# nemi G+ nano

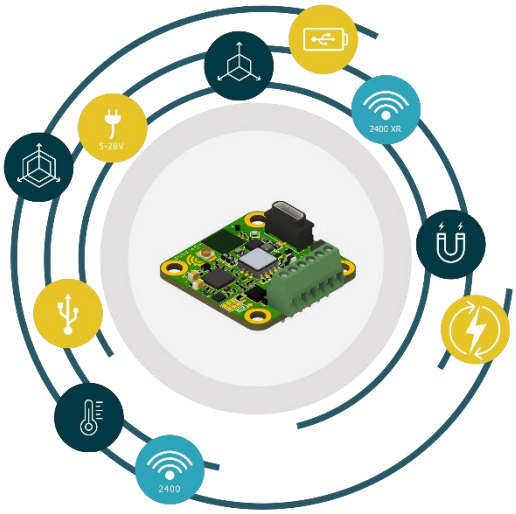
Tiny wireless Sensor with Energy Harvesting Module for Measuring Accelerations, Vibrations and Rotation Rates

## Description

nemi G+ nano is a tiny Integrated Sensing product for wireless measuring vibrations / accelerations, rotation rates, rotation angles and magnetic fields in and around all three axes. Due to the highly efficient nemi Link 2400 radio technology, very long battery runtimes can be achieved. With solar energy harvesting battery runtimes can be extended many times over. It is also suitable for permanent installations using a wide-range voltage input or the solar panel.

## Key Features

- **Compact & lightweight design**
  30 x 30 x 12 mm, 6 grams
- **Completely wireless and maximized battery life** due to radio technology nemi Link 2400 and **solar panel**
- **Energy harvesting:** solar panel offers **unlimited run times**
- Transmission of **live raw data** or **smart data** pre-evaluated by edge computing




High-resolution, triaxial, capacitive **MEMS accelerometer**; measuring range up to 8 g or up to 40 g

**IMU sensor module** for measuring accelerations and rotation rates in and around all 3 axes; ACC up to 16 g; GYR up to 4000 °/s

Triaxial **magnetometer**; measuring range up to 16 Gauss

Internal **temperature sensor**; measuring range- 20 - 60 °C

**nemi Link 2400** - i4M's own robust and **flexible radio technology** in the 2.4 GHz frequency band

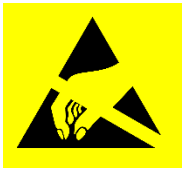
Optional Connector for Continuous operation with **wide range voltage input** 5 - 30 V DC

Optional Connector for Solar **Energy Harvesting** with MPPT

Power supply/ battery charging via **micro USB**

Optional Connector for **battery** (with charger)

## ESD (Electrostatic Discharge) Sensitive device:



These devices have limited built-in ESD protection and damage may thus occur on devices subjected to high-energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## Quick-Start

- Connect the external antenna to nemi G+ nano
- Connect a power source

### Option E1:

- Connect a secondary cell. **A rechargeable battery must have its own protection circuit!**
- Connect USB or solar panel to start nemi G+ nano. The LED should now flash continuously.
- Disconnect USB and/or solar panel if desired. nemi G+ nano remains switched on as long as the battery is connected and has a sufficient charge.

### Option E2:

- Connect DC in with 5 – 30 V DC
- Nemi G+ nano starts and the LED should flash continuously.

- Follow the operation instructions of the receivers software your are using.

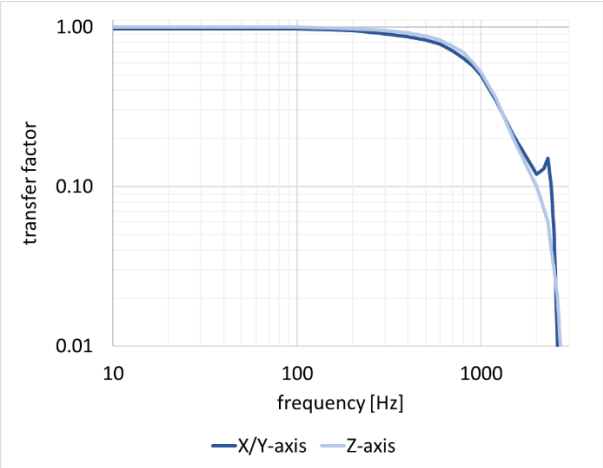
## Specifications

| General information | | |
|---|---|---|
| Dimensions<br>(without connectors) | 30 x 30 x 12<br>(30 x 30 x 4,2) | mm |
| Weight<br>(with connectors) | Option E1: 6,3<br>Option E2: 5,3 | grams |
| Power supply | 5 (Micro USB)<br>Option E1: Connectors for battery (with charger), solar panel, batterie backup<br>Option E2: 5 - 30 V DC in | V |
| Temperature range permitted during operation | -25 to 85 | °C |
| Onboard MCU, usable for edge computing | 64 MHz ARM Cortex M4F, 1 MB Flash, 256 KB RAM; various hardware crypto features | - |
| Housing protection class | Without housing | - |

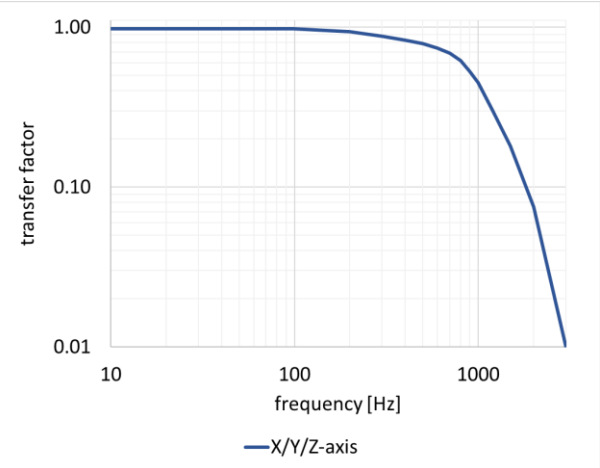
| | | |
|---|---|---|
| **Main sensor device (MEMS accelerometer)** | | |
| Selectable sampling rates | 4,000 / 2,000 / 1,000 / 500 / 250 / 125 | Hz |
| Stability of the sampling rate (over the entire temperature range) | ± 50 | ppm |
| Realizable signal bandwidths (-3 dB) | 800 / 500 / 250 / 125 / 62,5 / 31,25 | Hz |
| Selectable measuring ranges<br>Variant 08<br>Variant 40 | <br>± 8 / 4 / 2<br>± 40 / 20 / 10 | <br>g<br>g |
| Sensor resonance frequency<br>Variant 08<br>Variant 40 | <br>2,400<br>5,500 | <br>Hz<br>Hz |
| Signal resolution | 20 | bit |
| Non-linearity<br>(related to measuring range) | 0.1 | % |
| Cross-sensitivity | 1.0 | % |
| Inaccuracy<br>(related to measuring range)<br>Without calibration<br>With calibration (on request) | <br><br>< 8<br>< 1 | <br><br>%<br>% |
| **Additionally integrated 9-DoF IMU**<br>**3-axis MEMS accelerometer (ACC) / gyrometer (GYR) / magnetometer (MAG) each** | | |
| Sampling rates | = 1/25 of the sampling rate of the main sensor<br>e.g. = 160 Hz at 4,000 Hz | Hz |
| Selectable measuring ranges ACC | ± 16 / 8 / 4 / 2 | g |
| Selectable measuring ranges GYR | ± 4,000 / 2,000 / 1,000 / 500 / 250 / 125 | °/s |
| Selectable measuring ranges MAG | ± 16 / 12 / 8 / 4 | Gauss |
| Signal resolution | 16 | bit |
| **Internal temperature sensor** | | |
| Measuring range | -20 to 60 | °C |
| **Solar Energy Harvesting** (Option E1) | | |
| Input voltage ($V_{Solar}$) | 0.05 to 5 | V |
| Maximum input current | 110 | mA |
| Input power | 0.003 to 550 | mW |
| Maximum powerpoint tracking (MPPT) | 75 % x input voltage (max. 4) | V |
| **Secundary Battery (rechargeable)** (Option E1) | | |
| Charging cut-off voltage | 4.2 | V |
| Discharge cut-off voltage | 3.3 | V |
| Charge ready voltage | 3.35 | V |
| Charging speed (Option BS) | up to 100 | mA |
| **Primary Battery** (Option E1) | | |
| Cut-off voltage | 2.4 | V |
| Maximum voltage | 4.5 | V |
| **DC Input** (Option E2) | | |
| Input Voltage | 5 – 30 | V |
| Maximum Power Consumption | 50 | mW |

## Frequency responses of the main sensor module

### Variant 08: measuring range max. ± 8 g

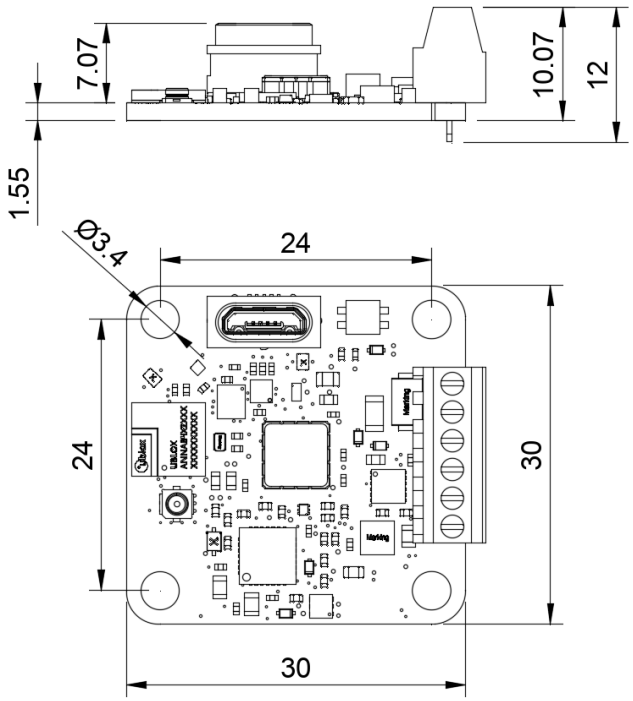



### Variant 40: measuring range max. ± 40 g




## Dimensions

(All dimensions in mm)




## Energy supply and pin assignments

Nemi G+ nano does not have an integrated battery, but it has various connection options for power supply. You can choose Option E1 or E2.

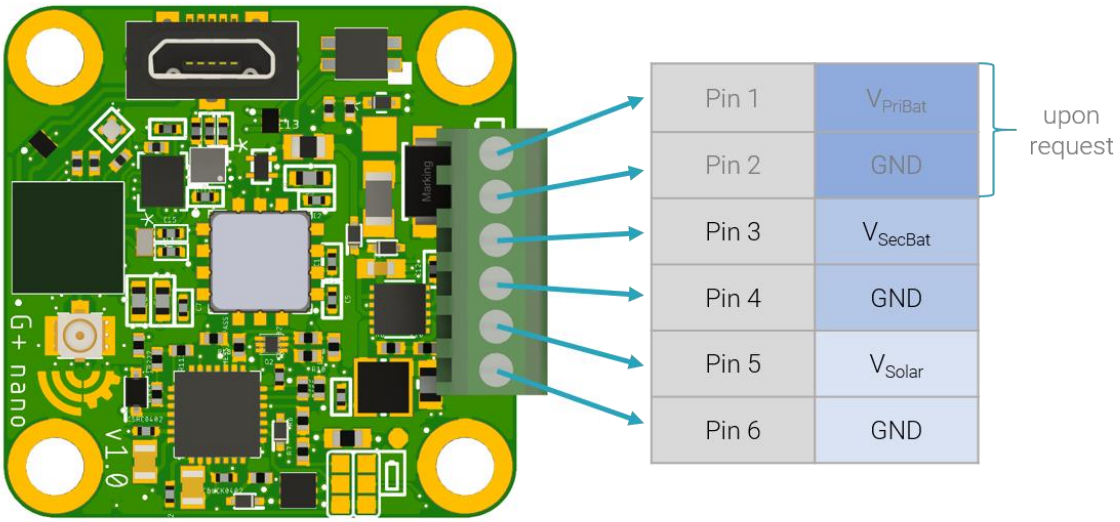
### Option E1:

In Option E1 for the energy supply of nemi G+ nano, there are following options:

- Connection of a USB cable (5 V) with plug-in power supply
- Connection of a powerbank to the USB port
- Connection of a secundary battery to pin 3 and pin 4
- Connection of a solar panel to pin 5 and pin 6
- Upon request: connection of a primary battery to pin 1 and pin 2;

**In any case of Option E1, a secundary battery, a supercapacitor or a large capacitor (> 150 µF) is needed!**

In energy supply option E1 nemi G+ nano has 6 pins.




$V_{PriBat}$ ≙ Supply Voltage Primary Battery

$V_{SecBat}$ ≙ Supply Voltage Secundary Battery

GND ≙ Ground

$V_{Solar}$ ≙ Solar Module Voltage

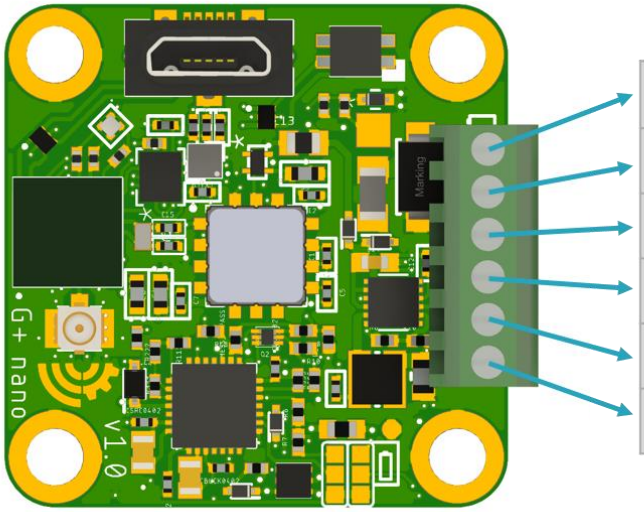
## Option E2:

In Option E2 for the energy supply of nemi G+ nano, there are following options:

- Connection of a USB cable (5 V) with plug-in power supply
- Connection of a powerbank to the USB port
- Connection of a primary battery (5 – 30 V) to pin 1 e.g. 2-7 Lithium battery in series, 12 V car battery, 24 V,...

**Battery charging is not possible in Option E2.**

In energy supply option E2 nemi G+ nano has 2 pins.




| | |
|---|---|
| Pin 1 | $V_{DC}$ |
| Pin 2 | GND |
| Pin 3 | Do not connect |
| Pin 4 | Do not connect |
| Pin 5 | Do not connect |
| Pin 6 | Do not connect |

$V_{DC}$ ≙ Supply Voltage DC in GND ≙ Ground

⚠ Reversing the polarity of pins 1 - 6 can damage nemi G+ nano!

## Radio technology nemi Link 2400

Our own radio technology nemi Link 2400 is a wireless, battery-powered sensor network in the 2.4 GHz frequency band with star topology and one receiver module. This high-speed network enables the reliable transmission of data at high sampling rates. The high efficiency of our robust radio technology enables very long battery runtimes of our products. Our wireless sensors synchronize their internal clocks to the clock of the receiver module with extremely small deviations.

To optimize the measurements of a use case, nemi Link 2400 offers the possibility to adjust the number of sensor nodes per radio channel and the radio speed to achieve the perfect balance between range, data rate and runtimes for each application.

Please find detailed information in the nemi Link 2400 info sheet.

## Compatible receiver modules in the nemi Link 2400 wireless network

nemi DAQ nano is compatible with all receiver modules in i4M's nemi Link 2400 network. The following products are available under the nemione® trademark:

nemi EdgeBase

nemi Connect

nemi Log (+ cellular)

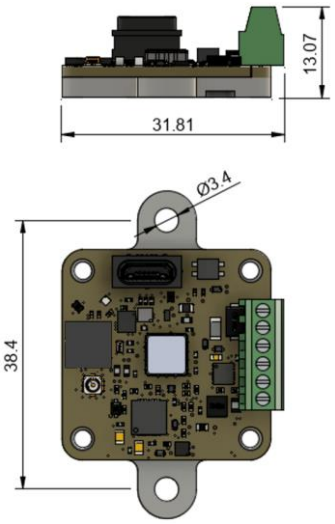
## Application

Because of the compact and lightweight design nemi G+ nano can easily be integrated in smallest installation spaces and turns your components and machines into smart products. Due to its long battery life and our highly efficient nemi Link 2400 radio technology, nemi G+ nano is ideally suited for use in rotating or moving applications such as pitch bearings of wind turbines or gearboxes.

## Mounting options

Nemi G+ nano is supplied with an aluminum mounting plate to which nemi G+ can be screwed or glued. The best vibration transmission is realized with a grub screw connection.

In addition to that, we recommend using the mounting plate because of nemi G+ nanos THT connections (legs sticking out at the bottom).




## LED Blink Codes

The nemione® nemi G+ has integrated LEDs that are visible through the housing. This flashing indicates the various operating states of the sensor node:

| Operating Mode | Description |
|---|---|
| Rapid flashing in the sequence white, green, red, blue | Indicates a restart of the sensor node. |
| Red LED, continuously | The battery is charging, power supply via USB or wide-range voltage input. |
| Red LED no longer lights up continuously | The battery is fully charged. |
| Green lights up continuously, yellow flashes simultaneously | A USB port with a data connection has been detected. The sensor node is waiting for a virtual COM port to open. |
| Green lights up continuously, blue flashes simultaneously | The virtual COM port has been opened. The sensor node is waiting for new RF parameters or settings from the PC software. |
| Regular short red flashes for approx. 2 seconds | The sensor node samples and transmits measurement data. |
| Regular short green flashes all 10 seconds for approx. 1 second | The sensor node is in sleep mode. |
| Regular short blue flashes for approx. 1 second | The sensor node resynchronizes with the wireless network (time synchronization). |
| The green LED lights up temporarily or continuously in wireless mode | The internal data memory (ring buffer) is 80 % full as the data could not be transmitted via radio link. There is a risk of data loss. |

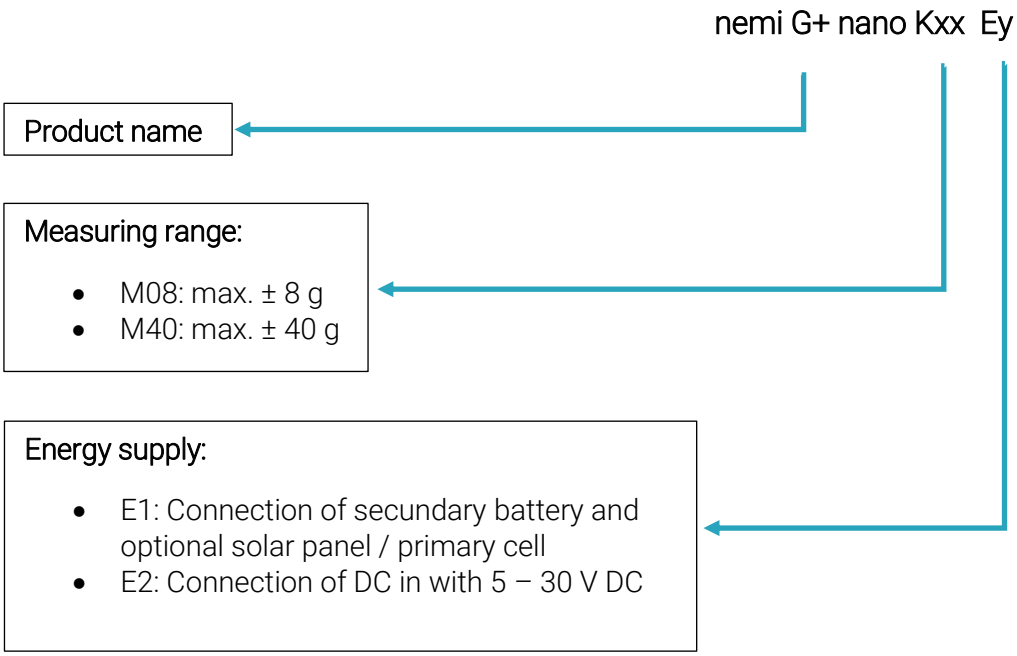
## Data Analysis

Upon request, we will be happy to support you with data analysis. The data analyses can be performed directly in the sensor or in the gateway by edge analytics as well as on the server or measuring computer. A great advantage of edge analytics is the **reduction of the transmitted data to the essentials** ("smart data"). This **reduces storage space** and **increases battery runtimes**.

Based on our knowledge from a multitude of previous projects, we have developed **algorithms for data evaluation** to generate **maximum added value** for our customers. We will gladly advise you on this. In addition to our existing algorithms we create **individualized scripts** upon request.

At the same time, the **data remains your capital**: We do not rely on big cloud providers but **keep the data in your IT ecosystem**. Alternatively, you can rely on our nemione® cloud solutions - hosted in the European Union.

## Ordering options of nemi G+ nano



## Contact

nemione® is a trademark of

i4M technologies GmbH
Försterstrasse 5
52072 Aachen
+49 (0) 157 34 10 59 30
info@nemi.one

www.nemi.one
www.i4M-tech.de