User Manual

AiSight Aion

Contents

1. Introduction

The Aion measures the vibrations, magnetic fields, and heat created by your machines. These sensor nodes collect machine information and transmit data to our machine learning algorithm for processing. As a result, we can detect anomalies and faults in your machine and prevent bigger failures. Once a fault is detected you will receive a notification providing the information you need to plan maintenance in advance, avoiding the need for unplanned production stops.

In order for us to give you the best and most accurate results, it is important that you carefully read and understand this instruction manual.

2. Definitions and glossary

Package: the package received by the client is a recycled paper box that includes the sensor node, power supply, and mounting interfaces.

Sensor node: the AiSight sensor node (Aion).

Power supply: the 90~240 V ac to 24 V power supply to power the sensor node with 24 V dc.

Power cable: the cable with M8 4-pin connector powers the sensor with 24 V from machine panels, other local dc power sources, or the battery pack. In the last case, the power cable is also used as a signal line since it allows communication between the sensor node and the battery pack.

Battery pack: the AiSight Aion battery pack.

MAC address: a unique identifier number for each sensor node, also known as a serial number.

Mounting interface: any mechanical or chemical combination used to attach the sensor node to the machine.

Provisioning application (app): a smartphone application that connects with the sensor node via BLE to input the Wi-Fi credentials.

Bluetooth Low Energy (BLE): a low power consumption wireless technology standard used for exchanging data between fixed and mobile devices over short distances using short-wavelength UHF radio waves.

Wi-Fi network: a wireless technology standard used for exchanging data between fixed and mobile devices over medium-range distances with higher data rates, also providing access to the internet.

Machine Insight Center: web application used to access the machine status, features, and anomalies.

User: end client of the Aion.

Cloud: provides storage and processing of the user's machines' vibration, magnetic field, and temperature data.

This manual contains the requirements for the correct installation, provisioning, and operation of the Aion, designed for the sole purpose of condition monitoring. It must only be handled and installed by trained personnel.

Not following this manual may cause malfunction of the sensor node, unprecise anomaly detection, or damage to the machines and to the environment.

AiSight must be notified of any abnormal behavior from or defect in any Aion, and will provide maintenance or replacement of the malfunctioning or damaged sensor node.

The user is not authorized to open or to perform any maintenance actions on the sensor node and power supply.

3. Proper handling

Proper handling of the AiSight Aion sensor node is critical to prevent any damage. The following situations should be **avoided** at all times:

- Dropping the Aion or hitting the unit against sharp or hard surfaces
- Using excessive force when mounting the Aion
- Exposing the Aion to temperatures above 85°C
- Exposing the Aion to any reactive chemicals
- Recharging the Aion battery pack: the Aion battery pack contains primary cells, which can't be recharged. Do not attempt this!

During installation of the Aion, **avoid the** following situations:

- Touching the pins of the Aion connector or its power supply with any metal tools or conductive devices
- When using the magnet mounting accessory:
  - Impact (due to magnetic attraction) when mounting the sensor on the desired surface.
  - Operator body parts coming between the magnet and metal surface
  - Pacemaker wearers: a distance lower than 20 cm from the exposed surface of the magnet
- When using the swivel mounting:
  - Forcing the mounting without the presence of a thread
- Handling of the power cable (when used instead of the power supply) by untrained electrical personnel

The user's environmental, health, and safety (EHS) manager must be consulted to ensure the safe installation of the sensor. The technicians who are responsible for the installation must follow all EHS guidelines, use the required personal protective equipment (PPE) and use the proper and indicated tools.

For adhesive mounting options, the cure time must be respected before the operation of the machine restarts.

The power supply cable or the power cable alone must be securely tied to fixed parts of the body of the machine, cable trays, or ducts. It's suggested to use cable ties, clips, and clamps.

3.1.   Caution and warnings

Caution indicates a hazard that could cause minor personal injury, or property damage if ignored.

A warning indicates a hazard that could cause severe personal injury, death, or substantial property damage if ignored
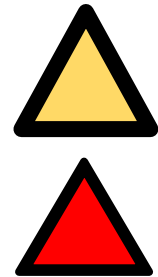
3.2.   Risk assessment

The risk assessment of the sensor is based on the CENELEC GUIDE 32 and can be shared on demand. Please contact AiSight for any further information.

3.3.   Compliance

Federal Communications Commission (FCC) Compliance Statement – Aion (HVIN: V4PRO)

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.

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

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.

Federal Communications Commission (FCC) Compliance Statement – Aion BP

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.

Industry Canada (IC) Compliance Statement - Aion (HVIN: V4PRO)

[EN] This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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

Industry Canada (IC) Compliance Statement - Aion BP

[EN] This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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4. Datasheet

Compliance and safety	
Compliant with	CE, FCC, IC

Vibration measurements	
Type	3-axis digital accelerometer
Bandwidth	6.3 kHz
Acceleration range	Up to ±16 g
Resolution/sensitivity	<0.5 mg/LSB

Magnetic measurements [2]	
Type	3-axis digital geomagnetic sensor
Bandwidth	1.6 kHz
Magnetic range	±160 mT
Resolution/sensitivity	30 µT

Temperature measurements	
Refresh rate	104 Hz
Temperature range	-40 to 105°C
Resolution/sensitivity	256 LSB/°C

Environmental	
Sensor node temperature range	−20 to 85°C
Cable (sensor node to battery pack) temperature range	Fixed: -10°C to +80°C Flexible: -5°C to +80°C
Power supply temperature range	-20 to 60°C
AiSight battery pack temperature range	-20 to 60°C
Ingress protection	IP67
Salt and mist	Standards IEC 60068-2-11: 2000

Power	
Alternating current power supply	
Input connector	IEC Type C
Input voltage	90 – 264 V ac
Input frequency	47 – 63 Hz
Output voltage	24 V
Maximum output ripple	<200 mV pk-pk
Output power	>18 W
Direct current cable	
Interface connector 1	M8, 4 pins
Interface connector 2	BB-02XXMA-QL8MPP
AiSight battery pack	
Cell chemistry	Lithium thionyl chloride
Output voltage	3.6 V
Autonomy	Lifetime up to 5 years[1]
Cable length	1 m (shielded cable)
Dimensions	86 mm x 86 mm x 48 mm
Weight	200 g
Connector	M8, 4-pin female
Compliance, emission, immunity, and safety	
External power supply certifications	CE, UL, TUV, TUV/GS, Energy Efficiency Level VI; European CoC Tier 2
Battery pack certifications	CE, FCC, UN38.3, IEC62133
Emissions and immunity approvals	EN55022 Class B, EN61000-3-2 Class A, EN61000-3-3, EN55024, + additional certifications depending on the model
Safety approvals	IEC60950-1, EN60950-1, UL60950-1

[1]Estimation of expected lifetime upon specific acquisition interval.

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[1] Lifetime expectation only under specific data acquisition profile at room temperature. Environmental conditions and/or different data acquisition profile may lead to a reduction of the expected lifetime.

Connectivity for provisioning (Bluetooth)	
Protocol	Bluetooth 5.0
Radio	Receiver with –97 dBm sensitivity, Class-1, transmitter, AFH
Connectivity for operation (WiFi)	
Protocol	802.11 b/g/n (802.11 n up to 150 Mbps)
Frequency range	2412 to 2484 MHz
Integrated antenna	Able to connect to routers/gateways up to 60 meters in industrial environments.
User Interface	
Machine Insight Center	Custom-made client solution

Physical [3]	
Dimensions	72 mm x 61 mm x 29 mm
Weight	150 g
Mounting accessories	M5 tapped hole, magnet, motor fins adaptor, screw pad adaptor, food contact safe cyanoacrylate or industrial-grade epoxy
Connector	M8, 4-pin male

5.   Service and installation instructions

To successfully install the Aion and access the data in the AiSight Machine Insight Center, three steps are needed:

1. **Mounting**: mount the Aion with the help of the provided mounting accessories
2. **Powering**: connect the Aion to power
3. **Connecting**: provision the Aion with Wi-Fi credentials
4. **Operating**: read data from AiSight Machine Insight Center

Steps 1. **Mounting** and 2. **Powering** MUST be performed by qualified personnel.

5.1.   Mounting
5.1.1.   Sensor orientation

The Aion includes triaxial vibration and magnetic field sensors. The axes for both measurements are configured as shown in Figure 5.1. The "x" axis is aligned with the logo, while the "y" is aligned with the M8 connector. The "z" axis covers the resulting dimension, perpendicular to the body of the sensor.
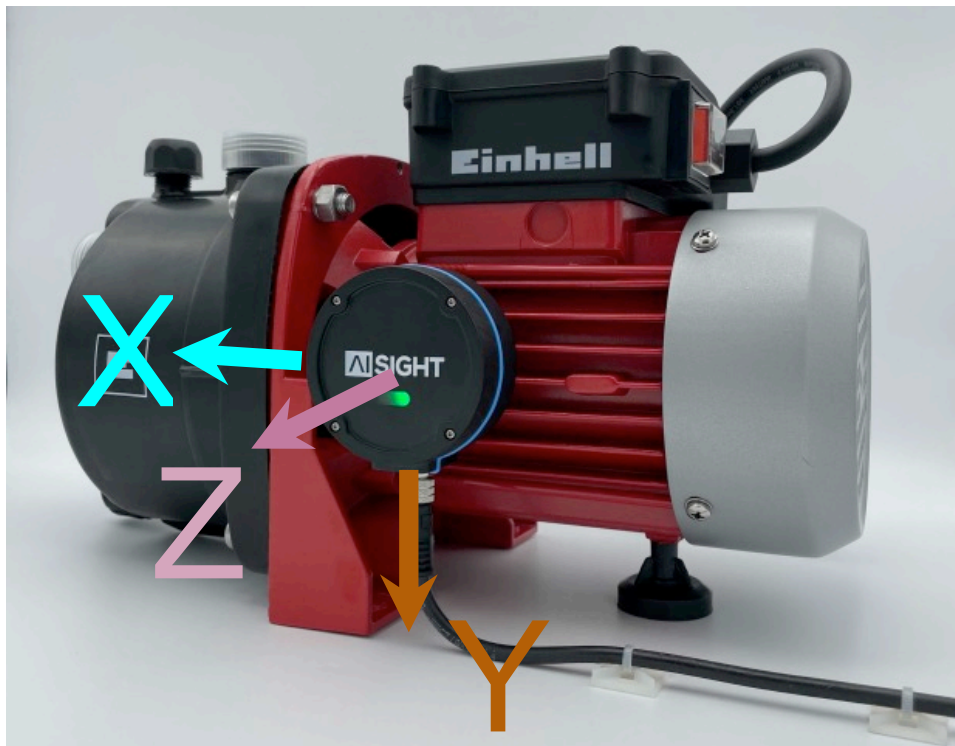

Figure 5.1 - Sensor orientation

The first step is to identify the ideal mounting position on the machine. As we are measuring the vibration of the machine, and we rely on very good transmission of data, it is not recommended to attach the sensor simply anywhere on the machine.

Ideally, if a probable failure location is known, it is recommended to place the sensor as close as possible to this location.

Steps

1. Identify the best monitoring position on the machine
2. Start by cleaning the surface of your machine with the cleaner and cloth. Be sure no dirt is remaining.
3. Sand the surface to improve the mounting contact and then clean the surface again of sanding residue.
4. Carefully slide the protective metal ring from the magnet using pliers
5. Apply the Aion to the previously prepared surface

For additional information regarding mounting the Aion, please contact AiSight.

Safety Precautions

The AiSight magnet is very strong. It is necessary to take exceptional care when handling it in the vicinity of magnetic surfaces and the user's fingers.

When handling magnets and magnet systems, persons wearing pacemakers should be especially careful. A minimum distance of 20 cm must be maintained from the device, as otherwise the pacemaker could temporarily malfunction. The use of magnets and magnet systems in explosive atmospheres is unsafe. Falling magnets could generate sparks and shatter.

5.2.   Powering

Three options to power the sensor can be used depending on customer preference and contract details. The first option is to use the custom ac power supply compatible with the product, the TRE25R240 with 3 m long cable and female M8 4-pin connector, as shown in Figure 5.2.

Figure 5.2 - AiSight custom power supply with M8 connector

In cases where an ac connection is not possible close to the machine (either because of physical or safety constraints), the customer can also use a 2-wire or 4-wire cable with M8 4-pin female connector to directly connect the sensor node from existing machine panels or switchboards that have dc connection from 3 to 40 V (24 V recommended). A cable with an over-molded connector or a cable with a field installable connector, as shown in Figure 5.3 can be used. For either case, the cable must be designed for industrial use, have internal and external insulation jackets and have the UL94 classification V0 or higher (5VB or 5VA).

The sensor node consumes a maximum of 3 W and supports a power supply voltage from 3 to 40 V dc, with a preferred supply of 24 V dc.

Figure 5.3 - Example of a cable with M8 female plug connector

Only authorized and technically trained personnel should handle and install the power supplies and cables, specifically when access to panels and switchboards is necessary.

In case none of the previous options are applicable, the sensor node can be powered by the Aion battery pack, specifically designed by AiSight to fulfill the power needs of the sensor node. The battery pack can be connected to the sensor node through 1 m shielded cable with male/female M8 4-pin connector (provided by AiSight).

Figure 5.4 – AiSight battery pack

5.2.1. Powering with the ac power supply

The TRE25R240 power supply accepts voltage levels from 90 to 264V ac, with a maximum input current of 0.7A. Overcurrent protection and exclusive breakers can be set by the user if required.

The power supply includes a cable with power plug (CEE 7 or NEMA).

The ac connection must be at a distance equal to or less than 3 linear meters from the installation of the sensor node. The power supply must be connected to the ac mains, in a vibration and stress-free environment, as stable as possible. The preferred connection points are wall outlets or secure outlets on the floor. The outlets can also be connected via an extension cord, as long as the connection end is safe and secure.

The power supply doesn't share the same ingress protection level as the sensor node. The customer must take care during installation to protect the power supply against ingress by choosing an appropriate location with limited dust and water.

5.2.2. Powering with dc cable

When using a cable (4x0.25 mm² minimum) with an over-molded female M8 4-pin connector (Figure 4.9) the cable follows the industrial standard, including the pin numbers and colors. The sensor node accepts from 8 to 40 V dc and the recommended voltage is 24 V dc. The customer must observe that most cables are limited to 30 V. The M8 connector must follow the IEC 61076-2-104 standard with A-coding. The cable construction must be IP65 or higher, built either with PVC or PUR materials with UL94 rating HB or superior.

5.2.3.   Powering with the AiSight Aion battery pack

The battery pack option is strongly recommended when access to a power supply is difficult or not possible (i.e., no ac plugs in proximity, no access to a machine panel). The battery pack can be attached to any metal surface in proximity to the sensor node thanks to the magnet on its back.

Figure 5.5 - The BP must be aligned so the text reads left to right with the cable extended towards the floor, or as close as possible

**Necessary Equipment**
- Surface cleaner and cloth

Steps
1. Identify the best installation point in proximity to the sensor Node
2. Start by cleaning the target point with the cleaner and the cloth. Be sure no dirt is remaining.
3. Carefully slide the protective metal plate from the magnet using pliers
4. Connect the battery pack to the sensor node through 1 m shielded cable with a male/female M8 4-pin connector (provided by AiSight). The recommended torque for mating the connector is 0.4 N•m; over- or under-torque might cause a deterioration of the mating surfaces or result in a poor and unstable connection, respectively.

The battery pack has been designed to guarantee the sensor node a lifetime of up to 5 years if, during the installation, the following conditions have been fulfilled:

- Install the battery pack in an upright position, since the capacity of the cells is affected by the orientation
- Affix a zip tie around the cable to a point on the machine to prevent the device from falling in the event it is knocked from its mounting
- Install the battery pack at a point where the temperature is close to the environment temperature. Although the battery pack has been designed to operate from -40°C to +85°C, the available capacity of the cells is influenced by the temperature

Even though the battery pack complies with the European Union Waste Electrical and Electronic Equipment (WEEE) Directive, the user is not permitted to discard the battery pack. When the Aion battery pack is close to the end of life, the user must ship it back to the address indicated on the contract; AiSight will provide a new Aion battery pack without additional costs. The user **must not open** the Aion battery pack under any circumstances. Any misuse of the device might lead to injuries or harmful situations.
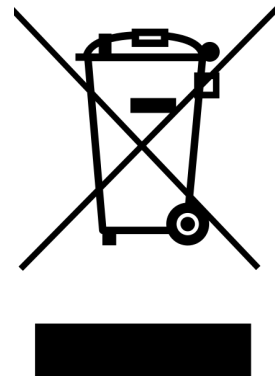
Safety precautions

The back of the Aion battery pack includes a very strong magnet. It is necessary to take exceptional care when handling it in the vicinity of magnetic surfaces and the user's fingers.

When handling magnets and magnet systems, persons wearing pacemakers should be especially careful. A minimum distance of 20 cm must be maintained from the device, as otherwise the pacemaker could malfunction temporarily. The use of magnets and magnet systems in underline explosive atmospheres is unsafe. Falling magnets could generate sparks and shatter.

Additionally avoid placing the battery pack in environments with harsh corrosive chemicals, as this can corrode the enclosure and expose the batteries. It is strongly recommended to not use the battery pack in environment where there is high

concentration of: strong mineral acids, water, and alkali solutions. In cases like this a power adapter is best to use as there is no risk of battery corrosion.

The Aion battery pack contains primary cells. The cells used in this device may present a risk of fire or chemical burn if mistreated. Do not recharge, disassemble, heat above 100°C, or incinerate. Batteries must not be replaced by the user.

In the remote event of fire involving the battery pack, it is important to react as indicated below:

1. Lith-X (Class D extinguishing agent) is the only effective suppressant for fires involving lithium batteries. If the cells are directly involved in a fire DO NOT USE: WATER, SAND, CO_2, HALON, and DRY POWDER, OR SODA ASH EXTINGUISHERS.

2. If the fire is in an adjacent area and the cells are either packed in their original containers or unpacked, the fire can be fought based on fueling material, e.g., paper and plastic products. In these cases, the use of copious amounts of cold water is an effective extinguishing media. The storage area may also employ a sprinkler system with cold water.

In case of firefighting, wear a self-contained breathing apparatus to avoid breathing irritant fumes (NIOSH approved SCBA & full protective equipment). Wear protective clothing and equipment to prevent bodily contact with the electrolyte solution. Fire may be fought only from a safe fire-fighting distance. Evacuate all persons from the immediate area of the fire. During thermal decomposition, generation of chlorine (Cl_2), hydrogen chloride (HCl), and sulfur dioxide (SO_2) can occur.

5.2.4. Cable management

A cable is present in both powering alternatives and it must be securely installed independently. The customer can install the cable inside distribution trays and ducts. For external installation, if existing cables (for power or communication) or safe mechanical lines or fixed machines parts are present, the cable can be attached to them by using cable ties. If there is no support or existing cables, cable tie holders

can be installed in flat surfaces. Ensure the surface is clean and degreased before installing adhesive cable tie holders.

Once the cable is close to the sensor mounting point, some safety precautions must be taken to provide enough distance from any moving parts (i.e., shafts, belts). Since the connector must be screwed to the sensor node and/or to the battery pack, some slack must be ensured. The connector and cable cannot introduce any traction on the sensor node and/or to the battery pack, since this may compromise the sensor reading and functionality.

The suggested external installation procedure with adhesive cable tie holders is described below.

1. Observe the complete path of the cable before starting the installation.
2. Draw lines or use a level if necessary to mark the support points. In case of using the battery pack, keep in mind that this system uses a shielded cable. The performance of the cable is guaranteed if the curvature radius is greater than 37.5 mm or 60 mm for fixed or mobile installations respectively
3. Clean all the surfaces with industrial surface cleaners (i.e., Loctite 7063 or 7061).
4. Install the cable tie holders.
5. Lay the cable and install all the cable ties partially.
6. Ensure some cable slack close to the sensor mounting location. In case of using the battery pack as power supply for the sensor node, the same considerations regarding the cable are applicable.
7. Finish all cable ties and cut the excess edges.
8. Connect the first end to the ac plug or 24 V dc supply. Only in case of powering through Aion battery pack, connect the M8 female connector to the battery pack and turn the connector in clockwise direction until a secure connection is achieved. Recommended torque is 0.4 N•m [3.54 lb-ft].

After the cable is securely installed, the M8 connector must be plugged into the sensor:
1. Verify the polarity of both parts and align them.
2. Push (without turning) the connector until it reaches the limit.

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3. Turn the connector in clockwise direction until a secure connection is achieved. Recommended torque is 0.4 N•m [3.54 lb-ft].

Once the power is on, the sensor node's status LED will visually indicate the status of the connection. The white light will indicate that the sensor is on. The light should shortly change to a red color, which will indicate that the sensor is ready for the next step.

5.3. Connecting

This section describes the requirements and steps for provisioning the sensor node.

5.3.1. Required parts

- Aion sensor node
- Alternating current power supply, 24 V power cable, or Aion battery pack
- Apple iPhone or iPad with enabled Bluetooth connectivity
- Provisioning application (app) can be found in the Apple App Store using the link below
  - https://apps.apple.com/de/app/aisight-ble-provisioning/id1531196751
  - Alternatively, the user can look for *AiSight BLE Provisioning*
- Wi-Fi router with internet connection or Wi-Fi cellular gateway

5.3.2. Sensor node overview

- Protocol: IEEE-802.11B/G/N (802.11N up to 150 Mbps).
- WPA, WPA2, WPA2-Enterprise (soon) and WPA3 (following months).
- Frequency range: 2412 to 2484 MHz (2.4 GHz).
- Integrated antenna: able to connect to routers/gateways up to 30 meters away.

5.3.3. Wi-Fi requirements

In order to successfully connect Aion with the cloud, the following requirements must be met:
- Robust access points with high performance features (e.g., MU-MIMO - multi-user, multiple-input and multiple-output)
- DHCP and network configured for an appropriate topology (e.g., correct subnet size, VLANs, etc.)
- Network must be able to handle communication over MQTT protocol (TLS1.2)
- DNS: mqtt-prd.aisight.de
- Port 8883 must be open

5.3.4. Provisioning

Connect the sensor node to the power supply (TRE25240), the 24 V power cable, or the battery pack. Make sure the plug is securely tightened to the sensor connector (recommended torque 0.4 N•m). Aion can be provisioned at any time when it is not battery powered, except during updates which are indicated by a purple status LED.

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When powered by battery, provisioning is possible during the first 10 minutes after connecting the node to the battery pack. This power-cycling process should be repeated when Aion is required to connect to a different network with new credentials.

Open the app and make sure the Bluetooth connections are allowed and click on **Provision Device**, as shown in Figure 5.6. The app will scan for all available devices in range. The devices will be shown in a list as shown in Figure 5.7. Observe the node serial number on its lid and choose the matching number in the app.
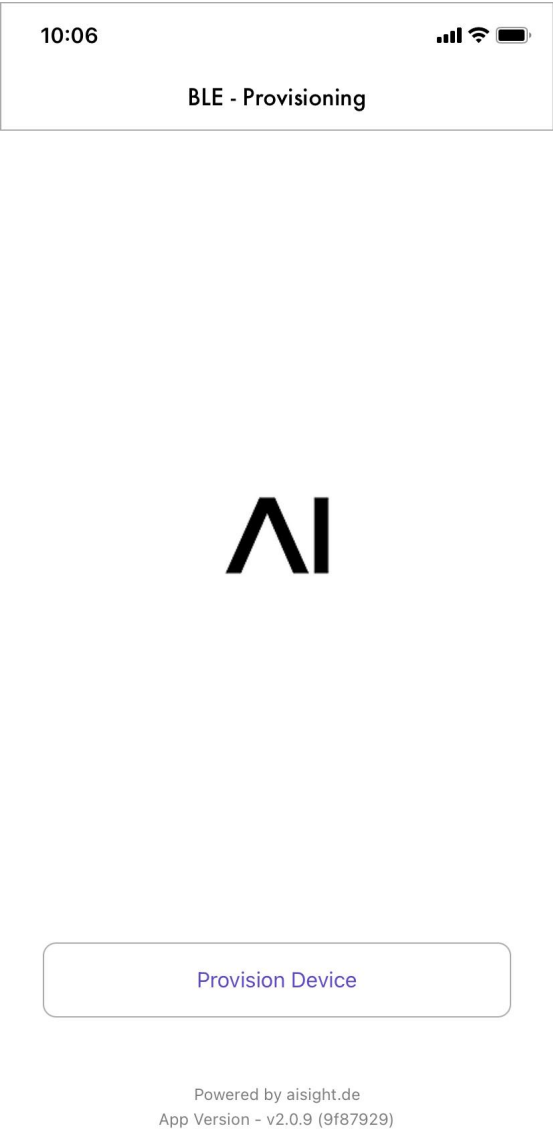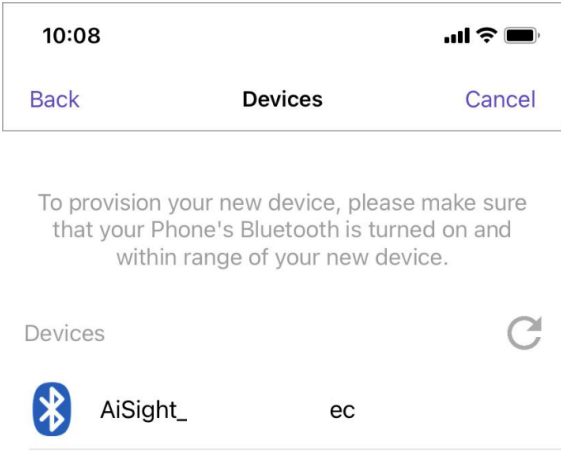

Figure 5.6 - Initial screen

Figure 5.7 - List of available sensors

After selecting the proper node, the app will command the node to scan available Wi-Fi networks in range and displays them as shown in Figure 5.8(a). Select the network that will be used for the nodes. Enter the network password, as shown in Figure 5.8(b).

(a)   (b)
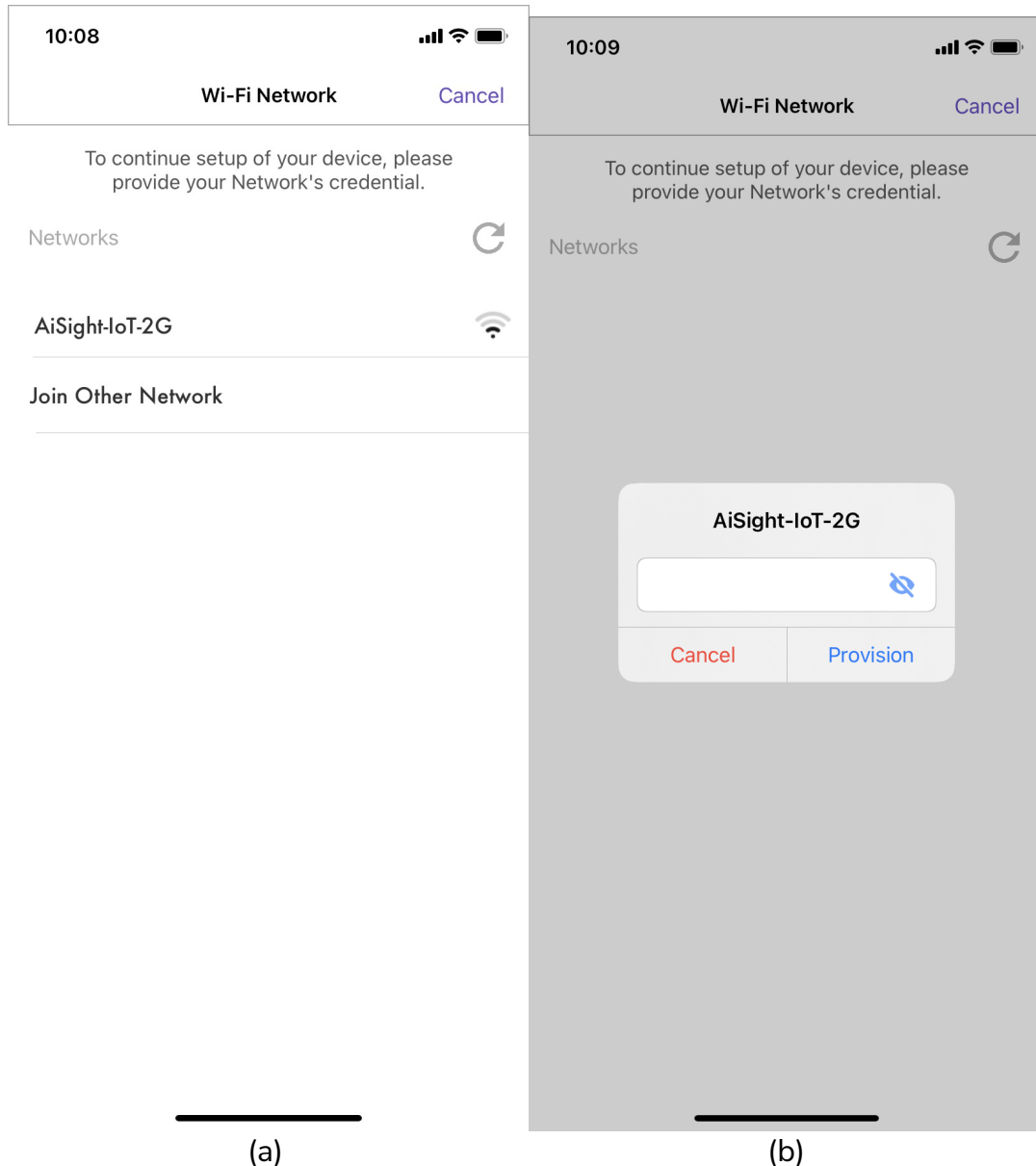
Figure 5.8. (a) Available Wi-Fi selection (b) Password screen

Once the password is entered, the app will proceed to the next screen, Figure 5.9. Initially, the app will confirm that it sent the credentials to the sensor node and, if everything is correct, confirm the Wi-Fi connection. If there is any mistake with the password, the app will confirm sending the credentials, but it will fail on the confirmation. Simply repeat the process with the correct password.

✓ Sending Wi-Fi credentials.

✓ Confirming Wi-Fi connection.

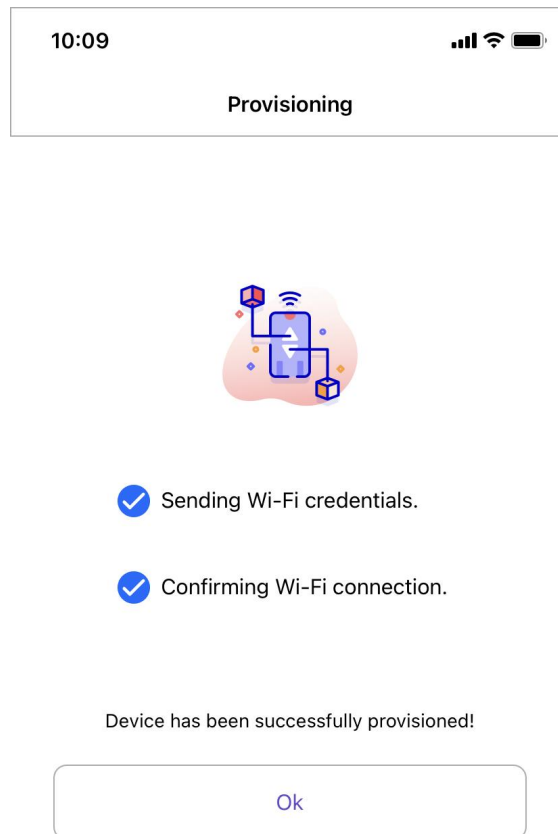Device has been successfully provisioned!

Ok

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Figure 5.9. Screen confirming the connection of the sensor with the Wi-Fi.

By clicking the OK button, the user can start the provisioning process for the next sensor node in range.

The sensor node should now change its color to yellow as soon as it connects to the Wi-Fi. Shortly after, it should turn green confirming the connectivity with our platform in the cloud, as shown in Figure 5.10. If the node stays with the yellow LED on, the network requirements presented at the beginning of this document must be reviewed.

Figure 5.10 - Sensor node provisioned and connected to the Wi-Fi