APPLICATION NOTE

SKY85405-11: Performance with and without a Thermal Pad

Introduction

This Application Note provides information on thermal and RF performance of the SKY85405-11, with and without a thermal pad. Similar-class power amplifiers (PAs) are expected to show similar thermal and RF performance.

With the introduction of 4 x 4 mm and 8 x 8 mm WiFi designs, thermal management has become a challenge. One way of keeping power amplifiers operating at lower temperature is to cover the PCB with a thermal pad that transfers heat away from the PA and adjacent components to the shield.

Skyworks Green™ products are compliant with all applicable legislation and are halogen-free. For additional information, refer to *Skyworks Definition of Green™*, document number SQ04–0074.

Setup Procedure

This test was conducted according to the following procedure:

1. The shield was assembled on the SKY85405-11 Evaluation Board. See Figure 1.
2. A thermal probe was attached on the top layer of the board, near the final stage (1 mm away from the chip), to monitor the temperature.
3. A GP5100 thermal pad with thermal conductivity 3.0 W/m-k was used. The thermal pad made contact between the PCB, including the PA, and the bottom of the shield.
4. The SKY85405-11 was operated at 5 V.
5. Temperature and RF performance were measured with and without the thermal pad while the shield was in place.

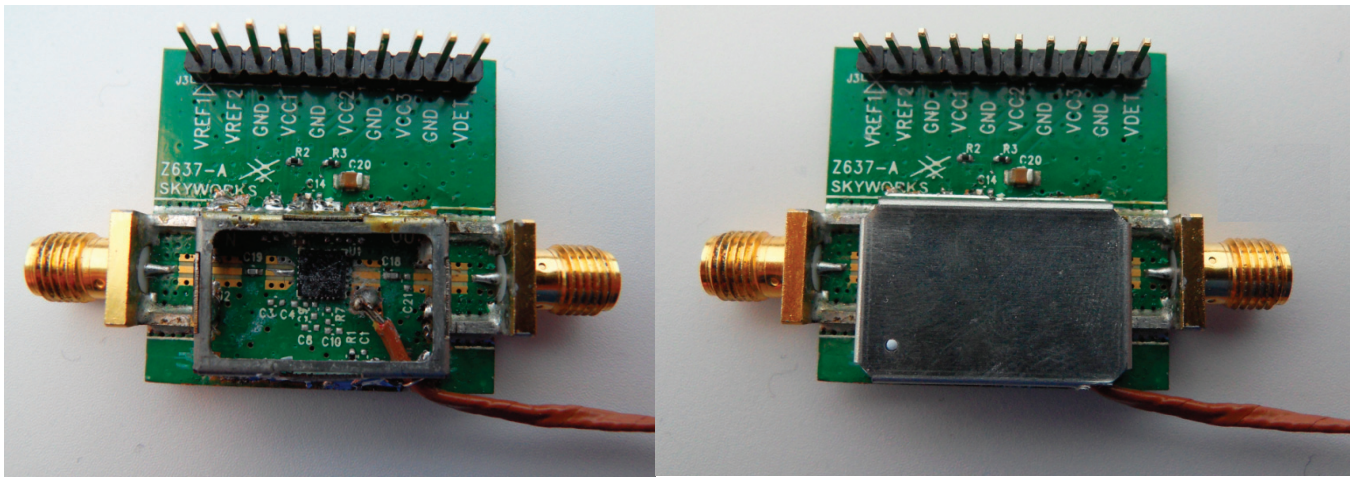

Figure 1. SKY85405-11 Evaluation Board with Installed Shield

Performance Tradeoff

Temperature Measurements

The temperature was measured with a thermal probe while the device was set to 5540 MHz, MCS0, 100% duty cycle at +28 dBm. The device was left on for 5 minutes at +85 °C ambient temperature prior to recording the temperature with the thermal probe.

The measured temperature on the board was 94°C with the thermal pad and 96.5°C without the thermal pad.

RF Performance

Small signal gain and dynamic EVM across frequency were measured with and without the thermal pad.

The small signal gain variation increased from ~ 1 dB to ~4.5 dB across frequency.

Dynamic EVM was greatly degraded to the point that EVM was not adequate for 11ac applications.

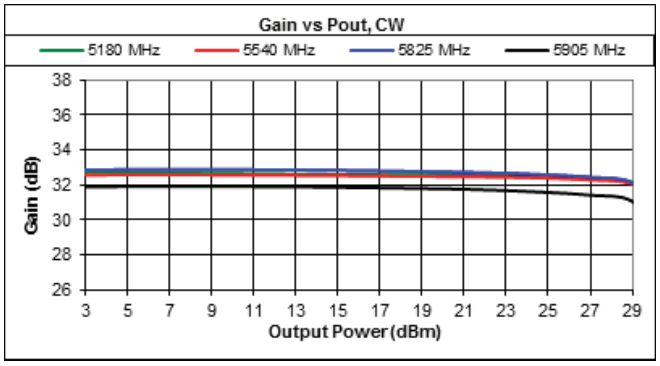

Figure 2. Small Signal Gain at 85° C without Thermal Pad

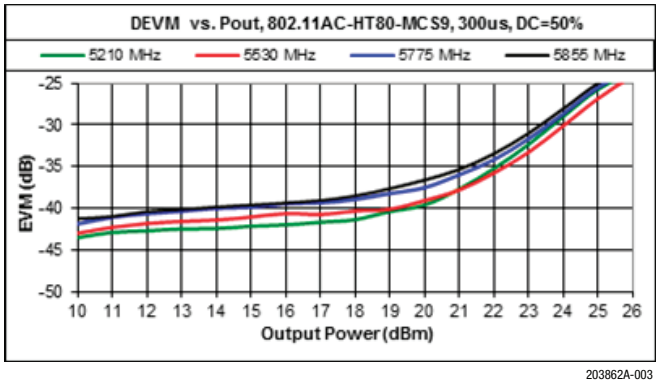

Figure 3. Dynamic EVM at 85° C without Thermal Pad

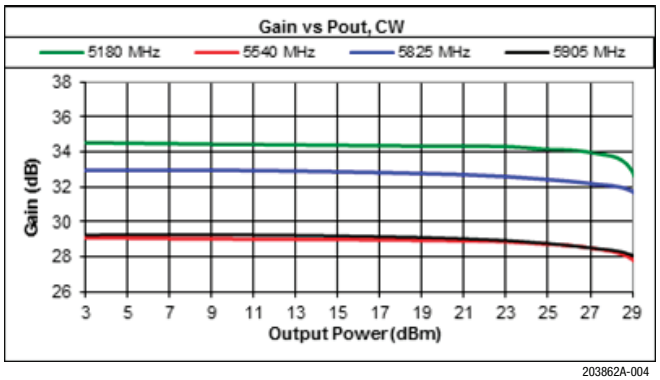

Figure 4. Small Signal Gain at 85° C with Thermal Pad

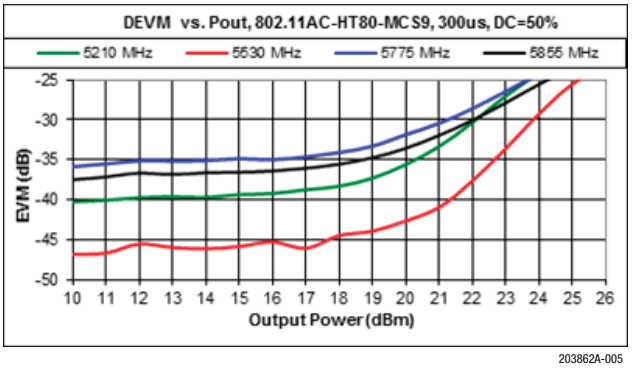

Figure 5. Dynamic EVM at 85° C with Thermal Pad

Conclusion

The addition of the thermal pad reduces the junction temperature of the PA die by 2.5 °C, which is useful in applications that have thermal restrictions. However, the thermal pad de-tunes the PA to a point where the design becomes practically unmatchable.

Careful compromise has to be made between the benefit of the reduced temperature and the degraded RF performance.

Our recommendation is to avoid using thermal pads with the SKY85405-11 device whenever possible.