MachineDoctor:
The World's First 6-in-1 Energy-Centered Sensor

Detect faults earlier. Spot hidden energy waste. Act with precision.

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Model Overview

Nanoprecise's MachineDoctor is engineered to go beyond surface-level monitoring. It delivers continuous, high-fidelity data across six critical parameters, enabling earlier detection, deeper insights, and smarter decisions, all in one compact, wireless sensor. Boasting a battery life of up to 8 years and support for WiFi and cellular communication. It is built for flexibility in any environment, no matter how remote or rugged.

Nanoprecise offers four distinct MachineDoctor models designed to meet various industrial monitoring needs. Each model provides comprehensive sensing capabilities with different connectivity options and form factors.

NS002 - W

Compact WiFi enabled sensor with advanced edge computing capabilities

NS002 - EB

Extended battery life variant of the NS002 model

NS003 - W

Larger form factor with enhanced WiFi connectivity options

NS003 - LTE - W

Cellular-enabled model with global connectivity capabilities

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Sensing Elements

All MachineDoctor models feature identical sensing capabilities, providing comprehensive monitoring aross multiple parameters.

Tri-axial Vibration

Detect mechanical issues through precise vibration monitoring across three axes

Acoustics/Ultrasonic

Capture audible and ultrasonic emissions for early fault detection

Temperature

Monitor equipment temperature to prevent overheating and energy waste

Humidity

Track ambient humidity levels that may affect equipment performance

RPM

Ensure accurate load management and detect slippage to improve energy efficiency and equipment performance.

Magnetic Flux

Detect magnetic field variations that may indicate electrical issues

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Temperature Measurement

IR Resolution

All MachineDoctor models offer identical temperature measurement resolution:

- 0.1°C / 0.18°F

This high-resolution temperature sensing enables precise thermal monitoring for early detection of equipment issues.

Temperature Range

All MachineDoctor models share the same temperature measurement range:

- -40°C to 120°C / -40°F to 248°F

This wide temperature range makes the sensors suitable for monitoring equipment in various industrial environments, from cold storage to hot manufacturing processes.

All MachineDoctor models feature identical **shock tolerance of 10,000g for 0.2ms**, ensuring reliable operation even in high-vibration industrial environments.

Operating Temperature Ranges

Ambient Operating Temperature

NS002 Series:

- 0°C/32°F minimum
- Min = -20°C / -4°F if mounting surface < 0°C/32°F

NS003 Series:

- 0°C/32°Fminimum
- Min =-20°C/-4°F if mounting surface <0°C/32°F

MaximumEquipment Surface Temperature

Without Thermal Isolator (ForMax.Amb.Temp55C):

- All models: up to 80°C / 176°F

With Thermal Isolator (For Max. Amb. Temp 55C):

- All models: up to 120°C / 248°F

Humidity Measurement

Range (Relative Humidity)

All MachineDoctor models offer identical humidity measurement range:

- 20-80% RH @ +-3.5%

This range covers most industrial environments where equipment operates, allowing for correlation between humidity levels and equipment performance.

Accuracy (LSB)

All MachineDoctor models provide the same humidity measurement accuracy:

- 0.004% RH/LSB

This high-precision measurement enables detection of subtle humidity changes that might affect equipment operation or indicate environmental control issues.

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Acoustic and Ultrasonic Measurement

Frequency Range (Fmin to Fmax)

All models: 50Hz to 80kHz

Peak Sensitivity

All models: 26dB FS ±1dB

Operating Range

All models: Up to 160kHz

All MachineDoctor models feature identical acoustic and ultrasonic measurement capabilities, enabling **detection of both audible and ultrasonic emissions** from equipment. This wide frequency range allows the sensors to capture various fault signatures, from low-frequency mechanical issues to high-frequency ultrasonic emissions from compressed air leaks or electrical discharges. The acoustic measurement capabilities make MachineDoctor sensors particularly effective at detecting early-stage bearing faults, gear mesh issues, and other mechanical problems before they become audible to human ears.

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RPM and Rotational Speed Measurement

Hall Sensor (Magnetic Flux)

All MachineDoctor models offer identical RPM measurement capabilities using magnetic flux detection:

- Range: 10 RPM through 5000RPM
- Accuracy: 99.9%

VirtualRPMSensor

Our platform enables equipment-level virtual RPM sensing, allowing speed to be measured once and shared across all components of the asset, no magnetic markers required.

- Range: 60 - 20,000RPM

The dual RPM measurement methods provide flexibility for monitoring various types of rotating equipment, with or without magnetic markers, across a wide speed range from very slow (10 RPM) to very fast (20,000 RPM) rotation.

Magnetic Flux Measurement

Range

All models: Adjustable ±20 mT or ±200 mT

Sensitivity

All models:0.00125 mT/bit (±20 mT) or 0.0125 mT/bit (±200 mT)

Sampling Rate

All models: 370Hz

Fmax Output

All models: 180Hz

All MachineDoctor models feature identical magnetic flux measurement capabilities. This functionality enables detection of magnetic field variations that may indicate electrical issues in motors, generators, and other electromagnetic equipment. The adjustable range allows for optimization based on the specific equipment being monitored.

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Advanced Technology Features

All MachineDoctor models share identical special features that enhance their monitoring capabilities and intelligence.

1 **Advanced Edge Computing**
Process data locally to reduce bandwidth requirements and enable faster response times

2 **Equipment Health Status**
Automatically detect on-off states to provide operational context for measurements

3 **Adaptive Configuration**
Dynamically adjust monitoring parameters based on equipment conditions and requirements

These advanced features work in concert with the sensing elements to provide comprehensive equipment health monitoring and early fault detection capabilities.

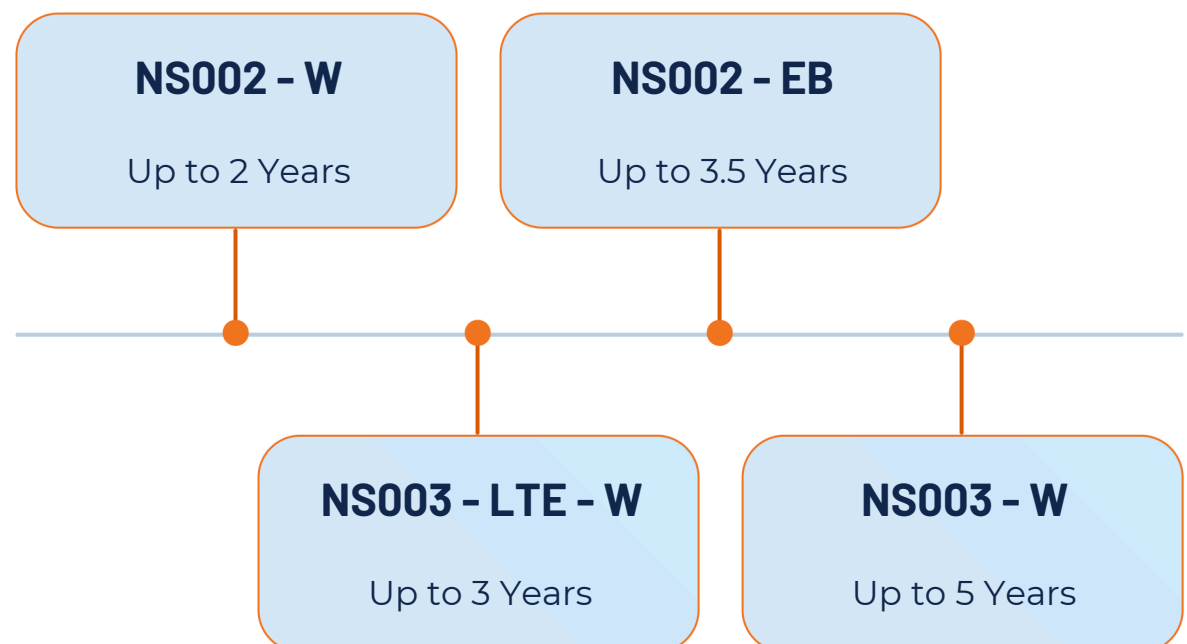# Memory and Battery Specifications

On-Board Memory Storage

All MachineDoctor models feature identical memory specifications:

- 4 MB storage capacity
- Can store up to 8 days of data locally
- Storage duration depends on data configurations

This local storage capability ensures data availability even during temporary network outages.

Battery Life*

Battery performance varies significantly between models:

NS002 - W
Up to 2 Years

NS002 - EB
Up to 3.5 Years

NS003 - LTE - W
Up to 3 Years

NS003 - W
Up to 5 Years

* Affected and varies based on temperature, network, and upload rate.

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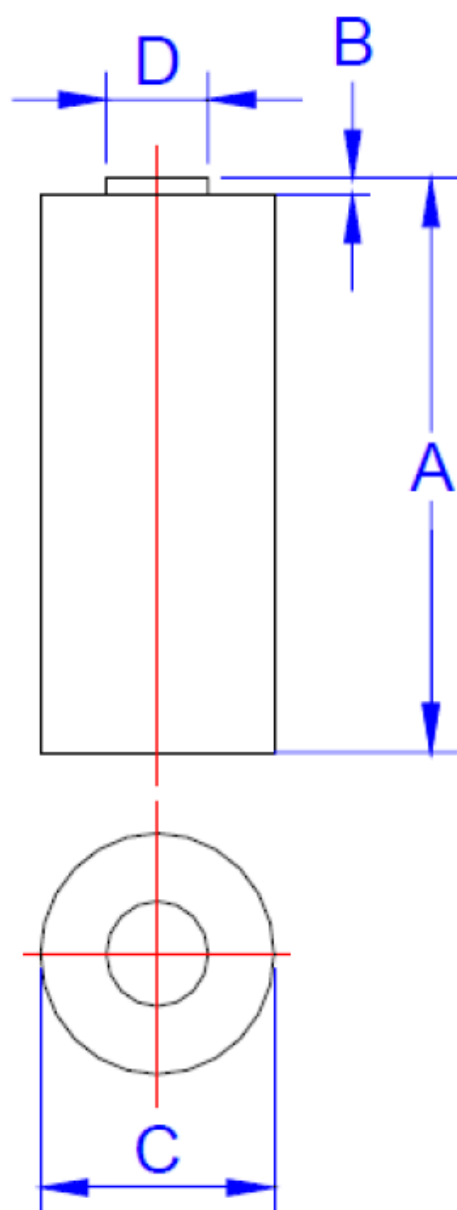# Battery Specifications

NS002 Battery

The NS002 sensor is powered by a Tenergy CR123A Lithium Manganese Dioxide (Li/MnO$_2$) primary cell rated at 3.0 V with a nominal capacity of 1600 mAh at 1 mA discharge or 1400 mAh at 20 mA discharge (2.0 V cut-off at 20 ± 3 °C).

It supports a standard discharge current of 20 mA and a maximum continuous discharge of 1 A, with an open-circuit voltage of 3.05–3.40 V and a closed-circuit voltage of ≥ 2.60 V under a 3.9 Ω load for one second.

The cell withstands 1500 pulse cycles at 20 °C and 700 cycles at –20 °C under a 0.9 A load (3 s ON / 27 s OFF to 1.55 V cut-off).

It measures 34.0 ± 0.5 mm in length and 16.5 ± 0.3 mm in diameter, weighs 16.0 ± 0.5 g, and operates reliably from –40 °C to +70 °C.

Constructed with a lithium anode, manganese dioxide cathode, and organic electrolyte, the CR123A maintains long-term stability and low self-discharge, making it ideal for continuous, low-drain industrial monitoring.

A: 34.0 ± 0.5mm

B: 1.45 ± 0.25mm

C: 16.5 ± 0.3mm

D: 6.3 ± 0.3mm

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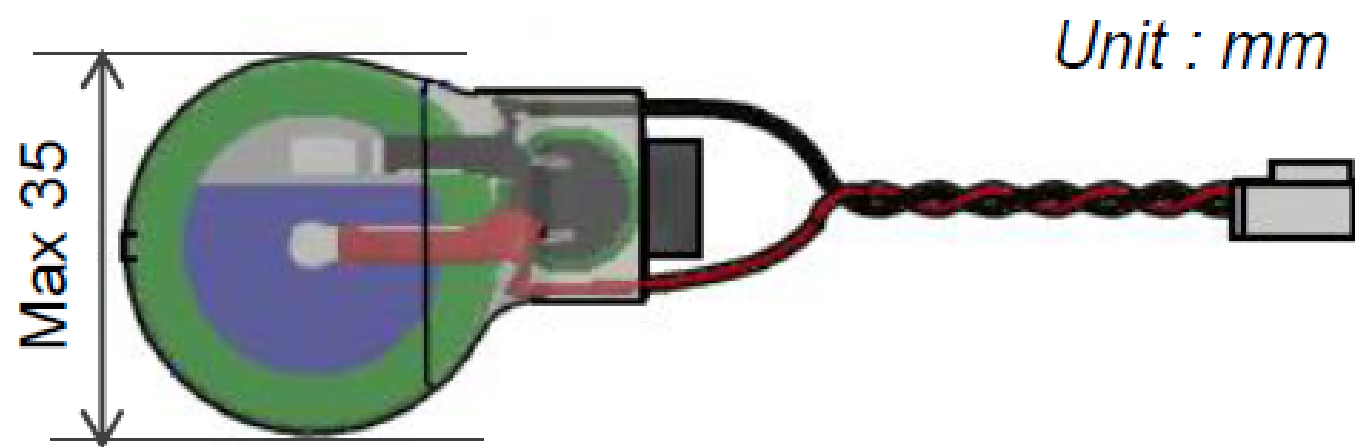
Battery Specifications

NS003 Battery

The NS003 sensor uses a XenoEnergy XL-205F Lithium Thionyl Chloride (Li/SOCl$_2$) primary cell that provides a nominal voltage of 3.6 V and a typical capacity of 19 Ah at 500 mA with a 1% duty cycle.

It supports a 1-second pulse current of up to 5.0 A, with no voltage delay and a pulse duration of up to 1000 s at 500 mA to 2.8 V.

The cell operates reliably from –40 °C to +85 °C, maintains 90% capacity after 10 years of storage, and weighs approximately 117 g.

Encased in a sealed D-size (ER32L615) form factor, it delivers high energy density, excellent voltage stability, and strong pulse capability without passivation, making it ideal for long-term industrial monitoring applications.

Unit : mm

Max 35

For best performance battery should be mounted in the application in upright or horizontal position.

Max 46.0   140±3

Max 63.0

XENO   XL-205F

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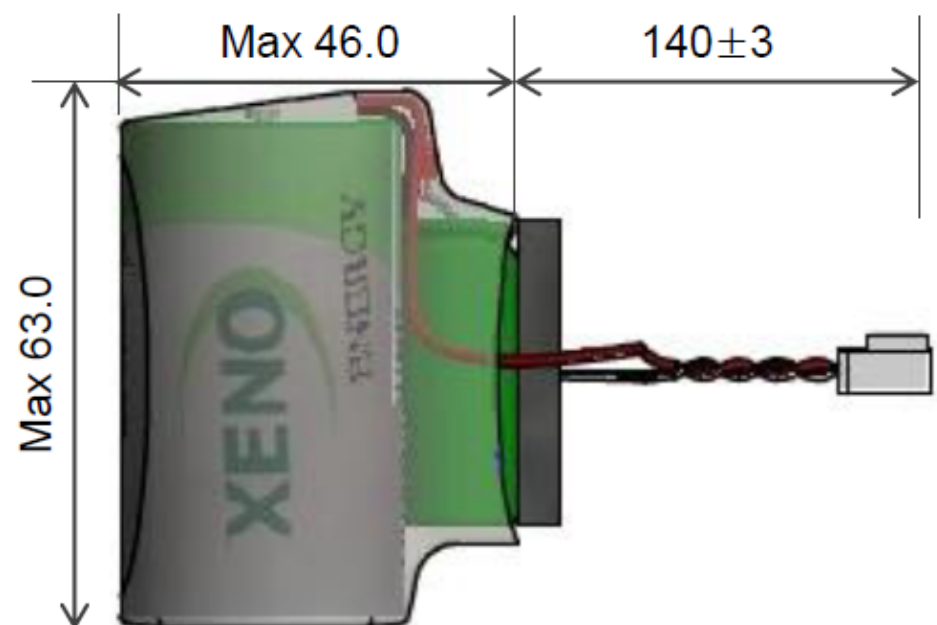
Battery Specifications

Capacitor

The NS003 integrates a VINATech XLC-1335 Lithium-Ion Capacitor (LIC) in parallel with the primary cell to provide rapid pulse support and voltage recovery.

Rated at 4.0 V and 250 F, the capacitor operates across 2.5–4.0 V and a wide temperature range of –25 °C to +85 °C (extending to –40 °C when paired with the $Li/SOCl_2$ battery).

It features a DC ESR of 100 mΩ, AC ESR of 50 mΩ (1 kHz), and a leakage current of 5 µA after 72 hours at 4.0 V, with over 97% voltage retention.

The capacitor endures 50,000 charge–discharge cycles at 25 °C and maintains performance through 1000 hours at 85 °C and 100 temperature cycles between –40 °C and +85 °C.

With a compact Ø12.5 × 35.0 mm design and a mass of 8.2 g, it ensures fast response, low resistance, and stable pulse delivery for high-frequency transmissions in the NS003 sensor system.

D (Φ) 12.5 +1.0 Max

L (㎜) 35.0 ±1.5

d (Φ) 0.8 ±0.1

P (㎜) 5.0 ±0.5

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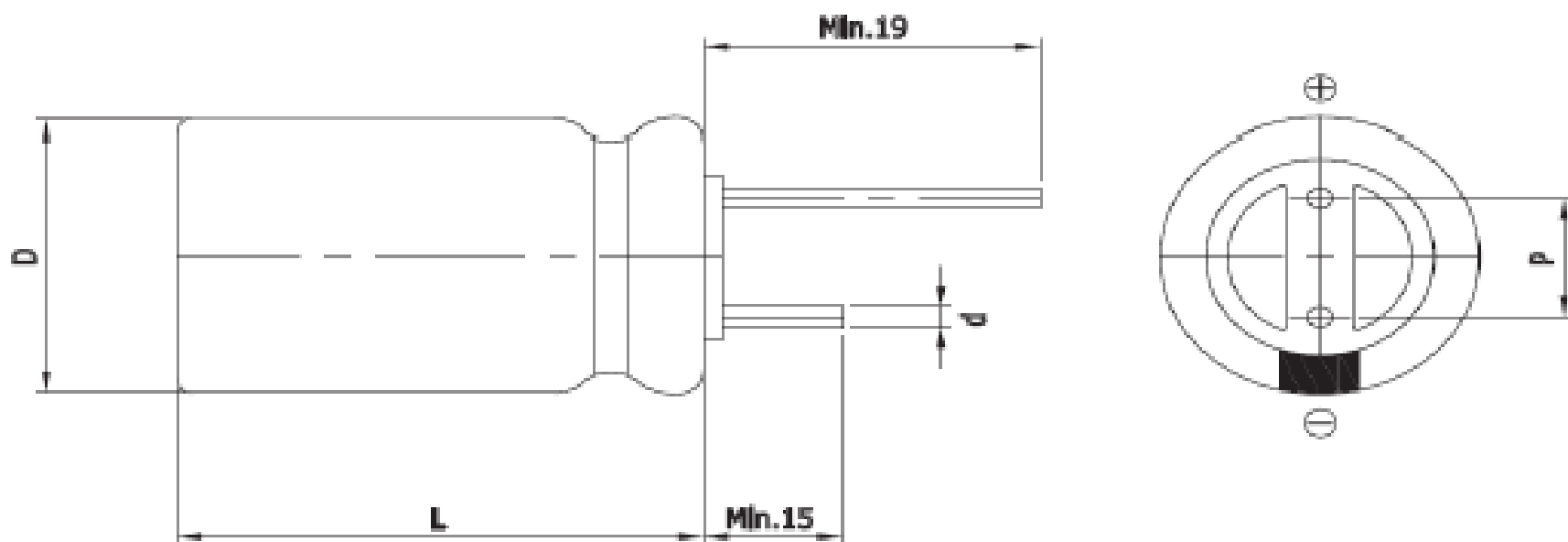
Physical Installation

Mounting Methods

All MachineDoctor models offer identical mounting options for flexible installation:

- Magnetic Base - For quick installation on ferrous surfaces
- Adhesive - For permanent mounting on non-ferrous surfaces
- 1/4-28 stud - For secure threaded mounting in pre-drilled holes

Physical Dimensions

MachineDoctor sensors come in two distinct size categories:

NS002 Series

- 52mm (2") Diameter
- 78mm (3") Tall

NS003 Series

- 72mm (2.8") Diameter
- 100mm (4") Tall

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WiFi Communication Specifications

Feature	NS002 - W	NS002 - EB	NS003 - W	NS003 - LTE - W
Protocol	WiFi: 802.11 b/g/n	WiFi: 802.11 b/g/n	WiFi: 802.11a/b/g/n/ac dual-band	WiFi: 802.11a/b/g/n/ac dual band
Frequency Range	2.4 GHz	2.4 GHz	2.4 GHz and 5GHz	2.4 GHz and 5GHz
Receiving Sensitivity	-91 dBm for 802.11b	-91 dBm for 802.11b	-91 dBm for 802.11b	-91 dBm for 802.11b

Security Protocols

NS002: WEP, WPA, WPA2-Personal

NS003: WEP, WPA, WPA2-Personal, WPA3-Personal (SAE), and WPA2/WPA3 transitional mode

Common Security Features

All MachineDoctor models share these security capabilities:

- Encryption: WEP/TKI/AES 256
- Network Protocols: HTTP, TCP/IPv4
- Packet Filtering: limited list of IP addresses and openports
- Certification:SOCIIType 2 Compliance

Communication Range and Performance

Range
All MachineDoctor models offer identical wireless range:

- Up to 20m / 65ft line of sight (without repeater)

For applications requiring extended range, network repeaters or strategic sensor placement should be considered.

Data Rate

All MachineDoctor models provide consistent data transmission capabilities:

- Up to 500kbps

This data rate is sufficient for transmitting the full spectrum of sensor measurements while maintaining reasonable power consumption.

Antenna Configuration

NS002 - WiFi: Integrated

NS002 - EB: Integrated

NS003 - WiFi: Integrated

NS003 - LTE - W: Integrated + Mounted

The NS003 - LTE - W model features both integrated and mounted antennas to support its cellular capabilities, while all other models use integrated antennas only.

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Cellular Communication Options

01

Cellular Module

NS003 - LTE - W:EG21-G

174

E-Sim Support Countries

Available only on NS003 - LTE - W model

02

Cellular Protocols

NS003 - LTE-W:2G,3G,4G,LTE-M, NB-IoT

343

E-Sim Telecom Operators

Available only on NS003 - LTE - W model

For detailed country coverage information, visit:
https://esimpro.korewireless.com/esim-coverage?productCategory=619fac093837620012870b62

Bluetooth Connectivity

Bluetooth Support

The NS003-W and NS003 - LTE - W offer Bluetooth connectivity, providing additional options for local device configuration and data access. This feature makes the NS003 models particularly suitable for applications where direct local access to the sensor may be required without connecting to the primary network.

Bluetooth connectivity enables maintenance personnel to interact with the sensor using mobile devices for quick diagnostics and configuration changes in the field.

Regulatory Certification

The NS003-LTE-W model is CE and FCC Certified, making it suitable for deployment in regions requiring this compliance.

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Accelerometer Selection Options

Feature	D1 Accelerometer	D2 Accelerometer
Bandwidth	8.5kHz for Z & X & Y	6.3kHz for Z & X & Y
OTA Configurable Fmax settings	8.5kHz, 6.4kHz(default), 3.2kHz, 1.6kHz, 0.8kHz	6.3kHz (default) 5.6kHz, 2.7kHz, 1.3kHz, 0.65kHz
Sample Rate	12.8kHz default (max 25.6kHz)	13.2kHz default (max 26.6kHz)
# of Samples	16k sample (default) max 150k(3D)/ 450k(1D)	16k sample (default) max 150k(3D)/ 450k(1D)
Max Acceleration Measurement	± 16g (default) / 64g (Max)	± 8g (default) / 16g (Max)
Noise Sensor Density	300 µg/$\sqrt{Hz}$	75 µg/ $\sqrt{Hz}$
Accelerometer Sensitivity	1.95mg/LSB @±64g to 0.24mg/LSB @± 8g	0.48mg/LSB @±16g to 0.061mg/LSB @± 2g

MachineDoctor sensors offer two accelerometer options with different characteristics. The D1 accelerometer provides higher bandwidth and g-force range, making it suitable for high-speed or high-impact applications. The D2 accelerometer offers lower noise density and higher sensitivity, making it ideal for precision monitoring of lower-amplitude vibrations.

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Magnet Specifications

Flat Neodymium Magnet - Model: A30

The A30 Flat Neodymium Magnet provides high pull strength and dimensional stability in compact assemblies. It is optimized for magnetic mounting, sensing, and automation systems requiring uniform magnetic fields and consistent holding force.

Parameter	Condition / Method	Specification
Nominal Pulling Force	Direct vertical tensile force	30.7 – 32.3 kgf (average 31.8 kgf)
Adhesive Bond Strength	24 h bonding under standard room conditions	≥ 1000 N (vertical)
Dimensional Tolerance	Machined surfaces	±0.05 mm
Corrosion Resistance	0.5% saltwater, 35 ºC, 240 h spray test	No visible rust or pitting
High/Low Temperature Resistance	-18ºC (24 h) to +60ºC (24 h) cyclic exposure	Adhesive and coating remain intact
Surface Finish	—	Smooth, uniform, free of scratches and contaminants

Parameter	Description
Size	D: 30 mm h: 7 mm
Composition	NdFeB Magnet + Steel base
Plating Options	Teflon (for enhanced corrosion resistance)
Bonding Method	Industrial-grade adhesive, tested for vertical shear and pull strength
Magnetization Direction	Axially magnetized

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Magnet Specifications

Flat Neodymium Magnet - Model: A30

The A30 Flat Neodymium Magnet provides high pull strength and dimensional stability in compact assemblies. It is optimized for magnetic mounting, sensing, and automation systems requiring uniform magnetic fields and consistent holding force.

Parameter	Description
Size	Ø 48 mm (1.89 in)
Thickness	As per drawing (standard pot configuration)
Composition	NdFeB Magnet + Steel Pot Housing
Coating / Surface Treatment	Ni–Cu–Ni (Nickel triple layer)
Magnetization Direction	Axially through thickness – poles on flat faces
Unit Weight	111 g (± 0.5 g)
Tolerances	± 0.004 in (0.1 mm)

Parameter	Condition / Method	Specification
Residual Induction (Br)	N40 grade typical	12.6 kGs (1.26 T)
Coercivity (HcB)	N40 grade typical	10.8 kOe (860 kA/m)
Intrinsic Coercivity (HcJ)	N40 grade typical	12.5 kOe (995 kA/m)
Maximum Energy Product (BH)max	N40 grade reference	40 MGOe (318 kJ/m³)
Surface Flux Density	Measured on flat pole surface	≈ 12,600 Gauss
Nominal Pull Force	Direct vertical tensile test on flat steel plate (10 mm thick)	≈ 145 lb (65.7 kgf)
Max Operating Temperature	Continuous service	≤ 80 ºC (176 ºF)
Dimensional Tolerance	Machined surfaces	± 0.1 mm (± 0.004 in)
Surface Finish	—	Smooth, uniform nickel finish free of defects or discoloration

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Magnet Specifications

Curved Neodymium Magnet – Model: C30

The C30 Curved Neodymium Magnet was inspected for pull force and material verification. All results met the required standards, confirming consistent magnetic performance and stable bonding quality for the N35-grade magnet.

Parameter	Description
Size	A curved (arc) magnet designed to fit around a circular profile with an outer diameter of approximately 30 mm.
Grade	N35
Material	NFeB
Pull Force Range	25.1 – 26.2 kgf
Average Pull Force	25.5 kgf

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