DUO Smart Noise Monitor
Technical Data Sheet

01dB.com

01dB

ACOEM Group

SOUND LEVEL METER AND NOISE MONITORING TERMINAL

ALL-IN-ONE

01dB introduces DUO Smart Noise Monitor, the new generation of instruments and a breakthrough in the field of environmental noise assessment. DUO is completely modular and offers the most comprehensive range of options so to be able to use the same unit as sound level meter or a full-fledged noise monitoring station.

01dB brings to bear its expertise in environmental monitoring with the DUO software system, offering a remarkable range of functions: appropriate and relevant acoustic indicators, a smart system of event detection filters, continuous metrological audio recording, the facility to listen in remotely, automatic calibrator detection, electronic checks to ensure flawless metrology, etc Class 1 IEC-61672 certification (for both reference directions: 0° and 90°) has been certified by the LNE, PTB and METAS laboratories, demonstrating the level of care taken by 01dB to ensure DUO's metrological quality.

DUO is a new member within 01dB ecosystem focused on improving your productivity. You will appreciate its simplicity of use, its degree of remote controllability and the power of its processing software

MAIN SPECIFICATIONS

DUO presents the unique technical specifications:
- IEC 61672 Class 1
- Built-in preamplifier
- Pre-polarized weatherproof microphone type G.R.A.S. 40CD
- Weatherproof body
- Large dynamic range 118 dB
- Self-check system (CIC)
- Automatic calibrator detection
- High-definition color display
- Rubber side grips
- All-in-one: Wi-Fi, 3G Modem, GPS…
- Remote control by web interface
- Parallel storage of all acoustic indicators
- Advanced triggers
- HTTP commands for integrators
- Push Data Mode
- Metrological and MP3 audio recording
- Wireless vibration signal recording in 3 axis (option)
- Built-in battery for more than 60 hours battery lifetime
- Building Acoustics Module (option)
- Multiple processing software packages (dBTrait, dBInside, dBFa…)
- Compatible with 01dB WebMonitoring services
- Numerous accessories (all weather case DSC01, weather station…)…

From short term measurements to long term noise and weather monitoring DUO has become *the* new reference for environmental noise assessment.

MAIN APPLICATIONS

DUO can either be used as a sound level meter or as a monitoring terminal for general environmental noise and weather assessment in the following but not restricted areas:

- Construction site noise
- Urban noise
- Industrial noise
- Aircraft noise
- Road noise
- Railway noise

- Windmill noise
- Recreational activities noise
- Vibration of machines
- Vibration of structures
- Building acoustic
- …

OUTSTANDING INSTRUMENT

THE 01DB ECOSYSTEM

DUO is a member the new 01dB product range sharing with FUSION and CUBE the same ecosystem focused on improving your productivity. Being familiar with one of them just means mastering the other ones. Same built-in screen, same web interface, same accessories, same software tools… everything is designed in order to optimize the time you need to use these instruments.

WEATHERPROOF

DUO is designed for outdoor use under all weather conditions: no need for additional protection! It is equipped with the exclusive revolutionary microphone 40CD developed by the well-known Danish company G.R.A.S. Its grid includes a water and dust repellent protection device for safety and long term stability.

The integral grey protection foam makes DUO discreet in the measurement environment.

A clever design of the mounting profile allows for securing using the anti-theft device.

SIMPLIFIED ERGONOMICS

DUO can be used with its context keys and high-definition built-in colour screen. It is therefore possible to load a stored configuration, to start an acquisition, to mark an event and start an audio recording, to do a calibration and to access stored measurements …

No more need for a computer keyboard to manage the whole set of measurement campaigns!

REMOTE COMMUNICATION

Using a communicating tool (smartphone, tablet, laptop…) you can access DUO using a simple internet browser. Thanks to the embedded webserver DUO offers direct access to any of the available functions: configuration, coding, acoustic calibration and electrical check, real time display of instant values…) without the need of further specific applications.

Remote connection is possible using Ethernet, Wi-Fi or 3G integrated modem (option). Therefore remote access to DUO is possible from wherever you are.

UNMATCHED BATTERY LIFETIME

DUO optimized power consumption allows for an expected battery lifetime (T° from -10 °C to +50 °C) of:
- 60 hours with Wi-Fi active 10% of the time
- 48 hours with 3G modem data transmission (10% of the time)

OPTIMIZED POWER CONSUMPTION

Programmable stand-by mode allows for optimizing DUO's power consumption when there is no mains power available on site. The operator can select date and time for stand-by and wake-up in dBDUO web interface. He can also force a manual wake-up by sending an SMS or by pressing the power on button.

Moreover DUO can send an SMS when the battery capacity becomes inferior to 10%.

When the battery capacity becomes less than 3%, DUO automatically stops the acquisition, stores the data in the SD card and enters stand-by mode. As soon as the power supply is connected again, DUO wakes up and retrieves the previous measurement mode.

GPS LOCATION

Measurement data include GPS location for easy visualization of the measurement position in dBTrait post-processing software.

In case of an unexpected displacement of DUO, a user defined movement detection function will warn the operator by sending an SMS with the new geographical coordinates and the distance from the previous location.

ADVANCED ANALYSIS BASED ON SYNCHRONIZED LEVELS DIFFERENCE

Using several DUO instruments synchronized on a single site allows for a detailed analysis of the recorded phenomena. It becomes possible to clearly identify a car and/or train pass-by, a building site noise, an industrial noise, using multiple coding. Analysis at the measurement point takes advantage of the information collected at the coding points (and thus validates that the incriminated sources are indeed active).

Moreover, data post-processing using dBTrait allows assigning markers from the coding points onto the measurement campaign collected at the measurement point.

SMART AND POWERFUL

DUO measures noise and vibrations perfectly. Its powerful functions contribute to optimizing your operational efficiency: continuous audio recording (metrological and MP3), innovative trigger threshold definition, smart source recognition (building acoustics) advanced acoustic indicators, automatic calibrator detection, periodic electrical checks, remote setting changes and listening, etc.

WIRELESS IN YOUR OFFICE

Direct access to DUO is possible from your office Wi-Fi network without additional software. Any of your collaborators can thus have hands on one or several DUO instruments using Wi-Fi access.

Measured data are collected at a glance and you can already schedule your next measurement campaign!

01DB SOFTWARE: SO POWERFUL

To cover each application, 01dB offers a complete range of software tools: dBTrait (processing of data such as LAeq…), dBFa (advanced frequency analysis of measured data) or dBInside (processing of building acoustics measurements).

dBTrait is the most commonly used software program with the entire range of 01dB products. Initiated in the early 90's dBTrait was progressively improved over the years, taking also benefits from users feedback. It includes processing functions such as multiple indicators calculations, analysis results according to regulations as well as advanced coding capabilities which help identify noise sources.

dBInside has a new interface designed to enhance acoustics consultants' efficiency and productivity. The purpose is to reduce the time spent on:
- data entry related to the measurements (measurement location and details, etc.),
- calculation of standardized indicators (unique indices)
- generation of measurement reports.

To simplify your work, you can install 01dB software as many times as needed. Furthermore, there is no physical protection key to plug into your PC.
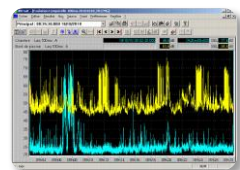
GENERAL OVERVIEW

01 – Nose cone
02 – Class 1 microphone
03 – Integrated preamplifier
04 – Windscreen
05 – Colour display
06 – Keyboard
07 – Grips

08 – Mini HDMI
09 – DC 8-28V power supply input
10 – RJ45 Network
11 – External microphone preamplifier input and analogue output
12 – Mini USB
13 – SIM card slot
14 – RS232 input
15 – TTL input/output
16 – SD card slot

NO COMPROMISE WITH METROLOGY

ACOUSTIC CALIBRATION DETECTION

In order to simplify the deployment of DUO in the field, an automatic function for the detection of a sound level calibrator is used to launch the calibration procedure without any action required from the user, other than powering up the calibrator.

When DUO detects a stable level around the predefined calibration level, it automatically starts the calibration procedure. At the end of this procedure, DUO indicates the new calculated sensitivity and prompts the user for validation, repeat or rejection of the calibration. Information provided is stored and added up to the historical data of the instrument.

MULTI-FREQUENCIES CHARGE INJECTION CHECK (CIC)

Designed for unattended measurements DUO integrates an automated procedure to check the integrity of the entire measurement chain.

The built-in charge injection check allows testing the entire measurement chain, including the microphone. It consists in injecting a sinusoidal charge (1 or 2 levels) into the microphone membrane, at the selected frequencies. The principle is to collect reference levels (initialisation stage) and to check over time that the maximum deviation between the reference.

The controlled frequencies are 1000, 2000, 4000 Hz and a two user-defined frequencies. A multiple-frequency check offers the advantage of a better assessment of a possible degradation of the microphone membrane. The process lasts from 10 to 30 seconds and occurs between two measurement campaigns, so as to make their validation easy.
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0° AND 90° REFERENCE DIRECTIONS

0° REFERENCE DIRECTION

During a measurement with the instrument in hand, the sound level meter must be pointed at the source according to standard IEC 60651. This is why DUO can be configured for measurements with an angle of incidence of 0° with respect to its main axis.

The IEC-61672 standard requires a perfect control of the frequency response polar diagram, in particular at ± 30°. The fine shape of DUO, along with its conical upper part, allows complying with this criterion, with or without a nose cone. Statutory aircraft noise measurements also require the 0° incidence configuration.

90° REFERENCE DIRECTION

During unattended monitoring measurement, multiple sources are usually measured with a random position with respect to the measurement point. Noise generated by ground transportation, leisure activities, construction sites is coming from all directions, although mainly the horizontal direction.

Placed vertically and configured for a propagation direction oriented 90° from its axis DUO perfectly meets the requirements of the IEC 61672 standard on sound level meters relative to noise incidence from the horizontal direction.

The main technical difficulty is the criterion for the maximum level difference allowed between two random incidence angles. Close collaboration with our Danish partner G.R.A.S. resulted in a cone-shaped device that fulfils this criterion, in particular at ± 30°.

THREE MEASUREMENT MODES

SLM MODE (INTEGRATING SOUND LEVEL METER)

The integrating sound level meter mode allows for a simple but complete noise assessment over a period that includes overall global and spectral data as well as statistics. In case of an unexpected event (dog barking, police or ambulance siren) during a measurement a back erase function will reject the last 5 or 10 seconds of measurement.
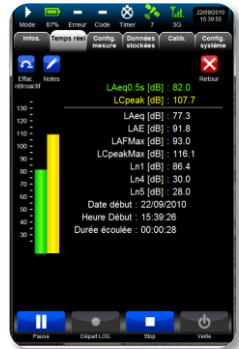
LOG MODE (INTEGRATING LOGGING SOUND LEVEL METER)

DUO in LOG mode includes the storage of time histories. It is designed for experts familiar with the short term Leq method. Instantaneous values and spectra are stored at every logging period T.

When the trigger option is active, up to 5 different markers can be entered manually. In addition up to 5 event detectors can be defined with limits based on 24 possible consecutive periods of the day. DUO can record a (non-compressed) metrological audio signal simultaneously with the events. When an event occurs, a fast logging period set by the user becomes active. Finally, during acquisition, written time-stamped comments can be recorded in the measurement campaign.

BUILDING ACOUSTIC MODE (OPTION)

In this mode, DUO enables all acoustics technicians to respond to all building acoustics measurement requirements:

- L1 Source level
- L2 Receive level
- Li Impact noise level
- Lb Background noise
- T Reverberation time with interrupted source
- T Reverberation time with impulsive source.
- Le Equipment noise level

This DUO module has an unrivalled feature set:

- Smart organization of measurements for effective post-processing
- Reuse of previous measurement data
- Automatic detection of the type of measurement performed
- Measurement quality indicators for reverberation time (ISO 3382 standard)
- Display of decay on the built-in display
- Storage of the time history and fast time history of all instantaneous and spectral parameters for each measurement
- Parallel recording of audio signal
- Three-button control keypad
- Remote control via a mobile device (smartphone, tablet, computer PC/MAC, etc.)
- Recording of audio comments
- Automatic distribution of measurements for each test
- Ratings calculated immediately in the field in the sound level meter, without user intervention
- Can be used with any sound source and tapping machine without requiring any control interface between the sound level meter and the source
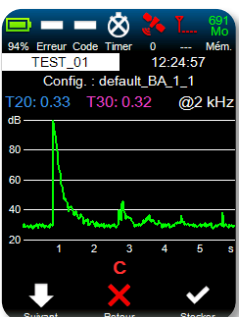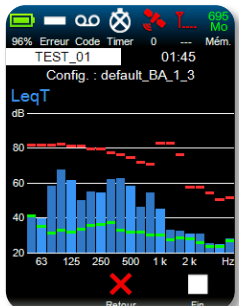
The dBInside software completes this DUO module with the following features:

- Ratings calculated immediately on data transfer, without user intervention
- On-the-fly calculation of ratings as changes are made
- Comparison with regulatory values
- One-click report covering all tests

Note: *See the 01dB Building Acoustics Solution data sheet for more information.*

MULTI-COMMUNICATION

COMMUNICATION MODULES

The integration of communication modules in DUO allows communicating with the instrument using in 4 different ways:

- USB storage
- Ethernet network (RJ45)
- Point-to-point Wi-Fi network
- Infrastructure Wi-Fi network
- 3G communication using the built-in modem
 *(Modem option needs to be active; SIM card and subscription are not included).*

All connection parameters are accessible from the web interface.
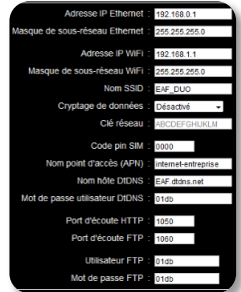
REMOTE DATA TRANSFER

Access to stored data and data transfer can be obtained in different ways using:

- FTP client as for instance Filezilla®
- dBFileManager software (included with DUO) for manual downloads on demand
- dBDataCollector software for automatic periodic parallel downloads.
- USB mass storage (SD card access)
- SD card removed and an external memory card reader.
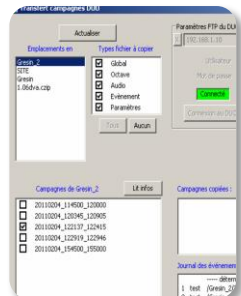
STRUCTURE OF STORED DATA

The structure of the measurement files allows the user selecting the types and dates of the data to transfer. This flexibility is particularly interesting in case of 3G communication where the cost of data transfer usually depends on the quantity of data to upload.

It is thus possible to transfer first all instantaneous values stored at each logging period. Then, and after preliminary analysis, time slots and additional data (spectra, markers and events at fast IT, audio files, provided all relevant options are active) can be selected to complement the transferred measurement campaign.

The corresponding file format (*.cmg) is compatible with all 01dB software.

DETAILS OF WEB INTERFACE

REMOTE COMMUNICATION

Direct access to DUO is possible with the web interface GUI (Graphical User Interface) in a web browser: there is no application software to install. The user has full control of the instrument (measurement and system setups, real time displays, calibrations, stored data) with a few clicks on tabs. An Internet tablet allows for comfortable on-site display and navigation.

Remote connection is possible using Ethernet, Wi-Fi or 3G integrated modem.

Therefore remote access to DUO is possible from wherever you are.

STATUS BAR

Always on display, the status bar can be used to rapidly check the operating of the main functions of DUO: current acquisition mode, battery status, detection of an error (overload, electrical check), possible marker(s) in progress, activation of a timer or not, number of GPS satellites picked up, type of connection and 3G signal strength.

MEASUREMENT CONFIGURATION

A measurement configuration for DUO can be set using ergonomic sub-menus. It is then possible to remotely configure the parameters to store, the automatic trigger thresholds, the logging period and delayed starts.

Configuration management allows rapidly loading a predefined configuration.
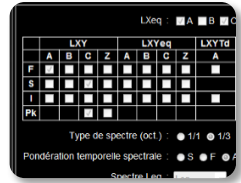
DATA ACCESS

Data stored in the instrument's memory can be viewed using the web interface: the user can visualise the different measurement campaigns stored in the instrument, without disturbing the measurement in progress. Additionally an automatic function can be activated in order to remove data older than a predefined number of days..
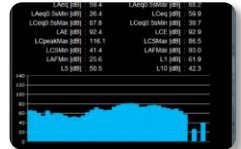
POWERFUL DATA ACQUISITION

INNOVATIVE ACOUSTIC INDICATORS

On top of usual instantaneous data measured and stored (Leq, spectra, …), DUO allows for acquiring advanced indicators at logging period rate on user defined periods:

- Sliding LAeq with two user defined sliding period,
- Sliding Ln with user defined sliding period,
- Exposure level with predefined background noise,
- PNL and PNLT for aircraft noise certification.

## UNIQUE EVENT DETECTION FILTERS

In order to efficiently detect noise events (upon noise threshold or noise source recognition conditions), DUO has a unique system of filters, based on event configurations including one or several triggers (according to the selected option).

All instantaneous data measured at logging period rate can be used as criteria for triggers, including advanced indicators, frequency bands and weather data.

Each trigger is defined by 7 different parameters (start/stop noise levels, pre-/post-trigger duration…). Furthermore, it can be typically setup on an hourly basis, which allows creating up to 24 different triggers in a day.

With the Advanced Trigger option, up to 5 triggers can be combined with logical operators ("AND"/ "OR) to define an event. Up to 5 different events can be created, and then activated according user-selected days in a week (for instance: only Saturday and Sunday).

An event can generate several actions: personalised SMS, audio recording, parallel measurement with fast logging period, TTL output …
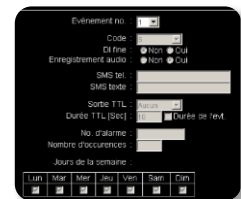
VIBRATION BUT DIFFERENTLY

INNOVATION

Sometimes classical sound level meters can interface with vibration sensors more or less successfully. In any case this requires a wired solution, using one single measurement channel and… reading the collected results on a dB scale dedicated for acoustics!

As a world premiere 01dB proposes FUSION the only sound level meter capable of recording and storing in parallel 3-axis vibrations, audio signals and all acoustic indicators.

3-AXIS WIRELESS VIBRATION

Relying on Wi-Fi connection FUSION interfaces with the wireless sensor WLS developed by ACOEM. This industrial sensor allows recording vibration signals on 3 axes (X, Y, and Z). The sensor's lifetime is 8 hours it can be recharged using a simple USB connection.

ACOUSTIC AND VIBRATION

FUSION allows recording vibrational signal on 1 (Z) or 3 axes simultaneously (X, Y and Z). What is more: FUSION can record and store in parallel 3-axis vibrations, audio signals and all acoustic indicators (instant values, spectral values…).

Audio and vibration signals recording is possible either manually using FUSION integrated keyboard, or remotely with a web interface connection to the instrument, or based on an acoustic trigger as part of the parameter definition of the current settings.

In fact it can be useful to further process vibration signals which correspond to a sound source with higher level than authorized.

AUTOMATIC POST-PROCESSING

In order to optimize the analysis, the acquired signals (audio and vibration, recorded with a metrological quality) can be analyzed "on the spot" once imported within dBTRAIT. Predefined analysis can be set by the user and assigned in dBTRAIT. Of course such parameters can be modified at any time.

As soon as the automatic processing is performed, computed results corresponding to each signal become available within dBTRAIT for further processing and analysis.

ADVANCED DATA POST-PROCESSING

MARKERS BETWEEN DUOS

Using several DUO instruments synchronized on a single site allows for a detailed analysis of the recorded phenomena. It then becomes possible to clearly identify a car and/or train pass-by, a building site noise, an industrial noise, using multiple markers.

Analysis at the measurement point takes advantage of the information collected at the coding points (and thus validates that the incriminated sources are indeed active). Moreover, data post-processing using dBTrait will allow assigning markers from the coding points onto the measurement campaign collected at the measurement point.
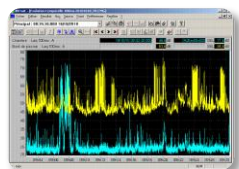
SYNCHRONIZED LEVELS DIFFERENCE MARKERS

Analysis in dBTrait allows first to calculate the time history of the difference between the measurement point and the coding point.

The time history of such difference is then analysed and automatically marked in order to detect events during which the disturbing source(s) emerge(s) from the sum of all other noises sources.

The example besides illustrates an analysis of the time difference between measurement and coding points. Results in blue (positive difference: noise levels at the measurement point higher than at the coding point) indicate some non-significant noise at the measurement point, whereas results in yellow show a negative difference which highlight some significant noise at the coding point.
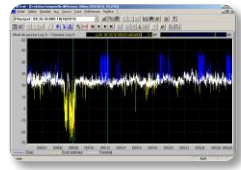
AND EVEN MORE

IMPORT AND EXPORT OF CONFIGURATION FILES

Measurement configurations can be stored, exported and imported for the benefit of the user: it becomes therefore possible to load measurement configurations from a DUO instrument onto several ones, and thus run measurement campaigns relying on the same parameter settings for all instruments. This feature is also of temporary use for saving measurement configurations while DUO is sent for performing a periodic check at a calibration laboratory. This feature is also of temporary use to replace a DUO while performing a periodic test at a laboratory.

DATA STORAGE MANAGEMENT

A retention period can be configured to automatically delete data older than a predefined past date.

REMOTE LISTEN-IN

Remote listen-in is possible with a voice & data subscription simply by dialing the telephone number of the SIM card in DUO; DUO will pick up the line after 2 tones and you can directly listen to the audio signal in real time.

THE 01dB WEBMONITORING OFFER

DUO is designed for monitoring. Each user can integrate DUO in his/her own system but he/she may want to spend less time on practical issues related to deploying and setting-up a noise monitoring project (network deployment, computer management, on-site maintenance). In addition trying to lower the overall operating expenses also comes into the play!

For such reasons, 01dB offers web services suited to the requirements of each type of noise and vibration monitoring activity: 01dB WebMonitoring.

01dB WebMonitoring offers unrivalled service quality that guarantees reliable data to the customer without compromise on metrology. This is a sound basis for automatic calculations and/or expert analysis achieved by an acoustic consultant
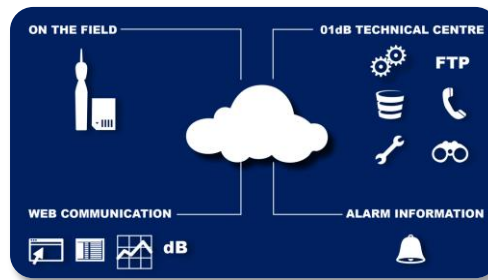
01dB WebMonitoring overview

With 01dB WebMonitoring, 01dB offers a simple and performing Web interface accessible to the different persons involved in a monitoring project. From any terminal (computer, tablet, smartphone, etc.) connected to the Internet, you can view all the information available, offline and real-time.
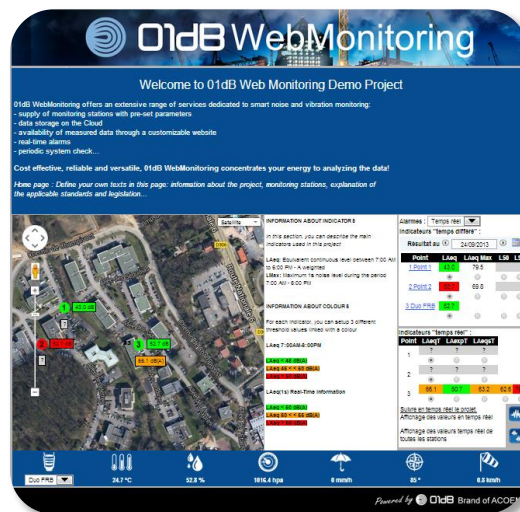
"Site" page on the Web interface

Available in 8 languages, the 01dB WebMonitoring interface is accessible upon customer's choice in private mode (which requires a user ID and a password) or in public mode.

In standard mode, a first level of customisation allows inserting a corporate logo and all information relative to the project (description, pictures of measurement points, hardware used, etc.).

Note: See the 01dB WebMonitoring data sheet for more information.

ACCESSORIES

WLS WIRELESS VIBRATION SENSOR

DUO interfaces in a very simple way to the WLS industrial wireless sensor. It allows recording vibrational signal on 3 axes (X, Y and Z) simultaneously with the recording of audio signals and all acoustic indicators (instant values, spectral values…).

The WLS sensor allows vibration recording on 1 axis (Z) or 3 axes simultaneously (X, Y and Z) with a frequency sampling of 12.8 kHz and a dynamic scale of 80g.

Battery operated (type Li-Ion) with an average lifetime of about 8 hours; it is rechargeable using a simple USB connection.

Several mounting accessories are available.

OUTDOOR MICROPHONE UNIT DMK01

In case of unsafe measurement locations, it is preferable to put DUO in a safe place and use the outdoor microphone unit DMK01. DMK01 is specifically designed for DUO and reuses the 40CD microphone and nose cone. It includes a new PRE22 preamplifier connected to the external output, a specific wind screen and a dummy microphone to protect DUO's top part.

Specific electronic corrections are implemented in DUO external input (embedded settings) in order to satisfy 0° and 90° reference directions.

Charge injection calibration check can also be operated from DUO using DMK01 unit.

WEATHER STATIONS

A weather station can be interfaced to DUO so as to be able to simultaneously measure and store noise and weather data.

It is possible to select either reference WXT532 (2 parameters) or WXT536 (6 parameters) from Vaisala. These two weather stations have the particularity of transducers without any moving parts to avoid any breakdown in case of harsh weather conditions.

The same mains power is used for DUO and for the weather station; the 10 meters unique cable between the station and DUO offers a good flexibility and ease of installation. The weather data logging period is defined as a multiple of the noise logging period.

	WXT532	WXT536
Wind speed	●	●
Wind direction	●	●
Air temperature		●
Relative humidity		●
Rain intensity		●
Barometric pressure		●

ALL WEATHER CASE DSC01

For mid- and long-term environmental noise and vibration measurements FUSION can be inserted into a DSC01 weather protected case. This case will provide complete protection against bad weather conditions and also deals as a protection against theft or vandalism.

This case can incorporate one or two DEB01 high capacity batteries providing an average battery life of 10 to 20 days.

The DSC01 case also includes several glands which allow you to use different cables (microphone extension cable, cable link with a weather station…) ensuring perfect sealing properties...

TAPPING MACHINE TM01

The **TM01** tapping machine consists of an aluminium frame standing on 3 rubber feet, the height of which can be adjusted. It includes a camshaft that drives 5 hammers with a mass of 500g each, set 10 cm apart one from another. The **TM01** machine allows for the hammers falling from a 40-mm effective height with a time interval of 100 ms between the drop of each hammer.

The **TM01** machine includes a lead-acid gel battery that allows for an optimum and standardised continuous operation time of 2 hours.

A pushbutton is used to manage the operation of the machine. Depending on the length of time the button is pressed, the following actions can be achieved:
- Power-up of the machine: Short push (< 850 ms)
- Operating for 5 min: Short push
- Operating for 20 min: Long push (850-2,500 ms)
- Turn-off of the machine: Long push (> 2,500 ms)

The **TM01** machine is supplied with a radio frequency remote control that allows for remote start and stop. The remote control is effective through the walls and floors normally built in residential and office buildings (the emitter's range in direct field is greater than 100 m).

OMNIDIRECTIONAL NOISE SOURCES LS01/LS02

01dB offers 2 omnidirectional sources, **LS01** and **LS02**, compliant with standards ISO 140 and ISO 3382.

Both sources have the same design. They consist of a 12-loudspeaker dodecahedron and contain each:

- a power amplifier
- a noise generator

Robust, compact and easy to implement, both sources **LS01**/**LS02** can be driven using a remote control. In addition to starting and stopping the sources, the user can control:

- the volume level by +/-2 dB steps or with a known gain (0 dB, -8 dB, -30 dB…).
- the type of noise: pink, white, swept sine according to different frequency ranges

The **LS01** source is delivered with a battery pack that provides more than 1 hour of operating time.
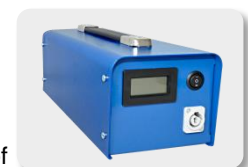
OPTIONS

DUO2001000 – MULTISPECTRA (INCLUDED IN DUO ADVANCED 3G KIT)

Activates multi-spectra measurement and storage:
- Type of spectrum: 1/1 or 1/3 octave
- Time weighting: Fast or Slow or none
- Simultaneous measurement and storage of two types of spectra (Leq and time weighting)

Stores spectral data at the logging period rate

If Trigger option (DUO2003000) activated:
- Possibility to store spectra at a faster logging period during events (down to 20 msec)

DUO2002000 – AUDIO RECORDING (INCLUDED IN DUO ADVANCED 3G KIT)

Activates metrological audio recording:
- Selectable frequency sampling
- Manual trigger for recording start and stop directly from DUO or remotely from the web interface
- User defined timer (periods and duration)
-
Activates MP3 audio recording:
- Selectable frequency sampling
- Selectable MP3 bit rate
- Manual trigger for recording start and stop directly from DUO or remotely from the web interface
- User defined timer (periods and duration)

If Trigger option (DUO2003000) is activated
- Automatic audio recording during an event
- Synchronized audio recording simultaneously with manual markers

DUO2003000 - TRIGGER (INCLUDED IN DUO ADVANCED 3G KIT)

Activates single trigger:
- Days of the week condition for event detection activation
- One of the instantaneous values (broadband or frequency bands) measured can be selected (including weather data) for each period; event detection is defined by;
  - User defined start trigger and end trigger levels
  - User defined pre-trigger
  - User defined post-trigger
  - Minimum time duration
- Up to 24 user defined periods within a day

Additional actions triggered during an event:
- SMS generation (with 3G Modem Option DUO2004000)
- TTL output (event or user defined duration)
- Audio recording (with Audio recording option DUO2002000)
- Fast logging parallel measurement

DUO2004000 – 3G MODEM ACTIVATION (INCLUDED IN DUO ADVANCED 3G KIT)

Activates 3G modem for internet connection using 3G/GPRS/EDGE and UMTS/HSDPA networks:
- Full remote control and access with a smartphone, an internet tablet or a standard computer (Windows, Ios, MAC)
- FTP server for data transfer
- Automatic SMS notification on event detection (with Trigger option FSN2004000)
- Support of DTDNS dynamic IP address server
- SMS alarm on low battery (10%)
- SMS alarm on movement detected from initial location
- Possibility to call FUSION as a mobile phone to listen to real time noise from the microphone (voice subscription necessary)

DUO2005000 – EXTENDED TRIGGER (INCLUDED IN DUO ADVANCED 3G KIT)

Similar to Trigger option (DUO2003000) with the possibility to create up to 5 different events instead of a single one

Activates the possibility to combine (logical "and" / "or") up to 5 different triggers to create an event

SMS can be sent to several telephone numbers

DUO2006000 – ADVANCED INDICATORS (INCLUDED IN DUO ADVANCED 3G KIT)

Measurement and storage of the following instantaneous indicators:
- Sliding LAeq (start time and end time, sliding duration)
- Sliding Ln (start time and end time, sliding duration)
- Exposure Level (start time and end time, predefined background noise level)

DUO2007000 - PNL-PNLT (INCLUDED IN DUO ADVANCED 3G KIT)

Measurement and storage of PNL (Perceived Noise Level) or PNLT (Perceived Noise Level Tone corrected) for aircraft or helicopter

DUO2008000 – WEATHER (INCLUDED IN DUO ADVANCED 3G KIT)

Measurement and storage of weather data acquired by Vaisala weather stations types WXT536 (6 transducers) or WXT532 (2 transducers):
- User defined selection of parameters
- Altitude correction for barometric pressure
- User defined Logging period (as a multiple of the noise logging period)
- Real time display of weather information with dBDUO (wind rose for wind direction, time history for wind speed, instantaneous values for the other weather parameters)

DUO2009000 – HTTP COMMANDS (INCLUDED IN DUO ADVANCED 3G KIT)

Activates integrators HTTP commands mode

The "integrators commands" allow retrieval of information in real time. The operator has the possibility to query DUO by a simple HTTP request, and CUBE responds with the corresponding real time values.

DUO2019000 – PUSH DATA (INCLUDED IN DUO ADVANCED 3G KIT)

Activates Automatic data transfer in push mode (from the instrument to one or two server)

The following parameters allows for selecting the types of data o upload:
- Instant values
- Sliding and exposure values
- Instant spectrum values
- Instant weather values
- Overall values
- Events
- Signal(s)

DUO3026000 – VIBRATION SIGNAL RECORDING OPTION

Activates metrological signal recording from the WLS sensor:
- Definition of the number of axes to be recorded: 1 (Z) or 3 (X, Y and Z)
- Manual trigger for recording start and stop directly from DUO or remotely from the web interface
- User defined timer (periods and duration)

If Trigger option (FSN2004000) is activated
- Automatic audio recording during an event
- Synchronized audio recording simultaneously with manual markers

DUO2022000 - BUILDING ACOUSTICS OPTION

For the DUO, activation of parameters, acquisition and storage of building acoustics measurements (1/1 or 1/3 octave) including:
- spectrum of average levels in the source room during operation of the noise source
- spectrum of average levels in the receiving room during operation of the noise source
- spectrum of average levels in the receiving room during operation of the shock generator
- spectrum of average background noise in the receiving room
- reverberation time T20 & T30 with information regarding compliance of indicators with the ISO 3382-2 standard
- measurement of maximum equipment noise level
- ratings calculated immediately in the field in the sound level meter, without user intervention

Parallel recording of audio signal, time history and fast logging time history of all instantaneous and instantaneous spectral parameters for each measurement

PACKAGES

DUO OVERALL SPECIFICATIONS

All DUO packages contain:

- Point to point Wi-Fi connection
- Ethernet connection
- 3G Modem
- Wi-Fi data transfer
- Ethernet data transfer
- GPS location
- integrators HTTP commands
- GPS or NTP time synchronization
- Periodic electrical check (multi CIC 5 frequencies, 2 levels)
- USB connection(mass storage)
- SD card reader
- 0° reference direction
- 90° reference direction
- Remote control by web interface
- Automatic data transfer in push mode

- dBFileManager software for manual data transfer
- SLM mode (Start/Stop)
- LOG mode (time history)
- Instantaneous values (up to 44 values in parallel)
- Global values
- 1/1 or 1/3 octave
- Global statistical values (7 Ln values)
- PNL/PNLT indicators
- Sliding LAeq, sliding Ln and exposure level
- Audio recording
- Back erase (mode SLM)
- Timer functions : immediate, delayed, daily periodic
- 5 user-definable events

AVAILABLE KITS

It is possible to order separately one or several options (for the delivery or as evolutions).

	DUO2020000 Logger	DUO2001000 Multispectra	DUO2002000 Audio recording	DUO2003000 Triggers	DUO2004000 3G modem	DUO2005000 Extended Triggers	DUO2006000 Advanced Indicators	DUO2007000 PNL/PNLT indicators	DUO2008000 Weather	DUO2009000 http commands	DUO2019000 Push Data	DUO3026000 Vibration signal reocording	DUO2022000 Building Acoustics
DUO3032000 Advanced 3G	●	●	●	●	●	●	●	●	●	●	●	○	○

● *Included* ○ *Option*

TECHNICAL SPECIFICATIONS

IEC Class
IEC 61672-1 edition 2 (2013) (0° and 90° reference direction).
IEC 61620 (1995) NF EN 61260/A1 (2002).

Sound Level Meter, Integrating Sound Level Meter with storage, group X.

Type approval (extract)
LNE-21674 rev3 8th July 2015
PTB-1.63-4075326 10th February 2015

Dynamic range
21-138 dB (A, B), 26-138 dB (C), 31-138 dB (Z),
1 single range for a rated sensitivity of 50 mV/Pa (between 46 and 56mV/Pa)

Linear operating range for A weighting (5 frequencies)
31,5 Hz: 25-97 dB
1 kHz: 22-137 dB
4 kHz: 22-137 dB
8 kHz: 22-133 dB
12,5 kHz: 22-129 dB

Dynamic range Peak
60-140 dBC, 1 single range

Time weightings
Slow, Fast, Impulse, Peak

Frequency weightings
X=A, B, C, Z; Y=S, F, I for LXeq and LXY
X=A; Y=S, F, I for LXYTd
X=C, Z for LXpk

Instantaneous broadband values stored

	LXY				LXYeq				LXYTd	LXYMinMax			
	A	B	C	Z	A	B	C	Z	A	A	B	C	Z
F	X	X	X	X	X	X	X	X	X	X	X	X	X
S	X	X	X	X	X	X	X	X	X	X	X	X	X
I	X	X	X	X	X	X	X	X	X	X	X	X	X
Pk			X	X									

PNL and PNLT (Perceived noise level) aircraft and helicopter
LnsT (sliding Ln)
LAeqsT (sliding LAeq)
LAexPT (exposure level)

Instantaneous weather data stored
Wind speed [m/s]
Wind direction [°]
Rain intensity [mm/h]
Barometric pressure [hPa]
Air temperature [°C]
Humidity [%HR]

Noise logging period T
Min. 20 msec - max. 3,600 s, 5 msec steps.
Fast logging interval: min. 20 msec - max. standard logging interval or 60 sec if standard logging interval is more than 60 sec, 5 msec steps.
Fast logging interval applicable only during coding.
The fast logging interval is a sub-multiple of the primary logging interval.

Weather logging period
Weather logging period is a multiple of T with a minimum of 1 second

Spectral analysis
Parallel measurement and storage of Leq and LY (Y=F, S, I)

Filters
1/1 (8Hz-16kHz) et 1/3 (6.3Hz-20kHz)

Statistics
7 selectable Ln in parallel from L1 to L99, 1 dB class
Samples for calculation: T if Leq or 20 ms if LXY, 0.1 dB resolution

Back erase
0, 5s or 10s, SLM mode only

Input high pass filter
0,3 Hz / 10 Hz

Reference directions
0° and 90°, correction applicable for internal input and external input if used with DMK01

Reference point for microphone
Centre of the protection grid (with or without nose cone).

Reference Level
94 dB.

Starting point for linearity tests
Reference level, i.e. 94 dB.

Data storage modes
SLM (hand-held sound level meter) and LOG (logging sound level meter)

Signals recording
Audio signal type
allows selecting either RAW (uncompressed data for dBTrait post-processing) or MP3 (format MPEG-1/2 Audio Layer 3 compressed data).
Audio signal sampling frequency
allows selecting audio signal sampling frequency; Possible choices:
For RAW : 51.2kHz, 25.6kHz, 12.8kHz, 6.4kHz, 3.2kHz, 1.6kHz).
For MP3 : 48kHz, 32kHz, 16kHz, 8kHz.
MP3 bit rate [kbps]
allows selecting MP3 bit rate ; possible choices :

Fe [kHz]	48	32	16	8
Possible bit rate [kbps]	32	32	8	8
	96	96	32	32
	192	192	96	96

Vibration
Signal: Metrological, Fs = 12,800 Hz
Pre-trigger = 0 sec
1 (Z) or 3-axis(X, Y and Z)

Audio recording triggers
Simultaneously with events and manual (using DUO integrated key and the web interface)

Automatic event detection
5 user-defined events: markers 6 to 10
24 user-defined periods per day
An event is defined by a logic combination of up to 5 different triggers ("and" or "or")

Triggers
Pre-trigger, post trigger, minimum duration, end duration
Based on instantaneous acoustic (broadband and spectral) and weather data (except wind direction) and TTL input

Manual markers
On DUO instrument: marker 1
On web interface: 5 markers 1 to 5

Timers
Immediate, differed, daily periodic
Audio: periodic

All weather microphone + nose cone
½'' pre-polarized GRAS microphone type 40CD
Nose cone RA0208; stainless steel

Preamplifier
Integrated, not removable
External type PRE22 (included in DMK01) on external input (standard 10 m lemo extension cable)

Acoustic background noise
Noise from the complete system, microphone placed in a isolated cavity.

Electric background noise
The microphone is replaced by a ADP12 adaptor, and the input is short-circuit.
Measurement is performed with 30 sec averaging.

Background noise (typical)
Microphone (thermal noise): 14.5 dBA, 15.0 dBC, 15.3 dBZ.
Electronics: 11 dBA, 12.5 dBC, 18.5 dBZ.
Total: 16.1 dBA ; 16.8 dBC, 20.2 dBZ.

	[dB]	$L_{A\ S/F}$	$L_{C\ S/F}$	$L_{Z\ S/F}$	$L_{Aeq T}$
acoustic	Typical	16,1	16,8	20,2	16,1
	maximuml	20,0	21,0	24,0	20,0
electric	typical	11,0	12,5	18,5	11,0
	maximum	16,0	17,0	21,0	16,0

Integrated keys
4 silent keys: on/stand-by/off and 3 multi-functions keys

Status indicators
LED red (overload)
LED blue (Wi-Fi connection)
LED green (power ON, blinking on on-going measurement, charge ON)

Display
High contrast colour screen 38*50mm resolution 320*240 pixels
3 sets of colours (day, contrast, night)
Display rate: 0.1s, Display resolution: 0.1dB

USB connection
Type 2.0; mass storage mode, charge on USB

Ethernet connection
Connector RJ45 (shielded cable maximum length 3m).
Speed: 100 Mbits/s.
DHCP mode

Wi-Fi connection
IEEE 801.11b, g standard
Point to point connection and infrastructure mode

Cellular network connection
Embedded modem 3.5G compatible with 4-band GSM/GPRS/EDGE and 3-band UMTS/HSDPA

Data connectivity
Integrated Network protected http server for web interface
Integrated FTP server for data access
Integrated FTP client for automatic data upload to server.

Voice activation on cellular network
Possibility to call DUO phone number with « voice » subscription to listen to the on-going measurement;
Gain 20dB gain, signal compression in modem

SMS alarms
- On event: SMS text with DUO serial #, location, date and time, user defined text, IP address:http port
- On low battery (10%): SMS text with DUO serial #, location, date and time, % remaining battery
- On movement: SMS text with DUO serial #, location, date and time, GPS coordinates, distance from previous location, IP address:http port (the alarm trigs if DUO has moved more than the user defined distance)
- On CIC error (electrical check).

Automatic SMS actions
By sending "IP" by SMS to DUO it replies by sending an SMS with DUO serial #, location, date and time, IP adress: http port and automatically sends a new SMS at every new IP address in case of floating IP

Actions on SMS sent to DUO
- On SMS sent « IP », DUO replies by sending an SMS with DUO serial #, location, date and time, IP:port address
- On SMS sent « stop », DUO stops replying new SMS if IP has changed

- On SMS « reboot », DUO reboots to establish a new connection and replies with an SMS with DUO serial #, location, date and time, IP :port address

Web interface refresh rate webpages
Standard: twice per second
Mobile: once per second

Analog output
Audio: A, B, C or Z
Gain: 0, 10, 20, 30, 40, 50 dB
 (Disabled if external input selected)

Electrical check
User defined periods 1, 2 or 4 times a day (0:00; 0:00 and 12:00; 0:00, 6:00, 12:00 and 18:00)
3 predefined frequencies (1000, 2000 and 4000 Hz) and 2 user defined frequencies (between 10 Hz and 20 kHz)
2 user defined excitation levels, max 5V (100%)

External microphone input
For DMK01, PRE22; (R=560kOms / 22Vpp +/- 11V)

TTL output
R = 100 Ohms / 0 / 5V

TTL input
R = 100 kOhms / 0...1V = "0"   1.8...5V ="1"

Battery
Type lithium polymer
Voltage 3.7V / Capacity 18.9 Ah
Non removable, charging time around 8 hours

Typical power consumption
Without communication (screen switch off): < 1200 mW
+ Wi-Fi & screen switch on: < 1800 mW
+ Modem: <3800 mW

Autonomy
(For temperatures between 10°C and 50°C, in LOG mode with T = 1s, fine T = 100ms, 1/3octave band spectra and audio recording on trigger during 10% of the time)
60 hours with Wi-Fi active communication during 10% of the time
48 hours with 3G active communication during 10% of the time

External power supply
DC from 8 to 28 V
DC 5V on USB (slow charge)

Memory
32GB (or more) SD-, SDHC- or SDXC-cards (2GB = standard delivery) for measured data and audio. Recommendation is Class 10 minimum.
01dB delivers tested/validated 2GB & 32GB SD-Cards for usage with DUO.
Data stored on DUO SD card every 10 seconds.
Nonvolatile memory for storage of configurations, system log, calibration data (500) and electrical checks (500)

Clock
GPS PPS, error < 50 ms
NTP Synchronisation
Internal clock drift < 0.5s/24h

Localization
Automatic with integrated GPS
Information stored with measurement campaigns

Warm-up time
From power off: < 20 seconds

Operating temperature
-10°C to +50 °C

Humidity
According CEI 61672-1

Electromagnetic compatibility
According to Directive 2004/108/EC.
NF EN 61000-6-1 NF EN 61000-6-2 NF EN 61000-6-3 NF EN 61000-6-4 (2001).

ETSI EN 300 328 V1.5.1 (2004).

Protection
IP40 in standard use.
IP42 if the instrument is used in vertical position with the 40CD microphone (weatherproof microphone)

Influence of vibration

Use with no outdoor microphone
- For mechanical vibration of an acceleration level of 1 m/s² perpendicular to the microphone diaphragm, at frequencies 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz: the lower limit of the linear operating domain for A-weighting becomes 80 dB.
- For mechanical vibration of an acceleration level of 1 m/s² parallel to the microphone diaphragm, at frequencies microphone diaphragm, at frequencies 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz: the lower limit of the linear operating domain for A-weighting becomes 60 dB.

Use with outdoor microphone unit DMK01
- For mechanical vibration of an acceleration level of 1 m/s² perpendicular to the microphone diaphragm, at frequencies microphone diaphragm, at frequencies 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 630 Hz, 800 Hz and 1000 Hz: the lower limit of the linear operating domain for A-weighting becomes 75 dB.

Weight and dimensions
1100 g - H x L x P: 360 x70 x 52 mm

Accessories
- Weatherproof external charger IP67 (10m cable)
- Weather station Vaisala type WXT532 specific for DUO (2 parameters: wind speed and direction)
- Weather station Vaisala type WXT536 (6 parameters: wind speed and direction, rain intensity, relative humidity, air temperature, barometric pressure
- Connection cable between weather station and DUO, for powering simultaneously DUO and the weather station
- Outdoor microphone unit type DMK01 including preamplifier type PRE22
- All weather case DSC01 with option 1 battery (10-days) or 2 batteries (20-days)
- Wireless vibration sensor 3-axis (X, Y, Z) 80g, Weight 373 g, Dimension Ø42 x H116 mm, 8h battery life.

Connecting these accessories has no influence on measurements.

Building Acoustics Module (option)

Product Code
FSN2009000: Building option for **FUSION**

Frequency-based analysis
1/1 or 1/3 octave, 50 to 5000 Hz

Levels L_1, L_2, L_i (Emission, Reception, Impact noise)
Calculation of the mean spectrum LZeq over the specific coding duration, detected automatically (source on duration)

Background noise level L_b
Calculation of the mean spectrum over the entire measurement duration
Integration times (IT)
1 second; 20 milliseconds

Maximum averaging time for spectra L_1, L_2, L_b and L_i
120 seconds

Maximum measurement time for equipment noise
600 seconds

Simultaneous audio recording
Sampling frequency: 51.2 kHz, 25.6 kHz, 12.8 kHz, 6.4 kHz, 3.2 kHz, 1.6 kHz

Equipment noise levels
Selection of the maximum level for one of the following parameters: LXYMax where X = A, C or Z and Y = F, S or I

Calculation of reverberation times
Fine IT 20 ms for decay analysis
Simultaneous calculation of T20 and T30
Automatic detection of interrupted or pulsed noise sources
Schroeder integration for pulsed sources
Estimate by least squares approximation

Calculation of quality indicators (ISO 3382)

Name	Indicator	Description
N	Background noise level too high*	Low dynamic range (between 41 and 45 dB for T30; between 31 and 35 dB for T20)
D	Calculation impossible*	Insufficient dynamic range (< 41 dB for T30; < 31 dB for T20)
<	Reverberation time too low	Tr < 0.24 seconds (scaled by logging period = 20 ms)
ξ	Non-linearity*	Non-linearity parameter ξ >1%
C	Curvature*	C > 10% or C < 0; see [1] appendix B.3
L	Linearity of the sound source linearity	Difference between adjacent 1/1 or 1/3 octave bands > 6 dB

*: ISO 3382-2 standard indicator

Invalid indicators displayed on the Tr spectrum and stated on decay

Audio comments
Used to store a voice comment, with the same sampling frequency as for the measurement

PC Software
dBInside

DELIVERABLES AND OPTIONAL ACCESSORIES

Deliverable DUO

Noise cone

Windscreen

Fastening profile

Microphone

Charger block

Integral protection

DUO

SD card, 2Go

Mini-USB cable

Connectors cover

Optional accessories

DUODataCollector

dBTrait

Internet tablet

Smartphone

Anti-theft system

Outdoor microphone kit

Calibrator

SD card, 32 Go

Weather station 6 parameters

Weather station 2 parameters

Weatherproof charger

Clamp for pole mounting

Rolling backpack

Suction pads

About ACOEM

ACOEM Group
Reduce your environmental impact

In today's fast-moving world, the environment is increasingly impacted. The ACOEM Group is committed to sustainable development and help companies and public authorities limit their environmental impact by offering products and services that:

- Prevent and control air, noise and vibration pollution
- Increase the productivity and reliability of industrial machinery
- Contribute to the development of effective, robust & noiseless products
- Protect soldiers, sites and vehicles in military theaters of operation

Across the world, ACOEM's 670 employees innovate in the measurement, analysis and control of all environmental parameters through the 01dB, ECOTECH, ONEPROD, FIXTURLASER, MEAX and METRAVIB brands.

For more information, please visit our website at acoemgroup.com

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