

OPERATION AND INSTALLATION MANUAL

Industrial LoRaWAN vibration sensor - VibrexIoT

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Purpose: Instructions for safe installation, commissioning, operation, maintenance and interpretation of the VibrexIoT sensor. Keep this manual available to installers and maintenance personnel.

1. Product overview

VibrexIoT is an industrial wireless vibration sensor for condition monitoring and predictive maintenance of rotating and reciprocating machinery. An external industrial piezoelectric probe acquires machine vibration while the battery-powered LoRaWAN unit processes selected condition indicators and transmits them to the monitoring platform.

1.1 Intended use

- motors, pumps, fans and gearbox condition monitoring
- bearing vibration and mechanical fault monitoring
- predictive and preventive maintenance
- industrial machinery health monitoring
- production equipment and machine-tool monitoring
- factory automation and Industrial IoT applications
- remote monitoring of critical rotating equipment

1.2 System components

- VibrexIoT LoRaWAN electronics enclosure
- external industrial piezoelectric vibration probe with cable
- two 3.6 V AA lithium batteries (installed or supplied according to order)
- mounting accessories according to the selected installation method
- LoRaWAN network and monitoring platform access, supplied separately (if client order it)

1.3 Key characteristics

- ± 50 g peak measurement range and approximately 20 mV/g sensitivity
- 1-9,000 Hz frequency response ($\pm 10\%$) (Extended: 0.5-12,000 Hz (± 3 dB))
- ACC RMS, ACC Peak, Velocity RMS, Crest Factor and Health Index outputs
- probe operating temperature from -40 to $+120$ °C
- up to 1,000 g peak shock resistance
- LoRaWAN Class A communication with encrypted data transfer
- expected battery life up to 7 years, depending on configuration and environment

Important: VibrexIoT supports condition monitoring and trend-based maintenance decisions.

2. Measured and calculated parameters

The value of VibrexIoT data is highest when measurements are trended over time and compared with a stable machine baseline under similar operating conditions.

Parameter	Meaning and typical use
ACC RMS (m/s ²)	Overall vibration severity represented by the root-mean-square acceleration. Useful for tracking sustained vibration changes.
ACC Peak (m/s ²)	Highest acceleration observed during the measurement window. Useful for detecting shocks and short transient events.
Velocity RMS (mm/s)	Overall vibration velocity. Commonly used to assess general machine vibration severity, subject to machine class and applicable standards.
Crest Factor	Ratio of peak amplitude to RMS level. A rising value may indicate increasingly impulsive behavior, impacts or developing bearing defects.
Health Index (1-5)	Integrated condition indicator that summarizes machine behavior. Interpret together with trends, operating state and other measured parameters.
Machine behavior tracking	Integrated processing used to observe changes in the machine vibration signature over time.

2.1 Practical interpretation

- A sustained increase in ACC RMS can indicate increasing overall vibration.
- An increase in ACC Peak or Crest Factor can indicate impacts, looseness or intermittent defects.
- A change in Velocity RMS can indicate a change in overall machine condition or alignment.
- A change in Health Index should trigger review of the underlying parameters and the machine operating context.
- A single reading should not be used as the sole basis for a maintenance or safety decision.

Baseline: Operate the machine under representative normal conditions and allow VibrexIoT to establish its normal vibration baseline.

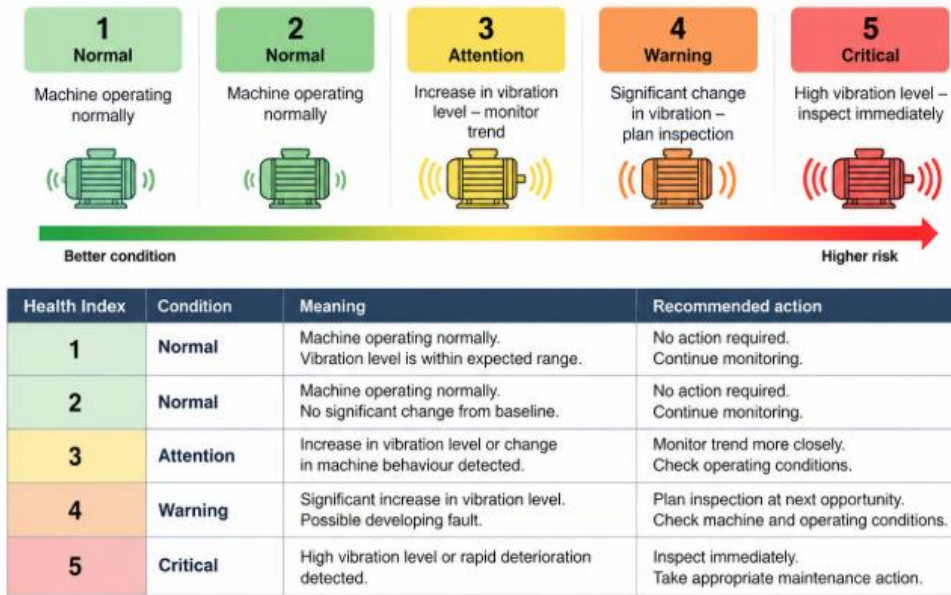
2.1.1 Practical information on how interpretate health index:

The Health Index (1–5) is an integrated condition indicator calculated from multiple vibration parameters (ACC RMS, ACC Peak, Velocity RMS, Crest Factor) and the machine's behavior over time. It provides a simple overview of the machine's condition and helps to identify when attention may be required.

The Health Index should always be interpreted together with the individual parameters and their trends.

Important:

- Health Index is a general condition indicator. It is not a detailed fault diagnosis.
- Always interpret the Health Index together with ACC RMS, ACC Peak, Velocity RMS, Crest Factor, baseline and trends.
- A single reading should not be used as the sole basis for maintenance or safety decision.



2.2 Downlink messages

Downlink messages

The downlink data messages must be sent via port No. 3 in the specific format. Minimal data size is 3 bytes.

Header	Payload length	Payload	
Settings ID	Settings data		
0xBA	1 byte	1 byte	0-n bytes

The downlink data messages are as follows:

Setting ID	Setting Length	Comment
0x1B	1 byte	LED control: • 0x00 – green LED OFF • 0x01 – green LED ON • 0x02 – green LED toggle for 5 s
0x1C	0 byte	Reset device

The examples of the downlink single messages:

- BA021B01 – green LED ON.
- BA011C – Reset device.

It is recommended to send downlink data messages each by each after setting actual operational validation. When downlink message is sent for the setting of the vaping threshold index value, the new index setting is deployed after time interval which is equal corresponds the data sending sequence in relation with time intervals. The forced new vaping threshold index value setting deployment can be performed after resetting the sensor in order to shorten new vaping threshold index value deployment time duration.

In case if downlink message is sent to the sensor working on “ABP” mode, the vaping threshold index value change will take effect only after the time interval equal to the previous time interval.

The example to send the downlink message through the “Things Of The Network”:



Uplink

Downlink

Schedule downlink

Insert Mode

- ☐ Replace downlink queue
- ☒ Push to downlink queue (append)

FPort *

3

Payload type

- ☒ Bytes ☐ JSON

Payload

BA 03 1D 00 8C

The desired payload bytes of the downlink message

- ☐ Confirmed downlink

Schedule downlink

3. Planning the installation

3.1 Personnel and tools

Installation shall be carried out by personnel competent to work around the relevant machinery and electrical/mechanical hazards. Follow the site lockout/tagout procedure before approaching moving parts.

- appropriate personal protective equipment
- manufacturer-approved probe mounting hardware
- cleaning materials suitable for the machine surface
- fasteners and cable restraints suitable for the environment
- LoRaWAN network credentials and platform access, where required
- a mobile device or computer for commissioning and verification

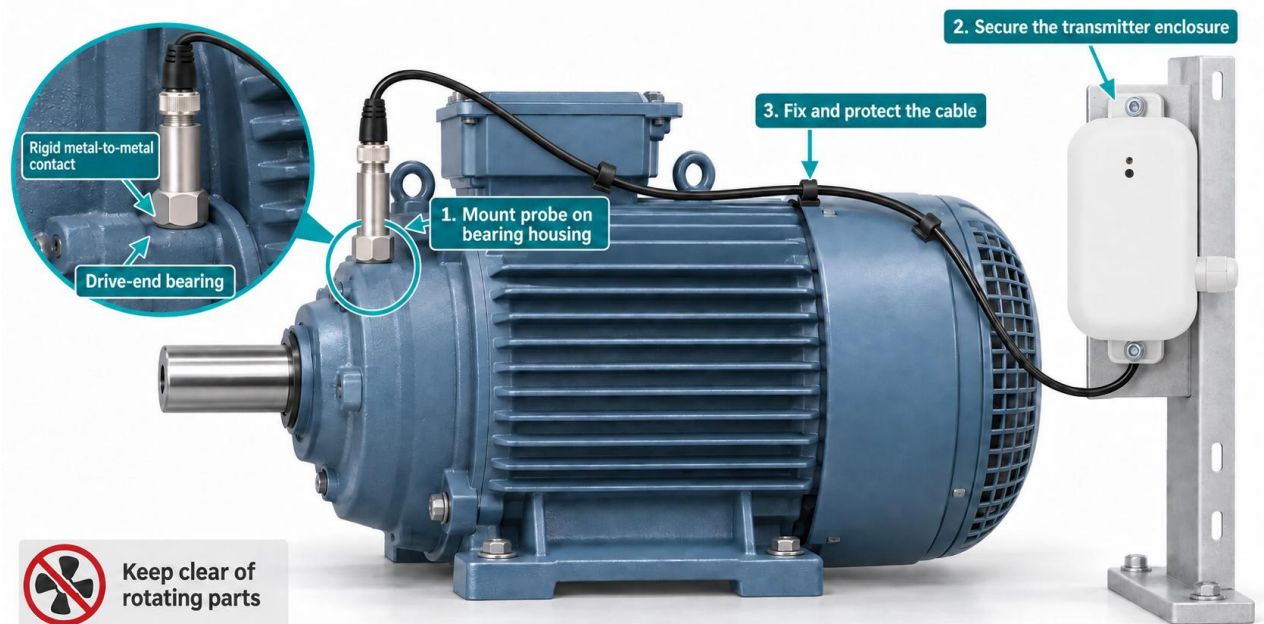
3.2 Selecting the measurement point

- Choose a rigid location close to the bearing housing or other vibration transmission path.
- Avoid thin covers, guards, flexible panels, loose brackets and surfaces that can resonate independently.
- Use the same position and orientation for comparable machines whenever possible.
- Keep the probe clear of hot surfaces beyond its rating, moving parts, washdown jets and impact zones.
- Select an enclosure location that protects the cable and provides adequate LoRaWAN radio coverage.

3.3 Environmental checks

- Confirm the selected enclosure variant has the IP rating required by the installation.
- Confirm the probe temperature remains within -40 to +120 °C.
- Confirm the electronics storage temperature remains within 10 to 70 °C.
- Avoid aggressive chemicals, corrosive atmospheres and direct mechanical impact unless the installation has been specifically approved.

Radio survey: The specified range depends on walls, metal structures, antenna orientation, interference, gateway placement and LoRaWAN configuration.



4. Mechanical installation

4.1 Safety preparation

1. Identify the machine and confirm the approved monitoring point.
2. Stop and isolate the machine where installation near moving or energized parts presents a hazard.
3. Verify zero-energy state according to the site procedure.
4. Inspect the probe, cable and enclosure for transport damage.
5. Clean and prepare the selected mounting surface.

4.2 Mounting the vibration probe

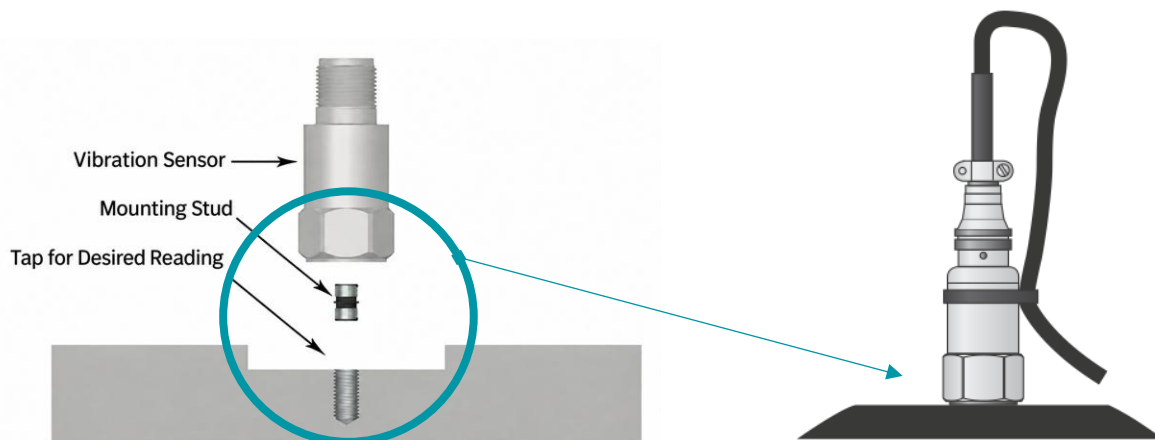
A rigid, repeatable mechanical connection is essential. The mounting method directly affects the usable frequency response and comparability of measurements.

1. Install the probe on the selected rigid measurement point using the approved threaded, stud, magnetic or bonded adapter specified for the application. For permanent condition monitoring, rigid threaded or bonded mounting is preferred. Magnetic mounting should primarily be used for temporary measurements or commissioning unless specifically validated for the application.
2. Orient the sensitive axis consistently with the monitoring plan. Record the probe orientation and machine location.
3. Tighten the mounting hardware to the adapter or machine manufacturer's specified torque. Do not twist the cable while tightening.
4. Check that the probe is fully seated and cannot rock or move independently of the machine surface.
5. Route the cable away from rotating shafts, couplings, belts, hot surfaces and sharp edges.

Mounting quality: A loose, flexible or contaminated interface can create false resonances or attenuate vibration. Do not compare trends after changing the mounting method without establishing a new baseline.

4.3 Mounting the LoRaWAN enclosure

1. Use the enclosure mounting features and suitable fasteners for the supporting surface.
2. Mount the enclosure on a stable surface where it is protected from impact and service access remains possible.
3. Do not mount the enclosure directly on a surface that exceeds the electronics environmental limits.
4. Leave enough cable slack for service, but do not form loops that can contact moving parts.
5. Secure the cable at suitable intervals without crushing or sharply bending it.





5. LoRaWAN commissioning

5.1 Network requirements

- LoRaWAN 1.0.3 compatible network
- Class A end-device support
- OTAA by default; ABP is optional
- ADR and adaptive channel setup support
- regional frequency plan matching the device order and local regulations
- application capable of receiving and decoding the VibrexIoT payload

5.2 Commissioning procedure

1. Register the device in the LoRaWAN network using the identifiers and keys supplied with the sensor.
2. Confirm that the configured region matches both the gateway/network and local radio regulations.
3. Install or activate the batteries according to Section 8.
4. Initiate network joining using the commissioning method supplied for the ordered device configuration.
5. Verify that the network receives an uplink from the expected device.
6. Confirm that measured values appear correctly in the monitoring platform.
7. Run the machine in a known operating condition and store the first verified baseline measurement.
8. Document the asset name, probe point, orientation, installation date and sensor serial number.

5.3 If the device does not communicate

- verify battery installation, polarity and battery condition
- verify device identifiers, activation mode and keys
- verify regional frequency plan and enabled channels
- check gateway connectivity and application routing
- temporarily test closer to the gateway
- check for shielding by metal enclosures or machinery
- contact UAB Nano sensorics support if the issue remains

Security: LoRaWAN communication uses end-to-end encryption (AES-CTR) and data-integrity protection (AES-CMAC). Protect device credentials and restrict platform access to authorized personnel.



6. Operation and alarm strategy

6.1 Establishing normal behavior

1. Confirm that the probe and enclosure are securely installed.
2. Collect data across representative machine speeds, loads and operating modes.
3. Label non-operating, start-up, steady-state and shutdown periods where the platform supports it.
4. Define a normal baseline only after enough stable measurements have been collected.
5. Review the baseline with personnel familiar with the machine and its maintenance history.

6.2 Setting thresholds

Thresholds depend on the machine type, mounting point, operating speed, load and maintenance policy. Use applicable standards, OEM recommendations and site engineering judgment. Avoid applying a single universal threshold to unlike machines.

- Use warning thresholds for early review and alarm thresholds for urgent investigation.
- Apply persistence or repeated-event logic where appropriate to reduce nuisance alerts.
- Review thresholds after maintenance, relocation, probe remounting or major operating changes.
- Record each threshold change, its reason and the approving person.

6.3 Responding to abnormal data

1. Confirm that the machine operating condition is comparable with the baseline.
2. Inspect the probe mounting, cable and enclosure for looseness or damage.
3. Compare ACC RMS, ACC Peak, Velocity RMS, Crest Factor and Health Index trends.
4. Check related process data such as load, speed, temperature and recent maintenance.
5. Arrange further inspection or specialist vibration analysis when the cause is not clear.
6. Follow the site safety procedure if machine condition may present immediate risk.



7. Inspection and maintenance

7.1 Routine inspection

- Check that the probe remains tight and seated on the original measurement point.
- Check the cable for abrasion, crushing, sharp bends, heat damage or contact with moving parts.
- Check the enclosure and cable entry for damage and loss of sealing.
- Check that fasteners and cable restraints remain secure.
- Verify recent data reception and review battery status where available.
- Clean only as described below.

7.2 Cleaning

Isolate the area as required by the site procedure. Wipe the enclosure gently with a soft, slightly damp cloth. Do not use alcohol, solvents, abrasive cleaners, high-pressure jets or aggressive detergents. Do not immerse the electronics enclosure.

7.3 After maintenance or relocation

- reconfirm the probe point and orientation
- reinspect cable routing and enclosure fastening
- verify LoRaWAN communication
- collect a new reference measurement
- document whether a new baseline is required

7.4 Calibration and verification

The piezoelectric probe is supplied as a factory-specified sensing element. Periodic verification requirements depend on the site quality system and application criticality. Contact UAB Nano sensorics for application-specific verification or service guidance. Do not disassemble or modify the probe or electronics enclosure. The enclosure may only be opened for battery replacement according to Section 8.



8. Battery replacement

Battery type: Use only two 3.6 V AA lithium batteries of the same approved type. Do not mix old and new batteries, manufacturers, chemistries or states of charge.

1. Make the machine area safe and remove the enclosure from service if required.
2. Open the enclosure using the approved service method without damaging the seal.
3. Note battery orientation before removal.
4. Remove both batteries. Dispose of them according to local regulations.
5. Inspect the battery compartment for contamination, leakage or corrosion. Do not use the device if damage is present.
6. Install two new approved 3.6 V AA lithium batteries with correct polarity.
7. Inspect the enclosure seal and close the enclosure evenly. Do not pinch the seal or cable.
8. Verify LoRaWAN communication and a valid measurement in the platform.
9. Record the replacement date and battery type.

8.1 Battery precautions

- Do not recharge primary lithium batteries.
- Do not short-circuit, crush, puncture, heat, incinerate or disassemble batteries.
- Keep batteries dry and away from conductive objects.
- Remove discharged batteries promptly.
- If leakage is found, avoid contact with the material and follow the battery manufacturer's safety instructions.
- Transport and dispose of lithium batteries in accordance with applicable rules.

9. Important safety information

Read this manual before installing or servicing the device. UAB Nano sensorics does not accept responsibility for damage or injury caused by installation or use contrary to these instructions.

- Follow all site machinery-safety, electrical-safety and lockout/tagout procedures.
- Never install, adjust or service the sensor where rotating or moving parts can be reached unless the machine is safely isolated.
- Do not use a visibly damaged probe, cable, connector or enclosure.
- Do not disassemble, crush, puncture, deform, paint or modify the sensor.
- Do not insert foreign material into openings or connectors.
- Do not exceed the specified acceleration, shock, temperature or environmental limits.
- Use only approved mounting accessories and replacement batteries.
- Keep the electronics and batteries dry during service.
- Do not dry the device or batteries with an external heat source.
- Do not rely on VibrexIoT as the only means of protecting people, machinery or production.
- The sensor is not intended for commercial accounting or legal metrology.

9.1 Symbols and markings

The product label identifies the model, serial number and other device-specific information. Keep the label readable. The crossed-out wheeled-bin symbol indicates separate collection of electrical/electronic equipment and batteries.

9.2 Waste disposal

Dispose of the sensor according to Directive 2012/19/EU on waste electrical and electronic equipment (WEEE) and applicable local rules. Do not discard the sensor or batteries with unsorted household or industrial waste. Remove and dispose of batteries separately where permitted and required.

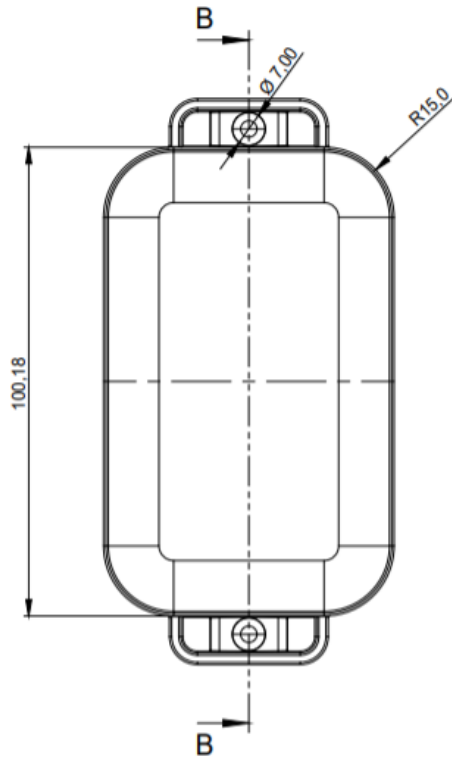
10. Technical specifications

Characteristics	Characteristics
Sensor technology	Industrial piezoelectric probe
Acceleration range	±50 g peak
Sensitivity	Approximately 20 mV/g
Frequency response	1-9000 Hz (±10%)
Extended response	0.5-12,000 Hz (±3 dB)
Amplitude non-linearity	±1%
Shock resistance	1,000 g peak
Probe temperature	-40 to +120 °C
Probe housing	304 stainless steel
External probe	Separate from LoRaWAN electronics
ACC RMS	m/s ²
ACC Peak	m/s ²
Velocity RMS	mm/s
Crest Factor	Available
Health Index	1-5
Machine behavior tracking	Integrated
Mechanical specification	Mechanical specification
IP rating	IP65; IP67 optional
Dimensions	121 × 62 × 26 mm
Enclosure	Plastic ASA
Storage temperature	10 to 70 °C
Sensor power supply	Sensor power supply
Battery type and voltage	2 × 3.6 V AA lithium battery
Expected battery life	Up to 7 years, depending on configuration and environment
Radio / wireless specification	Radio / wireless specification
Wireless technology	LoRaWAN 1.0.3
Wireless security	End-to-end encryption (AES-CTR); data-integrity protection (AES-CMAC)
LoRaWAN device type	Class A end-device
Supported LoRaWAN features	Default: OTAA; optional: ABP, ADR, adaptive channel setup
Supported LoRaWAN regions	EU863-870, US902-928; optional: AU915-928, EU433, RU864, IN865
TX power	14 dBm ±1 dBm (region-specific)

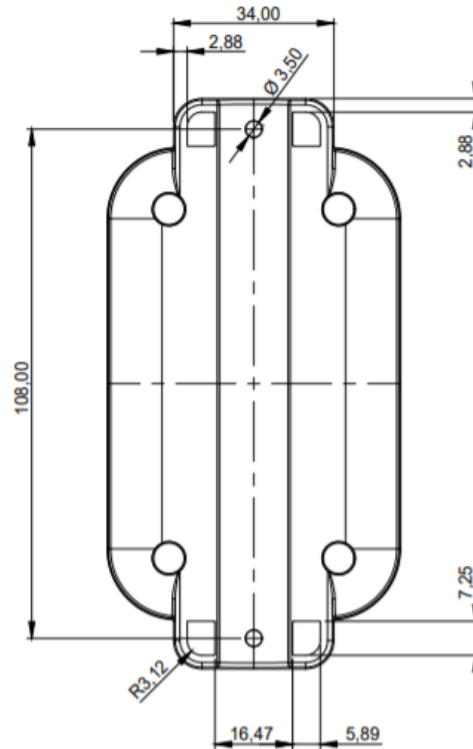
Characteristics	Characteristics
RX sensitivity	-132 dBm (LoRa, SF12, 293 bps); -118 dBm (FSK, 5 kHz deviation, 1.2 kbps)
Link budget	137 dB (SF7) to 151 dB (SF12)
Communication range	Up to 10 km line-of-sight; actual range depends on the environment

11. Sensor dimensions

Nominal enclosure dimensions are 121 × 62 × 26 mm. Verify the supplied enclosure and mounting accessories before drilling or preparing a mounting plate.



Front view



Back / mounting view

Drawing note: Dimensions shown are in millimetres. The drawings are for installation planning; do not scale them for fabrication.

11.1 Identification record

Field	Record
Asset / machine	
Measurement point	
Probe orientation	
Sensor serial number	
LoRaWAN DevEUI	
Installation date	
Installer	

12. Transportation and storage

Transport the packed sensor in a covered vehicle. Secure it against movement, shock and mechanical damage. Do not store it with aggressive chemicals or in conditions that may cause corrosion. Observe applicable lithium-battery transport requirements.

- Store the electronics within 10 to 70 °C.
- Keep the probe, cable, connector and enclosure dry and clean.
- Protect the probe and connector from impact.
- Avoid sharp cable bends and do not lift the sensor by its cable.
- For extended storage, follow the supplied battery manufacturer's instructions.

13. Regulations and conformity

UAB Nano sensorics develops and manufactures sensors with integrated low-power processing and wireless communication. According to the supplied product documentation, VibrexIoT is designed for conformity with applicable CE, RoHS, electromagnetic compatibility, low-voltage and radio-equipment requirements. The formal EU Declaration of Conformity supplied for the specific product and market is the controlling document.

Product specifications, firmware and documentation may be updated without notice. Check the latest product information before installation. Nano sensorics product names, logos and trademarks are the property of UAB Nano sensorics.

14. Warranty

The manufacturer warrants that the sensor parameters will meet the technical requirements when transportation, installation, storage and operating conditions are followed. Unless different terms are stated in the sales agreement, the warranty period is 12 months from the manufacturing date, with an option to extend it for an additional charge. Warranty does not cover tampering, unauthorized modification, incorrect installation, misuse or external damage.

15. Manufacturer and support

UAB Nano sensorics
Pakaunės St. 70, LT-47243 Kaunas, Lithuania
info@nanosensorics.com
www.nanosensorics.com

Support request: Provide the sensor model, serial number, asset description, installation photographs, LoRaWAN network details and a description of the observed issue.



16. Payload decoder for Things stack platform

```
function decodeUplink(input) {  
  return {  
    data: {  
      Battery: input.bytes[0] + input.bytes[1]/100,  
      Index: input.bytes[4],  
      ACC_peak: ((input.bytes[5]<< 8) + input.bytes[6])/100,  
      ACC_RMS: ((input.bytes[7]<< 8) + input.bytes[8])/100,  
      Vel_RMS: ((input.bytes[9]<< 8) + input.bytes[10])/100,  
      crest: ((input.bytes[11]<< 8) + input.bytes[12])/100,  
      Base: input.bytes[13] + input.bytes[14]/100  
    },  
    warnings: [],  
    errors: []  
  };  
}
```