EMU - ENVIRONMENTAL MONITORING UNIT

The EMU Environment Monitoring Unit is ideal for anyone who needs to continuously monitor multiple environmental parameters. Covering noise, weather, ground vibration and blast overpressure measurement all in the same unit, users can demonstrate compliance with operating limits, manage activities to maintain compliance, and capture data over long periods to inform planning and manage external stakeholders.

The EMU provides the highest quality precision measurement data compliant with the widest range of applicable legislation. Designed to operate standalone, or in conjunction with other sensors as part of a Sentinel or ANOMS managed service, it may be deployed as either a permanent monitor or easily relocatable portable monitor. Each unit comes complete with sensors, analyzer, storage, battery and cellular/Wi-Fi communication in a rugged water- and dustproof enclosure so you don't need to purchase, connect or operate anything else to get going – simply unpack, connect the sensors, switch on and start acquiring data.

USES AND FEATURES

Uses
Permanent and portable monitoring of construction, mining, airports, ports and other industrial activities, etc. requiring unattended outdoor measurement for, for example:

- Ensuring compliance with noise and vibration legislation for all purposes in the outdoor environment
- Assessment of background levels
- Combined vibration and blast overpressure monitoring in mining and demolition
- Protecting against structural damage during construction activities
- Ambient vibration monitoring around sensitive imaging equipment at hospitals/manufacturing

Features

- Noise, weather, vibration and blast over-pressure in a single outdoor monitoring unit delivers ease of use and cost savings
- Fully integrated solution combing measurement, remote communication, system monitoring and power supply, so procurement, setup, operation and maintenance is simpler
- Up and running in seconds
- Powered by mains power, external battery pack
- Option for Continuous operation on solar power
- Integrated backup battery maintains operation under solar at night or while external batteries are changed
- Permanent or portable configurations, ground or pole mounted
- Available as noise only, vibration only or combined
INTRODUCTION

The Environmental Monitoring Unit (EMU) is capable of continuously monitoring noise, weather, ground vibration and blast over-pressure all in the same unit. It is a fully integrated solution combining measurement, communication, system monitoring and power supply to ensure that you’re up and running in seconds.

It provides the highest quality measurement data covering wide range of noise and vibration measurement standards. Designed to operate standalone, or as part of a Sentinel or ANOMS managed service, it may be deployed as either a permanent monitor or easily relocatable portable monitor.

High Quality
- Precision measurement covering wide range of noise and vibration measurement standards
- Continuous uninterrupted measurement with self-monitoring and auto-restart capabilities for increased uptime and minimal gaps in data
- Robust, IP67 chassis for use in harsh conditions reduces the risk of damage or unit failure
- Noise: IEC 61672 Class 1 specifications; uniquely, including windscreen effects. Type approval underway
- Vibration: high sensitivity (VC-E) with standard transducer

Easy to operate
- Easy to use: connect the transducer (microphone, geophone, weather station) and switch it on – you’re recording data and streaming it automatically over its cellular router or wifi
- Three status LEDs confirm correct operation or diagnose problems on site
- Remote sensor check ensures data integrity (noise & vibration only)
- Seamless integration with ANOMS, Sentinel and Sentinel On Demand for long term monitoring with multiple locations - switch on the unit and it automatically starts delivering data
- Standalone operation with embedded web server giving:
  - Real time display of data, remote control
  - Transfer of information for reporting and post processing in standard applications like Microsoft® Excel®, Brüel & Kjær PULSE Reflex and MATLAB, and with predefined report formats (PDF and CSV)*
  - Immediate and fast data transfer and alert generation if thresholds exceeded

* Formats available dependent on measurement parameter

EMU Block diagram
The EMU interfaces to the Outdoor Smart Microphone, with easy maintenance and calibration. It connects directly to the EMU providing the real-time ½ s or 1 s parameters that enable the complete unit to fulfil the strictest measurement standards (IEC 61672 Class 1) and give you results you can trust. The logged parameters, including broadband and spectral Leqs and SPLs with multiple frequency and time weightings, as well as the raw signal are sent live to the EMU for additional processing, storage and data transfer.

The basic design principle is ease of use. The Outdoor Smart Microphone fits directly on top of standard, widely available, 1” water pipe or can be mounted on a tripod. The microphone's exterior housing provides high protection against corrosion. The microphone's long-term stability is suitable for unattended outdoor use. The windscreen and bird spike can be removed in seconds, enabling easy acoustic calibration of the microphone using a compatible Sound Calibrator.

Frequency response is precisely controlled such that, with the appropriate linearization, IEC 61672 Class 1 requirements are fulfilled.

Noise event detection parameters can be set in the EMU to capture specific deviations from background levels and can be set up to be compliant with ISO 20906, ICAO Annex 16.

The Outdoor Smart Microphone is set up and controlled from the EMU. Further monitoring and analysis is also performed by EMU.

EMUs can simultaneously monitor weather conditions from a connected weather station and store the data with noise information for later use. These data are useful for determining the validity of measured noise data and ensuring that measurements are not contaminated by wind noise, increased noise due to heavy rainfall and that temperature and humidity comply with the standards for good measurement practice.

Two types of weather station are available for use with EMUs – one with the two most used parameters: wind speed and wind direction for correlation with wind data; and another with six parameters: wind speed, wind direction, temperature, pressure, humidity and rainfall for full correlation and analysis. The weather stations include a 2m cable to connect to the EMU and an adaptor for mounting on a pole or tripod.
VIBRATION

When used with a geophone, the EMU continuously measures ground vibration in three axes, providing metrics for a wide range of applications including monitoring structural damage to buildings, assessing human response to vibration, or monitoring background vibration to ensure sensitive equipment operates correctly.

It continuously measures in compliance with ISEE (2 to 250 Hz), DIN 45669-1 (1 to 315 Hz), DIN 45669-1 (1 to 80 Hz), ISO 2631 and a range of other standards. The system's extensive dynamic range from 2 µm/s (VC-E) to over 300 mm/s ensures full coverage of vibration velocity levels. The EMU logs data at 1 second intervals, creates periodic reports at intervals of between 1 second and 60 minutes, and generates, within seconds, vibration alerts in real-time, based on user-configurable trigger levels.

A variety of measurement parameters are available including velocity and acceleration in each axis, expressed as Peak, RMS and in SI (eg mm/s) or Imperial (eg in/s) units. The dominant frequency in Hz is calculated using either zero crossing frequencies or with FFT depending on the standard chosen. A wide range of measurement weightings can be selected depending on the measurement standard chosen.

BLAST OVERPRESSURE

An outdoor Blast Overpressure Microphone can be added to the unit to enable high level measurements of blast overpressure simultaneously with vibration to enable compliance monitoring of blasting activities around mines. It provides a durable and robust solution that, unlike many other industry-standard solutions, continues to meet the ISEE requirements even after being used for a long time in the field. In addition, the VMT with this microphone is a complete, robust and reliable blast monitoring solution that is easy to operate. The combination fully meets the requirements of the International Society of Explosive Engineers, ISEE 2017 for ground vibration and blast overpressure monitoring. For more information about the Blast Overpressure Microphone, see the appropriate Product Data sheet.
COMMON FUNCTIONALITY

The EMU has some common functionality for noise, weather, ground vibration and blast overpressure.

Events can be detected based on vibration or on noise. They are based on a selected parameter that exceeds a trigger level for a user-defined period of time. Events include maximum levels and time of maximum and fulfill relevant standards for noise and vibration. The EMU can be set up to send alerts via SMS or email. The details of the event detection and the available reports are dependent on how the product is used.

Data can be exported for viewing, processing and reporting for any user-defined period either Excel, PDF, WAV, MATLAB or CSV format. The data sets include:

- Periodic Reports, configurable from 1 second to 60 minutes with selected Measurement data
- Sensor Check reports: Results of the sensor checks, which can be performed automatically several times a day and manually initiated as required
- EMU Health Reports on an hourly basis including information on measurement uptime, battery, clock and cellular signal strength. When used with Sentinel and ANOMS, EMU system Alarms related to power and internal temperature are available in real time.

Further details can be found in the specifications.

Data can be streamed over LTE cellular (3G/4G) or Wi-Fi-based communication to the central control server with EMS Brüel & Kjaer’s noise management solutions. Once on the server, EMS Brüel & Kjaer’s central control software client can access and analyse the data. In addition, the EMU’s user interface can be viewed directly in a web browser allowing simple remote access to data, listening to the signal, and the status of the EMU from any PC, tablet or smart phone. The EMU can be remotely upgraded to ensure it has the latest software. Licensing to interface to third party software for noise monitoring with batch data transfer.

The EMU is housed in a rugged aluminum enclosure, water- and dustproof to IP 67, and can operate in ambient temperatures from –20 to +53°C, making it suitable for harsh environments, and reducing the risk of insect ingress. It is a complete unit with sensor conditioning, processing, storage, GPS and wireless communication. All suitable antennas are included, so you simply insert a SIM card to connect to a cellular network. The unit is service-friendly, with simple replacement of field replaceable components in the event of failure, thus requiring no specialist expertise.

Three status LEDs confirm correct operation and the status of the battery, communications and data logging, and help intuitively diagnose problems on-site. To confirm data validity, a sensor check can be scheduled at regular intervals and manually initiated as required, and results stored. In addition, the robust and reliable EMU has a heartbeat function to ensure stable operation and, if that fails, its self-healing function ensures continued operation with minimal manual intervention. Hourly instrument status reports include the status of the battery, sensor check, count of measurements, and wireless and GPS signal strengths. The EMU’s clock has a maximum deviations of 1 second relative to the world clock provided there is GPS or communications network coverage.

When used with Sentinel and ANOMS, EMUs have a number of alarms that are triggered as soon as the related condition is detected so users can quickly respond to instrumentation issues.
The unit is typically connected to mains power. Alternatively, it can be operated for over 24 hours, depending on use, with its integrated, robust LiFePO4 battery*. Directly connect it to solar power systems or external batteries for continuous operation. The EMU is self-starting when power is interrupted, so you do not have to visit the location to turn it on. To enable extended operating life, the EMU can operate in “broadband batch mode” where only broadband data is measured and transmitted every 15 minutes.

An included security cover hides display lights and helps protect the front panel from damage and physical interference. Alternatively, its LEDs may be disabled.

**USAGE: SENTINEL, ANOMS & STANDALONE**

The EMU can operate standalone, or as part of a Sentinel or ANOMS managed service.

**Standalone**
For stand-alone use, the EMU has a built-in web server which can be accessed via wi-fi from a laptop or smart device. The same interface enables set-up, display and operation anywhere, as well as data transfer to standard applications like Microsoft® Excel®. Real-time data, updated every second, can be viewed.

The EMU may be setup using either Bluetooth, wi-fi or cellular connection to the unit from any web browser on a PC, laptop or smart device. The built-in web server provides easy to use configuration profiles to set-up including measurement indices, reporting formats optimized to several standards, and trigger level configurations for alerts and reporting. It is also possible to set up at which times of day trigger levels are active.

The event may be set to trigger an SMS to a smart phone with an overview of the alert and a link to the alert report for viewing. The EMU can also automatically send the PDF report via email. The EMU can present the measured data against a range of trigger or compliance curves.

Noise and vibration events occur when levels exceed defined limits easily set up within the browser using a simple threshold on any parameter or compliant with relevant standards. When triggered the EMU automatically records the noise and vibration waveforms with a pre- and post-trigger to ensure the full waveform is captured. The data is processed and a PDF report produced summarizing the event in accordance with one of a range of specific standards or formats.

1 Standalone use is limited to vibration only until late 2019
**Sentinel and ANOMS**

The EMU is specifically designed to work seamlessly with EMS Brüel & Kjær’s Sentinel and ANOMS managed services. Simply switch the unit on and it automatically connects, configures itself and starts delivering data as part of a multi-unit system. All control of the EMU is done remotely including setup, remote display, operation and reporting.

The EMU provides the measured data and metrics required by relevant standards and legislation, and signal recordings for presentation or investigation. Data can be streamed continually and with minimal delay or, alternatively batch-transferred, either at regular intervals or when the unit is connected to the server, either physically or virtually. Noise events, with their associated metrics and signal recordings, and system condition alarms are generated within seconds of them occurring and analysed, visualized and reported by the managed service. The EMU can be set up with different trigger levels for different times of the day. The EMU can also provide data for advanced server-side processing. For more information on its use with Sentinel and Sentinel On Demand for urban and industrial applications or the ANOMS airport noise management solution please refer to appropriate product documentation such as the Sentinel product data sheet BP 2389.

**CONFIGURATIONS**

The Environmental Analyzer comes in 3 hardware variants: the complete solution, Environmental Analyzer, the Noise for measuring noise and weather only and a Vibration Analyzer for vibration and blast overpressure. Each of these configurations is available in different regional versions that ensure that the unit comes with suitable communications and power hardware.

Based on these, we have built complete permanent and portable monitoring terminals containing everything you need to be ready for deployment and use.

<table>
<thead>
<tr>
<th>Configuration vs Function</th>
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<tbody>
<tr>
<td><strong>Analyzer</strong></td>
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<tr>
<td>Environmental Analyzer</td>
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<tr>
<td>Noise Analyzer</td>
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<tr>
<td>Vibration Analyzer</td>
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</table>
The EMU is a complete solution for permanent or long-term noise monitoring when you add an optional mounting kit for fastening the analyzer to a wall or pole. This mounting kit allows the use of small, low-cost, standard size water pipes to protect the cables for the microphone and weather station. Padlocks can be attached, and protection is also provided for the cabling to reduce the risk of tampering or accidental damage. Used with an optional compact and lightweight tripod for mounting the Outdoor Smart Microphone it is suitable for shorter term monitoring, for example for periods of a few hours to several weeks. The analyzer can be padlocked to a solid object to reduce the risk of theft.

A complete solution for vibration monitoring, Vibration Monitor, including a padlock for protection and a ground mounting plate is also available.

A range of useful accessories to provide complete solutions for a range of situations are available including tripods, analyzer wall/posts mounts, extension cables, tripods, geophone wall mounts, tripods, solar panels, external power packs, lightning protection, enhanced antennae, etc. For compliance with specific legislation, standards and de facto good practice, the microphone must be placed at, for example, 4 or 6 m height and at some distance from large reflecting surfaces. EMS Brüel & Kjaer can supply a range of alternative masts for permanent or temporary mounting of the analyzer and correct positioning of the microphone. These include ground-mounted, wall-mounted and telescopic masts. For continuous monitoring for periods of one week or more, mobile configurations, typically trailer mounted, are available as special orders enabling independent operation. Please contact your EMS local Brüel & Kjaer representative for more information.

EMUs are delivered with an internal battery so that they can function even when there is no usable local power source or mains power has been disrupted. The internal battery is charged whenever sufficient power is applied to the EMU. Additionally, the EMU can be powered from a variety of sources connected through the DC supply input. Thus, solar panels can be added to the EMU, which enables lower power use or even permanent 24/7 operation. Additional batteries can be added to provide sufficient backup for operation in overcast conditions, even during winter months.

Older VMTs can be upgraded to the latest hardware version to enable you to get the most out of your unit. It is possible to upgrade from one configuration to another with a return to base service.

**SERVICE AND SUPPORT**

EMS Brüel & Kjaer offers a wide range of support and services to ensure efficient and problem-free operation and traceable measurement and reporting. These include a range of calibration services (accredited and traceable), repairs, conformance tests, warranty extensions, installation, training, a help line and equipment rental. These services can be performed on site, locally or at authorized centres.

Annual and long-term service packs for EMUs and for entire environmental management or monitoring systems are also available. In addition, EMUs may be operated from systems hosted by Brüel & Kjaer, such as WebTrak for airports and Sentinel for urban and industrial applications.
SPECIFICATIONS FOR ENVIRONMENTAL MONITORING UNIT

All specifications are valid with EMU Software Version 4.2 and Hardware Version 2

NOISE

Conforms with the following National and International Sound Level Meter Standards:
- EC 61672–1 2013 Class 1. Conforms to the following National and International Frequency Analysis Standards:
- IEC 61260 2014, 1/3-octave. Bands Environmental Monitor Unit is connected to the Environmental Analyzer through a cable.

MEASURING RANGES (BROADBAND)
Dynamic Range: 1 kHz pure tone signal, A-weighted: Noise floor to max. level, 17 dBA – 140 dB Linear Operating Range: In accordance with IEC 61672, A-weighted: 1 kHz: 26 dBA to 140 dBA

SELF-GENERATED NOISE LEVEL
Typical broadband values at 23°C for nominal microphone open-circuit sensitivity:

<table>
<thead>
<tr>
<th>Weighting</th>
<th>Microphone</th>
<th>Electrical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>14.0 dB</td>
<td>14.0 dB</td>
<td>17.0 dB</td>
</tr>
<tr>
<td>C</td>
<td>13.0 dB</td>
<td>17.0 dB</td>
<td>18.5 dB</td>
</tr>
<tr>
<td>Z (10Hz – 20 kHz)</td>
<td>14.4 dB</td>
<td>24.0 dB</td>
<td>24.5 dB</td>
</tr>
</tbody>
</table>

CALIBRATION
Initial calibration is stored for comparison with later calibrations
Acoustic calibration:
- Using Sound Calibrator Type 4231, the calibration process automatically detects the calibration level
Automatic checks: Performed as required (up to every minute) using Charge Injection Calibration (CIC)

BASIC MEASUREMENTS
Logging Rate: ½ or 1s broadband and 1/3rd-octave spectral data
Detectors: Parallel detectors on every measurement:
- A-weighted: Broadband detector channel with Fast, Slow and Impulse exponential time

FREQUENCY ANALYSIS
1/3 octave band Centre Frequencies: 16 Hz – 16 kHz in accordance with IEC 61260:2014, Leq parameter

EVENT DETECTION
ISO20906 compliant
Settings: Individual setting for each hour in a 24-hour period
Event Start Trigger: Leq or L(SPL) with minimum threshold exceeding duration
Detection parameters: Level threshold, minimum duration, maximum duration, guard time

SOUND RECORDING
Continuous audio recording 48kHz 32bit
Format: WAV (Sentinel/ANOMS only)

Outdoor Smart Microphone
Extension Cable to Analyzer: Up to 30 m without degradation of the specifications
Display: EINK display shows LAS, LAF, LCS, LCF, Under range, Overload, heartbeat
NOISE REPORTS

Periodic Reports:
- Start time; Stop time; Lmax time
- Lmin(SPL) over the period; Lmax(SPL) over the period; Total Leq; eight LN values (L1, L5, L25, L50, L75, L90, L95, L99); Level distribution,
- Leq Event; Leq non event value;
- Overload indicator, underrange indicator

Event Reports:
- Event data samples are Leq values if the trigger is set to Leq or relevant L(SPL) values if the trigger is set to SPL.
- Data: Based on ½ or 1 s logging.
- Start time; Stop time; Event data; T10 Duration; LE(T10) calculated; Leq Spectrum; LE calculated; Maximum Leq; Time of maximum of Leq; Maximum of L(SPL); Time of maximum of (SPL);
- Tonal metrics EPNL; Total Leq; PNL and PNLT data
- Event spectra; Number of event spectra
- GPS: Latitude; Longitude; Altitude

VIBRATION

Sensors: Triaxial geophone, optional blast overpressure microphone

PROCESSING AND ANALYSIS

Signal processing with sensor in compliance with ISEE (2 to 250 Hz), DIN 45669-1 (1 to 315 Hz) and DIN 45669-1 (1 to 80 Hz)

Supported Measurement Standards: ISO 4866, DIN 4150-2, DIN 4150-3, BS–7385, DIN 45669–1, ISO 2631 Parts 1, 2 & 4, BS 6472 acceleration, ISEE-2017, SBR 002.13, SBR 001.10

Vibration Signal Recording: Continuous signal recording 2kHz

Format: 3-channel in MATLAB compatible (lossless compressed) or calibrated WAV format

Measurement weighting: DIN 415669-1 1-80Hz, DIN 45669-1 1-315Hz, DIN 45669-1 4-315 Hz, ISEE 2-250Hz, ISO Unweighted 0.5 – 80Hz, ISO Unweighted 1 – 80 Hz, ISO 2631-4 Wd Wb, ISO 2631-1 Wd Wk, ISO 2631-2 Wm, RAW (linear 0.1-400 Hz)

Noise floor: <1.8 μm/s PPV

Dynamic Range: 1.8 μm/s up to 312 mm/s PPV

Accuracy: ±5% or 0.5 mm/s PPV between 1 and 315 Hz, whichever is smaller.

Resolution: 0.1 μm/s

Sampling Rate: 24 bit up to 8 ksps

Measurement quantities:
- Peak Particle Velocity, PPV
- Zero-crossing frequencies
- FFT-based frequency detection (DIN 4150-3)
- RMS Velocity
- RMS Acceleration
- KBFt, KBF, KBFMax

Compliance Curves:
- City of Toronto 514-2008
- DIN 4150-3
- NBR 9653
- USBM RI 8507
- BS 7385-2
- File formats: Microsoft® Excel®, CSV, PDF, Calibrated WAV files, MATLAB®
- Compatible with Sentinel monitoring service and Bruel & Kjaer PULSE Reflex

Operating Modes
- Broad-band batch mode: batch communications every 15 minutes, broadband measurements only
- Full Power mode: all measurement data, continuous streaming communications

VIBRATION EVENTS

- Triggered from defined vibration level in any measurement parameter.
- Maximum PPV in each axis, zero-crossing frequencies and time of maximum
- Vibration waveform in each axis between 1 to 3 seconds with pre-trigger
- Alerts via SMS or email

VIBRATION PERIODIC REPORTS

- Maximum PPV in each axis, zero-crossing frequencies
- Time of maximum level

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1 Which data is available is dependent on the central system management software the EMU is used with. For more information, see the relevant central system management software’s Product Datasheet.

2 All trigger levels, Leq values and SPL values can be with any available frequency and time weightings.

3 Available from June 2019
**COMMUNICATIONS**
Web server - Remote access, display and download
Real-time Dashboard updated every second, subject to sufficient communication network bandwidth
- Dominant frequency - XYZ
- Peak Particle Velocity - XYZ
- Peak Acceleration – XYZ
- Peak Vector sum – XYZ
- Realtime graph of one of the above parameters
- Real time graph of velocity waveform

**Blast Overpressure**
Sensor: ½” microphone with stainless steel diaphragm
Microphone Noise Floor: 75 dB (112 mPa) Microphone
Maximum input: 160 dB peak SPL (2000 Pa)
Microphone frequency range: 2 Hz to 250 Hz (-3 dB)
Accuracy: ISEE compliant
Other features:
- Windscreen
- Anti-bird spikes
- 3 m microphone cable
- Field calibration with acoustic calibrator

**Environmental**
Connectors are water- and dust-proof to IP 66

**With VMT**
**Vibration Events**
- Enables max blast overpressure data to be added to vibration events

**Vibration Climate**
- Enables blast overpressure data to be added to 1 second logged data

**Export**
- Event blast overpressure signal in WAV format

**With VMT and Sentinel**
**Vibration Alerts**
- Enables max blast overpressure data to be added to vibration alerts

**Weather**
**Inputs**: Weather Station (6 channels) or Weather Station (2 channels)
**Weather Reports**: Wind speed; Wind direction; Temperature; Relative humidity; Atmospheric pressure; Liquid precipitation
- 1-minute resolution: Wind speed and direction can be set to 1-second resolution
- Additional Data for ANOMS: Wind speed at time of event maximum Leq; Wind direction at time of event maximum Leq; event Humidity; event Temperature

**Common Specifications**
**Configuration**
- LED lights on/off (hides unit in field)
- Disable power button
- Password reset
- Instrument reboot
- Time zone
- Measurement units
- Measurement Weighting

**Export**
- User defined time period of noise or vibration level
- Noise or Vibration waveforms, events, periodic reports, 1/3 octaves and system health
- Transferred in either Excel, PDF, WAV, MATLAB, CSV

**Instrument Display**
- Battery OK
- Communications OK
- Logging OK

**Connections**
- Microphone/Geophone/Blast Overpressure Microphone
- Auxiliary: weather station
- External 4G antenna
- External GPS antenna
- Mains power

**Processing and Analysis**
**Features**:
- Sensor check
- Built in Web server for set-up, display and data download
- Heartbeat and self-healing operation
COMMUNICATIONS
• Bluetooth® Low Energy (BLE)
• Wi-Fi® (the product does not use the Wi-Fi n/ac bands)
• 2G/3G/4G/LTE cellular with SIM card (not supplied)

Storage
• 256GB of data storage: all vibration measurements, alerts and data
• Retention duration depends on what sensors are active
  • For vibration only: 300 days
  • For noise only: 40 days
  • For noise, vibration, weather, all full raw samples and all calculated metrics: 30 days

SYSTEM INFORMATION
Diagnostics, battery-life, temperature, wireless signal strength, uptime, unit health

REPORTS
Periodic Reports:
• Periods available:
  10ms, 125ms, 500ms, 1s, 1min, 5min, 10min, 15 min, 20min, 30min, 60min
  Periods <1 s are not available for vibration measurements
• Data is dependent on whether noise or vibration is selected

Events
• Report Data is dependent on whether noise or vibration is selected
• Alerts via SMS or email

Vibration Spectra (CSV format)
• Velocity: RMS and PPV data in 3 axes
• Acceleration: RMS data in 3 axes
• Air Overpressure: LPk data

Weather Reports:
• Weather (with optional Weather Station: Wind speed; Wind direction; Temperature; Relative humidity; Atmospheric pressure; Liquid precipitation. 1-minute resolution: Wind speed and direction can be set to 1-second resolution

• Weather (with optional Weather Station: Wind speed; Wind direction. 1-minute resolution: Wind speed and direction can be set to 1-second resolution
• Additional Data for ANOMS: Wind speed at time of event maximum Leq; Wind direction at time of event Temperature

Sensor Check Reports: Sensor check. Start time; Leq during check; Leq before check; Leq after check
Instrument Health Reports: One-hour reports with Count of measurements; Battery level (%); Battery voltage; Clock difference to NTP server; Cellular signal strength; internal temperature, pressure and relative humidity of analyzer; Firmware version

EMU Alarms (Sentinel and ANOMS only): Power off/on, Battery voltage below/above set value, Temperature above/below set value, Router power off/on

POWER SUPPLY
EMU Batteries are charged from the External AC supply or sufficient External DC supply. Typical Operating Times are given at room temperature. At low temperatures it will be reduced.

<table>
<thead>
<tr>
<th>Mode</th>
<th>Power (W)</th>
<th>Operating time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibration</td>
<td>Low Power</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Full Power</td>
<td>11.5</td>
</tr>
<tr>
<td>Noise</td>
<td>Low Power</td>
<td>3.8</td>
</tr>
<tr>
<td></td>
<td>Full Power</td>
<td>10.7</td>
</tr>
<tr>
<td>Noise &amp;</td>
<td>Low Power</td>
<td>6.0</td>
</tr>
<tr>
<td>Vibration</td>
<td>Full Power</td>
<td>12.5</td>
</tr>
</tbody>
</table>

POWER CONSUMPTION
Version 2 Hardware:
• Low power mode measures broadband metrics only with optional communications every 15 minutes
• High power mode is capable of full measurement and continuous real time communication
• Operating life on internal rechargeable battery

Additional power specifications
• Blast overpressure microphone 0.004W
• Weather station 0.05W
• Weather station heater
  - Between -2°C and +3°C 5.5W
  - < -2°C 11W
• Low cellular / wi-fi signal strength reduces operating life on battery power
• Internal battery recharge from exhausted requires 3 hours charge time with a supply capable of supplying continuous 60W

Version 1 Hardware (Vibration only):
• 15-hour battery backup in Broad-band Batch mode (6.1 W)
• 7-hour battery backup in Full Power mode (12.4 W)

Mains Power: 90 – 264 VAC
External DC Power Supply:
• Voltage: 12 – 24 V DC

External AC Power Supply:
• Voltage: 90 – 132 and 180 – 264 VRMS,
• Auto ranging
• Frequency: 47 – 66 Hz

Operating Temp. (ambient):
• With Battery: -20 to +53°C (-4 to +127°F)
• With Power Supply Plugged in: -45 to +53°C (-49 to +127°F)
• Recommended to store at room temperature
• All temperatures are indicated in shade and subject to operating conditions

PHYSICAL
Size: 140 × 200 × 480 mm (5.5 × 7.9 × 18.9“)
Weight: Without sensors:
4450-X hardware version 1: 9.0 kg (19.8 lb)
hardware version 2
4450-X and 4450-X-NV: 8.3 kg (17.6 lb)
4450-X-N: 7.7kg (17.0 lb)
Geophone: 0.80 kg (1.77lb)
Pole/Wall Mounting Kit: 1.4 kg (3.1 lb)
Outdoor smart microphone 1.3 kg (2.9 lb)

ENVIRONMENTAL
• Water- and dust-proof to IP 67 (microphone capsule IP44)
• Integrated LiFePO4 battery (ROHS compliant)
### COMPLIANCE WITH STANDARDS

The **CE** marking is the manufacturer’s declaration that the product meets the requirements of the applicable EU directives.

**RCM** mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME.

China **RoHS** mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China.

**WEEE** mark indicates compliance with the EU WEEE Directive.

### SAFETY

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN/IEC 60950–1</td>
<td>Safety requirements for information technology equipment</td>
</tr>
<tr>
<td>ANS/UL 60950–1</td>
<td>Safety requirements for information technology equipment</td>
</tr>
</tbody>
</table>

### EMC EMISSION

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61326–1 (2013)</td>
<td>Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements</td>
</tr>
<tr>
<td>EN 301489:</td>
<td>EMC standard for radio equipment and services:</td>
</tr>
<tr>
<td>- EN 301489–1: V1.9.2 (2011–09)</td>
<td>Common technical requirements</td>
</tr>
<tr>
<td>- EN 301489–17: V2.2.1 (2012–09)</td>
<td>Specific conditions for broadband data transmission systems</td>
</tr>
<tr>
<td>- EN 301489–24: V1.5.1 (2010–10)</td>
<td>Specific conditions for IMT-2000 CDMA Direct Spread (UTRA and E-UTRA) for mobile and portable (UE) radio and ancillary equipment</td>
</tr>
<tr>
<td>CISPR 22</td>
<td>Information technology equipment – Radio disturbance characteristics of information technology equipment. Class B Limits</td>
</tr>
<tr>
<td>CISPR 25</td>
<td>Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of on-board receivers</td>
</tr>
<tr>
<td>EN 55022</td>
<td>Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement. Class B equipment, device and apparatus</td>
</tr>
<tr>
<td>FCC Rules, Part 15</td>
<td>Complies with the limits for a Class B digital device</td>
</tr>
<tr>
<td>Canadian ICES-003</td>
<td>Information technology equipment (including digital apparatus) — Limits and methods of measurement</td>
</tr>
<tr>
<td>IEC 61672 –1, IEC 61260, IEC 60651, and IEC 60804</td>
<td>Instrumentation standards</td>
</tr>
</tbody>
</table>

### EMC IMMUNITY

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 61326–1 (2013)</td>
<td>Electrical equipment for measurement, control and laboratory use – EMC requirements</td>
</tr>
</tbody>
</table>

**Note:** The above is only guaranteed using accessories listed in this document.

### TEMPERATURE & HUMIDITY

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60068–2–1 &amp; IEC 60068–2–2</td>
<td>Environmental Testing. Cold and Dry Heat Operating Temperature: –20 to +53°C (–4 to 127°F) Storage Temperature: –40 to +60 °C (–40 to 140 °F) Humidity up to 100%</td>
</tr>
</tbody>
</table>

### MECHANICAL

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60068–2–6</td>
<td>Vibration: 0.15 mm, 20 m/s², 10 – 500 Hz</td>
</tr>
<tr>
<td>IEC 60068–2–27</td>
<td>Shock: 500 m/s²</td>
</tr>
<tr>
<td>IEC 60068–2–29</td>
<td>Bump: 1000 bumps at 150 m/s²</td>
</tr>
</tbody>
</table>

### ENCLOSURE

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 60529</td>
<td>Protection provided by enclosures: IP 67</td>
</tr>
</tbody>
</table>

### COMMUNICATIONS CERTIFICATION

<table>
<thead>
<tr>
<th>Certification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU RED Directive 2014/53/EU, FCC, ASA/CA S042, Peru (MTC), Anatel, WPC (India), TRCSL (Sri Lanka), CRC (Colombia), CTT (Macau)</td>
<td></td>
</tr>
</tbody>
</table>

**Note:** The International IEC Standards are adopted as European standards by CENELEC. When this happens, the letters IEC are replaced with EN and the number is retained. The analyzers also conform to these EN Standards.
ORDERING INFORMATION

The EMU comes in 3 regional variants, indicated as an X below; A Europe; B Americas; C Asia-Pacific

4 configurations are available

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AU-3680-X</td>
<td>Vibration Monitoring Terminal</td>
</tr>
<tr>
<td>AU-3680-X-N</td>
<td>Noise Monitoring Terminal</td>
</tr>
<tr>
<td>AU-3680-X-NA</td>
<td>Noise Monitoring Terminal for Airport Systems</td>
</tr>
<tr>
<td>AU-3680-X-NV</td>
<td>Environmental Monitoring Unit</td>
</tr>
</tbody>
</table>

Type AU-3680-X Vibration Monitoring Terminal includes the following:

- Type AU-4450-X: Vibration Analyzer (according to terminal variant)
- Type AU-8380: Triaxial Geophone
- AU-KF-0012: Accessory Bag with Shoulder Strap
- AU-FB-0737: Mounting Plate, for geophone
- AU-UA-0006: Geophone Ground Spikes, set of 3
- AU-UA-0007: Security Cap
- AU-UL-1065: Dual-band Antenna (WiFi, 2.4 to 5.85 GHz), set of 3
- AU-UL-1066: GPS Antenna
- AU-DK-1769: Lock with cable
- AU-DP-0127: Dust Cap for antenna connectors
- 3 x AU-YI-0073: Geophone Stud Nut
- AU-QX-0049: Screwdriver for Security Cap
- Power Supply (country dependent)

Type AU-3680-X-N Noise Monitoring Terminal and Type AU-3680-X-NA Noise Monitoring Terminal for Airport Systems include the following:

- AU-4450-X-N: Noise Analyzer (according to terminal variant)
- AU-2000 Outdoor Smart Microphone
- AU-AO-0002-030 3 m microphone cable
- AU-KF-0012: Accessory Bag with Shoulder Strap
- AU-UA-0007: Security Cap
- AU-UL-1065: Dual-band Antenna (WiFi, 2.4 to 5.85 GHz), set of 3
- AU-UL-1066: GPS Antenna
- AU-DK-1769: Lock with cable
- AU-DP-0127: Dust Cap for antenna connectors
- AU-QX-0049: Screwdriver for Security Cap
- Power Supply (country dependent)

Weather stations, mounting brackets, extension cables, tripods, solar panels, larger antennas, additional power packs and hardware upgrades are also available. Contact your EMS Bruel & Kjaer sales representative for more information.

For a full list of accessories and spare parts, see the User Manual.

Services

AU-3680-EW1 EMU Extended Warranty - 12 months

The following accredited initial and renewed calibrations are available on request (depending on country):

- AU-8380-CTR Traceably Calibrated Replacement Geophone
- AU-8380-CTI Triaxial Ground Vibration Geophone, Traceable Calibration Initial
- AU-2000-CAF Outdoor Smart Microphone, Accredited Calibration
- AU-2000-CAI Outdoor Smart Microphone, Calibration Accredited Initial

Although reasonable care has been taken to ensure the information in this document is accurate, nothing herein can be construed to imply representation or warranty as to its accuracy, currency or completeness, nor is it intended to form the basis of any contract. Content is subject to change without notice - contact EMS Bruel & Kjaer for the latest version of this document.