PHILIPS

High IP3 MMIC LNA at 900 MHz

Application note for the BGA2011

The BGA2011 is a MMIC LNA for cellular applications at 900 MHz that require good linearity, like CDMA. The MMIC is produced by the single metal DPO Philips process and is packaged in a 6-pin SOT363. The circuit is equipped with control pin that can set the amplifier to low current-low noise mode or to high current-high linearity mode and/or disable (off) mode. This report describes an application in which the LNA can be tuned for gain and input IP3. At 900 Mhz, the input IP3 is adjustable between 2 dBm at 19 dB gain and 7 dBm at 16 dB gain.

Circuit description

The LNA consists of one RF stage. The RF transistor is biased with a controlled bias circuit that can set the collector current of RF transistor to the desired value. The trade-off between noise/linearity and current consumption can be found by setting the collector current of RF transistor. In this way it is possible to make a low noise mode and a high linearity mode. Moreover, the control pin serves as an enable/disable pin that can switch the supply current off.
In order to increase the linearity of LNA, a series feedback has to be introduced, made by stripline, from the emitter of the RF transistor to ground.

Measured results

conditions:
demo board without u-stripline (0 mm)
freq=900 MHz; Vsupply= 3V; temp=25 deg

Vc	Isupply	S21	Input return loss	Output return loss	IIP3	NF	Pout$_{1db\ compression}$
[V]	[mA]	[dB]	[dB]	[dB]	[dBm]	[dB]	[dBm]
1.0	1.4	11.9	4.3	5.4	-21	1.1	-17
1.4	3.5	16.6	8.7	8.1	-9	1.3	-9
1.6	4.6	17.5	10.0	8.9	-6	1.3	-6
1.9	6.5	18.3	11.1	10.2	-5	1.4	-2
2.3	11.1	19.0	11.3	11.4	+2	1.5	+3
2.7	13.9	19.1	11.2	11.8	+3	1.6	+6
3.0	15.5	19.2	11.2	12.0	+4	1.7	+7

conditions:
demo board with 1.5 mm u-stripline
freq=900 MHz; Vsupply= 3V; temp=25 deg

| Vc	Isupply	S21	Input return loss	Output return loss	IIP3	NF	Pout$_{1db\ compression}$
[V]	[mA]	[dB]	[dB]	[dB]	[dBm]	[dB]	[dBm]
1.0	1.4	10.3	6.9	6.8	-9	1.1	-16
1.4	3.5	13.8	14.6	9.5	-2	1.4	-7
1.6	4.6	14.4	18.0	10.4	+1	1.4	-5
1.9	6.5	15.1	21	11.3	+4	1.5	-2
2.3	11.1	15.7	18.6	12.7	+7	1.6	+4
2.7	13.9	15.8	17.7	13.0	+8	1.7	+7
3.0	15.5	15.8	17.4	13.1	+8	1.8	+8

note:
IIP3 - input IP3 measured with Δf=100 kHz and Pin<-28 dBm
Isupply - is a total supply current from 3 Volt supply source

Application diagram
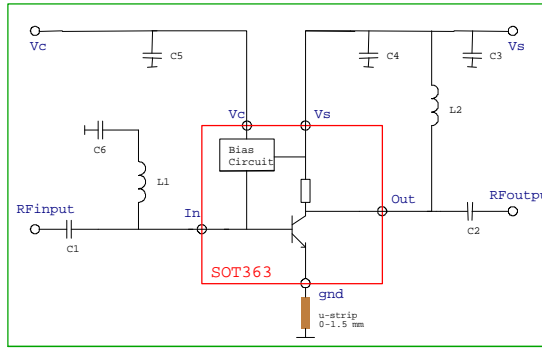
Demo board
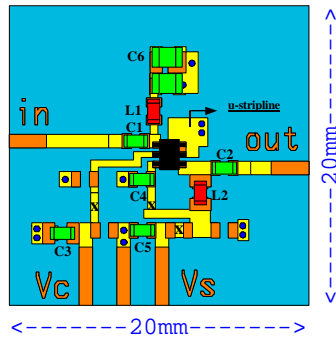
Component	Value	Typ
C1	100 pF	Philips 0603
C2	100 pF	Philips 0603
C3	22 nF	Philips 0603
C4	5.6 pF	Philips 0603
C5	22 nF	Philips 0603
C6	2x 100 nF	Philips 0805
L1	10 nH	TDK 0603
L2	8.2 nH	TDK 0603

notes:
1. There are 4 types of demo board layouts available: no stripline (0 mm), 0.5 mm, 1.0 mm and 1.5 mm stripline; marked L0, L05, L10 and L15.
2. The u-stripline to ground is optimized for each length.
   For no stripline (0 mm), the metal under pin 5 and 6 is filled with vias to the ground plane to reduce inductance.
   For the stripline versions, the stripline ends in 2 vias.
3. The standard demo board also needs three 0 Ù SMD's (0603) at the spots marked with an X. Additional components to adjust the biasing can be placed at these spots.