



# Node & Gateway USER MANUAL

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# SAFETY INFORMATION

## Electrical Safety

Electrical Specification USB Port Input Voltage: 5VDC,  $\pm 0.5V$  Input Current: 400mA Max  
Solar or External Supply Input 5 -10 VDC SDI-12 Output Signal Voltage: Typically, 0-5VDC  
Power Output Voltage: 12VDC Short Circuit Current: 400mA  $\pm 20\%$

## Operation Safety

Before installation of the system, carefully read all manuals and documentation regarding the contents of the packages sent. Before use, ensure all products are free and clear of any damage, especially to the mainboards and battery terminals. If any damage or defects are visible, contact your dealer immediately. Avoid short circuits by keeping any loose metals, screws, or paper clips away from the inner workings of the products. Avoid allowing internal components to be exposed to dust, water, and extreme temperatures. Operating temperature range is 5° C to 45°C.

## Environmental Operating Temperature:

Humidity: 0 to 90% RH, Non-condensing  
-10 to +50°C (+14 to +122°F)


**Note:** This limitation comes from the lithium-ion cell.

**Note:** The Acclima Solar Node has physical limitations on what temperature range it will fully operate in. If it will be used in freezing weather ( $< 1^{\circ}\text{C}$  or  $< 33^{\circ}\text{F}$ ) for extended periods, the end-user should plan to periodically have the lithium-ion 18650 battery swapped out for a fully charged replacement because the battery charging circuit is disabled at ( $0^{\circ}\text{C}$  or  $32^{\circ}\text{F}$ ). The battery will still run the data logger for the duration of the remaining charge but will not be recharged at or below those temperatures. When recharging backup batteries in a desktop charger, care should be taken to allow the batteries to warm up to room temperature before recharging them or the battery could be permanently damaged. Similarly, if the temperature inside the enclosure exceeds ( $50^{\circ}\text{C}$  or  $122^{\circ}\text{F}$ ) the battery will stop charging.

# INTRODUCTION

The Acclima Solar Node and Gateway are simple-to-use wireless data recorders that work together to provide the user access to captured SDI-12 sensor data in the cloud. They provide the ability to read and log data from a variety of SDI-12 sensors. Conveniently, data is collected and transmitted over the air via long-range radio, then forwarded to the cloud via LTE cellular networks. Each Solar Node supports up to ten SDI-12 sensors and each Solar Gateway supports up to ten Nodes. The Solar Node records all the measurements of the SDI-12 devices. The Solar Gateway collects this information and makes it available to suit the user's needs online at [data.acclima.com](http://data.acclima.com).

## About This Guide

In this guide, you will find information about the Acclima Solar Node and Gateway. Notably, you will find our recommendations for the installation and use of the Node and Gateway system. The guide contains real photos, artistic interpretations, 3D models, CG renders, and illustrations. All graphics contained in this guide are for example's sake, are subject to change, and are not always to scale. Therefore, these images will not be labeled by figure. The document is best if viewed in color. Pages that require the use of color will be labeled with this symbol. 

## How this guide is organized

This guide includes the following components:

- **Product Information**
- **Basic Installation**
- **Device Software**
- **Field Installation**
- **Support/Warranty**

### Items you may need:

Auger/Roto Digger 1-5/8

Rubber Mallet

Flathead Screwdriver 1/8"

5-7ft 1 ¼ inch Sch 40 PVC per Gateway or Node (straight pipe)

2 ½ to 3ft (lower) + 5-7' (upper) per Node (sectional)

3-way 1 ¼ inch SCH 40 PVC Tee Fitting connector per Node (sectional)

64bit Windows™ 7, or newer PC

# SPECIFICATIONS & FEATURES

Node	Gateway
Weather Resistant Enclosure	Weather Resistant Enclosure
Solar Powered Recharging 3.7-volt Lithium-ion cell Battery	Solar Powered Recharging 3.7-volt for the Lithium-ion cell Battery
Recharging is supported for temperatures between 5° C to 45°C	Recharging is supported for temperatures 5° C to 45°C
Min & Max operating temperatures -20° C to 60° C	Min & Max operating temperatures -20° C to 60° C
Five SDI-12 connectors Support for 10 devices at 12v	LoRa Radio Transceiver Cellular Radio Transceiver
Support for sensors that consume up to 5 watts	Support for up to 10 Node Connections
Maximum record retention before overwriting: 32,032 logs.	8GB Micro SD card Memory Expansion
Records all M! command inputs	Cellular Networks: GSM
LoRa Radio Transceiver	Cellular technology 2G, CAT-M1 (4G LTE)
Standard Range Mode: 0-2 miles Line-of-Sight Data rate: 201.4 b/s Range: up to 2 miles	Complete packet forwarding to Acclima Cloud <5-minute latency.
Long Range Mode: 2-5 miles Line-of-Sight Data rate: 66.5 b/s Range: up to 5 miles	Scanning/Forwarding @ 30-minute intervals.
Radio frequency: 902 - 928 MHz (Frequency Hopping Spread Spectrum)	Radio frequency: 902 - 928 MHz (Frequency Hopping Spread Spectrum)
<b>Dimensions:</b> Height 12.5"(w/Antenna) 7.00" (w/o Antenna) Width 6.63" Depth: 4.63" Weight: 2.25 lbs.; Package: 3.0 lbs.	<b>Dimensions:</b> Height 12.5"(w/Antenna) 7.00" (w/o Antenna) Width 6.63" Depth: 4.63" Weight: 2.20 lbs Package: 2.65 lbs

# PACKAGE CONTENTS

1x Weather Resistant Enclosure	
1x USB 2.0 A-B Cable	
1x SDI 12 Ports (1-5)	
5x SDI-12 Terminal blocks	
1x LoRa Radio Antenna	
1x Lithium-ion 18650 Battery	
1x 45° Angled Elbow, Neck, Locking Nut, and Hardware Kit Combo	

1x Weather Resistant Enclosure	
1x USB 2.0 A-B cable	
1x Micro SD card	
2x LoRa Antennas	
1x Lithium-ion 18650 Battery	
1x GSM Nano Sim (Activated)	
1x 45° Angled Elbow, Neck, Locking nut, and Hardware Kit Combo	

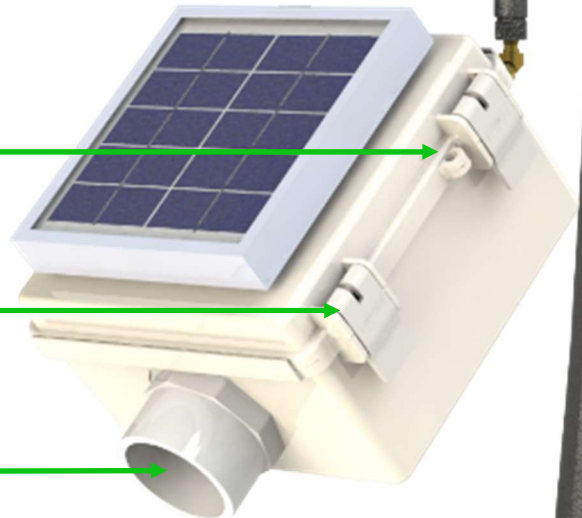


# NODE/GATEWAY EXTERIOR LAYOUT

SMA Connectors



Lock porthole



Latch



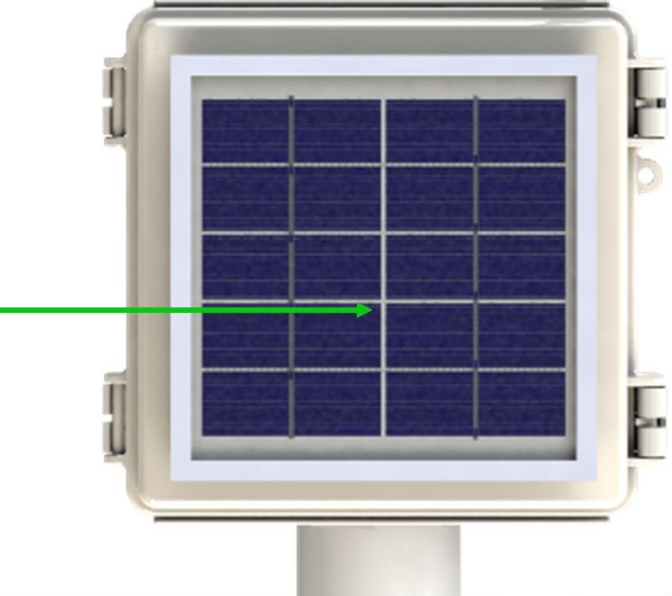
Enclosure Neck / Porthole



LoRa Radio Antenna

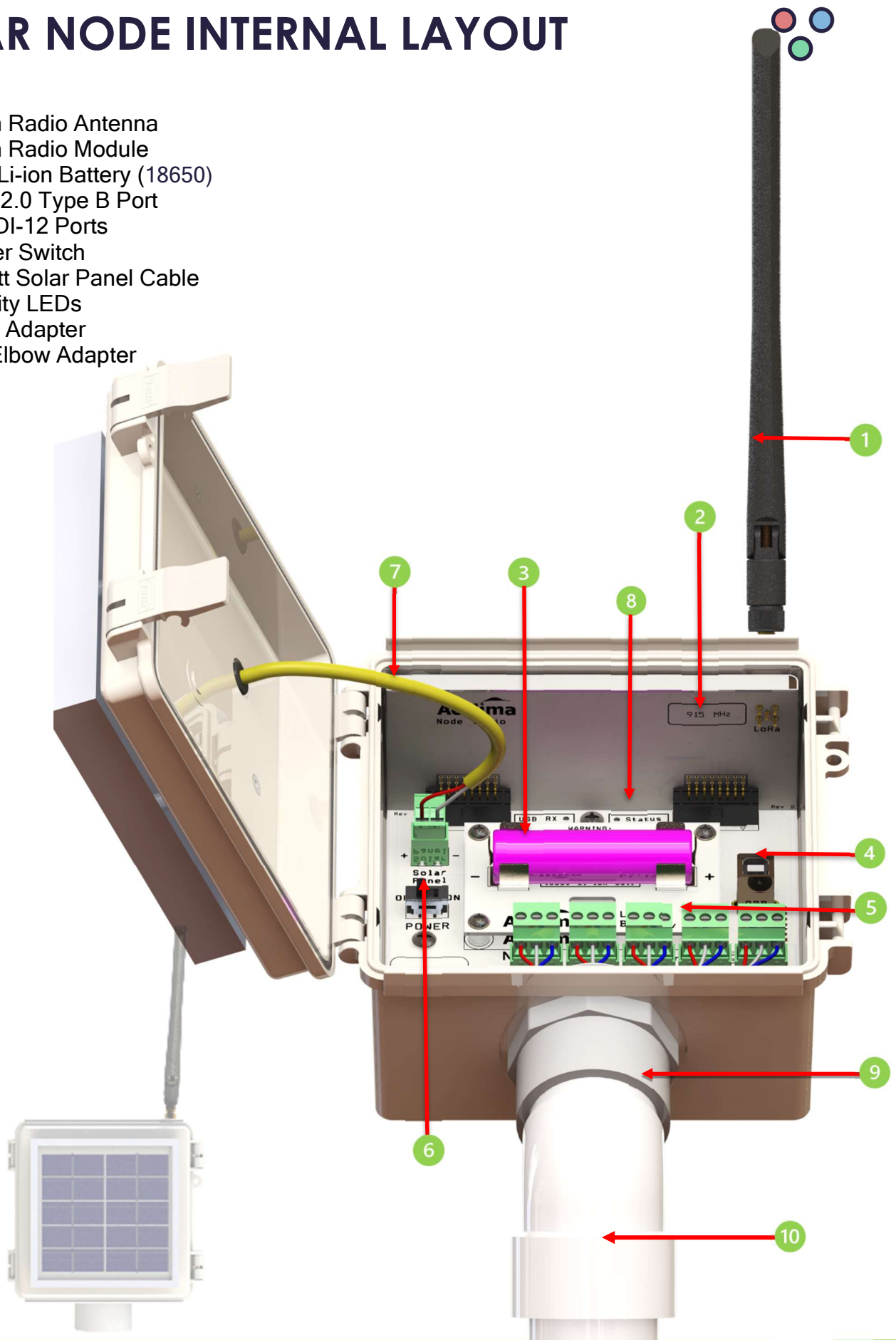


5-watt Solar Panel



# SOLAR NODE INTERNAL LAYOUT

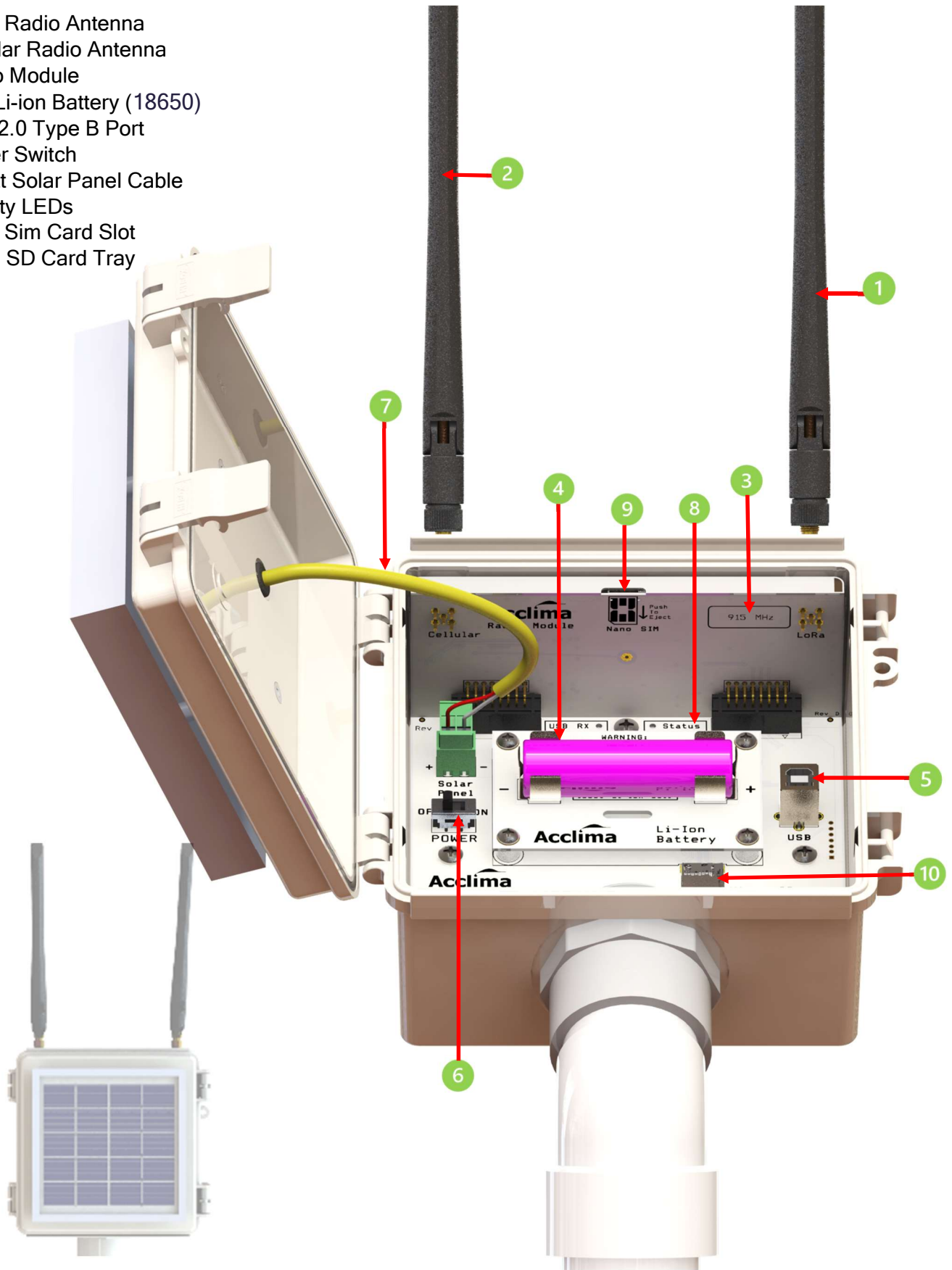
1. LoRa Radio Antenna
2. LoRa Radio Module
3. 3.7v Li-ion Battery (18650)
4. USB 2.0 Type B Port
5. 5x SDI-12 Ports
6. Power Switch
7. 5-watt Solar Panel Cable
8. Activity LEDs
9. Neck Adapter
10. 45° Elbow Adapter





# SOLAR GATEWAY INTERNAL LAYOUT

1. LoRa Radio Antenna
2. Cellular Radio Antenna
3. Radio Module
4. 3.7v Li-ion Battery (18650)
5. USB 2.0 Type B Port
6. Power Switch
7. 5-watt Solar Panel Cable
8. Activity LEDs
9. Nano Sim Card Slot
10. Micro SD Card Tray



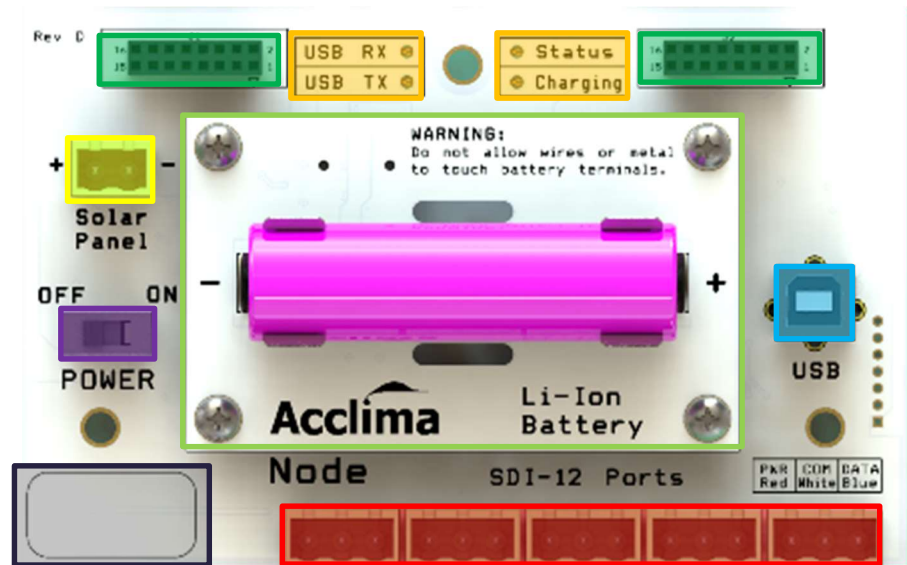
# NODE MOTHERBOARD



Each board is coated by a non-conductive silicone gel designed to improve the system's resistance to humidity.

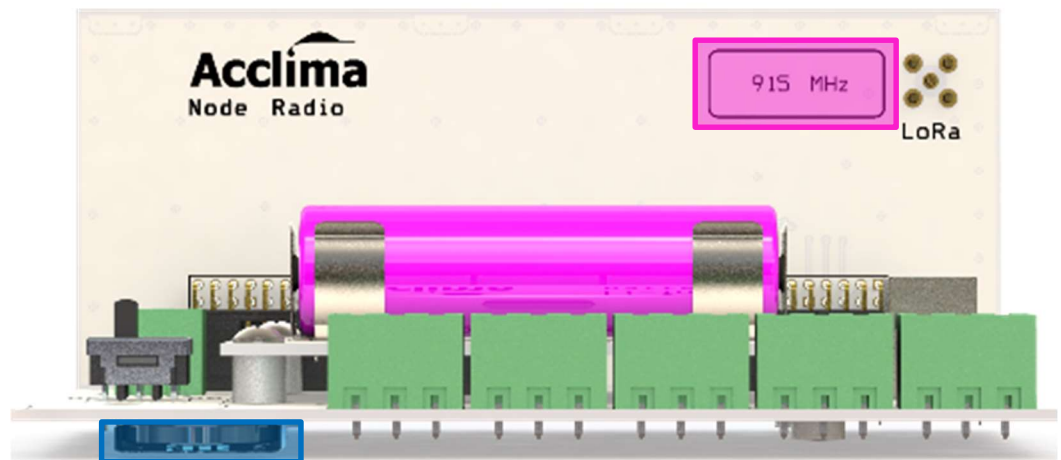
## Top View

- Radio Module Connectors
- Activity LEDs
- 5v Power Input
- Battery Riser Board
- USB 2.0 B Port
- Power Switch
- SDI-12 Terminal Ports
- Serial Number



## Front View

- Coin-cell Battery
- LoRa Frequency



**NOTE:** The Solar Nodes are designed to be weather resistant and are assembled in such a way that makes it difficult to access certain components after assembly in the factory. If there are any issues with the device's functionality, contact technical support for assistance.

Support@acclima.com

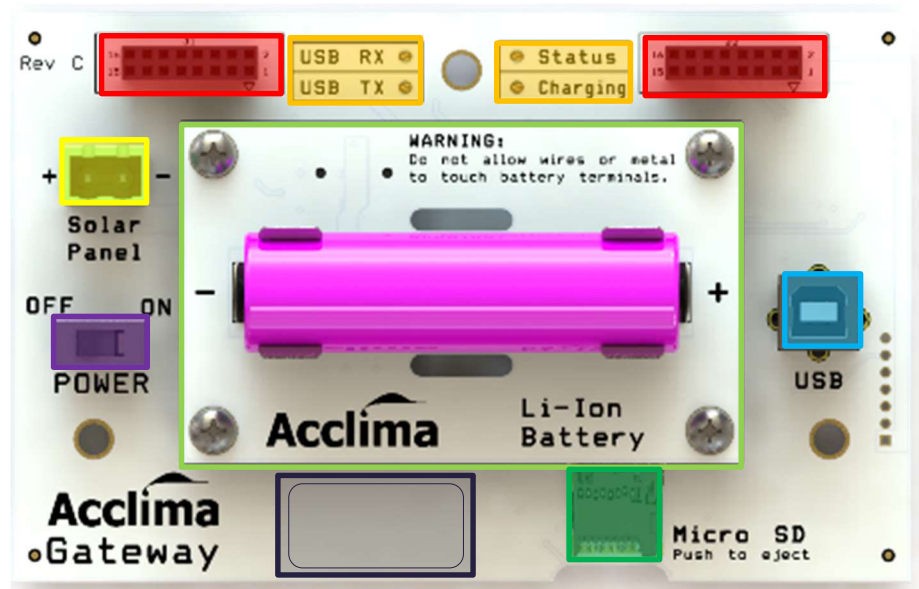
# GATEWAY MOTHERBOARD



Each board is coated by a non-conductive silicone gel designed to improve the system's resistance to humidity.

## Top View

- Radio Module Connectors
- Activity LEDs
- 5v Power input
- Battery Riser Board
- Micro SD Card Slot
- USB 2.0 B Port
- Power Switch
- Serial Number



## Front View

- Coin-cell Battery
- LoRa Frequency



**NOTE:** The Solar Gateways are designed to be weather resistant and are assembled in such a way that makes it difficult to access certain components after assembly in the factory. If there are any issues with the device's functionality, contact technical support for assistance.

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# SYSTEM FUNCTIONALITY

The Acclima Solar Nodes and Gateways are LoRa Radio, SDI-12, data loggers that allow data to be collected and transmitted wirelessly and stored in a secure and private data repository. Each Acclima Node can attach up to ten SDI-12 devices. These devices do not need to be Acclima-specific hardware meaning, any SDI-12 device is supported provided that the total system load does not exceed 5 watts. Each SDI-12 device replies to M! (Measurement) commands sent from the Node, and the Node records those replies. The user can set the “Read Intervals” to record data from a group of connected sensors from anywhere as low as 10 minutes, to as high as every 24 hours. These measurements are collected and stored in the Acclima Nodes which can save up to 32,000 logs before overwriting the oldest files. Once the log is saved, the Node transmits this data via (LoRa) a long-range radio system within the 902 to 928 MHz frequency bands, at the request of a Solar Gateway. The Acclima Solar Gateway retrieves the data from the Node, saves the files within its memory, and forwards this data to the cloud via an LTE cellular connection. Testing has shown that Nodes and Gateways can successfully communicate with one another for more than 10 miles line-of-sight in rural environments. However, the recommended maximum range is 5 miles or less. After the Node data has been uploaded to the cloud, it can be viewed by authorized parties on the secure and private data portal website hosted by Acclima.

Achieving this level of system functionality is both affordable and technically simple. The Solar Node and Gateway system can be acquired and operated by anyone desiring soil and atmospheric data from their personal properties. The system can just as easily be scaled up to provide large entities with the ability to source their data, in ways specific to their needs. Amazingly, in less than one hour, a single person can install one Gateway, three Nodes, and ten sensors.

## Gateway Continued

The Acclima Solar Gateway is a solar-powered data repeater that gathers data from up to ten Acclima Solar Nodes - each of which, can accommodate ten sensors - and transmits the data to the cloud via GSM Cellular Network.

The Gateway utilizes two radios: a LoRa Transceiver for communications with the Nodes and a Cellular Modem for communicating with the cellular network. The Gateway initiates communications every 30 minutes, it scans its list of affiliated Nodes and gathers data from them in quick succession, it writes the received logs to its memory. With each communication cycle, it also sends timing information that the Nodes use to synchronize themselves for the next data-gathering cycle. After the data from the Nodes are gathered, they are transmitted to our cloud repository on the where they are stored, analyzed, and formatted for easy access and interpretation by the user. The user accesses the data through an Acclima portal using their username and password. Data from up to one hundred sensors are accessible through a low-cost user subscription.

Data transmission between the Nodes and the Gateway has been confirmed at 10 miles line-of-sight using the *Long-Range Mode*. Five-mile line of sight communications is practical using standard settings. These 'comfortable' settings give a considerable margin to increase power and drop bandwidth if the 5-mile link is somewhat marginal. The typical distance for tree-cluttered and building-blocked communications is one mile. Gateway to cloud communications works wherever GSM cell phone service operates.

## Gateway Cellular Service/Acclima Cloud Data

Acclima Solar Gateways are equipped at the factory with a pre-installed nano sim card utilizing Hyper SIM technology. The Gateway can forward data to the cloud anywhere in the United States that has a minimum of 2G GSM cell tower coverage. This technology allows activated Solar Gateways to connect to the internet while having redundant access to the cloud thanks to its automatic outage detection capability. These features allow the Gateway to hop between multiple carrier networks that are providing GSM coverage overlap in the area. The Gateway supports multiple carrier signals like 2G, CAT-M1, and LTE.

**NOTE:** The Acclima Cloud service is activated without contracts and is pre-paid on an annual basis. Contact your distributor for pricing and renewals information.

# BEFORE INSTALLING

Before *field installation* of the Node and Gateway System, it is important to be aware of some key points. These topics below will be revisited throughout the document.

- Sensors
- Media
- Site Prep
- Burial depth
- Batteries
- Solar Power
- Line of sight

## Sensors

Acclima has been developing soil-moisture sensor technology for over 20 years and has gained a wealth of information regarding soil-moisture sensor technology. There is a wide range of SDI-12 devices on the market and each has different methods of capturing data points. Due to this, the end user must make all arrangements to understand the sensor technologies they will be implementing with Acclima's Solar Node and Gateway system. Please source manufacturer documents about the sensors you plan to use with the system, to ensure that the readings you are viewing are correctly labeled and formatted. However, if you choose to mix and match different sensors, please take the time to study the characteristics of each type and assure that the data from each is formatted correctly.

## Media

Soils and their varying properties will prove to be a difficult challenge to understand and overcome. It is important to learn the characteristics of the media in which you plan to install your sensors before their installation. Document the serial number, soil type, GPS coordinates and burial depth for each sensor at your desired installation location.

## Site Prep

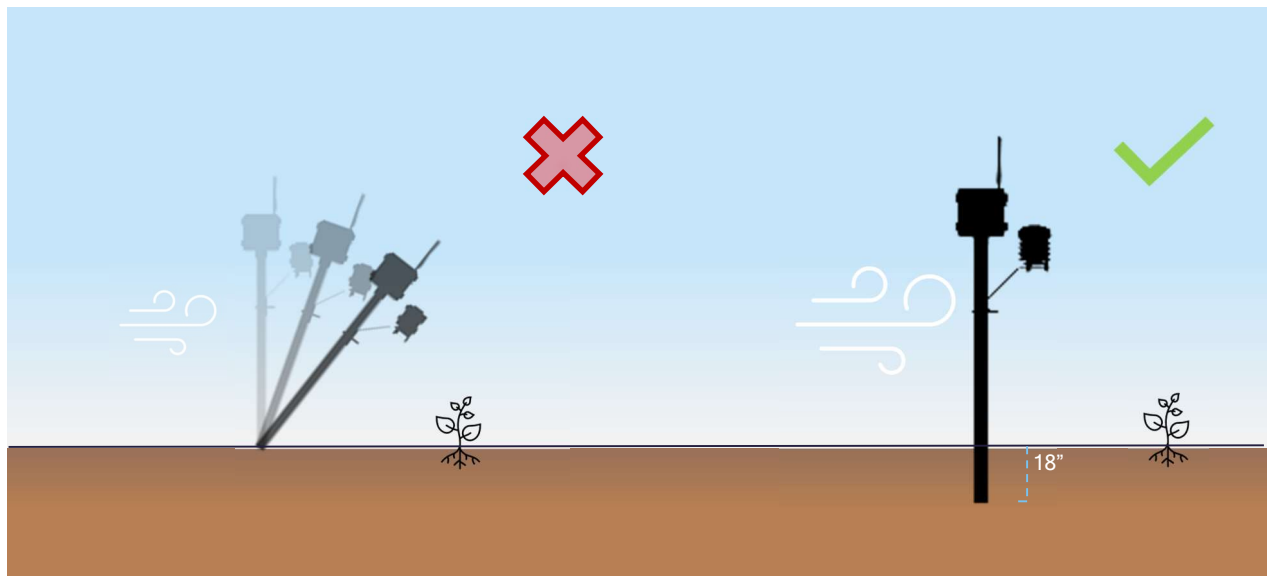
When considering the installation zone, select an area that allows for good cellular reception, line-of-sight between devices, and SDI-12 device proximity to Solar Nodes is within 200 feet.



## Burial Depth for the Support Mast

Weather patterns in your local area should be a big part of the decision process when installing the Node and Gateway system. If your area is prone to flooding or high winds, take appropriate steps to mitigate the need for maintenance by burying (posts/conduits) deeper into the soil.

Acclima recommends using a 2 ½ meter tall post and burying it between 18” - 24” deep. In most cases, these depths provide the strength to keep the Nodes and Gateway upright during winds as high as 40 mph.



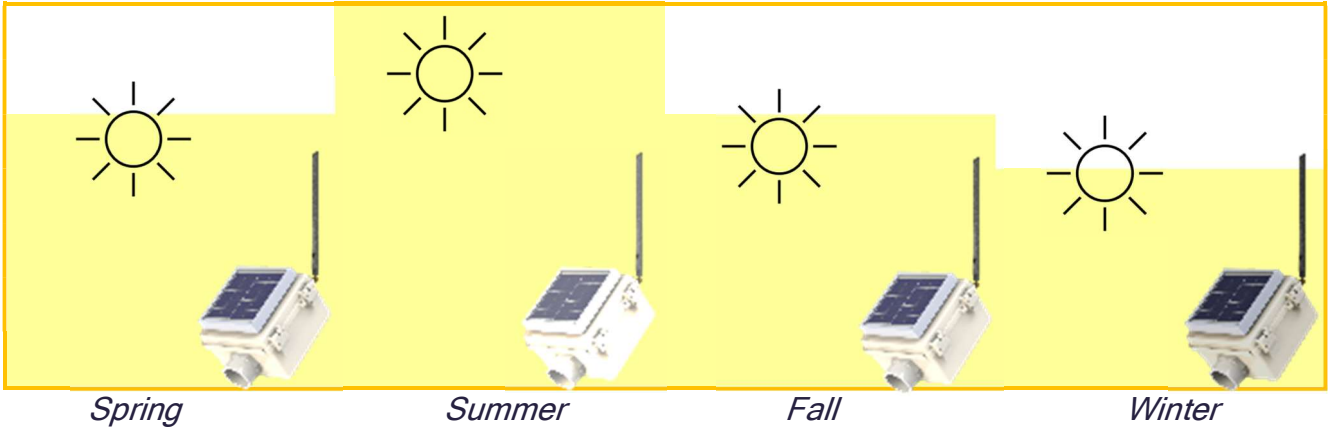
## Batteries

The Solar Node and Gateway are powered by a 3.7v Lithium-ion battery that is recharged by solar energy. With access to sunlight and favorable climate conditions, the included battery can live for years without needing replacement. Although the technologies in lithium-ion cells are fantastic, the technology is not without its drawbacks. Like humans, Lithium batteries do not like temperatures too hot or too cold. In the case of the batteries, too hot is anything over 45°C too cold is under 0°C. Lithium batteries can survive these temperatures for brief periods, but prolonged time exposed to extreme temperatures will reduce their life span.



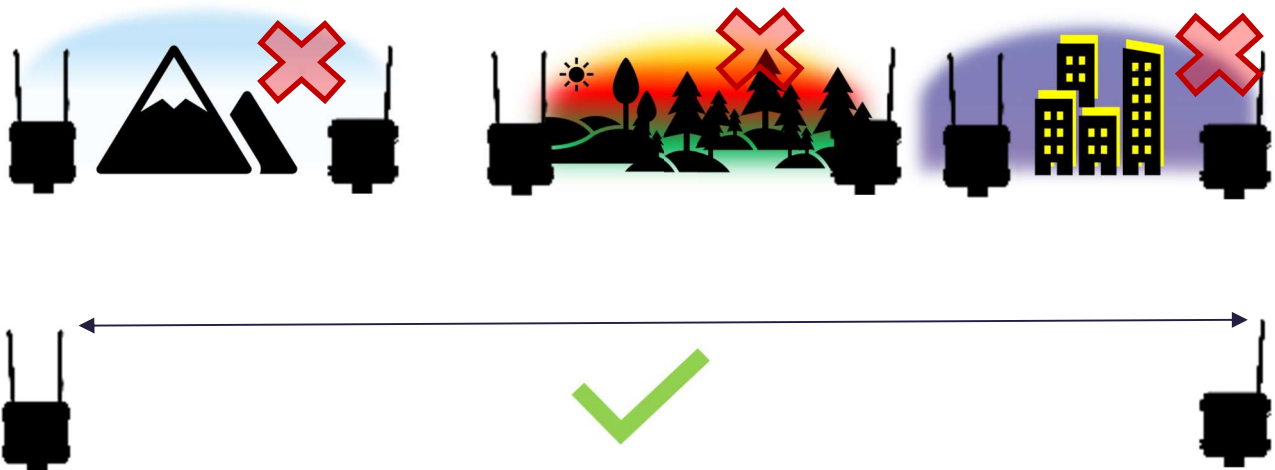
### Solar Power

When preparing for installation, it is key to pick the best spot for the Solar Node and Gateway to get the most sunlight throughout the year. The Gateway should have an unobstructed view of the daytime sky. Try to avoid facing mountain ranges or buildings that the sun can dip behind for long hours in the winter months. Reduced sunlight will reduce the solar current, therefore, reducing the speed the battery is replenished.



### Line-of-Sight

Achieving proper line-of-sight between the Nodes and Gateways may be the most difficult problem to overcome when installing in the field. To simplify the methodology, try to imagine your LoRa antenna as a flashlight. The fewer the objects the beam of light must scatter around, the greater the opportunity for the target to view the light being shined on it. Ideally, you want little to no obstructions between the Node and Gateway, just like you would not want any trees between your flashlight and whatever you wanted to illuminate.



At distances greater than 1 mile minimize the obstructing objects between the LoRa antenna.

# INSTALLATION DETAILS

## Battery

The included battery will be pre-installed and secured by a Velcro strap. The Lithium-ion battery will be unlabeled, with no visible (+) positive or (-) negative symbols. Therefore, if it is removed you must identify the positive and negative parts of the battery to seat it correctly into either a Node or a Gateway.

- i. Flat side is Negative (-) raised button side is Positive (+)



- ii. Use the included Velcro strap to secure the battery into the battery terminals.

**Caution:** Do Not Allow Wires or Metal to Touch Battery Terminals!

**Note:** Protective insulators were added to the battery cradle to prevent accidental shorting from tools and other metallic objects dropped into the housing. Do not remove the insulators from the battery cradle. If there is damage to the pink outer layer of the battery, replace the battery.



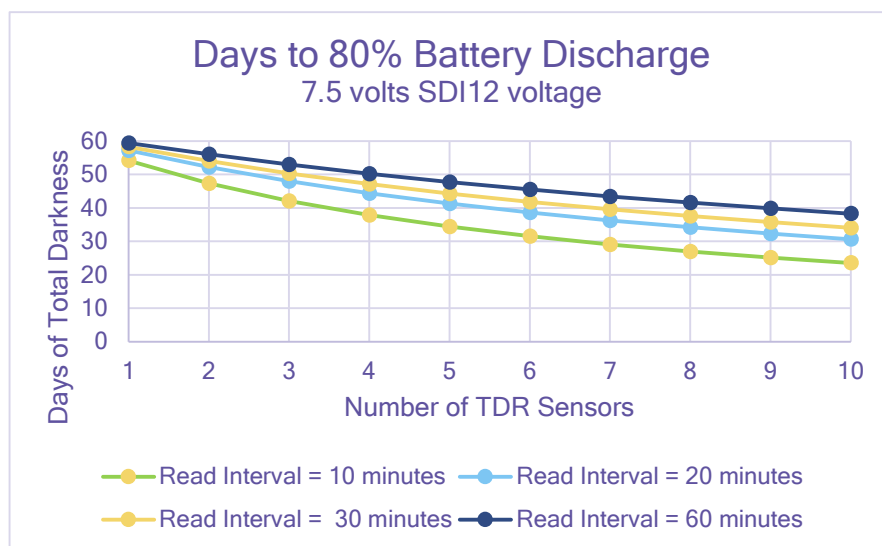
## Battery Life

Energy for the Node and all attached sensors is stored in an 18650 Li-ion battery with a 3.0 Amp-hour capacity. The self-discharge rate of the battery is less than 2% per month in worst-case summer weather. The battery is charged by a 5-Watt solar panel at the rate of 400 mA in full sunlight. The time to fully charge the battery is 7.5 hours in full direct sunlight of at least 800 Watts per square meter intensity.

The battery capacity is sufficient for operating the Node and attached sensors during the night and long periods of darkness. Figure 1 below shows the number of days the Node will operate before the battery runs down in total darkness. It includes the battery self-discharge current, the Node operating, and communications current, and the current drawn by up to 10 sensors.

Figure 1 was derived using the 7.5-volt option for the SDI12 voltage, but the 12-volt option shows very similar results.

Figure 1. Battery Discharge Time (days) when no sunlight is available to recharge the battery.



**NOTE:** Battery life is estimated based on internal tests using manufacturer-specified conditions. These estimates are used as a baseline for approximating the theoretical battery life expectations for most users.

The key takeaway from this information should be that when the sensor load increases, the requirement for ample sunlight also increases. High load configurations should provide the Solar Node with ample opportunity to receive maximum solar current or face the risk of the battery becoming 'depleted'. The battery management system will disconnect the battery from the Node or Gateway when it becomes discharged to the point where further current drain would damage the battery.

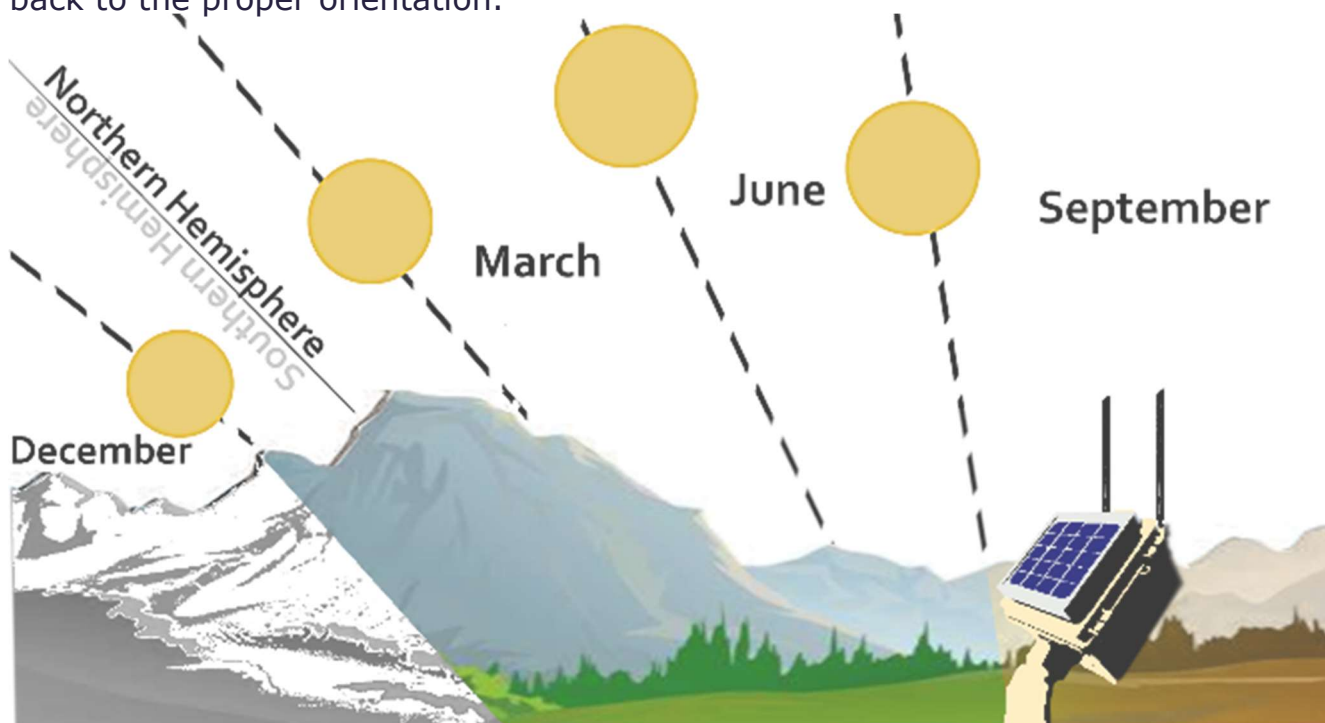
## Solar Panel Orientation

For proper operation of the Solar Node and Gateway hardware, it cannot be overstated that the solar panels need to have as much access to sunlight as possible. The best way to achieve this is by orienting the panel at 45° towards the southern sky if you are installing in the Northern Hemisphere and vice versa for the South.

As you are already aware, Earth is a globe with a 23° tilt, that rotates on its axis and revolves around the sun. Throughout the year different parts of the globe will receive greater or fewer sunlight rays depending on the time of year. During these seasonal changes the angle at which the sun appears overhead during noontime shifts. Which will cast shadows differently during the year's equinox and solstice periods. Keeping these shifts in mind can help predict whether an installation site will be free from shadows all year round.

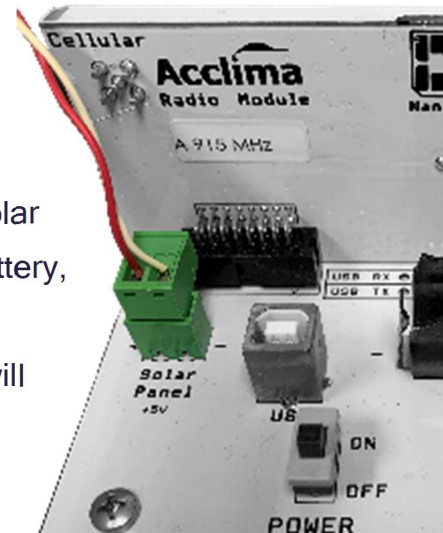
We recommend choosing an installation that accounts for the shifting positions of the sun throughout the year. This is best done by choosing an installation location clear of any trees, nearby buildings, or mountains, and then angling the Solar Panel 45° toward the southern sky. If this is done correctly, the Sun's arc will always rise and travel over the width of the solar panel for the greatest number of hours possible per day.

**Note:** If the Node and Gateway devices are installed incorrectly or nudged out of alignment, the neck adapter allows the installer to manually twist the enclosure back to the proper orientation.



## Solar Current

The included 3.7v Lithium-ion battery is recharged each day by a 5-watt Solar Panel. The battery recharge state occurs when the enclosure temperature is less than 45°C and greater than 0°C, and the Battery voltage is less than 4.2 volts. The Solar Node and Gateway require a minimum of 3.6 volts from the battery, to operate according to specification. Below this threshold, the Node will cease communication with Gateway, and Gateway will cease transmission to cellular networks. In a typical day and night cycles, the solar panels will provide ample voltage to resupply the battery and provide proper power to the system.



The battery voltage and available solar charging current are both monitored and reported by the Nodes and Gateway. These data are available on the data portal and on demand via USB export. Allowing the user to assess the condition of the overall Node/Gateway power system.

## Potential trouble with Solar Current

**Temperature:** As discussed previously, the Solar Node and Gateways are designed to operate on their own in harsh conditions and hard-to-reach areas. However, they are not immune to the environment if there is a heat wave or cold snap that lasts longer than 2-3 weeks. Paying close attention to the *status* of the systems may be an important measure to prevent data loss. In the case of extreme heat above 50°C, there can come a time when the internal enclosure temperature reaches levels higher than exterior temperatures. This is important to keep in mind because it means, even when temperatures outside have reduced to reasonable levels, temperatures inside the Node or Gateway may still be too hot to recharge the battery. The same can be said in cold temperatures below 0°C. Prolonged time exposed to these temperatures may prevent the battery from recharging. Many days of operating under these conditions will deplete the battery and cease the functionality of the system and manual intervention will need to take place to recharge the batteries.

**Avoiding the Shade:** Overcast days, aren't enough to prevent the solar panels from getting sunlight. Solar radiation can still penetrate through some clouds and allow enough energy to reach the solar panel cells. Making sure that the panels are angled 45° toward a clear sky has the most impact on solar panel performance. This allows the most rays to strike the panels even when they are not facing directly at the source. The panel performance is most negatively impacted by objects that cast shadows onto the panels. So be mindful of nearby trees, and their potential to change throughout the year. Also, buildings under construction can have an impact post-installation. We recommend that the Solar Node and Solar Gateway be installed in a location far from trees and other large obstacles that might cast shadows directly onto the solar panels.

**Debris from birds and animals:** If the reported solar charging current appears to be abnormally low, it may be necessary to clean debris from the panel.

## SDI-12 Ports

SDI-12 is the name of the communications protocol that the sensor uses to communicate with the logger. SDI-12 employs a bidirectional serial data line to communicate between the sensors and an SDI-12 recorder. The maximum wire length between any sensor and recorder is limited to 200 feet. The Acclima Solar Node supports up to ten SDI-12 devices.



The Node comes with five SDI-12 connectors which will allow for dual wire splicing of two sensors per connector. When the data recorder needs a sensor reading, it transmits the command [aM!] to the address of a specific sensor. All the sensors will hear the request for the sensor data, but only the sensor with a matching address will respond. All Acclima SDI-12 sensors are shipped from the factory with the default address of '0'. If two or more sensors are connected before the default address has been changed to a usable address, the sensors will not read, and failures will occur. Follow the steps on page (45) to ensure that all sensors are addressed properly.

**Note:** The SDI-12 port can provide up to 5 watts of power. Shared among up to ten connected SDI-12 devices.

## Line-of-Sight/Range

Acclima has gone to great effort to ensure the process of pairing Nodes and Gateways is as easy as possible. Nevertheless, careful forethought and planning may still be required, especially if you have intentions of maximizing the ranges between the devices. In both standard-range and long-range configurations, the name of the game is 'line-of-sight'. Although we all wish it were as simple as having the devices within visual range, connected by an imaginary line, there just so happen to be many variables that add physical and non-physical obstructions between the devices themselves, making device connections more challenging.

### *Physical barriers and other factors*

The Acclima Nodes and Gateway communicate with each other using the 915MHZ ISM band. This is a heavily used band and is highly restrictive of the power levels and field intensities used in it. As the local use of the band becomes denser, the associated range for all users in that area is reduced because of the noise from competing signals. Frequency Hopping Spread Spectrum technology is used to greatly reduce these interferences and is the key to success in achieving long ranges with small power levels. High-gain antennas are not allowed because they concentrate the radio frequency power and increase the interference to other users. Using the allowed Omi-directional antennas at low power levels means that only a very small fraction of the transmitter output power is aimed in the direction of the receiver. Most of the radiation is wasted.

With these restrictions and physical limitations, it is important to maximize the power received by the receiver by consideration to the following:

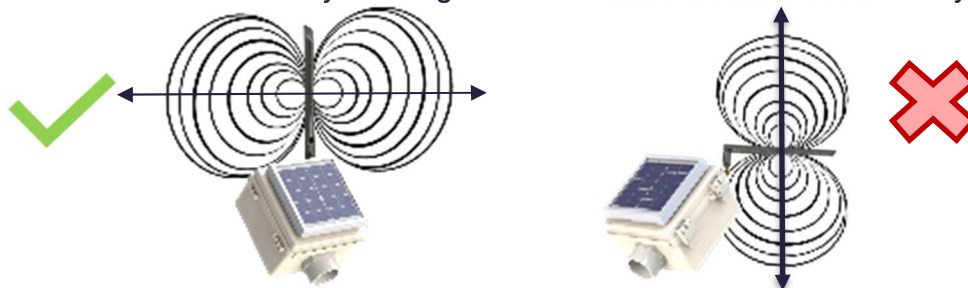
**Establish line-of-sight communications.** Hopefully, your communications path between the Node and Gateway is free of buildings, hills, trees, and crop canopies. In crops such as corn, it may be desirable to raise the antenna to an elevation above the crop canopy where it can see the antenna with which it is communicating. If this is not practical, you will still be able to communicate for about one mile according to the testing we have done.



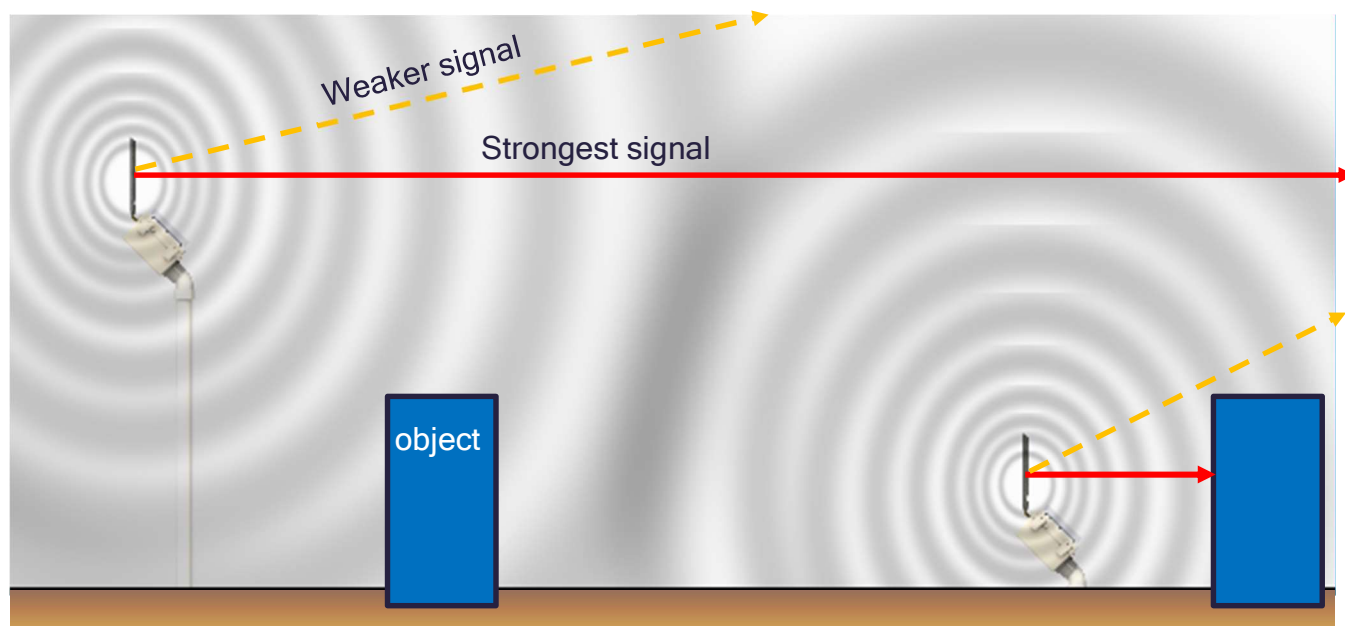


**Make sure the antennas are in a vertical position.**

Omnidirectional whip antennas produce a flattened donut-shaped field. The most intense part of the field for both transmitting and receiving is straight out (perpendicular to the antenna) in all directions. The weakest signal strength is at the tip of the antenna. If the antenna is mounted parallel to the Earth very little signal will be transmitted or received by the antenna.



**Provide reasonable clearance from the ground.** Signal strength is impaired by objects that reside within a cigar-shaped path called the Fresnel Zone. The radius of this zone for 915 MHz communications is roughly 20 meters. Envision a tunnel about 40 meters in diameter between the Node and Gateway and keep it as clear as possible from interfering objects - including the ground. It is generally not practical to place the antennas 20 meters above the ground, but it is a good idea to keep them at least 1 meter above the ground. In our range testing the antennas were at eye level. That provides good communications at 5 miles.

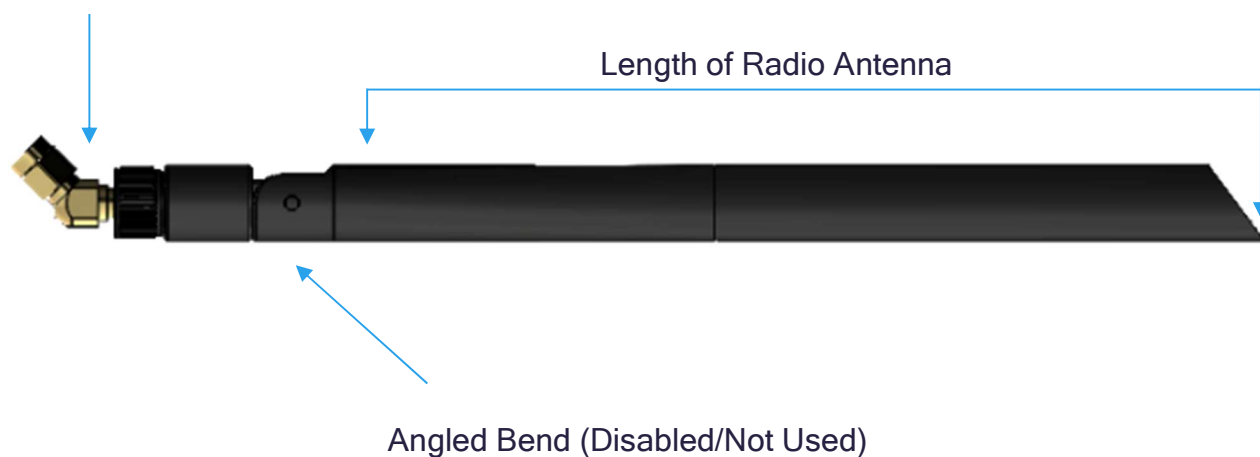


The height of the antenna from the ground directly impacts signal strength. At lower installation heights, there will be less signal to spread due to a large percentage of the wave being absorbed by the ground. At lower heights, there is a greater requirement for the Fresnel Zone to be clear of any obstruction.

## LoRa Radio Antenna

Installing your antenna correctly is imperative to achieving good signal transmission and reception. The LoRa radio antennas must be kept in the vertical position to allow the length of the antenna's surface area to capture in or transmit-out, as much signal as possible. The Solar Nodes and Gateways are to include a 45° SMA adapter. This adapter helps to ensure the antennas will always remain at 90°. The angled SMA adapter can be removed for a <1% improvement in signal quality. However, doing so removes the antenna's ability to retain a secure fixture, as the built-in antenna connector can easily become loose, and then roll over to a less-than-ideal position. In most units, the antenna's angled bend has been disabled at the factory. Keeping the 45° adapter reduces the need for regular maintenance to right the antenna back to its proper vertical position. In most cases, the 45° SMA adapter will be pre-installed onto the enclosure.

### 45° SMA Adapter

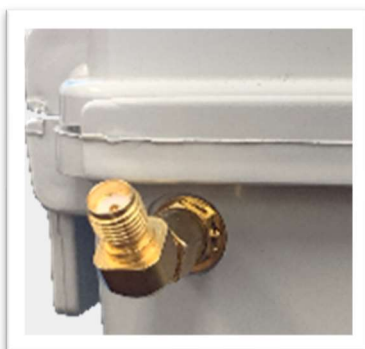


# INSTALLATION STEPS

## LoRa Antenna

1. Screw the 45° SMA adapter to the SMA connector on the rear of the enclosure. Use the included wrench found in the hardware kit to tighten the nut onto the bolt

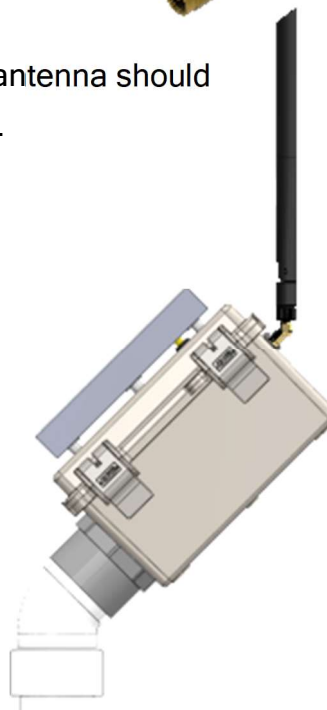
**Note:** Make sure the 45° adapter is screwed down and arrives in the vertical/skyward position.



2. Screw down the LoRa radio antenna clockwise onto the 45° male SMA adapter.



3. After the Antenna has been affixed to the SMA connector, the antenna should remain in the upright position for the duration of the installation.

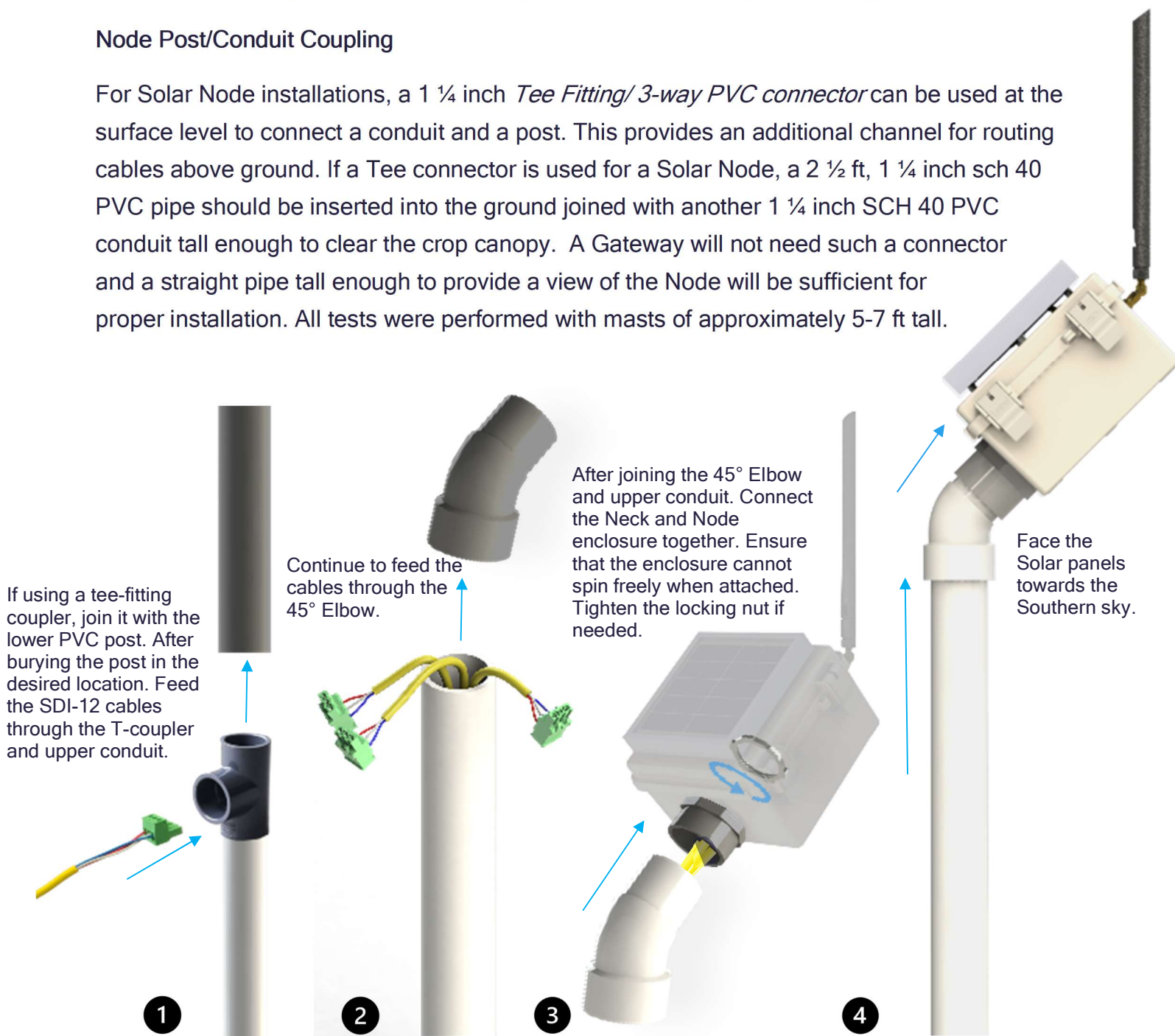


## Conduit/Post Installation

The Node and Gateway were designed to use a 1 ¼ inch PVC pipe as a mast to erect the Solar Node or Gateway above ground. We recommend using a 1 ¼ Sch 40 Furniture PVC Pipe, 6-8 feet long. However, these materials are not included and cannot be sourced through Acclima. They are commonly found in local hardware stores or online retailers at relatively reasonable costs. The Solar Node and Gateways do include a PVC Neck, and 45° elbow adapter, designed to aid the user in coupling the Node or Gateway to a conduit and still achieve the appropriate angle for solar energy absorption. The 45° elbow has a thin end, designed to fit snugly into the Neck Adapter, and is secured by the locking nut.

### Node Post/Conduit Coupling

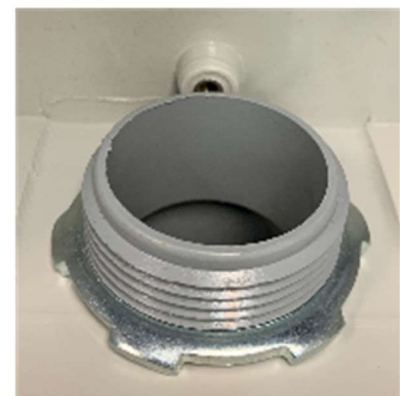
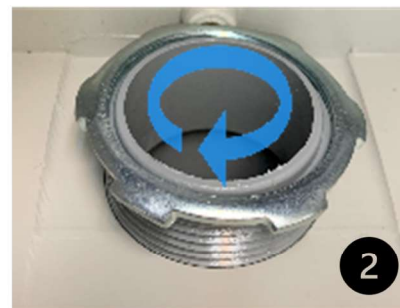
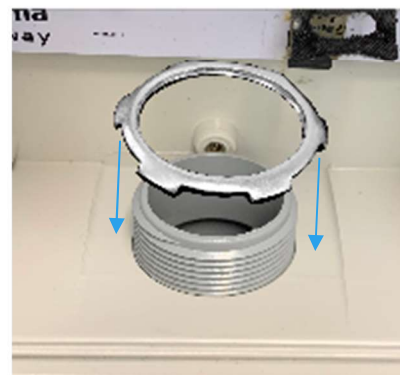
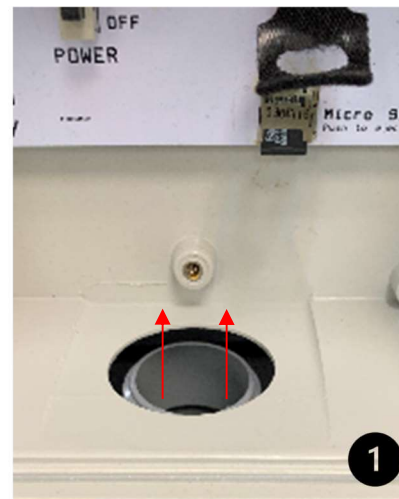
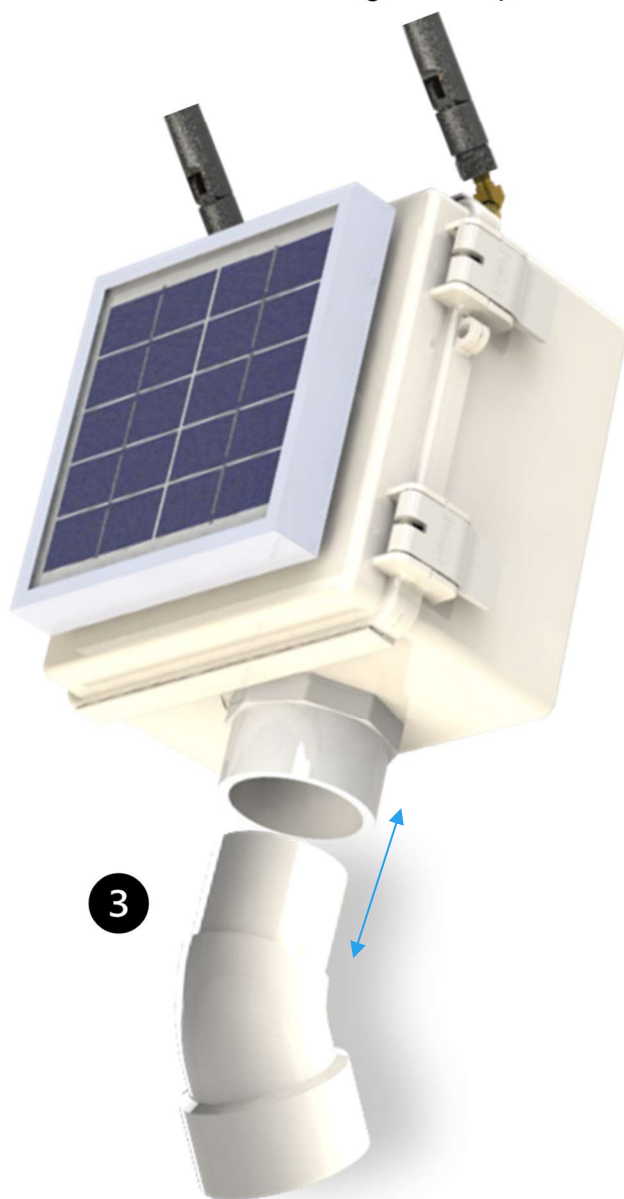
For Solar Node installations, a 1 ¼ inch *Tee Fitting/ 3-way PVC connector* can be used at the surface level to connect a conduit and a post. This provides an additional channel for routing cables above ground. If a Tee connector is used for a Solar Node, a 2 ½ ft, 1 ¼ inch sch 40 PVC pipe should be inserted into the ground joined with another 1 ¼ inch SCH 40 PVC conduit tall enough to clear the crop canopy. A Gateway will not need such a connector and a straight pipe tall enough to provide a view of the Node will be sufficient for proper installation. All tests were performed with masts of approximately 5-7 ft tall.



## Neck and Elbow Adapter

For ease of installation, we recommend the following steps to secure the Neck and 45° Elbow to the Node/Gateway enclosure.

1. With the lid open, seat the enclosure onto the Neck adapter.
2. Screw the locking nut down onto the Neck with the teeth of the locking nut facing down.
3. Push the 45° Elbow into the Neck. Friction between the elbow and neck will hold them together in place.



## USB 2.0 A-B Port

The Acclima Solar Nodes and Gateways are equipped with a USB-B port. Use a USB-A to B cable to connect the Node or Gateway to your Windows 64-bit PC. You can configure or sync data from the device directly to your PC via such a cable. Drivers are installed automatically once a connection has been established.

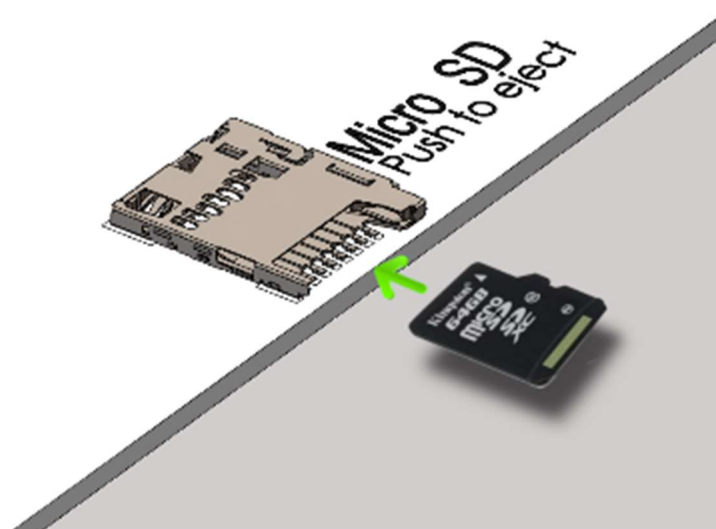


## Micro SD Card

1. The Gateway stores data via a memory card. SD/SDHC/SDXC MicroSD Cards using the Fat16/32 formats are supported.



- i. The MicroSD card should only be installed with gold contacts facing down, and characters facing up.
- ii. To insert a MicroSD card push it into the MicroSD card slot until an audible 'click' can be heard.
- iii. Push it inward a second time to release or eject the MicroSD card.



**Note:** Do not remove the MicroSD card, while a Node/Gateway is powered [On]. Doing so can result in the loss of data.

## Nano Sim Card

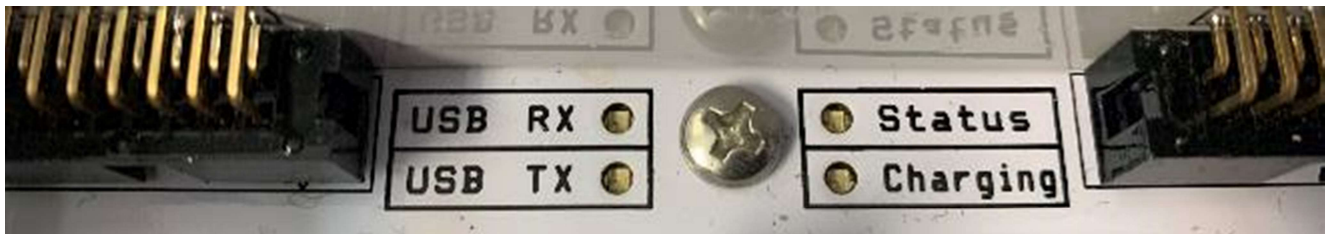
A pre-activated Nano sim card can be found in the Nano sim card slot at the top center of the radio module, inside the Gateway enclosure.

**Note:** If a Nano Sim is not Included, install an Acclima-activated GSM Nano Sim Card with the gold contacts facing towards you, with the cut-out on the left-hand side pointed downward. Push the Nano Sim gently into the locking connector. You will hear an audible click when it is seated properly. Otherwise, refrain from removing the Nano Sim card once it has been seated. Contact Acclima for activation guidance if a non Acclima SIM card will be used with your Gateway.



## Activity LEDs

Located on the top center of the motherboard. There are 4 Activity LEDs found on both Nodes and Gateways.



### USB RX:

When SDI-12 device data is being received, the USB RX LED will flash green in correspondence with the data flow.

### USB TX:

When data flow is being transmitted through a USB cable. USB TX LED will flash green rapidly in correspondence to the data flow.

### Status:

The Status LED flashes every 5 seconds to indicate that power is available. This LED also becomes solid when a connection between a Node and a Gateway has been made.

### Charging:

When current is available via a Solar Panel cable from a USB connection, the charging LED will illuminate solid green.



# INSTALLING SOIL MOISTURE SENSORS I

## Supported Soil Moisture Sensors

The Acclima Solar Node will support all SDI-12 sensors that are compatible with versions 1.0 through 1.4 of the SDI-12 specification, including all Acclima TDR sensors. When using Acclima sensors the first five data points are captured.

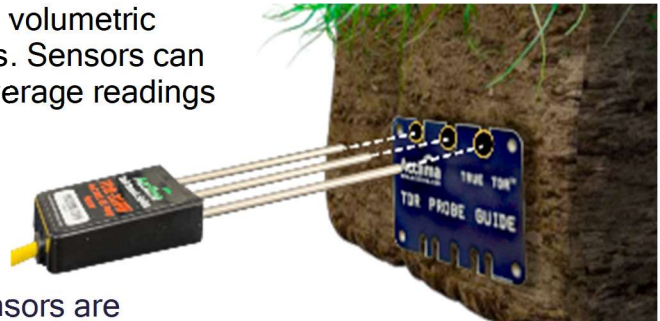
- |    |                                    |       |
|----|------------------------------------|-------|
| 1. | Volumetric Water Content           | %     |
| 2. | Temperature                        | °C    |
| 3. | Permittivity                       |       |
| 4. | Bulk Electrical Conductivity       | μS/cm |
| 5. | Pore Water Electrical Conductivity | μS/cm |

The Solar Node SDI-12 power is limited to 400mA. Some sensors with higher power requirements may require an external power connection.

## Sensor Orientation

Sensors should be installed in the region of interest where soil moisture measurements are desired. Acclima sensors measure the average volumetric water content over the length of the sensor rods. Sensors can be buried in any orientation and will produce average readings as follows:

- Flat/Horizontal: Provides a moisture reading at a discrete depth. This orientation is frequently used when monitoring plants with shallow roots such as turf, or when multiple sensors are used to create a soil moisture profile vs. depth.
- Vertical: Provides average moisture reading over a depth of about six inches. Often used when monitoring deeper root systems such as trees.
- Edge-Horizontal or diagonal: Provides average moisture reading over a variable depth.



## Environmental Variables

When selecting a site for sensor placement, consider the following environmental factors:

- Non-permeable surfaces such as rocks and roads can generate runoff and cause variation in moisture content nearby.
- Depressions and the base of slopes tend to collect excess moisture.
- Peaks of slopes, south or west-facing hillsides, and areas where reflected light is focused tend to dry out more quickly.
- If monitoring plant conditions, the sensor must be buried among the roots of the plant of interest. Otherwise, the effects of transpiration will not be measured.



## Installing Soil Moisture Sensors II

The Acclima Soil Moisture sensors report soil moisture as a percentage of the total volume measured. This means that the measured volume of soil should be free of foreign objects or variations that may alter the measurement made by the sensor. Consider the following conditions:

- Avoid placing the sensor near rocks or other similar objects.
- Small roots near the sensor are acceptable and desirable. Avoid large woody roots.
- Do not create air pockets or voids around the sensor rods during installation.
- Force the sensor rods straight into undisturbed soil using the Acclima-supplied guide tool. Sensors with waveguides installed with backfilled, compacted soil may not report a VWC number that is representative of the nearby undisturbed soil.
- Where sensors are installed in the sidewall of excavations, be sure to replace and compact all the excavated soil to the same density as the surrounding unexcavated. Otherwise, preferential percolation paths may be created which can cause errors in VWC readings.
- Avoid placement of sensors within the Volume of Influence of one another. For Acclima sensors this is within a two-inch diameter around the sensor, other sensors may have a larger or smaller volume of influence.

### Add Acclima Sensors

To add one or more Acclima sensors to the Solar Node:

- Wire each Acclima sensor to the Solar Node as described in the 'SDI-12 Device termination' section page (34).
- Click the sensors tab in NodeView
- Click Start Scan.
- Set a New Address 0-9 (do not duplicate address characters on any single Node!)
- Repeat the above steps for each Acclima sensor.

### Add non-Acclima Sensors

Like Acclima sensors, each non-Acclima sensor must be added individually to the Node:

- Physically disconnect the wires of all existing sensors from the Node.
- Wire the new sensor to the Node as described in the 'SDI-12 Device termination' page (34),
- Click the Sensors tab in NodeView, page (43).
- Click Start Scan.
- Set a New Address 0-9 (do not duplicate address characters on any single Node!)



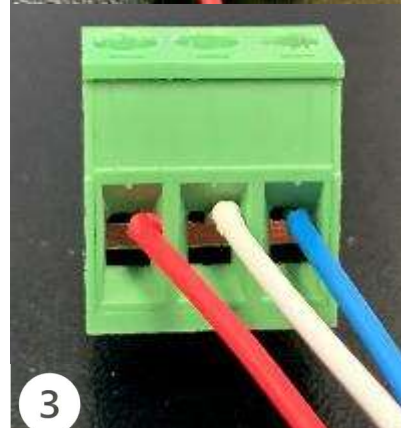
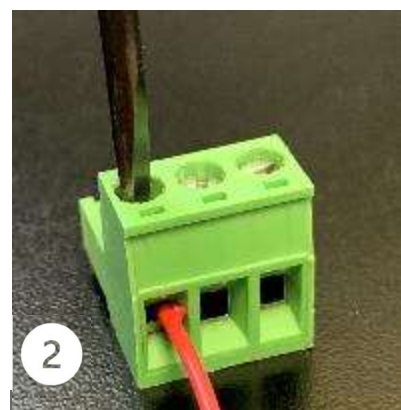
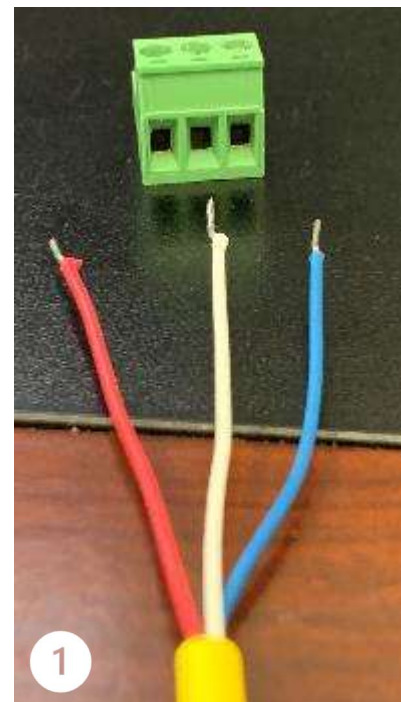
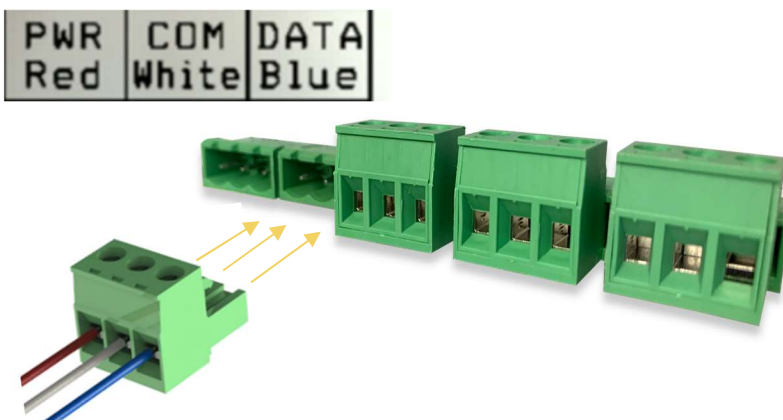
# SDI -12 DEVICE TERMINATION

## How-To-Wire

Proper termination of SDI-12 connectors is key to capturing reliable data from SDI-12 devices. Follow these steps to ensure your wiring is done correctly on the first try. You will need a 1/8" flathead screwdriver or similar tool to complete this task.

1. Insert the wire terminals into the open port of the terminal block connector.
2. Use a 1/8" flathead screwdriver to screw the terminal contact closed onto the wire terminal.
  - Avoid allowing the insulation to interfere with the contacts of the terminals.
3. Repeat the process for the remaining wire terminals.

**NOTE:** The SDI connector may arrive in a port-closed or open configuration. Before inserting wire terminals make sure that the ports of the block are screwed open so that the metal contacts may be closed onto the wire terminal.



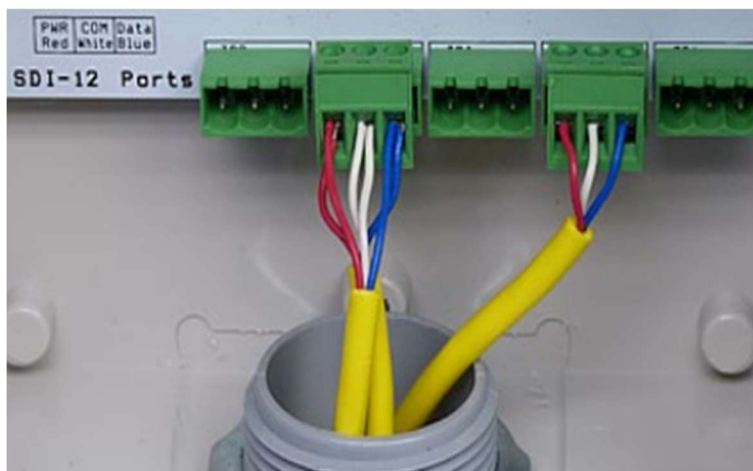


## Connecting Sensors to the SDI-12 Port

SDI-12 sensors communicate and draw power from the same wires. They share the connection to the Solar Node with all other sensors connected to the same Solar Node. This type of connection is sometimes called 'parallel' or 'bussed.' Sensors can be spliced or connected at a single common point or as taps into a longer run of wire.

Upon wiring completion:

- Every sensor red wire has electrical contact with the red 'Power' terminal
- Every sensor white wire has electrical contact with the white 'Com' terminal.
- Every sensor blue wire has electrical contact with the blue 'Data' Terminal

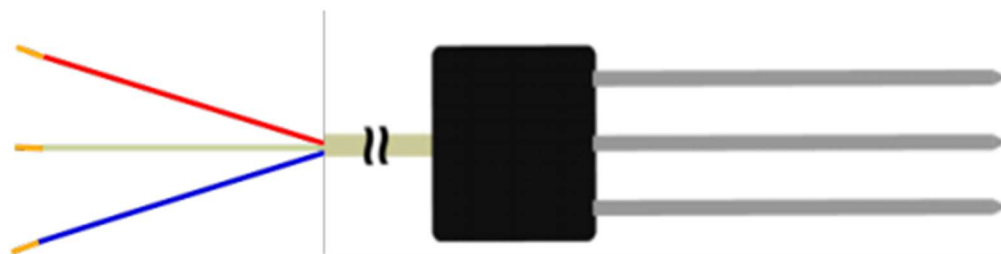


### Consider the following points when wiring sensors:

Red (power)

White (com)

Blue (data)



- The maximum recommended wire length from a sensor to the Solar Node is 200 feet.
- For convenience, the green terminal block can be removed from the SDI-12 port while wires are connected to it. Simply pull on the block to remove it from the inside of the Solar Node. To connect the terminal block, insert it back into the Solar Node with the screws facing right. See page (34).
- One or two sensors can easily be wired directly into the green terminal block as shown above. To do this, insert all red wires into the left portion of the terminal block and tighten the screw to secure them in place. Repeat the procedure for the white wires in the middle portion of the block and the blue wires in the right portion of the block.
- When connecting ten sensors to one Solar Node, multiple wire splices will be necessary. This can be performed by repeating the dual wire splice procedure on each of the five provided SDI-12 terminal blocks. Each of the terminal blocks will have two wires in each of the three terminal ports on the block. Provided the total power draw does not exceed 400mA and you have previously addressed the sensors 0-9, the Node will detect and support the sensors. See page (43) for addressing sensors.

# NODEVIEW

NodeView™ Software & Driver software must be installed before field installation. The Solar Node and Gateway require a Windows™ driver to be installed before use with a PC. The driver is installed during the USB connection with a Node/Gateway with a PC for the first time.

## Minimum System Requirements

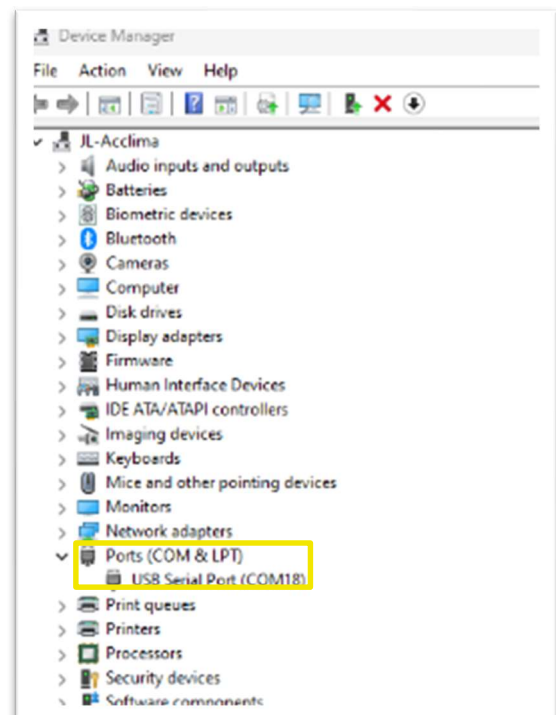
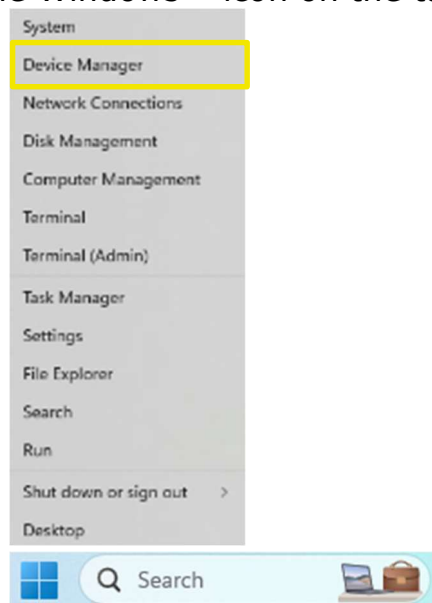
- Microsoft Windows 7™, Windows 8.1™, Windows 10™, or Windows 11™ operating systems
- 50 MB hard drive space
- Available USB port

## NodeView App Installation

### Driver

When the Acclima Solar Node is first connected to the computer via a USB cable and the device is powered [On], it will automatically be detected by the operating system and the installation of the driver will occur. Once the driver is found and installed, the Solar Node will be assigned to a port and will be available for use. To view more details about the port, open the 'Device Manger' in the Windows™ Control Panel. The Solar Node is visible in the Device Manager under the 'Ports (COM & LPT)' heading. The Device Manager only shows active ports by default. When the Node is disconnected from the computer, it will no longer be visible in the Device Manager, unless unhidden in the Ports (COM & LPT) menu.

**Note:** Device manager can be found by using the search icon in Windows™ and entering "device manager" or by right-clicking the Windows™ icon on the taskbar.



# INSTALLING NODEVIEW SOFTWARE

Installing NodeView™ is simple and easy. Download the NodeView setup application. Visit the following webpage to start the download process.

The NodeView™ software can be downloaded here.

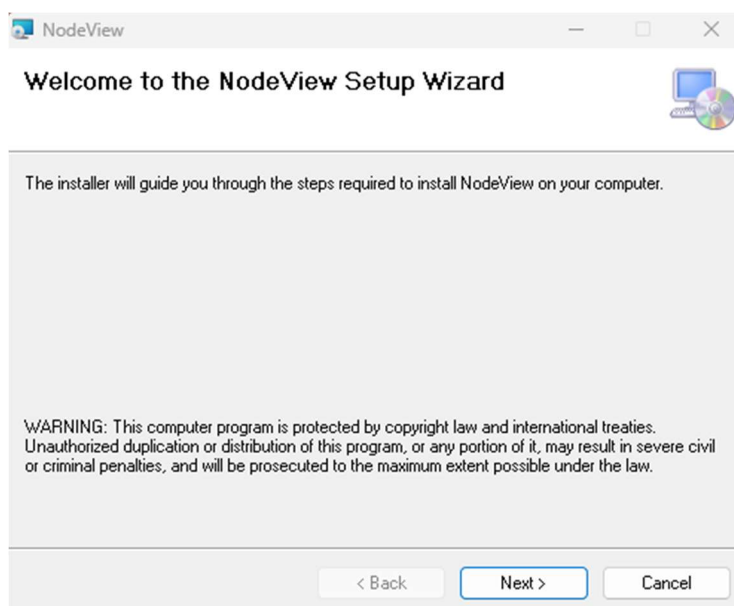
<https://acclima.com/nodeview>

**NOTE:** The screenshots and steps below may vary slightly depending on which version of Windows™ you're using.

## NodeView™ Installation I

Find the installer in the download location on your drive. Double-click the installer to begin the set-up process.

**Click 'Next' to proceed through the installation.**

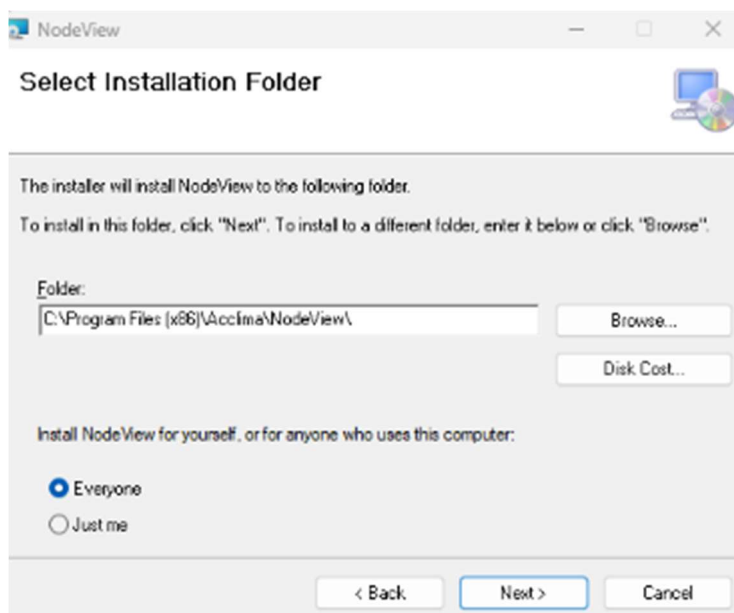


You may pre-determine the destination where the installation folder will be stored.

The default location is set to create a folder for Acclima NodeView's components in the OS drive location.

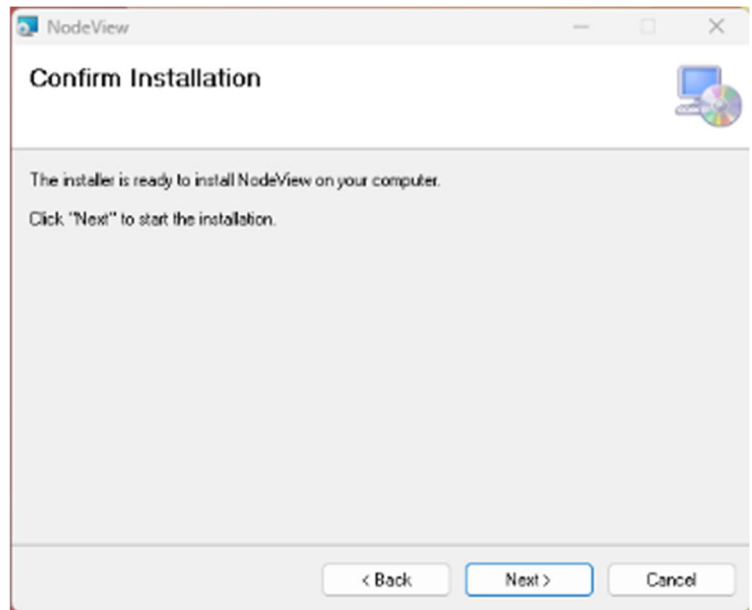
**Note:** We do not recommend setting the installation destination to a flash drive.

**Click 'Next' to proceed through the installation**

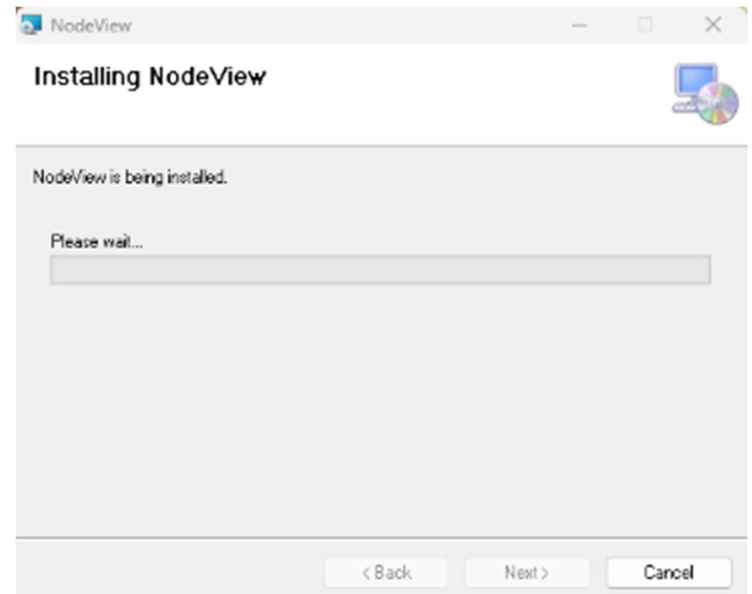


## Installation Steps II

The installation process begins and will prompt a request to approve 'Administrative Privileges' to make appropriate changes to the system.

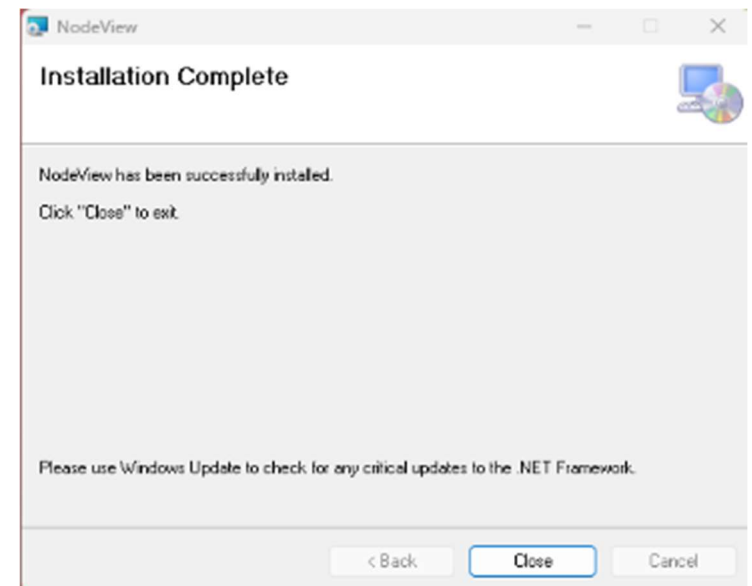


Installation may take a few moments.



Installation is completed and you may close the installer window.

Click 'Close' to start using the app.





# USING ACCLIMA NODEVIEW SOFTWARE

## NodeView™ Layout

Here is a breakdown of the components of NodeView™ when a Solar Node has been selected.



The screenshot shows the Acclima NodeView application window. The interface is divided into several sections, each highlighted with a numbered callout:

- 1:** The top menu bar containing 'File', 'Actions', and 'Help'.
- 2:** The top navigation tabs, including 'Configuration' and 'Sensors'.
- 3:** The 'Gateways/Networks' sidebar on the left, showing a list of gateway nodes.
- 4:** The 'Detached Nodes' sidebar at the bottom left, showing a list of detached nodes.
- 5:** The main 'Node Device Details' panel, which includes 'Node Settings' (Sensor Read Interval, Distance Settings), 'Connected Gateway' information, and 'Advanced Node Options' (Force SDI-12 CRC, Power SDI-12 sensors, SDI-12 bus voltage).
- 6:** A link to 'My Acclima Data Portal' in the top right corner.
- 7:** The 'Device Details' tab at the bottom right of the main panel.

**Use the numbers to identify the sections of the NodeView™ App.**

1. Action Menu
2. Action Tabs
3. Gateways/Networks
4. Detached Nodes
5. Device Details and configuration options
6. Link to data.acclima.com
7. Activity Log

# HOW TO USE NODEVIEW™

The Acclima NodeView software provides three essential functions:

1. Node configuration - configuring Node or Gateway for operation.
2. Configuring a Network of Nodes and Gateways.
3. Configuring SDI-12 devices and sensors.

## Connecting a Node to NodeView™ I



1. After installing the NodeView™ software, please connect a Node via USB, turn the power [ON], and open the application.
  - a. With NodeView™ open you should see something like the following screenshot:



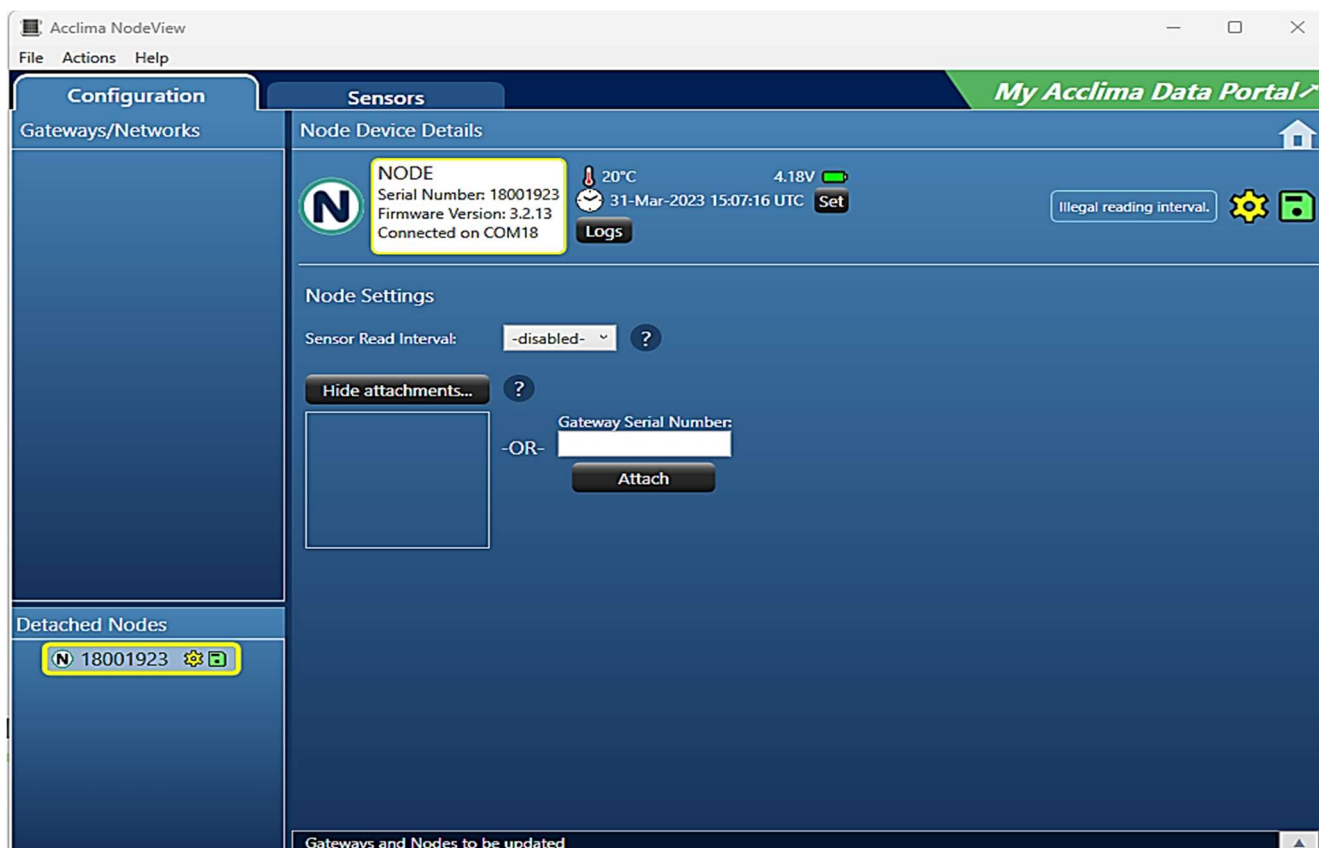




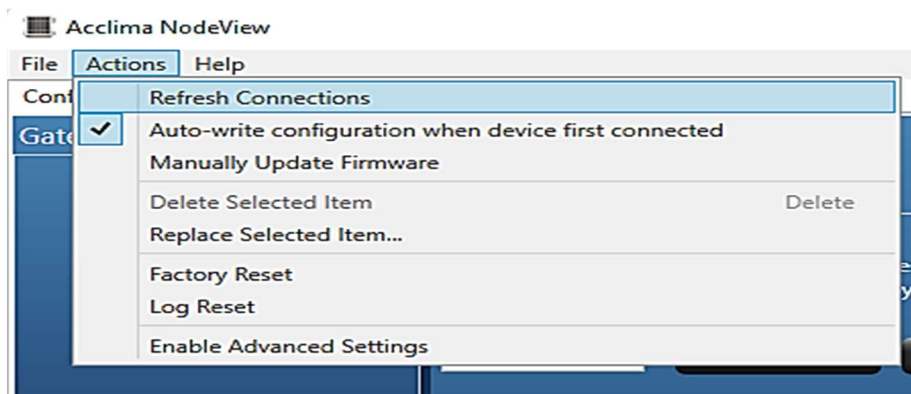
## Connecting a Node to NodeView™ II

2. Any devices that have been recognized and are actively communicating with the software will appear highlighted in white  for Node, or  for Gateway.

**NOTE:** The icon will be grayed if it is not communicating over USB.



- b. If the Node is not listed, make sure the device is connected via a USB 2.0 A-B cable. Flip the power switch [On].
- c. Hover the mouse over menus: Select; **Actions** >> ***Refresh Connections***



- d. The device should now populate either in the 'Detached Nodes' or 'Gateways/Networks' section, if it had been previously configured.

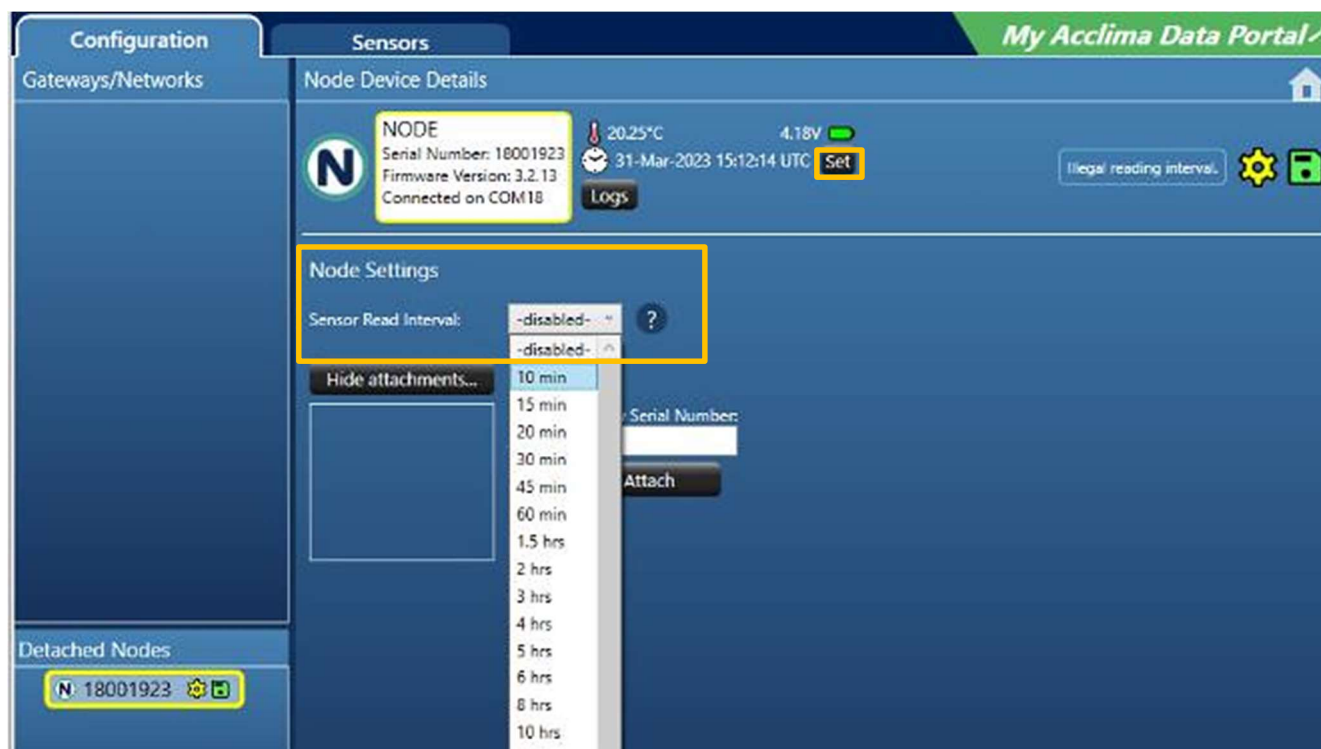


# NODE SETUP

## Configure a Node

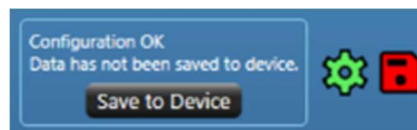
Verify basic Node assembly is complete. The battery and the antenna are installed and connected to the device, the unit powers [On] and the Status LEDs show activity.

1. Insert a USB A-B cable into the Acclima Solar Node and connect the other end to the PC.
2. Windows drivers should automatically install or have been installed previously, and a 'Com Port' should be assigned in the background. See page (36).
3. The newly connected Node should appear in the 'Detached Nodes' section of NodeView. Alternatively, an already configured Node may appear in the 'Gateway Networks' section if it had been previously attached to a Gateway. Click the Node in the list so it is highlighted.
4. Click the 'Set' button to synchronize the date and time with your PC's UTC settings.
5. Choose the desired 'Sensor Interval' from as long as 24 hours, to as short as 10 minutes.



**NOTE:** The sensor interval is the time between recordings of internal sensors in the Solar Node and the connected SDI-12 Devices.

6. Finally, save the configuration changes, by clicking "Save to Device".



# ADDRESSING SDI-12 SENSORS WITH A NODE

The Acclima Solar Node can support data logging for ten individual SDI-12 devices. The user must manually identify each of these devices so that data logging can occur uninterrupted by errors caused by SDI-12 devices being too indistinguishable. The process of separating these SDI-12 devices is called “addressing”. Where a character is added to a device, to separate it from the other nine potential devices that can be connected to that Node.

## How to Address an SDI-12 Sensor I

**NOTE:** Nodes can address sensors simultaneously, however, if the connected sensors share the same address conflicts may occur that create parity errors. Addressing the sensors one at a time, resolve these issues.

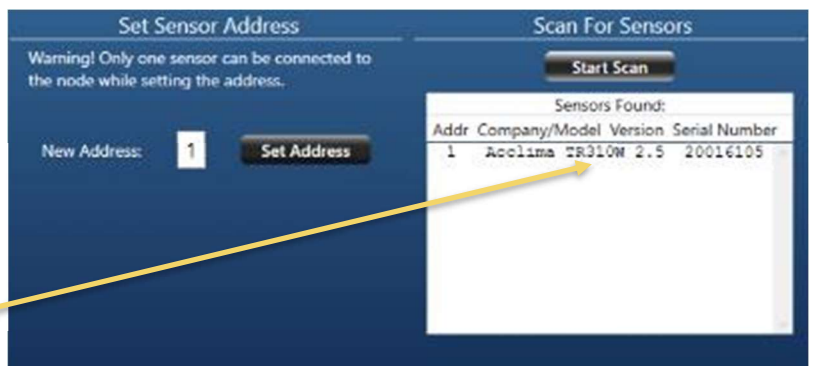
1. Open NodeView™ and navigate to the ‘Sensors’ tab.

2. Before setting the address, you may need to ‘Scan for Sensors’ to determine if your sensor is being detected by the Node.

- a. Select a Node in the ‘Select Node’ list on the left. The correct Node needs to be highlighted in yellow, to proceed with the process.
- b. Plug in a terminated SDI-12 device into any SDI-12 port on the Node.
- c. Click ‘Start Scan’ and wait for the process to finish. If the scan fails to detect the sensor, check the wires, and try the scan again.



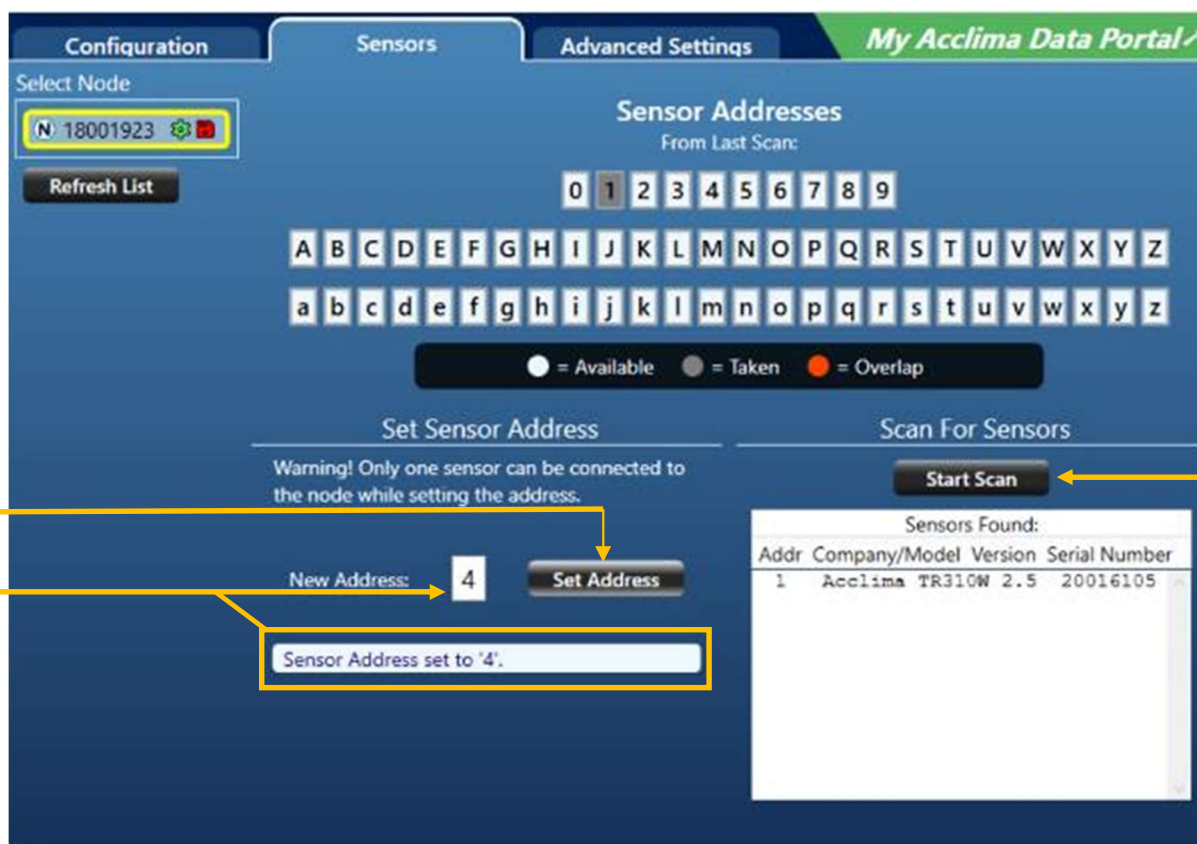
- i. The scan may make several passes on the sensor to fully identify it.
- ii. Once identified, the sensor may appear in the list in the order of **Address, Company, Model, Version, and Serial Number**.



**NOTE:** If a scan does not return a sensor, verify the wires are terminated Red, White, and Blue per the SDI-12 wiring standard. See page (34). Unplug the sensor and re-run the scan. If multiple sensors are not being detected unplug each and change each sensor address to a new address. The scan should show all individual sensors attached with unique addresses.

## How to address an SDI-12 Sensor II

3. Once the scan has returned a sensor, you may use the 'Set Address' button to address the sensor accordingly.
  - a. Enter a value in the 'New Address' field. You may use *only* a single character per sensor, per address.
    - i. Numbers: [0 - 9]
    - ii. Letters: Capital [A - Z], or lowercase [a - z]
    - iii. We recommend using the same convention per Node.
  - b. Use the 'Scan for Sensors' button to confirm that the address change was made.



- c. Repeat this process for up to ten sensors per Node. See page (35), for instructions on wiring two sensors to a single SDI-12 Terminal Block.

**NOTE:** If there are overlapping sensors using the same address. This will cause data measurement problems for the Node. All sensors connected to the Node must have unique addresses.

## Attaching a Node to a Gateway

At any time up to 10 Nodes can be assigned to individual Gateways. The process of linking the Node to a Gateway is called “attaching”. When a Node has been attached to a Gateway, and the settings have been saved on both devices, a Gateway Network has been created. There are a few ways to attach Nodes to Gateways.

### How to attach a Node Method I [Begin with a **Node**]

1. Locate the Gateway’s serial number that the Node will be attached to.
  - See page (13).
2. Plug in the Solar Node via USB, select the Node so that it is highlighted in yellow.
3. Click “Attach to Gateway”, enter the Gateway’s serial number into the Gateway Serial Number field and click ‘attach’. Your Node will appear to join the Gateway with that serial number in the Gateways/Networks section.
4. Select the Node so that it is highlighted in yellow and click “Save to Device”.
5. Disconnect the Node, then connect the Gateway via USB, select it, and click “Save to Device”.
6. Verify both devices have been properly configured and saved. Repeat if needed.



### How to attach a Node Method II [Begin with a **Gateway**]

1. Establish the serial numbers for each device to be in a Gateway Network.
  - *For example:* 1 Gateway serial number and 10 Node serial numbers.
2. Plug in the Solar Gateway via USB, select it so that it is highlighted in yellow.
3. Enter the Node serial number in the Node Serial Number field and click “attach”. The entered serial number will appear to join the connected Gateway in the Gateways/Networks section.
4. Select the connected Gateway so that it is highlighted in yellow and click “Save to Device”.
5. One at a time, plug in each Node in the Gateway Network and click “Save to Device”.
6. Enter a new Node Serial Number in the field and click “attach” to add another Node .

**NOTE:** If any mistakes are made during this process, you will need to delete the device from the configuration page. Select the erroneous entry so that it is highlighted, click the Actions button, then click “Delete Selected Item”, or press the ‘Delete’ key on your keyboard.

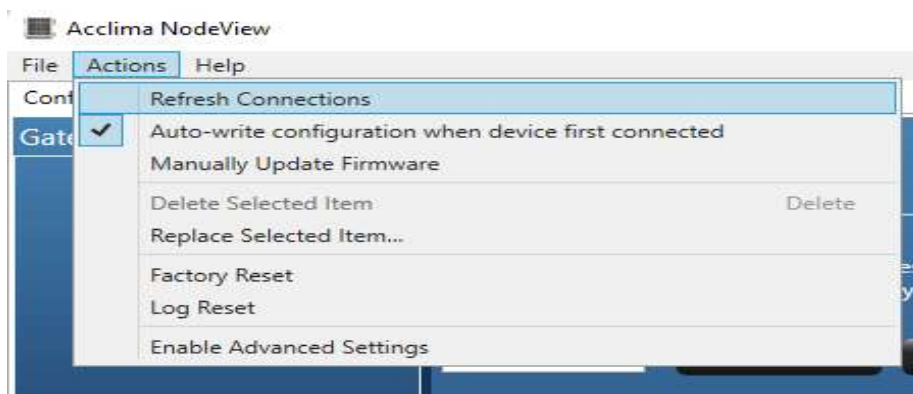
# GATEWAY SETUP

The Acclima Solar Gateway can receive data from up to 10 Solar Nodes and forwards that data wirelessly to the cloud, where it is stored, so that it can be retrieved and viewed by authorized parties.

1. Open NodeView™ and connect a Gateway via USB, and turn the power [ON].
2. Any devices that have been recognized and are actively communicating with the software will show up highlighted in white  for Node, or  for Gateway.

**NOTE:** If the Gateway is not listed, make sure the device is connected via a USB 2.0 A-B cable. Flip the power switch [On].

- a. Hover the mouse over menus: Select; **Actions >> Refresh Connections**



- b. The Gateway should now populate in the 'Gateways/Networks' section.

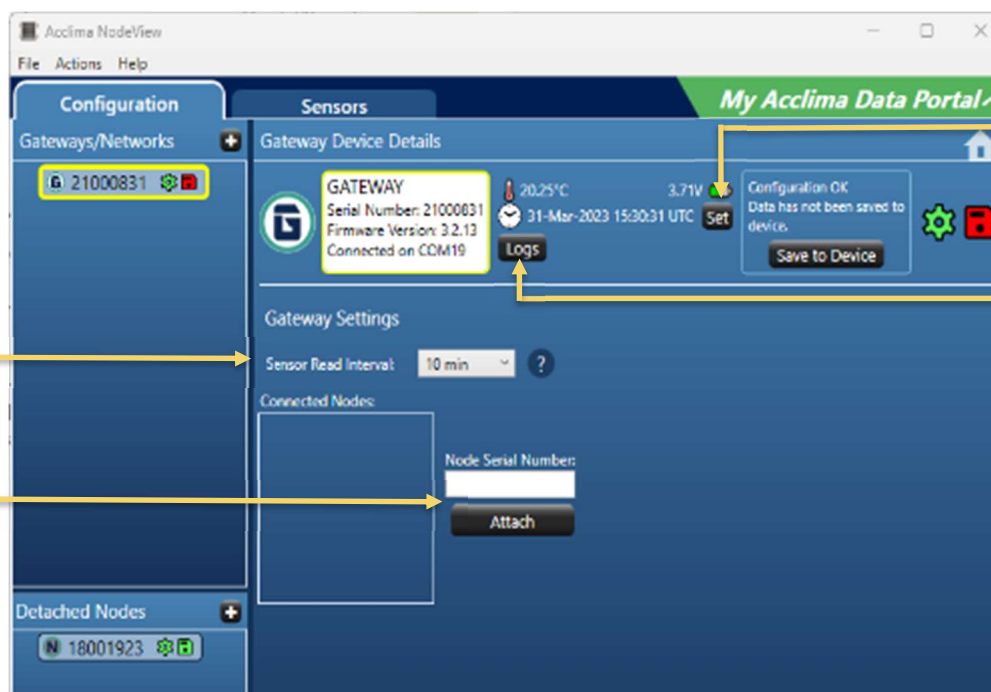




# GATEWAY CONFIGURATION

In the configuration tab, you can change the settings of a Gateway. Select the Gateway so that it is highlighted in yellow. Change the settings to your preferred configuration.

1. **Sensor interval:** The amount of time between internal sensor readings of the Gateway.
  - i. Both the Node and Gateway have 4 data points that are collected by internal sensors that indicate device status and environmental conditions: battery voltage, enclosure temperature, solar current, and solar voltage).
2. **Attach:** You can attach serial numbers from Nodes that are connected/or disconnected by typing in their serial number in the 'Node Serial Number' field. Click 'Attach' to see it join the selected Gateway.
3. **Date/Time:** Synchronizing the device "Date and Time" with the PC's Universal Time Clock setting, can be performed by clicking the "Set" button found under device details.
4. **Logs:** Can be retrieved directly from the Gateway's internal storage by clicking the "Logs" button found under Gateway details. Logs are exported in a .CSV file format, compatible with Microsoft Excel. Both Nodes and Gateways support manual data extraction via this method. To Retrieve the logs press 'Help', in the actions menu, then press "Open Logs Folder" where logs can be filtered and downloaded.



**NOTE:** After the configuration settings have been changed. Remember to save the configuration to the device. Click "Save to Device" to proceed to the next step.



# CREATE A NODE-GATEWAY NETWORK

Finally, a network of Nodes and Gateways must be created to achieve device communication. Creating a Node-Gateway network lays the foundation for the automatic detection capability of the devices to take hold. Once the networks of Nodes and Gateways have been ‘saved’ successfully in NodeView™. The devices will start to send data within the parameters previously configured.

## How to Create a Node-Gateway Network I

Connect your Gateway via USB first.

1. Verify that your Gateway is detected. Click the Gateway to confirm it is selected and highlighted in yellow.
2. Confirm the date and time are accurate, click the “Set” button to synchronize the date and time with the computer’s clock.

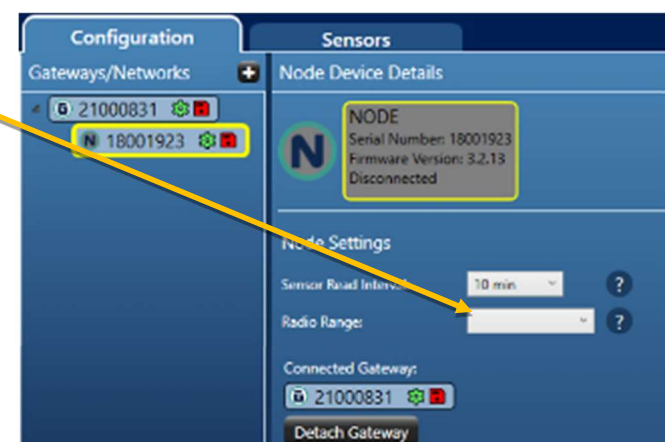


**Note:** “Set” synchronization “Logs” and “device details” are only accessible when connected via USB.

3. Select the desired “Sensor Interval.” Use the pull-down menu to select a preferred sensor interval time.
4. Enter the desired Node’s serial number and click “Attach.”



5. With the Node “Attached,” you can now adjust the “Radio Range”.



**NOTE:** After the Node has been added, you can save the Gateway configuration. Newly attached devices will need to be plugged in and highlighted so their configurations can also be saved.





## How to Create a Node-Gateway Network II

To complete the Network, the Node must now be configured.

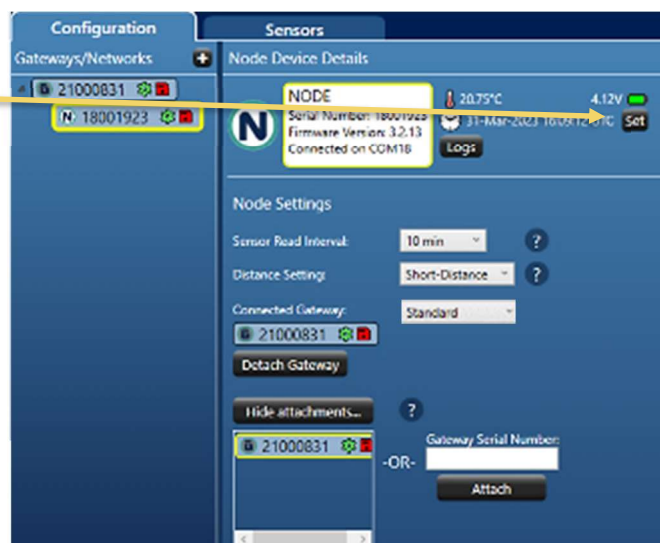
1. Select the newly added “Node” under the “Gateway/Networks” section to proceed with the pairing process.



2. Connect the USB cable between the newly added Node and the PC. The Node should illuminate its symbol and change from gray to white; make sure to select it so that the Node is highlighted in yellow around the edges.



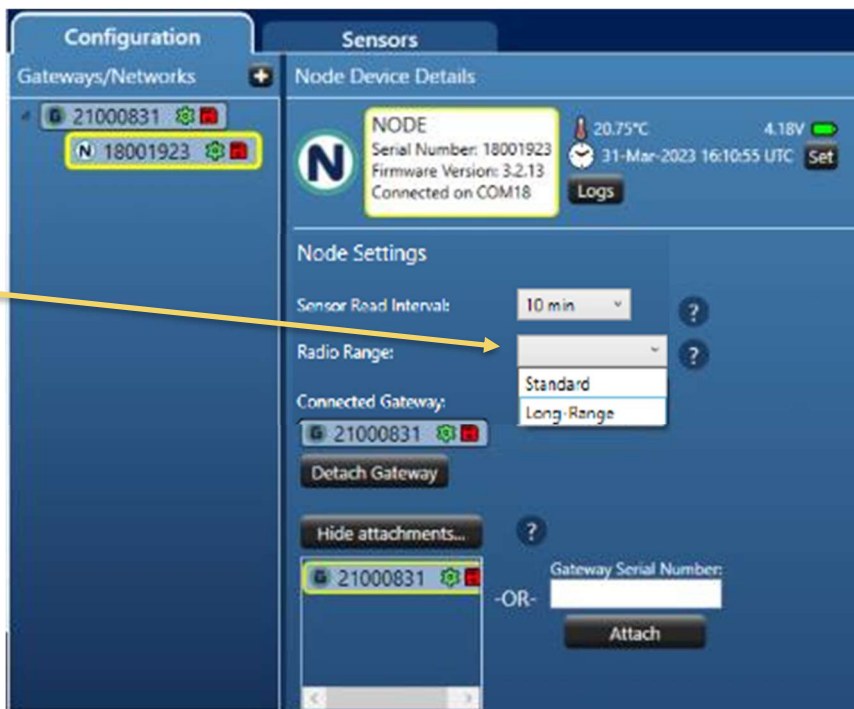
3. Configure the Node and click “Set” to synchronize the date and time with the Universal Time Clock (UTC) settings found on your PC.





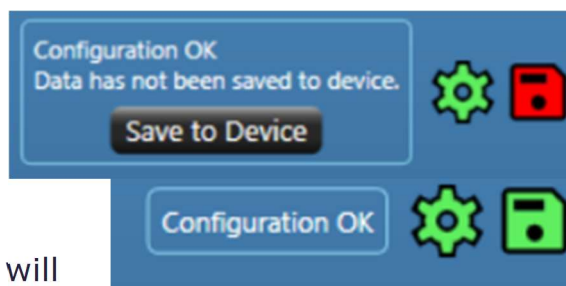
## How to Create a Node-Gateway Network III

4. Select the desired “Sensor Interval.” Use the pull-down menu to select a preferred sensor interval time.
5. Select the desired “Radio Range” mode.



**NOTE:** Standard range mode, uses fast data communication at high efficiency. Best if used within 1-2 miles with low obstructions to the line of sight. Long-range mode, utilizes slower data communication, and redundant retry attempts to pair Nodes and Gateways at long distances. Best if used within 1-5 miles with little or no obstructions to line-of-sight, does consume more power.

6. Finally click “Save to Device.”



**NOTE:** After functional settings have been changed and saved, the red “floppy disk” icon will change to Green.

**NOTE:** Repeat this process to add up to ten Nodes to a Gateway/Network.

After the Node/Gateway Networks have been created you can keep the devices running and verify system functionality in the Acclima Data Portal pages . Once functionality has been confirmed you may gather all hardware needed to install the units in the field.  
Continued page (63).



## Confirming Network is Ready for Installation

After making the desired changes to the configuration settings of the Gateway and Nodes. You must confirm that all hardware in the “Gateways/Networks” list is communicating as previously configured. This is indicated by the status symbol to the right of the serial number of a device. All Nodes paired with a Gateway need to display green gears and green save icons (Floppy).



## Configuration Status Color Key

### Yellow

- **Yellow Gear:** An illegal setting has been selected.
  - i. FIX - Change functional settings like ‘*Sensor Interval*’ and [Save to Device].

### Green

- **Green Gear:** Chosen configuration settings are functional and ready to use.
  - i. Device Ready!

### Green

- **Green Floppy:** Configuration changes have been saved to the device.
  - i. Settings Saved!

### Red



- **Red Floppy:** Configuration Changes are Unsaved.
  - i. Fix - Select the device and click [Save to Device].



**Configuration OK/Ready:** Is determined when all Nodes are joined together with the parent Gateway. This is visually indicated by all solid green ‘gear’ and green save ‘floppy disk’ icons.



**Network Will Not Communicate:** This occurs if any device in a network has illegal settings or settings that have not been saved to the device.

**NOTE:** A device will not save unless it is ‘connected by USB’ and ‘selected.’ This is indicated by the white background of the N  or G  image.

# ACTIONS AND BEHAVIORS

## Menu I

### File

**Archive Configuration Data** - Creates a portable .cfg that contains all stored configuration data.

**Restore Configuration Data** - Imports a previously exported configuration profile in .cfg format.

**Delete All Configuration Data** - Clears currently active configuration data.

**Exit Without Save** - Closes Application

**Exit (default)** - Closes application and saves most recent changes (does not save to device)

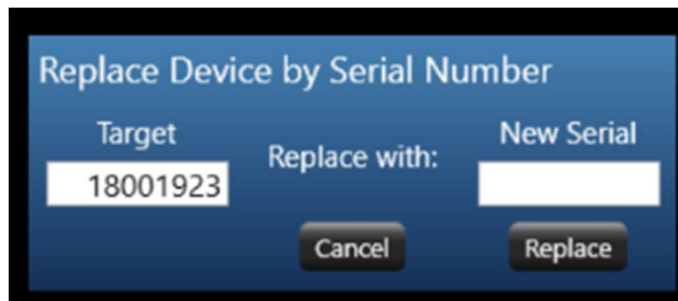
### Actions

**Refresh Connections** - Rescans ports to detect the hardware.

**Manually Update Firmware** - Select a previously downloaded update file to upgrade Node/Gateway firmware. Can be found at [Acclima.com](http://Acclima.com).

**Delete Selected item** - Click an item to be removed from view, the 'Delete Key' provides the same functionality.

**Replace a Selected item-** Change a target's "serial number" to a "new serial." Associates all devices attached with the "target serial" to the "new serial" number.



Target	Replace with:	New Serial
18001923		

Cancel Replace

## Menu II

### Actions

**Factory Reset** - Resets a selected device to factory default settings. Does not erase log files.

**Enable Advanced Settings** - Unhides the “Advanced Settings” Tab and enables certain features previously “hidden” to be “unhidden” at the user’s behest.

### Help

**User Manual** - A link to this guide can be found at any time.

**Open Updates Folder** - Open the folder on the PC where Node/Gateway updates are kept. Updates downloaded from acclima.com can also be dropped into this folder so that Nodes and Gateways can be updated.

**Open Logs Folder** - Opens widget that can be used to extract logs from Nodes or Gateways, within a user defined date range.

## Behaviors

### Different Configurations

After a Node or Gateway has been configured. The changes that are made are saved in NodeView and on the Device. When these settings appear to be different, NodeView will ask which setting you would prefer to use. The “Device Settings” on the left or the “NodeView Settings” on the right. The user must select one to proceed.

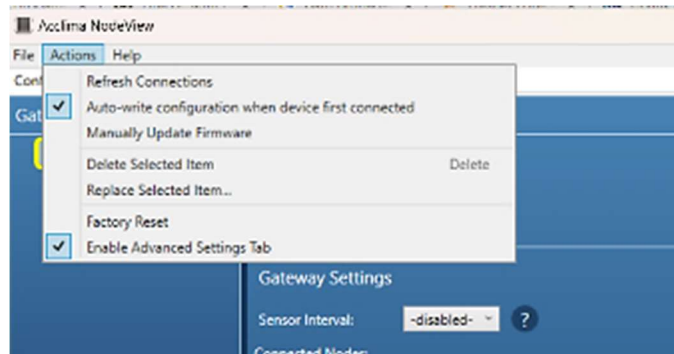


### USB Connect/Disconnect

After a Node or Gateway has been updated. The update window will need to be closed so that the USB device can be shown as active within NodeView. Similarly, after a Gateway network has been created, all devices will need to have the USB disconnected to continue the pairing process.

# ADVANCED SETTINGS I

To modify Advanced Settings, click “Actions” and then click “Enable Advanced Settings.” Doing so exposes hidden features that are user modifiable on the homepage of NodeView.



Click the new “Advanced Settings” tab, found to the right of the Sensors tab. To make advanced settings visible, click the “Hidden” button next to the setting you want to be made available. Once the advanced settings are unhidden, they can be found within their respective device details page.

## ADVANCE SETTINGS

Options are hidden by default. Enabling an option allows it to be visible and turned on from the 'Configuration' tab.

**WARNING:** Some options may affect Gateway and Node performance, battery life, and ability to report data. Do not make changes without consulting the user manual.

### Gateway Options

Change APN	Hidden	?
Disable cellular reporting	Hidden	?

### Node Options

Enable option to force SDI-12 CRC	Hidden	?
Power SDI-12 sensors between readings	Hidden	?
Set SDI-12 bus voltage level	Hidden	?

Enable device reports	Visible	?
-----------------------	---------	---

Option to add by serial number:	Hidden	?
---------------------------------	--------	---

**NOTE:** Some options may affect Gateway and Node performance, battery life and ability to report data. Do not make changes unless the risk is understood.

## Advanced Settings II

### Change APN

APN or Access Point Name is a network identifier that points to an external network for the Gateway to connect to. When entering a new APN, make sure to enter the details correctly.

### Cellular Reporting

Enabled by default, the user can elect to disable cellular reporting. This ceases the functionality of the Gateway cellular modules. This setting changes the Gateway into a manual data-gathering hub for subscription-less users.

### Force SDI-12 CRC

This option enables visibility for Cycling Redundancy Checking. Enabling this feature enhances error-checking and correcting capability at a reduction in the speed of data transmission. This function requires native support from the DSI-12 device. If it is used on unsupported devices, errors will be detected in the data collection process.

### Power SDI-12 between Readings


Disabled by default, enabling this setting allows connected SDI-12 devices to remain powered on. This improves overall system performance with a small hit to battery life.

### SDI-12 bus voltage

Solar Nodes will support sensors with voltages as low as 7-volts. However, 12v is the standard for SDI-12 devices. Using this setting may add system instability if devices are added operating at different voltages.

### Enable device Reports

Debugging tool (DNF)




The screenshot shows the 'My Acclima Data Portal' interface. The 'Advanced Settings' tab is selected. Under 'Gateway Device Details', a 'GATEWAY' card displays 'Serial Number: 21000831', 'Firmware Version: 3.2.13', and 'Disconnected'. A 'Configuration OK' message states 'Data has not been saved to device.' Below this, 'Gateway Settings' includes a 'Sensor Read Interval' set to '-disabled-' and a 'Connected Nodes' list with one node 'N 18001923'. An 'Attach' button is present. On the right, 'Advanced Gateway Options' shows 'Change APN' set to 'hologram' and 'Cellular reporting' set to 'Enabled'.



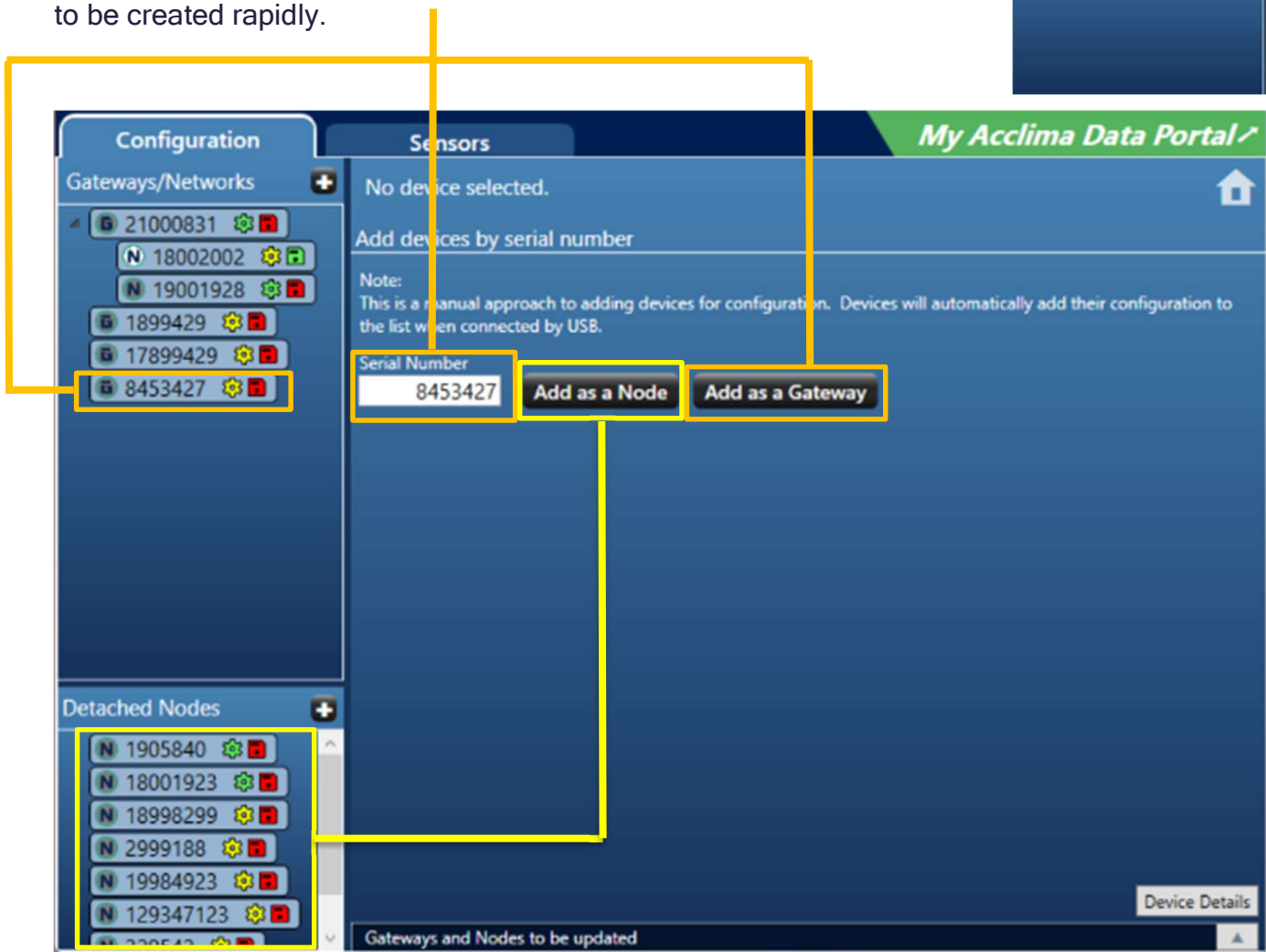
The screenshot shows the 'Node Device Details' page. A 'NODE' card displays 'Serial Number: 18001923', 'Firmware Version: 3.2.13', and 'Connected on COM18'. It also shows '23°C', '4.18V', and a timestamp '31-Mar-2023 20:09:15 UTC'. A 'Save to Device' button is visible. Below, 'Node Settings' includes a 'Sensor Read Interval' of '15 min' and a 'Distance Setting' of 'Short-Distance'. The 'Connected Gateway' is '21000831'. On the right, 'Advanced Node Options' shows 'Force SDI-12 CRC' set to 'Disabled', 'Power SDI-12 sensors between readings' set to 'Currently: OFF', and 'SDI-12 bus voltage' set to '12 Volts'.

## Advanced Settings III

### Bulk Serial Number Attachments

The option to add by Serial Number is disabled by default. Enabling it exposes two new identical buttons in the form of a  plus icon. Each button performs the same function.

Once activated a screen appears that allows Nodes and Gateways to be added into the Detached Nodes and Gateway/Networks one after another. This allows many serial numbers to be entered prior to the units being plugged in via a USB cable. If careful consideration is applied, the user can pre-configure multiple networks beforehand and then be return to later to connect the devices via USB. Allowing for Gateway Networks to be created rapidly.



**NOTE:** This is an advanced option because of the issues that may arise due to incorrect entries. We recommend creating one Gateway Network at a time.



# ACCLIMA DATA PORTAL

## Account Creation

A user account can be created at any time at [data.acclima.com](https://data.acclima.com)

### Create a User Account:

1. Visit [data.acclima.com](https://data.acclima.com)
2. Click the link "Create New Login."
3. Enter a preferred Email and Name in the fields.
4. A message will be sent to that email with instructions on how to proceed.



### User Registration Email

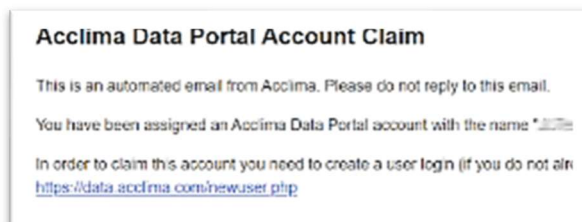
1. Find the email sent by [dev@acclima.com](mailto:dev@acclima.com)
2. Click the email verification link, before its expiration in 6 days.
3. The link will redirect you to create a new password.

**NOTE:** The password must be complex, containing at least 12 characters.

### Claim Account Devices

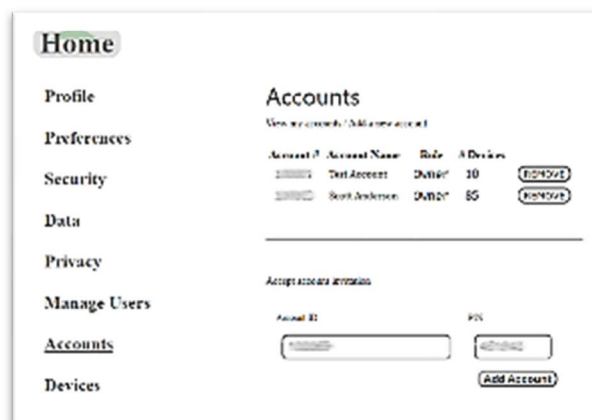
After successful login, you will need to link your Devices to your User Account. A sales representative from Acclima will have sent a link with an Account ID and PIN. These unique identifiers allow you to join your User Account with Devices you have purchased."

1. Find the email that was sent after purchase titled, "Acclima Data Portal Account Claim."
2. Separately, use the User Menu in the Acclima Data Portal and click "Settings," and navigate to "Accounts".
3. Copy the "Account ID" and "PIN" from the email into the corresponding fields in the Data Portal.
4. Click "Add Account."



**Note:** Once complete "Account Added" will appear in red and purchased Acclima Gateways will now be visible in the "Devices" section.

**Note:** Similarly, a user can be given access to an account per invitation from an "Account Owner." The User will need to accept the invitation from the home screen or in the User Settings Menu.



# ACCLIMA DATA PORTAL II

## Account Settings

- **Profile** - You can modify your Name into a Nickname or other moniker, to better help identify the user profile.
- **Security** - You can modify your complex password.
- **Data** - You can process data from the Gateway attached to an account. This data is converted into a .CSV file that can be imported into the Microsoft Excel software. Data can be filtered by data and individual devices.
- **Privacy** - Data Sharing is Opt-out by default. It can be changed by selecting Opt-In.  
**NOTE:** "We do not sell data to third parties under any circumstance".
- **Manage Users** - You can add new users via email invitation to your account and provide certain permissions.
  - Owner:** Owns the account and has full control over data, and permission modification.
  - Manager:** Has control over data and some ability to modify permissions.
  - Observer:** Can view data, with no ability to modify permissions.
- **Accounts** - View account information including the number of Node and Gateway devices.

**Note:** Sim Card must be activated with a current subscription to Acclima Cloud Services, to view data being sent by Acclima Nodes and Gateways on the data.acclima.com data portal.

**Note:** Acclima Cloud data access ceases once the subscription has expired. Data must then be manually gathered from Nodes and Gateways.

**Note:** Cloud service is restored for 12 months when the subscription is renewed.



# ACCLIMA DATA PORTAL III

## Home Page Layout

1. Home
2. Quick Links
3. Settings
4. Account
5. Body

The screenshot shows the Acclima Data Portal home page. At the top is a blue navigation bar with the Acclima logo (1), an 'Account Data' link (2), and a user profile icon (3). Below the navigation bar is a yellow bar showing the current account as 'Test Account' with a red status icon and the text 'Minor outage' (4). Underneath is another yellow bar for the user 'Scott Anderson' with a green status icon (5). The main body of the page features a large background image of a field with hay bales. Overlaid on this is a 'Southwest Middle Gateway' overview card showing the time 'Thu 4:10:00 PM', temperature '7.75 °C', GDD: 0, battery level '4.18 V', and power '271 mW'. Below this are 'Nodes Average' readings: '10.13 °C' and '4.17 V'. To the right of the gateway card is a grid of 14 node status cards, each showing a node ID and a temperature reading with a green status indicator.

**Home** - Shortcut back to the homepage.

**Quick Links** - Shortcuts to the Data page .

**User Menu** - Shortcut to Account configuration setting and button to Logout.

**Account** - When collapsed it shows current account, and its health.

**Dashboard Body** - Device focus; shows the Gateways, the Nodes attached to those Gateways, the SDI-12 devices attached to the Nodes, and the readings for the devices.

This screenshot shows the Acclima Data Portal home page with the account cards collapsed. The top navigation bar remains the same. Below it, two yellow account cards are stacked vertically. The top card displays '+Test Account' with a red status icon and the text 'Minor outage'. The bottom card displays '+Scott Anderson' with a red status icon and the text 'Minor outage'.


**NOTE:** When accounts are collapsed, they will stack vertically. You can quickly see the status of each account by looking at the status icon to the right of the account name.







# ACCLIMA DATA PORTAL IV

## Using the Data Portal

From the home page, you can view your account and the devices attached to it. Quickly identify important status updates about the health of the account by viewing the status icon color.

-Scott Anderson 

-  **Red** = Requires Attention
-  **Yellow** = Intermittent issues
-  **Green** = System is good
-  **Gray** = Awaiting update

## Device Focusing

Clicking an account expands it to show the connected Gateways and its attached Nodes. The center device selected is the device that is in focus. Selecting a device to the left or right brings that newly selected device into the center.

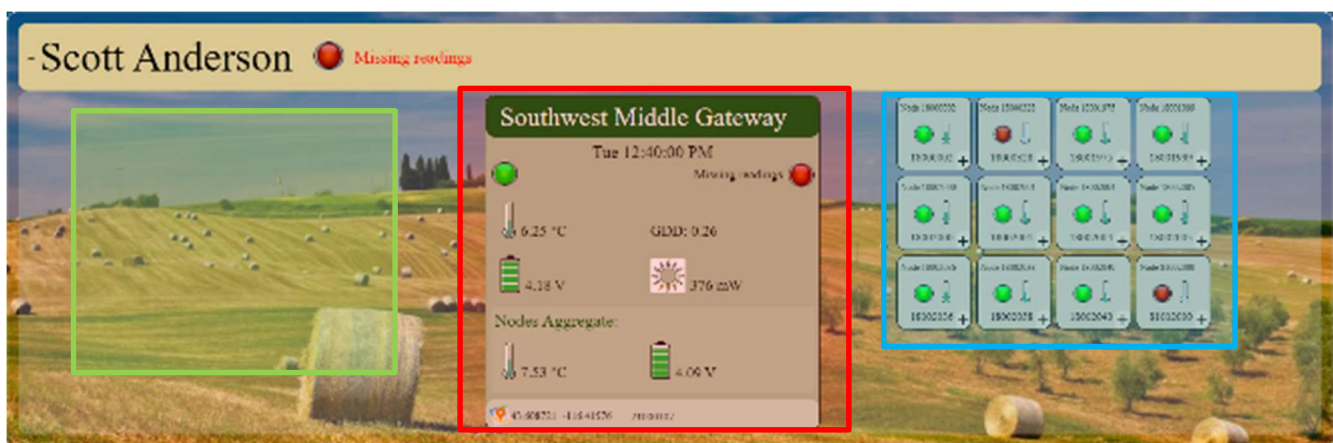
When a Gateway is selected, there is nothing to the left, but a list of connected Nodes can be found to the right. When a Node is selected, the Gateway it is connected to is moved out of focus and to the left stage. The Node will now take center stage. When a Node has sensors connected to it, they will be found to the right of the Node in focus. Selecting a sensor, brings the sensor to center stage and moves the Node to the left stage.

To go backward, simply select the device to the left of the center stage, until you are brought back to the Gateway.

### Left Stage

### Center Stage

### Right Stage



The screenshot shows the Acclima Data Portal interface for user Scott Anderson. The account name is displayed with a red status icon and the text "Missing readings". The main content area is divided into three stages:

- Left Stage:** A green-bordered box highlights a landscape image of a field with hay bales.
- Center Stage:** A red-bordered box highlights the "Southwest Middle Gateway" details. It shows a green status icon, the time "Tue 12:40:00 PM", and "Missing readings" with a red icon. Key metrics include:
  - 6.25 °C
  - GDD: 0.26
  - 4.18 V
  - 376 mW
  - Nodes Aggregate:
  - 7.53 °C
  - 4.06 V
- Right Stage:** A blue-bordered box highlights a grid of 12 nodes. Each node card shows a status icon (green, red, or gray), a node ID, and a plus sign.

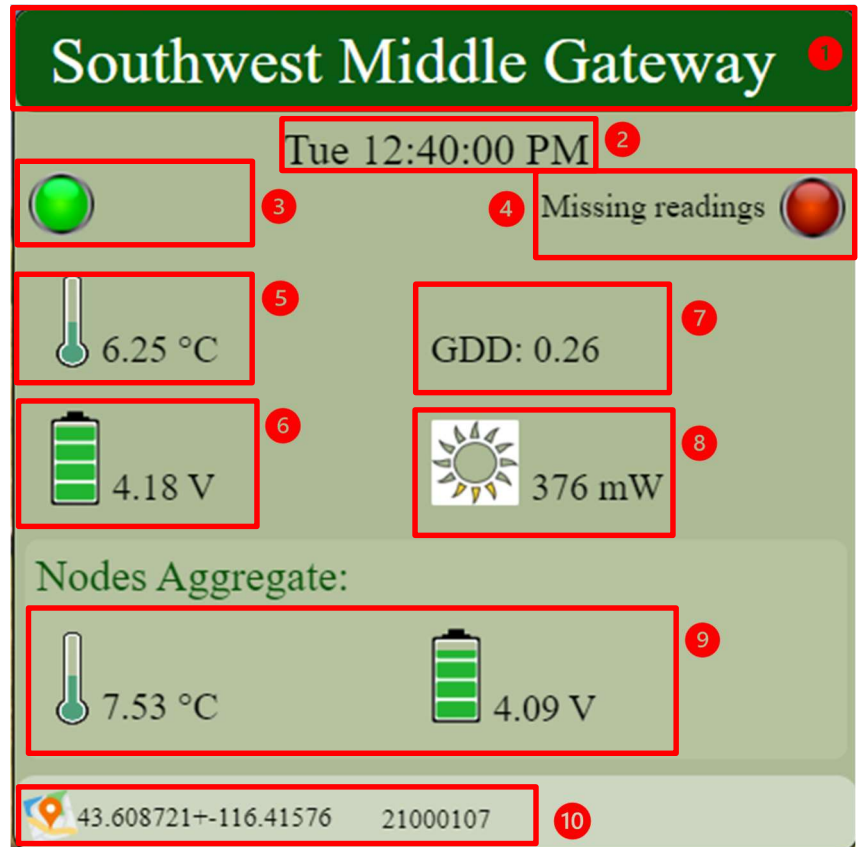


# ACCLIMA DATA PORTAL V

## Device Focus – Gateway

When a Gateway is in focus you will find important information about its status.

1. Gateway (Nickname)
2. Date and Time of last reading
3. Detected 4G Connection Status
4. Detected Node Connections
5. Gateway Enclosure temperature
6. Gateway Battery Voltage
7. Gateway Solar Current (mW)
8. Growing Degree Days
9. Node Average Enclosure Temperatures & Node Average Battery Voltage
10. GPS and Maps/ Gateway Serial Number

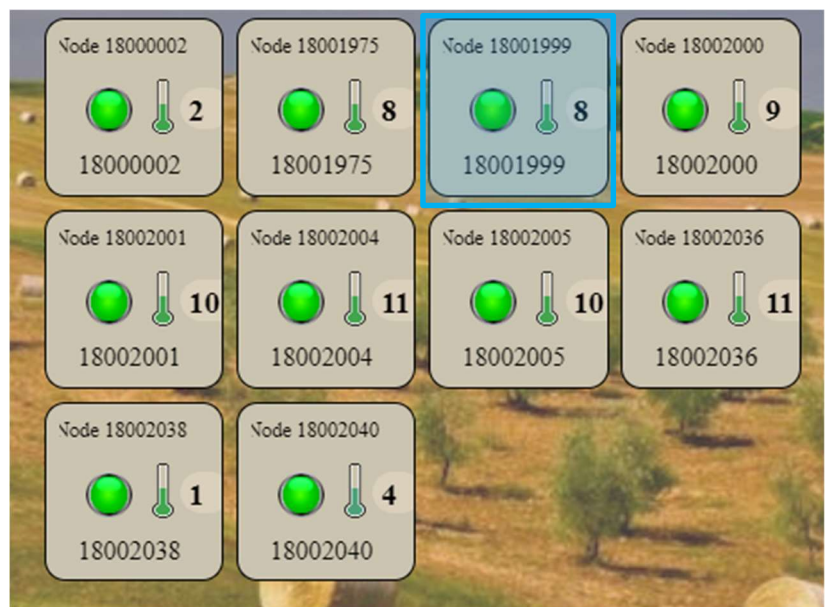


## Right Stage

**NOTE:** To the right of the Gateway in focus you will find all Nodes attached to that Gateway. Only 10 Nodes can be active at once.

**NOTE:** You can quickly spot important devices, by their name, number of sensors, device status, and average temperature.

Click on an attached Node to see the details of that Node and its internal sensors.



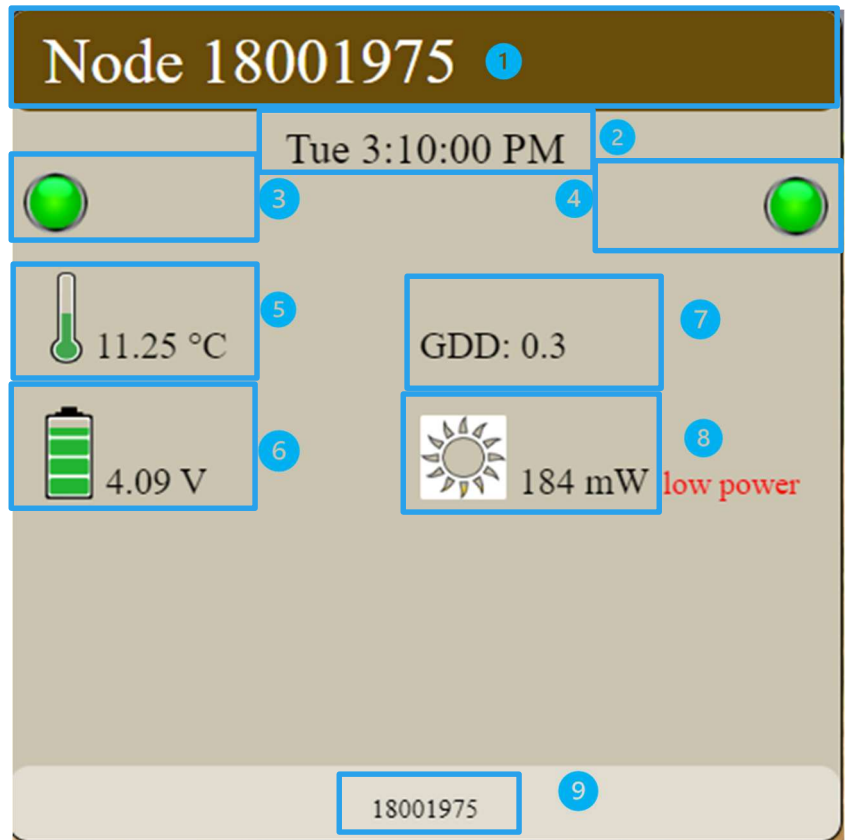
# ACCLIMA DATA PORTAL VI



## Device Focus – Node

When a Node is in focus you can see important information about its status.

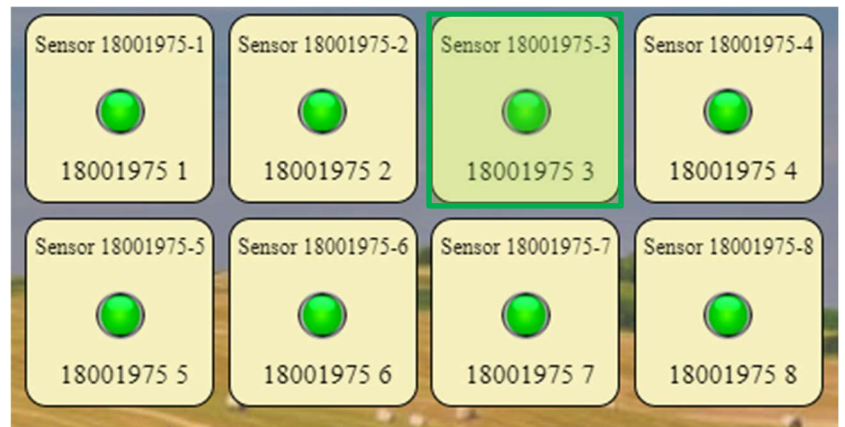
1. Node (Nickname)
2. Date and Time (Last Interval)
3. Detected connection with Gateway.
4. Detected connections with SDI-12 Devices.
5. Node Enclosure temperature
6. Node Battery Voltage
7. Growing Degree Days
8. Solar Current (mW)
9. Node Serial Number



## Right Stage

**NOTE:** To the right of the Node in focus you will find all the SDI-12 devices attached to the Node.

Click on an SDI-12 device to see the details of that device.



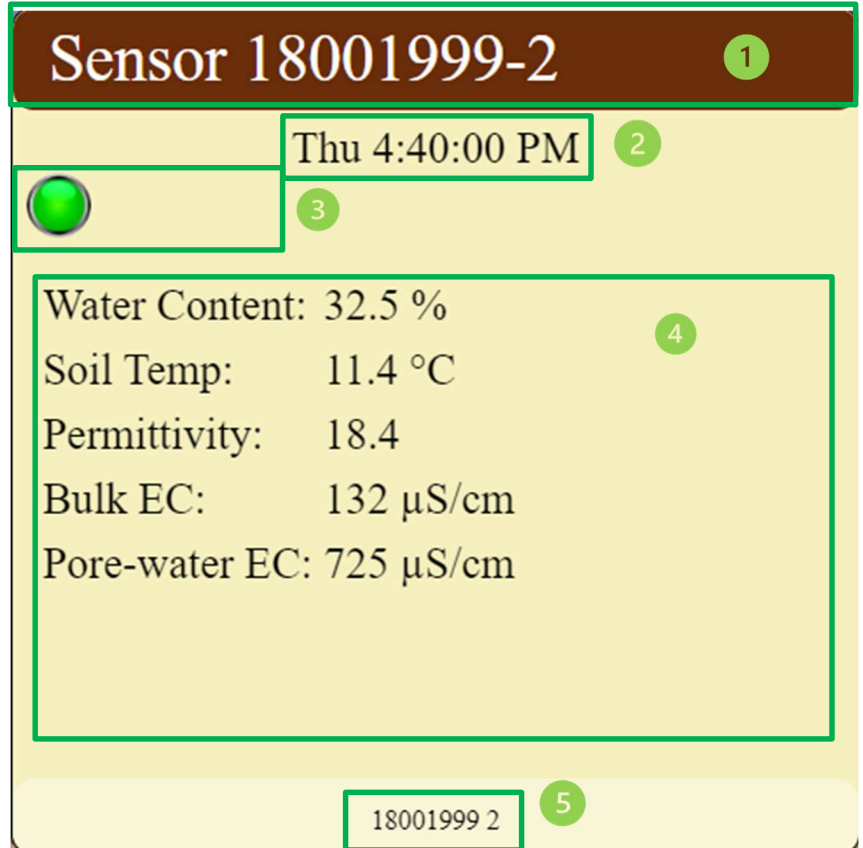


# ACCLIMA DATA PORTAL VII

## Device Focus – SDI-12 Device

When an SDI-12 device is in focus. You can see all readings gathered from the most recent sync interval.

1. Node and Device Address
2. Date and time (Last Interval)
3. Detected connection with Node.
4. (M!) Measurement command replies per last reading interval.
5. SDI-12 device serial number



**Sensor 18001999-2** 1

Thu 4:40:00 PM 2

3

Water Content: 32.5 % 4

Soil Temp: 11.4 °C

Permittivity: 18.4

Bulk EC: 132  $\mu$ S/cm

Pore-water EC: 725  $\mu$ S/cm

18001999 2 5

## Left Stage

**NOTE:** To the Left of the device in focus, you will find its parent device.

Click on the parent device in the left stage to be brought to that device's latest status.



# ACCLIMA DATA PORTAL VIII

## Raw Data

To view the raw data table. You can export the data into a .csv file so that it can be visualized in an Excel spreadsheet.

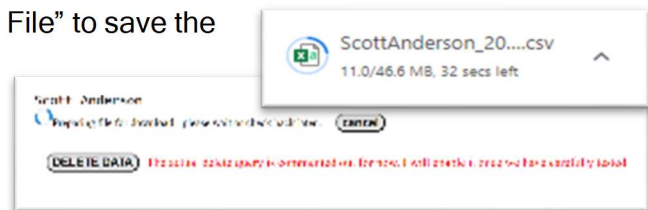
1. Click the “Account Data” shortcut.
2. Click “Download Data.”
3. Select a device or all devices and then choose a specified date range or just start from the beginning and click “Start File Prep”.



**NOTE:** The Cloud server will process a file conversion. That exports the data currently stored on the Acclima Cloud Data Portal, according to the user’s parameters. This process may take several minutes and continues if the user leaves the page.

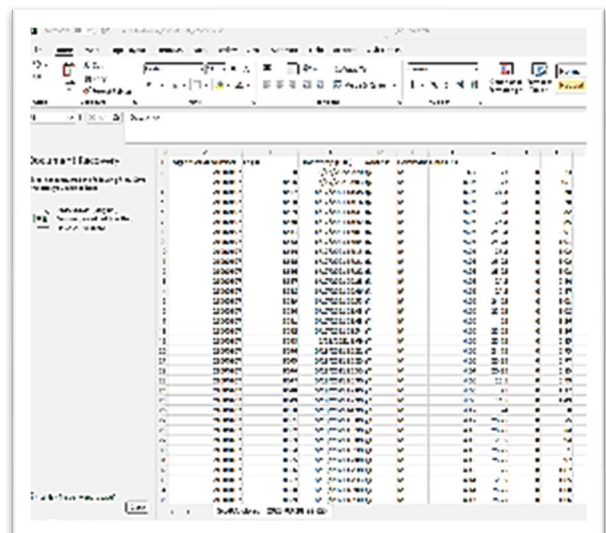


4. Once the file has been created. Click “Download File” to save the file into your downloads folder.
5. You can now open the file with compatible software that supports .csv file types.



**NOTE:** We recommend Microsoft Excel or Google Sheets to open the .csv files. However, both have limits to the total number of rows supported.

**NOTE:** Data rewrite may begin after 32,000 logs.





# FIELD INSTALLATION

## Recommended Tools

- 1/8" Flathead Screwdriver
- Conduit masts for each Node/Gateway use: 1 1/4" SCH 40 PVC
- Shovel/Hand trowel
- Roto Digger/Auger 1 5/8" drill bit, 36 - 60 tall
- Rubber Mallet

## Node/Gateway Field Assembly I

- 1) Set up Node and Gateway in NodeView™.
  - a. Follow guidance from pages (42 - 50) to get Nodes and Gateways networked together and ready for deployment.
- 2) Create your user profile at data.acclima.com.
  - a. Follow the steps found on page (51 and 57) so that you may see the devices update their data on the portal once the system is set up.
- 3) Feed SDI-12 device cables through the conduit for the Solar Nodes. Gateways can skip to step 5.
  - a. Use page (29) as a resource. Attach the Neck and 45° Elbow adapter.
  - b. Use pages (28 - 29) as a resource. Screw down the locking nut onto the Neck
- 4) Terminate SDI-12 sensor wires into the terminal blocks.
  - a. Follow the steps on pages (34 - 35)
- 5) Connect the Neck and 45° Elbow Adapters and feed the cable through the opening. Plug terminal blocks in SDI-12 connectors. Mate the Node, 45° elbow and neck assembly onto the conduit.



## Field Assembly II

- 6) Insert SDI-12 terminal blocks into the SDI-12 connectors of Solar Nodes. Gateways can skip to step 7.
- Use page (35) for guidance.

- 7) Connect the 45° Elbow to the conduit and seat it tightly into the neck. Seat the assembly onto the mast.
- Use page (29) for more details.

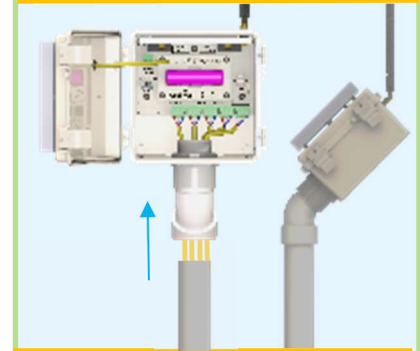
- 8) Tightly screw down the LoRa Radio antenna.
- Use page (27) for more details.

**NOTE:** Antennas must be installed vertically. Use the included wrench in the hardware kit to tighten the SMA adapter into the vertical position.

- 9) Use a shovel and dig a hole to desired depth for soil sensor installation. Keep the excavated soil nearby so that it can be used again later.
- Use pages (32 - 33) for more details.

**Note:** Install sensors within 200 feet of its Node.

- 10) Insert the SDI-12 device into the desired location.
- Maximum cable length is 200ft per device.
  - Sensors can *also* be installed vertically for certain measurements.
  - Use page (33) for more details.



### Field Assembly III

11) Use a Shovel or an Auger to dig a hole for the post/conduit.

**NOTE:** Try to avoid striking previously installed pipes, conduits, and cables.

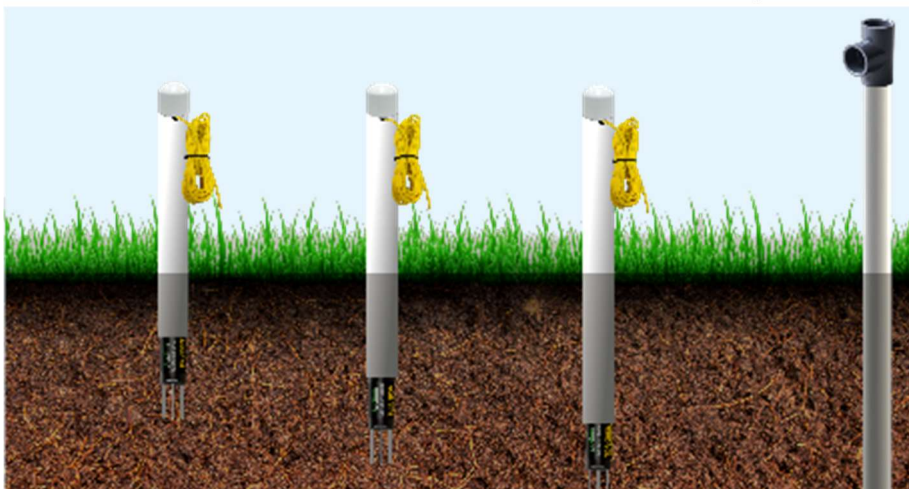
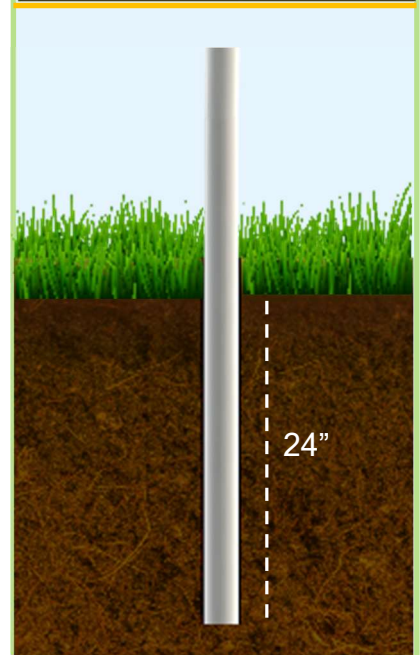
**NOTE:** Acclima recommends a depth of 18" to 24" to properly secure any post or conduit for the Node and Gateway.

12) Insert a PVC post into the opening to support the Node/Gateway in the vertical orientation.

**NOTE:** Use a small mallet to gently tap the post deeper into the soil.

13) Compact the soil around the post to secure it upright.

**NOTE:** Sensors like the TDR-310N can be installed vertically with a 1 ½" PVC pipe. Nodes can then benefit from above-ground sensor cabling. Build the Node utilizing a *3-way SCH 40 1 ¼ inch Tee Fitting coupler* and 2 posts, a lower (approx. 2-3 ft.) and an upper (approx. 5-7ft.). SDI-12 cables can be routed into the conduits through the Tee connector, reaching the Node. The rest of the cable can be raised above ground.



14) Compact the original soil around the sensors to the same density it was before the soil's excavation.

**Note:** A boot or gentle fist should provide enough force to compact the soil to its prior density.

15) If needed dig a narrow, shallow trench approximately 10 to 12 inches, to bury any exposed cables. Do not allow sensor cables to rest on the ground exposed.

**Note:** It is recommended to mark the sensor locations with a small flag.

16) Drive the assembled Node/Gateway into the opening or mate it with any T-Post adapter component and protect the cables from potential hazards.



### Field Assembly Complete

- Power device [On]
- Face the solar panels towards the Sun.
- Securely seal the lid.
- Check Acclima's Data Portal to view sensor readings.  
[Data.acclima.com](http://Data.acclima.com)



# TROUBLESHOOT

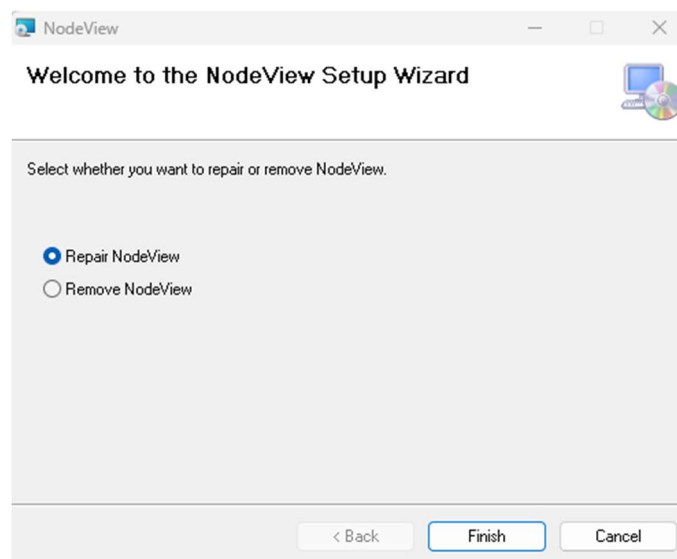
## Uninstalling NodeView

To uninstall NodeView, you may use either the setup utility or you can locate NodeView in your control panel.

### Uninstall with Setup Utility

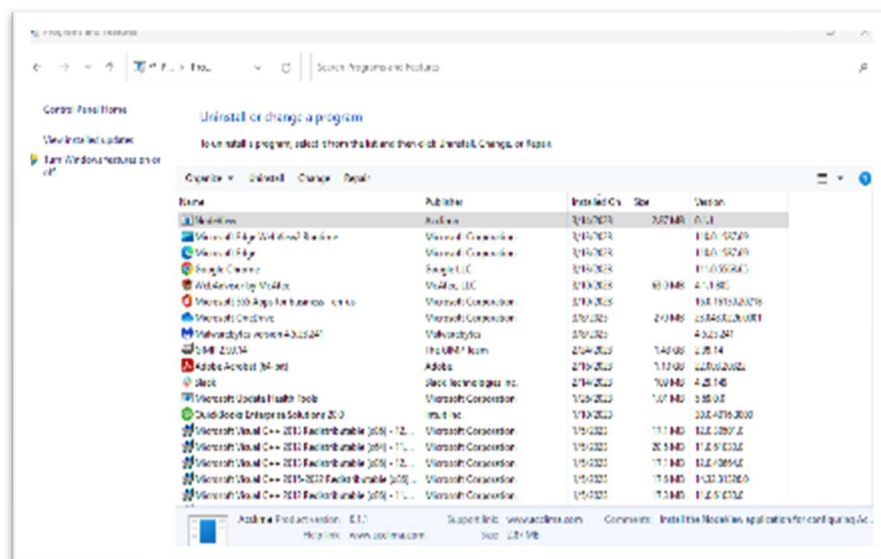
1. Double-click the installer for NodeView.
2. Select “Remove NodeView”.

**Note:** The ‘Repair NodeView’ option should only be used if NodeView fails to launch after attempting to open it. It will reinstall the application while keeping the settings intact.



### Uninstall with Control Panel

1. Open the ‘Control Panel’ application.
2. Click ‘Uninstall a Program.’
3. Search for ‘NodeView’ in the list of installed applications.
4. Select ‘NodeView’ and click ‘Uninstall’

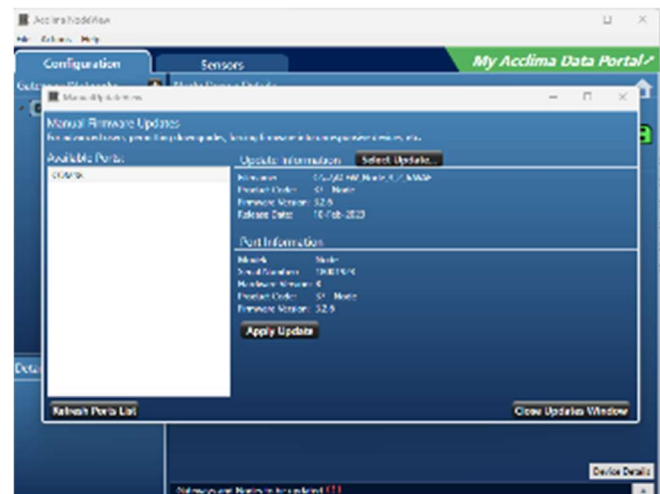
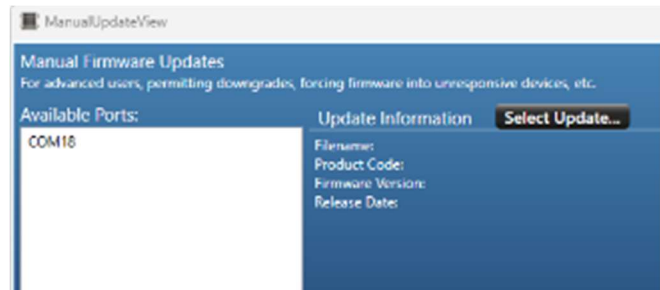


## Updating a Node or Gateway

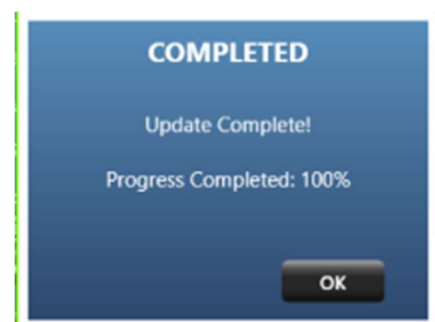
### Manually Updating Firmware

When an update has been made available at [acclima.com](http://acclima.com), it can be downloaded from the website and installed manually into a Node or Gateway. The Node will only accept compatible files and will load files that are incompatible with the hardware selected.

1. Click “Actions” and select [Manually Update Firmware].
2. Connected devices should appear in the field on the left. Select the available “Com Port.”
3. When selected details of the device will appear in the “Port Information” Section.
4. Click “Select Update,” and File Explorer will appear, locate where you have extracted the update file, and click [Open].
5. Select [Apply Update]. A progress bar will appear and complete the update.
6. Click close Updates Window.



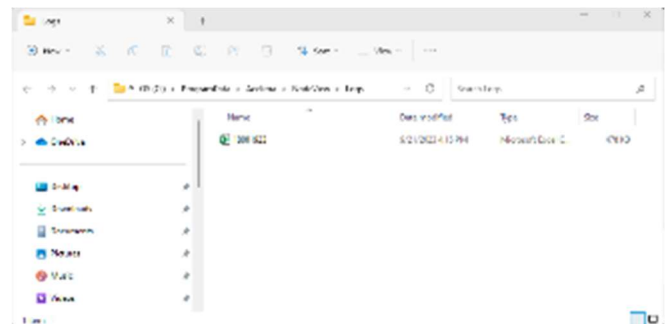
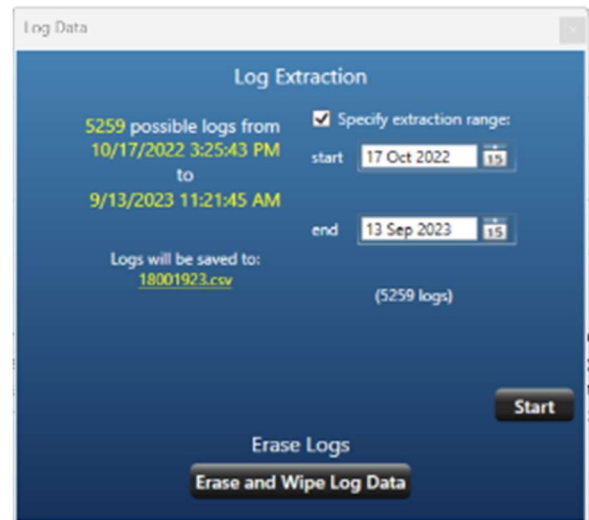
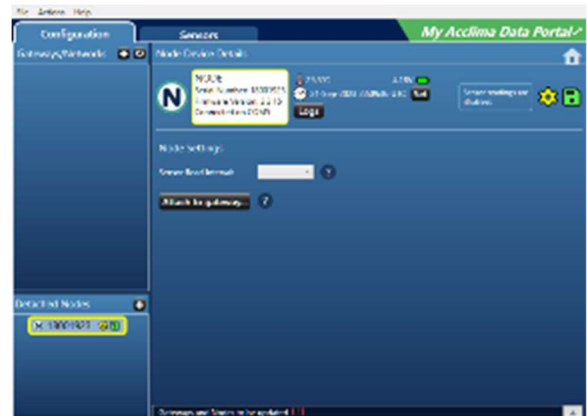
**NOTE:** If the update fails close NodeView and retry the update process.



## Retrieving Logs from Devices

Follow these steps to retrieve logs from a Node or Gateway.

1. Plug in the USB cable into the device and PC.
2. The device will populate into NodeView.
3. Click the Logs button.
4. Select an extraction date range and press “Start”.
5. A .csv file will be created, a short cut to the file can be found by clicking the Help button in the action menu, then clicking “Open Logs Folder”.



# WARRANTY

## Acclima Products Limited Warranty Policy

- A. Our warranty strictly covers manufacturing defects in materials and workmanship in products. The warranty is valid from the date of purchase by the original purchaser and for a period of 24 months.
- B. Exclusions: A) Damage or failure caused by abuse, misuse, faulty installation, and operation, improper or inadequate maintenance, and any repair not conducted by Acclima. B) Damaged resulting from inadequate packaging or carrier mishandling. C) damage incurred by lightning or catastrophic natural disasters such as floods, earthquakes, tornados, hurricanes, or fires. E) Damage incurred from acts of war, of force majeure.
- C. It is the original purchaser's responsibility to provide dated proof of purchase. The warranty is not transferrable.
- D. Acclima will at its sole discretion repair or exchange a product under warranty. No credit will be issued.
- E. The warranty is void when: a) the product serial number has been altered or removed. B) the product has been altered, serviced, or manipulated by anyone other than Acclima or without the prior written authorization of Acclima.
- F. All shipping charges must be pre-paid by the sender. We will ship 'best way' at our discretion.
- G. Service and repairs: Contact [support@acclima.com](mailto:support@acclima.com) or call 866-887-1470. To request a return authorization number RMA. Do not send a product without first securing an RMA#.



# APPENDIX

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# LOG

Rev. 1 Change Log

Additions: Describes all features available at product release.

April 2023.

Rev 2.

Updated GFX, fixed minor issues with templating.

Added retrieving logs page 71.

Acclima Solar Node – Solar Gateway  
User Manual

Visit [www.acclima.com](http://www.acclima.com) for information on all Acclima's products.  
Contact [sales@acclima.com](mailto:sales@acclima.com) with questions.

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