Application Note

Designing an Amplifier Lineup for SDARS Applications

AN009

Guerrilla RF offers a variety of automotive SDARS 2320 to 2345 MHz LNA solutions. Here is a brief overview where we focus on the input SAW filter and stage 1 LNA characteristics.

From an LNA design standpoint, the critical requirements are as follows:

1) Gain
2) Noise Figure (NF)
3) IMRR Rejection
4) Blocker Rejection

None of the above requirements are difficult to optimize on their own, but simultaneously satisfying items 2, 3 and 4 is quite difficult. The satellite radio LNA specification defines two general classes of LNAs as follows:

Case 1: **LNA *with* co-located cellular transmitter element within the antenna module**

This is the most common automotive application that we see at Guerrilla RF and it is the most demanding in terms of RF performance. The fundamental design issue is maintaining the sub-1.0 dB cascaded NF while meeting the +10 dBm blocker requirements. This blocker requirement drives the need for a second SAW filter which must be placed before the first LNA. Due to the filter loss and its negative effect on the cascaded NF, the stage 1 LNA must be state-of-the-art in terms of gain and NF in order to pass the NF specification.

The rub here is that higher out-of-band (OOB) rejection from the input SAW device goes along with higher insertion loss in the passband. This high OOB rejection is critical in obtaining the best possible blocker performance from the LNA. Note that this is the same OOB rejection that makes passing the IMRR requirements relatively easy.

GRF2093 (DFN-6) / GRF2074 (DFN-8) offer the industry's best combination of ultra-low NF along with high gain. These characteristics allow the use of the optimal input SAW for the best possible combination of NF and blocker/IMRR performance. This is the highest performance architecture available.

Case 2: LNA *without* co-located cellular transmitter element within the antenna module

In this use case, the SDARS LNA is situated in an environment **without** a co-located cellular or WLAN transmitter, and is subject to a lower blocker requirement (-10 dBm instead of +10 dBm). This makes possible a cost-reduced, single-SAW LNA architecture. Guerrilla RF has reference designs available to support these case 2 applications with flexible levels of gain and sub-1.0 dB NF. (See App Note AP010 for additional details on this specific reference design.)

Without a SAW filter on the input of the first LNA, discrete LC filtering is required to satisfy the IMRR2 and IMRR3 requirements, and these discrete components are included in the reference designs. Our GRF2071, GRF2072, GRF2073 and GRF2074 / GRF2093 devices provide a range of gain levels to address any application requirement while achieving excellent NF.

Note regarding cascaded LNA gain: Since all of Guerrilla RF's stage 1 LNA offerings have high gain over the 2320 to 2345 MHz SDARS band, choosing the ideal stage 2 LNA is relatively easy. We have many offerings from which to choose: GRF2106, GRF4002, GRF4014, and the entire GRF207X family of devices. Regardless of the specific cascaded gain requirement, we have the ideal device to use for your stage 2 LNA.

No matter how challenging your technical requirements, Guerrilla RF is committed to providing the highest performance RF solutions and applications support necessary to make your product a success.

Contact us at applications@guerrilla-rf.com or sales@guerrilla-rf.com!

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Revision History

Revision	Date | Reason for Revision
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