THALIA
DESIGN AUTOMATION LTD

CUSTOMER CASE STUDY - DESIGN CENTERING OF AN LNA

DESIGN ENABLER - CENTER A LOW NOISE AMPLIFIER (LNA) AND GENERATE A LOWER POWER DESIGN

Thalia's AMALIA™ design automation flow and deep experience of RF design enabled design centering of an LNA circuit, with a saving in design time of more than 50%. Thalia provided the customer with a choice of design solutions and new product features. In addition, the new design met demanding 3rd order intermodulation product requirements, and allowed the customer to reduce current consumption by around 17%.

Business issue and need

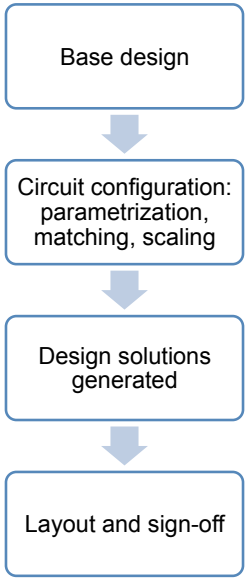
Low noise amplifiers (LNAs) are fundamental building blocks of communication systems and instruments. The four important parameters in LNA design are: gain, noise figure, non-linearity and impedance matching. The function of the LNA is to take the extremely weak and uncertain signal from the antenna, usually on the order of microvolts or under -100 dBm, and amplify it to a more useful level, usually about one-half to one volt.

LNA circuit design is a very time-consuming exercise and requires RF design expertise. Typical timelines to re-design an LNA are more than 4-6 person-weeks (and in some cases much longer).

Thalia's customer had an existing IP in-house, which did not meet 3rd order intermodulation product requirements; the customer also needed to reduce the current consumption. The existing IP was targeted at SMIC's 40nm process.

The customer requested Thalia deliver a set of solutions that addressed the design issues they were facing. The customer's design flow for this effort was to select from the Thalia solutions generated with Thalia's AMALIA™ design automation flow and if required, add additional design features.

This methodology was deployed instead of redesigning the existing LNA to improve the efficiency of the design team and speed up the design process.

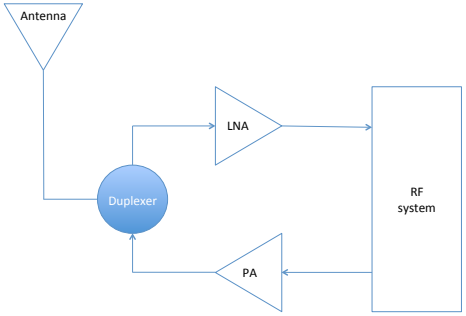


Thalia's solution

Thalia deployed an experienced RF design engineer to identify key design components within the LNA that impacted the current consumption and 3rd order intermodulation product (IM). The designer also identified components that needed to be configured before the AMALIA automated analog design flow could be deployed.

This effort entailed components like differential pairs, current mirrors, loads matched, scaled and parametrized in line with circuit functionality.

AMALIA incorporated this circuit information and leveraged an industry standard simulator - Mentor Graphics's Eldo and Eldo RF - to identify potential design solutions.



The design enablement using Thalia's technology allowed the new LNA design to be delivered in less than two weeks, a saving of more than 50% in design time.

The new design also enabled a significant improvement in performance with respect to power consumption, saving around 17% in active current draw.

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LNA CASE STUDY

Summary and conclusion

Thalia deployed an experienced RF Designer and AMALIA design enabler technology to enhance and re-center the customer's existing LNA offering.

Thalia's proposed solutions met all the design requirements and reduced the current consumption by about 17%.

More than 10 candidate solutions were generated using Thalia's technology and design flow and saved the customer more than 50% in design time.

Specification		Min	Typ	Max	Unit	Base Design	Low Power
Supply Voltage		1.08	1.2	1.32	V	1.2	1.2
Temperature			27		°C	27	27
Operating Current			4	5	mA	4.2	3.5
Differential Voltage Gain		18		23	dB	20.6	22.4
Spot Noise Figure			4.8	5.5	dB	4.9	5.5
3rd order Intermodulation Product	Input -40dBm			-10	dB	-14.9	-19.3
3rd order Intermodulation Product	Input -35dBm			-10	dB	-14.9	-18.9
3rd order Intermodulation Product	Input -30dBm			-10	dB	-15.1	-17.7
3rd order Intermodulation Product	Input -20dBm			-10	dB	-8.0	-12.6
3rd order Intermodulation Product	Input -10dBm			-10	dB	-4.3	-11.6
Input Impedance		5 - 24j		15 + 24j	Ω	12.2 - 23.7j	9.9 - 17.2j
Loop Gain (Feedback Loop 1)		0	4		dB	3.5	16.8
Phase Margin (Feedback Loop 1)		60		100	degrees	100.2	68.4
Loop Gain (Feedback Loop 2)		0	8		dB		
Phase Margin (Feedback Loop 2)		-45	50	100	degrees	52.1	101.1
Transient Step Response (Input)				200	µV	-27.0	48.5
Transient Step Response (Supply)				200	µV	-44.8	11.6
Area					µm²		16,616

THE THALIA APPROACH

Thalia's approach to customers' analog and mixed signal design projects combines the experience and expertise of our design team, with the use of AMALIA - our proprietary and highly innovative design automation technology.

Our unique combination of expertise and analog design automation allows us to cost-effectively undertake development projects on behalf of our customers, with multiple benefits:

- Faster project turnaround
- More cost-effective than using customers' internal engineering resource
- Allows internal teams to focus on innovation and value-add

The AMALIA design enabling software:

- Assists in porting of schematics from one technology to another
- Supports our design team in validating and centering their design post migration
- Enables the generation of circuit variants: eg low power, different loads, or area-optimization
- Enables rapid qualification of the circuit topology in a new process node
- Facilitates analysis and understanding of the impact of trading off circuit characteristics

AMALIA integrates with Cadence® and Mentor® design flows, and leverages industry standard simulators such as Spectre, APS, Eldo and AFS.

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