PE42448
6-GHz Performance Improvement

Application Note 109

Summary

The PE42448 is a HaRP™ technology-enhanced SP4T RF switch that supports a 10 MHz–6 GHz frequency range. It delivers extremely low insertion loss and high linearity with high input power handling capability, making this device ideal for hybrid analog beamforming and 5G massive multi-input, multi-output (mMIMO) applications. By adding an external matching network, the performance at 6 GHz can improve insertion loss and enhance return loss performance.

Introduction

The PE42448 provides outstanding linearity combined with high power handling capabilities. When combined with an external matching network, this feature enhances support for 5–6 GHz frequency applications, including Sub-6 GHz LTE/5G NR-U and Wi-Fi® 6/6E. To enhance insertion loss and return loss performance at 6 GHz, add a matching network of shunt capacitors to the RF common port (RFC) and the four RF ports (RF1–RF4), as verified through de-embedded S-parameter simulations. The simulation results clearly demonstrate significant improvements in both insertion loss and return loss at 6 GHz after implementing the matching network.

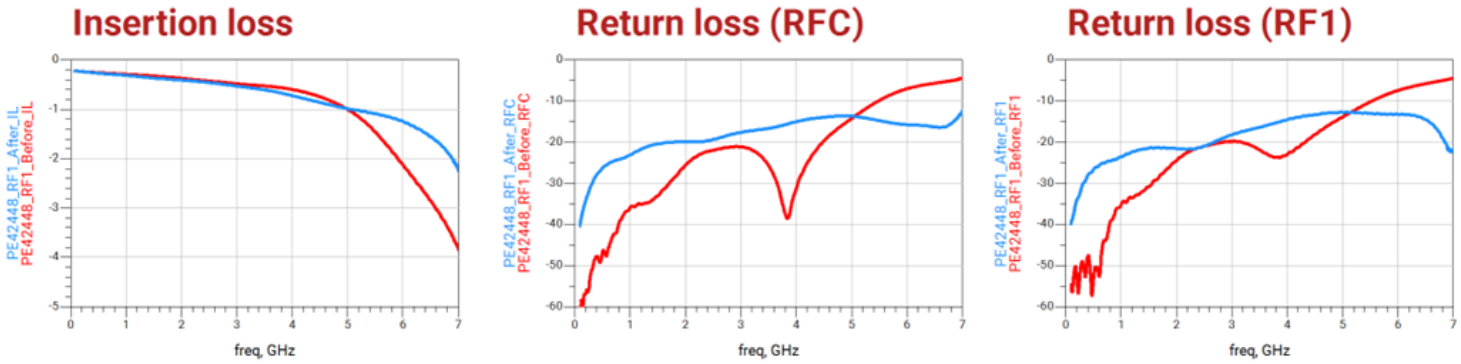

Figure 1. PE42448 RF1 ON status — De-embedded S-parameter simulation comparison

dB @ 6 GHz	Insertion loss	Return loss (RFC)	Return loss (RF1)
Default (before)	-2.131	-6.971	-7.404
With matching (after)	-1.247	-15.724	-13.205

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EVK tuning comparison

pSemi used the PE42448 Evaluation Kit (EVK) to perform a direct tuning comparison between the default configuration ("Before") and after the addition of the matching network ("After"), as shown in Figure 2. Matching network components were soldered onto the EVK RF traces for accurate tuning and validation, as shown in Figure 3. Shunt capacitors were installed to improve performance at 6 GHz. Because the PE42448 supports high power handling, pSemi used Murata capacitors rated for 200 VDC. Given the PE42448's high power-handling capability, these capacitors were selected to ensure robust and reliable performance.

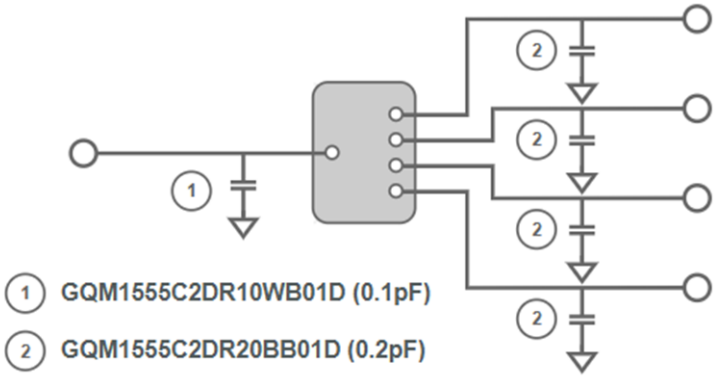

Figure 2. PE42448 and matching network schematic

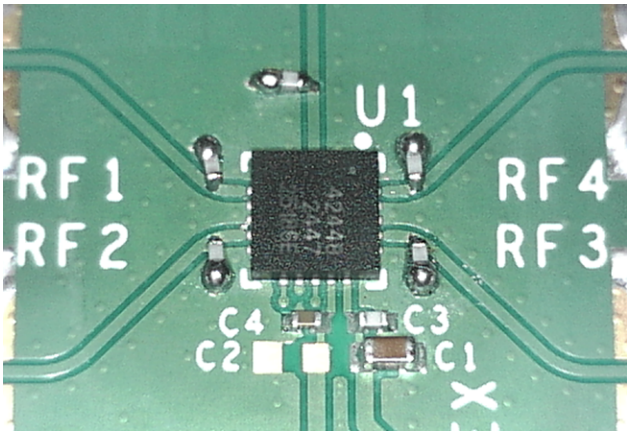

Figure 3. PE42448 and shunt capacitors mounted to the EVK board

S-parameter comparison

pSemi implemented the S-parameter comparison in three temperature conditions (-30°C, 25°C, and 85°C). To ensure accurate relative comparisons, S-parameters including EVK embedded trace effects were used. The results confirmed consistent improvements in insertion loss and return loss at 6 GHz across all tested temperature conditions.

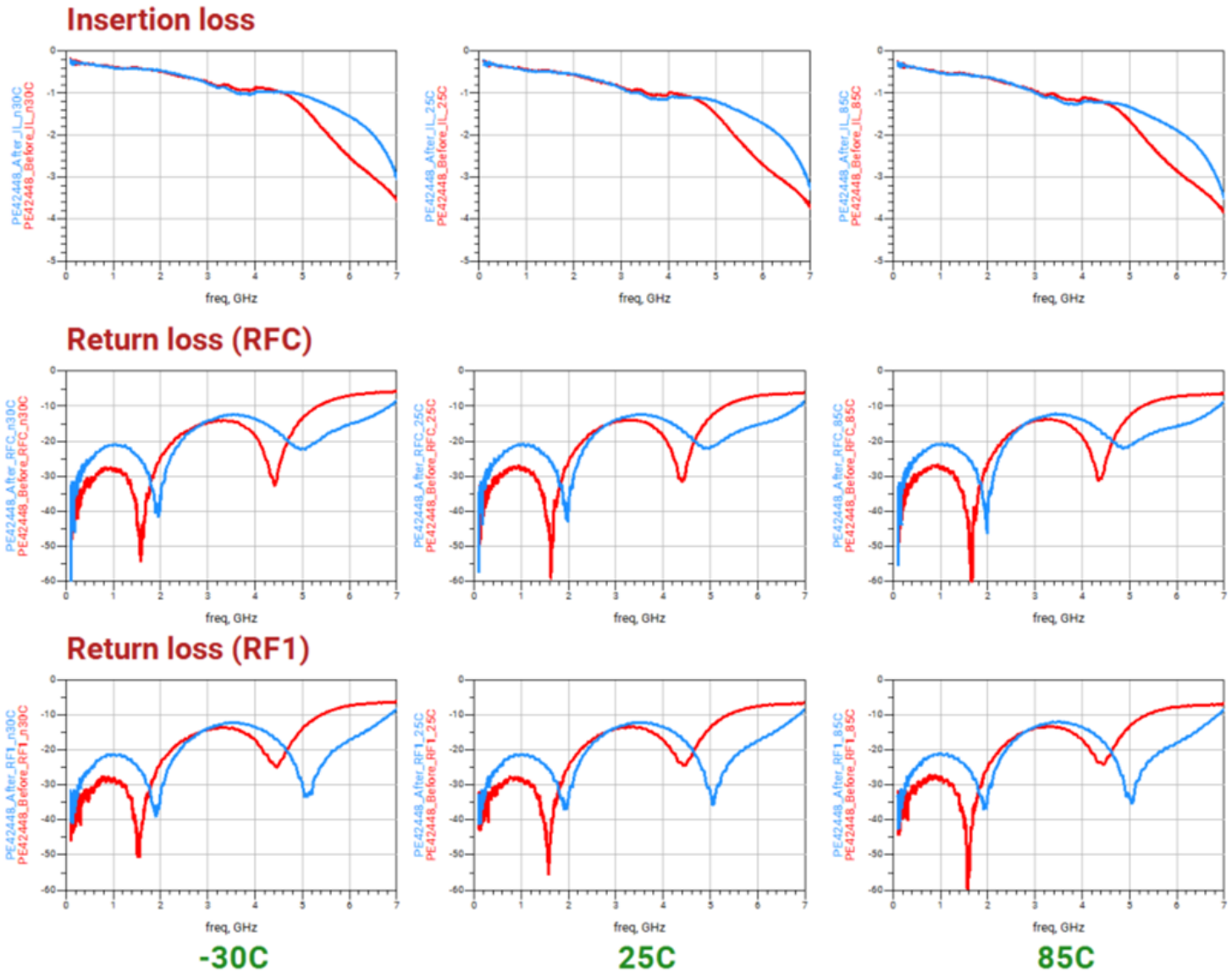

Figure 4. PE42448 RF1 ON status measurement

Table 1. PE42448 RF1/RF2/RF3/RF4 ON status measurements

dB @ 6 GHz	On path	-30 °C		25 °C		85 °C	
		Before	After	Before	After	Before	After
Insertion loss	RFC–RF1	-2.526	-1.558	-2.704	-1.728	-2.850	-1.890
	RFC–RF2	-2.278	-1.503	-2.436	-1.666	-2.569	-1.829
	RFC–RF3	-2.302	-1.524	-2.477	-1.692	-2.622	-1.849
	RFC–RF4	-2.409	-1.526	-2.590	-1.710	-2.739	-1.879
Return loss (RFC)	RFC–RF1	-6.969	-15.208	-7.069	-15.411	-7.230	-15.802
	RFC–RF2	-7.032	-12.493	-7.203	-12.794	-7.435	-13.193
	RFC–RF3	-6.993	-12.301	-7.142	-12.559	-7.346	-12.899
	RFC–RF4	-7.161	-15.946	-7.265	-16.132	-7.462	-16.586
Return loss (RFn)	RFC–RF1	-7.247	-16.868	-7.389	-17.184	-7.588	-17.768
	RFC–RF2	-8.092	-18.442	-8.303	-19.144	-8.612	-19.849
	RFC–RF3	-7.880	-17.242	-8.091	-17.845	-8.337	-18.544
	RFC–RF4	-7.585	-17.232	-7.779	-17.539	-8.060	-18.091

Switching response

pSemi evaluated the switching response behaviors using one default EVK (“Ref.”) and two EVKs with matching networks installed (“Tuned_1” and “Tuned_2”). The evaluation found that adding the matching network does not significantly impact the switching response characteristics.

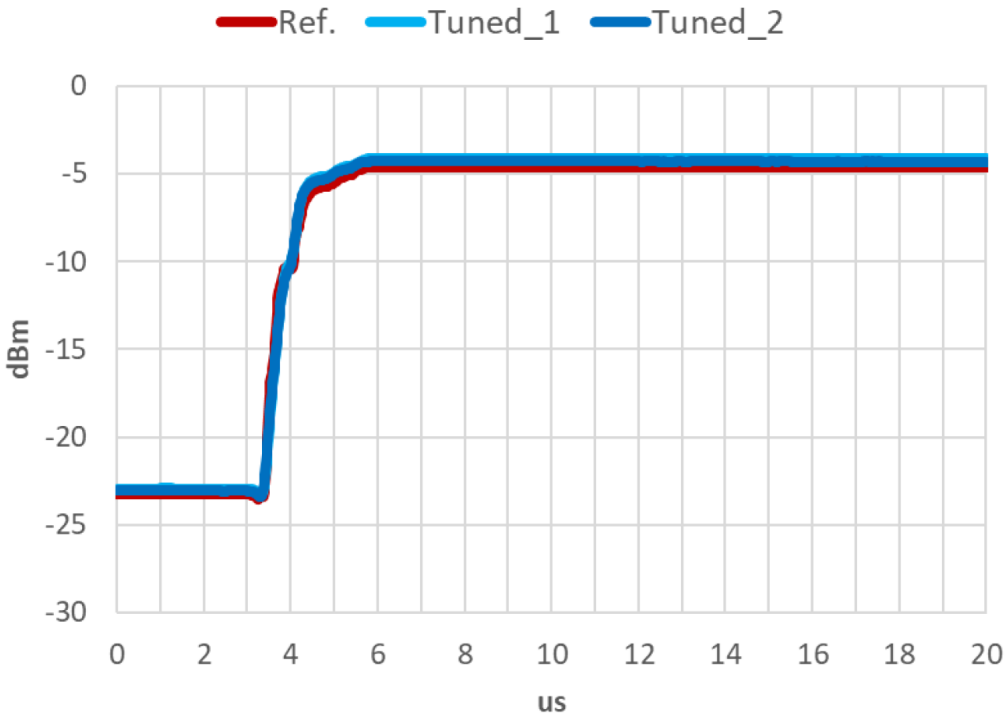

Figure 5. PE42448 RF1 ON switching condition

Linearity IIP3

pSemi assessed the linearity characteristic of the input third-order intercept point (IIP3) using the default EVK and the EVK with the implemented matching network. The results proved that there is no significant change between the reference EVK and the tuned EVK.

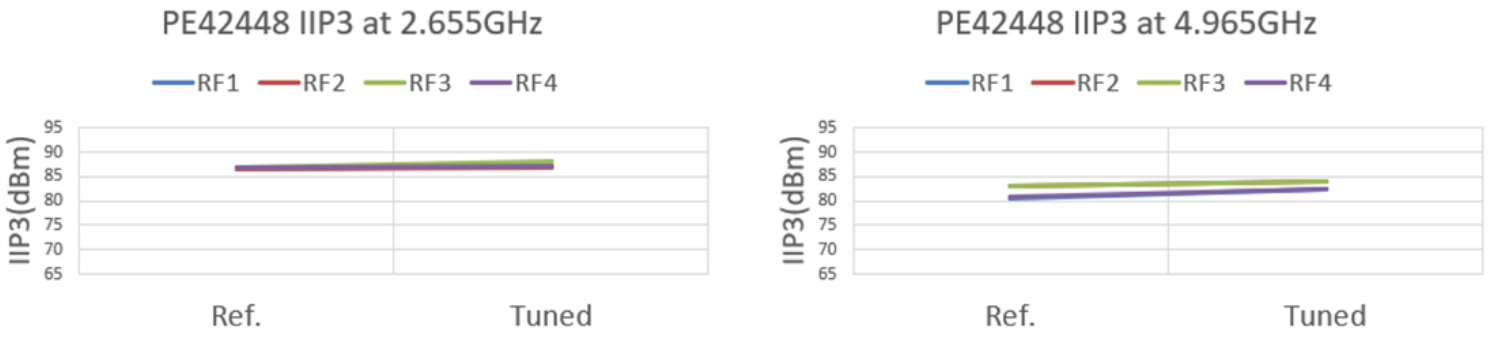

Figure 6. PE42448 IIP3 measurement

Conclusion

Integrating shunt capacitors at the RF ports of the PE42448 significantly improves insertion loss and return loss performance at 6 GHz. The PE42448, combined with an optimized matching network, maintains its excellent linearity and high power-handling capabilities, effectively supporting its frequency coverage up to 6 GHz.

Sales contact

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