StructureIQ Xnode - Product User Manual

Version: 2.0

Date: January 2026

Xnode Wireless Smart Sensor

User Manual & Installation Guide

Models:

- **Xnode Wireless Smart Sensor** (General Purpose)
  - 24-bit accelerometer
- **Xnode Wireless Smart Sensor** (High Precision)
  - 32-bit digital accelerometer

Manufacturer: StructureIQ, Inc.

Wireless AI-enabled Sensor for Structural Risk Mitigation

Scalable | Synchronized | Precise

Table of Contents

1. Introduction

1.1 Product Overview

The **Xnode Wireless Smart Sensor** is an advanced, environmentally hardened sensor platform designed for high-fidelity structural health monitoring (SHM), seismic sensing, and industrial equipment monitoring.

Built for data-intensive applications, the Xnode features a 24-bit (general purpose model) or 32-bit (high precision model) digital accelerometer and a dual-core embedded processor capable of on-board computation. It delivers precisely synchronized data (under 20 microsecond precision) across distributed channels from up to 48 Xnode sensors, making it the ultimate solution for detecting structural stress, vibration, and sudden seismic events.

1.2 Key Features

- **High-Fidelity Sensing:** Ultra-low noise 3-axis accelerometer with 24/32-bit resolution.
- **Synchronized Sampling:** Time synchronization <20 µs across up to 48 sensors per gateway.
- **Edge Computing:** Dual-core processor enables on-board filtering, decimation, and threshold detection.
- **Long-Range Connectivity:** Wireless transmission range >1km (line of sight).
- **Robust Design:** IP67-rated enclosure for harsh environmental conditions.

2. Safety Information

WARNING: Read all safety instructions before installing or operating this equipment.

- **Lithium-Ion Battery:** This device contains a high-capacity 10,000 mAh rechargeable Lithium-Ion battery. Do not puncture, crush, or expose to temperatures outside the rated operating range of -20°C to +60°C.
- **Charging:** Only use the provided solar panel or wall charger. Do not use high-voltage industrial power supplies directly on the charging port.
- **RF Exposure:** The radio operates in the 2.4 GHz band, and the cellular modem operates in the 4G LTE frequency bands. Maintain a separation distance of at least 20cm from the human body during continuous operation to comply with standard RF exposure limits.
- **Mounting Safety:** When using the magnetic mount on overhead structures, ensure the surface is ferromagnetic and flat. For critical overhead installations, use the bolt-down bracket option to prevent falling hazards.

3. System Overview

3.1 Architecture

The StructureIQ SHM system consists of three main components:

1. **Xnode Sensors:** Distributed wireless sensors for data collection.
2. **Xnode Gateway:** A central hub that coordinates the network and aggregates data.
3. **Graphical User Interface:** Web-based interface for visualization, configuration, and analysis.

3.2 Interfaces & Indicators

1. **Power/Status LED:** Indicates power state, network connection, and battery level.
2. **Charging Port:** Waterproof port for solar panel or wall charger connection.
3. **Mounting Interface:** Sensor base accommodates magnet, plate, or bracket attachments.

4. Quick Start Guide

Step 1: Unpack

Verify the box contains the Xnode Sensor, mounting magnets (attached), connector cable, and any optional accessories (solar panel, wall charger, and mounting brackets).

Step 2: Charge

Ensure the device is fully charged prior to deployment. Connect the sensor to the included charger using the charging cable. The sensor does not need to be turned on in order to charge. Time to full charge is approximately 3 hours.

Step 3: Power On

Activate the sensor (and gateway, if applicable) by setting the power switches to the ON position. The Xnode will automatically attempt to connect to the StructureIQ cloud server.

- *Note: In gateway-based deployments, the Xnode software proactively avoids interference with WiFi traffic in the 2.4 GHz band*.

Step 4: Verify Connection

Check the web-based graphical user interface on your PC/tablet. The sensor should appear in the sensor list for the asset. Automatic sensor-to-gateway network configuration ensures seamless pairing.

5. Installation & Mounting

5.1 Placement Guidelines

- **Range:** For gateway-based deployments, ensure the sensor is within 1 km (line of sight) of the gateway.
- **Building Placement:**
  - One sensor should be placed at ground level.
  - One sensor should be placed on a structural element on (or near) the roof.
  - For larger structures: an additional sensor can be placed on a structural element on the middle floor.
- **Bridge Placement:**
  - Sensors should be placed at predetermined locations on the structure (e.g., mid-span, quarter-spans, top of pylon, cables, etc.)

5.2 Mounting Options

The Xnode is designed for fast and simple mounting. Choose the method best suited for your surface:

- **Magnetic Mount (Included):** Best for temporary deployment on steel structures (beams, girders).
- **Clamp Mount:** For cables.
- **Adhesive Plate:** For flat concrete or composite surfaces where drilling is not possible.
- **Screw Mounting:** Wooden beams, some concrete surfaces, and high-vibration environments.

5.2.1 Building Mounting

Mount the sensor using the selected mounting option.

- **Note:** The sensor should be installed on a load-bearing structural element (beam, column, load-bearing wall, etc.) and not on non-structural elements (most interior walls, decorative architectural elements, etc.).

1. Connect the included wall charger to the mounted sensor using the provided connector cable.
2. Plug the charger into a standard electrical wall outlet.
3. Turn the sensor on.

4. Verify that the sensor is active and operational via the web-based graphical user interface.
5. Allow 3 minutes after turning the sensor on for initial connection and synchronization with the cloud server.

5.2.2 Bridge Mounting

Mount the sensor using the selected mounting option.

- **Note:** The sensor should be installed on a load-bearing structural element (beam, truss, cable, etc.) and not on non-structural elements (wind fairing, fencing, etc.).

1. Install the solar panel near the sensor (within reach of the provided connector cable).
2. Connect the mounted solar panel to the mounted sensor using the provided connector cable.
3. Turn the sensor on.
4. Verify that the sensor is active and operational via the web-based graphical user interface.
5. Allow 3 minutes after turning the sensor and gateway on for initial connection and synchronization with the cloud server.

6. Operation & Configuration

6.1 Data Acquisition Modes

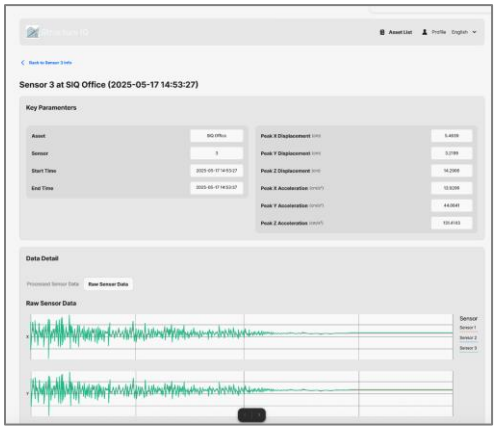
- **Periodic Monitoring:** Scheduled sampling intervals for long-term health tracking.
- **Event-Triggered:** Automatically records data when vibration exceeds a specific threshold (e.g., seismic event, vehicle impact, freight train crossing).

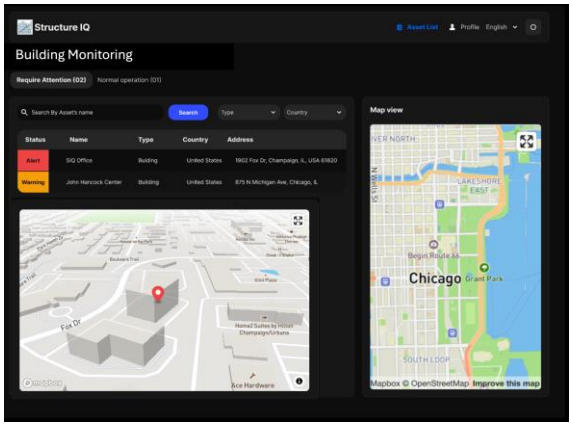
6.2 Web-based Graphical User Interface

Users can configure the following parameters via the StructureIQ Dashboard:

- **Sampling Rate:** Programmable up to 1 kHz.
- **Cut-off Frequencies:** Adjust digital filters to isolate specific structural frequencies.
- **Trigger Levels:** Set acceleration thresholds for event detection.
- **Notifications:** Enable/disable e-mail/SMS notifications for detected events.
- **Other parameters:** Additional configuration options specific to a deployment

Shown here are examples of the StrutureIQ dashboard controls and data output for the Xnode Sensors.





7. Technical Specifications

1. Xnode Wireless Smart Sensor (General Purpose) - SPECIFICATIONS

General	
External Sensors	5-channel analog voltage input
Internal Sensors	3-axis acceleration Temperature
Data Storage	32MB SDRAM, 128MB NAND Flash, 4GB microSD
External Analog Signal Acquisition	
Analog-to-digital converter (ADC)	24-bit delta-sigma
Resolution, effective number of bits[2]	20 ENOB
Maximum sampling frequency	1 kHz
Typical sampling frequencies	50-500Hz (with antialiasing)
Input voltage range	0-3.3 V
Precision	0.04%
Internal Accelerometer	
Sensitivity	0.66 v/g
Acceleration range (selectable)	±6g, ±2g
Noise floor, Z axis	0.7 mg
Noise floor, X and Y axes	0.3 mg
Radio Characteristics	
Operating frequency	2.4 GHz
Communication protocol	IEEE 802.15.4
Transmission power	-17 to +4 dBm (+24 dBm with optional built-in amplifier)
Data rate	250 kbps – 1 Mbps
Maximum line-of-sight transmission distance	1.2 km
Gateway Connectivity	
Cellular network standards	4G, 4G LTE
Cellular modem compatibility (variants)	North America, Europe, Asia-Pacific
SIM (included)	Global multi-network
Operating Parameters	
Temperature range	-20 to +60 C
Internal power source	10,000 mAh rechargeable lithium-ion battery
External power source	5 V DC (USB or solar panel)
Physical Specifications	
Dimensions	150 x 70 x 50 mm
Weight	750 g
Environmental rating	IP67
Case material	Plastic
Mounting options	Magnet (included), plate, bracket

2. Xnode Wireless Smart Sensor (High Precision) - SPECIFICATIONS

General	
Internal Sensors	3-axis acceleration
Data Storage	32MB SDRAM, 128MB NAND Flash, 4GB microSD
Internal Accelerometer	
Accelerometer type	32-bit digital
Maximum sampling frequency	1 kHz
Typical sampling frequencies	50-500 Hz (with antialiasing)
Noise density (rms)	0.2 uG/√Hz
Acceleration range	±15 G
Resolution	0.06 µG/LSB
Sensitivity error (ppm)	$\pm 500 \times 10^{-6}$
Vibration rectification coefficient	$\pm 50\ \mu G/G^2$
Radio Characteristics	
Operating frequency	2.4 GHz
Communication protocol	IEEE 802.15.4
Transmission power	-17 to +4 dBm (+24 dBm with optional built-in amplifier)
Data rate	250 kbps – 1 Mbps
Maximum line-of-sight transmission distance	1.2 km
Gateway Connectivity	
Cellular network standards	4G, 4G LTE
Cellular modem compatibility (variants)	North America, Europe, Asia-Pacific
SIM (included)	Global multi-network
Operating Parameters	
Temperature range	-20 to +60 C
Internal power source	10,000 mAh rechargeable lithium-ion battery
External power source	5 V DC (USB or solar panel)
Physical Specifications	
Dimensions	150 x 70 x 50 mm
Weight	750 g
Environmental rating	IP67
Case material	Plastic
Mounting options	Magnet (included), plate, bracket

8. Customer Support

For technical assistance, warranty claims, or calibration services, please contact StructureIQ support.

Company: StructureIQ
Address: 60 Hazelwood, Champaign, IL 61820
Phone: +1 312-788-7092
Website: www.StructureIQ.ai
Email: support@structureiq.ai

9. Warranty

Limited Warranty Agreement

This Limited Warranty Agreement ("Warranty") is issued by StructureIQ ("Service Provider"), with principal offices at 60 Hazelwood Drive, Champaign, IL 61820, for the Xnode Smart Sensor ("Product").

1. Warranty Coverage StructureIQ warrants that the Xnode Smart Sensor will be free from material defects in materials and workmanship under normal use for the duration of the Services Agreement between Customer Service Provider ("Warranty Period"). This Warranty applies solely to the original purchaser ("Customer") and is non-transferable.

2. Warranty Scope During the Warranty Period, if the Product is found to be defective in materials or workmanship, StructureIQ will, at its discretion, either:

- Repair the Product using new or refurbished parts,
- Replace the Product with a new or refurbished unit of equivalent specifications

3. Exclusions and Limitations This Warranty does not cover:

- Normal wear and tear, cosmetic damage, or minor performance variations that do not materially impact functionality.
- Damage caused by misuse, neglect, abuse, accident, unauthorized modification, improper installation, or use outside the Product's specifications.
- Damage resulting from external causes, including but not limited to environmental factors, electrical surges, liquid exposure, or acts of nature.
- Theft and vandalism of the Product.
- Consumable components such as batteries, unless failure is due to defects in materials or workmanship.
- Any Product that has been modified, serviced, or repaired by unauthorized personnel.
- Any loss or damage to data stored within the Product.

4. Warranty Claim Process To initiate a warranty claim, Customer must:

1. Contact StructureIQ Support via info@StructureIQ.ai to obtain a Return Merchandise Authorization (RMA) number.
2. Provide the contract number of the Services Agreement, and a detailed description of the defect.
3. Ship the defective Product, with the RMA number clearly marked, to the address provided by StructureIQ.

5. Limitation of Liability TO THE MAXIMUM EXTENT PERMITTED BY LAW, STRUCTUREIQ SHALL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES ARISING FROM THE USE OR INABILITY TO USE THE PRODUCT, EVEN IF STRUCTUREIQ HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. STRUCTUREIQ'S TOTAL LIABILITY

UNDER THIS WARRANTY SHALL NOT EXCEED THE ORIGINAL PURCHASE PRICE OF THE SERVICES AGREEMENT.

6. Governing Law This Warranty shall be governed by and construed in accordance with the laws of the State of Illinois, without regard to its conflict of law principles. Any disputes arising under this Warranty shall be resolved in the courts of Chicago, Cook County, Illinois.

7. Consumer Rights This Warranty provides specific legal rights and does not affect any statutory rights that the Customer may have under applicable consumer protection laws. If any provision of this Warranty is deemed unenforceable, the remaining provisions shall remain in full force and effect.

For further assistance, please contact StructureIQ at info@StructureIQ.ai.

StructureIQ
60 Hazelwood Drive, Champaign, IL 61820
www.StructureIQ.ai

END OF WARRANTY

10. Standards compliance

1. FCC Compliance Statement

StructureIQ Product Compliance
This product complies with the following standards:

- United States – Federal Communications Commission (FCC)
- Device Uses Approved Radio: NL-SW-LTE-TC1WWG
- Contains FCC ID: RI7LE910CXWWX
- Contains IC: 5131A-LE910CXWWX

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standards. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2. Modification Notice

Changes or modifications made to this equipment not expressly approved by StructureIQ may void the FCC authorization to operate this equipment.

Information in this document is subject to change without notice.