Application Note

Amplifier Design: Improving Gain Flatness Without Sacrificing Return Loss

AN002

Your broadband application requires a highly efficient, linear amplifier that features superior gain flatness with excellent return losses over the band. The return loss requirement prevents the use of mismatch at the low end of the band to flatten the gain, so what do you do?

Consider the requirements for a driver amplifier first. Since the noise figure (NF) in a driver application is typically not critical, there is freedom to tweak the input matching to flatten the gain. Gain will be highest at the low end of the band, so the challenge becomes how to selectively reduce the low frequency gain more than the high frequency gain while maintaining good return losses.

A frequency selective resistive load on the device input will do just that. Below is an s-parameter screenshot of the GRF4003 LNA/Driver optimized for 400 to 1000 MHz, or a fractional bandwidth of about 85%.

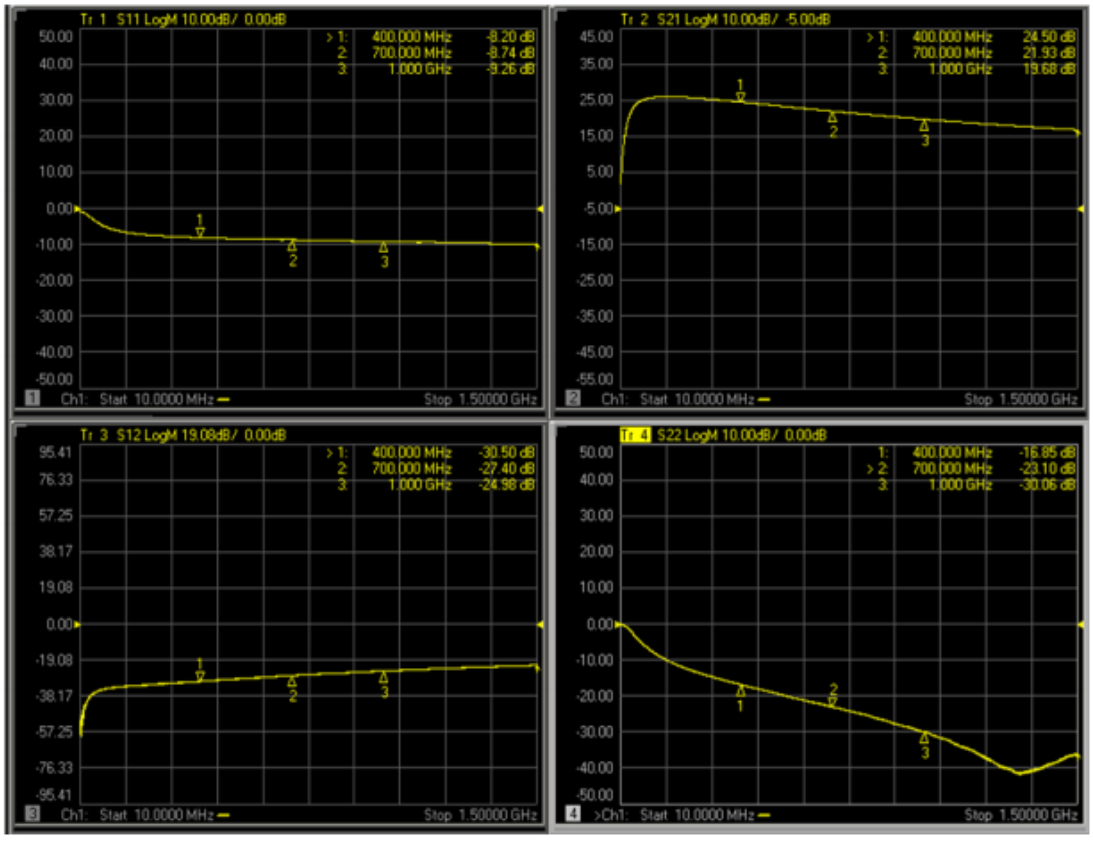

Figure 1. GRF4003 S-Parameter Responses

As you can see, the output return loss is very good across the band, but the input return loss is only around 8.5 dB and the gain roll-off is almost 5 dB.

The evaluation board schematic shows the driver solution with a shunt RL added to the device input. This configuration selectively loads the low end of the band more than the high end, so it should enhance the gain flatness with an S(1,1) improvement as well.

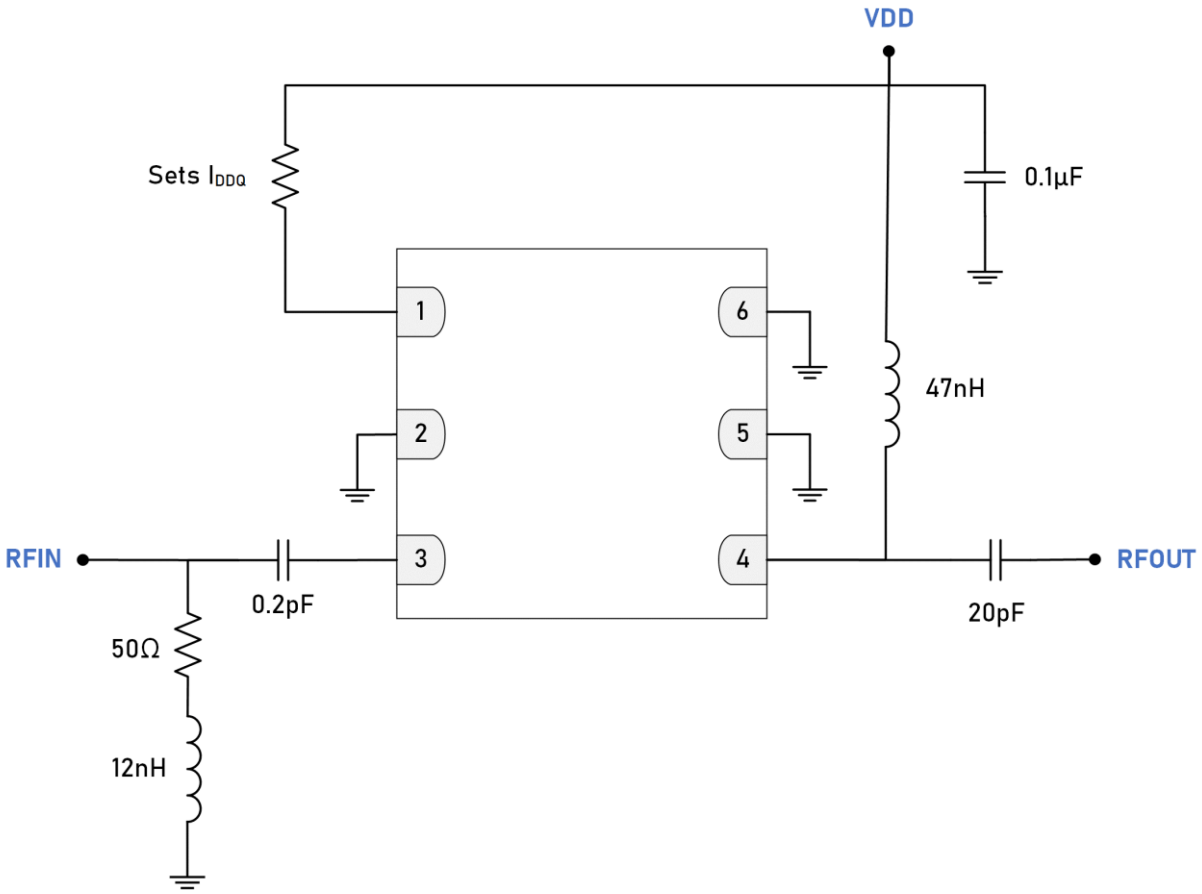

Figure 2. GRF4003 Evaluation Board Schematic (400-1000MHz Tune)

Below are the evaluation board results using the frequency selective resistive loading on the input. Notice how both the gain flatness and the input return losses are both improved significantly.

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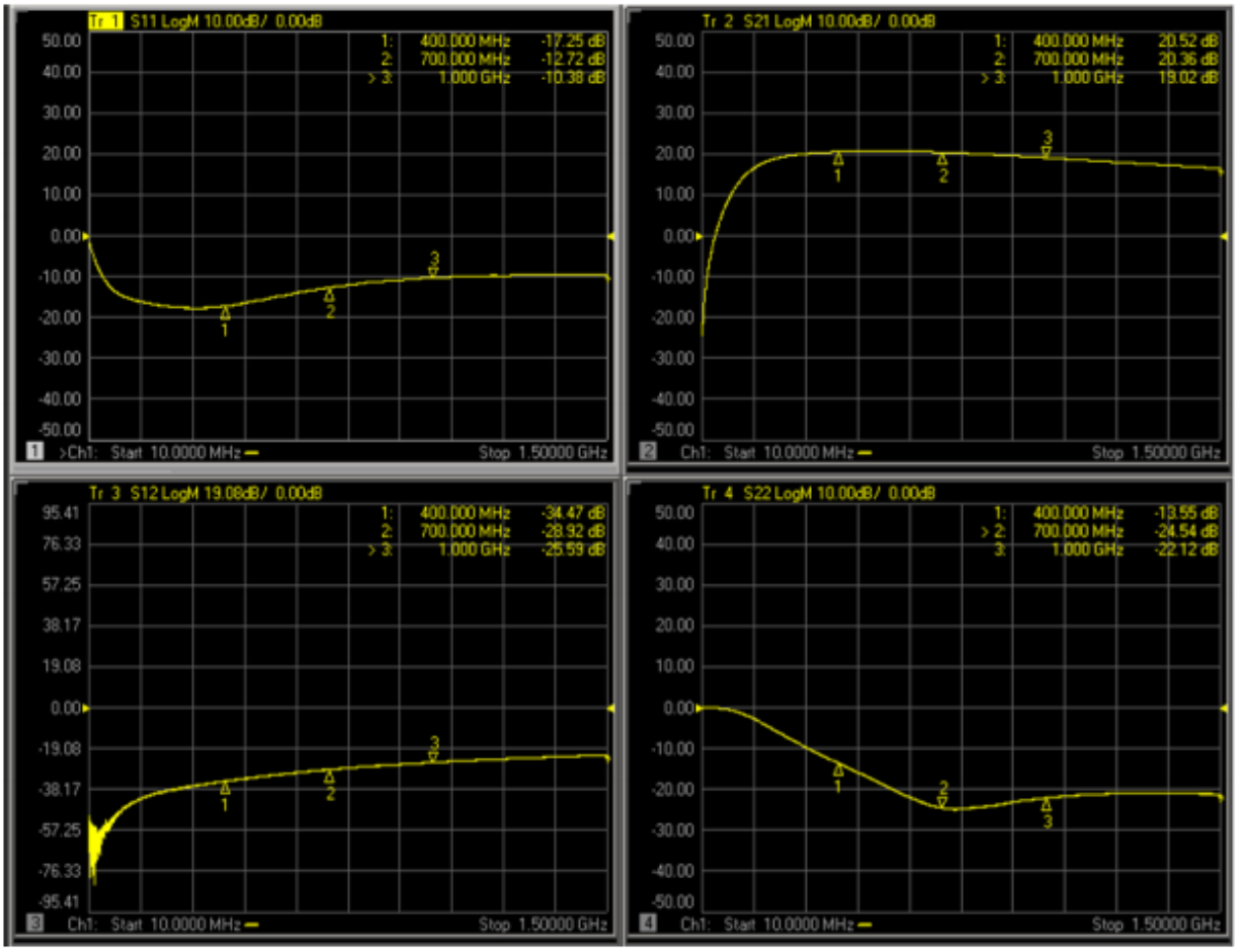

Figure 3. GRF4003 S-Parameters for App Circuit with Frequency-Selective Resistive Loading on the Input

Had this been an LNA application instead of a transmit driver, the shunt RL network could have simply been placed on the output side of the device with no impact on the input-referenced linearity. Due to the high gain of the device, this resistive loading on the output would have resulted in essentially no noise figure degradation.

Please take a look at our excellent LNA/Driver offerings and contact our applications team at applications@guerrilla-rf.com with any questions!

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Revision History

Revision	Date | Reason for Revision
Initial Release	September 1, 2020