CRYSTAL INSTRUMENTS

Patented Technology & Improved Hardware Extends Spider System Dynamic Range to 160 dB

Application Note 053

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Crystal Instruments pioneered the concept of using Dual ADCs at each input channel. With the two ADCs working in parallel and set to different voltage ranges, Spiders system can measure low amplitude variations within a high amplitude input signal with great amplitude resolution and accuracy.

This immensely successful patented technology helped Crystal Instruments to develop CoCo and Spider systems to achieve a dynamic range of up to 150 dBFS.

With advancements in electronic components and manufacturing, electronic components with lower noise have evolved. Crystal Instruments integrated the advances in electronics into the Spider systems to achieve an additional 10 dB in dynamic range, extending the dynamic range of Spider systems to 160 dBFS. An experimental analysis highlighting this new achievement is published in this article.

Dynamic Range Measurement

There are several ways to measure the dynamic range of equipment. **Dynamic range** is typically derived by calculating the lowest possible amplitudes that a device can accurately measure with respect to the ability of the device to measure the highest amplitude.
Due to the inherent nature of electronic noise and the loose definition of dynamic range, Crystal Instruments employs a widely accepted format for measuring dynamic range, called "Full Scale Dynamic range" (represented by dBFS).

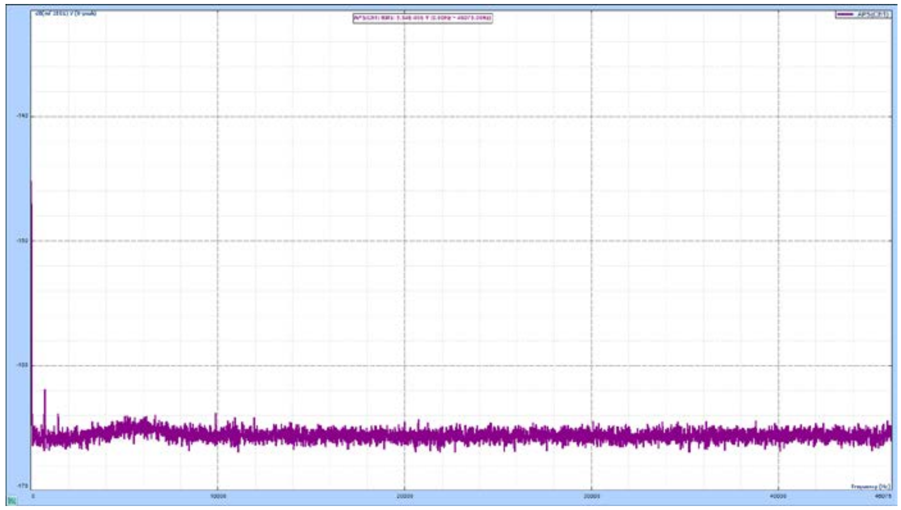

Figure 1

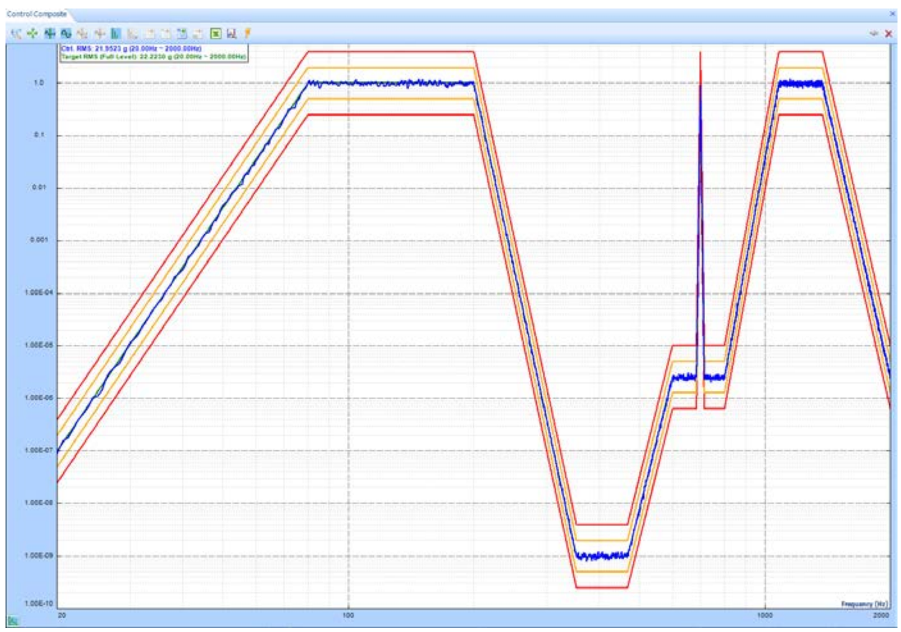

Figure 2

With this definition, **dynamic range** is defined as:

$$dBFS=20 \log (V_{FS}/V_N)$$

V_{FS} is the maximum measurement range of the device and
V_N is the system base noise.

Typically, V_N is measured by terminating the input channels with a 50 Ω resistor to simulate a standard non-floating ground condition.

Experimental Analysis

Experimentally, V_N can be easily measured in the frequency domain in dB with respect to the V_{FS}. Thus, the equation for dBFS can be restructured as:

$$dBFS= - (20 \log (V_N/V_{FS}))$$

The spectral signal above (Figure 1) shows the spectrum in dB (with reference to the full scale) for a complete frequency range of 46 KHz.

Evidently,

dBFS>160 dB

for the complete frequency range supported by the Spider system. This achievement extends the capabilities of Spider systems to accurately and effectively control some of the most difficult high dynamic range Random tests. (Figure 2)

The above picture depicts the accuracy of the control signal to the profile signal of a Random test with a high dynamic range profile.

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