Design of a “line –up” for N-CDMA

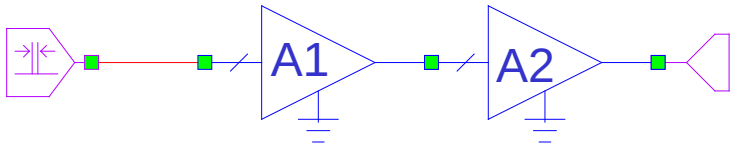
General Specifications

- Center Frequency: 1960 MHz, Band : 1930-1990 MHz
- Channel band: 1.2288 MHz (IS-95) Channels spacing: 2.5 MHz
- Output power: ≥ 100 W PEP (2-tone)
- Gain: ≥ 27 dB (max input power 200 mW PEP (23 dBm))
- Linearity: C/I ≥ 30 dB (2-tone)

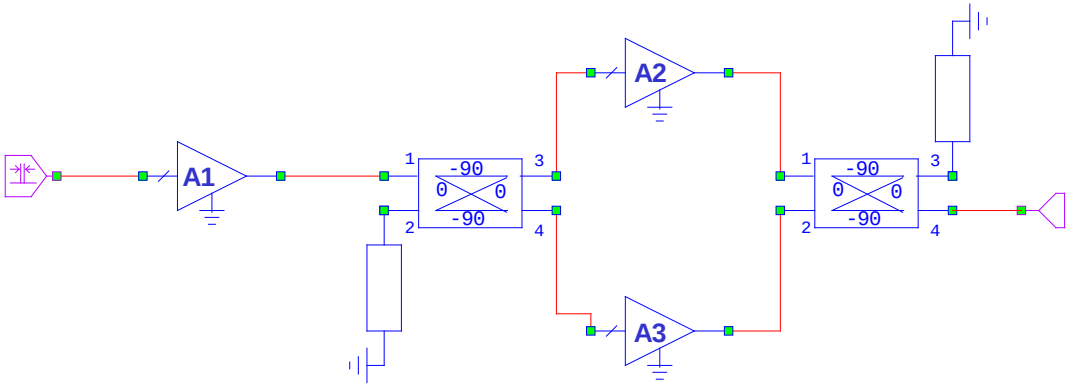
PAE > 25% with 2-tone at rated PEP

Possibile topologies

- Due cascaded stages



- Single stage followed by a balanced pair



Devices choice

Manufacturer: **Freescale**

Final stage

MRF5S19130 (P1dB=125W, Vdd=28V, Gt=13 dB, η=33%) → Topology 1
MRF7S19100 (P1dB=100W, Vdd=28V, Gt=17.5 dB, η=30%) → Topology 1
MRF6S19060 (P1dB=60W, Vdd=28V, Gt=16 dB, η=35%, IM3=-35 dBc) → Topology 2
MRF19045 (P1dB=45W, Vdd=26V, Gt=14.5 dB, η=36%, IM3=-30 dBc) → Topology 2

Driver

MRF6S20010 (P1dB=20W, Vdd=28V, Gt=16 dB, η=41%, IMD=33 dBc) → Topology 1/2
MRF282 (P1dB=10W, Vdd=26V, Gt=12 dB, η=33%, IMD=31 dBc) → Topology 1/2

2 cascaded stages

Chosen final device: MRF5S19130 (IP3=61.5 dBm, G_{final}=13 dB).
Evaluation of IP3 of the driver (imposing the overall CI3):

$$P_{\omega 1} = PEP - 6 \text{ dB} = 44 \text{ dBm}$$

$$IP_{3,tot} = \frac{CI + 2P_{\omega 1}}{2} = 59 \text{ dBm}$$

Sum in power of distortion

$$IP_{3,tot} = IP_{3,final} - 10\log\sqrt{\left(1+10^{(IP_{3,final} - G_{T,final} - IP_{3,driver})/5}\right)}$$

$$IP_{3,driver} = IP_{3,final} - G_{T,final} - 5\log\left(10^{(IP_{3,final} - IP_{3,tot})/5} - 1\right)$$

$$\rightarrow IP_{3,driver} = 46.82 \text{ dBm}$$

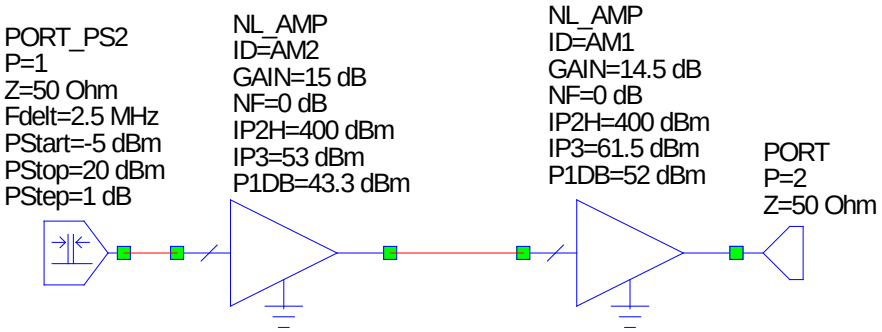
Sum in voltage of distortion

$$IP_{3,tot} = IP_{3,final} - 10\log\left(1+10^{(IP_{3,final} - G_{T,final} - IP_{3,driver})/10}\right)$$

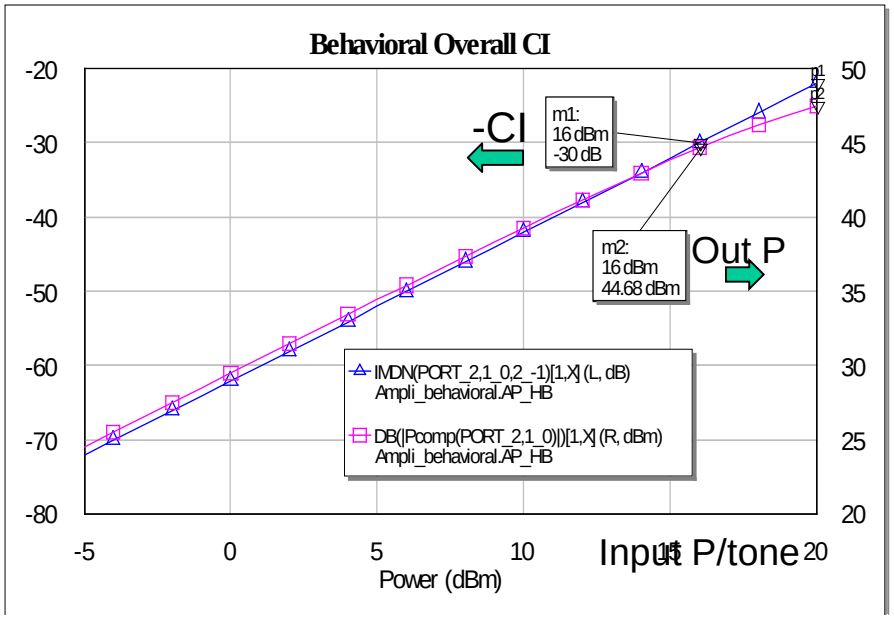
$$IP_{3,driver} = IP_{3,final} - G_{T,final} - 10\log\left(10^{(IP_{3,final} - IP_{3,tot})/10} - 1\right)$$

$$\rightarrow IP_{3,driver} = 49.58 \text{ dBm}$$

Verification with behavioral models

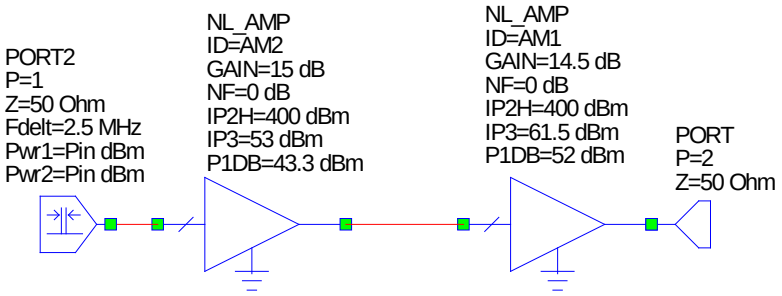


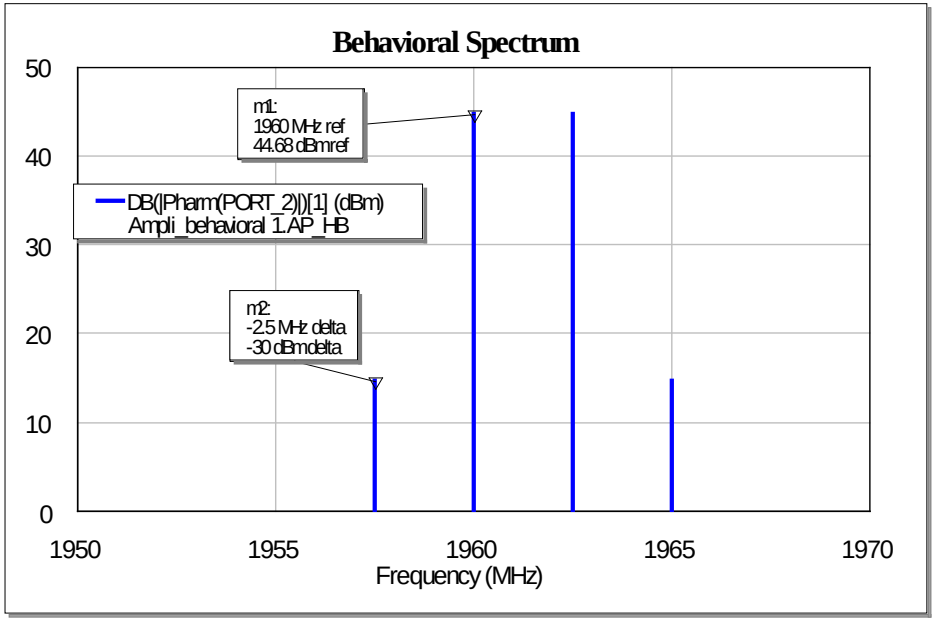
Requested outP/tone:
44 dBm



Chosen device for the driver:
MRF6S20010 (**IP3=53 dBm**)

Spectrum evaluation for CI=30 dBm

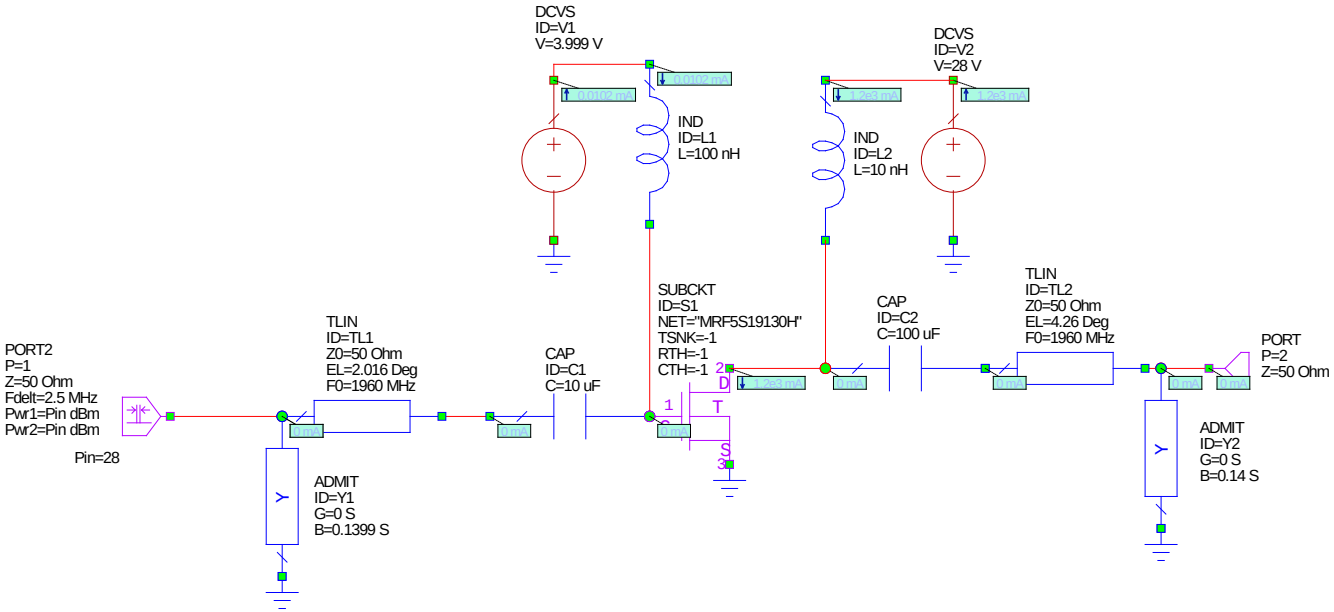




Potenza out: 116.95 W (PEP)
C/I: 30 dBc
Gt=28.68 dB (Pin/tone=16 dBm)

Evaluation of the optimum loads

- Starting points: optimum impedances reported on datasheets).
- Topology of the networks suggested by the manufacturer
- Biasing point reported on datasheets for optimum performances
- Tuning of the networks for maximize Pout e C/I



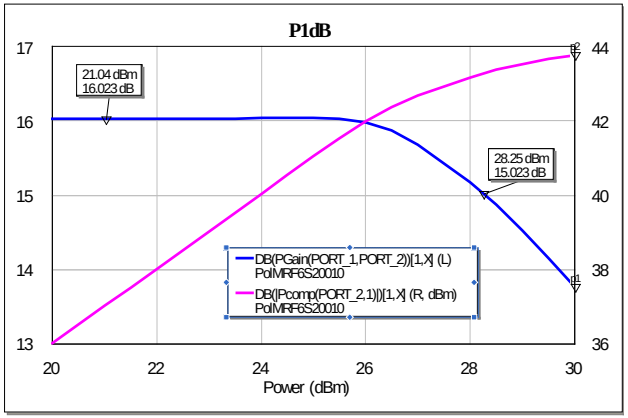
La polarizzazione è realizzata con reti ideali (L e C)

Result of the simulations (Harmonic balance)

Driver: MRF6S20010

Bias: Vdd=28, Id=130 mA

Zs=9.52+j2.14 Z_L=2.75+j3.67



P1dB,driver=43.3 dBm

IP3,driver=50.5 dBm

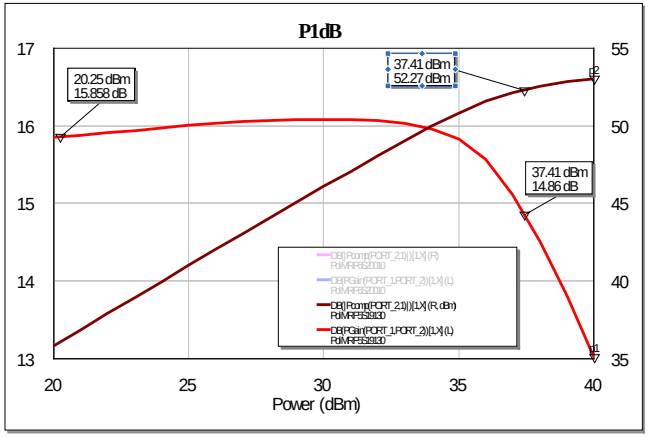
CI=34.4 (PEP=39.44 dBm)

G=17.44 dB

Final: MRF5S19130

Bias: Vdd=28, Id=1200 mA

Zs=2.35 - j7.6 ZL=1.28 - j1.5



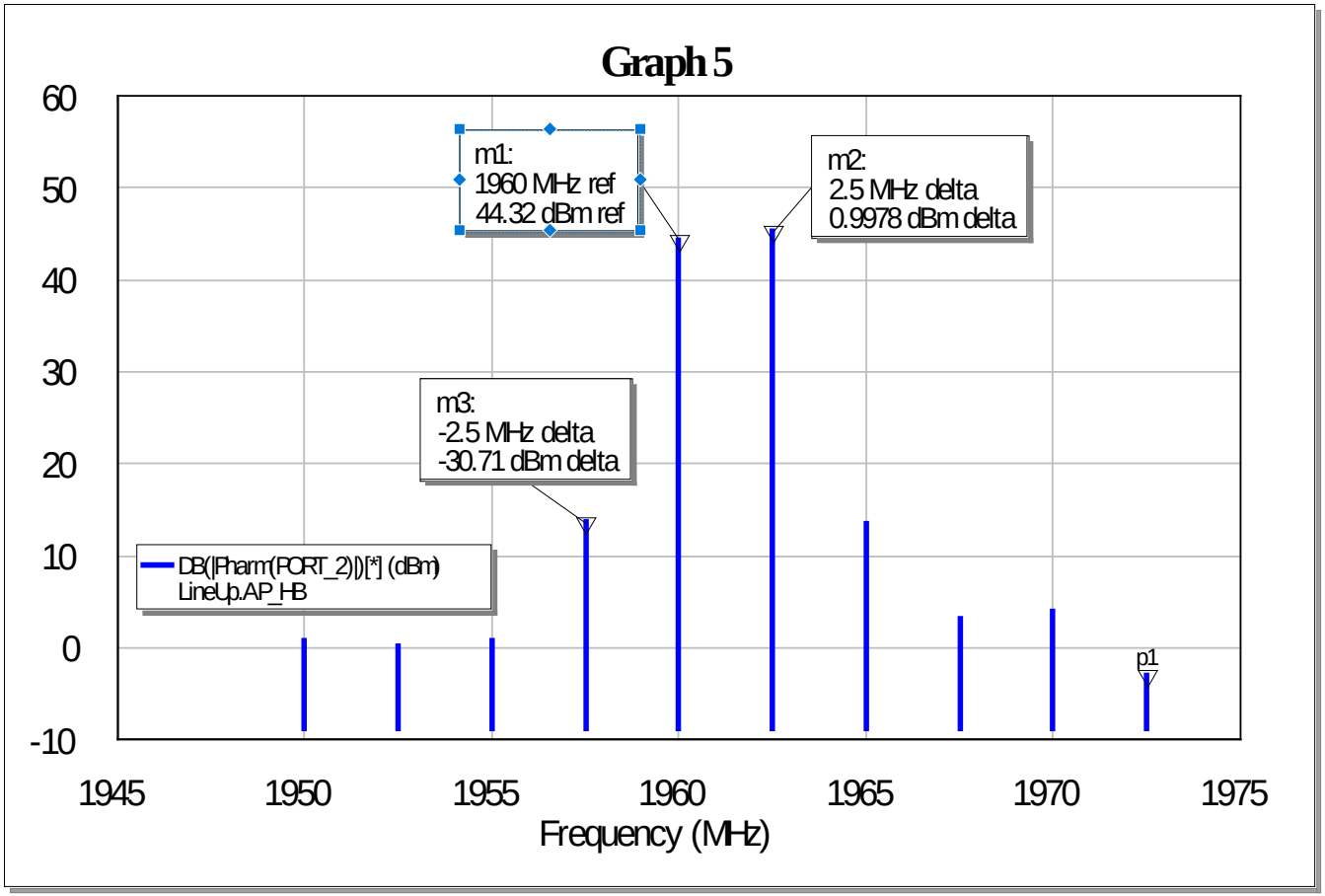
P1dB,final=52.3 dBm

IP3,final=60.4 dBm

CI=32. (PEP=50.33 dBm)

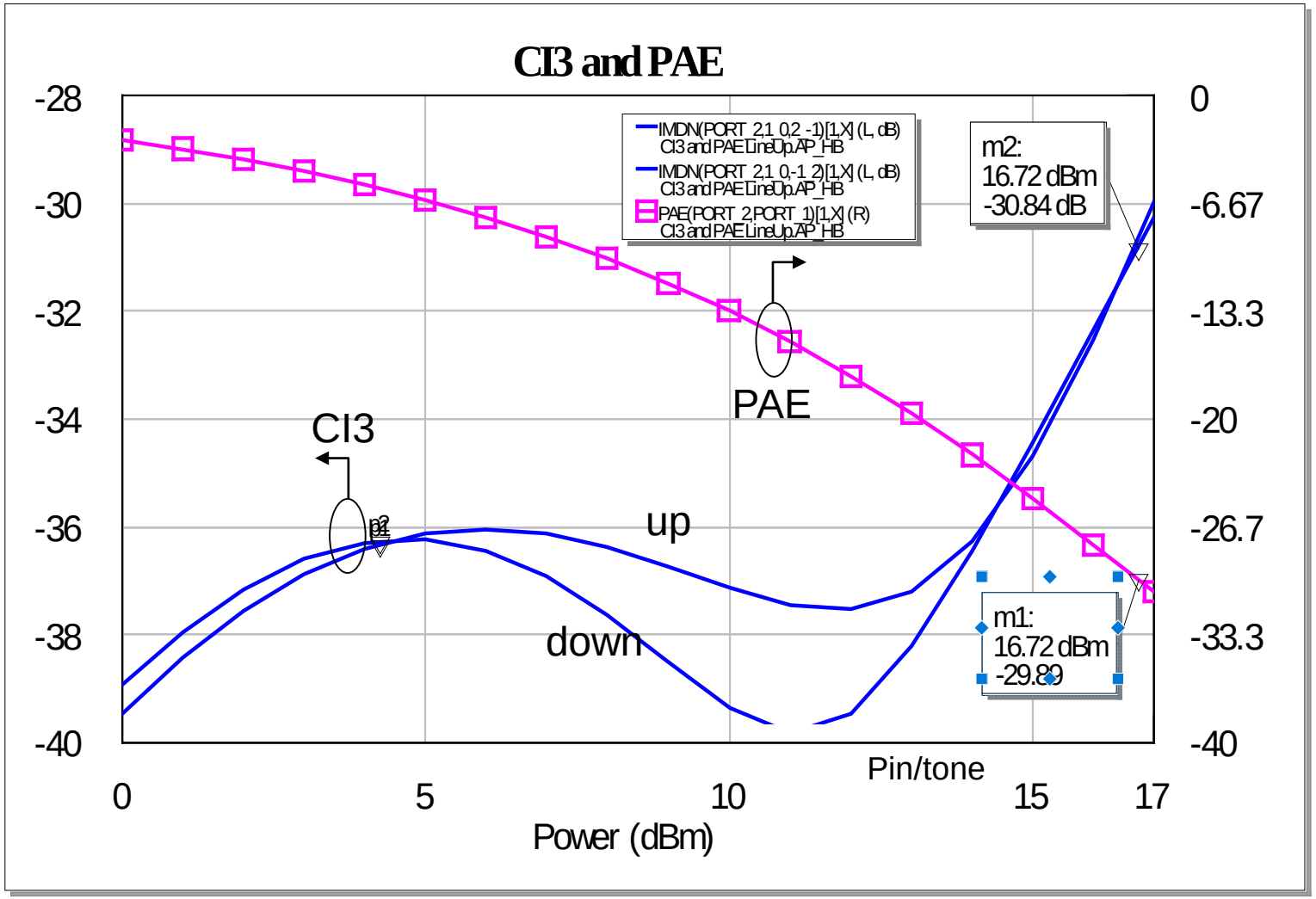
G=12.33 dB

Overall line-up: Spectrum for Pout max



Pout: 107.9 W (PEP), C/I: 30.7 dBc Gt=27.6 dB (Pin=187 mW PEP)

Overall line-up : CI3 e PAE vs Pin



Asymmetry CI3 → Memory effects