

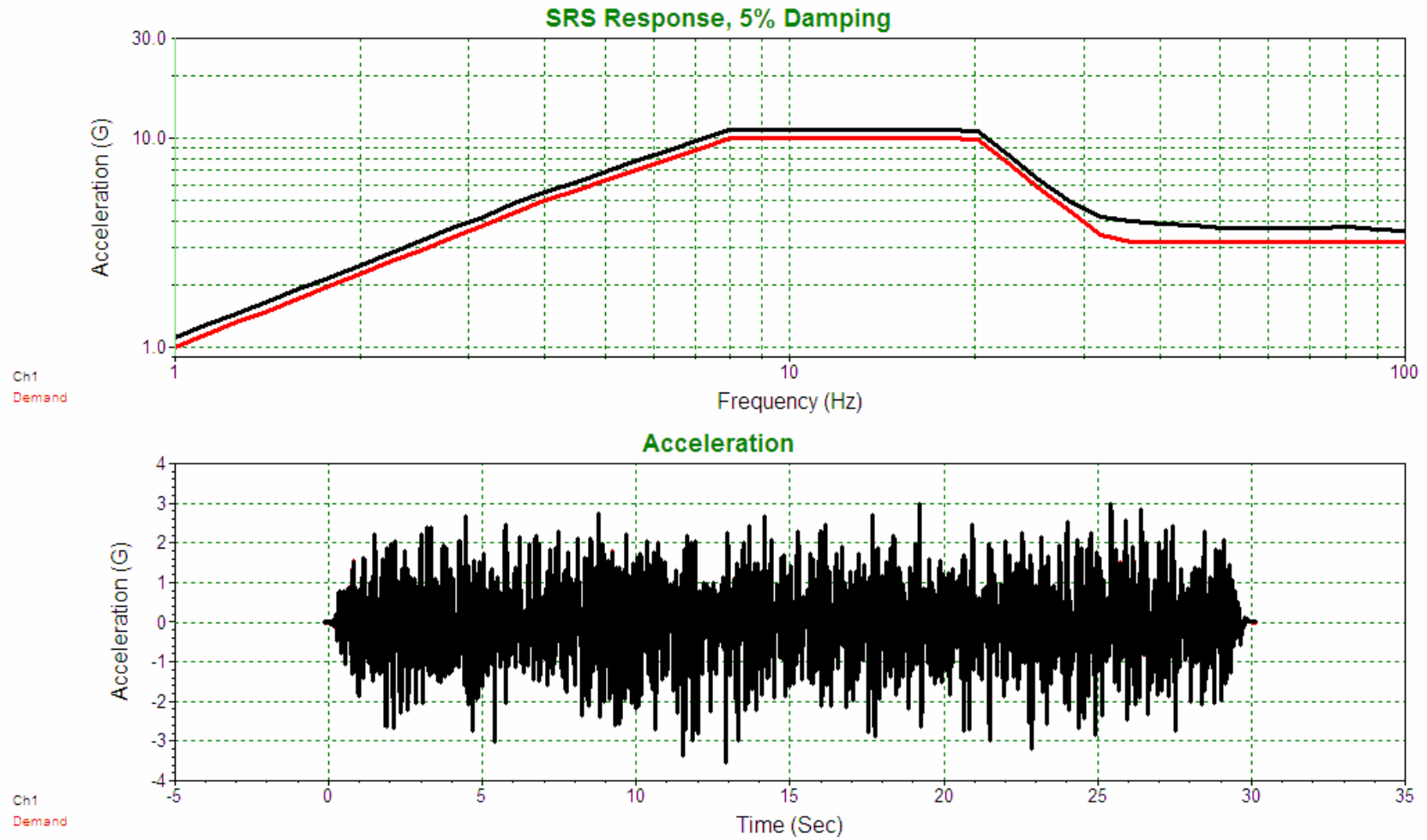
Earthquake Simulation

DEFINITIONS

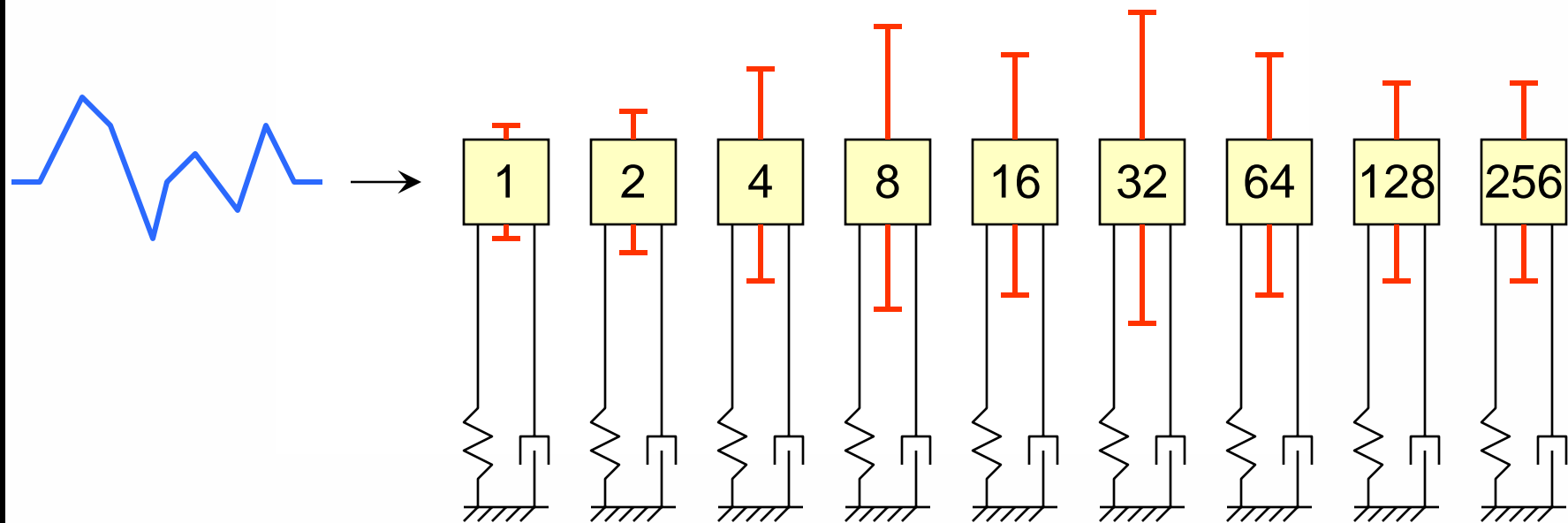
- **RESPONSE SPECTRA:** A plot of the maximum response, as a function of oscillator frequency, of an array of single-degree-of-freedom (SDOF) damped oscillators subjected to the same base excitation.
- **REQUIRED RESPONSE SPECTRA (RRS):** The response spectrum issued by the user as part of the specifications for qualification. The RRS constitutes a requirement to be met.
- **TEST RESPONSE SPECTRA (TRS):** The response spectrum that is developed from the actual time history of the motion of the shake table.
- **ZERO PERIOD ACCELERATION (ZPA):** The acceleration level of the high-frequency, non-amplified portion of the response spectrum. This acceleration corresponds to the maximum peak acceleration of the time history used to derive the spectrum.
- **CUTOFF FREQUENCY:** The frequency in the response spectrum where the ZPA asymptote begins. This is the frequency beyond which the SDOF oscillators exhibit no amplification of motion and indicate the upper limit of the frequency content of the waveform being analyzed.



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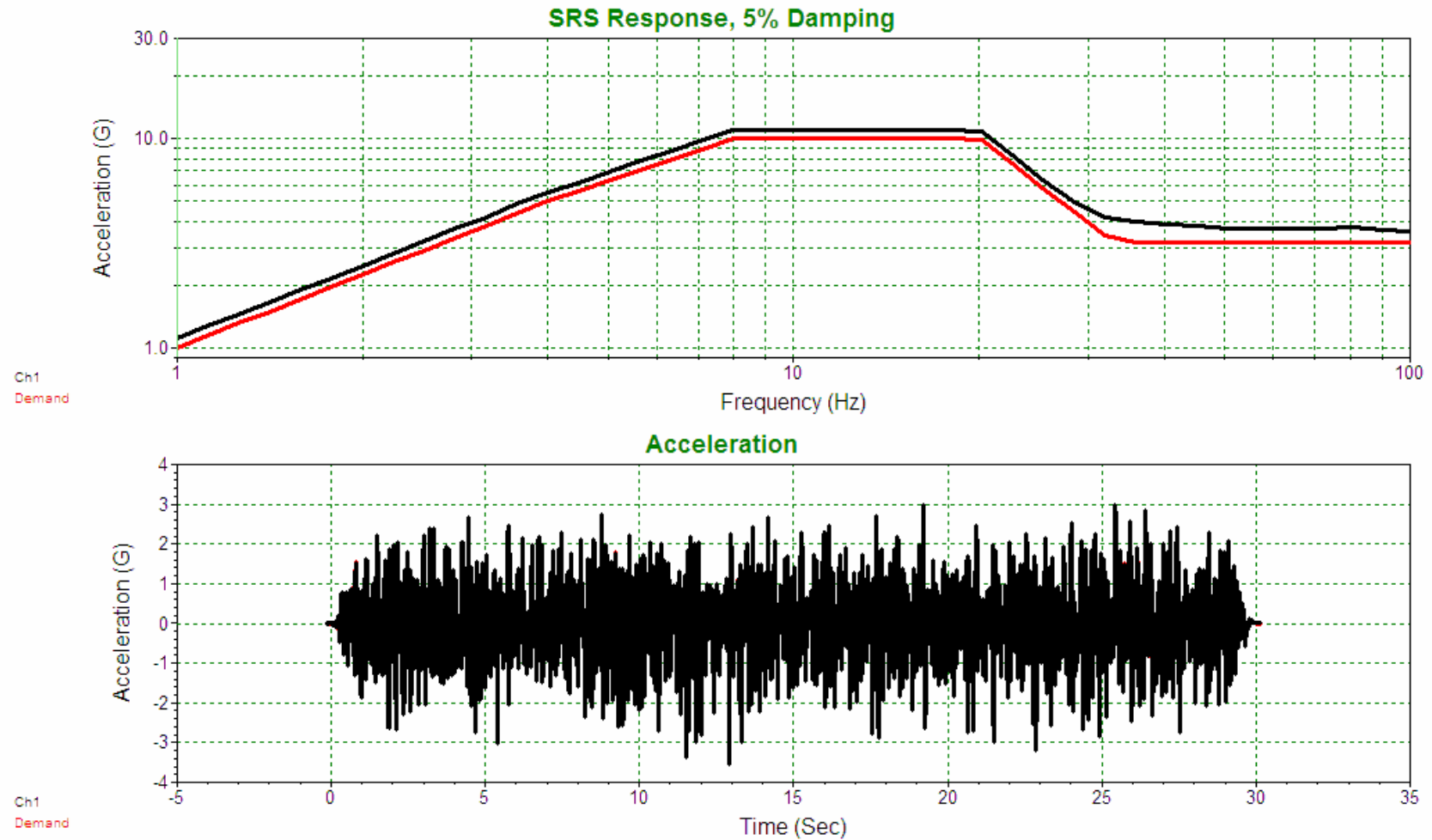
Shock Response Spectrum



5% Damping



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Earthquake Simulation

Measurement of Zero Period Acceleration (ZPA)

IEEE 344 REQUIREMENTS

- ZPA must be measured to show that the TRS envelops the RRS.
- The ZPA of the TRS is required to envelop the ZPA of the RRS considering only frequencies of the test-table motion time history lying within the RRS amplified region. This is called the **true ZPA** of the TRS.



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Measurement of Zero Period Acceleration (ZPA)

THE MEASUREMENT PROBLEM

- Test table time histories contain frequencies higher than those corresponding to the RRS amplified region. High frequencies are generated by:
 - a) Waveform distortions from hydraulic actuators, torque tubes, etc.
 - b) Looseness and rattling between the test table-fixturing-test item.
 - c) Looseness and rattling within the test item itself.
- These influences preclude the accurate measurement of the **true ZPA** without further analysis.



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Measurement of Zero Period Acceleration (ZPA)

ANALYSIS METHODS

- When the shape of the TRS is similar to the shape of the RRS, a reasonably accurate measure of the ZPA can be obtained from the TRS high-frequency asymptote.



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Measurement of Zero Period Acceleration (ZPA)

ANALYSIS METHODS

- When the TRS tends to increase in the high-frequency region, a supplemental analysis is performed at different damping values.
- The **true ZPA** is indicated at the high-frequency end where the TRS curves coincide.
- If the TRS curves do not meet, **true ZPA** can only be found by carrying the TRS analysis out to a higher frequency range.



Earthquake Simulation

Measurement of Zero Period Acceleration (ZPA)

ANALYSIS METHODS

- When the TRS indicates that high frequencies are present, a supplemental analysis is performed on the waveform by low-pass filtering the signal above the RRS cutoff frequency. This shows the value of the **true ZPA**.

