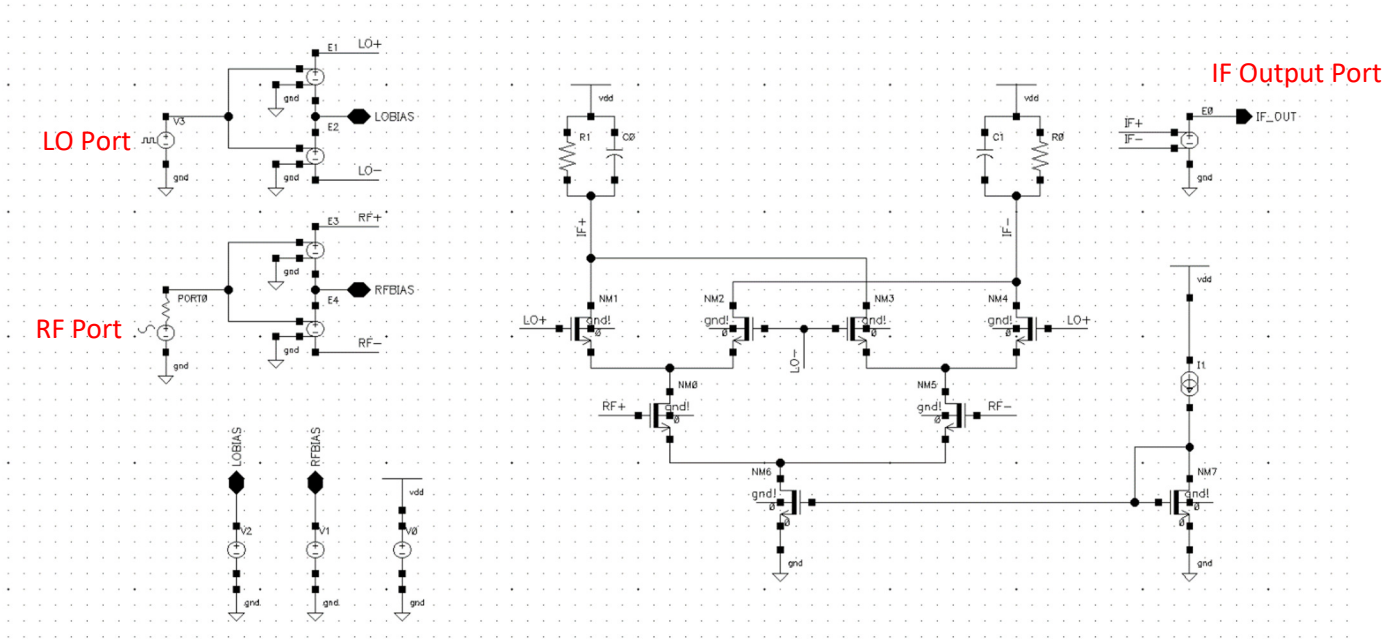


**EE230 – HW4 Report**  
**CMOS down-conversion Mixer**  
 (@ 1.9 GHz & using 45nm CMOS Technology)

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**1. Schematic Setup:**



**Fig. 1. Active Mixer schematic**

**Table 1. Transistor parameters**

Transistor	W [um]	L [um]	Multiplicity
NM7	10	0.6	2
NM6	15	0.6	20
NM0, NM5	50	0.6	10
NM1, NM2, NM3, NM4	15	0.15	10

**Table 2. Component values**

Component	Value
R0, R1	600 Ohms
C0, C1	200 fF
IBIAS	250 uA
LOBIAS	0.9 V
RFBIAS	0.7 V
VDD	1.8 V
E0, E1, E2, E3, E4	0.5 V/V

Table 3. RF port (left) & LO port (right) parameters

**Edit Object Properties**

Apply To:   Of:

Show: ☐ system ☒ user ☒ CDF

Property	Value	Display
Library Name	analogLib	off
Cell Name	psin	off
View Name	symbol	off
Instance Name	PORT0	off

Change All: ☐ User Property: ☐ Master Value: TRUE Local Value: Display: off

CDF Parameter	Value	Display
Frequency name	F1	off
Second frequency name		off
Noise file name		off
Number of noise/freq pairs	0	off
Resistance	50 ohms	off
Port number	1	off
DC voltage		off
Delay time		off
Sine DC level		off
Amplitude		off
Amplitude (dBm)	PRF	off
Initial phase for Sinusoid		off
Frequency	1.98 Hz	off
Amplitude 2		off
Amplitude 2 (dBm)		off
Initial phase for Sinusoid 2		off
Frequency 2		off
FM modulation index		off
FM modulation frequency		off
AM modulation index		off
AM modulation frequency		off
AM modulation phase		off
Damping factor		off
Multiplier		off
Temperature coefficient 1		off
Temperature coefficient 2		off
Nominal temperature		off
Noise temperature		off
AC magnitude		off
AC phase		off
XF magnitude		off
PAC magnitude		off
PAC magnitude (dBm)		off
PAC phase		off
Number of Frequencies	0	off
Number of FM Files	<input checked="" type="radio"/> none <input type="radio"/> one <input type="radio"/> two	off
Source type	sine	off

**Edit Object Properties**

Apply To:   Of:

Show: ☐ system ☒ user ☒ CDF

Property	Value	Display
Library Name	analogLib	off
Cell Name	vpulse	off
View Name	symbol	off
Instance Name	V3	off

Change All: ☐ User Property: ☐ Master Value: TRUE Local Value: Display: off

CDF Parameter	Value	Display
Frequency name for 1/period	F2	off
Noise file name		off
Number of noise/freq pairs	0	off
DC voltage		off
AC magnitude		off
AC phase		off
XF magnitude		off
PAC magnitude		off
PAC phase		off
Voltage 1	500.0m V	off
Voltage 2	-500m V	off
Period	500p s	off
Delay time		off
Rise time	10p s	off
Fall time	10p s	off
Pulse width	230p s	off
Temperature coefficient 1		off
Temperature coefficient 2		off
Nominal temperature		off
Type of rising & falling edge		off

## 2. DC operating points:

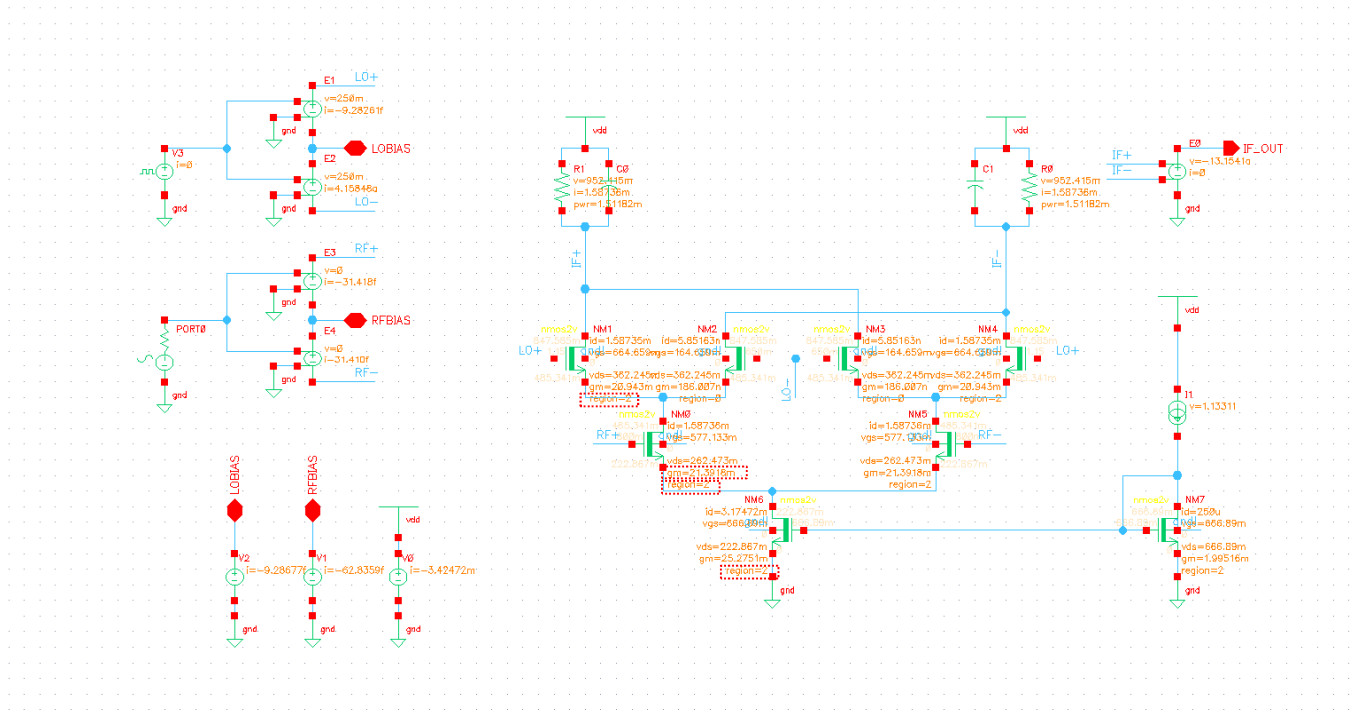


Fig. 2. DC operating points (after running dc analysis)

## 3. PSS Simulation:

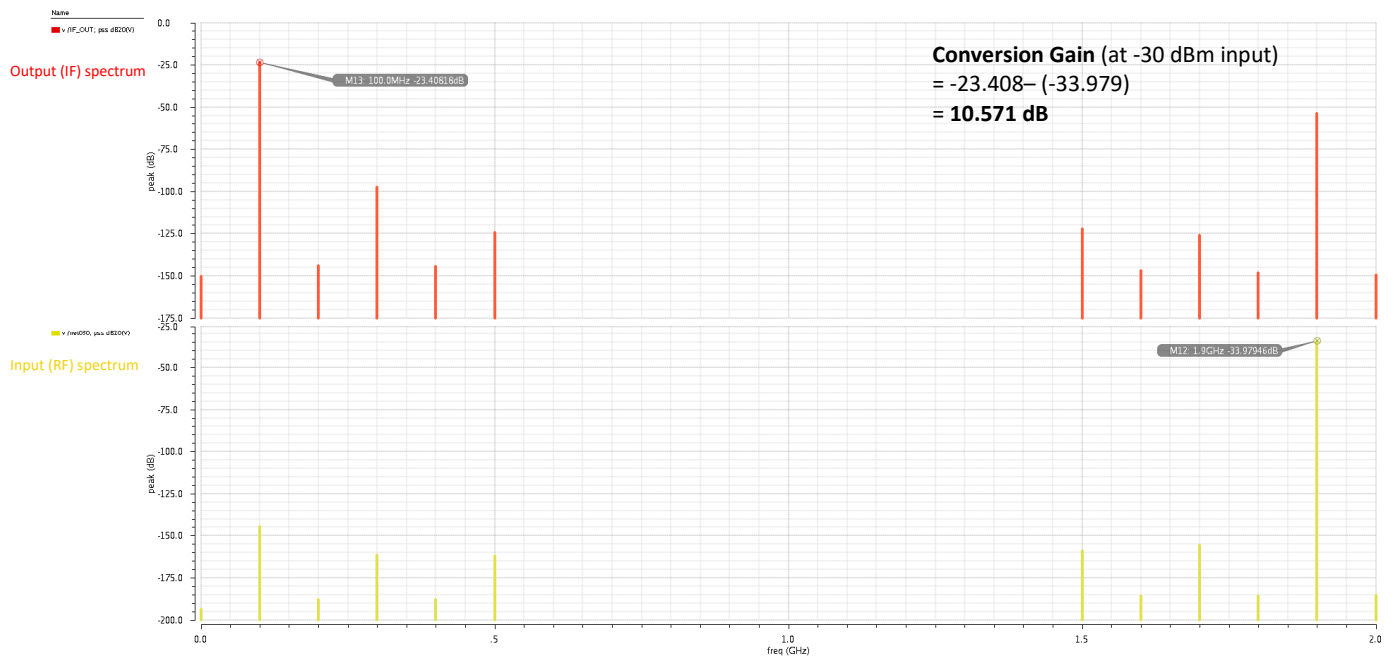
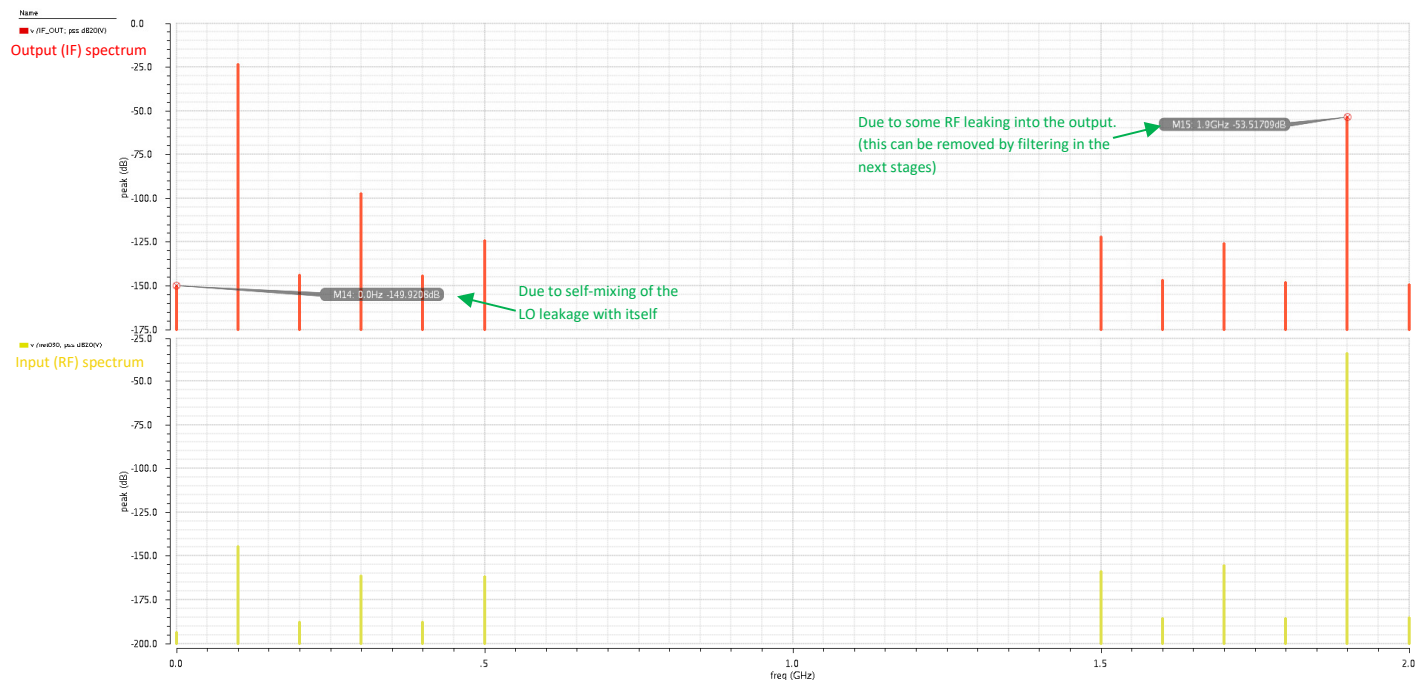


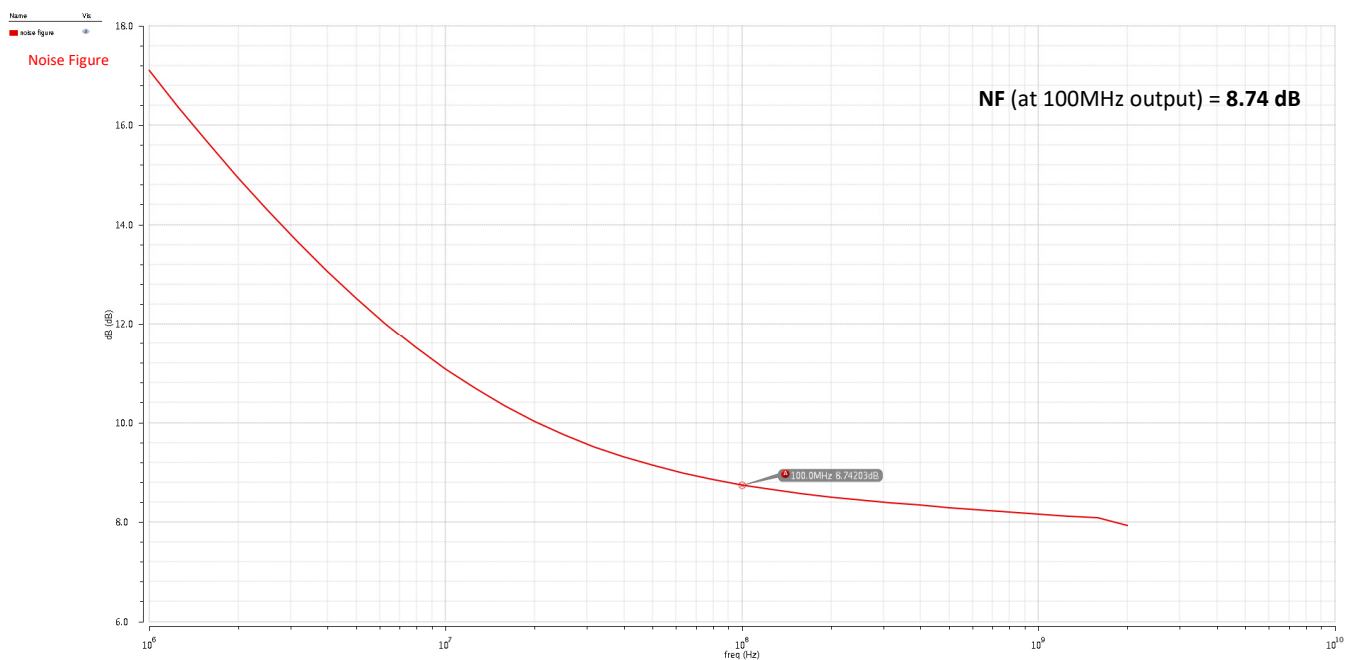
Fig. 3. Output & Input Spectrum



**Fig. 4. Undesired Output Spectrum**

#### 4. PNoise Simulation:

5.



**Fig. 5. Noise Figure of the Mixer**

## 6. SPSS Simulation:

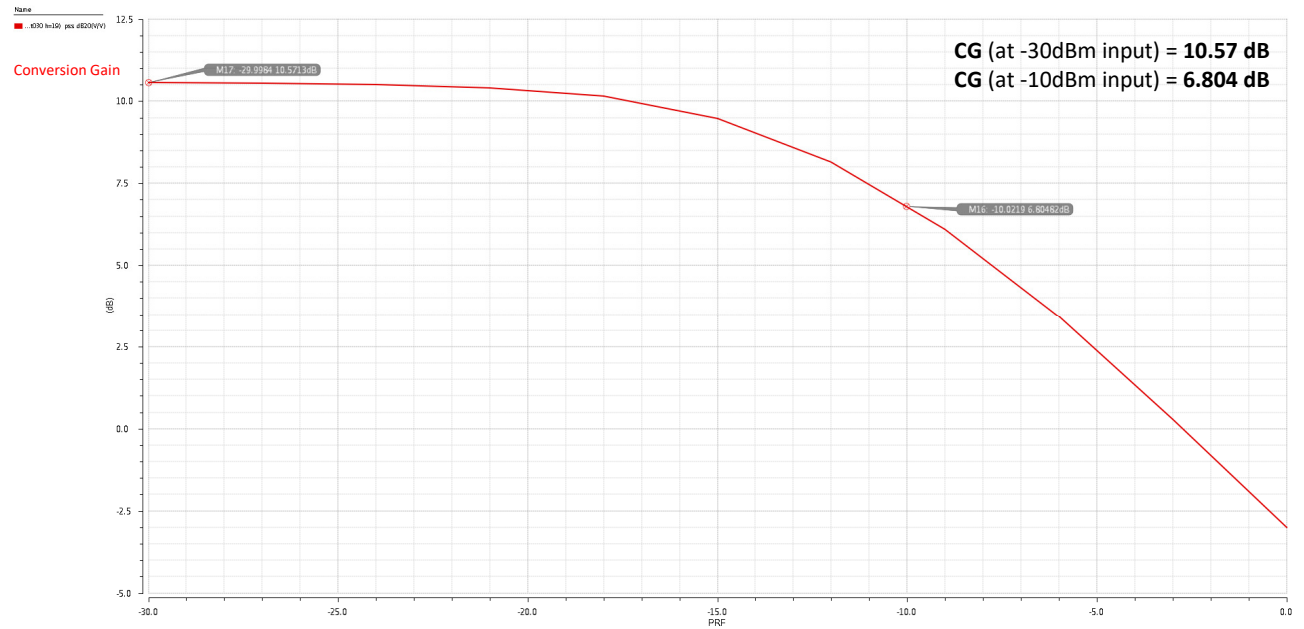


Fig. 6. Conversion Gain Vs Input Power

## 7. QPSS & QPAC Simulation:

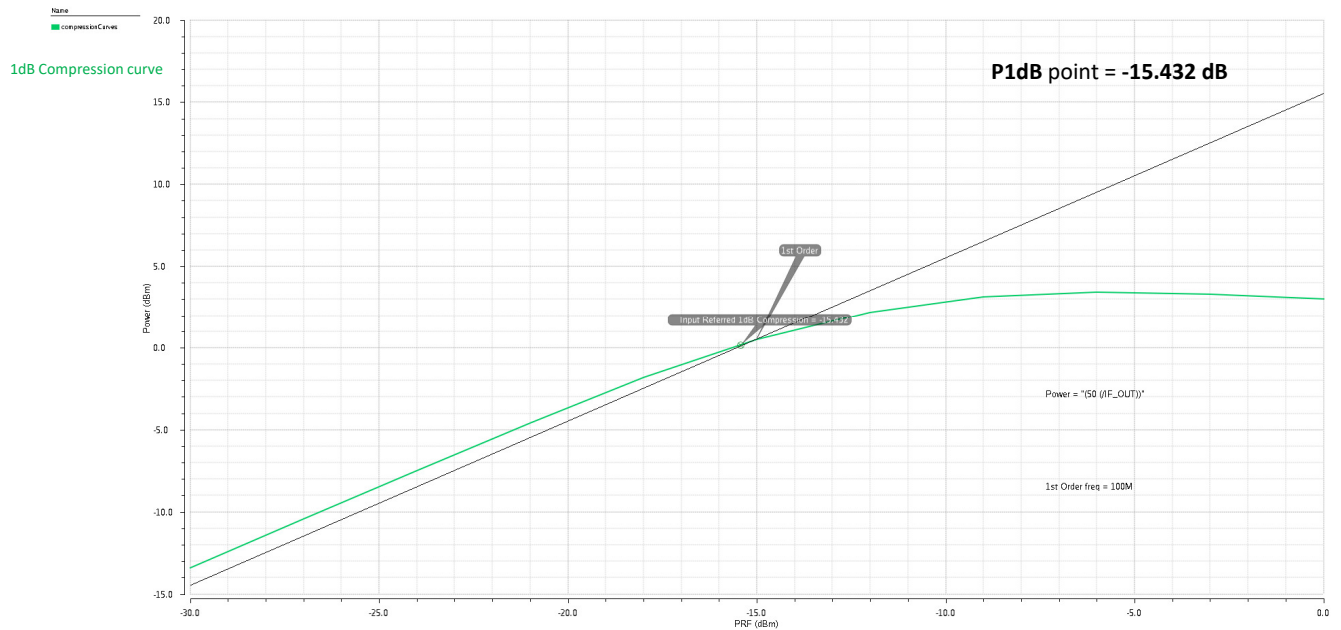
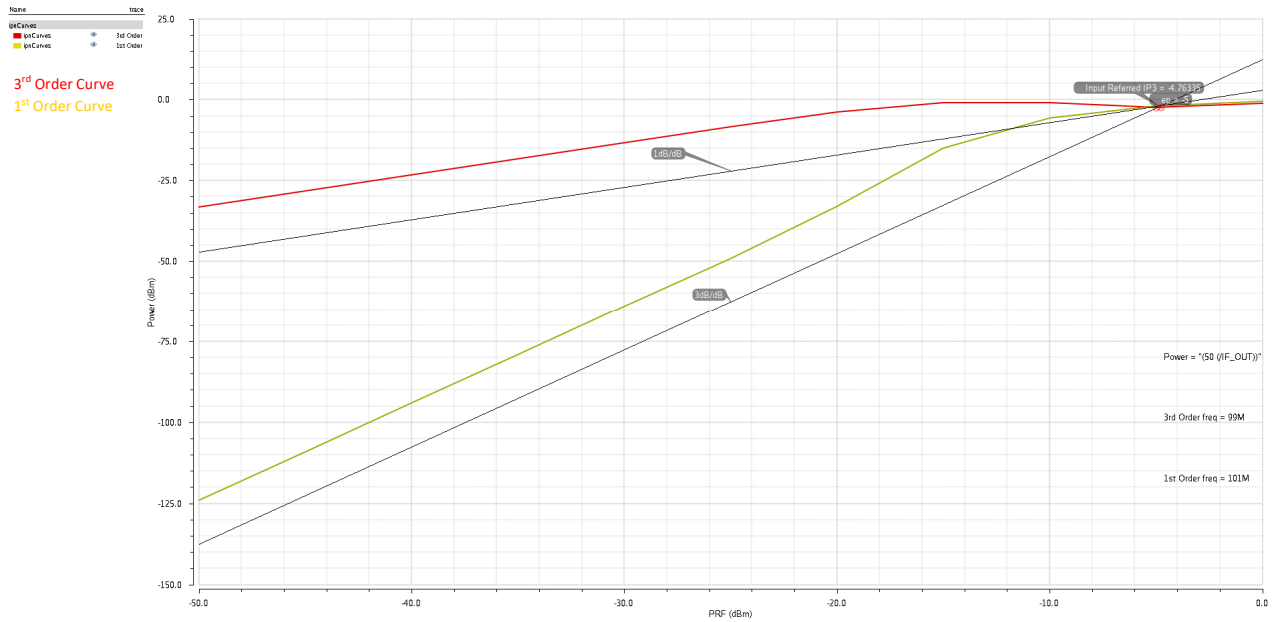


Fig. 7. Output Power Vs Input Power  
(Compression curve)



**Fig. 8. Fundamental & 3<sup>rd</sup>-order Output Power Components Vs Input Power from the 2-tone test (IPN curves)**

## 8. Summary of the results:

Parameter	Value
Power Dissipation	3.42 mA * 1.8 V = <b>6.16 mW</b>
Conversion Gain (@ -30 dBm)	<b>10.57 dB</b>
Noise Figure	<b>8.74 dB</b>
P1dB Compression Point	<b>-15.43 dBm</b>
IIP3	<b>-4.76 dBm</b>