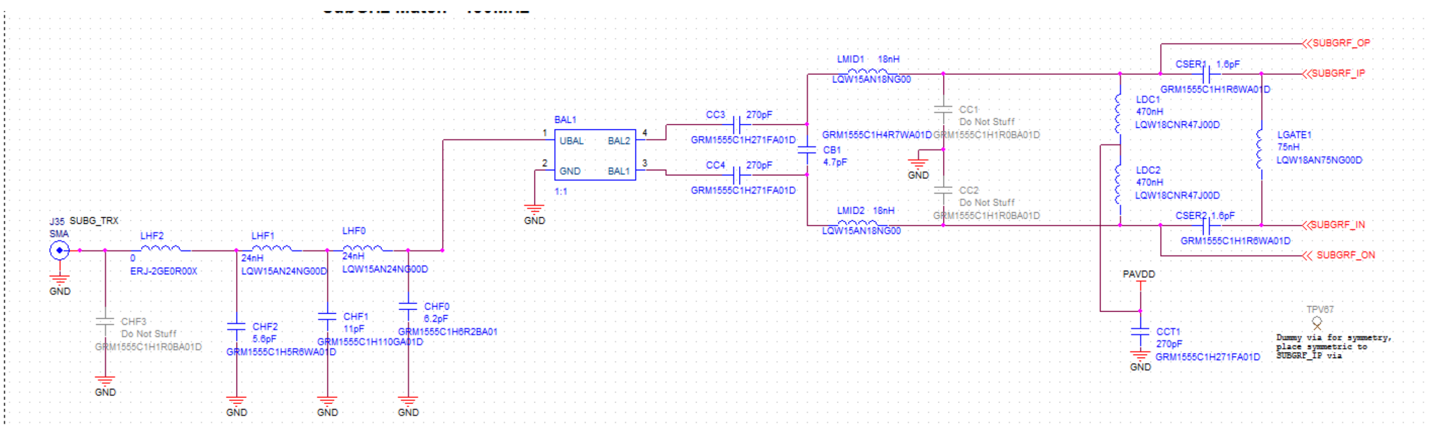
AN1146: Johanson 434 MHz IPDs for EFR32 Series 1 Wireless SOCs

EFR32 Series 1 devices supporting sub-GHz frequency bands utilize an external matching network. This network serves several purposes, including impedance transformation from a 50 Ω antenna to the optimum transmit and receive path impedance for EFR32, single-ended to differential conversion, and low-pass filtering to minimize transmit harmonics and receive out-of-band interference. This network is often implemented by discrete components as shown below.

Some applications, however, benefit in terms of minimized space, bill of materials, and reduced complexity by integrating this external network in a single integrated passive device (IPD).

KEY POINTS

- IPDs simplify the EFR32 Series 1 sub-GHz RF matching network design, reducing complexity and PCB board space by 70%
- IPDs are available from leading RF ceramics providers supporting both the 434 MHz and 868 MHz frequency bands
- Including IPDs in EFR32 Series 1 designs is made straightforward with a few hardware and software design considerations



1. Component Reduction

A reduction in the number of matching components is desirable not only to reduce material cost but also the cost of inventory, assembly, and testing. Additionally, a smaller number of parts allows a smaller board area, which also decreases total cost. Silicon Labs has partnered with Johanson to develop an Integrated Passive Device (IPD) that implements a complete 434 MHz +14 dBm RF matching network within a single small surface mount ceramic package. Using a proprietary Low Temperature Co-Fired ceramic (LTCC) process, Johanson has successfully integrated all the required discrete matching components. The RF matching network on the front page is now highly simplified, as shown below.

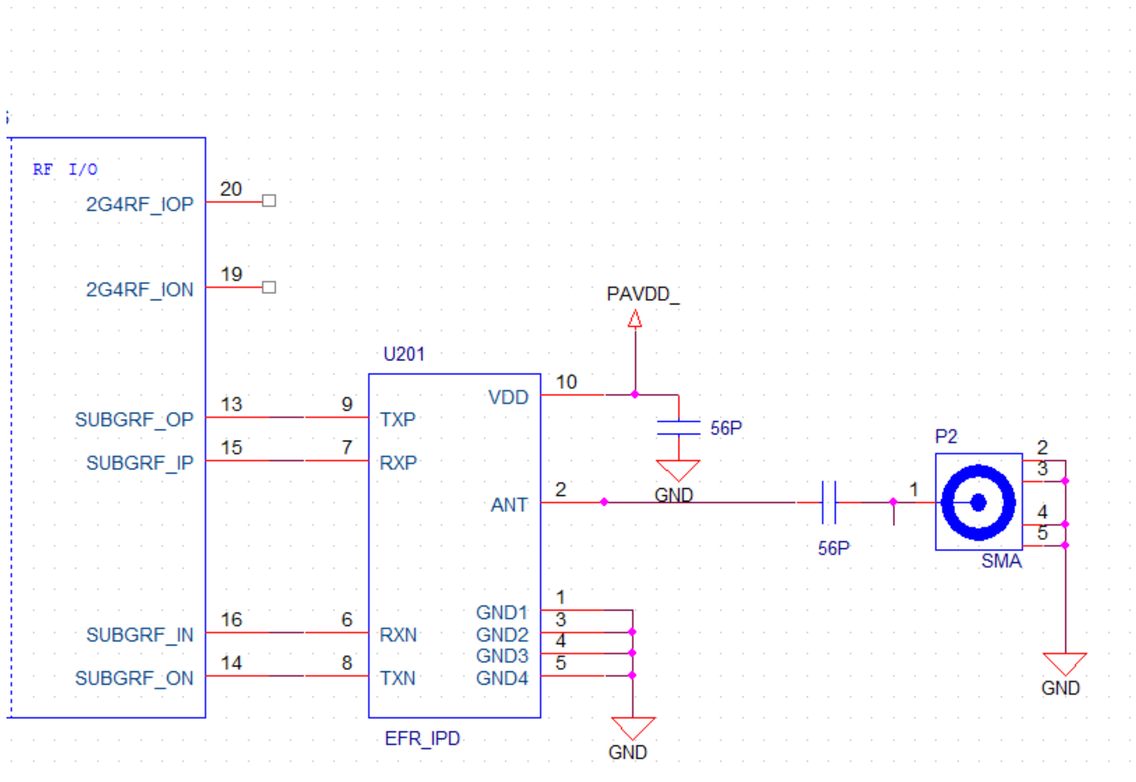


Figure 1.1. IPD RF Matching Network

2. PCB Space Comparison

An IPD solution also significantly reduces the PCB area. A comparison between a layout using discrete components and one using an IPD solution is shown in figure below. The red circles highlight the PCB space savings when using the IPD solution.

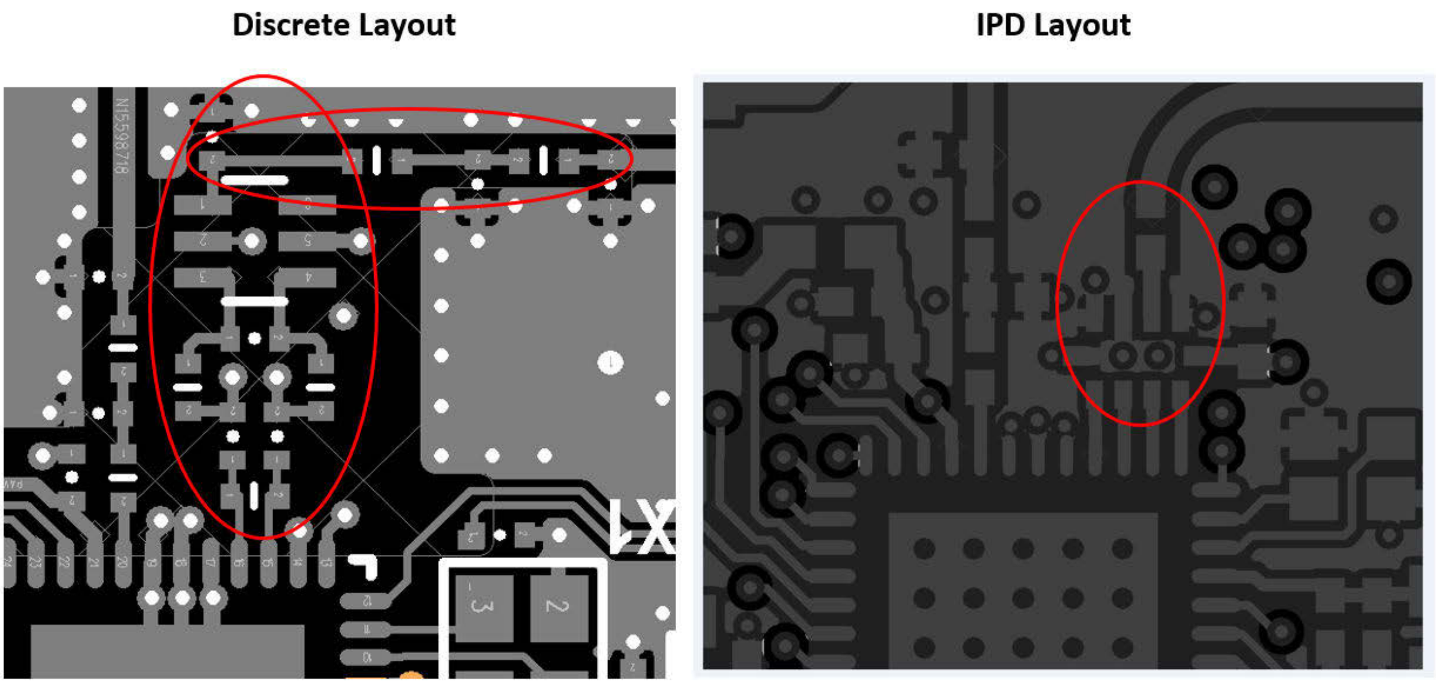


Figure 2.1. Layout Comparison between Discrete Solution (Left) and IPD Solution (Right)

The Johanson part number for the 434 MHz solution is 0434BM15B0027 and is suitable for use at 434 MHz at ~ +14 dBm output power with the following RFICs from Silicon Laboratories.

- EFR32MG1x
- EFR32BG1x
- EFR32FG1x

Reference design collateral (e.g., schematics, board design files, gerbers and BOM lists) for the Johanson device can be downloaded from the Silicon Laboratories website.

The data sheet for the Johanson 0434BM15B0027 device may be downloaded at https://www.johansontechnology.com/silabs or https://www.johansontechnology.com/datasheets/0434BM15B0027/0434BM15B0027.pdf.

3. Measured Performance

Silicon Laboratories has performed extensive testing of reference design boards with the Johanson IPDs to characterize the performance in comparison to the discrete solution. The results are shown below.

3.1 Transmit Output Power vs. PA Power Control Level

The conducted Transmit Output Power of four Johanson IPDs (matched boards) is compared against a discrete match solution in the figure below.

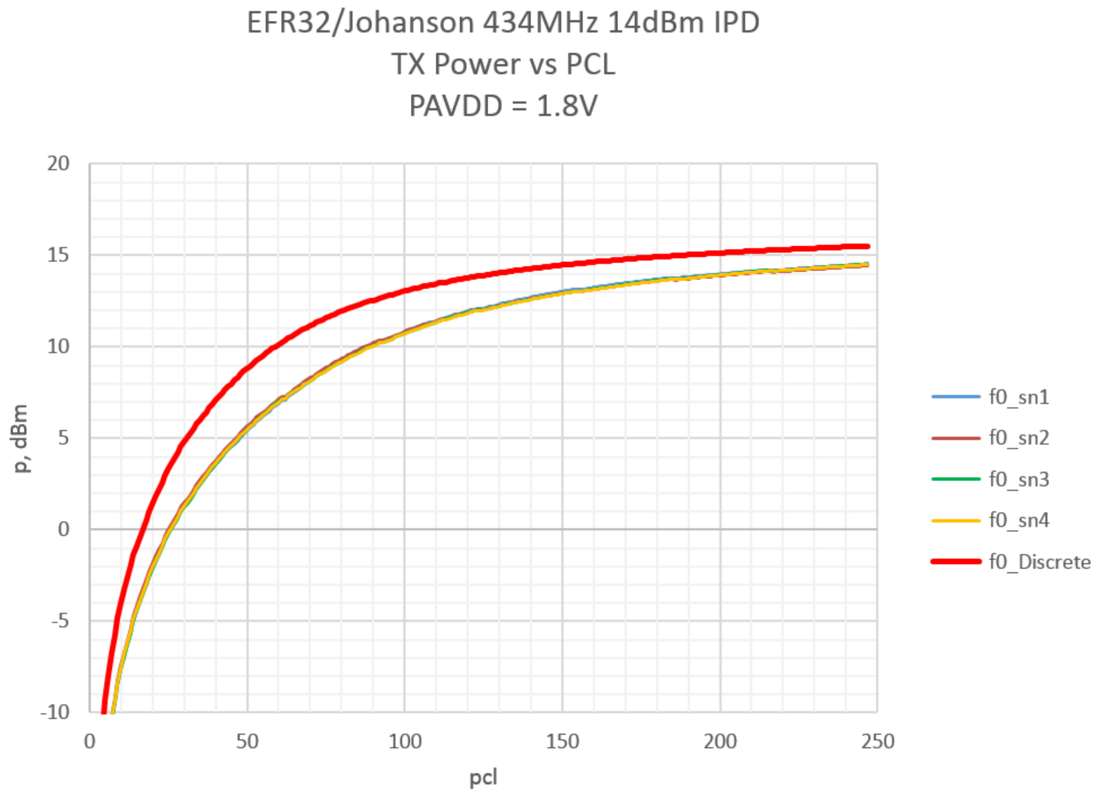


Figure 3.1. Conducted Transmit Output Power (Four Johanson Boards vs. Discrete Matched Solution)

3.2 Transmit Current Consumption vs. PA Control Level

The Conducted Transmit Current of four Johanson IPDs (matched boards) is shown below compared against a discrete match solution.

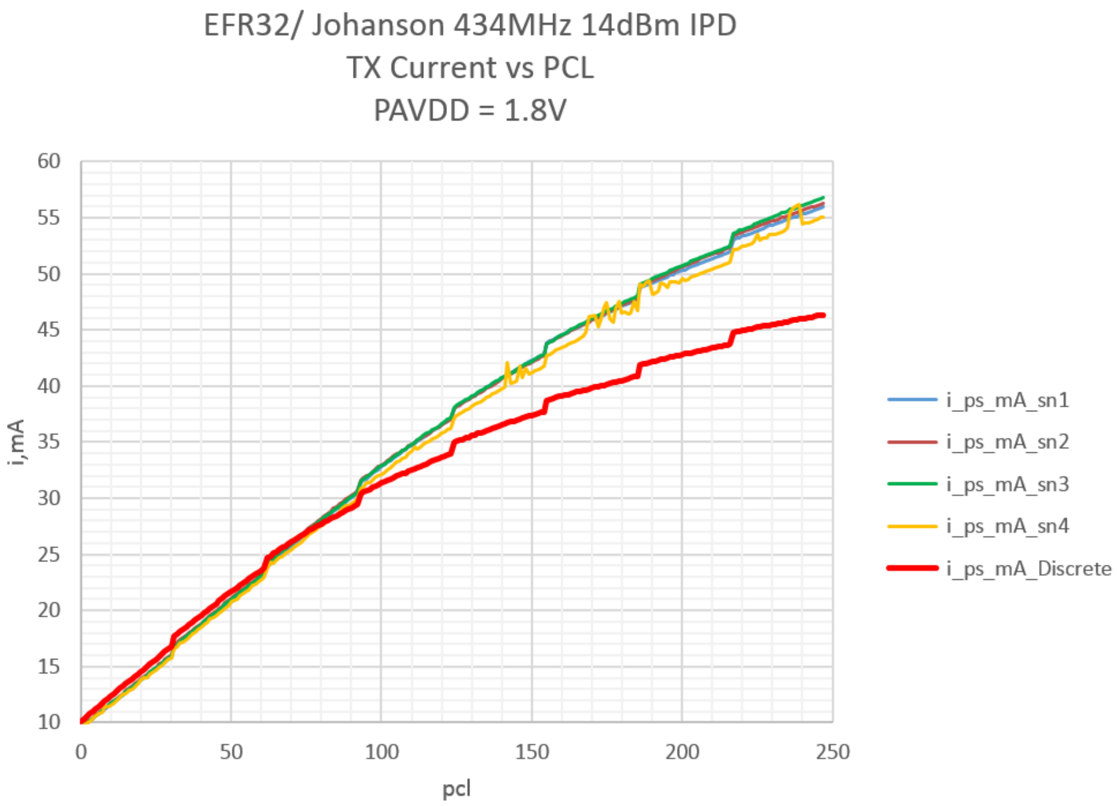


Figure 3.2. Conducted Transmit Current of Four Johanson IPDs (Matched Boards)

3.3 Transmit Power, Second Harmonic Performance vs. PA Control Level

The Conducted Transmit second harmonic Performance of four Johanson IPDs (matched boards) is shown below compared with that of the discrete matched solution.

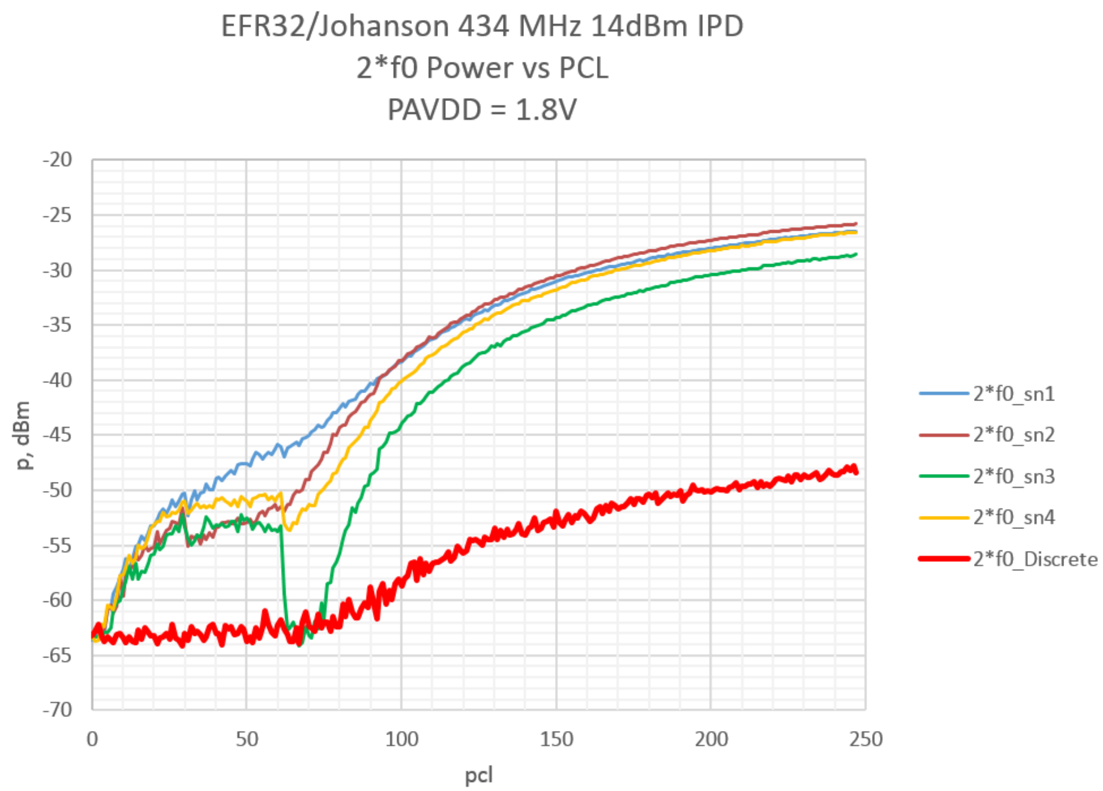


Figure 3.3. Conducted Transmit Second Harmonic Performance of Four Johanson IPDs (Matched Boards)

3.4 Transmit Power, Third Harmonic Performance vs. PA Control Level

The Conducted Transmit third harmonic Performance of four Johanson IPDs (matched boards) is shown below compared with that of the discrete matched solution.

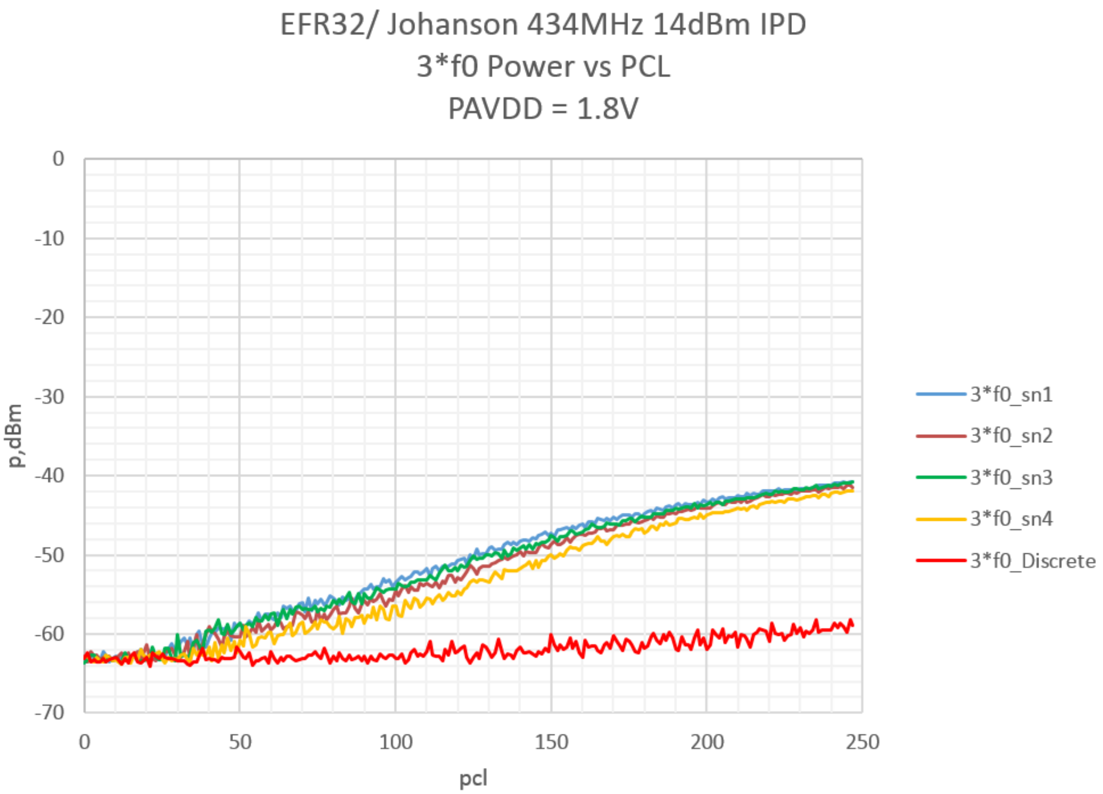


Figure 3.4. Conducted Transmit Third Harmonic Performance of Four Johanson IPDs (Matched Boards)

3.5 Receiver Packet Error Rate Performance at 434 MHz

The RX Packet Error Rate (PER) for a 62.5 kbps GFSK signal is shown below for four IPDs (matched boards) compared to that of the discrete matched solution.

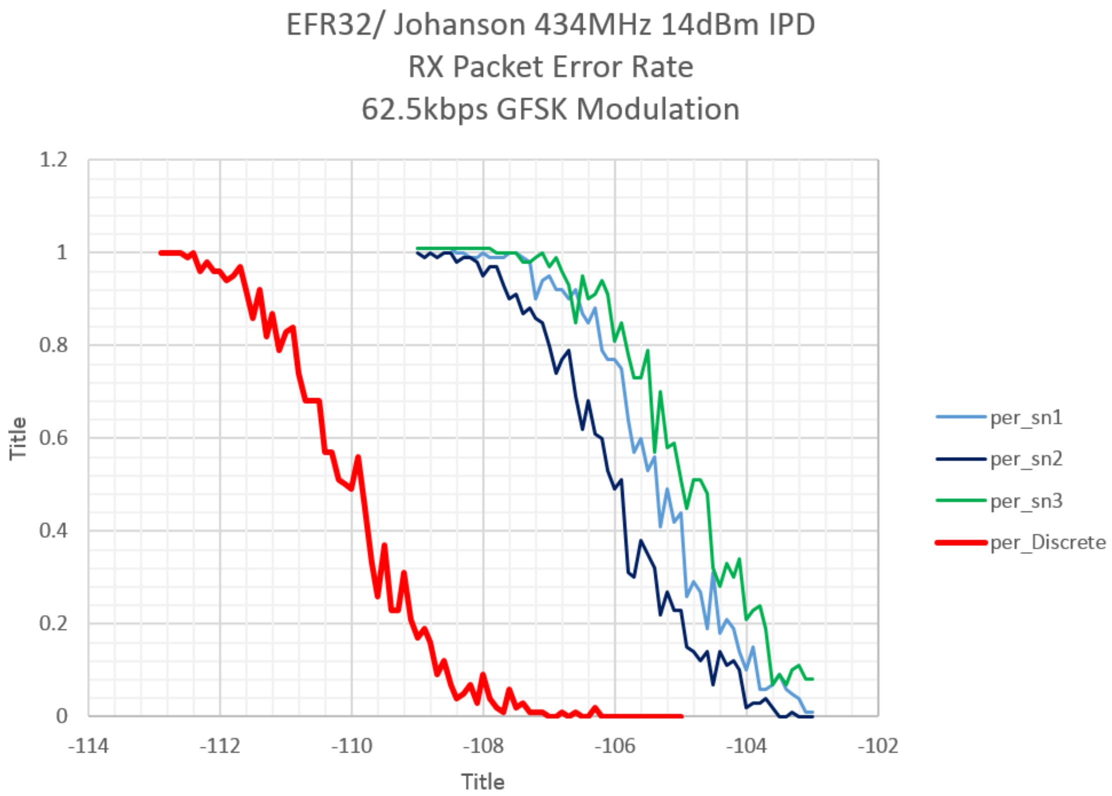
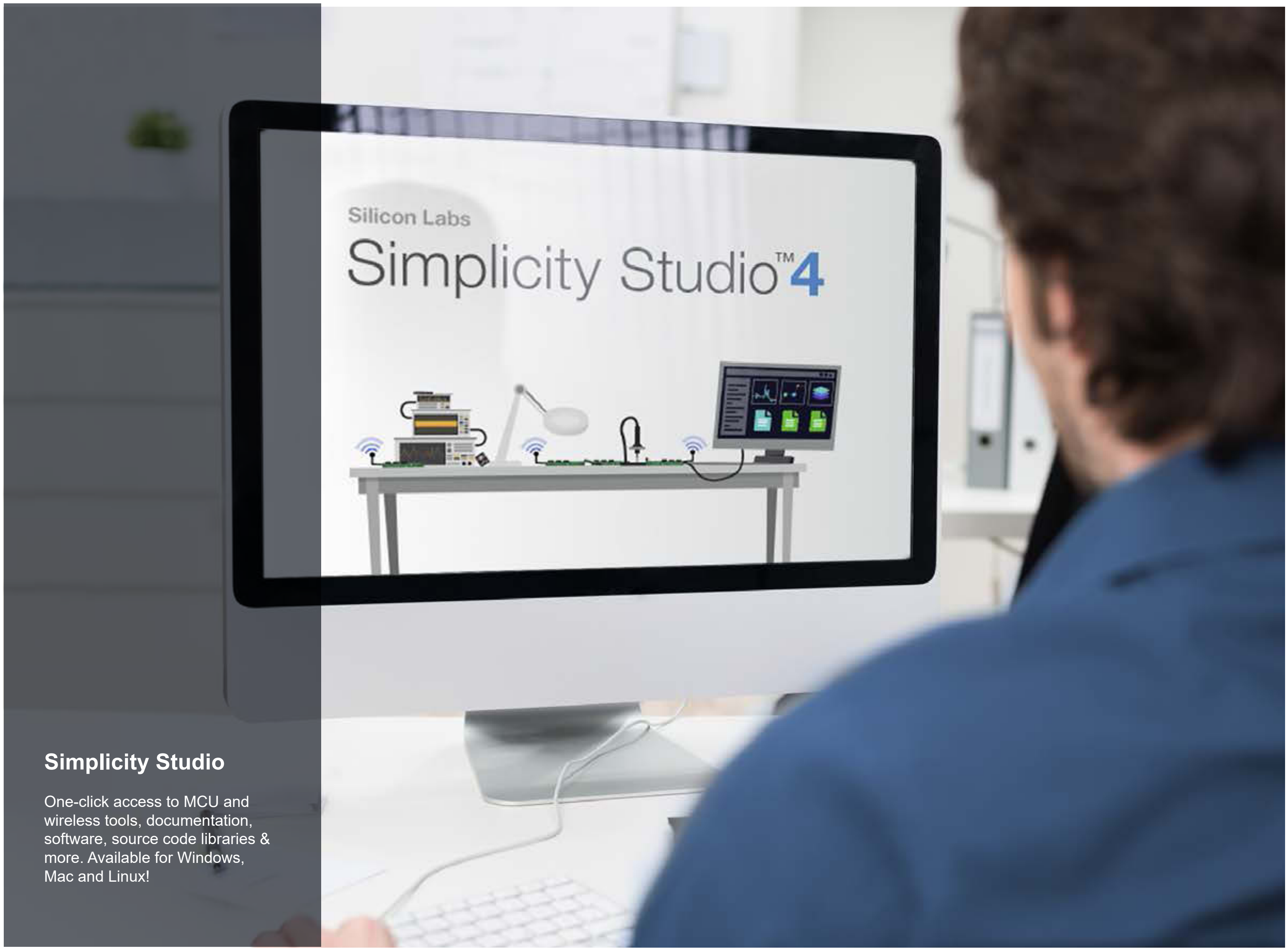


Figure 3.5. Receiver Packet Error Rate



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