nemi Motion

Miniaturized and ruggedized wireless 9-axis IMU with up to 256 g accelerometer measuring range

Description

nemi Motion is a particularly compact, lightweight, ruggedized and sealed wireless acceleration and rotation rate sensor (wireless IMU) for highly dynamic measurement tasks. With its 3-axis accelerometer, 3-axis gyroscope and 3-axis magnetometer plus temperature sensor, it is a wireless inertial measurement unit (IMU) with 9 degrees of freedom, almost as small as very small cabled piezo accelerometers. It is a ruggedized and waterproof product with a rating of IP 67 for highly demanding applications. nemi Motion is the ideal entry into the nemi Link 2400 portfolio.

Key Features

- **Very small & lightweight** (25 x 25 x 14.5) mm, 18 grams (with aluminum bottom)
- **9-DoF IMU:** accelerometer, gyroscope and magnetometer (3 axes each) plus temperature sensor
- **High sampling rates** up to 4 kHz on all acceleration and rotation rate axes simultaneously, wide bandwidth, static and dynamic (0 to approx. 1,500 Hz)
- **Large acceleration measuring range** up to ± 256 g
- **Completely wireless** with µs-precise time synchronization and buffered transmission due to nemi Link 2400
- **Ruggedized & weatherproof (IP 67)**
- With **screw holes** for secure installation



IMU sensor module for measuring accelerations and rotation rates in and around all 3 axes; ACC up to 256 g; GYR up to 4000 °/s; 16 bit

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

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

Internal rechargeable battery with more than 10 hours runtime at a sampling rate of 3.84 kHz (all six ACC/GYR axes active)



Internal **temperature sensor**



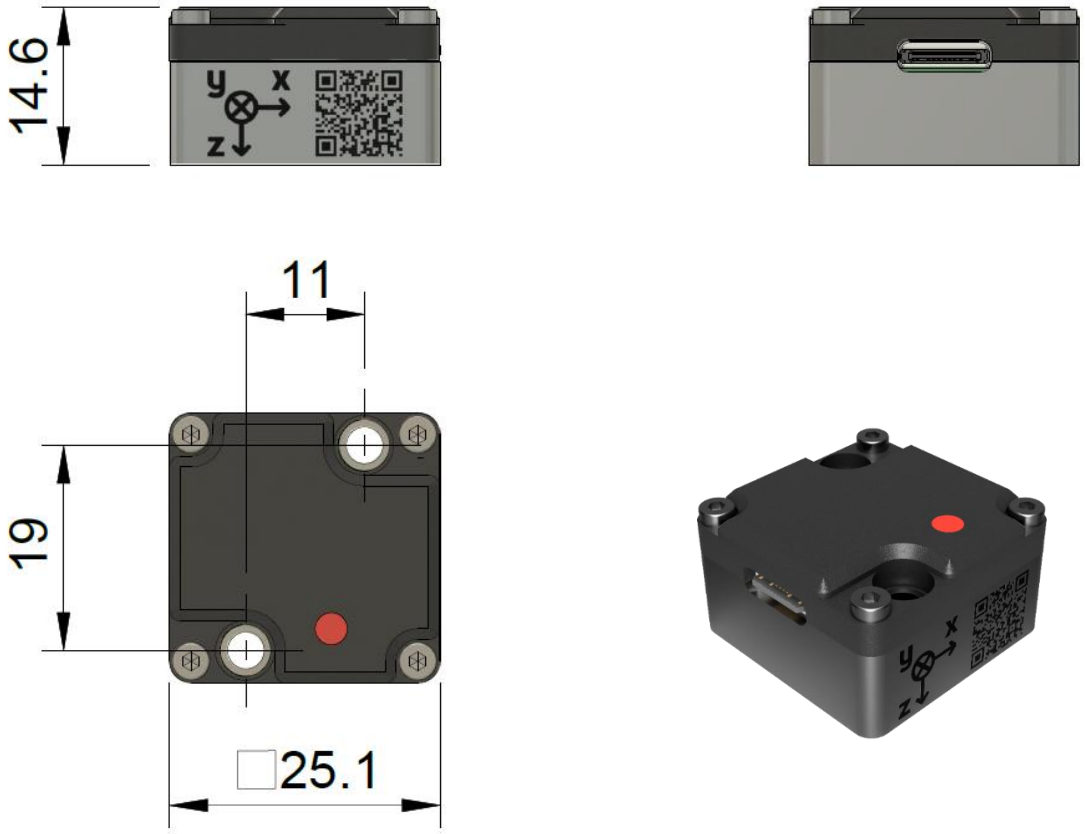
Power supply/ battery charging via **USB-C**

Specifications

General information		
Dimensions	25 x 25 x 14.5	mm
Weight	approx. 18	gram
Internal power supply	Rechargeable battery, 95	mAh
Runtime with full battery at 3,840 Hz (all six ACC/GYR axes active)	> 10 Several weeks possible depending on configuration (lower sampling rate, intermittent operation, sleep mode)	hours
Charging time (0 - 100 %)	approx. 2	hours
External power supply / charging	5 (USB-C) External battery packs via USB-C possible (please contact us)	V
Temperature range permitted during operation	-20 to 60	°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	IP 67	-
IMU: 3-axis accelerometer (ACC) and 3-axis gyroscope (GYR)		
Selectable sampling rates	4000 / 2000 / 1000 / 500 / 250 / 125	Hz
Selectable measuring ranges ACC	± 2 / 4 / 8 / 16 / 32 / 64 / 128 / 256	g
Selectable measuring ranges GYR	± 4,000 / 2,000 / 1,000 / 500 / 250 / 125	°/s
Signal bandwidth (-3 dB) at 3,840 Hz ACC, ranges ± 2 to 16 g ACC, ranges ± 32 to 256 g GYR	 600 1,500 528	 Hz Hz Hz
Signal resolution	16	bit
Static inaccuracy ACC Without calibration With 3D calibration (on request)	 8 Low G Path ≤ 16 g: < 0.1 High G Path≥ 32 g: < 1	 % % %
Angle resolution with sensor fusion (dynamic applications)	approx. 0.1	°
Magnetometer (MAG)		
Sampling rate	1/8 of ACC/GYR sampling rate	Hz
Measuring range	± 16 / 12 / 8 / 4	Gauss
Signal resolution	16	bit
Internal temperature sensor		
Sampling rate	1/16 of ACC/GYR sampling rate	Hz
Measuring range	Full operating temperature range	°C
Signal resolution	0.1	°C

Dimensions

(All dimensions in mm)



Radio technology nemi Link 2400

Our radio technology nemi Link 2400 is a wireless 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 and over long ranges of up to 350 m. 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 wireless performance for every 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 Motion 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)

Software and interfaces

Our software **nemi Studio** is included with all products at no extra charge. In combination with a nemi Connect (USB), it enables the configuration of sensors and channels, live data display, data recording (CSV) and online analyses such as FFT. Rotation angles and rotation rates can be calculated directly via sensor fusion. Our interfaces are open and well documented:

- **Python API** for easy access to the live data; USB protocol of nemi Connect disclosed on request
- Recording as **CSV, Parquet or i4M .bin** files (Python decoders to pandas DataFrames or CSV included)
- Direct connection of several nemi Connect to a **Gantner Instruments Q.Station** via plugin
- **nemi Log** (SD card, cellular MQTT/FTP) and **nemi EdgeBase** (SSD, VPN/FTP, MQTT) for autonomous recording, data transfer and dashboards

Application

nemi Motion plays to its strengths wherever **small dimensions and minimal weight** are decisive: the measured object is influenced only minimally, while wireless data transmission and simple screw mounting enable particularly **fast and flexible measurement setups**. Typical applications are in the field of test & measurement and monitoring:

- Test benches, prototype tests and measurements on small and lightweight components
- Measurements on moving or rotating components, e.g. torsional vibrations on shafts (tangential acceleration or gyroscope)
- Measurement of rotation angles and rotation rates using sensor fusion, e.g. on rotating shafts
- Vibration and acceleration measurements in highly dynamic applications up to ± 256 g

For high-precision quasi-static inclination measurements, we recommend nemi G+ due to its higher resolution and lower measurement noise.

Mounting options

The compact, lightweight and completely wireless nemi Motion is very easy to mount. It is best screwed on, but can also be fastened magnetically, clamped or glued. The best vibration transmission is realized with a screw connection.

Adhesive, mounting plate and magnet are not included.

Attention: When fastening with a magnet, the measurements of the magnetometer installed in the nemi Motion are affected.

LED Blink Codes

The nemione® nemi Motion has an integrated LED. 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.
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.

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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 Motion

nemi Motion

Options on request:

- Weatherproof variant: potted (internal battery can then no longer be replaced) or with additional housing
- 3D calibration of the acceleration axes (static deviation < 0.1 % low G / < 1.0 % high G)
- External battery packs via USB
- Battery replacement as a service
- Customer-specific firmware features

Contact

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