

Digital De-emphasis Filters in Gramophone Recording Digitisation

ARSC 50th Annual Conference 2016

Indiana University, Bloomington

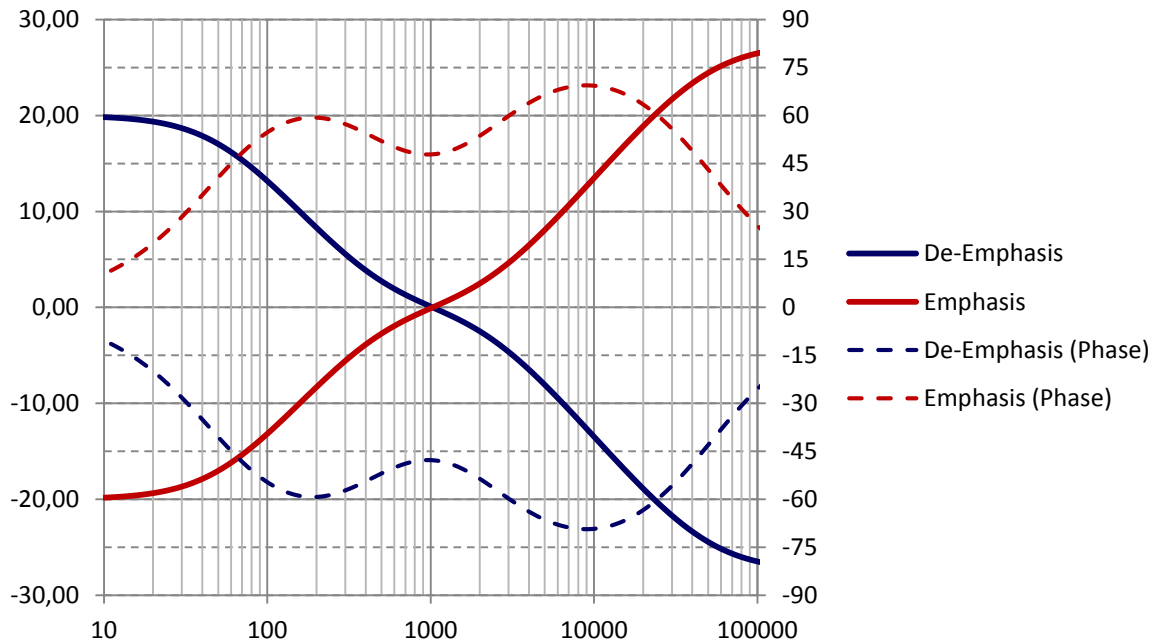
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What I will talk about..

- ▶ Emphasis and de-emphasis in basic
- ▶ Digital de-emphasis filters: Problems & possible improvements
- ▶ Digitization workflows using analog & digital de-emphasis
- ▶ Simplification in archiving by an „Audible Preservation File“

Emphasis – Deemphasis basically



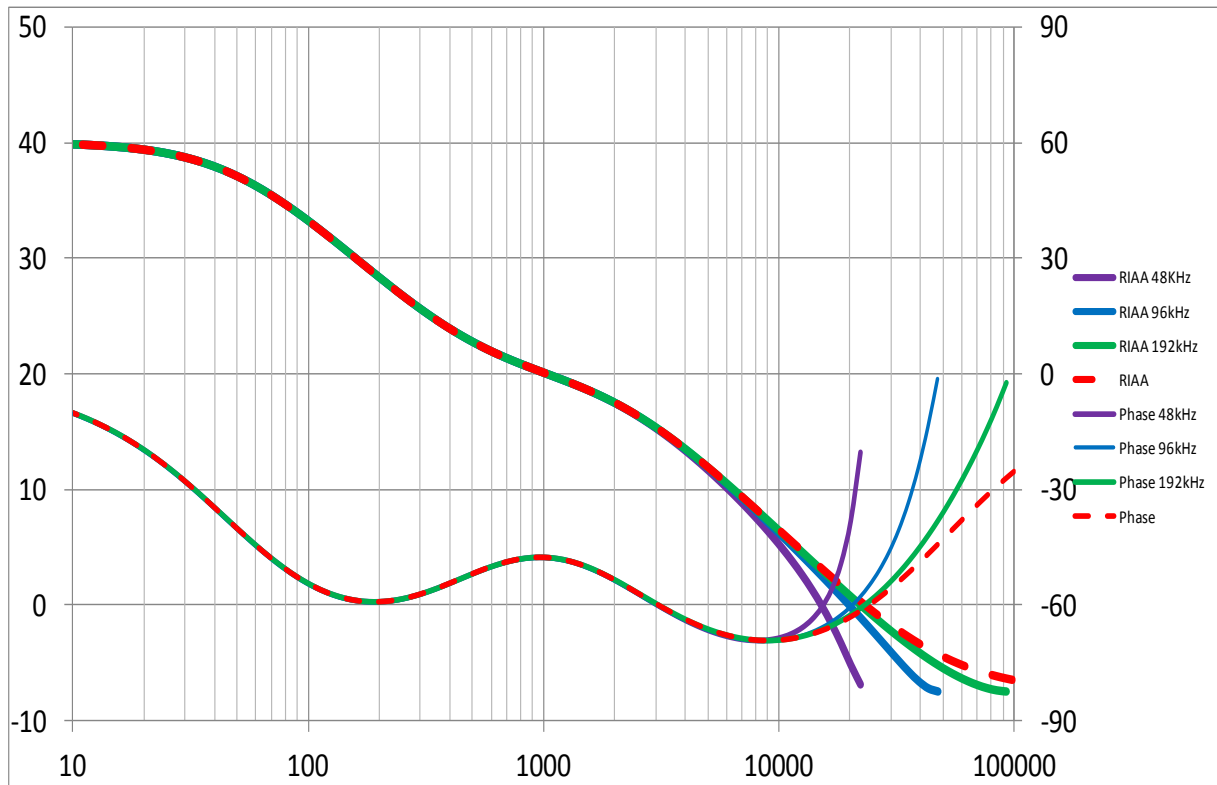
- ▶ Required for frequency independent amplitude in the groove
- ▶ De-emphasis can and should exactly compensate emphasis
- ▶ RIAA Norm since 1954, especially from before 1954 hundreds of variations exist

Playback: Amplitude Frequency Response Errors

Best case:

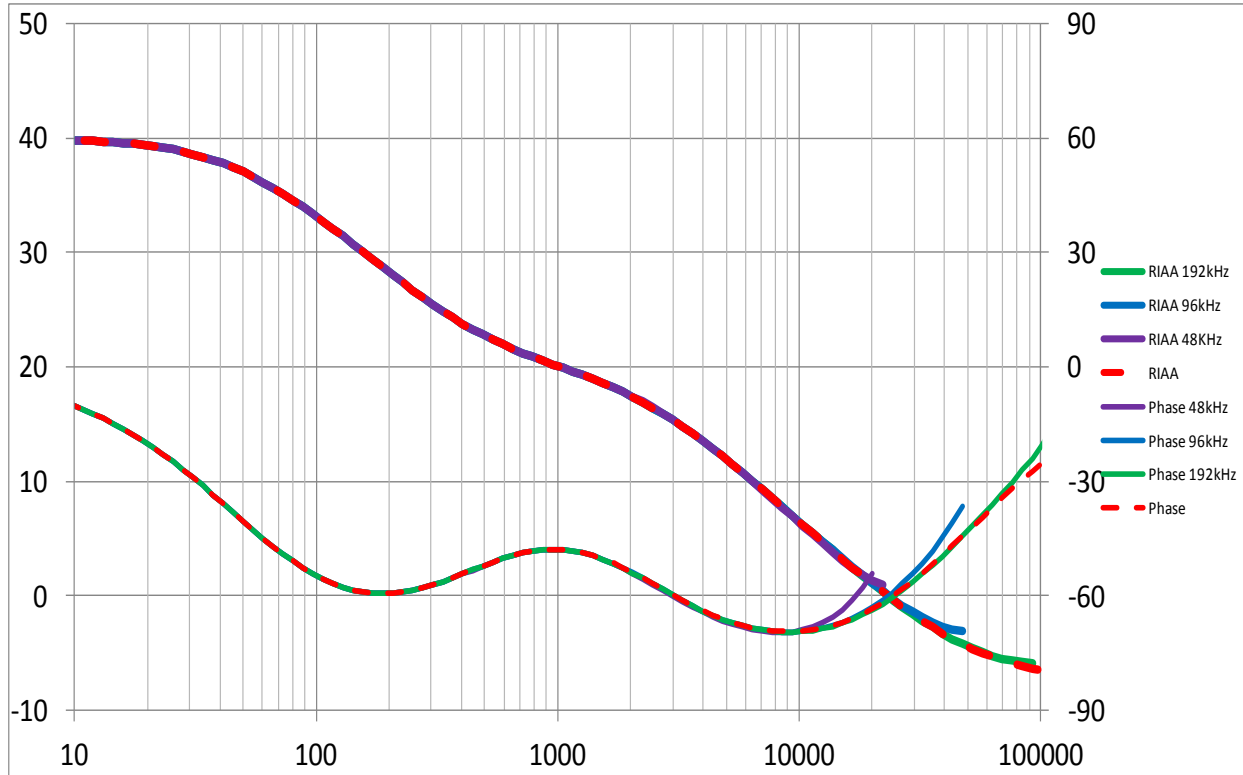
- ▶ +/- 0.5dB: phono cartridge
- ▶ +/- 0.1 dB: highend RIAA preamps
- ▶ +/- 0.2dB: Temperature & aging effects

Digital De-Emphasis: High-Frequency errors



- ▶ 48 kHz Samplerate:
-5dB / +15° @20kHz
- ▶ 96kHz Samplerate:
-1dB/+1° @20kHz
- ▶ 192kHz Samplerate:
-0.5dB/+0.5° @20kHz

Digital De-Emphasis: Improved Filters



- ▶ 48 kHz Samplerate: 0.2dB / +5° @20kHz
- ▶ 96kHz ++: nearly exact
- ▶ Using adapted Neumann Constant for compensation of the digital filter behaviour

Analog versus digital emphasis / de-emphasis

Analog

- ▶ No high-frequency problems
- ▶ sensitive to component tolerances
- ▶ complex to automate
- ▶ repeated emphasizing and de-emphasizing slightly degrades the signal by additional noise and accumulating tolerances

Digital

- ▶ high frequency response differs from analog filters, this can be minimized
- ▶ no tolerances
- ▶ easy to automate
- ▶ emphasizing and de-emphasizing is lossless, if computation is exact

Digital De-emphasis annotation in the BWF BEXT Coding History

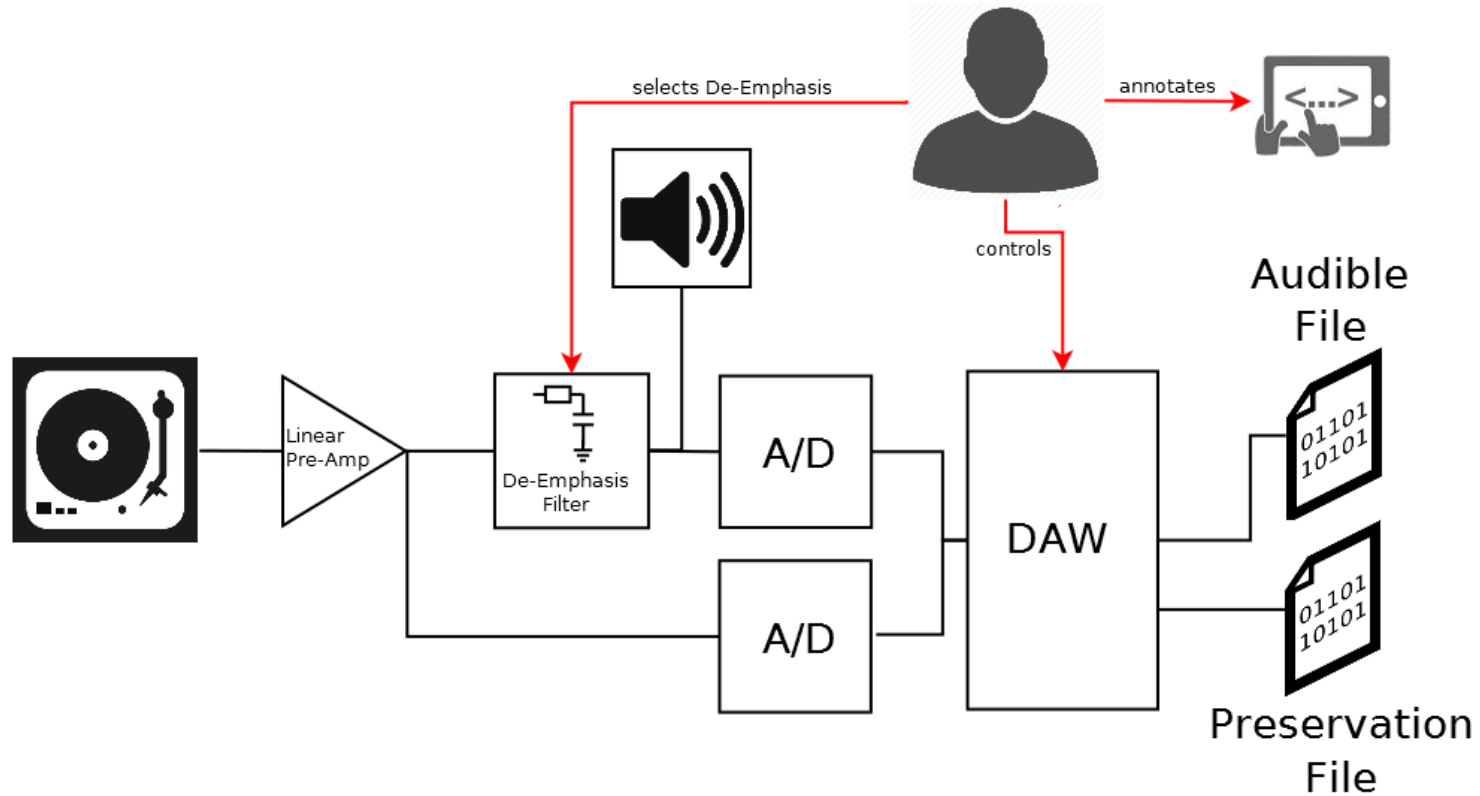
```
A=ANALOGUE,M=stereo,T=Replayer;DN:SL-1210MK2;SN:2658  
A=PCM, F=96000, W=32, M=stereo, T=AD;DN:N7000c;SN:#1256A04C  
A=PCM, F=96000, W=32, M=stereo, T=Deemphasis;DN:RIAA+Neumann;DT1:3180;DT2:75;DT3:318;DT4:3.18  
A=PCM, F=96000, W=24, M=.....
```

- ▶ Using the text (T=) field in the CodingHistory
- ▶ Controlled syntax to read out the de-emphasis parameters
- ▶ Plain text: Human readable

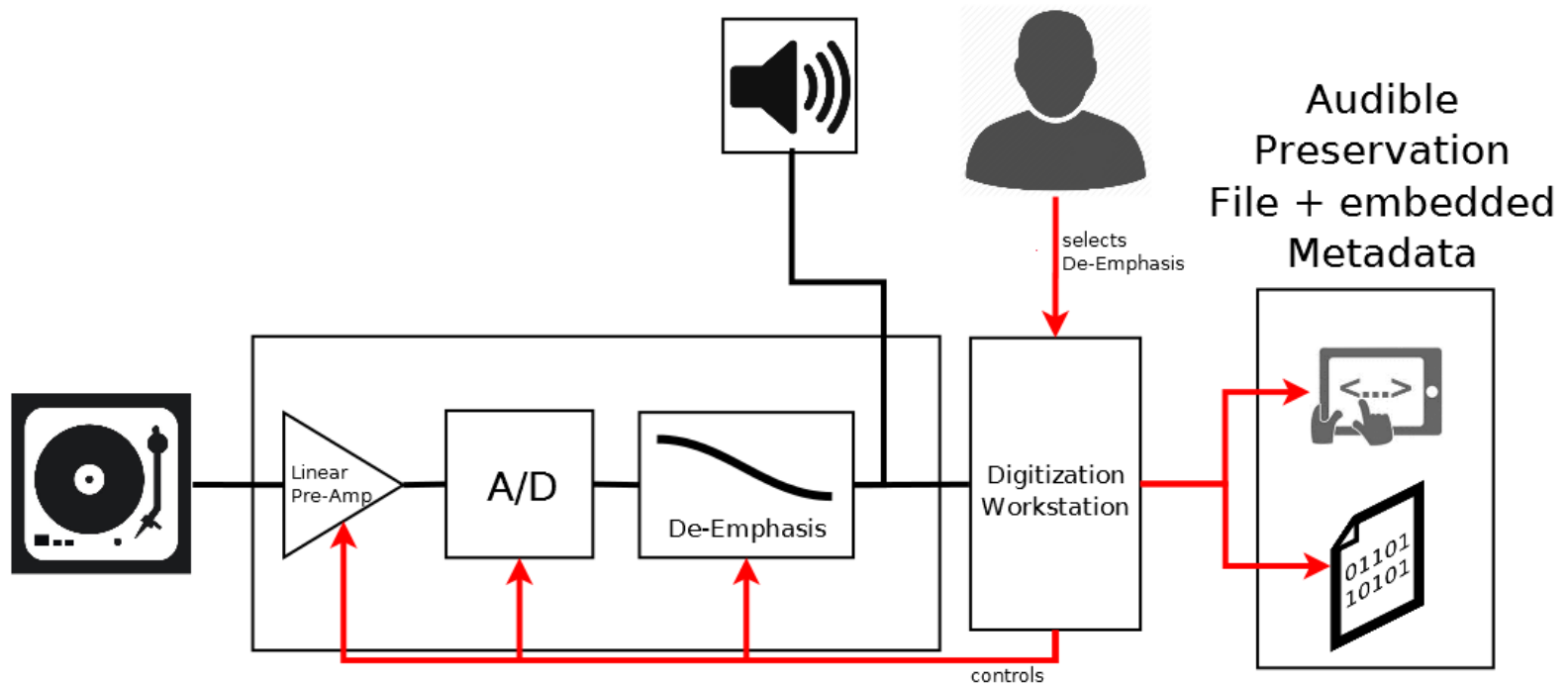
Preservation File - Audible File

- ▶ Preservation aspect: archive an un-deemphasized file
- ▶ Usage aspect: archive a de-emphasized (audible) file
- ▶ Storing both files introduces complexity
- ▶ Archiving a digitally de-emphasized file with its exact de-emphasizing parameters -> lossless re-emphasizing is then possible at any time.
„Audible Preservation File“

Analog de-emphasis digitization with an audible and a preservation file output

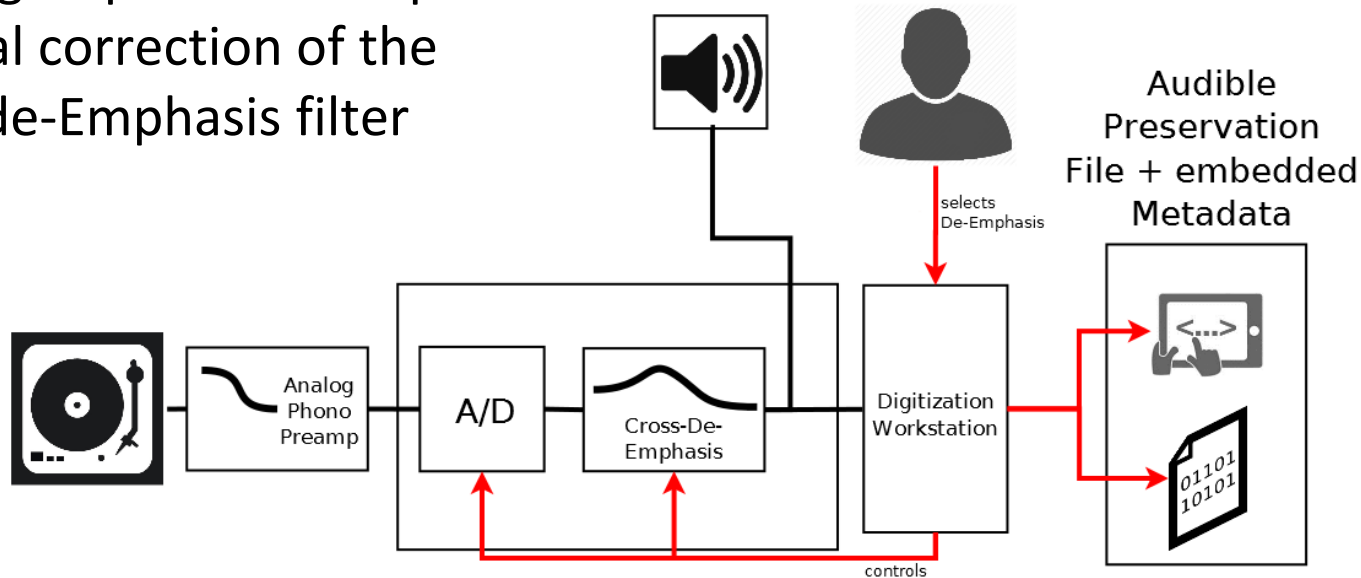


Digitization using digital de-emphasis

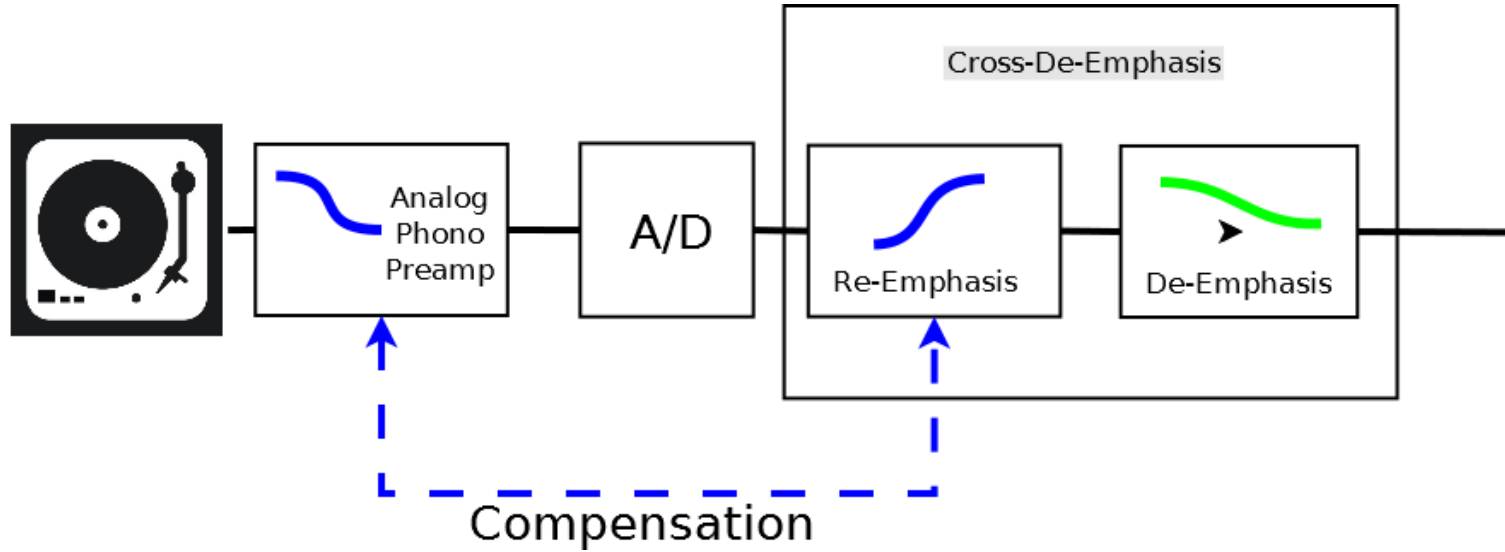


Cross-De-Emphasis

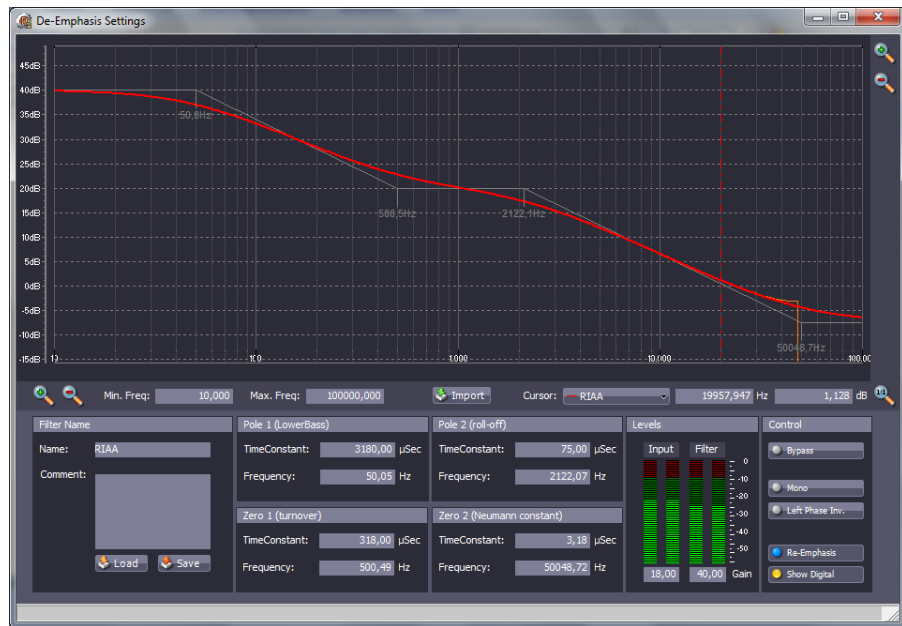
- ▶ Using analog Preamp
- ▶ Applying required de-emphasis by digital correction of the analog de-Emphasis filter



Cross-De-Emphasis Principle



User interface in NOA Record



- Loading and storing of filter presets
- Adjusting filter parameter by time constants or corner-frequencies
- Live monitoring
- Controlling levels and gains to avoid intermediate clipping
- Options to handle “lateral cut” records by phase inversion and mono summing
- Importing tabular data, for example from measurements or simple freq-level tables
- Visual comparing of digital and analog filter behavior

Product reference N7000c Audio Ingest Frontend

- ▶ 4 x Stereo ADC, 4x AES In
- ▶ BitProof™ secured recording
- ▶ DANTE™ requires no soundcard
- ▶ Digital (Cross-) De-emphasis
- ▶ Live monitoring



Conclusion

- ▶ Digital de-emphasis filters can be nearly as exact as analog filters
- ▶ Arbitrary de-emphasis curves can be easily defined and applied
- ▶ Due to 100% reversability, an „Audible Preservation File“ can be used for archiving
- ▶ Automatic documentation of the filter parameters
- ▶ Better process control

Thank you for your attention !



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Swedish Broadcasting Resources

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Voice of Vietnam

ATOS, internat.

Vectracom, FR

Radio Romana

Magyar Radio

memnon, BE

RTV Slovenia

Sudan Radio

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