

AES 59th International Conference

Suitability of Folded-Ribbon High-Frequency Drivers for High-Power Sound Reinforcement Systems

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Overview

1. Introduction
2. Theory
3. A Case Study: System Layout
4. Measurements
5. Sound Quality
6. Summary

Introduction

Modern live sound with line arrays

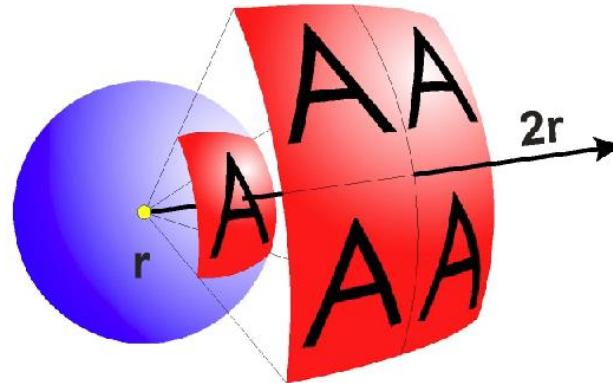
- Tweeters
 - Usually compression drivers
 - Less energy above 12 kHz
- Alternative: Air Motion Transformer (AMT)
 - **An old principle with new technology**
 - Better materials available
 - Improved mechanical characteristics, largely increased power handling
 - Frequencies up to 24 kHz

=> Development of a line array with new Folded-Ribbon Driver

Theory

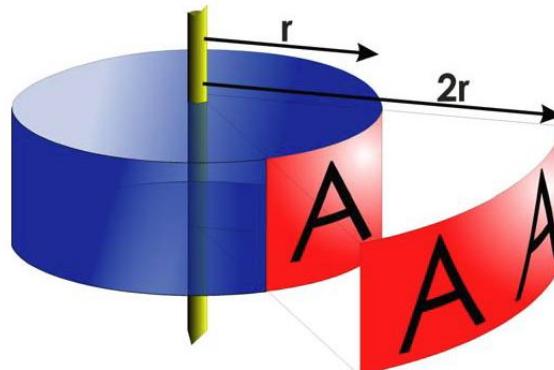
Spherical sound source

- Sound pressure decreases by 6 dB per doubling of distance
- Interferences in line array



Line sound source

- Cylindrical waves
- Sound pressure decreases by 3 dB per doubling of distance
- Nearfield / far sound field



Theory

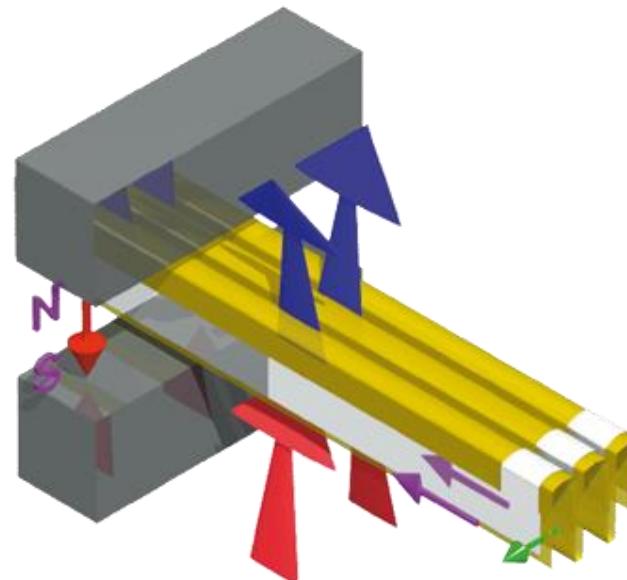
Compression driver

- Wave guide required

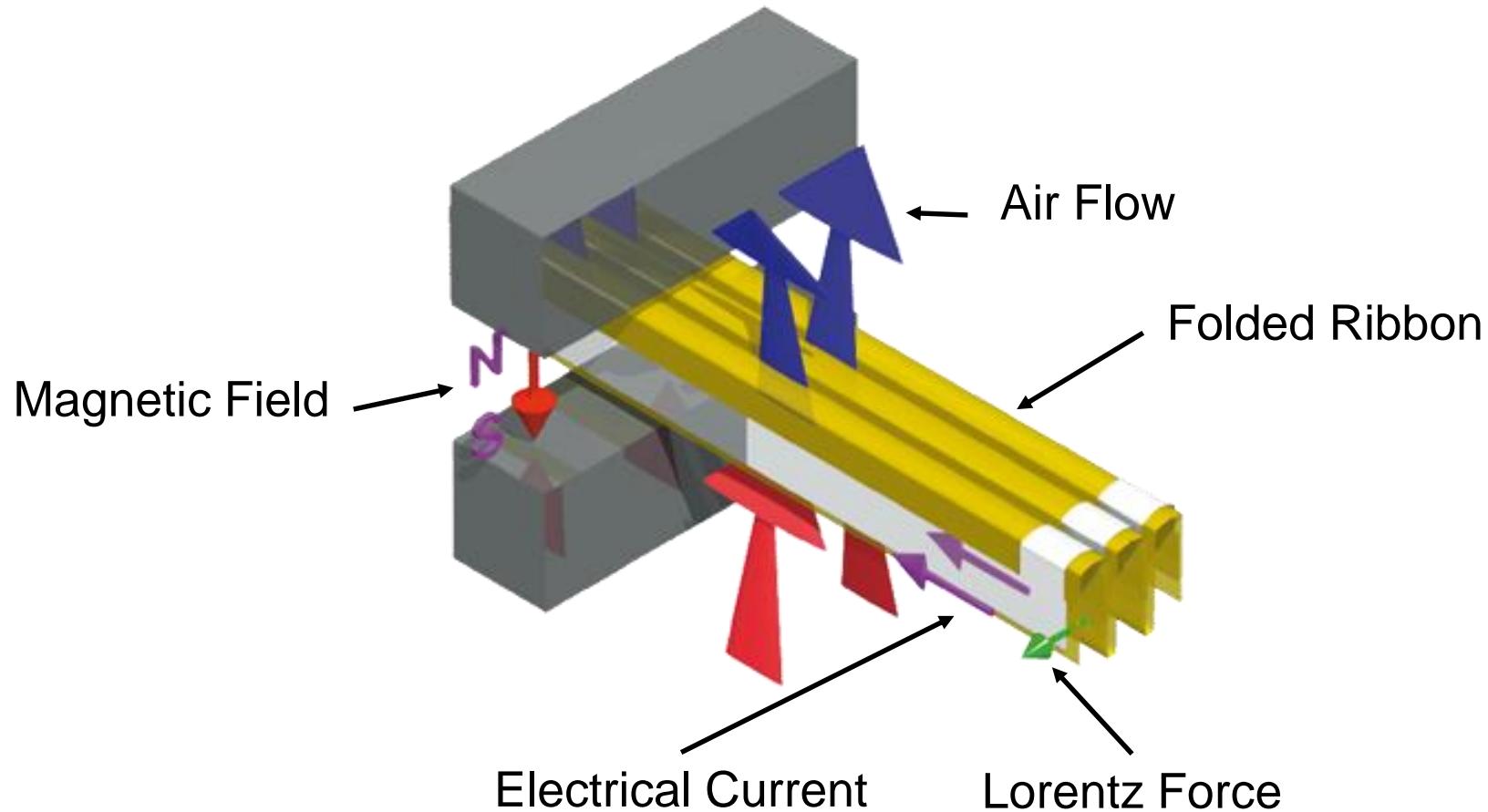


Air Motion Transformer

- Line source by nature



Operating Principle



Folded-Ribbon Driver Advantages

- Line sound source by nature
 - No partial vibration (if manufactured properly)
 - Distortion dominated by 2nd Order
 - Very good impulse behavior
- Well adequate for use in line arrays

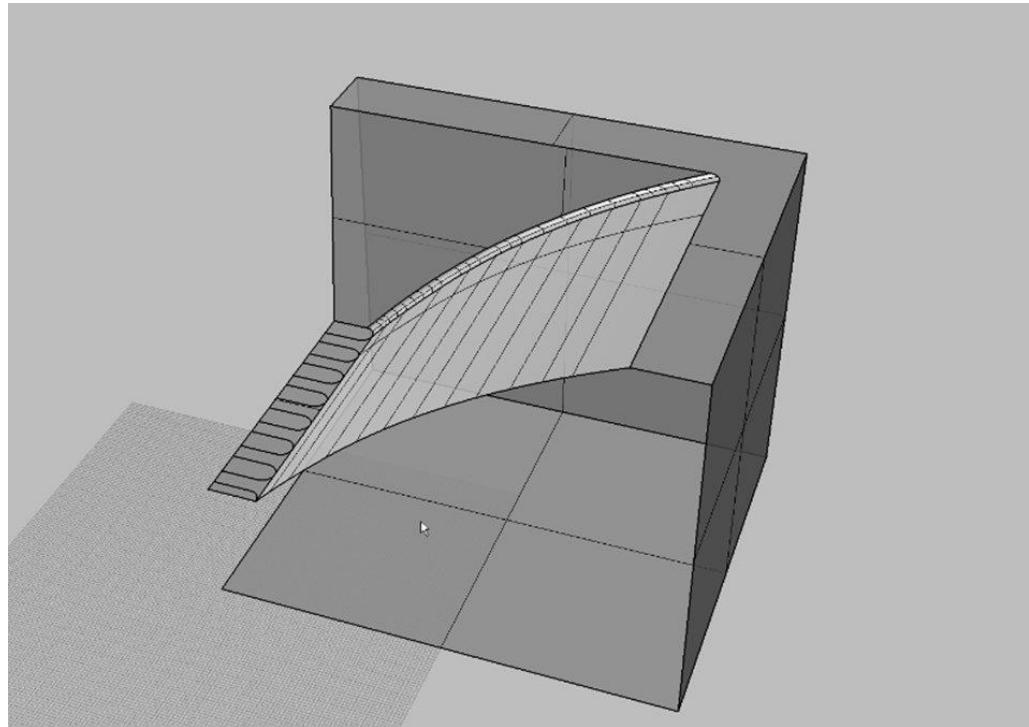
A case study

System:

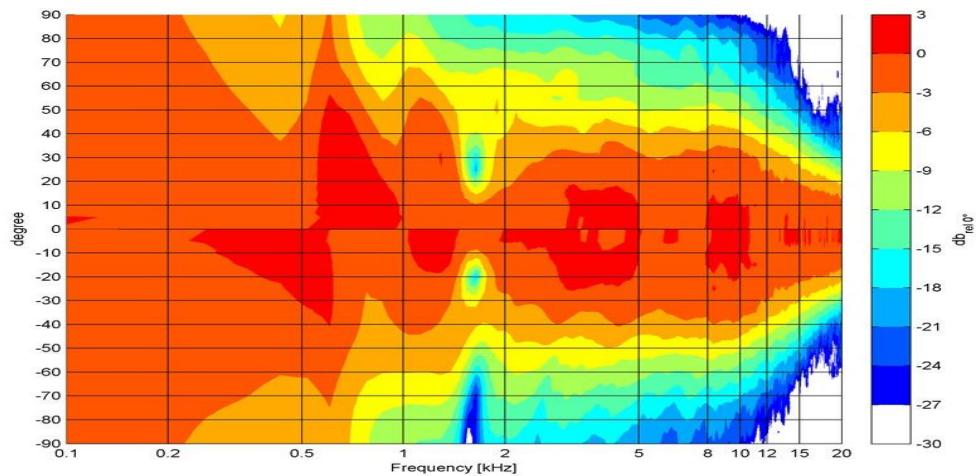
- Decision for 8"-System with 2.5-way-system
- Target parameters based on market research
 - Frequency Response: 90 Hz – 18 kHz
 - Horizontal directivity: 90° independent of frequency
 - Max. SPL: 130 dB for one cabinet

Case study

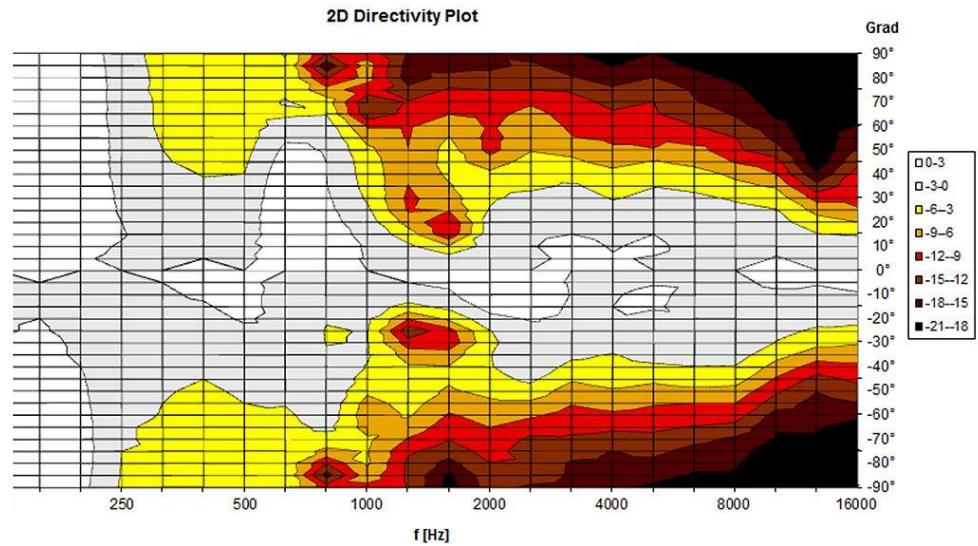
- Measurement of 8"-chassis and the AMT
- Bassyst simulation
 - Bass reflex setup
- Horn calculation for target directivity (90°)



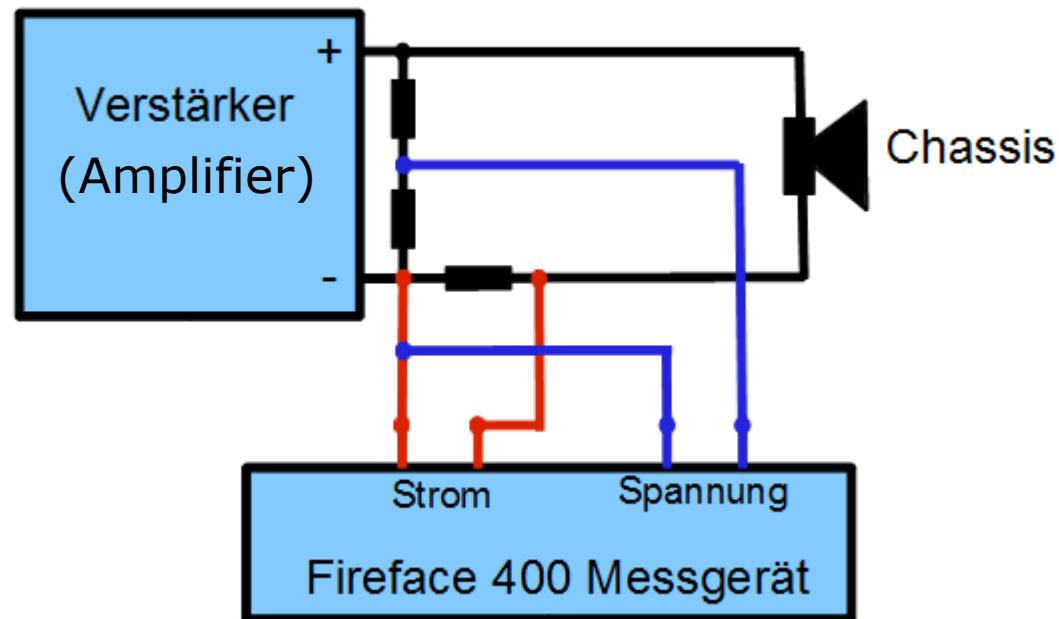
Simulated Horizontal Directivity



Measured Horizontal Directivity

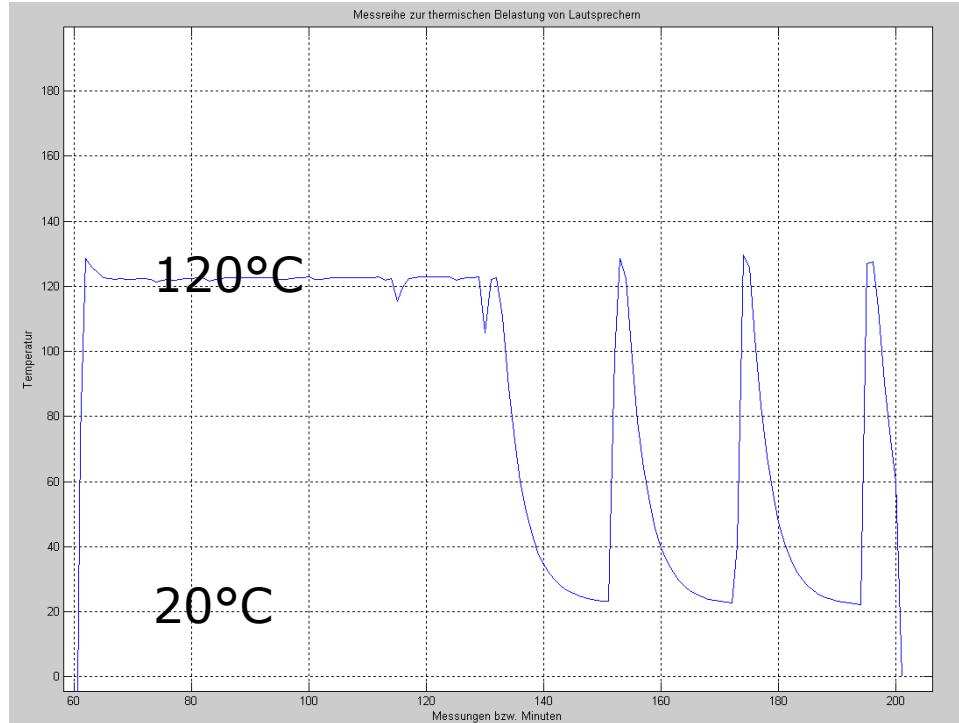


„Power is nothing without Control“



(Monitoring voltage and current to calculate temperature in MATLAB)

Thermal measurement: AMT driver



Loading time	Power
170 ms	1500 W
340 ms	1330 W
680 ms	670 W
1360 ms	420 W
Continuous	250 W

Case study: 2 ½ way Cabinet



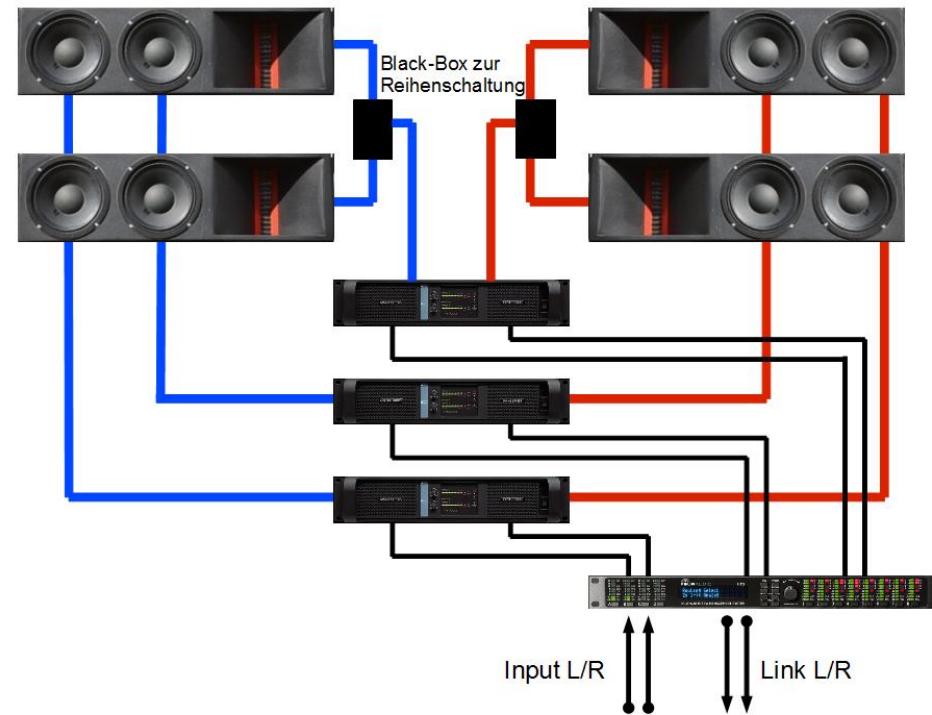
System Setup: Schematic view

Amplifier

- Lab.gruppen FP+14000
 - 900 Watt per chassis

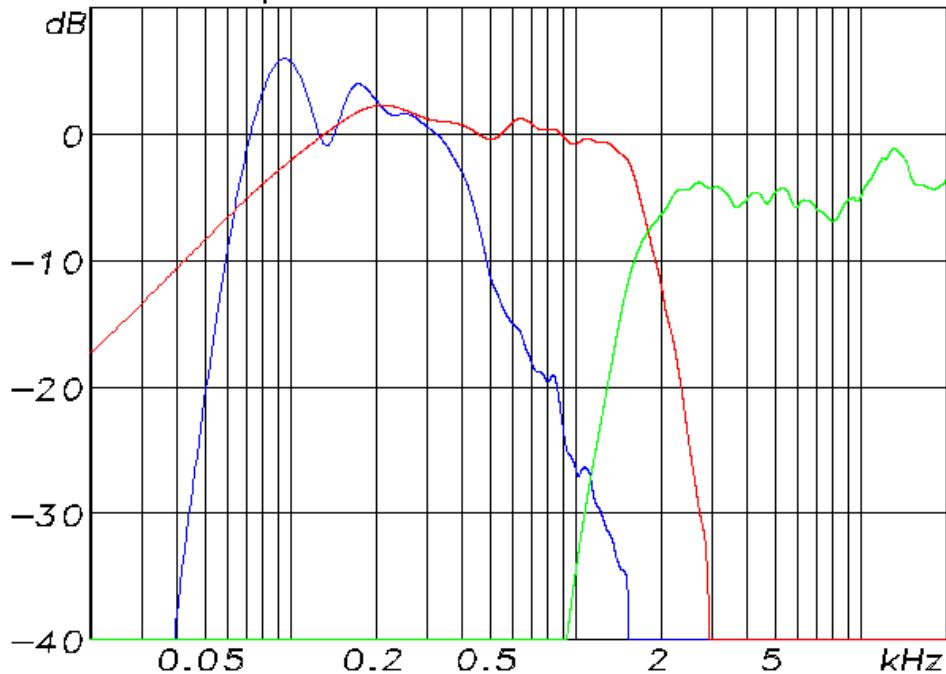
Controller

- Four Audio: HD 2

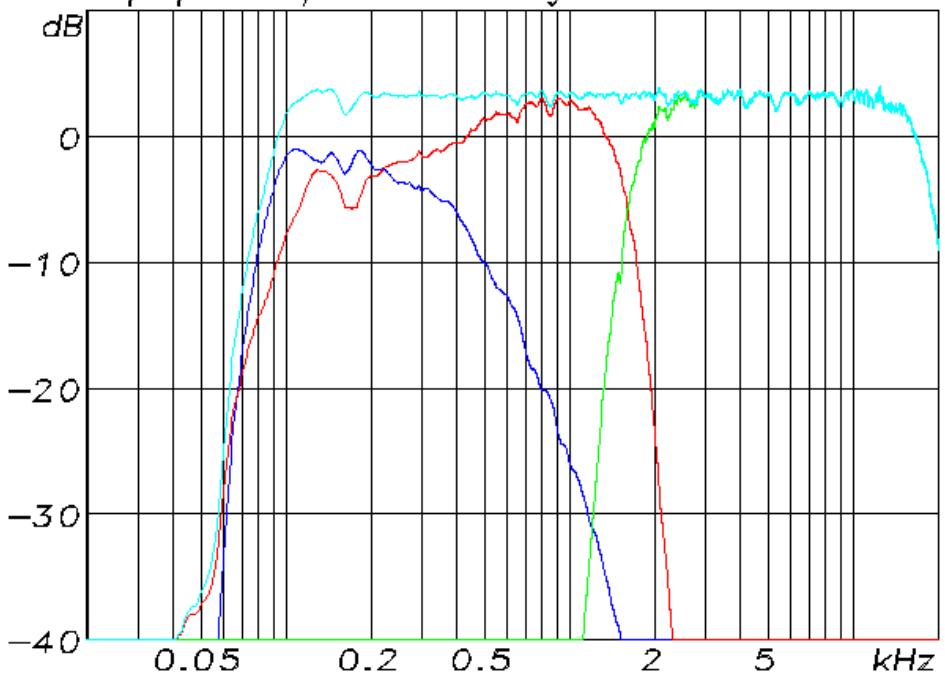


FIR Filters, Frequency Responses

FIR filter passbands

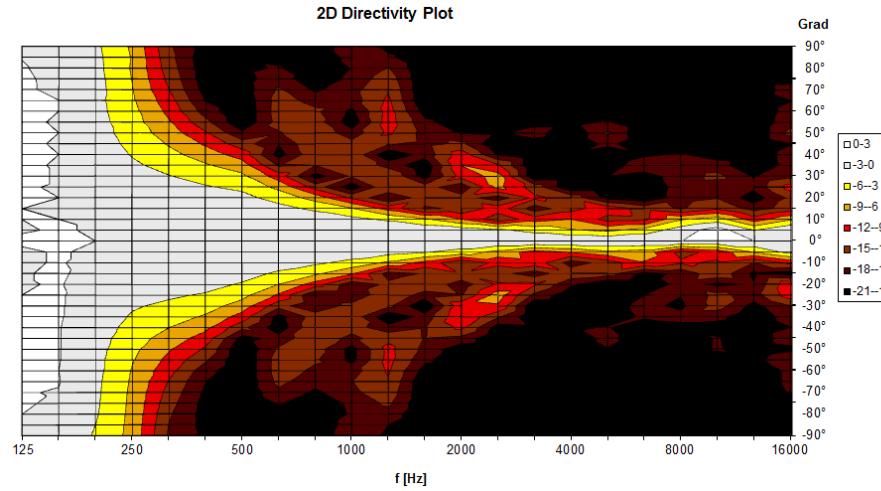


Freq.Resp. Gesamtsystem 1xRLA Einzelwege + resultierender Gesamtverlauf

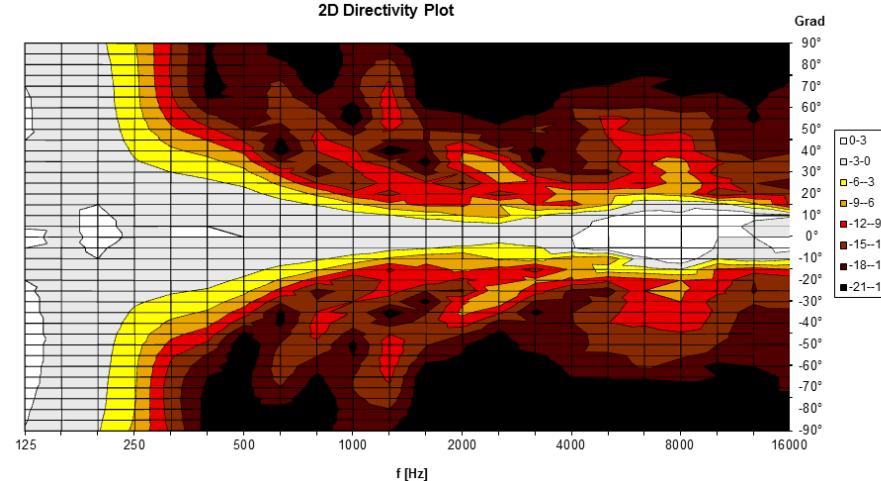


System Directivity

Directivity (vertical)
3 cabinets at 0° splay angle

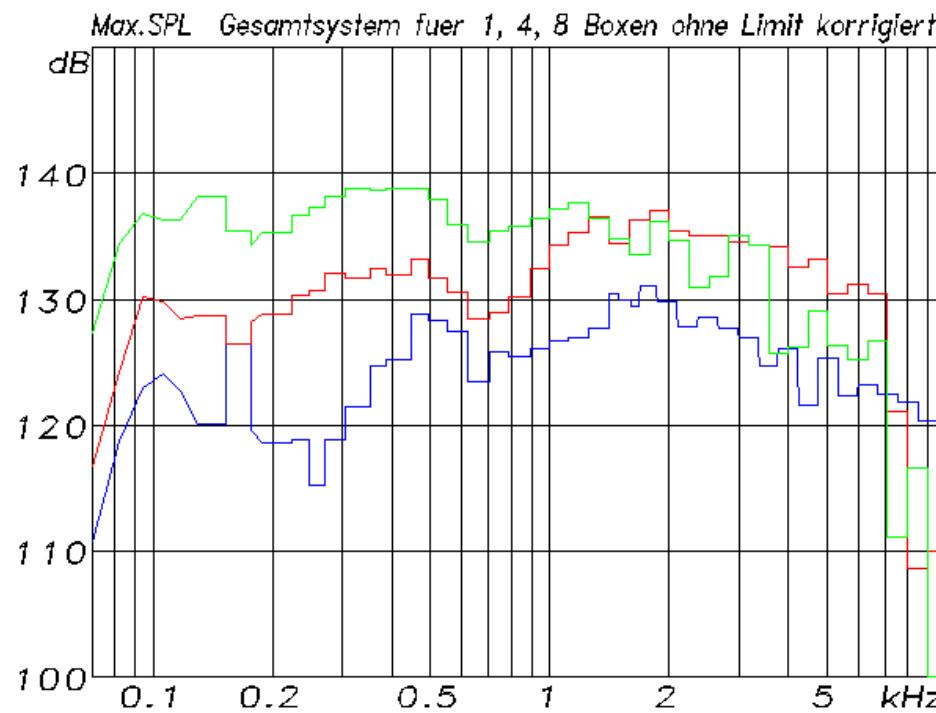


Directivity (vertical)
3 cabinets at 5° splay angle

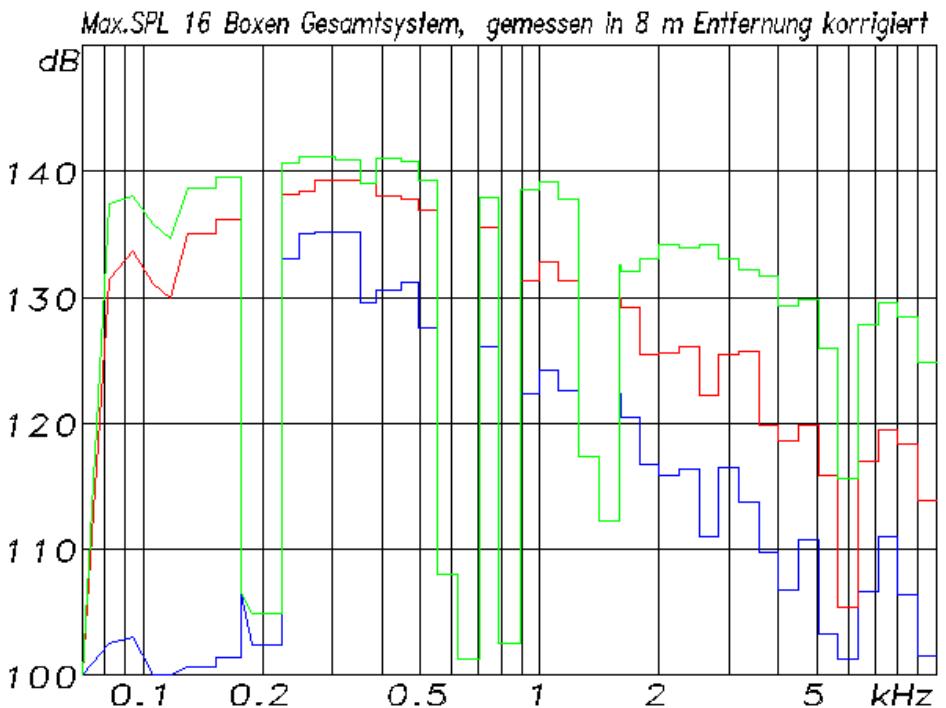


Case study: Maximum Sound Pressure Level

Max SPL 1,4,8 cabinets



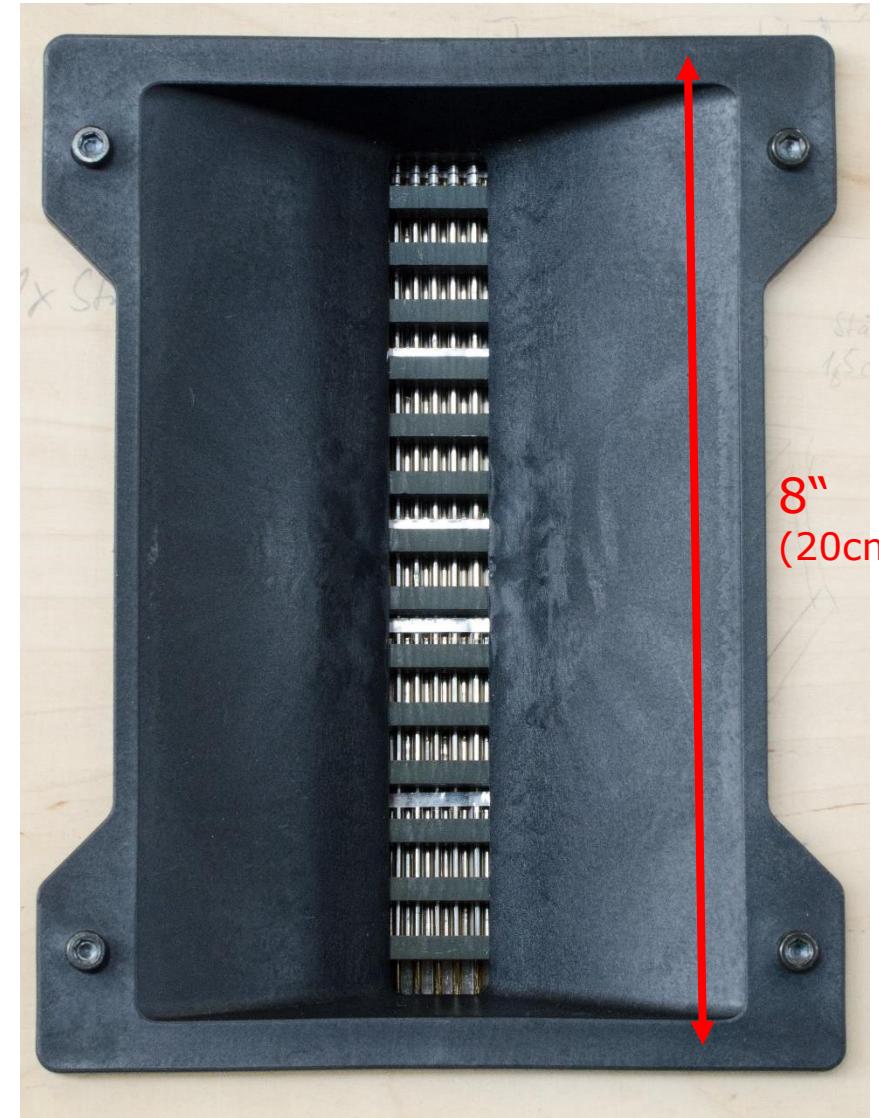
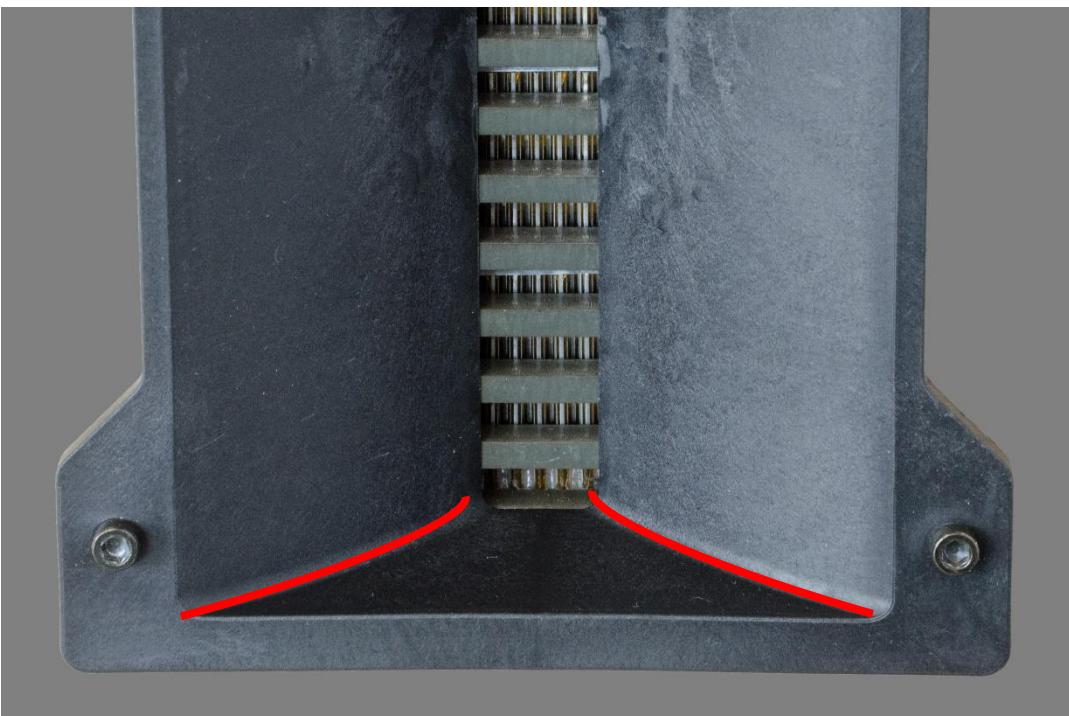
Case study: Max SPL 16 cabinets



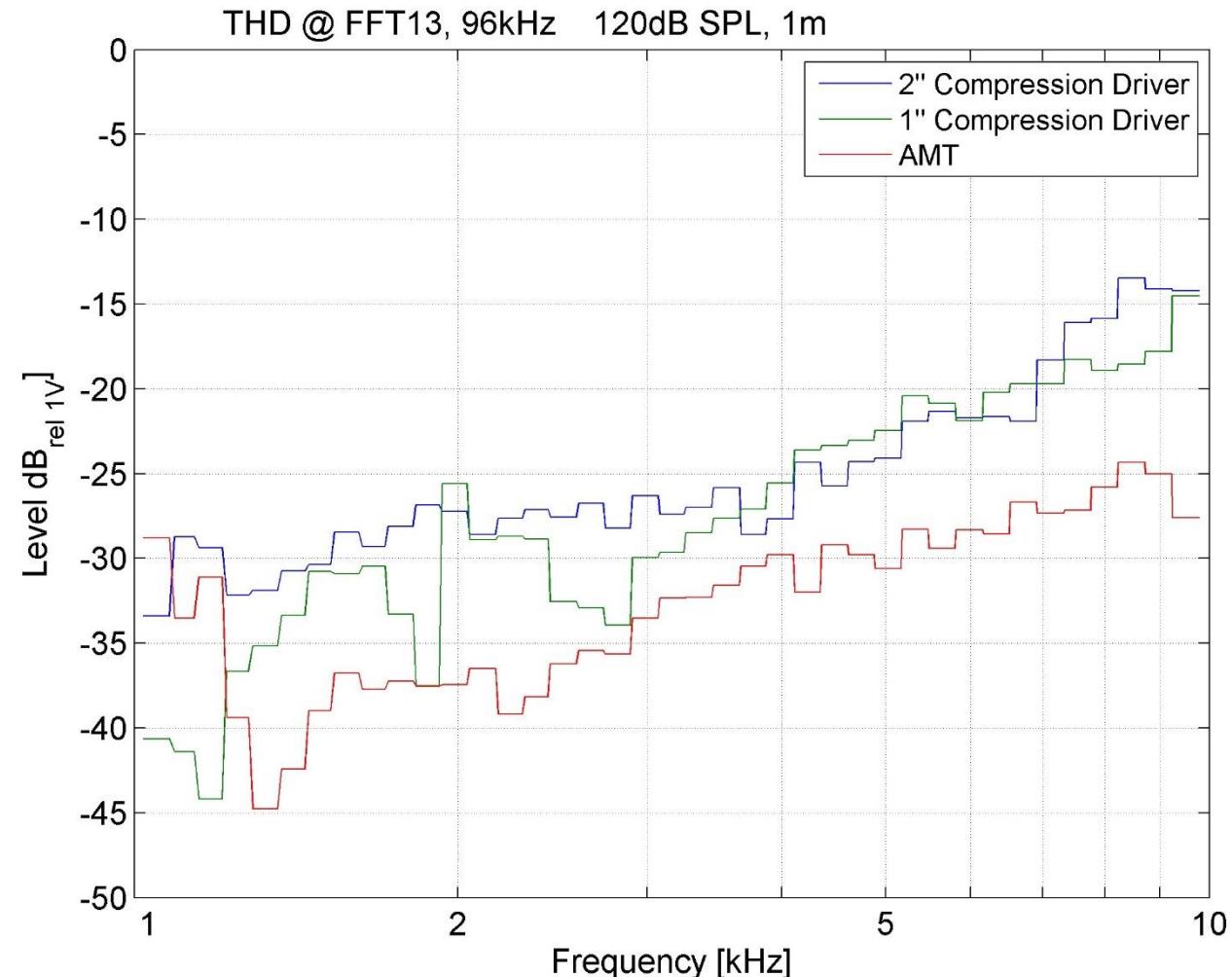
123 dB in 50m distance

2015 DRIVER

SMALLER HORN FOR 3KHZ CUTOFF

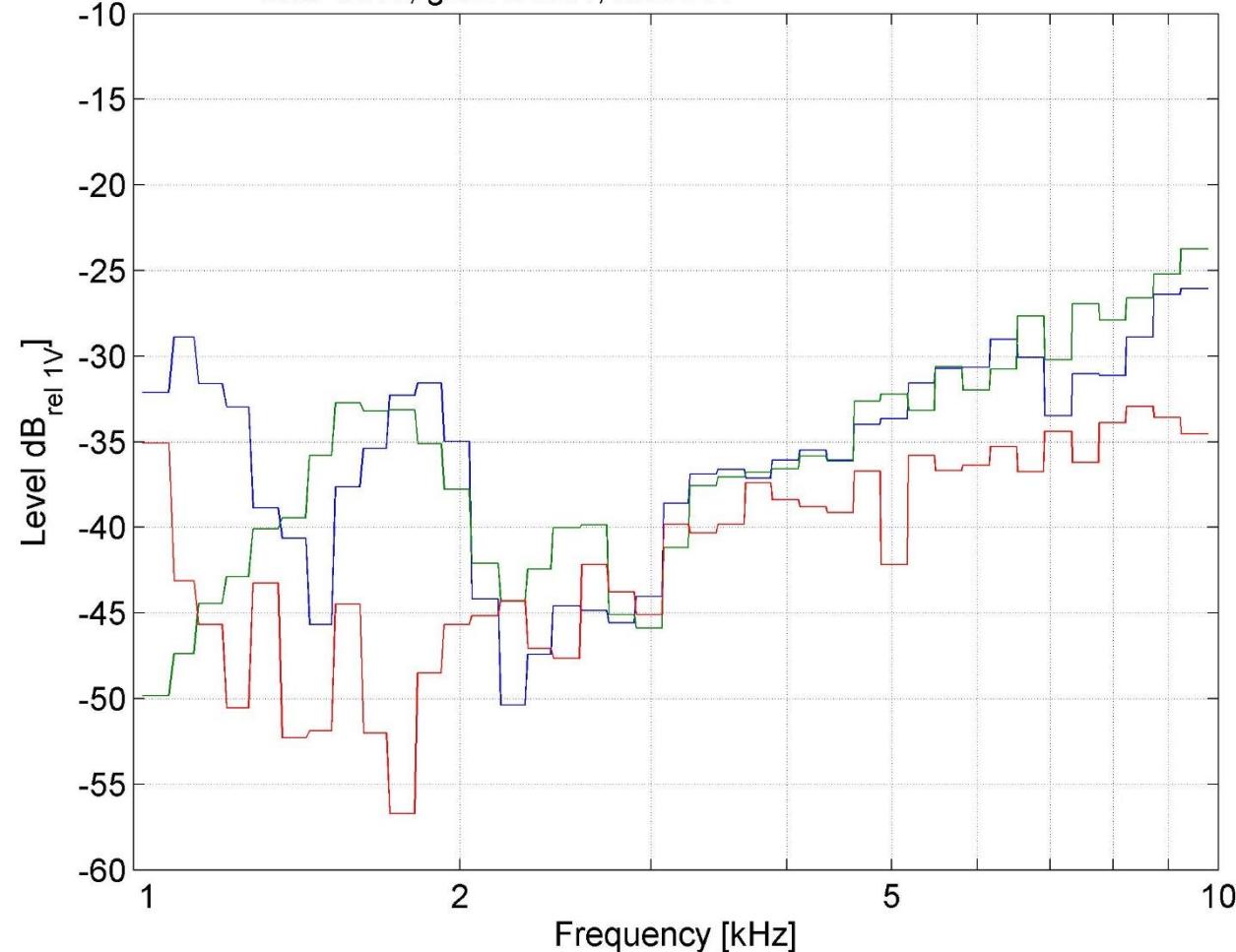


2015 DRIVER



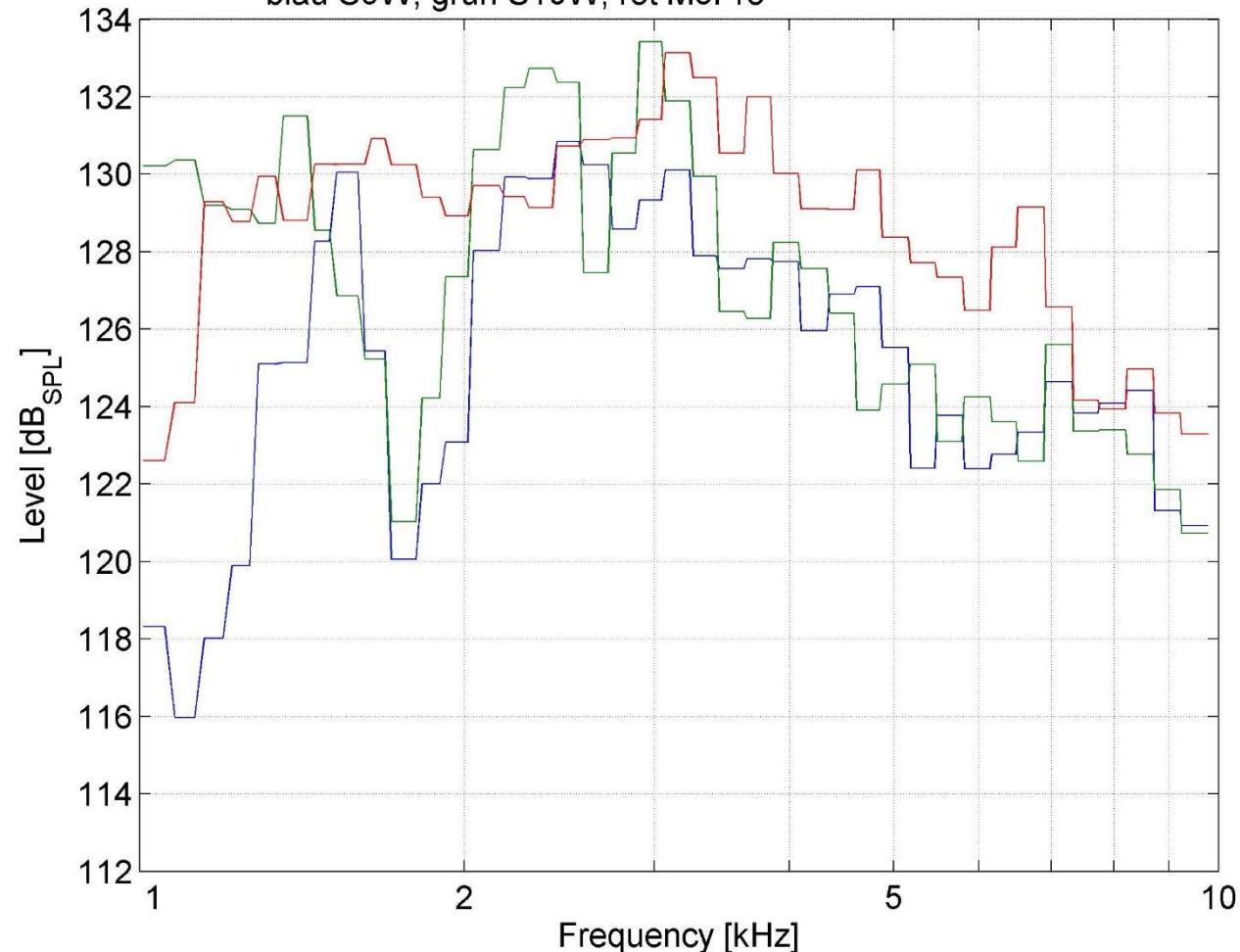
2015 DRIVER

Harmonic dist. THD @ FFT13, 110 dB SPL, 1m
blau S5W, grün S10W, rot RLA



2015 DRIVER

Max SPL (d=4m) MaxSPL FFT12 96kHz 1%/3%/10%
blau S5W, grün S10W, rot M8Pro



APPLICATION: OPEN AIR CONCERT (60M LONG-THROW)



Sound Quality

Informal Testing in Practical Setups

- Open Air Concerts with 2x8 cabinets plus 16x Sub extension
- Music from CD,
- Different genres of live music
- Very clear and transparent sound
- FOH engineers report on „easy work“, level independant sound color

Formal, scientific proof requires significant effort

- Which questions should be asked?
- Realistic Listening Levels (-> search for venue)
- Which competing systems should be chosen?

THANK YOU FOR YOUR ATTENTION!

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