ALTA by MONNIT

ALTA PAR Light Meter
USER GUIDE

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I. ABOUT THE WIRELESS PAR LIGHT METER

The ALTA® PAR (Photosynthetically Active Radiation) Light Meter monitors the ideal light wavelength plants need for photosynthesis. Commercial growers, greenhouse staff, and grow house managers can use these quantum light sensors to monitor light presence or absence, measure light intensity, and record daily saturation levels that affect plant health and growth.

The ALTA PAR Light Meter uses a blue-enhanced silicon photodiode with a spectral range of 389-692 nm +/- 5 nm to measure the specific wavelengths of light that plants need for photosynthesis. The meter or sensor measures temperature-compensated Photosynthetic Photon Flux Density (PPFD) in µMol/m2/s. PPFD is the amount of PAR light (photons) that arrive at the plant's surface each second. The PPFD measurement is integrated throughout the day to produce the Daily Light Integral (DLI) in mol/m2/day. The PAR Light Meter resets the DLI accumulation at a customer configurable time of day. The sensor reports immediately when configurable light level thresholds and DLI thresholds are breached to keep users informed of the most critical data as quickly as possible.

The PAR Light Meter comes equipped with a threaded M8 6-pin connector built into the lead for quick and easy disconnect or replacement as needed.

FEATURES: PAR LIGHT METER
- Blue-enhanced silicon photodiode with a spectral range of 389-692 nm +/- 5 nm
- Light sensor rated to IP-68 and built with a self-cleaning, anodized aluminum body with an acrylic diffuser
- 5-meter long cable with a waterproof connector
- Mounting bracket with a leveling plate included

EXAMPLE APPLICATIONS
- Grow houses
- Greenhouses
- Growth chambers
- Outdoor growing environments
- Aquaculture
- Aquariums

Figure 1

II. ORDER OF OPERATIONS

It's important to understand and follow the order of operations for activating your PAR Light Meter. If performed out of sequence, the sensor may have trouble communicating with iMonnit Software. Please complete the steps below in the order indicated for best results.

SETTING UP A NEW NETWORK

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

2. Register your gateway(s) and sensor(s) in iMonnit.

3. Power on / connect the gateway and verify it checks into iMonnit.

4. Power on the sensor and verify it checks into iMonnit.
We recommend powering the sensor on near the gateway, then moving to the installation location, checking signal strength along the way.

5. Configure the sensor for use.

6. Install the sensor in the final location.

ADDING A SENSOR TO AN EXISTING NETWORK

1. Register your sensor(s) in iMonnit.

2. Press the button on your gateway to download the sensor(s) just registered in iMonnit to the gateway. The gateway can also be power cycled to download the new sensors.

3. Power on the sensor and verify it checks into iMonnit.
We recommend powering the sensor on near the gateway then moving to the installation location, checking signal strength along the way.

4. Configure the sensor for use.

5. Install the sensor in the final location.

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

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

III. SET UP

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 set up your iMonnit account, please consult the iMonnit User Guide.

STEP 1: ADD DEVICE

1. Add the sensor to iMonnit.

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

Desktop

Mobile

2. Find the device ID. See Figure 2.

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.
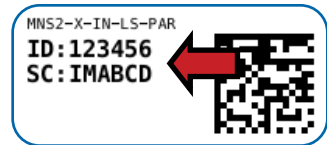

Figure 2

3. Adding your device. See Figure 3.

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 3

- 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: SET UP

Select your use case. See Figure 4.

Choose one of the following options for your use case: Very Low Light, Low Light, Moderate Light, High Light, Very High Light, or Full Light.
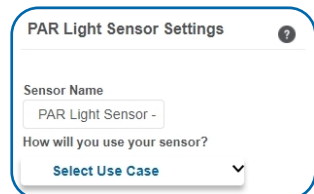

Figure 4

To help you define the light level you plan to monitor, refer to the following light use case descriptions based on DLI metrics. See Figure 5:

- **Very Low Light = 4 mol / m2 / day**
- **Low Light = 7 mol / m2 / day**
- **Moderate Light = 13 mol / m2 / day**
- **High Light = 30 mol / m2 / day**
- **Very High Light = 52 mol / m2 / day**
- **Full Light = 65 mol / m2 / day**

Figure 5

Selecting "Set" will display the default settings for your product. Adjust your settings and pick the **Save** button when complete.

PPFD	1	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000
Hours	DLI																			
1	0,0036	0,4	0,5	0,7	0,9	1,1	1,3	1,4	1,6	1,8	2,0	2,2	2,3	2,5	2,7	2,9	3,1	3,2	3,4	3,6
2	0,0072	0,7	1,1	1,4	1,8	2,2	2,5	2,9	3,2	3,6	4,0	4,3	4,7	5,0	5,4	5,8	6,1	6,5	6,8	7,2
3	0,0108	1,1	1,6	2,2	2,7	3,2	3,8	4,3	4,9	5,4	5,9	6,5	7,0	7,6	8,1	8,6	9,2	9,7	10,3	10,8
4	0,0144	1,4	2,2	2,9	3,6	4,3	5,0	5,8	6,5	7,2	7,9	8,6	9,4	10,1	10,8	11,5	12,2	13,0	13,7	14,4
5	0,0180	1,8	2,7	3,6	4,5	5,4	6,3	7,2	8,1	9,0	9,9	10,8	11,7	12,6	13,5	14,4	15,3	16,2	17,1	18,0
6	0,0216	2,2	3,2	4,3	5,4	6,5	7,6	8,6	9,7	10,8	11,9	13,0	14,0	15,1	16,2	17,3	18,4	19,4	20,5	21,6
7	0,0252	2,5	3,8	5,0	6,3	7,6	8,8	10,1	11,3	12,6	13,9	15,1	16,4	17,6	18,9	20,2	21,4	22,7	23,9	25,2
8	0,0288	2,9	4,3	5,8	7,2	8,6	10,1	11,5	13,0	14,4	15,8	17,3	18,7	20,2	21,6	23,0	24,5	25,9	27,4	28,8
9	0,0324	3,2	4,9	6,5	8,1	9,7	11,3	13,0	14,6	16,2	17,8	19,4	21,1	22,7	24,3	25,9	27,5	29,2	30,8	32,4
10	0,0360	3,6	5,4	7,2	9,0	10,8	12,6	14,4	16,2	18,0	19,8	21,6	23,4	25,2	27,0	28,8	30,6	32,4	34,2	36,0
11	0,0396	4,0	5,9	7,9	9,9	11,9	13,9	15,8	17,8	19,8	21,8	23,8	25,7	27,7	29,7	31,7	33,7	35,6	37,6	39,6
12	0,0432	4,3	6,5	8,6	10,8	13,0	15,1	17,3	19,4	21,6	23,8	25,9	28,1	30,2	32,4	34,6	36,7	38,9	41,0	43,2
13	0,0468	4,7	7,0	9,4	11,7	14,0	16,4	18,7	21,1	23,4	25,7	28,1	30,4	32,8	35,1	37,4	39,8	42,1	44,5	46,8
14	0,0504	5,0	7,6	10,1	12,6	15,1	17,6	20,2	22,7	25,2	27,7	30,2	32,8	35,3	37,8	40,3	42,8	45,4	47,9	50,4
15	0,0540	5,4	8,1	10,8	13,5	16,2	18,9	21,6	24,3	27,0	29,7	32,4	35,1	37,8	40,5	43,2	45,9	48,6	51,3	54,0
16	0,0576	5,8	8,6	11,5	14,4	17,3	20,2	23,0	25,9	28,8	31,7	34,6	37,4	40,3	43,2	46,1	49,0	51,8	54,7	57,6
17	0,0612	6,1	9,2	12,2	15,3	18,4	21,4	24,5	27,5	30,6	33,7	36,7	39,8	42,8	45,9	49,0	52,0	55,1	58,1	61,2
18	0,0648	6,5	9,7	13,0	16,2	19,4	22,7	25,9	29,2	32,4	35,6	38,9	42,1	45,4	48,6	51,8	55,1	58,3	61,6	64,8
19	0,0684	6,8	10,3	13,7	17,1	20,5	23,9	27,4	30,8	34,2	37,6	41,0	44,5	47,9	51,3	54,7	58,1	61,6	65,0	68,4
20	0,0720	7,2	10,8	14,4	18,0	21,6	25,2	28,8	32,4	36,0	39,6	43,2	46,8	50,4	54,0	57,6	61,2	64,8	68,4	72,0
21	0,0756	7,6	11,3	15,1	18,9	22,7	26,5	30,2	34,0	37,8	41,6	45,4	49,1	52,9	56,7	60,5	64,3	68,0	71,8	75,6
22	0,0792	7,9	11,9	15,8	19,8	23,8	27,7	31,7	35,6	39,6	43,6	47,5	51,5	55,4	59,4	63,4	67,3	71,3	75,2	79,2
23	0,0828	8,3	12,4	16,6	20,7	24,8	29,0	33,1	37,3	41,4	45,5	49,7	53,8	58,0	62,1	66,2	70,4	74,5	78,7	82,8
24	0,0864	8,6	13,0	17,3	21,6	25,9	30,2	34,6	38,9	43,2	47,5	51,8	56,2	60,5	64,8	69,1	73,4	77,8	82,4	86,4

Legend: 0-5 | 5-10 | 10-15 | 15-20 | 20-25 | 30-35 | 35-40 | 40>

Figure 6

The above table (Figure 6) can help you determine the DLI for your crops based on PPFD and time. The DLI is determined by the PPFD (at the top) and the number of hours that intensity is delivered. Understanding PPFD and DLI values are essential to successful monitoring using the PAR Light Meter. Refer to this table as you set thresholds for Actions and alerts in iMonnit.

STEP 3: VALIDATION

Check your signal. See Figure 7.

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

1. Check that your gateway is powered on. If not, press (do not hold) the button. Make sure there are lights on (System will complete): 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. Make sure your gateway has communicated with the portal. If not, press (do not hold) the button on the gateway to reset. (System will complete): This step will autocomplete if the gateway is communicating with iMonnit. Press the gateway utility button 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 the 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.

Figure 7

STEP 4: ACTIONS

Choose your actions. See Figure 8.

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 8

POWERING THE SENSOR ON AND INSTALLING THE ANTENNA

Attach the RF 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 the device. Make sure the antenna connection is snug, but do not overtighten. Refer to the "Antenna Orientation" section below for how to achieve the best radio performance.

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

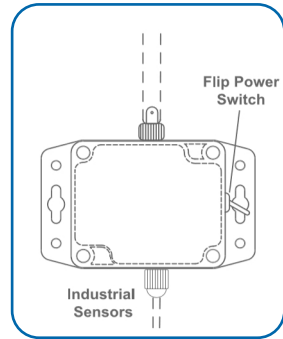To power the sensor, toggle the power switch to the "On" position.

Figure 9

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" position before storing the sensor to preserve battery life.

Antenna Orientation
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 the 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. However, 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 10.
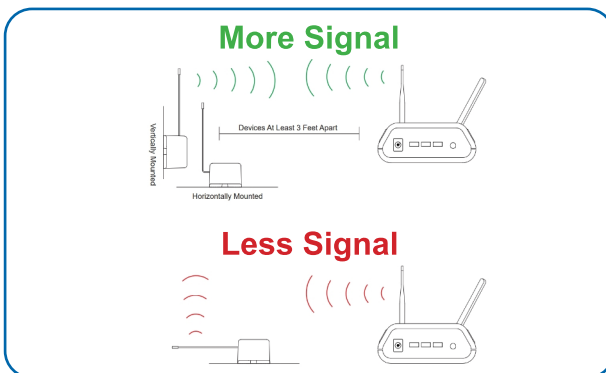

Figure 10

IV. SENSOR OVERVIEW AND INSTALLATION

DEPLOYMENT AND INSTALLATION

To accurately measure PPFD incidents on a horizontal surface, the sensor element must be level. Mount the element to the provided Mounting Bracket using the nylon screw provided. Information on the Mounting Bracket can be found on the next page.

Figure 11

> **Important: Only use the nylon screw provided when mounting to insulate the non-anodized heads of the aluminum sensor head from the base to help prevent galvanic corrosion. For extended submersion applications, more insulation may be necessary.**

To minimize azimuth error, the element should be mounted with the cable pointing toward true north in the northern hemisphere or true south in the southern hemisphere. Azimuth error is typically less than 0.5 %, but it is easy to minimize by proper cable orientation.
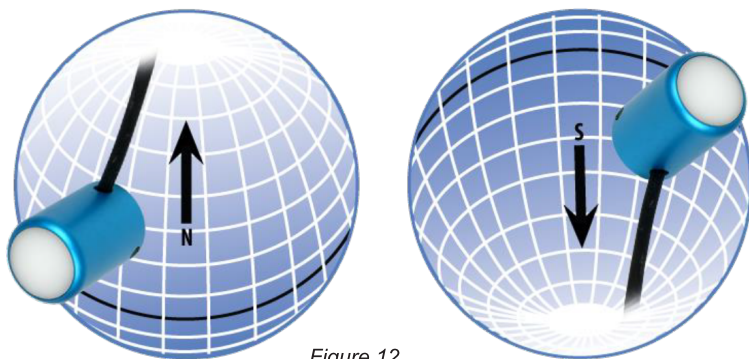

Figure 12

In addition to orienting the cable to point toward the nearest pole, the element should also be mounted such that obstructions (e.g., weather station tripod/tower or other instrumentation) do not shade the element. Once mounted, the blue cap should be removed from the element. The blue cap can be used as a protective covering for the element when it is not in use.

MOUNTING BRACKET

The Mounting Bracket is designed to mount the sensor element to a mast or pipe with an outer diameter of 1.3" - 2.1". The Bracket has an integrated bubble-level to make leveling accurate and straightforward for proper sensor installation.
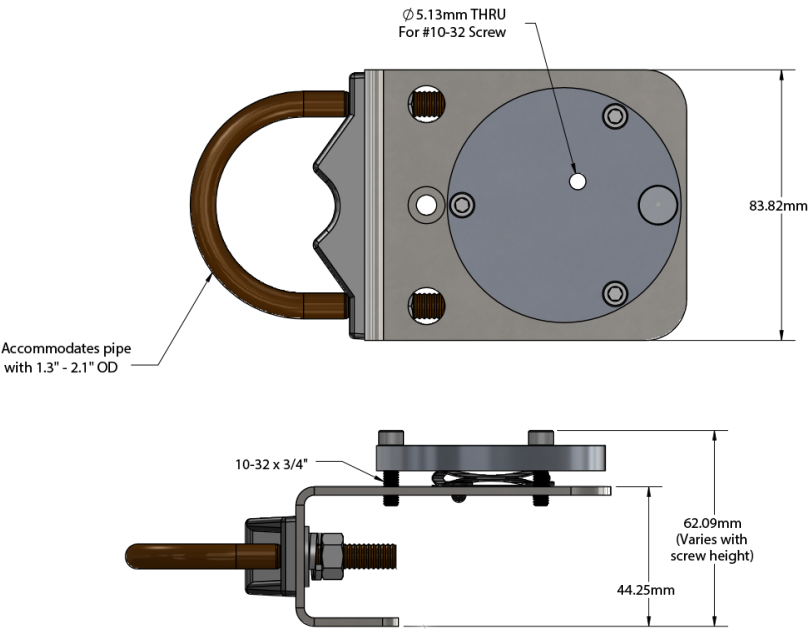

Figure 13

Cable Connectors

Alignment: When reconnecting a sensor, arrows on the connector jacket and an aligning notch ensure proper orientation.
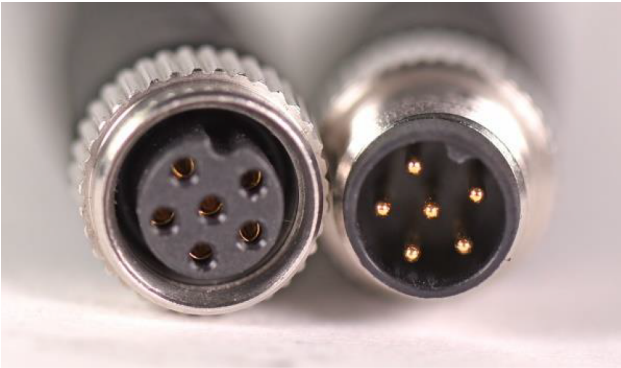

Figure 14

Disconnection for extended periods: When disconnecting the sensor for an extended period from an installation, protect the remaining half of the connector still on the station from water and dirt with electrical tape or another method.

Tightening: Connectors are designed to be firmly finger-tightened only. There is an O-ring inside the connector that can be overly compressed if a wrench is used. Pay attention to thread alignment to avoid cross-threading. When fully tightened, one to two threads may still be visible. See Figure 15.

WARNING: **Do not tighten the connector by twisting the black cable; only twist the metal connector.**

Finger-tighten firmly.

Figure 15

MAINTENANCE

Blocking of the optical path between the target and detector can cause low readings. Occasionally, accumulated materials on the diffuser of the upward-looking sensor can block the optical path in three common ways:

1. Moisture or debris on the diffuser.
2. Dust during periods of low rainfall.
3. Salt deposit accumulation from the evaporation of sea spray or sprinkler irrigation water.

The sensor elements have a domed diffuser and housing for improved self-cleaning from rainfall, but active cleaning may be necessary. Use water, window cleaner, and a soft cloth or cotton swab when cleaning the device. Salt deposits should be dissolved with vinegar and removed with a cloth or cotton swab. Salt deposits cannot be removed with solvents such as alcohol or acetone.

Use only gentle pressure when cleaning the diffuser with a cotton swab or soft cloth to avoid scratching the outer surface. The solvent should be allowed to do the cleaning, not mechanical force. Never use abrasive material or cleaner on the diffuser.

Although sensor elements are very stable, a little accuracy drift is typical for all research-grade sensors. To ensure maximum accuracy, we generally recommend sensors are recalibrated every two years, although you can often wait longer according to your particular tolerances.

To determine if a specific sensor needs recalibration, the Clear Sky Calculator (www.clearskycalculator.com) website and/or smartphone app can be used to indicate PPFD incidents on a horizontal surface at any time of day at any location in the world. It is most accurate when used near solar noon in the

spring and summer months, where accuracy over multiple clear and unpolluted days is estimated to be ± 4% in all climates and locations worldwide.

For best accuracy, the sky must be completely clear, as reflected radiation from clouds causes incoming radiation to increase above the value predicted by the Clear Sky Calculator. Measured PPFD can exceed PPFD predicted by the Clear Sky Calculator due to reflection from thin, high clouds and edges of clouds, which enhances incident PPFD. The influence of high clouds typically shows up as spikes above clear sky values, not a constant offset greater than clear sky values. To determine recalibration, input site conditions into the calculator and compare PPFD measurements to calculated PPFD for a clear sky.

If sensor PPFD measurements over multiple days near solar noon are consistently different than calculated PPFD (by more than 6%), the sensor should be cleaned and re-leveled. If measurements are still unsatisfactory after a second test, calibrate the sensor using the iMonnit portal via the Calibration tab, then retest the sensor to verify accuracy.

Immersion Effect Correction Factor

When a radiation sensor is submerged in water, more of the incident radiation is backscattered out of the diffuser than when the sensor is in the air (Smith, 1969; Tyler and Smith, 1970). This phenomenon is caused by the difference in the refractive index for air (1.00) and water (1.33) and is called the immersion effect. Without correction for the immersion effect, radiation sensors calibrated in the air can only provide relative values underwater (Smith, 1969; Tyler and Smith, 1970). Immersion effect correction factors can be derived by making measurements in air and at multiple water depths at a constant distance from a lamp in a controlled laboratory setting.

Apogee SQ-500 series quantum sensors have an immersion effect correction factor of 1.25 (serial numbers 2876 and above) or 1.32 (serial numbers 0-2875). This correction factor should be multiplied by PPFD measurements made underwater to yield accurate PPFD.

Further information on underwater measurements and the immersion effect can be found on the Apogee webpage:

 (http://www.apogeeinstruments.com/underwater-par-measurements/).

Smith, R.C., 1969. An underwater spectral irradiance collector. Journal of Marine Research 27:341-351.

Tyler, J.E., and R.C. Smith, 1970. Measurements of Spectral Irradiance Underwater. Gordon and Breach, New York, New York. 103 pages

Spectral Error

The combination of diffuser transmittance, interference filter transmittance, and photodetector sensitivity yields the spectral response of a quantum sensor. A perfect photodetector/filter/diffuser combination would exactly match the defined plant photosynthetic response to photons (equal weighting to all photons between 400 and 700 nm, no weighting of photons outside this range), but this is challenging in practice. A mismatch between the defined plant photosynthetic response and sensor spectral response results in a spectral error when the sensor measures radiation from sources with a different spectrum than the radiation source used to calibrate the sensor (Federer and Tanner, 1966; Ross and Sulev, 2000).

Spectral errors for PPFD measurements made under radiation sources for growing plants were calculated for Apogee SQ-100 and SQ-500 series quantum sensors using the method of Federer and Tanner (1966). This method requires PPFD weighting factors (defined plant photosynthetic response), measured sensor spectral response (shown in Spectral Response section on page 7), and radiation source spectral outputs (measured with a spectroradiometer). Note, this method calculates spectral error only and does not consider calibration, directional (cosine), temperature, and stability/drift errors.

Spectral error data (listed in the table below) indicate errors less than 5 % for sunlight in different conditions (clear, cloudy, reflected from plant canopies, transmitted below plant canopies) and standard broad-spectrum electric lamps (cool white fluorescent, metal halide, high-pressure sodium), but more significant errors for different mixtures of light-emitting diodes (LEDs) for the SQ-100 series sensors. Spectral errors for the SQ-500 series sensors are smaller than those for SQ-100 series sensors because the spectral response of SQ-500 series sensors is a closer match to the defined plant photosynthetic response.

Quantum sensors are the most common instrument for measuring PPFD because they are about an order of magnitude lower in cost than the spectroradiometers, but spectral errors must be considered. The spectral errors in the table below can be used as correction factors for respective radiation sources.

Spectral Errors for PPFD Measurements with Apogee SQ-100 and SQ-500 Series Quantum Sensors

Radiation Source (Error Calculated Relative to Sun, Clear Sky)	SQ-100 Series PPFD Error [%]	SQ-500 Series PPFD Error [%]
Sun (Clear Sky)	0.0	0.0
Sun (Cloudy Sky)	0.2	0.1
Reflected from Grass Canopy	3.8	-0.3
Transmitted below Wheat Canopy	4.5	0.1
Cool White Fluorescent (T5)	0.0	0.1
Metal Halide	-2.8	0.9
Ceramic Metal Halide	-16.1	0.3
High Pressure Sodium	0.2	0.1
Blue LED (448 nm peak, 20 nm full-width half-maximum)	-10.5	-0.7
Green LED (524 nm peak, 30 nm full-width half-maximum)	8.8	3.2
Red LED (635 nm peak, 20 nm full-width half-maximum)	2.6	0.8
Red LED (667 nm peak, 20 nm full-width half-maximum)	-62.1	2.8
Red, Blue LED Mixture (80 % Red, 20 % Blue)	-72.8	-3.9
Red, Blue, White LED Mixture (60 % Red, 25 % White, 15 % Blue)	-35.5	-2.0
Cool White LED	-3.3	0.5
Warm White LED	-8.9	0.2

Figure 16

Federer, C.A., and C.B. Tanner, 1966. Sensors for measuring light available for photosynthesis. Ecology 47:654657.

Ross, J., and M. Sulev, 2000. Sources of errors in measurements of PAR. Agricultural and Forest Meteorology 100:103-125.

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 PAR Light Meter. See Figure 17.
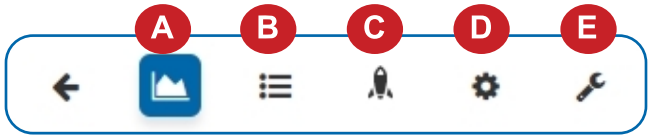
MENU SYSTEM

Figure 17

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

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 18.
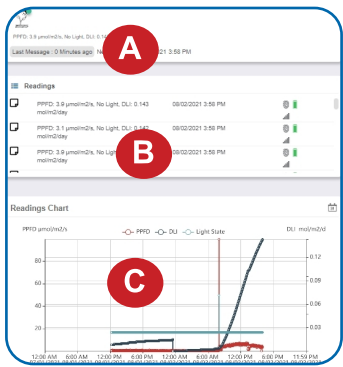

Figure 18

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 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 is 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 nine messages when using default configurations.

STS Specific Codes (aaaa -> bit 4321):

1. STS bit 4 set. This indicates that the DLI threshold has been exceeded. This will remain set till the DLI resets. This behavior is normal for a sensor in good operation.
2. See the troubleshooting section for the remaining STS codes; the remaining codes are error indicators.

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 19.

A. Sensor Name is the unique name you give the sensor to 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. Low Light Threshold: The sensor will report "No Light" if the light level falls below this threshold. No change to aware state or behavior. Measured in micromoles per square meter per second. (µmol/m²/s).

E. Saturated Light Threshold: The sensor will report "Saturated Light" and observe aware behavior if the light level is above this threshold. The sensor will report immediately when transitioning between different light states. Measured in micromoles per square meter per second. (μmol/m²/s).

Note: if the sensor is aware for any other configured reason, the sensor will report aware, but if the sensor transitions across other configured thresholds or to a different light state, it will report immediately.

F. Light Threshold Buffer: The sensor will only transition from aware to not aware when the light level is below the Saturated Light Threshold plus the buffer value. This feature prevents rapid transitioning between aware states when the sensor reads near a threshold.

G. DLI Reset Time: Each day the sensor will reset the photosynthetically active radiation daily light integral (PAR DLI) accumulation to zero. The sensor will report total 24-hour PAR accumulation at the reset time indicated. PAR DLI will reset to zero, and on the next heartbeat, the sensor will report the PAR DLI since the reset. To properly measure, track, and report PAR DLI based upon a full day, Monnit recommends configuring the DLI Reset Time for 11pm, 11:15pm, 11:30pm, or 11:45pm. The configuration will not automatically adjust for daylight savings. That will require a manual adjustment if desired.

Note: When this configuration is sent to the sensor, the sensor will reset.

H. Measurement Interval: Frequency of photosynthetic photon flux density (PPFD) measurements used to calculate PAR DLI.

Note: When this configuration is sent to the sensor, the sensor will reset PAR DLI.

I. PAR DLI Threshold: The sensor will report aware and report when the PAR DLI value goes above this threshold. Measured in moles per square meter per day.

J. Enable Temperature Compensation: When enabled, the sensor will apply temperature compensation adjustments to the sensor transducer readings. If the sensor base is not close to the same temperature environment as the element on the end of the lead, it is recommended to disable temperature compensation. Temperature compensation has minimal effect at 20° Celsius. If the environment is kept at 20°C +/- 5°C then compensation will have less than a 1% impact on the sensor reading. If fast temperature swings that occur in less than 30 minutes are common in your application, it is also recommended that temperature compensation be disabled.

Note: The temperature element is in the sensor base, not in the light-sensing element on the end of the lead. Since the temperature element is sealed in the sensor base, temperature response will be

Finish by selecting the **Save** button.

Figure 19

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 following 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

To calibrate the sensor, ensure that the environment of the sensor and other calibration devices are stable. See Figure 20.

Choose "Zero Calibration" or "Scan Calibration" from the drop-down menu. Set your expected reading and press **Calibrate.**

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

Calibrate Sensor

Important: Perform these steps in the order indicated.

1. Zero Calibration: Zero's the sensor at the current light level. Sensor Zero should be performed before Calibration for best accuracy.

2. Span Calibration: Calibrates sensor to current light level reading. The higher the value you can calibrate the more accurate the sensor will be.

Select Calibration Type

[Select   ⌄]

[Create Calibration Certificate]

Figure 20

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 following sensor heartbeat.

Note: If you would like to send the changes to the sensor right away, please power off your sensor. This forces the communication from the sensor to the gateway and the message to make a change from the gateway back to the sensor.

Creating a Calibration Certificate

Creating a sensor calibration certificate will mask the calibration tab from those who should not have permission 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."

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.

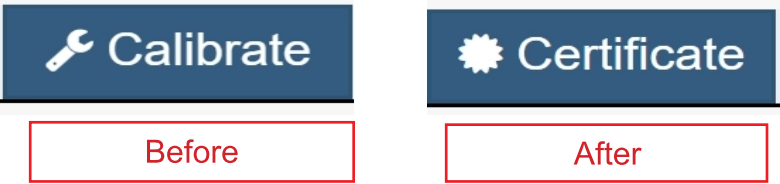*Figure 21*

Before   After

Figure 22

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 to "Calibrate" after the period for the certificate ends.

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 23.
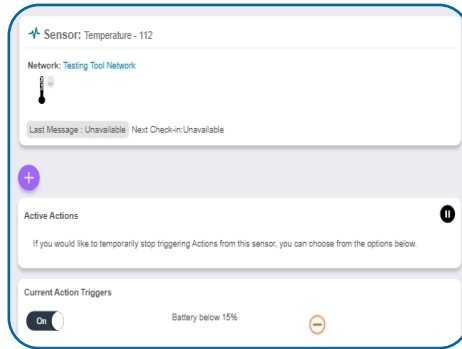

Figure 23

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 24.

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

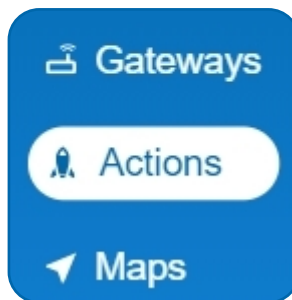
Figure 24

• 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 25.

Figure 25

Step 1: What triggers your action?

The drop-down menu will have the following options for Action Types (See Figure 26):

- **Sensor Reading:** Set actions based on activity or reading.

- **Device Inactivity**: Actions when the device doesn't communicate for an extended period.

- **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 26

- Select Sensor Reading from the drop-down menu.
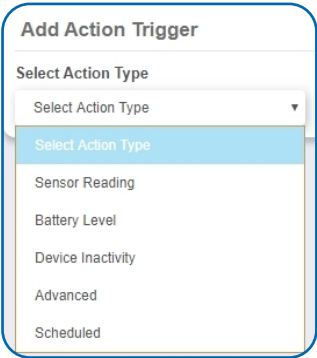
- A second drop-down menu will appear. From here, you will be able to see a list of the different type of sensors registered to your account. Choose **PAR Light Sensor** in the drop-down menu.

- Select your reading from PPFD, Temperature, Voltage, and PAR DLI

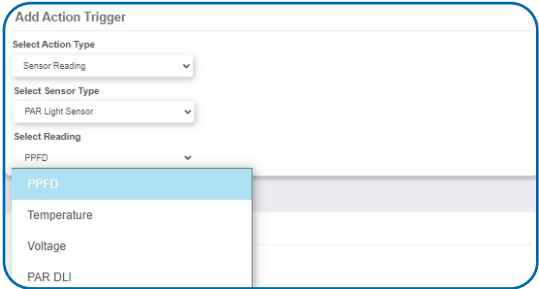- Next, you will be asked to input the trigger settings. See Figure 27.

Figure 27

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 28.

   B. Customize the message body for the notification. See Figure 28.

   C. Recipient list identifies who will receive the notification. See Figure 29.

Figure 28

Figure 29

• 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 30.

- 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.
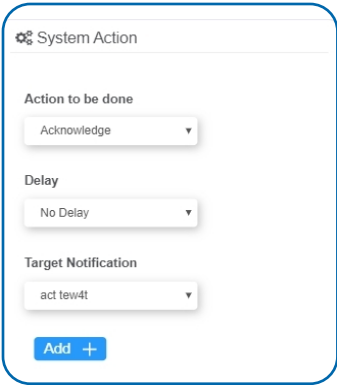
Figure 30

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 31.

- 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 31

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

VII. SECURITY

Data security and integrity are 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 sensors, gateways, 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 is 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 and reviewed with a cyclic redundancy check (CRC) 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.

SENSORPRINTS
SensorPrints™ uses 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 fingerprint or token. If this feature is purchased for the device (via iMonnit software), the device's 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 the gateway or never connected to the gateway.	Power cycle sensor by turning the switch off for 60 seconds then toggling it on. 1. Ensure the network is set up correctly in iMonnit (sensor and gateway are on same network). Press utility button on gateway. 2. If network is setup correctly reform the gateway. 3. Move sensor ~10 feet from the gateway. 4. Move progressively further from the gateway ensuring at least two signal bars are showing. Keep in mind the signal bars represent the 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).
"Comm Failure (Hardware Error)" is Reported in iMonnit	The sensor base cannot communicate with measurement circuitry in the sensor base. Bit 1 of STS is set.	Contact Monnit for an RMA. Generally, this error can only be corrected through a repair by a skilled technician.
"Temperature Out of Range" error is reported in iMonnit	The temperature reads outside of the capable range. Bit 2 of STS is set. If the sensor reads low sensor reports -40.1° C, if over +125.1°C.	If temperature compensation is required, contact Monnit for an RMA, this error can only be corrected by a skilled technician.

Symptoms	Detailed Problem Description	Solution
The sensor doesn't seem to respond to light. Readings are either random or static regardless of the light level.	Static or randomly fluctuating readings regardless of light levels.	1. Detach lead via the connector, inspect for any corrosion, obstructions, or anything other than clean straight interface pins. Good pins are an untarnished gold color. 2. If the connector looks good, reinsert male and female ends completely then tighten connector collar. Power cycle the sensor by switching it off and on, then verify the sensor produces several good measurements. 3. If the problem persists there may be a break somewhere in the cable. Contact Monnit for an RMA.
"Sensor Imbalance" is reported in iMonnit.	The sensor is reading a light level outside of its capable range. Bit 3 of STS is set.	1. Detach lead via the connector, inspect for any corrosion, obstructions, or anything other than clean straight interface pins. Good pins are an untarnished gold color. 2. If the connector looks good, reinsert male and female ends completely, then tighten connector collar. Power cycle sensor and verify sensor produces several good measurements. If the problem persists there may be a break somewhere in the cable. Contact Monnit for an RMA.
Lower that expected readings.	Lower than expected readings.	Low readings can be caused by a number of different obstructions, below are a few to consider. 1. Moisture or debris on the diffuser 2. Dust during periods of low rainfall 3. Salt deposit accumulation from evaporation of sea spray or sprinkler irrigation water 4. Shade from any kind of obstruction

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 hospitals airports, aircraft, etc.*
- *Where there is risk of explosion such as gasoline stations, oil refineries, etc.*

It is the 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 equipment introduced on the market. All of the relevant information 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 .

MONNIT®

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Change Log

Revision	Author	Date (yyyy/mm/dd)	Change
1	K. Lewis	2021/08/03	Original release.