EDM Post Analyzer Software Specifications

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Table of Contents

CRYSTAL INSTRUMENTS

Engineering Data Management (EDM) Post Analyzer

Crystal Instruments offers EDM Post Analyzer software as a powerful adjunct to your CoCo or Spider-based analysis tool kit, enabling users to analyze time stream recordings acquired with a dynamic signal analyzer. The beauty of this approach is the ability to analyze and re-analyze digitally recorded data after the recording event.

Recording first and analyzing second makes sense for first-responder problem solvers. All tactical measurement decisions are not necessary before data is acquired when one is simply recording. Oftentimes, a new problem requires some “getting acquainted” measurements to really define its difficulty and root cause. Humans usually lack the resources to guess the cause of a new challenge. We need to look at some representative measurements from different analytic viewpoints to start understanding the problem and home in on its solution. This approach is eminently suitable for a team effort. A recording technician can acquire data using a minimal amount of equipment while the analyst can remain on post with his analytic work station.

Post Analyzer (PA) contains many powerful post processing tools with batch processing capabilities. Post Analyzer is an independent Windows application that analyzes recorded data files on a computer using various algorithms. Most of the algorithms implemented in PA are identical to those used in the real-time DSP of Spider or CoCo hardware. PA is capable of simultaneously processing data from up to 512 channels. The user should expect the same calculation results using PA as to those computed in real-time in the hardware. This document describes the PA functions.

File Converter is an independent Windows application that converts files in various data formats to standard ATFX format. FC is included in each installation of PA.

For ordering convenience, we created two PA bundles: PA Basic has FFT spectral analysis, curve fitting, demodulation spectrum and 3D signal display functions; PA Premium has more advanced functions including File Converter, offline sine reduction, real-time filters, octave filters and order tracking.

After purchasing PA Basic, advanced functions can be ordered separately.

Licensing of Post Analyzer

Users can order and manage the PA license through the Online License Management system (OLM). Through OLM, the user initiates a purchase request. After the purchase order is processed, an appropriate number of licenses are granted. The user can install the PA software on multiple PCs without using any hardware. Through OLM, the user can de-activate or re-activate the PA installation license on any PC.

Basic Post Analyzer

FFT Spectral Analysis

Provides all spectrum analysis options that DSA provides for live signals but allows them to be applied to recorded time streams and block signals instead.

- *Maximum Number of Channels*: 512
- *Block Size/Line*: 128/56, 256/112, 512/225, 1024/450, 2048/900, 4096/1800, 8192/3600, 16384/7200, 32768/14400, 65536/28800 time samples/spectral lines
- *Overlap Ratio*: no overlap, 10%, 25%, 40%, 50%, 75%, 80%, 90%
- *Average Mode*: exponential, linear, peak hold
- *Window*: Hann, Hamming, Flattop, Uniform, Kaiser-Bessel, Blackman, Force, Exponential, Force-exponential
- *Auto Spectrum Type and Scaling*: linear spectrum with peak or RMS scaling, power spectrum or power spectrum density with RMS scaling (Spectrum Units: EUpk, EUrms, EUrms2, EU2/Hz, EU2·s/Hz), sqrt(EU2·s/Hz))
- *APS View*: as FFT or Octave of 1/1, 1/3, 1/6, 1/12, 1/24
- *Average Non-contiguous Sections of Time Stream Signals*: position block section cursors to select parts of a signal to be analyzed. The selected parts do not need to be adjacent. With this feature, users can process data while excluding the undesired parts of signals.
- *Save Time Streams Absolute Time*: processed time, recorded time
- *Correlation Functions*: auto and cross correlation functions derived from the Inverse Fourier transforms of the power spectra
- *Cepstrum*: inverse Fourier transform of the logarithm of the estimated spectrum of a signal

Acquisition Mode

- *Mode Selection*: free-run, continuous after trigger, single shot with trigger, single shot without trigger, auto-arm trigger, manual-arm trigger
- *Trigger Conditions*: trigger source > high level (rising edge); trigger source < low level (falling edge); low level < trigger source < high level; trigger source > high level OR trigger source < low level (bi-polar)
- *Trigger Delay*: ±100% of block size
- *Trigger Setup Display*: a special display view is created for trigger setup. User selects the acquisition mode, trigger source, trigger level, trigger delay, and trigger condition
- *Trigger Run-Time Display*: in manual arm-mode, a smaller window will pop up for the user to accept or reject the transient captured signals. Only accepted signals are

averaged into the spectra.

Polynomial Curve Fit
Polynomial curve fitting is an analytic process by which an equation is least-squares fitted to a frequency domain measurement. The fitted equation is more properly termed as a "rational fraction of polynomials", since it is the quotient of a numerator and denominator polynomial (i.e. A(S)/B(S)). These fits are typically used in Modal Analysis to determine a structure's natural frequencies and damping factors from the roots of the denominator polynomial. However, polynomial fits are also useful in servo-mechanism analysis and filter design. The independent variable of each polynomial is the complex frequency variable.

- *Calculation of Polynomial by PA*
  - A rational fraction of polynomials may be fitted to a measured Frequency Response Function (FRF) by entering the number of modes to be found and specifying a frequency range to search for them. A graphic overlay plot displays the "goodness of fit". A proper fit literally overlays the central values of an acceleration/force FRF. The results may be output as a list of numerator and denominator coefficients, or as a list of poles and zeros, or as a list of natural frequencies and viscose damping factors. For servo and electronic studies, the desired curve form may be defined by the order of the desired numerator and denominator polynomials. Polynomial curve fitting may also be applied to power and cross spectra.

- *User Defined Curve Synthesis*
  - The polynomial curve fitter may also be used to synthesize an FRF or other complex spectrum. The user simply enters the frequency span of the synthesis and either the numerator and denominator coefficients or the (equivalent) poles and zeros. Such synthesis is a very powerful design tool applicable to many disciplines.

Orbit Plot
An Orbit Plot is a cross-plot of the amplitudes of two time streams. The signals plotted normally come from perpendicularly-mounted shaft displacement probes or bearing-cap accelerometers. An orbit provides insight into shaft clearances, lubrication pressure and other operating characteristics of a rotating machine.

Demodulation Spectrum
Bearing and gearing problems often manifest as amplitude modulation of a narrow carrier frequency. By demodulating the amplitude at a cursor-identified peak, problems such as a chipped gear or a worn-out bearing is often found.

- Demodulation Bandwidth: 24 bandwidth options from 0.0 Hz to 720 Hz

Batch Processing
Users can sequentially process an unlimited number of signals with the same attributes in the same manner automatically, in sequence. Users can save processed results by a pre-defined schedule.

Signal Display Types
- *Overlaid Plot*: signals of the same type can be plotted together in the same window
- *Stack Plot*: multiple panes may be allocated within the same window
- *Bode Plot*: display the magnitude and phase of complex signals
- *Waterfall Plot*: displays a set of signals (amplitude versus frequency versus time or RPM) in 3D waterfall format
- *Colormap*: display the 3D signals in a color-map (spectrogram)
- *Text Window*: display the signal values in text

Measurement Quantities
PA supports a wide range of measurement quantities. Typical measurement quantities include acceleration, velocity, displacement, force, strain, torque, temperature, voltage, angle, phase, resistance, tachometer speed, pressure, voltage, current, time, frequency, angular velocity, and sound pressure.

Report
Testing reports are created directly in Open XML format and are read by Microsoft Word or many other open source Office tools. Fields and attributes are customizable. Logo and report layout preview is provided.

Data File Export
A data file may contain multiple signals or time streams. Users can export data files into other formats using EDM software. The user can choose to export a single data file, multiple data files in batches, or portions of the data file into another format. Files or signals will be exported according to the appropriate signal attribute settings under Global Settings.

- *Export File Formats*: ASAM-ODS XML, UFF ASCII, UFF Binary, ASCII, Excel, CSV, Matlab, .Wav

Import Test Settings from EDM
EDM setup can be exported and opened in PA. Users are able to save or record data using EDM in real time and can use the recorded/saved data for post processing with the same test settings.

Controller Area Network (CAN) Bus Data Management
CAN Bus Data Analysis allows the user to view and analyze time signals recorded by a CoCo-80X from an automotive On Board Diagnostic (OBD II connector) bus or other source of ISO 11898 compliant data. Users can view CAN Bus data (such as vehicle speed and hundreds of other SAE J1962-specified variables) in lock-step with analog signals simultaneously acquired. The CAN Bus data can display in a variety of formats including analog or digital meters and tabular listings as well as time histories.

Display and Report for GPS Signals
With GPS capability, the CoCo-80X is able to put a location and time stamp on recorded signals. When EDM PA displays such signals, the GPS trace identifies when and where the signal was recorded.

Acceleration, Velocity, and Displacement
Math Conversions for Time Streams: acceleration to velocity, acceleration to displacement, velocity to displacement
High-Pass Filters: user-defined cut-off frequency to filter out the DC and low frequency
Math Conversions for Spectra: convert any acceleration, velocity or displacement signal from one measure to another through synthetic integration or differentiation.

Premium Post Analyzer

PA Premium includes all options from PA Basic. In addition, PA Premium includes signal conditioning, digital filtering and re-sampling, Shock Response Spectrum analysis (SRS), octave analysis and sound level meter (SLM) functions, order tracking, offline sine-reduction and File Converter. Users can order these options separately in addition to PA Basic.

User Defined Signal Conditioning Modules

- *Math Modules*: abs, +, -, *, /, square, square-root, log, and offset scale.
- *Offset Scale*: apply a multiplier gain and an offset to any input data stream and generate the output stream continuously
- *Statistic Modules*: peak, Peak-to-Peak, Root Mean Square (RMS), Histogram, Statistics
- *RMS*: apply RMS estimation to an input data stream and generate a continuous RMS output data stream
- *Peak/Peak-Peak*: extract the instantaneous peak or peak-to-peak and output it as a time stream
- *Histogram*: generate and display the histogram of a time stream signal for statistical analysis.
- *Statistics*: calculate the overall RMS, peak, peak-peak, and Ln. EDM PA offers 4 Ln's for user-defined.
- *Integration/Differential Modules*: integration with low-pass, integration with high-pass, double integration with low-pass, double integration with high-pass, differentiation, double differentiation

Digital Filters and Resample Modules

Digital filters are advanced signal conditioning modules that are applied in the data conditioning phase. The user can cascade digital filters or other data conditioning modules to construct powerful post analysis functions. The user designs the filter model with a graphic design tool provided in the Data Conditioning tab and uses the filter design parameters for execution.

- *Filter Design Display*: the user enters the filter type, filter order, cut-off frequencies and criteria for attenuation and ripple. The design tool provides the frequency response of the filter in a graphic format.
- *Decimation Filter*: 2:1 decimation with built in anti-aliasing filter. Anti-aliasing attenuation is more than -80 dB which provides sufficient removal for high frequency noise. User sets decimation stages. Each stage decimates data by 2.
- *Finite Impulse Response (FIR) Filter Using Window Method*: A FIR filter is designed multiplying the Sync (Sin(x)/x) shaped impulse response of a perfect "brick-wall" filter by a window function and sampling the resultant product. The available window types are: Hanning, Hamming, Flattop, Uniform, Kaiser-Bessel, and Blackman. The user selects either low-pass, high-pass, band-pass or band-stop filter type; sets one or two cut-off frequencies (either relative to the sampling rate or in fixed value); and sets the filter length (the number of samples or "taps") between 11 and 127.
- *FIR Filter Using Remez Method*: the Remez FIR Filter design block implements the Parks-McClellan algorithm to design and apply a linear-phase filter with an arbitrary multi-band magnitude response. The user selects low-pass, high-pass, band-pass or band-stop filter type; sets one or two cutoff frequencies (either relative to sampling rate or in fixed value); and sets the filter length between 11 and 127 taps.
- *IIR Filters (3 Types)*: Butterworth, Chebyshev I, Elliptic: the user selects one of the aforementioned infinite impulse response (IIR) filter types, selects low-pass, high-pass, band-pass or band-stop characteristic; sets one or two cutoff frequencies (either relative to the sampling rate or in fixed value); and sets the filter length between 1 and 20.
- *Digital Resampling*: The user does not need to provide arguments to this filter. The input signal is low-pass filtered to prevent aliasing and the filter's output is decimated by two, retaining only every other sample. This results in a signal of half the bandwidth sampled at half of the input sample rate. Higher decimation ratios may be obtained by cascading decimation filters.

Shock Response Spectrum

Calculate the shock response spectrum from the selected resource file.

- *Maximum Number of Channels*: 512
- *SRS Spectrum*: Positive SRS, Negative SRS, Maximax SRS.
- *Parameters*: 1/1, 1/3, 1/6, 1/12, 1/24, 1/48 octave, low frequency, high frequency, reference frequency, damping ratio.

Octave and Sound Level Meter Post Analysis

Both Octave filter and Sound Level Meters are implemented based on high precision real-time filters. FFT spectral analysis, octave analysis and Sound Level Meter analysis can execute at the same time.

Octave Analysis

- *Maximum Number of Channels*: 512
- *Standards*: conforms to ANSI std. S1.11:2004, Order 3 Type 1-D and IEC 61260-1995
- *Filter Implementation*: real-time digital filters
- *Frequency Weighting*: A, C, Z comply with IEC 61672-2002 class 1. B complies with IEC 60651-1979 type 0.
- *Octave Fractional Resolution*: 1/1, 1/3, 1/6, 1/12, 1/24
- *Frequency Range (Band centers)*: Up to 20 KHz
- *Midband Frequencies*: base 10 complies with ANSI std. S1.11:2004 Annex A.
- *Average Type*: linear, exponential, peak hold, time linear, time exponential
- *Time Weighting*: fast, slow, impulse, 2, 10, 100, 500, 1000
- *Y-axis Scaling*: Linear, Logarithmic, Decibels(dB), Phons and Sones

Sound Level Meter Analysis

- *Maximum Number of Channels*: 512
- *Standards*: conforms to IEC 61672-1 2002
- *Filter Implementation*: real-time digital filters
- *Frequency Weighting*: A, C, Z comply with IEC 61672-2002 class 1. B complies with IEC 60651-1979 type 0
- *Time Weighting*: fast, slow, impulse (complies with IEC 61672-2002)
- *Average Time Interval*: from 0.125 seconds to 24 hours. Unique moving linear averaging method allows independent setting averaging time interval and time trace update rate.
- *Measurement Types*: time-weighted sound level (L), time-averaged sound level (L_{eq}), sound exposure level (L_E), peak sound level (L_{peak}), peak C sound level (L_{Cpeak}), maximum time-weighted sound level (Lmax), minimum time-weighted sound level (L_{min}), maximum time-averaged sound level (L_{eqmax}), minimum time-averaged sound level (L_{eqmin}), statistical sound level (LN) and statistical sound level distribution (dB Histogram)

	Time Weighting	Frequency Weightings			
		Z	**A**	**B**	**C**
Time-Weighted Sound Level (L)	**F (Fast)**	L_{ZF}	L_{AF}	L_{BF}	L_{CF}
	S (Slow)	L_{ZS}	L_{AS}	L_{BS}	L_{CS}
	I (Impulse)	L_{ZI}	L_{AI}	L_{BI}	L_{CI}
	User-Defined	L_{ZU}	L_{AU}	L_{BU}	L_{CU}
Time-Averaged Sound Level (L_{eq})		L_{eq}	L_{Aeq}	L_{Beq}	L_{Ceq}
Sound Exposure Level (L_E)		L_{ZE}	L_{AE}	L_{BE}	L_{CE}
Statistical Level (L_N)		L_1	L_5	L_{50}	L_{95}
Peak Sound Level		L_{peak}		L_{CPeak}	

- *Measure Time Control*: free run, user-defined
- *Decay Time Constant for F and S Time-weighted Sound Levels*: 34.7 dB/s (by standard, >25 dB/s) and 4.34 dB/s (by standard, between 3.4 – 5.3 dB/s)

Sound Power Measurement

PA-08 includes calculation of Sound Power from sound pressure measurement.

- *Standards*: ISO 3744 and 3745
- *Octave Fractional Resolution*: 1⁄3
- *Test Room Types*: Hemi – Anechoic and Anechoic
- *Microphone Arrangements*: Fixed – Equal/Unequal Areas, Co-Axial, Meridonial, Spiral

Order Tracking and Rotating Machine Analysis

Developed and based on a precise tachometer measurement of rotating speed, the Order Tracking in Post Analyzer uses fast digital re-sampling at a multiple of the shaft rotating speed and a proprietary DFT method to acquire any required fractional orders of interest at a fast slew rate. Users can make the following measurements in the Order Tracking option: raw time streams, real-time order tracks and order spectra, narrowband RPM spectra and fixed band RPM spectra, overall RPM spectrum, and order tracks with phase relative to tachometer signals.

Order Tracks and Order Spectra

Real time order tracks are the frequency amplitude signals graphed against the RPM variable. Users can measure, display, and save multiple order tracks. Order Spectra are auto power spectra that are normalized to orders.

- *Maximum Number of Channels*: 512
- *Max Order Tracks*: up to 28 tracks
- *Max Order of Interest*: 200
- *Order Tracks Scaling*: linear spectrum with peak or RMS scaling, or power spectrum with RMS scaling
- *Spectrum Units*: EU_{pk}, EU_{rms}, EU_{rms}^2
- *Tracking RPM Range*: 3 – 300,000 RPM (0.05 Hz – 5 kHz)
- *RPM Resolution*: 10 – 10,000 RPM
- *Delta Order of Order Spectrum*: 0.025 to 1
- *Acquisition Mode*: Free Run, Run Up, Run Down, Run Up and Down, Run Down and Up
- *Order Spectrum View Mode*: 2-dimensional, waterfall, or spectrogram (with RPM as z-axis)

Narrowband RPM Spectra

Narrowband RPM spectra are 3D signals that display the auto power spectra changing with RPM. Fixed Band RPM spectra are RMS measurements extracted from the 3D RPM spectrum within fixed frequency bands.

- *FFT Block Sizes*: 256 to 4,096
- *Data Window Functions*: Hanning, Hamming, Flat-top, Kaiser-Bessel, Blackman
- *Auto Power Spectrum Type and Scaling*: linear spectrum with peak or RMS scaling, power spectrum or power spectrum density with RMS scaling (Spectrum Units: EU_{pk}, EU_{rms}, EU_{rms}^2, EU^2/Hz, EU^2·s/Hz)
- *RPM Range*: 3 – 300,000 RPM (0.05 Hz – 5 kHz)
- *RPM Resolution*: 10 – 10,000 RPM
- *Average Mode*: linear, exponential, peak hold
- *Acquisition Mode*: free run, run up, run down
- *Fixed Band RPM Spectra*: user-definable band range. The instrument calculates the total power within the fixed band versus RPM. Spectrum Units, EU_{rms}, EU_{rms}^2.

Order Tracks with Phase

Order Tracks with phase are order spectra with the phase measurements that are relative to the tachometer signals as reference. All the specifications are the same as real order tracks except that order tracks with phase can also be displayed as Bode, Polar, or Nyquist plots. The orbit display can be enabled for any two data channels with this option.

Tachometer Processing

The user can view either the original tachometer input waveform or the translated RPM signal. The user sets the RPM trigger threshold, rising or falling edge detection, and the number of tachometer pulses per shaft revolution. Tachometer signal processing automatically removes unwanted noise and glitches.

Offline Sine Data Reduction

The Offline Sine Data Reduction function analyzes the time streams recorded during the vibration control process. Before Offline Sine Reduction is applied, a DSA system is used to record time streams of the additional signals desired. It must also record the time stream of the VCS Constant Output Level Adaptor (COLA) output signal, a constant amplitude sine wave at the same frequency as the sweeping drive applied to the shaker. This offline function calculates all response spectra and the transmissibility FRFs between pairs of signals. The signal processing is exactly the same as that employed by the VCS; the recorded COLA synchronizes the analysis of the DSA signals.

Analysis Parameters:

- *Pulse Edge Type*: falling, rising
- *Pulse Edge Value*: threshold voltage for edge detection
- *Frequency Range*: up to 46 kHz analysis frequency range of the COLA signal
- *Spectrum Display Resolution*: 256 to 4096
- *Sweep Type*: Log, Linear
- *Measurement Strategy*: tracking filter, RMS, Mean, Peak
- *Tracking Filters*: proportional: 7%, 12%, 25%, 50%, 100%, Fixed (Hz): 1-500Hz

Analysis Signals:

- *Measured Signals*: sweep spectrum, up sweep spectrum, and down sweep spectrum of each channel, complex transmissibility signals, and the time trace of sweeping frequency
- *Complex Transmissibility Signals*: may be calculated from any two channels and both classical estimators “H1 and H2” are provided.

Vibration Intensity

- *Channel Count*: Analysis on 3 channels (x, y, z axis)
- *Calculation Methods*:
  - Standard (Basic) Method
  - Running RMS Method
  - Fourth Power Vibration Dose Method
- *Reported Values*:
  - Weighted RMS total or for individual signals;
  - Maximum Transient Vibration Value (MTVV) for each direction;
  - Vibration Dose Value (VDV) for each direction
- *Reports*: Automatically generate PDF reports to review on the CoCo or upload to a computer. Reports contain the following values:

- Applications
- Position
- Frequency Range
- Calculation Method
- Test Time
- Weighted RMS – channel
- Weighted RMS – Overall
- Test Conclusion (if applicable)
- Weighted Signal Trace Display: Track any weighted input channel over time. Values are updated every second.

Whole Body Vibration

- *Standards*: ISO 2631-1:1997
- *Applications*: Health, Comfort, Perception, Motion Sickness
- *Testing Positions*: Seated, Standing, Recumbent (lying)
- *Frequency Weightings*: Wa, Wd, We, Wf, Wj, Wk
- *Frequency Range*:
  - 0.5 Hz – 80 Hz: Health, Comfort, Perception
  - 0.1 Hz – 0.5 Hz: Motion Sickness

Hand-Arm Vibration

- Standards: ISO 5349-1:2001
- Frequency Weightings: Wh
- Frequency Range:
  - 6.3 Hz – 1250 Hz

Building Vibration

- *Standards*: ISO 2631-2:2003, BS 6472-1:2008
- *Frequency Weightings*: Wm
- *Frequency Range*:
  - 1 Hz – 80 Hz

Ship Cabin Vibration

- *Standards*: ISO 6954:2001
- *Frequency Weightings*: Wm
- *Classification*: A, B, C
- *Frequency Range*:
  - 1 Hz – 80 Hz

File Converter (EDM-FC)

File Converter is a Windows application that converts various files into standard ATFX-ODS format. The user can save the file attributes into a template for future use. Batch processing allows the user to convert the same type of files automatically.

The following file types can be read and converted:

- *ASAM-ODS XML*: ASAM Open Data Source binary format (default, recommended)
- *UFF ASCII*: Universal File Format 58; ASCII format header and data.
- *UFF Binary*: Universal File Format 58b; ASCII header, binary format data.
- *ASCII*: user defined format and selected attributes. User enables the signal attributes and the format of ASCII data and specifies template for future use.
- *Excel CSV*: Coma Separated Variables (CSV) file can be opened directly in Microsoft Excel.
- *MATLAB*: *.mat binary format that can be opened and analyzed using MATLAB. Both single and double floating point precision supported.
- *.WAV*: sound files that can be played by media players found on most computers. Exported wave files do not contain file header information. Only time signals can be exported in this format.
- *.RAW*: this is a proprietary file format from Pacific Instruments Company
- *RPC III*: sequential, fixed length, 512-byte record files, which contain a standard header that is followed by data. Supported extensions are tim and rsp.
- *.SIG*: a file format from Dactron software (RTPro or Shaker control)

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Computer Requirements

Minimum System Requirements:

- *Operating System Support*: Windows 7 SP1 or higher
- *Operating System Type*: 32-bit or 64-bit
- *Processor Speed*: 1.5 GHz Dual-Core x86
- *RAM*: 4 GB
- *Available Storage Space*: 10 GB

Recommended System Requirements:

- *Operating System*: Windows 10, 64-bit
- *Processor*: Intel Core i7, 2.0 GHz or Higher
- *RAM*: 8 GB DDR3 1600 or higher
- *Available Storage Space*: 10 GB

Functions Provided by EDM Post Analyzer Bundles

Function	PA Basic (EDM-02)	PA Premium (EDM-03)
Browse, display, and edit long waveform files	x	x
Signal display with different spectrum unit and X-Y scale	x	x
Signal annotation, cursor, play sound, calculate RMS, THD, ZOOM-in, ZOOM-out, auto scaling	x	x
Create template-based report in HTML, Excel, Word or PDF	x	x
Engineering unit conversion, dB reference	x	x
Export to standard formats including ASAM-ODS, UFF, BUFF, MATLAB, user-defined ASCII, and wave files	x	x
3D display: waterfall, colormap	x	x
Import user-defined ASCII file, wave file, Pacific Instrument file	x	x
Acceleration, velocity and displacement conversion	x	x
Polynomial Curve Fit	x	x
FFT Spectral analysis: FFT, auto power spectra, cross power spectra, frequency response function	x	x
Math Functions: abs, +, -, *, /, square, square root, log, integration, differentiation, RMS, peak, offset and scale	x	x
User defined data conditioning modules (PA-05)		x
Digital Filters: IIR, FIR, Low-pass, High-pass, Band-pass (PA-06)		x
Shock Response Spectra (SRS) (PA-07)		x
Fractional octave filters and SLM: 1/1, 1/3, 1/6, 1/12 (PA-08)		x
Order Tracking: RPM spectra, order spectra (PA-09)		x
Offline Sine Data Reduction (PA-10)		x
Sound Power		x
Vibration Intensity (PA-11)		x

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