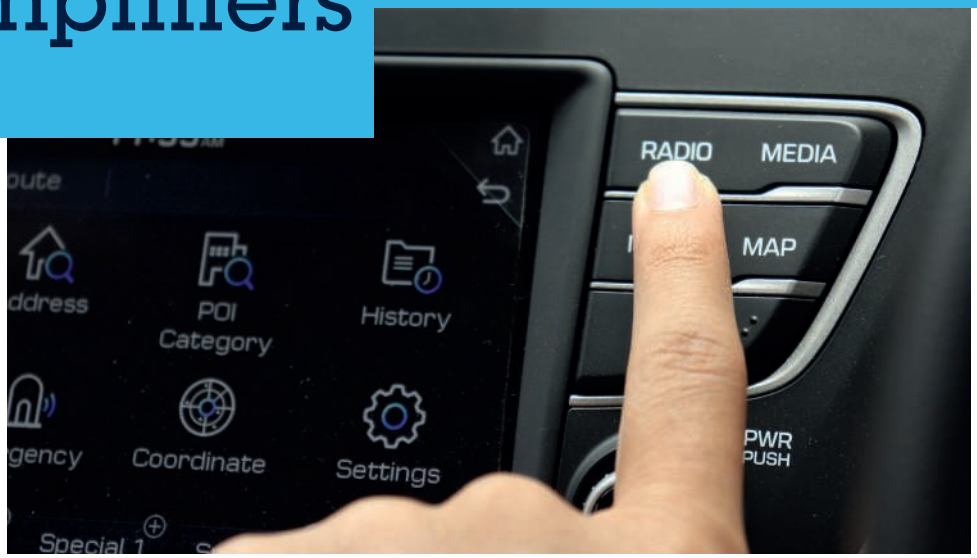
Compact, feature-rich, high-frequency (2 MHz), class-D audio amplifiers for automotive applications

Compact, high-efficiency audio amplifiers



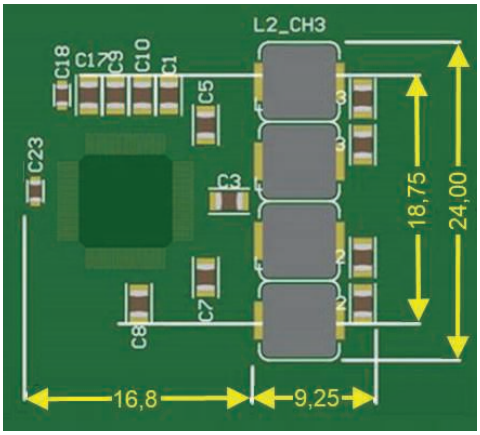
Introducing our new series of high-frequency audio amplifiers, designed to deliver **exceptional performance with lower power consumption and a smaller form factor**. These Class-D amplifiers are specifically targeted for head-up displays and smart cockpit audio applications, where high power is not a necessity.

Our focus is on providing a cost-effective solution that prioritizes efficiency, making these amplifiers ideal for cost-sensitive environments that demand careful power management.

To ensure compliance with CISPR25 Class 5 standards, these compact audio amplifiers feature an **embedded spread spectrum technology** that meet all automotive EMC requirements.

Moreover, this series also offers **low latency** designed to reduce the audio processing delay, making these devices suitable for advanced active noise cancellation (ANC) and road noise cancellation (RNC) applications, without any impact on the sound quality.

Additionally, they feature **advanced diagnostics** to address the need to detect open load conditions while music is playing and reduce the time-to-play.



INNOVATIVE COMPACT DESIGN WITH REDUCED BOM AND OPTIMIZED PIN COUNT

-10%

Reduced external BOM cost

HF(D)A devices come in a small, 48-pin QFP package (7 x 7 mm), which is the smallest option available for 4-channel audio power amplifiers in the automotive market.

This is made possible thanks to its innovative architecture:

- Complementary FETs for the output stages eliminate the need for bootstrap capacitors
- Ground referred solution for digital and analog parts ensures an optimized pin count

These solutions reduce the number of pins and external components in the final application.

REDUCED HEATSINK SIZE FOR SIZE-CONSTRAINED APPLICATIONS

The use of an external 3.3V supply rail and embedded high-efficiency power stages helps to reduce the size of the entire heatsink, making the HF(D)A series suitable for all platforms where space is a key parameter, such as head-up displays, smart cockpits, AVAS, and eCall systems.

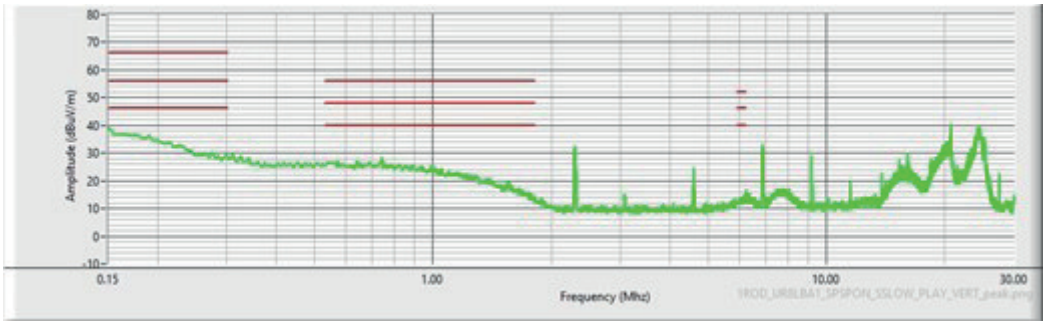
HIGH-END SOLUTION WITH HI-FI AUDIO QUALITY

Designing for a compact solution doesn't mean reducing external components without considering the impact on audio performance. The HF(D)A series is designed to achieve high-end audio quality. The default frequency response is flat (±1 dB) up to 40 kHz and can be easily extended up to 80 kHz without any limitations, as the HF(D)A series supports sampling frequencies up to 192 kHz.

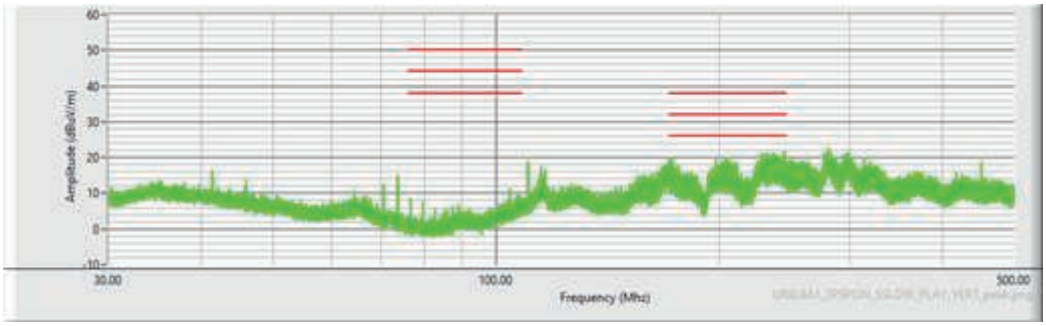
The HF(D)A series combines several patents to achieve the best audio performance in terms of total harmonic distortion (0.015%), very low noise (27 µV), and the best power supply rejection ratio (80 dB) that a ground-referred architecture can reach. This series uses an external 3.3V supply, which is already present in the application, thereby increasing the overall efficiency of the entire platform.

INNOVATIVE SPREAD SPECTRUM TECHNIQUE FOR CISPR25 CLASS 5 REQUIREMENTS

Electromagnetic compatibility (EMC) has long been a requirement in the automotive market. In the past, it was easily satisfied using analog input Class AB linear audio amplifiers, which lack the switching output stages found in Class D amplifiers. However, the high PWM frequency in Class D amplifiers, while reducing the external BOM cost, makes it challenging to meet EMC requirements. The innovative spread spectrum feature embedded in the HF(D)A series allows it to comply with all EMC regulations in the automotive market.



Radiated emissions (rod-type antenna)



Radiated emissions (BiLog-type antenna)

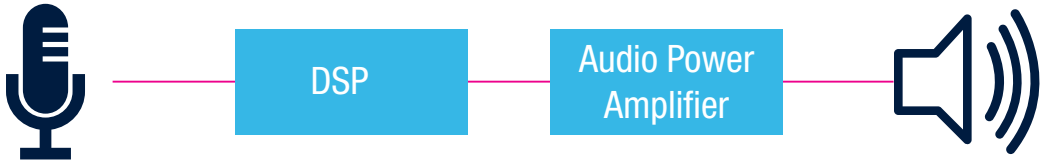
LOW LATENCY MANDATORY FOR ADVANCED ANC AND RNC APPLICATIONS

Widely used in consumer devices, such as headphones, to eliminate surrounding noise, active noise canceling (ANC) is also becoming increasingly common in automotive systems to reduce noise from the road, wheels, and vibrations of plastic materials inside the car.

The HF(D)A series introduces low latency, reducing audio processing delay and making these devices suitable for advanced ANC and RNC applications.

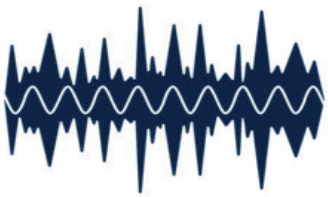
ANC applications are evolving to also remove noise from wind and external sources, known as road noise cancellation (RNC), which varies with speed and includes additional components in the high-frequency band (1 to 10 kHz). Additionally, background noise in vehicles typically consists of several components in the low to medium range of the acoustic spectrum (50 Hz to 1 kHz).

This evolution highlights the importance of low latency in the audio processing chain. Effective noise cancellation depends on the seamless performance of the microphone, DSP, and audio power amplifier.



Advanced diagnostics for a premium audio experience

Speaker diagnostics are crucial for ensuring the proper operation of audio systems in automotive applications. Two key features in this area are DC diagnostics and AC diagnostics. Thanks to a new algorithm, these diagnostics can detect the presence of DC-coupled and AC-coupled speakers, determine whether a speaker is connected, and identify the characteristics of the connected speakers. These diagnostics can be performed either at startup or in free-running mode.



Diagnostics at start-up

At start-up, a self-generated tone with limited timing and known amplitude is injected upon each user request. This diagnostic can verify if there are any connection issues at the speaker terminals. It is possible to perform this with both DC-coupled and AC-coupled speakers, and it must be done without an audio output signal.

Free-running DC diagnostics and open-load detection during playback

This diagnostic generates a non-audible sub-tone superimposed over the audio signal, allowing it to remain active while the device is playing. This enables real-time monitoring of the output connection and the detection of an open load during playback. With the new algorithm, speaker connections can be detected even when the audio signal volume is very low. Thanks to free-running diagnostics, start-up diagnostics can be avoided, thereby reducing the time-to-play.

Digital Admittance Meter (DAM)

The HF(D)A series includes a feature called 'Digital Admittance Meter', which measures the impedance of the speaker each time a diagnostic is performed, both at startup and during free-running operation.

This enables the customization of open- and short-circuit thresholds to accommodate the different speakers used in various applications.

HF(D)A SERIES PORTFOLIO

Device	Channel	Input	Spread Spectrum	Low Latency	DAM	Load Current Monitor
HFDA90D	4	Digital	Embedded	Embedded	Embedded	Embedded
HFDA80D	4	Digital	Embedded	Embedded	Not embedded	Not embedded
HFDA80D2(*)	2	Digital	Embedded	Embedded	Not embedded	Not embedded
HFDA90D2(*)	2	Digital	Embedded	Embedded	Embedded	Embedded
HFA80A	4	Analog	Embedded	N.A.	Embedded	Not embedded

Note (*) Under development

life.augmented

For more information on ST products and solutions, visit www.st.com

Order code: BR2504HFAUDIO