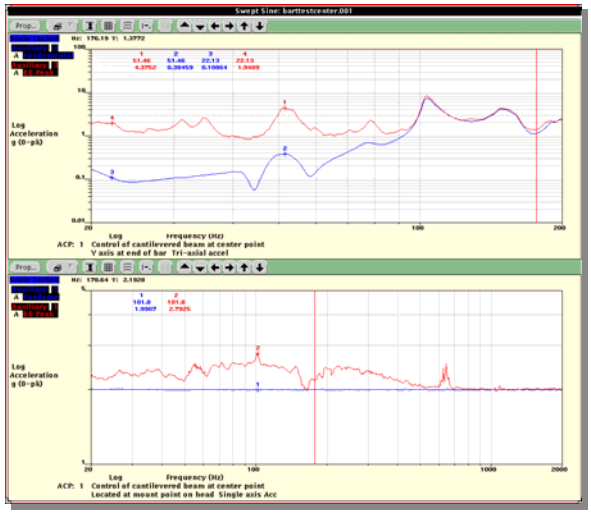

Figure1.

Purpose of Sine Testing: Traditionally the goal was to identify Resonant Frequencies of the structure. Newer requirements are to stimulate all frequencies one at a time with pure analog quality sine energy that constantly and smoothly changes frequency with no detectable steps in the frequency.

Measurement Choices for Control: User must elect to control to one of the following: a) Broadband Peak of the measured signal; b) the Fundamentally Processed signal (Tracking Filters are required), or c) the RMS of the broadband. **Figure 1** shows the control channel in the bottom frame in both BB Peak and Fundamental. The upper frame shows an auxiliary channel in the same manner. The signal is processed both ways simultaneously enabling the differences to be understood by the test engineer. The RED trace in both cases is the BB Peak energy and the Blue trace is the fundamentally processed, Tracking Filtered data. Please call your local Spectral Dynamics Sales Office for details about why these levels differ and how it affects the test results. See the SD document "An Advanced Sine Vibration Control Algorithm" for more detailed description of JAGUAR Sine Control.

Tracking Filters: The purpose of the tracking filter is to bandpass the desired data, synchronizing the center frequency of the bandpass filter and locking it to the drive frequency. In this way the measurement bandwidth is limited to the bandwidth the test engineer chooses, **CENTERED** on the driven frequency. This permits the control algorithm to make decisions only on the bandwdith of interest rather than "other" energy that does not relate to the response **AT** the driven frequency. A good filter shaper, shown to the right in **Figure 2**, should reject on the order of -80dB with no oscillation or significant "lobes" to inject unwanted energy. The filter MUST sweep with the changing drive signal to avoid serious sampling errors.

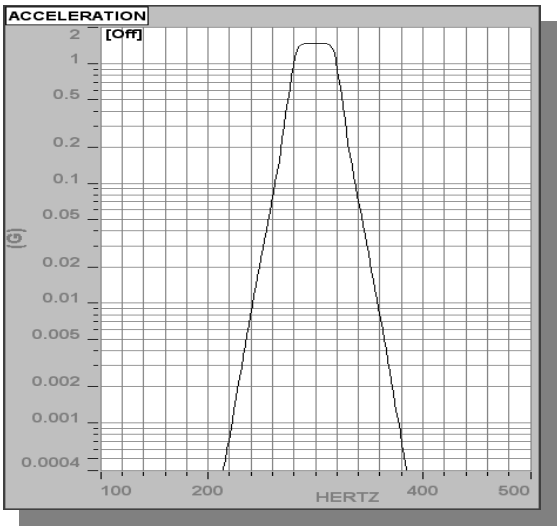

Figure 2.

Improper Tracking Filter Examples: Most vendors offer a digital process as a substitute for an actual filter. The "process" loosely referenced as a Tracking Filter, has two very significant shortcomings. Digital smearing is the name for the fact that the "filter" does not smoothly track the drive frequency, causing the signal to be measured like an FFT would, showing the pure tone as though it were many closely spaced frequency lines of the FFT, thus SMEARING between many lines. The FFT process JUMPS, not sweeps. The other issue is very poor rejection. See examples in **Figure 3**.

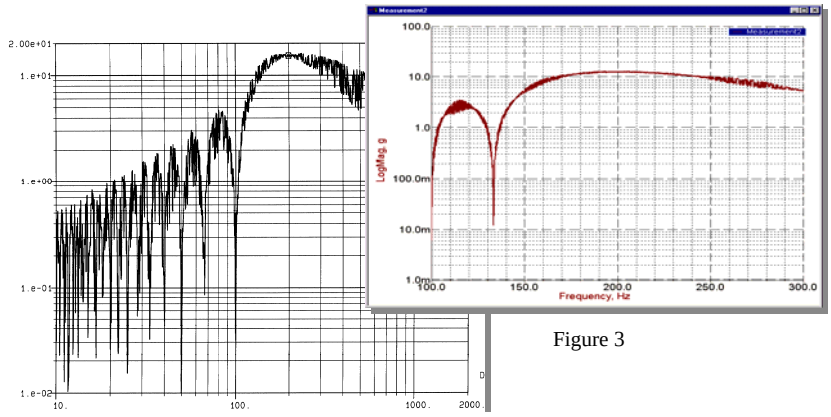

Figure 3

Example Tracking "Filters": Figure 3, at left, shows **a**ctual measured filter shapes from selected vendors who claim to have tracking filters.

P/N 2560-9421 up to 38 channels
P/N 2570-9421 up to 98 channels

jaguar

MISO Swept Sine Control, Analysis & Tracked Dwell

Technical Specifications JAGUAR Systems

Methods & Options

Control method	Patented adaptive control accurately and quickly compensates for non-linear or time varying changes in the dynamic load. Digital tracking filters, implemented in micro-code, allow high speed, simultaneous processing on up to 98 control channels.
Advanced ACP control	Supports multiple Acquisition & Control Peripherals (ACP) option for up to 588 simultaneously sampled input channels. Control and Limit channels are defined in the master ACP (up to 98 channels); auxiliary measurement channels may be activated in all ACPs.
Tracked dwell	Separate option to enable automated resonance survey and tracked resonance dwell features.
Swept sine analysis	Separate analysis option to enable processing using tuning frequency channel (COLA) to deter mine sweep frequency. May process data that was stored to TPD by Signal Analysis. Supports tracking filters and all data storage and display features.
Throughput Disk (TPD)	Optionally supports 1-6 drives for storing all frequency domain data to disk during a test. Data may be replayed to recreate spectral test displays. See separate data sheet.

Output / Inputs

Output channel	16-bit DAC with 204,800 sample rate. Up to ±10V full scale controlled by 48-bit attenuator. A 1V peak COLA signal is also available.
Input channels	8 to 588 simultaneous channels with up to 6 synchronized acquisition & control peripherals (ACP).

Control Performance

Dynamic range	Up to 90 dB with .05 dB level step control over the full amplitude range. Amplitude adjustments are ramped between set-points.
Output	Analog quality digital sine generation using a double precision integrated phase algorithm for low distortion and accurate sweeping drive frequency.
Accuracy	Control a linear system to within $\pm$2 dB through a resonance with a Q of 50 at 150 Hz while sweeping at 1 oct/min. Control accuracy applies to both limit and control channels.
Sweep resolution	$\pm$ 0.5% of the drive frequency.
Loop time	The greater of either 5 ms or ½ the period of the fundamental frequency with no more than 0.5 ms increase for each additional control channel.
Compression	Up to 3500 dB/sec with unconditionally stable feedback control loop. Selectable from 1 to 100% of nominal gain.
Harmonic distortion	Less than -80 dB at full output.

Reference Spectra

Definition	Up to 100 frequency segments. Level specified in terms of acceleration or engineering units (EU) with user supplied label.
Segment types	Constant displacement, velocity & acceleration and linear or logarithmic ramped acceleration.
Crossover frequencies	Automatically calculated to avoid discontinuities.
Alarm and abort limits	Independent $\pm$alarm and $\pm$abort margins. Box tolerances for intentional discontinuities.
Sweep range	User defined between 0.1 Hz and 10,000 Hz.
Sweep resolution	User defined from 200 to 2000 points per sweep.
Dynamic limits	Range (dB) and maximum/minimum for acceleration, velocity and displacement.
Limit profiles	Defined with up to 40 frequency segments; may initialize with Reference spectrum or other profiles.

Control Parameters

Mode of operation	Manual or automatic with fixed parameters.
Control spectrum	Combine multiple channels as average, minimum, maximum or RMS.
Measurement process	Parallel tracking filters (Fundamental), BB RMS or BB Peak; selected individually for all channels.
Tracking filter types	Proportional to drive frequency or fixed bandwidth.
Transducer types	Control via acceleration or displacement transducer with programmable transition frequency band.
Control channels	Up to number of installed input channels in 1st ACP.
Limit channels	Limit profiles override defined control method on loop by loop basis to prevent over-test. May select any/all available channels in 1st ACP for limit.
Abort channels	Abort test when specified profile is exceeded.

Start-up Parameters

Initial test level	-30 to 0 dB (relative to maximum reference). System increases drive rms until the control amplitude equals the specified level.
Level increment	0.1 to 10 dB.
Output level control	Automatic or manual (step up, down, full level).

Sweep Parameters

Sweep mode & rates	Linear: 0.0001 to 300 Hz/s. Log: 0.1 to 100 oct/min. Integer mode for MIL-STD-167 with user dwell time.
Initial direction	Sweep up or down in frequency.
Manual control	Hold, resume or reverse. Manual sweep start.

Safety Features

Shaker limits	Pretest verification that dynamic limits are within shaker operational limits (acceleration, velocity, displacement and voltage).
Loop check drive	Selectable maximum from 10 to 1000 mV RMS.
Limit profiles	Independent profiles for each limit & abort channel.
Control signal loss	Continuous automatic detection.
Manual abort	Graphical and keyboard abort buttons.
Maximum drive signal	May specify maximum from 0.01 to 10 Vpeak.
Startup/shutdown rate	Independently selectable, 0.1 to 50 dB/sec.

Channel Setup

Channel type	Control, auxiliary, limit, abort or inactive.
Coupling	Select AC, DC or ICP with 24V supply.
Sensitivity	0.01 to 100,000 mV/g or mV/(m/s^2).
Channel loop check	Enabled or disabled for each channel.
Channel labels	Up to 45 characters via 2 labels for each channel.
Import	Import from spreadsheet or other applications.

On-Line Displays

Simultaneous displays	Up to 12 windows with up to 4 grids per window.
Traces per grid	Up to 4 (192 traces for 48 grids).
Auxiliary monitor	Optional second monitor for test displays.

On-Line Analysis

Spectral functions	Reference, control, limit, drive, error, auxiliary spectra; transfer function magnitude/phase.
Measurement type	Acceleration spectra can also be viewed as equivalent velocity and displacement spectra.
Data cursors	X and Y value readout, peak search, trace tagging, multi-window locked positioning.
Scaling of display	Log or linear; auto-scaled or fixed.

Data Storage & Review

Setup & format	Store every N sweeps, last sweep only or manual. Binary files are easily converted to Ascii formats (UFF, spreadsheet, Matlab) and transferred to PC.
Playback	Scan forward/backward through multiple sweeps.
Test overlays	Data from multiple tests may be overlayed.
Record annotation	Date/time stamp, sweep number, sweep direction.

Documentation

Test summary	Fully documented post-test summary, easily printed or incorporated into any document using standard word processing software.
Message log	Records system messages displayed during test.
Automatic plot	Automatic plotting & conversion at test completion.
Batch plots	Setup plotting for all waveforms and optional EPS & PDF plot file creation.

SPECTRAL DYNAMICS

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