Success Story

Richardson RFPD Engineers Overcome Automotive SDARS Design Challenges With NI AWR Software

"The stability analysis and optimization features of NI AWR software are very powerful and efficient in yielding the desired results. These features combined with the network synthesis and iFilter wizards enabled a fast turnaround time between simulation and bench testing."

Elias Ghafari, Richardson RFPD

Company

Richardson RFPD, an Arrow Company, is a specialized electronic component distributor providing design engineers with deep technical expertise and localized global design support for the latest new products from the world's leading suppliers of RF, wireless, internet of things (IoT) and power technologies. The company's specialized knowledge in RF, wireless, IoT and power management engineering helps customers accelerate time to market, find complete solutions, save development costs, and, ultimately, improve design performance.

Challenge

The need to add new antenna elements a vehicle rooftop antenna module to keep up with customer demand for in-vehicle information/entertainment is increasing. Crosstalk (coupling) between those antenna elements within the module is one of the most critical and challenging issues that antenna engineers are faced with and struggle to overcome. This crosstalk between the antenna elements results in leakage of unwanted signals, which are picked up by an antenna. A specific example is the influence of the cellular antenna element, which causes interference, overloading, and added noise in the low-noise amplifiers (LNAs) of the rest of the antenna elements.

At-A-Glance

Application

- Antenna
- Amplifier
- LNA
- Filter
- Receiver

Software

- NI AWR Design Environment
- Microwave Office
- AXIEM
- iFilter
- Network Synthesis

Benefits

- Ease of use
- Innovative features
- Speed of simulations
- High accuracy
- 50% reduction in design time

Richardson **RFPD** designers were tasked with developing a robust LNA lineup for a satellite digital audio radio service (SDARS) antenna that has higher immunity to external interfering signals. The LNA lineup was for the SDARS antenna designed for multiband antennas for rooftop automotive applications to fit in a very small volume to satisfy automotive market requirements.

The LNA consisted of two active LNA stages and two bandpass filters (BPFs). The most critical design challenge was to meet the sub 1.0-dB noise figure (NF) for the complete LNA chain at an acceptable input return loss, especially since the lineup required placement of a bandpass filter in front of the first LNA stage.

The second design challenge was to meet the out-of-band rejection requirements, namely the filter frequency response when interfaced with non-50-ohm LNAs impedances. The third design challenge was to obtain a 50-ohm match between the stages to optimize the overall gain response and minimize the gain ripple.

Solution

The designers used NI AWR software, specifically Microwave Office circuit design software, inclusive of the network synthesis wizard and iFilter™ integrated filter synthesis wizard, to simulate the complete LNA circuit.

Figures 1 and 2 show the overall NF and frequency response, respectively. Figure 3 provides the results of the measured NF. Figure 4 illustrates the simulated and measured gain overlaid on the same graph. As can be seen from the graphs, the measured results and the simulation results are very comparable.

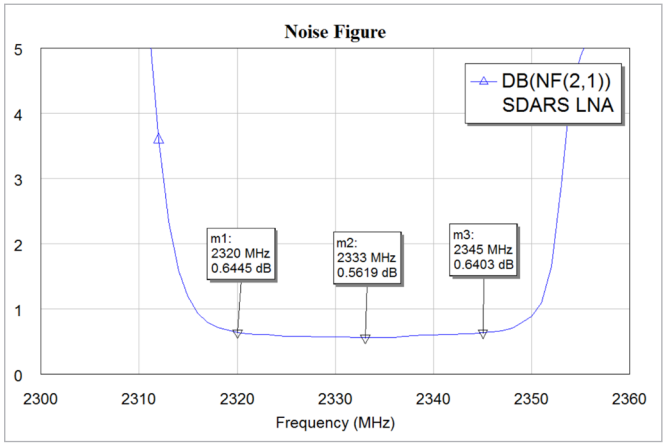

Figure 1: Noise figure simulation result.

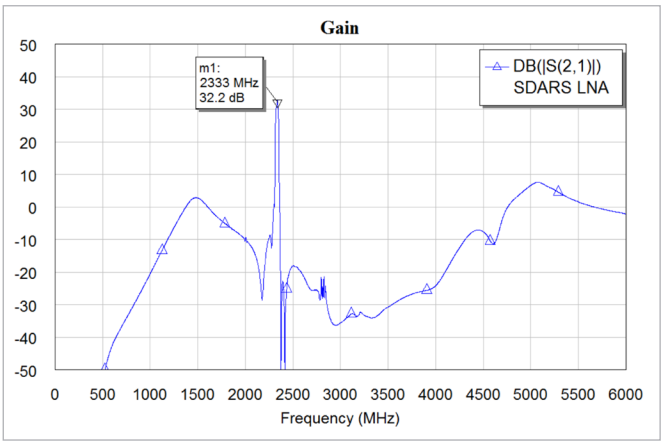

Figure 2: Frequency response simulation result.

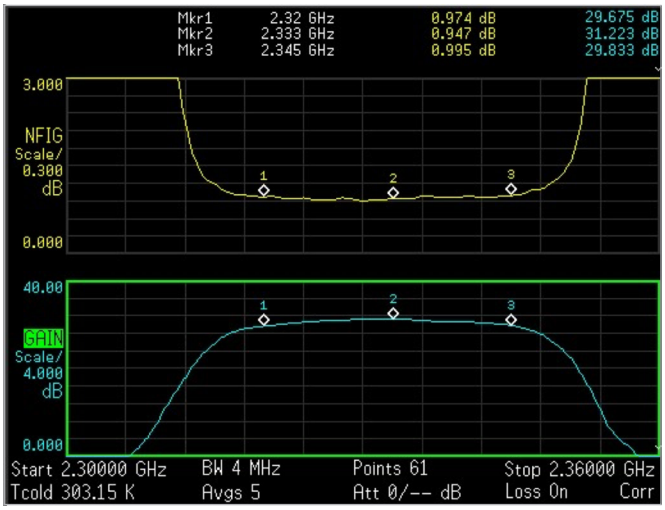

Figure 3: Results of measured NF.

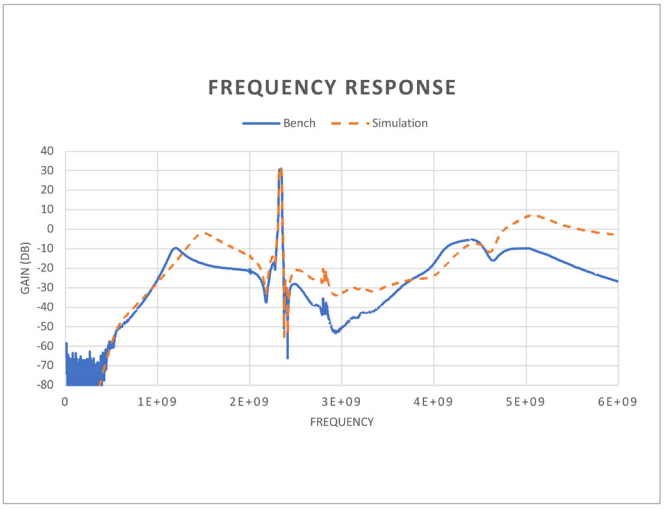

Figure 4: Simulated and measured gain.

Conclusion

The designers chose the NI AWR Design Environment platform because they were very familiar with the software and its reliable results. The intuitive user interface along with the availability and power of the network synthesis and iFilter wizards were additional reasons that motivated them to use the software. The team noted that the user interface was very intuitive and user friendly and the stability analysis and optimization features were very powerful and efficient in yielding the desired results. All these features enabled a fast turnaround time between simulation and bench testing.

The flexibility of importing the S-parameter files and interfacing between the network synthesis and iFilter wizards and the schematic window made it possible to efficiently design the LNA in a short amount of time and yet obtain very good results. The network synthesis wizard was extensively useful for generating the matching components to address the out-of-band impedance matching requirements, since the bandpass filters required 50-ohm terminations to operate properly. This enabled the team to meet the out-of-band frequency response requirements.

The designers cited the main benefits of using NI AWR software as including the ease of building the schematic and the high speeds and efficiency of the simulation runs, as well as the high accuracy of the results. The iFilter and network synthesis wizards were also key benefits because they automatically generated the components network topology and the components values from the definition of the frequency band and performance target parameters, which saved a great deal of time and iterations. The extensive examples list provided within the software and application notes were also beneficial in expediting the simulation process.

The key advantage gained by the design team was the reduction in time taken to achieve the desired simulation results thanks to the ease of building the schematic and using the network synthesis wizard. Without NI AWR software the design would have taken at least twice as long.

Special thanks to Elias Ghafari, FAE for his contributions to this success story.