

# Noise & Vibration

Testing and Analysis Solutions

for Marine Industries



# Made for Your Demanding World

## 1- Improve Efficiency

### Test Cells

- > Prototype validation
- > Factory acceptance



## 2- Maximize Uptime

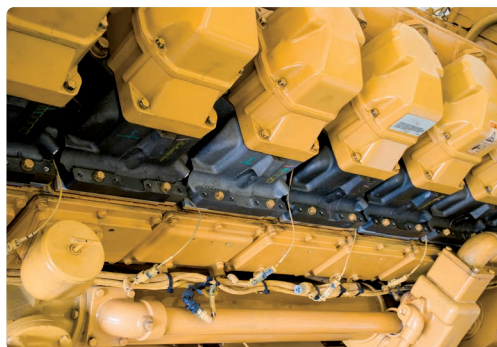
### On-board Testing

- > On-board acceptance
- > Maintenance operation
- > Diagnostics and troubleshooting



### Remote Monitoring

- > Unpredictable & unrepeatable phenomena



## 3- Minimize Costs

### Improve Production Testing Efficiency

- > Integrated & automated test process and report generation
- > User-friendly operation
- > Multichannel real-time processing and displays
- > Universal and multiple sensor's types: microphones, acceleration, temperature, strain, pressure...

### Travel Light for Reliable Tests

- > Versatile toolbox for all noise and vibration diagnostics applications
- > Distributed acquisition systems over the ship
- > Portable and rugged analyzers for field measurements
- > Multichannel simultaneous acquisition
- > Real-time analysis for field efficiency
- > Distributed acquisition systems over the ship

### Optimize Costs and Prevent Failure

- > Alarm triggering warning via email, web dashboard, or sms
- > Collect raw signal information for thorough office processing



### They trust OROS

- > "With my OROS analyzer, I'm really confident during on-board measurements thanks to its toughness and its complete panel of functions."

Noise and Vibration Maintenance Engineer,  
Propulsion Department.



# Measuring your Ships and Propulsion Systems

## Rotating Analysis

### Roller Bearing Analysis

Damaged roller bearings are common vibration sources. Their vibration spectrum, measured with an accelerometer mounted on the casing, allows to determine mechanical failures on balls or races. **Envelope demodulation and kinematics markers**, part of FFT-Diagnostics module, are the key tools for that purpose.

### Monitoring

On board ships, noise and vibration levels can often increase rapidly and unexpectedly.

To achieve efficient countermeasures, you need detailed information and not only overall levels. No need to stay on site waiting for vibration levels to exceed unacceptable limits: the system operates **autonomously triggering actions** on alarms and **can be accessed remotely** for further diagnostics.

### Torsional Analysis

Torsional vibration and torque fluctuation are usual phenomena especially on large internal combustion engines.

The OROS torsional software module utilizes a frequency to voltage converter for speed input providing the following information: the angular velocity profile displays **RPM variations**. In addition, a 2 pulse train combination allow to detect torsional resonances.

### Reciprocating Machine Analysis

Reciprocating machines are complex installations. Generating specific vibration signatures. The objective is their performance optimization and faults detections. For example, **injection delay, valves faults, segmentation wear** can be identified with EngineDiag.

This software module integrates the machine mechanical properties: number of cylinders, firing order and timing diagram, allowing to provide pertinent decision criteria on the field. Time signal, **overall levels** as well as **angle-frequency representation** on the machine cycle are efficient results for diagnostics.

### Gear Analysis

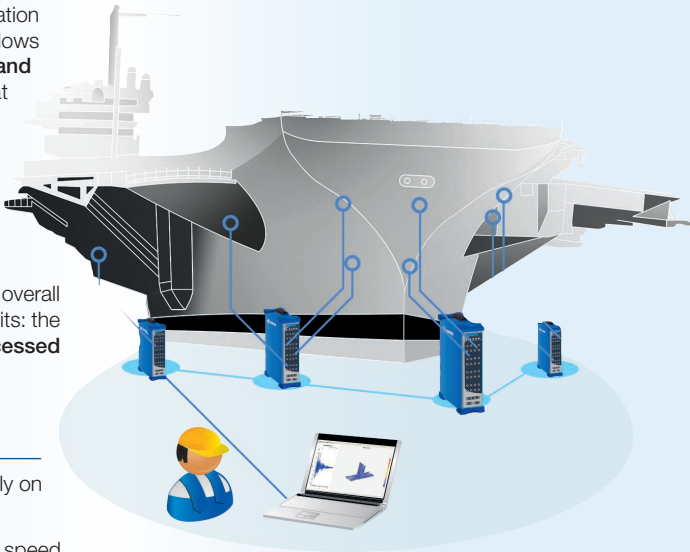
Gear boxes on ships have to be silent and have a complex vibration signature, usually occurring at high frequencies.

The FFT-Diagnostics module, such as **cepstrum, correlation, kurtosis** and harmonic markers are necessary to describe and understand the generated vibrations.

In addition, the virtual tachometers management feature allows the analyst to achieve order tracking (magnitude, phase and speed) information based on the gear ratio.

## On-Site Measurements & Applied Trainings

Experts from OROS may come on-site for applied trainings. They will help you using your OROS system. They can provide assistance in your measurement. They are also able to recommend optimization in your measurement process depending on your application and field requirements.

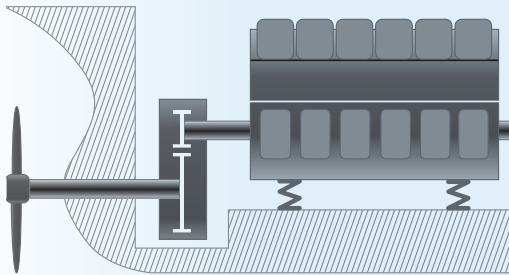


### Shipbuilding

- > Hull
- > Tower
- > Air Conditioning
- > Pumps
- > Compressors

### Propulsion Systems

- > Gas Turbines
- > Diesel Engines
- > Generators
- > Motors
- > Gearboxes
- > Flexible Coupling



## Structural Dynamics

### ODS (Operating Deflection Shape)

A powerful analysis to solve problems related to forced vibrations. Only with few measurement points, determine the source of high vibration level and the structural modifications to be implemented on the machine.

### Damping & Isolation

Absorbing and damping mounts are the components through which the vibration energy is transmitted between the engine and the rest of the ship: their properties, dimensions and positions should be determined with care. The techniques used are **cross spectrum, transfer functions, damping**, as well as **ODS (Operating Deflection Shape)**.

### Modal Analysis

Modal Analysis is one of the key steps when testing machines: it determines their structural characteristics and so, defines how they reacts to operating excitations. **Shaker or impact hammer** excitations can be used to capture the experimental datasets: the final stage is the actual **OROS modal analysis**.

## Noise Analysis

### Structure-Borne Noise Analysis

This technique uses acoustics tools, typically 1/3 octave analysis. The results allow to identify and reduce the transmission to structure-borne noise.

### Underwater NAH (Near Field Acoustic Holography)

This technique offers highly accurate acoustic maps based on the sound pressure measured by a hydrophone array close to the hull. Together with the far-field radiated noise level prediction capability, it is the ideal tool for acoustic signature management and noise control of submarines and vessels.

### TPA (Transfer Path Analysis)

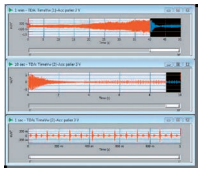
This powerful solution allows the determination and ranking of the contributing noise and vibration sources and transfer paths to the targets. Targets can be set either inside the cabin in order to improve the comfort, or outside the hull to enhance the acoustic stealthiness or reduce the noise emission.

# OROS Solutions

## Enhance your Efficiency

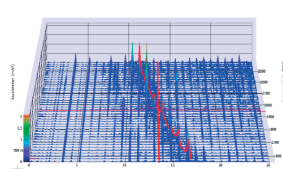
### SOFTWARE R&D, Acceptance, Diagnostics

#### Data Acquisition



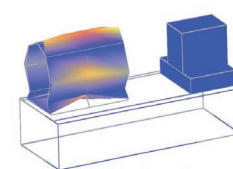
- > Recorder
- > Time Domain Analysis

#### Rotating Analysis



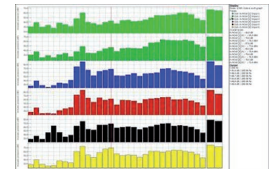
- > Spectral Based Diagnostics
- > Torsion and Twist
- > Synchronous Order Tracking
- > Reciprocating Machines
- > Diagnostics: EngineDiag
- > Balancing
- > Monitoring

#### Structural Dynamics



- > FFT
- > ODS (Operating Deflection Shape)
- > Modal analysis

#### Noise Analysis



- > 1/3rd Octave
- > Sound Intensity
- > TPA (Transfer Path Analysis)
- > Underwater Holography

### INSTRUMENTS from 2 to 32 channels, distributed up to 1000+

#### Flexible Connection

- > Mobile Analyzer
- > Distributed Configuration
- > Remote Access
- > Large Channel Count Systems

#### Multioperations

- > PC Free Recorder
- > Online & Post-Analysis
- > Multianalysis
- > Handles Any Transducer



#### Made for the Field

- > Portable
- > Rugged
- > Real-Time
- > Multi-Channel

#### Accurate

- > DSP-based
- > 24 Bit – 40 kHz – 140 dB
- >  $\pm 40$  V input range
- >  $\pm 0.02$  dB /  $\pm 0.02^\circ$

### SERVICES Everywhere Close to You



#### Training

- > Initial
- > Advanced
- > Webinar



#### Coaching

- > Software customization
- > Assistance in your measurements

#### Testing

- > Expertise in diagnostics
- > Troubleshooting
- > Tools for automation



#### A Dedicated Team

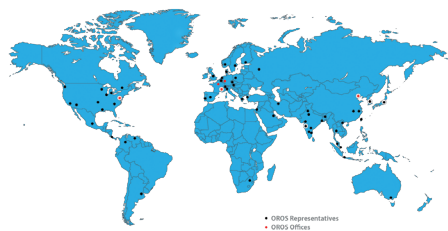
- > Dynamic and responsive Services department
- > Worldwide hotline
- > Global Accredited Maintenance Centers (worldwide coverage)
- > Rentals
- > Ready-to-go systems at any time



#### Maintenance and Contracts

- > Premium contracts
- > Software updates
- > Hardware upgrades
- > Calibration

# Ordering Information



**OROS is a global manufacturer and solution provider of noise and vibration testing and analysis solutions.**

OROS masters the latest technology of data acquisition, digital signal processing as well as user interface software.

OROS instruments are used in the major sectors of industry and research, for industrial acoustics, structural dynamics and rotating machinery applications. Hardware and software are totally designed in-house.

35-years in business, OROS instruments are renowned as being designed for the field but powerful enough for any lab.



Find out more on the OROS offer in the Range brochure.

Downloadable on [www.oros.com](http://www.oros.com)

## Software Modules

### Rotating Analysis

ORNV-SOA	Synchronous Order Analysis plug-in
ORNV-FFTDiag	Spectral Based Diagnostics software Module (Envelope, Cepstrum, Pk; Pk-Pk, Crest factor, shaft view)
ORNV-IVC	Integrated Instantaneous angular Velocity Converter plug-in, allows on-line and offline torsional analysis
ORNVS-ENGD	EngineDiag, Reciprocating Machines Diagnostics Software Module
ORNVS-BAL	Single Dual Plane Balancing module
ORNVS-MONI	Monitoring Solution

### Structural Dynamics

ORNV-FFT	Real-time FFT plug-in
ORNVS-MOD-ODS	ODS (Operating Deflection Shape) Solution
ORNVS-MOD-EMA	Experimental Modal Analysis Solution

### Data Acquisition

ORNV-REC	Recorder
ORNV-TDA	Real-time time domain analysis plug-in

### Noise Analysis

ORNV-OCT	Real-time filter based 1/n octave plug-in
ORNV-SI	Sound Intensity Solution
ORNV-S-WH-PCK	Underwater Holography software pack
ORNV-TPA-A	Advanced TPA (Transfer Path Analysis)

## Instruments

### Analyzers: examples of configurations

Above software options may be added to these configurations

OR10-DAQ-8	OR10 Mobile DAQ 8 ch. instrument pack
OR34-INST-4	OR34 compact 4 Ch. instrument pack
OR35-INST-10	OR35-8 + 2 Ch. Teamwork instrument pack
OR36-INST-16	OR36-16 Ch. Teamwork instrument pack
ORMP-INST-16	ORMP-16 Ch. Teamwork instrument pack
OR38-INST-32	OR38-32 Ch. Teamwork instrument pack

### Inputs Conditioners

OR36/8 - PXD-B	8 Ch. Strain gauges bridge conditioner XPOD for OR36 & OR38
OR36/8 - PXD-T	8 Ch. PT100 and thermocouple conditioner XPOD for OR36 & OR38
OR36/8-XPOD-V	3 Display analog and digital vumeter monitoring XPOD

## Specifications

<b>Channels count</b>	<b>2 to hundreds of channels</b>
<b>Inputs</b>	
Sampling	2 kS/s to 102.4 kS/s - 24 bits delta sigma ADC
Accuracy	Phase $\pm 0.02^\circ$ - amplitude $\pm 0.02$ dB - Dynamic > 140 dB
Conditioning	AC/DC/CP/TEDS up to 40 V
<b>Auxiliaries</b>	
Outputs	DC to 40 kHz - $\pm 10$ V range - 24 bits DACs - THD < 0.002%
Ext. synth (Trigger / Tach)	64 x over sampled - Resolution < 160 ns ( $0.06^\circ$ @ 1 kHz) - up to 40 V
DC channels*	Sampling 10 Hz - 50 Hz/60 Hz rejection - reproducibility < 1 mV
<b>System</b>	
Hard disk	128 to 512 GB SSD
Internal battery	up to 2h
Link to PC	1 Gb/s Ethernet
Weight from	from 1.4 kg/3 lb to 10 kg/22 lb
* Optional features	

M002-100-5

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