OPERATION AND INSTALLATION MANUAL

Structural integrity sensor - BRIDGE.AI

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General information

The **BRIDGE.AI** is advanced technology sensor applied for measurement of the magnitude displacement, vibration and temperature of bridges and buildings. BRIDGE.AI sensor embedded with integrated advanced intelligent (AI) computational algorithm enables reliable capability of the measurements. The data transmitted from the sensor based on LoRaWAN Internet of things network. BRIDGE.AI is powered with D-cell batteries and able to operate up to 5 years depending on the configuration.

General Parameters

Battery Voltage

Indicates the current battery voltage level of the device. This parameter is used for monitoring the power condition of the sensor and estimating maintenance or battery replacement needs.

Displacement

Represents the estimated relative movement of the monitored object or structure. This parameter is used to detect structural movement, deformation trends, load-induced motion, or abnormal positional changes over time.

It is especially useful for:

- bridges,
- scaffolding,
- parking structures,
- temporary constructions,
- industrial supports,
- heavy-duty equipment structures.

Markings

One the backside of the sensor there will be label indicating sensor name, serial number, production date and QR code.

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Axis-based Diagnostic Parameters

The following parameters are calculated independently for the **X**, **Y**, and **Z** axes. Each axis corresponds to movement or vibration in a different spatial direction.

These parameters help identify:

- abnormal vibration behavior,
- mechanical looseness,
- structural instability,
- dynamic load response, progressive condition changes.

Peak-related Parameters

XP1_fr / YP1_fr / ZP1_fr

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Represents the **primary dominant vibration component** detected on the corresponding axis. This parameter is used to identify the main repeating dynamic behavior or structural response present in the measured signal.

It can be useful for detecting:

- dominant vibration modes,
- repetitive movement behavior,
- structural resonance tendencies,
- operational excitation patterns.

XP1_mg / YP1_mg / ZP1_mg

Represents the **strength of the primary dominant vibration component** on the corresponding axis. This parameter indicates how pronounced the main detected dynamic event or oscillation is.

It is useful for identifying:

- increased vibration intensity,
- structural excitation,
- abnormal dynamic loading,
- changes in operating or structural condition.

XP2_fr / YP2_fr / ZP2_fr

Represents the **secondary dominant vibration component** detected on the corresponding axis. This parameter provides additional insight into more complex vibration behavior where multiple dynamic sources or structural responses are present.

It may help reveal:

- secondary vibration modes,
- multiple excitation sources,
- developing structural irregularities, more complex movement behavior.

XP2_mg / YP2_mg / ZP2_mg

Represents the **strength of the secondary dominant vibration component** on the corresponding axis. This parameter helps assess the significance of the second most notable dynamic feature in the measured response.

It is useful when analyzing:

- mixed vibration patterns,
- evolving anomalies,
- distributed structural excitation,
- changes in dynamic response over time.

Shape / Severity Parameters

X_Crest / Y_Crest / Z_Crest

Represents the **crest factor** of the vibration signal on the corresponding axis. This parameter describes how strongly the measured signal is influenced by sharp peaks, shocks, or transient dynamic events.

Higher crest behavior may indicate:

- impacts,
- sudden structural excitation,
- intermittent shocks,
- looseness,
- abnormal impulsive events.

This parameter is particularly useful for identifying early-stage mechanical or structural abnormalities that may not yet appear as constant vibration increases.

Energy-related Parameters

X_High_Fr_E / Y_High_Fr_E / Z_High_Fr_E

Represents the amount of vibration energy present in the **higher-frequency dynamic range** on the corresponding axis. This parameter is used to identify changes in faster or sharper vibration behavior.

It may help detect:

- increased local vibration activity,
- structural excitation,
- loosened elements,
- mechanical disturbance,
- impact-related dynamic behavior.

This parameter is useful for detecting condition changes that are not always visible in displacement trends alone.

X_Low_Fr_E / Y_Low_Fr_E / Z_Low_Fr_E

Represents the amount of vibration energy present in the **lower-frequency dynamic range** on the corresponding axis. This parameter reflects slower or larger-scale movement behavior of the monitored object.

It is especially useful for identifying:

- structural sway,
- load-induced movement,
- slow dynamic response,
- large-body motion,
- gradual instability or flexibility changes.

This parameter is particularly relevant for:

- scaffolding,
- bridges,
- parking decks,
- temporary structures, large industrial frames.

Practical Interpretation

These parameters should not be evaluated only as isolated values. The highest value is obtained when they are analyzed together and trended over time.

Typical interpretation logic includes:

- **Displacement increase** → possible movement or deformation
- **Peak amplitude increase** → stronger recurring vibration source
- **Crest factor increase** → shocks, impacts, looseness, or transient abnormality
- **Low-frequency energy increase** → larger structural motion or load response
- **High-frequency energy increase** → sharper vibration or local disturbance
- **Emerging secondary peak** → more complex or changing dynamic behavior

Together, these parameters provide a compact condition signature of the monitored structure or equipment.

Applications

The sensor is designed for **wireless vibration, displacement, and condition monitoring** of structures, industrial assets, and heavy-duty equipment. It is particularly suitable for environments where **continuous monitoring, predictive maintenance, and early anomaly detection** are required.

Typical Application Areas

Bridge and Civil Structure Monitoring

The sensor can be installed on:

- bridges,
- overpasses,
- viaducts,
- support structures,
- retaining structures,
- temporary construction elements.

It is used to monitor:

- vibration behavior,
- structural movement,
- dynamic response under traffic load,
- abnormal oscillations,
- long-term displacement trends.

This enables early identification of:

- structural fatigue,
- loosened elements,
- excessive dynamic loading, progressive deformation.

Parking Structures and Heavy Vehicle Load Monitoring

The device is suitable for:

- parking garages,
- logistics ramps,
- industrial yards,
- heavy vehicle access zones,
- transport loading areas.

It can be used to detect and analyze:

- structural response to heavy vehicle traffic,
- repeated dynamic loading,
- abnormal vibration patterns,
- local movement or deformation caused by concentrated loads.

This is particularly useful for:

- reinforced concrete decks,
- steel platforms,
- prefabricated parking structures,
- heavily loaded slab systems.

Heavy Vehicle and Mobile Equipment Monitoring

The sensor can be mounted on:

- dump trucks,
- cranes,
- excavators,
- loaders,
- agricultural machinery,
- rail vehicles,
- other heavy-duty mobile equipment.

It is used for:

- vibration monitoring,
- displacement-related condition tracking,
- shock and movement analysis,
- detection of abnormal dynamic behavior.

Typical monitored areas include:

- hydraulic systems,
- suspension-related motion,
- structural frame behavior,
- moving assemblies and mounted components.

This helps to reduce:

- unexpected breakdowns,
- mechanical fatigue,
- safety risks,
- maintenance costs.

Industrial Asset Monitoring

The device can be used on:

- steel structures,
- machine frames,
- process equipment,
- support constructions,
- industrial platforms,
- mounted equipment bases.

Typical use cases include:

- machine condition monitoring,
- vibration-based diagnostics,
- early fault indication,
- movement trend observation,
- structural stability verification,

It is particularly suitable where wired monitoring is difficult or costly.

Factory Automation and Industry 4.0

The sensor supports **industrial digitalization and IIoT deployments** by enabling remote condition monitoring of equipment and structural elements.

Typical applications include:

- monitoring of automated production equipment,
- vibration tracking of machine structures,
- movement monitoring of mechanical assemblies,
- data acquisition for predictive maintenance systems,
- integration into smart factory monitoring platforms.

This supports:

- improved operational visibility,
- reduced downtime,

- maintenance planning,
- data-driven asset management.

Construction Site and Temporary Structure Monitoring
The device is suitable for temporary or semi-permanent deployment on:

- scaffolding support elements,
- temporary steel structures,
- modular installations,
- construction support frames,
- temporary access structures.

It can be used to observe:

- movement,
- vibration,
- displacement trends,
- unusual dynamic activity during construction or operation.

This is valuable for:

- safety monitoring,
- load response observation,
- construction phase diagnostics.

Scaffolding and Temporary Structure Safety Monitoring

The sensor is highly suitable for monitoring **critical points of scaffolding systems and temporary structures** where excessive movement, vibration, or structural instability may indicate elevated safety risk.

Typical installation points include:

- highly loaded scaffolding joints,
- support frames,
- anchoring points,
- elevated working platforms,
- temporary access structures,
- façade scaffolding sections exposed to wind or dynamic loads.

The sensor can be used to detect:

- abnormal vibration,
- excessive structural movement,
- displacement trends,
- load-induced instability,
- unusual dynamic response caused by wind, machinery, or human activity.

This enables:

- early warning of unsafe structural behavior,

- improved worker safety,
- remote condition monitoring of temporary structures,
- risk reduction in high-exposure construction environments.

Installation Manual recommendations for Concrete Structures

1. Installation Principle

The system shall be installed on **adjacent concrete structural elements**, such as:

- columns,
- beams,
- slab edges,
- joints between structural members.

The displacement sensor is mounted **directly between two adjacent concrete elements**, spanning the joint or monitored interface. The Bridge.AI enclosure is mounted **rigidly on one of the concrete elements**, at a short distance from the sensor.

2. Displacement Sensor Installation

3.1 Mounting recommendations

The displacement sensor shall be:

- mounted **directly to concrete surfaces,**
- installed **without intermediate brackets or adapters,**
- aligned **in a straight line,**
- fixed on **two separate structural elements,**
- **A protective cover must be installed where exposure to direct sunlight is possible**

Each mounting point shall be:

- located **not less than 30-50 mm from the concrete edge in case that not to damage the concrete edges,**
- positioned according to the required mounting distance (**210 mm center-to-center**) **in case of 100mm measurement.**

3.2 Drilling and Anchoring

For each mounting point:

- Drill diameter: **Ø10 mm,**
- Drill depth: **30–40 mm.**

Install:

- **M6 metal anchors** (expansion or drop-in type).

Fix the sensor using:

- **M6 bolts (approx. 40 mm length),**
- **M6 washers on both sides of the sensor,**

3.3 Installation Procedure

1. Mark mounting points on both concrete elements,
2. Verify spacing (**210 mm between mounting points**),
3. Drill holes (Ø10 mm, 30–40 mm depth),
4. Install metal anchors,
5. Position the sensor,
6. Insert bolts with washers,
7. Tighten bolts **gradually and evenly.**

Important:

- Do not pre-load or bend the sensor,
- Ensure the sensor remains **straight after tightening.**

The Installation example:

4. Environmental Protection of the Sensor

To ensure **measurement stability and long-term reliability**, the displacement sensor should be protected from:

- **direct solar radiation**
- **rapid surface heating**
- **local thermal shocks**

It is recommended that the sensor is **covered with a protective shield**, for example:

- a **metal cable tray**
- a **small protective cover**
- or another rigid shading element

This helps to reduce the influence of:

- sudden temperature fluctuations
- direct sun exposure
- local thermal expansion effects on the sensor body and mounting area

Recommendation

The protective cover should:

- not touch or mechanically load the sensor
- provide shading from direct sunlight
- allow inspection and maintenance access

5. Enclosure Installation

5.1 Mounting Location

The Bridge.AI enclosure shall be mounted:

- on one of the concrete structural elements
- the maximum distance is 2000mm from displacement probe on a solid and stable concrete surface

5.2 Fastening Method

The enclosure shall be fixed using **4 mounting points**.

Recommended fastening:

- **metal concrete screws** (preferred), or
- **metal anchors with screws**

Typical specification:

- screw diameter: **4.5–5 mm**
- length: **30–40 mm**
- with **metal washers**

Drilling:

- pilot hole diameter: **3.5–4 mm**
- depth: **~30 mm**

5.3 Installation Procedure

1. Mark 4 mounting points
2. Drill pilot holes
3. Position enclosure
4. Insert screws with washers
5. Tighten firmly

Important:

- The enclosure must be mounted **rigidly**
- Avoid soft or flexible mounting interfaces

6. Cable Routing

- Route the cable **directly from sensor to enclosure**
- Avoid sharp bends
- Secure the cable to the concrete structure if necessary
- Ensure no mechanical tension is applied to the sensor

7. General Notes

- Installation must be performed on **clean and solid concrete surfaces**
- Avoid mounting on damaged or loose concrete
- Ensure all fasteners are properly tightened
- Follow structural engineer requirements (e.g. minimum edge distances)

Push button and LED indicator description:

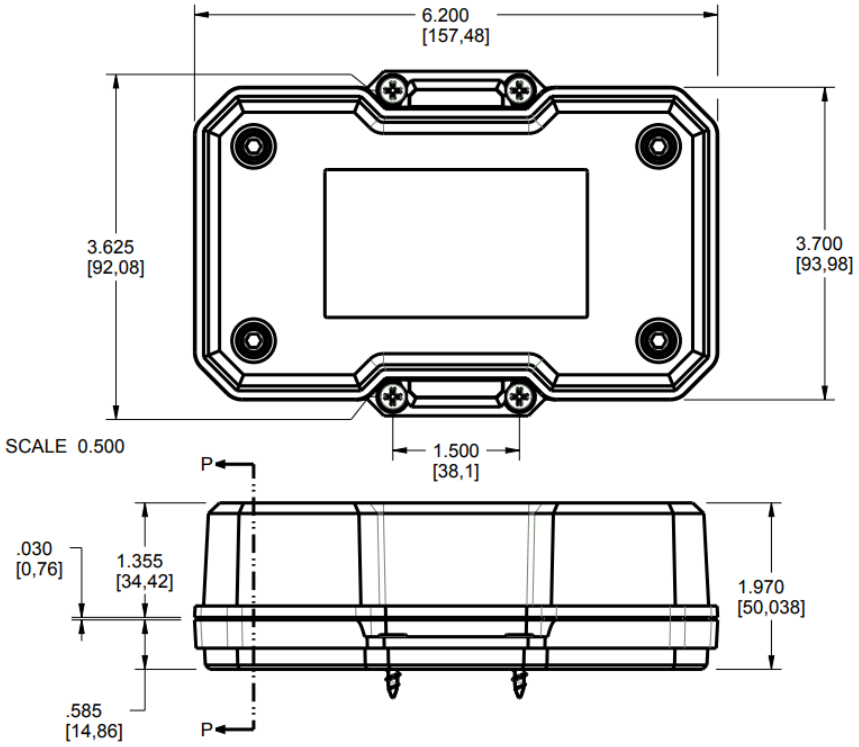
- Once sensor is installed reset button will be pushed in the sensor, it will automatically attempt to connect to the LoRaWAN network and the LED indicator will start to be blinking / flashing for 15 seconds.
- In case of the successful connection to the LoRaWAN network LED indicator will stay on for 3 seconds and LED indicator will stop flashing and go dark. This means sensor successfully connected to the LoRaWAN network.
- If the sensor will not connect on the initial try, it will attempt to connect to the LoRaWAN network after 10 seconds, then after 60 seconds, then after 10 minutes, then after 1 hour, then after 24 hours till successful connection to the LoRaWAN network.
- The sensor will restart by pressing the button on the sensor and it will attempt instantly to connect the LoRaWAN network.

The BRIDGE.AI sensor is maintenance free except replacement of the batteries.

Calibration

Factory calibrates the BRIDGE.AI sensor when it is produced. The BRIDGE.AI sensor is maintenance-free in normal indoor environments due to the Nano sensorics integrated intelligent computational algorithms (AI) and Automatic Baseline Correction (ABC) technology.

Sensor dimensions:



Important safety information

Read this manual before attempting to install the device. UAB „ Nano sensorics" will not accept responsibility for any damage or injury resulting from not following the instructions in this manual.

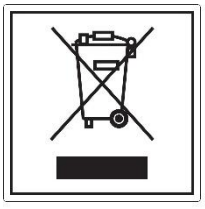
- The sensor is for indoor or outdoor use;
- Do not disassemble, crush, puncture, short internal circuits;
- Remove batteries if the sensor is not used, discharged battery has to be removed from the battery sensor, in this case left batteries might leak and damage the sensor;
- Keep the battery or device dry and away from water or any liquid as it may cause a short circuit;
- Replace batteries only with the same or equivalent type recommended by the manufacturer;
- Discard used batteries according to the manufacturer's instructions;
- Do not bend, deform, shred, microwave, paint the sensors, or other hardware;
- Do not insert external material into any opening on the sensors;
- Disassembling or puncturing the battery (whether integrated or removable) can cause an explosion or fire;
- Do not dry the sensors or battery with an external heat source such as a microwave oven or hairdryer;
- Observe proper precautions when handling batteries. Batteries may leak or explode if improperly handled;
- The sensor is not applied as a metrological, commercial accounting purposes and UAB „Nano sensorics" will not be held liable for any damage which may result from inaccurate readings;
- Do not use any detergent or alcohol to clean the device;
- Clean only with a soft, damp cloth.

Regulations

UAB "Nano sensorics" is the company which develops and produce highly innovative sensors with integrated intelligent computational algorithms (AI) enabling extremely low power data transmission. Declaration of conformity Hereby, UAB „Nano sensorics" declares that BRIDGE.AI complies with the essential requirements and other relevant provisions of Directive CEM 2014/30/UE, BT 2014/35/UE, RED 2014/53/UE, CE, RoHS

Waste disposal

The sensor disposed according to the Waste Electrical and Electronic Equipment Directive, (WEEE Directive) 2012/19/EU. The sensor and its individual parts has to be disposed according to local laws and regulations your product should be disposed of separately from household waste and industrial waste. When this product reaches its end of life, you have to bring the sensor, its components to the collection point designated by local authorities in order to protect the environment and to reduce waste through recycling. The battery must be disposed of separately.



Sensor technical details

nano sensorics

Sensing characteristics	
Temperature measurement (internal)	Accuracy 0.5C
Accelerometer (3-axis)	+/- 2, 4, 8, 16G
Battery voltage	device supply voltage monitoring
Displacement	calculated structural or object displacement in mm
X-axis Parameters	
XP1_fr	first dominant local peak frequency on X-axis (Hz)
XP1_mg	amplitude of first dominant peak on X-axis (mg)
XP2_fr	second dominant local peak frequency on X-axis (Hz)
XP2_mg	amplitude of second dominant peak on X-axis (mg)
X_Crest	crest factor on X-axis, calculated as ratio of peak to RMS value
X_High_Fr_E	vibration energy in corresponding frequency of the band on X-axis
X_Low_Fr_E	vibration energy in corresponding frequency of the band on X-axis
Y-axis Parameters	
YP1_fr	first dominant local peak frequency on Y-axis (Hz)
YP1_mg	amplitude of first dominant peak on Y-axis (mg)
YP2_fr	second dominant local peak frequency on Y-axis (Hz)
YP2_mg	amplitude of second dominant peak on Y-axis (mg)
Y_Crest	crest factor on Y-axis, calculated as ratio of peak to RMS value
Y_High_Fr_E	vibration energy in corresponding frequency of the band on Y-axis
Y_Low_Fr_E	vibration energy in corresponding frequency of the band on Y-axis
Z-axis Parameters	
ZP1_fr	first dominant local peak frequency on Z-axis (Hz)
ZP1_mg	amplitude of first dominant peak on Z-axis (mg)
ZP2_fr	second dominant local peak frequency on Z-axis (Hz)
ZP2_mg	amplitude of second dominant peak on Z-axis (mg)
Z_Crest	crest factor on Z-axis, calculated as ratio of peak to RMS value
Z_High_Fr_E	vibration energy in corresponding frequency of the band on Z-axis
Z_Low_Fr_E	vibration energy in corresponding frequency of the band on Z-axis
Mechanical specification	
IP rating	IP67/IP68 optional
Dimensions	157 x 93 x 38 mm
Enclosure	Plastic ASA
Storage Temperature	-30 to 70 °C
Sensor Power Supply	
Battery Type and voltage	2 x 3.6 V D-Cell Lithium Battery
Expected Battery Life	Up to 5 years (Depending on configurations and environment)
Radio / Wireless specification	

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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 Optional: US902 – 928, EU863 – 870, AU915 – 928, EU433, RU864, IN865
TX Power	14dBm±1dBm (Region specific)
Rx Sensitivity	-132 dBm (LoRa, Spreading Factor=12, Bit Rate=293bps) -118 dBm (FSK, Frequency deviation=5kHz, Bit Rate=1.2kbps)
Link Budget	137 dB (SF7) to 151 dB (SF12)
Communication range	10 km (line-of-sight, actual transmission distance depends on the environment)
Sensor specification	
Supported displacement sensors	Elastic semiconductor type or classic Cylindrical type
Supported external sensors	Sensors with 4-20mA current output Sensors with 0-10V voltage output
Displacement accuracy	with elastic sensor: 0.5%
Displacement resolution	0.01%
Elastic displacement sensor options	50mm / 100mm (Optional 5mm / 20mm /250 mm)
Cylindrical displacement sensor options	Optional

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**
0x1A	2 bytes	Set sensors measurement time (Tx) period in seconds. Minimum value is limited to 30 s. Maximum value is 65536 s (1092 min / 18.2
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
0x1D	2 bytes	**Acceleration threshold for computation trigger (mg).** Minimum

		value: **16 mg**. When exceeded, the device starts collecting samples and performs the vibration analysis.
0x21	2 bytes	**Acceleration threshold for vibration message transmission (XP1_mg).** Minimum value: **16 mg**. The message is sent only if at least one axis exceeds this threshold and the detected frequency is within the configured range

The examples of the downlink single messages:

- BA031A0384 – set measurement time to 15 minutes (900 s);
- BA021B01 – green LED ON.
- BA011C – Reset device.
- **BA 03 21 00 20 sets the message transmission threshold to 32 mg.**
- **BA 03 1D 00 40 sets the FFT computation trigger threshold to 64 mg.**

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 Tx, the new Tx setting is deployed after time interval which is equal to the previous Tx value plus 30 s. The forced new Tx setting deployment can be performed after resetting the sensor in order to shorten new Tx deployment time duration.

In case if downlink message is sent to the sensor working on "ABP" mode, the Tx change will take effect only after the time interval equal to the previous Tx value.

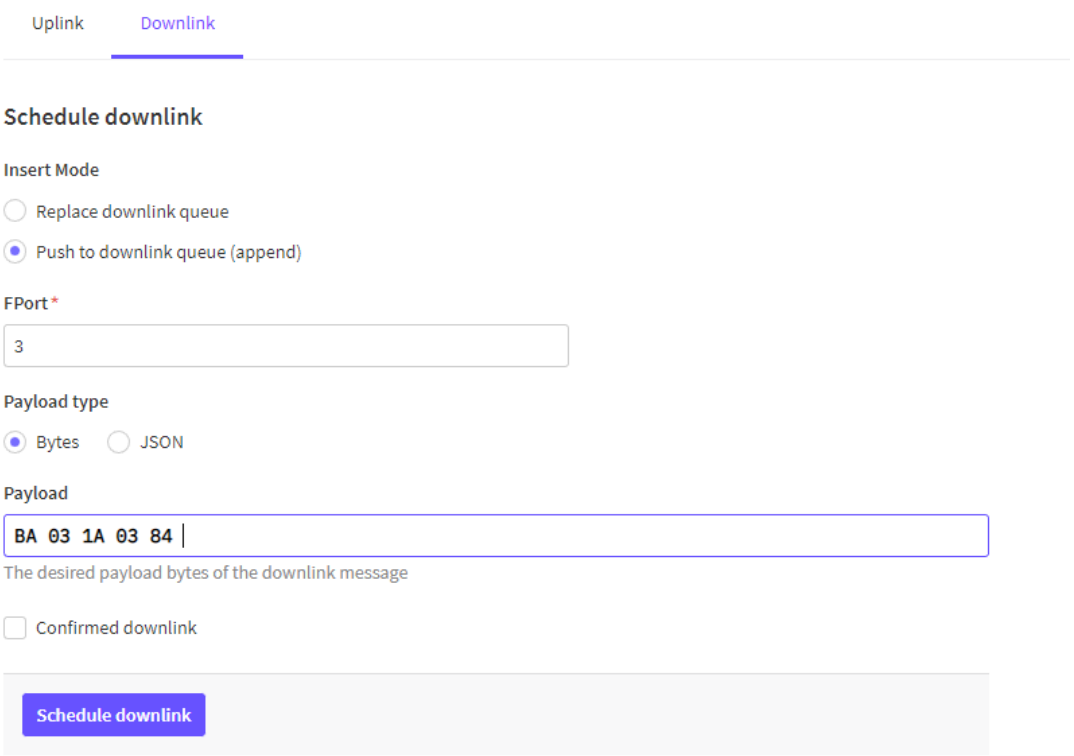
The multiple settings can be sent through the downlink single message. The sum of the bytes has to be indicated without counting of the header.

Header	**Total Payloads length**	**Payload 1**		**…**	**Payload n**		
Setting ID	**Settings data**	**Setting ID n**		**Settings data n**			
0xBA	1 byte	1 byte		0-n bytes	…	1 byte	0-n bytes

Multiple commands:

* BA051A03841B02 – Set measurement time to 15min and toggle green LED for 5s

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



Recommendations for setting the parameters:

Application	Computation Threshold (0x1D)	Message Threshold (0x21)	Recommendation
Bridges / Bridge Columns	16–32 mg	32–64 mg	High sensitivity for structural monitoring
Parking Structures	16–32 mg	32–64 mg	Suitable for traffic-induced vibrations
Conveyor Systems	32–64 mg	64–128 mg	Reduces transmissions caused by normal operation
Heavy Industrial Equipment	64–128 mg	128–256 mg	Recommended for high vibration environments
Commissioning / Site Testing	16 mg	16–32 mg	Maximum sensitivity for initial setup

Note: The recommended values are intended as initial settings only. Final thresholds should be adjusted during commissioning according to the normal vibration level of the monitored structure or equipment. The message threshold (0x21) should normally be equal to or higher than the computation threshold (0x1D).

It is recommended to keep Tx for 15min, in order to ensure optimal energy consumption from the batteries.

Payload decoder (in case TTN network scenario)

```
function decodeUplink(input) {
 if(input.fPort === 2)
 {

  return {
   data: {
    Displacement: (input.bytes[0]<< 8) + input.bytes[1]),
    Battery: input.bytes[2] + input.bytes[3]/100,
    Temperature: input.bytes[4] + input.bytes[5]/100,
    XP1_fr: input.bytes[6]*0.78125,
    XP1_mg: (input.bytes[7]<< 8) + input.bytes[8],
    XP2_fr: input.bytes[9]*0.78125,
    XP2_mg: (input.bytes[10]<< 8) + input.bytes[11],
    X_Crest: input.bytes[12] + input.bytes[13]/100,
    X_Low_Fr_E: input.bytes[14]*100 + input.bytes[15],
    X_High_Fr_E: input.bytes[16]*100 + input.bytes[17],

    YP1_fr: input.bytes[18]*0.78125,
    YP1_mg: (input.bytes[19]<< 8) + input.bytes[20],
    YP2_fr: input.bytes[21]*0.78125,
    YP2_mg: (input.bytes[22]<< 8) + input.bytes[23],
    Y_Crest: input.bytes[24] + input.bytes[25]/100,
    Y_Low_Fr_E: input.bytes[26]*100 + input.bytes[27],
    Y_High_Fr_E: input.bytes[28]*100 + input.bytes[29],

    ZP1_fr: input.bytes[30]*0.78125,
    ZP1_mg: (input.bytes[31]<< 8) + input.bytes[32],
    ZP2_fr: input.bytes[33]*0.78125,
    ZP2_mg: (input.bytes[34]<< 8) + input.bytes[35],
    Z_Crest: input.bytes[36] + input.bytes[37]/100,
    Z_Low_Fr_E: input.bytes[38]*100 + input.bytes[39],
    Z_High_Fr_E: input.bytes[40]*100 + input.bytes[41]
   },
   warnings: [],
   errors: []
  };
 }
 else
 {
  return {
   data: input.bytes,
```

```
    warnings: [],
    errors: []
  };
 }
}
```

Note: if the decoded value received as 65536 means no vector magnitude is detected.

Transportation and Storage

Packed sensors may be transported in any type of covered vehicle. Equipment should be anchored reliably to avoid shock and possibility to shift inside vehicle. Sensors should be protected against mechanical damage and shock. No aggressive chemical substances should be stored together because of corrosion hazard.

Warranty

Manufacturer gives warranty that sensor parameters will meet the technical requirements, listed in the “Sensor technical details” paragraph of this document, if transportation, installation, storage and operation conditions will be followed. Warranty period is 12 month from manufacturing date, with additional possibility to extend it for additional charge. Warranty apply, when device is used as intended and if there was no tampering done with the device or other external damage done to the device from outside sources.