THE EXPERTS IN NOISE & VIBRATION MEASUREMENT

# Prosig Data Analysis Software DATS & P8000 Noise & Vibration Measurement & Analysis Systems

WHO ..? **Acoustic Consultancy Aerospace Automotive Civil Engineering** Defence **Education** Engineering **Environmental Test Health & Safety** Manufacturing **Marine Engineering Medical Research** Mining **Motorsport Power Generation Railways** R&D Shipping **Transportation Vibration Consultancy** Wind Tunnels











WHAT..?

Acoustic Studies Audio Measurement Production Testing Fatigue & Durability Hammer Testing Human Biodynamics Modal Analysis Noise Path Analysis NVH ODS

Powertrain Investigations Refinement Studies Ride & Handling Road Load Studies Room Acoustics Rotating Machinery Shaft Balancing Sound Quality Studies Sound Mapping Structural Animation Vibration Testing



# Fast, rugged, 24-bit, high precision, high quality data acquisition systems





# **P8004**

- Small, light, ultra portable
- 24-bit precision
- Sample at up to 400k samples/second/channel
- 4 analog channels plus tacho input
- 102dB dynamic range
- -120dB noise floor
- USB 2.0

# P8012/8020 P8012 - 3 card chassis

- P8020 5 card chassis
- Up to 40 analog channels plus tacho
- 24-bit precision
- Up to 100k samples/second/ channel (24 bit)
- Up to 400k samples/second/ channel (16 bit)
- 102dB dynamic range
- -120dB noise floor
- USB 2.0



# **P8048**

- High channel count
- 12 cards per chassis
- Multiple chassis up to 1024 analog channels
- 24-bit precision
- Up to 100k samples/second/ channel (24 bit)
- Up to 400k samples/second/ channel (24 bit)
- 102dB dynamic range
- -120dB noise floor
- USB 2.0

# **P8000 input & output channel options**

The P8012, P8020 and P8048 can be configured with a number of different input and output cards. The following cards are available...

- 4 channel high speed analogue and 1 channel tachometer input card, with BNC connectors.
- 4 channel high speed analogue and 1 channel tachometer input card, with 6 pin LEMO connectors.
- 4 channel high speed analogue charge input card.
- 8 channel thermocouple input card, with universal thermocouple connector.
- 8 channel analogue input card with IEPE support, with 50 way D type connector.
- 8 channel analogue input card with programmable excitation, with 50 way D type connector.
- 4 channel precision tachometer measurement input card, with BNC connectors.
- 4 channel digital to analogue output card, with optional digital I/O, BNC connectors.
- 2 channel CAN-BUS input card, with 9 way D type connectors.





Comprehensive data capture, signal processing, automation and reporting for noise and vibration



# CAPTURE

- Customisable realtime displays during capture
- Easy-to-use grid based setup
- Setup 'assistants' for simple test configuration
- Built-in transducer database
- Integrated project manager



# ANALYSE

- Intuitive worksheet interface for Reporting closely integrated easy investigation
- Huge range of analysis functions Create reports with familiar plus application add-ons
- 'Visual Scripting' for automated capture, analysis & reports
- DATS BASIC scripting for standalone applications
- packages



# REPORT

- with Office applications
- Office tools
- Automate with DATS
- Generates 'live' graphs in reports - no more copy & paste
- Repeatable high quality reports
- Import/export from many other Can be added to scripts for fully automated sequences

# **Application software**

DATS software can be configured with a number of special solution add-ons that support a wide range of noise & vibration based applications...

- **NVH Analysis**
- **Rotating Machinery Analysis**
- Fatigue Life Analysis
- **Structural Animation**
- **Multiplane Balancing**
- Hammer Impact Analysis
- Sound Quality Audio Replay
- Sound Mapping

- **Noise Path Analysis**
- **Human Response Biodynamics**
- **Modal Analysis**
- Flight Test Software
- **Time Frequency**
- **Acoustics Analysis**
- **Crash Biomechanics Analysis** 
  - WWW.PROSIG.COM



### A complete list of all the analysis functions available in the basic DATS Toolbox package

#### Arithmetic (Data & Data)

Data & Data Arithmetic (+ - \* /) Data + Ind. Var. Arithmetic (+ - \* /) Data and Reference

Arithmetic (Data & Constant) Real Data & Constant (+ - \* /) Complex Data & Constant (+ - \* /) Mod/Phase Data & Constant (+ - \* /) Remainder

#### Calculus

Differentiate Integrate Integrate X with Y Omega Arithmetic

#### **Complex Functions**

Complex to & from Mod/Phase Complex to Real Complex to Imaginary Complex Output (Imag+iReal, Real+i0, Imag+i0, Real+iZ) Data & Conjugate(Data) (+ - \* /)

#### Curve Fittina

Fit Stepped Data Forsythe Lagrange Lanczos Least Squares Polynomial Mean Median Despike Remove Spikes from Data Savitsky-Golay Smooth Spline Fit

### Data Acquisition Spreadsheet Style Setup

Multi-channel realtime displays of numeric values, time histories, FFT, spectrum waterfalls, orders Setup Information Stored with Data Multi-channel range display Dynamic/Static Signal Calibration Tools Automatic Gain Ranging Over-range indications Automatic Increment of filenames

#### Event Processing

Extract Event Mark Event Remove Event

#### Export Data

ASCII Comma Separated Variables (CSV) SDF (HP/Agilent) Matlab MS Excel RPC III TDM TecPlot Universal File (UFF) WAV

#### Filtering

Alpha Beta Filter Bessel (Low, high & band pass & band stop)

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Butterworth (Low, high & band pass & band stop) Chebyshey (Low, high & band pass & band stop) Equalisation Filter Filter Octave (Band Pass) Impulse Response Filter Median Filter Notch RC Filter

#### Frequency Analysis

Remove Jitter

Shelving Filter Smoothing

Auto (Power) Spectrum Auto (Power) Spectrum (Limit Hold) Auto (Power) Spectrum (Hopping) Carpet Plot Cepstrum . Coherence Spectrum Complex to Mod/Phase Cross Spectrum Cross Spectrum (Limit Hold) dB Weighting DFT DFT (Goertzel) Find Peaks in Spectrum Weighting (A,B,C,D) FFT (Full Range) FFT (Half Range) Hopping FFT Inverse FFT (Full / Half Range) Inverse FFT (Long Complex Full Range) Omega Arithmetic Third Octave Bands RMS Over Frequency Range Autoregressive Filter Coefficients Envelope (Complex Demodulation) Envelope (Fourier) Long FFT Instantaneous Frequency Interpolate Signal Minimum Phase Spectrum (Hilbert) Maximum Entropy Autoregressive Maximum Entropy Spectral Estimate Short Time FFT Spectrum Level Spectrum Level (Limit Hold & Hopping) Transfer Functions Winograd Transform Zoom FFT Zoom Auto Spectral Density Zoom Cross Spectral Density

#### **Generate Data**

ADC Simulation Sine (Sine, Damped, Linear & Log Sweep, Haversine, Modulated & Pulsed) Random (Autoregressive, Gaussian, Rectangular, Narrow Band, Pink & Red Noise, Rayleigh Random Numbers) Random Time History From Spectrum Impulse Square (Pulse & Swept) Step Triangle (Triangle, Saw Tooth)

Exponential Decay Straight Lines & Ramps Pulse (Rectangular, Triangular, Gaussian, Mono, Hanning, Raleigh, Half Sine) Frequency Characteristics (Butterworth, Chebyshev & Bessel)

Actuator (Stepped Sine, Swept Sine) Break Points Spectrum Spectrum from Break Points Gaussian Probability Density Log Probability Density Rayleigh Probability Density Sine Probability Density Classical Data Windows Cosine Taper Window Exponential Decay Window Force Window

#### Import Data

Artemis ASCII Binary B & K Pulse CATMAN Comma Separated Variables (CSV) DASYLab DIA / DIAdem DX3 SDF (HP/Agilent) Matlab MS Excel nCode PICOLoa Realwave Pocket Analyser RES Data Rion WAV RPC II / III Sony Convert Data Store Plex (Racal) Syen Log Data TAFFmat TDM Universal File (UFF) WAV WaveView (Iotech)

#### Math Functions

Absolute Arcsin, Arccos, Arctan, Arccosec, Arcsec, Arccotan Arcsinh, Arccosh, Arctanh, Arccosech, Arcsech, Arcsech, Arccoth Antilog Backward & Forward Difference Conjugate Error Function (ERF) Exponential Gamma Function Inverse ERF Linear to dB, dB to Linear Log e, Log 10 Negate Nth Integer Root Raise To Power Reciprocal Sin, Cos, Tan, Cosec, Sec, Cot Sinh, Cosh, Tanh, Cosech, Sech, Coth Square Root

#### Pulse Analysis

Angular Vibration of Shaft Pulses to Rate Pulses to Amount Pulse Duration (All Crossings, Pos-Pos, Neg-Neg, Pos-Neg, Neg-Pos) Create Speed Signal

Pulse Crossing Times Time Stamp To Pulse

Shock Spectral Analysis Primary, Residual & Composite Linear spacing, Logarithmic spacing & Octave spacing Shock Time History (Lin, Log, Octave Spacing)

### Signal Manipulation

Amend Control Record Append Signal to Dataset Apply Classic Window Apply Exponential Decay Apply Force Window Apply Sine/Cosine/Ramp Taper Copy Common Length Copy Whole Signal Copy Section of Signal Extract Named Elements Include Signals to Dataset Join Signals Extend by Repetition Mesh Two Signals Recalibration Modify Named Elements , Repair Signal Replace Signal Replace Single Named Element Reverse Signal Signal Quality Check Sort Signal View Signal History

#### Statistical Counting

Level Counting Peak and Trough Count Rainflow Counting (Cycle Peak / Trough) Rainflow Counting (Cycle Range / Mean)

#### Time Domain Analysis

Apply Threshold Auto / Cross Correlation (Lagged Products or Fourier Transform) Convolution in the Time Domain Cosine Taper Function Ensemble Statistics Normalise Resample Signal Decimation Signal Interpolation Speed from Vibration Statistics

#### Trend Analysis

Bias removal Evaluate Trend (Mean, SD, RMS, skew, kurtosis, M5, M6, Min, Max) Trend Removal (Linear Averaging Points, Exponential Averaging & Linear Averaging . Duration)

### Probability Analysis Joint Probability Density Function

Percentile Calculations Probability Density Function

# Some of the real life stories of how our users benefit from using Prosig systems

#### Brake Squeal Evaluation on High Performance Vehicle



The customer uses microphones, accelerometers, thermocouples & pressure transducers attached to a performance vehicle to measure brake squeal events. A **Prosig P8020** is used to capture, store and analyse all significant events during a two hour road test. Sophisticated pre- and post-trigger capture along with data visualisation in **DATS** helps to achieve a better understanding of brake squeal. The Prosig system was selected after similar, competitive systems were unable to cope with the environmental and capture/analysis requirements.

#### Assessment of Human Exposure to Vibration



A **Prosig P8004** and the **DATS Human Biodynamics Analysis Suite** is used to make assessments on the exposure of the human body to vibration data. The data is captured on a moving train. Health and comfort criteria are calculated according to various ISO standards and provided to the user in the form of standard reports. The end-user has used many of the results in expert testimony work in legal cases.

#### **Testing in Low Temperature Transonic Wind**

A high channel-count **P8048 system** is used to capture the vibration signals from an aircraft model sited in a wind tunnel that can operate at temperatures as low as -261C and flow speeds as high as Mach 1.3. Strain and acceleration measurements at various locations on the body of the model are taken over a preset range of tunnel conditions. An additional **8-channel Prosig system** monitors the real-time forces and moments experienced by the balance gauge mounted inside the model.

#### **Monitoring Flow in New Domestic Water Meter**



Prosig have supplied a turnkey industrial monitoring system that measures the accuracy of an innovative new design of domestic water meter. A **P8020** system is used to capture pre-conditioned fluid pressure waveforms together with other test rig control parameters such as temperatures and pressures. Advanced pulse analysis software in **DATS** analyses the captured signals and produces detailed reports that compare meter performance at different flow rates under various test conditions.

#### Pre-build Assessment of Vibration in Tower Block



The customer needs to check whether noise and vibration from an underground train line is going to cause a nuisance in a proposed multi- storey housing block. A sophisticated measuring system based on a triaxial accelerometer is connected to a **Prosig P8000**, which is used to capture the data. The results of further analysis are used to determine if the noise and vibration of the trains will fall within prescribed limits.

#### Measurement of Vibration and Pressure in Rocket Motor



The digital control lines from the firing control sequence from solid propellant rocket motors are used to control a **Prosig P8048**, which measures vibration and pressure signals. The **P8048** system is configured with a digital control module and custom acquisition software for transducer calibration, automatic data structuring and rocket test sequence measurement.

#### **Evaluation of Vibration in Industrial Packaging**



A Prosig system is used to simultaneously capture CAN-bus data and vibration signals on an industrial robot. The robot is controlled by a CAN-bus and the **Prosig P8000** measures the relationship between sending commands to the robot and seeing the vibration effects caused by the displacement of the hydraulics. The combination of CAN-bus and vibration measurement make the **P8000** an ideal fit for this application.

#### Investigation of Road Surface Materials



The customer uses a **Prosig P8004** connected to a custom triaxial accelerometer to study tarmac surfaces. As a car moves over a road it causes a ripple in the road surface. **DATS** is used to derive displacement from the measured accelerations. The results are used to study different types of surface and changes due to humidity and temperature. The goal is to find a surface that does not flex and break, but is not too rigid.

#### Motorcycle Helmet Compliance Testing



A weight is dropped on to a motor cycle helmet mounted on a dummy head. The acceleration of the weight and helmet is measured. Different accelerations profiles must be achieved for different test standards. The **DATS Biomechanics** software is then used to check if test has met the required profile and to verify whether the helmet meets the necessary standards.

#### Testing Seats Against ISO/ANSI Standards



A **Prosig P8000** system is used to measure vibrations at defined points on seat designed for commercial / industrial / agricultural vehicles. The seats are tested on a 3-axis shaker rig while suitably loaded. The **DATS Human Response** software is then used to check that the seat complies with the relevant standard.

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# **DISÖZI**Č

**Rotating Machinery** 

Acoustic Analysis

**Audio Replay** 

**Fatigue & Durability** 

**Source Path Analysis** 

Reference 2

Measured response

Response

# ADD ONS Optional measurement & analysis packages



### **Modal Analysis**



Human Response



### **Multiplane Balance**



### Time-Frequency

# urce 2

### **Contact Prosig**

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