



# impaq Pro

PORTABLE 4 CHANNEL DYNAMIC SIGNAL ANALYZER



[www.benstone.com/tm](http://www.benstone.com/tm)

**Benstone**  
INSTRUMENTS

# impaq Pro

## Introduction

impaq Pro is a new generation of portable signal analyzers from Benstone Instruments. Powered by Windows 10 multi-tasking feature, multiple FFT spectrum analysis, Order Tracking Analysis and Octave spectrum analysis can be measured at the same time.

Equipped with a large 10.1" multi-touch color display, information is not only on display, but a more intuitive user interface with keypads on both sides.

An internal rechargeable Li-Po battery provides 6-hours of continuous operation. Should the battery appear low, the user can attach an external 5V battery bank to the mini USB charging port to extend the operation time in the field prior to recharging the battery.

Designed with dual color ABS plastic housing and IP65 rated, the impaq Pro is ideal for your harsh environment. This new design reduces weight to 1.4 kg (3.0 lbs) and thickness by 47% which is noticeable in your hands.

## 5 Operational Modes

To support your different measurement requirements, impaq Pro can work in one of the following operational modes:

**Real-time Mode:** Measure analog signal and conduct real-time analysis with live display.

**Raw data recorder Mode:** Measure analog signal and record the raw signal to the hard drive or memory.

**Real-time + Recorder Mode:** Measure and record the raw signal to the hard disk or memory at the same time while simultaneously conducting real-time measurements.

**Playback Mode:** Replay a previously saved raw signal file and conduct selected post-process analysis.

### Report Mode:

Import or export measured data, conduct mathematical operations, examine data with different plot formats and cursors, make reports and more.

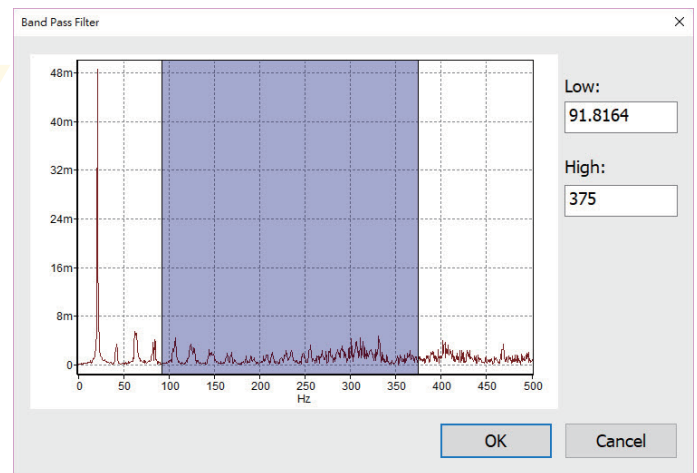


## Mathematical Operations (standard feature)

Apply mathematical operations such as custom filtering, Fourier transform or Inverse Fourier transform, scaling, integration, differentiation, windowing, and more for further examination of your data. These operations can be applied by simply tapping an icon or select undo/redo as needed.



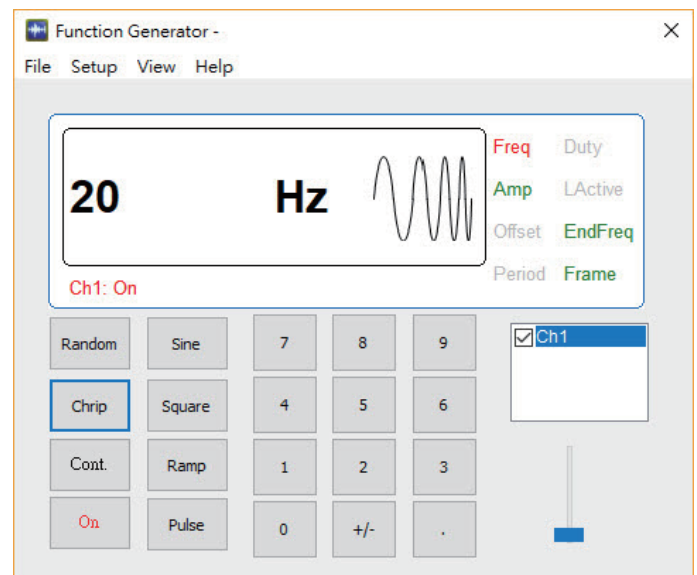
Tap on the icons to conduct mathematical operations.



Band pass filter applied to a spectrum.

## Built-in signal generator (standard feature)

impaq Pro's built-in signal generator can generate signals, such as random, burst random, chirp, sine, square, ramp or pulse signals. Users can use these signals to drive a shaker, perform calibration or for training purposes.



impaq Pro generating a 20 Hz chirp signal to the Ch1 analog output.

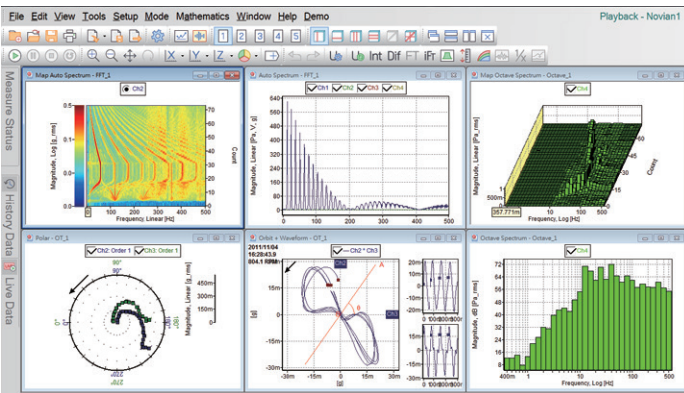


### Multiple Analysis (standard feature)

impaq Pro supports multiple analysis which allows you to run multiple analysis modules, such as FFT, Octave and order tracking analysis, at the same time.

Channel Number	RPM	FFT	Octave	Order Tracking
1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Assign selected channels to FFT, Octave and Order Tracking analysis



Real-time measurements for multiple analysis at the same time.

### Virtual channel (standard feature)

Virtual channels allow for user defined operations such as the summation of channel 1 and channel 2. This virtual operation (summed value) can then be used in any of the analysis modules.

Channel	Enable	Window	Label	Expression	dB ref.	[Min]	Unit Type	Display Unit
Vch1	<input checked="" type="checkbox"/>	Hann	Fx	ch1+ch2	1		Acceleration	g
Vch2	<input checked="" type="checkbox"/>	Hann	Fy	ch3+ch4	1		Acceleration	g
Vch3	<input checked="" type="checkbox"/>	Hann	Fz	ch5+ch6+ch7+ch8	1		Acceleration	g
Vch4	<input type="checkbox"/>	Hann	Mx	1*(ch5+ch6-ch7-ch8)	1		Acceleration	g
Vch5	<input type="checkbox"/>	Hann	My	1*(-ch5+ch6+ch7-ch8)	1		Acceleration	g
Vch6	<input type="checkbox"/>	Hann	Mz	1*(-ch1+ch2)+1*(ch3-ch4)	1		Acceleration	g
Vch7	<input type="checkbox"/>	Hann	Mxp	Mx+Fy*1	1		Acceleration	g
Vch8	<input type="checkbox"/>	Hann	Myp	My-Fx*1	1		Acceleration	g
Vch9	<input type="checkbox"/>	Hann	ax	-Myp/Fz	1		Acceleration	g
Vch10	<input type="checkbox"/>	Hann	ay	Mxp/Fz	1		Acceleration	g
Vch11	<input type="checkbox"/>	Hann	Tz	Mz-Fy*1+Fx*1	1		Acceleration	g
Vch12	<input type="checkbox"/>	Hann	COFx	Fx/Fz	1		Acceleration	g
Vch13	<input type="checkbox"/>	Hann	COFy	Fy/Fz	1		Acceleration	g
Vch14	<input type="checkbox"/>	Hann	COFxy	sqrt(COFx^2+COFy^2)	1		Acceleration	g

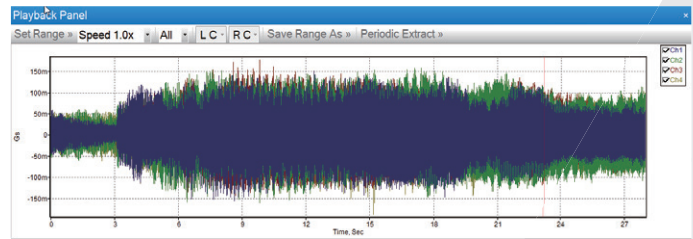
Virtual channels created with mathematical expressions from incoming signals.

### MODULAR SOFTWARE

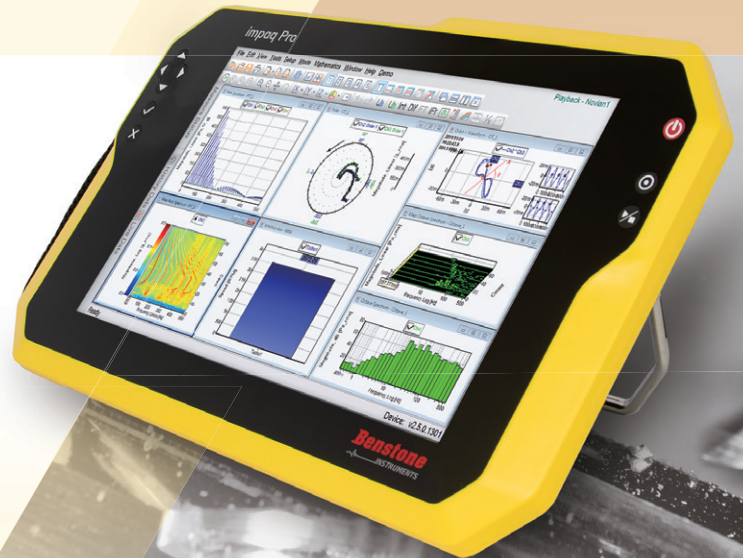
The impaq Pro's modular software allows for the proper configuration of your analyzer. Optional modules available are raw data recorder, FFT spectrum analysis, 1/3 Octave spectrum analysis and computed order tracking analysis.

### Raw Data Recorder (optional feature)

The Raw Data Recorder software module allows the user to measure analog signals in the Recorder mode or Real-time + Recorder mode at the same time while storing the raw data signal directly to the hard drive or memory. Replay the stored raw signal in the playback mode, apply user defined parameters such as certain time periods for further analysis.



Continuously record the raw signal to the hard drive or memory and replay in playback mode with selected analysis.

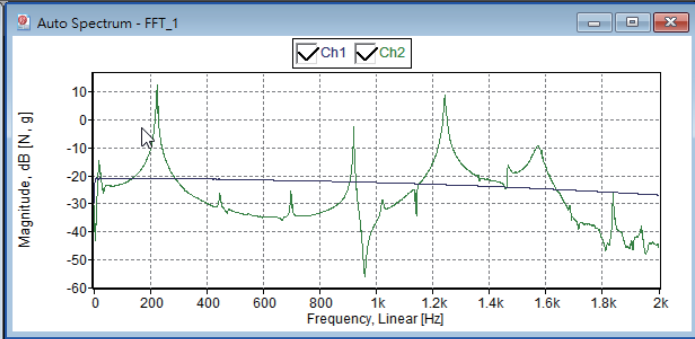
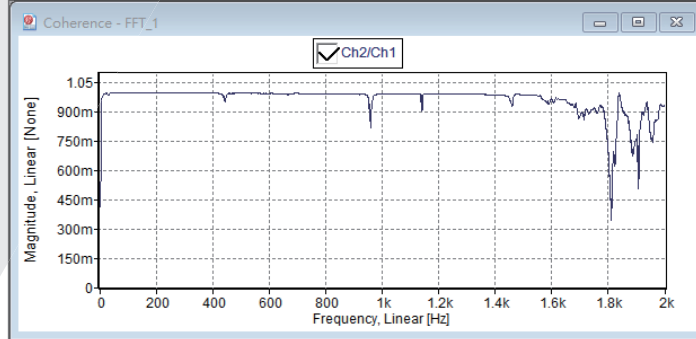
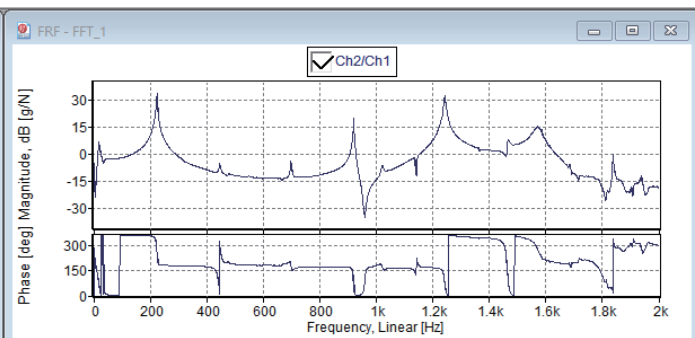
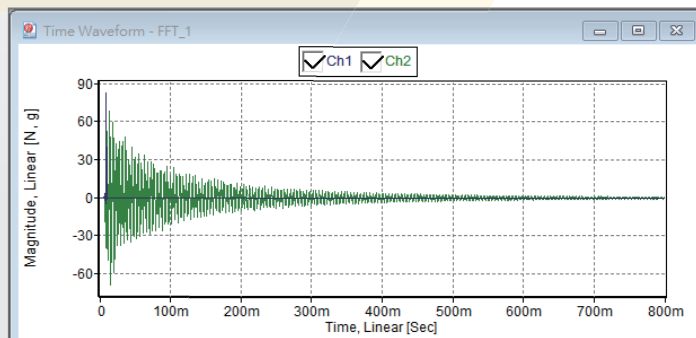




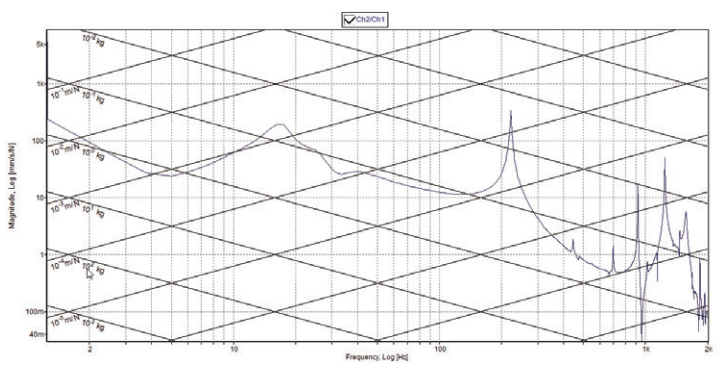
## FFT Spectrum Analysis module (optional feature)

The FFT (Fourier Transform) spectrum analysis provides up to 14 different measurement functions for your sound and vibration needs. Define alarm, severity levels, apply bands, display Go/NG on plots and more. Continuous start-up/coast-down spectrum and display the results on a 3D waterfall/intensity plot. Perform modal, ODS, enveloping and more.

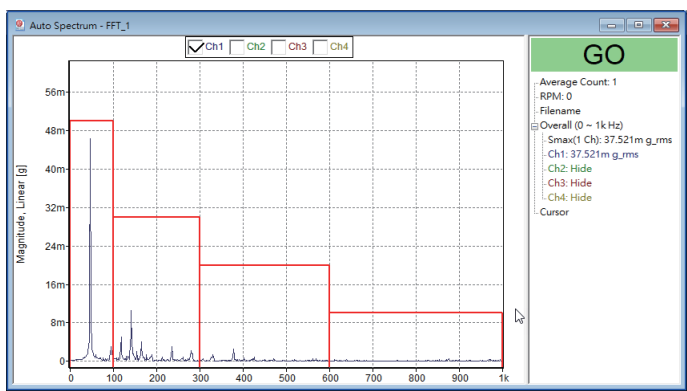
- General sound & vibration analysis
- Modal testing and ODS measurement
- Sound intensity measurement
- Sound and vibration quality measurement
- Stiffness measurement
- Bearing diagnosis
- Variable speed machine measurement



Example: Modal testing to measure time waveform, FRF, power spectrum and coherence functions at the same time.

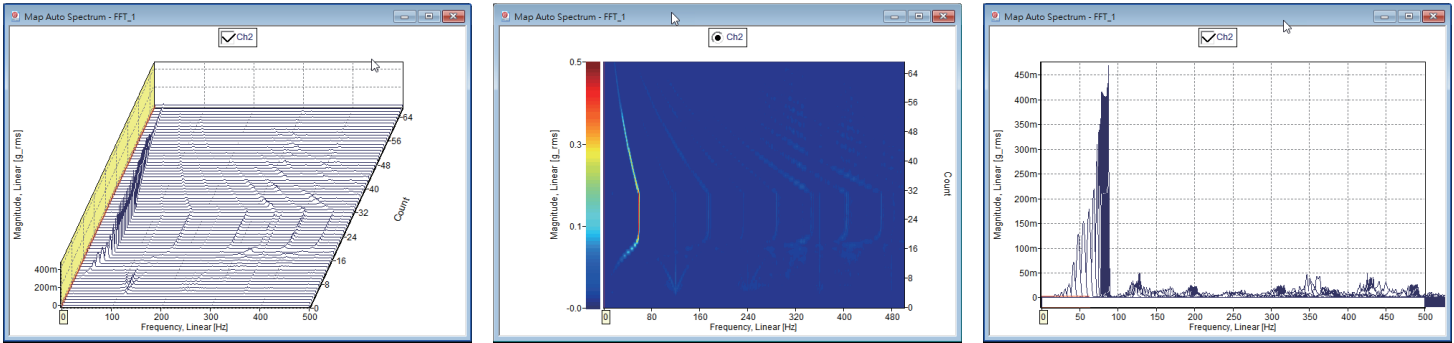


Display of FRF functions in Accelerance, Mobility or Compliance plots to investigate the structure's dynamic stiffness.

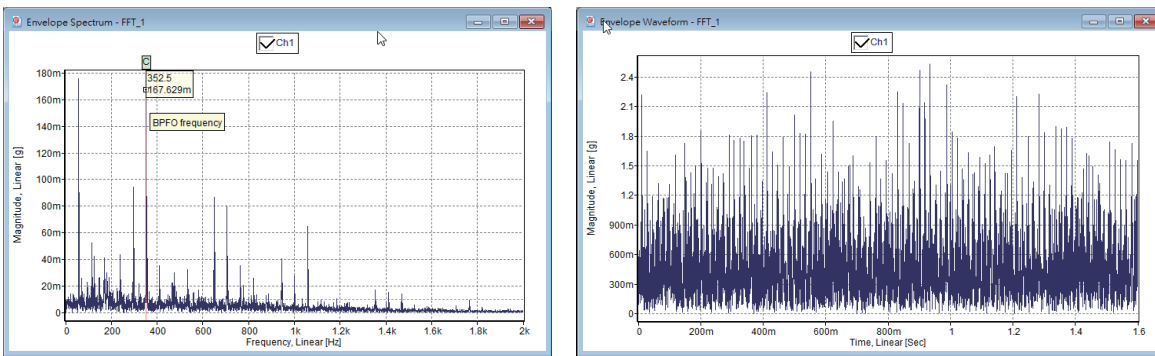


Overlay of band limit curve(s) on the spectral plot showing the severity of vibration or acoustic signals.





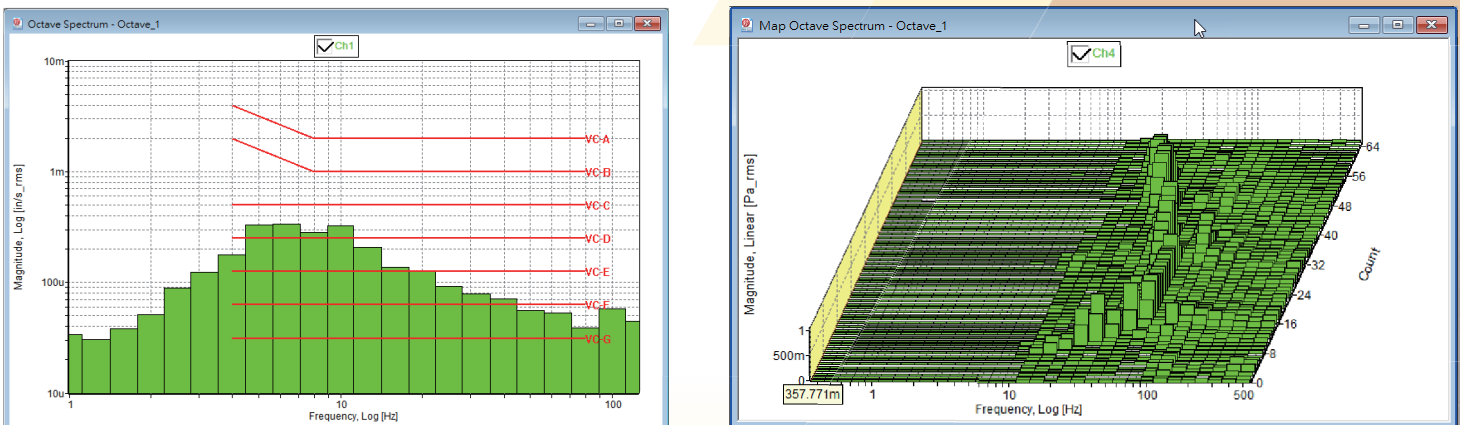
Continuously measure signals in time or rpm step, displaying the results in a 3D waterfall plot, intensity plot or overlapped plot.



Measure the bearing signal and convert it to an envelope waveform or envelope spectrum for damage diagnosis.

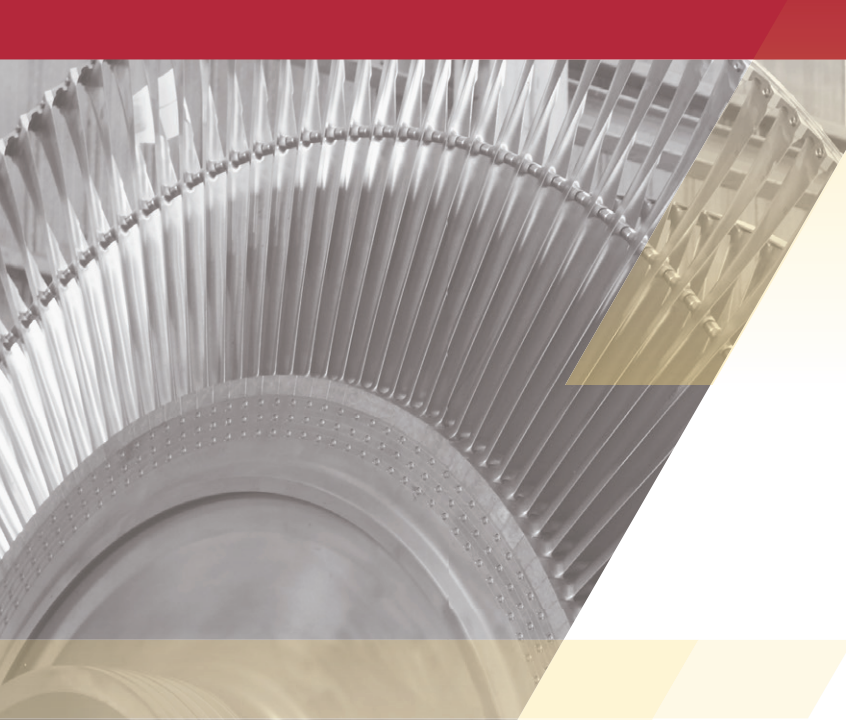
### Octave spectrum analysis module (optional feature)

The octave spectrum analysis utilizes parallel time domain filters to generate octave, 1/3 octave or 1/12 Octave spectrum. Conforming to IEC 61260 and IEC 61672 standards, this module is suitable for evaluating the sound or vibration severity. Built-in user defined weighting functions supports specific measurements such as: ISO 6954 (vibration on ships), ISO 8041 and ISO 2631 (human vibration) to name a few. Many high-tech factories are concerned about floor vibration. User defined VC curves can be displayed on the Octave spectrum plot to determine the level of vibration.



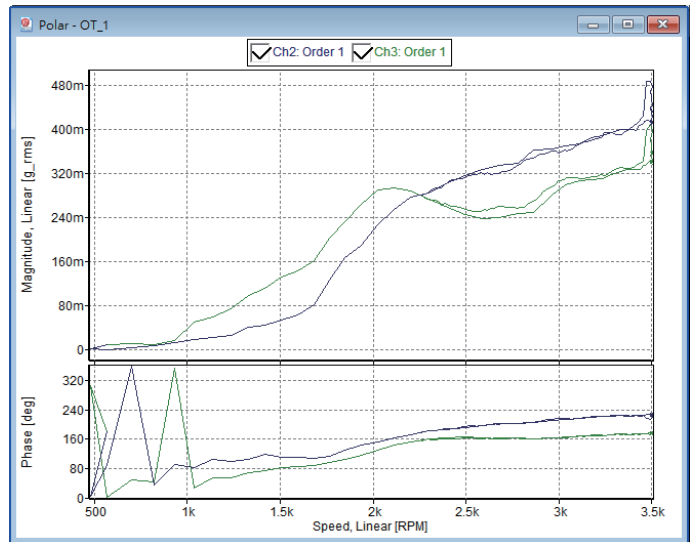
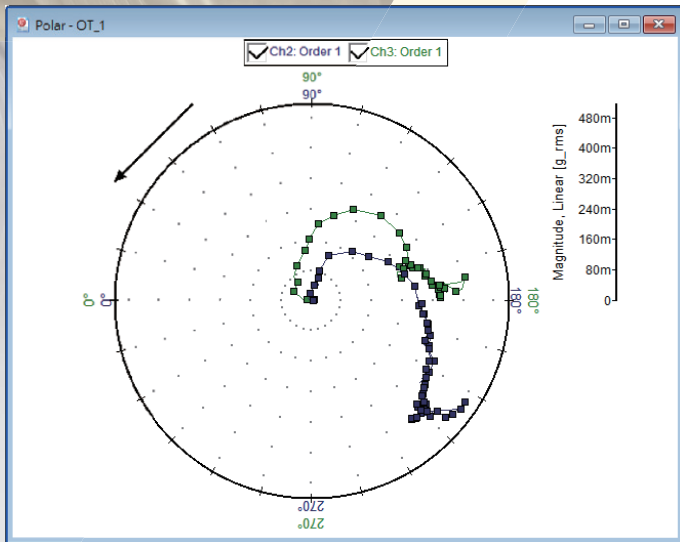
Measure vibration in 1/3 Octave spectrum and display the VC curves on it to check the vibration grade of floor in high-tech factories.

Measure 1/3 Octave spectrum continuously and display the results in a 3D waterfall plot, intensity plot or overlap plots.

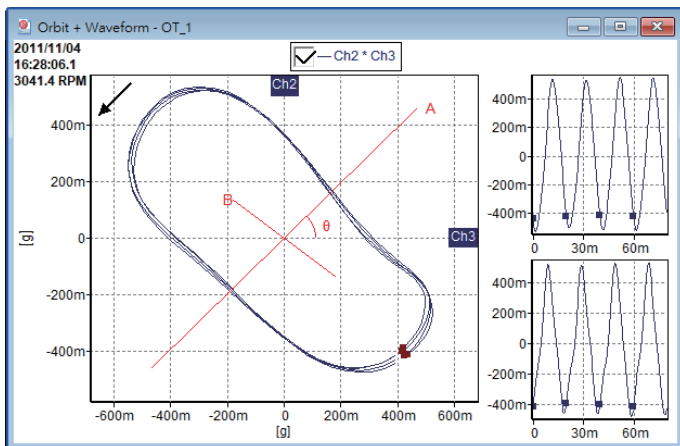


## Computed Order Tracking module (optional feature)

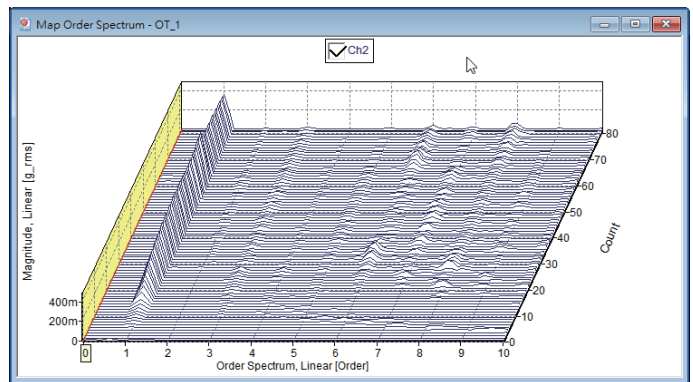
The computed order tracking program is designed to measure sound and vibration on varying speed machines. A digital re-sampling algorithm is used to make the spectral resolutions be the same at different rotation speeds. Typical applications for this software module are NVH (Noise, Vibration, Harshness) testing of vehicles or advanced vibration analysis of turbine machines. Order spectrum, order traces, filtered or unfiltered orbits, gap reading, and centerline of a shaft are accurately measured and displayed during a start-up or coast-down process. The user can input geometric position(s) of the vibration sensors to display orbit and shaft centerline motion, which relates to the realistic behavior of a turbine machine.



Measure order traces during a start-up or coast-down process and display the results in Linear, Polar, Bode, Real+Imaginary or Nyquist plots



Measure and display filtered or unfiltered orbits with the time waveform plot.



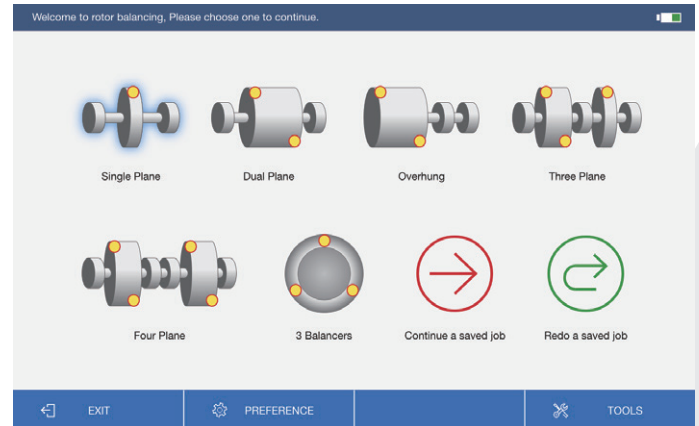
Measure order spectrum continuously and display the results in a 3D waterfall plot, intensity plot or overlap plot.



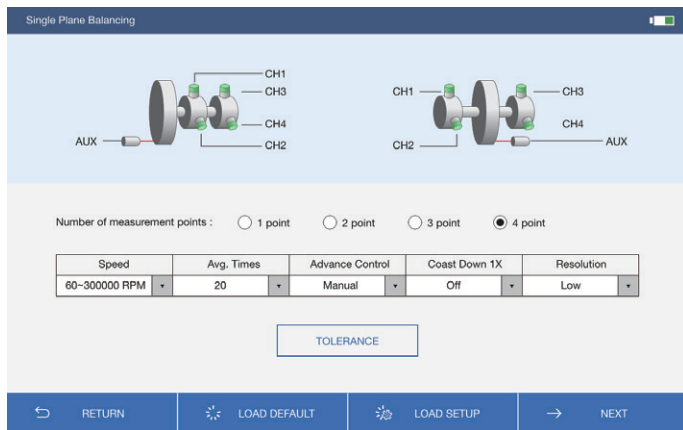
## Rotor Balancing module (optional feature)

The impaq Pro's rotor balancing package can balance your rotating machines in the field with industry leading balancing techniques like; single plane, dual plane, overhung dual plane, 3 plane, 4 plane and 3 weights balancing. This advanced balancing software makes it very simple to balance machines in-field with a very high level of accuracy. Now with multiple-point balancing, vibration in BOTH horizontal and vertical directions are minimized at the same time. By enabling coast-down measurements for 1X vibration, the heavy spot is identified correctly with only one measurement, saving you time, money and increasing safety. This technique prevents the user from danger by putting the trial weights in the wrong place and shortens the time required to balance. Other features / functions are:

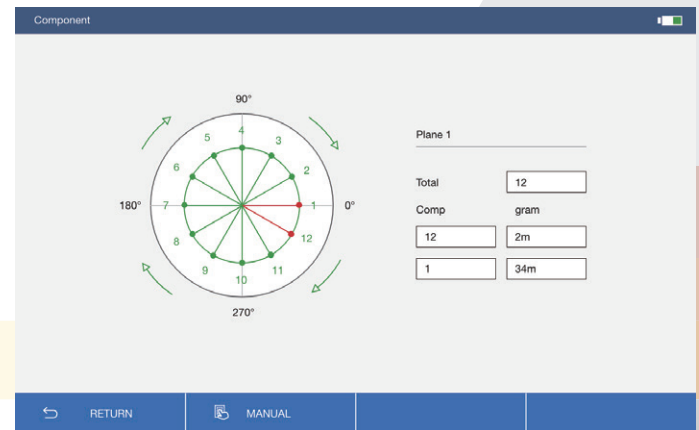
- Multi-point balancing
- Component calculation
- Drill depth calculation
- Allowable residual unbalance calculated from the ISO 1940 standard
- Unequal radii calculation
- Decoupled balancing (couple + static)
- Review historical vibration data on a polar plot.
- Review historical balancing data on a polar plot
- Heavy spot estimation with one shot measurement.
- Redo a previous balancing job with saved balancing factors.
- Continue an unfinished balancing job from a saved file



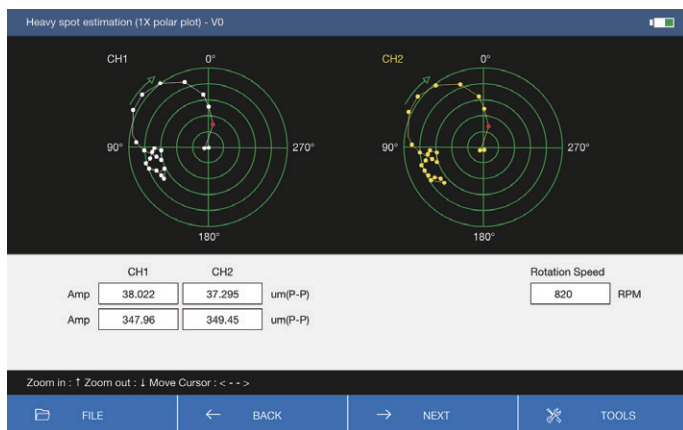
Select the desired balancing function from the main display



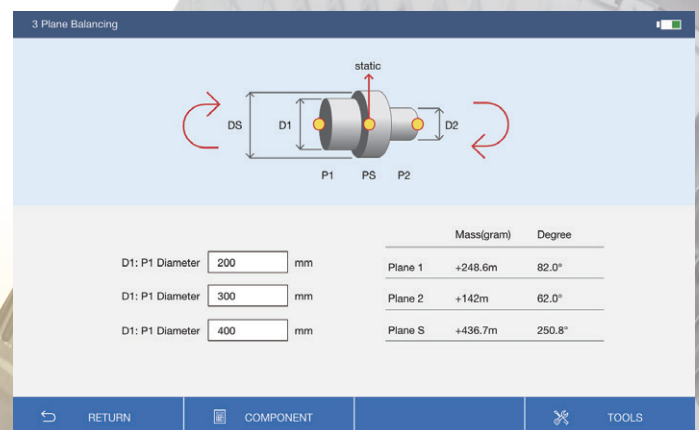
Select up to 4 measurement points for single plane balancing



Component calculation for discrete weight locations



Find out the heavy spot location from a single coast-down measurement of 1X vibration.



Conversion of dual plane balancing into static and couple balancing measurement of 1X vibration.

## Specifications

Hardware Feature	Technical Specifications
Operating system	Windows 10
Input channels	4 analog channels and 1 tacho channel
Output channel	1 analog channel, BNC connector
Connector of input channels	Analog: BNC, tacho: 6 pin Lemo
Channel coupling	AC, DC, IEPE
Tacho input	TTL signal, with built-in power supply
CPU	Quad-core 1.6MHz
External memory	USB memory stick or hard drive
Internal memory	64G SSD and 128G SD card inside
Battery	Li-Po battery, 6-hour operation
Interface	WiFi, Bluetooth, USB 3.0, audio and HDMI
LCD display	1280x800 10.1" multi-touch color screen
Operating temperature	-10 deg C to + 45 deg C
Safety certifications	CE Mark
Sealing / Ruggedness	IP 65
Housing material	ABS plastic
Weight	3.1 lb (1.4 kg)
Size	12.2"x7.7"x1.6" (311mm*195mm*40 mm)
Input signal range	± 1Volt, ± 10Volt
Dynamic range	150 dB typical (measured from spectrum)
A/D converter	24-bit sigma-delta A/D converter
Frequency range	0 Hz~20 kHz (51.2 kHz Max sampling rate)
Input impedance	1M Ohm

### Feature for Raw Data Recorder

Recorded data	Raw time data and TTL tacho signal
Monitor display	Recorder mode: Waveform, continuous waveform or spectrum (resolution 400 lines) Real-time + recorder mode: same as real-time measurement setting
Storage media	Internal 64G SSD, 128G SD card or external USB device
Data review	Replay data in Playback mode
Maximum bandwidth	20 kHz with 4 channels on, plus tacho channel
Maximum length of recording	limited by storage space
Recording stop	by time, rpm, file size or manual

### Feature for Computed Order Tracking

Measured functions	Order trace, order spectrum, spectrum map, RPM profile, orbit, gap and shaft centerline
Measurement control	Time step, rpm step or both time and rpm step
Rotation speed	6 rpm to 480,000 rpm
Order resolution	1/2, 1/4, 1/8, 1/16 order
Order traces	User selectable orders plus overall traces
Max. order	800 order
Waterfall cursor	X, Y, dual X, dual Y, Slant, Slant + XY cursor
Y-Axis of order traces	Linear, log, dB, real, image, phase, number and polar plot
Geometry setting	Selectable angular location of sensors
Order trace plot format	Linear, Polar, Bode, Real+ Imaginary, Nyquist,
Orbit plot format	Orbit, filtered orbit, orbit+ waveform, gap, shaft centerline
3D Plot format	Waterfall, intensity map, overlapped

### Feature for FFT Analysis

FFT real time rate	20 kHz with 4 channels on
FFT resolution	100-128,000 lines
Spectral map	3D waterfall or intensity plots for continuous spectrum measurements
Time windows	Hanning, hamming, flattop, rectangular, force, exponential Bartlett, Blackman, Kaiser
Measured functions	Complex spectrum, power spectrum, cross power spectrum, FRF, time waveform, envelope waveform, envelope spectrum, coherence, PSD, Cepstrum, overall level, mean trend, rate trend, rotation speed
Engineering units	Automatic units transform with pre-defined conversion table
Zoom FFT	Yes
Average	Off, Linear, exponential, time, peak hold
Trigger	Off, input channel triggering, pre/ post triggering, peak triggering or level triggering
Map functions	Time waveform, complex spectrum, auto spectrum, cross spectrum envelope spectrum
Control of Map measurement	Free run, by total count, total time, armed by time step or RPM step
Cursor	Single, harmonic, dual, side band, peak cursor, cursor mark, global or local coupled
Envelope filters	500~2kHz, 1k~2.5kHz, 2k~5kHz, 5k~10kHz or user defined
2D Plot format	Linear, Polar, Bode, Real+Imaginary, Nyquist, Accelerance/Mobility/Compliance
3D Plot format	Waterfall, intensity map, overlapped
Mathematic operation	Unit conversion, FFT, iFFT, integration, differentiation, band pass filter, high pass filter, low pass filter, band notch filter, scaling, weighting, window, reciprocal, detrend, redo,undo

### Feature for Octave Analysis

Measured functions	Waveform, octave, 1/3 Octave and 1/12 Octave spectrum
Maximum band	20 kHz
Integration time	1/128, 1/64, 1/32, 1/16, 1/8, 1/4, 1/2, 1, 2, 4 and 8 seconds
Detection method	Fast, slow, impulse, linear
Trigger sources	Off, external, input channels, manual Average type
Average type	Off, Linear, exponential, peak hold
Average time	1/128, 1/64, 1/32, 1/16, 1/8, 1/4, 1/2, 1, 2, 4 and 8 seconds
Weighting	A, C, flat ISO 2631, 6954, 8041 and user defined
2D Plot format	Linear, bar
3D Plot format	Waterfall, intensity map, overlapped

### Feature for Rotor Balancing

Rotor type for balancing	Single plane, dual plane, 3 plane, 4 plane, overhung dual plane, 3 weights balancing
Balancing speed	60 rpm to 300,000 rpm
Order resolution	Low, normal, high, 0.03, 0.015, 0.008, and 0.004 order
Average number	10, 20, 50 and 100
Balancing grade	Built-in ISO 1940 standard or user defined
Tools	1X coast down order trace, decoupled balancing (static and couple), unequal radii, component calculation, drill depth, vibration history, balancing history and recalculation of balancing coefficients

# Benstone

INSTRUMENTS

BENSTONE INSTRUMENTS, INC.



#### Benstone Instruments USA

32905 Northland Court, St. Paul, MN 55045  
TEL: 651-257-6500

#### Benstone Instruments Canada

26 Noble Street, Unit 5, Toronto ON M6K 2C9  
TEL: 647 395 8621

#### Benstone Instruments Asia

2F-2, No. 83, Sec. 2, Gongdao 5TH Rd., Hsinchu, TAIWAN  
TEL: 03-5722555