

Wiver

high-performance wireless condition monitoring sensor

Technical Manual

Model: WIVER CO.FW14
Internal Part Number: 07851284R2
Doc. WV-23-0002A

About MAPER

MAPER is a leading manufacturer of industrial condition monitoring solutions. Since 2015, we have focused on developing innovative wireless sensors and monitoring systems that help maintain asset reliability and optimize industrial operations. Our headquarters in Mexico City houses our R&D center and main manufacturing facility, where we design and produce the full range of MAPER monitoring solutions, including the Wiver sensor family and associated systems.

Company information

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Overview

WIVER is a high-performance wireless condition monitoring sensor. Coupled with MAPER's Asset and Process Health Platform, it can provide smart insights on asset health by measuring tri-axial vibration and temperature. Its multiple configuration options allow condition monitoring of diverse machines, including highly intermittent assets which are difficult to diagnose with competing products. Multiple WIVERS can be automatically synchronized for simultaneous measurement of a given asset. MAPER offers multiple versions: WIVER standard (optimized for the most common assets in industry) and WIVER FS for highly intermittent machines. Each of these can also be configured according to the operation ambient rating: standard, HT (high temperature – up to 100°C continuous operation) and Ex for explosive atmospheres.

- Easy installation in 15'.
- NFC allows single-touch configuration using a cell phone.¹
- Multiple mounting options (adhesive base, mounting fins, screw mount, etc.)²
- Highly configurable for diverse machine types
- Periodic acceleration and velocity RMS value measurement
- Periodic spectrum measurement
- Magnetometer³ for diagnosing electrical faults.
- Wireless synchronization
- Long wireless range
- Long battery life and easy battery replacement
- Regular alkaline AA batteries for ease of procurement
- Accurate timestamping allows event correlation with plant processes
- Internal health monitoring⁴ tracks the sensor's own condition.



¹ 2023Q2

² Contact MAPER Applications for more details.

³ 2023Q2

⁴ Contact MAPER Applications for more details.

Technical characteristics

| Parameter | Test condition | Min | Typ | Max | Unit |
|--|---------------------------------------|--|-------|-------------------|-----------------------|
| Vibration – Wiver HF | | | | | |
| Range | | ±2 | | ±16 | g |
| Sampling frequency (f _s) | | 0.2 | | 26.67 | kHz |
| Maximum spectral frequency (f _{MAX}) | | 0.1 | | 13.33 | kHz |
| Spectral resolution (Δf) | | 0.01 ⁵ | | | Hz |
| Sensitivity variation over temperature | | | 0.013 | 0.025 | %/°C |
| Sensitivity error | @50Hz | -2 | 0 | 2 | % |
| Frequency accuracy | | -0.03 | | 0.03 | % |
| Bandwidth (-3dB) | Horizontal, Vertical, Axial | | 6300 | | Hz |
| Noise | | | 70 | | μg Hz ^{-1/2} |
| Spectral lines | no overlap | 100 | | 13333 | |
| Windowing | | Hann, Hamming, Flat-Top, Rectangular, B-H | | | |
| Overlap | | 0 | | 100 | % |
| RMS report period ⁵ | | 2 | 15 | | minutes |
| Spectral report period ⁵ | | 2 | 6 | | hours |
| Temperature | | | | | |
| Accuracy ⁶ | -10°C to 60°C | -3 | | 3 | °C |
| | elsewhere | -3.5 | | 3.5 | °C |
| Battery and power consumption | | | | | |
| Battery type | non-Ex version | 2x AA (LR6) alkaline, 1.5V ⁷ | | | |
| | Ex version | 2x Energizer L91 (AA Lithium) ⁸ | | | |
| Duration ⁹ | Application #1 ¹⁰ – non-Ex | | 36 | | months |
| | Application #2 ¹¹ – non-Ex | | 18 | | months |
| | Application #1 – Ex | | 30 | | months |
| | Application #2 – Ex | | 15 | | months |
| Environmental and mechanical | | | | | |
| Operating temperature | | -30 | | 100 ¹² | °C |
| IP Rating | | | IP68 | | |
| Size | Diameter | | | 50 | mm |

⁵ Low-RPM configuration, compatible with f_{MAX} ≤ 200Hz. Standard configuration: Δf ≥ 1Hz for all f_{MAX}. Contact MAPER for details.

⁶ Subject to mounting condition.

⁷ MAPER recommends Energizer E91 Max or Duracell MN1500.

⁸ Use only recommended battery make and model.

⁹ Duration is highly dependent on machine intermittency, measurement configuration (periodicity, type and length of measurement, synchronization configuration), proximity to MAPER Gateway, network load, RF environment, and other environmental conditions such as ambient temperature. MAPER defines duration based on standard applications.

¹⁰ Application #1: machine which runs 24/7, 4 synchronized Wiver sensors on the same machine, configured for rms measurements every 20' and 1 spectrum every 4hs. Contact MAPER Applications for more details.

¹¹ Application #2: machine which runs intermittently, 4 unsynchronized Wiver sensors on the same machine, configured for rms measurements every 15' and 1 spectrum every 3hs. Contact MAPER Applications for more details.

¹² Value for WIVER HT. For standard operating environment configuration, max ambient temperature is 60°C. Do not confuse ambient temperature with base temperature.

| | | | | | |
|---------------------------------|--|----------------------|----|-----|-----|
| | Length ¹³ | | | 115 | mm |
| Weight ¹⁴ | | | | 341 | g |
| Base material | | Stainless Steel | | | |
| Shell material | | PP, translucent gray | | | |
| Wireless | | | | | |
| Range ¹⁵ | | | 70 | | M |
| Operating frequency (TX and RX) | | 915 | | 925 | MHz |
| EIRP | | | | 50 | mW |
| Communications protocol | <ul style="list-style-type: none">- Physical Layer: IEEE802.15.4-2015 O-QPSK PHY (DSSS modulation)- Modulation: O-QPSK- Channel Bandwidth: 850kHz @ -6dB (ANSI C63.10-2020 11.8.1 Opt 1)- Channel Spacing: 2MHz- Power Spectral Density: < -6 dBm/3kHz (ANSI C63.10-2020 11.10.3) | | | | |
| NFC | <ul style="list-style-type: none">- Dynamic NFC Tag type 5 (passive)- Protocol: ISO/IEC 15693- Operating Frequency: 13.56 MHz- Communication Range: Up to 1.5 cm- Data Rate: Up to 53 Kbit/s | | | | |
| Real time clock | | | | | |
| Timestamp accuracy | | -3 | | 3 | s |

Measurement characteristics

The Wiver provides comprehensive vibration and temperature monitoring capabilities. For vibration analysis, the sensor captures measurements across a wide dynamic range from $\pm 2g$ to $\pm 16g$ with sampling rates up to 26.67 kHz. This enables detailed spectral analysis up to 13.33 kHz, with resolution as fine as 0.01 Hz for precise component identification.

The device ensures measurement reliability through multiple technical features. Temperature stability is maintained with sensitivity variation under 0.025%/°C, while measurement accuracy is guaranteed by $\pm 2\%$ sensitivity error and $\pm 0.03\%$ frequency accuracy. The tri-axial sensor provides a 6300 Hz bandwidth on all axes, with a low noise floor of 70 μg $Hz^{-1/2}$ ensuring clean signal capture.

Analysis flexibility is achieved through configurable parameters. Users can select from multiple windowing options including Hann, Hamming, Flat-Top, Rectangular, and Blackman-Harris. Spectral resolution is adjustable up to 13,333 lines with customizable overlap from 0-100%. The reporting schedule can be tailored to application needs, with RMS values available every 2-15 minutes and spectral data every 2-6 hours.

¹³ Mounted on machine with standard base.

¹⁴ With 2x AA batteries, base (mounted on machine) not included.

¹⁵ Range is highly dependent on location and RF environment (eg. clearance to metallic objects, presence of walls/ceilings) and installation of the MAPER Gateway.

Temperature monitoring covers the full industrial range from -30°C to 100°C. Measurement accuracy is optimized for standard operating conditions (-10°C to 60°C) at $\pm 3^{\circ}\text{C}$, with $\pm 3.5^{\circ}\text{C}$ accuracy maintained across the extended range. This ensures reliable temperature tracking across all operating conditions.

Radio Physical Layer Specifications

The Wiver sensor utilizes the IEEE 802.15.4-2015 O-QPSK PHY layer with Direct Sequence Spread Spectrum (DSSS) modulation. This configuration provides robust wireless communication in industrial environments:

- The Offset Quadrature Phase-Shift Keying (O-QPSK) modulation, combined with DSSS, offers excellent interference resistance and efficient spectrum usage
- 2MHz channel spacing allows for 5 non-overlapping channels in the 915-925 MHz band, centered at 916...924MHz
- Channel bandwidth of 850kHz at -6dB provides sufficient data throughput while maintaining spectral efficiency
- Maximum EIRP of 50mW enables reliable communication range while meeting regulatory requirements
- Power spectral density below -6 dBm/3kHz ensures minimal interference with adjacent channels and other systems

This implementation enables reliable sensor data transmission even in challenging RF environments while maintaining power efficiency for extended battery life.

NFC Interface Specifications

The device incorporates a Dynamic NFC Tag Type 5 implementing ISO/IEC 15693 for device configuration and maintenance:

Specifications:

- Dynamic Tag Type 5 with passive operation
- ISO/IEC 15693 protocol support
- Operating frequency: 13.56 MHz
- Communication range: Up to 1.5 cm
- Data transfer rate: Up to 53 Kbit/s

This interface enables simple device configuration using NFC-capable smartphones or tablets. The passive operation requires no battery power for configuration tasks.

Explosive atmosphere certification details

The WIVER-Ex sensors are certified for explosive atmospheres. They comply with following standards:

IEC60079-0: ed. 6.0 (2011-06)

IEC60079-11: ed. 6.0 (2011-06)

IEC60079-26: ed. 6.0 (2011-06)

Certificate issuer: Bureau Veritas

Certificate number: BVA 23.0002X (Certificate upon request, contact MAPER for more information)

The WIVER-Ex sensors are rated as follows:

Ex ia I Ma

Ex ia IIC T4 Ga

Ex ia IIIC T150°C Da

-20°C ≤ Ta ≤ 60°C

Marking

The WIVER-Ex sensors are marked as follows:



Warnings

PELIGRO POTENCIAL DE CARGA ELECTROSTÁTICA - LIMPIAR ÚNICAMENTE CON UN PAÑO HÚMEDO

POTENTIAL ELECTROSTATIC CHARGING HAZARD – CLEAN ONLY WITH A DAMP CLOTH DANGER

POTENTIEL CHARGE ÉLECTROSTATIQUE - NETTOYER UNIQUEMENT AVEC UN CHIFFON HUMIDE

MÖGLICHE GEFAHR DURCH ELEKTROSTATISCHE LADUNG - NUR MIT FEUCHTEM TUCH REINIGEN

RISCHIO DI CARICA ELETTROSTATICA POTENZIALE - PULIRE SOLO CON UN PANNINO UMIDO

RISCO POTENCIAL DE CARGA ELETROSTÁTICA - LIMPE SOMENTE COM UM PANO ÚMIDO

Zones, Gas / Dust Groups and Temperature Classification

The WIVER-Ex sensors may be installed in the following zones:

| Zone | Group | Temperature class |
|------------|------------------|-------------------|
| Mines | I | - |
| 0, 1, 2 | IIA, IIB, IIC | T4 |
| 20, 21, 22 | IIIA, IIIB, IIIC | T150°C |

Ambient temperature: -20°C to 60°C

Notes for gas applications

The WIVER-Ex may be installed in the following zones:

- Zone 0: explosive gas atmosphere is present continuously or for long periods or frequently.
- Zone 1: explosive gas atmosphere is likely to occur periodically or occasionally in normal operation.
- Zone 2: explosive gas atmosphere is not likely to occur in normal operation but, if it does occur, it will exist for a short period only.

for the following gas groups:

- Gas group IIA: Atmospheres containing propane, or gases and vapors of equivalent hazard.
- Gas group IIB: Includes group IIA gases plus atmospheres containing ethylene, or gases and vapors of equivalent hazard.
- Gas group IIC: Includes group IIB gases plus atmospheres containing acetylene or hydrogen, or gases and vapors of equivalent hazard.

having a temperature classification of:

- T1: 450°C
- T2: 300°C
- T3: 200°C
- T4: 135°C

Notes for dust applications

WIVER-Ex may be installed in the following zones:

- Zone 20: explosive dust atmosphere is present continuously or for long periods or frequently.
- Zone 21: explosive dust atmosphere is likely to occur periodically or occasionally in normal operation.
- Zone 22: explosive dust atmosphere is not likely to occur in normal operation but, if it does occur, it will exist for a short period only.

for the following dust groups:

- Dust group IIIA: Atmospheres containing combustible flyings.

- Dust group IIIB: Includes group IIIA dusts plus atmospheres containing non-conductive dust.
- Dust group IIIC: Includes group IIIC dusts plus atmospheres containing conductive dust.

The maximum Surface Temperature for Dust Application is 150°C.

Installation and maintenance

Installation must be carried out in compliance with the latest issue of the following standards:

- IEC 60079-14: Explosive atmospheres - Electrical installations design, selection and erection.
- IEC 60079-10-1: Explosive atmospheres - Classification of areas. Explosive gas atmospheres.
- IEC 60079-10-2: Explosive atmospheres - Classification of areas. Explosive dust atmospheres.

The installation, maintenance and operation of this equipment must be carried out by qualified personnel only.

The device must not be modified.

To avoid accumulation of electrostatic charge, clean only with a damp cloth.

Only approved batteries must be used: Energizer model L91

A visual inspection is recommended every 6 months, to verify the integrity and the marking and integrity of the device.

FCC STATEMENT

This device complies with Part 15 of the FCC Rules. 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.

Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

This device and its antenna(s) must not be co-located or operation in conjunction with any other antenna or transmitter.

Radiation Exposure Statement

The device has been evaluated to meet general RF exposure requirement in portable exposure condition without restriction.