

Random Vibration Testing



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VR Core Focus

To make the world's most innovative sound and vibration technology tools, enabling our customers to make reliable decisions and trustworthy products

Company Values

Strong & Driven Work Ethic

We do the Right Thing

Capable & Competent

Accountable & Responsible

Collaboration

Innovation

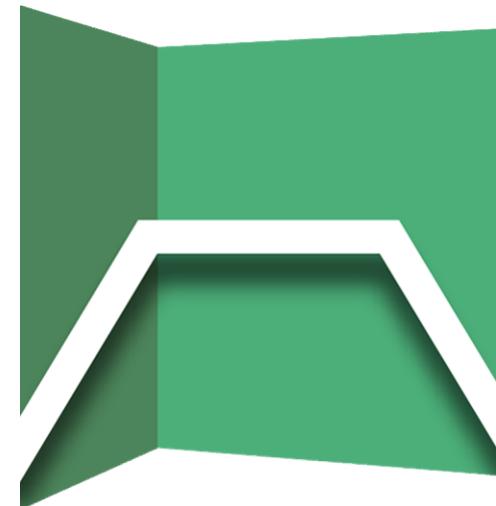
Random Vibration Theory

- Random Theory Webinar
 - http://www.vibrationresearch.com/training_video/Webinar/201711-Fundamentals-of-VibrationVIEW-2.html
- Random Theory – VRU
 - <http://www.vibrationresearch.com/university/course/random-testing/>

Random Testing in VibrationVIEW

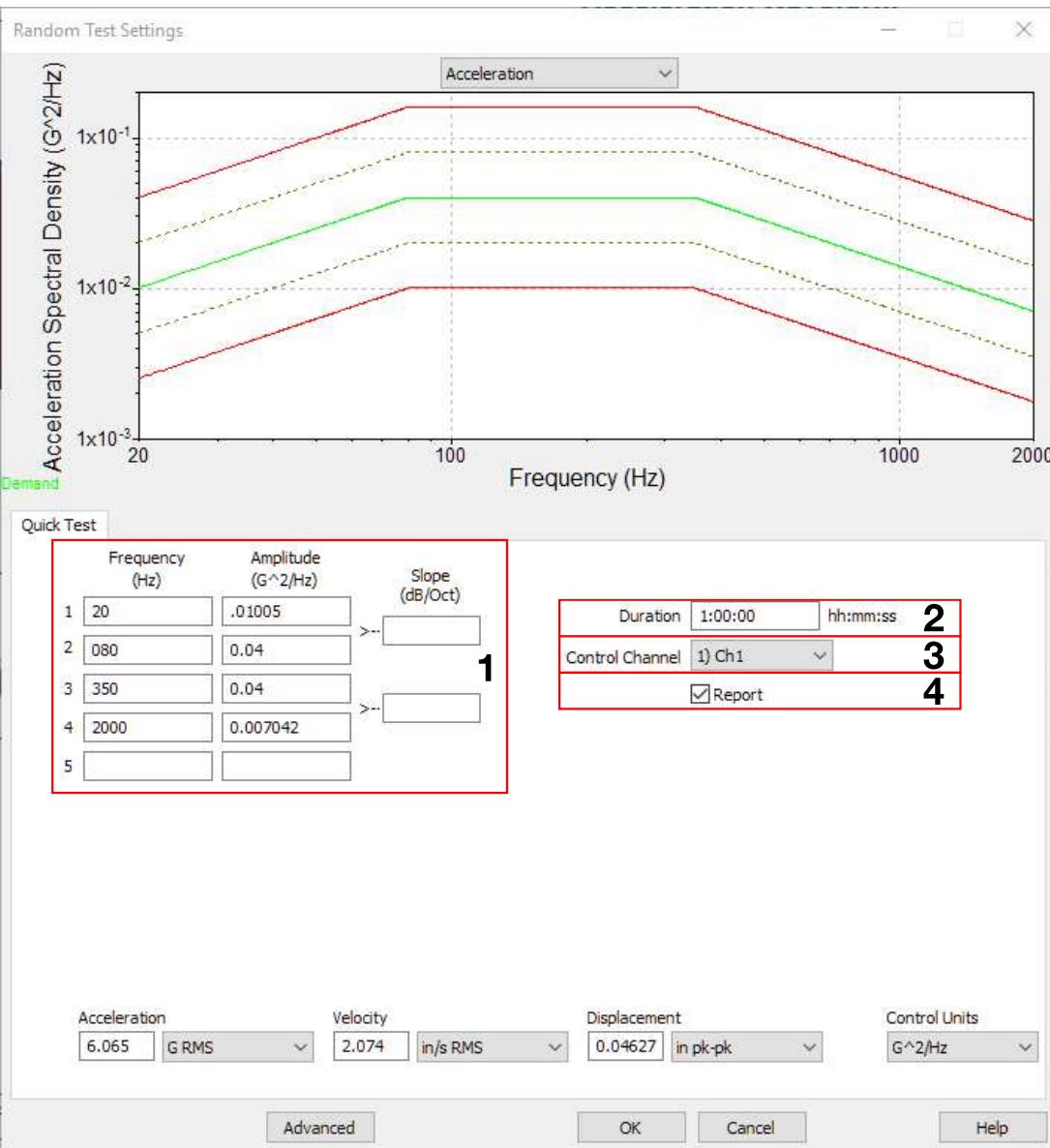
- Navigator – Random Test Libraries

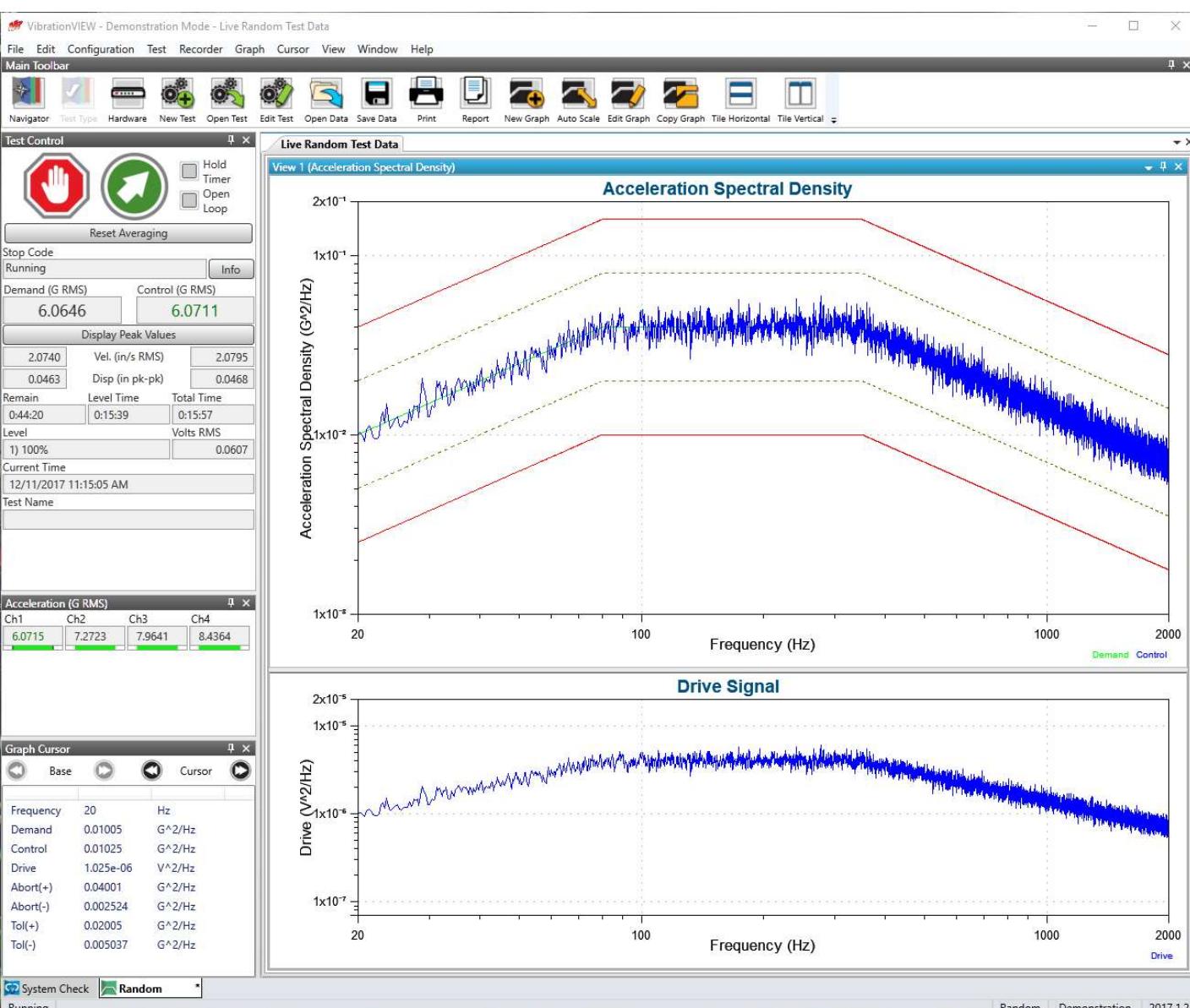
- ASTM
- ISTA
- Kurtosion
- Random (More)
 - Body and IP Profile
 - Dynamic Range Test
 - Engine Compartment Profile
 - iDOF
 - Lownav
 - NAVMAT



Random Quick Test

- New Test → Random
 - Breakpoint Table
 - Test Duration
 - Control Channel
 - Generate Test Report





Default Layout

- Test Control Toolbar
- Channel Readings
- Cursors (CTRL + D)
- ASD Graph
- Drive vs. Freq Graph

Random Advanced Test 1

- NAVMAT P-9492 is very common when screening systems

Frequency	Amplitude	Slope
20		3 dB/Oct
80	.04 G ² /Hz	
350	.04 G ² /Hz	
2000		-3 dB/Oct

**** 6.06 GRMS Test ****

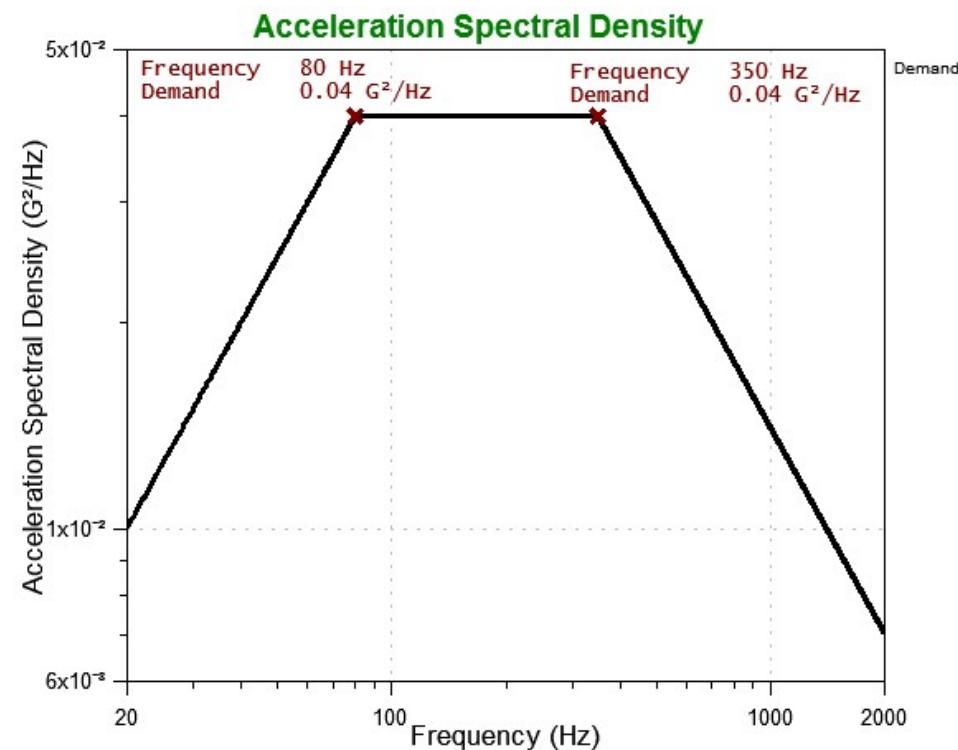


Table Tab

- Enter the Breakpoint Table for a NAVMAT Profile
 - To Calculate an Unknown Value:
 - Enter the First Known Value
 - Click on entry box for the second
 - Value to be calculated should turn **Yellow**
 - Enter the second known value
 - Click Enter

**** Automatically fill unknown amplitude values when the slope is known ****
**** Copy and Paste Breakpoints from Text directly into VibrationVIEW ****
**** Up to 10,000 Breakpoints in VibrationVIEW 2017 ****

Schedule Tab

- Enter Forms
 - Pre-Test
 - Post-Test
- Run Test at Low Level
- Wait for Operator
- Loop from Level
- Run Test at Full Level
- Generate Reports

	Table	Schedule	Parameters	Limits	Pre-Test	Channels	Data	Tables	Calc	Notch	Digital Outputs
1	Enter Form	Time hh:mm:ss	Modifier	Memorized Drive	0 1 2 3 4 5	Browse	<input type="checkbox"/>				
2	Run for	0:10:00	100 %								
3	Enter Form	Post-Test.html		Browse	<input type="checkbox"/>						
> 4	View Report	Test Report.rtf		Browse	<input type="checkbox"/>						

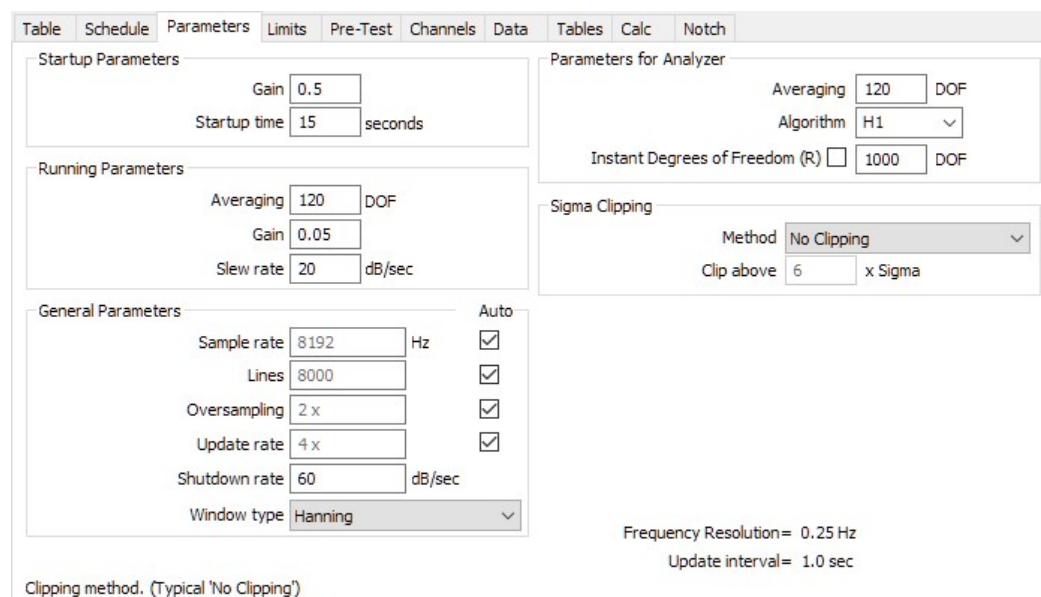
Insert Delete Use current drive for first level
 Start counting level timer immediately when using Memorized Drive
Select modifier file. Total Time at Level 0:10:00

Parameters Tab

- Define Control Loop Parameters

- Startup Parameters

- Used while the test is starting
 - Run button is Yellow or Blue
- Gain
 - Defines the scaling factor by which the error is multiplied for each control loop. Higher gain = faster reaction
- Startup Time
 - Time from Threshold Voltage (Limits Tab) to the Max output voltage
 - A long startup time (10-20 seconds) is recommended as it allows time for the operator to abort if necessary



Parameters Tab

- Running Parameters

- Averaging

- Define the Degrees of Freedom factor used to average data together
 - High DOF = Smooth Random PSD = Slow response to changes in input signal
 - Low DOF = Ragged Random PSD = Fast Response to changes in input signal

- Gain

- Determines scaling factor by which the error is multiplied for each control loop

- Slew Rate

- Maximum rate of change for the OUTPUT
 - 20 dB/second will allow the output to increase 10x in 1 second
 - Primarily effects the schedule level output where the drive is already equalized from a previous level or memorized drive

Parameters Tab

- General Parameters
 - Sample Rate
 - Set to **AUTO**
 - User is allowed to manually adjust, 2 to 2.6 times greater than highest frequency
 - Lines of Resolution
 - Set to **AUTO**
 - Frequency Resolution of the control loop
 - High lines = better control of low frequencies and sharp resonances = slower startup and response to changing dynamics
 - Oversampling
 - Set to **AUTO**
 - Allows analysis of frequency response beyond the defined test frequency
 - 8x Oversampling will adjust sample rate and lines allowing analysis to at least 8 times the max test frequency while still testing with the defined number of lines.
 - Update Rate
 - Set to **AUTO**
 - Select the amount of overlap between neighboring blocks processing the frequency data

Parameters Tab

- General Parameters (cont'd)
 - Shutdown Rate
 - Rate of decay for the output when the test is stopped.
 - Soft-stop
 - This protects the shaker and the product!
 - Window type
 - Configure the window type used in the FFT
 - FFT based measurements are subject to leakage error
 - Windowing is used to reduce the emphasis of the “ends” of a block of data and reduces leakage effects
 - Hanning is the most common, but other methods may be required in some specs
 - Blackman, Hamming, Trapezoidal, etc

**** Use the HELP button in the test profile ****

Limits Tab

- Spectrum Limits
 - $\pm 6\text{dB}$ Aborts $\pm 3\text{dB}$ Tolerance
 - Outlier limits (% or # of lines)
- RMS Limits
- Drive Limits
 - Startup
 - Running
- Monitored Startup

The screenshot shows the 'Limits' tab of a software interface. The tab bar includes Table, Schedule, Parameters, Limits, Pre-Test, Channels, Data, Tables, Calc, and Notch. The 'Limits' tab is active.

Spectrum Limits:

- Use limits from Table
- Plus Abort (+) dB
- Plus Tol (+) dB
- Minus Tol (-) dB
- Minus Abort (-) dB
- Max Outliers %

RMS Limits:

- Plus Abort RMS dB
- Plus Tol RMS dB
- Minus Tol RMS dB
- Minus Abort RMS dB
- Sensitivity

Startup Drive Limits:

- Limit drive output, but don't abort test
- Max System Gain Volts/G
- Output Threshold Volts rms
- First drive check %
- Second drive check %

Use System Threshold Setting

Running Drive Limits:

- Max System Gain Volts/G
- Max Output Volts rms

Monitored Startup:

- Start with Projected Levels
- Always start using manual control
- Initial level dB
- Step size dB

Allow tolerances and aborts to be set for each frequency segment (Typical NOT checked)

Channels Tab

- Multi-Channel/Extremal Control
 - Average
 - Weighted Average
 - Maximum
 - Minimum
- Individual Aborts for channels
- Load a Pre-defined input config

The screenshot shows the 'Channels' tab of a software interface. At the top, there is a navigation bar with tabs: Table, Schedule, Parameters, Limits, Pre-Test, Channels (which is highlighted in orange), Data, Tables, Calc, and Notch.

The main area contains a table for control channels:

Control Channel	Transducer	Weighting	System Limits Apply	Individual Channel RMS Limits	
			Enable	+ Abort	- Abort
1 <input checked="" type="checkbox"/> Ch1	10 mV/G	<input checked="" type="checkbox"/>	<input type="checkbox"/>	9	9
2 <input type="checkbox"/> Ch2	10 mV/G	<input type="checkbox"/>	<input type="checkbox"/>	9	9
3 <input type="checkbox"/> Ch3	10 mV/G	<input type="checkbox"/>	<input type="checkbox"/>	9	9
4 <input type="checkbox"/> Ch4	10 mV/G	<input type="checkbox"/>	<input type="checkbox"/>	9	9

Below the table, there are dropdown menus and checkboxes for combining control channels and loading input configurations. On the right, system limits are displayed:

Combine control channels using:
average of selected channels

Load this Input Configuration with the test

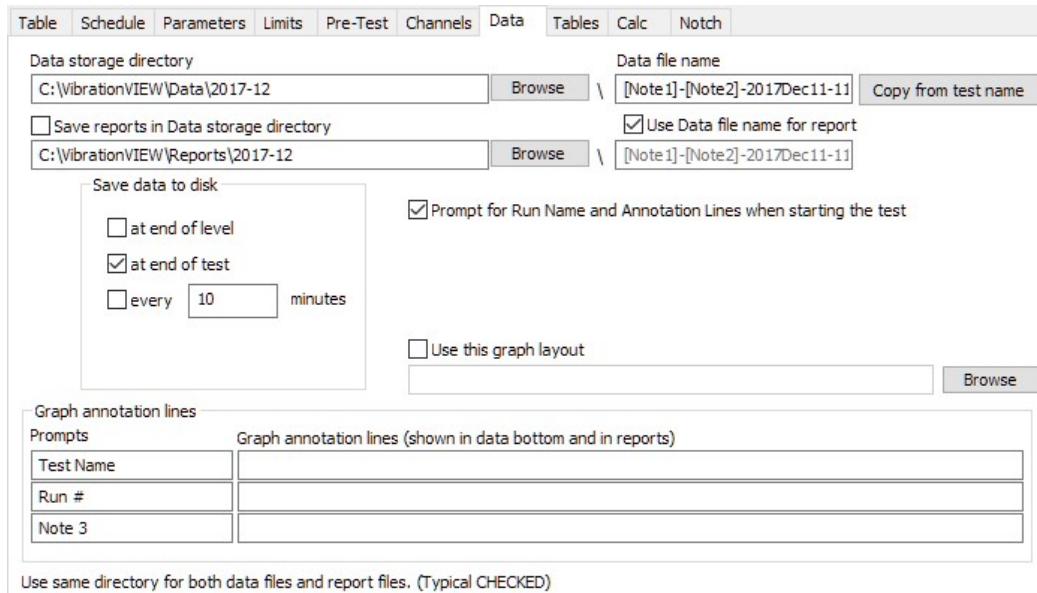
System Limits:
Accel=60.7843 G
Vel=59 in/s
Disp=0.5 in

Browse

Channels used to close the control loop.

Data Tab

- Data Storage Directory
 - Data File Name
- Report Storage Directory
 - Report File Name
- Prompt for Run Name and Annotation Lines
- Data File Save Schedule
- Set Default Graph Layout



Notch Tab

- Lower Limits
 - Boost or Abort
- Upper Limits
 - Boost or Abort
- Ch2 shall not exceed xdB
- Notch Table Demonstration

Table	Schedule	Parameters	Limits	Pre-Test	Channels	Data	Tables	Calc	Notch
Channel	Minimum (lower) limits				Mode	Level relative to control		Maximum (upper) limits	
1	None							None	
2	None							Notch (Table)	
3	None							None	
4	None							None	

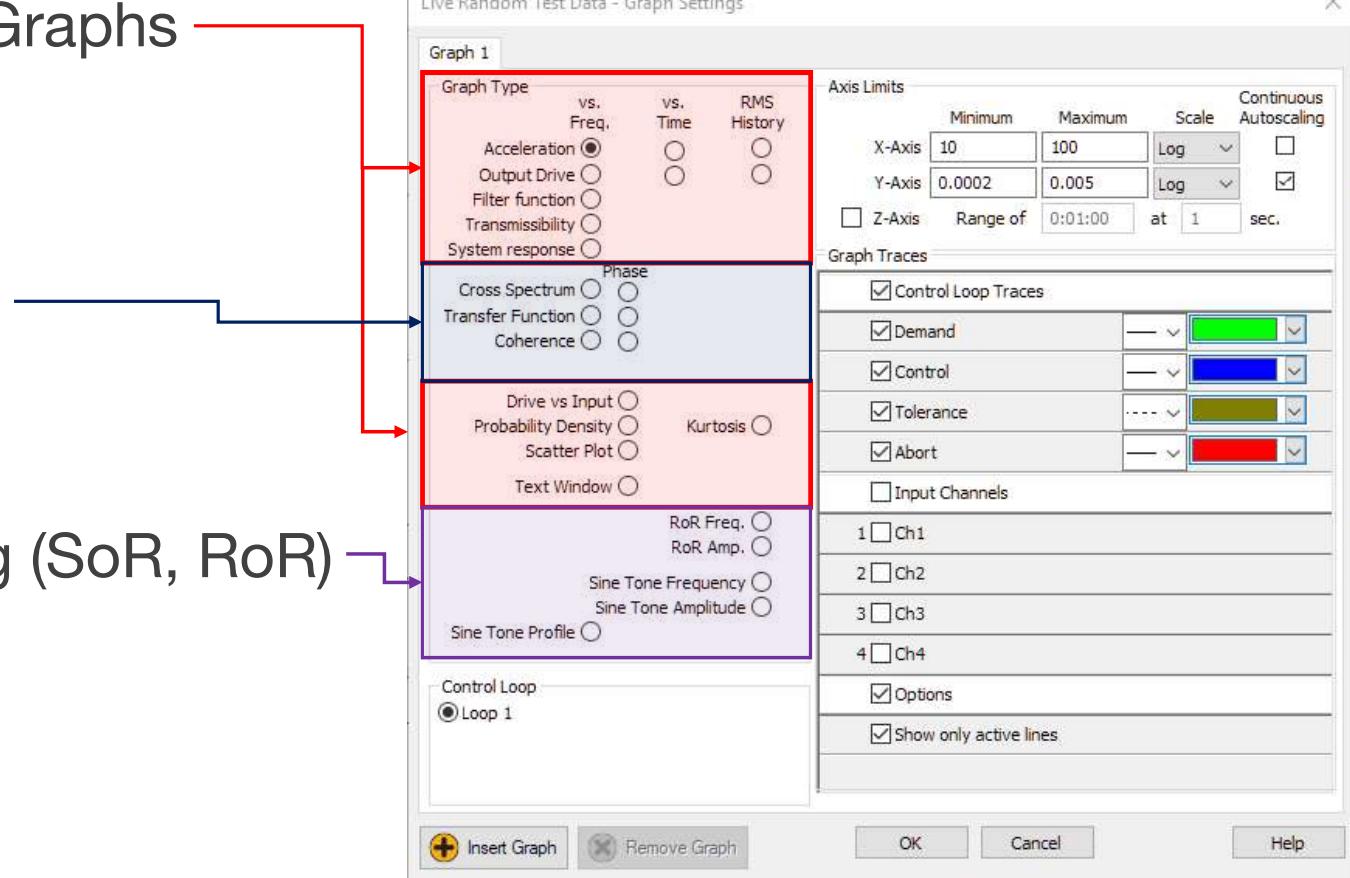
Hide the breakpoint table entry.

Random Graphs

- Standard Random Graphs

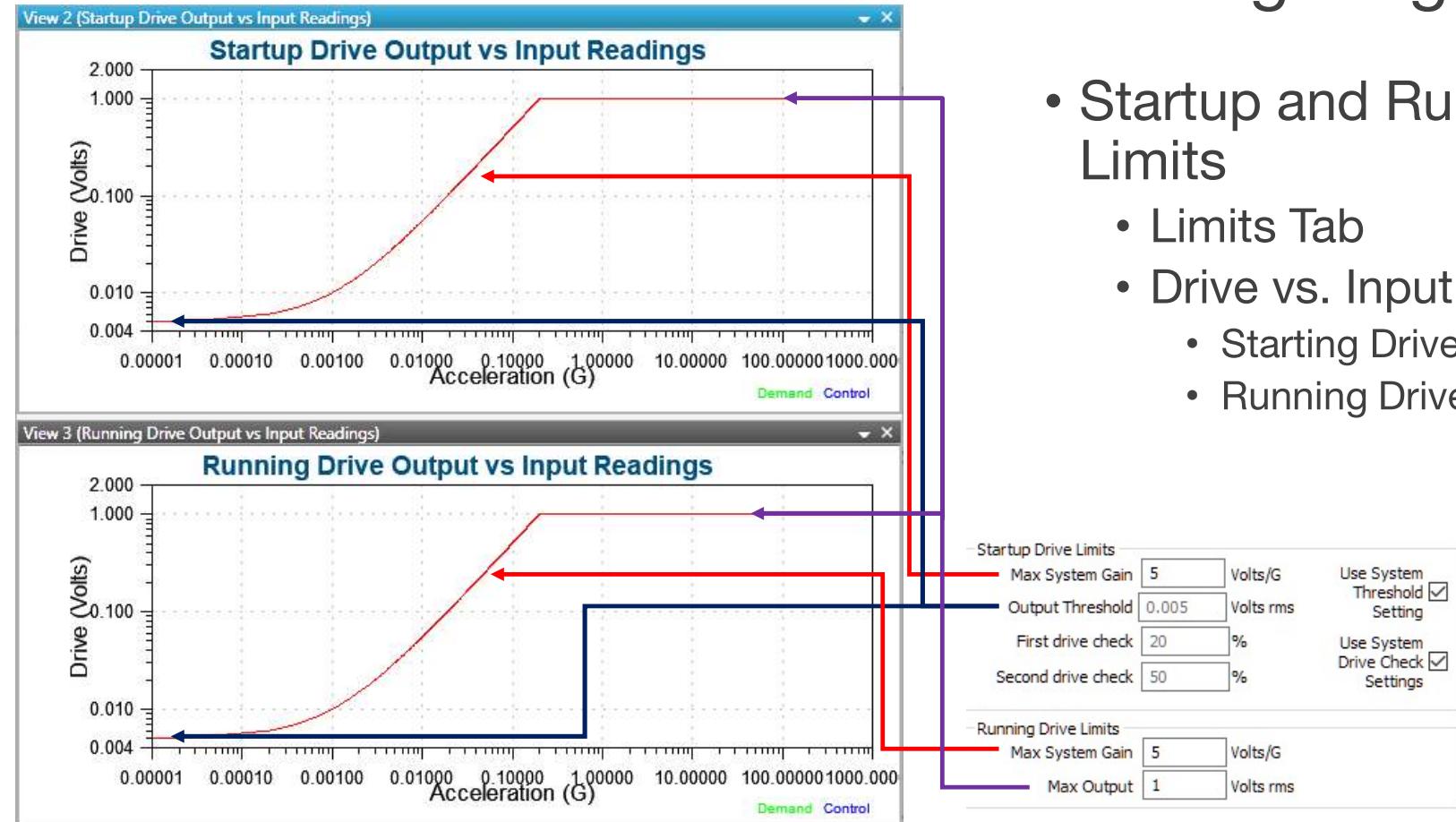
- Analyzer Functions

- Mixed Mode Testing (SoR, RoR)



Configuring Profile Limits

- Startup and Running Drive Limits
 - Limits Tab
 - Drive vs. Input Graph
 - Starting Drive Limits
 - Running Drive Limits



Tips and Tricks Review

- Function Keys in VibrationVIEW
 - F1 – Display help for current window
 - F2 – Show Control Buttons
 - F3 – Show the Channel Buttons
 - F4 – Move the selected annotation
 - F5 – Refresh Graphs
 - F7 – Remove an Annotation/Trace
 - F8 – Start the Test Sequencer
 - F9 – Run a test
 - F10 – Stop a test
 - F11 – Advance immediately to next level
 - F12 – Print the screen image to the printer

Tips and Tricks Review

CTRL + Key Mapping

- **A** – Auto Scale the Y Axis
- **B** – Show the sine big display
- **C** – Copy the selected graph/trace
- **D** – Enable Cursor Window
- **E** – Change email configuration
- **F** – Zoom out to fit data
- **G** – Change selected graph settings
- **J** – Resonance Annotation/Table
- **I** – Change the input configuration
- **M** – Save output to memorized drive
- **N** – Create a new graph

- **O** – Open stored data file
- **P** – Freeze/Unfreeze graph updates
- **Q** – Auto scale all open graphs
- **R** – Generate a Report
- **S** – Save a data file
- **T** – Insert Time/Date Stamp
- **V** – Paste text from clipboard
- **W** – Identify the controller
- **X** – Copy/Cut Text to Clipboard
- **Y** – Show the COLA Configuration

Tips and Tricks Review

- Other “Hot Keys”
 - Shift + Ins – Add annotation at nearest peak
 - Ctrl + Ins – Add annotation at nearest valley
 - Insert – Add annotation at cursor location
 - Del – Remove selected annotation/trace
 - → ← view next/previous data file in directory
 - Alt + PrtSc – copy the screen image to clipboard

My
Questions

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Register for our next webinar!
Classical Shock Theory and Testing
January 18, 2018

<http://www.vibrationresearch.com/Webinar/index.html>

**THANK
YOU**