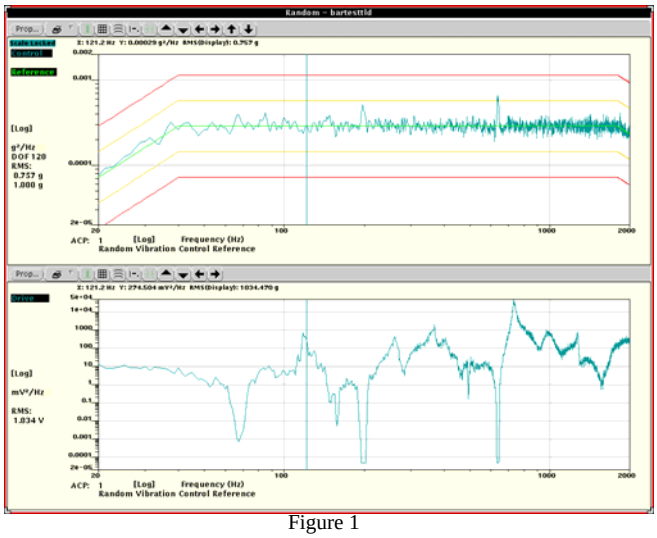


Figure 1

Random Vibration Control: The purpose of random excitation is to expose the test article to all frequencies, all phases, and all amplitudes in a truly random nature. The only condition to this is the customers SHAPE must be produced and maintained, without losing the true Random nature of the energy.

Control: The system must control to a PSD. Control to the system ID or H(f) is NOT what the original specifiers of this method of testing intended. The Power Spectral Density for Control, not simply as a view of data, is required. JAGUAR provides this capability.

Random Nature: All digital control systems must have a repeat period for the random. The period should be measured in years, not minutes or seconds. Random, for control to 120 Degrees Of Freedom (DOF) w/2KHz BW WILL, not may, deviate +/- 1dB on 90% of the lines and more on the remaining lines. Failure to do so is wrong testing. The Control Spectrum can NEVER look like the Reference, i.e. a straight line.

Control Dynamic Range: Dynamic Range alone is simply a computational specification. Adding "Control" requires the entire "Loop" to be considered. Both Input Hardware and Output Hardware affect the Control Dynamic Range. Data windowing, a requirement with random, also affects the control dynamic range. The problem represented in Figure (1) shows greater than 90 dB of Control Dynamic Range. The resonance rich structure demands large dynamic range for control. It is not simply having enough converter bits; it is even more critical to have the right control philosophy.

Control Philosophy: Stochastic Control, or controlling to the system ID, rather than PSD control, assumes that a low level model of system response is appropriate for full level testing. It assumes that resonant conditions will NOT have mechanical amplification. These assumptions are rarely valid. An example of the result of this test method occurs when you observe a small "blip" in the control spectrum that never improves independent of averaging. As the test level rises, the out of tolerance condition should be corrected real-time. JAGUAR controls; Quickly.

Throughput Disk: Random supports starting and stopping the throughput time stream during a control test via the control panel. The data may be archived as a single file or broken into multiple segments consistent with the number of streams that were stored. See figure 2 at right.

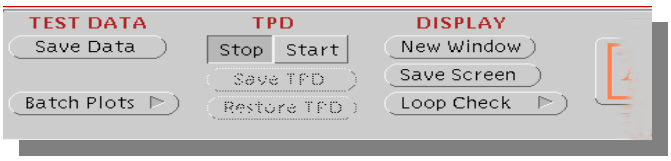
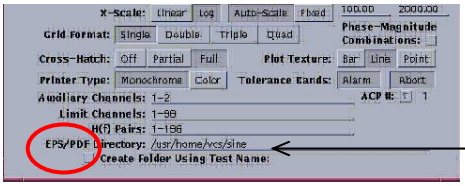


Figure 2

Figure 3



This Directory and Filename permits user control of file system & PDF/EPS file creation

Batch Plotting: Figure (3) at left shows a table that resides behind the "Batch Plot" button on the control panel for Random as well as in the Random Data Review control panel. Rather than only plotting from live data displays, batch plotting allows the test engineer to decide what will be plotted, how it will be scaled, and whether the auto scale feature will be invoked display type dependant. With Batch selected, local plotting still works in addition to the batch mode.

The Batch Plotting tool also permits report generation via, PDF generation and EPS for Microsoft Tools. Three button clicks and a directory assignment, and your report is ready to send/print.

jaguar

MISO Random

Control Methods

Control loop	Patented adaptive control algorithm with separate control loops dedicated to controlling the shape of the drive spectrum and overall RMS level optimized for control speed and stability.
Advanced ACP control	Optionally supports multiple Acquisition & Control Peripherals (ACP) for up to 588 simultaneously sampled input channels. Control and limit channels may be defined in the master ACP (up to 98 channels); auxiliary measurement channels may be activated in all ACPs.

Control Performance

Dynamic range	Greater than 90 dB.
Output	Pure Gaussian noise with smoothing filters. Choice of Kaiser-Bessel or Half-Sine window.
Equalization accuracy	Control to within $\pm$ 1 dB for a flat reference spectrum with 120 DOF and 90% statistical confidence.
Loop time	Less then 0.5 second typical (may be less depending on host model) for 4 control channels, 4 new frames per loop, 2000 Hz, 200 lines, 4 spectrum averages & 120 DOF.
Re-equalization rate	For an instantaneous change of 6 dB in all control spectrum lines, the spectrum RMS is re-equalized to $\pm$ 1 dB within 8 control loops for a flat reference with 120 DOF.

Reference Spectrum

Definition	Easily defined by a combination of up to 150 frequency breakpoints (PSD value, frequency value) and slopes (dB/octave values).
Alarm and abort limits	Independent positive and negative alarm and abort tolerances for each breakpoint.
Frequency ranges	DC to 50, 80, 100, 200, 400, 500, 800, 1K, 2K, 4K, 5K, 10K and 20K Hz.
Frequency resolution	100, 200, 400, 800, 1600 and 3200 lines.
Import reference	Any previously measured Monitor or Auxiliary spectrum may be used as a new reference spectrum or the reference spectrum may be imported in Universal File Format (UFF).
Re-scale reference	Automatic re-scale of the reference spectrum to achieve desired overall RMS level.
Units	g-in/s-in, g-m/s-mm or m/s^2-m/s-mm and user specified engineering units.
Limit profiles	Defined using up to 40 frequency break points and slopes; defaults to reference spectrum.

Control Parameters

Mode of operation	Manual allows user interaction during a test; automatic insures “hands-free” operation.
Test duration	User defined; maximum 999:59:59 (h:m:s).
Degrees of freedom	User defined; minimum 8, maximum 10,000.
Output level control	Automatic or manual (up/down/full level).
Multi-channel control strategy	Average, minimum, maximum, or limit.
Number of control channels	1 to all available channels; maximum 98.
Limit channels	Limit profiles override defined control method on a spectral line by line basis to prevent over-test. From 1 to 97 channels may be activated.

Startup Parameters

Equalization start level	Selectable from -30 dB to 0.0 dB.
Initial test level	Selectable from equalization level to 0.0 dB.
Time at initial level	Off or timed in seconds or loops (0 to 10,000).
Level increment	0.1 to 10 dB.
Pre-stored drive startup	Skip equalization by selecting the drive from stored test data (may confirm before start).

Safety Features

Shaker limits	Pre-test verification that dynamic limits are within shaker operational limits (acceleration, velocity, displacement and voltage).
Loop check drive	Selectable maximum; 10 to 3300 mV RMS.
Alarm/Abort RMS	RMS acceleration limit in dB or engineeringr. units.
Alarm/Abort spectral lines	Number of lines or percent of lines within user specified range.
Limit profiles	An independent profile for each limit channel.
Control signal loss	Continuous automatic detection.
Manual abort	Graphical and keyboard abort buttons.
Drive signal clipping	None, 2.5 to 6 sigma or 1 to 10 Volts.
Startup/shutdown rates	Independent selections; 0.1 to 50 dB/sec.

Test Automation

Level scheduling	User defined levels, time at level, transition time to reach the level and number of cycles.
Test scheduling	User defined sequence of up to 100 independent tests run automatically.

Channel Setup

Channel type	Control, auxiliary, limit or inactive.
Coupling	Select AC, DC or ICP with 24V supply.
Sensitivity	0.01 to 1,000,000 mV/(engineering units).
Channel loop check	Select as enabled or disabled.
Channel labels	Up to 45 characters (2 labels each channel).
Import sensor table	Import from ASCII spreadsheet file.

On-Line Displays

Simultaneous displays	Up to 25 windows, each with up to 4 grids.
Waveforms per grid	Up to 4 (up to 400 on 100 grids).
Auxiliary monitor	Optional second monitor for test displays.

On-Line Analysis

Spectral functions	Control, drive, error, auxiliary, monitor, H(f) magnitude & phase, and coherence.
Spectra averaging	Linear, exponential; user-defined DOF.
Cursors	X and Y value readout, peak search, trace tagging and multi-window locked positioning.
Scaling	Log or linear. Auto-scaled or fixed.

Analyzer Mode Acquisition

Function acquired	PSD spectra, frequency response function magnitude/ phase, and coherence acquired in non-control mode.
Averaging	Select linear or exponential averaging and the desired DOF.

Host Data Storage & Review

Setup & format	Automatically timed, timed at full level or manual. Binary files (published format) easily converted to UFF, spreadsheet, or Matlab and easily transferred to PC via network or floppy.
Playback	Scan forward or backward through the entire test data file, with adjustable delay.
Test overlay	Select files from multiple tests for overlay.
Annotation	Test name, test time, & level for each record.

Documentation

Test summary	Fully documented post-test summary, easily printed or incorporated into any document using standard word processing software.
Message log	Text file records all system status messages displayed during the test.
Automatic & batch plots	Automatic plot generation at test completion. Plot modes for sending all displays to the printer with single or multiple grids per page.

Throughput Disk

General description	Supports 1-6 drives for storing all time domain data to disk during a test. Data may be replayed to recreate spectral test displays or may be replayed via Signal Analysis to also view time domain data. See separate data sheet

SPECTRAL DYNAMICS

Spectral Dynamics, Inc.
2730 Orchard Parkway
San Jose, CA 95134-2012
408-678-3500 Fax 408-678-3580

www.spectraldynamics.co