



# D 3020

HYBRID DIGITAL AMPLIFIER STORY





# D 3020 Hybrid Digital Amplifier Story



### LEGENDARY PERFORMANCE

Bjorn Erik Edvardsen's radical design for the original NAD 3020 turned the music loving world on its ear when introduced by NAD in 1978. Proclaimed as one of the Top 10 (#2 actually) most influential audio components of all time by a leading British publication, the 3020 was a brilliantly conceived state-of-the-art amplifier that almost anyone could afford. Able to drive complex (and expensive)

loudspeakers with effortless resolve, this unassuming little amplifier easily embarrassed far more expensive and highly regarded amplifiers. The 3020's phono section alone is considered to be one of the best available at the time. The 3020 became the catalyst for an entirely new genre of audio components, which became known as "Affordable High End".



### REINVENTING AN ICON

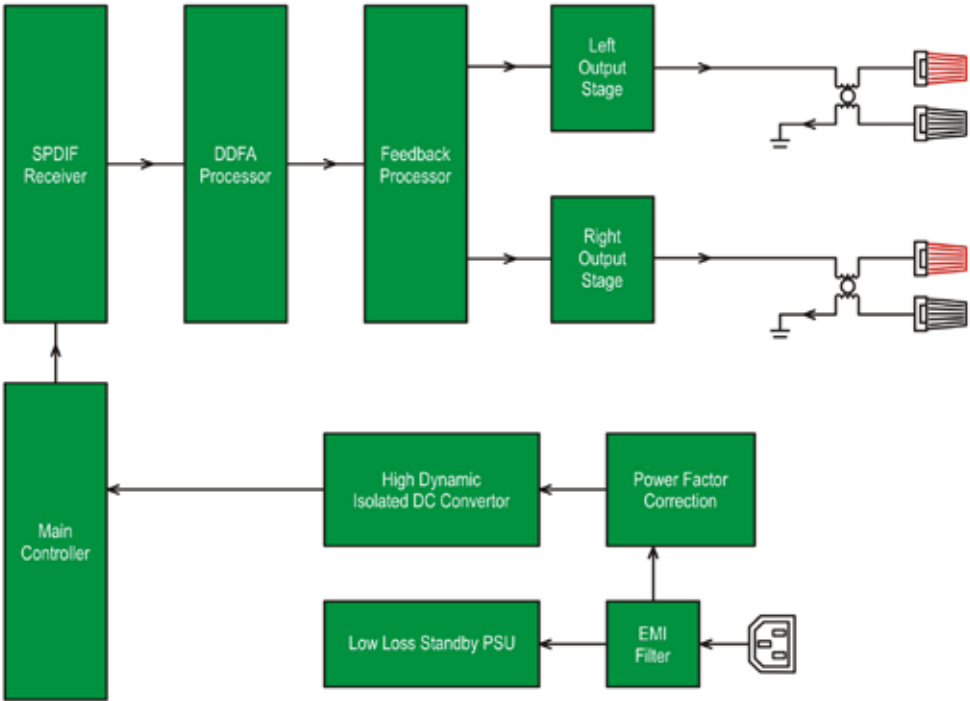
After the successful development of the game-changing M2 Direct Digital Amplifier, NAD became convinced that it could recreate the same incredible performance gap that distinguished the original 3020 from its peers in the fiercely competitive entry level of the market. But today the music sources are completely different. In 1978, the LP was the most popular high fidelity source with FM radio used for listening convenience. Today, the primary sources are computers, smartphones, and tablets streaming cloud-based music libraries. By adapting to today's media sources and by using the latest state-of-the-art digital technology, NAD has been able to translate the original 3020 concept and reinvent it for the new world of digital music.

When asked how he would compare his work of 35 years ago with today's D 3020, Bjorn Erik Edvardsen replied, "The 3020 and the D 3020 have much in common performance-wise. They are both small amplifiers that play very loud and clean, even in the most difficult to drive speakers. The big advantage of the D 3020 is the class D amplifier: higher power and very much higher efficiency, especially at normal listening levels." Edvardsen goes on to say, "The D 3020 has been designed to fit today's needs in terms of digital sources and has a good quality DAC with 8 channels mixed to 2, giving improved resolution which represents the same kind of value-bending innovation that gave the original 3020 its legendary phono stage."

### HYBRID DIGITAL ARCHITECTURE

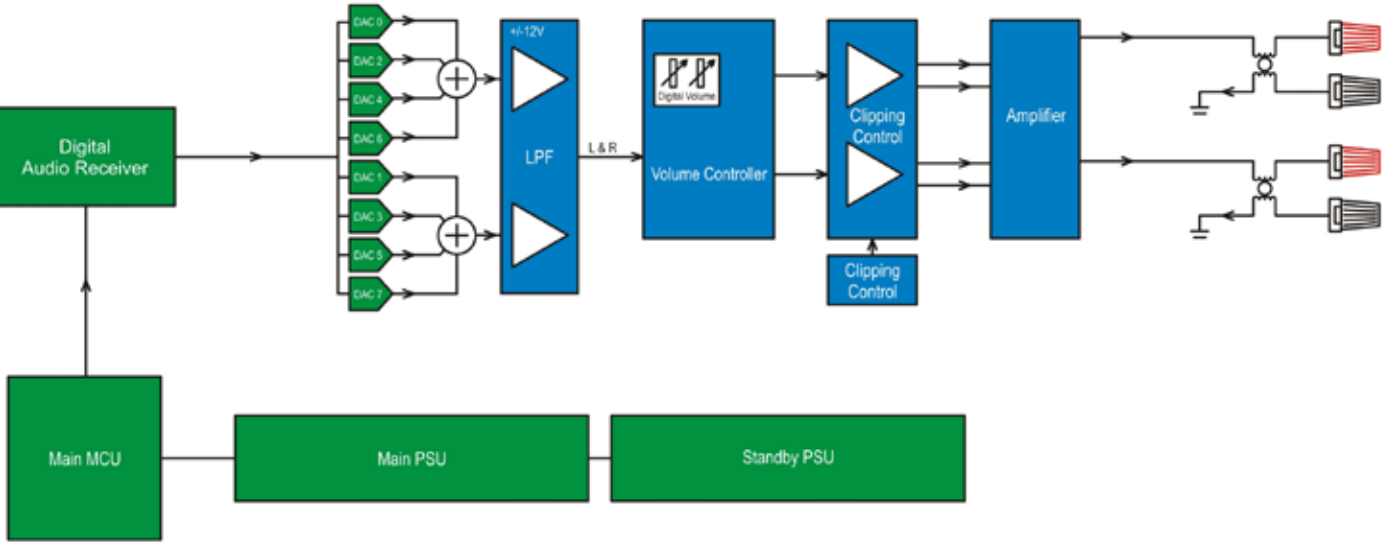
NAD's first ever Class D amplifier used the very innovative Direct Digital Feedback architecture to finally surpass the performance of the best linear amplifier designs using a switching amplifier design. By keeping all preamp functions in the digital domain and using high-speed error correction, total system performance is exceptional, especially for digital

sources. Basically an ultra-high-speed computer that performs all audio functions in the digital domain and then amplifies the result, this complex architecture is very effective, though too costly to apply to the 3020 concept. The very high modulation frequency responsible for the excellent performance requires all surrounding circuitry and even the PCB to be more expensive.



Our continued search for alternatives that could give similar performance at a more affordable price lead back to a more traditional architecture where we use a high quality codec (DAC) combined with discrete analogue Class D amplifiers. We knew the amplifier performance could be matched, but the overall system performance was a challenge since Direct Digital performs all signal processing in the digital domain.

To meet this challenge, particular attention was paid to the preamplifier by keeping it super simple and using top-shelf parts to minimize noise and bring it as close as possible to the performance of Direct Digital. Bjorn Erik Edvardsen developed a unique implementation of NAD PowerDrive™ to allow low impedance drive (current) and high dynamic power (voltage) at vanishingly low distortion levels.



INNOVATIVE AMPLIFIER TECHNOLOGY

The search for a high performance analogue Class D solution lead NAD to the Dutch company named Hypex, which holds the patent for a very innovative analogue Class D amplifier (UcD) that is self-oscillating and uses a variable modulation frequency based on operating conditions. This

super simple design is very highly optimized and gives phenomenal performance, both measured and subjective. The pure elegance of this concept strongly attracted Bjorn Erik Edvardsen and we were soon in discussions with Hypex to license their patent.

The UcD superiority over most other Class D technologies include:

- Load invariance, meaning it doesn't change sound with different speaker impedances
- Unaffected by very low impedances
- Loop gain is constant over the full audio frequency range leading to low distortion even at high frequencies.
- Ability to be constructed with all discrete parts (no expensive control ICs)
- Excellent EMC performance
- Low, flat output impedance for good bass control
- Flat response in all loads
- Distortion that is extremely low even into low impedance at the highest frequencies



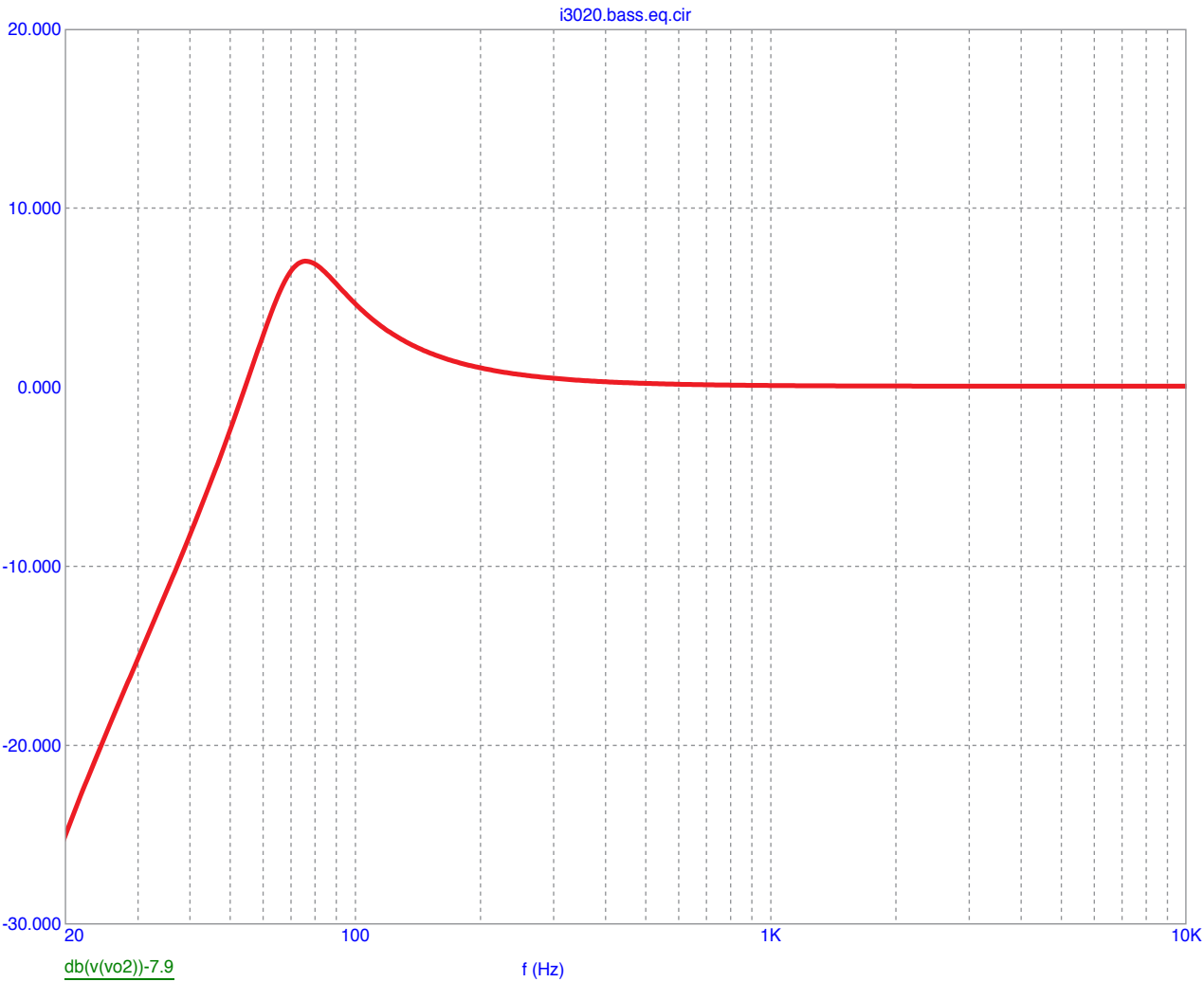
NAD then went to work to further refine the performance by upgrading output FETs and reconstruction inductors using low saturation cores to allow more current output into low impedance loads. The power supply is a stiff switch mode supply featuring synchronous (active MOSFET) rectification that eliminates supply pumping, a common characteristic of single-ended Class D amplifiers. It also benefits from the latest refinement of NAD PowerDrive™, our exclusive circuit that controls

the power supply voltage based on the actual load condition. This allows for short bursts of very high voltage without distortion or instability, while preventing thermal shutdown. Combined with a carefully modelled precision clipper, the D 3020 has that NAD character of sounding far more powerful than it really is. With its very small form factor allowed by the high efficiency of this amplifier, the D 3020 will surprise many for its visceral ability to control difficult loudspeakers.

PRE/DAC FEATURES AND PERFORMANCE

The Pre/DAC keeps features to a minimum, focusing instead on audio performance. This is sensible given the fact that most digital sources have extensive equalization options available, all performed in digital domain. Because we expect this amplifier will often be used with smaller speakers that have limited bass extension, we have brought

back NAD's BassEQ feature, a low Q filter centred on 80Hz with about 7dB of boost. This gives just the right amount of 'heft' to small bookshelf speakers without adding chesty colouration to male voices. For those wanting to further increase bass output we include a subwoofer output that also engages a high pass filter for the D 3020 outputs.



The preamp/volume control uses extremely high quality parts, nearly identical to those found in separate preamps selling for >\$10,000! This feeds the excellent LM 49860 super-OPamp used as

a high level preamp driving the UcD power amplifier. The DAC is a 114dB dynamic range Cirrus Logic 8-channel IC, mixed to 2 channels for even lower noise and distortion.





## CONNECTIVITY

The D 3020 features wireless streaming from smart devices and computers using the aptX version of Bluetooth in a custom designed NAD circuit. For a wired connection to a computer, the D 3020 provides a 24/96 capable ‘asynchronous’ USB input. This advanced circuit uses the precision clock inside the D 3020 to control the computer’s USB driver, providing a jitter-free music signal. These inputs allow full access to iTunes, Pandora, Spotify, and many other digital music sources.

Optical and Coaxial digital inputs connect to other digital devices like music streamers, disc spinners, and televisions. Analogue inputs are provided for legacy audio sources. Switching is silent and activated using soft touch controls. A simple IR

remote is included to allow wireless control of input selection, volume control and mute.

Headphone listening is a priority for many music lovers today, and for this reason we have included a separate high quality headphone amplifier to give the same high performance for headphone listening as for loudspeakers.

System evolution is made easy by the inclusion of a Subwoofer Output complete with an electronic high pass crossover filter. Adding a powered subwoofer dramatically elevates the system performance by reallocating all the power of the D 3020 to midrange/ treble speakers, while consigning the power hungry bass frequencies to a dedicated amplified woofer.



## INDUSTRIAL DESIGN

We wanted to liberate the D 3020 from the audio rack and allow it to reside wherever people like to listen to music. From table top, to bookshelf, to desktop, to windowsill, the diminutive D 3020 nestles in and nearly disappears. David Farrage of DF-ID studied design cues from the original 3020 and reinterpreted them in an entirely new and fresh way. Just like its sonic signature, it visually avoids calling

attention to itself. Materials and mechanical design are 21st century and there is a concerted effort to minimize environmental impact during its entire life cycle from production to recycling. The sleek sculptural form springs to life with a soft brush of the hand on the top panel. It automatically goes to sleep when the concert is finished saving energy and reducing environmental impact.

## PERFORMANCE BENCHMARKS

The original 3020 was rated at 20W (it could do about 28W) continuous (RMS) into 8 Ohms at 0.03% THD/IM/TIM from 20Hz to 20kHz. Dynamic power was an impressive 40W at 8 Ohms, 68W at 4 Ohms and 72W at 2 Ohms. Most small amplifiers of the era would protect below 4 Ohms and had horrendous distortion at anything below 6 Ohms!

The D 3020 bests all of these benchmarks by an impressive amount. Rated at 30W (it can typically do 40W) continuous into 8 or 4 Ohms at 0.004% THD/ IM/ TIM from 20Hz to

20kHz. Dynamic power is an amazing 60W at 8 Ohms, 100W at 4 Ohms and 165W at 2 Ohms.

How does the sound compare?

Bjorn Erik Edvardsen comments, “The D 3020 undoubtedly plays louder and cleaner, especially in low impedance speakers. It has a very marginally tighter bass, smoother midrange and better definition and accuracy in the HF region. That is what I expect you to hear.”



## SETTING A NEW STANDARD FOR AFFORDABLE SOUND




This kind of performance has, up until now, cost thousands of dollars. The D 3020 is unique in a market overpopulated with lousy ‘speaker docks’ and ‘Bluetooth speakers’. The ability to drive high quality speakers, chosen on the basis of a listener’s taste and budget, opens a new world to today’s music loving Digital Natives. The concept of ‘system evolution’ stands in stark contrast to the ‘disposable culture’

of consumerism. The D 3020 will improve the sound of a student’s headphones, then allow her to add quality speakers when she gets her first apartment, and then add a subwoofer when she buys a home. Like the thousands of 3020s still in use today, we predict the D 3020 will still be providing musical satisfaction to Digital Natives in the year 2048.





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