Integrated Speaker Measurement & Design

Features

- Precision Thiele-Small Measurement System (Microwatt to 200W test range)
- Measures Voice Coil and Suspension AC and DC Compression Effects
- 100pF-1000uF, 10nH-10H, .01-100K ohm Electrical RLC range
- Advanced TS Simulator with Box Alignment Analysis
- Precision or Fast Real-Time Modes (SnapTS™)
- Real-Time Acoustic Analysis
- THD, IM and SINAD Distortion Measurement
- Cumulative Spectral Decay Waterfall Display
- Rejects Room Reflections using Time Gated Impulse Response
- Room Decay Measurement
- Interactive Crossover Design: Simulate crossovers on your desktop
- 32 Dual Data Buffers for Testing and Overlays
- Mobile, USB Powered from Laptop

Thiele Small Driver Measurement

- Fast and Easy Two Step Process

1 Find Re, Fs and Q parameters
- Find Frequency dependent Le/Rem/Xem (Leap4 model)
- Find Fs (zero phase)
- Finds Zo and Q intercepts

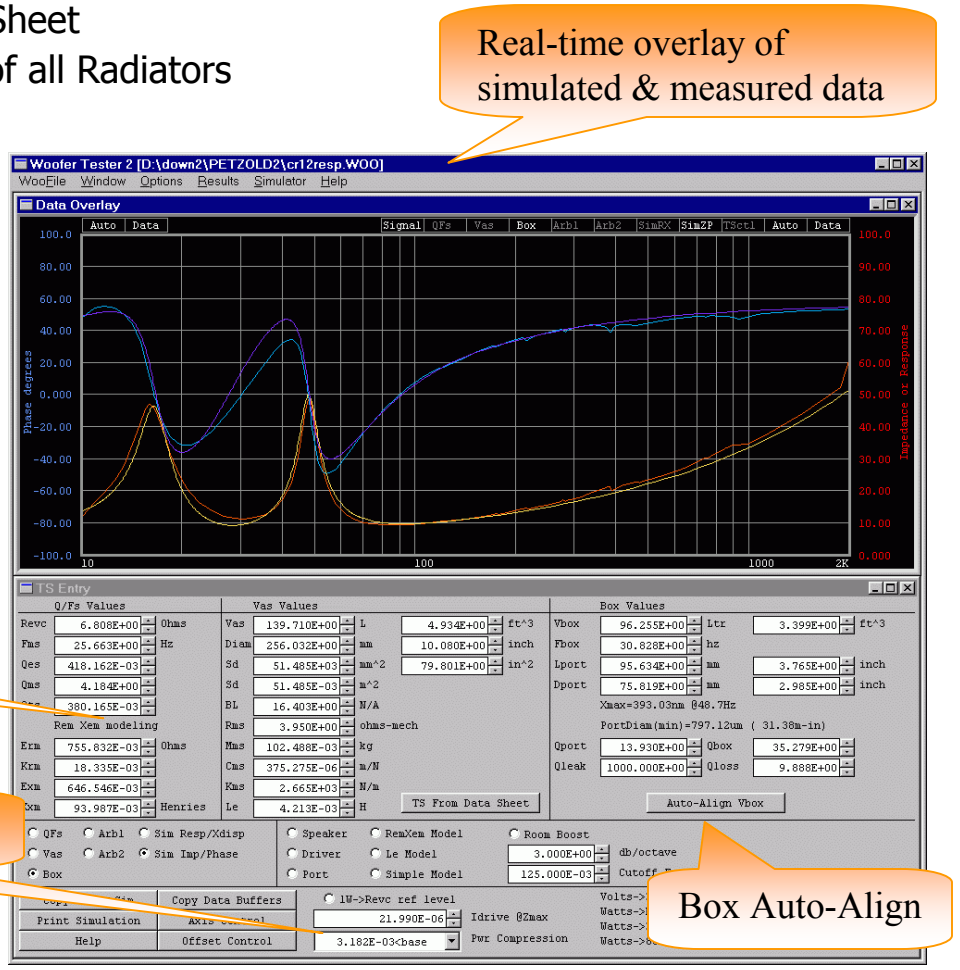
2 Find Vas and Motor Parameters
- Select from: Delta Mass, Delta Box or Efficiency
- VAS Test includes Phase Plug Area Correction

Export Results (to simulator or text)

```
Re        =    2.7341 ohms
Fs        =   23.3032 Hz
Zmax      =   91.5429 ohms
Qes       =    0.2836
Qms       =    9.2124
Qts       =    0.2751
Le        =    5.4490 mH  (at 1 kHz)
Diam      =   388.6200 mm  ( 15.3000 in  )
Sd        = 118615.1505 mm^2(183.8539 in^2)
Vas       =  196.2490 L   (  6.9305 ft^3)
BL        =   25.3967 N/A
Mms       =  458.6490 g
Cms       =   98.1890 uM/N
Kms       = 10184.4453 N/M
Rms       =    6.5412 R mechanical
Efficiency =    0.8228 %
Sensitivity =   91.1708 dB @1W/1m, 95.8336 dB @2.83Vrms/1m
Fs/Fsa    =   1.1524
Ideal Mass  = 257.9901 g
Mass used   = 150.5000 g
;--- Impedance Fitting Constants ---
Krm    12.322E-03 ohms     Freq dependent resistance
Erm    821.518E-03         Rem=Krm*(2*pi*f)^Erm
Kxm    77.654E-03 Henries  Freq dependent reactance
Exm    694.353E-03         Xem=Kxm*(2*pi*f)^Exm,
```

Advanced Thiele Small Simulator & Box Analyzer

- Vented, Sealed, Band Pass and Passive Radiator Box Models
- Import from WT Test Environment or Mfr Data Sheet
- Response, Impedance, Phase, Velocity & Xmm of all Radiators
- Find Box Alignment and Losses using Auto-Align
- Compare Simulated & Real-time Response
- Frequency Dependent Inductance Model
- Box, Port and Stuffing Losses
- Model Room/Car Pressurization Effects
- Vent Resonance (Pipe Organ) Effects
- Import TS versus Drive Level Test Data



In-Box Electrical Measurement of Driver

- Find traditional Fsb, Ha and Alpha values
- Automatically align simulator to tested data to find Box volume, Tuning and Loss Parameters

  ! Alignment Method will Refine Driver Parameters if they have shifted due to Drive Level, Temperature, etc.

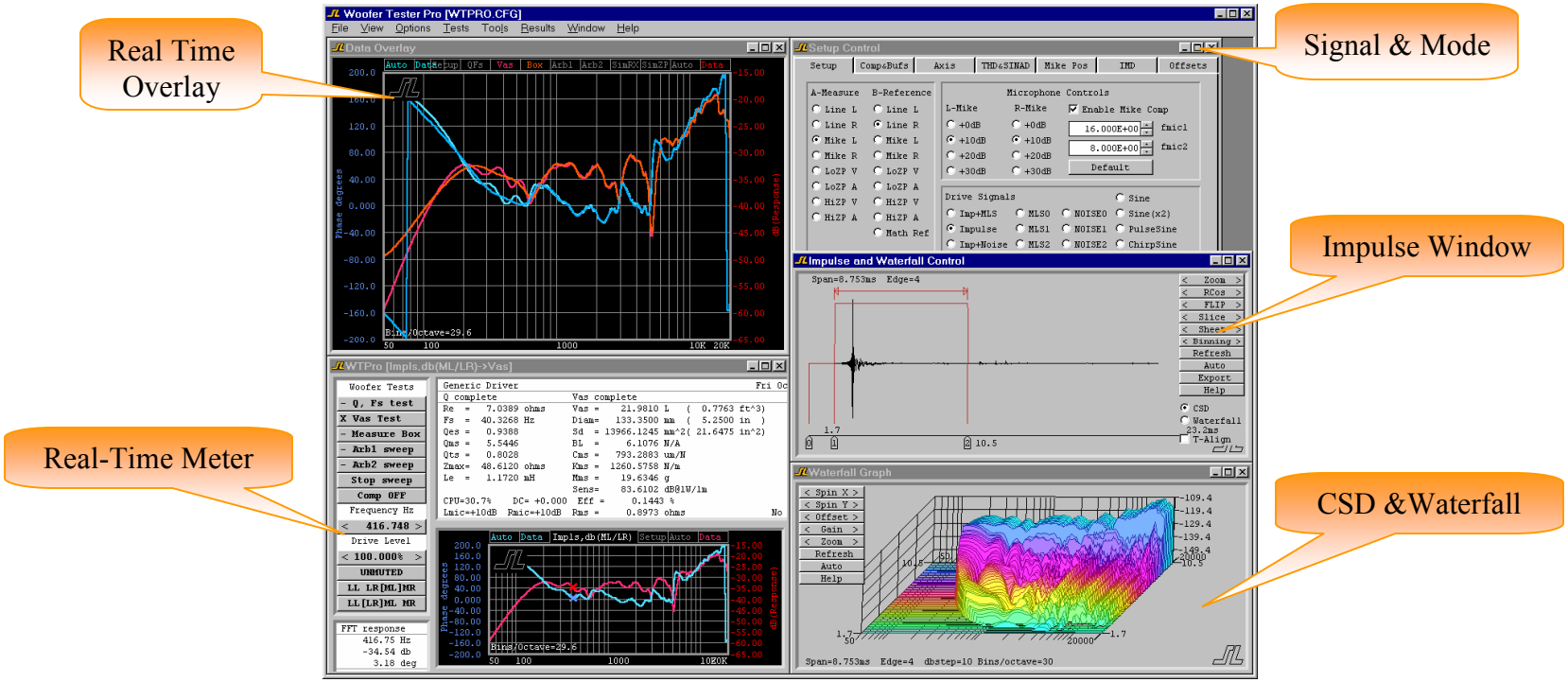
Example of simulated vs real data

Real-time overlay of simulated and in-air acoustic response

(< 0.5dB error)

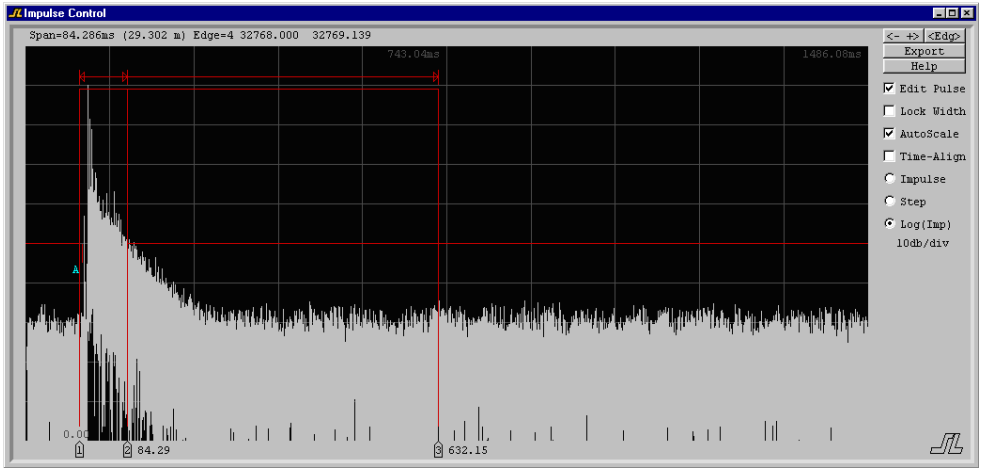
In-Air Acoustic Response

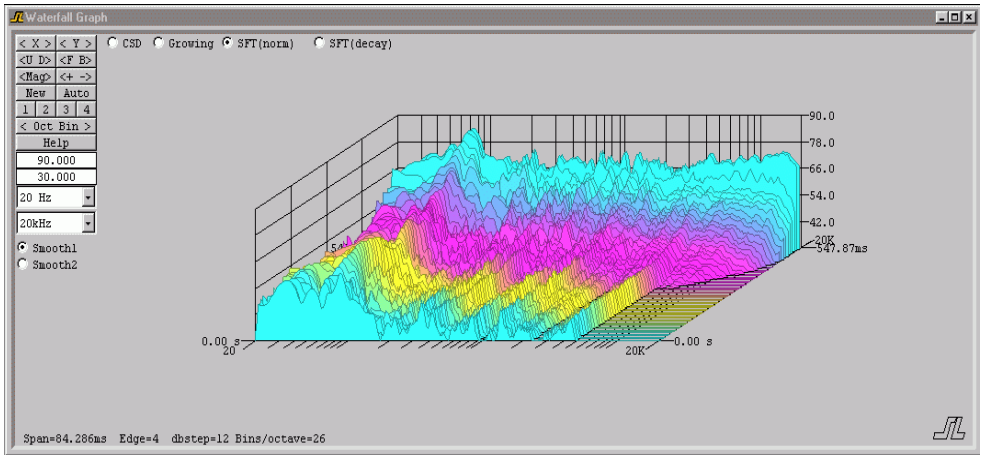
- MLS, Noise, Impulse and Chirp: Acquire response in real-time
- Sine and Pulsed Sine: Best noise rejection (Sweep and collect)
- Reject room reflections using Time Window (MLS and Step)
- Cumulative Spectral Decay and Waterfall Plots
- Acoustic Time of Arrival to µSec accuracy (fractions of mm)
- Dual Microphone alignment to further reduce room reflections



Room Decay Measurement

- Impulse Magnitude (including Log scale to Magnify Energy Decay further out in Time)
- 4 different types of 3-D Waterfall Plots Showing Decay or Growth
- Microphone Compensation for both Measurement & Reference Signals





Interactive Crossover Design

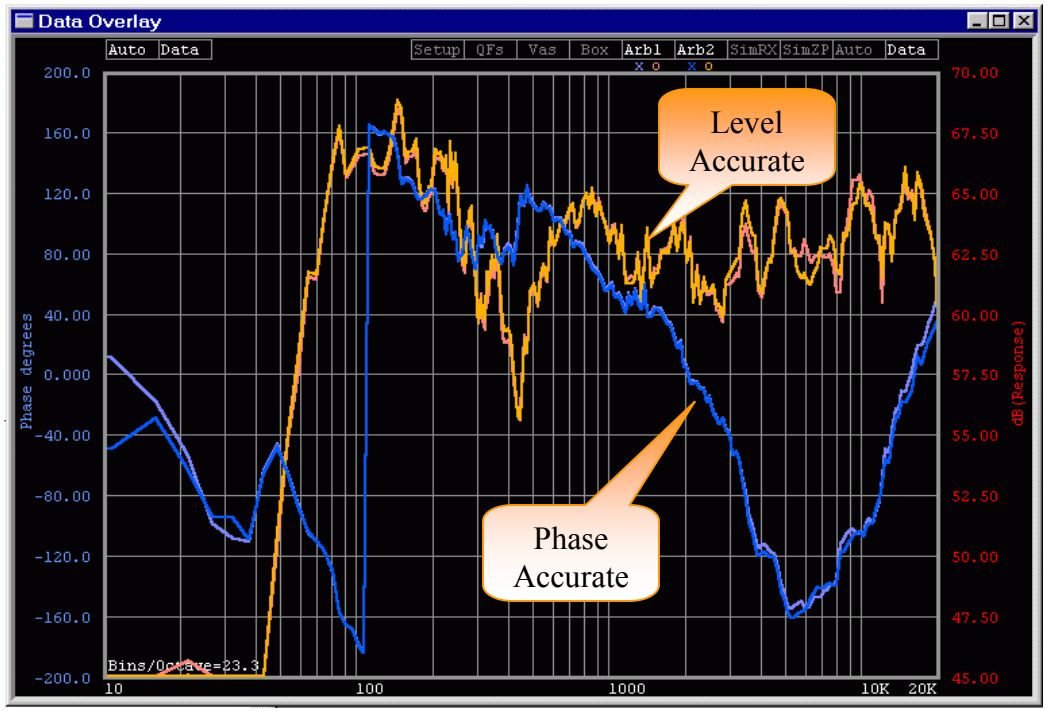
- Real-time crossover testing
- Simulated vs Real Accuracy to fractions of a dB
- Tweeter Protection Circuit
- Measure Driver time alignment to mm accuracy

Simulated

vs

Physical

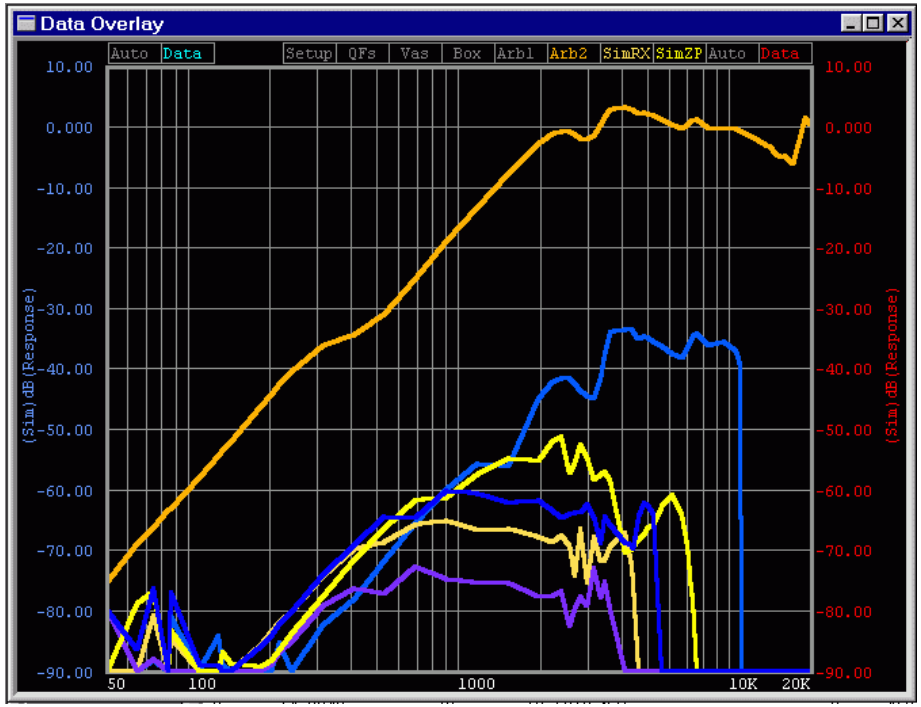
Crossover



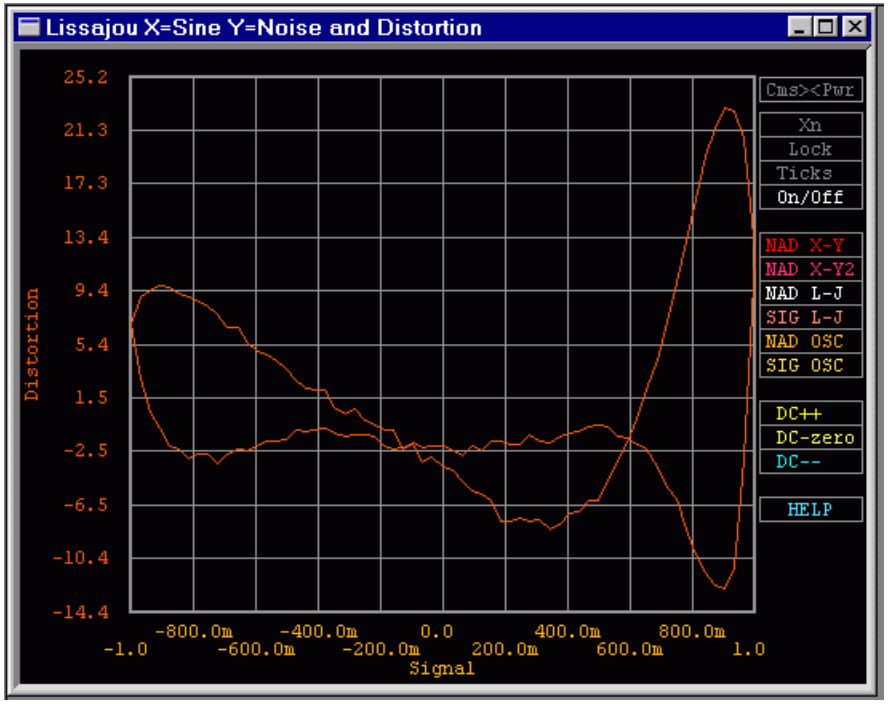
Harmonic, Inter-Modulation & SINAD Distortion Measurement

- Measure 1st through 6th Harmonics, Relative or Absolute Level vs Frequency
- Measure Inter-modulation Distortion
- Measure Signal to Noise and Distortion Ratio (SINAD)
- View SINAD as Signal Relative To Drive Signal, Oscilloscope or Lissajoux

Tweeter Response and Harmonics 1-6 on Absolute Scale



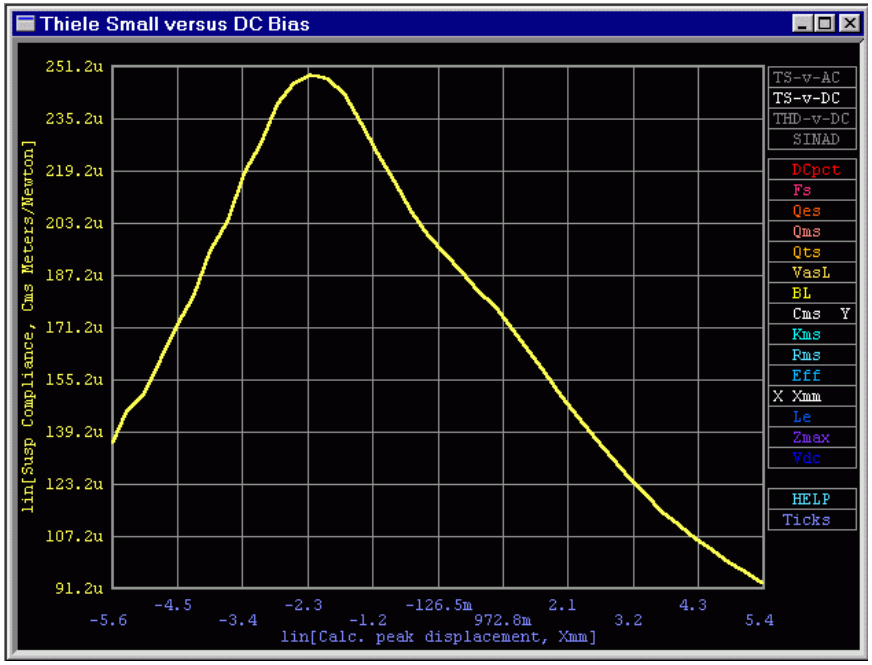
SINAD at 1 kHz Shown as Lissajoux Pattern



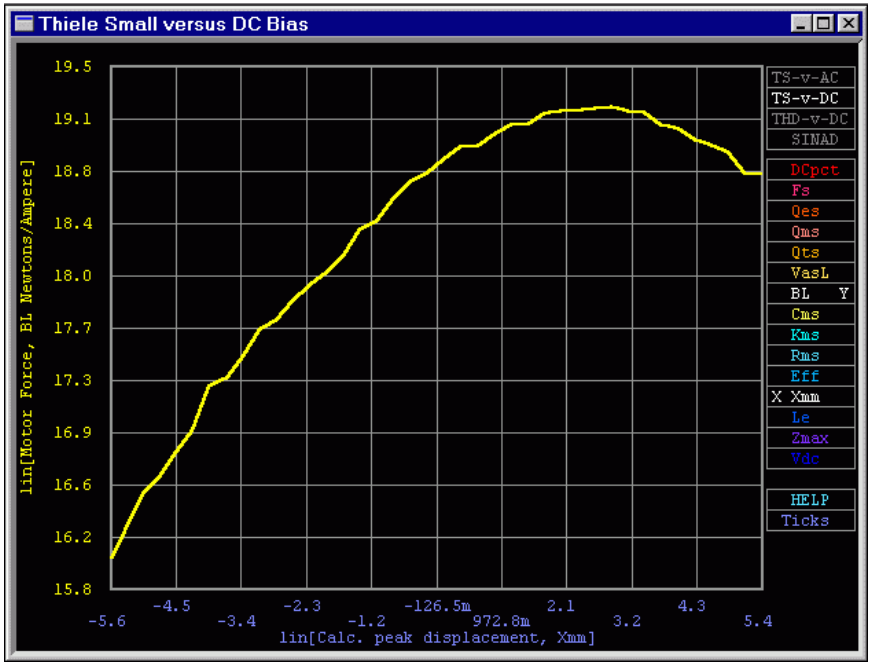
AC & DC Thiele Small Model Compression

- Full TS Model at Each DC Bias Point or AC Drive Level
- Reveals Suspension and Motor Mechanical Offsets
- XY Plot for any Parameter Pair

Cms versus Xmm Displacement



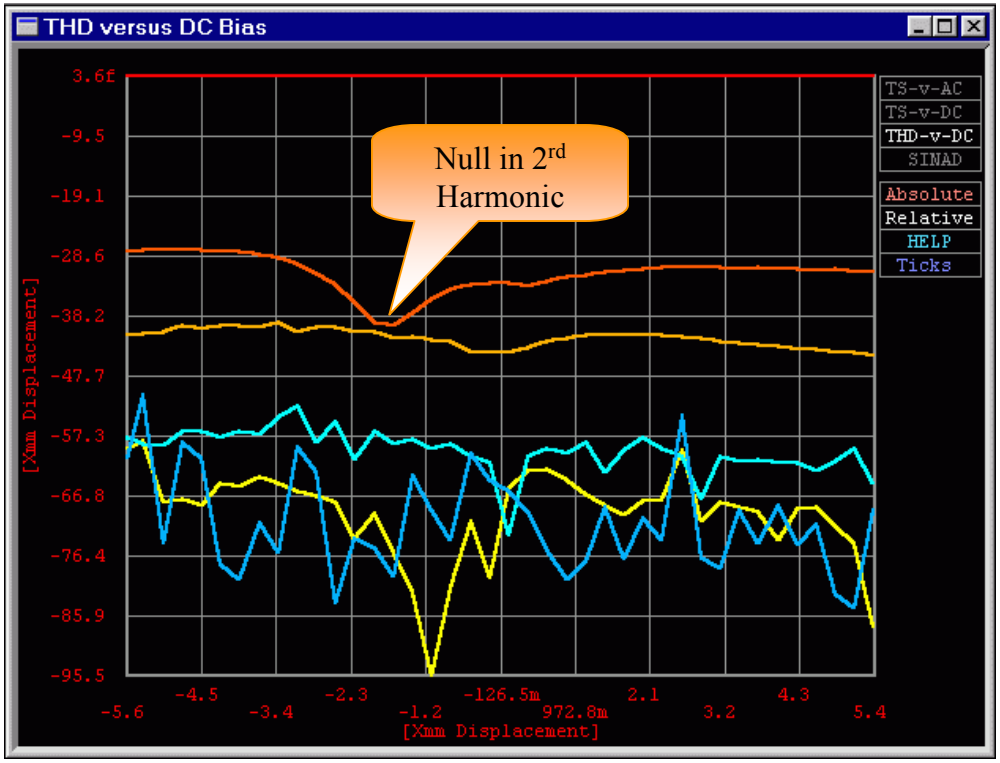
BL versus Xmm Displacement



Using Distortion for Voice Coil & Suspension Analysis

- Distortion vs Voice Coil displacement (DC offset)
- Reveals Suspension and Motor Offsets
- Measure 1st - 6th Harmonics, Relative or Absolute Level

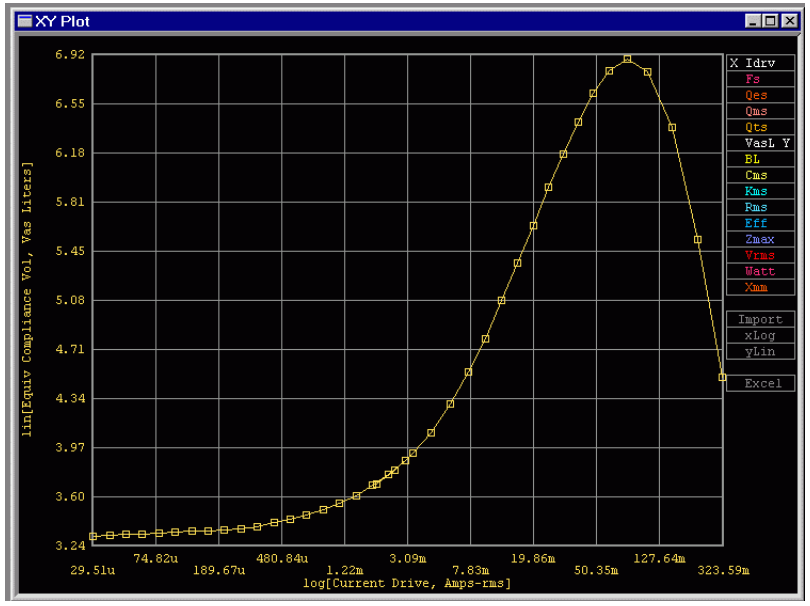
Driver Harmonic Distortion vs Voice Coil Offset



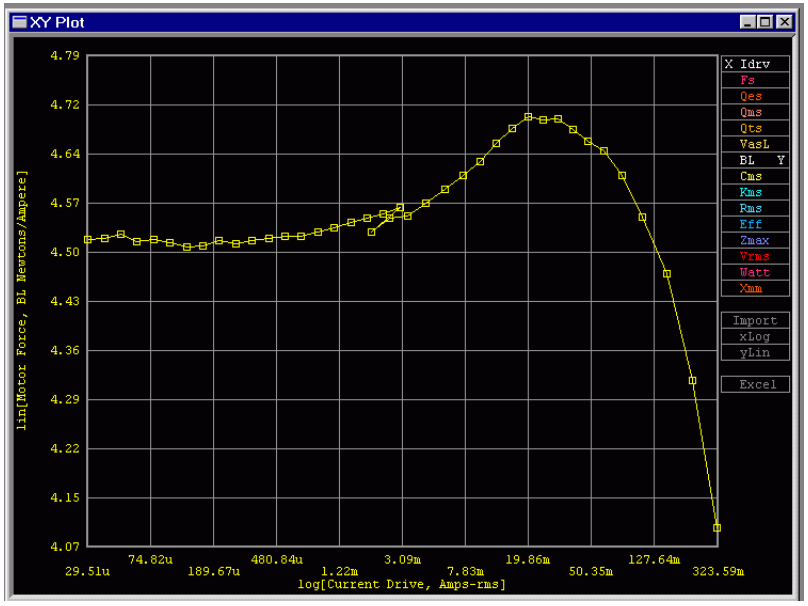
Thiele Small Parameters vs. AC Drive Level

- Continuum of Thiele Small Parameters from µW to 200W
- Compare Compression Response in Simulator
- Constant Current or Constant Voltage
- Power is Limited by External Amp and Sense Resistor (HiZP port)
- XY Plot for any Parameter Pair

Vas (Liters) versus AC Current Drive



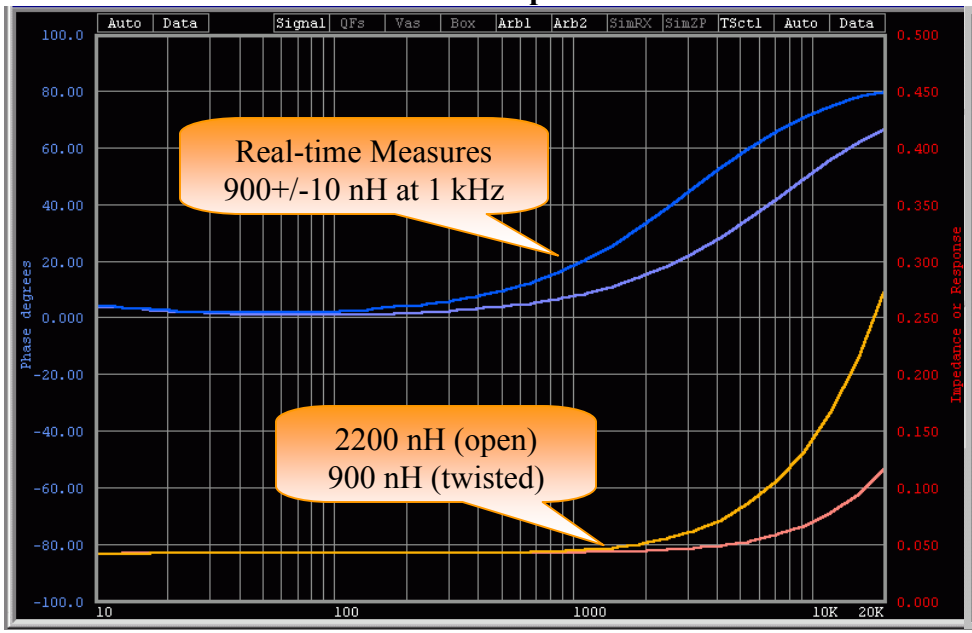
BL versus Xmm Displacement



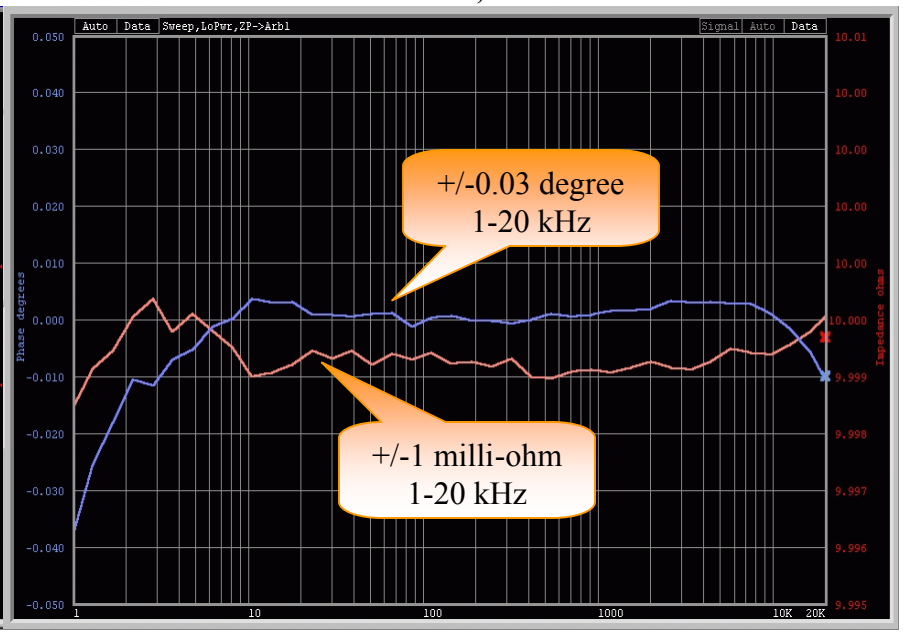
Crossover Component and Cable Measurement

- Measure Resistance, Inductance and Capacitance
  - Impedance and Phase from 1 to 20 kHz
  - 3 mA (low power) and 4 Amp (high power) Port Ranges
  - 5 Digit Accuracy at Full Scale
  - Easily Measures Speaker Cables
  - 100 pF to 1000 uF, 100 nH to 10 H, 10 milliohm to 100 kohm range

Δ Inductance of 36" Leads Open/Closed 50 mΩ/div



10 ohm cal resistor: 1 mΩ/div, 1-20 khz

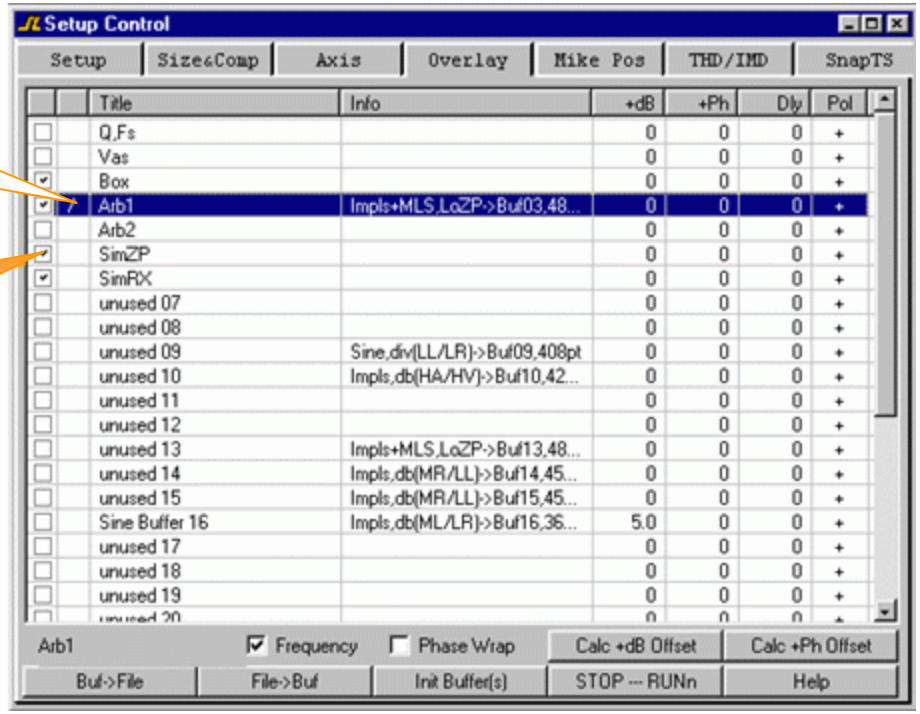


32 Dual Buffers for Testing & Overlays

- Each Buffer Stores Two Data Points: (Impedance, Phase, Response, Displacement, Velocity)
- Easy Setup and Control from One Place
- Set Response and Phase Offsets, Phase Wrapping and Polarity
- Tester Automatically Calculates Difference Between Measured and Desired Value

ARB1 is Data Destination from Main Control Window

Buffers Displayed in Overlay Window: Box, ARB1, SimZP and SimRX



Tester Comparison Matrix

Feature	Woofer Tester 2	Speaker Tester	Woofer Tester Pro
Precision Thiele-Small Measurement	•	•	•
VAS Test with Phase Plug Area Calculation	•	•	•
Thiele-Small Simulator	•	•	•
Automatic Box Analysis	•	•	•
RLC Meter	•	•	•
Low Power Impedance Measurement	•	•	•
Low Power AC/DC Compression Testing	•	•	•
Sine, Impulse, MLS, Noise & Chirp Test Signals	•	•	•
32 Dual Data Buffers for Testing & Overlays	•	•	•
Sweep and Real-Time Run, Stop and RunN Control	•	•	•
Interactive Crossover Design™		•	•
Real-time Acoustic Analysis (RTA)		•	•
Room Decay Measurement		•	•
Swept Sine In-Air Acoustic Response		•	•
THD/IM/SINAD Distortion Measurement		•	•
Cumulative Spectral Decay & Waterfall Plots		•	•
FFT Display		•	•
SnapTS™ Real-Time Thiele-Small Testing		•	•
Microphone Compensation for Signal & Reference		•	•
Impulse Time Gating		•	•
High Power Thiele-Small Measurement			•
High Power Impedance			•
High Power AC/DC Compression Testing			•
Speaker Linearity Testing			•
DC Bias Testing			•
High Power Box Compression			•
Calibration Option for Measurements at Cable Ends	•	•	•
Air-Core Inductor, Zobel & Tank Calculators	•	•	•
Popup Data Labels in Graphs	•	•	•
Customizable Legends	•	•	•
Mobile, USB powered	•	•	•

Low power is up to 3mA drive
High power is up to 40V, 5A, 200 watt amplifiers

About Smith & Larson Audio

Smith & Larson Audio is based in the USA and is the home of the original Woofer Tester, which was introduced in 1995. It was redesigned in 2005 and is in use by over 1000 customers worldwide. In 2006, the product line and our test capabilities expanded and now include the Speaker Tester and Woofer Tester Pro. *Smith & Larson* has over 40 years of combined experience in audio design and digital signal processing.

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