

# SYSTEM DATA

## PHOTON+™ Dynamic Signal Analyzer

### USB 2.0 Powered Real-time Analyzer for Noise and Vibration Analysis

PHOTON+ is a next-generation, ultra-portable, real-time analyzer designed for making fast and accurate vibration measurements with post-processing capabilities. It offers the convenience and speed of the industry standard USB 2.0 interface, and comes with two to four analog input channels, plus a waveform source/tachometer channel.

#### An Ultra-portable Dynamic Signal Analyzer

PHOTON+ makes any PC an instrument-quality portable dynamic signal analyzer for multi-channel noise and vibration analysis. Powered via its USB 2.0 port, PHOTON+ runs off a notebook PC battery so you can take it with you wherever you go.

#### Fast Real-time FFT Analyzer

Designed for real-time signal analysis, PHOTON+ offers remarkable performance in an FFT analyzer with a measurement dynamic range of 115 dB and a 84 kHz real-time rate. The RT Pro software provides a comprehensive set of time and spectrum measurement tools for fast real-time monitoring and analysis even when out in the field. It also features easy-to-use applications with flexible measurement and signal processing capabilities.

#### High-end Data Recorder

PHOTON+ with Data Recorder software offers traditional tape recording with voice annotation. The quick migration to post-processing also accelerates the time from data acquisition to analysis of results.

Dynamic switching between multiple measurement projects lets you navigate easily between data recording, data post-processing and analysis, and real-time analysis. With just one instrument, you can use it as an FFT analyzer, vibration analyzer or signal analyzer with recorded data interpreted in a wide variety of ways without spending time translating the data file format or changing between different software programs.

#### Uses

- In-vehicle testing
- In-flight testing
- Low-level acoustic and vibration testing due to PHOTON's extremely low measurement noise floor
- Field, laboratory and anywhere you need to make measurements
- Remote measurements: PHOTON+ can be placed up to 5 metres (16.4 ft) from the connected PC; with USB hubs used as repeaters, this can be extended to up to 30 metres (98.4 ft)

#### With RT Pro™ Software:

- Dynamic signal analysis: Time series analysis, FFT analysis, spectrum analysis and FRF and coherence
- Modal data acquisition compatible with popular modal packages: Force/exponential window and coordinate auto-incrementing
- Acoustic analysis: Real-time octave analysis and waterfall analysis
- Rotating machine diagnosis and analysis: Real-time order tracking, order analysis and waterfall analysis
- Environmental testing: Transient capture and SRS analysis
- Swept-sine measurements: Tracking filter analysis, log or linear sweeps, auto-gain control and manual sweep controls



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## System Features

- Portable and lightweight: weighs approx. 227 g (8 oz)
- USB 2.0 interface
- Power over USB connection – you do not have to carry an extra power supply for PHOTON+
- Expandable multi-channel analyzer with two to four inputs, one output (waveform source) and one tachometer
- Real-time FFT analyzer with frequency range up to 84 kHz
- 32-bit processing
- Wide dynamic range

- Built-in CCLD signal conditioning
- Easy installation: USB interface provides ‘plug and play’
- Covers the full range of FFT analyzer, vibration analyzer and signal analyzer applications

### With RT Pro Software:

- Windows®-based applications tailored for noise and vibration testing
- High precision FFT analyzer: 24-bit with full anti-alias protection

- Fast real-time processing for quick setup, instant results and on-site data verification
- Programmable digital filtering, real-time zoom and signal calculator
- One-click data recording, post-processing and real-time measurements
- Waveform recording which streams gap-free data to a PC disk drive
- With Data Recorder: Tape recorder functionality with voice annotation

## Specifications – PHOTON+ Dynamic Signal Analyzer

### Inputs

<b>Analog Channels</b>	2 standard, expandable to 4 simultaneous channels. All have differential input with 1 MΩ impedance. Each input channel has overload detection before both the analog and digital anti-alias filters. Setup allows per channel selection of input voltage range (0.01 V, 0.1 V, 1 V, 10 V), transducer sensitivity, sensor type (for example, acceleration, force, pressure, etc.), and coupling selections for DC, AC (high-pass cutoff at 0.5 Hz) and CCLD
<b>Electronics</b>	Differential amplifier, programmable gain amplifier, anti-aliasing filters, and 24-bit Analog-to-Digital Converter (ADC)
<b>Filtering</b>	An analog filter plus a 160 dB/octave linear-phase digital filter prevents aliasing and phase distortion
<b>Frequency Range</b>	Up to 84 kHz analysis frequency (192 k samples per second)
<b>Voltage Ranges</b>	±0.01, ±0.1, ±1.0, ±10 V
<b>Signal Conditioning</b>	Voltage or CCLD sensor power (2.4 mA, 22 V <sub>peak</sub> open circuit)
<b>Maximum Input</b>	±36 V <sub>peak</sub> without damage
<b>Resolution</b>	24-bit
<b>Dynamic Range</b>	115 dBfs two-tone test, 100 linear averages
<b>Accuracy</b>	±0.04 dB (1 kHz sine at full scale)

<b>Channel Match Amplitude</b>	Within ±0.04 dB
<b>Channel Match Phase</b>	±0.01 degree to 1 kHz ±0.2 degree to 21 kHz (from DC to 21 kHz, frequency response measurements, all inputs at full scale, linear average)
<b>Frequency Accuracy</b>	Within 0.01%

### Outputs

<b>Analog Channels</b>	Waveform Source standard
<b>Electronics</b>	24-bit Digital-to-Analog Converter (DAC) with analog and digital anti-imaging filters
<b>Filtering</b>	A 160 dB/octave digital filter plus an analog filter prevent aliasing and phase distortion
<b>Frequency Range</b>	Up to 42 kHz output frequency (96 k samples per second)
<b>Voltage Ranges</b>	±10 V <sub>peak</sub>
<b>Resolution</b>	24-bit
<b>Dynamic Range</b>	110 dBfs
<b>Output Impedance</b>	50 Ω
<b>Maximum Current</b>	24 mA peak

### Hardware

<b>Enclosure</b>	Ruggedized case encloses low-noise input/output board with 32-bit floating point DSP processor
<b>Connectors</b>	BNC connectors for inputs Tachometer Waveform source (output) USB connector socket
<b>User Interface</b>	Two status LEDs, Start/stop button
<b>Input Expansion</b>	From two to four total analog inputs by Hardware Activation code
<b>PC Requirements</b>	USB port: Compliant with USB specifications: 2.0, 1.1 or 1.0, and supply 500 mA Microsoft® Windows® XP, Windows Vista® or Windows® 7 (32-bit) operating system Microsoft® Word
<b>PC Expansion</b>	PC upgrades and peripheral additions do not delay or interrupt data acquisition and real-time processing
<b>Power</b>	Powered from PC with 5 V DC
<b>Power Consumption</b>	Less than 2.5 watts
<b>Dimensions</b>	Height: 2.8 cm (1.1 in) Width: 9.9 cm (3.9 in) Depth: 12.1 cm (4.8 in)
<b>Weight</b>	227 g (8.0 oz)
<b>Temperature</b>	5 to 45° C (41 to 113° F)
<b>Humidity</b>	10% to 90% RH non-condensing

## Software

<b>Architecture</b>	All signal processing done in DSP Distributed processing relieves the PC from the burden of real-time processing. True multi-tasking allows the PC to deliver maximum graphics performance and responsiveness. The software provides on-line test status and management through text displays, software toggle buttons and screen displays of multiple time and/or frequency signals
<b>Applications</b>	Signal Analysis and Waveform Source; Modal Data Acquisition; Acoustic Analysis; Real-time Order Tracking; Transient Capture and SRS Analysis; Automatic Pass/Fail Testing; Swept-sine Measurement; Waveform Recording; Data Recording; Sound Quality; and Re-calibration
<b>Features</b>	Online help, consistent management of user-defined engineering units, online graphics, and test documentation of both setup parameters and signals through Microsoft® Word (saved on disk and/or printed) via single-click icon

## Regulatory Compliance

<b>Compliance</b>	CE marking
<b>Safety</b>	EN/IEC 60950–1
<b>EMC</b>	FCC Part 15 (CFR 47) Class A, EN 61326 Class A, CISPR 22 Class A

## Specifications – RT Pro Signal Analysis and Waveform Source Software

### Real-time Spectrum Analysis

<b>Real-time Rate</b>	84 kHz for two channels with two auto-spectra and a cross-spectrum computed
<b>Dynamic Range</b>	115 dBfs
<b>Frequency Range</b>	DC to 84 kHz in 42 ranges
<b>Zoom</b>	21 spans from 17 Hz to 10.5 kHz. Max. upper frequency of 21 kHz
<b>Resolution</b>	Real-time mode*: 110, 225, 450, 900, 1800, 3600 spectral lines Online mode: Added selections for 7200, 14400, 28800, 57600, 115200 spectral lines
<b>Windows</b>	Kaiser-Bessel, Blackman, Blackman Max. Decay, Blackman Min. Sidelobe, Bartlett, Tukey, Welch

\* Up to 1800 lines with all functions enabled for all channels. Higher resolutions dependent on the number of functions and channels active

### Signal Processing Functions

<b>Time Domain</b>	Time capture, auto-correlation and cross-correlation functions, and statistics
<b>Frequency Domain</b>	Real-time spectrum analysis, auto-power spectrum, cross-power spectrum, power spectral density, frequency response function, coherence function, Fourier transforms, impulse responses, cepstrum, and synthesised octave analysis (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)
<b>Amplitude Domain</b>	Histogram (normalised and cumulative), statistical parameters (max., min., mean, peak, rms)

### Waveform Source

<b>Signals</b>	Swept-sine, shaped random, shaped burst random, white noise, pseudo-random, burst random, burst chirp, chirp, sine wave, square wave, triangle wave, impulse chain, arbitrary waveform, and DC level
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### Averaging

<b>Modes</b>	Time or frequency
<b>Types</b>	Exponential, linear, peak hold, peak hold for specified number of averages
<b>Overlap Processing</b>	User-defined percentage from 0% to 99%. Maximum overlap dependent on sampling rate
<b>No. of Averages</b>	1 to 32767 frames
<b>Frame Reject</b>	Automatic reject of frames with voltage overloads; manual accept/reject of overloaded frames; manual accept/reject for all frames

## Triggering

<b>Source</b>	Input channel, waveform source signal, digital input, time delay, free run
<b>Slope</b>	Positive, negative, bi-polar
<b>Level</b>	Percent of full-scale range or voltage level
<b>Pre-/Post-trigger</b>	User-selected number of samples. Up to 1023 samples before or up to 65535 samples after trigger point
<b>Modes</b>	Automatic or manual
<b>Run Modes</b>	Trigger first frame followed by free run; auto trigger every frame; manually arm every frame

## Measurement Controls

Measurement and source panel toggle buttons and toolbar icons provide easy access to test controls. For added convenience, commonly used commands are accessible via keyboard special functions

<b>Controls</b>	Start/stop, pause/continue, next frame buttons
<b>Requests</b>	Time capture, FFT, correlation, spectrum, FRF/coherence and histogram buttons
<b>Parameters</b>	Spectral lines, frame size, frequency range, sampling interval, spectral window, frames, trigger and average
<b>Waveform Source</b>	Start/stop, signal selection buttons
<b>Icons</b>	Reset frame averaging, Save signals and Quick report
<b>Status Displays</b>	Frame number, activity status, message box

## Transient Capture

<b>Sampling Rate</b>	Up to 192000 samples per second in 42 settings
<b>Frame Size</b>	256, 512, 1024, 2048, 4096 or 8192 samples. Deep memory capture adds frame sizes: 16384, 32678, 65536, 131072 and 262144
<b>Modes</b>	Single frame or multiple frames

## Signal Displays

Unlimited number of display windows in tile or cascade format with click & drag zoom, user annotation and cursors

<b>Window Format</b>	Per window selection of single, dual or four pane formats. Each pane can display single or multiple signals overlaid in either time or frequency. Independent choice of colour and texture for signals, grids, tick marks, labels, titles, etc.
<b>Scale Format</b>	Linear or logarithmic scales for X and Y axes with automatic or manual scaling
<b>Cursors</b>	Single or dual with X Y, $\Delta X$ , $\Delta Y$ , $\Delta RMS$ and Q value readouts. Manual peak marks, automatic peak/valley detection and marks, harmonic and sideband cursor,
<b>Frequency Signals</b>	Auto-spectrum, cross-spectrum, FFT, power spectrum, density, frequency response function, coherence
<b>Signal Formats</b>	Bode, magnitude, phase, unwrapped phase, polar, vector (Nyquist), real, imaginary
<b>Engineering Units</b>	English, SI, metric or mixed units for acceleration, velocity, displacement, force and pressure. User-definable
<b>Normalization</b>	Engineering Units (EU), $EU_{peak}$ , $EU_{rms}$ , $EU^2/Hz$ , $EU/\sqrt{Hz}$ , $EU^2 - S/Hz$ , decibels (dB)
<b>Frequency Axis</b>	Hz or CPM
<b>Time Signals</b>	Input time histories, auto- and cross-correlation
<b>Amplitude Signals</b>	Histograms
<b>Statistics</b>	Strip chart output for rms, mean, peak, max., and min. values of input signals

## Data Export

RT Pro provides seamless data interfaces to advanced analysis packages

<b>Binary File Formats</b>	Binary, ME'scopeVES™, MATLAB®, UFF, WAV, Agilent® SDF, MTS® ATI/AFU
<b>ASCII File Formats</b>	UFF, X-Y pair, Y only

## Signal Calculator

This feature allows you to create customised signals. All signals are calculated and displayed 'live' during testing

<b>Operations</b>	Add Subtract Multiply Divide Single and double integration or differentiation A, B and C-weighting Square Square root Mobility Compliance Sine Cosine Tan Arctan Inverse FFT
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## Advanced Graphics

<b>Quantities</b>	Spectra and time histories versus time
<b>Plot Formats</b>	Waterfall (3D display), waterfall with single or dual pane, spectrograms or colour contour (2D) plots
<b>Waterfall Analysis:</b>	
<b>Cursors – 3D Cursor</b>	Dual-axis cursor with trace colour highlighted in both axes
<b>Cursors – Synch.</b>	Synchronised cursor positioning for all cursors in all windows
<b>X Axis</b>	Hertz or CPM; linear or log scale
<b>Y Axis</b>	Engineering Units (EU), $EU_{peak}$ , $EU_{rms}$ , $EU^2/Hz$ , $EU/\sqrt{Hz}$ , $EU^2 - S/Hz$ , decibels (dB)
<b>Z Axis</b>	Seconds or RPM
<b>3D Orientation</b>	Viewing angle interactively set by mouse
<b>Slice Plot</b>	Selectable as X slice or Z slice

## Post-test Documentation

<b>Microsoft® Word</b>	Icon for single-click generation of data plots and test reports, including measurement parameter listings, test logs and formatted signal plots. Custom report templates and active reports can also be made
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## Modal Data Acquisition

<b>FRF and Coherence</b>	Arbitrary assignment of response–excitation pairs from among available inputs. H1 and H2 FRF calculations
<b>Spectrum</b>	Auto-spectra only or auto-spectra and cross-spectra
<b>Time Capture</b>	Frame size up to 262144 (using deep memory capture)
<b>Special Windows</b>	Force/exponential window with user-defined start point, flat-top points and damping factor
<b>Modal Coordinates</b>	Entry of measurement point, axis and sense in Channel Parameters table or via On-line Coordinate Update table
<b>Auto-incrementing</b>	Automatic updating of roving measurements using pre-set measurement point increment
<b>Frame Reject</b>	Automatic reject of frames with voltage overloads; manual accept/reject of overloaded frames; or manual accept/reject for all frames
<b>Modal Package Interface</b>	Data interface for popular modal analysis packages

## RPM Spectrum Processing

Tachometer:

<b>Pulses/Rev.</b>	1 to 1024
<b>Gear Ratio</b>	Ratio of two numbers, each from 0.1 to 10000
<b>RPM Range</b>	1 < RPM < 300000
<b>RPM Accuracy</b>	100 ppm (typical)
<b>Level Range</b>	Programmable from 0.25 V to 10 V

RPM Trigger:

<b>Level</b>	RPM plus tolerance setting
<b>Slope</b>	Run-up, run-down, absolute value

Run Modes:

<b>RPM Waterfall</b>	Low RPM, high RPM, delta RPM
<b>Frame Size</b>	256, 512, 1024, 2048, 4096 samples*
<b>Spectral Lines</b>	110, 225, 450, 900 or 1800 lines*
<b>Averaging</b>	Stable (linear), peak hold or exponential
<b>Overlap</b>	User-defined from 0 to 99%. Max. overlap dependent on sampling rate
<b>Windowing</b>	Hanning, Hamming, Flat-top, Uniform, Bartlett, Tukey, Blackman, Blackman (4th) max., Blackman (4th) min., Welch
<b>Waterfall Plots</b>	Amplitude vs. Hertz vs. RPM or seconds. All other attributes: As per Advanced Graphics

\* Up to 1800 lines with all functions enabled for all channels. Higher resolutions dependent on the number of functions and channels active

## Signal Reader

API for Microsoft® ActiveX® that provides access to binary data files through programs such as MATLAB, LabVIEW™, Visual Basic®, Visual C, etc.

## Specifications – RT Pro Dynamic Signal Analysis Series

### Data Recorder

The data recorder provides a user-friendly tape recorder interface for easy and quick data recording for all active channels and includes voice channel annotation via the PC sound card. The data recorder also provides quick and seamless transition to data playback and processing via the RT Pro Playback option(s). Note that real-time analysis cannot be performed while using the data recorder

<b>Max. Rate</b>	524 k samples per second aggregate
<b>Data Formats</b>	Binary, X–Y ASCII, Y-only ASCII, UFF binary, UFF ASCII, WAV, Agilent SDF, MTS ATI/AFU
<b>On-line Displays</b>	Input time histories for all inputs Channel status Recording view with summary of index files Recording events Voice records
<b>Post-processing</b>	Via playback in RT Pro Playback
<b>Voice Recording</b>	Unlimited number of voice recordings Each voice record: Up to 10 s

### Waveform Recorder Option

This software option enables streaming of long data records. Each record contains gap-free data simultaneously sampled for all active channels. Note that on-line signal analysis can be performed during waveform recording

<b>Max. Rates</b>	524 k samples per second aggregate
<b>Data Formats</b>	Binary, X–Y ASCII, Y-only ASCII, UFF binary, UFF ASCII, Wave, Agilent SDF, MTS ATI/AFU
<b>On-line Displays</b>	Input time histories for all inputs; channel status including voltage levels and overloads; FFT, auto-spectraK cross-spectra; FRF; coherence statistics; and waterfall displays are also possible

## Real-time Order Tracking Option

<b>Method 1:</b> Real-time digital resampling technique	
<b>Order Span</b>	1st up to 320th order tracked; 1 < RPM < 300000
<b>Order Resolution</b>	0.025, 0.05, 0.1, 0.125, 0.25, 0.5, 1.0 Max. order 20: 0.025 to 1 Max. order 40: 0.05 to 1 Max. order 80: 0.1 to 1 Max. order 160: 0.125 to 1 Max. order 320: 0.25 to 1
<b>Number of Orders</b>	Up to 20 orders simultaneously tracked on-line
<b>Amplitude Extraction</b>	Based on DFT frequency domain extraction of order amplitudes
<b>Run Mode</b>	Run-up, run-down and free run. Selectable number of runs with automatic rejection of data that violates the run mode criterion (wrong RPM direction)
<b>Waterfall Plots</b>	Amplitude vs. Order vs. RPM. All other attributes: As per Advanced Graphics Option
<b>Method 2:</b> FFT-based amplitude detection	
<b>Order Span</b>	1st up to 20th order tracked; 1 < RPM < 300000
<b>Order Resolution</b>	Set by FFT lines and frequency range (max. usable RPM limited by resolution, tach pulse rate, pulses/rev. and averaging used)
<b>Number of Orders</b>	Up to 20 orders simultaneously tracked on-line
<b>Amplitude Extraction</b>	Selectable based on fixed bandwidth, fixed spectral lines or frequency range. Additionally, proportional bandwidth (from 1% to 100%) in post-processing mode
<b>Waterfall Plots</b>	All attributes as per Advanced Graphics Option

## Environmental Data Reduction Option

Transient Capture:

<b>Sampling Rates</b>	Up to 192000 sps in 41 settings
<b>Frame Size</b>	256, 512, 1024, 2048, 4096 or 8192 samples
<b>Modes</b>	Single frame, multiple frames
<b>Averaging</b>	Exponential, linear, peak hold, peak hold for specified number of averages

Shock Response Spectrum:

<b>SRS Analysis</b>	Up to 14 octave range using maxi-max, negative maximum and positive maximum analysis techniques. User specifies high and low frequency, reference frequency, damping ratio or Q value, and resolution (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)
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## Acoustic Analysis Option

Real-time Octave Analysis:

<b>Method</b>	Real-time time domain octave filtering
<b>Standards</b>	1/1-octave: Conforms to ANSI standard S 1.11–1986, Order 7, Type 1–D, Extended and Optional Frequency Ranges 1/3-octave: Conforms to ANSI standard S 1.11–1986, Order 3, Type 1–D, Extended and Optional Frequency Ranges
<b>Frequency Ranges</b>	1/1-octave: Two inputs: 1 kHz – 16 kHz Four inputs: 1 kHz – 8 kHz 1/3-octave: Two inputs: 1 kHz – 20 kHz Four inputs: 10 kHz – 20 kHz
<b>Weighting</b>	Linear, A, B and C selectable
<b>Averaging Modes</b>	Linear, exponential or peak hold
<b>Sound Level Detectors</b>	Peak, hold, impulse, fast and slow sound level measurements
<b>Measurement Period</b>	From 1.3 ms to 48 hours
<b>FFT Auto-spectra:</b> Simultaneously measured during real-time octave acquisition	
<b>Averaging</b>	None, exponential, linear or peak hold
<b>Resolution</b>	225, 450 or 900 spectral lines
<b>Windows</b>	Hanning, Hamming, Flat-top, Uniform, Kaiser-Bessel, Blackman, Blackman max. Decay, Blackman min. sidelobe, Bartlett, Tukey, Welch
<b>Frequency Signals</b>	1/1 and 1/3-octave spectra and auto-spectra
<b>Barchart Display</b>	Solid or transparent with multiple signal overlays
<b>Time Signals</b>	Input time histories, overall level (linear or A-weighted) versus time, user-selected octave band level versus time

## Automated Test Option

Pass/Fail Limits and Criteria:

<b>Limits Checking</b>	Multiple, simultaneous limit checks on frequency domain, time domain, and amplitude domain signals
<b>Limits Definition</b>	Pass/fail limit criteria may be defined based on: <ul style="list-style-type: none"> <li>User created Limit Tables</li> <li>Measured signals resident in memory</li> <li>Signals imported from ASCII files</li> <li>Synthesised signals generated by using RT Pro's Signal Calculator function</li> </ul>
<b>Limit Tables</b>	High or low limit curves defined based on Breakpoint Table. Interpolation on linear–linear, log–linear, linear–log or log–log basis
<b>Limits Import</b>	Limit Tables seeded from imported ASCII, UFF or binary file. ASCII files generated by spreadsheet, MATLAB or other software
<b>Limit Scaling</b>	Limit curve scaling by using a user-defined value as a multiplying constant or offset value
<b>Limit Check Range</b>	Sample-by-sample checking (time domain) or line-by-line checking (frequency domain). Check range may be the whole range or a user-defined
<b>Limit Threshold</b>	User-defined percentage of values outside of limits to trigger fail flag
<b>Overall Limits</b>	Fail detection based on the RMS, maximum, mean, minimum, or peak value (time and amplitude domain only)
<b>Actions on Fail Flag</b>	Display alarm message, sound PC beep, generate test report, abort measurement, send email and source on
<b>User Messages</b>	User message strings displayed on test failure
<b>Frequency Domain</b>	Auto- and cross-spectra, 1/1 and 1/3 real-time octave spectra 1, frequency response function and coherence; and SRS 2
<b>Time Domain</b>	Time histories, synchronously averaged time records, auto- and cross-correlations (overall value limit checking only for correlations)
<b>Amplitude Domain</b>	Histograms (overall value limit checking only)

Test Schedule:

User-defined sequence of events that are automatically executed during the test

<b>Events</b>	Measurement duration (hours, minutes, seconds), limit checking on/off, start or stop the source signal, timed pause, save signals, and generate a test report Logic for sequence loop and nested loop
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## Specifications – RT Pro Playback Series (post-processing software)

### RT Pro Playback

Signal Processing Functions:

<b>Time Domain</b>	Time capture, auto-correlation and cross-correlation functions, statistics
<b>Frequency Domain</b>	Real-time spectrum analysis, auto-power spectrum, cross-power spectrum, power spectral density, frequency response function, coherence function, Fourier transforms, impulse responses, cepstrum, and synthesised octave analysis (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)
<b>Amplitude Domain</b>	Histogram (normalized and cumulative), statistical parameters: Max., min., mean, peak, rms

Spectrum Analysis:

<b>Resolution</b>	110 to 115200 spectral lines*
<b>Windows</b>	Hanning, Hamming, flat-top, uniform, force/exponential, Kaiser-Bessel, Blackman, Blackman max. decay, Blackman min. sidelobe, Tukey, Welch

\* Maximum lines may be limited by PC memory free

Triggering:

<b>Modes</b>	Automatic or manual
<b>Types</b>	Trigger first frame followed by free run; auto-trigger every frame; manual arm every frame

Averaging:

<b>Modes</b>	Time or frequency
<b>Types</b>	Exponential, linear, peak hold, peak hold for specified number of averages
<b>Overlap Processing</b>	User-defined percentage from 0% to 99%

General Features:

<b>Signal Displays</b>	Same specifications as for RT Pro Real-time Signal Analysis and Waveform Source
<b>Signal Calculator</b>	
<b>Documentation</b>	

### Sound Quality Playback

Standards:

<b>Zwicker Loudness</b>	SISO 532 Part B
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Frequency Ranges:

<b>1/3-octave</b>	1 kHz to 20 kHz
<b>FFT Analysis</b>	1 kHz to 20 kHz

Analysis:

<b>Sound Quality (2D)</b>	Zwicker loudness, sharpness, roughness, transient loudness, transient sharpness, fluctuation strength
<b>Sound Quality (3D)</b>	Zwicker loudness waterfall map, Zwicker loudness contour map
<b>Sound Field</b>	Free field or diffuse
<b>Resolution</b>	0.1 Bark (non-selectable)
<b>Time-varying Resolution</b>	Up to 1.45 rms
<b>Sharpness Settings:</b>	
<b>Method</b>	Zwicker or Aures
<b>Resolution</b>	0.1 Bark (non-selectable)
<b>Modulation Settings:</b>	
<b>Roughness</b>	Auto-detect or user-specified
<b>Fluctuation Strength</b>	Auto-detect or user-specified
<b>Octave Band Analysis:</b> 1/3-octaves	
<b>Resolution</b>	Linear, A, B, C selectable
<b>Averaging</b>	Linear, exponential
<b>FFT Analysis:</b>	
<b>Measurement</b>	Auto-spectra
<b>Resolution</b>	100, 200, 400, 800, 1600, 3200 lines
<b>Averaging</b>	Linear, exponential
<b>Windows</b>	Hanning, Hamming, flat-top, uniform, Kaiser-Bessel, Blackman, Blackman max. decay, Blackman min. sidelobe, Bartlett, Tukey, Welch

Data Editing:

<b>Time</b>	Time attenuate, time peak limit
<b>Frequency</b>	Frequency attenuate, frequency shift, demodulation, digital high-pass, low-pass, band stop Band-pass filters using Butterworth, FIR or Chebyshev algorithms with selectable transition frequency and pass band/stop band ripple

Data Export:

<b>Binary Formats</b>	Binary, UFF, SDF, wave audio
<b>ASCII Formats</b>	X-Y pair, Y only, UFF

### Acoustic Analysis Playback

Octave Analysis:

<b>Method</b>	Time domain octave filtering
<b>Standards</b>	1/1-octave: Conforms to ANSI standard S 1.11–1986, Order 7, Type 1–D, Extended and Optional Frequency Ranges 1/3-octave: Conforms to ANSI standard S 1.11–1986, Order 3, Type 1–D, Extended and Optional Frequency Ranges
<b>Weighting</b>	Linear, A, B, C selectable
<b>Averaging Modes</b>	Linear, exponential, peak hold
<b>Sound Level Detectors</b>	Peak hold, impulse, fast and slow sound level measurements
<b>FFT Auto-spectra</b>	Simultaneously calculated with octave spectrum
<b>Frequency Signals</b>	1/1- and 1/3-octave spectra and auto-spectra
<b>Barchart Display</b>	Solid or transparent with multiple signal overlays
<b>Time Signals</b>	Input time histories, overall level (linear or A-weighted) versus time, user-defined octave band level versus time

## High-resolution Octave Analysis:

<b>Method</b>	Octave-based DFT synthesis method gives true logarithmic distributed frequency spectrum
<b>Octave Resolution</b>	1/1, 1/3, 1/6, 1/12, 1/24, 1/48
<b>FFT Resolution</b>	225, 450 or 900 spectral lines
<b>Time Signals</b>	Input time histories

## SRS Analysis Playback

Shock Response Spectrum:

<b>SRS Analysis</b>	Up to 14 octave range using maxi-max, negative maximum and positive maximum analysis techniques. User specifies high and low frequency, reference frequency, damping ratio or Q value, and resolution (1/1, 1/3, 1/6, 1/12, 1/24, 1/48)
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## Order Tracking Playback

<b>Method</b>	Digital resampling technique
<b>Order Span</b>	1st up to 320th order tracked; 1 < RPM < 300000
<b>Order Resolution</b>	0.025, 0.05, 0.1, 0.125, 0.25, 0.5, 1.0
<b>Number of Orders</b>	Up to 55 orders simultaneously tracked on-line
<b>Amplitude Extraction</b>	Based on DFT frequency domain extraction of order amplitudes
<b>Run Mode</b>	Run-up, run-down, free run. Selectable number of runs with automatic rejection of data that violates the run mode criterion (wrong RPM direction)

## Ordering Information

### Systems

#### Type 986A0185 PHOTON+ Data Recorder

Includes the following hardware and software:

- Two inputs
- One waveform source
- One USB cable
- RT Pro Data Recorder software
- RT Pro Playback DSA-110 (for data post-processing)

#### Type 986A0186 PHOTON+ All-in-one

Includes the following hardware and software:

- Two inputs
- One waveform source
- One tachometer
- One USB cable
- RT Pro Signal Analysis and Waveform Source DSA-100 (for real-time measurements)
- RT Pro Data Recorder software
- RT Pro Waveform Recorder Option DSA-104
- RT Pro Playback DSA-110 (for data post-processing)

### OPTIONAL HARDWARE

Type 845-084100 Single-channel Analog Input (add one or two inputs to the base system)

### Software

#### REAL-TIME APPLICATIONS

##### DSA-100 RT Pro Signal Analysis and Waveform Source

Includes the following software features:

- Zoom Data Acquisition
- Advanced Graphics
- RPM Spectrum Processing
- Modal Data Acquisition
- Deep Memory Capture

DSA-101	Environmental Data Reduction Option (SRS Analysis)
DSA-102	Acoustic Analysis Option (1/1- and 1/3-octave Spectra)
DSA-103-01	Real-time Order Tracking Option
DSA-104	Waveform Recorder Option
DSA-106	Swept-sine Measurement Option

#### POST-PROCESSING APPLICATIONS

##### DSA-110 RT Pro Playback

Includes programmable digital filters

DSA-110-02	Order Tracking Playback
DSA-110-03	Acoustic Analysis Playback
DSA-110-04	SRS Analysis Playback
DSA-110-06	Sound Quality Playback

### OPTIONAL SOFTWARE

API-100	ActiveX® API Developer Kit
CAL-100-03	Re-calibration Software
DSA-100-03	RT Pro Automated Test
NET-103-02	NET-Integrator™ ActiveX® Application Interface

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