ACTIONS OVERVIEW

Device notifications can be created, deleted, and edited by selecting the **Actions Tab** in the tab bar.

You can toggle the Action Trigger on or off by selecting the switch under Current Action Triggers. See Figure 25.

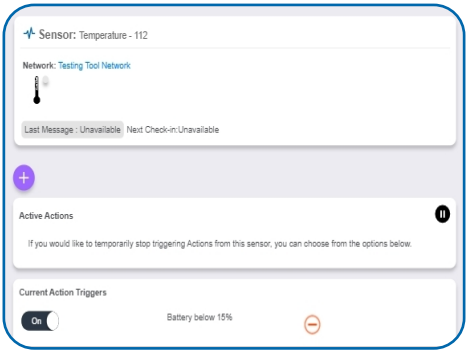

Figure 25

CREATING AN ACTION

- Actions are triggers or alarms set to notify you when a sensor reading identifies that immediate attention is needed. Types of actions include sensor readings, device inactivity, and scheduled data. Any one of these can be set to send a notification or trigger an action in the system. See Figure 26.

Choose **Actions** in the main navigation menu.

Figure 26

- A list of previously created actions will display on the screen. From here, you have the ability to filter, refresh, and add new actions to the list.

Note: If this is your first time adding an action, the screen will be blank.

From the Actions page, tap **Add Action** in the left hand corner. See Figure 27.

Figure 27

Step 1: What triggers your action?

The drop-down menu will have the following options for Action Types (See Figure 28):

- **Sensor Reading:** Set actions based on activity or reading.
- **Device Inactivity**: Actions when the device doesn't communicate for an extended period of time.
- **Advanced:** Actions based on advanced rules, such as comparing past data points with current ones.
- **Scheduled:** These actions are performed at a time set basis.

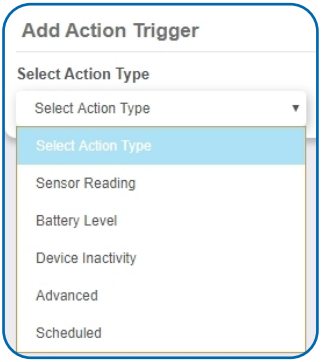

Figure 28

- Select Sensor Reading from the drop-down menu.
- A second drop-down menu will appear. From here, you will be able to see a list of the different type of sensors registered to your account. Choose **Soil Moisture** in the drop-down menu.
- Next, you will be asked to input the trigger settings. You have the option of setting this trigger to detect "moisture" or "temperature." See Figure 29.

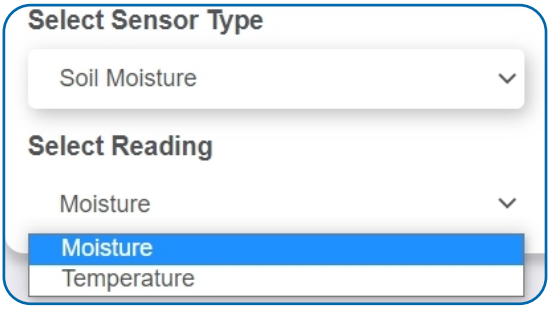

Figure 29

Press the **Save** button.

Step 2: Actions

- Press the **Add Action** button under the information header, available action types will then be presented in a select list.
- **Notification Action:** Specify account users to receive notification when this event triggers.
- **System Action:** Assign actions for the system to process when this event triggers.
- Choose **Notification Action** from the notification list.

A. Input the subject for the notification. See Figure 30.

B. Customize the message body for the notification. See Figure 30.

C. Recipient list identifies who will receive the notification. See Figure 31.

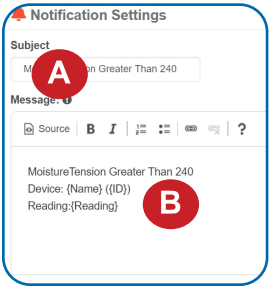

Figure 30

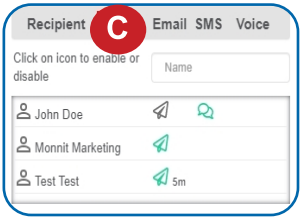

Figure 31

- Select the icon next to a user to specify how they will be notified.
- Choose if you want notifications sent immediately, when triggered, or if you want a delay before sending and press **Set**.
- A **green** icon indicates that the users that will receive the notifications.
- If a delay has been selected, the delay time will display beside the icon.

Select **System Action** from the Add Action list. See Figure 32.

- Scroll down to the System Action section.
- The Action to be done select list has the following options:

  Acknowledge: Automatically signals that you have been notified of an action. When an action has been triggered, alerts will continue processing until the action returns to a value that no longer triggers an action.

  Full Reset: Reset your trigger so it is armed for the next reading.

  Activate: Enable an action trigger.

  Deactivate: Disable an action trigger.

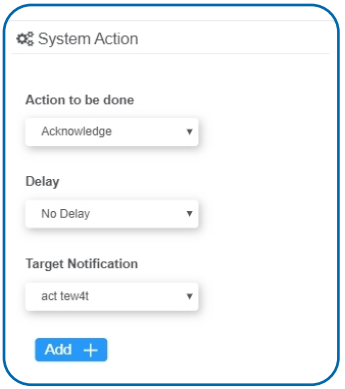

Figure 32

Step 3: Action Name and Devices

- By default, the sensor(s) will not be assigned to the action conditions you've just set. To assign a sensor, find the device(s) you want to designate for this action and select. Selected sensor boxes will turn green when activated. Choose the sensor box again to unassign the sensor from the action. See Figure 33.
- Continue toggling the sensor(s) corresponding to this new action until you are satisfied with your selection. These can be adjusted later by returning to this page.

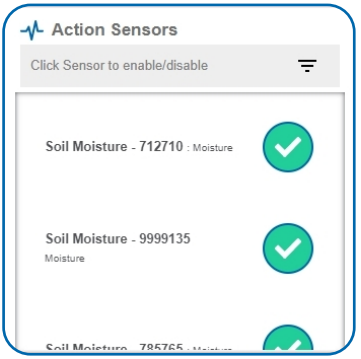

Figure 33

Press the **Check-mark** button to complete the process.

VII. SECURITY

Data security and integrity is paramount at Monnit. Each layer of the system is secured using encryption and protocols designed to protect customer data and information. The system consists of sensor(s), gateway(s), and iMonnit software. One or more sensors communicate with iMonnit software through a gateway.

SENSOR TO GATEWAY

Sensor and gateway radio modules are purpose built devices with proprietary unreadable firmware, which means the sensor cannot be physically hacked or re-purposed for malicious purposes. This adds a strong level of inherent security even before considering encryption. Data transmission between the sensor and gateway are secured using Encrypt-RF Security (Diffie-Hellman Key Exchange + AES-128 CBC for sensor data messages). Beyond the encryption, data transmissions are also structurally verified and CRC checked before they are passed up to iMonnit or down to the sensor, this ensures the integrity of the data itself.

GATEWAY TO IMONNIT

Data transmissions between the gateway and iMonnit software are secured using 256-bit, bank level encryption.

iMONNIT

Access is granted through the iMonnit user interface, or an Application Programming Interface (API) safeguarded by 256-bit Transport Layer Security (TLS 1.2) encryption. TLS is a blanket of protection to encrypt all data exchanged between iMonnit and you. The same encryption is available to you whether you are a Basic or Premiere user of iMonnit. You can rest assured that your data is safe with iMonnit.

SENSOR PRINTS

Sensor prints utilize a shared key between the software and the sensor to ensure that once the data comes to iMonnit it is guaranteed to be from the device identified by the sensor print. If this feature is purchased for the device (via iMonnit software) the devices data becomes impossible to spoof by any malicious device.

VIII.TROUBLESHOOTING

Symptoms	Detailed Problem Description	Solution
Not Checking into iMonnit	Sensor lost radio link to gateway or never connected to gateway.	Power cycle sensor by turning the switch off for 60 seconds then toggling it on. 1. Ensure the network is setup correctly in iMonnit (sensor and gateway are on same network). Press button on gateway. 2. If network is setup correctly reform the gateway. 3. Move sensor ~10 feet from gateway. 4. Move progressively further from gateway ensuring at least 2 signal bars are showing. Keep in mind the signal bars represent signal from the previous message, not the current message. Recommend taking two readings to verify signal strength. 5. Check antenna on the gateway.
Low Signal	Radio signal strength in iMonnit is lower than expected.	1. Ensure the gateway antenna is properly connected. 2. Ensure the gateway antenna is optimally oriented with respect to the position of the sensor. (See Antenna Orientation guide in Setup and Installation section).
Sensor Reads "Moisture Sensor Shorted"	This error state indicates the sensor is either over-saturated with water or the sensing element is physically shorted for some reason. STS = 1	Perform the following steps in order stopping when error is resolved. 1. Remove lead. Let sensor take reading while disconnected and the sensor should indicate "Moisture Sensor Open". This means the short is in the lead not the sensor base or base connector. 2. If connector is dirty or corroded, power sensor off and clean connectors with isopropyl alcohol and clean brush. Inspect o-ring inside connector collar using a flashlight and ensure you see a continuous green ring. If o-ring appears broken contact Monnit support. If confirmed clear, reattach lead, power sensor on, and look for good soil moisture readings. 3. Unbury the lead and let moisture sensing element dry out over a 24 hour period in a warm dry area. If element is working properly centibar readings should appear and increase as sensor dries out. If good readings appear sensor element was probably over-saturated. Ensure water is not running directly down sensor cable in application, if water enters the sensor from the top of the element this can cause a shorted reading. 4. If error state persists contact Monnit support there may be a short elsewhere in the system they help can identify and resolve.

Symptoms	Detailed Problem Description	Solution
Sensor reads "Moisture Sensor Open (Cable Break or Completely Dry)	Moisture sensor element is either completely dried out or there is a broken or bad connection in the cable, sensor base, or connector. STS = 2	Perform the following steps in order stopping when error is resolved. 1. Remove lead, inspect for rips or breaks in cable. If there is apparent damage to the cable contact Monnit support. 2. Inspect connector, if dirty or corroded, power sensor off and clean connectors with isopropyl alcohol and clean brush. Inspect o-ring inside connector collar using a flashlight and ensure you see a continuous green ring. If o-ring appears broken contact Monnit support. If confirmed clear, reattach lead, power sensor on, and look for good soil moisture readings. 3. Unbury the lead and submerge the lower half of the soil moisture element in water. If good readings or "Moisture Sensor Shorted" appears in iMonnit the sensor may have just dried out. Remove sensor from water and let it dry out over 24 hour period in dry area. Sensor should show gradually increasing centibar readings as the sensor element dries. 4. If error state persists contact Monnit support, there may be an open elsewhere in the system they can help identify and resolve.
Sensor reads "Moisture Out of Range"	Sensor reads "Moisture Out of Range and indicated soil moisture value is near or above 240 centibar. STS = 3	The sensor may be drying out or may have been calibrated to exceed range. Reset default in calibration tab and check to see if sensor has dried out completely. If problem persists contact Monnit support.
Sensor reads "Temperature Sensor Shorted, Temp compensation disabled"	Temperature element is shorted in some way. STS = 4	Check lead for any apparent damage. Check lead connectors for any water ingress or corrosion. Clean connector with isopropyl alcohol and a brush. If problem persists contact Monnit support.
Sensor reads "Temperature Sensor Open (Possible Cable Break), Temp compensation disabled"	Temperature element is open in some way. STS = 5	Check lead for any apparent damage. Check lead connectors for any water ingress or corrosion. Clean connector with isopropyl alcohol and a brush. If problem persists contact Monnit support.

Symptoms	Detailed Problem Description	Solution
Sensor reads "Temperature out of range, Temp compensation disabled"	Temperature element is open in some way. STS = 6	Check lead for any apparent damage. Check lead connectors for any water ingress or corrosion. Clean connector with isopropyl alcohol and a brush. If problem persists contact Monnit support.
Readings are not as expected.	Readings are higher or lower than expectations.	Go through installation steps again and make sure to follow instructions closely. A sensor that is too loose in the soil or improperly installed may produce unexpected readings.

SUPPORT

For technical support and troubleshooting tips please visit our support library online at monnit.com/support/. If you are unable to solve your issue using our online support, email Monnit support at support@monnit.com with your contact information and a description of the problem, and a support representative will call you within one business day.

For error reporting, please email a full description of the error to support@monnit.com.

WARRANTY INFORMATION

(a) Monnit warrants that Monnit-branded products (Products) will be free from defects in materials and workmanship for a period of one (1) year from the date of delivery with respect to hardware and will materially conform to their published specifications for a period of one (1) year with respect to software. Monnit may resell sensors manufactured by other entities and are subject to their individual warranties; Monnit will not enhance or extend those warranties. Monnit does not warrant that the software or any portion thereof is error free. Monnit will have no warranty obligation with respect to Products subjected to abuse, misuse, negligence or accident. If any software or firmware incorporated in any Product fails to conform to the warranty set forth in this Section, Monnit shall provide a bug fix or software patch correcting such non-conformance within a reasonable period after Monnit receives from Customer (i) notice of such non-conformance, and (ii) sufficient information regarding such non-conformance so as to permit Monnit to create such bug fix or software patch. If any hardware component of any Product fails to conform to the warranty in this Section, Monnit shall, at its option, refund the purchase price less any discounts, or repair or replace nonconforming Products with conforming Products or Products having substantially identical form, fit, and function and deliver the repaired or replacement Product to a carrier for land shipment to customer within a reasonable period after Monnit receives from Customer (i) notice of such non-conformance, and (ii) the non-conforming Product provided; however, if, in its opinion, Monnit cannot repair or replace on commercially reasonable terms it may choose to refund the purchase price. Repair parts and replacement Products may be reconditioned or new. All replacement Products and parts become the property of Monnit. Repaired or replacement Products shall be subject to the warranty, if any remains, originally applicable to the product repaired or replaced. Customer must obtain from Monnit a Return Material Authorization Number (RMA) prior to returning any Products to Monnit. Products returned under this Warranty must be unmodified.

Customer may return all Products for repair or replacement due to defects in original materials and workmanship if Monnit is notified within one year of customer's receipt of the product. Monnit reserves the right to repair or replace Products at its own and complete discretion. Customer must obtain from Monnit a Return Material Authorization Number (RMA) prior to returning any Products to Monnit. Products returned under this Warranty must be unmodified and in original packaging. Monnit reserves the right to refuse warranty repairs or replacements for any Products that are damaged or not in original form. For Products outside the one year warranty period repair services are available at Monnit at standard labor rates for a period of one year from the Customer's original date of receipt.

(b) As a condition to Monnit's obligations under the immediately preceding paragraphs, Customer shall return Products to be examined and replaced to Monnit's facilities, in shipping cartons which clearly display a valid RMA number provided by Monnit. Customer acknowledges that replacement Products may be repaired, refurbished or tested and found to be complying. Customer shall bear the risk of loss for such return shipment and shall bear all shipping costs. Monnit shall deliver replacements for Products determined by Monnit to be properly returned, shall bear the risk of loss and such costs of shipment of repaired Products or replacements, and shall credit Customer's reasonable costs of shipping such returned Products against future purchases.

(c) Monnit's sole obligation under the warranty described or set forth here shall be to repair or replace non-conforming products as set forth in the immediately preceding paragraph, or to refund the documented purchase price for non-conforming Products to Customer. Monnit's warranty obligations shall run solely to Customer, and Monnit shall have no obligation to customers of Customer or other users of the Products.

Limitation of Warranty and Remedies.

THE WARRANTY SET FORTH HEREIN IS THE ONLY WARRANTY APPLICABLE TO PRODUCTS PURCHASED BY CUSTOMER. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED. MONNIT'S LIABILITY WHETHER IN CONTRACT, IN TORT, UNDER ANY WARRANTY, IN NEGLIGENCE OR OTHERWISE SHALL NOT EXCEED THE PURCHASE PRICE PAID BY CUSTOMER FOR THE PRODUCT. UNDER NO CIRCUMSTANCES SHALL MONNIT BE LIABLE FOR SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES. THE PRICE STATED FOR THE PRODUCTS IS A CONSIDERATION IN LIMITING MONNIT'S LIABILITY. NO ACTION, REGARDLESS OF FORM, ARISING OUT OF THIS AGREEMENT MAY BE BROUGHT BY CUSTOMER MORE THAN ONE YEAR AFTER THE CAUSE OF ACTION HAS ACCRUED.

IN ADDITION TO THE WARRANTIES DISCLAIMED ABOVE, MONNIT SPECIFICALLY DISCLAIMS ANY AND ALL LIABILITY AND WARRANTIES, IMPLIED OR EXPRESSED, FOR USES REQUIRING FAIL-SAFE PERFORMANCE IN WHICH FAILURE OF A PRODUCT COULD LEAD TO DEATH, SERIOUS PERSONAL INJURY, OR SEVERE PHYSICAL OR ENVIRONMENTAL DAMAGE SUCH AS, BUT NOT LIMITED TO, LIFE SUPPORT OR MEDICAL DEVICES OR NUCLEAR APPLICATIONS. PRODUCTS ARE NOT DESIGNED FOR AND SHOULD NOT BE USED IN ANY OF THESE APPLICATIONS.

CERTIFICATIONS

United States FCC

This equipment has been tested and found to comply with the limits for a Class B digital devices, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

WARNING: *Changes or modifications not expressly approved by Monnit could void the user's authority to operate the equipment.*

RF Exposure

WARNING: To satisfy FCC RF exposure requirements for mobile transmitting devices, the antenna used for this transmitter must not be co-located in conjunction with any antenna or transmitter.

Monnit and ALTA Wireless Sensors:

This equipment complies with the radiation exposure limits prescribed for an uncontrolled environment for fixed and mobile use conditions. This equipment should be installed and operated with a minimum distance of 23 cm between the radiator and the body of the user or nearby persons.

All ALTA Wireless Sensors Contain FCC ID: ZTL-G2SC1. Approved Antennas

ALTA devices have been designed to operate with an approved antenna listed below, and having a maximum gain of 14 dBi. Antennas having a gain greater than 14 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

- *Xianzi XQZ-900E (5 dBi Dipole Omnidirectional)*
- *HyperLink HG908U-PRO (8 dBi Fiberglass Omnidirectional)*
- *HyperLink HG8909P (9 dBd Flat Panel Antenna)*
- *HyperLink HG914YE-NF (14 dBd Yagi)*
- *Specialized Manufacturing MC-ANT-20/4.0C (1 dBi 4" whip)*

Canada (IC)

English

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the Equivalent Isotropically Radiated Power (E.I.R.P.) is not more than that necessary for successful communication.

The radio transmitters (IC: 9794A-RFSC1, IC: 9794A-G2SC1, IC: 4160a-CNN0301, IC: 5131A-CE910DUAL, IC: 5131A-HE910NA, IC: 5131A-GE910 and IC: 8595A2AGQN4NNN) have been approved by Industry Canada to operate with the antenna types listed on previous page with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

This device complies with Industry Canada licence-exempt RSS standard(s). 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.

French

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la Puissance Isotrope Rayonnée Èquivalente (P.I.R.È) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteurs radio (IC: 9794A-RFSC1, IC: 9794A-G2SC1, IC: 4160a-CNN0301, IC: 5131A-CE910DUAL, IC: 5131A-HE910NA, IC: 5131A-GE910 et IC: 8595A2AGQN4NNN) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne figurant sur la page précédente et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, méme si le brouillage est susceptible d'en compromettre le fonctionnement.

SAFETY RECOMMENDATIONS - READ CAREFULLY

Be sure the use of this product is allowed in the country and in the environment required. The use of this product may be dangerous and has to be avoided in the following areas:

- *Where it can interfere with other electronic devices in environments such as hosp`itals airports, aircraft, etc.*
- *Where there is risk of explosion such as gasoline stations, oil refineries, etc.*

It is responsibility of the user to enforce the country regulation and the specific environment regulation.

Do not disassemble the product; any mark of tampering will compromise the warranty validity. We recommend following the instructions of this user guide for correct setup and use of the product.

Please handle the product with care, avoiding any dropping and contact with the internal circuit board as electrostatic discharges may damage the product itself. The same precautions should be taken if manually inserting a SIM card, checking carefully the instruction for its use. Do not insert or remove the SIM when the product is in power saving mode.

Every device has to be equipped with a proper antenna with specific characteristics. The antenna has to be installed with care in order to avoid any interference with other electronic devices and has to guarantee a minimum distance from the body (23 cm). In case this requirement cannot be satisfied, the system integrator has to assess the final product against the SAR regulation.

The European Community provides some Directives for the electronic equipments introduced on the market. All the relevant information's is available on the European Community website: http://ec.europa.eu/enterprise/sectors/rtte/documents/

Additional Information and Support

For additional information or more detailed instructions on how to use your Monnit Wireless Sensors or the iMonnit Online System, please visit us on the web at monnit.com .

Change Log

Revision	Author	Date (yyyy/mm/dd)	Change
1	Justin Taylor	2021/03/10	Original release.
2	Justin Taylor	2021/03/23	Updated wetting process and installation instructions. Wetting process now indicates overnight soak in irrigation water instead of 60 seconds. Enhanced instructions for physically installing sensor in the ground.