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## CHI SIAMO

AESSE AMBIENTE:  
STRUMENTI DI MISURA DI ACUSTICA  
E VIBRAZIONI AMBIENTALI






## DUO: Smart Noise Monitor



Fonometro  Stazione di Monitoraggio!!





## 25 ANNI DI INNOVAZIONI

01dB presenta DUO, lo Smart Noise Monitor, la nuova generazione di strumenti che rappresenta l'innovazione nel campo della valutazione del rumore ambientale. Duo è completamente modulare e garantisce la più completa gamma di opzioni che ne consentono l'utilizzo sia come Fonometro che come stazione di monitoraggio completa.

Grazie alla sua modularità, DUO può essere configurato in modo da garantire fin da subito le prestazioni desiderate evitando costi aggiuntivi non necessari. Le ulteriori opzioni possono essere implementate successivamente qualora diventino effettivamente utili.

Ti servirebbe per un tempo limitato? 01dB offre una gamma di servizi al cliente che comprende l'opzione noleggio mensile e i servizi di 01dB Web Monitoring per il monitoraggio di medio termine. 01dB garantisce ai suoi clienti non solo la soluzione più innovativa disponibile sul mercato, ma anche la più versatile, con un impareggiabile gamma di servizi!

# DUO: Smart Noise Monitor

## I Tuoi progetti, le nostre soluzioni



### UNA LUNGA SERIE DI INNOVAZIONI

01dB ha utilizzato le migliori tecnologie per creare DUO, una soluzione innovativa che soddisfa le esigenze di ogni cliente.

Già dal primo utilizzo DUO si distingue per la sua alta qualità delle finiture: facile da montare in modo sicuro su un treppiede grazie al suo profilo di fissaggio, l'impugnatura in gomma morbida al tocco per una maggiore maneggevolezza e un display a colori perfettamente visibile alla luce del sole. Il meglio deve ancora venire: DUO è dotato di un microfono impermeabile, unico nella sua tipologia, che permette l'utilizzo dello strumento in tutte le condizioni, ed ha integrata le connettività GPS e WiFi/3G che ne garantisce un completo controllo remoto.

### UN SISTEMA INTELLIGENTE

01dB mette in campo tutta la sua competenza in materia di monitoraggio ambientale con il software di gestione di DUO offrendo una notevole gamma di funzioni: indicatori acustici evoluti e specializzati; un sistema intelligente di trigger per il rilevamento degli eventi, registrazione in continuo dell'audio possibilità di ascoltare da remoto, rilevamento della presenza del segnale di calibrazione, la calibrazione elettrica per il controllo del perfetto funzionamento, ecc. La Certificazione di conformità alla classe 1 ai sensi della IEC-61672 (per entrambe le direzioni di riferimento: 0 ° e 90 °), rilasciata dai laboratori LNE, PTB e METAS dimostrano il livello di attenzione e cura che 01dB ha adottato per garantire una perfetta metrologia di Duo.



# → Una Soluzione Brillante per i tuoi Progetti

## RICONOSCIMENTO EVENTI

Ad ogni sorvolo aereo, DUO automaticamente individua l'evento, codifica i dati e attiva la registrazione audio. Questo è possibile grazie ad un potente sistema di trigger e filtri di rilevamento personalizzabili associato alle azioni definite dall'utente (marcatori, audio, trigger TTL, invio di messaggi di testo, ecc). Questa soluzione di 01dB, unica nel suo genere, rende possibile monitorare e rilevare eventi acustici di qualsiasi natura.



## STAZIONE METEOROLOGICA LOCALE

Perché i livelli di rumore, misurati nella gara di ieri, superano in modo significativo la media annua su questo circuito? La stazione meteorologica collegata via cavo a DUO offre una risposta possibile: la velocità del vento ha superato i 5 m/s durante tutto il giorno! Con DUO, 01dB fornisce una soluzione integrata per ottenere una migliore comprensione dei fenomeni acustici nelle attività sportive e nel tempo libero.

*"01dB offre la soluzione più versatile presente sul mercato"*

## L'UNICA SOLUZIONE È DUO

La pianificazione di un sistema di monitoraggio del rumore urbano implica decisioni su quali e quante stazioni è necessario impiegare, scelte che possono far venire essere mal di testa con un budget ristretto. Con DUO, 01dB offre la più versatile soluzione sul mercato: un fonometro che può anche essere usato come una stazione di monitoraggio del rumore permanente o rilocabile.

Non c'è bisogno di scegliere tra diversi tipo di strumenti: l'unico domanda che rimane da porsi è in quale modo devo installare DUO!



## SEMPRE IN ALLERTA!

I livelli di rumore nei cantieri devono essere monitorati con regolarità e tutti i reclami devono essere gestiti molto velocemente ed efficacemente. Con DUO, 01dB offre sistema di sorveglianza ad alte prestazioni: un messaggio di allarme viene inviato quando predefiniti limiti vengono superati o quando la batteria si sta scaricando, le e-mail di notifica sono gestite centralmente tramite il servizio Web Monitoring di 01dB. Inoltre, la sicurezza di DUO è garantita tramite un SMS che ci avvisa se l'unità viene spostata anche se soltanto di pochi metri.



## SEMPRE AGGIORNATO

Misurare il livello di rumore in siti industriali è un compito complesso, a causa di fattori quali la presenza di numerose sorgenti di rumore, la variabilità delle attività lavorative svolte sul sito e l'effetto degli agenti meteorologici. Con il suo GPS integrato, DUO consente di effettuare misure perfettamente localizzate e sincronizzate, indispensabili al fine di identificare l'influenza delle varie sorgenti di rumore in ogni diverso momento della giornata.



*"La Certificazione alla classe 1 ai sensi della IEC-61672 (per entrambe le direzioni di riferimento: 0 ° e 90 °), dimostra il livello di cura che 01dB ha adottato per garantire una perfetta metrologia di Duo"*

## FACILE DA INSTALLARE

I parchi eolici sono spesso installati in zone di difficile accesso. Pertanto l'installazione e il controllo remoto sono fattori che devono essere presi necessariamente in considerazione nella valutazione di impatto acustico.

DUO la soluzione all-in-one, con un design per tutte le stagioni offre la soluzione perfetta, di facile installazione (senza cavi), un batteria di lunga durata (60 ore) e il modem Sto 3G integrato consente l'accesso diretto ai dati, senza lasciare l'ufficio!



## Servizi "à la carte"

### 01dB Web Monitoring

Basato sulla sottoscrizione di un contratto a costi mensili fissi, il servizio 01dB offre una gamma di servizi di Web Monitoring, che va dal noleggio stazioni comprensivo dell'abbonamento 3G alla memorizzazione dati e alla realizzazione di un sito web dedicato e personalizzato. Questi servizi sono disponibili anche per tutti i clienti che desiderano utilizzare il loro DUO nel contesto di un progetto di monitoraggio acustico.





# Un Fonometro Innovativo

## Una stazione di Monitoraggio intelligente

All-in-One



### OGIVA ACUSTICA 0°/90°

- ✓ Due direzioni di riferimento 0° and 90° (configurabile)
- ✓ IEC-61672 Classe 1 certificato da LNE, PTB e METAS

### MICROFONO IMPERMEABILE

- ✓ Brevetto G.R.A.S
- ✓ Rilevamento automatico del calibratore
- ✓ Sistema di auto-verifica basato sull' iniezione di carica

### MODEM 3G/WI-FI INTEGRATO

- ✓ Controllo Remoto
- ✓ Download automatico dei dati
- ✓ Invio Messaggio di testo al verificarsi di eventi
- ✓ Invio messaggio di testo in caso di malfunzionamenti

### ANTENNA GPS INTEGRATA

- ✓ Sincronizzazione Temporale
- ✓ Codifiche Multi-punto sincronizzate
- ✓ Auto-Localizzazione

### DISPLAY A COLORI

- ✓ Alta definizione
- ✓ Alta leggibilità all'aperto

### TASTIERA A 3 TASTI

- ✓ Facile da usare
- ✓ Massima silenziosità

### CASE METALLICO IMPERMEABILE

- ✓ Semplice da installare all'aperto
- ✓ Materiale anti corrosione

### IMPUGNATURE LATERALI IN GOMMA

- ✓ Presa facile e sicura

### AUTONOMIA BATTERIE 60 ORE

- ✓ Flessibilità di utilizzo

### MEMORY CARD 2 -128 GB

- ✓ Capacità di Memorizzazione illimitata
- ✓ Indicatori acustici avanzati
- ✓ Registrazione Audio a 51.2KHz

### ACCESSORI



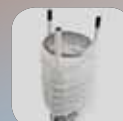
Spugna di protezione integrale



Unità outdoor DMK01



Meccanismo anti-furto



Stazione Meteo



## ACOEM

Monitoraggio Intelligente, diagnosi e soluzioni

ACOEM offre prodotti e servizi completi che comprendono il controllo intelligente, diagnosi e soluzioni, attingendo dalla sua esperienza, unica nel campo di vibrazioni e acustica.

ACOEM contribuisce al miglioramento di:

- Qualità della vita e prevenzione dei rischi negli ambienti urbani ed industriali
- Produttività e l'affidabilità dei processi industriali
- Progettazione di prodotti robusti e ad alte prestazioni con bassi livelli di rumorosità
- Tutela dei siti, dei veicoli e persone in ambienti ostili

Con i suoi marchi 01dB, Metravib e OneProd, ACOEM lavora con i leaders nel settore industriale, nella difesa e nell'ambiente in tutto il mondo.

Per ulteriori informazioni, visitate il nostro sito [www.acoemgroup.com](http://www.acoemgroup.com)



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# 01dB WebMonitoring

**Cloud services for smart noise & vibration monitoring**

**01dB WebMonitoring** is a simple and efficient solution for environmental noise & vibration monitoring. For a fixed monthly fee and a 3 month minimum rental period, **01dB** offers an extensive range of on-demand services:

- supply of monitoring stations with pre-set parameters,
- data storage and back-up on the Cloud,
- periodic system checks and remote maintenance,
- availability of measured data through a customizable website,
- real-time alarms based on thresholds for quick decision making.

Cost effective, reliable and versatile, **01dB WebMonitoring** takes the hard work out of monitoring and lets you focus on the data and results.

## A SOLUTION for every need

**MANAGE** noise emissions from your entertainment venue to reduce community impact



**MONITOR** urban noise levels to validate noise maps and inform noise reduction action plans

**DEMONSTRATE** the results of noise mitigation efforts at your industrial site



**ENGAGE** in developing more sustainable airport operations

**IMPROVE** and maximise the availability of your race track

**COMMUNICATE** to neighbours the noise and vibration impact of your building site





**Free your mind with a complete package\***

## ON THE FIELD



## 01dB TECHNICAL CENTRE



**FTP**



## WEB COMMUNICATION



**dB**

## ALARM INFORMATION



Provision of appropriate noise & vibration monitoring stations (DUO, OPER@ or dB4)

3G modem with SIM card and related subscription

Possible use of the customer's 01dB hardware platform where applicable



In-situ and remote setup of monitoring stations based on project specific requirements

Remote access and control of monitoring stations during the project if needed



Regular remote access and review by the 01dB team of the complete system (stations, communication, server)

Real time alerts of power failure and communication breakdown

Automated check of the entire measurement chain's integrity (multiple frequency CIC principle)



Cloud data storage

Back-up and periodic archives

Automated replication (option)

**FTP**

Download raw data via FTP link

Use of the dBTRAIT software for data processing & analysis



Part replacement or system exchange within 72 hours in case of failure\*

On site repair service\*

On-site installation and retrieval of monitoring stations



Customer support hotline for system setup and management



Website display of data, available in 8 languages

Public or private website with secure access (login and password)

Customisable graphic template (option)



Calculation and display of average and sliding indicators (Lden, Ln, Leq per period, Lmax...)

Range of graphic displays: time histories, daily and weekly summaries, spectrograms...

**dB**

Real-time display of measured data together with GPS localisation

Real-time time histories and spectrograms

On demand or continuous display relying on a 30-minute buffer memory (option)



Real-time alarms based on up to 2 user-defined thresholds

Automatic counting of events above thresholds

Coordination of multiple thresholds including across multiple locations

\*Services vary by country. Please contact your local representative for more information.





Una soluzione applicativa facile da usare per il calcolo, la verifica, la predizione e la presentazione dell'esposizione al rumore e l'impatto dell'inquinamento atmosferico.



# CadnaA in sintesi

Studiare il livello di immissione di rumore di un impianto industriale, di un centro commerciale con un'area parcheggio, del progetto per una strada o una ferrovia o perfino di un'intera città con aeroporto: qualsiasi sia il tuo obiettivo CadnaA è pensato per gestire tutti questi compiti!

## ❖ Presentazione interattiva online

Abbiamo realizzato una presentazione di CadnaA online e interattiva (15min-45min). Osserva le caratteristiche più importanti in base ai tuoi bisogni individuali. Tutto ciò di cui hai bisogno è un PC connesso ad internet ed un telefono.

Rivolgiti a [info@datakustik.com](mailto:info@datakustik.com)

## ❖ Gestione intuitiva

Lavora all'interno di un'interfaccia programmata in modo chiaro per calcoli semplici, beneficiando allo stesso tempo di sofisticate possibilità di input mano a mano che la tua analisi diventa più complessa.

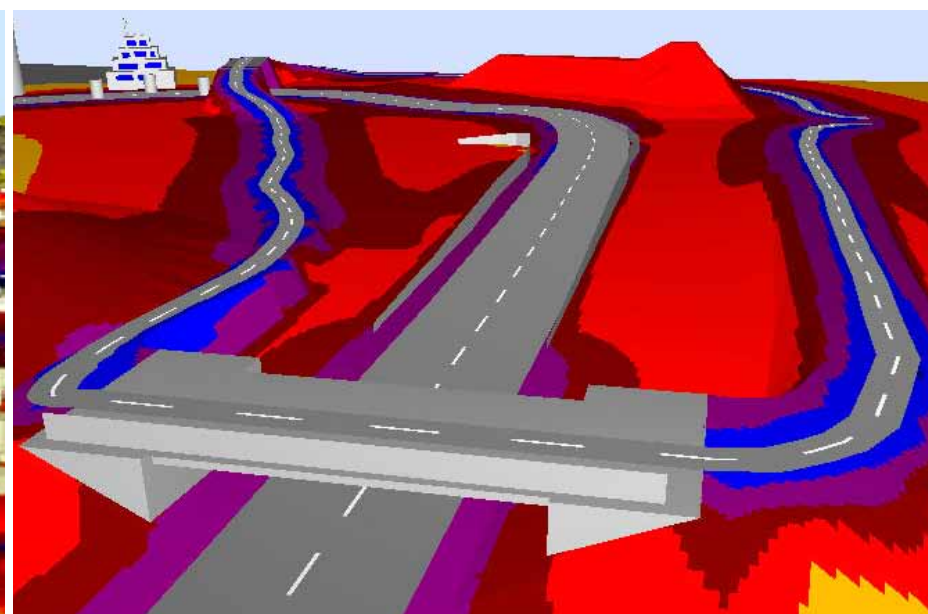
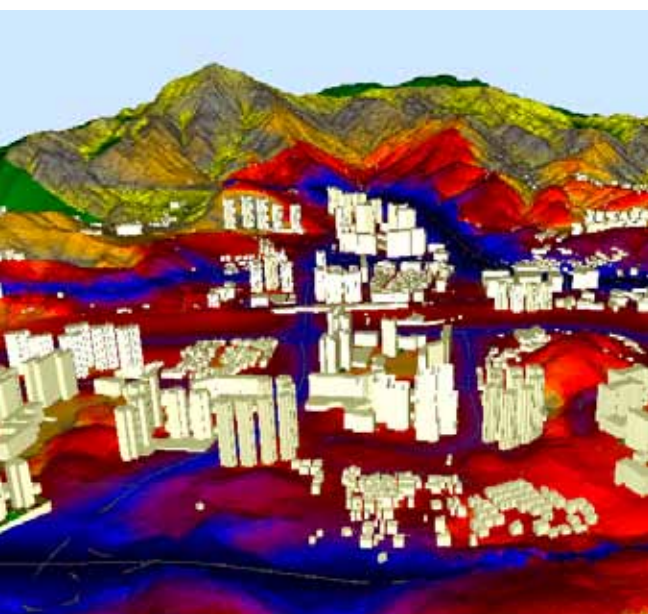
Dedica il tuo tempo al progetto piuttosto che al software. Tutti i dispositivi di input e di analisi sono gestibili in modo facile e intuitivo.

## ❖ Migliore produttività

Cambia la tua visualizzazione da 2D a 3D nel giro di un secondo. Moltiplica la velocità di modellazione utilizzando varie short cut e tecniche di automazione. Diverse tecniche di accelerazione per risparmiare tempo consentono di eseguire calcoli rapidi per i tuoi progetti. Accedi a tutti i dati oggettivi istantaneamente.

## ❖ Analisi avanzata

Basa la tua analisi su standard, metodi di calcolo e linee guida di provata qualità a livello nazionale e internazionale. Esegui analisi predefinite o personalizzate di tutti i dati contenuti nel modello: valutazione di costruzione, individuazione di punti caldi, mappa dei conflitti, ecc.



## Industria

- Progetta misure di riduzione del rumore
- Conserva i dati di emissione in pratici archivi
- Paragona i diversi scenari con variabili
- Rivedi il tuo modello con vari dispositivi sofisticati 3D
- Calcola la propagazione del suono all'esterno a partire da sorgenti di suono interne
- Approfitta dello scambio dei dati con il software Bastian™ per il calcolo del rumore interno
- Calcola l'incertezza con deviazioni standard per emissione e propagazione

## Strada e ferrovia

- Paragona diversi scenari di progettazione
- Ottimizza in modo automatico le barriere vicino a una strada o a una ferrovia
- Visualizza e analizza acusticamente gli scenari di riduzione del rumore
- Gestisci il progetto in modo efficiente con object tree e variabili
- Incrocia automaticamente i dati oggettivi con DTM
- Controlla il tuo modello tramite la visualizzazione di tutte le traiettorie di propagazione

## Mappatura del rumore

- Accelera il tuo tempo di calcolo con il calcolo distribuito e il multithreading
- Utilizza tutta la RAM disponibile con una tecnologia a 64-bit
- Unisci efficientemente vari tipi di dati utilizzando più di 30 diversi formati di importazione
- Accedi a tutti gli attributi oggettivi e alternativi nell'ambito della visualizzazione 3D
- Analizza il tuo modello utilizzando varie tecniche di valutazione del rumore
- Verifica il tuo modello tramite il sistema di assicurazione di qualità utilizzando tecniche di accelerazione
- Beneficia del massimo livello di complessità in dettaglio e della maggiore chiarezza possibile lavorando su segmenti su larga scala

## Sistema esperto in ambito industriale (Opzione SET)

- Genera automaticamente lo spettro di potenza sonora basato sui parametri tecnici di sistema di una sorgente di sonora (ad es. energia elettrica in kW, flusso del volume in m<sup>3</sup>/h, velocità di rotazione in rpm)
- Facilita il tuo lavoro utilizzando 150 moduli per le sorgenti sonore tecniche come motori elettrici e di combustione, pompe, ventilatori, torri di raffreddamento, trasmissioni, ecc.
- Modella i sistemi complessi comprese le trasmissioni combinando le sorgenti (ad es. ventilatore con due condotti)

## Aerei

### (Opzione FLG)

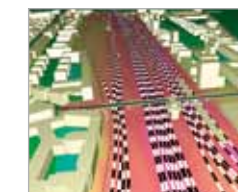
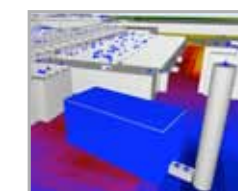
Calcola il rumore emesso dagli aeroporti civili e militari basato sui metodi di calcolo AzB 2008, AzB (1975), ECAC Doc.29 oppure DIN 45684-1

- Includi le procedure più importanti per la valutazione del rumore aereo a livello europeo e internazionale
- Conduci una valutazione complessiva dell'esposizione totale al rumore, includendo il rumore stradale, ferroviario e aereo
- Utilizza i dati radar e la classificazione di gruppo secondo il codice ICAO per calcolare il rumore aereo

## Inquinamento atmosferico

### (Opzione APL)

- Calcola, verifica e presenta la distribuzione di inquinante atmosferico secondo il modello atmosferico della dispersione di Lagrangian AUSTAL2000 (altri modelli sono in corso di integrazione)
- Combina la valutazione delle misure nel contesto di un rumore e i progetti di mitigazione della qualità dell'aria
- Approfitta dell'usabilità e del potere di calcolo di CadnaA anche mentre modelli la distribuzione dell'inquinante atmosferico
- Applica tutti i formati d'importazione senza alcun costo aggiuntivo






Versione demo gratuita

Visita: [www.datakustik.com](http://www.datakustik.com)



Approfondisci la tematica con i nostri web tutorial [www.datakustik.com](http://www.datakustik.com)



Utilizza il nostro software Cadna  R® per la previsione del rumore all'interno degli edifici e negli ambienti di lavoro. L'interfaccia utente e la gestione di Cadna  A\* e Cadna  R® sono quasi identiche e consentono una gestione efficiente del lavoro in entrambi i campi di applicazione.

## Servizi

### Helpdesk

I nostri esperti sono al tuo servizio. Effettua una semplice telefonata o inviaci il tuo file qualora dovessi incorrere in qualsiasi problema nell'ambito dei tuoi progetti.

### Seminari

Offriamo di frequente workshop per principianti ed esperti per tenerti aggiornato sugli ultimi sviluppi.

### Web seminar

Scopri gli ultimi sviluppi e le applicazioni specifiche rimanendo comodamente in ufficio. Questi workshop online sono un modo efficace per tenerti informato sullo stato dell'arte delle tecniche di modellazione.



Ulteriori informazioni sui  
seminari su:

[www.datakustik.com](http://www.datakustik.com)

## CadnaA Standard

tutti gli standard e le  
linee guida disponibili

tutti i tipi di rumore  
(industriale, stradale e  
ferroviario)

## CadnaA Basic

tutti i tipi di rumore  
(industriale, stradale e  
ferroviario)

Uno standard o linea  
guida per ogni tipo di  
rumore

## CadnaA Modular

Un tipo di rumore

Uno standard o linea  
guida per ogni tipo di  
rumore



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## CadnaA

CadnaA is a world-leading, state-of-the-art software for modeling, calculation and assessment of environmental noise. It can be used efficiently at any scale, starting with a few single receivers in a neighborhood up to noise mapping projects of entire countries. This works for various source types in the fields of road-, railway-, aircraft-, and industrial noise.

CadnaA is a highly usable, yet flexible program which enables a steep learning curve. The approach of having one interface for the whole program, without any modular separation, will allow CadnaA beginners to get started quickly, while the existence of sophisticated project organization techniques and advanced assessment tools will allow handling even complex projects with ease.

With CadnaA, program parts which are required for most projects, such as advanced visualization techniques in 2D and 3D and a wealth of possible import formats, are implemented in all possible CadnaA configurations. This makes CadnaA a valuable tool even in its most basic configuration. Users who want to perform special tasks, such as statistical evaluations for noise mapping projects, can upgrade with separate options if required.

### Uses

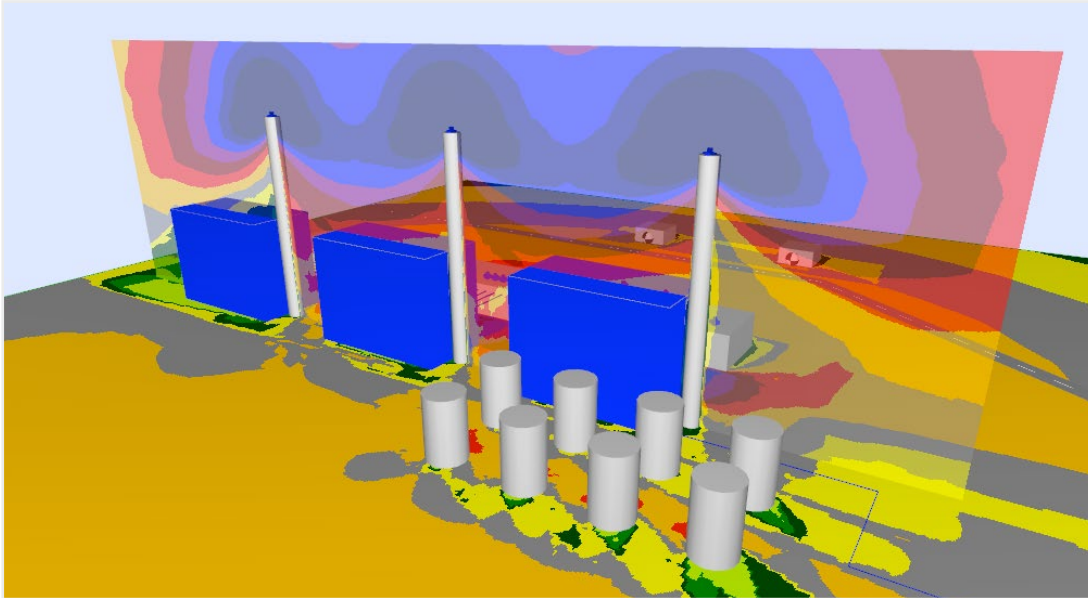
- Modeling and calculation of industrial- traffic- and aircraft noise at different scales
- Noise mapping according to the Environmental Noise Directive (2002/49/EC)
- Statistical evaluations of noise and other data

### Key Features

- Highly usable, yet flexible concept
- Calculation according to various national and international standards and guidelines
- Fast calculations even for large projects due to multicore use and 64bit option
- Flexible display and result output options

## Use Cases

The following pictures show a small selection of possible cases where CadnaA can be and has been used successfully. Of course, many more different cases are possible.

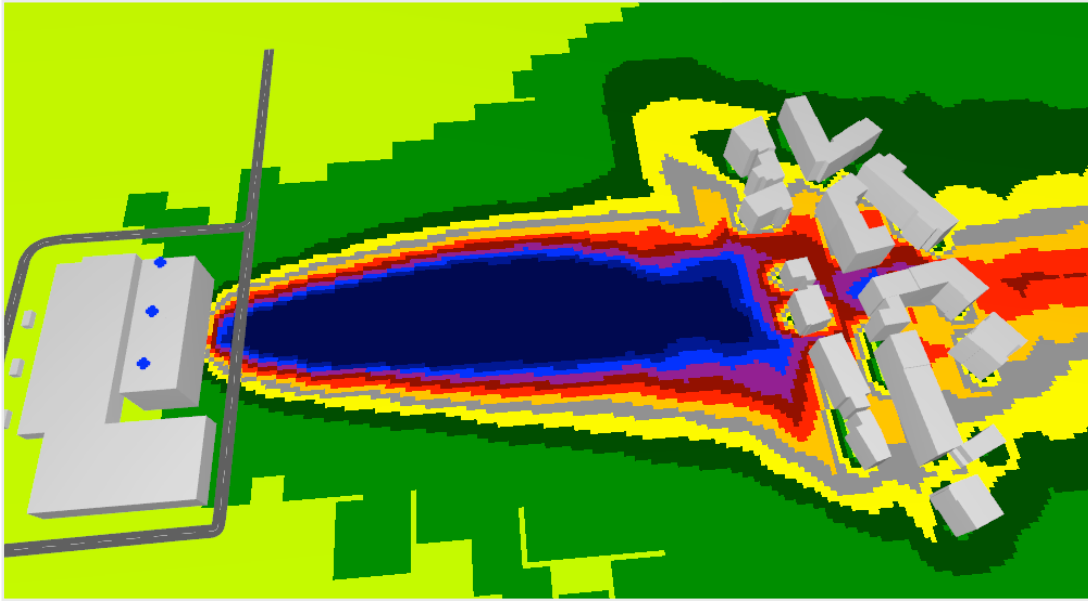


Noise distribution calculated around a power station

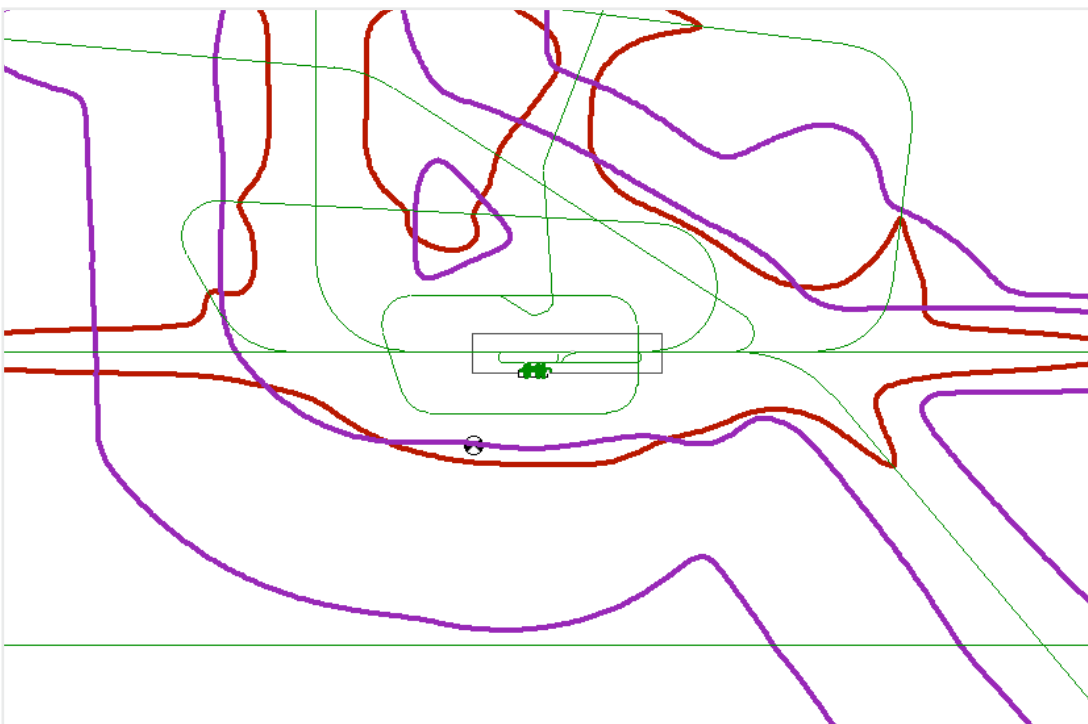


CadnaA 2D view of a railroad and road noise project and 3D View with Building Noise Map results

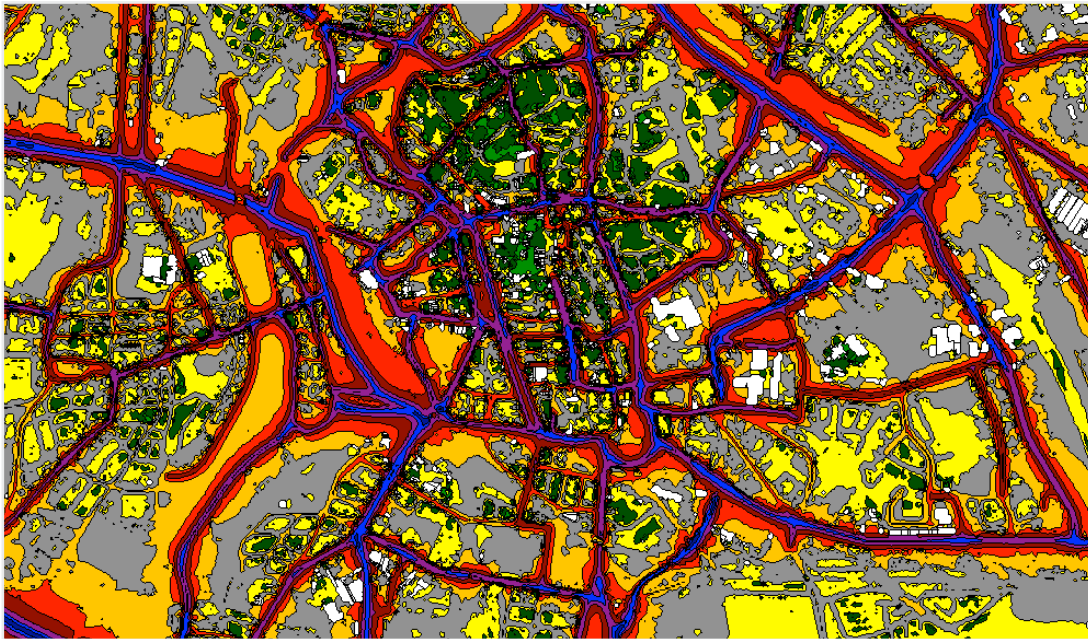




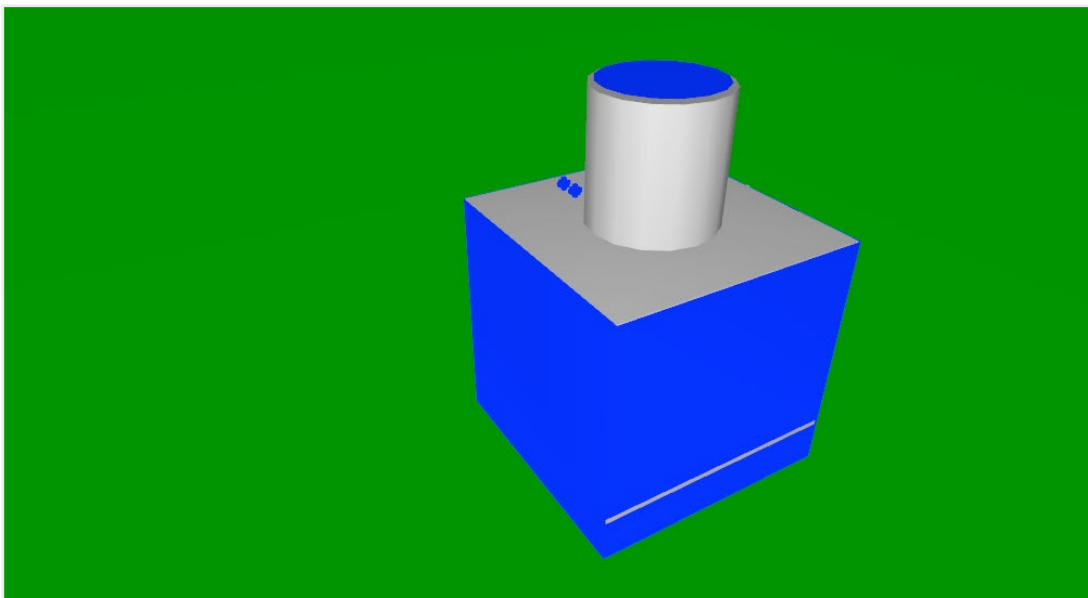
Air pollution calculated close to a dwelling



Noise contours around an airport

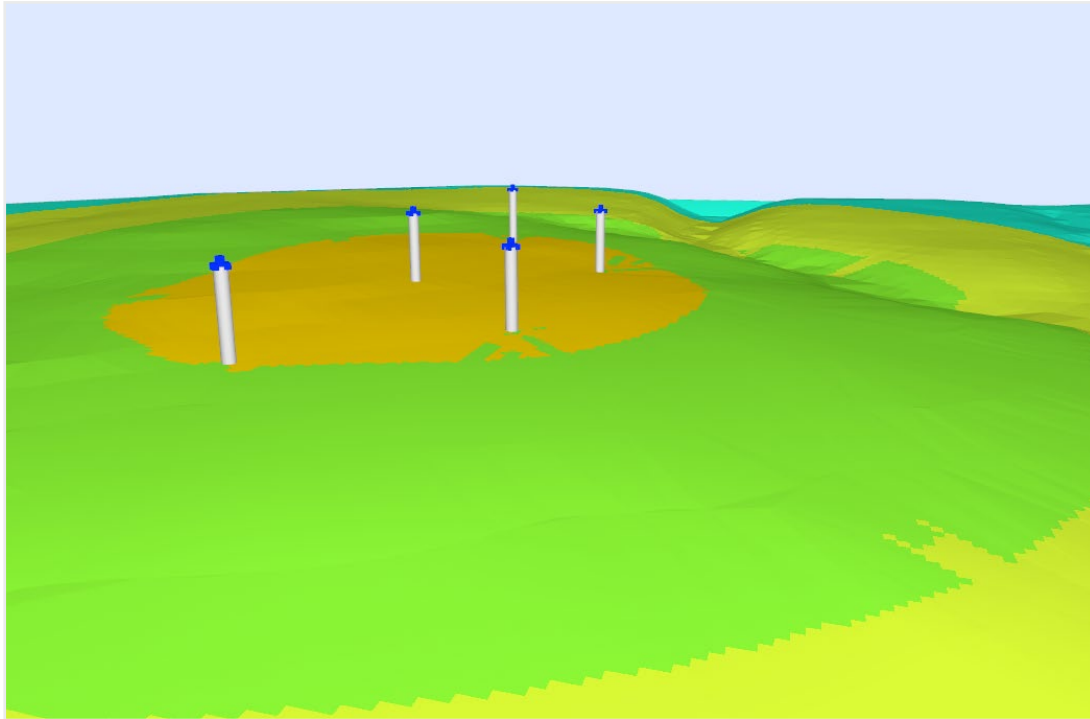


Small part of a large noise map which was calculated with CadnaA

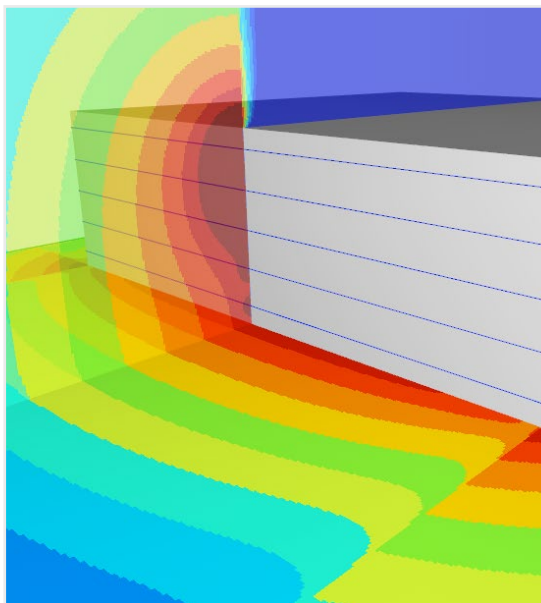


CadnaA model of a cooling tower. All emissions were calculated from technical parameters via CadnaA SET.

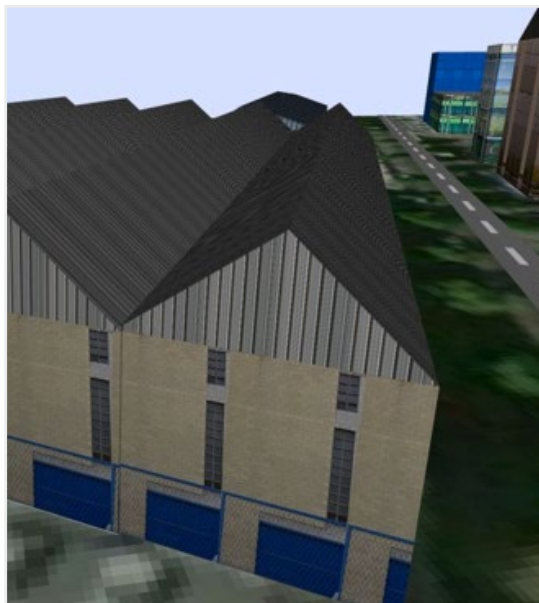




Several wind power stations modeled and calculated with CadnaA including meteorological corrections



Noise distribution outside a car park, calculated on a horizontal and a vertical grid



Model of an industry facility and surrounding buildings, including roof edges and high resolution facade pictures.

## Software Configurations

CadnaA is available in the general setup Basic, Standard, and Modular. No matter which setup you choose, program parts which are important for all kinds of projects are included even in the most light-weight configurations. The following list shows a selection of always available features.

### Selection of always available features

<b>Import</b>	Except for bitmaps, which require option BMP, the possible import formats in CadnaA are available for all possible CadnaA configurations
<b>Display</b>	You'll always have access to the possible and powerful display options
<b>PCSP</b>	Even for the smallest CadnaA packages, it's possible to subdivide projects into several sections, which then can be processed separately
<b>Result Tables</b>	It's possible to use, modify and create result tables for all CadnaA configurations
<b>Arithmetics</b>	The powerful grid arithmetic feature is available for all CadnaA configurations

### General CadnaA Configurations

<b>Standard</b>	With CadnaA Standard, you'll have access to all available calculation standards for the noise types Industry, Road and Railway
<b>Basic</b>	With CadnaA Basic, you'll have access to one calculation standard for each of the noise types Industry, Road and Railway
<b>Modular</b>	With CadnaA Modular, you can choose one calculation standard for one of the noise typed Industry, Road or Railway
<b>Modular Light</b>	With CadnaA Modular Light, you can choose one calculation standard for one of the noise types Industry, Road or Railway. The maximum number of sources is limited to 30 roads, railways, area source, line sources, and to 50 point sources

## CadnaA Options

<b>X</b>	A feature-pack especially for noise mapping. It contains the features Object-Scan, Population Density, Monetary Evaluation, Map of Conflicts, Close Polygons Automatically, Delete Height Points
<b>L</b>	Calculate with an unlimited number of screening objects
<b>XL</b>	Combination of options X and L
<b>64 bit</b>	Use CadnaA (incl. all further extensions) with 64bit address length. Handle large projects with one single file. 64GB of RAM can be addressed; a 64bit operating system is required.
<b>BMP</b>	Import various bitmap formats. Option BMP includes direct access to Google Earth (Import/Export)
<b>BPL</b>	Optimize area-based sound power levels depending on limiting values at receivers
<b>SET</b>	Create sound power spectra based on technical parameters. Combine different modules to create complex facilities.
<b>APL</b>	Calculate air pollution for more than 50 pollutants for industrial and road sources
<b>FLG</b>	Calculate noise propagation from aircrafts
<b>Radartracks</b>	Use radar tracks (Fanomos, Stanly, Topsonic) for aircraft noise calculations. Group assignment is done via ICAO code.
<b>MITHRA</b>	Assure compatibility of calculation results with the French program MITHRA.
<b>CALC</b>	Install CadnaA on up to 5 computers, which can participate in calculations.
<b>CALC XL</b>	As option CALC, but including 64bit capabilities

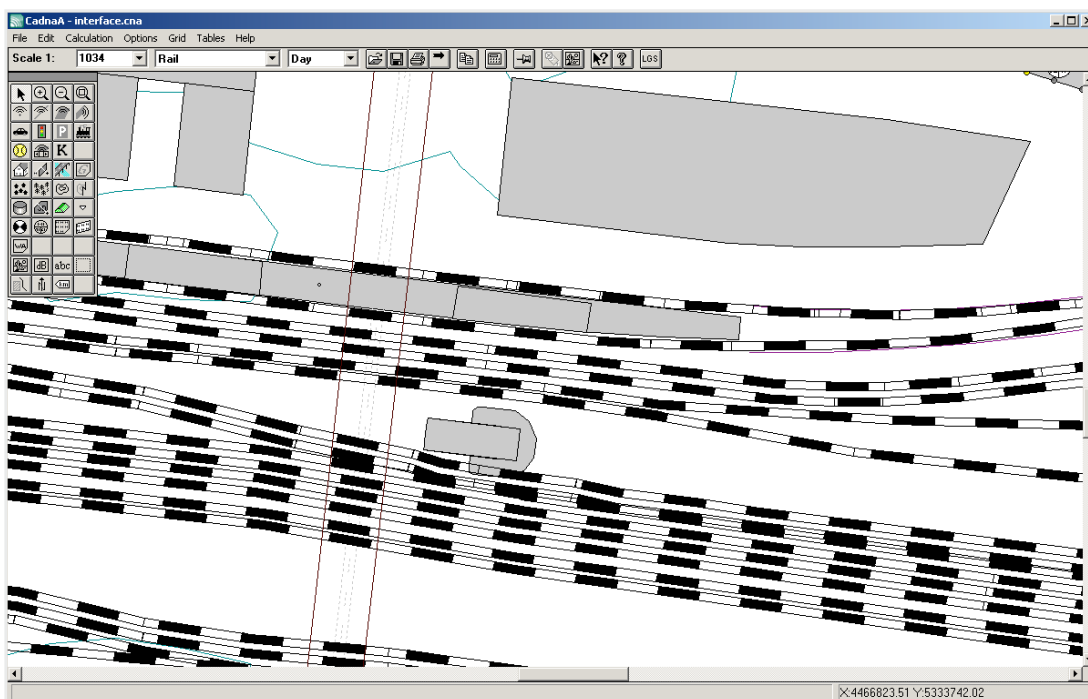


## Usability / Interface

In addition to the features which are available in all CadnaA setups, there are options, which can be purchased along with CadnaA. These options generally aim at specialized features, which can be very valuable depending on the type of project. The following options are possible:

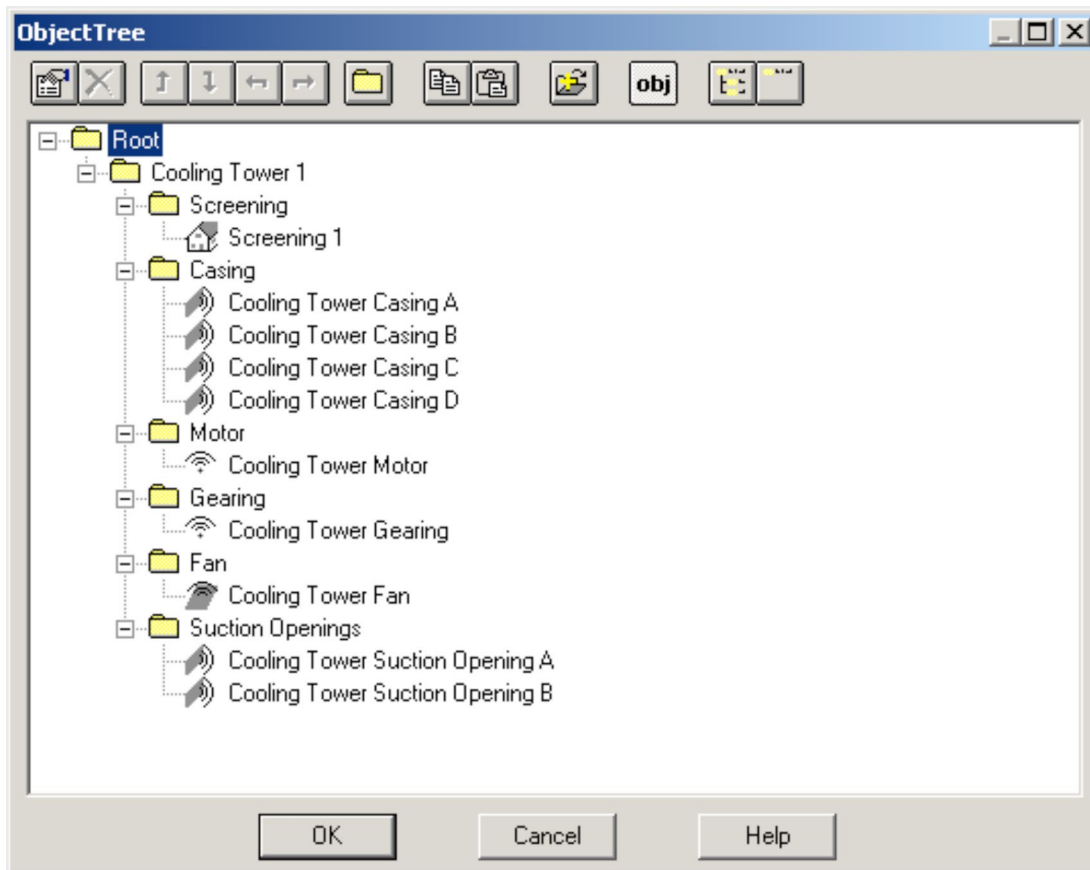
One interface for the whole software

One of the big CadnaA advantages is its advanced usability. No matter of what type your project is, no matter which options you might have purchased, CadnaA is always based on the same intuitively usable interface which doesn't require separate complicated modules. Due to this, CadnaA has a very steep learning curve, and even if you haven't used the program for a while, you'll be able to solve your noise related problems fast with it.



## Powerful Project Organization

CadnaA has a sophisticated concept for organizing larger projects. All objects can be structured hierarchically in an ObjectTree or organized in groups. Based on this organizational scheme, it's easy to create several variants in one file. If you for example want to compare sound sources with different properties, or completely different geometries, this is a fast and reliable way to do so.



## Object Access

It is significant to have access to all objects in CadnaA at any time. In CadnaA, this is not only possible in the 2D construction view, but also directly from the OpenGL based 3D view, from object tables and from the ObjectTree. So no matter which of the several possible ways of handling objects turns out to be your favorite one, access to objects is always ensured.

## Library Concept

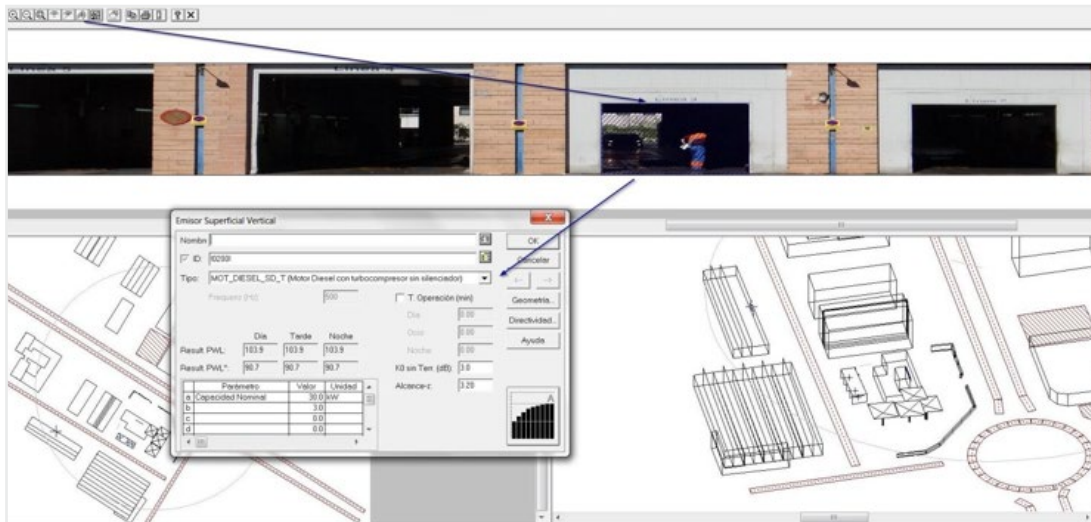
Elements which are no model of physical objects – e.g. sound power spectra or directivities - are stored in libraries. In CadnaA, libraries can exist locally for a project and globally for all projects. There are predefined libraries in CadnaA, which can easily be expanded by own measurements and definitions, and due to a conveniently usable library manager, it's easy to even exchange libraries with colleagues.

## 3D View

CadnaA features a powerful, OpenGL based 3D view, which serves several purposes: use it to quickly check your model, or for changing objects due to the direct access to them which you also have in 3D mode, or use it for presenting results to customers.

## Facade Editing

The Edit Facades command allows precisely to draw and calibrate emission sources which are located at the facade of buildings. By using the comfortable interface of the facade texture feature, you will have full control of the shape, position and type of the emission located at the facade. Additionally, every picture associated to any facade is represented within the 3D View in order to ensure project overview and high quality presentations at all times.



## Same Concepts as in CadnaR

CadnaA shares many of its concepts with CadnaR, the software for indoor noise calculation. Consequently the user of one of the two software products will be able to easily learn the other one.



## Flexibility

Several features and capabilities make CadnaA one of the most flexible noise calculation programs on the market. And this is not at the cost of usability!

### Object-Scan

The Object-Scan allows for statistical evaluations in your project. It can be used for analyses of exposed inhabitants according to EC regulations, but due to its flexible concept, all kinds of formulas for statistical evaluations can be used.

### Attribute Access

All objects in CadnaA have a set of attributes, which describe the objects entirely. Access to all attributes is ensured at any time. One of the access possibilities is the function Modify Attributes, which also gives global access to attributes easily.

### Grid Arithmetics

In case you have calculated several grids in CadnaA, they can easily be compared. With Grid Arithmetics, a large selection of mathematical operations can be performed on the grid, which effectively allows grid additions or comparisons without much effort.

### Dynmap

With the Dynamic Noisemap (Dynmap) it is possible to update calculated noise maps based on measurements. This is an extremely valuable tool when monitoring stations are available in a city. The update in CadnaA is very fast, as no new noise distribution calculations need to be executed.

### Geodetic Transformations

Objects in CadnaA can be transformed in a variety of modes, including geodetic transformations. So if your project for example is in UTM coordinates, but you want to use data which has been modeled based on e.g. Gauß-Krüger-Coordinates, transformation is easy. If desired, this can be done directly during import.

### Import options

CadnaA offers a huge variety of import formats. The most important import formats might be DXF, SHP and bitmaps from Google Earth; the whole list of possible formats for import can be seen further down in this document.

# Calculation

CadnaA is one of the most powerful noise calculation programs on the market. Here are a few of the reasons which make CadnaA such a superior calculation tool:

## Multicore Calculation

CadnaA supports multicore calculations to obtain results in very short times.

## 64 bit support

With 64bit support in CadnaA Option 64, you can use all available RAM. Especially for large projects this is an enormous advantage compared to old-fashioned programs which still don't support more than 32bit address length.

## Segmented Processing

CadnaA allows an easy subdivision of your projects into several tiles with the PCSP technology. With this technology, several computers in a network can participate in the calculation of a project

## Two calculation methods

CadnaA is the only noise calculation programs, where you can choose between the two most important noise calculation methods: *ray tracing* and *angle scanning*.

## Sophisticated Acceleration Techniques

In CadnaA it's possible to speed up the fast calculations even more by applying intelligent acceleration techniques. These techniques are optional and include interpolations, maximum search radii and the possibility to allow a maximum calculation error

## Statistical Evaluations

Especially when calculation acceleration has been used, statistical evaluation regarding exactness are important. CadnaA has an easy to use tool which executes them according to DIN 45687 (QSI).

## Uncertainty Calculations

CadnaA has a large selection of evaluation parameters. Among those are the possibility of calculating standard deviations, which is required by many guidelines like TA Lärm.

## Wall Optimizations

When a certain limiting level is given, CadnaA can automatically optimize given walls in order to minimize the required wall area in a way where the limiting levels are still not exceeded.

## Pass-by levels

CadnaA can not only calculate Leqs, but also show the time-based sound pressure levels based on passing sound sources like cars or trains. The results can be visualized in a graph, auralized and shown for a whole calculated grid.

## Many calculation standards

CadnaA can perform calculations according to various national and international standards. The following page shows the list of supported calculation standards:

## Supported Calculation Standards for Industrial Noise

ISO 9613	International, EC-Interim
CONCAWE	International
VDI 2714	Germany
VDI 2720	Germany
DIN 18005	Germany
ÖAL Richtlinie Nr. 28	Austria
BS 5228	United Kingdom
General Prediction Method	Scandinavia
Ljud från vindkraftver	Sweden
Harmonoise	International

## Supported Calculation Standards for Road Noise

NMPB-Routes-9	France, EC-Interim
RLS-90, VBUS	Germany
DIN 18005	Germany
RVS 04.02.1	Austria
STL 86	Switzerland
SonRoad	Switzerland
CRTN	United Kingdom
TemaNord 1996:525	Scandinavia
Czech Method	Czech Republic

## Supported Calculation Standards for Railway Noise

RMR, SRM II	Netherlands, EC-Interim
Schall03, Schall Transrapid, VBUSch	Germany
Schall03 new, draft	Germany
DIN 18005	Germany
ONR 305011	Austria
Semibel	Switzerland
NMPB-Fer	France
CRN	United Kingdom
TemaNord 1996:524	Scandinavia
FTA/FRA	USA

## Supported Calculation Standards for Aircraft Noise

ECAC Doc. 29, 2nd edition 1997	International, EC-Interim
DIN 45684	Germany
AzB	Germany
AzB-MIL	Germany
LAI-Landeplatzleitlinie	Germany
AzB 2008	Germany

## Supported Calculation Standards for Air Pollution

AUSTAL 2000	Germany
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## Result Display / Export

In CadnaA, all result display and output possibilities are easily to handle and provide results in a convenient and reliable way

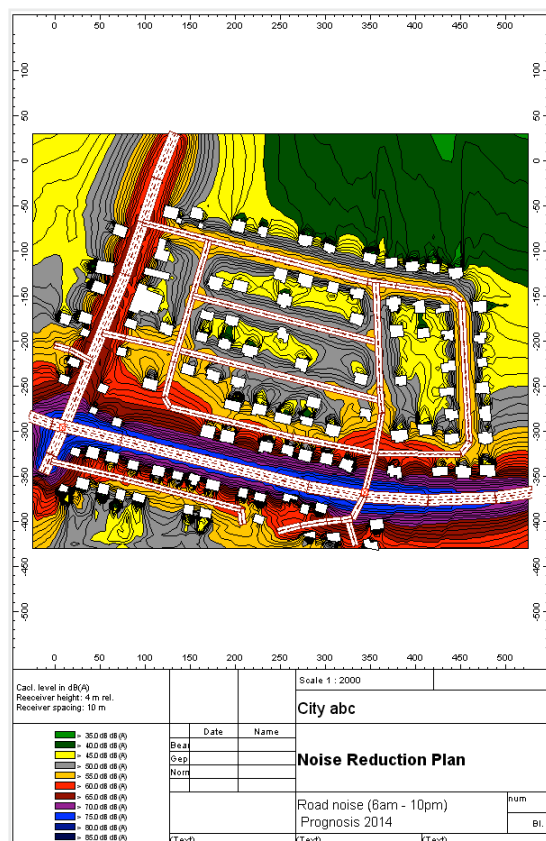
### Result Tables

Calculation results can be displayed in a configurable result table. Display all desired result properties including variant comparisons in highly adaptable tables.

Result Table											
Receiver		Limiting Value		Lr without barriers		Exceeding of lim.value (without barriers)		Lr with barriers		Exceeding of lim.value (with barriers)	
Name	ID	day	night	day	night	day	night	day	night	day	night
		dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
receiver 1	rec1	60	55	64.0	64.0	4.0	9.0	64.0	64.0	4.0	9.0
receiver 2	rec2	60	55	68.5	68.5	8.5	13.5	54.0	54.0	-	-
receiver 4	rec4	60	55	67.3	67.3	7.3	12.3	51.0	51.0	-	-
receiver 5	rec5	60	55	34.3	34.3	-	-	34.3	34.3	-	-
receiver 3	rec3	60	55	72.3	72.3	12.3	17.3	53.8	53.8	-	-

### Plot Designer

The Plot Designer is a unique way of presenting calculation results to the public. You can choose predefined designs to quickly obtain a plot or design own layouts from the scratch.



## Protocol

All calculations to single receivers can be traced. This means that a formatted protocol is written, which displays all attenuation terms from sources to receivers for direct and reflected rays, always depending on the chosen calculation standard. This makes it easy to see exactly where a calculated result comes from.

Point Source, ISO 9613, Name: "source1", ID: "source1"																			
Nr.	X	Y	Z	Ref.	Freq.	LxT	LxN	K0	Dc	Adiv	Aatm	Ag	Afol	Ahous	Abar	Cmet	RL	LrT	LrN
	(m)	(m)	(m)		(Hz)	dB(A)	dB(A)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	dB(A)	dB(A)
1	62.34	172.33	4.00	0	32	42.6	42.6	0.0	0.0	50.5	0.0	-3.0	0.0	0.0	0.0	0.0	-0.0	-4.9	-4.9
2	62.34	172.33	4.00	0	63	63.8	63.8	0.0	0.0	50.5	0.0	-3.0	0.0	0.0	0.0	0.0	-0.0	16.3	16.3
3	62.34	172.33	4.00	0	125	80.9	80.9	0.0	0.0	50.5	0.0	4.6	0.0	0.0	0.0	0.0	-0.0	25.8	25.8
4	62.34	172.33	4.00	0	250	102.4	102.4	0.0	0.0	50.5	0.1	3.5	0.0	0.0	0.0	0.0	-0.0	48.3	48.3
5	62.34	172.33	4.00	0	500	105.8	105.8	0.0	0.0	50.5	0.2	0.0	0.0	0.0	0.0	0.0	-0.0	55.1	55.1
6	62.34	172.33	4.00	0	1000	96.0	96.0	0.0	0.0	50.5	0.4	0.0	0.0	0.0	0.0	0.0	-0.0	45.1	45.1
7	62.34	172.33	4.00	0	2000	80.2	80.2	0.0	0.0	50.5	0.9	0.0	0.0	0.0	0.0	0.0	-0.0	28.8	28.8
8	62.34	172.33	4.00	0	4000	76.0	76.0	0.0	0.0	50.5	3.1	0.0	0.0	0.0	0.0	0.0	-0.0	22.4	22.4
9	62.34	172.33	4.00	0	8000	67.9	67.9	0.0	0.0	50.5	11.1	0.0	0.0	0.0	0.0	0.0	-0.0	6.3	6.3
10	62.34	172.33	4.00	1	250	102.4	102.4	0.0	0.0	54.1	0.2	3.8	0.0	0.0	0.0	0.0	6.0	38.3	38.3
11	62.34	172.33	4.00	1	500	105.8	105.8	0.0	0.0	54.1	0.3	0.0	0.0	0.0	0.0	0.0	6.0	45.4	45.4
12	62.34	172.33	4.00	1	1000	96.0	96.0	0.0	0.0	54.1	0.5	0.0	0.0	0.0	0.0	0.0	6.0	35.3	35.3
13	62.34	172.33	4.00	1	2000	80.2	80.2	0.0	0.0	54.1	1.4	0.0	0.0	0.0	0.0	0.0	6.0	18.7	18.7
14	62.34	172.33	4.00	1	4000	76.0	76.0	0.0	0.0	54.1	4.7	0.0	0.0	0.0	0.0	0.0	6.0	11.2	11.2
15	62.34	172.33	4.00	1	8000	67.9	67.9	0.0	0.0	54.1	16.8	0.0	0.0	0.0	0.0	0.0	6.0	-9.0	-9.0

## Export Formats

Not only calculated results, but also the geometries can be exported. The whole list of export formats can be seen further down in this document. This makes it easy to see exactly where a calculated result comes from.

# Technical Specifications

## File Types for Import

Atlas GIS	former GIS-software by ESRI (until 2001)
ArcView	Shape-file from ArcView/ArcInfo-GIS-software (by ESRI)
ASCII grid	ASCII-format for grid point data
ASCII Objects	ASCII-format for open or closed polygon-lines
AutoCad-DXF	AutoCad export format for object geometry (by Autodesk Inc.)
Building Height points	ASCII-format for building height points
CityGML	format for exchange and storage of virtual 3D city models
EDBS	format used by the German ordnance surveys
GML	format used by the UK Ordnance Survey
GYpSiNOISE	data interchange format CadnaA-GIS
LimA	format used by LimA software
MapInfo	format used by MapInfo (by MapInfo Corp.)
MITHRA	format used by MITHRA software
NTF	UK National Transfer Format
QSI	data interchange format according to DIN 45687 and ÖAL 36
Sicad	GIS-software by AED-SICAD AG
SLIP	format used by SLIP road noise software
SOSI	format used by SOSI software (© Ordnance Survey Norway)
SoundPLAN	format used by SoundPLAN software
Stratis	program system for road design & civil eng. (by RIB Software AG)
T-Mobil	format used by Deutsche Telekom MobilNet GmbH
Winput-DGM	ASCII-format by the Bavarian Ordnance Survey, Munich

## File Types for Export

ArcView Grid	used by ArcView/ArcInfo-GIS-software (by ESRI)
ArcView Shape	used by ArcView/ArcInfo-GIS-software (by ESRI)
AutoCad DXF	AutoCad format for object geometry (by Autodesk Inc.)
Building Height points	ASCII-format for building height points
Google Earth	Keyhole Markup Language (KML)
GYpSiNOISE	data interchange format CadnaA-GIS
IMMIS Luft	format used by IMMIS software
LimA	format used by LimA software
QSI	data interchange format according to DIN 45687 and ÖAL 36
RTF	document file format
Text files	
X-file	



## Object Types in CadnaA

Point Source  
Line Source  
Area Source  
Vertical Area Source  
Road  
Traffic Light  
Parking Lot  
Railway  
Tennis  
Optimizable Source  
Power-Plant-Source  
Building  
Barrier (incl. floating barrier, cantilevered barrier)  
Bridge  
Ground Absorption  
Built-Up Area  
Foliage  
Contour Line  
Line of Fault  
Cylinder  
3D Reflector  
Embankment  
Height Point  
Receiver  
Building-Evaluation  
Calculation Area  
Vertical Grid  
Area of Designated Land Use  
Bitmap  
Level Box  
Text Box  
Section  
Auxiliary Polygon  
Symbol  
Station  
Airport  
Air Route

## Specifications for Modeling and Calculating

### Maximum number of sources per project:

Unlimited, except when using CadnaA Modular Light, where it's limited to 50 point sources and/or 30 of other source types

### Maximum number of obstacles:

16 million

### General Calculation Methods:

Two general calculation methods are possible in CadnaA, either ray tracing or angle scanning

### Calculation with spacious sources:

Area- and line sources, including roads, railways, parking lots, are subdivided into several point sources for propagation calculation in CadnaA. This way, several rays are calculated from larger sources to receivers. In the case of existing obstacles, a so-called projection method ensures that rays are calculated in between objects for realistic results, when possible.

## Specifications for Terrain and Obstacles

<b>Contour Lines</b>	together with implicitly created triangulation lines, contour lines can have diffracting influence on noise propagation. Other objects can automatically be lifted to an appropriate height above the resulting terrain, in case their height set to relative
<b>Height Points</b>	Used to create triangulation lines, which have diffracting influence on noise propagation. Other objects can automatically be lifted to an appropriate height above the resulting terrain, in case their height set to relative
<b>Lines of Fault</b>	can be modeled with vertices to change the terrain height locally
<b>Barriers</b>	can be modeled on top of terrain, if desired. The height parameters define the upper edge, which can be absolute or relative. Barriers can act diffracting and reflecting (with different octave band based absorption coefficients being possible on both sides).
<b>Floating Barriers</b>	Like barriers, but the height of a lower barrier edge can implicitly be defined by entering a z-extension. Noise can propagate below the barrier.
<b>Cantilevered Barriers</b>	Like barriers, but with a cantilever. The cantilever dimension is entered in horizontal and vertical direction.
<b>3D Reflector</b>	an obstacle that can be defined as arbitrarily positioned plane. It can act diffracting and reflecting.
<b>Embankment</b>	Element that can be positioned on top of existing terrain. It's completely absorbing.
<b>Building</b>	Defined with vertices; can be entered in absolute height or relative to the terrain. Buildings can act diffracting and reflecting. They can also have a transparency value, allowing for parts of the noise propagating through buildings for special modeling situations. Furthermore, a number of residents can be assigned to any building.
<b>Roof Edges</b>	this function allows to calculate noise propagation shielded by buildings within the frame of calculation standards and also to create visual realistic appearance of buildings.
<b>Cylinder</b>	Defined by its center point and radius; the height can be relative or absolute. Cylinders in CadnaA can have reflecting and diffracting properties.

## Specifications for Modeling and Calculating Industrial Noise

<b>Source Types</b>	point, line, horizontal and vertical area sources
<b>Emission</b>	Sound Power Level, alternatively length-related PwL for line sources, area-related PwL for area sources and moving point sources for line- and area sources. PwL is either A-weighted level with indication of main frequency band or octave band sound power levels 31.5 Hz – 8000 Hz. Furthermore, CadnaA can automatically calculate the PwL based on technical parameters such as the pressure and flow rate of fans.
<b>Height</b>	z-coordinates in meters (absolute, relative to ground height or relative to the height of a roof)
<b>2D Geometry</b>	Points x and y or in polar coordinates (absolute or relative to the last point)
<b>Operation Time</b>	Can be defined in minutes for day, evening, night. The duration of these time periods and a level correction can be defined in the configuration menu.
<b>Directivity</b>	For point-, line- and area sources. Each directivity is referenced in the source input window and then positioned with a vector. Directivity index in 15°-steps from 0° to 180° for all octave bands 31.5 Hz to 8000 Hz. If values are missing these are interpolated automatically. Furthermore, predefined standardized directivities can be chosen.
<b>Emmission at facade</b>	Point, line and area sources can be modeled precisely in vertical section view through the “edit facades” interface.



# Specifications for Modeling and Calculating Road Noise

## Source Type

Road

## Emission

The emission can either be specified directly depending on the chosen standard, or, alternatively, be calculated based on the following parameters (also depending on chosen standard):

- **daily counts** (e.g. MDTD: mean daily traffic density Vehicles / 24h)
- **hourly count data** (Vehicles/1h).
- **percentage of heavy vehicles** (e.g. heavy vehicles, light trucks, noise reduced trucks)
- **speed**
- **type of road surface**
- **traffic flow**
- **road gradient correction**

## Road Gradient

The road gradient can be calculated based on the terrain model and processed further as road attribute upon calculation.

## Height

coordinates in meter absolute or relative to ground height. If heights are unknown for some polygon points these can be interpolated automatically using the heights of neighbouring points.

## Further Attributes

Further attributes are available for road noise:

- **road width at each point** (variable road width possible)
- **lateral slope at each point** (variable lateral slope possible)
- **speed limit** for day / evening / night and for cars / trucks separately

## Self-screening

the propagation from segmented road source is calculated as if the road surface was a reflecting plate. Diffraction at the plate edges is considered. This feature enables to model bridges, viaducts and other kind of raised roads. The additional width can be specified for left and / or right side of the road. On both sides the height of parapets can be entered.

## Pass-By Levels

A level – time history for a defined vehicle and speed can be calculated and displayed graphically. Alternatively, a video with a moving grid can be calculated.

## Auralisation

Pass-bys can be auralized; the sound will be reproduced including the Doppler Effect (for road sources).

# Specifications for Modeling and Calculating Railway Noise

## Source Type

Railway

## Emission

The emission can either be specified directly depending on the chosen standard, or, alternatively, be calculated based on the following parameters (also depending on chosen standard):

- **type of train:** predefined lists of trains types (depending on selected railroad standard)
- **train classes:** The type and number of trains (for intervals day, evening, night) can be entered into the library and is referenced by a class name. When the timetable change just the editing of the lists in the library are necessary. All railroad sections concerned by this change will be updated automatically.
- **percentage with disc brakes**
- **number of trains** (day, evening, night)
- **speed**, maximum speed
- **train length**, number of axes
- **corrections:** bridge, railway crossing, radius of curves

## Height

coordinates in meter absolute or relative to ground height. If heights are unknown for some polygon points these can be interpolated automatically using the heights of neighbouring points.

## Pass-By Levels

Each receiver point can be selected to calculate the level – time history for a defined vehicle and speed. Presentation as time history of the level at the receiver. Alternatively, a video with a moving grid can be calculated.

## Specifications for Modeling and Calculating Aircraft Noise

<b>Source Type</b>	Air Routes
<b>Emission</b>	The emission is described based on aircraft groups. For each aircraft group a reference spectrum at a reference distance and a directivity index is specified. In addition, for each aircraft group the flight path profiles for take-offs and landings are given. The aircraft groups are distributed by default.
<b>Percentage</b>	For each air route the percentage of flights can be specified for time intervals day/evening/night. With 100%-percentage the flight traffic data is considered as being specified within the calculation. With other percentages of flights different kinds of scenarios can be accounted for (e.g. with shorter reference time intervals) without the need to enter the number of flights again.
<b>Traffic-Count Calculator</b>	With the Traffic-Count Calculator the present numbers of aircraft on air routes with traffic specified for the time periods day/evening can be redistributed for the time intervals day/evening/night according to EC-directive without additional calculation or paperwork.
<b>Noise Contours</b>	Calculation of noise contours of constant equivalent sound pressure level. Aircraft noise zones are calculated according to AzB (with balancing of irregularities and optional protocol)
<b>Max. Level Statistics</b>	maximum level distributions can be calculated at predefined receiver points. By specifying a different percentage of flights on each air route the maximum level distribution can be calculated for a different time interval (e.g. one day instead of 6 months).
<b>Arousal Reactions</b>	additional arousal reactions during the sleep at night induced by aircraft noise events can be calculated with CadnaA
<b>Number of Exceedings</b>	Calculate the number of exceeding above a threshold value. In this case, the grid shows not levels, but the number of exceedings of the stated level.

# Specifications for General Calculation Results

## Calculation at single receivers

Single receivers can be placed on any position in the project. Here, calculations for up to 4 evaluation parameters and 16 variants at the same time can be done. Calculations can be tracked the following ways:

- **Partial Levels** show exactly, how much the different sources contribute to the overall receiver level
- **Rays** from all sources to receivers can be visualized; this includes reflected rays. Each ray informs about the amount of contribution to the overall level.
- **The protocol function** shows all attenuation terms for each calculated ray standard-depending.
- **Configurable labels** show results directly in the project view.

## Calculation at horizontal grids

By defining a receiver spacing and height, a grid can be calculated over larger areas. These areas can be restricted with closed polygons. Calculations can be calculated for up to 4 evaluation parameters at the same time.

## Calculation at vertical grids

Vertical grids can be defined anywhere in the project by entering the appropriate polygon. As for the horizontal grid, the receiver distance can be set up before calculating.

## Calculation at building evaluations

A distribution of receivers around buildings can be generated with CadnaA. These building evaluations can be used for whole building noise maps, representing results along facades. Building noise map receivers can be shown as rectangles, octagons or spheres in the 3D View.



## Service and Support

With CadnaA, you don't only buy a great software product, but you can also gain access to very good support. It's highly recommended to have a maintenance contract, which enables access to our hotline, web seminars and software updated. The following topics show the broad range of service and support we give our customers.

### Selection of Service and Support Possibilities

#### Hotline

Our team of CadnaA experts supports customers with maintenance contract with all kinds of technical questions regarding modeling and calculating with CadnaA. (German, English and Spanish supported)

#### Web Seminars

With a maintenance contract, you'll have access to our web seminars. They take place several times per year, each time for different time zones, and cover specific CadnaA topics.

#### Seminars

We offer seminars for CadnaA beginners as well as for advanced users up to expert seminars regarding specific topics such as industrial-, traffic- or aircraft noise. Seminars take place all over the world - if required, even in your office.

#### Web Tutorials

We have several hours of CadnaA related videos on our website, which especially aim at CadnaA beginners. A great way to start learning and using our software.

#### Updates

With a maintenance contract, you'll have access to our latest beta versions and release versions.

## More Information

For more information about CadnaA and about our software for indoor noise calculations (CadnaR) you can visit [www.datakustik.com](http://www.datakustik.com) or call +49 8192 933 08 0. Furthermore, we attend most major conferences on acoustics and noise, where you can meet us in person.

# Solo Black Edition

Concentrati sull'essenziale!



Solo Black Edition

## Prestazioni per tutte le esigenze di misura Una nuova generazione di fonometri: Solo Black Edition

Risultato di un continuo processo di innovazione, **Solo Black Edition** offre le ultime novità tecnologiche in fatto di ergonomia, affidabilità, autonomia operativa e comunicazione wireless.

**Solo Black Edition** è il primo fonometro dotato di auto-calibrazione della catena strumentale su più frequenze e più livelli; dal microfono per finire al valore letto a display. Queste nuove funzioni sono

un punto di forza di Solo e soprattutto una garanzia di correttezza metrologica della misura.



## Migliora il tuo know-how

*In acustica ambientale*

*In acustica edilizia*

*In acustica industriale*

*Nella ricerca e nella formazione*

### CONTROLLO REMOTO WIRELESS

#### Comanda Solo Black scopri la vera mobilità

- » Controlla il tuo Solo Black Edition a distanza dal tuo Pocket PC
- » Visualizza e codifica i dati a distanza
- » Aggiungi commenti orali e scritti

### modulo TRIGGER

#### Codifica le sorgenti sonore

- » Registra gli eventi al superamento di un livello di soglia
- » Controlla dispositivi esterni (TTL)

### modulo MEMORIA SD

#### Registra e memorizza nell'estensione di memoria di Solo Black Edition

- » Larga capacità di memoria SD
- » Misure di lunga durata (dati e audio)

### modulo AUDIO RECORD

#### Ri-ascolta gli eventi audio

- » Riproduci le registrazioni audio e identifica la natura delle sorgenti sonore
- » Analizza i segnali più in dettaglio

### modulo AUTO CHECK

#### Controlla automaticamente e periodicamente la calibrazione della catena di misura completa, incluso il microfono







- » Linearità di livello
- » Linearità in frequenza



Brand of acoem



# Solo Black Edition Specifiche Tecniche

<b>Normative</b>	IEC 61672-1 (2002) / NF EN 60651 (2000) / NF EN 60804 (2000) / ANSI 1.11 / ANSI 1.4 IEC 1260 (1995) / EMC IEC 61000-6-1 e 2 / EMC IEC 61000-6-3 e 4 LQ 447/95 - D.M.16/03/1998 - DPCM 05/12/1997 - UNI 11367	
<b>Metrologia</b>	Range singolo: 20-137 dB(A) / classe 1 o 30-137 dB(A) / classe 2 Leq (da 20 ms a 10 s), Lp, Lpmin, Lpmax (S, F, I), Lpk (C, Z), ponderazioni A, B, C e Z multispettro da 20 ms in tempo reale 1/1 e 1/3 ottave (12.5 Hz - 20 kHz)	
<b>Controllo remoto su Pocket PC</b> 	Comunicazione senza cavo Bluetooth™ classe 1 Visualizzazione e codifica dei dati su display a colori del Pocket PC (LAeq, LAFp, 1/3) Commenti scritti e orali (sincroni con il file di misura)	
<b>Memorizzazione</b> 	Memoria integrata 3.700.000 di valori fonometrici completi Memoria estesa da 2 GB su SDCard LAeq + LCpk (1s) > 99 giorni / LAeq + 1/3 (1s) > 99 giorni	
<b>Audio Record</b> 	Memorizzazione audio in formato wav non compresso (min. 1h40min (51.2 kHz) / max. 13h50min (6.4 kHz)) Frequenze di campionamento: 51.2 kHz / 25.6 kHz / 12.8 kHz / 6.4 kHz (24 bits)	
<b>Modulo Trigger</b> 	Codifica su soglie pre-programmate: codice (1), codice (2), codice (3) o codice (1) + audio Attivazione uscita TTL su soglia pre-programmata (start di dispositivi esterni come per es. telecamere)	
<b>Modulo Auto Calibrazione</b> 	Controllo automatico della catena di misura completa: microfono, preamplificatore e processore digitale. Analisi della risposta in frequenza e della linearità della catena di misura su 4 frequenze predefinite (500 Hz, 1 kHz, 2 kHz e 4 kHz) e su una frequenza a piacere selezionabile dall'utente e su 3 livelli impostabili	
<b>USB</b> 	Modalità come front-end di acquisizione digitale Modalità trasferimento dati via USB	
<b>Prestazioni generali</b>	Autonomia di misura tipica LAeq (1s): 24 h (modo standard) / 16 h (modo bluetooth) Start di misura programmabili: immediato / ritardato / per periodi	Misura parallela di tutti i parametri Storia temporale di tutti gli indicatori Lingue: Francese, Inglese, Spagnolo, Tedesco, Italiano, Olandese, Portoghese, Rumeno
<b>Accessori standard</b>	Preamplificatore PRE21S Microfono 1/2" 50 mV/Pa classe 1 o 20 mV/Pa classe 2 Protezione antivento	Batteria litio interna ricaricabile e alimentatore Cavi USB e RS232 Valigia di trasporto in alluminio software di scaricamento dati testo dBSLM32
<b>Accessori opzionali</b>	Pocket PC Win CE™, Tablet PC Win CE™ Borsa di protezione Caricabatterie esterne VES21 valigia da esterno	BAP21 unità microfonica per esterni 100-m cavo di prolunga basso rumore Calibratore CAL21 classe 1
<b>Software</b>	dBTrait: software post processo per acustica ambientale, codifica eventi, report automatico... dBBati: trattamento dati acustica edilizia (isolamento, T60...)	dBSolo: Pocket-PC software di controllo remoto USBTrig / USBBati / USBFa: acquisizione nel tempo ed in frequenza in modalità PC Choralis dBSolo-B (Edilizia) e dBSolo-E (Ambientale)

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**01dB ITALIA** Via Antoniana 278- 35011 CAMPODARSEGO- (PD) - Tel : 049 9200966  
info@01db.it / www.01db.it



# 01dB

## SOLO Black Edition For Building Acoustics



 New regulations include requirements relative to airborne noise insulation, impact noise and noise generated by technical equipment from the design stage. The verification of building sound quality requires precision instruments perfectly suited to the requirements of field measurements.

01dB offers the "modular" technical solution that fully meets all issues relative to building noise measurements: sound level meter SOLO Black Edition, combined with noise sources and dBbati software.



### SOLO Black Edition

designed based on good engineering practice ...

#### Blue Solo sound level meter

SOLO Black Edition presents all assets required for building acoustic measurements.

- Measurement of sound levels and octave (1/1) or third octave (1/3) spectra
- Measurement of reverberation time T60
- Real-time signal acquisition
- Large storage memory (2GB SDcard)
- Module dedicated to building acoustics



#### dBbati software

dBbati is a software designed for noise measurement in buildings. It is compliant with all existing international standards.

Combined with Blue Solo, this software allows to process and analyze measurements very easily and according to statutory requirements.

- Sound insulation
- Room criteria
- Acquisition and real-time processing directly on the PC

#### Noise sources

01dB offers different noise sources (tapping machines, amplified and high-power stand-alone directional and omni-directional noise sources) to perform all measurements recommended by regulations.

- Airborne noise insulation
- Room acoustics
- Impact noise insulation
- Spatial decay



#### Accessories

- The Autopole® pole can be used to perform façade insulation measurements very safely. The microphone is placed 2m in front of the façade.









#### Enhance your know-how

- Noise measurements
- Building acoustics
- Room acoustics
- Façade insulation





# Technical specifications for SOLO Black Edition / dBbati

Features	SOLO Black Edition
Standards	IEC 61672-1 (2002) / NF EN 60651 (2000) / NF EN 60804 (2000) / ANSI 1.11 / ANSI 1.4 IEC 1260 (1995) / CEM EN 50081-1 and 2 / EN 50082-1 and 2
Metrology	Single dynamic range: 20-137 dB(A) / class 1 or 30-137 dB(A) / Class 2 Leq (from 20 ms to 10 s), Lp, Lpmin, Lpmax (S, F, I), Lpk (C,Z), A, B, C and Z weightings Real-time 20 ms 1/1 and 1/3 octave multispectra (12.5 Hz – 20 kHz)
Building Module	Preprogrammed setups: emission / reception / background noise / T60 / equipment noise Built-in generators: pink noise / white noise / sine (variable gain) Source management: stable / remote control / impulse (on trigger) Selection of room type: bedroom, kitchen, living room, bathroom, etc.
PC or Tablet PC Remote Control Module 	Bluetooth wireless communication, class 1 Live display and data coding on color touch-screen Pocket PC (LAeq, LAFp, 1/3) Written comments (synchronized with measurement file)
USBbati Transfert 	Acquisition front-end mode / File transfer mode
General performances	Upgrade to other modules: Audio  Memory  , Trigger  , Environment  Typical operating life: 24 hr (standard mode) / 16 hr (remote control mode) Parallel measurement and time history of all indicators Language: French, English, Spanish, German, Italian, Dutch, Portuguese, Romanian

## dBbati

Standards and indices	Airborne noise insulation: Dn,T / DnAT / Dn,w / Dn,T,w (NF S 31-057, NF EN 10052, ISO 140, ISO 717-1) Transmission loss indices: R / R' / Rw / R'w (according to ISO 140) Impact noise insulation: L'n / L'nT / L'nAT / L'n,w / L'n,w / L'nT,w (ISO 140 and ISO 717-2) Equipment noise: standardized level LeT (according to NF S 31-057 and NF EN 10052) Absorption coefficient: a <sub>s</sub> (ISO 354) Reverberation time: T <sub>60</sub> (ISO 3382)
Room criteria (option)	STI, RASTI / EDT, Clarity index C80, Definition D50, ST1 / Impulse method
General performances	Display of customizable graphics and tables / User-defined analysis and calculation managers Automation of measurements / Recomposition, addition, subtraction and average operators Result printing, advanced copy / paste and export functions Automatic reports compliant with NF, EN, ASTM, JIS and ISO standards (Word format)

## Noise sources

Airborne noise	<div>GDB-S</div> <div>Unidirectional</div> <div>Pink noise generator</div> <div>Sound levels:</div> <div>Built-in pink noise generator 103dBA/1m</div> <div>Solo's pink noise generator 106dBA/1m</div> <div>Operating life: 10h at 20°C / Weight: 15 kg</div> <div>HF remote control</div>	<div>OMNI12</div> <div>Omnidirectional (12 loudspeakers)</div> <div>Pink and white noise generator</div> <div>Sound levels:</div> <div>Built-in pink noise generator 99 dBA/1m</div> <div>Solo's pink noise generator 100 dBA/1m</div> <div>Operating life: 1h30 at 20°C / Weight: 37 kg</div> <div>HF remote control</div> <div>480 W amplifier</div>
Impact noise	MAC01: Standardized tapping machine. 5 x 500g hammers / Frequency 10 Hz / Total mass: 19.5 kg / HF remote control / Battery life: 2h	

## Accessories

	Autopole® for façade insulation with 2m pole / tripods Window cable NPF95 / extension cable for microphone
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# PHON-X<sup>®</sup>

## Diffusore Acustico Omnidirezionale

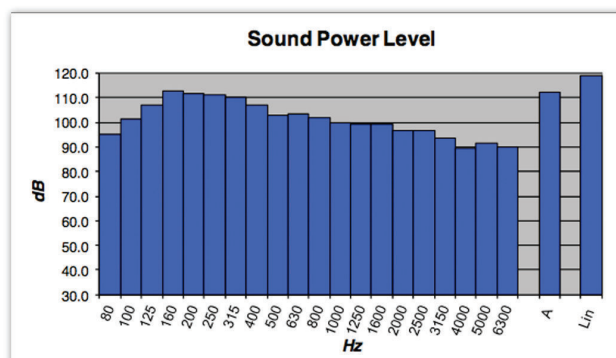
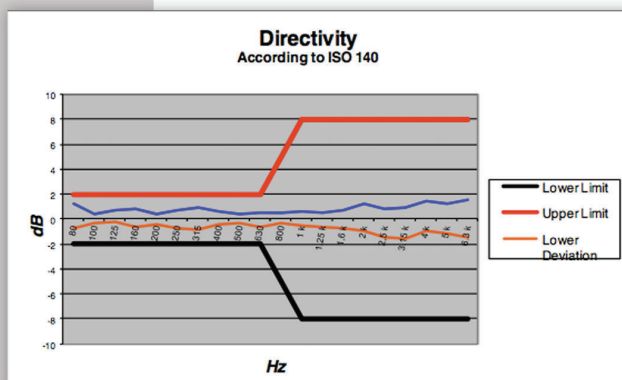
*FOUR*

è un diffusore acustico omnidirezionale realizzato per rispettare le norme UNI EN ISO 140.

12 altoparlanti da 4" larga banda sono montati in un robusto case dodecaedrico per raggiungere oltre 120dB Lw con direttività uniforme su 360°.



Risposta in Frequenza	100Hz - 6400 Hz
Potenza Sonora	Migliore di 120dB
Impedenza	3 Ω
Altoparlanti	12 x 4"
Connettori	1 x Neutrik Speakon 4 pole
Struttura Cabinet	Multistrato Betulla da 15 mm
Dimensioni (Diametro Sfera)	30 cm
Peso	8.5 kg
Diametro Ingaggio Stativo	25 mm
Accessori	Borsa morbida (in dotazione)



FOUR è dotato di un contenitore semi rigido che ne facilita il trasporto, proteggendolo da urti e da contaminazioni esterne.

Il sistema di sostegno inferiore è dotato di una piccola base che ha anche la funzione sostenere il dodecaedro sul pavimento evitando la sua accidentale rotazione e/o capovolgimento.



DISTRIBUITO DA



Nella configurazione standard FOUR può funzionare solo in abbinamento all'amplificatore PHON-X Mark1 distribuito B.I.G. srl.

# PHON-X<sup>®</sup>

## Amplificatore di potenza **MARK 1**



*PHON-X Mark1 è lo strumento in grado di fornire l'appropriata amplificazione dei segnali diretti al sistema **FOUR** (diffusori omnidirezionali) nonché alla cassa acustica non amplificata **ARROW** (diffusore direzionale non amplificato).*

### **Misure:**

**Larghezza 57 - Profondità 17 - Altezza 21 cm**

**Peso (con slot batterie) 12,5 kg**

**Peso (senza slot Batterie) 11,2 kg**

PHON-X Mark1 è lo strumento in grado di fornire l'appropriata amplificazione dei segnali diretti al sistema **FOUR** (diffusori omnidirezionali) nonché alla cassa acustica non amplificata **ARROW** (diffusore direzionale non amplificato).

Il sistema è racchiuso in un robusto contenitore, dalle dimensioni veramente ridotte.

La doppia alimentazione rete - batteria (con l'ausilio integrato di alimentazione a batterie LI-PO installato a richiesta) rende PHON-X Mark1 estremamente versatile anche in casi in cui non sia possibile accedere alla rete elettrica o in cui il cavo di alimentazione possa creare problemi di connessione o intralcio.

A rendere ancora più autonomo PHON-X Mark1 è un generatore di rumore rosa e bianco che, comunque, non preclude la possibilità di ricevere sorgenti esterne attraverso gli ingressi dedicati.

Il sistema PHON-X Mark1 racchiude nel suo interno:

### **PRE-AMPLIFICATORE**

Il pre-amplificatore è il cuore del sistema su cui vengono: convogliate e controllate le sorgenti interne ed esterne, controllato il guadagno del segnale in uso e controllati con un led il superamento della soglia di saturazione segnale (overload).

Fanno parte integrante del pre-amplificatore i due ingressi in parallelo per gli ingressi "linea" esterni jack e BNC.

### **GENERATORE DI RUMORE ROSA E BIANCO**

Integrato nel sistema di pre-amplificazione troviamo il generatore di rumore rosa e bianco che, attraverso un selettore a levetta, permette di scegliere e inviare all'amplificatore uno dei due rumori internamente disponibili.

### **AMPLIFICATORE DI POTENZA**

Sono presenti due finali di potenza in classe "D" i quali provvedono ad amplificare ciascuno metà dei dodici altoparlanti del sistema **FOUR**.

Questa soluzione ha permesso di ottenere, in spazi ridotti, potenze elevate anche con alimentazione a batterie e l'ottimizzazione della dissipazione di calore con l'utilizzo di ventola di raffreddamento a bassissimo rumore (trascurabile durante le misurazioni).

Gli amplificatori inoltre posseggono le seguenti protezioni auto- ripristinabili dopo l'intervento:

- Termica
- Corto circuito
- Over current
- Over signal

### **GRUPPO BATTERIE**

Tutto il sistema può funzionare a batterie, tramite una coppia di batterie Litio Polimeri integrate nello stesso flight case. L'unità batterie (fornita a richiesta) fornisce l'energia necessaria per un'ora di autonomia.



**DISTRIBUITO DA**





# PHON-X<sup>®</sup>

## Macchina del calpestio



### WOODPECKER

La macchina per la generazione del rumore da calpestio denominata Woodpecker è una sorgente sonora progettata per rispondere alle specifiche degli standard in materia di misurazioni di trasmissione sonora da impatto ed è conforme alle specifiche:

ISO 140, ASTM E 492, DIN 52210, BS 5821 ed ISO 717.

#### Pesi e dimensioni:

Peso : 12Kg;

Dimensioni : altezza 25 - larghezza 50 — profondità 10.5 Cm

Dimensioni max Apertura: altezza 25 - larghezza 55- profondità 23.5 Cm

L'unità usa 5 martelli pesanti ciascuno 500gr che cadono liberamente da un'altezza di 40mm. La frequenza di impatto è di 10Hz ossia di 10 battute al secondo.

I martelli sono azionati da un albero a cammes innovativo e silenzioso fatto ruotare da un motore elettrico di adeguata potenza con encoder di retro azionamento giri accoppiato a questo con cinghia dentata e pulegge ottenendo così una trasmissione uniforme potente e costante nel tempo.

L'elettronica di controllo è completamente digitale ed facilmente comandabile dalla Consolle principale. L'elettronica controllata da microprocessore gestisce le seguenti funzioni:

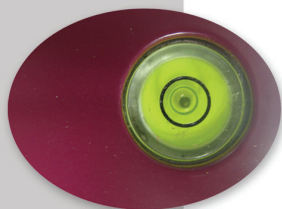
- Alimentazione PWM al motore;
- Il controllo remoto della macchina con telecomando ;
- Controllo integrale della trazione motore (corrente e tensione) per mantenere costanti i giri e la potenza;
- Doppia alimentazione rete / batterie (interne).

La macchina è interamente costruita in alluminio speciale fatta eccezione per gli elementi battenti e di azionamento meccanico costruiti in acciaio speciale.

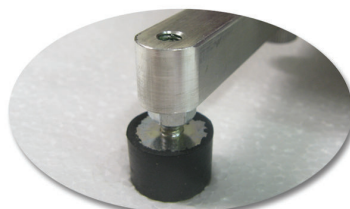
La macchina è sorretta da tre piedini in gomma antivibrazioni completamente regolabili per la messa in bolla dello strumento.

In fine la macchina è dotata di una pratica cappottina per il trasporto con annessa sacca laterale porta accessori.

L'alimentazione della macchina e il servizio di ricarica batterie è gestito da un alimentatore esterno in dotazione.



Livella per la messa in bolla dello strumento



Piedino Anti-Vibrante regolabile

DISTRIBUITO DA



Cappottina in naylor nero protettiva

## Addressing the issue of individual exposure to vibration:

### Vibrometer VIB and software dBMaestro...

Light, robust and compact, VIB is a suitable instrument for the measurement of «hand-arm» and «whole-body» vibrations, according to the requirements of European Directive 2002/44/EC.



**“VIB**  
**Occupational health**  
**and prevention of**  
**repetitive strain**  
**injury**

#### Whole-body and hand-arm vibrometer: VIB

The vibrometer consists of a portable, ergonomic and miniaturised housing, hosting the acquisition unit, signal processing, data storage and data transfer.

- » X, Y and Z vibration levels, daily exposure A(8)
- » Signal and 1/1 or 1/3 octave spectrum recording
- » Presence detector and warning light
- » 16-hour operating life

#### Processing software: dBMaestro

dBMaestro is used for transfer, process, report and archive data.

- » Compliant with ISO5349 & ISO2631 standards
- » Data transfer via USB2.0
- » Workshop approach
- » Automatic reports

#### Wireless remote control: dBA(8)

From a PC computer or PC tablet, the dBA(8) control software is the interface between the operator and vibrometer VIB.

- » Simultaneous control up to 5 instruments
- » Management of measurement configurations
- » Collection of measurement files
- » Real-time display of measured data on a colour screen



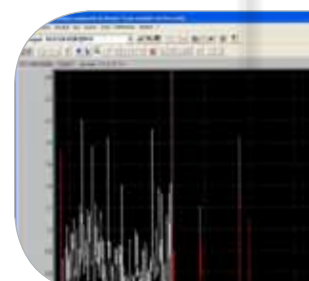
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m/s <sup>2</sup> )	1.4	1.4
(m/s <sup>2</sup> )	0,59	0,60
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# VIB / dBMaestro Technical specifications

<b>Standards</b>	ISO 8041 (2005), ISO 5349 (2002), ISO 2631 (1997) CEM Radio ETSI EN 300 328 V1.5.1 (2004) / Emission CEI IEC 61000-6-3 / CEI IEC 61000-6-4 / Reception CEI IEC 61000-6-1 / CEI IEC 61000-6-2		
<b>Metrology</b>			
Channels	From 1 to 4 (depending on configuration and option)		
Display resolution	0.01		
Conditioning	IEPE: 12V-4mA or 24V-4mA		
Voltage (input)	5V AC peak		
<b>Overload</b>	Yes (separate detection for each channel)		
<b>Filtering</b>	Wd, Wk, Wh (digital, according to ISO 8041) Programmable filter: 0.4 - 4000 Hz 1/1 octave: 1Hz - 2kHz / 1/3 octave: 0.8Hz - 2.5kHz (optionnal on 1 channel)		
<b>Measured magnitudes</b>	Simple vibrometer: acceleration, peak, peak - peak, peak factor, rms (x, y, z) Hand-arm: acceleration, peak, peak - peak, rms (x, y, z), ahv, A(8) Whole-body: acceleration, peak, peak - peak, peak factor, rms (x, y, z), av, aeq, A(8), A(8)v, VDV, MTVV, SEAT Signal recording: manual or on trigger ( $f_{e_{max}} = 8192\text{Hz}$ (optionnal on 1 channel)) Parallel measurement and time history of all indicators		
<b>Calibration</b>	With a calibrator, by input of sensitivity or by gravity		
Temperature	-10°C / +50°C (0-95% HR)		
Dimension / Weight	105 x 60 x 25 mm / 135 g		
<b>Memory module</b>	Integrated 2 GB flash memory, type Micro SD Storage of measurement files (minimum rate: 1s) Signal storage (programmable sampling frequency)		
<b>General performances</b>	Typical battery life: 16 hours (stand-alone mode) / 10 hours (remote controlled mode) 3.7 V - 2.3 A battery - Charging time: 6h30 (USB or charger)		
<b>Depending on configuration</b>	Triaxial Hand-Arm accelerometer HA_AP2042	Triaxial Whole-Body seatpad WBA 001	Monoaxial accelerometer for SEAT DJB A 120V-L
Sensitivity	10 mV/g	115 mV/g	10 mV/g
Dynamic range	500 g	18 g	500 g
Bandwidth	1 to 1200 Hz (-1dB)	0 to 400 Hz (-3 dB)	0.1 to 1000 Hz (-3 dB)
Resonance frequency	> 36 kHz	24 kHz	> 28 kHz
Weight	13 grams	243 grams	18 grams
Temperature range	-40°C / +125°C	-40°C / +105°C	-50°C / +125°C
Material / Characteristics	Titanium	Seatpad with presence detector	Stainless steel
Accessories	Adapters for handle, steering wheel and finger	Removable retractable reel cable	Floor mounting using an isolated magnetic base
<b>Control software dBA(8)</b>	Control using Tablet, Netbook, Laptop or Desktop PC: configuration management / real-time display / data collection Wireless Bluetooth communication Programmable start modes: immediate / delayed / by periods / on detection of presence Visual display and coding of data on colour screen of remote control Pre-programmed configurations (whole-body, hand-arm, free) Storage of signal: manual or automatic on trigger PC-compatible software Languages: English, French		
<b>Processing software dBMaestro</b>	Transfer of measurement files generated by VIB through USB2.0 Calculation of A(8) and peak factor according to Directive 2002/44/CE, calculation of dose on coded events Whole-body, Hand-arm Time history plots for all indicators Calculation of average values between cursors Automatic reports		
<b>Standard package</b>	VIB - Transducer - Desktop charger - dBA(8) dBMaestro - Carrying case / CD / Documentation		
<b>Options</b>	Vibration calibrator Tablet PC		



The presented characteristics are subject to change without notice. July 2012 version

## Addressing the issue individual noise exposure assessment:

### acoustic dosimeter WED and software dBLexd...

Based on a multiple-point metrologic approach, the technical solution consists in deploying a set of dosimeters in the work place, which are operated using a wireless remote control.

This simple and non-invasive device is a valuable tool when implementing new regulations.



## “WED noise control in the work place

### Dosimeter exposimeter WED

WED consists of a portable, ergonomic and miniaturised housing, hosting the acquisition unit, signal processing, storage and data transfer.

- » Measurement of sound levels in dB(A) and dB(C)
- » Calculation of daily exposure  $L_{ex,8h}$
- » Measurement dynamic range from 40 to 140 dB(A)
- » Counting of 135, 137 and 140 dB(C) peaks
- » Operating life: 50h

### dBLexd, processing software

dBLexd is used for transfer, process, report and archive data.

- » Compliant with NF S 31-084 and ISO 9612 standards
- » Transfer or importation of data
- » Calculation of  $L_{ex,8h}$ , coming from HEG
- » Taking into account of uncertainties
- » Automatic reports

### Wireless remote control dBWed

From a PC tablet, the dBWed control software is the interface between the operator and dosimeter WED.

- » Simultaneous control up to 5 instruments by workshop or study area
- » Management of measurement configurations
- » Collection of measurement files
- » Real-time display of measured data on a colour screen
- » Programming of start modes
- » Voice comments, written comments



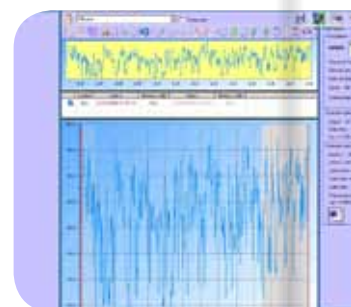
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# WED / dBLexd Technical specifications

## Standards

CEI IEC 61252 (2002) / ANSI 1.25 (1991) / CEI IEC 61672-1 (2002)  
CEM Radio ETSI EN 300 328 V1.5.1 (2004) / Emission CEI IEC 61000-6-3 /  
CEI IEC 61000-6-4 / Reception CEI IEC 61000-6-1 / CEI IEC 61000-6-2

Metrology	Leq / Lp channel	Peak channel
Precision class	Class 2	
Linearity domain	80 dB(A)	50 dB(C)
Dynamic range	2 40-120 dB(A) / 60-140 dB(A) 45-120 dB(C) / 65-140 dB(C)	1 (fixed) 93-143 dB(C)
Frequency weightings	A and C in //	C or Z
Measured magnitudes	LAeq, LCEq, LASp, LAFp LASpmax, LAFpmax, LASeq, LAFeq	LCpk, LZpk
Configuration	Tc, Lc, LCutoff, Q (3, 4, 5 and programmable)	135, 137 and 140 dB
Peak counting	—	Yes
Calculated magnitudes	Lex,d, EAT, Dose, SEL, LAvg, TWA, Lex,8h, projected dose, Lxx	
Intégration time	From 1s to 60s	
Microphone	Type MCE321 class 2, 10 mV/Pa, 9mm, weight <10g	
Operating temperature	0°C /+ 40°C (0-95% HR)	
Dimensions	105 x 60 x 25 mm	
Total weight	145 g	
Memory module	Integrated flash memory, type Micro SD 2 Go Storage capacity: LAeq (1s) + LCpk > 100 days	
General performances	Typical operating life: 50h (standard mode) / 10h (remote control mode) Parallel measurement and time history of all indicators Pilot light indicating status Integrated self-test Keayboard locking	
Control software dBWed	Control using Tablet PC: configuration management / real-time display / data collection Wireless Bluetooth communication Programmable start modes: immediate / delayed / by periods / by periods Visual display and coding of data on colour screen of Tablet PC Pre-programmed configurations (type ISO85, OSHA,...) Leq mode (Start/Stop) Written comments (synchronised with measurement file) PC-compatible software Languages: English, French	
Processing software dBLexd	Compliant with NF S 31-084 (2002) and ISO 9612 (2009) standards Transfer of measurement files Import of 01dB measurement sessions (compatible with SIE95/CLS95/*.cmg and *.sip files) Start in simplified mode Visual display of time histories Coding of periods HEG management (tasks or operations) Calculation of noise exposure parameters according to standards Simulation of ear protection wearing Printing of results as standardised sheets Automatic reports Storage of projects	
Standard package	Dosimeter WED including a MCE321-type microphone with integrated preamplifier, tie clip and soulder 1m extension cable Table charger with main power supply (1 unit or 5 units depending on version) Carrying case dBWed software Processing software dBLexd User manual	
Options	Vibration calibrator Tablet PC	



The presented characteristics are subject to change without notice. July 2012 version



**01dB**

**01dB-METRAVIB**

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# SO Analyzer

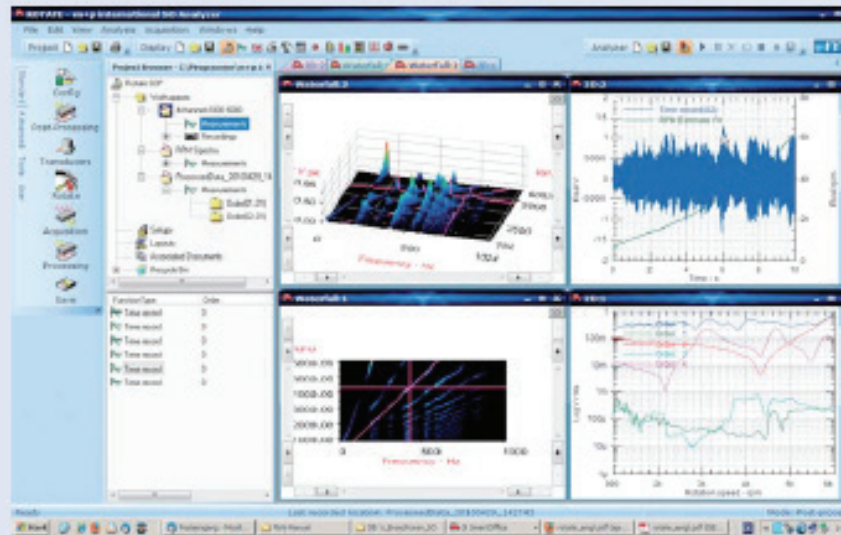
Noise and Vibration Measurement,  
Analysis and Reporting



# SO Analyzer

With the SO Analyzer, m+p international has developed a dynamic signal analyzer that takes full advantage of the constant improvements in hardware and software technologies.

It is the perfect choice for accurate and efficient noise and vibration measurements, third-party data import/export, data analysis and reporting of your results in a single package.



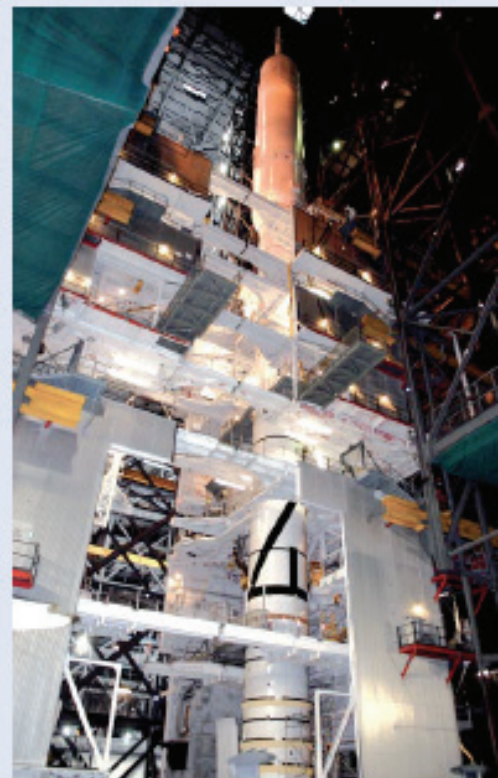
Analyzing rotating machinery data

## ■ Comprehensive Application Coverage

A multitude of measurement and analysis software modules covers the widest range of applications in today's dynamic signal analysis (DSA):

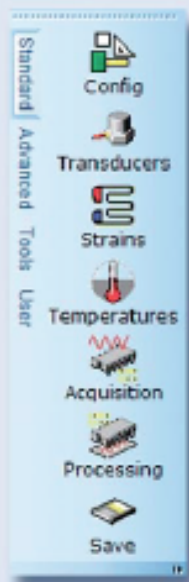
- Real-time FFT and time history data acquisition (throughput to disc)
- Structural analysis including
  - Modal analysis
  - Single/Multiple Degree of Freedom (SDOF, MDOF)
  - Impact testing
  - Operating Deflection Shape (ODS)
  - Multiple Input/Multiple Output (MIMO)
  - Swept and stepped sine analysis
  - Ground vibration testing
- Rotating machinery
- Acoustic analysis including
  - Octave analysis
  - Sound power analysis
  - Sound intensity measurement
  - Acoustic intensity mapping
  - Sound quality
  - Human vibration
- Environmental testing
- Vehicle pass-by-noise testing

SO Analyzer runs on a desktop PC or laptop and is designed for noise and vibration applications in the field, in the test laboratory and in the office. For highest system flexibility it supports a range of measurement frontends (USB, PCI, PXI, VXIbus) enabling applications from 4 to hundreds of input channels. Software and hardware modularity allows you to tailor the SO Analyzer to your specific needs, meaning maximum performance for minimum investment and a common user interface across all applications.



Modal tests on Ares I-X test rocket, photo credit: NASA





## ■ Easy and Safe Operation

Ease of use was one of the key objectives when developing the SO Analyzer. Therefore the SO Analyzer has a Microsoft Windows like user interface which simplifies the integration into your company's network system. Test data and setups from multiple sources can be stored into one common workspace or multiple workspaces that also allow creation of substructures to manage different data views or analyze data sets. Drag & drop operation helps to exchange data quickly between workspaces, thus enabling simple or complex data structures to be saved as one project.

The SO Analyzer software provides you with comprehensive capabilities for browsing, viewing, editing, analysing and reporting data. Full ActiveX compliance allows you to rescale and analyze test data in Microsoft Word and PowerPoint on any PC and to share the active documents with colleagues using the free SO Viewer software. Integrated wizards will guide you step by step through the set-up of all measurement parameters, simplifying use and minimizing setup errors.

## ■ Wide Variety of Frontend Technology

A large range of highly accurate measurement frontends is available – from ultra-portable USB to high-channel count, high-performance VXibus – handling multiple signal sources from simple voltage and IEPE to full strain gauge signal conditioning.

SO Analyzer supports pocket-sized hardware from National Instruments with 24-bit resolution and self-powered USB 2.0 connectivity for precise mobile and lab testing. m+p International's own VibPilot frontend provides market leading dynamic range and outstanding real-time performance via high-speed USB interfacing. Several of these compact, fan-less frontends can be synchronized by means of the clock in/clock out circuitry with no loss of their excellent measurement performance.

With National Instruments PC/PXI data acquisition cards you get maximum flexibility of measurement options and interfacing: The SO Analyzer software provides a complete off-the-shelf and fully supported solution that can be used with any PC from an embedded PXI controller to a portable laptop to a desktop as required by your application. For high-channel count noise and vibration applications, the SO Analyzer is operated with VXibus hardware from VTI Instruments. No matter how many channels are connected, the system provides highly precise cross channel measurements, gap-free throughput to disc recording and reliable online and offline analysis.

As well as dynamic signal acquisition low-speed temperature monitoring can be integrated to provide overlays of thermal conditions directly with dynamic results. Support for a range of thermocouples and RTD sensors is available.

SO Analyzer software can be easily switched between different hardware frontends and the intuitive user interface is consistent across all platforms. This means that many more applications can be covered at a lower cost and with reduced training requirements.



SO Analyzer with pocket-sized USB hardware



8-channel VibPilot

# Core Concept

The SO Analyzer enables the engineer to manage large sets of noise and vibration test data and analysis results regardless of origin, format or location.

For ease of use, you do real-time data acquisition, import third-party N+V data formats, analyse the results and create your reports within a common user interface.

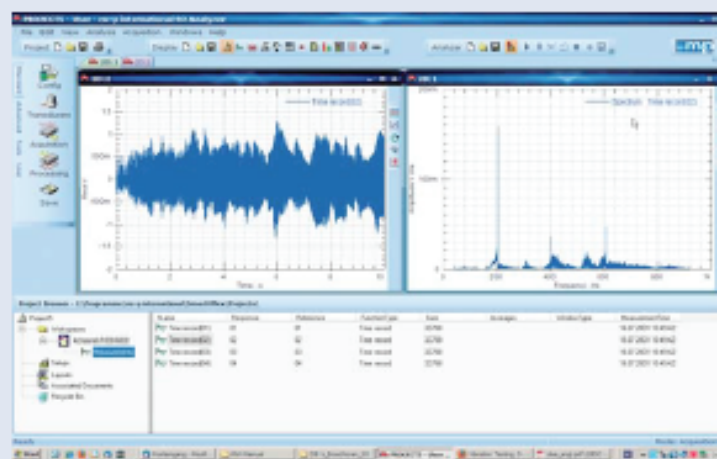
SO Analyzer is made up of three core modules for General Data Acquisition, Central Management & Reporting and General Data Analysis. All optional modules for advanced noise and vibration applications are used in combination with these three core modules.



## ■ General Data Acquisition

The General Data Acquisition module acquires multi-channel FFT and time history data while displaying the data in real time for general FFT analysis and optional structural analysis, rotating machinery, acoustics and many other advanced applications. For maximum system flexibility it supports a range of industry-standard measurement frontends, from 4-channel portable USB to high-channel count VXibus hardware.

- Multi-channel FFT data acquisition
- Acquisition of multi-channel time history data from any source, use file as "virtual frontend"
- Continuous or triggered measurements
- Peak and rms time history data reduction
- Real-time acceleration to velocity and displacement computations
- Display and storage of all intermediate results
- Time history recording to memory or file, replacing conventional tape recorders
- Unlimited throughput to disc acquisition with scheduled time data recording
- Post-processing from throughput files for analysis of large measured or imported time data files with batch processing of multiple files

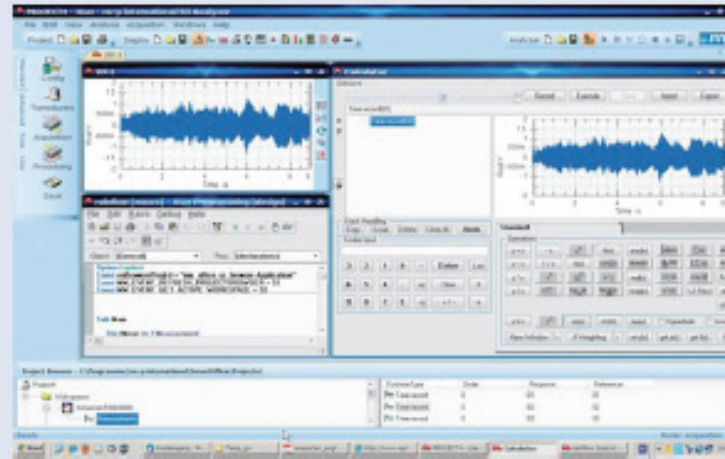




## ■ e-Reporter

e-Reporter is the powerful data management and reporting tool within the SO Analyzer. It provides test engineers with comprehensive capabilities for browsing and viewing data, copying & pasting data to ActiveX applications, importing test data from many third-party N+V systems and automating repetitive tasks. This full functionality is available without any measurement front-end connected.

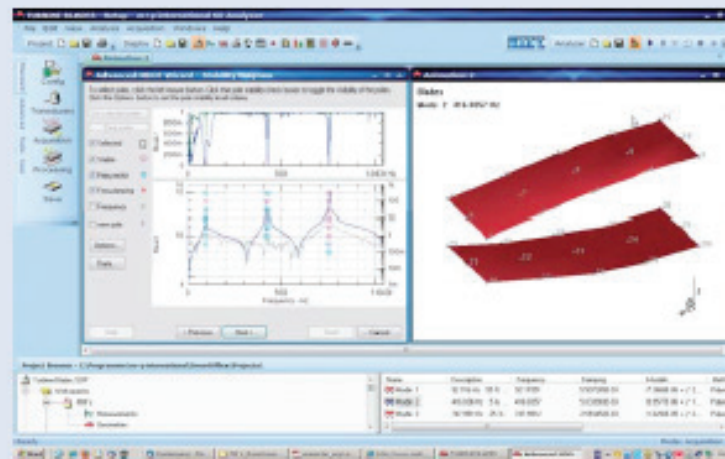
- Central management, analysis and reporting of all noise and vibration data
- Browse, view, rescale, analyze, calculate, organize measurement and mode shape results
- Data Import/export from/to many popular N+V formats for common analysis
- 2D, 3D (waterfall) charts, animation display for mode/deflection shape
- Mathematical operations with built-in calculator
- Automated ActiveX reporting to Microsoft Word and PowerPoint
- Rescaling and analyzing test data in Microsoft Word or PowerPoint on any PC with the free SO Viewer software
- Visual Basic compatible programming for automating repetitive tasks and implementing your own functions



## ■ General Data Analysis

No matter whether the data was acquired using the SO Analyzer measurement hardware or imported from third-party systems, the General Data Analysis module post-processes this data in the same way supporting a large number of analysis functions.

- High-resolution online FFT analysis using the 2D/3D viewers of the e-Reporter
- Copy & paste to ActiveX applications
- Data Import/export



# Advanced Measurement and Analysis Applications

The modular design of the SO Analyzer allows you to adjust the software to your specific needs, adding the solutions you require when you need them.

SO Analyzer supports a full range of optional modules covering various noise and vibration measurement and analysis applications. These optional modules are used together with the three core modules for data acquisition, analysis and reporting.

## ■ Structural Acquisition and Analysis

The structural dynamics package provides a complete set of tools for observing, analysing and documenting the vibrational behaviour of machines and mechanical structures. It includes modules for advanced modal analysis, guided impact hammer testing, MIMO acquisition as well as for ODS, SDOF and MDOF analysis. SO Analyzer offers a wide range of measurement techniques including impact hammer and source modes (e.g. random, burst, sweep, arb etc.) for shaker excitation. Multiple sources are available with open- and closed-loop amplitude control. Swept and stepped sine analysis is typically used for single- or multi-shaker excitation of larger structures and for this normal mode tuning is also available. Modal model validation is used for mode comparisons between tests or between tests and FE results.

The software makes it very simple to create the structure's geometry and calculate modal parameters including mode shape animation. The experimental modal data are obtained by curve fitting a set of FRF measurements. Wizards take you through a simple series of steps to complete the acquisition and analysis process and also make intelligent estimates of all analysis options. The MDOF wizard, for example, handles the most sophisticated modal analysis tasks like detecting repeated or closely spaced modes.



Structural dynamics testing during a parabolic flight, photo credit: German Aerospace Center (DLR)

### Standard

- Impact testing (modal hammer)
- Creation of component-based geometries
- ODS (Operating Deflection Shape) analysis

### Advanced

- Advanced modal analysis
- SDOF (Single Degree of Freedom) analysis
- MDOF (Multiple Degree of Freedom) analysis
- Operating modal analysis
- Modal model validation (MAC graph and table)
- MIMO analysis incl. multi-source outputs
- Swept and stepped sine online analysis
- Ground vibration testing
- Interface to FEMtools for SDM analysis

## ■ Rotating Machinery Acquisition and Analysis

This software package is designed for rotating machinery diagnostics, troubleshooting and analyzing noise or vibration problems related to speed characteristics of rotating or reciprocating machines in operation. Specifications include processing of analog and digital tachometer signals, RPM or time-dependant triggering, real-time and computed order tracking, real-time waterfall display, tachometer spline fit, RPM spectral map and frequency order tracking. The orbit analysis wizard is used for the study of shaft displacement on rotating machinery.



## ■ Acoustic Analysis

Noise is increasingly the subject of new regulations for the protection of human health and safety as well as for improving the environment in general. SO Analyzer provides a comprehensive range of applications from basic 1/3 octave spectrum analysis to the latest human factor analysis for sound engineering, product refinement and comparative product ranking. It serves as a real-time acoustic analyzer for fractional octave analysis according to ANSI S1.4 and IEC 60651 type 1.

The online sound intensity measurement module uses a standard dual microphone intensity probe to measure sound pressure, intensity and pressure-residual intensity index. Unlike standard single microphone pressure measurement this technique can be used in difficult environments that have high background noise or multiple sources to calculate sound power and perform sound source localisation. The acoustic intensity mapping option uses a 3D model and guided sound intensity measurements to quickly develop a 3D colour contour map for source localisation. SO Analyzer's sound power module provides you with a range of standard methods, using either pressure or intensity measurements, to determine sound power emission levels and also includes the sound transmission loss calculation wizard. Sound quality is becoming more and more important: Product designers and developers have to find the "right" sound that attracts their customers. The SO Analyzer sound quality analysis module based on Zwicker loudness offers a range of functions to assess perceived sound quality and also includes pitch and warble analysis.

For protection from mechanical vibration, exposure limits have been defined, for example, for the use of hand-held power tools or riding in vehicles. SO Analyzer's human vibration module enables the evaluation of hand-arm and whole body vibration according to the latest ISO and BS standards.

## ■ Environmental Vibration Testing

SO Analyzer provides independent or additional monitoring channels for vibration control with both online and offline sine reduction. This mimics the tracking filter analysis used on shaker controllers so providing a cost-effective measurement channel extension.

Classical Shock data capture and Shock Response Spectrum (SRS) analysis is used to examine the effects of short-duration peak stresses and accelerations (e.g. on drop tables) and to evaluate the damage of shock pulses on a structure. Overlays of target specification limits provide a complete test reporting capability.

SO Analyzer can also be used for advanced analysis of shaker test data that can be directly imported from m+p International's VibControl shaker control system and integrated with other data sources for automated analysis and report generation.

## ■ Vehicle Pass-by-Noise Testing

Manufacturers have to certify that their vehicles comply with the strict international noise emission standards. Our market-leading pass-by-noise testing system based on SO Analyzer uses GPS components for both position and velocity information, thus providing maximum accuracy and repeatability. It allows full operation from within the car and by just one person. The portable system frees the user from cumbersome and error-prone manual triggers and radar guns and allows immediate reverse runs and instantaneous pass/fail criteria.



Testing A340 winglets at Stirling Dynamics, UK



Pass-by-noise testing at Cooper Tire, USA



1000

# VibPilot

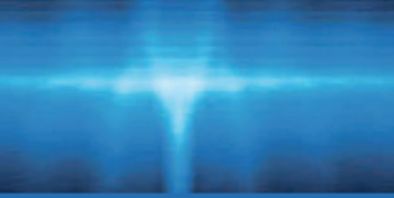
## Vibration Controller & Dynamic Signal Analyzer

**Small in Size.  
Huge in Performance.**



- The All-in-One Device for Professional Vibration Testing and Dynamic Signal Analysis
- High-Precision Measurement and Outstanding Real-Time Performance in a Compact Design
- 4- and 8-Channel Input – Easily Expandable
- Operation Indoors and Outdoors in Any Environment





With the 4/8-channel VibPilot, m+p international sets a new standard for affordable performance in vibration control and dynamic signal analysis.

VibPilot is based on the latest generation of IC technology resulting in high-precision measurement ability and impressive real-time performance in signal analysis. Equipped with 24-bit sigma-delta A/D converters with up to 102.4 kHz sampling rate, the VibPilot allows for alias-protected measurements in a frequency range up to 40 kHz and with more than 120 dB spurious-free dynamic range.

Compact and rugged, VibPilot has a robust look and feel and has a clearly arranged front panel with four or eight BNC connectors. Thanks to its dust-proof design you can operate it indoors or outdoors even under harsh conditions. VibPilot provides USB 2.0 connectivity to a host PC or laptop and is operated by either an external AC mains power supply or alternatively, by a 9 – 36 V DC supply, e.g. for in-car operation.

To extend input channel capability it is possible to synchronize two or more VibPilot devices by means of the clock in/clock out circuitry without influencing their performance. This allows you to use additional channels (e.g. 2 x 8 input channels) or to combine vibration tests and dynamic signal acquisition applications with ease.

**Small in Size.  
Huge in Performance.**

## Dynamic Signal Analysis

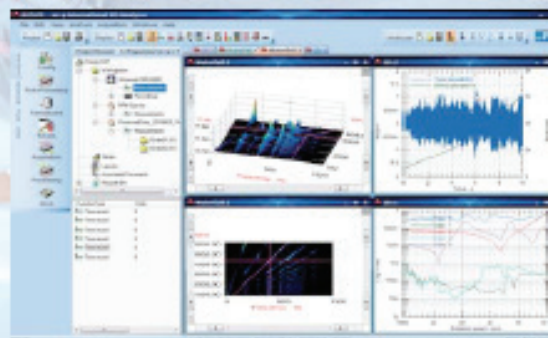
VibPilot fully supports m+p international's SO Analyzer software for accurate and efficient noise and vibration measurements, third-party data import/export, data analysis and reporting of your results.

With the SO Analyzer software, VibPilot provides all the hardware features in one box for the widest range of applications in dynamic signal analysis:

- General data acquisition
- Time history recording (throughput to disc)
- Modal analysis
- Rotating machinery testing
- Impact testing
- Acoustic analysis
- Environmental testing
- Vehicle pass-by-noise testing

VibPilot's 24-bit resolution A/D converters and its excellent dynamic range provide the necessary precision to make the SO Analyzer well suited for the most demanding tasks in dynamic signal analysis in the field and in the laboratory. The fan-less, noise-free operation of the VibPilot enables noise measurements requiring a quiet environment. Two tachometer inputs are included with 32-bit high-speed up/down counters for measuring synchronous signals on rotating machines or for use as COLA synch inputs for shaker sine reduction applications.

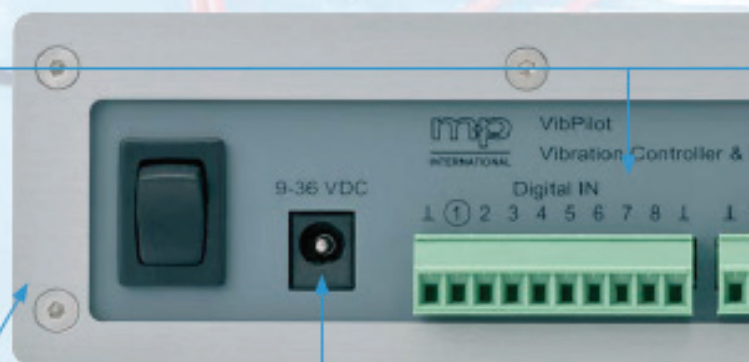
With a multi-channel analyzer such as the VibPilot it is crucial to have a powerful tool for central management of the potentially large data sets acquired. Therefore the SO Analyzer software provides you with comprehensive capabilities for browsing, viewing, editing, analysing and reporting data as well as with full ActiveX compliance.



Eight digital inputs and outputs for remote control

Compact, rugged, dust-proof chassis: 211 x 50 x 190 mm

DC supply e.g. for in-car operation





## Vibration Testing

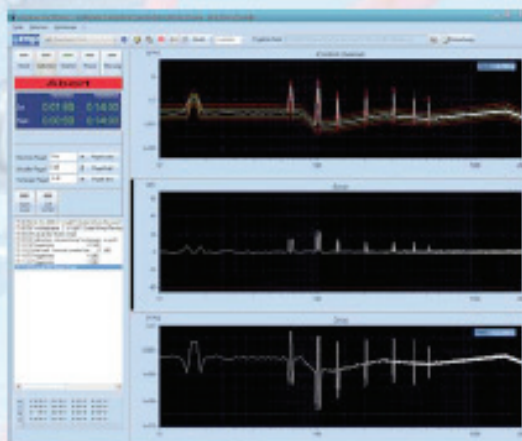
The VibPilot instrument covers the full functionality of our proven VibControl shaker control software and all test modes that are used in vibration testing today, everything from simple ESS random and sine testing to mixed mode gunfire simulation. Drop table capture, time history recording to throughput disc as well as unlimited time data replication and road load simulation mean that m+p international can tackle the widest range of requirements. All tests are fully compliant with ISO, DIN, MIL-STD 810 and all other vibration testing standards.

Using true multi-tasking functionality, the VibControl software is extremely robust in operation and allows you to run multiple tasks in parallel from the same keyboard without loss of real-time control. A variety of sophisticated analysis and reporting functions helps you to complete your testing job with a minimum of fuss.

The eight digital inputs and outputs enable automatic operation under climatic chamber control for combined environment test programs. Individual tests can be easily combined in any complexity of nested loops. When the system is left unattended, e.g. for an overnight or weekend run, you can still be in control: Test status reports are sent via email or SMS text message to your mobile phone.

Two 300 MHz floating-point dynamic signal processors in each unit pre-process the data, thus guaranteeing the high performance and short control cycles.

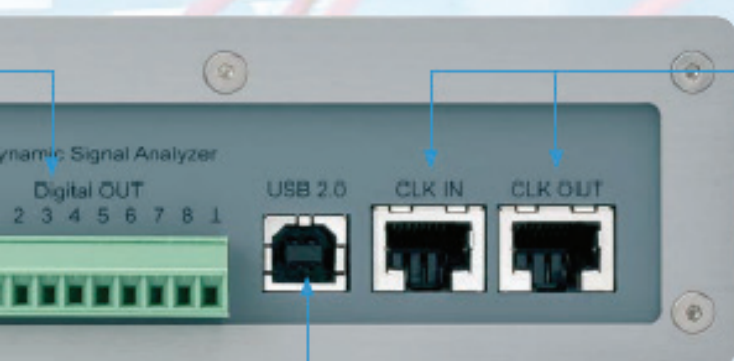
For the most critical tests time sample data can also be recorded in parallel with control to the throughput disc without any reduction in control performance.



VibPilot's analog input circuits have advanced sigma-delta converters which offer advantages such as simultaneous sampling by independent A/D converters on each input, reduced noise and improved accuracy due to 64 times oversampling on each input, both analog and digital filtering is used for full aliasing protection and they provide excellent low-level signal-to-noise performance and differential linearity.

Two precision low-noise analog outputs are available together with hardware shutdown circuitry which ramps down the source signals in a controlled manner in case of emergency.

As well as normal differential voltage inputs with AC/DC coupling, signal conditioning for the analog input channels also provides source capabilities for ICP sensors including cable break indicators and an interface for accessing standardised Transducer Electronic Data Sheets (TEDS). TEDS support allows automatic front-end setup based on information stored in the transducer, e.g. sensitivity, calibration and serial number.



Synchronization extends input channel capability

USB connectivity to a host PC or laptop



**Small in Size.  
Huge in Performance.**



## VibPilot

Are you searching for a compact multi-channel instrument meeting the most demanding requirements of today's vibration testing and/or dynamic signal analysis?

An instrument that handles general data acquisition and signal processing tasks as reliably as sine, random, shock and mixed mode testing, modal analysis, rotating machinery testing, acoustics, etc.?

A mobile, yet powerful and highly precise instrument that covers the complete measurement process from acquisition to reporting and can be operated in any environment?

Then m+p international's VibPilot should be your first choice.

### Benefit from the affordable excellence of the VibPilot:

- 4 or 8 analog input channels – expandable
- 102.4 kHz simultaneous sampling
- ICP sensor conditioning
- TEDS support
- 2 source output channels
- Safety shutdown for source channels
- 2 tacho inputs
- 8 digital inputs and 8 digital outputs
- DSP powered real-time processing
- Multiple VibPilot synchronisation
- USB 2.0 host interface
- Compact, dust-proof, rugged housing
- Fan-less, noise-free operation
- AC/DC supply, only 20 W power consumption

VibPilot is delivered with 12-months or optionally 24- or 36-months warranty and with a full calibration certificate. For us your system operational reliability is one of the major criteria for promoting sustained and long cooperation with our customers. We offer return to m+p repair service including an optional guaranteed 24-hours back-to-operate as well as factory re-calibration at m+p international as well as on-site calibration.

To keep you ahead of your competition, VibPilot is designed to put the products you test at the forefront of performance, durability and quality.

Please refer to the VibPilot, VibControl and SO Analyzer brochures and product information sheets for detailed specifications.

VibPilot, VibControl and SO Analyzer are products of m+p international. All trademarks and registered trademarks are the property of their respective holders.

Specifications subject to change without notice.

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# *Selection Guide*

# **Microphones & Preamplifiers**



**G.R.A.S.**  
SOUND & VIBRATION

## Index

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### Introduction

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Measurement microphones can be divided into three groups: Free-field, Pressure, and Random Incidence. The differences between microphones from group to group are at the higher frequencies, where the size of a microphone becomes comparable with the wavelengths of the sound being measured. In all cases, the microphones discussed in the following are condenser microphones.

### Pressure microphones

---



A pressure microphone is for measuring the actual sound pressure as it exists on the surface of the microphone's diaphragm. A typical application is in the measurement of sound pressure in a closed coupler or, as shown at left, the measurement of sound pressure at a boundary or wall; in which case the microphone forms part of the wall and measures the sound pressure on the wall itself.

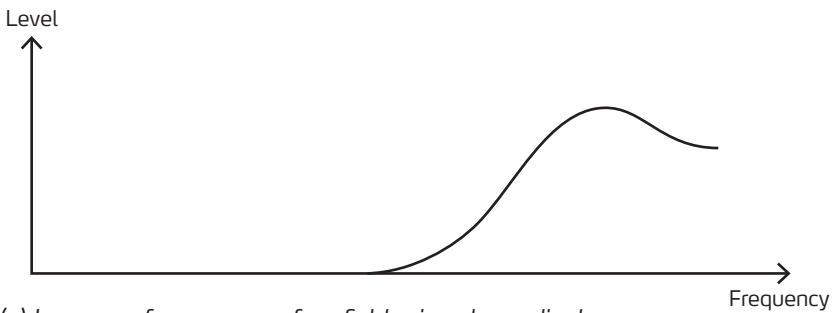
### Free-field microphones

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A free-field microphone is designed essentially to measure the sound pressure as it existed before the microphone was introduced into the sound field. At higher frequencies the presence of the microphone itself in the sound field will disturb the sound pressure locally. In general, the sound pressure around a microphone cartridge will increase because of reflections and diffraction.

The frequency characteristics of a free-field microphone are designed to compensate for this increase in pressure; hence the output of a free-field microphone is a signal proportional to the sound pressure as it existed before the microphone was introduced into the sound field. A free-field microphone should always be pointed towards the sound source ( $0^\circ$  incidence) as shown at left. In this situation the presence of the microphone's diaphragm in the sound field will result in a pressure increase in front of the diaphragm depending on the wavelength of the sound and the diameter of the microphone, see curve (a) next page.

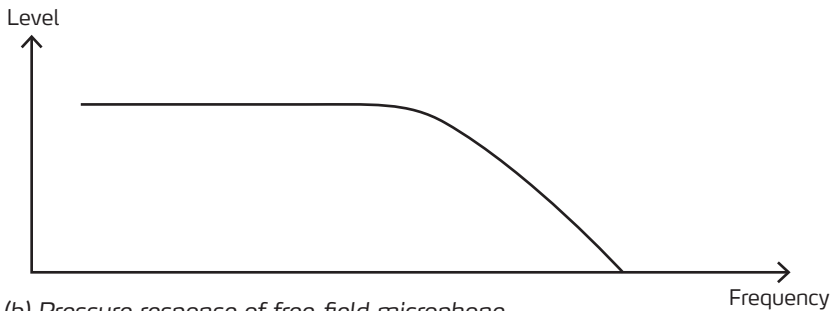


(a) Increase of pressure on free-field microphone diaphragm

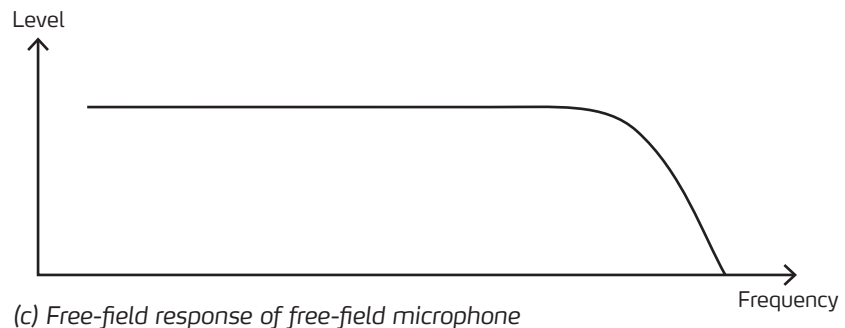
For a typical 1/2" microphone, the maximum pressure increase will occur at 26.9 kHz, where the wavelength of the sound ( $\lambda$ ) coincides with the diameter of the microphone, i.e.:

$$\lambda = \frac{342 \text{ m/s}}{26.9 \text{ kHz}} \approx 12.7 \text{ mm} = \frac{1}{2}''$$

The result is an output from the microphone cartridge which is proportional to the sound pressure as it existed before the microphone was introduced into the sound field, see curve (c) below. Curve (a) above is also called the free-field correction curve for the microphone and must be added to the pressure response of the microphone shown in curve (b), to obtain the characteristics of a free-field microphone shown in curve (c).



(b) Pressure response of free-field microphone



(c) Free-field response of free-field microphone



## Random-incidence microphones

---



In principle, a free-field microphone requires that it is pointed towards the sound source and that the sound waves travel, essentially, in one direction. In some cases, e.g. when measuring in a reverberation chamber or in other highly reflecting surroundings, sound waves will not have a well defined direction of propagation, but will arrive simultaneously at the microphone from various directions.

Sound waves arriving at the microphone from the front will cause a pressure increase as described above for a free-field microphone, whereas sound waves arriving from behind the microphone will, to a certain extent, cause a pressure decrease because of the shadowing effects of the microphone. The combined influence of sound waves coming from all directions depends, therefore, on how the sound waves are distributed over the various directions. For measurement microphones, a standard distribution has been defined based on statistical considerations; resulting in a standardized random-incidence microphone.

## Pre-polarized vs. externally-polarized microphones

---

Externally-polarized microphones are used with standard preamplifiers, which have a 7-pin LEMO connector. The preamplifier should be connected to a power module or an analyzer input which can supply the preamplifier with power as well as 200 V polarization.

Pre-polarized microphones are used typically with CCP (Constant Current Power) preamplifiers. These microphones must be connected to an input stage for CCP transducers or be powered by a CCP supply.

## Frequency range of a microphone

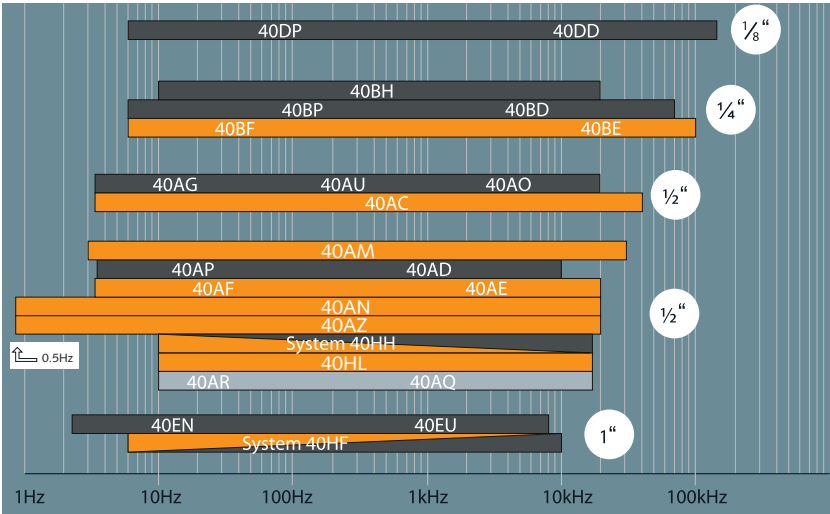
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The frequency range of a microphone is defined as the interval between its upper-limiting frequency and its lower-limiting frequency.

### Upper-limiting frequency

The upper-limiting frequency is linked to the size of the microphone, or more precisely, the size of the microphone compared with the wavelength of sound. Since wavelength is inversely proportional to frequency, it gets progressively shorter at higher frequencies. Hence, the smaller the diameter of the microphone, the higher the frequencies it can measure. On the other hand, the sensitivity of a microphone is also related to its size which affects its dynamic range as well.

The frequency ranges of various G.R.A.S. microphones are shown in the chart below. The Type or Model number of each microphone is shown. The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".



### Lower-limiting frequency

The lower-limiting frequency of a microphone is determined by its static pressure equalization system. Basically, a microphone measures the difference between its internal pressure and the ambient pressure.

If the microphone was completely airtight, changes in barometric pressure and altitude would result in a static deflection of its diaphragm and, consequently, in a change of frequency response and sensitivity.

To avoid this, the microphone is manufactured with a static-pressure equalization channel for equalizing the internal pressure with ambient pressure. On the other hand, equalization must be slow enough to avoid affecting the measurement of dynamic signals.

### Dynamic range of a microphone

The dynamic range of a microphone can be defined as the range between the lowest level and the highest level that the microphone can handle. This is not only a function of the microphone alone but also of the preamplifier used with the microphone. The dynamic range of a microphone is, to a large extent, directly linked to its sensitivity.

In general, a microphone with a high sensitivity will be able to measure very low

levels, but not very high levels, and a microphone with low sensitivity will be able to measure very high levels, but not very low levels.

The sensitivity of a microphone is determined chiefly by the size of the microphone and the tension of its diaphragm. Generally speaking, a large microphone with a loose diaphragm will have a high sensitivity and a small microphone with a stiff diaphragm will have a low sensitivity.

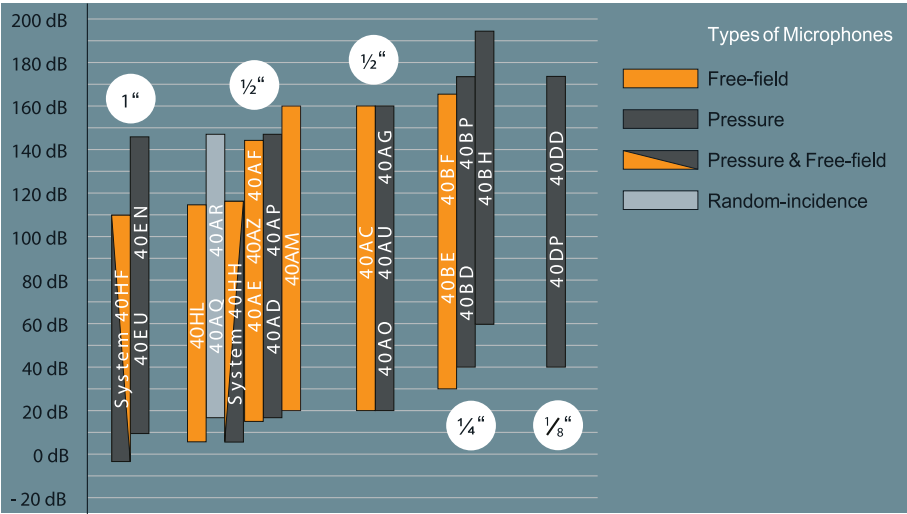
### Upper limit of dynamic range

The highest levels that can be measured are limited by the amount of movement allowed for the diaphragm before it comes into contact with the microphone's back plate.

As the level of the sound pressure on a microphone increases, the deflection of the diaphragm will accordingly be greater and greater until, at some point, the diaphragm strikes the back plate inside the body of the microphone. This is ultimately at the highest level the microphone can measure.

In fact, as the deflection of the diaphragm becomes large, the relationship between diaphragm deflection and the consequent change in microphone capacity becomes non-linear and results in distorting the output signal of the microphone. Because of this, the upper limit of the dynamic range is described as that level where distortion reaches 3%. A distortion limit of 10% usually occurs at about 6 dB higher.

The dynamic ranges of various G.R.A.S. microphones are shown in the chart below. The Type or Model number of each microphone is shown. The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".



## Lower limit of dynamic range

The thermal agitation of air molecules is sufficient for a microphone to generate a very small output signal, even in absolutely quiet conditions. This “thermal noise” lies normally at around 5  $\mu\text{V}$  and will be superimposed on any acoustically-excited signal detected by the microphone. Because of this, no acoustically-excited signal below the level of the thermal noise can be measured.

This 5  $\mu\text{V}$  output signal is equivalent to a certain “apparent” sound pressure level which can be calculated from the sensitivity of the microphone. For a microphone with a sensitivity of 50 mV/Pa, this would correspond to an apparent sound pressure of:

$$\frac{5 \mu\text{V}}{50 \text{ mV/Pa}} = 0.0001 \text{ Pa}; \text{ in other words around } 14 \text{ dB re. } 20 \mu\text{Pa}$$

Similarly, for a microphone with a sensitivity of 4 mV/Pa, this would correspond to an apparent sound pressure of:

$$\frac{5 \mu\text{V}}{4 \text{ mV/Pa}} = 0.00125 \text{ Pa}; \text{ in other words around } 36 \text{ dB re. } 20 \mu\text{Pa}$$

Hence, a microphone with a sensitivity of 50 mV/Pa can measure down to about 14 dB whereas a microphone with a sensitivity of 4 mV/Pa can only measure down to about 36 dB.

In practice, a microphone needs to be connected to a high-impedance preamplifier in order to handle the very weak output signal from the microphone. A preamplifier also has a certain amount of noise which will be added to the thermal noise generated by the microphone. See Part 2.



### Introduction

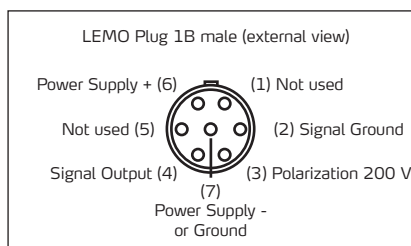
The output signal from a microphone is very weak and cannot drive cables, so it is necessary to mount a preamplifier directly on to the microphone or very close to it. The preamplifier does not normally amplify the microphone signal but converts the high impedance microphone signal to a low impedance signal which can drive long cables etc; for this reason, a preamplifier is sometimes also called an impedance converter.

### Preamplifier types

Preamplifiers come in two different versions; one is what is normally referred to as "traditional" and the other as CCP. Both types are available from G.R.A.S. and are described here.

#### Traditional preamplifiers

Traditional preamplifiers require an external power supply which delivers a supply voltage of either  $\pm 15$  to  $\pm 60$  V DC or +28 to +120 V DC. This type of preamplifier is normally connected to a suitable power supply (for example the G.R.A.S. Type 12AK) via a 7-pin LEMO plug, see diagram below, or to an analyzer with a suitable LEMO connector.



#### CCP preamplifiers

CCP preamplifiers connect to a CCP supply (for example the G.R.A.S. Type 12AL) via a standard coaxial cable and plug (e.g. BNC) or to an analyzer with a CCP input. In a CCP preamplifier, the power supply maintains a constant current superimposed on the same wire carrying the signal, therefore requiring only a standard coaxial cable and connector.

## Preamplifier frequency range

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All G.R.A.S. preamplifiers cover a frequency range which tops at 200 kHz where the lower limit of the frequency range is determined by the microphone's capacitance.

Most G.R.A.S. preamplifiers have an input impedance of  $20\text{ G}\Omega$  which, combined with the capacitance of the microphone cartridge, forms an RC network that determines the low-frequency cut-off.

A typical microphone, such as the G.R.A.S. Type 40AF, has a capacitance of  $17\text{ pF}$  which results in an electrical lower-limiting frequency of  $2.7\text{ Hz}$ .

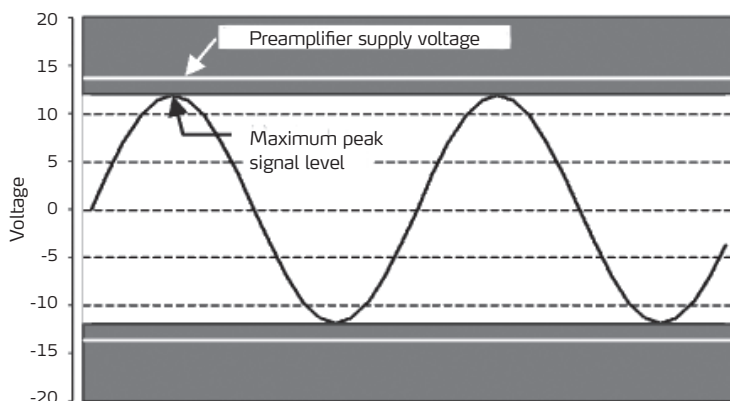
## Preamplifier dynamic range

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The dynamic range of a preamplifier can be defined as the range between the highest level the preamplifier can handle and the lowest level it can measure. The highest level is related to the voltage supplied to the preamplifier, whereas the lowest level is related to the noise generated by the preamplifier itself.

### Upper limit of dynamic range

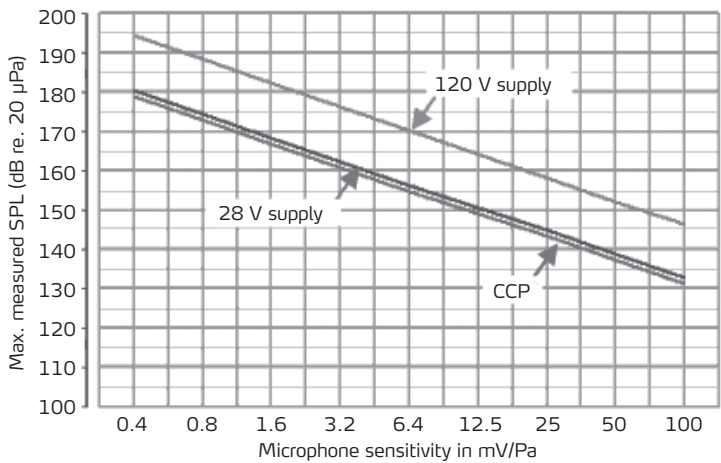
The highest level is related to the voltage supplied to the preamplifier so that the peak-to-peak variation in signal levels that can be handled by the preamplifier is slightly less than the voltage supplied. For example, for a supply voltage of  $\pm 14\text{ V DC}$ , the preamplifier can handle peak signals up to  $12\text{ V}$  or peak-to-peak signals up to  $24\text{ V}$ . See diagram below.



For a CCP preamplifier, the supply voltage is limited to  $24\text{ V}$  which gives a maximum peak-to-peak output signal of  $22\text{ V}$ .

The sound pressure levels which can be measured with a particular preamplifier depends on the sensitivity of the microphone used for the measurements, such that

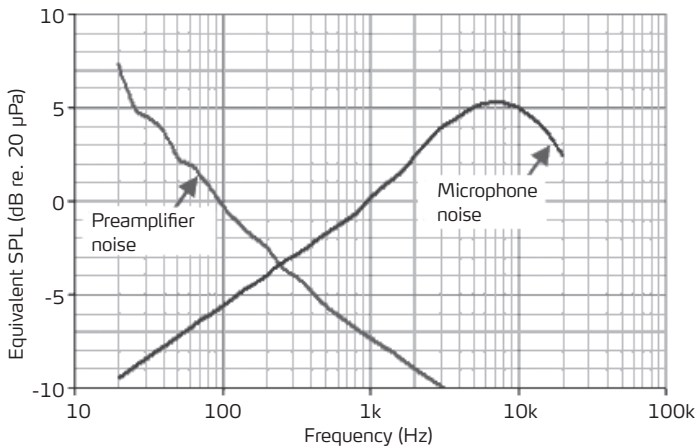
a microphone with a low sensitivity can measure higher levels than a microphone with a high sensitivity, see diagram below.



**Lower limit of dynamic range**

The lower limit of a preamplifier’s dynamic range is determined by the noise floor of the preamplifier. A typical preamplifier generates a broad-band noise signal of around 3 µV and will mask the microphone’s signal if it lies below this.

The noise spectrum of the preamplifier is dominated by low frequencies as shown in the graph below.



When a microphone is mounted on a preamplifier, the inherent noise of the microphone will be added to the preamplifier noise and the noise floor of the system will be determined by the combined microphone and preamplifier noise.

As the graph above shows, the lower limit of the dynamic range is determined by preamplifier noise at the low frequencies and by microphone noise at the high frequencies.

### Easy selection

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The measurement microphone sets have been combined so they fulfil our users' typical measurement needs. Independently of your measurement system and application you should be able to find a set that suits your needs.

### Plug & Play

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The microphone sets can be connected directly to all professional measurement systems and as indicated they are available for both CCP and 7-pin LEMO inputs.

If your measurement platform supports intelligent transducers according to IEEE 1451.4 (TEDS) you can simply plug in the microphones and they will identify themselves with their specific properties, types and calibration data. A feature especially appreciated by multi-channel users.

### Cables

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The CCP sets use high-quality coaxial cables, whereas the LEMO sets use a special, soft type of multicore shielded cable. Some sets have a 3 m cable included and others have cables as accessories.

If extended cables are to be used you should consider the possible influence on the upper frequency and dynamic ranges. More information about this can be found on [gras.dk](http://gras.dk).

### Calibration data

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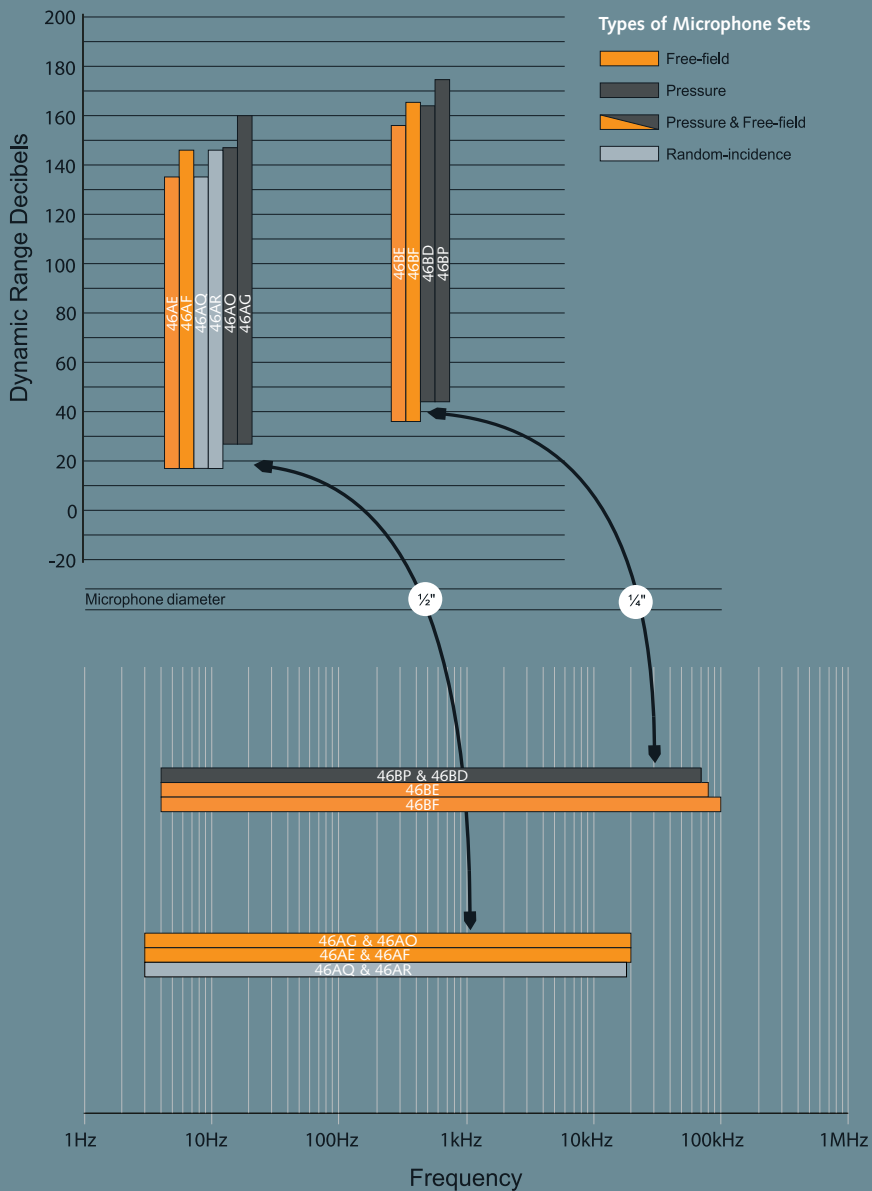
All microphone sets are delivered as a unit and are calibrated accordingly. The sets are delivered with calibration charts including sensitivity values and frequency response curves for the complete set. The sensitivity value can therefore be used directly in your system setup.

### Verification and annual calibration

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For frequent verification of the measurement chain a sound source will be required. G.R.A.S. supplies a 114 dB sound calibrator for this purpose. Depending on the use and your internal quality control requirements we recommend that the sets are recalibrated at least every second year.





### Introduction

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Special microphones are often required for applications where there are particular requirements surrounding the methods of measurements and configurations as in the following.

**Surface microphones** for general purpose measurements on planar and curved surfaces. Wide useful frequency range reaching up to 70 kHz and a large dynamic range topping at around 174 dB.

**Array microphones** for situations where concurrent measurements are required at several points in an array. For example in the analysis of sound fields, sound power and transients. Close manufacturing tolerances together with the advantages of the TEDS chip provide these array microphones with a high degree of interchangeability; a major advantage when used in multiples forming arrays and matrices.

**Outdoor microphones** are for permanent outdoor use and encased stainless steel units that can withstand all weathers year after year e.g. in airport noise monitoring systems.

**Environmental microphones** are smaller units meant for temporary outdoor use in terms of days or weeks, such as in time limited consultant work.

**The Low-noise Microphone System** can measure pressure levels well below the threshold of human hearing and is amply suitable for use in sound power measurements on even very quiet products. Its very wide dynamic range permits measurements down to below -2 dB re. 20  $\mu$ Pa (in 1/3-octave bands) from 20 Hz to 20 kHz. A stand-alone low-noise microphone system, type 40HL, for connecting directly to any analyzer input module with 7-pin LEMO, is now available.

**Intensity Probes** from G.R.A.S. comprise two closely spaced, face-to-face microphones and a set of 1/4-inch preamplifiers as well as a control handle. The 1/2-inch and 1/4-inch intensity microphone pairs have been carefully manufactured and selected to have minimum phase difference.

**Probe Microphones** for measurements in difficult or inaccessible situations, for example at high temperatures or conditions of airflow. Its right-angled design makes it particularly well suited for measurements in exhaust systems and machinery in general, as well as for scanning surfaces such as loudspeakers and cabinets.

Microphones Sets

Variety	Size	Model	Sensitivity (mV/Pa)	Freq. Range (Hz - kHz)	Dynamic Range (dB re. 20uPa)	Polarization Voltage (V)/ Connection
Free-Field	1/2"	46AE	50	3.15 - 20	17 - 135	CCP input
	1/2"	46AF	50	3.15 - 20	17 - 146	LEMO input
	1/4"	46BE	4	4 - 80	36 - 157	CCP input
	1/4"	46BF	4	4 - 100	36 - 166	LEMO input
Pressure	1/2"	46AG	12.5	3.15 - 20	27 - 160	LEMO input
	1/2"	46AO	12.5	3.15 - 20	27 - 147	CCP input
	1/4"	46BD	1.6	4 - 70	44 - 165	CCP input
	1/4"	46BP	1.6	4 - 70	44 - 174	LEMO input
Random	1/2"	46AQ	50	3.15 - 16	17 - 135	CCP input
	1/4"	46AR	50	3.15 - 16	17 - 146	LEMO input

Microphones

Free-Field	1/2"	40AC	12.5	3.15 - 40	20 - 160	200
	1/2"	40AE	50	3.15 - 20	15 - 146	0
	1/2"	40AF	50	3.15 - 20	14 - 146	200
	1/2"	40AN	50	0.5 - 20	14 - 146	200
	1/2"	40AM	12.5	3.15 - 40	20 - 160	0
	1/2"	40AZ	50	0.5 - 20	14 - 146	0
	1/4"	40BE	4	10 - 80	30 - 166	0
	1/4"	40BF	4	4 - 100	30 - 166	200
Pressure	1"	40EN	50	2.6 - 8	9.6 - 146	200
	1"	40EU	50	2.6 - 8	9.6 - 146	200
	1/2"	40AD	50	3.15 - 10	16 - 146	0
	1/2"	40AG	12.5	3.15 - 20	20 - 160	200
	1/2"	40AO	12.5	3.15 - 20	20 - 160	0
	1/2"	40AP	50	3.15 - 10	16 - 148	200
	1/2"	40AU	12.5	3.15 - 20	20 - 146	200
	1/4"	40BD	1.6	4 - 70	40 - 174	0
	1/4"	40BH	0.4	10 - 20	60 - 194	200
	1/4"	40BP	1.6	4 - 70	31 - 174	200
	1/8"	40DD	0.7	6.5 - 140	40 - 174	0
	1/8"	40DP	1	6.5 - 140	40 - 174	200
Random	1/2"	40AQ	50	3.15 - 16	16 - 148	0
	1/2"	40AR	50	3.15 - 16	17 - 146	200
Probe		40SA	3	2 - 20	40 - 166	200
		40SC	3	2 - 20	40 - 160	0
Array	Free-field	40PH	50	10 - 20	32 - 135	0
	Free-field	40PL	10	10 - 20	32 - 150	0
Surface		40PS	5	20 - 20	30 - 136	0
		40LS	1.5	5 - 70	46 - 164	0
Environmental	1/2"	41AL	50		20 - 146	
	1/2"	41AO	50		20 - 146	
Outdoor	"Airport"	41AM	50 unified		20 - 136 (38 - 156)	
	"Community noise"	41CN	50 unified	20 - 20	20 - 136 (38 - 156)	
Low Noise System	1"	40HF	System: 1100	6 - 12.5	-2 - 110	200
	1/2"	40HH	System: 750	6 - 20	6.5 - 113	200
	1/2"	40HL	System: 900	6 - 20	6.5 - 113	200
	1/2"	40HT	System: 750	6 - 20	6.5 - 113	200
Intensity Pair	1/2"	40AI	25	1 - 16	20 - 160	200
	1/2"	40AK	25	1 - 16	20 - 160	200
	1/4"	40BI	3	4 - 70	30 - 166	200
	1/2"	40GI	12.5	1 - 16	20 - 160	0
	1/2"	40GK	12.5	1 - 16	20 - 160	0

## Preamplifiers

Size	Model	Connector	Description
1/2"	26AK	7-pin LEMO	General-purpose
1/2"	26AG	7-pin LEMO	Insert-Voltage
1/2"	26AH	7-pin LEMO	Syscheck, incl. 3 m cable
1/2"	26AJ	7-pin LEMO	SysCheck
1/2"	26AM	7-pin LEMO	General-purpose, incl. 3 m cable
1/2"	26TK	7-pin LEMO	General-purpose, with TEDS
1/4"	26AB	7-pin LEMO	General-purpose
1/4"	26AC	7-pin LEMO	General-purpose, incl. 3 m cable
1/4"	26AL	7-pin LEMO	Syscheck, incl. 3 m cable
1/4"	26AN	7-pin LEMO	Insert-Voltage
1/4"	26AS	7-pin LEMO	Super short, incl. 3 m cable
1/4"	26HG	7-pin LEMO	High Impedance, incl. 3 m cable (For Low Freq.)
1/4"	26TC	7-pin LEMO	General-purpose, with TEDS, incl. 3 m cable
1/4"	26AA	4-pin LEMO OB	For use with Intensity Probe Type 50AI
1/2"	26CA	BNC	CCP incl. TEDS
1/2"	26CF	BNC	CCP, with gain & filters (0 dB/+20 dB) (A-Lin-HP)
1/4"	26CC	SMB	CCP, with TEDS, for use on Array Modules
1/4"	26CB	Microdot	CCP, with TEDS, 3 m Microdot-BNC cable
1/4"	26CS	Microdot	CCP Short Version, with TEDS
1/4"	26CG	Microdot	CCP, High Impedance, with TEDS (For Low Freq.)

## Power Modules

### Traditional

Type	Connector	Channels	Polarization Voltage	Frequency Response	Gain	Filters	Preamplifier Supply	Power Supply
12AD	7-pin Lemo	1	0 - 200	0.5 Hz - 200 kHz	0 dB	No	±15 V	Battery / Adapter
12AR	7-pin Lemo	2	0 - 200	0.5 Hz - 200 kHz	0 dB	No	±15 V	Battery / Adapter
12AN	7-pin Lemo	4	0 - 200	0.5 Hz - 200 kHz	0 dB	No	±15 V	Battery / Adapter
12AK	7-pin Lemo	1	0 - 200	3.5 Hz - 200 kHz	0 - 50 dB	Yes	28 / 120 V	Battery / Adapter
12AG	7-pin Lemo	8	0 - 200	3.5 Hz - 200 kHz	0 - 50 dB	Yes	28 / 120 V	Battery / Adapter
12AA	7-pin Lemo	2	0 - 200	3.5 Hz - 200 kHz	-20 - 40 dB	Yes	28 / 120 V	Battery / Adapter
12AQ	7-pin Lemo	2	0 - 200	2 Hz - 200 kHz	-20 - 70 dB	Yes	15 / 60 V	Battery / Adapter

### CCP

Type	Connector	Channels	Polarization Voltage	Frequency Response	Gain	Filters	Preamplifier Supply	Power Supply
12AL	BNC	1	CCP	1 Hz - 200 kHz	0 dB	Yes	4 mA sourced from 28 V	Battery / Adapter

www.gras.dk

We make microphones



