

Is this the best Class-D amp ever made?

There's a new amplification technology in town, which purports to take Class D concepts to a new level, with negligible distortion, extraordinarily low noise, load-invariant response, exceptionally clean clipping, low losses and high efficiency, while delivering 400W of power without even getting hot. It comes from Purifi, in Denmark, which has named the technology 'Eigentakt', which is German for 'self-clocking'.

We'd exercise our usual caution with such remarkable claims, but what makes us more inclined towards credence in this case is NAD's rush to adopt it, and also the team that's behind it. The three listed co-founders of Purifi Audio are Bruno Putzeys, Lars Risbo and Peter Lyngdorf — a pretty illustrious trio.

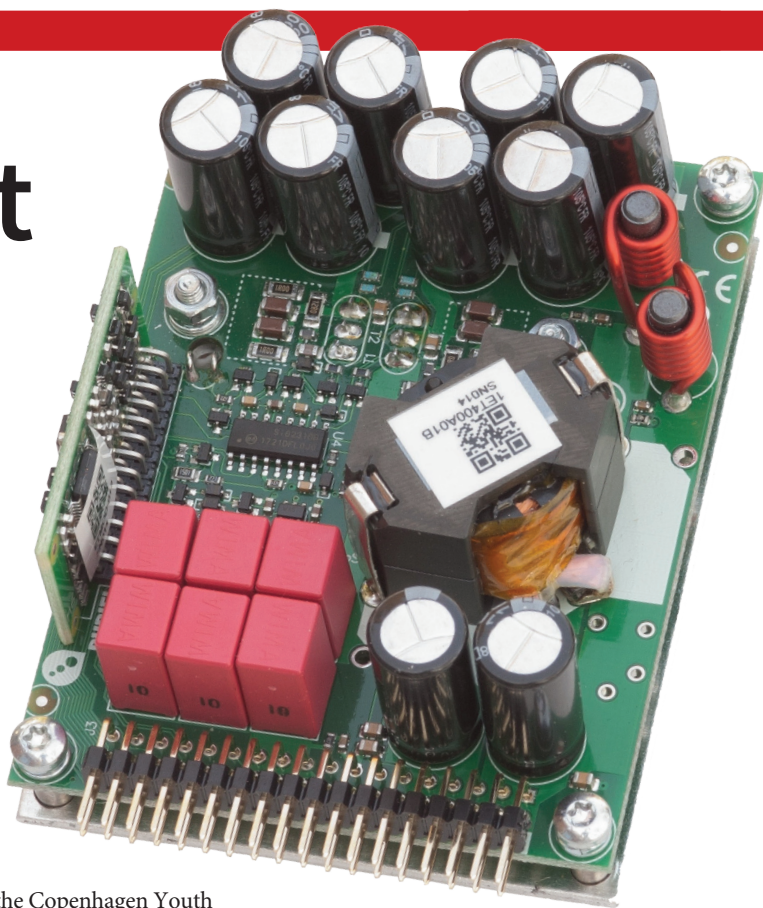
Meet the team

Bruno Putzeys is a Belgian engineer who spent a decade at Philips working on switching amplifier technologies before striking out on his own with Hypex, also as a collaborator in Grimm and later as CTO with Kii Audio. NAD's adoption of Hypex's Universal Class D amplification and Ncore revolutionised its amplifier range a decade ago, and for the last few years Ncore has been the go-to audiophile Class-D module for many audiophile brands.

Putzeys seems an entertaining individual beyond his audio prowess: his personal website is well worth a visit, where he describes his professional activities as "including most things audio, analogue hardware in particular. My first hobby is trying to be relaxed about being not at all good at my second hobby, which is trying to be zen about failing miserably at the first." Other posts include his formulation of a 'Quantum Theory of Female Vestimentary Preparedness', which states that "Teenage women preparing to go out will remain in an indeterminate state of readiness until observed,

at which point the wave function instantly collapses into an immaculately dressed and quite stunning apparition."

Lars Risbo, meanwhile, first established his musical credentials as principal cellist of the Copenhagen Youth Symphonic Orchestra, going on to develop 'equibit' technology in his Danish company Toccata Technology, as used in the highly regarded TacT Millennium amp way back in 1999, this early 'digital amp' circuit gaining rare audiophile praise. He was also early in more carefully defining the technology to overcome the general disdain for 'digital' amplification, really being a powered DAC in which the signal remains digital all the way through to the point it exits to the speaker terminals, achieved by switching from a PCM bitstream to pulse-width modulation (PWM), although he notes that "the PCM-to-PWM process is the easy part — the power stage was the hard part", where the PWM is integrated at the output by switching a steady voltage.



Toccata was subsequently purchased by Texas Instruments in 2000, where Risbo started a project called 'SmartAmp' and went on to be elected TI Fellow in 2012 and Audio CTO in 2013, now holding more than 30 patent 'families'. This connection has seen several other TI personnel come to work with Purifi. One of these is the company director Claus Neesgaard (below), who developed several core innovations in Class-D amplification for Toccata and went on to head TI's Audio DSP product line, leading the transition into streaming-based system solutions.

Also involved in the TacT amplifier was hi-fi luminary Peter Lyngdorf — also now a co-founder of Purifi. Lyngdorf brings his



► Purifi co-founder Lars Risbo (left) and Director Claus Neesgaard, whose connections go back 20 years through Texas Instruments to Toccata Technology, and who together hold a raft of patents.

connections to the likes of DALI, Steinway Lyngdorf and the Hi Fi Klubben retail network, as well as a close relationship with NAD dating back almost to its earliest days.

Put these Purifi co-founders together and you have a team able to develop switching amplification at its highest level, to bring it to market, and to enjoy themselves in the process. The resulting Eigentakt module is small given its stated output of 400W, although it is notable that NAD, which is adopting the technology for its Masters series in the forthcoming M33, is rating that M33 model at 200W continuous, perhaps because the distortion characteristics of the module rise dramatically above 150W into eight ohms, reaching 1% THD+N, whereas below that the figures are astonishingly low: 0.00017% at 100W into eight ohms across the full audio spectrum, and output noise of just ~11.5µV A-weighted. Putzeys says the module has the frequency and phase response of a second-order Butterworth filter cornering at 60kHz, so very nearly 'linear phase' in the audio band. The quoted dynamic range for the module is 131dB, and its efficiency greater than 94%. Chunky heatsinks should not be required.

The secret of Eigentakt

Eigentakt's secret, says Purifi, is the application of nonlinear control theory, with a "mathematically exact" optimisation of the feedback circuit that improves performance by at least an order of magnitude over existing implementations. The result is a large-signal self-oscillating amplifier which is extremely stable, has an output impedance below 65µΩ at 1kHz, and makes the impedance curve of the speaker irrelevant (subject, we gather, to a lower limit). There's also an immunity to noise from even simple switched-mode power supplies, as well as a comprehensive protection system which makes it robust in operation and particularly easy to integrate into complete amplifier designs.

There's one particular development highlighted by Putzeys and Risbo (who admit to their 'bro-mance' being the spark which brought the new company into being), and that we thought to be best explained in a Q&A with the pair published by *audiophile-style.com*, where Putzeys explains: "The only real surprise we had recently was to do with the output choke. Magnetic materials have something called hysteresis, but there is precious little information about what this really does. If you test a magnetic core with a sine wave, the distortion looks a little like soft clipping, perfectly benign. But what came out of tests on iron parts in loudspeakers was that hysteresis has a long-term memory, so you can get intermodulation between things that happen now and things that happened 10 minutes ago. With music, this distortion sounds like half correlated noise."



► March Audio's P451 monobloc design, the first Eigentakt amp available in Australia.

"The modules from Purifi have raised the bar both technically and subjectively over Bruno Putzeys' previous Hypex Ncore designs. If there were any slight deficiencies in the sound of older Hypex Ncore designs I think they are now banished."

"Crackling," interjects Risbo. "You hear when each magnetic domain flips."

"When you put the coil inside the amplifier's feedback loop, that distortion gets reduced along with the distortion of the power stage and everything else," continues Putzeys. "We have a strong suspicion here that the most audible distortion in typical Class-D amplifiers may very well be that."

In the Eigentakt circuit, he says, the extreme amount of loop gain (about 75dB all the way to 20kHz, 20dB better than Putzeys' previous designs) reduces the sonic footprint of the output choke.

While NAD claims a first in the use of the Eigentakt module, it has appeared elsewhere, initially in a prototype Lyngdorf 8-channel amplifier, more recently in amplifiers by Nord Acoustics and by Australia's own March Audio in the \$1295 P451 monoblock amplifier. March Audio also uses Hypex Ncore modules in its P701 amplifier, but Alan March is clear about his preference.

"The 1ET400A modules from Purifi have raised the bar both technically and subjectively over Bruno Putzeys' previous Hypex Ncore designs", he tells us. "If there were any slight deficiencies in the sound of older Hypex

Ncore designs I think they are now banished. They have a sweet extended high frequency range with great power and definition and tightness in the bass. They are just neutral — but don't think for one minute that means clinical or unengaging. They just let the music through. Tremendous power output with low



► Bruno Putzeys, the man behind Hypex Ncore, and 'bro-mance' collaborator with Lars Risbo on the new Purifi Eigentakt amplification.

► NAD's forthcoming M33 BluOS streaming amplifier will be its first to use the Purifi technology, which NAD says is adapted to the company's "signature design requirements".

power consumption and cool running temperatures in a very compact format. What more do you need?"

Purifi has made the Eigentakt module available to anyone for DIY purposes — the EVAL1 kit combines two 1ET400A amplifier modules and a stereo front-end board "highly suited for DIY projects", priced at 4700 Danish krona, a little over A\$1000. NAD does note, however that the companies specifically cooperated to adapt the Eigentakt circuit to NAD's signature design requirements.

Rolling in the deep...

The module is not Purifi's only new development. Perhaps surprisingly, Purifi's other new product is a 6.5-inch woofer, which leverages the same reduction in magnetic hysteresis distortion in the goal to deliver a small long-throw driver which delivers the greater linearity of a larger short-throw driver. Purifi identified the problem of Force Factor Modulation, where the magnetic field created by current in the voice coil adds itself to the field created by the permanent magnet, so varying the magnetic flux in the air gap. And in long-stroke drivers a larger portion of the coil is in play, exacerbating the problem.

And as Purifi notes, with FFM comes a "side order" of magnetic hysteresis distortion. While iron-free drivers overcome this, they are an expensive option. Purifi's new motor claims to be virtually free from FFM, while a new surround design addresses the additional issue of the cone surface area changing as excursion increases.

Again March Audio has trialed this new driver, and is currently incorporating it into its forthcoming 'Sointuva' speaker design, along with Purifi's PTT6.5PR passive radiators and a BlieSMa T34A-4 tweeter.

"Although the passive radiators perform the same job as a port, in this design it results in a very tight and controlled bass similar to a closed design but with the better low frequency extension of a ported design," Alan March tells us.

► Australia's own Jones-Scanlon Baby Reds active studio monitors, using Purifi's 6.5-inch woofer with almost FFM-free motor and area-maintaining surround.



One Australian company already using the woofer is Wayne Jones Audio. The Jones-Scanlon Baby Reds active studio monitors extend the collaboration between Jones and Aria-award-winning live and studio engineer Steve Scanlon, and have already received a rave review from *Sound On Sound* magazine.

"We make our own drivers with Michail Barabasz of Lorantz Audio in Melbourne, so it was a big thing for us to go to another type," Jones tells us. "But we needed a midrange for our smaller monitors and Michail said to me 'this is the closest thing to what we're doing'. The driver is incredible for its dimensions, and with excellent stereo imaging."

Jones tell us he is already doubling down on his original order of the Purifi drivers.

Purifi itself has installed the transducer in a SPK5 demonstration cabinet, and it is perhaps telling that Purifi co-founder Peter Lyngdorf's DALI speaker company already addresses the issue of hysteresis by using an iron-free Advanced Soft Magnetic



Compound magnet known as SMC. Given Lyngdorf's role in Purifi, our money is on DALI bringing the Purifi transducer to market in one of its own designs in the not too distant future.

For more, visit www.purifi-audio.com

