Using the PE42422 and PE423422 in Wi-Fi 6E and 7 Applications

Application Note 95

Summary

This application note shows how to extend the usable bandwidth of the PE42422 SPDT and the automotive PE423422 SPDT into the Wi-Fi 6E and 7 bands using a simple PCB modification. Plots and S-parameter files accompanying this application note will demonstrate an improvement from 6 GHz to > 7.2 GHz. This allows the use of the PE42422 and PE423422 in the new Wi-Fi 6E and 7 bands for transmit/receive switching.

Introduction

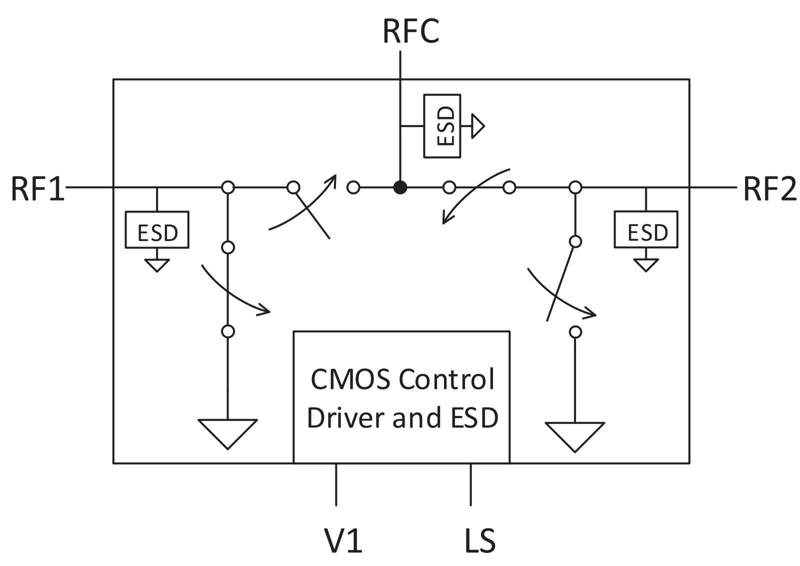
PE42422 and PE423422 are short reflective SPDT RF switches, currently specified for operation to 6 GHz. This limits use in the new Wi-Fi 6E and 7 markets. For example, the PE42424 WLAN TX/RX from pSemi has been re-specified to 10 GHz to cater to this market as a TX/RX switch. In order to allow the PE42422 or PE423422 to be used as a transmit/receive switch in the Wi-Fi 6E and 7 bands, the bandwidth must be extended beyond 7 GHz. It was found that some simple PCB layout modifications perform this improvement without the need for any additional components.

Note: *All of the following notes refer to the PE42422 but are equally valid for the PE423422 automotive version of this part.*

PE42422

In its default configuration, the PE42422 is a simple SPDT, short reflective switch as shown in **Figure 1**.

Figure 1 ▪ PE42422 Functional Diagram

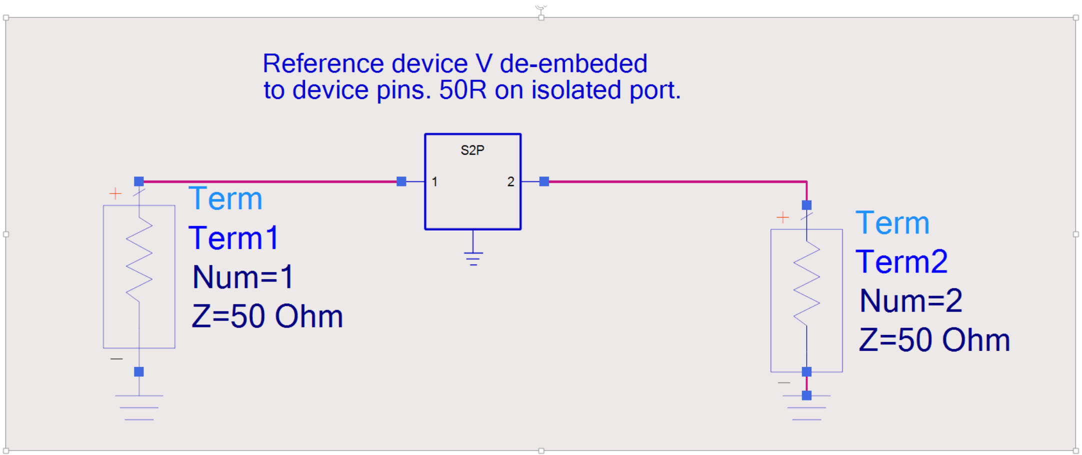


Note: *All information including datasheets, S-parameter files and other application notes can be found on the pSemi website.*

Simulations

The PE42422 vector de-embedded S-parameters were obtained using a standard evaluation kit (EVK) available from pSemi. The 2-port simulation is shown in **Figure 2**.

Figure 2 ▪ Initial ADS Simulation



After analysis of the vector de-embedded S-parameters, a simple configuration was found to be sufficient to give improved Wi-Fi 6E and 7 responses. This configuration is a single change to the transmission line impedance on the common RFC port only. This simulation is shown in **Figure 3**.

Figure 3 ▪ Simulation of the Modified Network

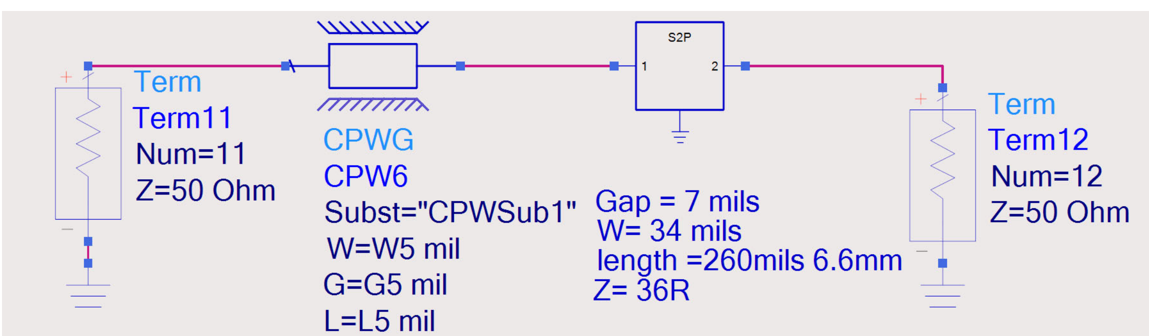
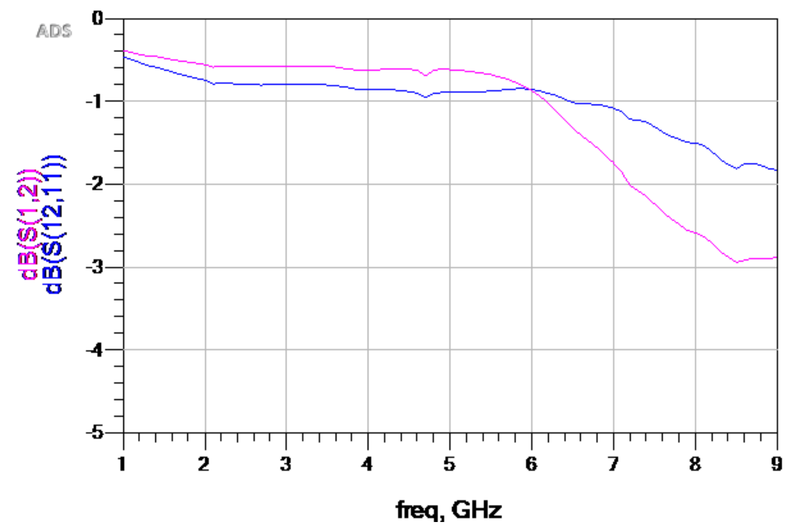


Figure 4 shows the result of the modified network with a comparison between the original and optimized circuit.

Figure 4 ▪ S21 Simulation Results

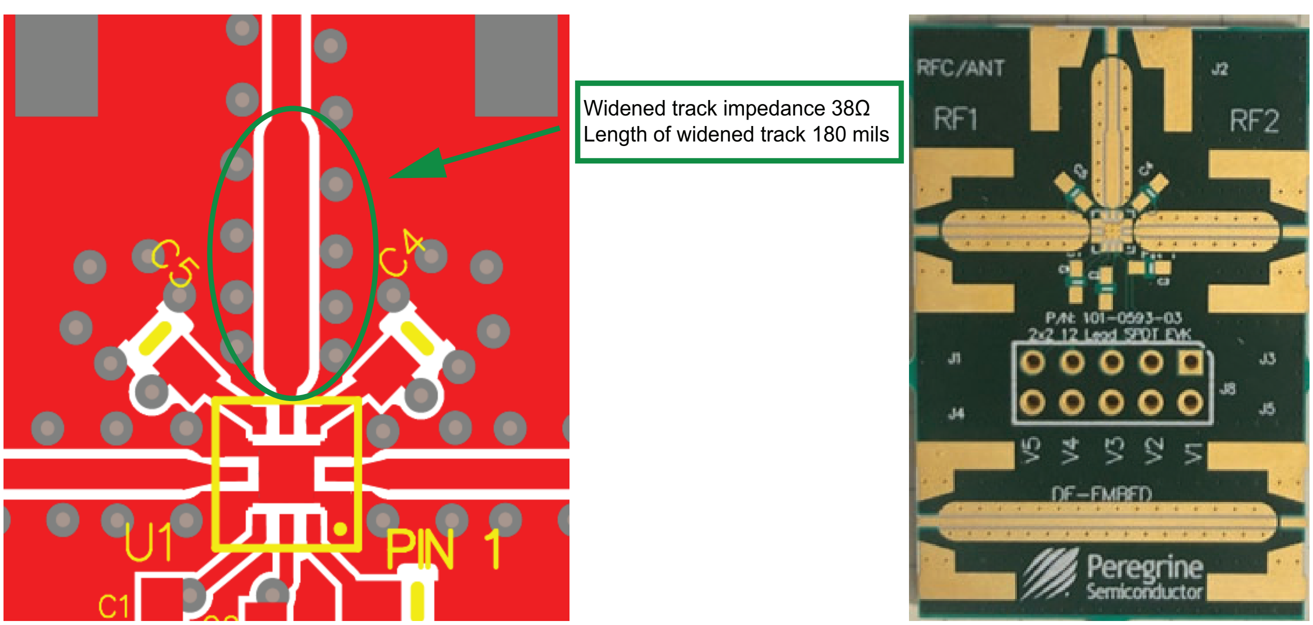


Details

A modified PE42422 evaluation board (EVB) shows a wider, low impedance RF track. A process of optimization determined the difference between the simulation and the real-world solution, with the real circuit optimization resulting in a 4.5 mm length of 34Ω impedance line.

The resultant PCB layout and EVB are shown in **Figure 5**.

Figure 5 ▪ Board Layout Details and Final EVK



Note: *To remove an unrelated resonance on V_{DD} and the control lines, the de-coupling capacitors, C4 and C5, have been moved to the top (device-side) layer.*

Results

The modified board was measured for frequencies 100 MHz to 9 GHz.

Figure 6, **Figure 7** and **Figure 8** show the measured S21 insertion loss, S11 reflection coefficient, and S21 in isolation mode, with a comparison of the original EVK (red trace) using the same calibration files.

Figure 6 ▪ S21 Insertion Loss of Original (Red) and Modified Layout (Yellow)

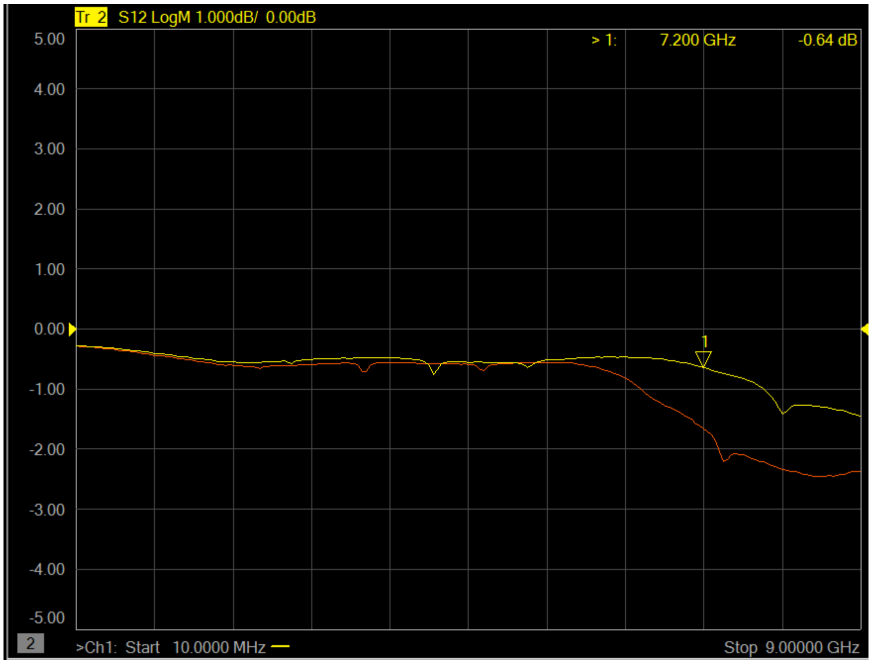


Figure 7 ▪ S11 Reflection Coefficient of the Original and Modified Board

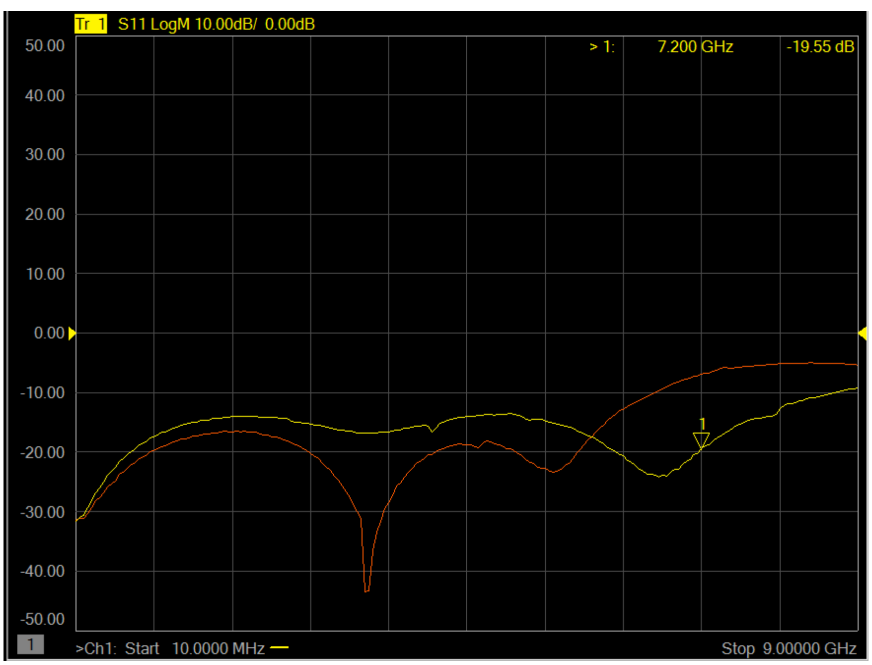
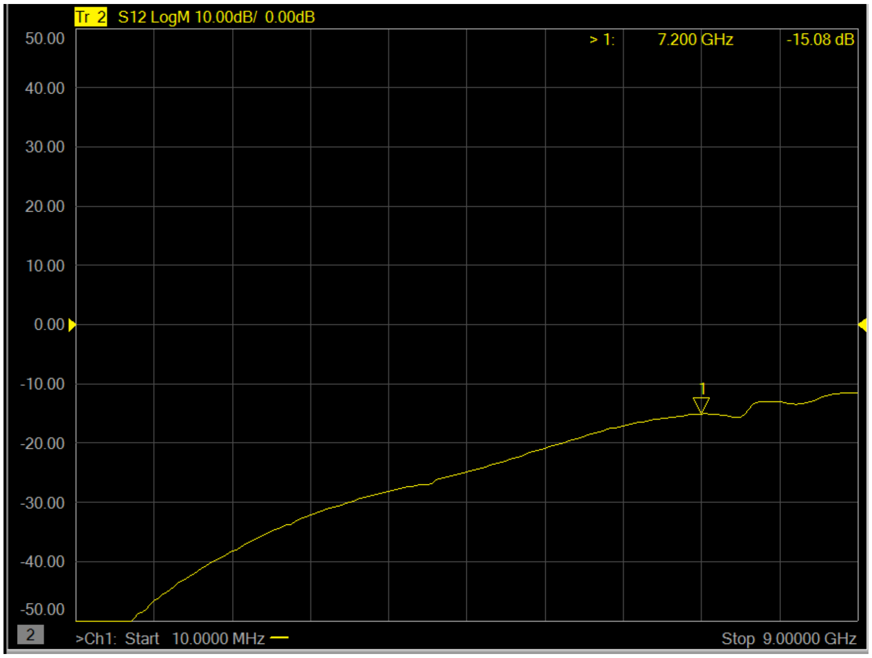


Figure 8 ▪ S21 Isolation Mode of Modified Board



Alternative Discrete Design

It is also possible to achieve a similar improvement in performance using a discrete component board modification. A carefully placed series inductor can produce similar results. However, as the distance of the inductor from the device is critical and longer than the alternative 34Ω impedance stub already outlined, along with the cost of a tight tolerance 0.7 nH inductor, this is not a preferred solution.

The prototype board, with discrete inductor, and the initial S21 Insertion loss result are shown in **Figure 9** and **Figure 10** respectively.

Figure 9 ▪ Prototype Board

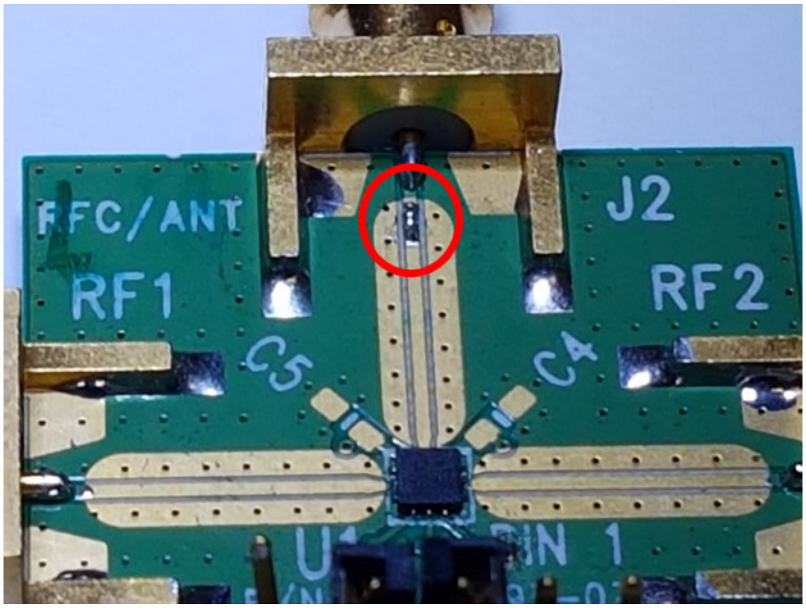
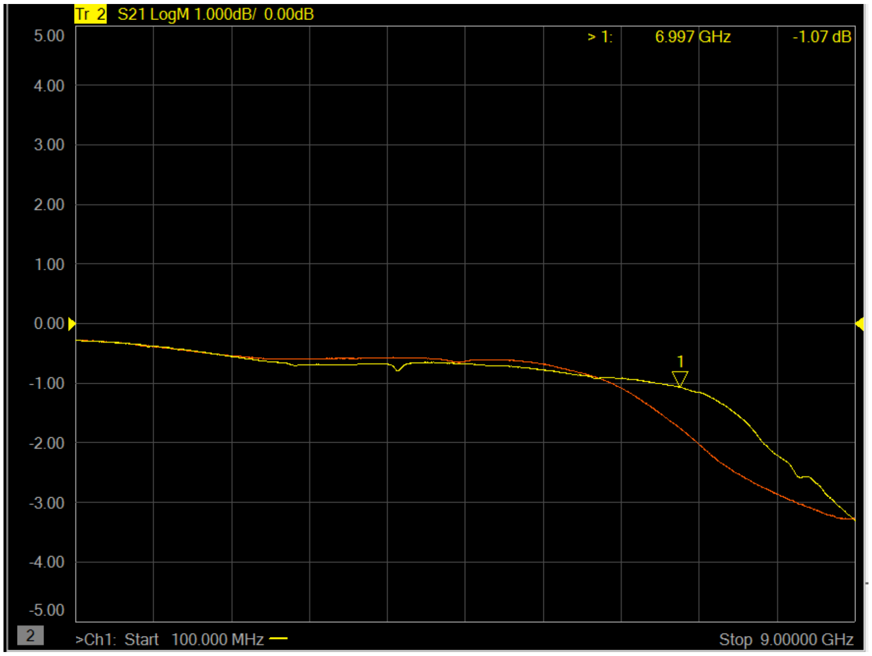


Figure 10 ▪ Initial S21 Insertion Loss Result Using Discrete Inductor



Conclusion

This paper details a simple modification that results in improved performance of the PE42422 and PE423422, extending the operating frequency into the Wi-Fi 6E and 7 bands by using a simple track modification.

Sales Contact

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