

## Baseband power amplifier with attenuator

### SPECIFICATION

#### 1 FEATURES

- TSMC 65 nm CRN65LP
- Differential inputs, outputs
- High frequency 2 – 100 MHz
- Available attenuation range from 0 to 60 dB (step by 1 dB)
- Power amplifier with high IM3
- Maximum Output Power 14 dBm
- Supported foundries: TSMC, UMC, Global Foundries, SMIC

#### 2 APPLICATION

- PA signal processing

#### 3 OVERVIEW

PA consists of attenuator, 1-stage amplifier with tunable gain. Attenuator reduces output power by 1dB from 0 to 60 dB. The amplifier gain is adjustable in increments of 2 dB.

#### 4 STRUCTURE

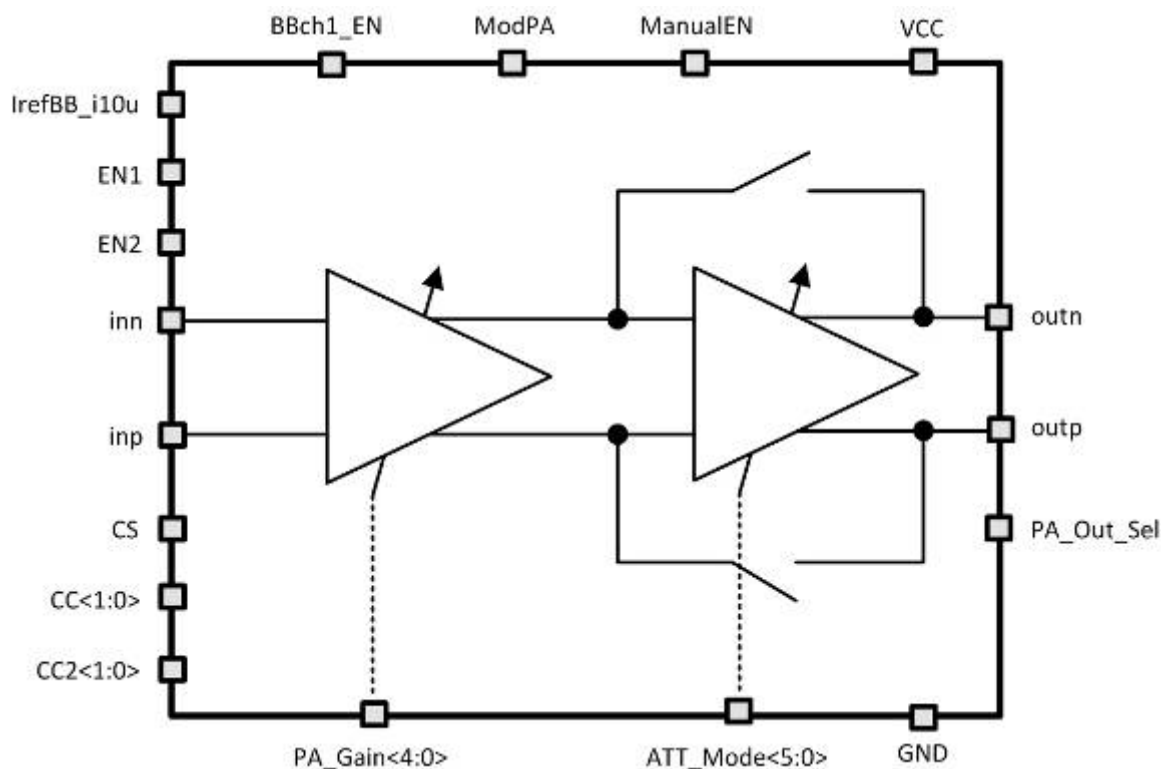


Figure 1: Baseband power amplifier with attenuator structure.

## 5 PIN DESCRIPTION

Name	Direction	Description
IrefBB_i10u	I	PA reference current 10 $\mu$ A
EN1	I	1 <sup>st</sup> current mirror enable/disable
EN2	I	2 <sup>nd</sup> current mirror enable/disable
inp	I	Attenuator differential input
inn	I	
BBch1_EN	I	PA enable
ModPA	I	PA gain control mode
GC_MD	I	Manual mode gain control (if ModPA = "1")
CS	I	Current mirror mode selection
CC1<1:0>	I	1 <sup>st</sup> reference current control
CC2<1:0>	I	2 <sup>nd</sup> reference current control
ATT_Mode<5:0>	I	Attenuator level select
PA_Out_sel	I	Output transistor size select
PA_Gain<4:0>	I	PA gain control
outp	O	PA differential output
outn	O	
vcc	IO	Supply voltage
gnd	IO	Ground

## 6 LAYOUT DESCRIPTION

The block dimensions are given in the table 1.

**Table 1:** Block dimensions.

Dimension	Value	Unit
Height	280	$\mu\text{m}$
Width	950	$\mu\text{m}$

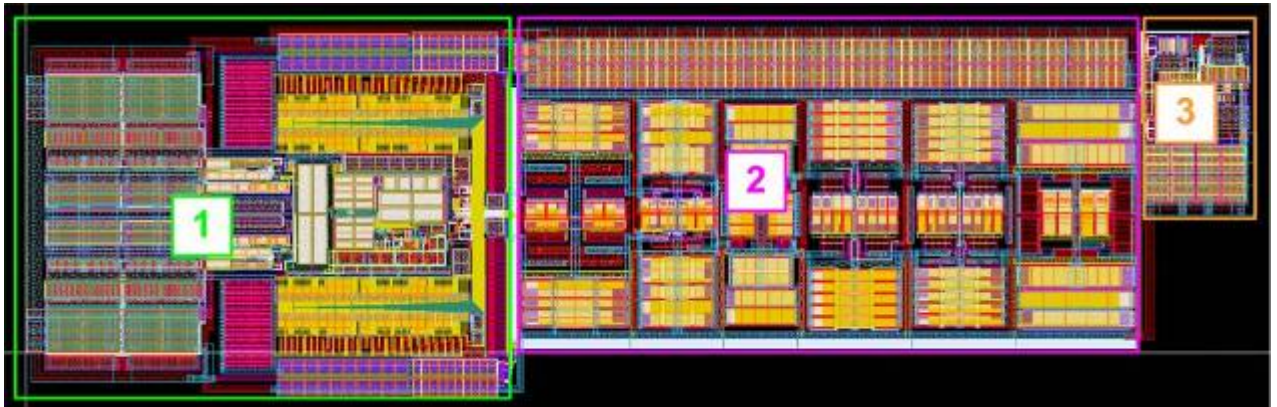


Figure 2: Device layout view.

1. Power amplifier
2. Attenuator
3. Bias

## 7 OPERATING CHARACTERISTICS

### 7.1 TECHNICAL CHARACTERISTICS

Technology \_\_\_\_\_ TSMC CMOS CRN65LP  
 Status \_\_\_\_\_ silicon proven  
 Area \_\_\_\_\_ 0.27mm<sup>2</sup>

### 7.2 ELECTRICAL CHARACTERISTICS

The values of electrical characteristics are specified for  $V_{cc} = 2.375 \div 2.625$  V and  $T = -40 \div +125^\circ\text{C}$ . Typical values are at  $V_{cc} = 2.5$  V,  $T_a = +85^\circ\text{C}$ , unless otherwise specified.

Parameter	Symbol	Condition	Value			Unit
			min	typ	max	
Supply voltage	$V_{cc}$		2.375	2.5	2.625	V
Temperature range	$T_a$		-40	+85	+125	$^\circ\text{C}$
Input power signal level	$P_{in}$			-11	-9	dBm
Current consumption	$I_{cc}$	$P_{out}=5\text{dBm}$	-	138	-	mA
Current consumption in standby mode	$I_{stb}$	-	-	180	-	nA
Pass band	F	-	2	-	100	MHz
Maximum output power	$P_{max}$	-	-	14.5	-	dBm
Minimum output power	$P_{min}$	-	-	-60	-	dBm
Attenuator gain control step	$A_k$	-	0.8	1	1.2	dB
PA gain control step	$P_k$	-	1.8	2	2.2	dB
Third order intermodulation	IM3	$P_{out}=5\text{dBm}$	-	54.34	-	dB
Input impedance	$R_{in}$	Differential	-	25	-	$\Omega$
Output impedance	$R_{out}$	Differential	-	25	-	$\Omega$
Input high-level voltage	$V_{IH}$	For digital input	$0.85V_{cc}$		$1.15V_{cc}$	V
Input low-level voltage	$V_{IL}$		-0.2	-	+0.2	V

## 8 TYPICAL CHARACTERISTICS

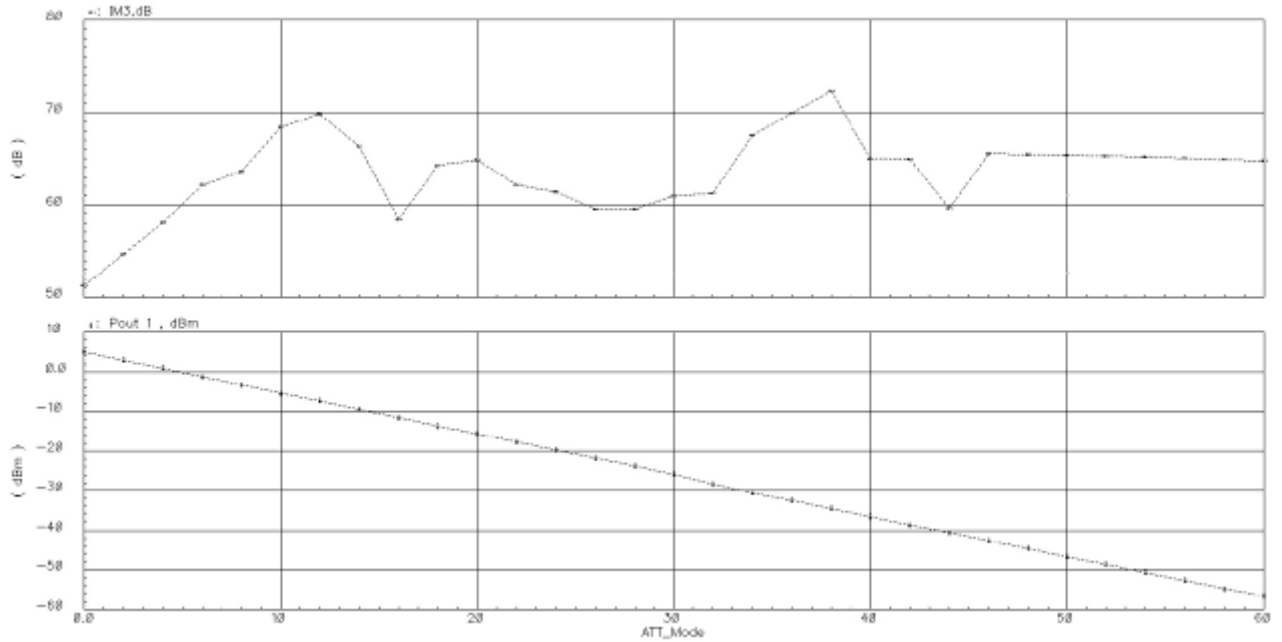


Figure 3: IM3 and output power vs attenuation code ( $ATT\_Mode_{dec}$ )

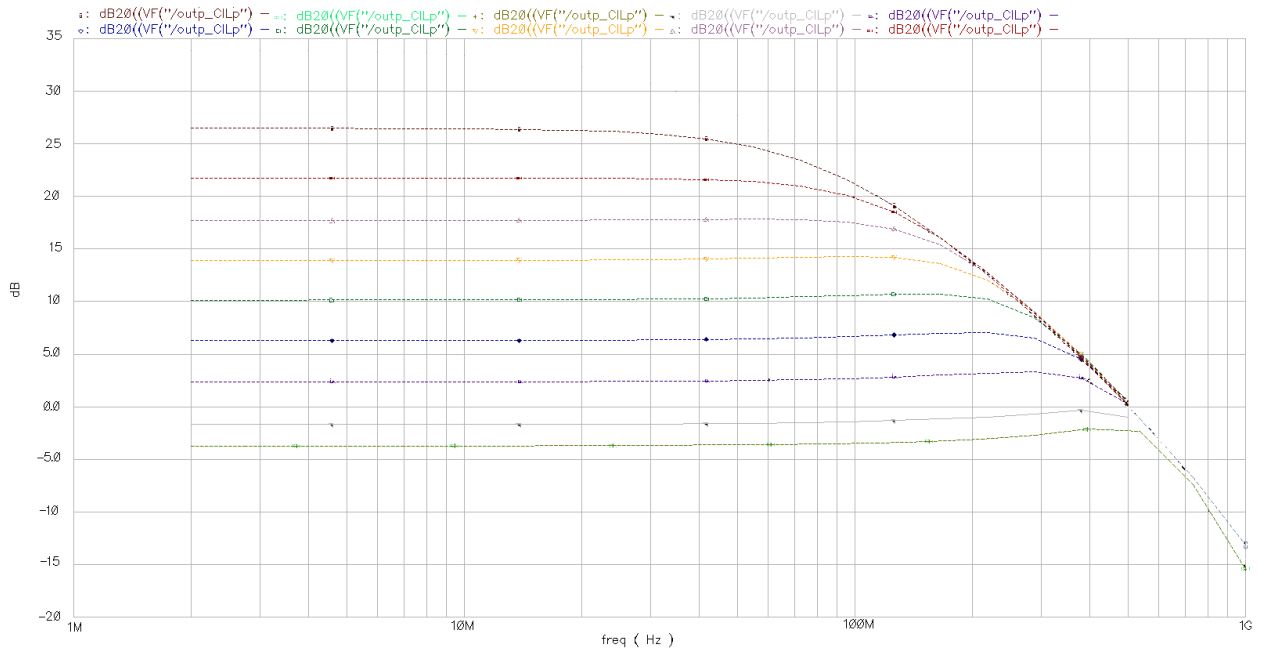


Figure 4: Frequency response ( $P_{in} = -9$  dBm and attenuator gain = -2 dB)

## 9 DELIVERABLES

IP contents:

- Schematic or NetList
- Layout or blackbox
- Extracted view (optional)
- GDSII
- DRC, LVS, antenna report
- Test bench with saved configurations (optional)
- Documentation