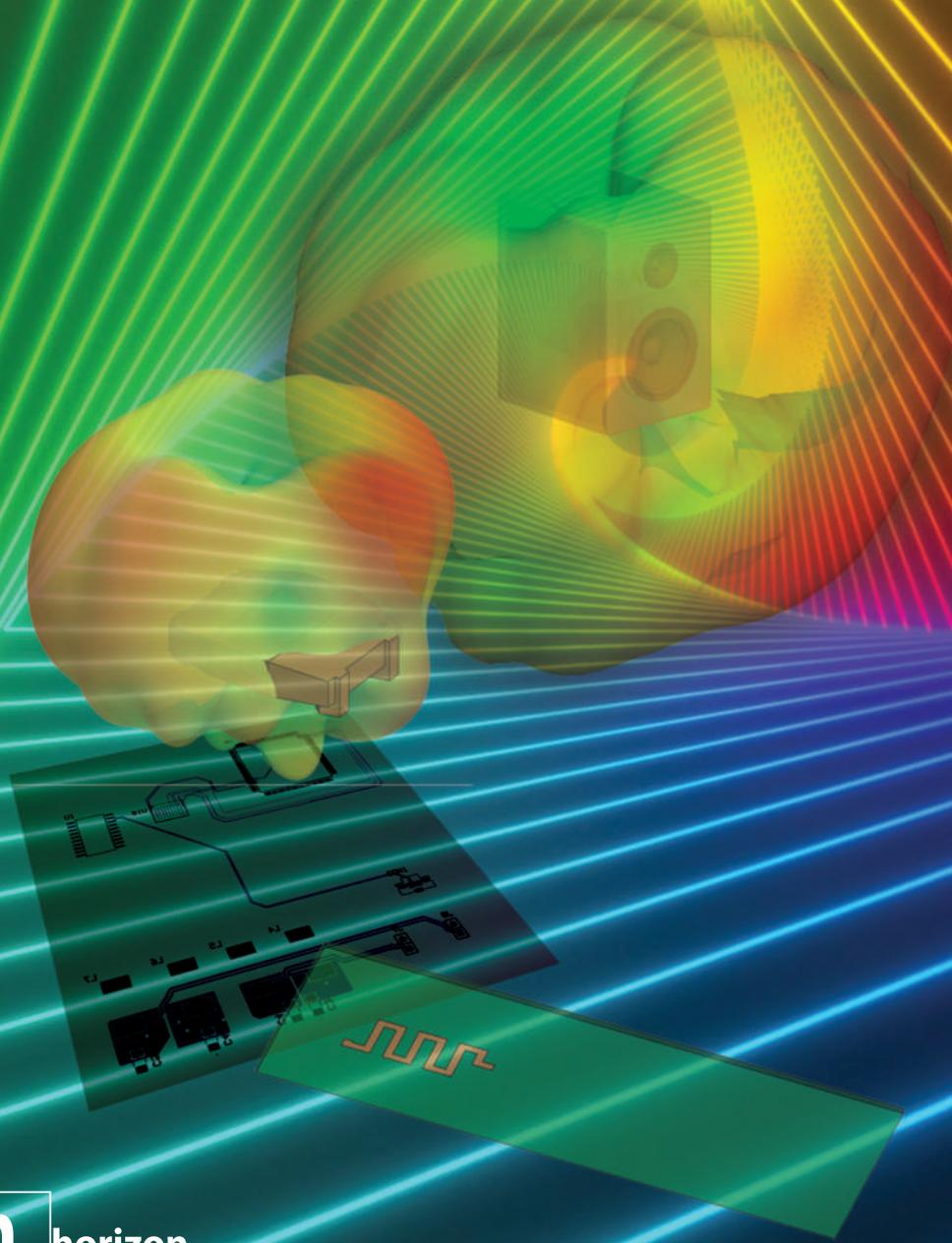


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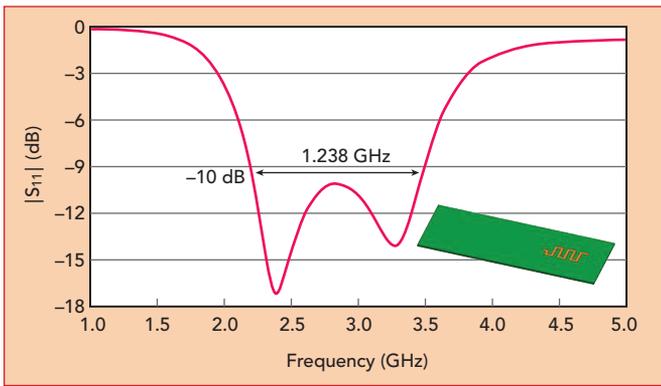
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▲ Fig. 6 |S₁₁| of the MLA designed for BT.

high and low thresholds are 1.3 and 0.4 V, respectively. Additionally, it is assumed that the required setup and hold times for the interface are 2 and 1.5 ns, respectively. As the eye diagram shows sufficient voltage margin, the interface lines are well routed for reliable 256 Mbps data exchange between the controller and memory.

A board thermal analysis was performed to check the main audio amplifier's operating temperature, using the amplifier's quad flat package and 5 W power rating at room temperature. **Figure 5** shows the temperature contours for two conditions: 1) natural convection (see Figure 5a) and 2) forced air convection with an air flow of 5 m/s (see Figure 5b). With natural convection, the highest temperature of 85°C is the maximum allowed for normal amplifier operation. Forced convection decreased the tempera-

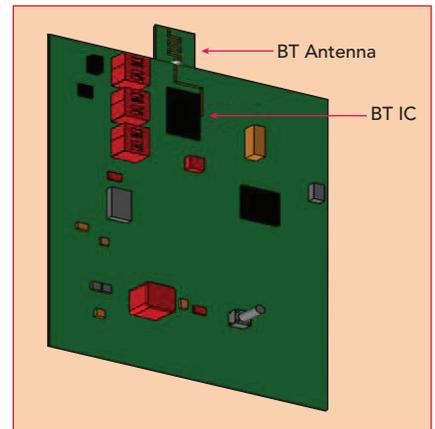
ture from 85°C to 59°C, which improves reliability. The antenna design was inspired from the meander line antenna (MLA) concept proposed by Rashed and Tai.⁷ The antenna was integrated on the PCB and placed in its working environment within the speaker assembly to identify the optimal location. Antenna electromagnetic (EM) characteristics in different configurations changing the location and orientation of the PCB inside the speaker cabinet were simulated using the 3D high frequency EM simulation tool, Altair Feko.⁸

Meandering the antenna increases the surface current path and enables reducing the antenna size. The resonant frequency of an MLA is a function of the meander separation and meander

ture from 85°C to 59°C, which improves reliability.

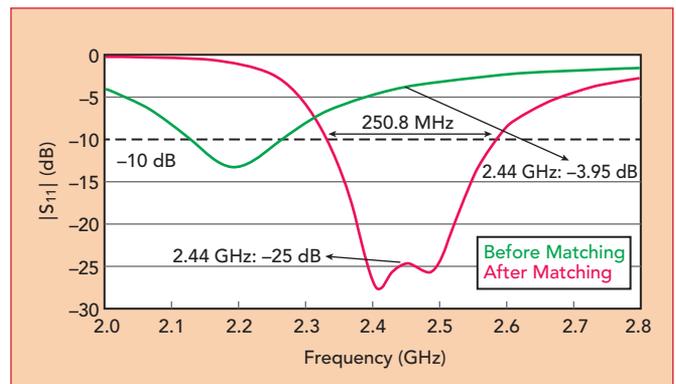
ANTENNA DESIGN AND INTEGRATION

The antenna design was inspired from the meander line antenna (MLA) concept proposed by Rashed and Tai.⁷ The antenna was integrated on the



▲ Fig. 7 MLA integrated with the BT PCB.

spacing; the resonant frequency can be reduced by increasing the meander separation, and vice versa.⁹ As shown in **Figure 6**, the simulation showed the magnitude of the reflection coefficient of the MLA design on an FR4 substrate was ap-



▲ Fig. 8 |S₁₁| of the MLA integrated with the PCB.



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