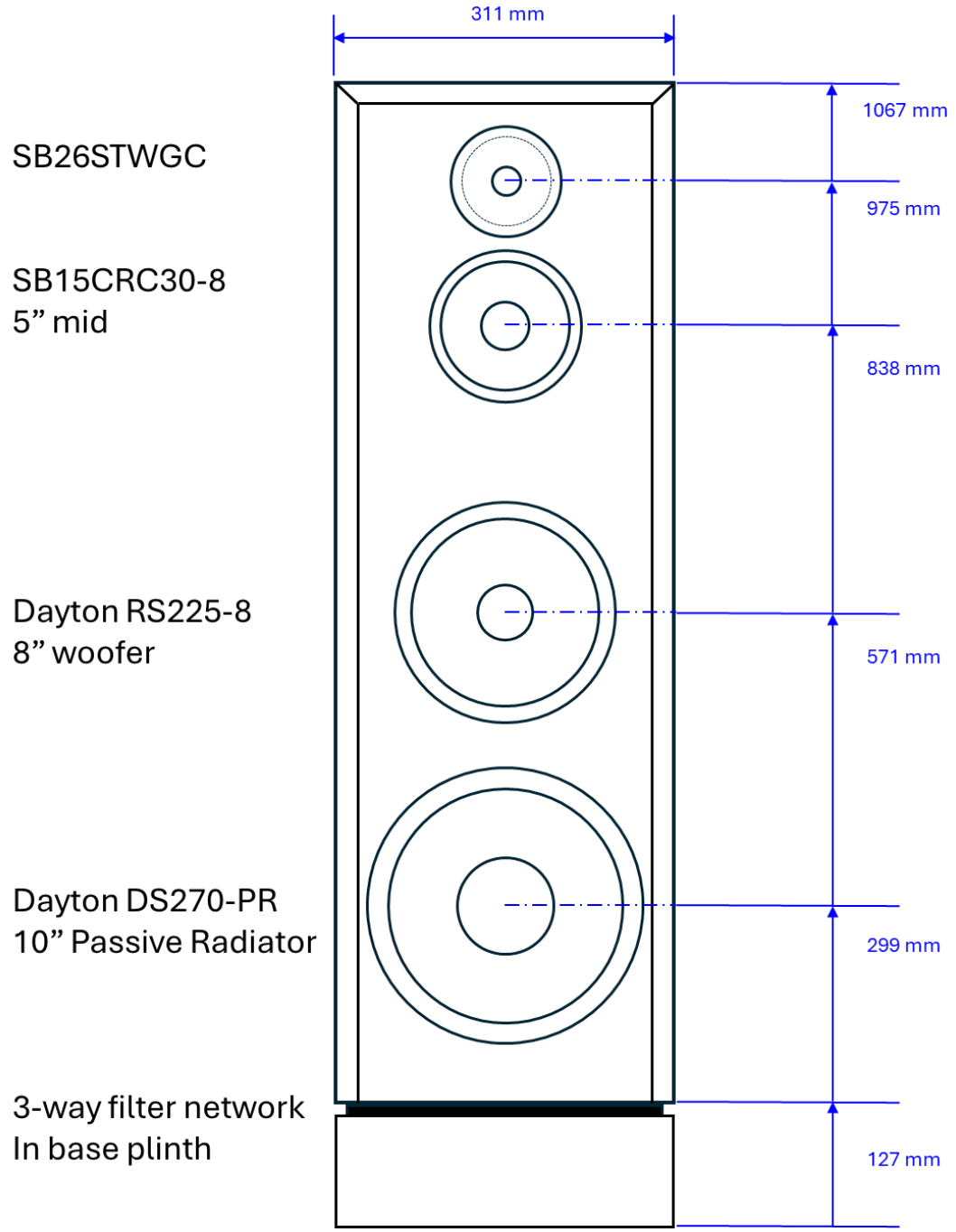
# *The Terra Incognita*

# Terra Incognita Loudspeaker

*MiniTower 8.3-PR*

- 3-way speaker with 8 inch woofer and 10 inch passive radiator
- Full Range Frequency Response
  - +/- 2.4 dB from 40 Hz to 20 kHz
  - Bass extension: -3 dB at 43 Hz
    -6 dB at 33 Hz
- Nominal impedance: 8 Ohm
- Sensitivity: 87 dB SPL at 1 m at 2.83 Vrms
- 42” H x 12.25” W x 10” D
- 42 liter woofer enclosed volume
- 3.5 liter midrange sub chamber



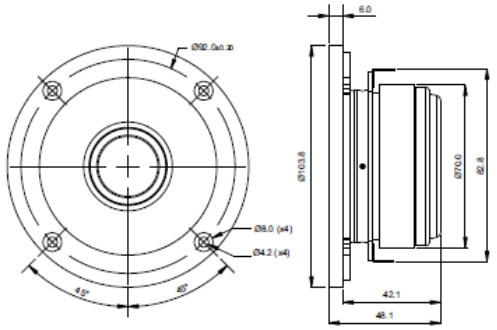
- **Drivers**

- SBA  SB26STWGC Waveguide Soft Dome Tweeter
- SBA  SB15CRC30-8 Midrange:  Carbon-Epoxy Rohacell Cone
- Dayton RS225-8 Aluminum Cone Woofer

SB ACOUSTICS

# SB26STWGC-4

Prototype Data



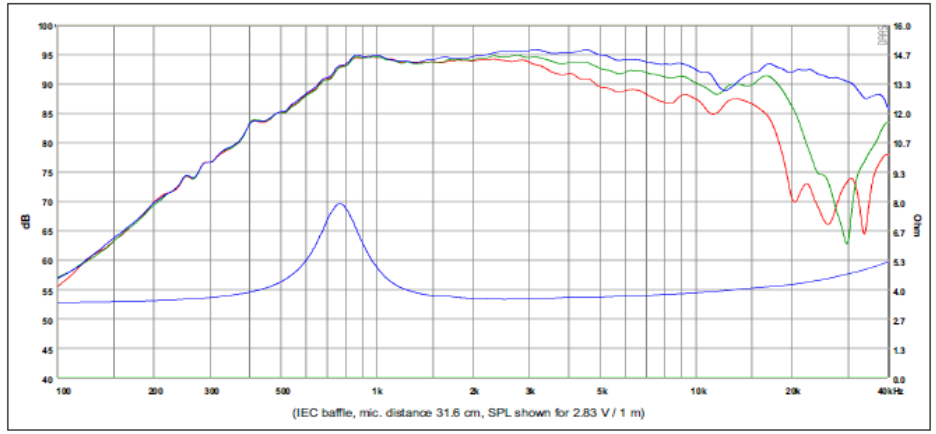

## FEATURES

- Solid aluminium waveguide
- Controlled directivity
- Adapter ring for bolt-less mounting to driver
- Copper cap for reduced voice coil inductance and minimum phase shift
- Non-reflective rear chamber with optimized damping for improved dynamics
- Flow optimized vented pole piece for optimum coupling to rear chamber
- Fine weave soft fabric dome for smooth frequency response
- Saturation controlled motor system for low distortion
- CCAW voice coil for low moving mass
- Long life silver lead wires
- Low resonance frequency

## Specs :

| | | | |
|---|---|---|---|
| Nominal Impedance | 4 Ω | Free air resonance, Fs | 780 Hz |
| DC resistance, Re | 3.2 Ω | Sensitivity (2.83 V / 1 m) | 93 dB |
| Voice coil inductance, Le | 0.04 mH | Mechanical Q-factor, Qms | 2.8 |
| Effective piston area, Sd | 6.2 cm² | Electrical Q-factor, Qes | 2.1 |
| Voice coil diameter | 25.4 mm | Total Q-factor, Qts | 1.2 |
| Voice coil height | 1.3 mm | Force factor, Bl | 1.6 Tm |
| Air gap height | 2.5 mm | Rated power handling* | 120 W |
| Linear coil travel (p-p) | 1.2 mm | Magnetic flux density | 1.15 T |
| Moving mass incl. air, Mms | 0.3 g | Magnet weight | 0.22 kg |
| | | Net weight | 0.61 kg |

* IEC 268-5, high-pass Butterworth, 2600 Hz, 12 dB/oct.




Response Curve :

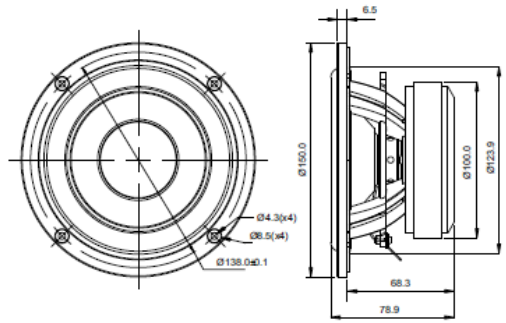
(Blue) : on axis (Green) : 30° off-axis ( Red ) : 60° off-axis

Rev1 (02.09.2019)



SB ACOUSTICS

# 5" SB15CRC30-8



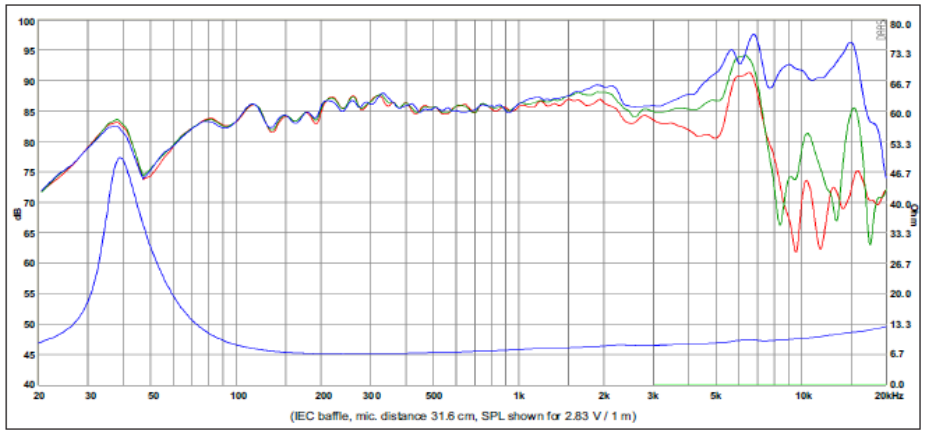

## FEATURES

- Rohacell®/Carbon fibre sandwich cone for optimized stiffness/damping ratio
- Vented cast aluminum chassis for optimum strength and low compression
- Low damping rubber surround for improved transient response
- Non-conducting fibre glass voice coil former for minimum damping
- Extended copper sleeve on pole piece for low inductance and low distortion
- CCAW voice coil for reduced moving mass
- Long life silver lead wires
- Vented pole piece for reduced compression

## Specs :

| | | | |
|---|---|---|---|
| Nominal Impedance | 8 Ω | Free air resonance, Fs | 40 Hz |
| DC resistance, Re | 5.9 Ω | Sensitivity (2.83 V / 1 m) | 86 dB |
| Voice coil inductance, Le | 0.14 mH | Mechanical Q-factor, Qms | 3.52 |
| Effective piston area, Sd | 82 cm² | Electrical Q-factor, Qes | 0.46 |
| Voice coil diameter | 30.5 mm | Total Q-factor, Qts | 0.41 |
| Voice coil height | 16 mm | Moving mass incl.air, Mms | 9.8 g |
| Air gap height | 5 mm | Force factor, Bl | 5.6 Tm |
| Linear coil travel (p-p) | 11 mm | Equivalent volume, Vas | 14.9 liters |
| Magnetic flux density | 1.0 T | Compliance, Cms | 1.62 mm/N |
| Magnet weight | 0.54 kg | Mechanical loss, Rms | 0.7 kg/s |
| Net weight | 1.46 kg | Rated power handling* | 50 W |

* IEC 268-5, T/S parameters measured on drive units that are broken in.




Response Curve :

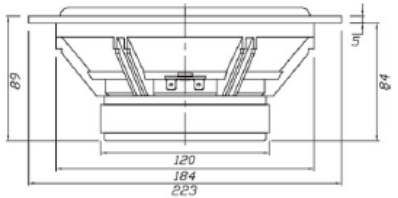
(Blue) : on axis ( Green ) : 30° off-axis (Red) : 60° off-axis

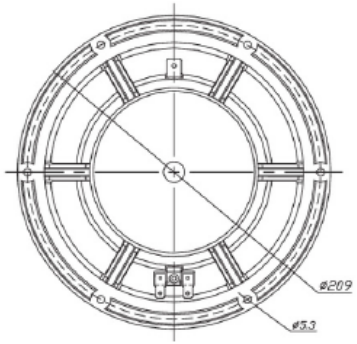
REV1 (26.02.2020)

DAYTONAUDIO

# RS225-8 8" Reference Woofer 8 Ohm

RS225-8

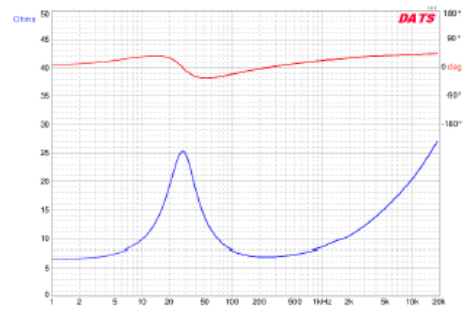



## PARAMETERS

| | |
|---|---|
| Impedance | 8 ohms |
| Re | 6.5 ohms |
| Le | 0.86 mH @ 1 kHz |
| Fs | 28.3 Hz |
| Qms | 1.46 |
| Qes | 0.51 |
| Qts | 0.38 |
| Mms | 35.8g |
| Cms | 0.88 mm/N |
| Sd | 213.8 cm² |
| Vd | 149.7 cm³ |
| BL | 9.05 Tm |
| Vas | 56.8 liters |
| Xmax | 7.0 mm |
| VC Diameter | 38 mm |
| SPL | 86.8 dB @ 2.83V/1m |
| RMS Power Handling | 80 watts |
| Usable Frequency Range (Hz) | 28 - 2,400 Hz |

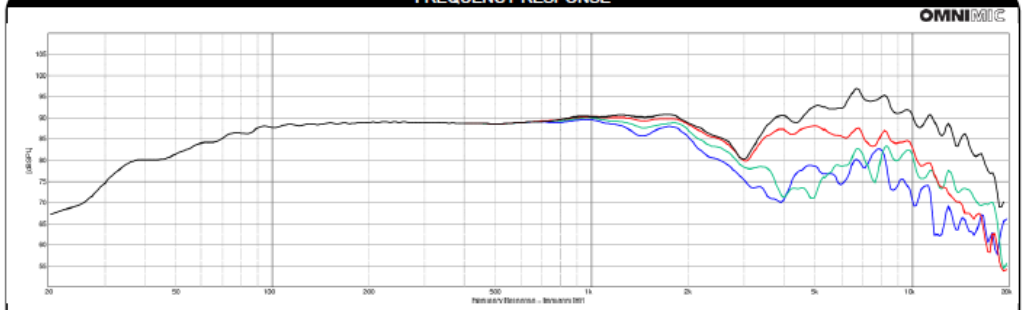
## IMPEDANCE/PHASE




## FEATURES

- One of the lowest distortion, highest resolution driver series available
- Low-distortion high-excursion motor system with two short-circuit paths
- Compliant suspension and rigid black anodized aluminum cone for strong bass performance
- Heavy-duty 6-hole cast frame, low-loss rubber surround, and solid aluminum phase plug
- Designed and engineered in the USA

## FREQUENCY RESPONSE




Note: 1/24th octave smoothing - nearfield response included in graph below 450 Hz.

Black = 0°
Red = 15°
Green = 30°
Blue = 45°

| Dayton DS270-PR 10" Passive Radiator | | |
|---|---|---|
| **Thiele-Small Parameters** | | |
| Resonant Frequency (Fs) | 21.9 | Hz |
| Mechanical Q (Qms) | 3.98 | |
| Compliance Equivalent Volume (Vas) | 106 | liter |
| Mechanical Compliance of Suspension (Cms) | 0.6 | mm/N |
| Diaphragm Mass Inc. Airload (Mms) | 88.4 | g |
| Maximum Linear Excursion (Xmax) | 11 | mm |
| Surface Area of Cone (Sd) | 353 | cm^2 |
| Volume displacement (Vd) | 388 | cm^3 |

# Woofer / Passive Radiator Design

Driver configuration

1 driver

Isobaric

series

Series

Parallel

2 ‖ 2 ...

3 ‖ 3 ...

Extra mass 0.0 g

U 2.83 V

P 1.23 W to 6.5 Ohm

Dayton Audio RS225-8 Vd [cm3] 150

Radiator type Passive radiator

Align | Enclosure | Filter | Info

Box Rear 1

| | |
|---|---|
| Volume [l] | 42.0 |
| Qa | 20 |
| Ql | 15 |
| Fb [Hz] | 34.7 |

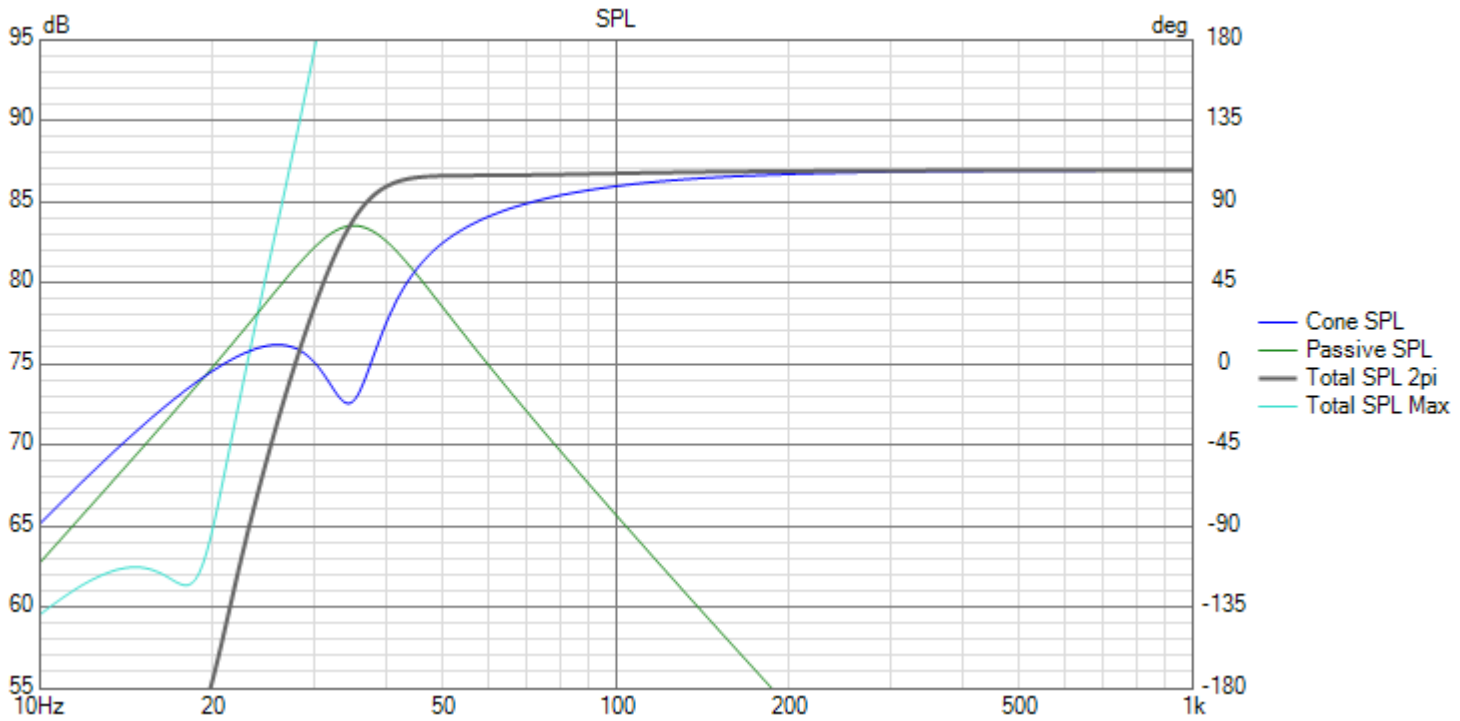
Passive

| | | | |
|---|---|---|---|
| Vas [l] | 106 | fs [Hz] | 21.9 |
| Sd [cm2] | 353 | fe [Hz] | 18.9 |
| Qms | 3.98 | Xsus [mm] | 11 |
| Mms [g] | 88.4 | Number | 1 |
| Extra [g] | 30.0 | Solve | Get |

Dayton DS270-PR Vd [cm3] 388

## 2-pi Small Signal Analysis

RS225-8 in 42 liter box, with DS270-PR passive radiator, 30 g added mass



# Woofer / Passive Radiator Design

Driver configuration

1 driver

Isobaric | Series

series | Parallel

Extra mass 0.0 g

2 ‖ 2 ...

U 20.13 V

3 ‖ 3 ...

P 62.3 W to 6.5 Ohm

Dayton Audio RS225-8 Vd [cm3] 150

Radiator type Passive radiator

Align | Enclosure | Filter | Info

Box Rear 1

| | |
|---|---|
| Volume [l] | 42.0 |
| Qa | 20 |
| Ql | 15 |
| Fb [Hz] | 34.7 |

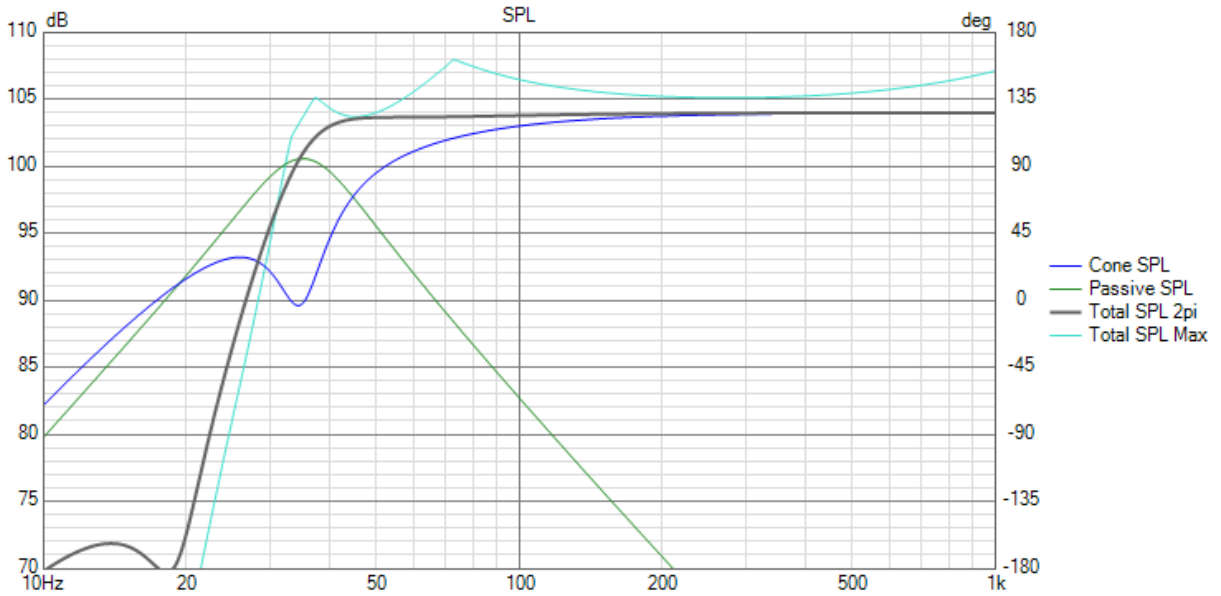
Passive

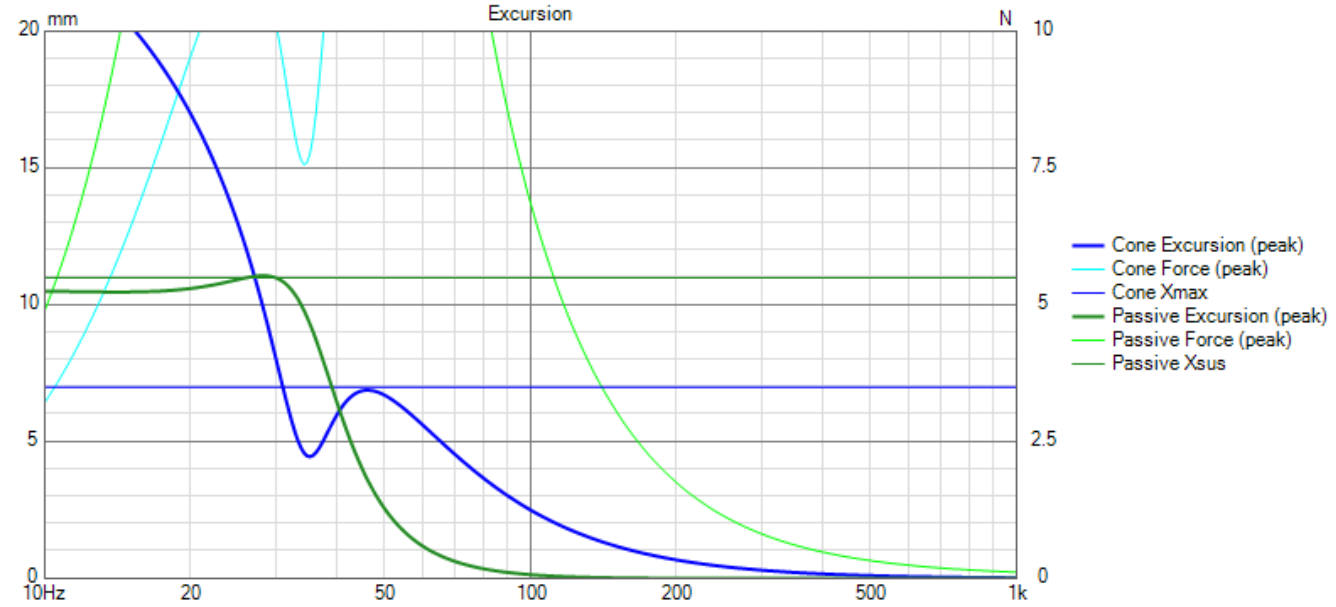
| | | | |
|---|---|---|---|
| Vas [l] | 106 | fs [Hz] | 21.9 |
| Sd [cm2] | 353 | fe [Hz] | 18.9 |
| Qms | 3.98 | Xsus [mm] | 11 |
| Mms [g] | 88.4 | Number | 1 |
| Extra [g] | 30.0 | Solve | Get |

Dayton DS270-PR Vd [cm3] 388

## 2-pi Large Signal Analysis

Woofer and PR both reach excursion limit at 103.5 dB SPL (nominal), at 62 W

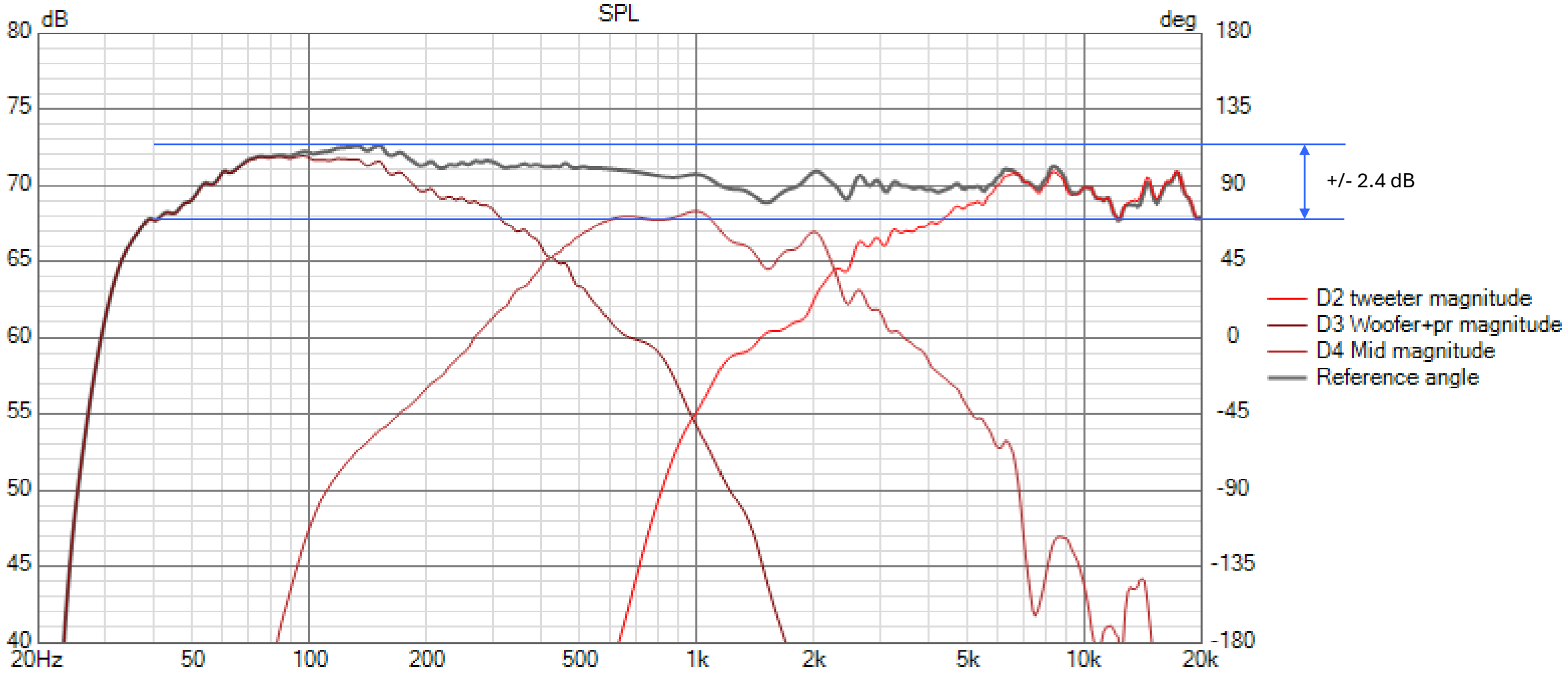


# *Measured Performance*

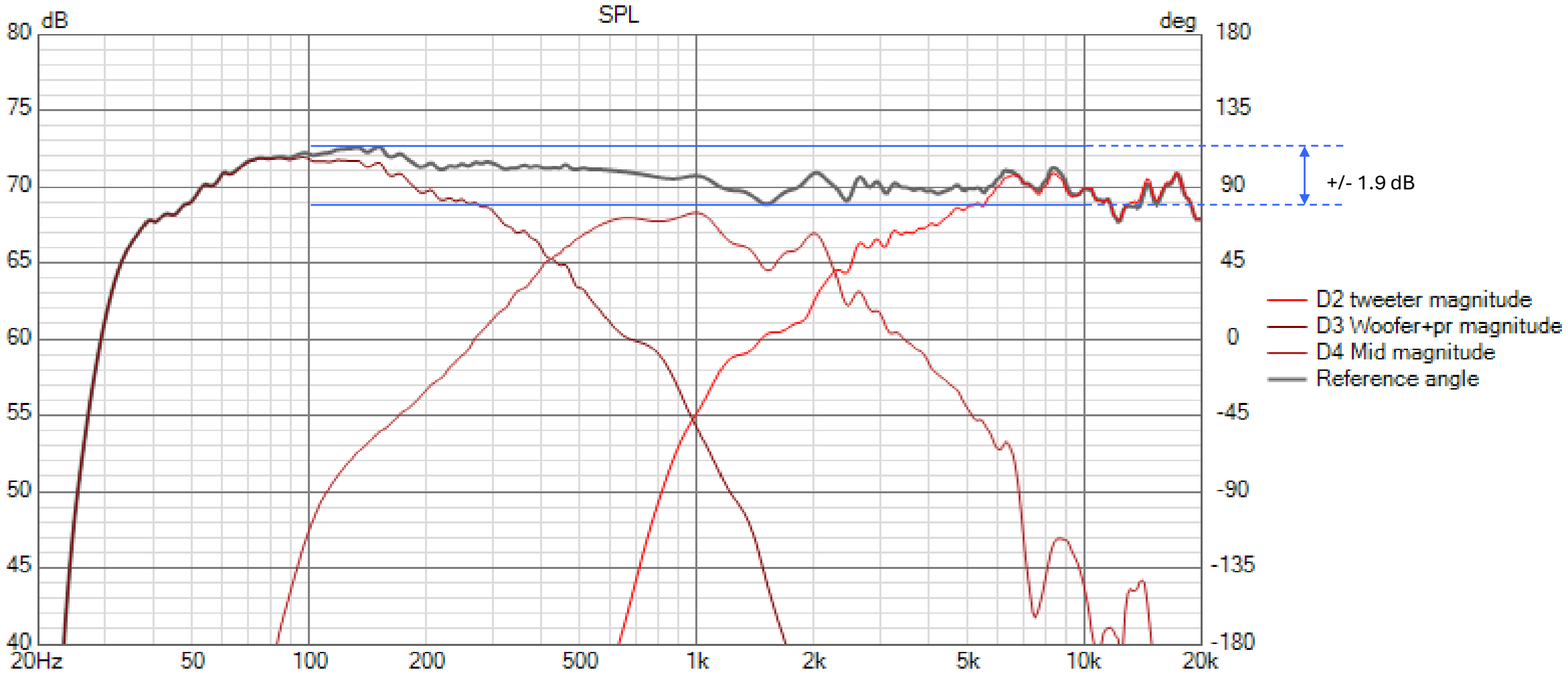
- Audix TM1 calibrated microphone, Motu M2 audio interface, ARTA software suite, VituixCad2 processing of impulse response and merging
- Far field gated FR scans at 1 m, 5 ms reflection free time window (gate), horizontal polar measurements at 15º increments
- Individual driver data:  Near field FR scans for low frequencies were merged with gated far field scans using the VituixCad merger tool
- System level data:  An outdoor ground plane scan for low frequencies was merged with gated far field scans using the VituixCad merger tool
- ARTA suite used for cumulative spectral decay, burst decay, and harmonic distortion analysis

## Frequency Response: +/- 2.4 dB from 40 Hz to 20 kHz



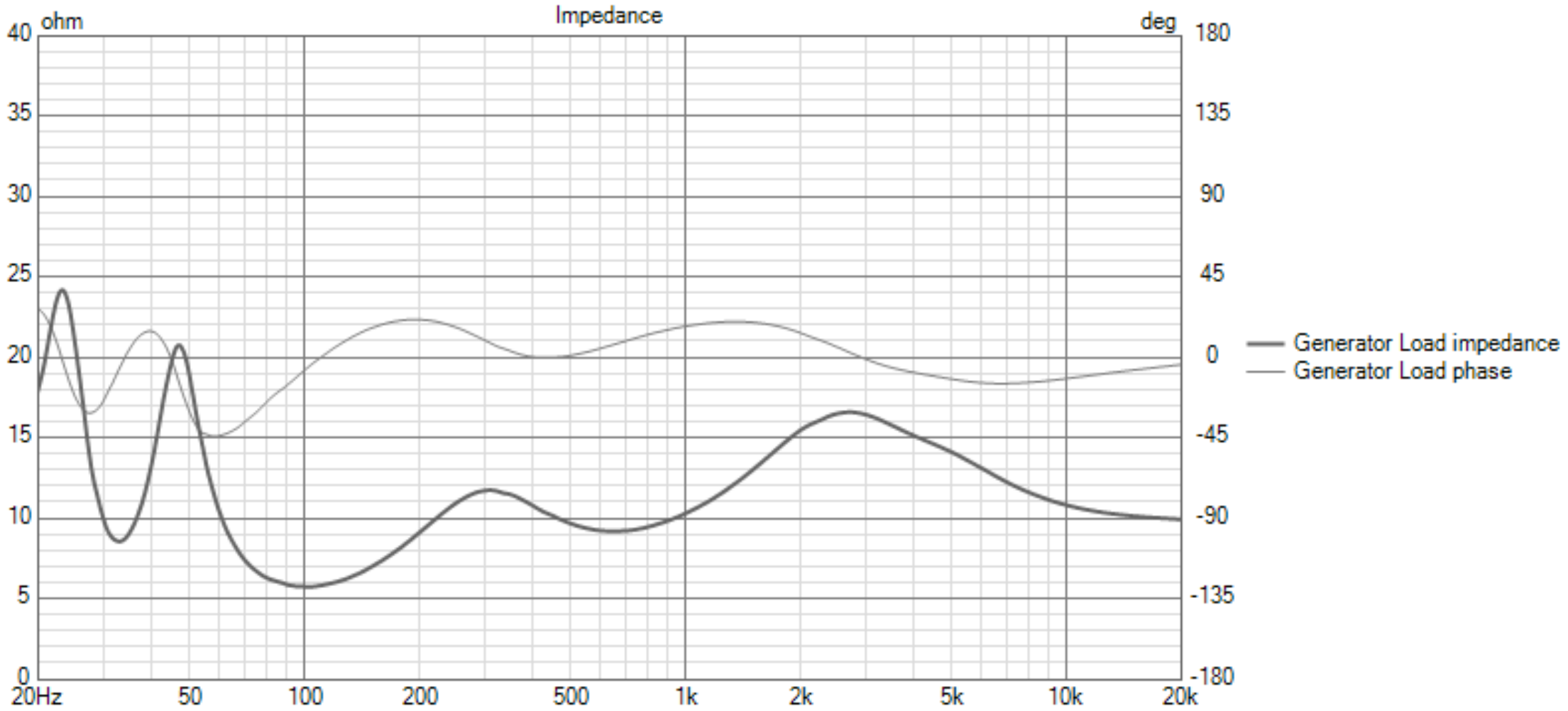

*Frequency response: +/- 2.4 dB from 40 Hz to 20 kHz, measured on tweeter axis at 1 m*
*Bass extension: -3 dB at 43 Hz, -6 dB at 33 Hz (relative to 200 Hz)*

# Frequency Response in the Critical Middle Frequencies: +/- 1.9 dB from 100 Hz to 10 kHz



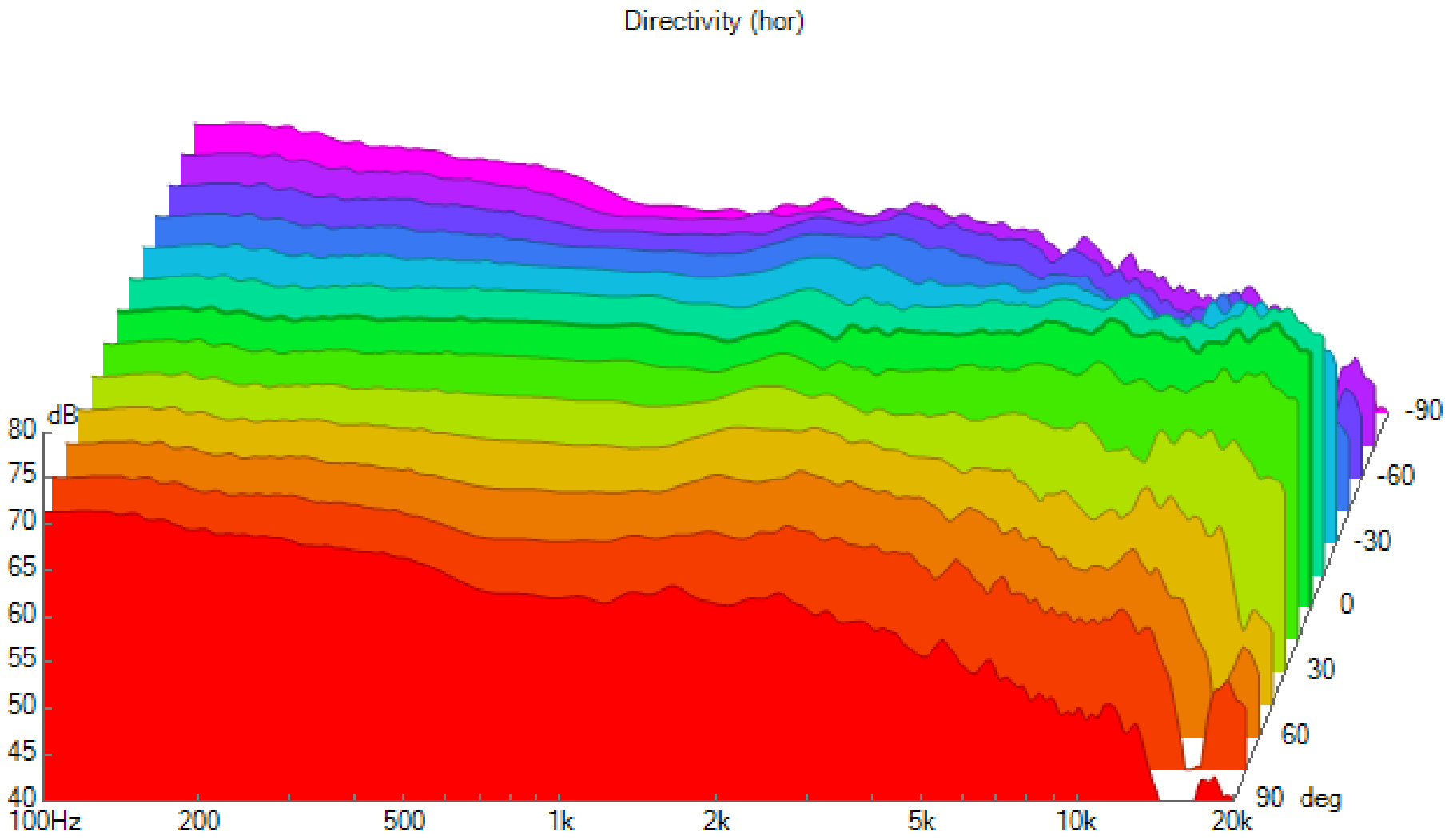

*Frequency response: +/- 1.9 dB from 100 Hz to 10 kHz, measured on tweeter axis at 1 m*

## Impedance Response



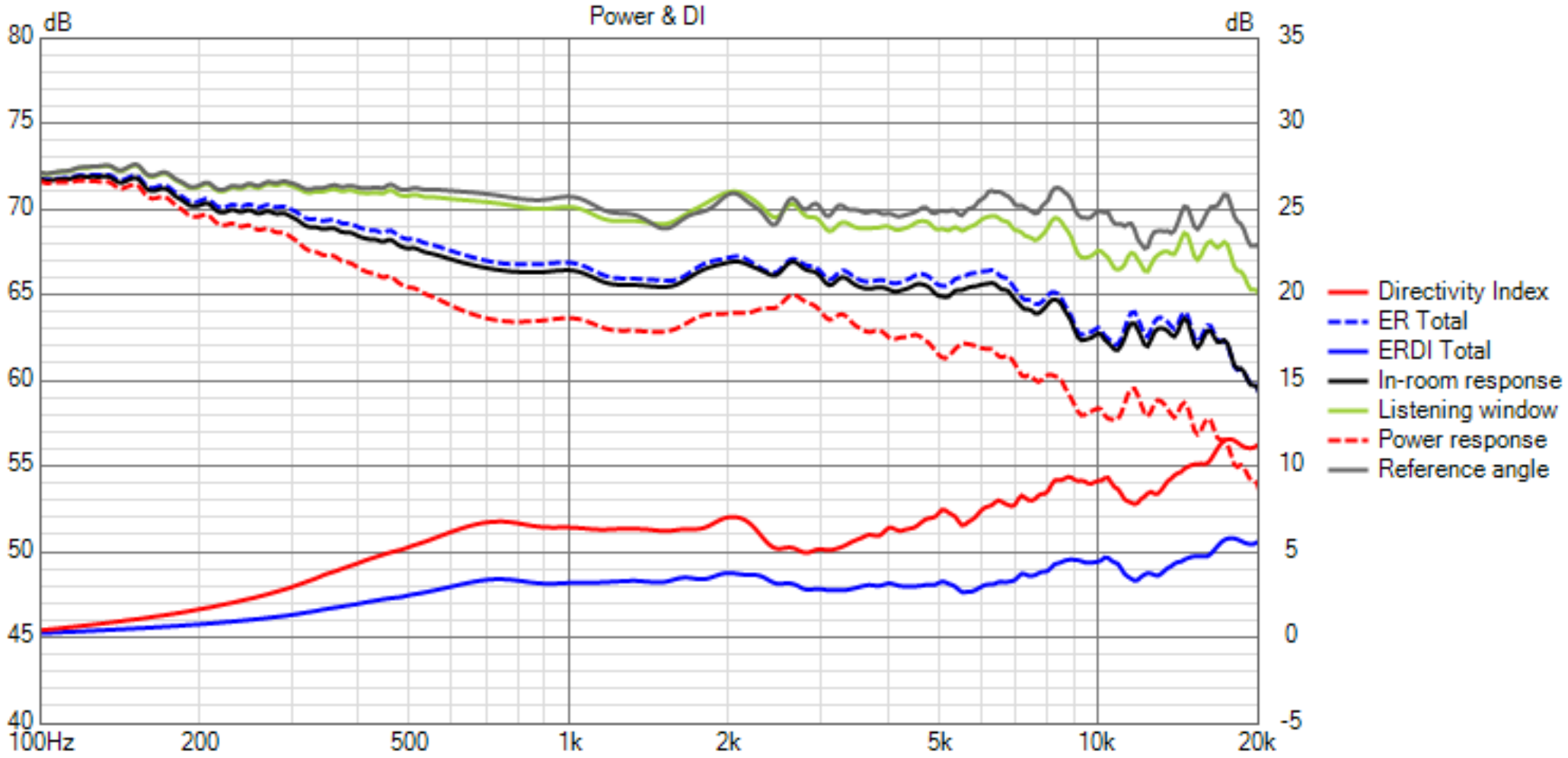

*Nominal 8 Ohm impedance with benign phase angle. Minimum impedance is 5.8 Ohm @ 100 Hz.*

# Horizontal Polar Response



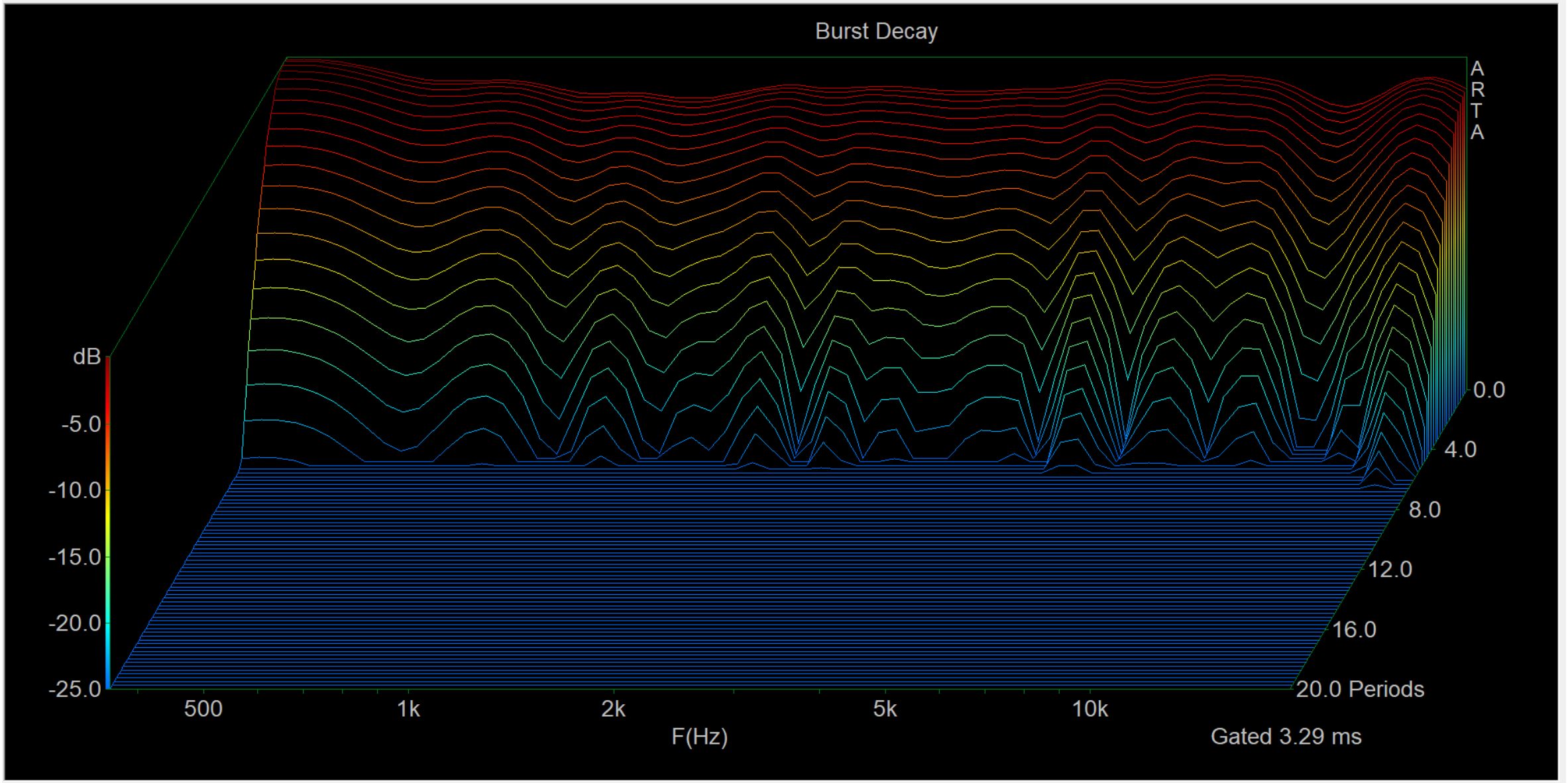

*Very nice off-axis performance*

## Sound Power and Directivity Performance (ANSI/CTA-2034A Performance Data)




*Both the Sound Power and the Predicted In-Room curve are well behaved. This speaker should be easy to position in a room and will be unfussy about speaker and listener position*

## Burst Decay Plot, 3.29 ms time window

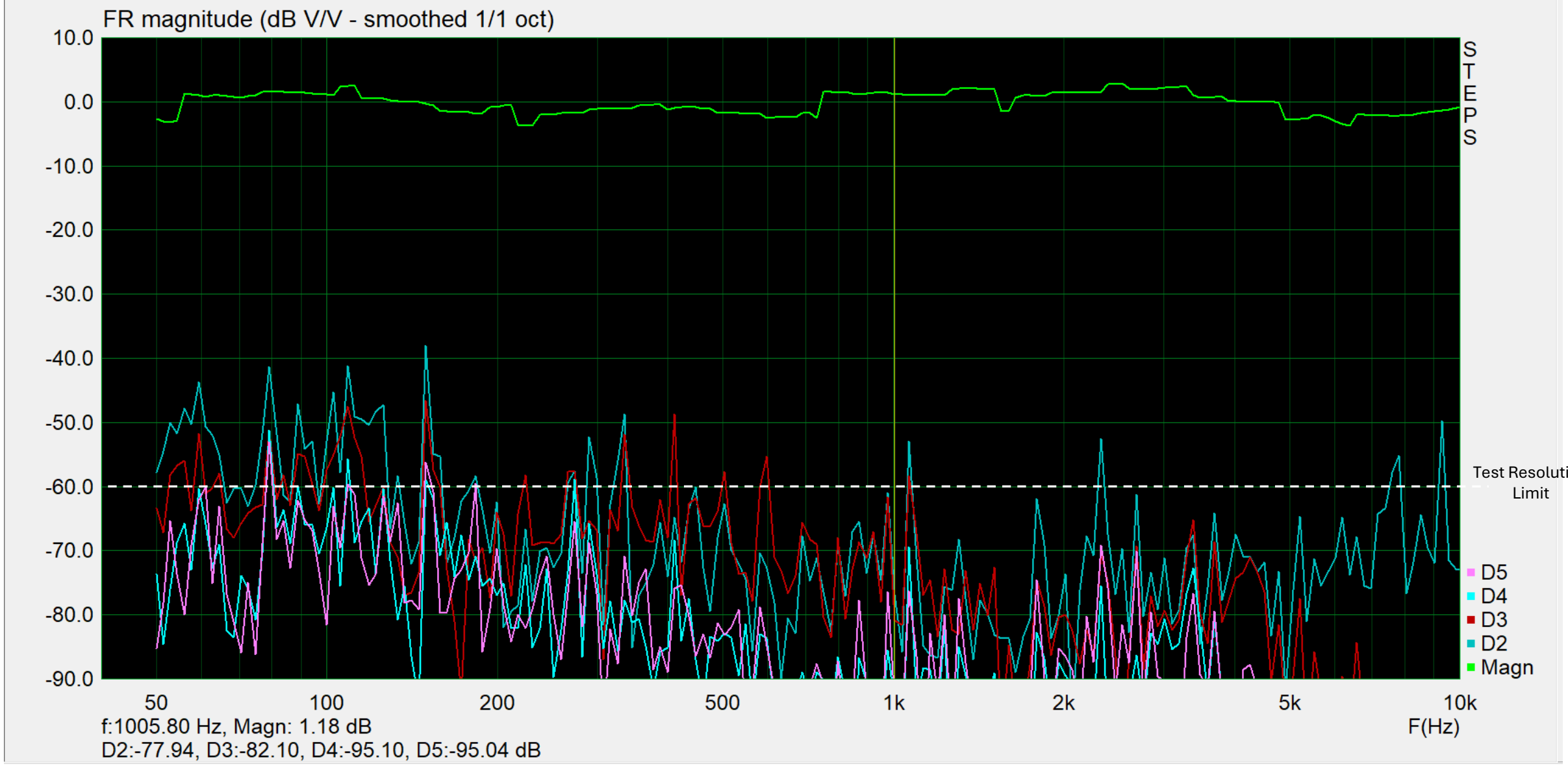



*Clean Decay and minimal resonances down to -25 dB*

# Harmonic Distortion, 2nd – 5th Harmonic

Test conducted at 91 dB SPL at 1 m (ref 1000 Hz).

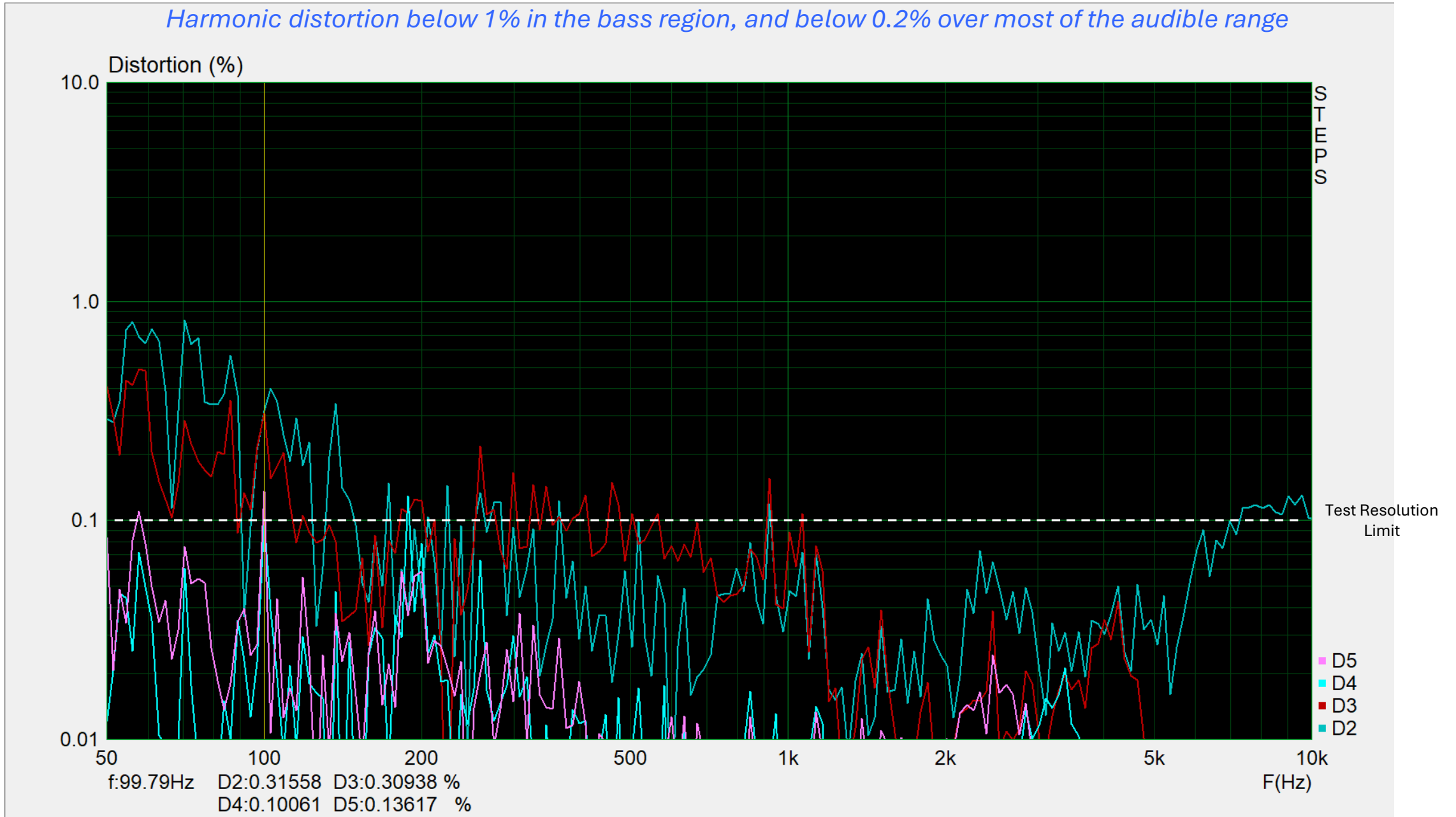
Fundamental signal smoothed with octave band smoothing,  Test Resolution limit: -60 dB



# Percent Harmonic Distortion, 2nd – 5th Harmonic

Test conducted at 91 dB SPL at 1 m (ref 1000 Hz). Test Resolution limit: 0.1% (-60 dB)

*Harmonic distortion below 1% in the bass region, and below 0.2% over most of the audible range*



- *Simulations used early in the design phase to optimize:*
  - *Driver position and spacing*
  - *Baffle edge effects*
  - *Woofer / passive radiator bass tuning*

- *Prototype constructed to validate the simulations*
  - *Baffle edge effects on high frequencies*
  - *Driver horizontal and vertical polar response*
  - *Driver distortion*

- *Several midrange drivers were evaluated during prototype testing*

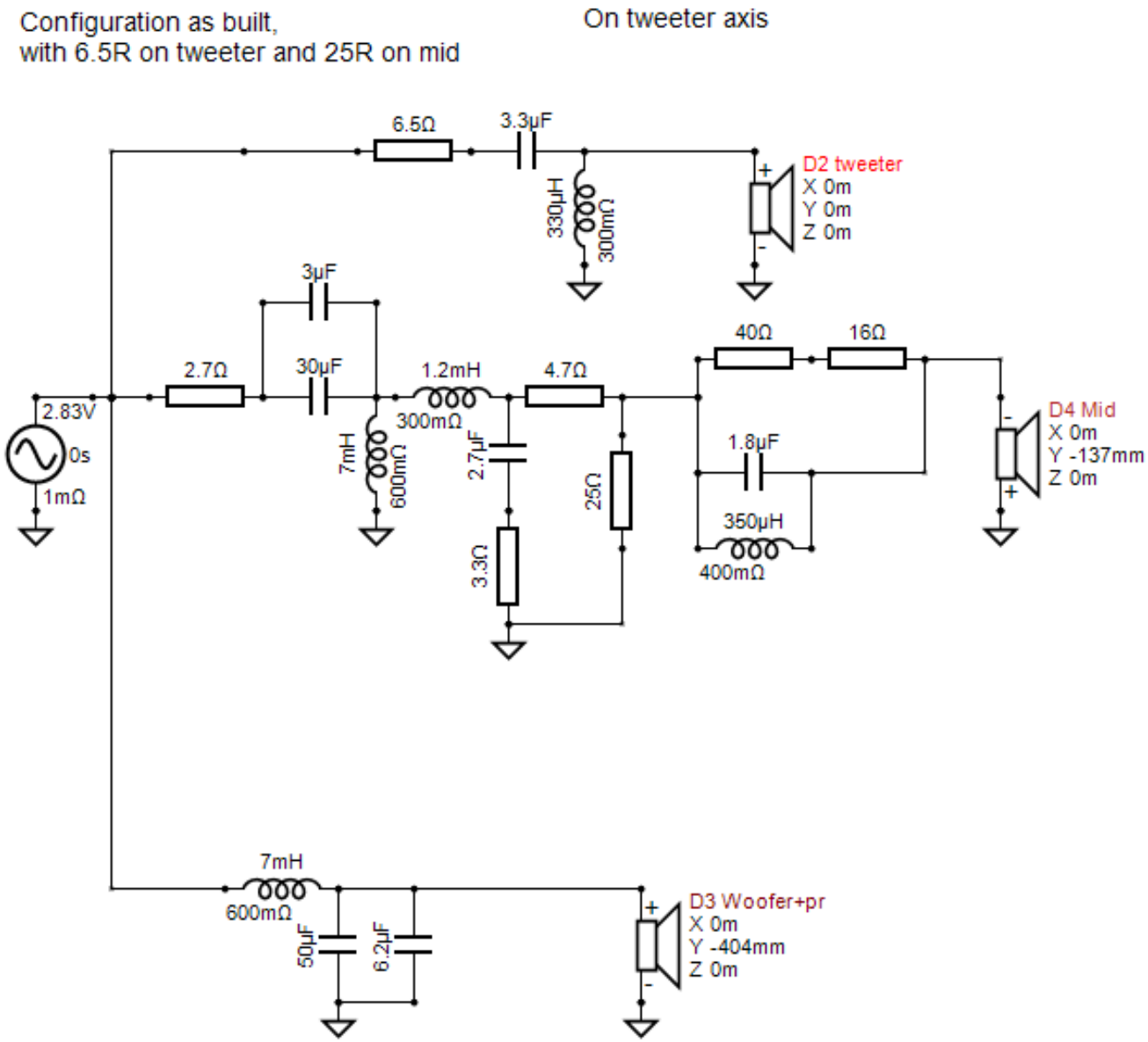
**Individual Driver Far Field Time Windowed Horizontal Polar Response Measurements**

A reflection-free time window of 5 ms allows quasi-anechoic resolution down to 200 Hz

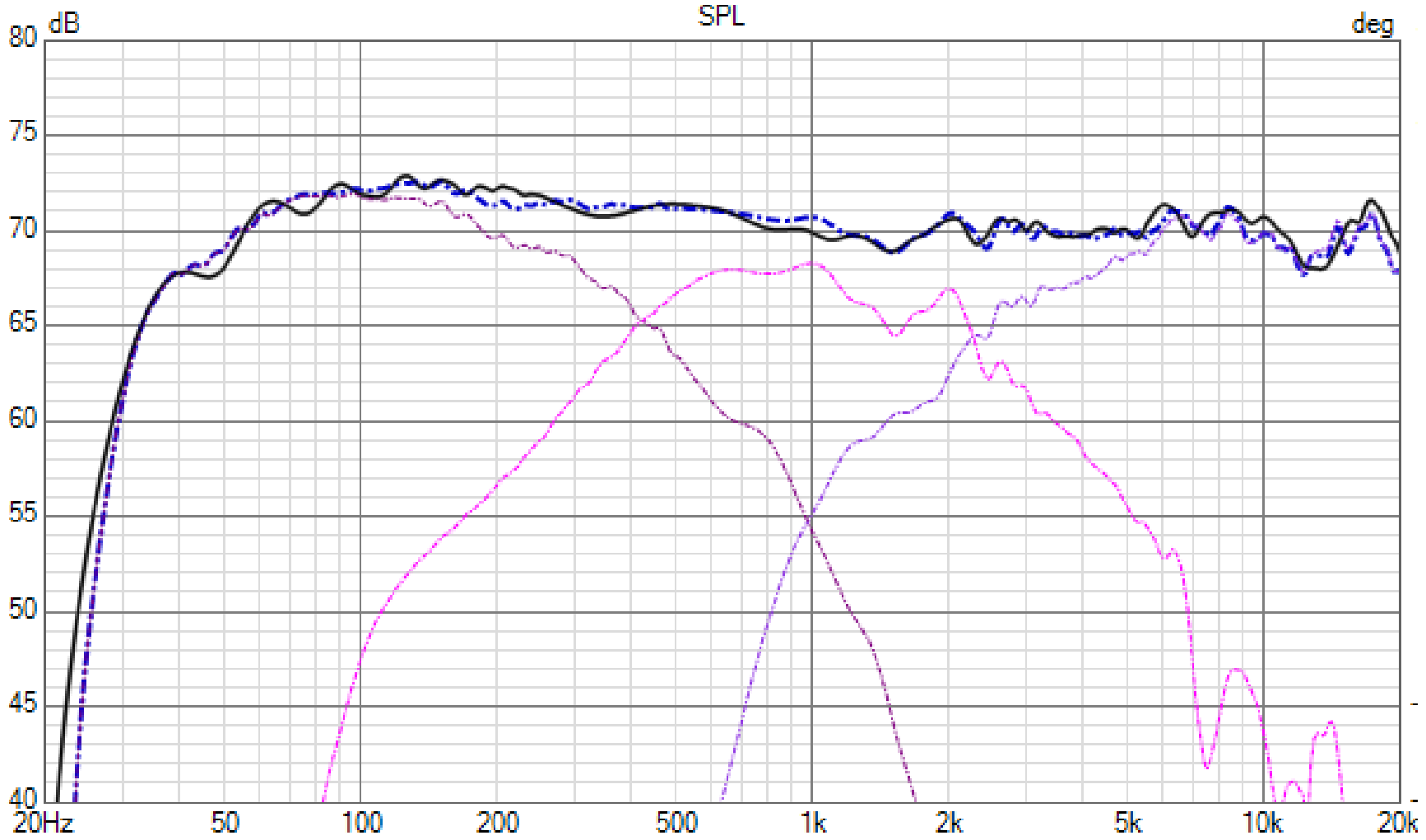
**System Level Outdoor Ground Plane Measurement for Low Frequencies**

Reflection-free zone of 19 ft radius allows low frequency resolution down to 30 Hz

- *3-Way filter network developed with VituixCad2*
- *Program inputs are measurements taken with drivers installed in completed cabinet*
  - *Impedance response*
  - *Driver near-field response*
  - *Driver far-field polar response 0-180°*
- *Filter network optimized for multiple competing attributes*
  - *On/off axis frequency response,*
  - *Benign impedance*
  - *Power dissipation*
  - *Ease of tuning*



# Comparison of Simulation to Measured Response shows Excellent Agreement

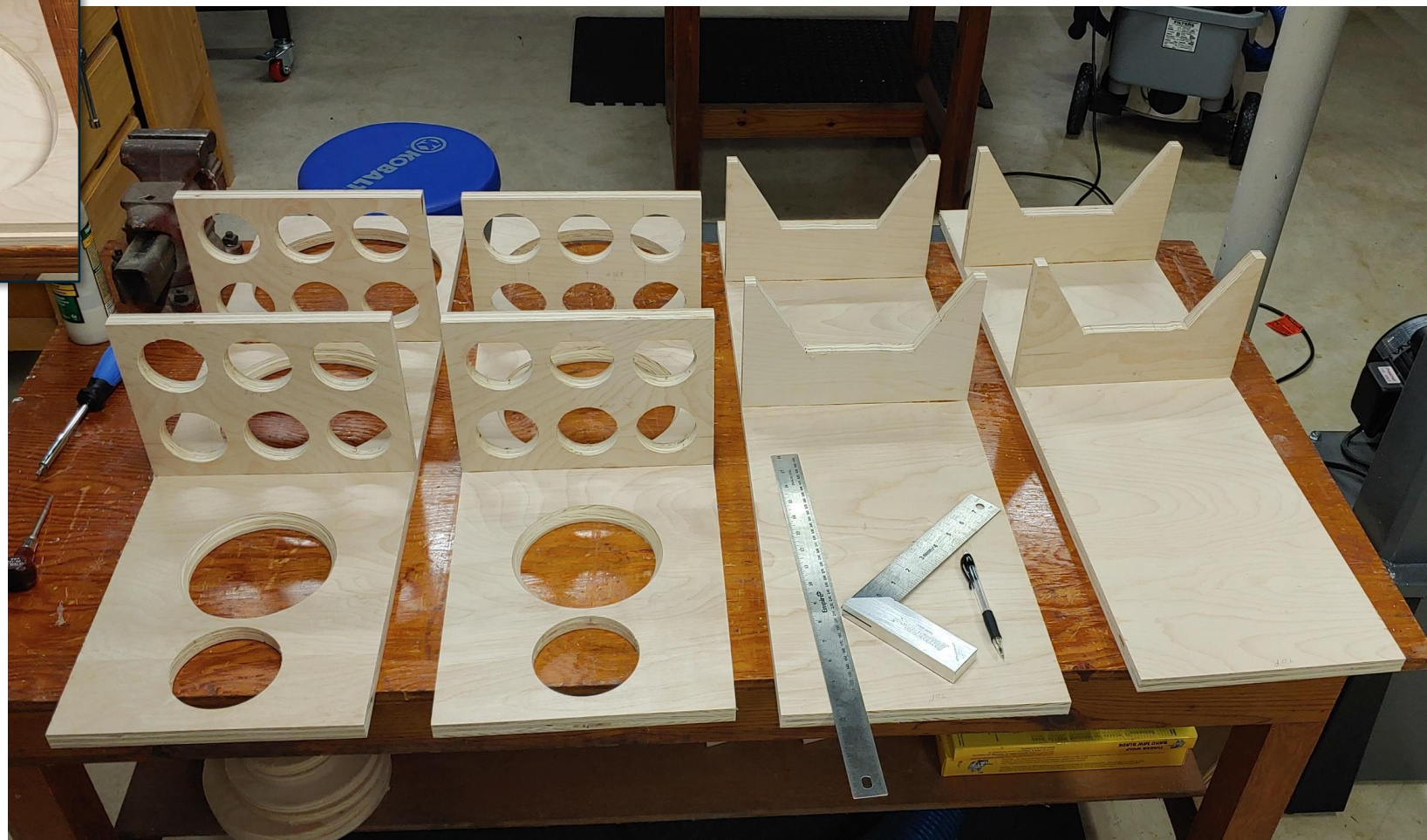



Dashed line: VituixCad simulation based on measured individual driver responses

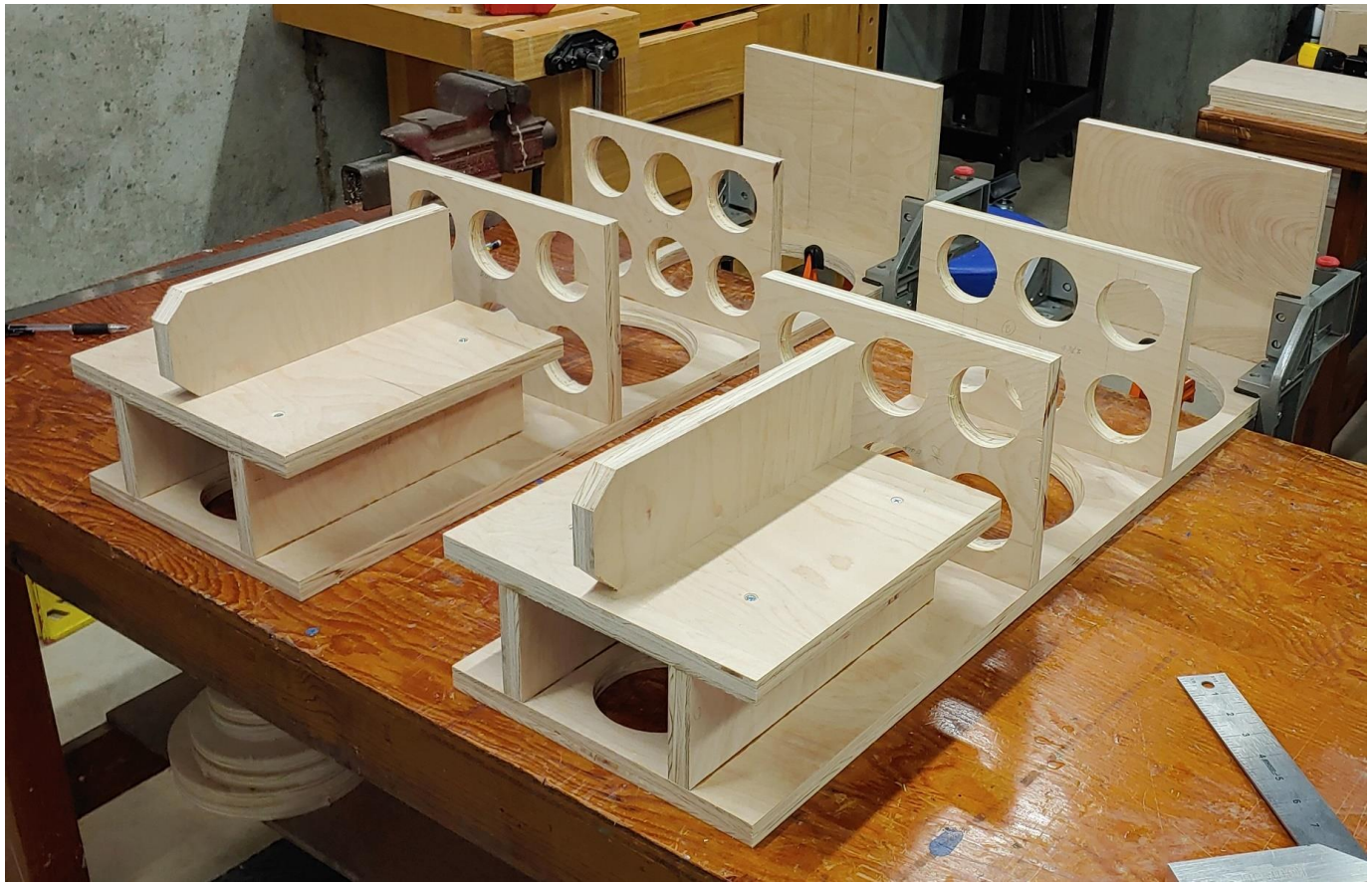
Solid line: System level measured response; Far field windowed data above 200 Hz, outdoor ground plane data below 200 Hz

# *Construction Photos*

First steps in the assembly process



Structural bulkheads and the midrange sub-enclosure are assembled to the inner baffle



Inner carcass consisting of inner baffle, rear wall, top, bottom, and all interior bracing.  Next step is side walls and outer baffle

⬇ Outer baffle after machining


⬆ Attaching the outer baffle.  Total baffle thickness is 1.5” (38 mm)

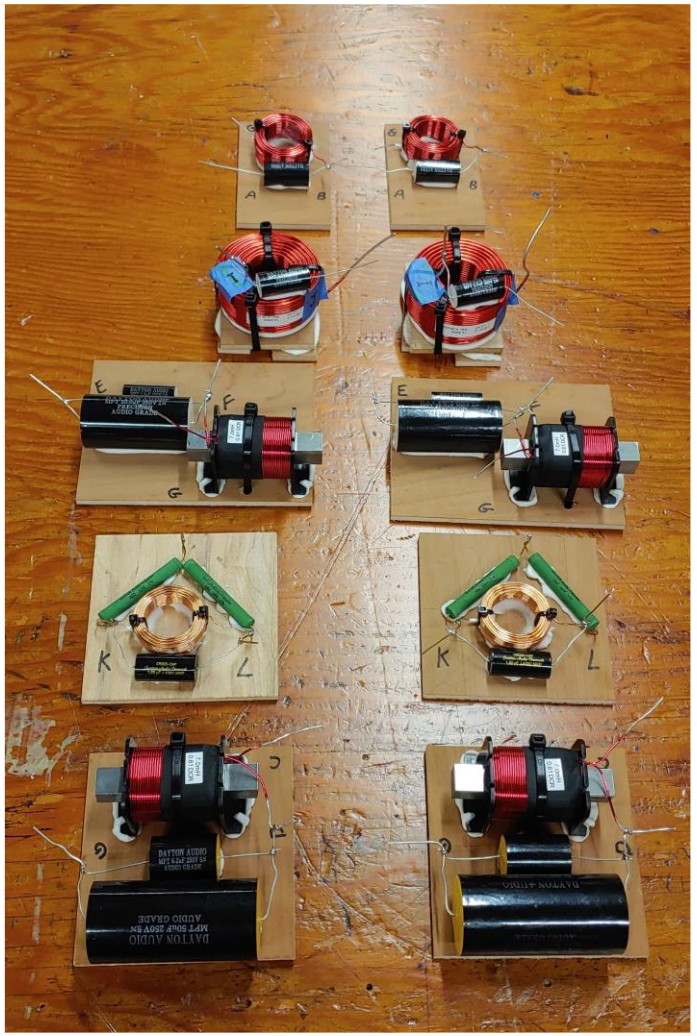
Machining the bevels.  Beveled edges are a key feature of the diffraction mitigation plan.  When combined with a waveguide tweeter, diffraction is significantly reduced

Main cabinet complete

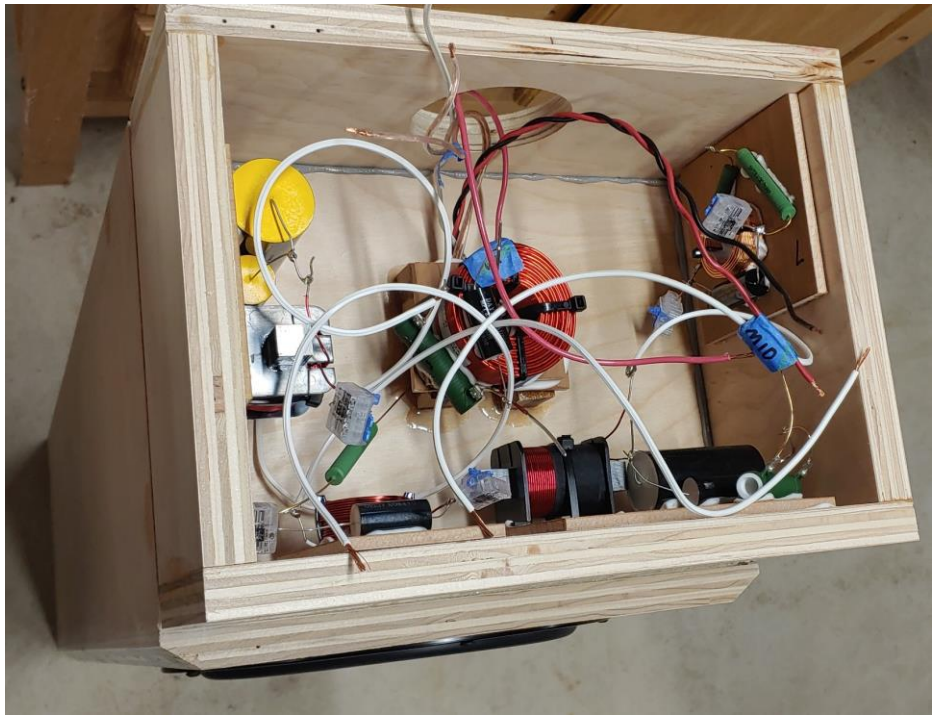
⇐ Finished cabinet, ready for testing.
On the left, the speaker is without the base plinth. Individual driver testing took place in this configuration.

After the preliminary crossover filter was designed and built, the base plinth was added. On the right, the speaker is undergoing system level testing.

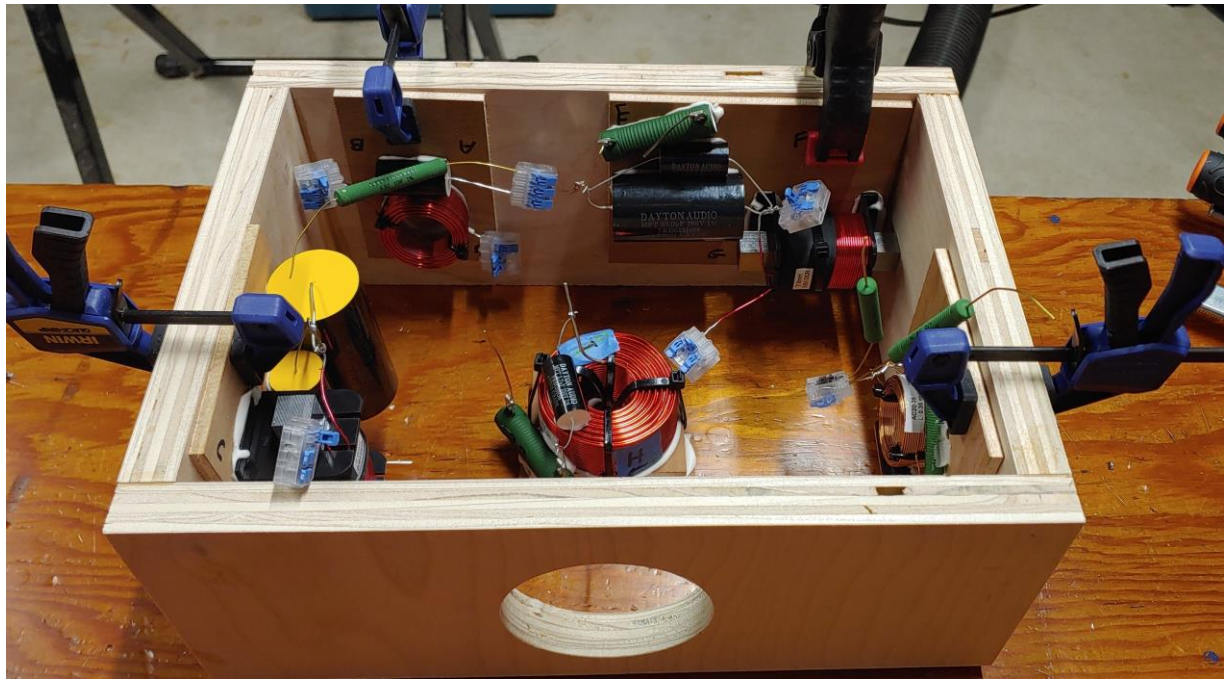
Crossover Assembly



Crossover installed in the base



Crossover physical mockup



Veneering and finishing process.  Sapele veneer was applied to all sides and finished with satin polyurethane varnish.  Support brackets and rubber feet were added.

Details of foot bracket – mahogany bracket with rubber feet.  A removable plate on the bottom allows access to the electrical filter network

After testing, the speakers underwent a subjective evaluation for final crossover adjustment