Keywords: lna, low noise amplifier, 315MHz, front end, ic, feic, keyless entry, ism, 2640, 2641, rf, rfic, wirless, rf ics, radio frequency, rfics, automotive keyless entry

APPLICATION NOTE 2241

MAX2640 LNA Operates at 315MHz for Automotive Keyless Entry Applications

Sep 22, 2003

Abstract: The MAX2640 low-cost, ultra low-noise amplifier (LNA) was originally characterized over the 400MHz to 2500MHz range. The device has also proven useful at 315MHz for keyless entry applications. Testing has shown that the part can typically achieve 16dB gain and 1.3dB noise figure at 315MHz, while consuming only 3.5mA from a single 2.7 to 5V supply.

General

Click here for an overview of the wireless components used in a typical radio transceiver.

The MAX2640 low cost, ultra-low noise amplifier was designed for operation in the cellular, PCS, GPS, and 2.4GHz ISM Bands. It operates from a single 2.7 to 5.5V supply and typically consumes only 3.5mA of current. Offered in a 6-pin SOT23 package, it is ideal for portable devices where PCB space is at a premium.

Originally characterized over the 400MHz to 2500MHz range, the device has also proven useful at 315MHz for keyless entry applications. Maxim has recently tested the IC for this extended frequency range with promising results. The data presented here will demonstrate the IC's ability to function well at 315MHz, with typical gain of approx. 16dB, and a 1.3dB noise figure.

Objective

Optimize the MAX2640 EVKit for 315MHz operation, and demonstrate selected operating characteristics over a statistical sample.

Results

A standard evaluation kit was obtained and modified as shown in the schematic in **Figure 1**. The modifications require positioning of Z1a and Z1b on the pads for Z1. See **Figure 2** for detailed component placement information.

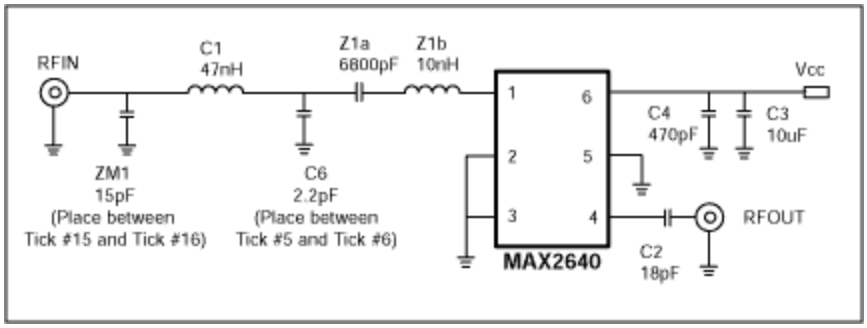

Figure 1.

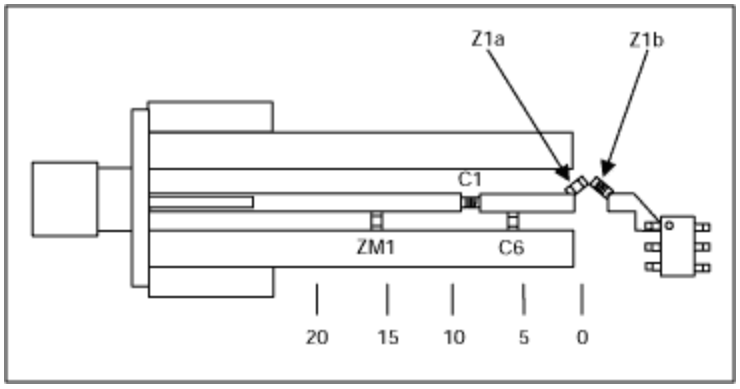

Figure 2.

Key parameters were measured, and the results are shown in Table 1 (Board 'A'). A second board (Board 'B') was modified to the same schematic and displayed similar results. A plot of return-loss and gain is shown in **Figure 3**.

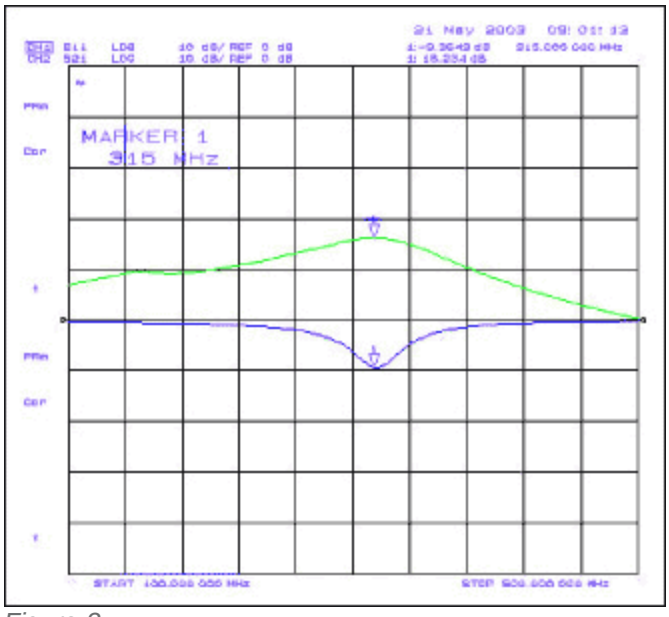

Figure 3.

Table 1.
V_{CC} = 3.0Vdc

Fin = 315MHz
Ta = 25°C

Parameter	Measured	
	(Board A)	(Board B)
S11 (dB)	-9.2	-10.0
S21 (dB)	17.2	16.5
S12 (dB)	>50	>50
S22 (dB)	-13.1	-13.4
Supply Current (mA)	3.6	3.3
Input 1dB Compression Point (dBm)	-27	-28
Input IP3 (dBm)	-17.4	-18.1
Noise Figure (dB)	1.8	1.7

After the initial tuning measurements, the same parameters were tested over an additional 30 IC's. The actual and averaged data from these tests is shown in Tables 2 and 3 respectively. This data demonstrates that the IC is very capable of operating at 315MHz with only slight application circuit adjustments.

Table 2
V_{CC} = 5V
Fin = 315MHz
Ta = 25°C

Parameter / IC#:	Icc(mA)	S11(dB)	S21(dB)	S12(dB)	S22(dB)	NF(dB)	IIP3(dBm)	P1dB(dBm)
01	3.38	-9.06	15.60	-70.0	-13.56	1.32	-17.48	-28.80
02	3.62	-8.54	16.26	-59.70	-13.30	1.28	-17.79	-28.60
03	3.57	-9.30	15.98	-60.00	-13.00	1.36	-17.53	-28.80
04	3.54	-8.91	15.42	-59.50	-14.50	1.28	-17.74	-28.80
05	4.00	-8.32	17.14	-59.27	-13.10	1.29	-17.00	-28.20
06	3.52	-9.01	15.96	-65.00	-13.71	1.30	-17.24	-28.70
07	3.59	-8.60	16.08	-65.00	-13.83	1.30	-17.16	-28.60
08	3.67	-9.23	16.44	-64.89	-13.89	1.30	-17.44	-28.80
09	3.50	-8.89	15.76	-65.00	-13.70	1.31	-16.85	-28.80
10	3.45	-9.58	15.86	-65.00	-13.83	1.30	-17.31	-28.80
11	3.55	-9.09	15.95	-66.00	-13.68	1.31	-17.28	-28.80
12	3.63	-9.10	16.25	-67.00	-13.98	1.32	-17.08	-28.60
13	3.63	-9.48	16.30	-67.90	-13.65	1.33	-17.25	-28.70
14	3.69	-9.52	16.38	-68.90	-13.70	1.34	-17.07	-28.60
15	3.54	-8.97	15.94	-67.40	-13.64	1.29	-17.20	-28.70
16	3.69	-8.98	16.40	-69.90	-13.71	1.28	-16.99	-28.70
17	3.49	-9.27	15.91	-70.00	-13.85	1.32	-17.25	-28.70
18	3.47	-9.31	15.99	-68.00	-13.73	1.32	-17.37	-28.80
19	3.50	-9.23	15.98	-68.70	-13.78	1.30	-17.44	-28.70

20	3.50	-8.81	15.98	-71.50	-13.80	1.29	-17.35	-28.70
21	3.68	-9.03	16.35	-70.00	-13.63	1.30	-17.08	-28.60
22	3.50	-9.10	15.97	-71.00	-13.94	1.30	-17.28	-28.70
23	3.56	-9.32	16.19	-70.00	-13.78	1.31	-17.33	-28.70
24	3.63	-9.26	16.30	-70.00	-13.82	1.32	-17.22	-28.70
25	3.55	-8.59	16.10	-68.70	-13.65	1.26	-17.45	-28.60
26	3.42	-8.97	15.76	-71.40	-13.65	1.32	-17.41	-28.80
27	3.72	-9.34	16.44	-70.50	-13.96	1.32	-16.83	-28.60
28	3.58	-9.52	16.20	-71.20	-13.69	1.34	-17.23	-28.70
29	3.58	-9.40	16.17	-70.00	-13.77	1.32	-17.23	-28.60
30	3.49	-8.95	15.84	-70.23	-13.67	1.31	-17.29	-28.70

Table 3
V_{CC} = 5V
Fin = 315MHz
Ta = 25°C

Parameter	Average (30pcs.)	Standard Deviation
S11 (dB)	-9.08	0.31
S21 (dB)	16.10	0.30
S12 (dB)	-67.52	3.60
S22 (dB)	13.72	0.25
Noise Figure (dB)	1.31	0.02
Input IP3 (dBm)	-17.24	0.23
Input P1dB (dBm)	-28.68	0.11

Related Parts	
MAX2640	300MHz to 2500MHz SiGe Ultra-Low-Noise Amplifiers

More Information
For Technical Support: http://www.maximintegrated.com/support
For Samples: http://www.maximintegrated.com/samples
Other Questions and Comments: http://www.maximintegrated.com/contact

Application Note 2241: http://www.maximintegrated.com/an2241
APPLICATION NOTE 2241, AN2241, AN 2241, APP2241, Appnote2241, Appnote 2241