Application Report
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AIC321x, AIC326x EMI Filtering on Speaker Outputs

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ABSTRACT

This application report identifies suitable components for EMI filtering on the Class-D output stages of the AIC321x and AIC326x audio codecs. The AIC321x and AIC326x are highly integrated, high-performance audio codecs from Texas Instruments which include class-D output stages that can be operated in filter-free mode.

Since the switching of Class D amplifiers results in EMI emissions, employing EMI filtering at the outputs can be a helpful step in blocking high frequency emissions and in passing FCC and CE testing. This is particularly important when system mechanics dictate long PCB traces or speaker wires of the Class D outputs.

Typically, EMI filters use a ferrite bead inductor and a capacitor. Component selection can become critical for these filters, as the codecs employ integrated overcurrent protection circuits, which can be unintentionally tripped due to improper implementation of the EMI filter.

1 Introduction

When designing an EMI filter, both space and cost come into play, as well as performance. For this reason, ferrite bead inductors are an excellent choice for eliminating high frequencies. Most EMI filters use a ferrite bead inductor in conjunction with a capacitor.

Care must be taken not to trip the overcurrent protection of the AIC321x and AIC326x, which shuts down the output stage of the amplifier if a short circuit of the output is detected.

This application report recommends a specific ferrite bead inductor and specific capacitance value. With proper evaluation and testing, other components can be used to implement an EMI filter, if necessary.

2 Over Current Protection

The AIC321x and AIC326x has a short-circuit protection feature for the speaker drivers that is always enabled to provide protection. If the output is shorted, the output stage shuts down on the overcurrent condition. (Current limiting is not an available option for the higher-current speaker driver output stage.) In the event of a short circuit on either channel, the output is disabled and a status flag is provided as a read-only bit on B0_P0_R44_D7 for SPKL and on B0_P0_R44_D6 for SPKR. If shutdown occurs due to an overcurrent condition, then the device requires a reset to re-enable the output stage.

A potential issue is that ferrite beads appear as almost a short circuit at the switching frequency, their impedance typically begins to rise above 1 MHz, with peak impedance near 100 MHz. Because the impedance is low at the Class D amplifier switching frequency, ferrite beads can increase the peak current during output transitions. It should also be noted that some ferrite bead inductors can be prone to more ringing or oscillation. If not accounted for, the combination of these factors can cause overcurrent protection trips.

3 EMI Filter Component Recommendation

Ferrite bead filters for Class D amplifiers are derived empirically while measuring the radiated emissions. A ferrite bead should be rated for at least the peak load of the audio signal into the load impedance to prevent distortion of the class-D output signal. For example, if the Class D amplifier operates from 5 V into a 4-Ω load, a ferrite bead with at least 1.5-A peak current capability should be selected. An impedance rating of 100 Ω or higher at high frequencies is recommended to ensure a high level of EMI suppression.

A capacitor that is not large in relation to the impedance of the ferrite bead is also needed to prevent large drops in impedance at high frequencies. The value for these capacitors is often determined empirically, but 470 pF is a good starting point.

Figure 1 shows a recommended EMI Filter for AIC321x and AIC326x.

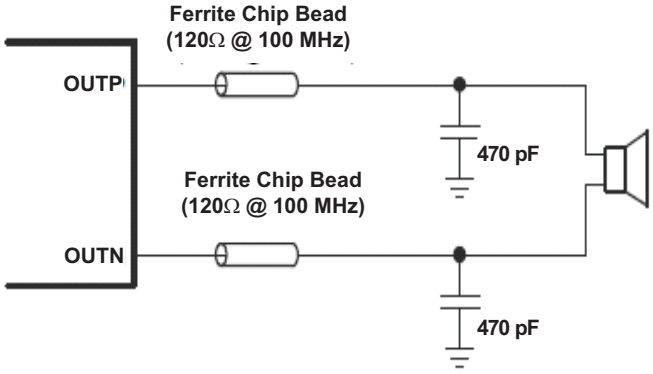

Figure 1. Recommended Class-D EMI Filter for AIC321x and AIC326x

The ferrite bead inductor shown in Figure 1 is the Murata BLM15EG121SN1D. It has a DC resistance of 120 Ω at 100 MHz, and is rated for 1.5 A. The capacitor shown in Figure 1 is the TDK C1005X7R1H471K at 470 pF.

4 Conclusion

When designing an EMI filter that is optimized for space and cost, a ferrite bead and capacitor are often an excellent choice. This is contingent on proper selection of components; however, as improper selection can trigger overcurrent protection in the AIC321x and AIC326x devices.

For further questions, consult TI through the E2E forum or your local sales representative.

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