PE562212 Front-end Module 2.4 GHz Wi-Fi Performance

Application Note 108

Summary

This application note describes the PE562212 Front-End Module (FEM) typical 2.4 GHz Wi-Fi© connectivity performance metrics including the following:

- Broadband small signal performance
- Wi-Fi MCS0 EVM versus input power for 2.4 GHz
- Wi-Fi MCS7 EVM versus input power for 2.4 GHz

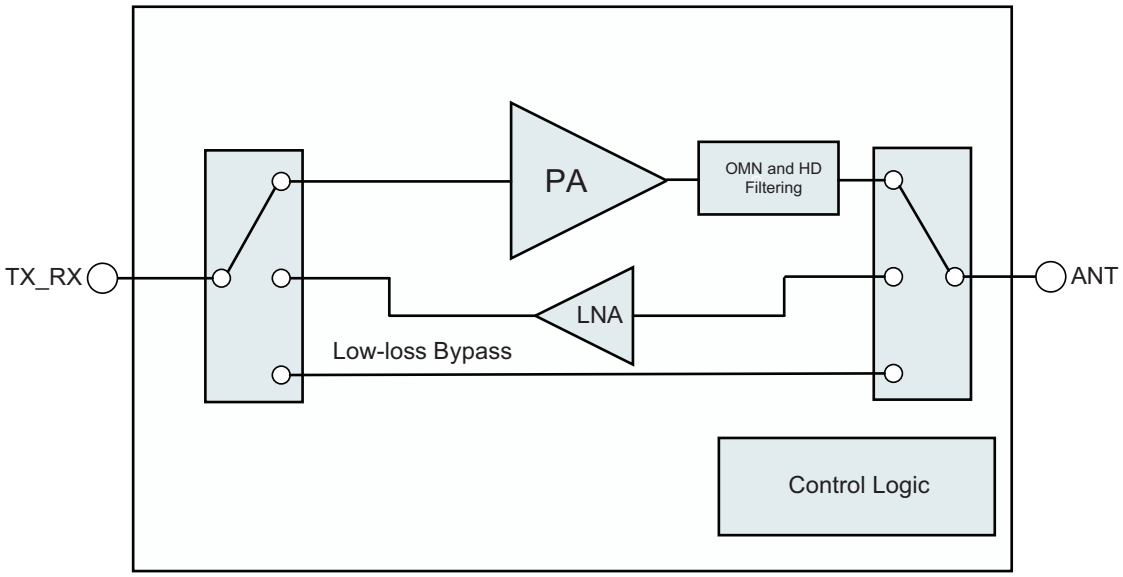
The PE562212 is ideal for smart home and Internet-of-Things (IoT) devices needing extended range and compact hardware.

Introduction

The PE562212 consists of a single pSemi UltraCMOS© integrated circuit provided in an ultra-compact 14-lead 1.8 × 1.8 × 0.63 mm LGA package.

The PE562212 is a high performance, fully integrated FEM designed for Thread, Zigbee®, and Bluetooth® applications. This highly versatile FEM features an integrated power amplifier (PA) with up to +21 dBm output power, adjustable output power with a 15-dB range, an integrated LNA with a 1.6-dB NF, and a low-loss bypass path with 0.6 dB typical IL.

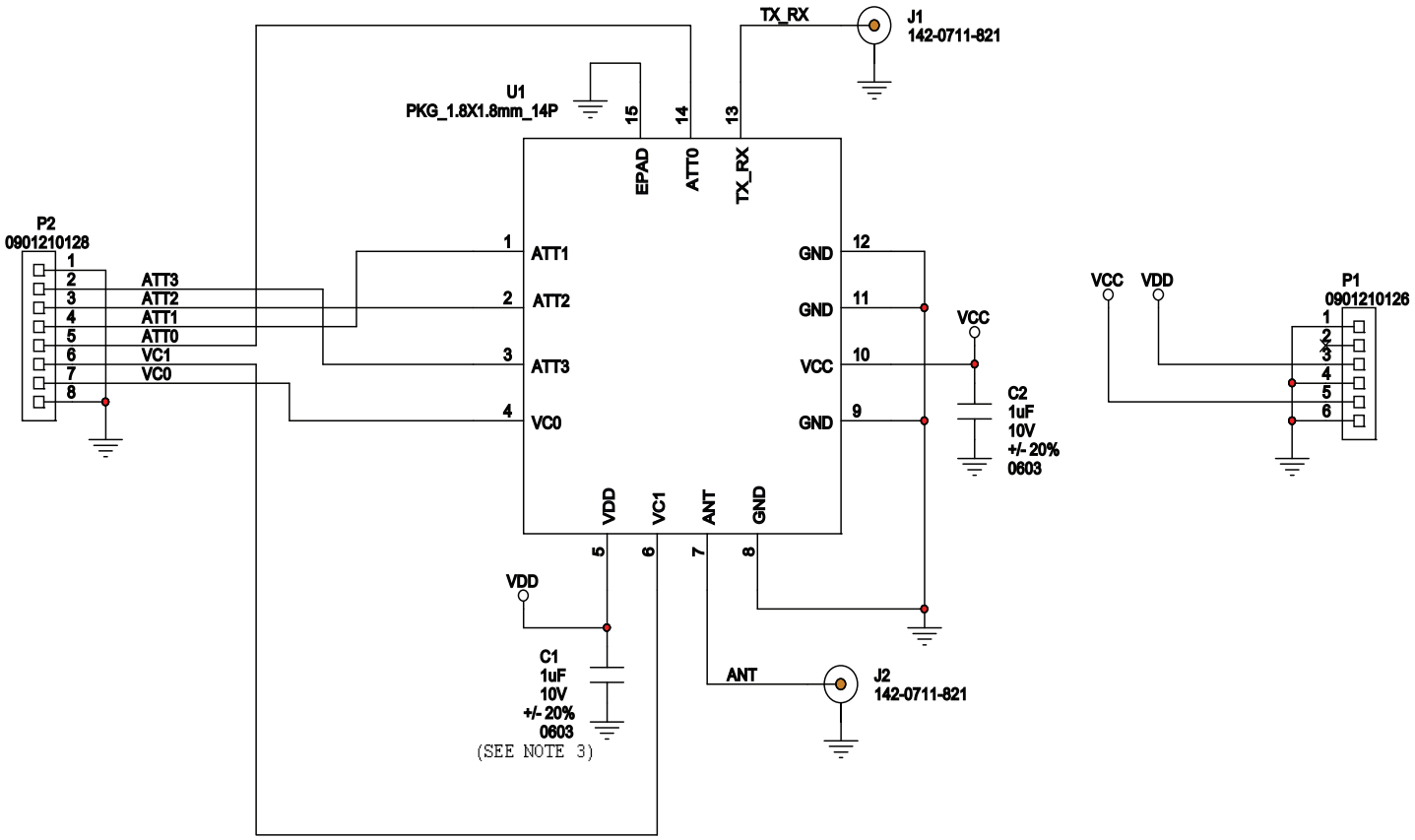
Figure 1 ▪ PE562212 Functional Diagram



Product Highlights

- Integrated PA with up to +21 dBm output power
- Digital gain control with a 15-dB range in 1-dB steps
- Integrated LNA with a 1.6 dB NF and a low-loss bypass path with 0.6 dB typical IL.
- Thread Tx compliant
- Bluetooth BDR (+21 dBm) and EDR (+15 dBm) operation
- Low-to-medium Wi-Fi (MCS7) capability
- Minimal external components required (bypass capacitors on VCC and VDD, as shown in **Figure 2**)
- Packaging: Ultra-compact 14-lead 1.8 × 1.8 × 0.63 mm LGA (MSL3)

Figure 2 ▪ PE562212 Evaluation Board Schematic



NOTES:
1. USE PRT-85211-01.
2. CONTAINS PARTS AND ASSEMBLIES SUSCEPTIBLE TO DAMAGE BY ELECTROSTATIC DISCHARGE (ESD).
3. C1 1µF CAPACITOR IS OPTIONAL.

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In addition to its native Thread and Bluetooth operation, the PE562212 delivers low-to-medium Wi-Fi (MCS7) performance. This function/feature paired with digital gain control ensures that transmit levels comply with regional regulatory standards.

Figure 3–**Figure 11** show the typical PE562212 Wi-Fi performance for small signal gain. **Figure 3** shows the representative 0 dB, -3 dB, and -15 dB attenuator levels and the Bypass mode.

Figure 3 ▪ PE562212 Broadband Gain in Tx Mode for the 0, -3, and -15 dB Attenuator Levels and the Bypass Mode

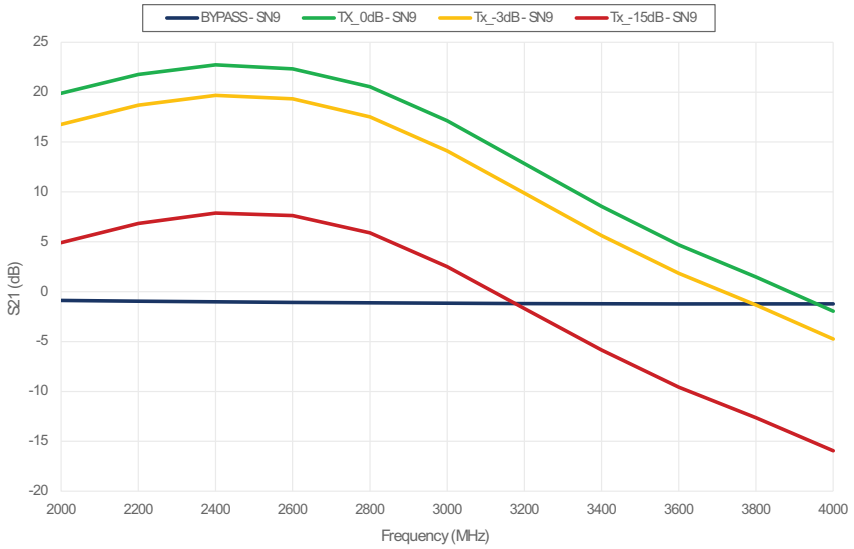


Figure 4 shows the input and output return loss for the transmit path.

Figure 4 ▪ PE562212 Broadband Input and Output Return Loss in Tx Mode

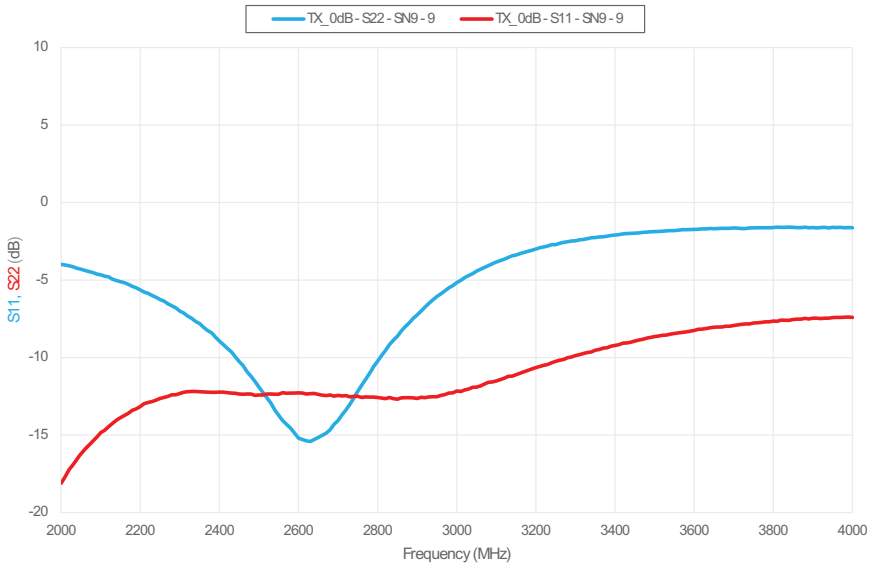


Figure 5 shows the PE562212 EVM performance operating under the 802.11n 2.4-GHz protocol plotted against the output power level for an MCS0 20-MHz waveform. In this case, more than 20 dBm of output power can be achieved while maintaining better than a -10 dB EVM level.

Figure 5 ▪ EVM versus Output Power Sweep for 2412, 2437, and 2462 MHz, MCS0 Waveform

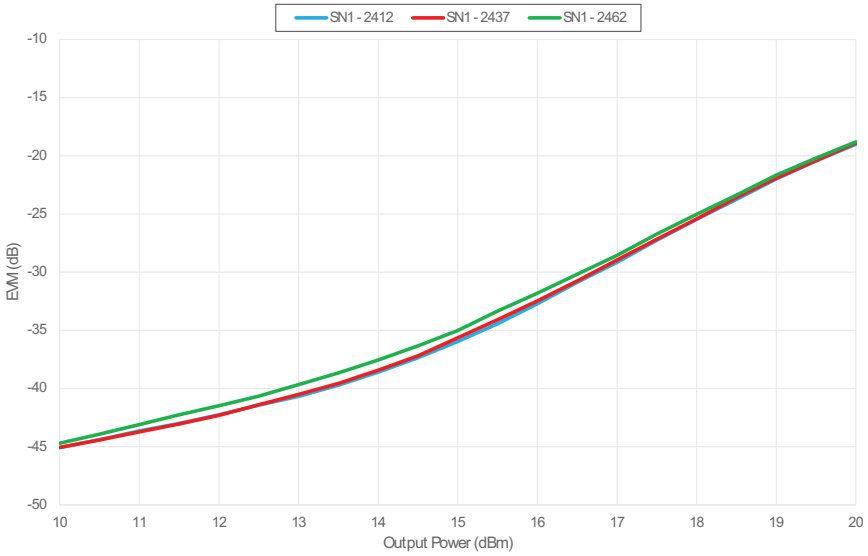


Figure 6 shows the EVM level versus output power for an MCS7 20-MHz waveform, indicating that a power level of 16.5 dBm is possible while maintaining an EVM better than -27 dB across the 2.4 GHz frequency range.

Figure 6 ▪ EVM versus Output Power Sweep for 2412, 2437, and 2462 MHz, MCS7 Waveform

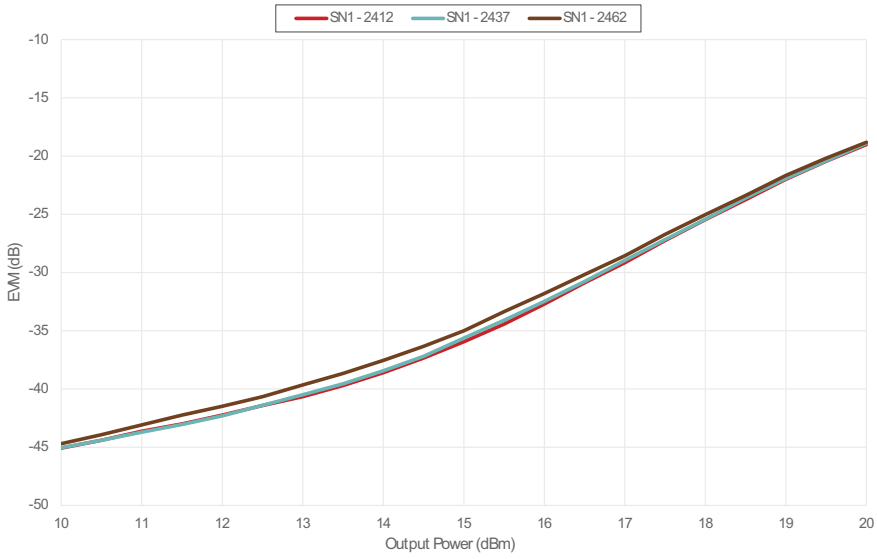


Figure 7 shows the PE562212 total transmit current draw versus the transmit output power. For MCS0 operation at 18.5 dBm, the current level is 110 mA, and at 16.5 dBm the total current is less than 95 mA.

Figure 7 ▪ Maximum Current versus Output Power for 2412, 2437, and 2462 MHz, MCS0 Waveform

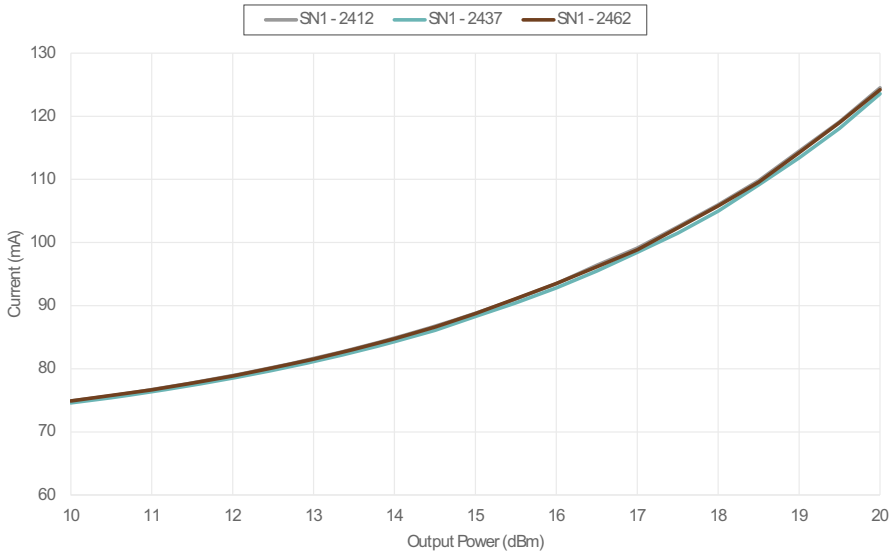


Figure 8 shows the PE562212 802.11 spectral mask margin performance, indicating that it is the limiting factor of MCS0 output power. For MCS0 operation, the spectral mask margin crosses 0 dB at 18.5–19.0 dBm.

Figure 8 ▪ Spectral Mask Margin versus Output Power for 2412, 2437, and 2462 MHz, MCS0 Waveform

Figure 9 shows a -41.2 dBm spurious level in the 2310–2390 MHz range occurring at an output power of 15.7 dBm for channel 1 at 2412 MHz for an IEEE 802.11n MCS0 20-MHz waveform.

Figure 9 ▪ Out-of-band Spurious Emissions versus Output Power for 2412 MHz, MCS0 Waveform

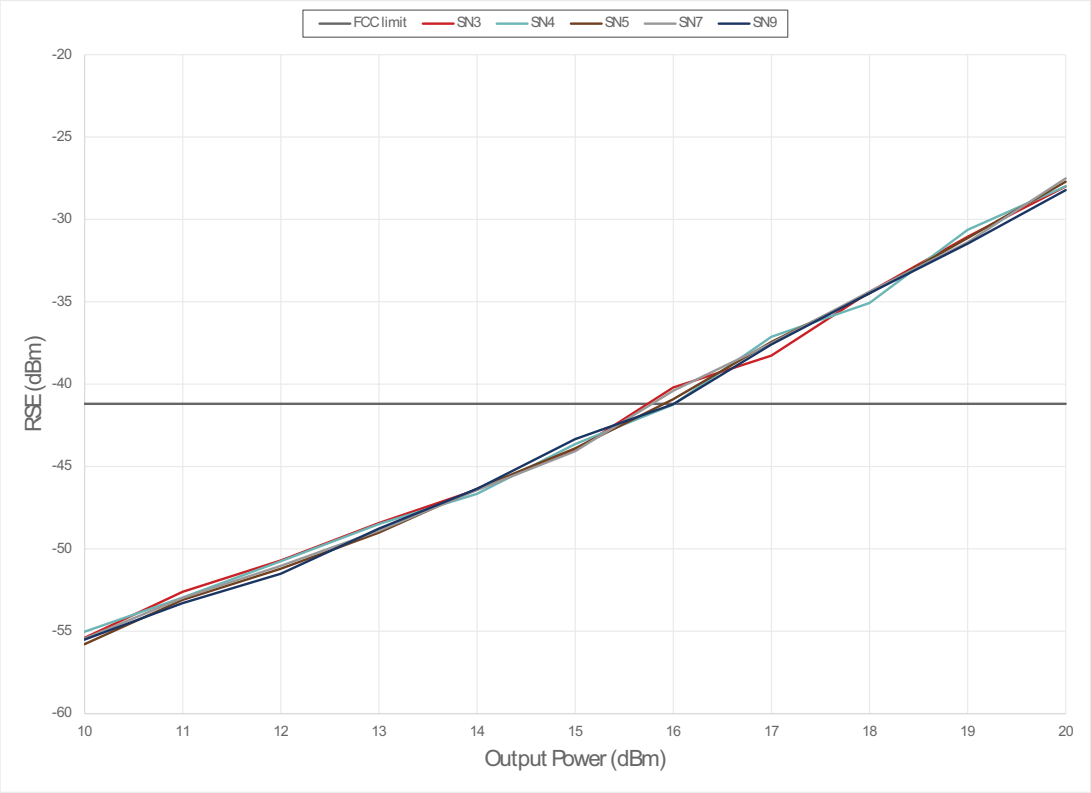
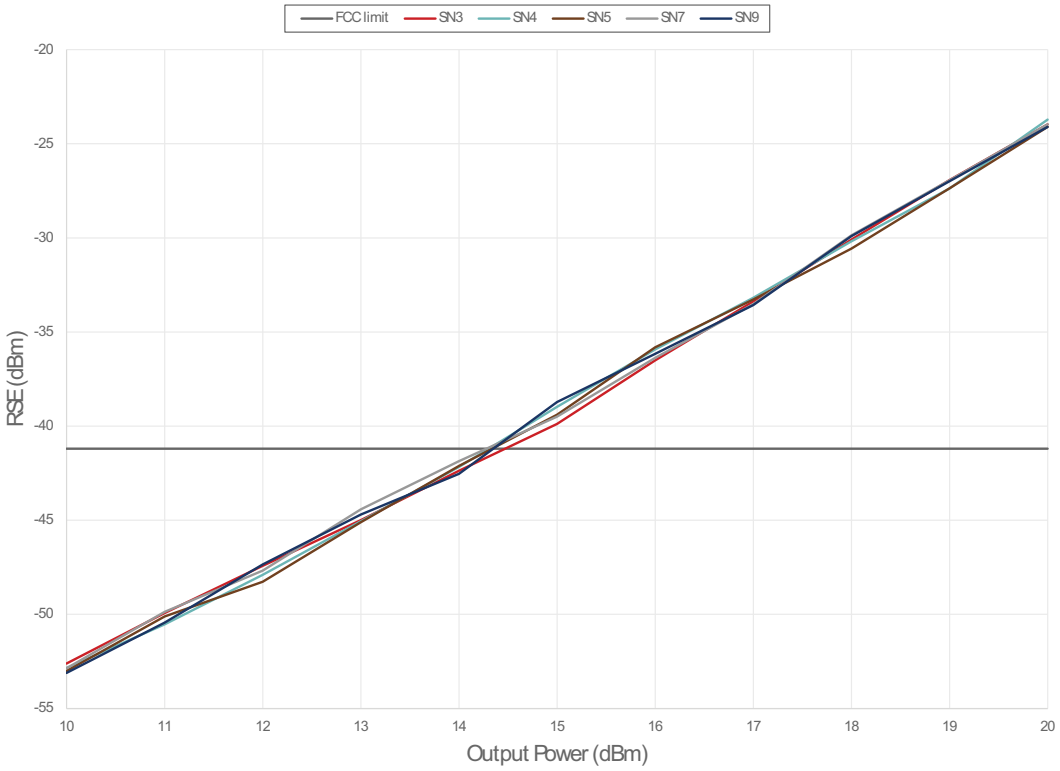


Figure 10 shows a -41.2 dBm spurious level in the 2483.5-2500 MHz range occurring at an output power of 14.3 dBm for channel 11 at 2462 MHz for an IEEE 802.11n MCS0 20-MHz waveform.

Figure 10 ▪ Out-of-band Spurious Emissions versus Output Power for 2462 MHz, MCS0 Waveform



As a full FEM, the PE562212 includes a low-noise amplifier (LNA). In receive mode, the typical in-band gain level is 15 dB and the noise figure is 1.6 dB. **Figure 11** shows the typical gain and the input/output return loss.

Figure 11 ▪ Receiver Gain and Return Loss versus Frequency

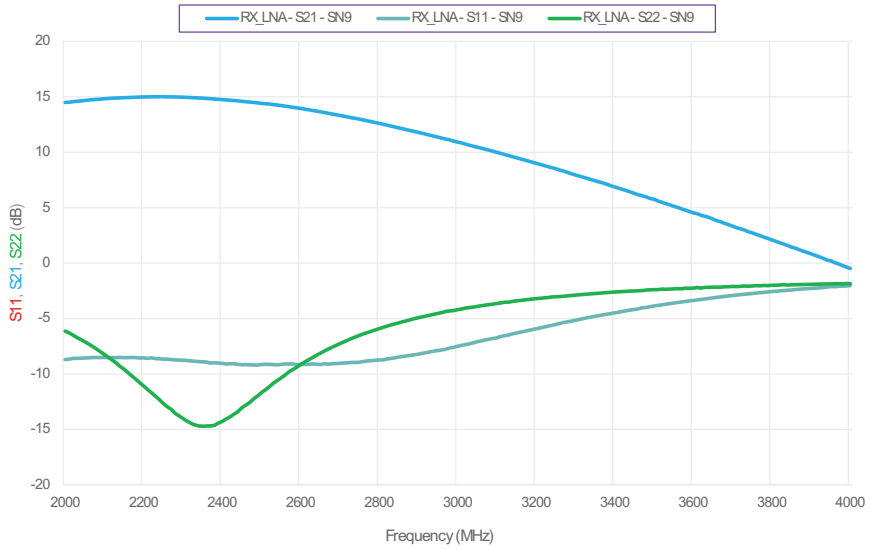


Table 1 lists the PE562212 Wi-Fi transmit and receive performance.

Table 1 ▪ Wi-Fi Performance Summary

Parameter	Condition	Typ	Unit
Transmit			
Gain	2400–2483 MHz	23	dB
P_{OUT} (MCS0)	EVM ≤ -10 dB	20	dBm
P_{OUT} (MCS7)	EVM ≤ -27 dB	16.5	dBm
I_{DD} maximum	MCS7, P_{OUT} = 16.5 dBm	95	mA
Receive			
Gain	2400–2483 MHz	15	dB
Rx noise figure	2400–2483 MHz	1.6	dB

Conclusion

The PE562212 is the latest 2.4 GHz SOI Front-end Module from pSemi. The FEM delivers competitive performance by combining an integrated PA with digital gain control and an integrated LNA with a low-loss bypass path.

Sales Contact

For additional information, contact Sales at sales@psemi.com.

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