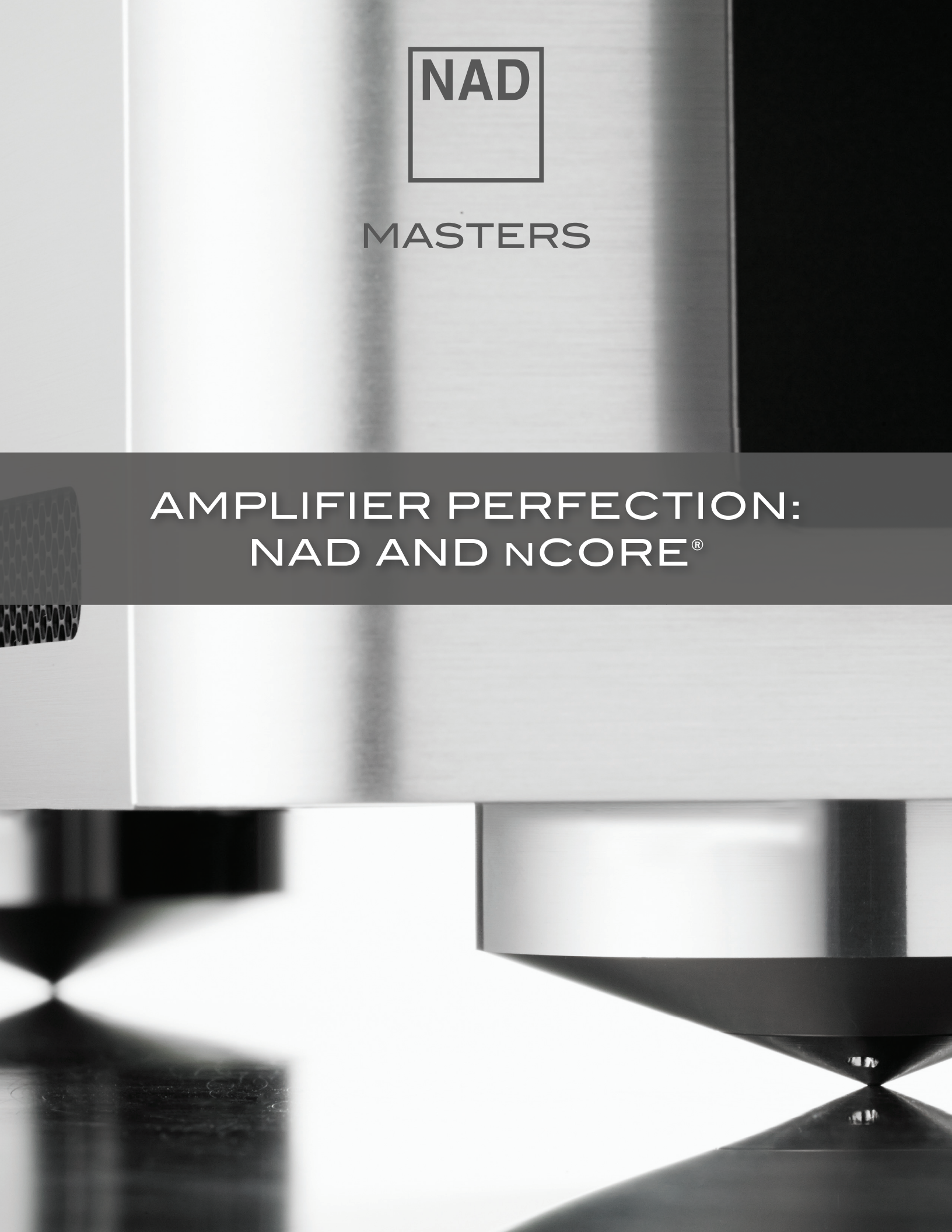


AMPLIFIER PERFECTION: NAD AND NCORE®

MASTERS AMPLIFIER PERFECTION: NAD AND NCORE®

In 2009, NAD introduced the world to what was termed by the press as a “new amplifier paradigm” in the Masters Series M2 Direct Digital Amplifier—essentially a DAC that amplifies and uses noise shaping error correction (a digital form of negative feedback) to reduce distortion across the band. Making the error correction work properly led directly to a DAC architecture with amazing linearity, extremely wide dynamics, and performance that is almost totally free of jitter and timing errors, which plague all conversions from digital-to-analogue. Many audiophiles blame jitter for the poor sound quality often associated with ‘digital sound’. Several other highly acclaimed NAD models have used the DirectDigital™ process to attain award-winning performance. NAD DirectDigital™, using CSR’s patented DDFA technology, remains a core technology used in many NAD products, including the new companion M12 Direct Digital Preamp/DAC and the award-winning M51 Direct Digital DAC.

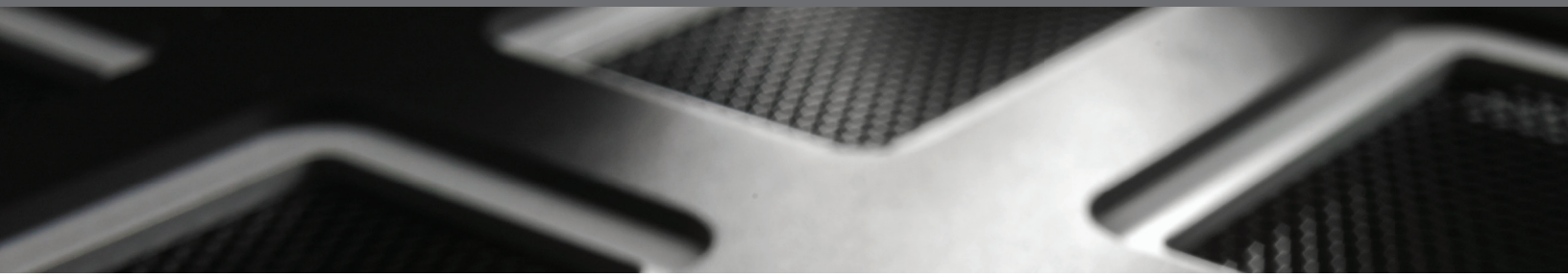
But we never rested on our laurels and NAD’s Director of Advanced Development, Bjørn Erik Edvardsen, identified a very unique and promising new technology being developed by Hypex in the Netherlands. While the idea for a self-oscillating Class D amplifier has been around for many years, nobody had perfected it to an acceptable performance level before Hypex introduced the amazing UcD concept in the early ‘90s. Unlike DirectDigital™, which starts with a digital signal and uses active digital processing to perform error correction, the UcD concept is a switching analogue amplifier with all parameters highly optimized to allow self-regulation. Hypex has refined this concept to new levels of perfection with nCore®, which improves the modulator for more accurate feedback subtraction and PWM generation. The all discrete driver and output stages have also been improved for lower open loop THD as well as lower idling losses, normally conflicting requirements with conventional IC driver circuitry, and added control loop incorporating an integrator with adaptive clipping enables 20dB more feedback to be used across the audio band because of its extremely low phase shift resulting in a dramatic reduction in distortion across the audio band. This is added to UcD’s already amazing characteristics of load invariance and high current capability, features of great sounding amplifiers.

Feedback. Did we say feedback? Isn't that a dirty word in Audiophile circles? Well there are many examples of amplifiers with poorly executed feedback to reinforce the negative reputation, but most of today's best amplifiers rely on feedback to linearize response, reduce noise and distortion and increase damping factor—all positive performance attributes. Only badly designed or poorly executed amplifiers with high feedback sound bad. Giving feedback a bad name was a generation of high negative feedback amplifiers with very low THD, but with other serious shortcomings like high TIM (Transient Intermodulation Distortion), inadequate current capability, and badly distorting protection systems. The bad sound was erroneously blamed on just the high negative feedback. The shortcomings of poorly executed negative feedback were clearly detailed by Matti Otala in the '70s with his AES papers describing a measurement technique for identifying TIM. Rather than perfecting the use of negative feedback, these findings led many designers to reduce the amount of feedback and to therefore, accept much higher levels of THD. This reaction figuratively threw out the baby with the bathwater! Although NAD experimented with a zero feedback design in its S300 Integrated Amplifier introduced in the '90s, we found more success in developing high current amplifiers using smaller amounts of localized feedback to reduce phase shift and achieve both low TIM and low THD. As long as there is no internal overload in worst case loads (<2 Ohms) across the musical spectrum, and no nasty current or VI limiting, we have used as much as 30dB of negative feedback to obtain 0.004% THD at 20kHz into 4 Ohms. While this is achievable in a Class AB output stage, Class D has opened up the possibility of using even higher levels of feedback without any of the shortcomings we faced in the Class AB world.

Of course, the output stage is only one of several circuits in the amplifier, and each must complement the other to obtain optimal performance. The new M22 and M27 amplifiers are DC coupled throughout, from input to output, with no capacitor at all in the forward signal path. Yet it has a beneficial 12dB/octave roll-off below 2Hz. It does this using a unique circuit topology that is functionally a forward servo. It is, however, not a servo in the traditional sense, as it does not measure DC at the output and feed back a correction signal. Instead part of the input signal is fed to a side chain with a second order low pass filter. The output of this is subtracted from the forward signal input to the second stage thus rejecting DC. Control for PowerDrive™ is derived by sensing the average output power, applying a time constant, and then cleanly hard clipping the signal, thus limiting it to the rated continuous clipping power over a sustained loading. By controlling the power envelope, we obtain maximum clean power for every operating condition.

The performance of the entire signal path is critically dependent on the power supply—in this case a well regulated, but not too tight, custom switch mode design. This allows maximum dynamic power, very high current yet with very low distortion at all times and under all operating conditions. Some key features of this NAD-developed supply include:

1. High efficiency over very wide operating range, including <0.5W in standby (about 150mW).
2. Very low conducted and radiated EMI.
3. Very low acoustic noise, unlike most high power switch mode supplies at high output power levels.
4. Synchronous rectification for low losses and the elimination of supply pumping.
5. Low complexity, simple topology circuit for high stability and reliability with the design specially adapted for optimal performance with nCore™ amplifier output stages.
6. Safety Class 2 insulation (double isolation).
7. Sophisticated protection with hiccup mode.
8. Isolated auxiliary supply with a two stage discrete circuit power supply for very low noise and >120dB supply rejection for all low power circuits, including line amp and nCore amp input stage/modulator.



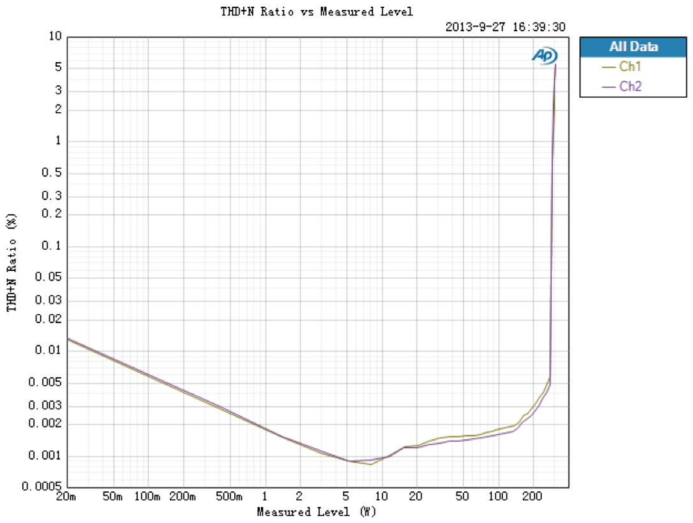
M27 SEVEN CHANNEL POWER AMPLIFIER

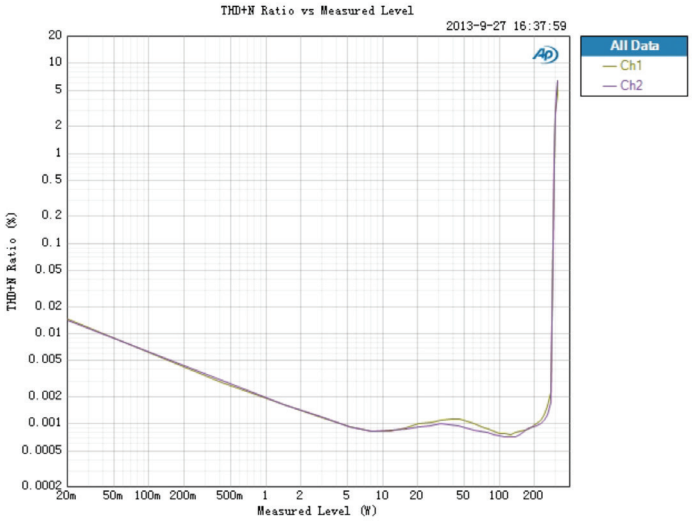
M22 STEREO POWER AMPLIFIER

To enhance amplifier reliability and improve damping factor and bass control, we have also completely eliminated the speaker relay, which with its significant resistance, would completely dominate the o/p impedance of the nCore output stage. The electronic protection acts much faster than relay protection, and in comparison allows only a small amount of energy to reach the speaker before the supply shuts down.

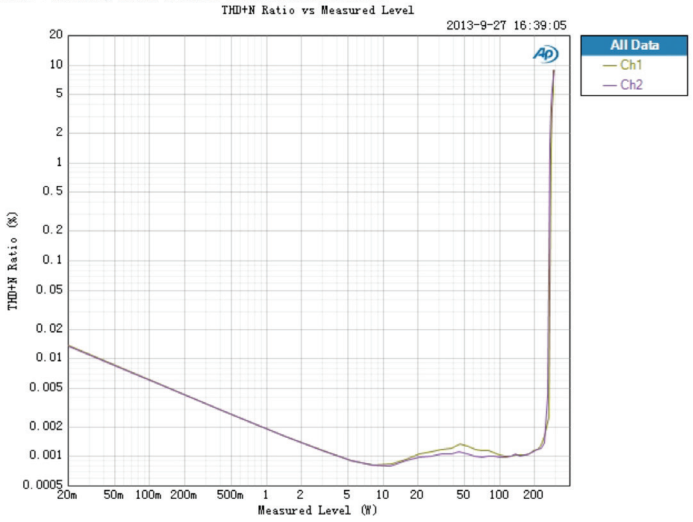
The most amazing characteristic of these new NAD Hybrid Digital amplifiers is the uniform excellence of ALL important performance criteria under every operating condition. While measurements don't tell the whole story of amplifier sound quality, all great amplifiers share certain common characteristics including low IM distortion at all operating powers and load conditions, harmonic distortion low in level and dominated by 2nd and 3rd harmonics, high signal-to-noise ratio, clean clipping behaviour with instant recovery, wide flat frequency response, high current capability and stability into low impedance loads. The new NAD Masters amplifiers do all this and more to provide a distortion-free view into the musical recording with highly resolving expression of musical detail and space. The sound is completely neutral and fatigue-free even when listening at very high sound pressure levels. Complete control of complex loudspeaker loads makes it possible to partner these new NAD Masters amplifiers with the worlds' best loudspeakers. High efficiency and low power consumption is just icing on the cake.

Superb Measured Performance Doesn't Tell the Whole Story





THD + Noise @ 20Hz 8 Ohms both Channels Driven



AS GOOD AS THESE GRAPHS ARE, THE TOTAL SILENCE, EXPLOSIVE DYNAMICS AND PRISTINE GRAIN-FREE SOUND OF THESE NEW NAD NCORE™ AMPLIFIERS PROVE THE SCIENCE.

		8 Ohms	4 Ohms	2 Ohms
RMS Power 20Hz -20kHz		250W	250W	250W
Dynamic Power 1kHz/10ms		350W	>600W	>600W
THD + Noise	@ 20Hz	0.005% 1W-250W	0.005% 1W-250W	0.005% 1W-250W
	@ 1kHz	0.005% 1W-250W	0.005% 1W-250W	0.005% 1W-250W
	@ 6.5kHz	0.005% 1W-250W	0.005% 1W-250W	0.005% 1W-250W
SMPTE IMD	@ 100W	0.002%	0.004%	0.007%
	@ 1W	0.002%	0.004%	0.007%
CCIF IMD	@ 100W	0.004%	0.006%	0.01%
	@ 1W	0.0006%	0.0009%	0.005%
Frequency Response 20Hz-20kHz		+/- 0.5dB	+/- 0.5dB	+/- 0.5dB
Signal/Noise Ratio Ref. 1W 20Hz – 20kHz		-100dB – 102dBA	-100dB – 102dBA	-100dB – 102dBA
Crosstalk	@ 1kHz	-104dB	-99dB	-92dB
	@ 10kHz	-95dB	-92dB	-87dB
Gain		28dB	28dB	28dB