Technical Article

Improve Class-D EMI to Downsize BOM Cost without Compromising Audio Performance

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Designers frequently choose Class-D audio amplifiers to drive the speakers in a variety of mid-power applications like TVs, *Bluetooth*® speakers and laptops. After all, when compared to conventional Class-AB, Class-D has lower heat dissipation and relatively high efficiency (for increased battery life). Class-D is also beneficial if compact board space is important.

The biggest challenge associated with Class-D is electromagnetic interference (EMI). External inductor-capacitor filtering is traditionally used to mitigate EMI, but it adds cost, area and complexity to end equipment.

TI has developed several closed-loop amplifiers including the TPA3110 (released in 2010), which made significant improvements to EMI by using advanced closed-loop power stages. TI has also just released the TPA3140 Class-D audio power amplifier, which includes several innovations that help provide true inductor-free performance even for speaker cables up to 1m in length. This inductor-free device is already in production in LCD TVs, where long speaker cables make meeting EMI requirements a challenge.

Edge-rate Control

One method used to reduce EMI radiation is to reduce the slew rate of the amplifier output transitions. Since the TPA3140 uses a proprietary high-performance feedback topology, a reduction in slew rate will not degrade total harmonic distortion (THD) or audio quality. The fast Fourier transform (FFT) image in Figure 1 shows a reduction in high-frequency content with slower edges.

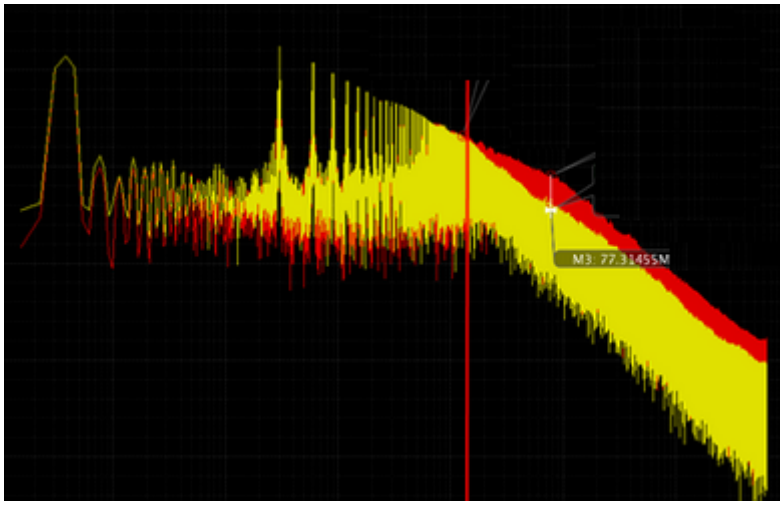


Figure 1. EMI Plots without Edge Rate (Red) and with Edge Rate (Yellow)

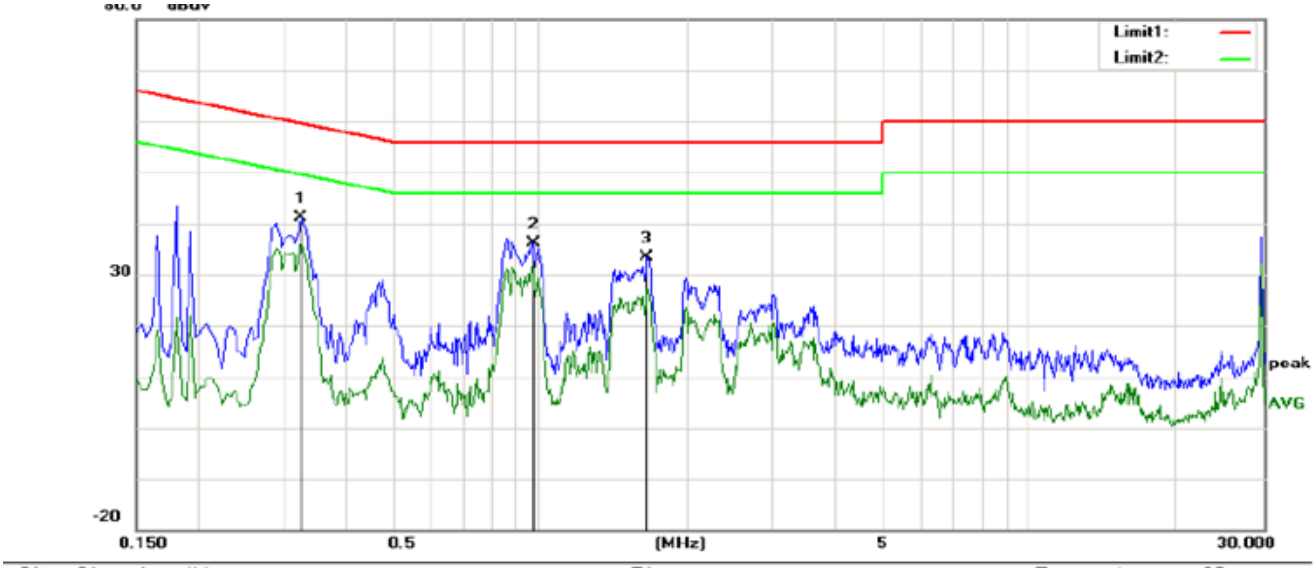
Spread-spectrum Clocking

While edge-rate control is an effective means of attenuating EMI when it arises in frequency ranges greater than 30MHz, it does not address the fundamental carrier frequency of the Class-D amplifier's switching output and its related harmonics, which fall in the range below 30MHz.

The TPA3140 includes a proprietary algorithm that adds a small amount of frequency modulation to the amplifier's clock circuitry. This algorithm doesn't affect the amplified audio quality, but significantly reduces peak energy of the switching frequency.

EMI Results

Figure 2 represents EMI test results from a TV with a close to 1m speaker cable length. The red line is the quasi-peak limit, and the green line is the average limit.



Site Chamber #1 Phase: N Temperature: 25
Limit: (CE)EN55022 class B_QP Power: AC 220V/50Hz Humidity: 55 %
EUT: LED TV
M/N:
Mode: USB
Note: 3393.PB851 NO LINE IN AC AV SPK LINE NEW SPLINE 600OHM+1N

No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1	*	0.3260	21.30	19.88	41.18	59.55	-18.37	peak	
2		0.9700	16.48	19.69	36.17	56.00	-19.83	peak	

Figure 2. EMI Plot: Blue Quasi-peak and Green Is Average Curve

Audio Performance:

- <0.05% THD+N at 1 W/4 Ω/1 kHz
- <65-µV A-wgt output noise

In conclusion, the TPA3140 Class-D audio power amplifier provides significant improvement in EMI that allows inductor-free operation providing major BOM cost savings without compromising audio quality.

Additional Resources

- Work with the TPA3140 evaluation module (EVM).
- Learn more about our other Class-D audio power amplifiers.
- Visit the TI E2E™ Community Audio Amplifiers forum, where you can search for solutions, get help, share knowledge and solve problems with fellow engineers and TI experts.

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