

**Control Methods**

**Control loop** Patented adaptive control method with cross-coupling compensation, frequency response matrix updating and coherence smoothing to accurately and quickly compensate for non-linear and time varying changes in the dynamic load. Control channel response vector controlled to the reference spectral density matrix. The control methods support a wide range of acoustic reverberation times.

**Control Performance**

**Dynamic range** Greater than 80 dB.  
**Output signals** Up to 16 outputs of pure Gaussian noise with smoothing filters and choice of Kaiser-Bessel or Half-Sine windows. Drive signals have zero coherence and random phase and may be further split via an external cross-over network (not supplied) to drive multiple bandwidth acoustic exciters.  
**Equalization accuracy** Control to within  $\pm 1.0$  dB for a flat reference spectrum with 120 DOF and 90% statistical confidence (accuracy may be limited by exciter system and instrumentation).  
**Loop time** Less than 1.2 seconds typical for 4 controls, 4 new frames per loop, 10kHz BW, 1600 lines and 120 DOF (dependent on host model).

**Reference SDM**

**Definition** For each control channel, easily defined by a combination of up to 100 frequency breakpoints (frequency, PSD value) and slopes (dB/octave). The same reference can be copied into each diagonal element of the Spectral Density Matrix (SDM). The phase & coherence between references may be set to zero (random phase between control channels) or arbitrary values may be specified.

**Units** Use EU label for common units of Pascal<sup>2</sup>/Hz or psi<sup>2</sup>/Hz for acoustic spectra or enter directly in dB SPL (displays OASPL). You may also use g<sup>2</sup>/Hz or (m/s<sup>2</sup>)<sup>2</sup>/Hz for acceleration. Uses V<sup>2</sup>/Hz for drives.

**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** 1/n octave spacing (select n from 1 to 24). Control loop uses FFT spacing of 100, 200, 400, 800, 1600 or 3200 lines depending on the specified lowest 1/n octave frequency.

**Rescale reference** User may enter a new overall RMS level; reference table values are rescaled to achieve the new level.

**Control Parameters**

**Multiple channel control** The maximum number of control channels is equal to the number of installed drive channels (max 16). Supports drive limiting based on limit profiles entered via features described under Reference Spectrum. Overrides control, if needed.

**Limit profiles** User defined up to 999:59:59 (h:m:s).  
**Test duration** User defined from 8 to 10,000.  
**Degrees of freedom** Automatic or manual (step up/down/full level).  
**Output level control** Automatic or manual (step up/down/full level).

**Control Strategy**

**Pre-stored [Z(f)]** Select equalized impedance from previous tests.  
**Adaptive gain** Z(f) update rate; selectable from 0.0 to 1.0.  
**Singularity threshold** Specifies when pseudo-inversion is used for Z(f).  
**Equalization method** Adaptive inverse frequency response matrix. May specify frequency range for PSD level control.  
**Characterization** Random signals with flat power spectral density.

**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.

**Safety Features**

**Loop check drive** Selectable maximum; 10 to 3300 mV RMS.  
**Alarm/Abort RMS** RMS limit in EU or dB with choice of DOF.  
**Alarm/Abort FFT lines** Number or percent of FFT lines or number of 1/n octave bands within specified range.  
**Control signal loss** Automatic detection.  
**Manual abort** Graphical and keyboard abort buttons.  
**Startup/shutdown rates** Independent selections; 0.1 to 50 dB/sec.  
**Acoustic limits** Separate limits for your acoustic exciters.

**Test Automation**

**Mode of operation** User (manual) interaction during a test or automatic "hands-free" operation.  
**Microphone calibration** Uses analyzer mode to calculate channel sensitivities for selected microphones.  
**Level scheduling** User defined levels, time at level, transition time to reach the level and number of cycles.

**Channel Setup**

**Channel type** Control, auxiliary (measurement) or limit.  
**Transducers** Microphone or accelerometer (for auxiliary).  
**Coupling** Select AC, DC or ICP with 24V supply.  
**Sensitivity** 0.000001 to 1,000,000 mV/(Units).  
**Loop check** Select as enabled or disabled (each channel).  
**Import sensor table** Import from ASCII spreadsheet file or other app.  
**Weighting** A, C or no acoustic weighting.

**On-Line Displays**

**Simultaneous displays** Up to 12 windows, each with up to 4 grids.  
**Waveforms per grid** Up to 4 (up to 192 on 48 grids).  
**Auxiliary monitor** Optional second monitor for test displays.

**On-Line Analysis**

**SDM functions** Reference, control and drive with magnitude, phase and coherence. Z(f) with mag. and phase.  
**PSD functions** Error, monitor, limit and auxiliary measurements.  
**MIMO H(f)** True MIMO [H(f)] magnitude and phase.  
**Spectra averaging** Auxiliary measurements processed with linear or exponential averaging separate from control loop.  
**Cursors** X and Y value readout, peak search, trace tagging and multi-window locked positioning.  
**Scaling** X: linear, log or log-1/n for 1/n octave display. Y: linear, log or dB (ref) for acoustic displays. Control, reference, monitor, auxiliary, error and limit PSD may be displayed with FFT or 1/n octave spacing. Drive, Z(f), H(f) & coherence only FFT spacing.

**Analyzer Mode Acquisition**

**Functions acquired** Spectra (PSD) acquired in non-control mode. Also used for microphone calibration.  
**Averaging** Select linear or exponential average and the desired DOF with 1/n octave or FFT spacing.

**Host Data Storage & Review**

**Setup & format** Automatic timed (any level) or timed at full level or manual mode. Binary files of narrow-band data converted to UFF or Matlab formats.  
**Playback** Scan forward or backward through test data file.  
**Test overlay** Select files from multiple tests for overlay.  
**Annotation** Test name, test time & level for each record.

**Documentation**

**Test summary** Documented post-test summary; easily printed or incorporated into documents using standard word processing software.  
**Message log** Text file records all system status messages that were displayed during the test.  
**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 (TPD)**

**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 replayed via Signal Analysis. See separate TPD data sheet.



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

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