



# SN400 Sensor Node Hardware User Guide

---



*January 2021*

*Release 1.7*

*R9 Technology*

*17217 Waterview Parkway Suite 1.202Y*

*Dallas, TX 75252*

[www.r9technology.com](http://www.r9technology.com)



## Document Revisions

Date	Version Number	Document Changes
09/28/2010	R1.4	Edit to pair button led flash info, other minor edits
01/11/2021	R1.5	Change DC adapter voltage to 3.0V, other minor edits.
01/21/2021	R1.6	Updated battery information
03/26/2021	R1.7	Updated battery information



## Table of Contents

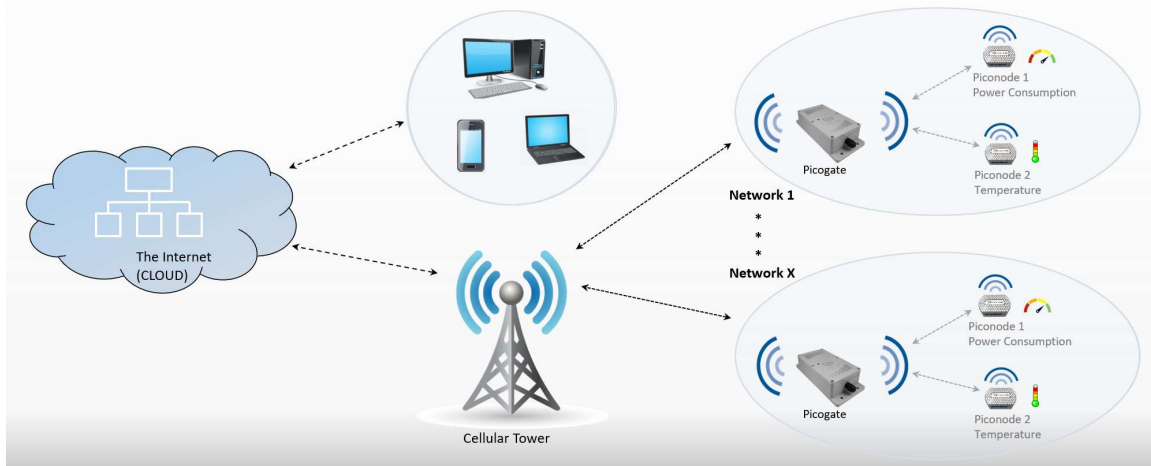
1	Introduction.....	4
2	SN400 Product Label.....	5
3	Wireless Operating Band (Antenna).....	7
4	Power.....	7
5	Indicators and Buttons.....	9
6	Physical Dimensions.....	11
7	Installation.....	11
8	Troubleshooting.....	13
9	Sales and Warranty Policy.....	13
6	Specifications.....	14
7	Certifications - United States FCC Statement.....	15

---

# 1 Introduction

This User Guide covers specific hardware features of R9 Technologies model **SN400 sensor node**. Several SN400 devices can accumulate electronic sensor data, and then wirelessly transmit this sensor information to a single gateway device (wireless sensor network). The gateway device will then use an LTE wireless data link to transfer this sensor data to a database located on an internet-based server. The database can be used by customers to view and analyze the gathered sensor information. Because the SN400 node has much lower cost, complexity, and power requirement than the gateway device, the overall system cost and flexibility is optimized.

The SN400 device's position in the overall network can be seen in the diagram below. The SN400 "Piconode" device is at the far-right end of the network diagram. It gathers sensor information using wired sensors, which will, ultimately, be viewed and analyzed on a user's personal computer or smart device using a web-browser. Alerts which are received via SMS text can also be implemented using the R9 web-based system.



The SN400 sensor node has four ports, each port can support one cabled sensor (for example, temperature, humidity, door closure, tank liquid level, light level). It is also possible to support multiple data types on one port, for example temperature and humidity can be read from the same cabled sensor. Cabled sensors are plugged into the SN400 using a three-pin connector. The connector is keyed, so the sensors cannot be installed using the wrong orientation. Typically, each SN400 sensor port is provisioned at the factory for a specific sensor type (analog, digital, specific communication format). Therefore, specific sensors will need to be plugged into specific port numbers. The

---

**SN400 Installation Guide** and **R9 Online Portal User Guide** contains information on specific sensors and associated port numbers. Also, when onboarding your system on the R9 web portal, you will be guided through the process of inserting wired sensors into the SN400. The onboarding process is customized for specific sensing applications.



The sensor node device is typically mounted to equipment, and then cabled sensors are applied to specific areas for sensing. For example, a node device is attached externally to a refrigerator, and then a cabled temperature sensor is routed inside the refrigerator to measure temperature.

**For simple installations, the SN400 node can be installed inside a room, or refrigerator/freezer, without cabling** for the measurement of temperature. If installed inside a refrigerator/freezer, wireless range may be diminished (typically by one third to one half), but should be adequate for connection to a nearby gateway device.

The SN400 sensor node requires an external DC power source, or two AAA alkaline batteries to operate. The sensor node does not have a power switch. When power is applied by DC jack or insertion of batteries, the device will power on and automatically begin to broadcast information to allow synchronization with, and connection to a nearby gateway that is also powered on. Note that in order to pair with (connect to) a gateway device, all sensor node devices should be setup first, using the online R9 portal. Refer to the **R9 Online Portal User Guide** for information on how to onboard and configure the gateway and sensor nodes in your monitoring system.

## 2 SN400 Product Label

The SN400 product label located on the side of the device will indicate several important features of the device.

1. The MAC ID, circled in red, in the picture below is unique to a specific SN400 device. The last 5 digits of the MAC ID will be entered into the online portal system during setup, and is used to identify the SN400 in the system. The last 5 digits of the serial number is also entered.
2. The complete model number of the SN400 device indicates the specific configuration of a particular device variant. For example, sensor port configuration, wireless bands of operation, enclosure color, etc.



A typical model number is **SN400-D1AAA**. This part number indicates:

- D1 – port configuration: Port 1 and 2 are set up for digital pulse counting, Port 3 is digital one wire, Port 4 is digital input.
- A(1) - Antenna: Internal 915 MHz. ISM band antenna is provisioned and selected.
- A(2) - Power: Powered by internal AAA batteries.
- A(3) - Enclosure: Indoor plastic case, color black.

In plain terms, the specific model/part number **SN400-D1AAA** has the following sensor port configuration:

- Port 1: temperature sensor (digital pulse count)
- Port 2: temperature sensor (digital pulse count)
- Port 3: dual sensor, humidity and temperature (bi-directional digital one wire)
- Port 4: Door Ajar (digital input by switch open/close)

Consult the factory for more information on available SN400 model number variants.

---

### 3 Wireless Operating Band (Antenna)

The SN400 will use only the 915 MHz. ISM band (United States) to wirelessly connect to, and transmit/receive data from the gateway device. The frequency range of operation is 902 MHz. to 928 MHz. The SN400 uses a frequency hopping algorithm to minimize generated noise and improve immunity from external RF interference. An 868 MHz. ISM band (European) version of the SN400 is also available (SN401).

The SN400 915 MHz. antenna is PCB mounted and located internally to the enclosure. Note that it is possible to connect an external antenna to the SN400 device. This is supported only as an option, and should not be necessary in a typical application.

### 4 Power

The SN400 sensor node requires an external DC power source, or two AAA alkaline batteries to operate. **Typical installations will always use batteries for power.** When power is applied by DC jack or insertion of batteries, the device will power on and automatically begin to broadcast information to allow synchronization with, and connection to a nearby gateway that is also powered on. Note that in order to pair with (connect to) a gateway device, a sensor node device must have been configured previously in the online R9 portal. Refer to the **R9 Online Portal User Guide** for information on how to onboard and configure the gateway and sensor nodes in your monitoring system.

**The sensor node does not have a power switch.** Remove the battery compartment lid located on the rear of the SN400 and install 2 AAA batteries in the correct orientation (marked on battery holder) and replace lid. To open the battery lid, pull the small tab toward the door, and lift at the same time (using your finger nail or small screw driver).

**DC Power Supply:** when using a DC power adapter, sensor values will not update if wall power is interrupted. For this reason, it is not recommended to use a DC wall adapter, unless absolutely necessary. Contact R9 Technology to purchase a DC wall adapter.

- The power supply is +3.0V, center pin positive. The DC power supply can be inserted into the sensor node without removing batteries.
- The DC power supply must be plugged into a 120V 60Hz. AC wall outlet if operating in the United States. The DC Jack output is then plugged into the power input port on the SN400.

- 
- An optional 220V AC, 50 Hz supply will be required in most parts of Europe or Asia.

#### **Batteries:**

- The sensor node can be powered from 2 AAA alkaline batteries. The expected battery life will vary for each specific application. Average battery life-span is approximately 2 years for the “Safezone” application (two temperature probes and 15-minute reporting interval).
- Batteries are not supplied with the sensor node, and should be inserted by the customer at the time of SN400 installation. If the sensor node device is not to be used for a long period of time, the batteries should be removed to prevent their depletion.
  - **AAA alkaline batteries are recommended** (can be purchased from drug store, shopping center, etc.). AAA alkaline cells provide the best value in terms of cost and battery longevity, at room temperature conditions. Alkaline batteries are ok for use inside a refrigerator (temperatures down to about 35F), although the longevity will likely be reduced.
  - **Lithium AAA batteries:** Lithium batteries should be used in extreme cold environments (sensor node located inside a freezer with temperature below 0F or -18C). Alkaline batteries do not operate optimally at temperatures below 0F or -18C. Lithium chemistry batteries operate at temperatures down to approximately -40F = -40C. It is best to use Lithium batteries in freezer environments (temperatures below 32F). Do not confuse Lithium AAA cells with Lithium polymer rechargeable batteries.

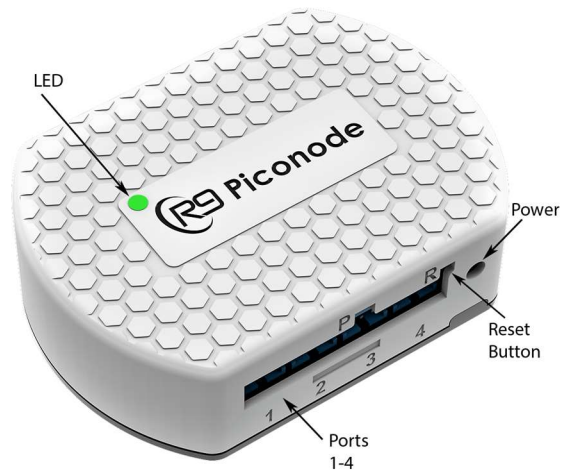


- **Rechargeable AAA batteries:** recently, several types of AAA equivalent rechargeable batteries have become commonly available. NiMH (nickel metal hydride) AAA rechargeable cells have been tested with the sensor node. NiMH cells have significant self-discharge, and will lose 5%-20% of their charge per month. Although rechargeable cells function, they are not recommended as they require more frequent re-charging as compared to alkaline cells.



---

## 5 Indicators and Buttons



1. Reset Button (R) – Momentary “quick” press resets the SN400 to power-on condition (initialize). The LED will quickly flicker red/green during power-on, or when reset button is pressed.
2. Pair Button (P) – Momentary “quick” press will use the LED to indicate paired status of the Node (to Gateway). See table on next page for pair button operation.
3. Power Input Port – Utilized for input of external DC power (3.3V) using DC jack. External power supply sold separately.
4. Sensor Ports – Utilized to connect external, wired sensor probes.
5. Pair/Reset LED – Indicates SN400 network paired status, as well as reset or power-up status. See table on next page.

The SN400 uses a red/green bi-color LED indicator to communicate the status of the sensor node. To save battery power, the SN400 sensor node will briefly illuminate the LED. To query the paired status of the SN400 without interrupting operation, a “quick” press of the pairing button (P) will indicate the network pairing status (to gateway) using the LED indicator. Long pressing the pairing button will cause the SN400 to clear its paired status to a gateway, and it will start broadcasting to initiate a new connection to a nearby gateway. Pushing reset does not clear the pairing memory or status. Pushing reset will cause the SN400 to initialize to a power on state. The tables below cover detailed operation of the pairing (P) and reset (R) buttons, as well as the LED indication.

SN400 LED indication - <b>power on and reset button quick press</b>			
	Color	Blink Count	Description
	Red/Green	fast 6	The SN400 LED will illuminate with a quick flicker of both red and green colors on the LED. The SN400 sensor node is initialized, but the gateway pairing information is not erased. A small screwdriver will aid in pushing the tiny button.

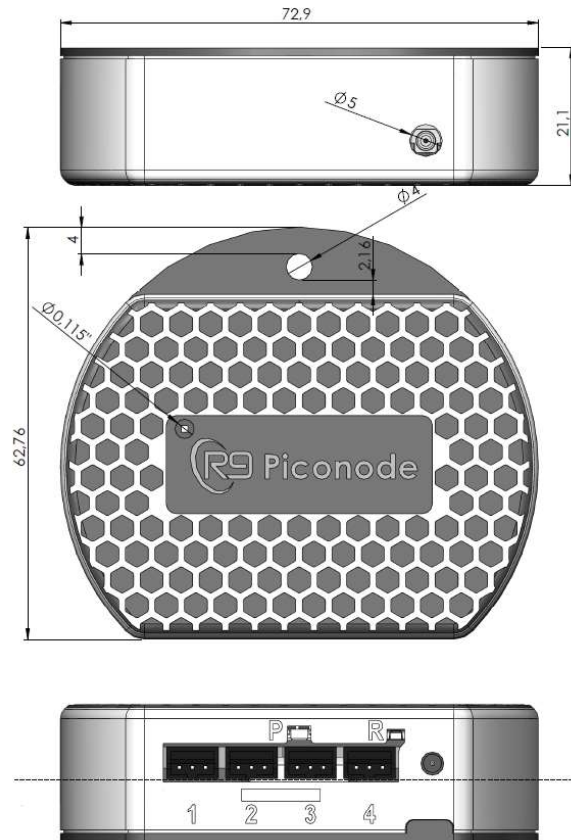
SN400 LED indication - <b>pairing button QUICK press</b>			
	Color	Blink Count	Description
	Red	quick 3	Indicates SN400 is on, and <b>IS NOT paired</b> to a gateway sensor network. The SN400 will continuously broadcast to try and locate a gateway to pair to. A gateway will not pair to a node unless it is provisioned to do so in the online portal.
	Green	quick 3	Indicates SN400 is on, and <b>IS paired</b> to a gateway sensor network, as provisioned in the online portal. Note that “paired” indicates the node pairing memory is set with gateway information. “paired” does not indicate the node is currently communicating with a gateway (communication happens infrequently based on sample interval, typically 15 minutes).

SN400 LED indication - <b>pairing button LONG press</b>			
	Color	Blink Count	Description
	Red/Green	fast 6	Erase the gateway pairing memory. Depress the pairing button for a count of five seconds and then release. The LED will quickly flash red/green six times to indicate that the gateway pairing information has been erased. The SN400 will begin broadcasting to find a nearby gateway to pair to. A small screwdriver will aid in pushing the tiny button.

---

## 6 Physical Dimensions

All dimensions are shown in millimeters.



## 7 Installation

To facilitate mounting, the SN400 is provided with two rear facing magnets for easy attachment to a ferrous metal, steel surface. Alternatively, a fastener screw, or double-sided adhesive foam tape can be used on the top flange for mounting to a wall or other flat surface. The node will frequently be attached to large equipment, and should always be located as high as possible on the equipment (for best wireless performance). Sensor cables should always exit the bottom of the enclosure in a downward direction (for first few inches) to prevent ingress of moisture or other contaminants. A separate document, the **SN400 Installation Guide** is available that covers the installation of the SN400 product and cabled sensors, at a user site, for remote monitoring of sensor data.

---

The image below shows the SN400 installed inside a refrigerator using integrated magnets (attached to steel shelf frame). The external sensor ports are protected by the refrigerator shelf from liquid spills. Ideally, the external ports should point downward to prevent ingress of spills and liquids.



The image below shows the SN400 installed on the outside of a refrigerator using integrated magnets. An external wired sensor is used to sense refrigerator temperature.



---

## 8 Troubleshooting

The table below indicates common issues and resolutions for the SN400 sensor node.

Symptom	Issue	Resolution
Reset button works properly, but pairing button does not work. SN400 will not connect to portal.	AAA batteries are low. When batteries are low, there is typically enough energy to allow the SN400 to reset, but not enough energy to run other operations.	Replace AAA batteries.

## 9 Sales and Warranty Policy

Please download the sales and warranty policy document from our website at [www.r9technology.com](http://www.r9technology.com). It is located online in the documentation section (under resources tab).

---

## 6 Specifications

- Wireless 915 MHz ISM band connectivity for sensor data transfer (868 MHz. option)
- Software-defined radio (SDR) chip-set
- AES128 encryption providing secure sensor node communication
- Provides local and remote digital temperature sensing
  - Four channels: -30°C to 85°C  $\pm$ 0.6°C remote sensing temperature range (wired probe)
  - Single channel: -20°C to 45°C local ambient temperature range (limited by batteries on module)
- Supports multiple digital probe types, including serial one wire, pulse counting, GPIO (one bit)
- Supports up to four channel analog input configuration (0V-10V)
- External reset button
- External network status button
- Small (62.8 mm height x 72.9 mm width x 21.1 mm thickness) ABS plastic enclosure
  - Integrated magnet system for attachment to metal surfaces, including refrigerator and freezer.
  - Mounting flange for use with screw-mount applications.
- Bi-color LED indicator (red/green)
- Built-in system sleep timer for lowest possible power consumption, and longest possible battery life
- Operated by Internal battery or external DC power supply
- 2x AAA alkaline battery power. (2+ years of battery life @ 15-minute reporting intervals)
- DC jack for external power input (0.65 mm, 3.0V)
- -20°C to 45°C device temperature operating range (with batteries on module)
- Optional external antenna can be configured
- Optional external DC power supply

---

## 7 Certifications - United States FCC Statement

### Compliance Statement (Part 15.19)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

### Warning (Part 15.21)

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement (Part 15.105 (b))

#### NOTE:

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

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

### FCC Radiation Exposure Statement:

This equipment complies with the FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator and all persons. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.