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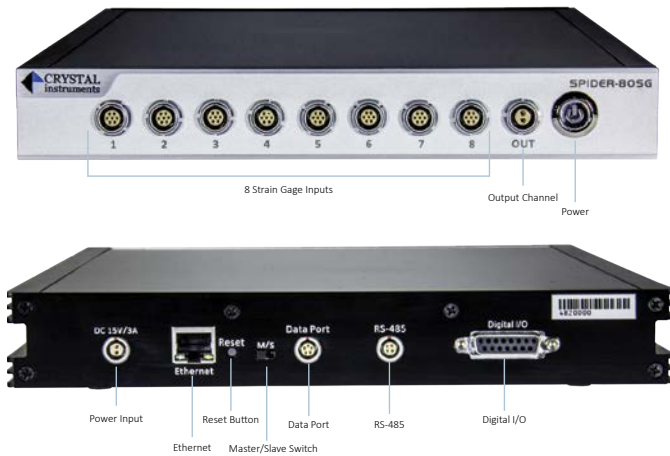
SPIDER-80SG DATA ACQUISITION WITH STRAIN GAGE

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Spider-80SG Data Acquisition with Strain Gage

www.crystalinstruments.com/spider80sg-general-data-acquisition-with-strain-gage



Compact Testing Solutions

The Spider-80SG/SGi is an eight-channel strain sensor processing system module useful for a wide range of physical tests and measurements. Spider-80SG/SGi is a natural adjunct to Spider-80X systems for machinery monitoring and modal analysis applications. This is a flexible module appropriate for low frequency “static” stress/strain measurements and bearing temperature monitoring as well as rapid dynamic stress analysis in vibration studies and modal analysis. Though somewhat intricate to install, the tiny and nearly massless strain gage is a marvelous sensor for vibration studies. It provides low-frequency sensitivity unmatched by accelerometers and does so without mass loading the object under study. Proper strain gauge installations can provide much focused information, allowing you to separate tensile, bending and torsional effects in a structure’s responses. Integrating these benefits within a DSA system facilitates new levels of structural understanding.

The Spider-80SG/SGi module can be network-integrated or PC connected through its Ethernet connector. It will precisely measure strain, based upon detecting small changes in resistance when a wire or foil strain gage is stretched or compressed.

With Crystal Instruments’ unique Ethernet based time synchronization technology, multiple Spider-80SG front-ends combine together to construct a system with a higher number of input channels.

Pluggable front-ends provide the system with maximum flexibility of analog channel configuration, making it ideal for a range of measurement tests under various circumstances. The modular design allows configurations with 8 input channels of isolated analog inputs and one analog output.



Spider-80SG Features Overview

8 strain gage / general purpose inputs per front-end
24-bit ADC channel
Supports multiple measurement quantities
Supports a variety of strain gages, load cells, pressure transducers, torque sensors, accelerometers and geophones
User selectable excitation voltage
User configurable synchronized sampling rate
Remote sensing
Precision excitation voltage of $\pm 2.5V$ and $\pm 5V$
Power supply voltage of 2.5V, 5V & 10V for sensor excitation
Shunt calibration
Offset nulling for any measurement quantity
Multiple trigger modes
Compact, portable design
Scale up to 512 channels using multiple front-ends

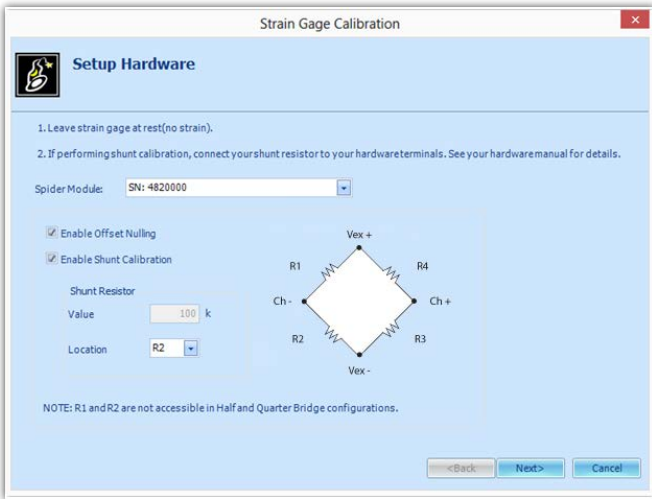
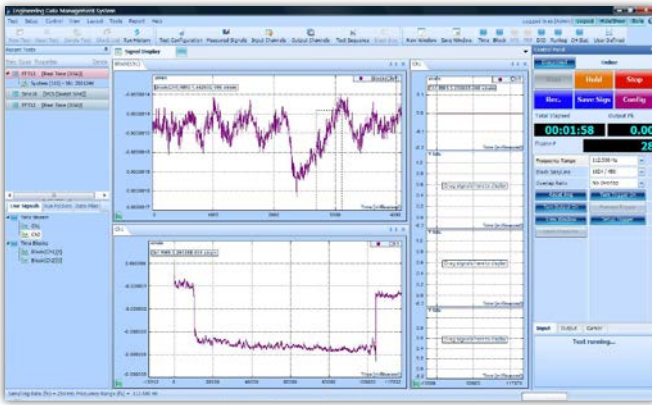
Each input channel is a dedicated DC-excited Wheatstone Bridge circuit with 24-bit digital output. Spider-80SG/SGi provides precision bridge-completion resistors for use with either 120 Ω or 350 Ω gages. A precision calibration shunt resistor is also provided, and shunt calibration is accomplished with a single command. The software also provides facility for physical input calibration. The module will auto-balance all channels upon command. There is no need to turn potentiometers or switch resistors into the circuit; all module controls are through software.

Each Spider-80SG front-end has its own mass storage media that houses the operating software and stores measurement data. This truly distributed system guarantees data recording at full speed without being subject to network speed limitations.

Input Channel Adapter

Each input channel is provided with a mating Input Channel Adaptor (ICA) or "breakout box". These inexpensive adaptors simplify the business of integrating a strain gage subsystem with the Spider-80SG. The adaptor mates to the Spider-80SG through a 14" cable terminated in a LEMO connector. The ICA provides an eight screw-terminal barrier strip to accept the wires soldered to an installed strain gage or bridge or partial bridge of strain gages.

The Input Channel Adaptor simplifies "mating" the multiple wires coming from one, two, or four strain gages to form a single channel input to the Spider-80SG. The ICA provides simple connection diagrams for all the conventional gage configurations. Provision to utilize remote sensing leads is provided.



The screenshot shows the 'Input Channels for FFT157 (DSA/SG)' software window. It contains a table with columns for 'On/Off', 'Location ID', 'Measurement Quantity', 'Bridge Type', 'Poisson Ratio', 'Gage Factor', 'Excitation Voltage (V)', 'Input Range', 'Shunt Resistance (Ω)', and 'Nominal Gage Resistance (Ω)'. The table lists 8 channels (CH1 to CH8) with various settings.

On/Off	Location ID	Measurement Quantity	Bridge Type	Poisson Ratio	Gage Factor	Excitation Voltage (V)	Input Range	Shunt Resistance (Ω)	Nominal Gage Resistance (Ω)
On	CH1	Strain	Half	0	2.08	2.5	Full	100000	120
Off	CH2	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH3	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH4	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH5	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH6	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH7	Strain	Full	0	2.08	2.5	Full	100000	120
Off	CH8	Strain	Full	0	2.08	2.5	Full	100000	120

Dual Modes of Excitation

The Spider-80SG is equipped with dual excitation modes. There is an option for Precision Excitation Voltage of $\pm 2.5V$ or $\pm 5V$ that can be used to excite a strain gage or a strain gage based sensor and measure the minute change in resistance accurately.

Remote Sensing

The Spider-80SG has been tested to work on strain gages up to 1000 ft away from the analyzer using the remote sensing feature. Using an 18AWG 5 conductor cable to measure the excitation voltage using remote sensing and changes in output voltage, the error was measured to be less than 1.5% for up to signal frequencies of 10 KHz.

Use with Vibration Controller

The Spider-80SG's compatibility allows it to be chained together with Spider-80X front-end(s), extending the capabilities of the Spider-80SG to read and record general purpose measurements simultaneously while performing a vibration control test.

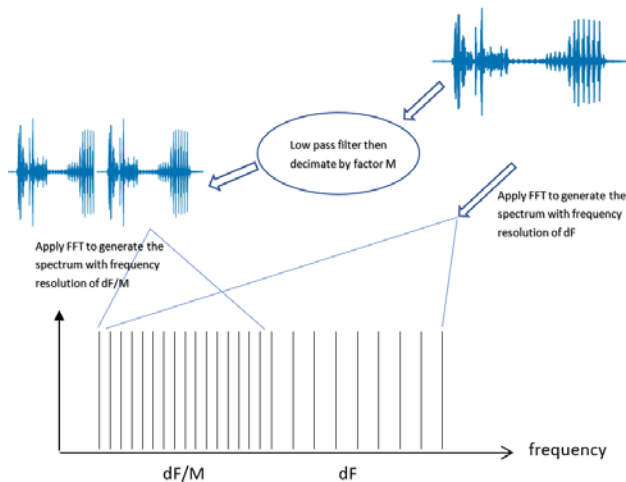
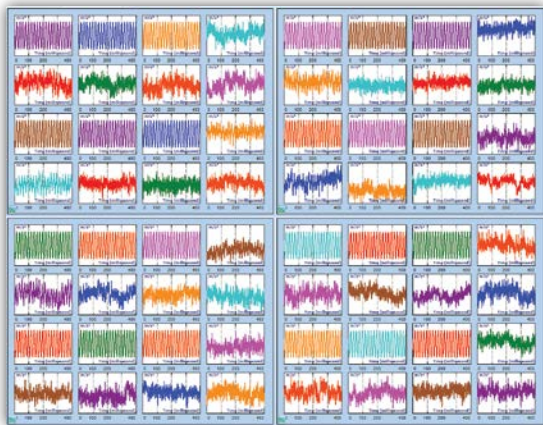
Black Box Mode: Run without PC

The Spider-80SG can operate in Black Box mode, which allows the measurements to take place without a PC. In this mode, a PC is used only to configure the Spider-80SG system before the system starts operating and to download data after the test is complete. During the test, the system can operate according to a preset schedule or is controlled from a variety of external devices, such as a tablet or iPad.



Real Time FFT Analysis

www.crystalinstruments.com/frequency-response-function



Comprehensive Data Acquisition with the Spider System

The FFT Spectral Analysis provides comprehensive data acquisition and FFT analysis functions. **Acquisition Mode** controls how the data is acquired block-by-block and processed with the signal analyzer functions. These time blocks can be either gap-free, overlapped, or with gaps, depending on the acquisition mode selection. **Sampling Rate** can be set from control panel directly. 54 sampling rate stages available and can be changed without stopping data acquisition. 3D waterfall processing allows the data acquired and processed in real time with either RPM or time as additional axis. Output has a dozen of signal source types to excite the testing articles.

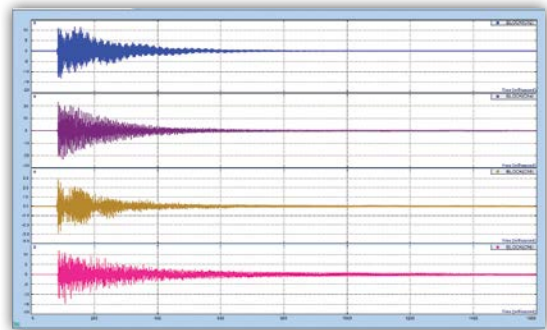
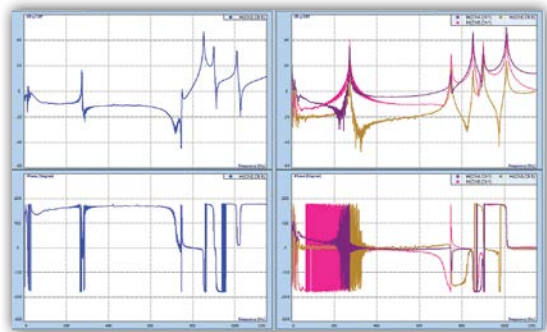
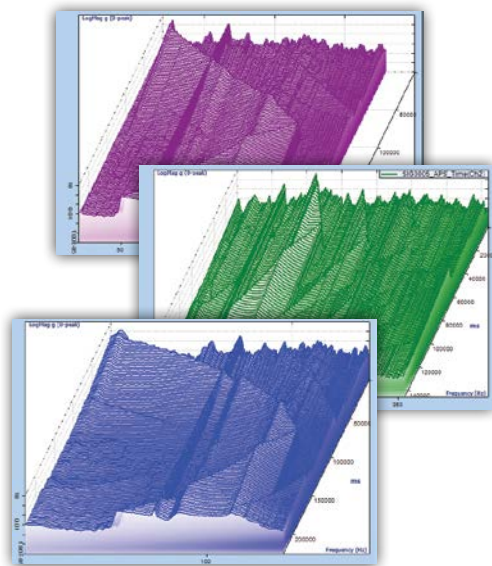
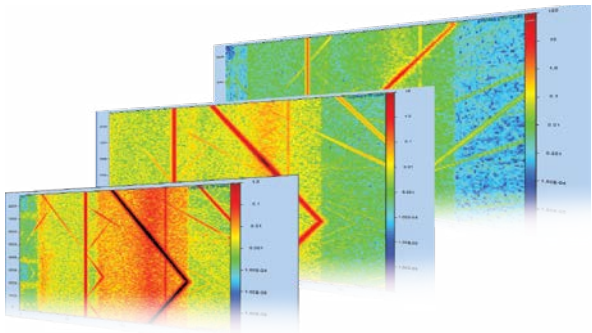
With the **Frequency Analysis Functions** the FFT with block size from 256 to 32,768 for all input channels can be applied simultaneously.

The data window type includes Hann, Hamming, Flattop, Uniform, Kaiser-Bessel, Blackman, Force, Exponential and Force-Exponential. The Spectrum Types include linear spectrum, auto power spectrum, frequency response function, coherence, cross power spectrum and phase spectrum. Hundreds of FRF signals with MIMO model can be computed simultaneously.

With extremely fast DSP, the processing overlap ratio can go as high as 75% or 90%. A special function enables to search the resonant frequency on any FRF signals.

Acquisition Mode includes free-run, continuous after trigger, single shot with trigger, single shot without trigger, auto-arm trigger and manual-arm trigger.

Multi-Resolution Spectrum provides the ability to use different spectral resolutions at low frequencies and high frequencies within the same spectrum. When analysis requires a denser frequency resolution in the lower frequencies compared to the higher frequencies, multi-resolution spectrum can be used. The need for a higher block size (for better frequency resolution) is eliminated because the spectral resolution is eight times higher below the user selected cut-off frequency.



Variable Sampling Rate in the FFT Analysis provides a convenient way to select sampling frequencies of each module in a high channel count system. Measurement quantities such as strain, temperature or pressure often require a much lower sampling rate when compared to acceleration or sound pressure. The variable sampling rate could be efficiently used to select a user defined sampling rate for each front-end while acquiring synchronized data from all channels in the system.

3D signal waterfall displays are available for block signals in all types of tests. 3D signals can be plotted with reference to Time or RPM (when tachometer input is available). User customizable trace number and reference axis settings are available for both Time and RPM reference axes.

With Spider some statistics signals can be computed and recorded into PC with “infinite time”. **RMS**: apply RMS estimation to an input data stream and generate a continuous output time stream; **Peak**: extract the peak or peak-peak value over a period of time and generate a time stream.

Math Functions applied to the signals includes operations such as abs, +, -, *, /, square, square-root, log, and offset scale.

Test Sequence creates a list of tests and run them sequentially. Test sequences can be initiated and controlled by a user command, digital input event, or Windows socket message.

Send Emails and IM as Event-Actions is the ability to send emails or instant messages as custom actions in response to a system or user event. Content of emails can be customized.

Remote Operation Communication using Socket Messages allows to communicate with and control Spider systems remotely with Window socket messages. Socket messages also allow communication with other hardware, such as temperature chambers. Please refer to the Socket Message document for detailed specifications.

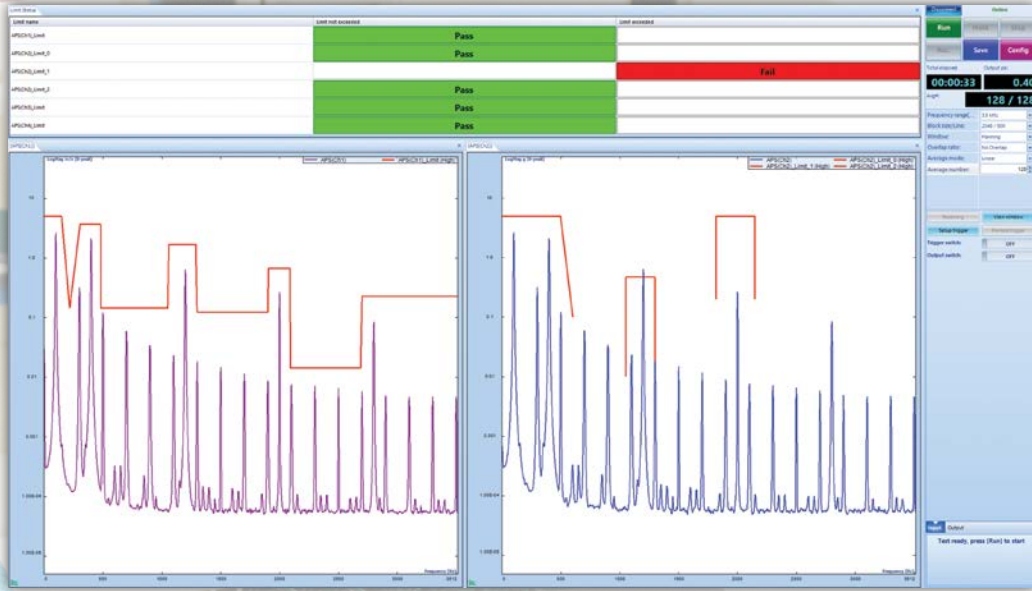
The Spider has strong System Failure Protection. With its **Power Loss Emergency Shutdown**, when a power loss is detected, the system will save all test data into non-volatile flash memory and safely shut down. With its **Ethernet Connection Loss Detection**, when a network loss is detected, the system can be configured to either save all data and ramp down the test or continue running the test in Black Box mode.

The **output channels** provide signal sources and generate user determined waveforms. Output Types include Sine, Triangle, Square, White noise, DC, Chirp, Swept sine, Arbitrary waveform, Shaped random, Playback

Spider system software can compute the **Shock Response Spectrum (SRS)** for all channels using maxi-max, maximum negative, and maximum positive analysis techniques.

Automated Production Testing Solutions

www.crystalinstruments.com/automated-production-testing

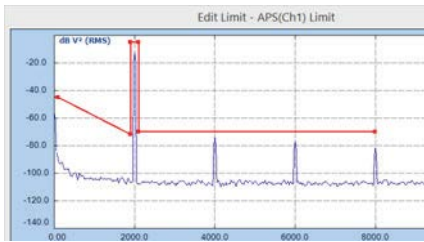


Automated Production Testing Solutions

Automated production testing is critical in today's competitive manufacturing environment. Companies can no longer rely on variable costs, non-uniformity, and potential health hazards that come with a laborer-based manufacturing line. This is no less true for sound and vibration tests, ranging from in-process burn-in tests to product validation and verification tests. The measurement tools and intelligence behind present day manufacturing include data acquisition equipment as well as closed-loop control. And while these systems may not take part in the assembly of any goods, they are just as important to ensure quality control for both components coming into an assembly line and products going out.

The PC can (optionally) be disconnected and tests run in "Black Box" mode without an attached computer.

Step 1:
EDM sets the alarm limit together with a special message string, such as "Exceeding Limit".



Step 2:
When an alarm event happens, the customized string, "Exceeding Limit" will be sent to the EDM Cloud email service.



Step 3:
User will receive an alarm email

EDM or EDM
Cloud Email
Service

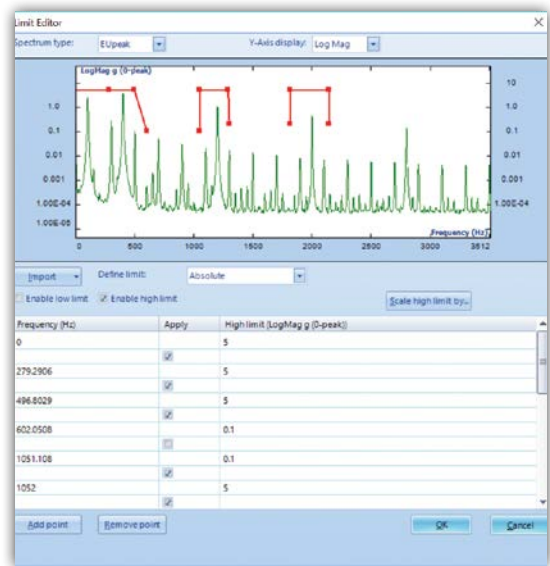


Testing status can be viewed on any PC, laptop, or even smart phone.

Black Box mode provides the ability to run Spiders without an attached computer. The Spider API, when used along with Black Box mode, is the gateway to integration with LabView, Mat-lab and other scripting software. A cellular phone, tablet or PC can control multiple Spider front-ends at distributed locations running disparate tests from a single control screen.

Limit Configuration

Alarm limits could be defined independently and multiple limits could be defined to each channel and may be applied to a Time Block, Auto Spectrum, FRF, Coherence, Octave Spectrum, Sound-Level Measurements, RMS, or Peak value. Spectra and time histories are tested by comparing against a custom test signal; a template which must bound the measured signal. Each test signal may be either an upper or lower limit and may contain up to 64 segments. Up to 64 test signals may be applied to a single measurement.

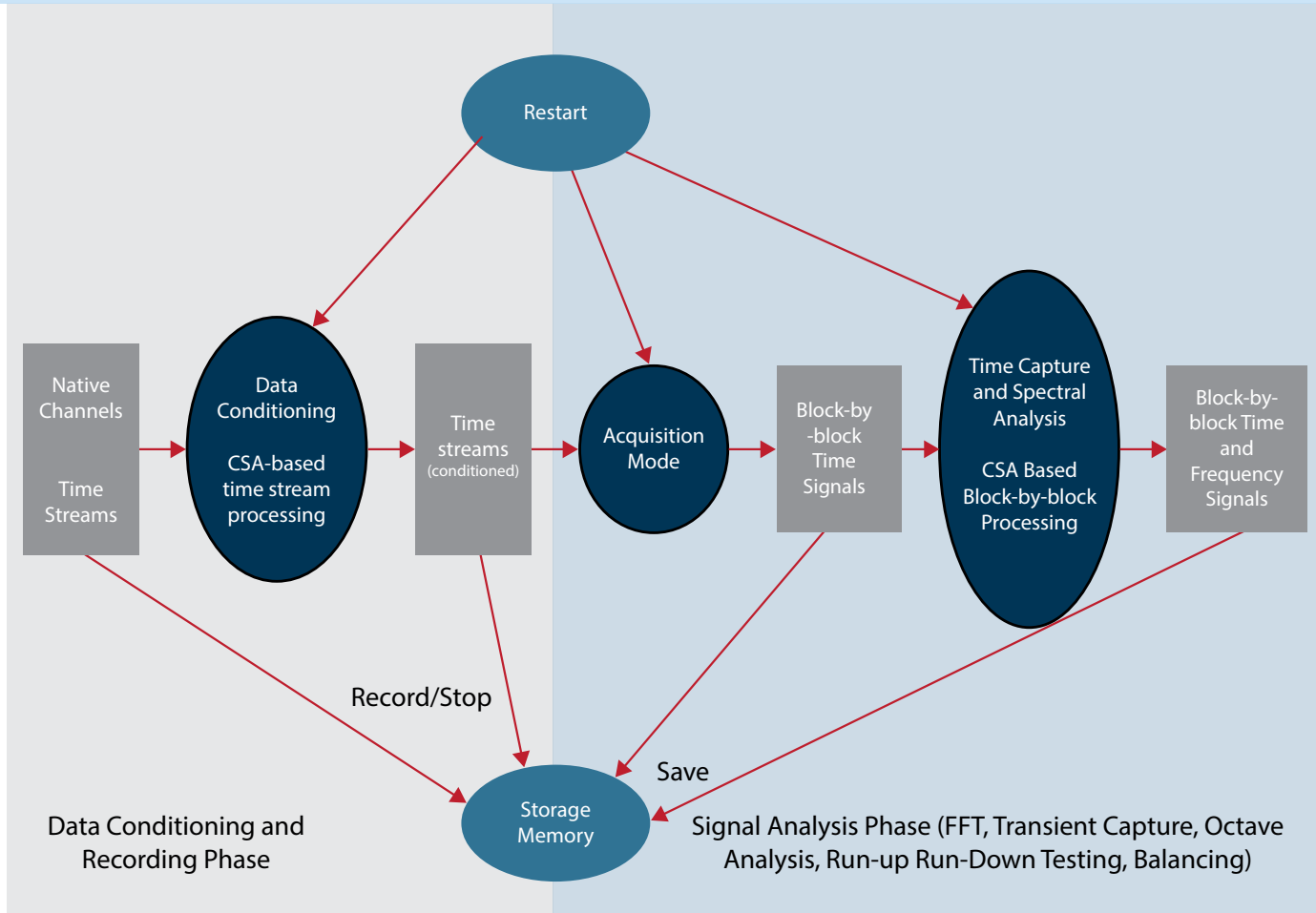


Customize Actions for Specific Events

Event-Action Rules (EAR) allows users to customize the system's response to every test event. User defined events include: signal exceeds a limit profile, signal is less than a limit profile, normal end-of-test, loss-of-signal or any of number of the events encountered during a VCS test. Responses include: halting a test, starting a different test, flashing the control screen, initiating a recording, sending a screen message, sending a text message, or sending an email. Users can program loops using EAR. Every event is logged on a cloud server and is identified by the text of a customized event string (only on EDM Cloud).

Continuous Data Recording & Post Analysis

www.crystallinstruments.com/data-recording-for-dynamic-signals



In a time-critical test, it is highly desirable to record the raw time data continuously, so that the data can be analyzed later when more time is available for a complete review. Integral raw data recording eliminates the need for a separate recording device so necessary just a few years ago.

The Spider platform simultaneously performs both real-time processing and continuous data recording. In most of real-time applications, the raw data can be recorded at any desired sampling rate with full 32-bit floating point precision. To increase the reliability of data recording, a special check sum algorithm is always applied to the measurements.

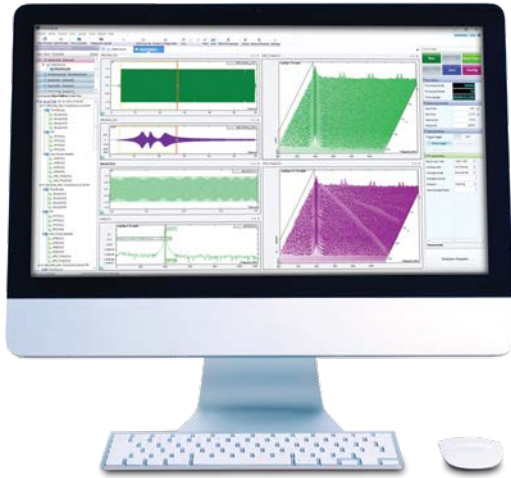
For example in a typical FFT process, the raw data time streams (full bandwidth, sampled at the instrument's highest sample rate) and/or the continuous output of a bandwidth-reducing data conditioning process can be recorded at a lower sample rate on the system's storage media while the real-time filtering and spectral analysis is in progress. This same design philosophy is incorporated in the Spider high channel count systems.

While being recorded, the measured values can be graphically displayed as y/t or y/x diagrams, as bar charts, as waterfalls, FFT, PSD, tachometer speed, or numerical statistics displays with a simple mouse-click. EDM software allows users to design an individual graphical visualization for each desired real-time measurement.

The recording function is driven by user-defined events. On Spider front-ends the recording "action" can be initiated via various events, including: hard button press, user software command, defined trigger-condition event, digital input event, third party software command, defined alarm limit event, fixed timer, etc.

EDM Post Analyzer Software

www.crystallinstruments.com/edm-post-analyzer-software



Crystal Instruments EDM PA

Crystal Instruments offers EDM Post Analyzer software, a powerful adjunct to your Spider-based analysis tool kit, allowing you to analyze Time Stream recordings made using your Dynamic Signal Analyzer. The beauty of this approach is that it lets you analyze and reanalyze digitally recorded data after the recording event.

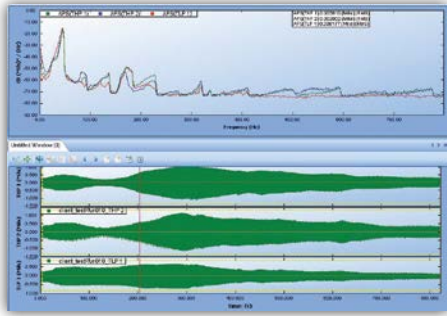
To offer a complete package of both real-time analysis and post processing, Crystal Instruments developed three separate but related software modules: Post Analyzer, Waveform Editor, and File Converter. Post Analyzer (PA) contains many powerful post processing tools with batch processing capability. 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 the Spider hardware. The user should expect the same or very similar calculation results using PA to those computed in the hardware in real-time. This document describes the PA functions.

Waveform Editor is an independent Windows application that allows the user to cut, edit or merge the time waveforms. File Converter is an independent Windows application that converts files in various data formats to standard ATFX format.

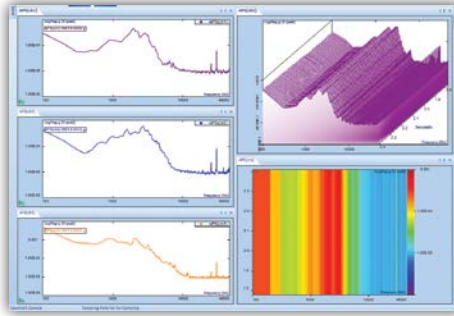
For convenience of ordering, we also created three bundles of PA: PA Viewer allows the user to view data and create reports; PA Basic has FFT spectral analysis, curve fitting, demodulation spectrum and 3D signal display functions; PA Premium has more advanced functions including Waveform Editor, File Converter, offline sine reduction, real-time filters, octave filters and order tracking.

Engineering Data Management (EDM) is a complete suite of turn-key solutions for both real-time processing and post analysis. Shown in the next page are typical screen shots of EDM PA functions, in the following order: Post Processing, PA Spectra, and PA Projects.

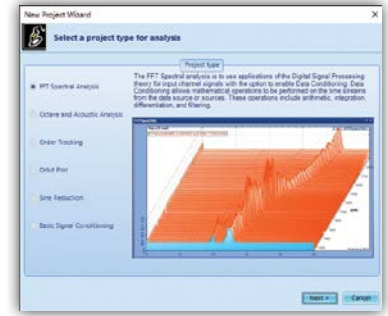
EDM - PA Bundles	
Part Number	Description
EDM-01	PA Viewer: View data, export data to UFF, BUFF, MATLAB, user-defined ASCII, and wave files. Generate reports. Includes File Converter and Waveform Editor.
EDM-02	PA Basic Bundle: In addition to functions of PA Viewer, PA Basic includes 3D display, File import, File export, trigger, FFT post-analysis.
EDM-03	PA Premium Bundle: In addition to PA Basic, PA Premium includes signal conditioning, digital filter and resampling, SRS, octave analysis and SLM, order tracking, offline sine reduction.



Post Processing



PA Spectra



PA Projects

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

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