DATA PHYSICS CORPORATION SOLUTIONS IN SIGNAL PROCESSING

# Stepped sine

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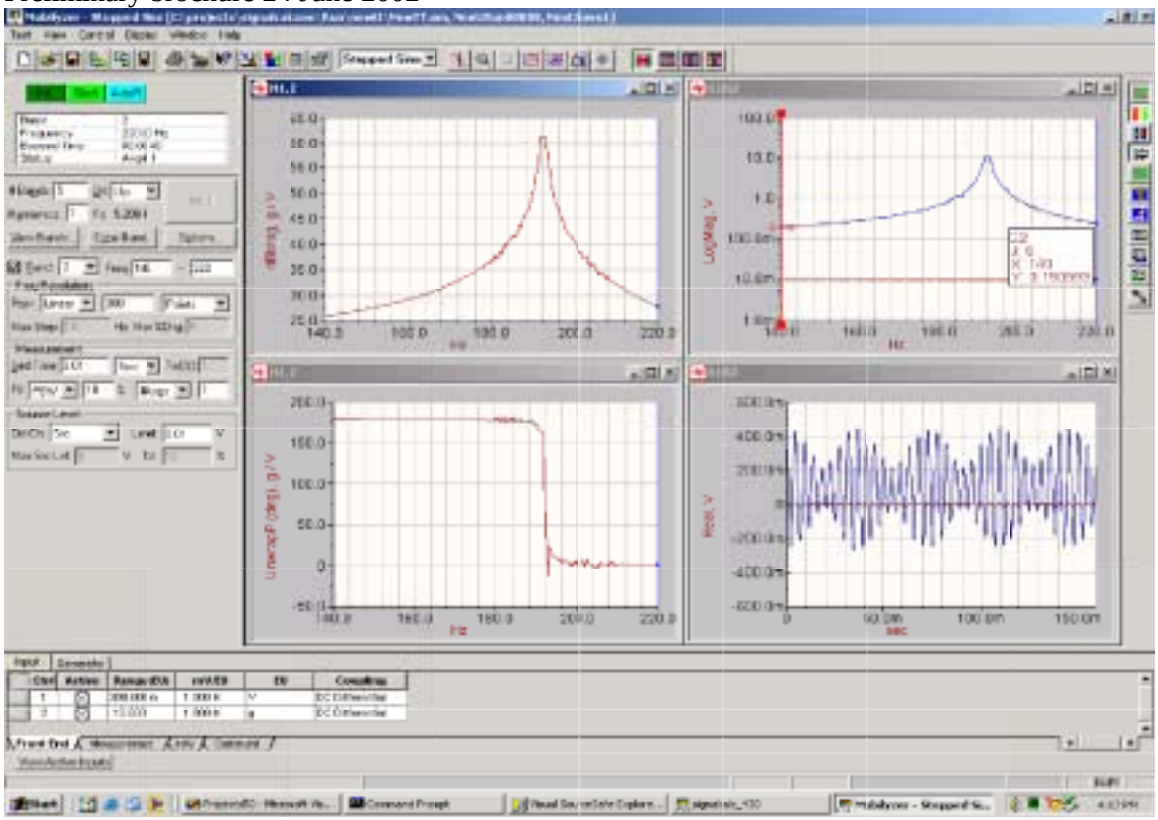


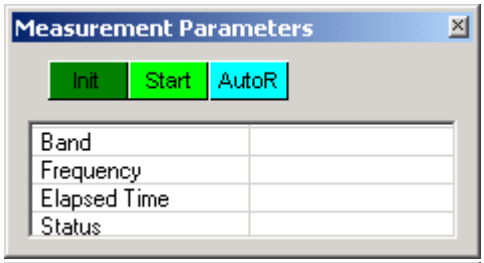
**Figure 1 Stepped sine test of noisy system**

SignalCalc stepped sine testing allows measurement of system frequency responses under particularly challenging conditions. Where the system under test exhibits enormous dynamic range, where signal to noise ratios are poor or the system must be measured while operating, where nonlinearities complicate the picture, these are the areas where stepped sine becomes the method of choice.

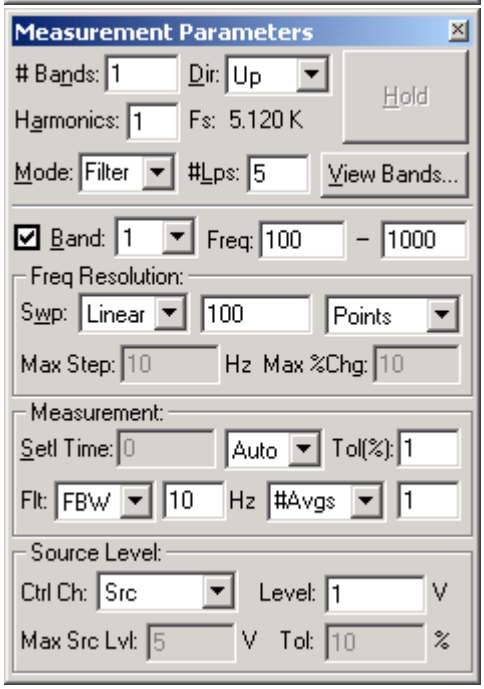
A warning: Stepped sine is, in general, slow. On the other hand, so is random once the number of averages gets into the thousands. Stepped sine can be complex to set up, if you're going to create a setup that is optimized for a particular test. But when complex test conditions require a complex test, it's worth the effort.

In a stepped sine test, the analyzer directs an internal signal generator to create a steady sine wave at one frequency. The system response is measured just at that frequency. The data point is stored, the signal generator is adjusted to a new frequency, and after a pause while the system transient response settles out, the measurement is repeated for the new point. Frequency response functions are built up from hundreds of individual measurements, each at a single point. Each measurement's signal to noise ratio is improved by the concentration of all signal and analysis on a single frequency, while noise remains scattered over the full bandwidth of the system.

## Measurement setup




Several global controls and indicators are here under Measurement Parameters. The Init, Start, AutoR line will be familiar to users of SignalCalc software. Underneath, a running report of the current measurement appears, with current band, current frequency, elapsed time of test, and a status indicator.




Global parameters: #Bands, sweep direction, Hold/Continue, Harmonics (used for THD measurements), Filter/Intg (tracking filter or integration time), #Lps (used in Auto modes to govern number of tries to converge to requested value). The View Bands control brings up a spreadsheet-style layout of all bands.

Band-specific parameters: active, lower and upper frequencies [Note that unlike any other stepped sine program, SignalCalc stepped sine does not require contiguous bands.],

Frequency resolution controls: sweep type (log, linear, or auto resolution), with step size or points per decade or, in auto, max % change. Max step sets a maximum step size in Hertz.

Measurement controls: settling time (seconds or cycles), or Auto, with tolerance. Fixed or proportional bandwidth filters, fixed in Hz, proportional in %. Number of averages or Min Coh.

Source controls: fixed source level or fixed input level. Note that controlling to an input channel is not compatible with Auto resolution.

## Displaying results

The most typical results of a stepped sine measurement are frequency response functions, and these are of course available as the Hxy signals familiar throughout SignalCalc. In addition, in the Stepped Sine Signal map you'll see a set of derived signals. Txy is the transmissibility between any two channels (note: to make efficient use of resources, Txy's are not automatically computed but must be set up in the Signal Map before the measurement starts), and some odd looking creations starting with P are measurement parameters. These are available so that you can see parameters such as resolution and source level, which may vary from band to band or even within a band if one or more of the controls has been set to Auto, as a function of frequency. RGx is input range (available for each channel), PRx proportion of input range used, PFreqRes is frequency resolution in Hz, PSetlTime is settling time in seconds, PmeasTime is measurement or integration time in seconds, PSrcLvl is source (output) level in volts. Gnhx is harmonic linear spectrum, THDx is total harmonic distortion. These last two only appear if Harmonics is set > 1

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