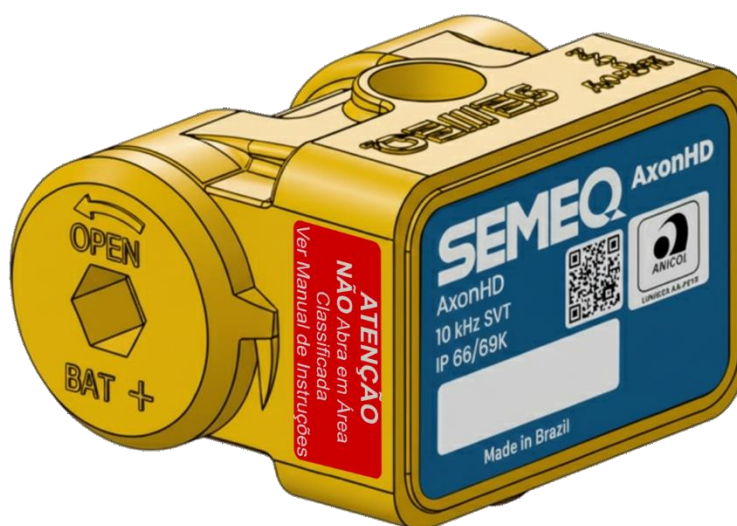


SEMEQ

AI-Driven Factory Reliability



USER'S MANUAL

AXONHD EX VIBRATION SENSOR

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2 ABOUT

AxonHD Ex Vibration Sensor is an advanced device for vibration and temperature monitoring, using Bluetooth® Low Energy 5.1 to easily connect to SMQ 990 Gateways. With triaxial sensitivity and high-frequency response, it detects faults at early stages, helping to reduce maintenance costs and prevent unplanned downtime or more severe damage.

The AxonHD Ex Vibration Sensor was developed to operate in environments with the imminent presence of combustible gases and dust. It has undergone extremely rigorous validation tests, in which it demonstrated full compliance, obtaining approval in all evaluation stages. Its INMETRO certification for operation in explosive atmospheres, combined with an IP66/IP69K protection rating, ensures the sensor is protected against gases, dust, water, and even chemical attacks. This means it can be safely installed in harsh industrial environments where durability and reliability are essential.

Equipped with a long-life, replaceable battery, the sensor requires no cabling, making installation simple and cost-effective. Its compact, low-profile design allows installation even in hard-to-reach locations or areas with space constraints, ensuring flexibility across a wide range of equipment such as industrial pumps, fans, compressors, electric motors, and turbines.

To meet the specific needs of different assets, SEMEQ offers four variants of the AxonHD Ex Vibration Sensor. The standard version transmits data at predefined intervals. The External Trigger variant enables acquisitions synchronized with process variables. Finally, the Data Collector variant allows manual data collection from different machines, with results transferred directly to the user's smartphone via the SEMEQ — DataCollect application, available for both Android and iOS.

All collected data is accessible through the SEMEQ Portal Stream, an intuitive web interface that combines simplicity with advanced features. This platform enables users to analyze data in detail, quickly identify issues, and optimize maintenance plans, increasing operational efficiency and machine reliability.

Designed to combine advanced technology, robust design, and ease of use, the AxonHD Ex Vibration Sensor provides a complete and reliable solution for predictive maintenance in classified areas. Its precision, durability, and flexibility across diverse industrial environments make it a benchmark for quality and performance, ensuring greater efficiency, reliability, and extended service life for your machines.

3 TECHNICAL CHARACTERISTICS

General Info	
Compatible Gateways	Any model or version of the SMQ990 Family
Approximated Gateway Occupation per Transmission	16 seconds
Transmission Interval ¹	Customizable. Default: 1 hour
Output Data - Vibration	
Sensing Element	MEMS Accelerometer
Number of Axis	3
Acceleration Range ²	from ± 8 g up to ± 64 g
Acceleration Resolution ²	from 0.24 mg up to 1.95 mg
Mechanical Signal Cutoff Frequency	10 kHz (X and Y-axis) and 6 kHz (Z-axis)
Sampling Frequency	25,600 samples/second
Samples Average	Customizable. Default: 2
Spectral Lines (Resolution)	Customizable. Default: 1,600 lines
Measurements Types	Acceleration, Velocity and Envelope
Measurements Formats	Overall Level, Bands, FFT and Waveform on Time
Data units	g, mm/s and in/s
Output Data - Temperature	
Range	-40 to 125 °C (-40 to 257 °F)
Resolution	0.08 °C
Precision	$\pm 4^{\circ}\text{C}$
Wireless Communication	
Protocol	Bluetooth® Low Energy 5.1
Frequency	2.402 to 2.480 GHz
TX Power	99 mW (20 dBm)
RX Sensitivity	-97 dBm
Antenna Range (Free Space) ³	200 m (656 ft)
Antenna Range (Industrial Environment) ³	70 m (230 ft)

¹Changing this value will increase or decrease the expected battery duration considerably.

²Automatically adjustable by the Axon HD Ex during each acquisition.

³These are empirical values and should be taken as an approximation since they are very sensitive to environment variables, as stated in the electromagnetic waves' theory..

Power Supply

ATTENTION: ONLY CERTIFIED BATTERIES CAN BE USED. CHECK THE USER MANUAL FOR THE BATTERY REPLACEMENT PROCEDURE.

Certified Battery Model	Panasonic CR-123APA/1B
Battery Cell Type	CR123A
Battery Quantity	1
Battery Chemistry	Lithium Manganese Dioxide
Battery Voltage	3 V
Battery Capacity	1550 mAh
Approximate Battery Duration ⁴	2 years

Explosive Protection Certification

Protection Type	Intrinsically Safe
Marking for Explosive Gases Atmospheres	Ex ia IIB T4 Ga
Marking for Combustible Dusts Atmospheres	Ex ia IIIC T135°C Da
Ingress Protection Rating	IP66 / IP69K

General Mechanical Specifications

Approximate Dimensions (W x L x H)	55 x 44 x 39.5 mm (2.2 x 1.7 x 1.6 in)
Weight	120 g (4.2 oz)
Material	PA66 GF30 and Stainless Steel A2
Battery Lid Allen Key Size	5/16 in
Mounting Screw	Socket Head Cap 1/4"-28 UNF x 1" 1/2
Screwdriver	Allen Key 3/16 in
Mounting Torque	8.5 to 9.5 Nm (6.3 to 7 ft.lb)

Environmental

Environment Temperature	-20 to 40 °C (-4 to 104 °F)
Temperature During Operation	-30 to 60 °C (-22 to 140 °F)
Maximum Surface Temperature During Operation ⁵	100 °C (212 °F)

⁴Battery life will vary significantly depending on the configured transmission interval and may also be slightly affected by operating temperature. The estimated duration applies only to the standard AxonHD variant with a one-hour transmission interval under ambient temperature conditions. Since the other variants are highly customizable, providing an accurate estimate is not possible. For a detailed battery expectancy tailored to your application, please contact SEMEQ support.

⁵This is an empirical value for an ambient temperature of around 22°C and may vary with it.

If further specifics are required, the product's Technical Datasheet offers an enhanced and detailed table. Please refer to it as needed.

4 PRODUCT DIMENSIONS

All dimensions are expressed in millimeters.

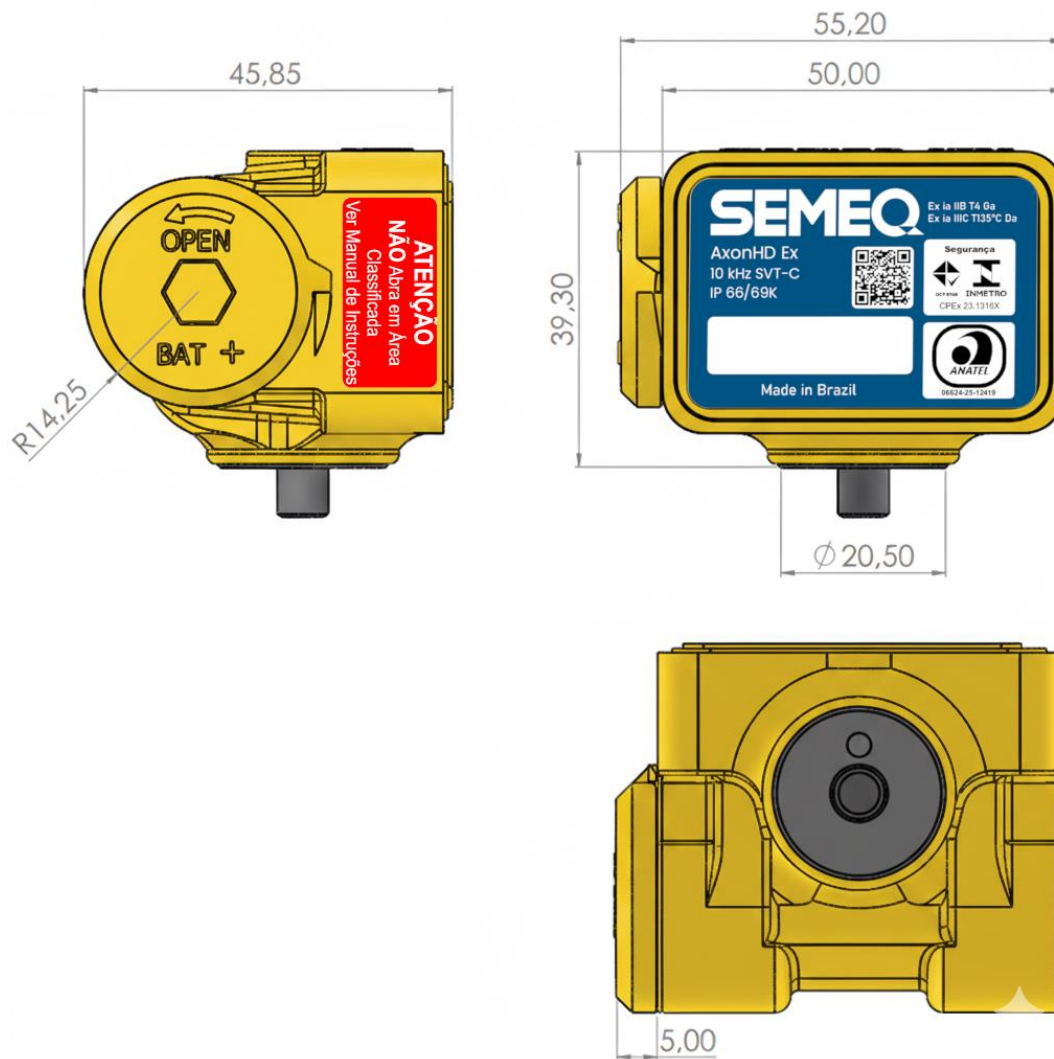


Figure 1 — AxonHD Ex dimensions.

5 WEB INTERFACE



Figure 2 — Vibration Analysis dashboard from SEMEQ Portal Stream.

Once installed, the processed data from the AxonHD Vibration Sensor will be displayed on the Vibration Analysis screen of the SEMEQ Portal Stream. The dashboard includes the following graphs:

a) X, Y and Z-axis Velocity Spectrum:

with a default maximum frequency of 800 Hz and 1600 lines of resolution, providing a frequency resolution of 0.5 Hz.

b) X-axis Acceleration Spectrum: two default options are provided:

- i. Maximum frequency of 12800 Hz and 3200 lines of resolution, providing a frequency resolution of 4 Hz.
- ii. Maximum frequency of 6400 Hz and 1600 lines of resolution, providing a frequency resolution of 4 Hz.

c) X-axis Envelope: with a default maximum frequency of 800 Hz and 1600 lines of resolution, providing a frequency resolution of 0.5 Hz.

d) X-axis Acceleration Waveform: two default options are provided:

- i. Maximum time of 4 seconds and 4096 lines of resolution, providing a time resolution of approximately 1 millisecond.
- ii. Maximum time of 0.25 seconds and 4096 lines of resolution, providing a time resolution of approximately 0.1 milliseconds.

Each of these graphs is accompanied by Overall RMS and peak-to-peak trends, including historical data.

6 AVAILABLE VARIANTS

The SEMEQ offers four variants of the AxonHD Ex Vibration Sensor, developed to meet the specific needs of each customer asset:

a) AxonHD Ex: the standard version of the vibration sensor. It performs data reading and transmission to the SMQ

990 gateway at predefined intervals, with a default of one hour.

- b) AxonHD Ex — External Trigger:** a highly customizable version that performs the reading and transmission of measurements to the SMQ 990 Gateway when automatically triggered by it. It is especially useful when acquisitions need to be synchronized with process variables. See [Section 11](#) for more details.
- c) AxonHD Ex — Data Collector:** a portable variant designed for measurements on different machines. The data is transferred directly to the user's smartphone through the SEMEQ — DataCollect app, available in the Google Play Store and the Apple App Store. See [Section 12](#) for more details.

Note: The mobile device used must have certification compatible with the classified area corresponding to the sensor.

7 EXTRA FUNCTIONALITIES

In addition to remote vibration monitoring, the AxonHD Vibration Sensor offers the following additional functionalities:

- a) Remotely Configurable Parameters:** Some of the device's parameters can be adjusted remotely for enhanced flexibility. Refer to [Section 13](#) for details.
- b) Over-the-Air (OTA) Firmware Updates:** Keep the device up to date effortlessly through automatic remote firmware updates.

8 PRODUCT DISPLAY



Figure 3 — AxonHD Ex Front Panel.

The AxonHD Ex Vibration Sensor has the following regions on its panel:

- a) Product Name:** Field that displays the product name, including its variant.
- b) Ex Marking:** Field containing the product's marking for classified areas.
- c) Internal Identifier:** Field that stores the product's commercial identification, intended only for internal control and not relevant to the end user.
- d) Ex Certification:** Field containing the certificate number for the product's classified area approval, the OCP (Product Certification Body) code, and the certifying agency.
- e) Protection Rating:** Field containing the product's IP protection rating.
- f) QR Code:** QR code that directs the user straight to this User Manual.
- g) Telecommunications Certifications:** Field containing information about the product's regulatory approvals and radio certifications.
- h) Serial Number (ID):** Field that contains the product's serial number (ID).

9 INSTALLATION PROCEDURE

To ensure proper and safe installation of the *AxonHD Vibration Sensor*, the process must be performed by an authorized and qualified professional, adhering to the best practices outlined in this document. Detailed instructions are provided in the following sections.

9.1 MOUNTING AND PLACEMENT

We strongly recommend the physical installation of the *AxonHD Vibration Sensor* to be performed or supervised by a professional with experience in vibration analysis for predictive maintenance. If needed, SEMEQ can provide this service; however, any qualified professional with relevant expertise is also suitable.

This type of analysis is extremely sensitive to how vibration data is collected, and factors such as sensor orientation, installation point, and the method of fixation can all significantly affect the quality and reliability of the acquired signal.

The following sections provide some recommended best practices, but users are encouraged to apply their expertise and go beyond these guidelines to ensure optimal measurement quality.

9.1.1 Installation Point Selection

The sensor should always be installed as close as possible to the vibration source, typically on the bearing housing of the machine. The installation point must be oriented either vertically or horizontally, meaning the sensor surface should be aligned parallel or perpendicular to the ground — never in the axial direction. Proper placement ensures accurate representation of the

machine's dynamic behavior and minimizes signal distortion.

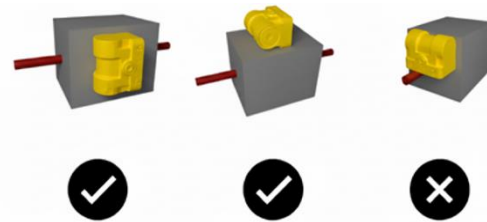


Figure 4 – Illustration showing the vertical, horizontal, and axial installation orientations, respectively.

9.1.2 Surface Preparation

The mounting surface must be as flat and smooth as possible. All paint, rust, or debris must be removed to ensure proper contact between the sensor and the machine. For best results, milling the surface is recommended to create a clean and precisely aligned area.



Proper surface preparation improves vibration transmission to the sensor, reduces signal distortion and damping, and increases the reliability and repeatability of the measurements.

9.1.3 Fixation Methods

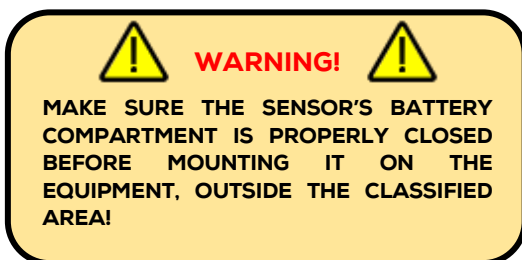
The use of the provided mounting screw is the preferred fixation method for accurate vibration measurements. This requires drilling the prepared surface and tapping the hole according to the mounting screw specifications described in [Section 3](#), ensuring a firm and rigid connection.



When drilling is not possible, alternative fixation methods such as adhesive or a magnetic base may be used. Even when using a magnetic base, reinforcing the fixation with an adhesive is recommended to prevent displacement. Always follow the adhesive manufacturer's instructions for proper application and curing. When selecting an adhesive, consider the sensor's material, operating temperature, and shear and tensile strength, as described in [Section 3](#).

9.1.4 Sensor Placement

Before mounting, energize the *AxonHD Ex Vibration Sensor* using the provided battery. Ensure the battery is inserted with the correct polarity to avoid damage to the device. For details on the battery installation process, refer to [Section 10](#).



The *AxonHD Ex Vibration Sensor* must be securely mounted at the chosen installation point using the selected fixation method. The sensor base must be aligned and parallel to the machine surface, ensuring proper vibration transmission.

The sensor's Z-axis must be aligned with the shaft of the rotating machine.

This Z-axis is marked on the top of the sensor, as illustrated below. In some units, the shaft direction may also be indicated by a label on the housing.



Figure 5 - Axis markings of the *AxonHD Ex Vibration Sensor* on the enclosure.

Remember the sensor's position and orientation relative to the equipment, as this information will be required later during the linking process.

9.1.5 Maintaining Sensor Reliability

To ensure consistent predictive maintenance measurements, users should perform periodic inspections of the sensor. These checks verify that the sensor remains securely fixed and correctly oriented. Over time, vibration, thermal cycling, and environmental conditions may loosen screws or adhesives, negatively impacting measurement accuracy. Regular inspections help maintain signal quality and ensure the reliability and repeatability of collected data.

9.2 LINKING

After being properly mounted, the *AxonHD Ex Vibration Sensor* must be registered to an installation point within the site's tree. This process, known as Linking, is performed by navigating to the *PdM Plan* screen on the *SEMEQ Portal Stream* and locating the site's tree. Select

the desired *Asset*, access its *Devices* menu, and click the *Link Device* button.

Figure 6 - Link Device menu from SEMEQ Portal Stream.

Inside the Figure 6 screen enter the device ID in the *Serial Number* field, which can be found on the *AxonHD Ex's* panel (refer to [Section 8](#) for its precise location), and press TAB or ENTER. Complete all the following required fields with details about the installation:

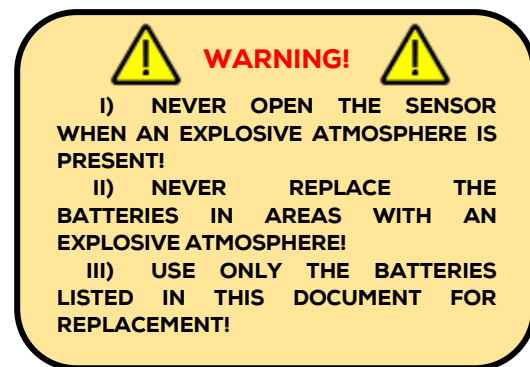
- a) **Device image:** Upload an image of the device at its installation location. Ensure the image has an 800x600 resolution or a 4:3 aspect ratio to prevent distortion.
- b) **Device Base:** Fill this field according to the mounting method used. Leave the default if a standard mounting screw was used. For alternative methods, such as adhesive or magnetic bases, contact SEMEQ support to ensure the correct orientation.
- c) **Point Description:** Provide an industry-standard code that identifies the monitoring point on the machine.
- d) **VIBRATION:** Select the image representing the installation orientation of the sensor.
- e) **TEMPERATURE °C:** This side menu allows you to configure temperature alarms within the *SEMEQ Portal Stream*:
 - i. **Yellow:** The temperature at which a yellow alarm will be triggered on the *SEMEQ Portal Stream* dashboard.
 - ii. **Red:** The temperature at which a red alarm will be triggered on

the *SEMEQ Portal Stream* dashboard.

To complete the Linking process, click the **SAVE** button.

Please note that the creation of the site's tree is not covered in this manual. For assistance with setting up the site's tree or for further troubleshooting, contact SEMEQ support.

10 BATTERY REPLACEMENT



Make sure you are outside the classified area before proceeding with opening the battery compartment.

Open the battery compartment lid located on the side of the *AxonHD Ex Vibration Sensor* using the Allen key specified in [Section 3: General Mechanical Specifications](#).

Next, remove the current battery and insert the new battery into its housing, ensuring that the negative terminal is in contact with the spring inside the sensor, as illustrated below.



Figure 7 - Correct orientation of the battery.

Finally, close the battery compartment lid by rotating it back into its original position. Make sure the lid is **fully seated** so that its tab reaches the corresponding step, as shown below. **This ensures proper sealing and allows the sensor to maintain its safety for operation in classified areas.**

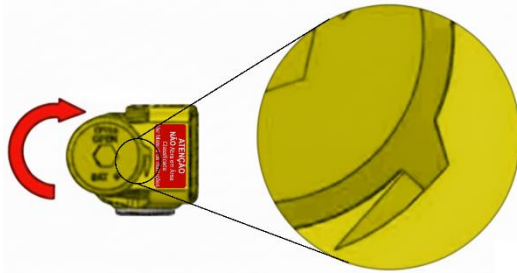


Figure 8 - Properly closed battery lid. The tab must be rotated fully until it stops against the illustrated step, ensuring correct sealing.

11 TRIGGERING VIA OPERATIONAL VARIABLES

The *AxonHD — External Trigger* variant (see [Section 6](#)) enables data acquisition and transmission based on external operational variables, offering greater integration flexibility. In this mode, the *SMQ 990 Gateway* monitors the variables and, whenever a defined condition is met, sends a Bluetooth command to all devices in range. Configured devices then start their acquisition and transmission process, ensuring seamless communication with

protocols such as OPC, PLC, and Modbus.

Since the *AxonHD Vibration Sensor* is a battery-powered solution, operating in this mode can be very power-intensive and significantly reduce battery life expectancy. Because client requirements are often complex, this variant offers extensive customization to balance performance and autonomy. The following parameters are available for this purpose, all of which can be adjusted remotely (see [Section 13](#)):

- a) **Wireless Trigger Timeout:** Ensures that the device performs a transmission even if the operational variable condition has not been met. Once this timeout is reached, the device will force a transmission, preventing long periods without data. The countdown begins when the device exits Deep Sleep mode, meaning that, in practice, the transmission interval in idle conditions will equal the sum of this parameter and the configured *Deep Sleep Duration*. These forced transmissions can later be filtered in the *SEMEQ Portal Stream* interface if needed.
- b) **Deep Sleep Duration:** Defines how long the device remains in a deep low-power state during which it does not listen for transmission commands. This setting helps prevent excessive transmissions, allowing the device to conserve energy and only respond when truly required.
- c) **Target Gateway:** Restricts the device to accept transmission commands only from a specific gateway, rather than any gateway in range. This provides greater control in environments where multiple gateways are present. By default, the device listens to all gateways.

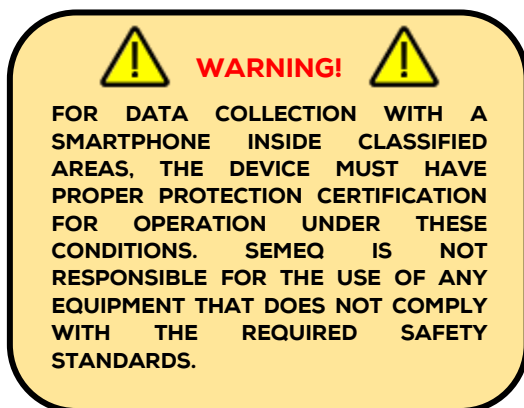
d) Start Delay: A fixed, user-defined delay between receiving a transmission command and starting data acquisition. It always applies the exact delay configured, allowing precise alignment with the monitored process.

e) Maximum Trigger Perception Delay: The maximum time the sensor may take to wake up after a gateway trigger. Unlike Start Delay, this delay is not fixed — the sensor might respond immediately or at any point up to the configured maximum. Because this parameter has the strongest effect on battery consumption, it should be kept as high as possible when battery life is critical.

To enable transmission triggering via operational variables, the desired protocol and operational variable must first be configured and integrated with a *SMQ990 Gateway*. Please note that this manual does not cover this setup. For assistance with this process, contact SEMEQ support.

12 MANUAL DATA COLLECTING

The *AxonHD Ex — Data Collector* variant (see [Section 6](#)) allows user to collect data in the field from different machines using a smartphone.



To get started, install the **SEMEQ – DataCollect** app on your device, available on both [Google Play Store](#) and [Apple App Store](#).

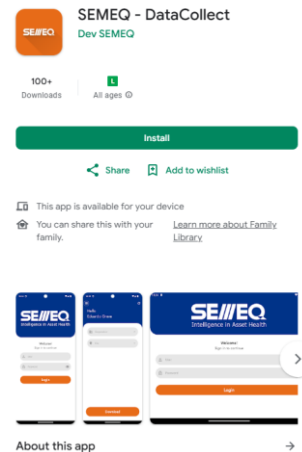


Figure 9- SEMEQ - DataCollect app in Google Play Store.

Open the installed app, enter your user credentials, select your site, and tap the *Download* button to retrieve the site's asset tree.



Figure 10 - Site selection screen.

Next, power on the *AxonHD — Data Collector* and place it at the desired measurement point (refer to [Sections 9.1](#) and [10](#) for details). In the app, navigate to the corresponding point in the site tree and tap it to start searching for available sensors. When the sensor is found, it will appear with the name *SMQCOL_XXXXX*, where XXXXX is the sensor's ID (refer to

[Section 8](#) for its location). Tap the sensor to proceed.

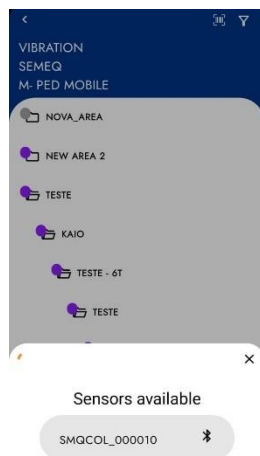


Figure 11 - Available sensors screen.

On the following screen, select the image that represents the orientation of the sensor to begin data collection and transmission.

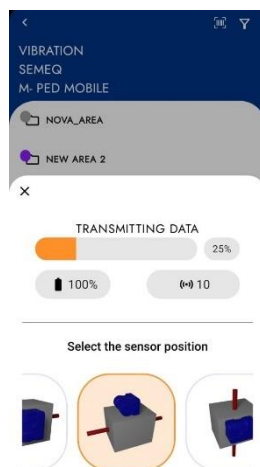


Figure 12 - Sensor orientation selection and data transmission screen.

Once data collection and transmission are complete, tap the button to proceed to the upload screen.

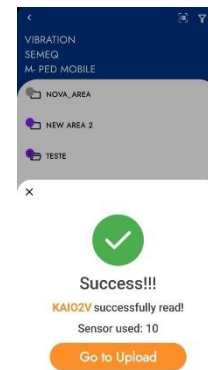


Figure 13 - Data collection success screen.

In the upload screen, simply tap **UPLOAD DATA** to send the collected information to the cloud, making it available in the *SEMEQ Portal Stream*.



Figure 14 - Collected data upload screen.

For instructions on creating the site's asset tree or using advanced app features, please contact SEMEQ Support.

13 REMOTE PARAMETERS

The *AxonHD Vibration Sensor* offers the capability to edit certain device parameters remotely via the *SEMEQ Portal Stream*, providing users with the flexibility to refine their monitoring settings according to specific needs.

To access the parameters menu, navigate to the *PdM Plan* screen within

the *SEMEQ Portal Stream*, locate the device in question, open its options, and click the **PARAMS** button.

Figure 15 — Device Parameters editing menu.

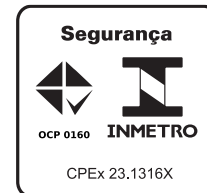
Inside the Figure 15 menu, users will find the units of measurement along with the default, minimum, and maximum allowed values for each parameter. Always refer to this menu, as these ranges may vary slightly depending on the sensor's firmware version. Below, we provide a detailed explanation of the configurable parameters, without repeating the numerical limits:

- a) Deep Sleep Duration:** Defines how long the device remains in a deep low-power state after transmitting data. For the standard variation of the *AxonHD Vibration Sensor*, this value will be equal to its transmission interval. For the other variants, please refer to [Section 11](#).
- b) Start Delay:** A fixed, user-defined delay before starting of data acquisition.
- c) Wireless Trigger Timeout:** A parameter specific to the *AxonHD — External Trigger* variant. Please refer to [Section 11](#) for details.
- d) Target Gateway:** A parameter specific to the *AxonHD — External Trigger* variant. Please refer to [Section 11](#) for details.
- e) Maximum Trigger Perception Delay:** A parameter specific to the

AxonHD — External Trigger variant. Please refer to [Section 11](#) for details.

14 REGULATORY CERTIFICATIONS

14.1 INMETRO (BRAZIL)



The products *AxonHD Ex*, *AxonHD Ex — External Trigger*, and *AxonHD Ex — Data Collector* are certified by INMETRO under certification number **CPEX 23.1316X** and **OCP 0160**.

The certificate allows operation in classified areas under the following categories:

For environments with Flammable Gas or Vapor:

Ex ia IIB T4 Ga

For environments with Combustible Dust:

Ex ia IIIC T135 °C Da

Operating temperature range:

–20 °C < Ta < +40 °C

The protection rating of the sensors is:

IP66/IP69K

14.2 ANATEL (BRAZIL)



The products *AxonHD Ex*, *AxonHD Ex — External Trigger* and *AxonHD Ex — Data Collector* are certified by ANATEL

under certification number **06624-25-12419**.

This equipment is not entitled to protection against harmful interference and must not cause interference to authorized systems.

For more information, please visit <https://www.gov.br/anatel/pt-br>.

14.3 FCC (USA)



This device complies with Part 15 of the FCC Rules and with Licence exempt RSS standards of Industry Canada.

Operation is subject to the following two conditions:

- a) This device may not cause harmful interference.
- b) This device must accept any interference received, including interference that may cause undesired operation.

Exposure to radio frequency energy.

The radiated output power of this device meets the limits of FCC/ISED Canada radio frequency exposure limits. This device should be operated with a minimum separation distance of 20 cm (8 inches) between the equipment and a person's body.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- a) l'appareil ne doit pas produire de brouillage.
- b) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

L'exposition à l'énergie radiofréquence. La puissance de sortie rayonné de cet appareil est conforme aux limites de la FCC/ISED Canada limites d'exposition aux fréquences radio. Cet appareil doit être utilisé avec une distance minimale de séparation de 20 cm entre l'appareil et le corps d'une personne.

WARNING: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. The term "IC:" before the radio certification number only signifies that Industry Canada technical specifications were met.

15 WARRANTY

According to the customer service policy, the product warranty period is 12 months.

16 CONTACT

TECHNICAL SUPPORT

Location: Av. Ambrósio Fumagalli, 2040 - Limeira/SP - Brazil - CEP: 13.485-333

Phone: +55 19 3446-6862 extension 877

E-mail: suporte@semeq.com

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