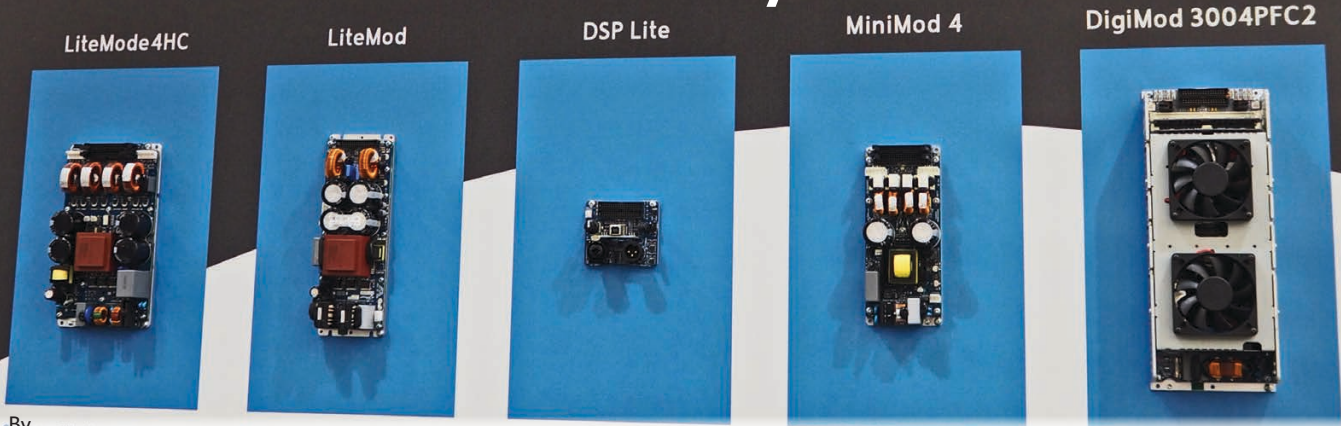




Powersoft OEM Power Amplifier Modules

Flexible Power for Active Systems



By **Ward Maas**
(The Netherlands)

Photo 1: Powersoft offers a full range of high-powered, compact, and scalable solutions for loudspeaker manufacturers.

In this article series, *audioXpress* continues to explore the history, technological developments, and new generation products from some of the most innovative amplifier platform companies serving all segments of the audio industry. We continue this series with Italian company Powersoft and we will focus specifically on the brand’s OEM amplifier modules.

Powersoft’s story began in 1995 when the brothers Luca and Claudio Lastrucci, and their friend Antonio Peruch who, during the period that follows university studies, shared the two brothers love for music, technology, and innovation. They called their new company Powersoft, and in their kitchen, they began to modify amplifiers—and with their background in power electronics—design new ones from scratch. As switch mode power electronics started to become more common, they became interested in designing a Class-D amplifier. Not only did they succeed in making it work in a stable way, but also at high levels of power. Their first amplifier delivered 150 W. Ever since then, Powersoft has been focused on the high-power segment of the market. The company also believed in active speakers and it was the first to develop Class-D amplifier modules that could be integrated into professional audio speakers.

In the August 2014 issue of *audioXpress*, Stuart Yaniger looked in detail at the foundational amplifier technologies developed and perfected by Powersoft Audio and the unique company philosophy. In this highly recommended reading, the article details the company’s Power Factor Correction (PFC) technology

integrated into switching mode power supplies and its Class-D Pulse Width Modulation (PWM) high-efficiency output stage. We are not going to repeat the detailed description of those technologies, shared by the company’s professional audio, installation, and touring amplifiers, and for this article, we will focus on the OEM modules.

Innovation

Powersoft products are entirely made in Italy. Today, Powersoft counts more than 90 employees at its headquarters in Scandicci (Florence, Tuscany), engaging in research and development, technical assistance, marketing, sales, and logistics. The R&D lab by itself involves more than 30 employees with interdisciplinary skills, which explains a lot about the company’s pioneering innovations.

From its initial concept, every electronic project (which comprises PCB routing), mechanical project, firmware, signal processing algorithms, and software, everything is developed entirely within the head office premises, where all tests are also carried out—both for certification purposes and to assure proper operation

of the products in the most demanding operating conditions. Powersoft, now a publicly traded company in Italy, also invests more than 10% of its turnover in the research and development of technologies applied to products and solutions dedicated to the pro-audio industry. And not only in amplification. In recent years, Powersoft has made significant inroads into innovative transducer technologies as well. As production also works closely with development, improvements deriving from market experience or from the results of research are easily implemented.

Three different production sites, focused on rack mount amplifiers and amp modules, are located respectively in S. Giovanni in Persiceto (Bologna), Ronchi dei Legionari (Gorizia), and Cotona in Italy, where around 100 people are employed. In line with the company values, these production sites make extensive use of solar energy. The entire production of Powersoft products is carried out using green energy—a trademark of its own technology efforts in amplification.

More than 20 years ago, Powersoft was the first company to introduce PWM in a way that enabled it to achieve an efficiency level that was unthinkable at that time. PFC was a natural product feature, allowing efficient energy savings and reducing heat generation due to cable losses.

In fact, the company's Smart Rails Management implemented into amplifiers and power supply and back electromotive force (EMF) energy recovery paved the path for Green Audio Power—Powersoft's registered trademark that identifies environmental friendly products.

“Saving energy has been an integral part of Powersoft, but fits perfectly with the demand for truly energy-efficient products based on global warming and increasing cost of petroleum-based products,” Powersoft CEO Luca Lastrucci says. “These phenomena have produced a marketing trend that has been particularly well received in the entertainment industry where there is a special consciousness about what is environmentally friendly or green.”

Powersoft has become a prime example of Italian excellence in audio and one of the leading companies in the global pro-audio industry with the most advanced products and technologies, reinforced by multiple associated patents. According to the company, there are currently more than 600 million watts of Powersoft amplification out there in the market.

The company is one of the world leaders in lightweight, high-power, rack-mounted, energy-efficient amplifiers for the professional audio market. Its amplifiers can be found in an array of markets, ranging from stadiums, sporting arenas, theme parks, performance venues, and airports to convention centers, churches, cinemas, and clubs and are used by the world's leading tour sound companies.

The subsidiary Powersoft Advanced Technologies Corp., located in New Jersey, is in charge of marketing and technical assistance for the US market.

OEM Approach

As mentioned, while Powersoft always had a focus on high-power rack-based products for the install and touring market, the company also introduced Class-D















		DSP-4	DSP-D	DSP-Lite	Small Heatsink	Medium Heatsink	Large Heatsink
							
DigiMod 3004PFC4		✓		✓			✓
DigiMod 3004PFC2		✓	✓	✓		✓	
DigiMod 3000PFC		✓	✓				✓
LiteMod 4HC		✓		✓		✓	
LiteMod HV		✓		✓	✓		
LiteMod		✓		✓	✓		
MiniMod 4		✓		✓			
IpalMod		✓					✓

Figure 1: The Powersoft OEM modules configuration table showcases the multitude of OEM options available.

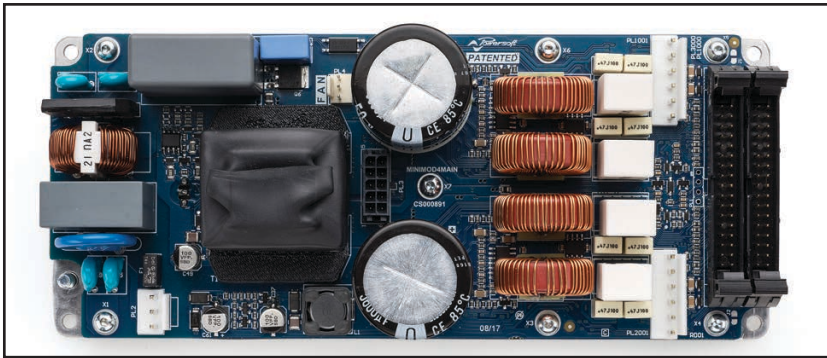


Photo 2: The Powersoft MiniMod 4 is an integrated module offering universal mains switching mode power supply with PFC and a total of 600 W of audio amplification, configurable as four, three, two channels, or single high power output channel.

amplifier modules for the OEM market. Initially with the DigiMod high-power modules, the company established a standard for active sound reinforcement systems in terms of quality, reliability, and robustness, complemented by flexible signal processing tools that allow tailoring the behavior of the module to perfectly fit any design. As with all Powersoft OEM products that came afterward, they include certifications, reports, and documentation to prevent designers from wasting time, energy, and resources.

Current OEM products range from the 150 W and more MiniMod series, the 600 W and more LiteMod series, to the 1000 W and more DigiMod series (see **Photo 1**). Special products like the IpalMod 8500W with 180 V output voltage and 95 A maximum output current are also available, allowing loudspeaker manufacturers to implement Integrated Powered Adaptive Loudspeaker (IPAL) technology, a functional solution to overcome the limitations of traditional low-frequency transducers.

The range now also includes special products such as the D-Cell504, suited for 12 V/24 V/48 V power supply operation. The D-Cell504 is an incredibly small and lightweight amplifier with 2x 350 W available at 4 Ω, bridgeable to have 700 W on a single 8 Ω load. It's proven to be a suitable solution for everything from small-mid power professional loudspeakers to studio monitors, home cinema systems, and even hi-fi applications. Including a PFC power supply and a two-channel output stage with easy mechanical integration, the D-Cell504 power supply can drive two amp units, one of which

can be bridged to drive three-way systems, as well as two-way bi-amped or symmetrical loads with higher power even at higher impedance.

The D-Cell504 IS Series of modules also includes an integrated two input/four output DSP, which can be integrated in a single module with an aluminum heatsink panel, an interface panel with input volume potentiometer, controls, and LED indicators, which include limit and clipping functions signaling. As with all Powersoft amplification products, these solutions can all be remotely controlled through the company's powerful Armonía Pro Audio software suite.

All in all, a complete range of modules, and all an OEM loudspeaker manufacturer needs to design powered systems, including pre-configured cables. Having a look at these products, the first thing that comes to mind is the completeness of the range (see **Figure 1**), not only with integrated wide operating voltage PFC power supplies, but also with all the accessories needed to easily design a complete product.

A Closer Look

We looked in more detail at the MiniMod 4, a compact and flexible 4x 150 W amplification platform offering universal mains switching mode power supply with PFC and a total of 600 W of audio amplification (see **Photo 2**). This compact module has low standby power consumption with smart rails management that also helps to reduce heat. The MiniMod 4 boosts flexibility, which is illustrated by the fact that it can be configured with five different output types:

- 4 x Single Ended (SE): Four independent channels with 4x 150 W at 4 Ω SE
- 2 x Bridge Tied Load (BTL): Two couples of channels bridged with 2x 300 W at 8 Ω BTL
- 2 x SE + 1 x BTL: A couple of channel bridged while the remaining two channels are kept single ended with 2x 150 W at 4 Ω SE + 1 x 300 W at 8 Ω PBT
- 2x Parallel Tied Load (PTL): Two couple of channels obtained by paralleling two channels of the module with 2x 300 W at 2 Ω PTL
- 1x Parallel Bridge Tied Load (PBT): A single channel can be obtained by bridging the PTL configuration with 1x 600 W at 4 Ω PBT
- These can be used in high channel count applications, three-way and two-way designs, subwoofer, and satellite systems.

Nowadays, every power amplifier module comes with a fault protection system designed to protect people from severe or fatal electric shocks and to avoid damage on the amplifier or the loudspeakers in case the electrical or thermal parameters run out of the design criteria limits or when radical changes in the environmental

About the Author

Ward Maas is the owner of Pilgham Audio. He studied electronics, marketing, and amplifier design. During his career in consumer electronics, Ward worked in areas ranging from CD standardization to radio and television to personal GPS navigation. Ward has worked on an extreme low-noise magnetic cartridge preamplifier and several special amplifier products. As the CTO of "Witchworld," a theme park near Amsterdam, he also works with animatronics. He lives in Almere, Netherlands, with his wife and son.

conditions occur. There is a clear separation between the power supply and the amplifier protection sections. Both are independently monitored.

For the universal input power supply there is a mains overcurrent protection in case of an over current situation due to internal failure (not customer replaceable or resettable). A mains overvoltage protection acts at 280 V_{RMS}, switching off the power supply and resetting at 275 V_{RMS}.

Furthermore, there is a three-stage power supply temperature protection starting at 80° when the fan starts. At 100°C, the power supply starts to reduce the amplifier output stage voltage and when the temperature exceeds 120°C the output stage is switched off.

The amplifier itself has a bit stricter thermal protection. The amplifier starts to reduce the output stage voltage at 85°C. When the temperature exceeds 100°, the output stage goes in safety thermal switch off mode.

In case of a too low load impedance or if the loudspeaker line has a short circuit (because of voice coil damage, wires that short circuit, and improper wiring, etc.), the amplifier output current protection trips. When the output current passes the threshold of 12 A peak, the amplifier section switches off instantly.

High-frequency signals tend to stress the amplifier section of the module as well as the loudspeaker's voice coils. If the input signal above 20 kHz is higher than 450 mVrms, the protection will activate, starting the fan first. With an increasing high-frequency content input, the amplifier module will start to reduce the output stage voltage until finally switching off the output stage completely.

All the protection monitoring signals are available on IDC connectors complete with auxiliary power supplies to enable customers to develop their own product implementations. To be able to evaluate the MiniMod 4,

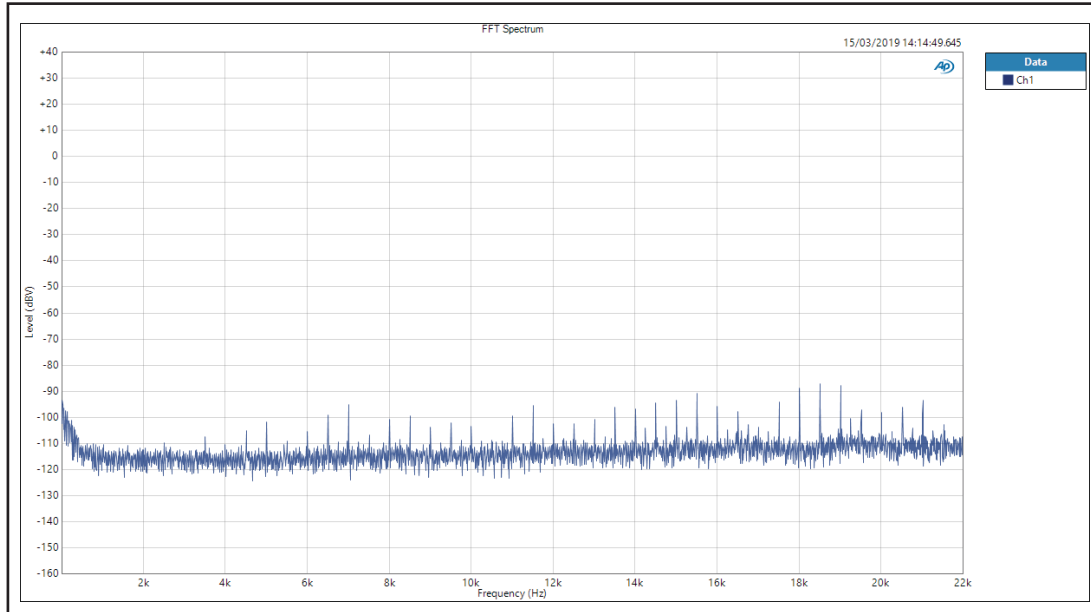


Figure 2: Looking at the MiniMod 4 amplifier module's specifications, we see that the single-end fast Fourier Transform (SE-FFT) at 8 Ω idle spectrum has a noise floor that stays below -110 dB on average with some spikes up to -90 dB.

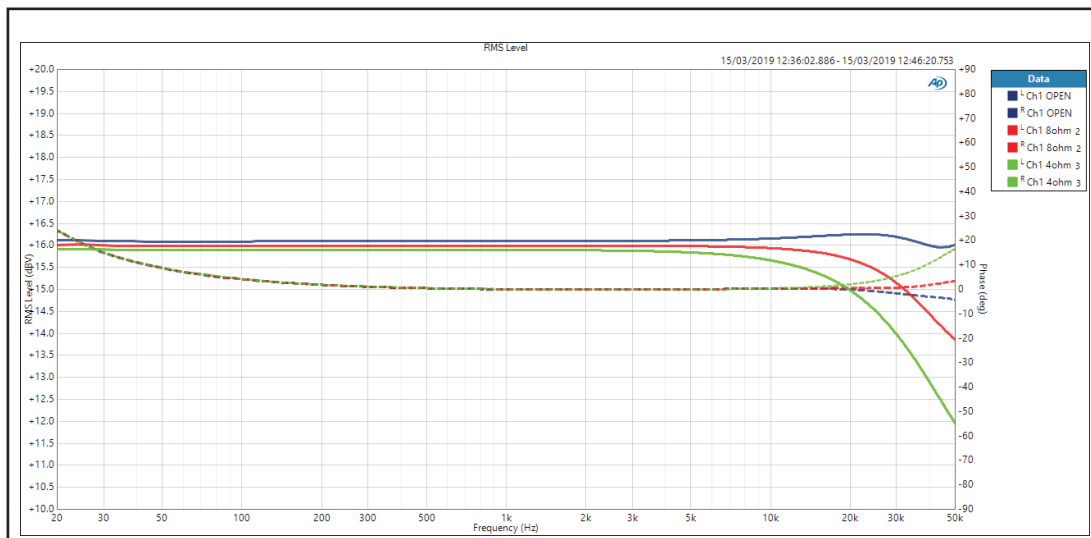
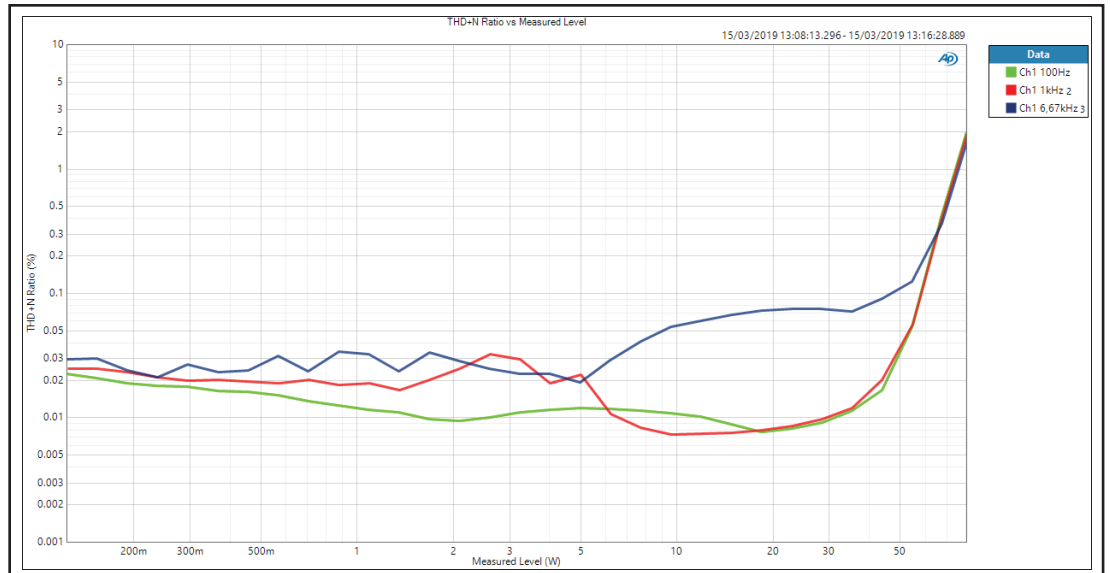


Figure 3: The MiniMod 4 amplifier module's single-end frequency response versus phase will vary depending on the load.

Figure 4: The total harmonic distortion plus noise (THD +N) versus power measurement at SE-8 Ω remains below 0.1% worst case (6.67 kHz) until the amplifier starts to clip.



there is the evaluation board KTP00477, which is an analog audio interface that includes a thermal limiter, a clip limiter, and other functions (mute, energy save enable) in order to evaluate the module without using a DSP. By correctly setting its limiters, it will be possible to run a long-term test without audio interruption, which would otherwise be triggered due to the module internal protection of over temperature or over power.

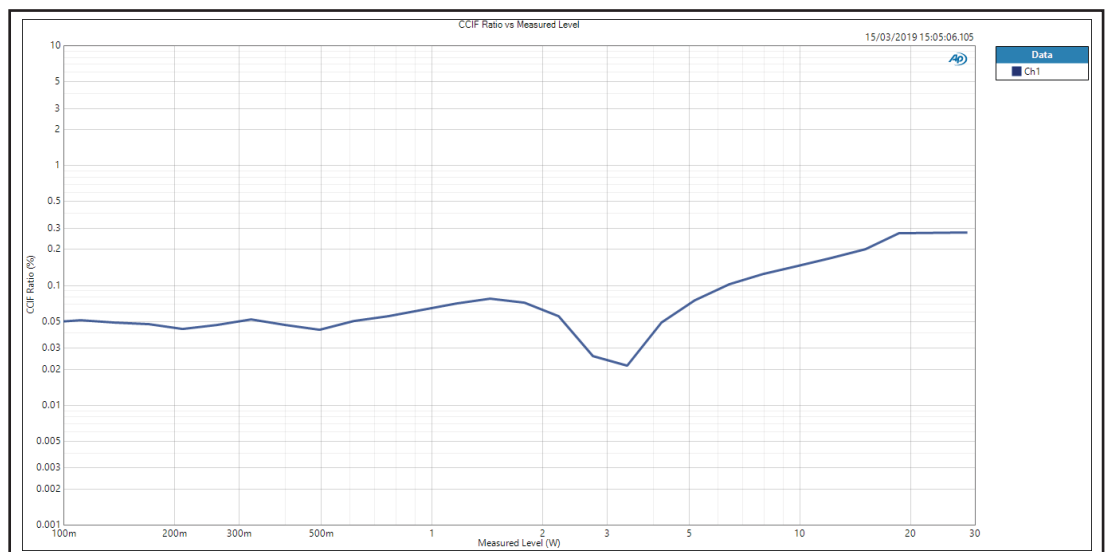
Certainly for Class-D amplifiers, apart from safety regulations, the EMC regulations are an area of particular interest due to the “switching” nature of these products. The MiniMod 4 comes with a comforting long list of relevant standards with which it is compliant. Clearly, Powersoft is living up not only to its own environmental vision but also safety and robustness.

Users working on the development of a project using this Powersoft module will be reassured with the remarkable quantity of information available to help

them in the design. From thermal calculations, complete circuit descriptions to interface the Powersoft modules, to the already mentioned cabling and heatsinking solutions. Products designed around the hardware modules—the amplifiers, power supplies and DSP solutions—have the strong benefit of being fully configurable and controllable with the Powersoft Armonía software solutions, which the company continues to develop and expand.

When we examined the Powersoft MiniMod 4 amplifier module, we noticed it has a fixed frequency PWM modulator with multiple feedback. According to Powersoft R&D Director Claudio Lastrucci, this allows a high level of predictability and immunity from intermodulation artifacts. Without entering into the discussion regarding its qualities versus the self-oscillating variants, it is evident that Powersoft found a nice balance between practical product use and required quality.

Figure 5: The MiniMod 4 amplifier module’s single-end intermodulation distortion using the CCIF standard is 18.5 kHz+19.5 kHz at 8 Ω.



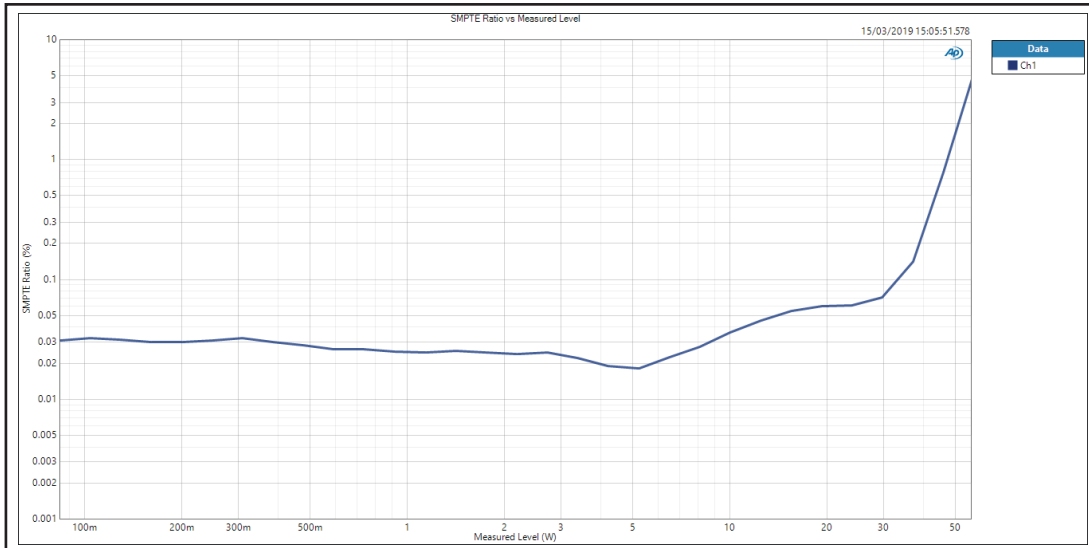


Figure 6: The MiniMod 4 amplifier module's single-end intermodulation distortion using the SMPTE standard is 60 Hz+7 kHz at 8 Ω.

Looking at the specifications of the MiniMod 4 amplifier module, the single-end fast Fourier Transform (SE-FFT) at 8 Ω idle spectrum has a noise floor that stays below -110 dB on average with some spikes up to -90 dB. (see **Figure 2**). When in SE at 8 Ω, the frequency response is flat with -0.25 dB at 20 kHz That will also vary depending on the load, with -1 dB at 20 kHz for a

4 Ω load (see **Figure 3**). The total harmonic distortion plus noise (THD +N) versus power measurement at SE-8 Ω remains below 0.1% worst case (6.67 kHz) until the amplifier starts to clip (see **Figure 4**). The CCIF and Society of Motion Picture and Television Engineers (SMPTE) intermodulation distortion measurements remain below 0.1% (see **Figure 5** and **Figure 6**).

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[CCIF intermodulation distortion testing consists of using two equal-amplitude, high-frequency signals spaced closely in frequency. The SMPTE standard specifies a two-sinewave test signal consisting of a low-frequency, high-amplitude tone linearly combined with a high-

frequency sinewave at one-quarter the amplitude of the low-frequency tone.]

These values are good. Not extremely good, but considering these modules can be used in SE, BTL, PTL, or PBTL modes, the measurement values do vary slightly depending on the load and the modulus operandi. It is very clear that this is a well-thought-out and practical amplifier module platform, capable for a wide range of applications.

In the professional audio industry, Powersoft has been known for its rugged, high-power, rack amplifiers for a long time. With its amplifier modules and the range's full complement of hardware and development tools, it becomes an attractive supplier for the OEM market and a powerful recipe for many active loudspeakers in multiple demanding application areas.

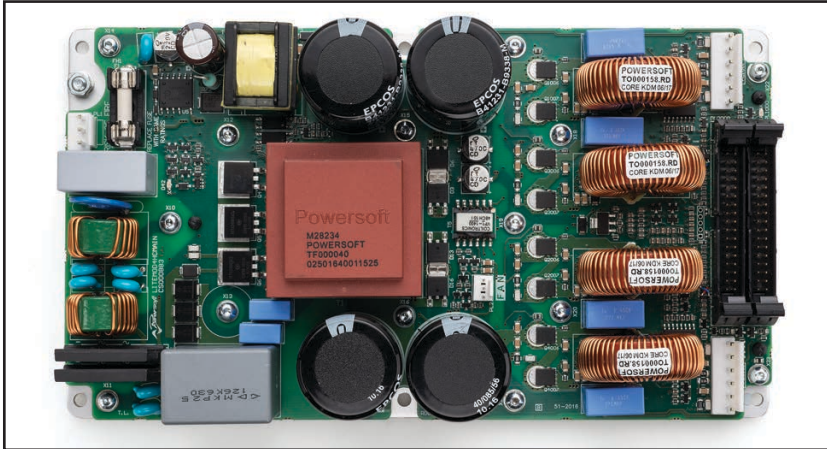


Photo 3: The Powersoft LiteMod 4HC amplifier module with PFC-equipped power supply for universal mains operation and four output stages delivers up to 2400 W total. It can be configured as four, three, two channels, or single high power output channel and support 2 Ω operation.

Working with a LiteMod 4HC Module

To demonstrate how easy and flexible the solutions that Powersoft offers are, we assembled a working system with a LiteMod 4HC module (see **Photo 3**). The LiteMod 4HC can be seen as MiniMod 4 on steroids, ideal to power sound reinforcement systems. It delivers 750 W at 4 Ω SE and can be bridged in BTL mode with 1400 W at 8 Ω, and 2400 W at 4 Ω PBTL. It is enough power to experiment with in very loud but efficient configurations.

But even a high-efficiency Class-D amplifier will generate heat. We can calculate an efficiency of 80% and 6 dB crest factor with 3400 W peak. The result is: $3400 (1-0.8)/4 = 170$ W to be dissipated. With a thermal protection set at 75°C (167°F) and an ambient temp of 45 °C (113°F) it gives $(75-45)/170 = 0.14$ °C/W or better requirement for the heatsink.

Powersoft has several heatsinks from which to choose, depending on the products you use. They all have a few things in common: they are predrilled, and they have an area for a brand's shield, PowerCON in/out connectors, and a place for DSP/connectors to the outside world. Of course, users can build in a DSP, connectors, and heatsink that matches with their products.

The next step is to choose the amplifier configuration. For instance, if a company wants to build a three-way line array element, it can choose a BTL setup for the bass, a SE in 4 Ω for midrange and a SE in 8 Ω for the highs. Given the flexible Powersoft approach, almost any configuration can be selected and combined with one of the brand's DSP solutions (see **Photo 4**). With that in mind, the appropriate cables can also be chosen from the bundle supplied in the sample system, and connected, including the DSP Lite unit (see **Photo 5** and **Photo 6**).

Having made all the right connections, it is time to make all the configuration settings with the Armonia software, which also allows saving product-specific presets. The ArmoniaPlus software is free to be used

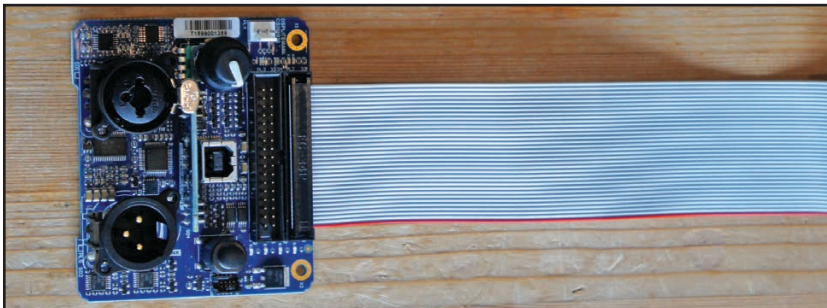


Photo 4: DSP Lite PCB, a complete DSP module for active speakers.



Photo 5: The assembled DSP Lite module with front plate

after registration and there's even a dedicated website (<https://armonia.powersoft.it>). After registration, developers can obtain a manufacturer's code, which allows to download and install the full Armonia Pro Audio Suite, Armonia ProManager, and activate the licenses.

Powersoft has worked extensively on the complete Armonia Pro Audio Suite, refining interfaces, updating platform support and delivering training tools, both for audio system users and developers. OEM manufacturers are able to use the software to display a system based on the chosen Powersoft amp modules, using the Armonia ProManager dedicated software tool to configure the system, and even initialize products with their own branding information.

Intriguing as it was, we did not fully pursue all of the options, as our goal was to evaluate the completeness of Powersoft's OEM solutions. But after downloading the right drivers for the USB connection, we could quickly find the correct hardware, after which we could configure delay input/output, input equalizer, output equalizer, crossovers, limiters, and lock the parameters. Where other manufacturers offer services for product development, Powersoft goes one step further by offering all the tools needed to develop products, guided by Powersoft's extensive expertise. Yes, very tempting! 📧

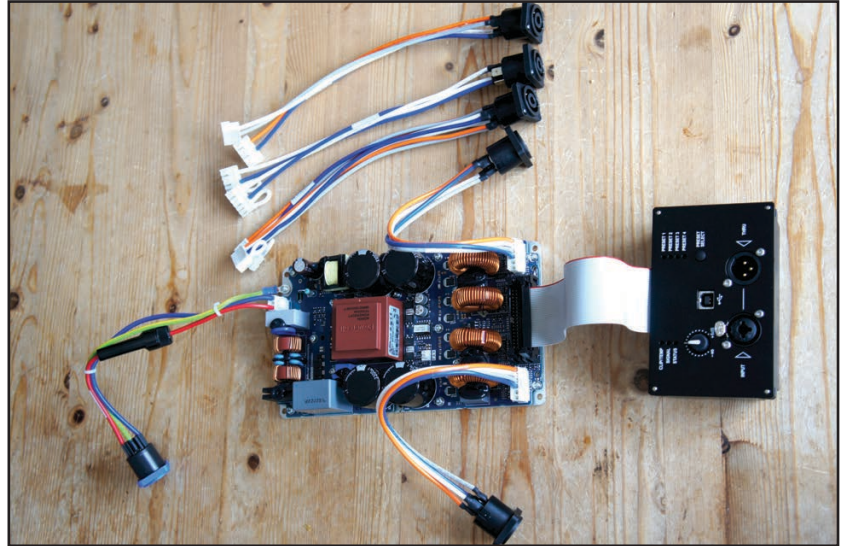


Photo 6: The Powersoft LiteMod 4HC module with all the cabling. Ready-made cabling sets are available for easy manufacturing of OEM products.

Resources

Armonia Plus System Manager, <https://armonia.powersoft.it>

Powersoft, SpA, www.powersoft-audio.com

S. Yaniger, "Future Shock. Powersoft Audio's Next Generation Green Amplifier Technologies," *audioXpress*, August 2014, www.audioxpress.com/article/r-d-stories-future-shock-powersoft-audio-s-amplifier-technologies

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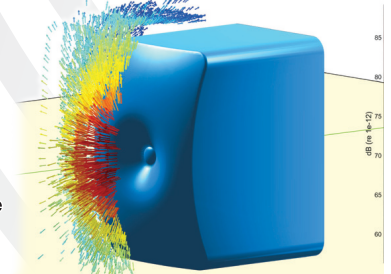
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