Diagnostic Test Tools: Users Manual

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1 DTT modes

DTT has four main modes:

Fourier Tools Compute spectra, coherence, and transfer functions using Welch's method (based on the FFT) using either data from the past or realtime data. Simultaneously, injections of nearly any waveform can be made into a collection of excitation points.

Swept Sine Response Used to measure transfer functions in real-time, by injecting a sinusoidal excitation over a collection of frequencies (one at a time) and demodulating readout channels at the same frequency.

Sine Response Performs a sinusoidal stimulus-response measurement at a single frequency.

Triggered Time Response Capture timeseries, possibly in conjunction with a time-series excitation.

1.1 Fourier Tools

Start The lowest frequency to include in the computed spectra. In most cases, zero (0) is an appropriate choice. If you want to compute a high-resolution (small-binwidth) spectrum of only a small portion of the available bandwidth, then choosing a nonzero value would be appropriate.

Stop The uppermost frequency to include in the computed spectra. The theoretical upper limit is given by the Nyquist frequency, which is half the sample rate of the measurement channel. DTT enforces a slightly lower maximum frequency. If you are measuring multiple channels simultaneously, the maximum upper frequency will be limited by the channel with the slowest sample rate.

BW The 'binwidth' (frequency resolution) of the computed spectra. This is the difference, in Hz, between adjacent frequency bins. The time required to compute one spectral average is inversely proportional to the binwidth. For example, if you'd like a spectrum with 0.1 Hz resolution, it will take 10 seconds to produce the first average. (With 50% overlap, only 5 seconds of additional data are subsequently required for each additional average.)

Settling Time

Window Windowing is a technique to reduce 'spectral leakage.' Unless you are aware of reasons to choose otherwise, the Hanning window is a safe, general default. If you are interested in the height of spectral peaks but not their width, the Flat-top window can be a better choice.

Overlap Percentage of the time series for each spectral average that overlaps with the time series used for the prior measurement. With the Hanning window, 50% is an appropriate choice.

Remove mean When this option is selected, the mean value of each chunk of time series is removed before computing spectra. Unless you are interested in values at DC, this is usually a good choice, since it can improve numerical accuracy.

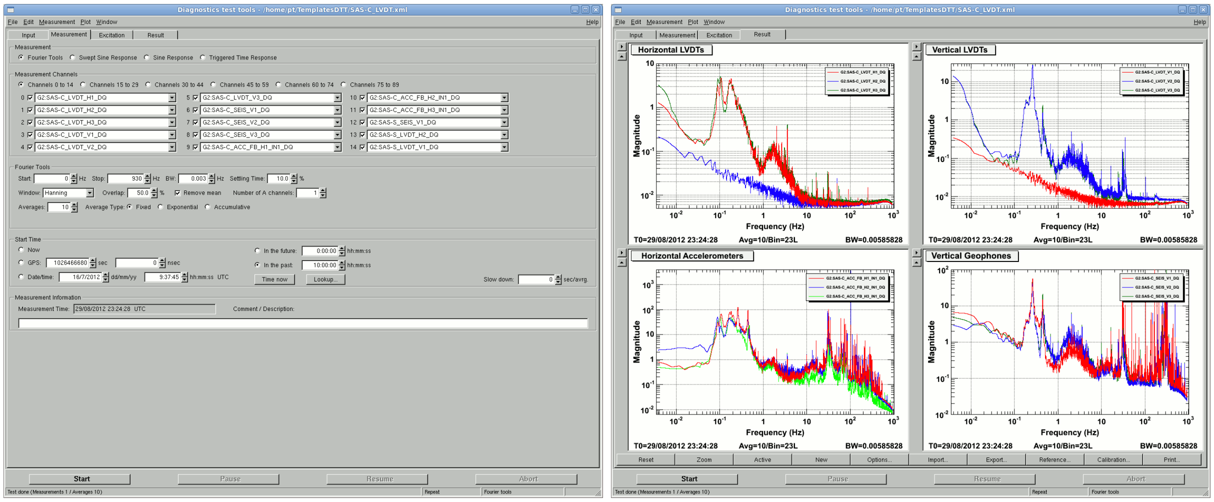

Figure 1: Screenshot of the measurement and result tabs in Fourier Tools mode

Number of A channels An "A channel" is any channel that can appear in the denominator of a transfer function.

Averages

Average type

fsdfsadf

1.2 Swept Sine Response

Start The lowest frequency to measure. Note: for a logarithmic sweep, this *must be nonzero*.

Stop The highest frequency to measure. This must be above the start frequency, but the direction of the sweep can be changed via the "Sweep direction" option (below).

Points Number of distinct frequencies to measure.

Settling Time

Measurement time: cycles/sec

Averages Number of measurements made at each frequency.

Harmonic Order This option is a great mystery.

Window *same as in fourier-tools mode*

Power Spectrum: I've never used this option either.

Number of A channels *same as in fourier-tools mode*

Sweep direction "up" or "down". If "up" is selected, then the sweep begins at the "start" (lowest) frequency and goes towards higher frequencies. Typically one chooses a downward sweep, since higher frequencies are quicker to measure.

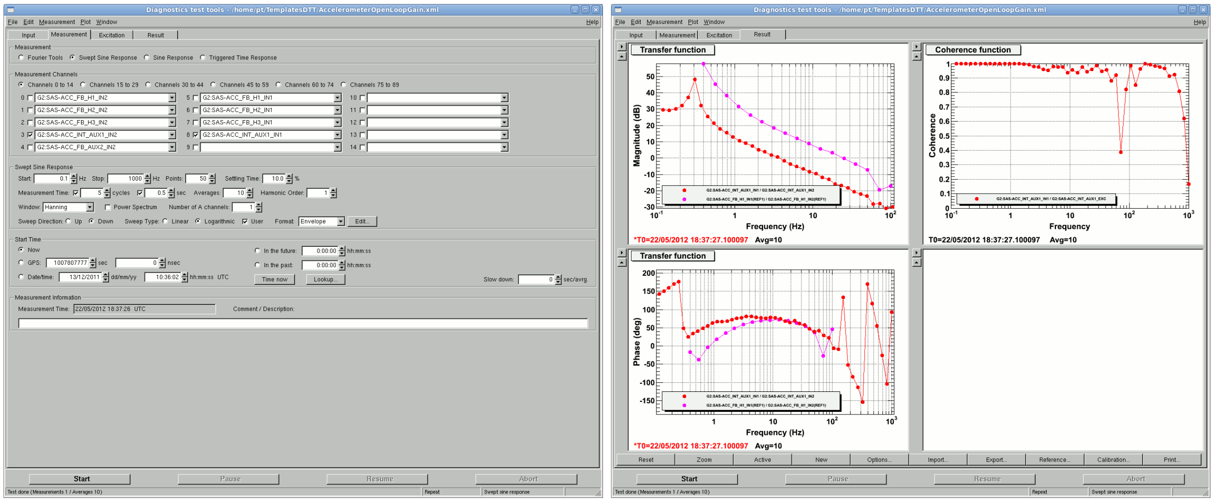

Figure 2: Screenshot of the measurement and result tabs in swept-sine mode

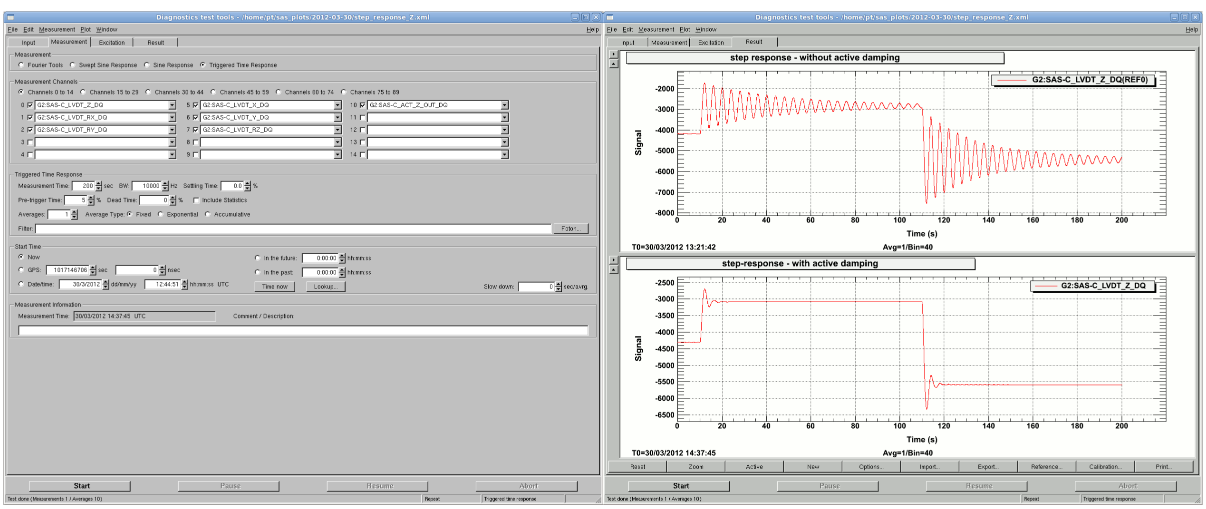

Figure 3: Screenshot of the measurement and result tabs in time response mode

Sweep type linear or logarithmic. Typically a logarithmic sweep is used to make a Bode plot, while a linear sweep may be more appropriate for examining a small bandwidth around some feature. The sweep type is also affected by the "User" option

User (checkbox)

1.3 Sine Response

Sine response is similar to swept-sine response, but the measurement is made only at a single frequency rather than sweeping over a collection of measurement frequencies.

This is particularly useful when tuning some parameter in real-time, where you would like to maximize or minimize the response to some excitation.

The parameters are a subset of the swept-sine parameters.

Measurement time *same as in swept-sine mode*

Settling time *same as in swept-sine mode*

Window s*ame as in swept-sine mode*

Power spectrum *same as in swept-sine mode*

Harmonic order *same as in swept-sine mode*

Averages *same as in swept-sine mode*

Average type *same as in swept-sine mode*

1.4 Triggered Time Response

This is DTT's one time-domain mode. It is most useful for capturing short segments of time series and making time-domain measurements such as step response. It does not provide a real-time scope-like display, nor is it really "triggered" in the sense that a scope can be triggered by an external input.

Measurement Time

BW

Settling Time

Pre-trigger time

Dead time

Include statistics

Averages

Average type

Filter

2 Excitation tab

Excitation channel

Readback channel

Waveform

Waveform file

Frequency, Amplitude, Offset, Phase, Ratio

Freq. Range

Ampl. Range

Filter

3 Result tab

4 Error messages

Looking at the source code to diag.cc shows (at least) 193 points at which an error message is generated. Most are self-explanatory, but the common ones can be quite cryptic. Here are some of the more ambiguous messages.

Synchronization error Some things to try: Make sure that the local workstation's clock and the clocks of the various CDS machines are correctly synchronized. Make sure all software agrees on the list of leap seconds.

5 Foton

foton is our tool for designing digital filters.

6 Arbitrary waveform generator, graphical interface (awggui)

awggui is a graphical interface to the arbitrary waveform generator.

7 Command-line interface

diag is the command-line interface to the global diagnostics system. It's specifically useful for clearing testpoints and excitations after something has crashed.

8 Dataviewer

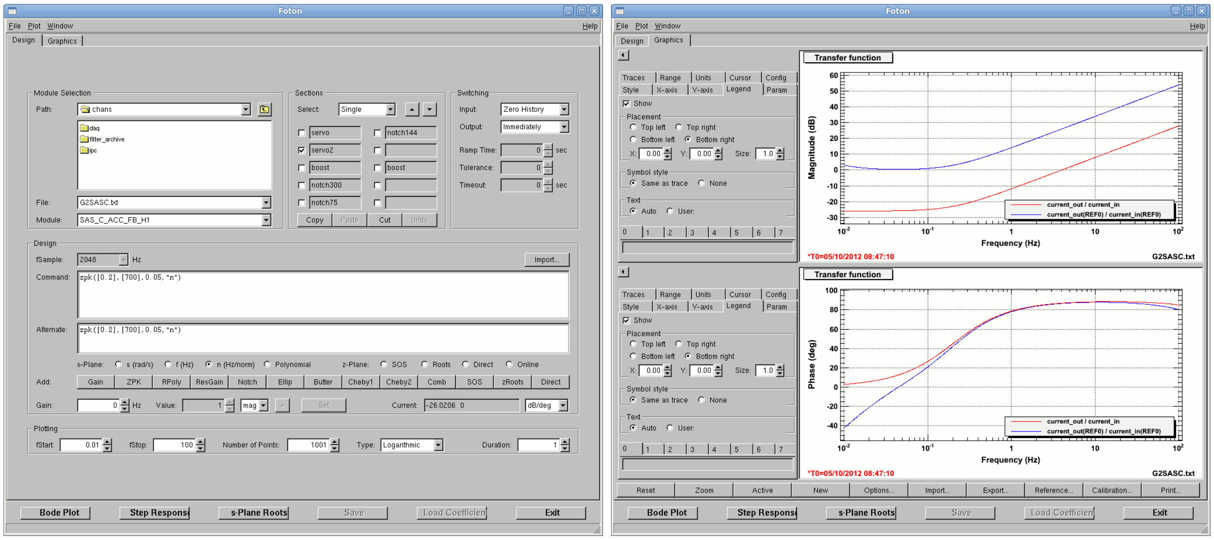

Figure 4: Foton screen shots

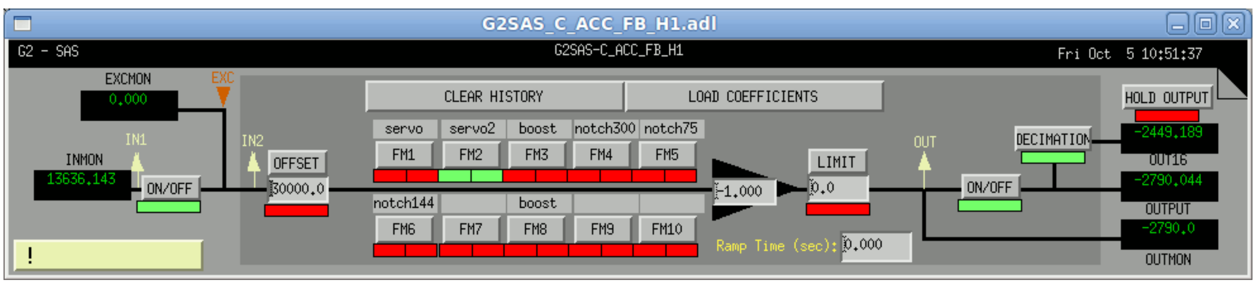

Figure 5: medm filter module screen

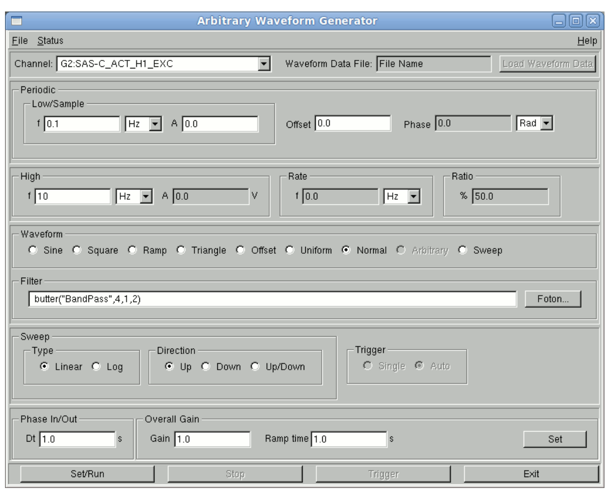

Figure 6: awggui

Figure 7: