

# Hugo 2 technical summary

An introduction into Rob Watts' technology  
that's in Hugo 2



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Hugo<sup>2</sup>

# Timing – WTA filter

- Hugo 2 has 49,152 tap 16FS WTA filter.
- It uses 45 208MHz DSP cores in parallel to create the WTA filters
- Following the first WTA filter is second WTA filter from 16FS to 256 FS
- This further improves timing reconstruction accuracy as the WTA filter calculates timing at 81 nS resolution
- Filter options – HF filter, 16FS WTA only or 16FS and 256FS filter to adjust the sound for taste – warm and soft or transparent and incisive
- HF filter is separate optional module set to 40 kHz -3dB

# Noise floor modulation

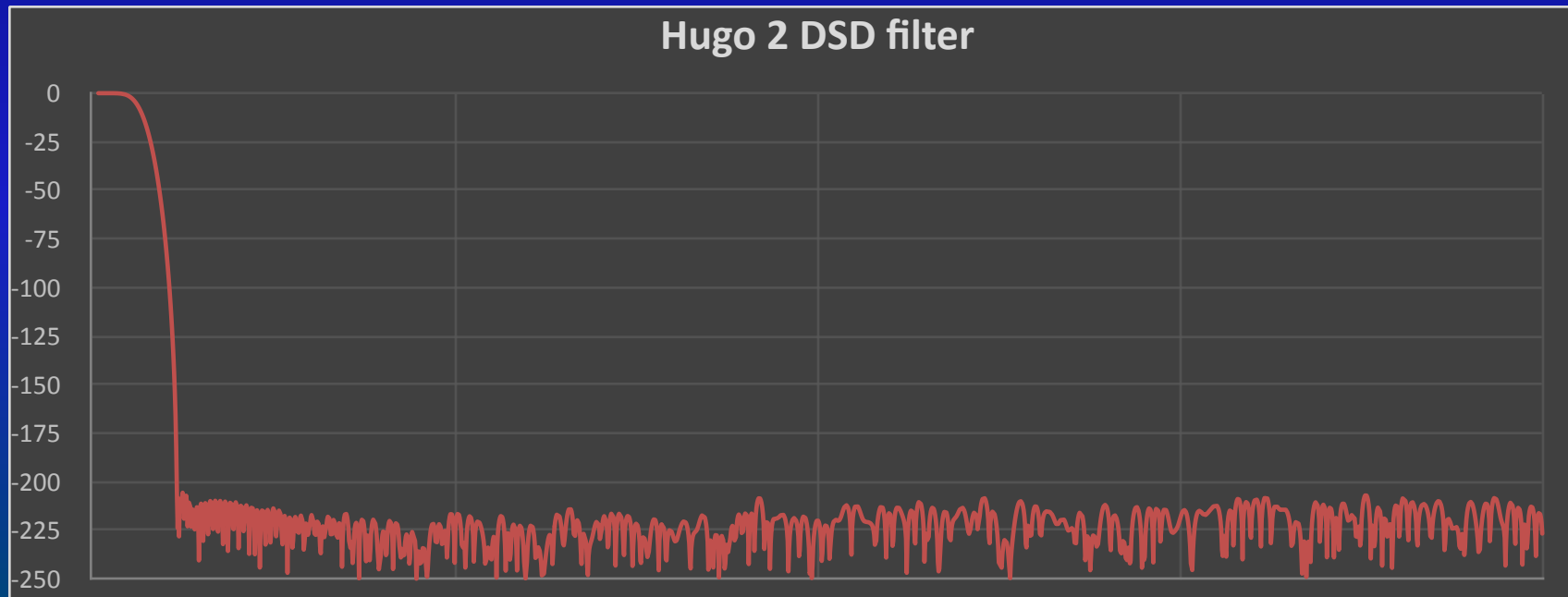
- Noise floor modulation occurs when noise increases/decreases depending upon the music signal.
- The ear/brain is extremely sensitive to this problem as it interferes with the brain's ability to separate sounds into individual entities
- Listening tests have shown sensitivity to noise floor modulation well below levels that are measurable
- Noise floor modulation make the sound hard, bright and aggressive; it degrades instrument separation and focus; reducing noise floor modulation improves sense of focus, smoothness and refinement – it sounds much more natural

# Hugo 2 and noise floor modulation

- The DAC architecture has a large influence on noise floor modulation – pulse array DAC's have innately very low levels of modulation
- The reference power supply to the DAC is crucial, this is very low noise and low impedance, with individual references per channel
- RF noise is a major problem as it inter-modulates with the analogue electronics causing noise floor modulation – extensive RF filtering is employed, together with steps to reduce the analogue sensitivity
- Quad layer ground planes are used, so that ground induced noise and distortion is eliminated
- Jitter is a big source of noise floor modulation – incoming jitter is eliminated by a digital phase lock loop (DPLL).
- Hugo 2 has extremely low noise floor of -175 dB with no measurable noise floor modulation

# Hugo 2 and DSD noise floor modulation

- DSD represents a severe challenge for noise floor modulation
- For example, DSD 64 has noise that is -20 dB down at 100kHz – this creates distortion and noise floor modulation and must be filtered for best sound quality
- DSD sources have large HF noise – this is digitally filtered by over 200dB at 100kHz giving much more natural sound quality for DSD
- Hugo 2 has a much improved DSD filter – it will also accommodate DSD64 to DSD512 in native and DoP modes (DoP to DSD 256). This filter has extraordinary performance with over 200 dB filtering eliminating the sound quality problems coming from DSD due to out of band distortion and noise



# Hugo 2 noise shapers

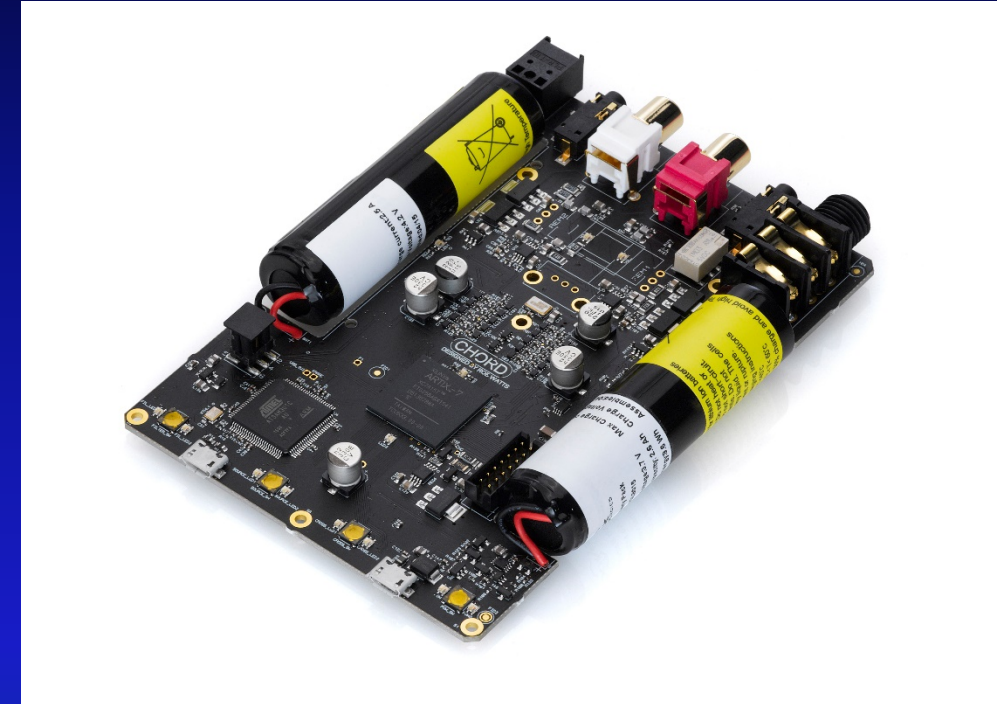
- The noise shaper is crucial for performance, particularly for accurate depth perception
- Hugo 2 has 10 Pulse Array elements
- The noise shaper is much improved; its 7<sup>th</sup> order, running at 104 MHz, with 260 dB performance – 1,000 times more resolution than before
- This ensures much better detail resolution and perception of sound-stage depth

# Headphone drive

- Hugo has a discrete OP stage integrated into the DAC output amplifier and filter
- It features second order noise shaping analogue section; this reduces distortion with load
- Hugo 2 has boost voltage to enable much more power output into low impedance loads
- The OP stage is full Class A (with 300 ohm loads)
- It is capable of 5.3v RMS and peak output currents of 0.5A
- The OP stage has an extremely low output impedance
- Digital cross-feed, with 3 settings, is implemented digitally at 16FS with two 48 bit DSP cores. The cross-feed uses an analogue type IIR filtering

# Measurements

- Dynamic range 126 dB Awt
- Noise 2.6  $\mu\text{V}$  AWT, no measurable noise floor modulation
- Distortion 0.0001% at 3V 300 ohms
- More power output – 1050 mW into 8 ohms, 740mW 33 ohms, 94mW 300 ohms
- 0.025 ohms output impedance





# And finally...

Thank-you for reading this presentation.



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