

# 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

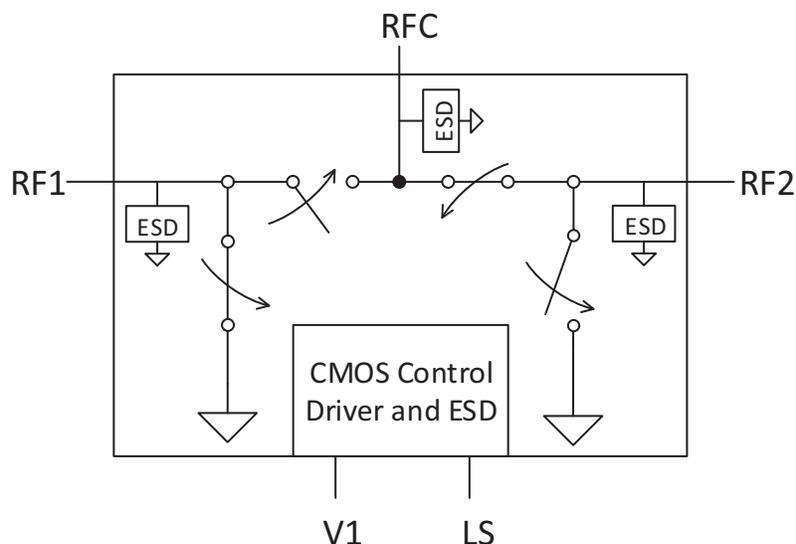
PE42422 and PE423422 are short reflective SPDT RF switches, currently specified for operation to 6 GHz. This limits use in the new Wi-Fi 6E and 7 markets. For example, the PE42424 WLAN TX/RX from pSemi has been re-specified to 10 GHz to cater to this market as a TX/RX switch. In order to allow the PE42422 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

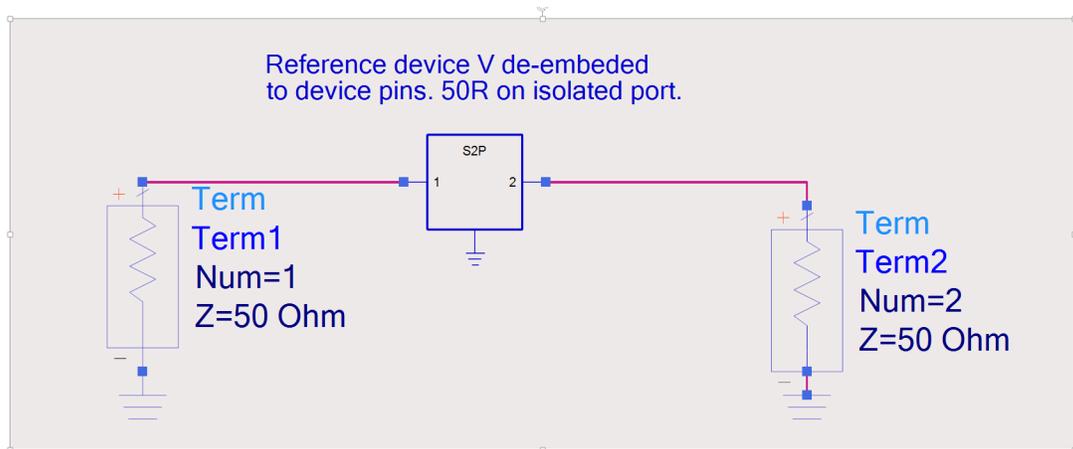


**Note:** All information including datasheets, S-parameter files and other application notes can be found on the pSemi website.

## 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

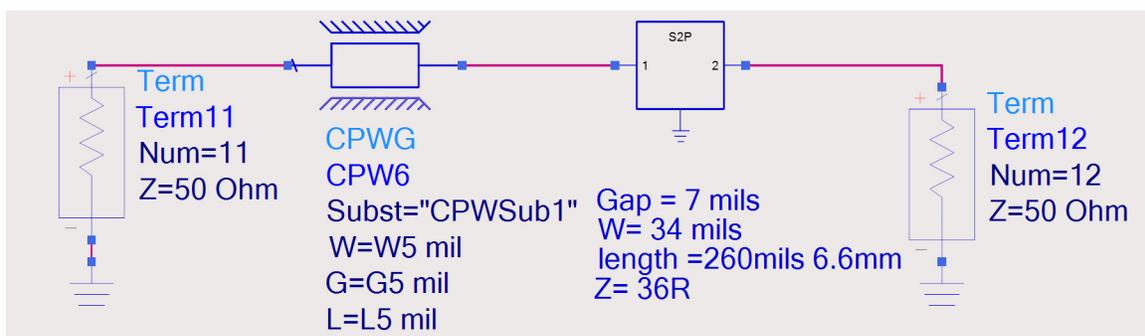
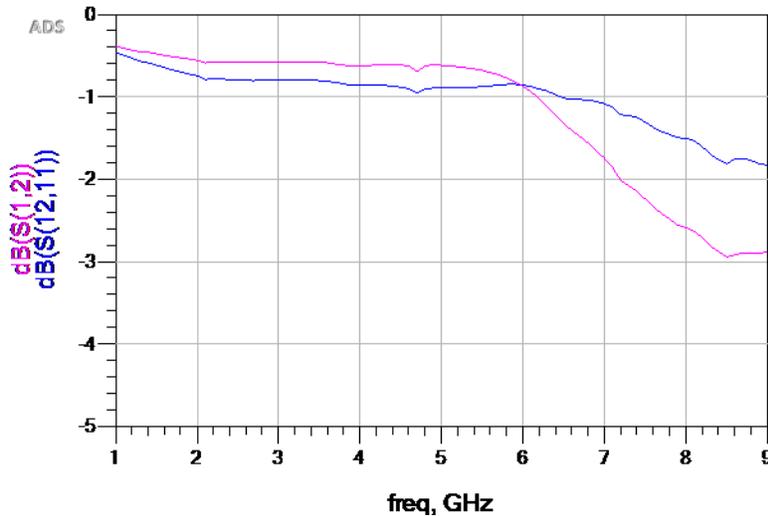


Figure 4 shows the result of the modified network with a comparison between the original and optimized circuit.

Figure 4 ■ S21 Simulation Results

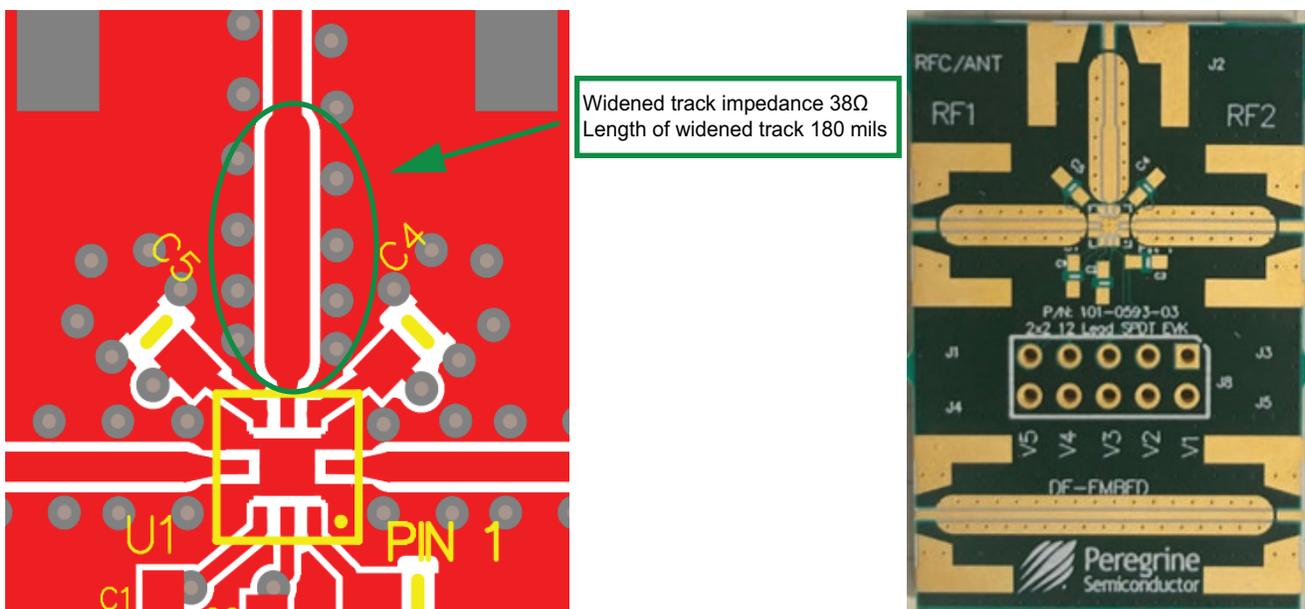


**Details**

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)

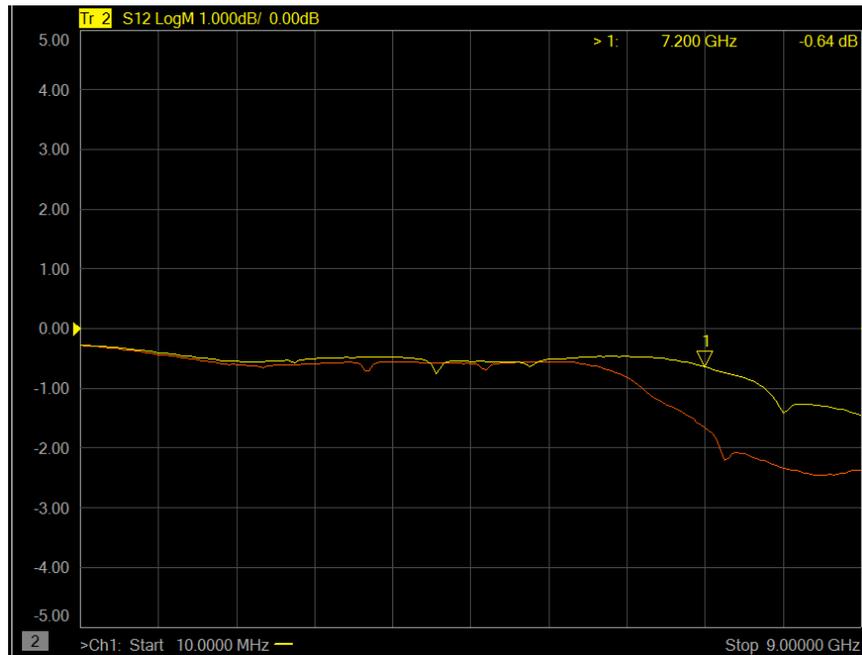


Figure 7 ■ S11 Reflection Coefficient of the Original and Modified Board

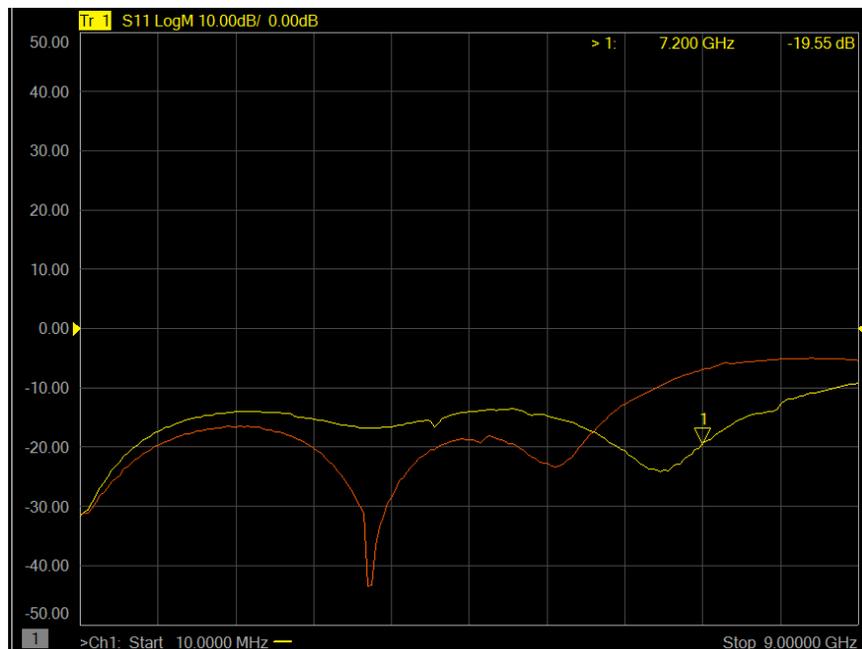
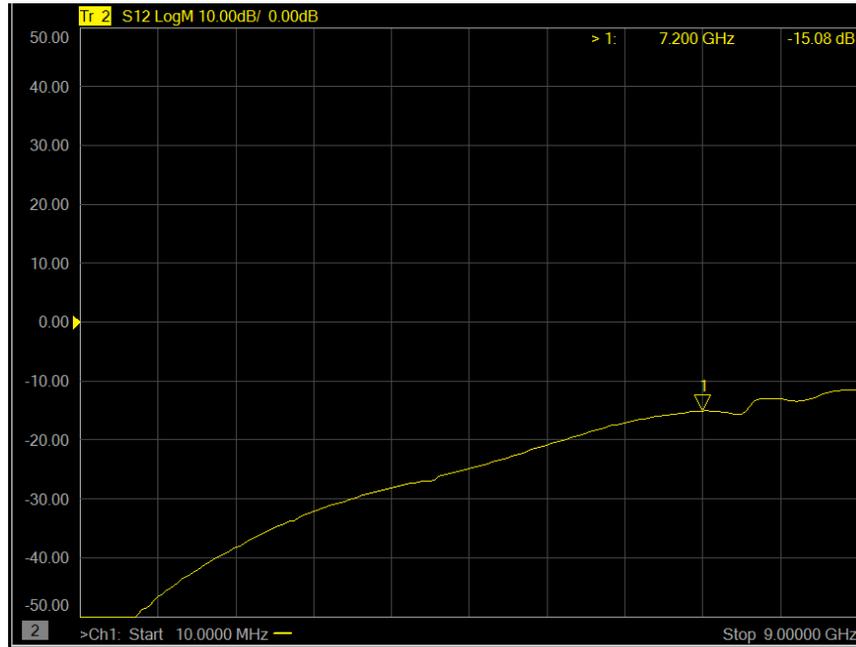


Figure 8 ■ S21 Isolation Mode of Modified Board



## 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  $34\Omega$  impedance stub already outlined, along with the cost of a tight tolerance  $0.7\text{ nH}$  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*

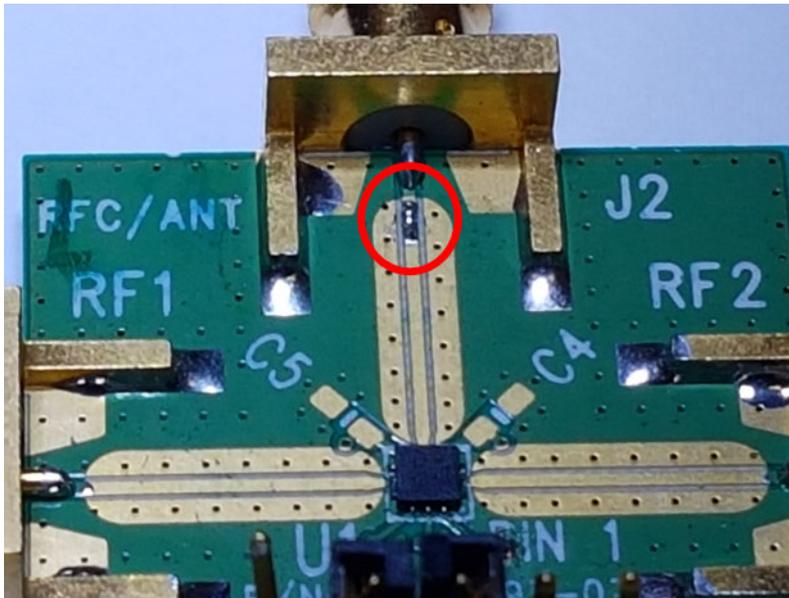
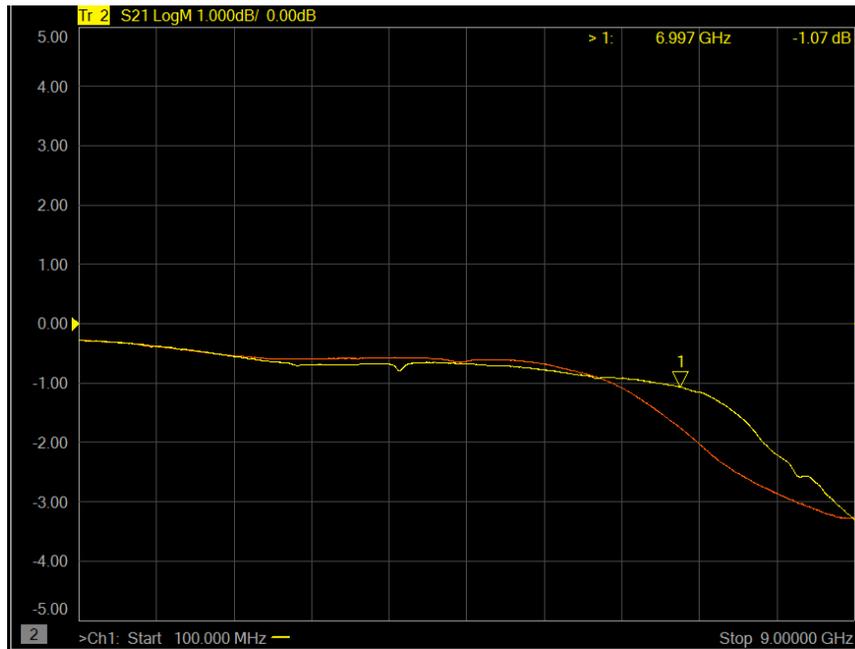


Figure 10 ■ Initial S21 Insertion Loss Result Using Discrete Inductor



## 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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