Sine Testing

October 2017 Webinar

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VIBRATION RESEARCH

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

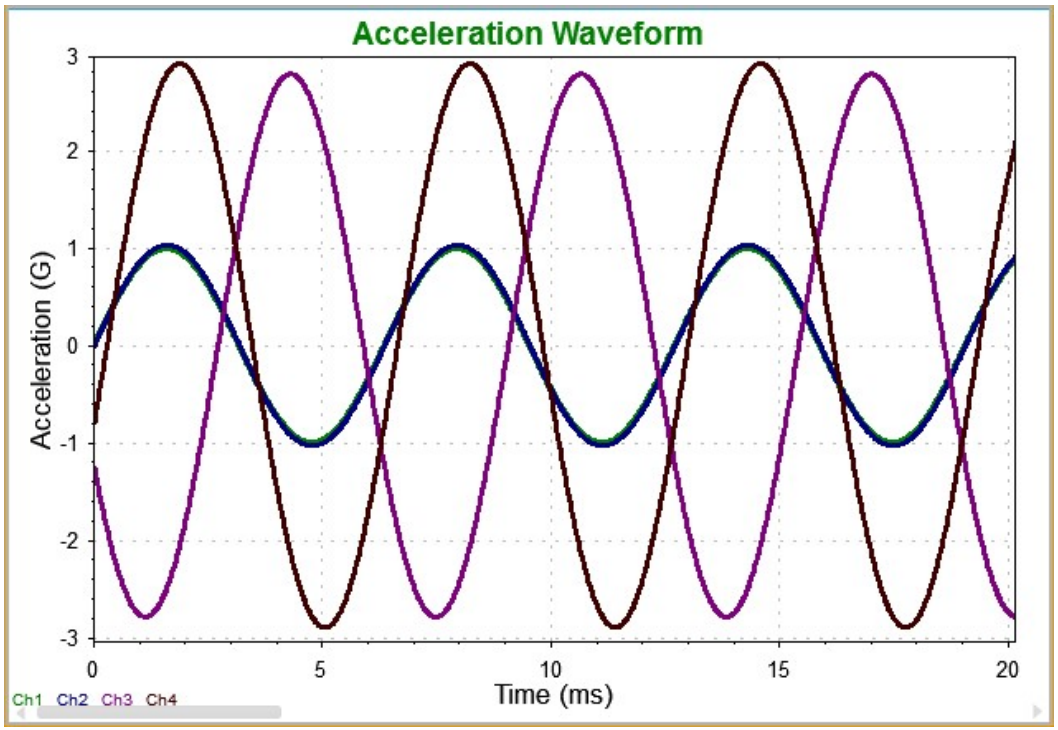
Capable & Competent

Accountable & Responsible

Collaboration

Innovation

Sine Testing Introduction



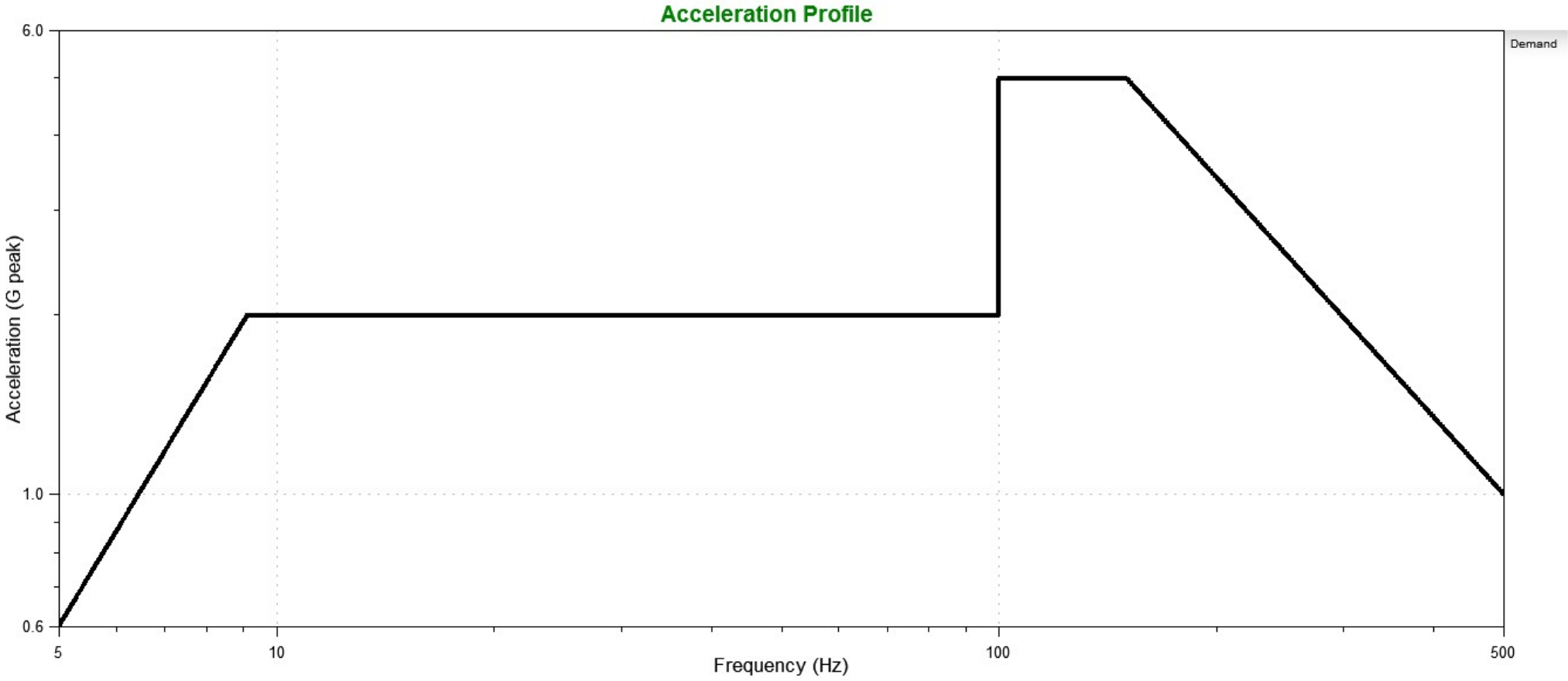
- NOT REAL WORLD TESTING!
  - Why do we run Sine Tests?
    - Engineering Evaluation (Excite specific structural resonances)
    - Product Resonance Search
    - Fatigue Testing
    - Product Performance Evaluations
    - Production (Pass/Fail)
    - Accelerometer Calibration
    - Shaker Validation
    - Fixture/Head Expander Mapping
    - Most efficient use of shaker power

Advanced Sine Test 1Profile

- Sweep from 5 Hz to 1000Hz and back to 5 Hz at 2 Octaves per minute. Traverse the cycle 5 times

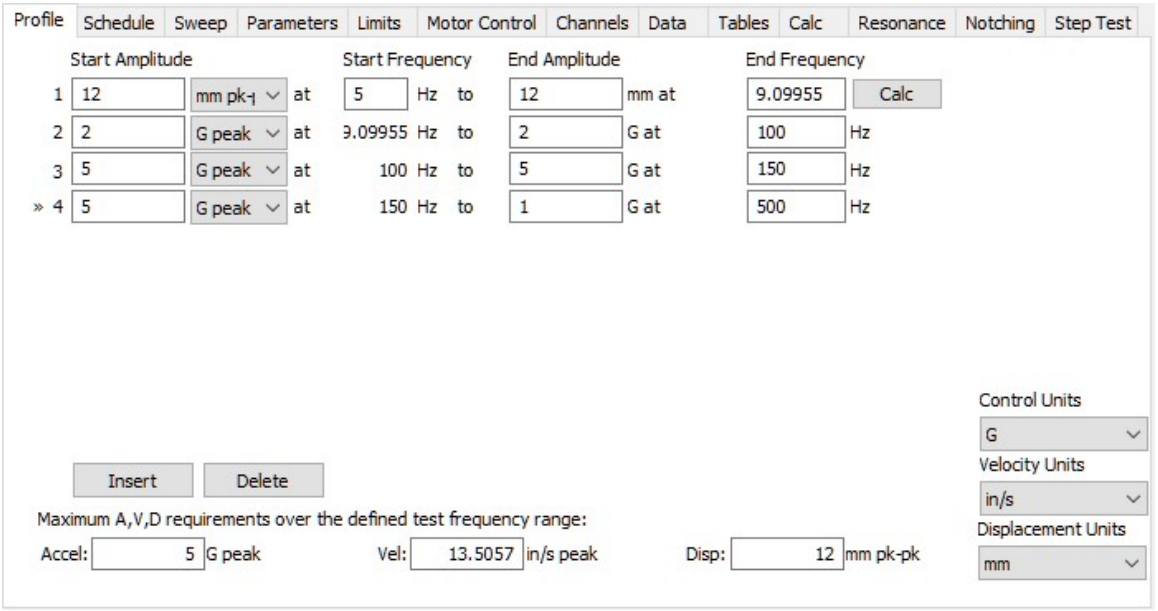
- The logarithmic frequency sweep is as follows: from 5Hz a peak displacement of 6mm (12mm total excursion) is maintained until 2G is reached (approximately 9 Hz). The amplitude is then maintained at 2G and the frequency increased until 100 Hz. At 100 Hz the peak acceleration is increased to 5G then frequency is increased until 150 Hz. At 150 Hz ramp down the acceleration until 1G is reached at 1000 Hz.

Advanced Sine Test 1Profile



Sine – Profile Tab

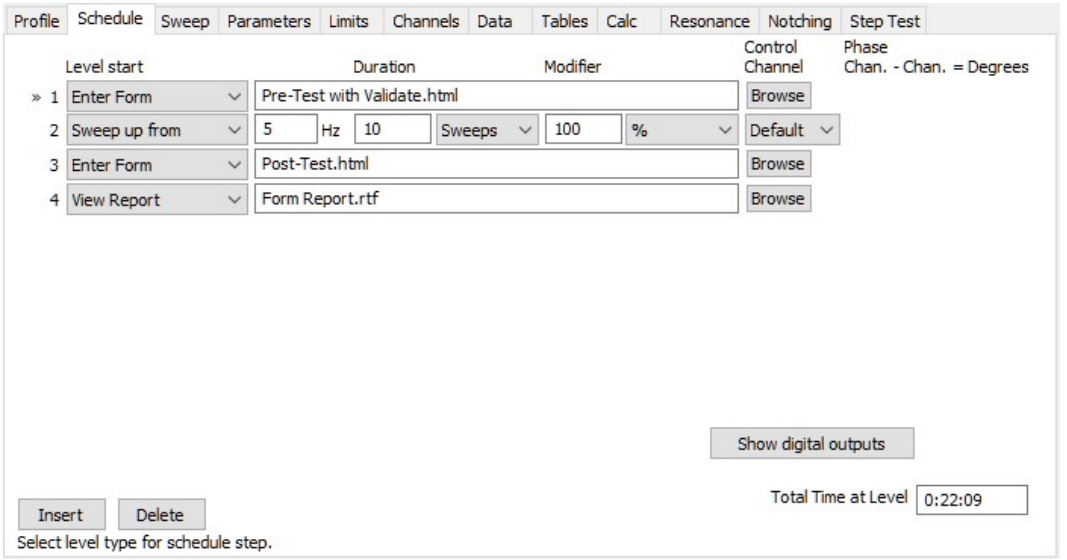
- 5 Hz to approx. 9 Hz
  - 12mm$_{pk-pk}$until 2G
- 12.8 to 100 Hz
  - Sweep up at 2G
- At 100 Hz increase to 5G
- From 150 to 500 Hz
  - Slope down to 1G



***** Change the Profile Displacement Units to Match the Test Specification *****
***** Use the "CALC" button to Auto-Intersect Points *****

Sine – Schedule Tab

- Pre-Test Form with Validate
- Sweep Up from 5 Hz
  - 10 times! Why not 5?
- Post-Test Form
- View Report – Form Report



Sine – Schedule Tab

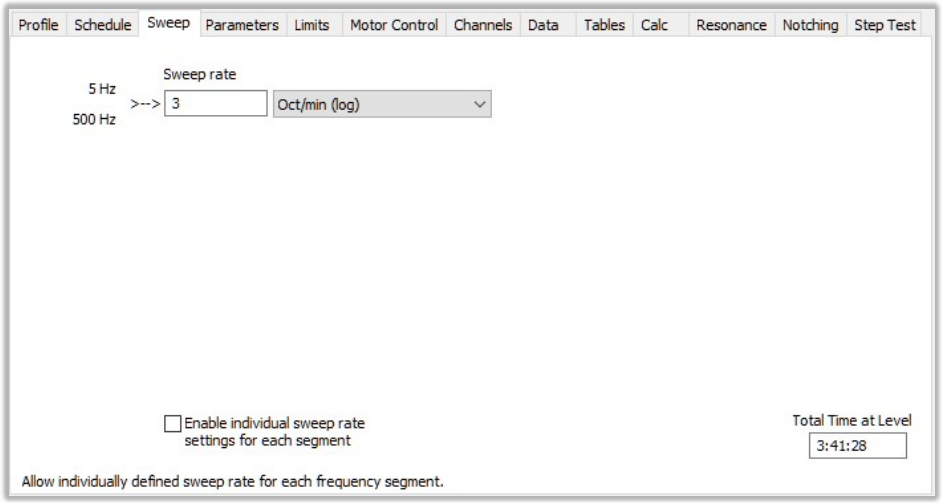
Sine Schedule Options

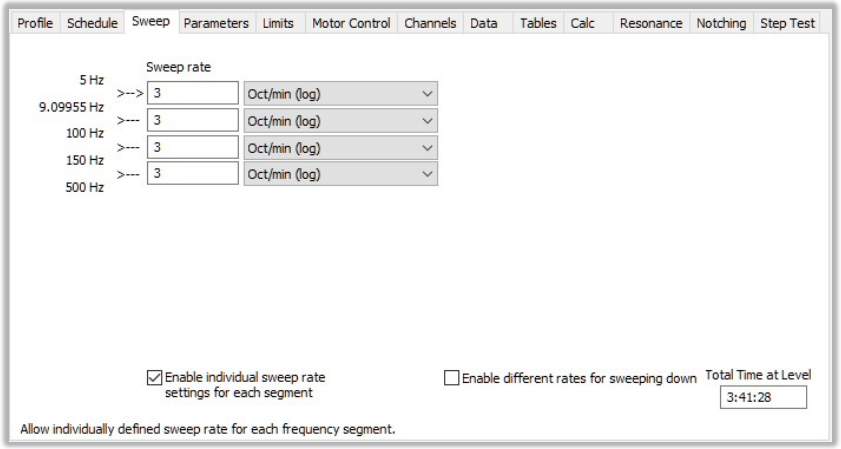
- Sweep Down From
- Sweep Up From
- Resume Sweep
- Hold At
- Hold Previous Freq
- Phase Track From
- Resume Phase Track
- Wait for Operator
- Timed Pause
- Loop from level

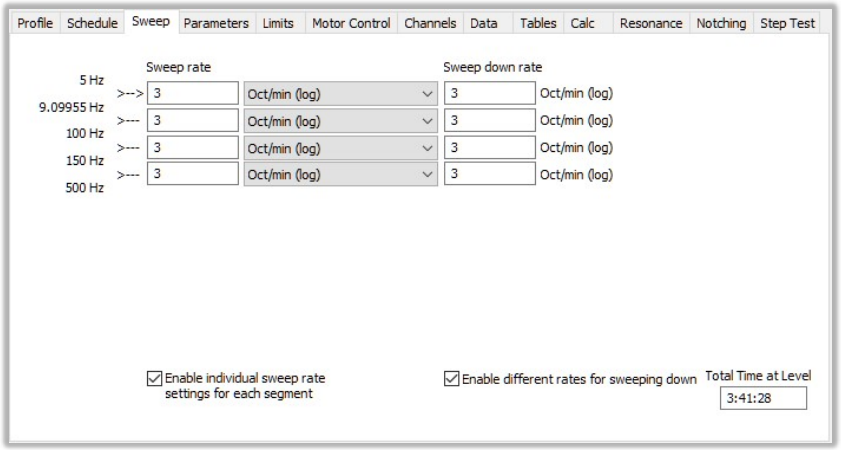
- View Report as…
- View Report
- Save Report as..
- Save Report
- Print Report
- Enter Form
- Start Recorder
- Stop Recorder
- Execute
- Calibrate Channel(s)

Sine – Sweep Tab

- Sweep Rate
- Individual Sweep Rate
- Different Sweep Rates Up and Down

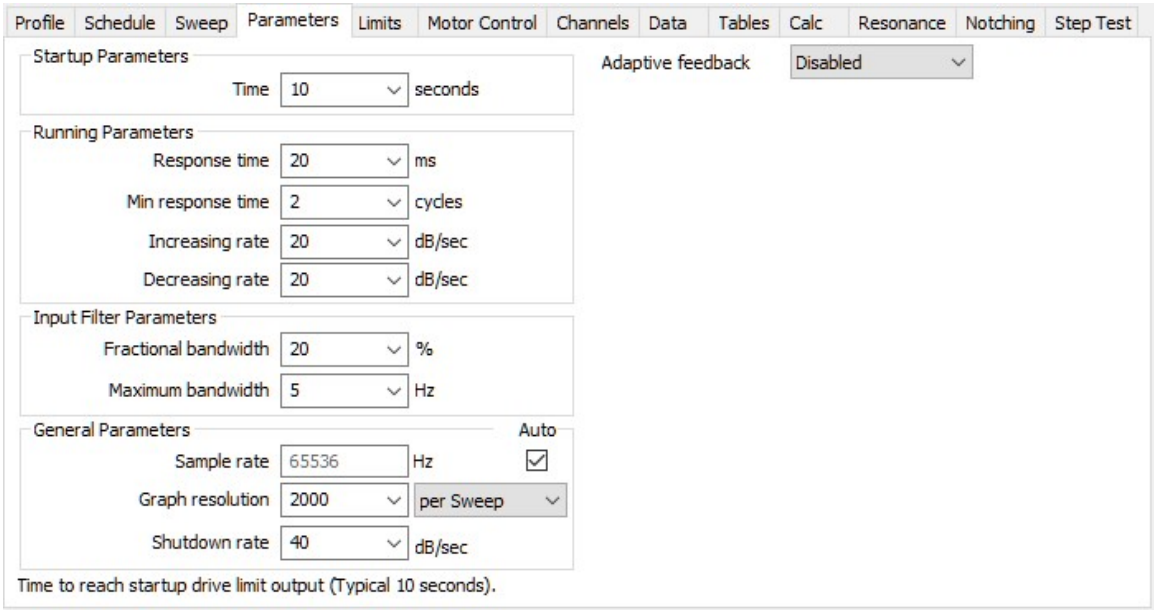






Sine – Parameters Tab

- Configure control param's
  - Startup
  - Running
  - Input Filter
    - Tracking Filters
  - General
    - Sample Rate
    - Graph Resolution
    - Shutdown Rate



Tuning a Sine Controller

- Startup Time:
  - Approximate time to go from 0 output to **maximum defined drive output**
    - A long start-up time is good practice (10-20 Seconds) G
      - Gives the operator more time to abort if it appears the shaker is moving but input signals are not being registered
- Response Time
  - Primary loop tuning parameter
    - Determines high frequency loop response.
      - Shorter Response times provides faster control response
      - Longer response times provide more stable control
- Min Response Time
  - Primary loop tuning parameter
    - Low frequency loop response
      - If the number of cycles specified in min response time at a given frequency is greater than the specified response time, then this parameter determines loop response

Tuning a Sine Controller

- Increasing/Decreasing Rate (Slew Rate)
  - Sets the maximum rate at which the output will change
    - A rate of 20 dB/sec will allow the signal to change 10x in 1 second
- Shutdown Rate
  - Defines the rate the output voltage will decrease when the test is stopped or aborted (Soft Stop)
- Sample Rate
  - Generally automatically generated
    - Controller will determine the optimum sample rate for a particular test
  - **MUST** be greater than **2.5 times** the maximum frequency of the test specification

Tuning a Sine Controller

- Fractional Bandwidth
  - Low frequency tracking filter width
    - Defined as a percentage of the test frequency
- Maximum Bandwidth
  - High Frequency tracking filter width

Tracking Filter Example

Smallest Value determines Tracking Filter BW

Demand Frequency = 20 Hz
Fractional BW = 20% *(20 Hz * 20% = 4 Hz)*
Maximum BW = 5 Hz

Tracking Filter BW = 4 Hz

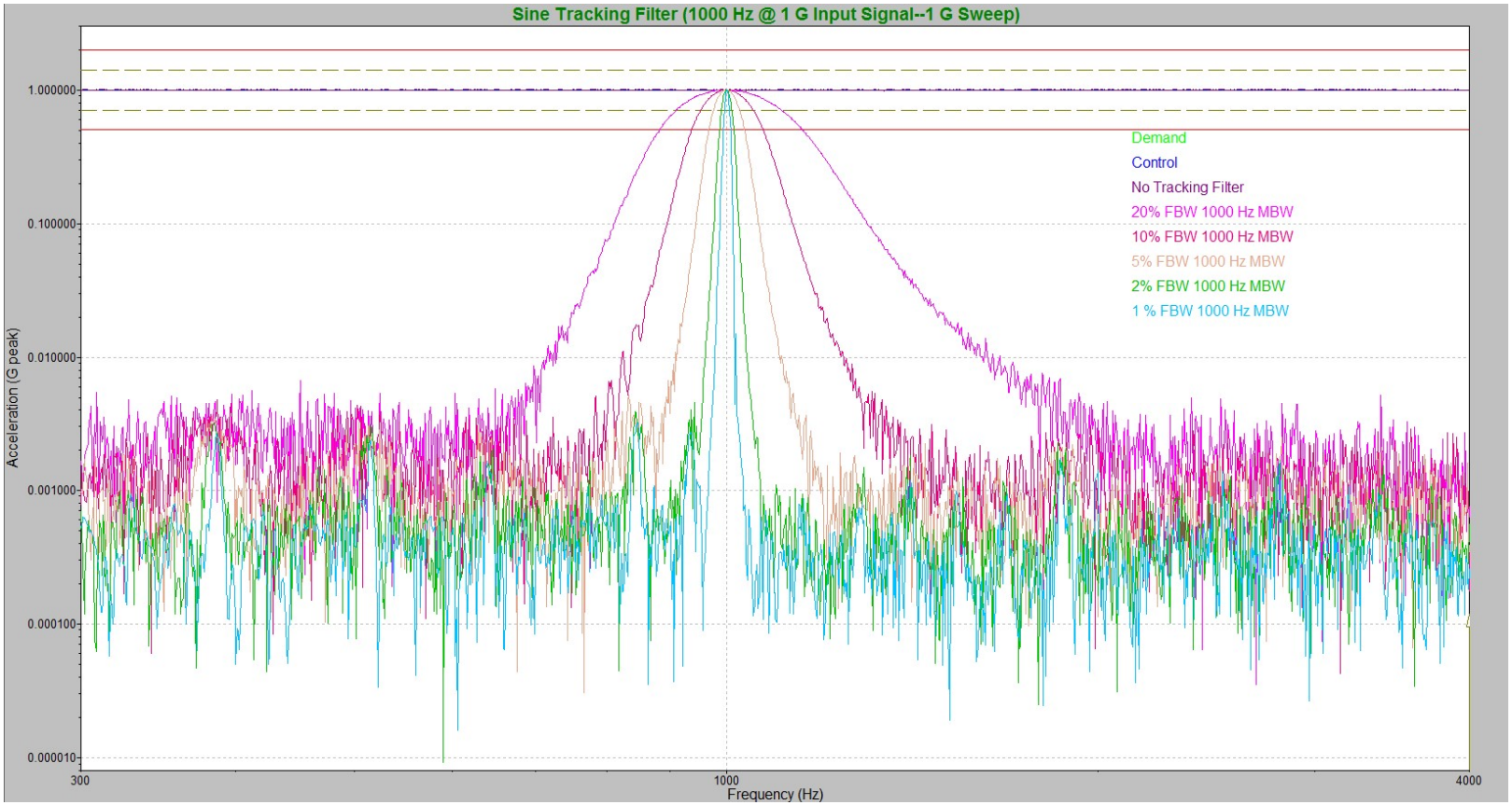
Demand Frequency = 200 Hz
Fractional BW = 20% *(200 Hz * 20% = 40 Hz)*
Maximum BW = 5 Hz

Tracking Filter BW = 5 Hz

Tuning a Sine Controller

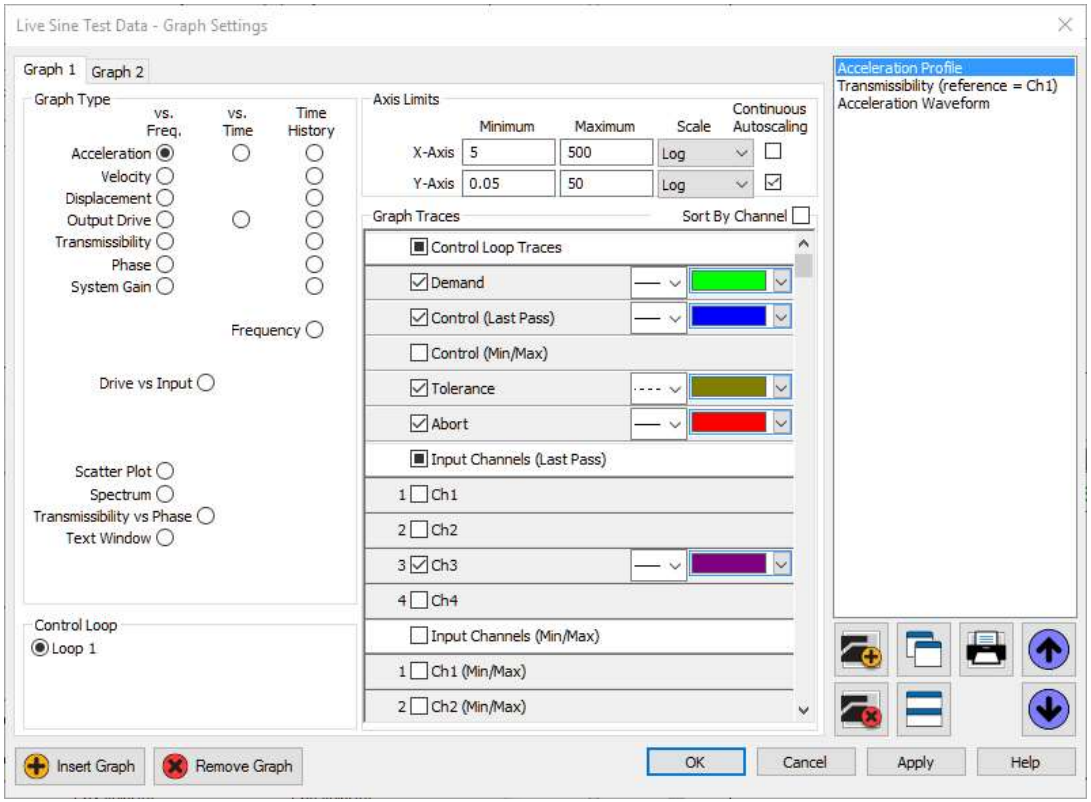
- Why do we use tracking filters?
  - To ensure that the product is being tested with the specified amplitude at the specified frequency
    - Noise and Harmonics alter the pure sinusoidal tone's amplitude
  - A tracking filter isolates the "pure" sine tone. This allows the controller to obtain an accurate reading of the amplitude and frequency. As the frequency varies, the tracking filter adjusts, removing noise at frequencies of non-interest, keeping the BW Narrow, thereby isolating the tone at each frequency.
  - A fast or quick measurement requires wider filters!

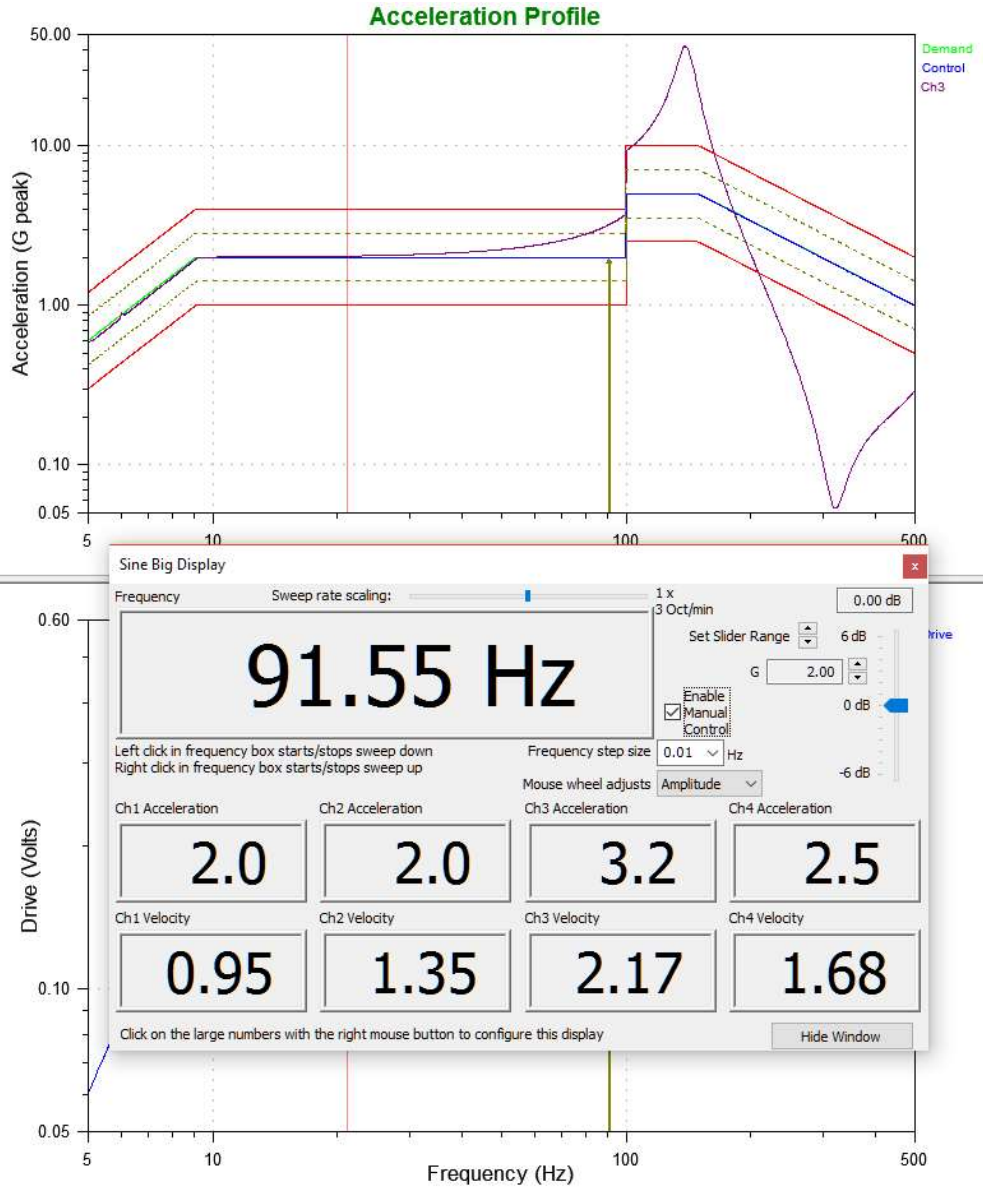
Tuning a Sine Controller



Sine Graphs

- Default Graphs
  - Acceleration Profile
  - Output Drive vs. Frequency
- Other Graphs
  - Velocity
  - Displacement
  - Transmissibility
  - Scatter Plot
  - Spectrum
  - Transmissibility vs. Phase



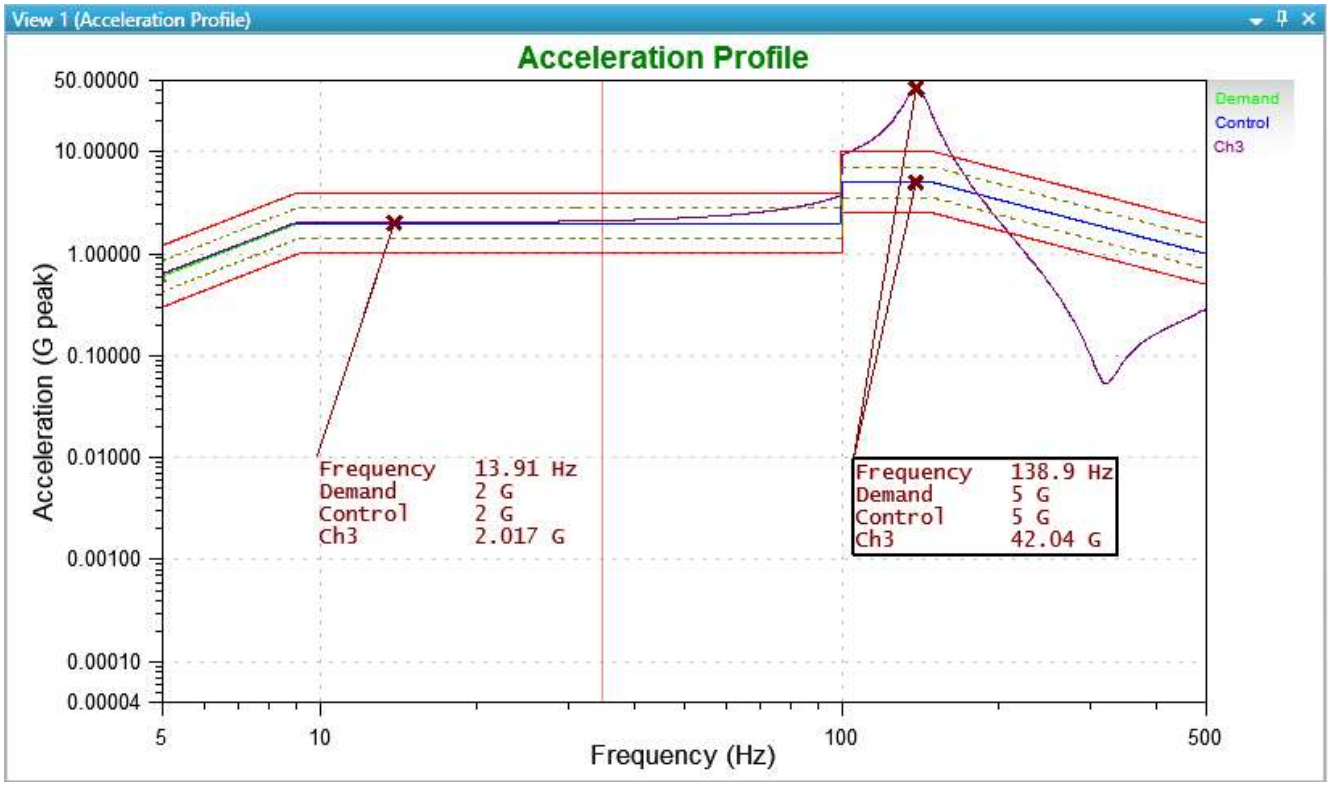


Sine Big Display

- CTRL + B
- Customizable Display
  - Right Click
    - Acceleration, Velocity & Displacement
    - **Parameters**
- Enable Manual Control
  - Sweep Up/Down
  - Sweep Rate
  - Amplitude
  - Frequency

Graph Cursors

- Sine Cursor Options
  - Standard
  - Resonance
  - Delta
  - Slope
  - Minimum
  - Maximum
  - MaxiMax
  - Mean
  - Dual
  - RMS



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


Any
Questions

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THANK
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Merci
Grazie
Спасибо
Gracias
Takk
Paldies
Suazia