JUNO OPERATING INSTRUCTIONS

Thank you for choosing the Apollon sensor from Sentinum. Please read the following operating instructions carefully to prevent damage to the sensor, yourself and the environment.

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1. GENERAL WARNINGS AND SAFETY INSTRUCTIONS

Warnings and important information about potential hazards or damage

Important information required for smooth operation of the devices

Please note:

- Observe the safety instructions and installation instructions in the manual and the installation list.
- Ensure that the installation environment complies with the prescribed application area guidelines. Observe the temperature and other limit values at all times.
- The device may only be used in the areas specified in the technical specifications.
- The device may only be used for the purposes and in the areas described.
- Safety and functionality can no longer be guaranteed if the device is modified or extended.
- The sensor must not be mounted on ceilings or floors
- Operation of the sensor is only permitted up to a maximum of 2000 meters above sea level.
- Operation is only permitted at a maximum room height of 2 meters.
- Due to human exposure regulations, a minimum distance of 20 cm must be maintained between the appliance and persons.
- Ensure that the installation environment complies with the prescribed guidelines for the area of application. Observe the temperature and other limit values at all times.
- Ensure that the installation environment complies with the prescribed guidelines for the area of application. Observe the temperature and other limit values at all times.

If the device is installed **incorrectly**:

- Could it not be working properly.
- Could it be permanently damaged?
- Could it pose a risk of injury.

Please note:

- Improper handling, e.g. improper mechanical stress, such as dropping the appliance, can result in damage.
- If battery cells other than those recommended are used, performance and product safety may be negatively affected.
- The appliance may only be installed and put into operation if it can be removed from its original packaging undamaged. A visual inspection for damage must be carried out immediately after removal. If the product is damaged, it must not be put into operation.

2. FURTHER DOCUMENTATION

Please observe the information and limit values in the technical data sheet.

The sensor-specific factory settings (Sentiface), as well as the keys and permitted values of the sensor can be found in the NFC and downlink description. The Senticom and Sentivisor tables can be found in the generic NFC and downlink documentation. The special functions for vandalism detection and opening detection are also generic.

The option to configure sensor communication can be found in the respective generic LoRaWAN® , Mioty® or Cellular (NB-IoT and LTE-M1) documentation, depending on the version.

All documents relating to generic documentation can be found at https://docs.sentinum.de/wichtig-produktübergreifende-dokumentation-für-sensoren.

3. INTENDED USE AND PRODUCT VERSIONS

These operating instructions apply to the entire Juno product series.
There are various product versions within the series, which differ in their localization methods as well as in the equipment and functionality of the sensors. The specific features and functions of the respective versions are explained separately in the rest of this manual.

3.1. PRODUCT CODES AND FUNCTIONS

Item number	Radio standard	Functions
S-JUNO(-iX)-LOEU	LoRaWAN®	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-MIOTY	mioty®	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-LOEU-TH	LoRaWAN®	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-MIOTY-TH	mioty®	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO-NB-TH	NB-IoT	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-LOEU-TRACK	LoRaWAN®	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-LOEU-TH-TRACK	LoRaWAN®	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-NBM1-TRACK-2	NB-IoT, CAT-M1	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-NBM1-TRACK-3	NB-IoT, CAT-M1	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-NBM1-TH-TRACK-2	NB-IoT, CAT-M1	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-NBM1-TH-TRACK-3	NB-IoT, CAT-M1	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-MIOTY-TRACK	mioty®	Tilt detection, activity detection, opening and motion detection
S-JUNO(-iX)-MIOTY-TH-TRACK	mioty®	Temperature, relative humidity, tilt detection, activity detection, opening and motion detection

3.2. PRODUCT CODES AND LOCALIZATION PROCEDURES

Item number	Radio standard	WIFI SSID Scan	GNSS Scan	GNSS	Cell Locate	Tracking in the LPWAN
S-JUNO(-iX)-LOEU	LoRaWAN®	X	X	X	X	✓
S-JUNO(-iX)-MIOTY	mioty®	X	X	X	X	✓
S-JUNO(-iX)-LOEU-TH	LoRaWAN®	X	X	X	X	✓
S-JUNO(-iX)-MIOTY-TH	mioty®	X	X	X	X	✓
S-JUNO-NB-TH	NB-IoT	X	X	X	✓	X
S-JUNO(-iX)-LOEU-TRACK	LoRaWAN®	✓	✓	X	X	✓
S-JUNO(-iX)-LOEU-TH-TRACK	LoRaWAN®	✓	✓	X	X	✓
S-JUNO(-iX)-NBM1-TRACK-2	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TRACK-3	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TH-TRACK-2	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TH-TRACK-3	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-MIOTY-TRACK	mioty®	✓	X	✓	X	✓
S-JUNO(-iX)-MIOTY-TH-TRACK	mioty®	✓	X	✓	X	✓

3.3. INTENDED USE

The Juno sensor is a wireless, battery-powered IoT device for recording environmental and motion data. It is designed for use in industrial and commercial applications, in particular for condition monitoring and localization of objects in indoor and outdoor areas.

Depending on the product variant, the sensor has different sensor modules (e.g. temperature, movement, inclination) and different localization technologies (e.g. GNSS, WIFI SSID Scan, GNSS Scna, LoRaWAN-based positioning). The sensor is intended exclusively for the applications described in the instructions and may only be operated within the scope of the technical specifications stated therein.

Any other use or use beyond this is considered improper use. Sentinum GmbH accepts no liability for any resulting damage.

3.4. DIFFERENCES BETWEEN THE IX VERSIONS

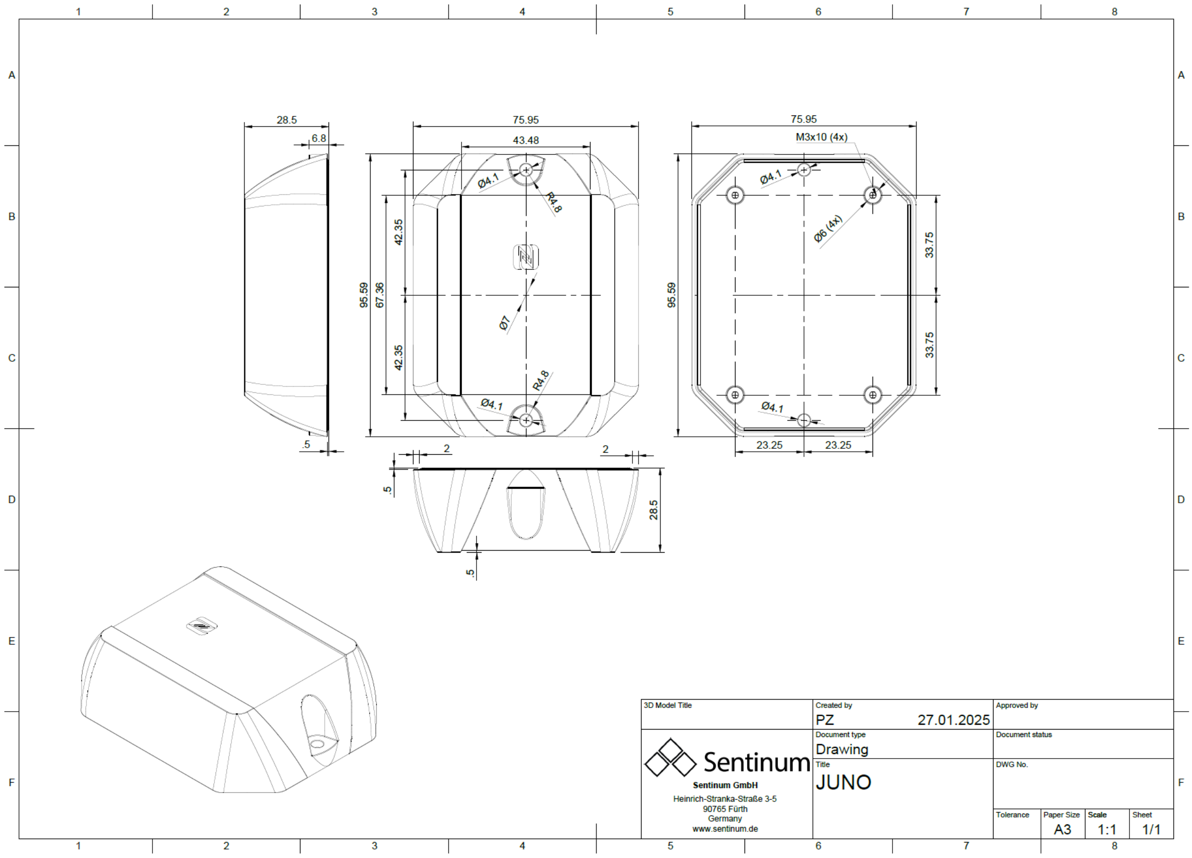
The Juno iX versions have extended certifications for industrial use.
They also offer an extended scope of delivery and additional configuration options in terms of measurement and transmission intervals. For example, the iX models allow a minimum measurement and transmission interval of one minute, while the standard version requires a minimum interval of five minutes . The industrial Juno versions and the standard versions also differ in their housing color.

Version	Housing color
Standard version	black
-iX industrial versions	silk gray

4. TECHNICAL DRAWING

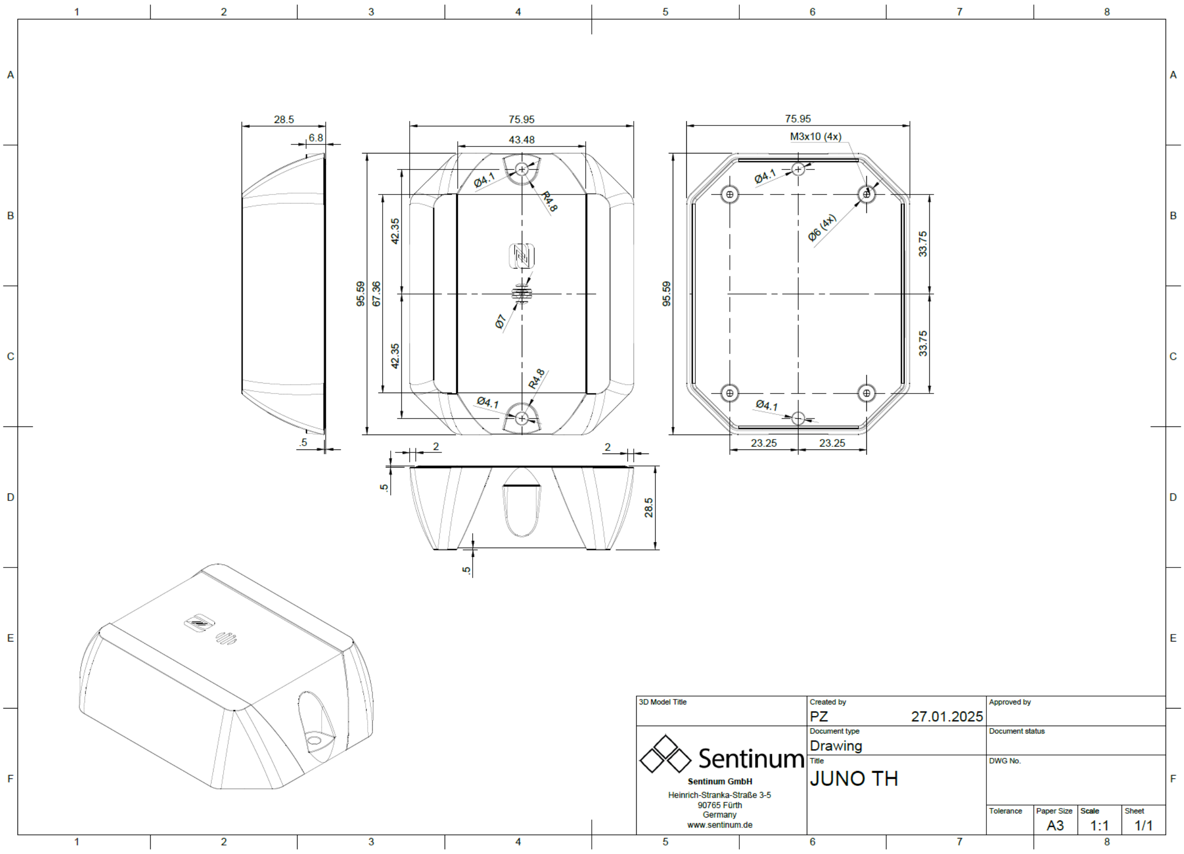
4.1. JUNO (WITHOUT TH)

Technical drawing without the opening for the TH sensor.



4.2. JUNO TH (WITH TH OPENING)

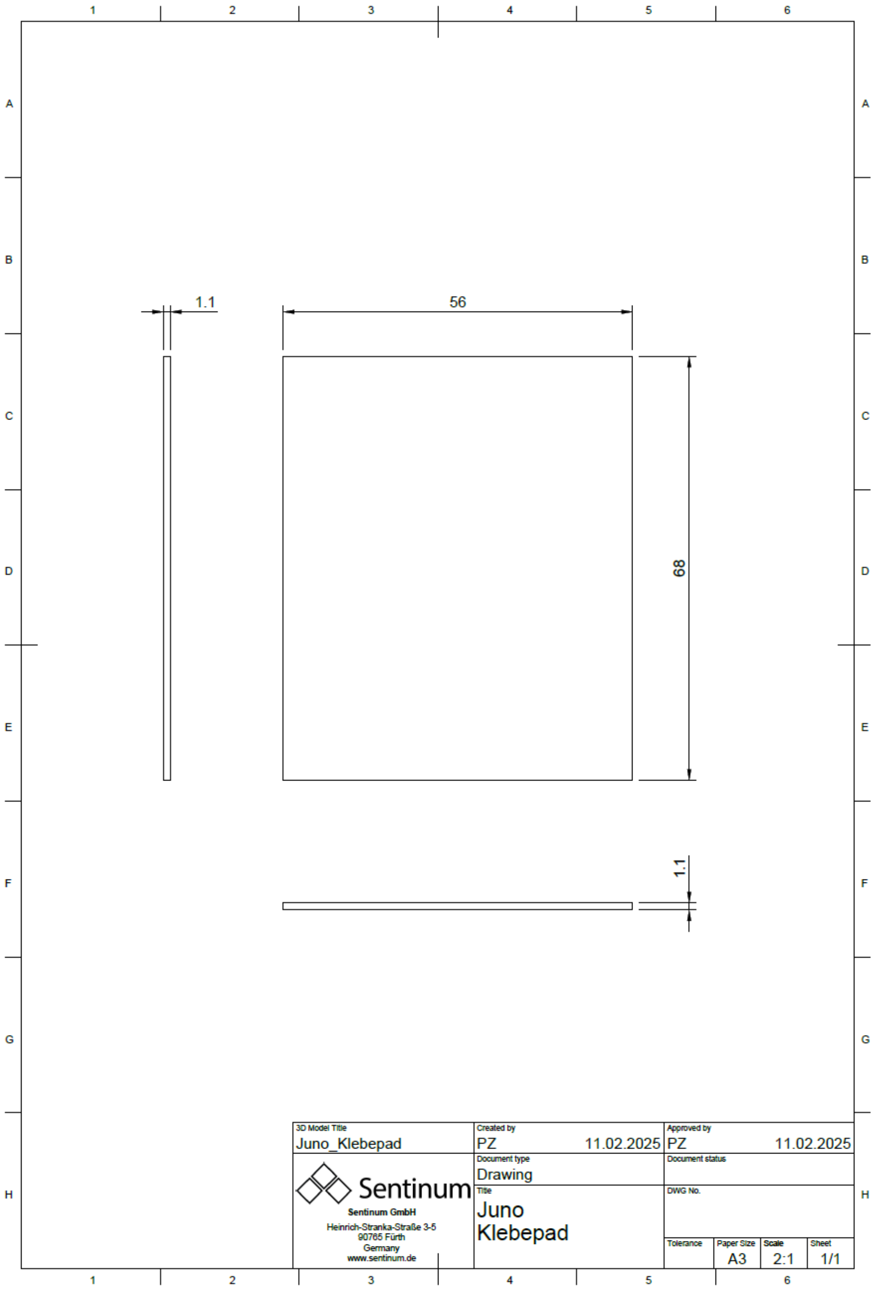
Technical drawing with the opening for the TH sensor.



5. SCOPE OF DELIVERY

Product versions	Scope of delivery
Standard version	• Sensor • Batteries
-iX industrial versions	• Sensor • Battery • Drilling template • Adhesive pad

5.1. ADHESIVE PAD TECHNICAL DRAWING



6. APPROVED BATTERIES AND TYPES

The following battery types are approved for operating the product. Please note that the choice of battery has a significant influence on the operating time.
For maximum operating time, we recommend the use of standard batteries.

Item number	Approved batteries
S-JUNO(-iX)-LOEU/MIOTY **S-JUNO(-iX)-LOEU/MIOTY-TH** **S-JUNO(-iX)-LOEU/MIOTY-TRACK** **S-JUNO(-iX)-LOEU/MIOTY-TH-TRACK**	• Energizer Ultimate Lithium AA • Varta ULTRA Lithium AA • Varta Longlife Power AA • SAFT LS14500 **(standard)**
S-JUNO(-iX)-NBM1-TRACK-2 **S-JUNO(-iX)-NBM1-TRACK-3** **S-JUNO(-iX)-NBM1-TH-TRACK-2** **S-JUNO(-iX)-NBM1-TH-TRACK-3** **S-JUNO-NB-TH**	• CR14505 (HCB) • ER14505M (HCB, **standard**) • UHR-ER14505-X (Ultralife)

7. ACCESSORIES

Item number	Description
PBA-000102	Adhesive pad for Juno
Z-JUNO-MAG-NEO	2x neodymium magnet with screws for Juno series sensors, holds 36kg.

8. DETECTION AND LOCALIZATION METHODS OVERVIEW

In general, all LoRaWAN® devices can be located via the LoRaWAN® . This requires gateways with GPS synchronization.

As of Q2 2025, the Apollon-Q and Juno series in the Sentinum product portfolio are equipped with extended tracking functions.

Localization via BLE function can be activated on request.

Item number	Radio standard	WIFI SSID Scan	GNSS Scan	GNSS	Cell Locate	Tracking in the LPWAN
S-JUNO(-iX)-LOEU	LoRaWAN®	X	X	X	X	✓
S-JUNO(-iX)-MIOTY	mioty®	X	X	X	X	✓
S-JUNO(-iX)-LOEU-TH	LoRaWAN®	X	X	X	X	✓
S-JUNO(-iX)-MIOTY-TH	mioty®	X	X	X	X	✓
S-JUNO-NB-TH	NB-IoT	X	X	X	✓	X
S-JUNO(-iX)-LOEU-TRACK	LoRaWAN®	✓	✓	X	X	✓
S-JUNO(-iX)-LOEU-TH-TRACK	LoRaWAN®	✓	✓	X	X	✓
S-JUNO(-iX)-NBM1-TRACK-2	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TRACK-3	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TH-TRACK-2	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-NBM1-TH-TRACK-3	NB-IoT, CAT-M1	✓	X	✓	✓	X
S-JUNO(-iX)-MIOTY-TRACK	mioty®	✓	X	✓	X	✓
S-JUNO(-iX)-MIOTY-TH-TRACK	mioty®	✓	X	✓	X	✓

8.1. COMPARISON OF DIFFERENT TECHNOLOGIES

Technology	Range under good conditions (m)*	Range in poor conditions (m)	Power consumption	Suitability for indoor tracking	Costs
BLE scanning (not implemented, on request)	1 - 3	5 - 10	Low	High	Medium
WIFI SSID Scanning	1 - 5	5 - 20	Low	High	Medium
GNSS (GPS, Glonass, BeiDou, Galileo)	3 - 5	5 - 10	High	Not suitable	High
Mobile radio localization via triangulation or radio cells	10 - 150	150 to several kilometers	Low	Low	Low
GNSS Scan	1 - 10	10 - 200	Low	Not suitable	Medium
UWB	<0,1 - 0,3	0,3 - 0,5	Low	Very high	Medium
Tracking via the LoRaWAN* **	200 - 500	500 - 1500	None	Practically not suitable	Low

*Good conditions: Few shadowing effects, direct connections to satellites or gateways, very good antennas
**Poor conditions: Large shadowing effects such as trees, buildings or walls, poor connection quality
***Depends on the number of gateways and gateway equipment

8.2. INTELLIGENT USE OF DIFFERENT TRACKING TECHNOLOGIES FOR ENERGY OPTIMIZATION

We combine various tracking technologies for precise and energy-efficient location determination: WiFi SSID scan, GNSS, GNSS scan and Cell Locate. Each of these technologies has specific strengths that we use flexibly and depending on the situation.

- The WiFi SSID scan detects available WiFi networks in the vicinity and determines a position based on known SSID locations. This method is extremely energy-efficient and enables fast location updates - ideal in urban areas with dense Wi-Fi coverage.
- GNSS (Global Navigation Satellite System, e.g. GPS) offers very precise positioning, but is very energy-intensive in comparison. GNSS is therefore only activated when other methods do not provide sufficiently accurate data.
- The GNSS scan only collects satellite data and optimizes the position calculation without permanently maintaining an active GNSS session. This also saves a considerable amount of energy compared to permanent GNSS use.
- Cell Locate enables positioning based on mobile radio cells. This method is available globally and ensures a rough but continuous location determination even if there is no WLAN or GNSS signal.

Intelligent control and prioritization - such as the preferred use of WiFi scans - can significantly reduce the device's energy consumption. Only when WiFi or cell positioning is not sufficient does the device automatically switch to GNSS or other more precise methods.

All tracking strategies and fallback mechanisms are individually configurable so that the best balance between energy efficiency, accuracy and availability can be selected for different applications and regions.
Even if individual technologies vary depending on the environment, this flexible combination enables virtually seamless and detailed route recording worldwide.

We also offer suitable solutions for indoor scenarios in which GNSS signals are often unavailable or inaccurate. The WiFi SSID scan and the use of known indoor access points make it possible to reliably determine the position even inside buildings. Optionally, indoor positioning can be supplemented by additional technologies such as Bluetooth Low Energy (BLE) beacons or inertial sensors.

This enables precise location determination even in complex environments such as shopping centers, airports or industrial halls - seamlessly integrated into the existing tracking concept.

8.3. WHICH SENSORS USE WIFI SSID SCAN?

In the Sentinum product portfolio, parts of the Juno and Apollon-Q series are equipped with a WIFI SSID scan function. The Cellular and mioty® products are equipped with a 2.4 GHz and 5 GHz WIFI SSID scan for the evaluation of up to 20 MAC addresses, the LoRaWAN® products with a 2.4 GHz WIFI SSID scan for up to six addresses:

Item number	Radio standard	2.4 GHz scan	5 GHz scan	Maximum number of MAC addresses
S-JUNO(-iX)-LOEU-TRACK	LoRaWAN®	✓	X	6
S-JUNO(-iX)-LOEU-TH-TRACK	LoRaWAN®	✓	X	6
S-JUNO(-iX)-NBM1-TRACK-2	Cellular	✓	✓	20
S-JUNO(-iX)-NBM1-TRACK-3	Cellular	✓	✓	20
S-JUNO(-iX)-NBM1-TH-TRACK-2	Cellular	✓	✓	20
S-JUNO(-iX)-NBM1-TH-TRACK-3	Cellular	✓	✓	20
S-JUNO(-iX)-MIOTY-TRACK	mioty®	✓	✓	20
S-JUNO(-iX)-MIOTY-TH-TRACK	mioty®	✓	✓	20

8.4. HOW DOES WIFI SSID SCANNING WORK

Wi-Fi SSID scan-based localization uses the detection of Wi-Fi networks in the environment to determine the location of a device. It uses the signal strength (RSSI) of the Wi-Fi signals to estimate the distance to the various access points (APs). This technique is often used indoors where GPS signals may be unavailable or inaccurate.

Essentially, the localization process works as follows:

1. Activation of the SSID scan: The device starts with a passive Wi-Fi scan, during which it listens for all beacon frames emitted by the access points (APs) in the vicinity. These beacon frames contain the SSID (the name of the network), the BSSID (the MAC address of the AP) and the signal strength of the received signal (RSSI).
2. Measuring the signal strength: The RSSI (Received Signal Strength Indicator) is measured for each signal received. This signal strength indicates how strongly the signal from the access point is received by the device. A higher RSSI usually means that the device is closer to the corresponding access point.
3. Comparison with known positions: To determine the position of the device, the measured RSSI values are used in combination with the known positions of the access points. This is done using methods such as triangulation or trilateration, in which the distances to at least three or more access points are calculated. Using these calculations, the device can determine its position on a map or in a room.
4. Position determination: The data collected from the access points is analyzed to determine the most likely position of the device. This is done taking into account the signal strength and the known positions of the access points. Modern algorithms can also further refine the localization by taking into account additional factors such as environmental conditions or the movements of the device.
5. Position display: Once the device has determined the position, this is displayed to the user on a map or in a corresponding user interface. If required, the accuracy of the position can also be updated in real time based on further SSID scans and changing signal strengths.

8.5. ADVANTAGES AND APPLICATIONS OF WI-FI-BASED LOCALIZATION:

- High accuracy indoors: As GPS signals are often weak or non-existent indoors, Wi-Fi scanning offers an excellent alternative to indoor positioning.
- Simple implementation: Since many buildings are already equipped with Wi-Fi networks, localization via Wi-Fi can be implemented with minimal additional effort.
- Cost-effective: Wi-Fi-based localization requires no additional hardware investment if Wi-Fi access points are already available.

This localization approach is particularly advantageous in indoor navigation systems, asset tracking or fleet management, as it enables precise positioning, even without the use of expensive GPS systems.

Positioning technology based on Wi-Fi SSID scanning is used in a variety of applications where a rough to medium level of positioning accuracy is required and existing Wi-Fi infrastructure can be used. A device records the names (SSIDs) and signal strengths (RSSI) of the surrounding Wi-Fi networks without connecting to them. This information can be used to estimate where the device is located - either by comparing it with an existing Wi-Fi database (e.g. from Google or Apple), by prior fingerprinting or with the help of a self-built Wi-Fi mapping model.

This technology is used, for example, for indoor localization in buildings such as shopping malls, airports or large office complexes where GPS signals are only available to a limited extent or not at all. Wi-Fi scanning is also used in logistics and asset tracking to track the location of devices or goods within warehouses or on company premises - often in combination with other technologies such as BLE or LoRaWAN. In smartphones and wearables, the method is used to enable location-based services such as map navigation, geofencing or location sharing, even if there is no mobile network connection.

Another typical use case is supportive positioning for battery-powered IoT devices where GNSS would be too energy-intensive. Here, Wi-Fi Scan can help to determine a sufficiently accurate position without putting a heavy strain on the battery. Due to the wide availability of Wi-Fi networks and the ability to estimate a position even without an active network connection, Wi-Fi SSID scanning represents a flexible, cost-effective and energy-saving alternative or supplement to classic GNSS or cellular positioning systems.

8.6. DEPENDENCE OF ACCURACY

The accuracy of Wi-Fi SSID scan localization depends on several factors and can vary greatly depending on the environment and system architecture. In general, the accuracy of position-based localization using Wi-Fi is typically between 1 and 20 meters. The exact position determination depends on various parameters that are both technical and environmental in nature.

A key influencing factor is the signal strength, also known as RSSI (Received Signal Strength Indicator). This is used to estimate the distance between the device and an access point. However, the relationship between signal strength and distance is not linear and can be significantly distorted by walls, furniture, other devices or structural conditions. In open spaces with few obstacles, the accuracy can be around 1 to 5 meters, while in more complex environments such as residential or office buildings with many obstacles, it tends to fluctuate between 5 and 20 meters.

The number and distribution of available access points also plays a decisive role. The more access points with a known and stable position are available, the more precise the positioning can be. If the device receives signals from at least three well-distributed access points, more precise positioning is possible through triangulation or trilateration. If, on the other hand, only one or two access points are available or if they are unfavorably distributed, the accuracy decreases accordingly.

The environment also has a significant influence on localization accuracy. Wi-Fi signals can be reflected, absorbed or scattered - depending on the material and arrangement of walls, furniture or other objects in the room. Nearby electronic devices can also cause interference. In a densely built-up office building with many steel beams, partition walls and other obstacles, for example, the localization accuracy can be between 5 and 15 meters, while in an open storage room or corridor it can be between 1 and 3 meters.

In addition to the hardware, the software also plays an important role: the quality of the positioning algorithms used can significantly improve accuracy. Methods based on machine learning or calibration data, for example, can take better account of environmental influences and help to interpret and smooth the measured RSSI values. This increases the reliability of the position information, particularly in more complex environments.

Another aspect is the visibility of the networks. Hidden SSIDs, i.e. WLANs that do not broadcast their network name, as well as interference from neighboring networks or other devices, can also reduce positioning accuracy. In such cases, the device has less usable information at its disposal, which can lead to less accurate positioning.

Overall, Wi-Fi scanning is a flexible and, in many cases, sufficiently accurate method for determining position - especially when other positioning technologies such as GPS are not available or are too energy-intensive. However, the accuracy that can be achieved always depends on the interplay of various factors.

8.7. THIS IS WHY POSITIONING VIA WIFI SSID IS USEFUL FOR JUNO

The Juno with WIFI SSID Scanning is particularly suitable for positioning applications where GNSS signals are weak or unavailable, such as indoors or in urban environments. By combining Wi-Fi scanning with GNSS and cell-based positioning technologies, more precise location data can be achieved.

- Wi-Fi scanning: Supports both active and passive scanning of 2.4 GHz and 5 GHz Wi-Fi networks.
- Energy efficiency: Optimized for applications with low power consumption, ideal for battery-operated devices.
- High security with WPA3 support
- Very good detection method for interiors
- Many existing networks
- Can significantly extend service life as it is much more energy-efficient than conventional GNSS

Juno Cellular can evaluate up to 20 different access points and thus provide very precise localization. The accuracy varies depending on the application. Accuracies of 3 to 20 meters are realistic.

8.8. HOW GNSS SCAN WORKS

The GNSS scan functionality makes it possible to determine position data via various GNSS systems such as GPS, Galileo, GLONASS or BeiDou. The position is determined by an integrated GNSS receiver, which continuously scans for visible satellites and calculates the position of the device based on the signals received. As soon as the position has been determined, the corresponding data is transmitted to a central station or cloud platform. This enables precise localization, even in remote areas, with low energy consumption as the GNSS receiver is only activated when needed.

The accuracy of the GNSS scan function in LoRa modules depends on various factors. The typical accuracies of GNSS positioning are between 2.5 and 10 meters, depending on the system used, when standard GPS is used. When multiple GNSS systems such as GPS, Galileo, GLONASS and BeiDou are combined, accuracy can be improved to 1 to 3 meters. However, in difficult environments, such as urban mountain canyons or strong signal shadowing, the accuracy can increase to 10 to 50 meters or more.

- Signal reception: The GNSS receiver (e.g. in the smartphone) receives radio signals from at least four GNSS satellites (e.g. GPS, Galileo, GLONASS).
- Time of flight measurement: Each signal contains a time stamp. The receiver measures how long the signal took to travel from the satellite to earth (transit time).

- Distance estimation: The distance to each satellite is calculated from the signal transit time (distance = speed of light × transit time).
- Position calculation (trilateration): Using the distances to at least four satellites, the receiver can calculate its own location (longitude, latitude, altitude) and the exact time by calculating the intersection points of the spheres around the satellites.
- Corrections: Errors due to the atmosphere, satellite orbits or clocks are partially corrected by algorithms or additional systems (such as DGPS or SBAS).

8.9. GNSS SCAN AND LORA® CLOUD

The LoRaWAN® devices such as the Juno Tracker or the Apollon-Q are based on the LoRa® Edge LR1110 chipset and send the GNSS scan information on port 197 and the WIFI SSID scan data on port 172. The data is sent to databases such as the LoRa® Cloud, where the latitude and longitude coordinates are calculated. The coordinates are then returned to the network server via standardized interfaces.

Sentinum offers such a service. You can simply send the data to our servers and we will do the rest for you. Just give us a call.

If you want your own integration, the following links will help you:

Connecting TTI with the LoRa Cloud: LoRa Cloud | The Things Stack for LoRaWAN®

Connecting Chirpstack to the LoRa Cloud: LoRa Cloud - ChirpStack open-source LoRaWAN® Network Server documentation

LoRa Cloud Homepage: Semtech LoRa Cloud

Example of TTI integration:

To connect The Things Stack (TTI) - the LoRaWAN® platform from The Things Industries - with the Semtech LoRa Cloud, you need to set up an integration so that data, e.g. GNSS scans, are correctly transmitted to the LoRa® Cloud and processed. The LoRa® Cloud takes over tasks such as geolocalization, GNSS conversion, Wi-Fi positioning or modem services.

```
Prerequisites:
```

- An active account at The Things Stack (TTI).
- A registered LoRaWAN device (e.g. a tracker with GNSS).
- API access to Semtech LoRa Cloud Services (via Dev Portal: https://lora-developers.semtech.com).
- LoRa Cloud Token (API Key) - you can get this in the LoRa Cloud Portal.

```
1. activate Semtech LoRa Cloud
```

- Go to https://lora-developers.semtech.com.
- Create an account or log in.
- Under LoRa Cloud→ Modem Services you will find your token (API key), which you must enter later in TTI.

```
2. set up integration in The Things Stack
```

- Log in to The Things Stack Console (e.g. https://eu1.cloud.thethings.industries/).
- Open the device you want to connect.

- Go to Integrations→ Webhooks.
- Click on Add Webhook and select Semtech LoRa Cloud as the template.

`3. configure webhook`

- Fill out the form:
  - Base URL: Is automatically suggested by TTI.
  - Token: Enter your API key from the LoRa Cloud here.
  - Activate the desired services, e.g:
    - Modem Services (for GNSS and Wi-Fi scans).
    - Geolocation (for TDOA/RSSI).
  - You can also send GNSS or Wi-Fi data, depending on the device type.

`4. adapt payload formats (if necessary)`

- Make sure that your end device uses the expected payload structure for Semtech LoRa Cloud Services (e.g. the format provided by Semtech's LoRa Basics Modem).

`5. check data`

- As soon as your device sends position data (e.g. GNSS raw data), it is forwarded to the LoRa Cloud via TTI.
- The response from the LoRa Cloud is then sent back to the end device or your application via TTI.

`Test & Monitoring:`

- Use the Live Data view in TTI to see whether data is being transmitted.
- In the Semtech Cloud, you can see whether requests are arriving and being processed.
- Check the response packets with the geodata (latitude, longitude) and position accuracy.

`Note:`

This integration works particularly well with devices based on Semtech's LoRa Basics Modem-E architecture (e.g. with LoRa Edge™ chips such as LR1110), but custom formats are also possible as long as the API requests are compatible.

8.10. PORT ASSIGNMENT FOR WIFI SSID SCAN PAYLOAD, GNSS SCAN PAYLOAD AND REGULAR PAYLOAD

Feature	LoRaWAN Port	Description
GNSS Scan Payload	197	Raw data (satellite ID, time, etc.) is sent to the geolocation backend.
WIFI SSID Scan Payload	194	Scanned MAC addresses + RSSI data are transmitted for localization.
Regular payload	1	Regular payload data from the sensor, such as temperature, relative humidity, angle, battery voltage, etc.

Example of the WIFI SSID scan payload:

```json
  },
  "correlation_ids": [
    "gs:uplink:01JX25NFV0V6Y7W4N3NYFZZC7R"
  ],
  "received_at": "2025-06-06T08:28:07.602296081Z",
  "uplink_message": {
    "session_key_id": "AZdBG9Zf0R4vwZawK/d+8Q==",
    "f_port": 197,
    "f_cnt": 41,
    "frm_payload":
      "AbqsHwkUDq62yPCegvM9rAAksQO5vasMuBX9AzmlACSxA5iB",
    "decoded_payload": {
      "access_points": [
        {
          "mac": "AC:1F:09:14:0E:AE",
          "rssi": -70
        },
        {
          "mac": "C8:F0:9E:82:F3:3D",
          "rssi": -74
        },
        {
          "mac": "00:24:B1:03:B9:BD",
          "rssi": -84
        },
        {
          "mac": "0C:B8:15:FD:03:39",
          "rssi": -85
        },
        {
          "mac": "00:24:B1:03:98:81",
          "rssi": -91
        }
      ],
      "format": 1
    },
    "rx_metadata": [
      {
        "gateway_ids": {
```


The following providers can be recommended for decoding the WIFI SSID SCAN and GNSS SCAN data:

- Semtech LoRa Cloud (discontinued at the end of July 2025)
- AWS
- Tencent
- Traxmate
- Sentinel

Local databases can be used for on-prem applications.

8.11. TRACKING IN THE LORAWAN®

Tracking in the LoRaWAN® network works by end devices (so-called nodes) transmitting radio signals that are received by several LoRaWAN® gateways. The exact position of the device is not determined directly by the device itself, but by evaluating the signals received in the network or in a special positioning platform (e.g. the Semtech LoRa® Cloud). There are various methods for determining position, which can be combined depending on the application and infrastructure.

A frequently used approach is the so-called TDOA method (Time Difference of Arrival). Here, the network measures the time difference with which a radio signal from a LoRaWAN® device arrives at various gateways. As radio signals propagate at the speed of light, these minimal time differences can be used to derive distance differences to the gateways. If at least three gateways receive the same signal, the position of the device can be calculated by triangulation. This calculation is performed centrally in the LoRaWAN® network server or in a connected cloud solution. The accuracy of TDOA is usually in the range of around 200 to 1000 meters, depending on gateway density, synchronization and environmental conditions.

The TDOA (Time Difference of Arrival) method in the LoRaWAN® network works on a principle similar to triangulation, or more precisely, it is a variant of multilateration. The position of a device is not calculated directly from the signal strengths (as with the RSSI method), but from the time differences of a radio signal at several gateways.

When a LoRaWAN® end device (node) sends a message, this signal is received simultaneously (or almost simultaneously) by several gateways within range. Each of these gateways notes with extremely high time resolution exactly when the signal arrived. As the radio signal propagates at the speed of light, even differences in the nanosecond range make a measurable difference to the calculated distance.

By calculating the time differences with which the signal arrives at the various gateways, the system can calculate circles (or hyperbolas) with possible positions of the device. The more gateways receive the signal, the more accurately the intersection of these hyperbolas can be determined - i.e. the actual position of the device. This method requires at least three synchronized gateways to calculate a two-dimensional position (latitude/longitude).

Are special gateways required?

A special type of gateway is required for tracking in the LoRaWAN® via TDOA:
These must be GPS-synchronized or have another precise time synchronization (e.g. PTP - Precision Time Protocol) so that the time stamps for receiving the signal are exact and comparable.

Standard LoRaWAN® gateways without time synchronization cannot provide reliable TDOA data, as even the smallest deviations in time recording would lead to large errors in position determination.

Accuracy

The accuracy of TDOA depends heavily on the density and distribution of the gateways, the quality of the time synchronization and the environment (e.g. reflections). Typically, it is in the range of 200 to 1000 meters, in ideal conditions even better. In urban environments, it can be affected by multipath effects (reflections).

TDOA for indoor tracking:

Indoor tracking with the TDOA method in the LoRaWAN® network is theoretically possible, but in practice it is very limited and usually not recommended when it comes to precise positioning inside buildings. Here are the reasons in detail:

Why TDOA is problematic for indoor applications:

1. Radio wave distortion due to obstacles
   Walls, ceilings, furniture and other objects cause strong attenuation, scattering and reflections of radio signals. This changes the effective propagation time of the signal, which leads to massive accuracy errors with a method based on time differences such as TDOA.
2. Multipath propagation
   Radio signals not only reach the gateways directly, but often also via reflections. These signals arrive with a minimal delay and distort the time measurement, making the position calculation inaccurate.
3. Difficult gateway placement
   For meaningful TDOA tracking, there must be at least three gateways with a clear line of sight to the device - this is difficult to achieve in buildings. Even large buildings are often only covered by one gateway, which does not allow TDOA positioning.

4. Synchronization suffers from poor GPS reception
GPS synchronization of gateways is often not possible or unreliable indoors, which ruins the basis for TDOA. Without accurate time synchronization, the entire method does not work.

> When TDOA works indoors *with restrictions:*

- In very large halls, airport terminals or open logistics areas with good gateway coverage.
- If additional technologies are used for error correction (e.g. algorithms that recognize multipath effects).
- In combination with other localization technologies such as Bluetooth, UWB or Wi-Fi to compensate for failures or inaccuracies.

8.12. TRACKING VIA THE "CELL LOCATE" MOBILE NETWORK

Mobile phone positioning works by a mobile device communicating with the mobile phone network via its radio signal, and the network then calculates the approximate location based on various parameters. Here is an overview of the most important methods:

Method	Typical accuracy	Remark
Cell ID	100 m - several km	Very rough; depends on cell size (city vs. country)
Enhanced Cell-ID	50 - 500 m	Better through timing information, but dependent on the network
TDOA (Time Difference of Arrival)	50 - 150 m	Requires several synchronized stations
AOA (Angle of Arrival)	100 - 200 m	Less common, requires special antennas

The accuracy of positioning via mobile radio depends heavily on the method used, the network coverage and the environment. The power consumption is very low compared to other technologies.

8.13. EDRX: ON THE WAY TO THE INTERROGABLE TRACKER

> The eDRX function is only available for mobile devices!

The dream of a tracker that is constantly listening and can be actively interrogated is becoming a reality. The eDRX function helps to realize this dream.

eDRX (Extended Discontinuous Reception) allows a **mobile device** to switch to an energy-saving "sleep mode" after a data transmission, in which it does not constantly communicate with the mobile network. Normally, mobile devices have to check at short intervals whether the network has new messages for them (e.g. incoming commands or updates). These frequent checks cost energy, even if there is no new data.

With eDRX, these check intervals are significantly extended: a sensor can be set so that it only listens for new network messages every minute or even hour. During idle periods, the device's receiver largely switches off, which drastically reduces energy consumption. As soon as the set eDRX phase ends, the sensor "wakes up", listens briefly for new messages and can then go back to sleep if nothing important has been received. The location of the device can be queried via a message from the network to the sensor.

The device remains registered with the network - it is not completely offline - but only reduces its active readiness to receive data. This is ideal for applications, where the device mainly sends data itself (e.g. location, sensor readings) and only rarely needs to be reachable.

eDRX cycles can last from seconds to hours (depending on the network operator and the application). The higher the eDRX frequency, the higher the quiescent current consumption of the device. It is therefore crucial to carefully define the required polling frequencies and always set these in relation to the intended service life of the device.

9. GENERAL HANDLING INSTRUCTIONS

1. Transportation and storage

- Transport and store the sensor in its original packaging to avoid mechanical damage and static discharge.
- Store the device according to the parameters specified in the technical data sheet

2. Assembly

- Only use the mounting points provided on the housing for fastening.
- Ensure that the sensor is mounted stably and vibration-free so as not to impair the measurement accuracy.

3. Commissioning

- Ensure that the battery is inserted correctly and has sufficient charge.
- Activate the sensor using the integrated magnetic switch or the smart phone app provided (depending on the model).
- Use the software or app provided by Sentinum for configuration.

4. Operation

- Only operate the sensor within the specified ambient conditions (temperature, humidity, protection class).
- Avoid strong magnetic fields or metallic shielding that could impair radio communication or sensor functions.

5. Cleaning

- If necessary, clean the housing with a slightly damp, lint-free cloth.
- Do not use any aggressive cleaning agents or solvents.
- The tracker versions (not -TH, without opening) are IP69k approved and can be cleaned accordingly

6. Maintenance

- The Juno sensor is low-maintenance. A battery change is required after several years, depending on use.
- Regularly check the function and the connection to the backend system.

7. Waste disposal

- At the end of its service life, dispose of the device in accordance with the local regulations for electronics and battery recycling.

9.1. SPECIAL HANDLING INSTRUCTIONS FOR -TH VERSIONS

The Juno TH versions are equipped with a special membrane to enable air exchange to ensure precise temperature and humidity measurements.

> Please observe the following instructions when handling the membrane:

- The membrane is sensitive to mechanical stress. Do not insert any pointed or sharp objects into the opening.
- Contamination from chips, dust or particles must be avoided at all costs. Make sure that the membrane does not become clogged - this impairs the measuring accuracy.
- Do not clean or replace the membrane yourself. Always contact the manufacturer or authorized specialists for this.
- The membrane must not come into contact with aggressive cleaning agents. This can permanently damage the membrane or change its permeability.

Mounting instructions:

- Even if the sensor has protection class IP67, water must not collect in the area of the membrane opening. Accumulated water can lead to incorrect measured values.
- For outdoor use, the sensor must always be mounted at an angle of at least 45° so that the membrane points downwards.
- Do not position the sensor close to the ground or in splash water areas to prevent splash dirt, mud or standing water from entering the opening.

Improper handling can lead to measurement errors or malfunctions.

The following still applies:

- Ensure air circulation: The sensor should not be installed in completely enclosed housings or heavily shielded areas. Free air circulation is essential for accurate humidity and temperature measurements.
- Avoid UV exposure: Long-term exposure to direct sunlight can affect the housing material and possibly the membrane structure. Installation in a (partially) shaded area or under a small cover (e.g. weather protection roof) is recommended if the ambient conditions permit.
- Avoid condensation: If temperatures fluctuate greatly, condensation can form in the area of the membrane opening in an unfavorable installation position. This is another reason why angled, downward-facing installation is crucial.
- Do not paint or coat: The housing - especially the diaphragm opening - must not be painted, varnished or coated. Even thin layers can seal the membrane and lead to significant measurement errors.
- Do not use in aggressive atmospheres (e.g. with high concentrations of solvent vapors, sulfur compounds, etc.) unless explicitly approved: Such conditions can affect the membrane and electronics.

10. ASSEMBLY AND INSTALLATION

10.1. WARNING AND SAFETY INSTRUCTIONS FOR INSTALLATION

If the sensor is still easily accessible after installation, install the sensor first and activate it after installation!

If the sensor is no longer accessible after installation, first activate the sensor and then install it after activation!

Before mounting the sensor in this way, make sure that the surface on which it is to be screwed is flat, otherwise the housing may be damaged.

Please note:

- Do not insert any objects or body parts into the openings of the sensor.
- Do not mount the sensor on the ceiling or floor.
- Do not install the sensor at heights above two meters.
- Only install the sensor indoors on a wall in a standard room at a height of 1.50 m to 1.80 m.

Permanent magnets can generate strong magnetic fields, which can be dangerous if handled incorrectly. Therefore, observe the following warnings:

- Protect hands and fingers: Strong magnets can suddenly attract and pinch fingers or skin. This can lead to painful crushing and injuries. Always keep sufficient distance when handling permanent magnets and wear protective gloves if necessary.
- Keep electronic devices away: Magnetic fields can damage electronic devices such as computers, smartphones, credit cards, pacemakers and other sensitive electronics or impair their function. Therefore, always keep a sufficient distance from such devices.
- Be aware of the risk of breakage: Many permanent magnets are made of brittle materials (e.g. neodymium) that can break under sudden impacts or high loads. The splinters can be sharp and cause injuries. Therefore, use the magnets carefully and avoid impacts or excessive loads.
- Health risks: People with pacemakers or other implanted medical devices should avoid contact with strong magnets as the magnetic fields may interfere with or disable these devices. If necessary, consult a doctor before use.
- Store magnets safely: Keep magnets at a safe distance from each other and from other metal objects. Sudden attraction can lead to damage, injuries or uncontrollable flying around of the objects.
- Danger for children: Permanent magnets are not toys! Small magnets in particular can be life-threatening if swallowed or inhaled and can cause serious internal injuries. Therefore, always keep magnets out of the reach of children.
- Avoid heating: Permanent magnets permanently lose their magnetic force at temperatures above their maximum operating temperature (between 80 and 200 °C, depending on the material). Therefore, do not expose magnets to direct heat or open flames.

10.2. RECOMMENDED FASTENING METHODS

Mounting type	Description	Recommended accessories
Screw connection	2 M4 or M5 screws	2x suitable countersunk head screw, wood screw 4mm - 5mm if necessary
Magnets	2 neodymium pot magnets M4, internal thread	2x neodymium magnets (indoor) together 16-32 kg load capacity
Gluing	Double-sided adhesive tape or mounting adhesive	Double-sided adhesive tape or mounting adhesive

10.3. GENERAL INSTALLATION INSTRUCTIONS

Installation of the Juno Tracker versions (without opening)

The standard versions of the Juno sensor are designed for a wide range of industrial and logistical applications and have robust housings with a high degree of protection. The following points must be observed during installation:

- Select an installation location that is within the specified ambient temperatures and conditions (see technical data).
- Do not cover the housing: Radio communication (e.g. LoRaWAN, BLE) must not be obstructed by metallic objects, sealed housings or structure-shielding materials.

> Ideally, mount the sensor with a clear line of sight to the sky. This will ensure smooth operation of the radio interfaces.

- Mount the sensor securely, ideally using the mounting holes provided. Low-vibration or solid surfaces are recommended.
- Alignment: The standard version does not require any special alignment, so it can be mounted flat, vertically or horizontally - depending on the application.
- Do not install in the immediate vicinity of strong electromagnetic sources in order to avoid signal interference.

10.4. INSTALLATION INSTRUCTIONS FOR JUNO TH VERSIONS

> The TH versions contain a sensitive air exchange membrane for precise climate monitoring. Additional requirements therefore apply:

- Always mount the sensor in an inclined position (at least 45° inclination) so that the membrane points downwards. This prevents water or dirt from collecting in the membrane opening.
- Do not install close to the ground or in splash water areas - the sensor should be mounted in an elevated position and protected from direct entry of dirt.
- Select an installation location that ensures free air circulation. Do not install in enclosed housings without ventilation.
- Do not expose to direct sunlight to avoid overheating and measurement distortion. (Partial) shading or a small weather protection is recommended.
- Avoid exposure to particles or dust: Do not install TH models in areas where high levels of dust or chips are to be expected (e.g. workshops, grinding stations).
- The membrane must not be sealed, glued or painted over.

- Cleaning or replacement of the membrane only by authorized bodies or in consultation with the manufacturer.

10.5. INSTALLATION INSTRUCTIONS FOR TRACKER VERSIONS

To ensure the best possible performance, please observe the following installation instructions for the tracker versions:

- The GNSS sensor should always be mounted **outside of metal housings.**
- Avoid installation in the immediate vicinity of metal surfaces or metallic structures.
- Make sure you have a **clear line of sight to the sky** to ensure the best possible GNSS reception.
- Keep **at least 30 cm away from metallic materials to the front and sides**.
- Place the sensor away from high-voltage power lines and strong electromagnetic fields.
- Avoid mounting in closed rooms or under covers that could block GNSS signals.
- If the tracker is used as a mobile device, make sure that the sensor is securely mounted during operation.

10.6. IMPORTANT NOTE FOR DEVICES WITH EXTERNAL ANTENNA

If you have ordered a device with an external antenna, which can be recognized by the gold RP-SMA connector, first install the antenna included in the scope of delivery.

External antenna: Please note that the antenna should always be mounted vertically and that the tip should point to the sky if the application permits. The antenna should be at least 2 cm away from metal surfaces. Make sure that the antenna is not shielded by surrounding metal parts, if the application allows this. Internal antenna: If your device has an internal antenna (no external antenna visible), the sensor should always be mounted with the long side vertical, as this allows the maximum signal strength of the device to be achieved. The antenna is located on the top (logo side) of the housing and should be at least 2 cm away from metal surfaces . Ensure that the antenna is not shielded by surrounding metal parts, as far as the application allows.

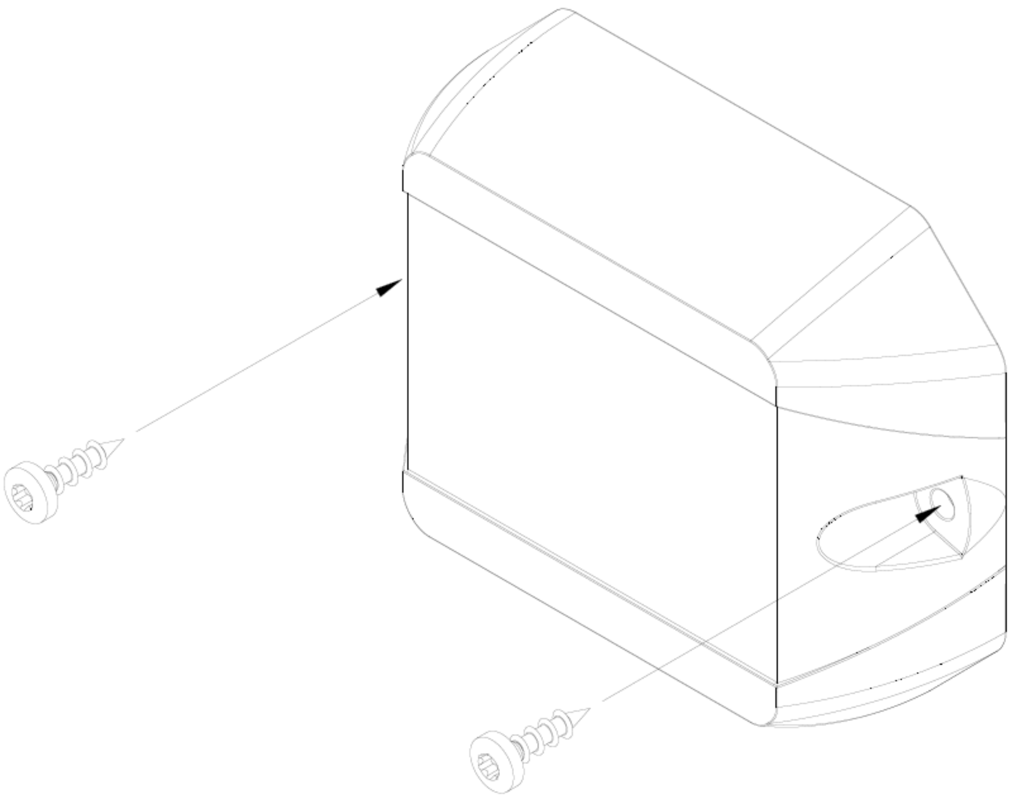
Please note: If you receive a device with an external antenna, never operate the device without an external antenna! This can lead to irreparable damage to the sensor.

10.7. WALL MOUNTING WITH SCREWS

The Juno sensor can be securely and permanently mounted on a wall or other solid surface. It is mounted using the screw holes provided in the housing flange.

Preparation for assembly

- Determine the mounting position: Select a mounting location that is low-vibration, dry and suitable for the sensor function (e.g. free air circulation for TH versions).
- Check the mounting surface: Solid substrates such as concrete, masonry, wood or technical plastic panels are suitable. Use suitable dowels for porous substrates.
- Provide tools
  - Cordless screwdriver or screwdriver with torque control
  - Drill bit (suitable for the wall texture)
  - Dowels (if required)
  - Screws (see below)



Screw selection

- The mounting holes in the sensor housing are designed for M4 screws.
- Depending on the mounting surface, we recommend
  - M4 cylinder head screws (e.g. DIN 912, stainless steel) for plastic housings or metal frames
  - Spax screws43 mm with suitable plugs for concrete, brick or timber walls

- The screw must be able to pass freely through the housing without distorting or damaging the housing.

Installation instructions

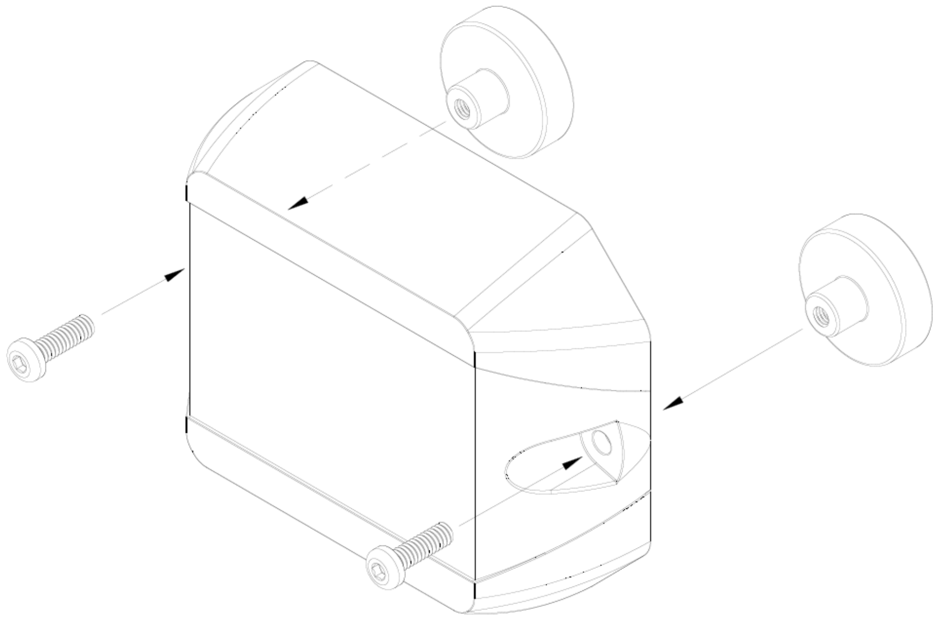
- Maximum tightening torque: 3 Nm. A higher torque can lead to housing deformation or breakage.
- Tighten the screws evenly and without tension.
- Ensure that the housing lies flat without mechanical stresses building up.
- Do not drill any additional holes or modify the housing.
- Do not mount upside down if condensation or dirt could collect in the sensor area.

Safety instructions

- Wear suitable protective equipment during installation (e.g. safety goggles for drilling work).
- Check that it is correctly attached by gently pulling and pushing on the housing.
- Make sure that no cables or electrical lines behind the wall are damaged.
- For TH versions: Observe the recommended tilt angle (min. 45°) and the downward orientation of the membrane.

10.8. WALL MOUNTING WITH MAGNETS

For applications where flexible or removable mounting is required, the Juno sensor can be attached to metallic surfaces using mounting magnets. The magnet modules are first firmly attached to the sensor housing with screws. The housing design has specially designed mounting holes for this purpose, the position and dimensions of which can be found in the technical drawing supplied.



To mount the magnets securely, it is important to only use the screw points provided and to ensure that the screws are tightened to a maximum torque of 3 Nm. Depending on the magnet type, M3 stainless steel cylinder head screws are generally suitable for fastening the magnets. The magnets themselves must be firmly attached to the housing to prevent slipping or loosening in the event of vibrations or impacts.

After mounting the magnets, the sensor can be placed on a suitable ferromagnetic surface (e.g. steel beam, switch cabinet, machine housing). Make sure that the contact surface is flat, clean and sufficiently load-bearing. Unevenness, rust, paint or dirt can significantly reduce the holding force of the magnets.

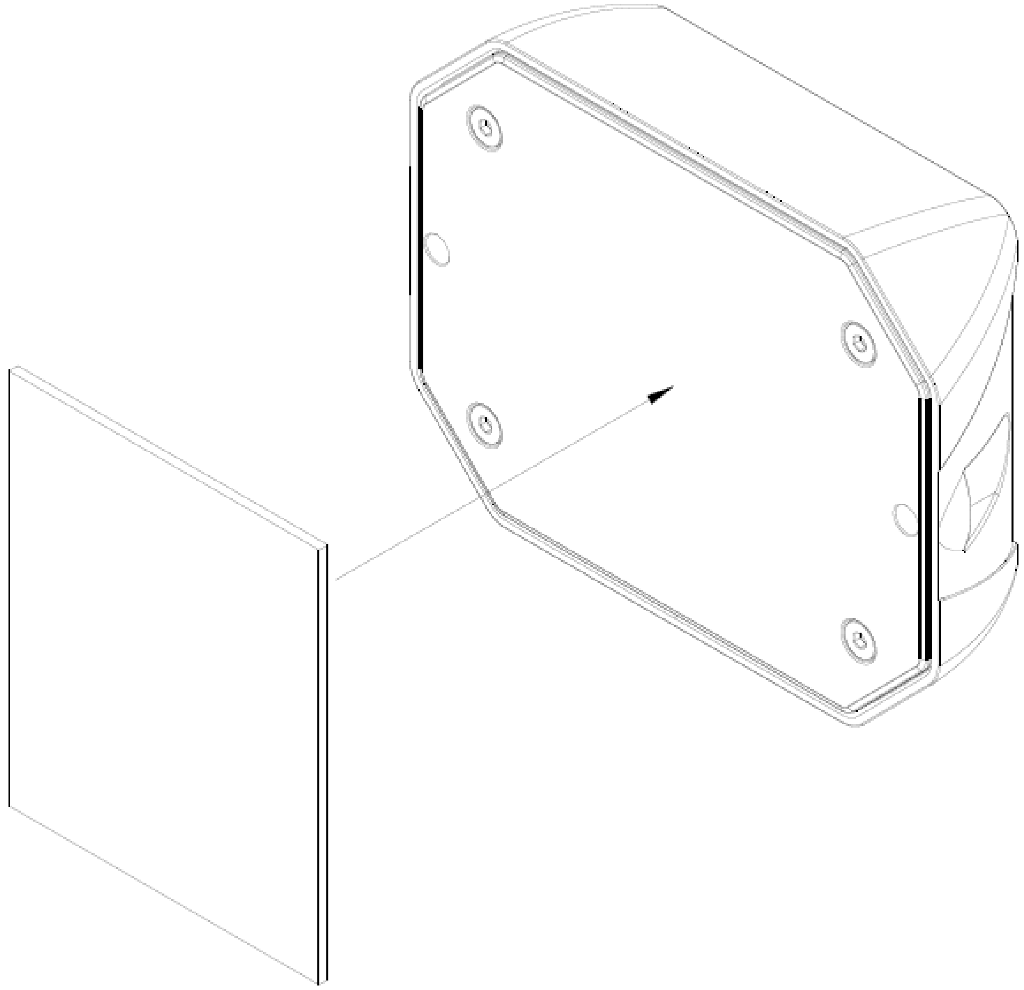
Magnetic mounting is particularly suitable for temporary use, test installations or locations where tool-free replacement is required. However, it must be noted that mechanical loads or vibrations can reduce the hold. In safety-relevant applications or for permanent installation, we recommend additionally securing the sensor or using a fixed screw connection.

Depending on the material composition, magnets can also age more quickly or become porous when exposed to direct sunlight, heat and weather conditions. Over time, this can lead to a loss of holding force or to the sensor slipping off - especially when used outdoors for long periods of time. For permanent outdoor applications, only weather-resistant, encapsulated magnetic holders should therefore be used and the sensor should be checked regularly to ensure that it is firmly seated.

The general notes on alignment also apply to magnet mounting - especially for TH versions with a sensitive diaphragm: The sensor should always be mounted at an angle of at least 45° with the diaphragm facing downwards to prevent water accumulation or particle ingress.

10.9. WALL MOUNTING WITH ADHESIVE STRIPS

As an alternative to screw or magnetic mounting, the Juno sensor can also be attached using high-quality 3M adhesive strips. The adhesive strips are pre-cut and specially adapted to the shape of the Juno housing to enable quick, clean and permanent installation - especially on smooth, solid surfaces.



Prerequisites and preparation

- The mounting surface must be even, stable, clean, dry and grease-free.
- Before application, clean the surface with isopropanol or a suitable plastic cleaner.
- The adhesive strip should not be used on porous, textured or very uneven surfaces, as adhesion will be impaired.

Assembly instructions

- Remove the protective film from one side of the adhesive strip and apply the strip flat to the back of the sensor. Placement can be based on the markings provided. Make sure that the strip is positioned exactly and that there are no air pockets.
- Then remove the second protective film and apply the sensor to the prepared surface with even pressure (approx. 10-15 seconds).
- The sensor should adhere undisturbed for at least 24 hours to achieve full adhesive strength.

Important notes

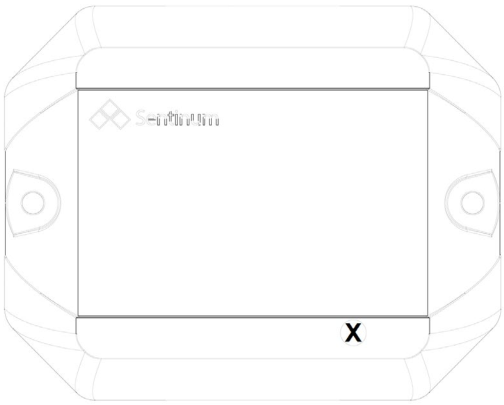
- The adhesive connection is designed for long-term use indoors or in protected outdoor areas.
- Adhesive performance may be impaired in environments with high UV exposure, moisture, high heat (> 80 °C) or constant vibration.
- Subsequent correction of the position after application is only possible to a very limited extent.
- For TH versions, the recommended mounting position (at least 45° inclined, membrane facing downwards) must also be observed for adhesive mounting in order not to jeopardize the functionality of the sensor membrane.
- The adhesive strips are not reusable. A new adhesive strip must be used when moving the sensor.

11. COMMISSIONING AND USE

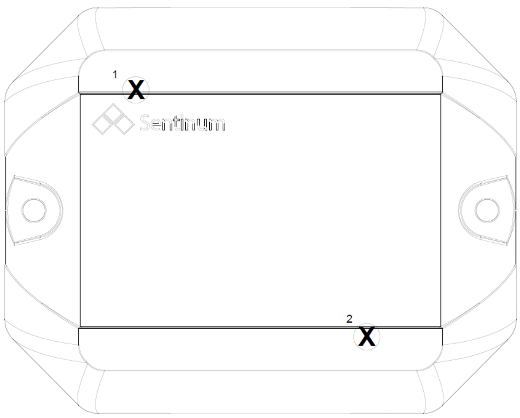
Please note that the housing or electronics may be damaged if knives or other sharp objects are used.

11.1. COMMISSIONING THE SENSOR WITH MAGNET

There is a magnetic field switch on the sensor for easy activation of the sensor. The following graphic shows the position of the magnetic field switch.

Item number	Approved batteries
S-JUNO(-iX)-LOEU/MIOTY **S-JUNO(-iX)-LOEU/MIOTY-TH** **S-JUNO(-iX)-LOEU/MIOTY-TRACK** **S-JUNO(-iX)-LOEU/MIOTY-TH-TRACK** **S-JUNO(-iX)-NBM1-TRACK-2** **S-JUNO(-iX)-NBM1-TRACK-3** **S-JUNO(-iX)-NBM1-TH-TRACK-2** **S-JUNO(-iX)-NBM1-TH-TRACK-3** **S-JUNO-NB-TH**	

To activate the sensor, hold a commercially available magnet to the point marked **X.** A neodymium magnet with a minimum surface area of 1 cm² is recommended. The magnet must remain in place for at least 2 seconds until the device is activated. This is acknowledged with a beep.



For operation, please note that Hall switch 1 can always be used to detect a damper opening and magnetic switch 2 is always triggered to activate or advertise the BLE.

11.2. COMMISSIONING THE SENSOR VIA BLE (QUICK GUIDE)

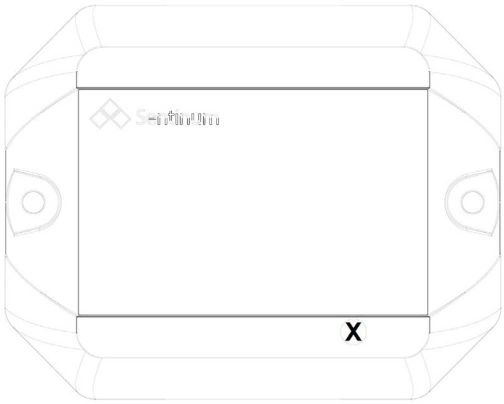
```
This activation via BLE only applies to the article numbers:
S-JUNO(-iX)-LOEU/MIOTY-TRACK
S-JUNO(-iX)-LOEU/MIOTY-TH-TRACK
S-JUNO(-iX)-NBM1-TRACK-2
S-JUNO(-iX)-NBM1-TRACK-3
S-JUNO(-iX)-NBM1-TH-TRACK-2
S-JUNO(-iX)-NBM1-TH-TRACK-3
```

1. Set the sensor to BLE advertising mode so that the Juno can be recognized and found by BLE-enabled end devices.

1.1 To activate advertising mode, hold a standard magnet to the point on the housing marked with an X in the image on the right.

- Hold the magnet close to the housing for at least 2 seconds,
  or
- briefly place it directly on the marked position.

Advertising mode is then started automatically.



1.2 TBD

TBD

11.3. COMMISSIONING THE SENSOR VIA NFC

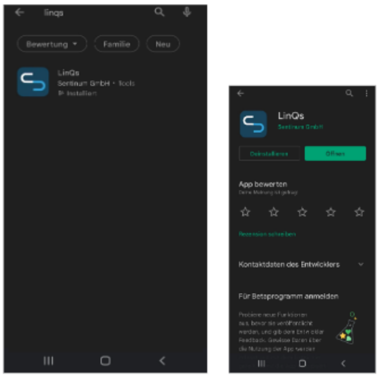
```
This activation only applies to article numbers:
S-JUNO(-iX)-LOEU/MIOTY
S-JUNO(-iX)-LOEU/MIOTY-TH
```

S-JUNO-NB-TH

Activation takes place via an NFC app. A smartphone is required for this. The app can be downloaded from the respective app stores. Simply search for "Sentinum LinQs" and download the LinQs app.

Google Play Store

iOS App Store



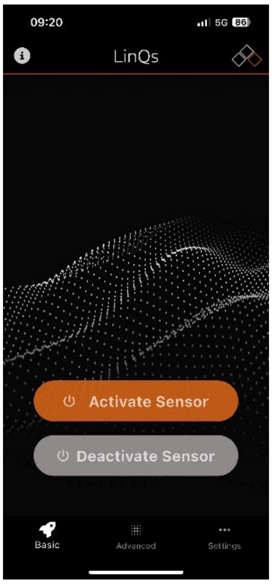
First locate the tag on the sensor and then the reader on your end device. The position of the NFC tag can be found at the position of the orange arrow.

The location of the tag is also marked on the top and labeled "Tap here". You can also see the position of the NFC tag in the technical drawing.

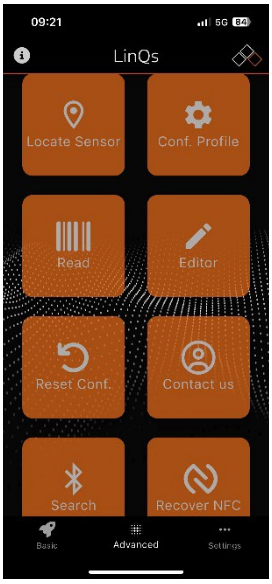
Open the app and activate the sensor. To start the sensor in the basic settings, click on the "Activate sensor" button in the app's start menu. Now place your device on the NFC mark on the sensor.

When the sensor is activated, "Sensor updated!" is displayed. You can then continue with the activation of the other sensors.

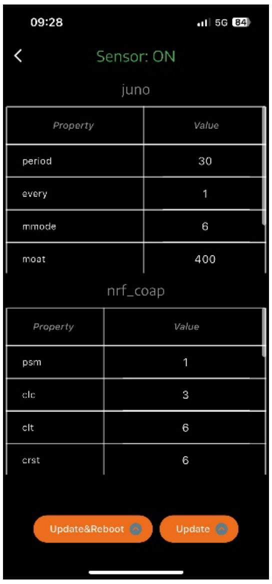
Activate sensor	Read and set parameters via NFC	Set values via NFC



Use the "Activate Sensor" button to activate the sensor and enable BLE advertising mode for the sensor



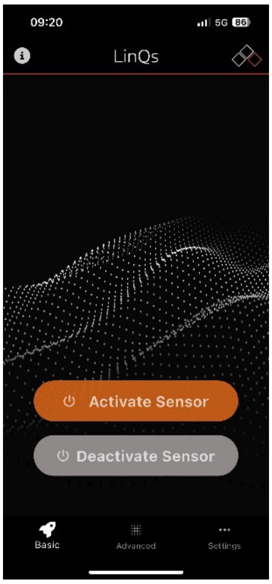
Use the "Read" button to read out the parameters.



Tap the desired table entry and change the values. Confirm with the button below "Update & Reboot" or "Update". Update and reboot forces a reboot in addition to the change, update is used for the next measurement or transmission.

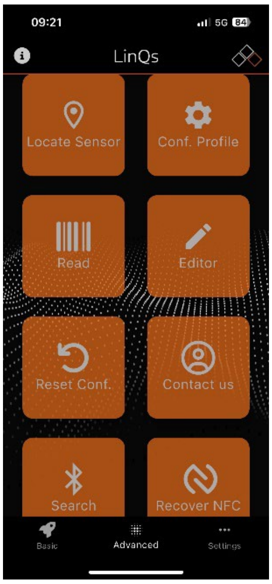
11.4. COMMISSIONING THE SENSOR VIA BLE

Activate BLE Advertising



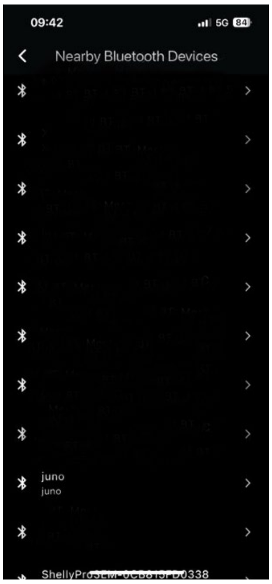
The BLE advertising mode can be activated with the magnet or after activating the sensor.

Search for BLE device



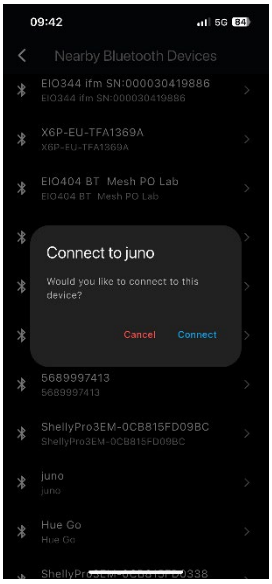
Use the "Search" button to search for the sensor via BLE.

Connect to the sensor via BLE



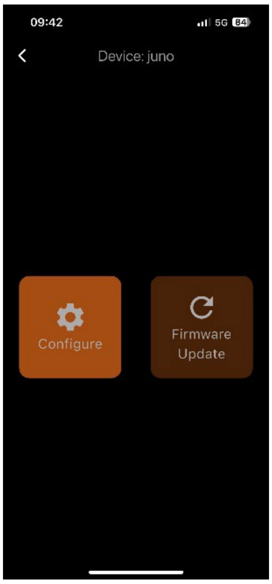
Select the correct sensor and confirm by clicking on "juno".

Connect to the sensor via BLE



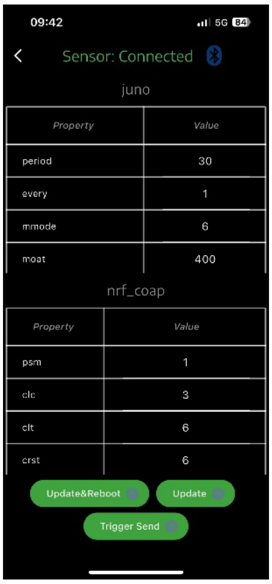
Click on the "Connect" button

Configure with the sensor via BLE



Now use the "Configure" button to set parameters.

Configure with the sensor via BLE



A transmission can be triggered using the "Trigger Send" button. Tap the desired table entry and change the values. Confirm with the button below "Update & Reboot" or

"Update". Update and Reboot forces a reboot in addition to the change, Update is used for the next measurement or transmission.

11.5. AUDIBLE SIGNAL AND FEEDBACK

- When the device is switched on, an acoustic signal consisting of several ascending tones sounds. This sequence of tones signals that the sensor has been successfully activated.
- When the device is switched off, several descending tones are played to acoustically confirm that the device has shut down.
- When establishing or disconnecting a Bluetooth connection (BLE), the sensor also emits an acoustic signal to confirm the connection status.

12. SENSOR FUNCTIONS

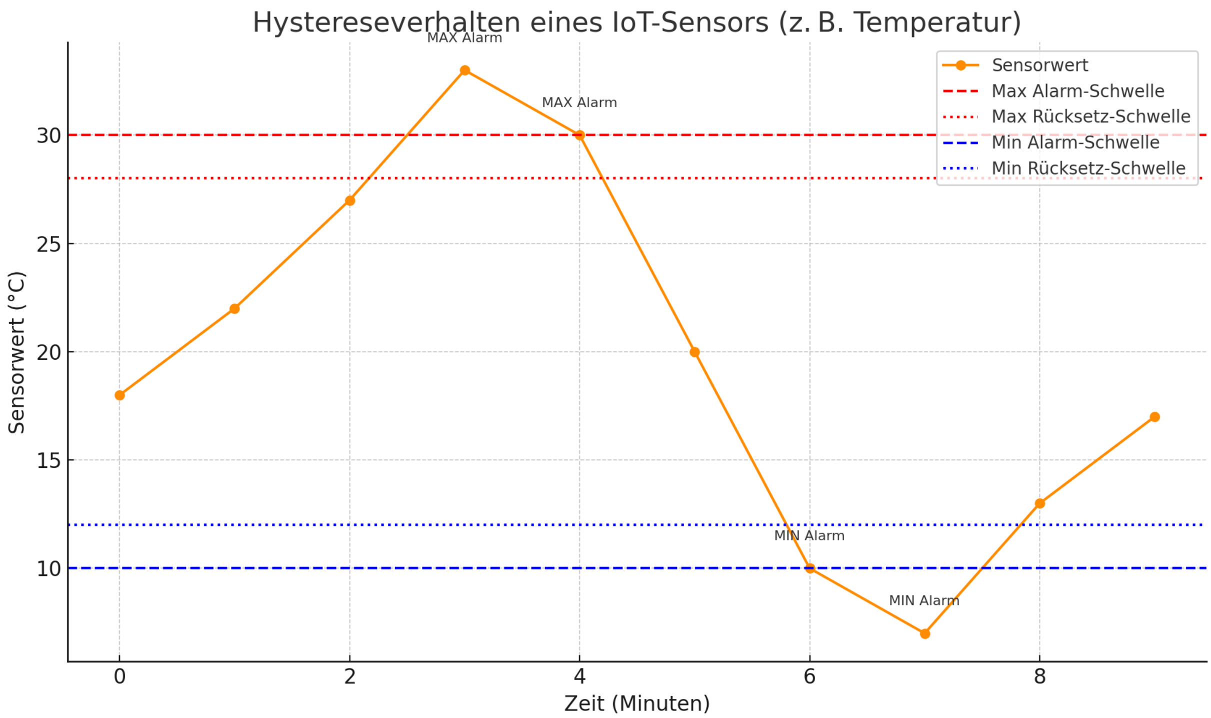
Specific sensor functions for the Juno are explained below.

12.1. HYSTERESIS

Hysteresis describes a behavior in which the reaction of a system depends not only on its current state, but also on its previous history. This means that the system "remembers" where it came from - and therefore reacts differently to the same stimulus, depending on whether the stimulus is currently increasing or decreasing.

Hysteresis = delay or difference in behavior when a signal or stimulus is increased or decreased.

Two hysteresis limit values are specified for the Juno, one for the temperature and one for the relative humidity. The values are applied to both the delta and the absolute limit values.



Description:

- Orange line: Sensor values over time.
- Red lines:
  - Dashed (--): Maximum alarm threshold value (e.g. 30° C).
  - Dotted (---): Reset point with falling temperature (e.g. 28° C).
- Blue lines:
  - Dashed (--): Minimum alarm threshold value (e.g. 10° C).
  - Dotted (---): Reset point when the temperature rises (e.g. 12° C).

Example procedure:

- The sensor triggers a "MAX alarm" as soon as the value is ≥ 30 °C.

- The alarm remains active until the value falls below 28 °C→ only then is it reset.
- Conversely, the same applies to the lower range with the "MIN alarm" at ≤ 10 °C.

The behavior prevents alarms from being constantly triggered or deactivated in the event of minimal fluctuations - typical for hysteresis.

12.2. TRACKING AND TRACKING IN MOTION

The localization of the device is independent of the transmission of the sensor data (e.g. temperature, tilt angle or relative humidity).
This means that
The interval for determining the location can be freely configured without changing the transmission intervals of the sensor data.

The measured values from the sensors are recorded and transmitted regardless of the tracker's movement status - whether the device is in motion or stationary.

The device is located either at fixed intervals or event-controlled, e.g. by detected movement or other activity parameters.

12.3. TILT AND TILT DETECTION

Two operating modes are available for the Juno sensors with integrated tilt detection:

1. Ultra-low power tilt detection
   This mode is characterized by a particularly low power consumption of only 1 µA. It reliably detects a tilt or damper opening from approx. 50 degrees. Ideal for applications where coarse tilt detection is sufficient and energy efficiency is paramount.
2. Advanced tilt detection
   In addition, an advanced mode is available that enables the precise detection of inclinations or flap openings. The power consumption here depends on the selected scanning frequency, but is higher than that of the ultra-low power variant. This mode is suitable for applications with higher accuracy requirements.

The tilt and opening detection and tracking in motion functions are mutually exclusive.
This means that a sensor with tracking in motion activated cannot perform real-time tilt or flap opening detection.

However, the current tilt angle is still transmitted regularly so that the position can be evaluated retrospectively.

13. COMMUNICATION WITH THE INTERFACE

The option to configure the sensor communication and the join behavior can be found in the respective generic LoRaWAN® , Mioty® or Cellular (NB-IoT and LTE-M1) documentation, depending on the version.

You can also find all documents relating to generic documentation at https://docs.sentinum.de/wichtig-produktübergreifende-dokumentation-für-sensoren.

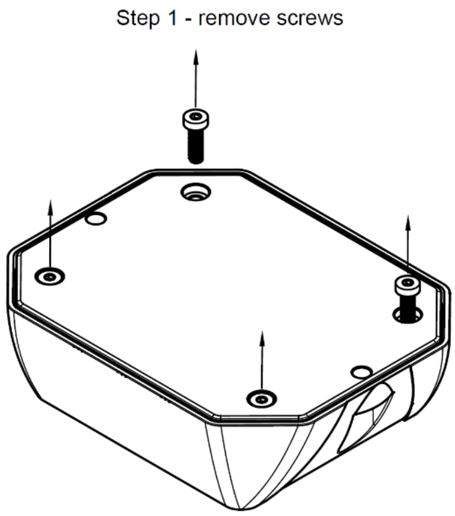
14. CARE AND CLEANING

To ensure that the sensor functions reliably and has a long service life, it should be maintained regularly. Please observe the following instructions:

- Clean the housing, especially the ventilation slots of the sensor, with a dry or slightly damp microfiber cloth. Make sure that no moisture penetrates the device.
- Carry out cleaning regularly, especially in dusty or pollen-rich environments, to ensure the long-term functionality of the sensor.
- Do not use cleaning agents containing alcohol or solvents, as these can damage the surface of the sensor.
- Do not use compressed air or other intensive cleaning methods, as these can damage sensitive sensor components.
- Hard deposits (e.g. limescale, oil or grease) can impair the measuring accuracy. If necessary, clean early with a soft, damp cloth and mild detergent.
- Make sure that there are no leaves, water or snow on the sensor. This can negatively affect the performance of the sensor.

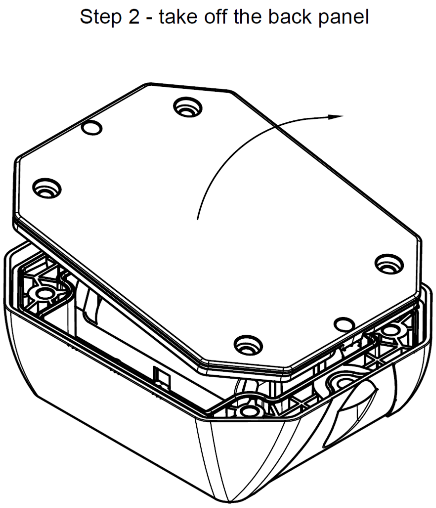
15. BATTERY CHANGE

1.



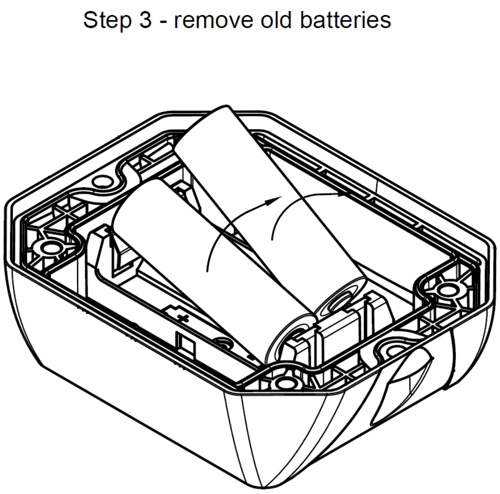
Open the 4 screws on the back of the sensor marked with the orange arrows. You will need a Torx T10 screwdriver for this and make sure that the seal is not damaged.

2.



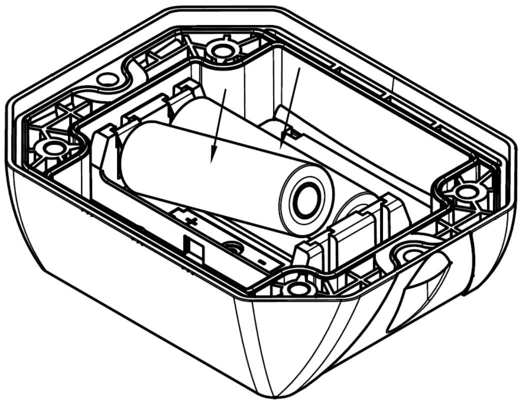
Remove the back of the sensor housing. Check that the seal is in place and take care not to damage it when opening it

3.



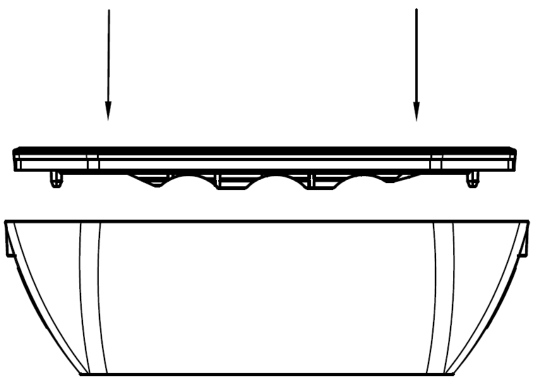
Remove the old batteries from the battery holder.

4. Step 4 - insert new batteries



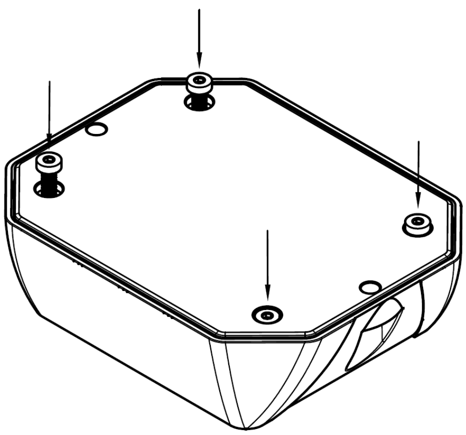
Insert 2 new battery cells. If cells other than those recommended are used, performance and product safety may be impaired and the running times and performance specified in the data sheets may not be achieved. After insertion, the sensor should start with a short beep. As soon as you hear this signal, replace the back of the housing.

5. Step 5 - close the back panel



Place the rear panel back on the top of the housing. Make sure that the seal is properly seated and that the housing can be closed properly.

6. Step 6 - tighten the screws (1,3-1,5 Nm max.)



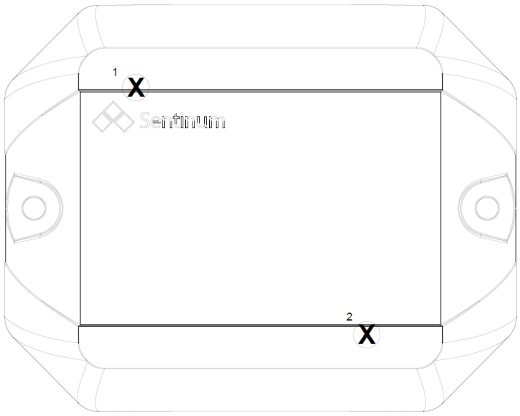
Screw the housing together. Tighten the screws crosswise to ensure even and tension-free fastening. Make sure that the original position of the seal has not been changed. Then reinstall the sensor at its place of use. Dispose of the old batteries in an environmentally friendly manner.

Item number	Approved batteries
S-JUNO(-iX)-LOEU/MIOTY **S-JUNO(-iX)-LOEU/MIOTY-TH** **S-JUNO(-iX)-LOEU/MIOTY-TRACK** **S-JUNO(-iX)-LOEU/MIOTY-TH-TRACK**	• Energizer Ultimate Lithium AA • Varta ULTRA Lithium AA • Varta Longlife Power AA • SAFT LS14500 **(standard)**
S-JUNO(-iX)-NBM1-TRACK-2 **S-JUNO(-iX)-NBM1-TRACK-3** **S-JUNO(-iX)-NBM1-TH-TRACK-2** **S-JUNO(-iX)-NBM1-TH-TRACK-3** **S-JUNO-NB-TH**	• CR14505 (HCB) • ER14505M (HCB, **standard**) • UHR-ER14505-X (Ultralife)

16. FLAP OPENING DETECTION AND TILT DETECTION

The flap opening detection can be carried out either via the magnetic switch or the acceleration sensor. Tilt detection (tilt feature) is carried out via the acceleration sensor

16.1. FLAP OPENING DETECTION VIA THE MAGNETIC SWITCH



For operation, please note that Hall switch 1 can always be used to detect a damper opening and magnetic switch 2 is always triggered to activate or advertise the BLE.

1. The magnetic field switch is active. Either one or both sensors can be used.
2. Large neodymium magnets are recommended. These should be attached as close as possible to the sensor. A recommended distance between the magnet and the sensor cannot be specified universally due to the variable size of the magnet. A maximum distance of 1 cm between the magnet and the housing is recommended.
3. For comparison: With a neodymium disk magnet with d = 20mm and h = 5mm, reliable values are achieved at distances of less than 1 cm.
4. The magnetic field switches can be operated in three different modes:

- Container is closed when the solenoid is applied.
- The container is open when the magnet is applied.
- The sensor counts an opening when the magnet passes through twice.

16.2. FLAP OPENING DETECTION WITH ACCELERATION SENSOR AND TILT DETECTION

The Juno sensor is equipped with an integrated 3-axis acceleration sensor of the type used for the reliable detection of changes in movement and position. One of the key functions of this sensor is to detect the opening of flaps, lids or housings, as typically found in industrial applications.

1. Position detection in idle state**:**
    - When the flap is closed, the sensor is in a defined, stable position.
    - The LIS2DTW12 continuously measures acceleration along the X, Y and Z axes.
    - The absolute position of the flap can be clearly identified via the so-called static acceleration (mainly caused by the earth's gravity).
2. Change of inclination or movement:
    - If the flap is opened or moved, the orientation of the sensor in the room changes.
    - The sensor recognizes this change by a clear deviation of the measured acceleration values on at least one axis.
    - This change is interpreted as a trigger event.
3. Threshold-based detection:
    - A tilt angle or a movement threshold can be defined in the Juno firmware setup (e.g. change by 15, not ultra-low power operation

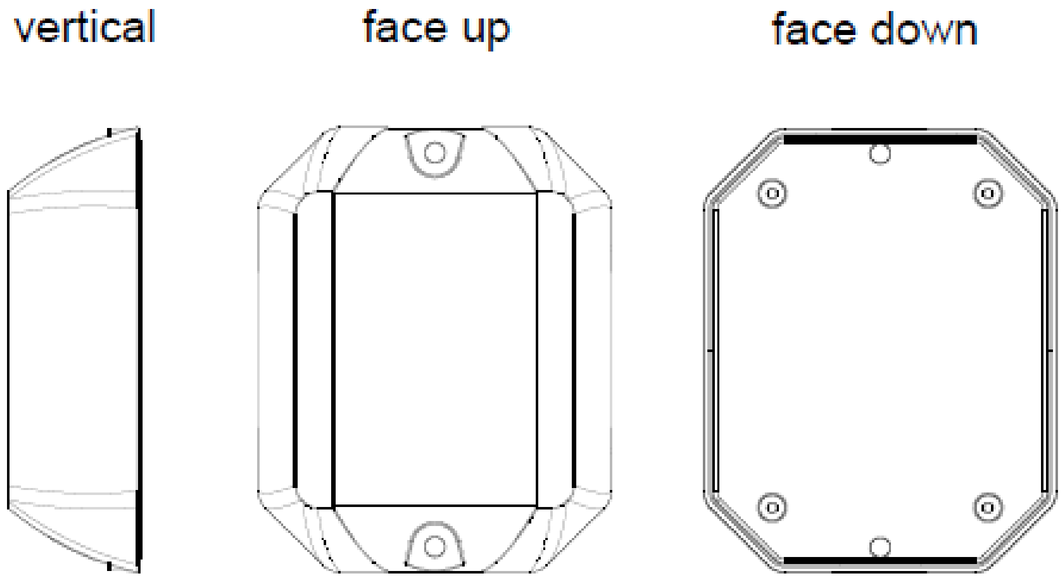
> The sensor can of course be operated in a very energy-saving manner by setting the measurement frequency of the angle to a correspondingly high value, e.g. 5 minutes. The measurement is then insignificant in relation to the remaining power consumption.

    - As soon as the measured values exceed this threshold value, a damper opening event is registered.
4. Optional: Interrupt-controlled operation:
    - The sensor supports low-power modes with interrupt triggering.
    - This means that the sensor remains in a low-power state and only triggers an interrupt to the microcontroller when movement is detected - ideal for extending battery life.
    - **Disadvantage: The angle cannot be adjusted and is fixed at 65°**
5. Event processing and data transmission**:**
    - After a detected opening, the event is logged in the internal memory.
    - Depending on the configuration, a data packet can be sent immediately via LoRaWAN, BLE or another network protocol to report the event.

Advantage of this method

- No mechanical components required (compared to reed or magnetic switches)
- Insensitive to magnetic field interference
- Simple retrofitting or adaptation via software

16.3. ORIENTATIONS



17. LORAWAN SPECIFIC FEATURES

17.1. LORAWAN JOIN BEHAVIOR

Before telemetry data can be sent via LoRaWAN, the device must establish a connection with the network. To do this, the device sends join requests until a join accept has been successfully received. As a compromise between energy consumption and a fast join, the transmission intervals of the join requests become longer and longer. In addition, the data rate is also varied (initially large data rate or small spreading factor, then smaller data rate or larger spreading factor). The join behavior strictly adheres to the specifications and recommendations of the LoRa Alliance specification. Sentinum sensors implement the specifications by means of so-called join bursts, the distance between which increases.

A join burst consists of a maximum of 6 join requests with decreasing data rate (DR5-DR0) or increasing spreading factor (SF7-SF12). The intervals between the requests increase quadratically in order not to violate the Lora-Alliance specific duty cycle guidelines. The LoRa Alliance prescribes a decreasing duty cycle for join requests according to the following table Time duty cycle <1h 1% <11h 0.1%

This means that in the first phase (<1h) the same amount of transmission budget is available as in the second (<11h), although only a tenth of the time is available. In order to make maximum use of the budget, the intervals between join bursts (consisting of max. 6 join requests) are initially small and then become larger. Specifically, 2 bursts are carried out in phase 1. In phase 2, 2 further bursts are carried out, and from phase 3 onwards, 1 burst is carried out per day. The length of the bursts increases from approx. 10 minutes in phase 1, to approx. 100 in phase 2, to up to 16 hours in phase 3.

18. LABELING AND CERTIFICATION