

Driving High-Power Class-D Audio to New Heights

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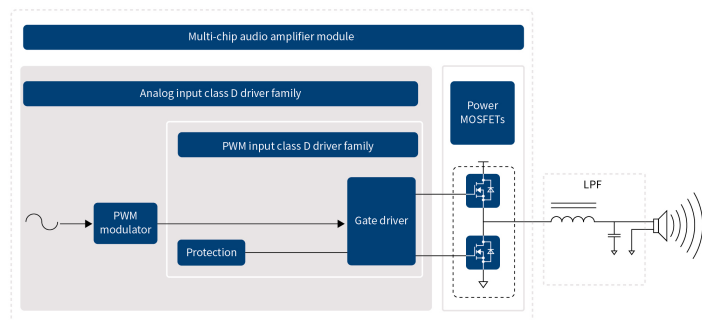
Categories: Amplifier (amp)

Tag: @Infineon #highpower #psd #powerelectronics

Infineon's best in class MOSFET technology enables 200 W heatsink-less amplifier solution in a 7x7 mm² package

Class-D audio power amplifiers have succeeded in professional and high-end consumer markets by offering a combination of small size, low heat dissipation, high integration, and great sound.

Efficiency has always been a strong point of the class-D topology; the key to eliminating the bulky heatsinks needed by traditional analog amplifiers, thus permitting smaller, more lightweight solutions. Their smaller size delivers practical benefits, expanding styling opportunities, permitting new generations of equipment better suited to **home use and small studios**, and allowing more channels to be integrated into a single unit.



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Figure 1. Class-D multi-chip modules integrate PWM modulator, high voltage gate driver, MOSFET output stage, and protection features in one device. (MERUS™ application brochure).

In the 100-400 Watts-per-channel range, class-D is the dominant technology in markets for **consumer products** such as soundbars, subwoofers, home theatre, and mini component systems. It is also preferred in **professional applications**, including active speakers, active studio monitors, guitar amplifiers, as well as aftermarket car and marine audio systems. Semiconductor development has played a key role in enabling class-D amplifiers to meet the demands of these markets. Successive generations of chips continue to unlock more potential, enabling improved thermal performance, easing circuit layout, strengthening system protection, increasing integration to help simplify design and enhance reliability, and further improving audio quality.

New high-power audio semiconductor families continue to power innovations in class-D product development. Key ingredients include the latest **power MOSFETs** with characteristics that are highly optimized for class-D audio-amplifier applications. Infineon has several families of discrete power MOSFETs that are ready to pair with various PWM drivers. The high-power family also includes multi-chip modules (MCMs) that integrate the analog input stage, PWM driver, and power MOSFET in the same device (Figure 1). Also, MCMs integrate additional protection features to simplify circuit design, save board space and bill of materials costs, and permit greater reliability.

MOSFETs and modules move forward

The Infineon MERUS™ MA5332MS[1] is an example of the latest generation of class-D audio MCM. As a richly

featured module, the device enables higher power density than a discrete solution of comparable power. At the same time, it allows a higher operating voltage than earlier MCMs such as the IR4302M, IR4312M, and IR4322M, and hence can handle more power.

MOSFET Technology

The OptiMOS™ 5 technology integrated into the MERUS™ MA5332MS has the leading Figure of Merit (FoM), which permits lower switching and conduction loss. On top of that, the MOSFET breakdown voltages are increased to 100 V and 150 V compared to the 40 V, 60 V, and 80 V ratings of preceding families with reduced RDS(on). This improvement allows the amplifier to deliver greater output power while keeping the same package size 7 x 7 mm².

Infineon's best-in-class 100 V MOSFET, contained in the new MCM, has on-resistance RDS(on) of just 24 mΩ, enabling heatsink-free operation that monolithic devices cannot achieve at the same power level. Indeed, the module can drive 2x 100 W into 4 Ω speakers with no heatsink or 2x 200 W with a small 8 C/W heatsink.

The new modules enable high power single-ended (SE) designs with reduced bus capacitors and output filters compared to a low-voltage bridge tied load (BTL) approach. Using a single-ended topology as an alternative to BTL can allow the sizes of bus capacitors and output low-pass filters to be reduced.

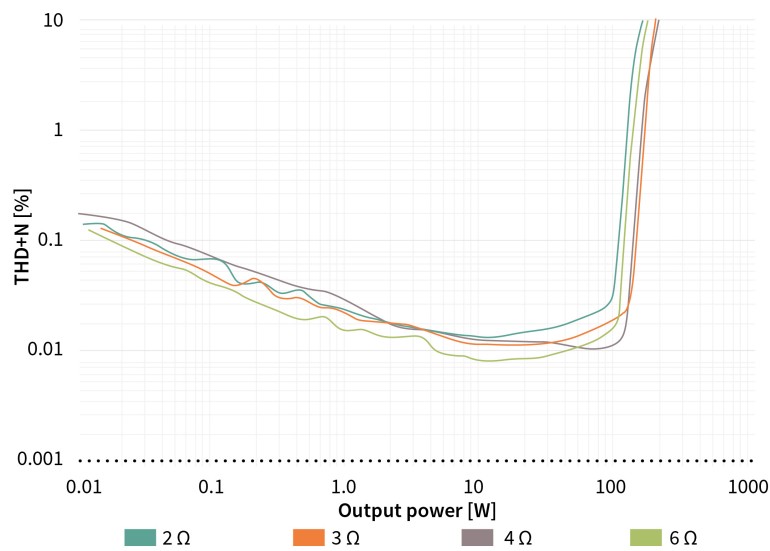
Protection on-chip

Highly-integrated MCMs, like the MERUS™ MA5332MS, integrate protection circuitry for functions such as over-current, over-temperature, and under-voltage protection with self-reset capability. This on-chip protection circuitry saves the time to design protection using external components and the board space and bill of material costs associated with general-purpose gate driver external protection circuitry. On top of that, there is also a new internal logic scheme to control soft-start operation that delivers a further reduction in click- and pop noise.

Leveraging these improved characteristics, and in a small 7x7 mm² package that reduces footprint by 80 percent compared to alternative solutions, the latest modules can operate heatsink-free or benefit from greatly reduced heatsink size. On the other hand, they can deliver more than 50 percent extra power with the same package size as the preceding IR43x2M MCMs.

Multi-Chip Module in action

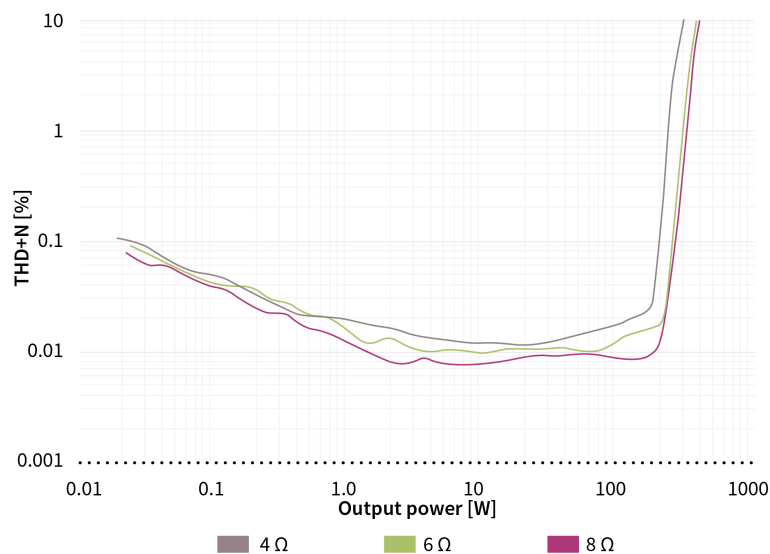
The EVAL_AUDAMP25[2] evaluation board lets designers try out the MERUS™ MA5332MS amplifier module in various configurations based on single-ended (SE) and bridge-tied load (BTL) output circuitry. Infineon has tested a dual SE amplifier to be used with a split power supply, typically used in applications such as audio/video receivers, high-end consumer distribution amplifiers, automotive aftermarket equipment, and professional active speakers. It is capable of driving 2 Ω - 6 Ω speakers and delivers 2x 200 W into a 4 Ω load. With the output filter provided on-board, harmonic distortion and noise (THD+N) is about 0.01 percent in the 10-100 W range, depending on impedance, as Figure 2 shows.



Click image to enlarge

Figure 2. THD+N for EVAL_AUDAMP25 as dual SE output.

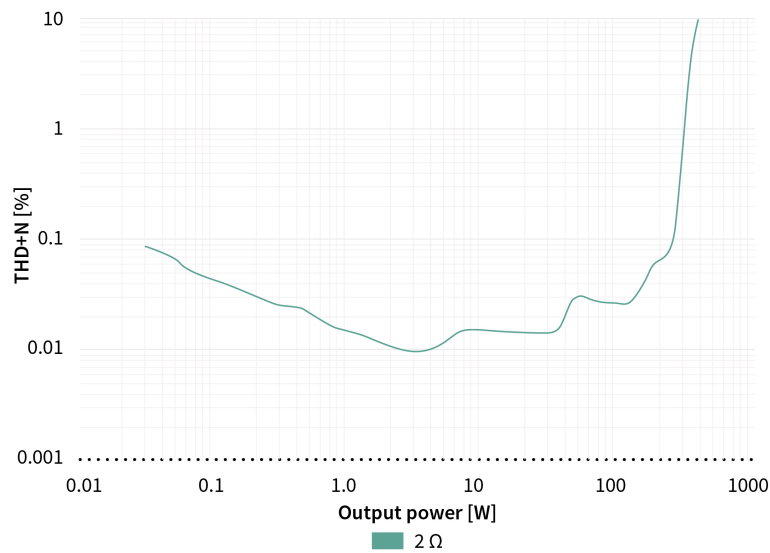
A second configuration with BTL output, designed for a split power supply, models the type of circuit used in high-power subwoofers and professional active speakers. Suitable for 4-8 Ω loads, it delivers 400 W into 8 Ω and exhibits THD+N (Figure 3) similar to that of the 2x 200 W dual SE amplifier described earlier.



Click image to enlarge

Figure 3. Low output distortion with the MERUS™ MA5332MS configured as BTL with split power supply.

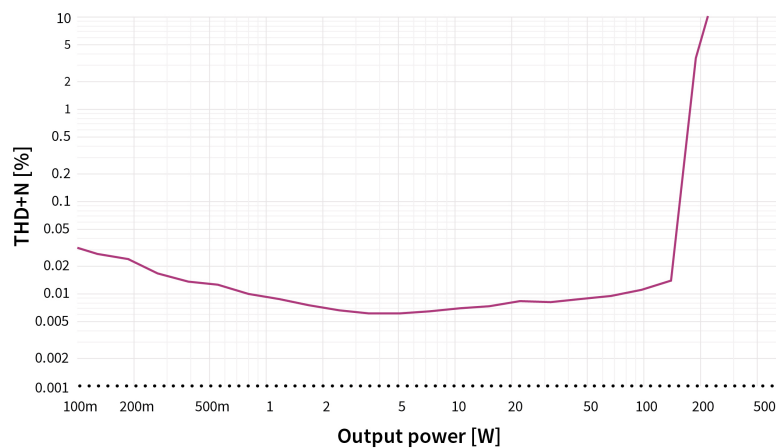
A parallel single-ended (PSE) configuration with a split power supply has also been tested. The PSE configuration is often used in applications such as subwoofers and aftermarket car audio. Ideal for 2 Ω high-power applications above 300 W, it has demonstrated low distortion driving 400 W into a 2 Ω load (Figure 4).



Click image to enlarge

Figure 4. Low distortion with split power supply and parallel single-ended output.

A reference design, REF_MA5332BTLSPS[3], has also been created based on the MERUS™ MA5332MS. The reference design has a BTL output with a single power supply, as often used in products such as woofers, subwoofers, soundbars, aftermarket automotive audio, and marine active speakers. As Figure 5 shows, this reference design has demonstrated THD+N considerably better than 0.01 over a wide frequency range, which has decent overall performance for such a compact design.



Click image to enlarge

Figure 5. THD+N performance of reference design at 4 Ω speaker impedance, with single power supply and BTL output.

Conclusion

Markets for high-power audio equipment constantly demand improvements in size, thermal performance, reliability, and sound quality. Technological advancement in semiconductors is essential to meet these needs.

The latest, best-performing **MOSFETs** and highly-integrated multi-chip modules (MCMs), such as MERUS™ MA5332MS audio MCM, deliver superior efficiency, low output distortion, robust protection, and higher power density, that help customers bring better audio products faster to the market.

For more information on Infineon's portfolio of fully integrated single-chip audio solutions and discrete audio solutions with highly scalable amplifier driver IC and power MOSFET combinations, please visit the **MERUS™ website**.

[1] MERUS™ MA5332MS is coming soon. For sample requests get in touch with our **support**.

[2] Evaluation board and ref-designs will be available soon. For sample requests get in touch with our [support](#).

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