Amplificadores de Potencia de RF

Load Pull

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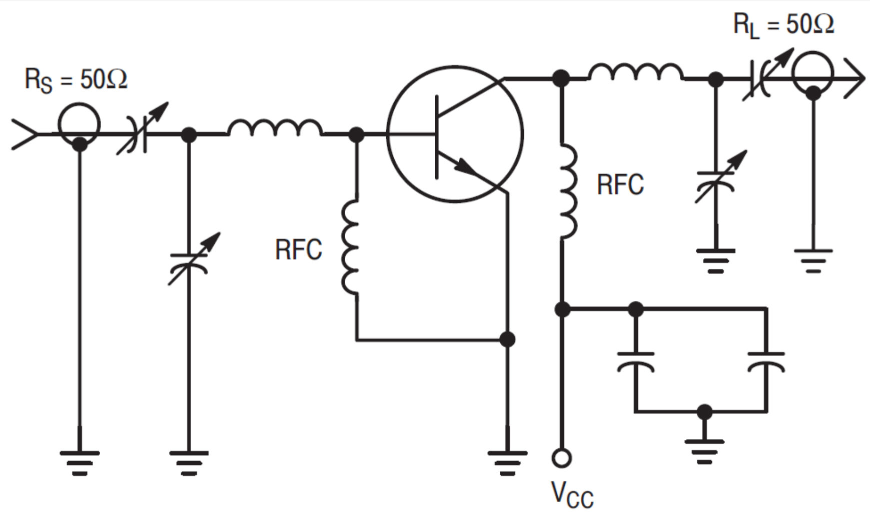
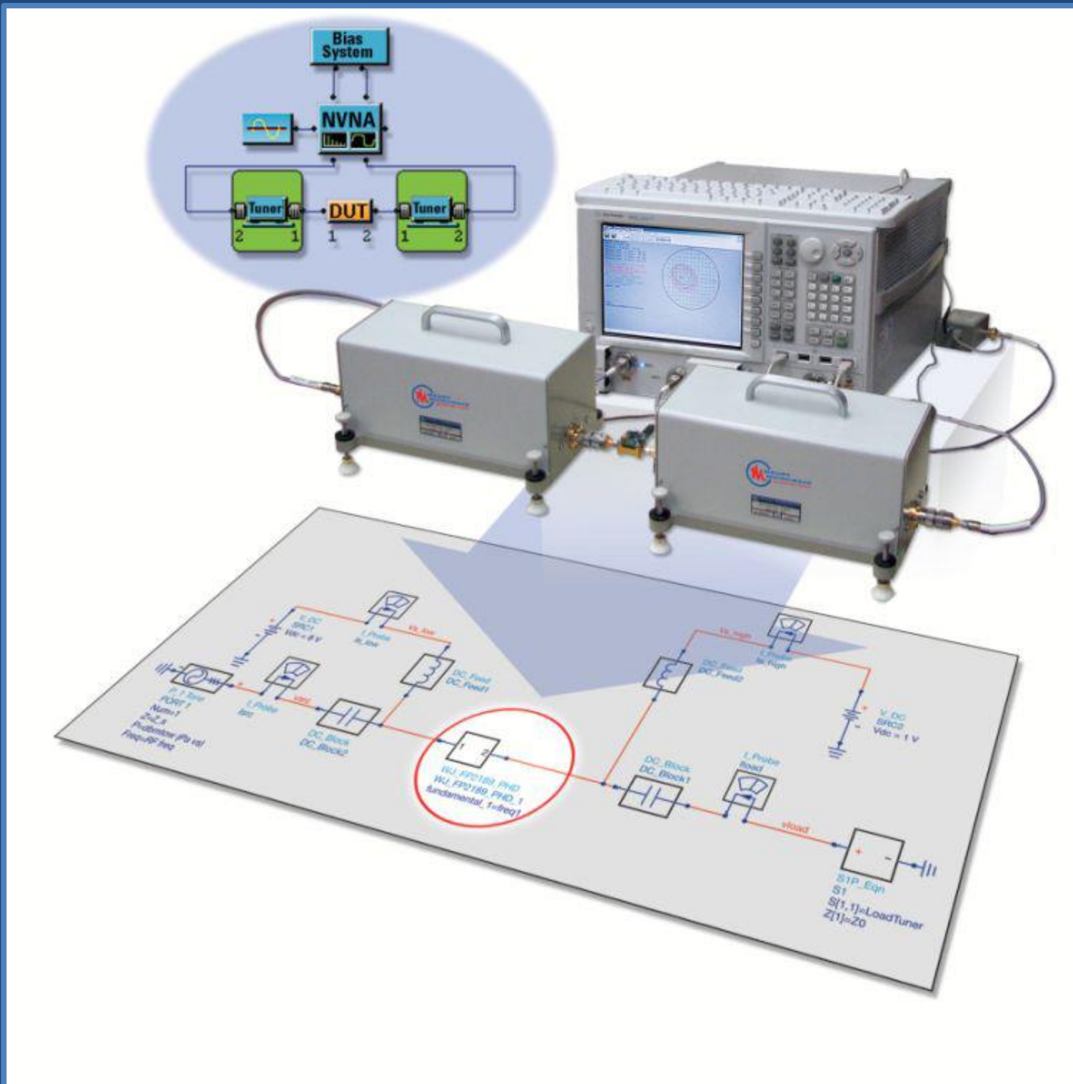
- Load Pull definición
  - Proceso que consiste en variar sistemáticamente la impedancia presentada a un puerto de un dispositivo, destinado a evaluar una performance dada (η, Pout, G, etc.)
  - Se aplica en condiciones de gran señal cuando las aproximaciones lineales (superposición) ya no son aplicables
  - Load Pull manual

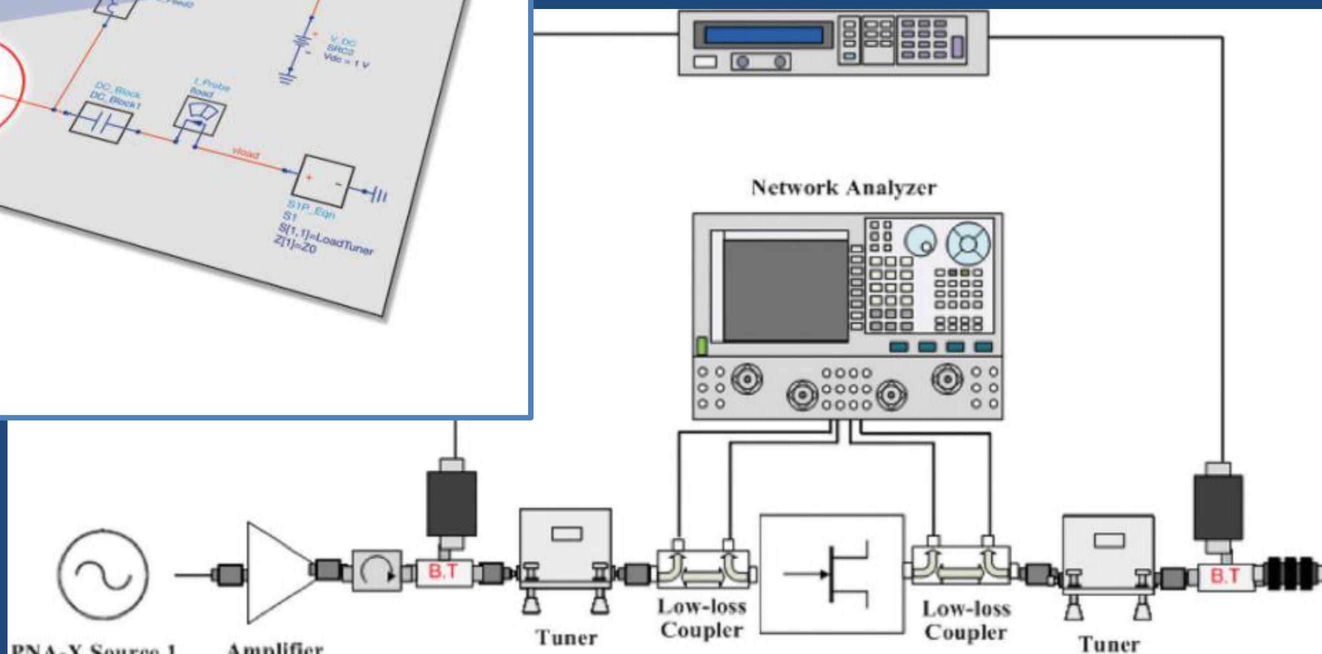


* Capítulo basado en: http://cp.literature.agilent.com/litweb/pdf/5990-9506EN.pdf



- Sistema automático con sintonizadores Maury
- Set-up con PNA-X nonlinear vector network analyzer (NVNA), fuente de polarización (oculta atrás), sintonizadores externos Maury y software de captura

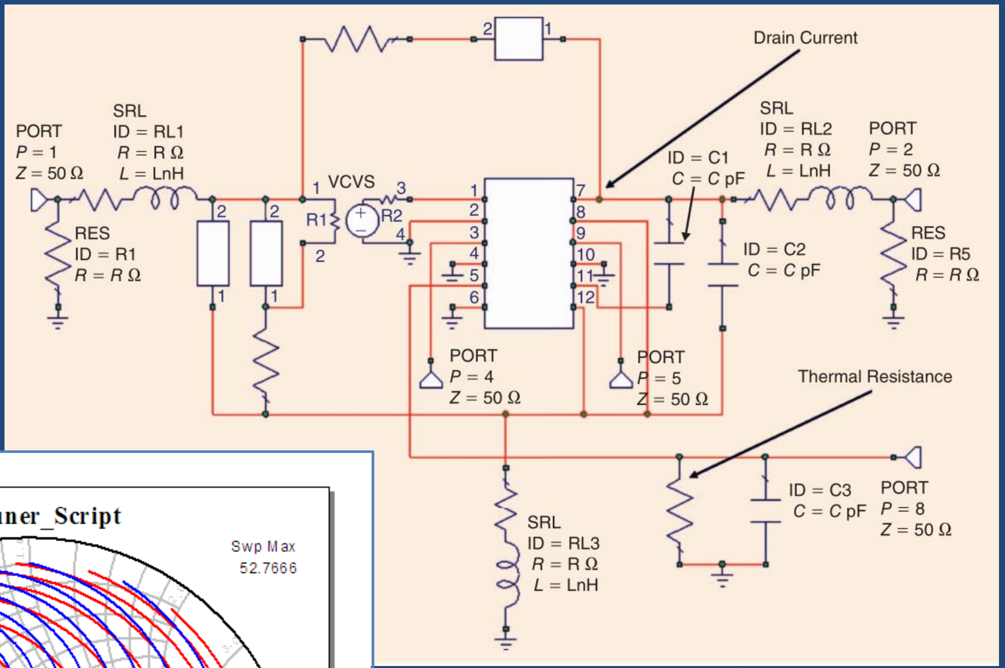
Descripción funcional



- Proceso

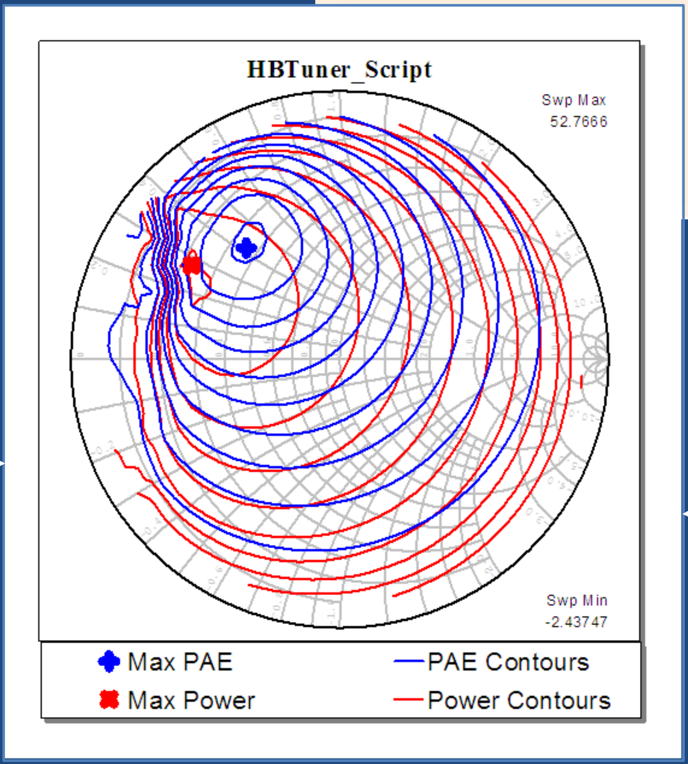
Dispositivo real

Modelo de Kondoh (1986) de 13 elementos Físico + Beheavioral



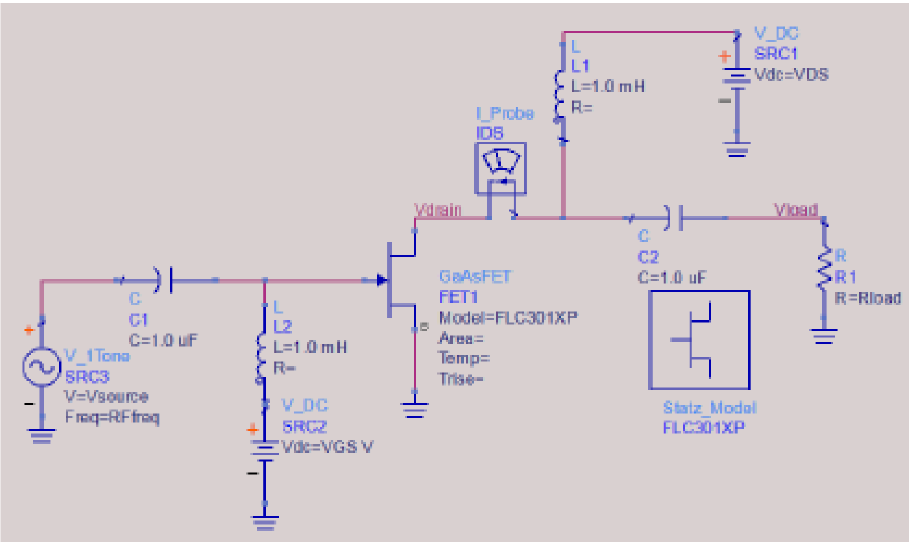
Datos de load-pull medidos con sistema Maury

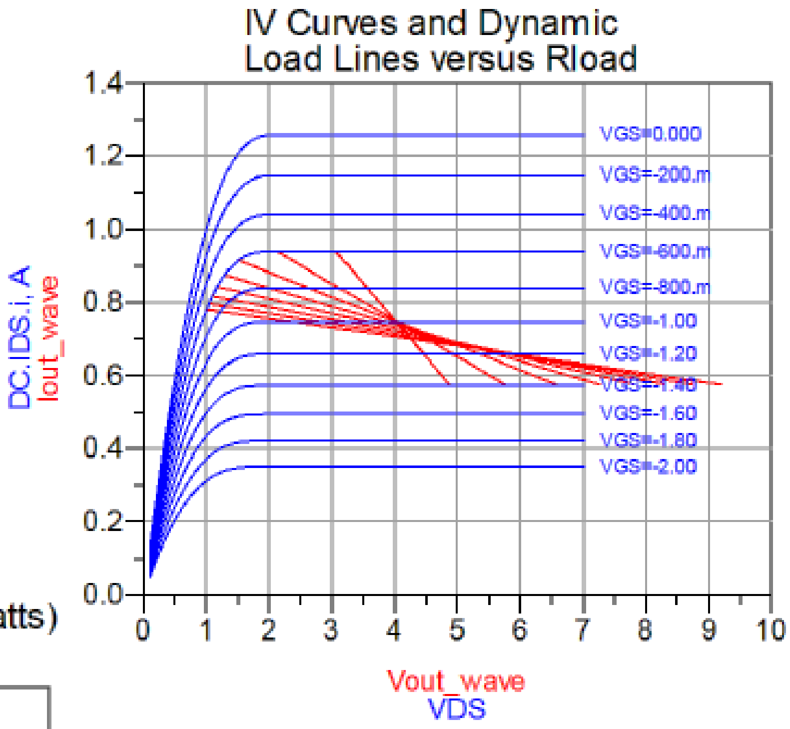
Datos de load-pull obtenidos de la sumulación del modelo

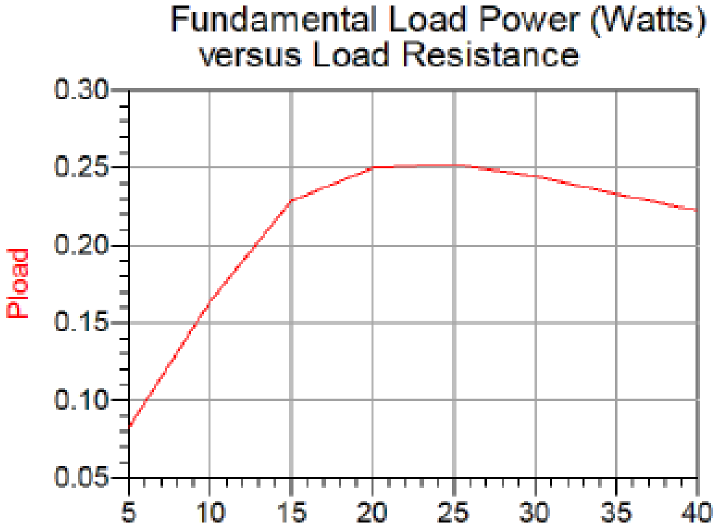


Contornos de load-pull con simulador

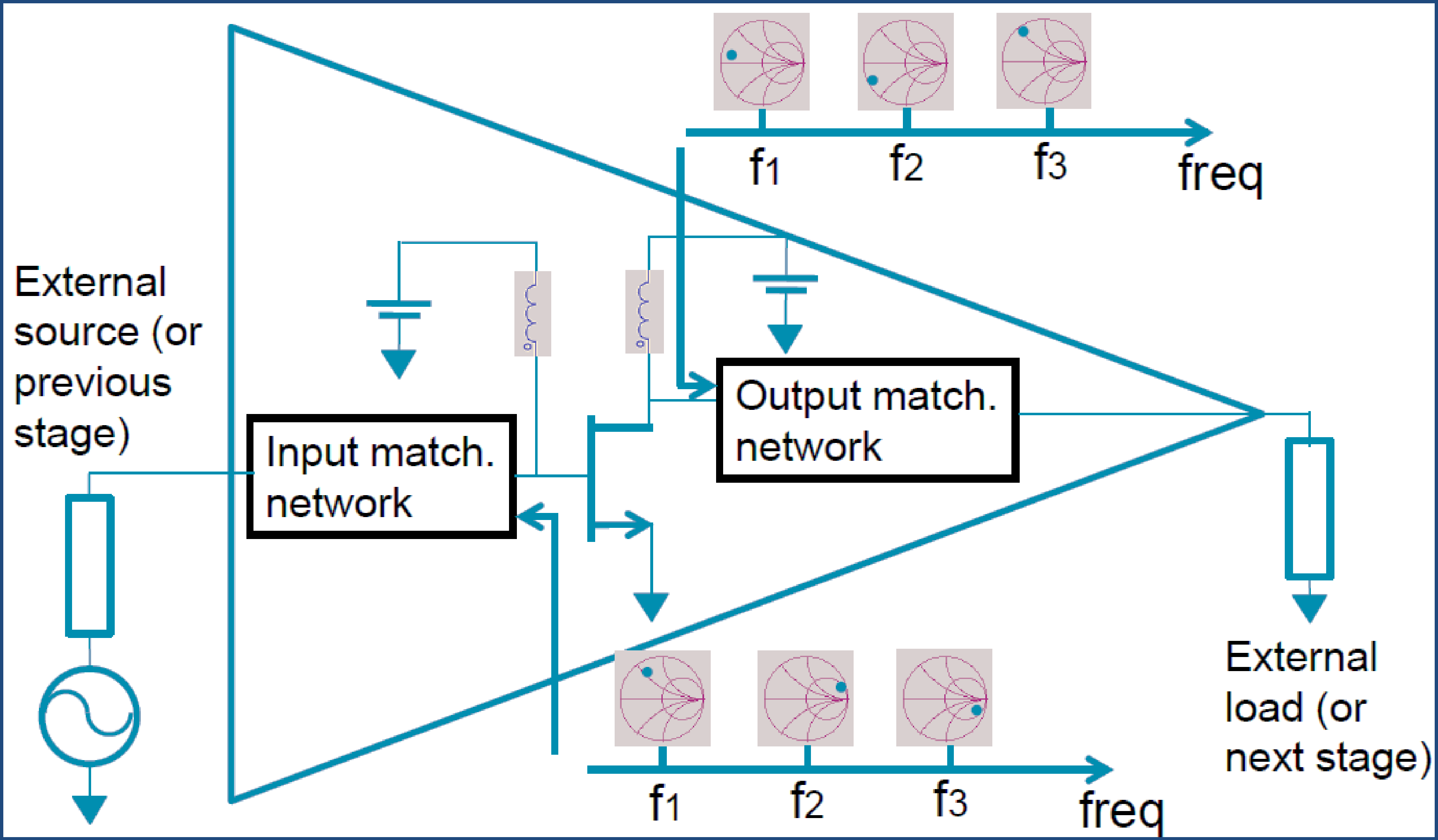
- Un caso de load pull extremadamente simple



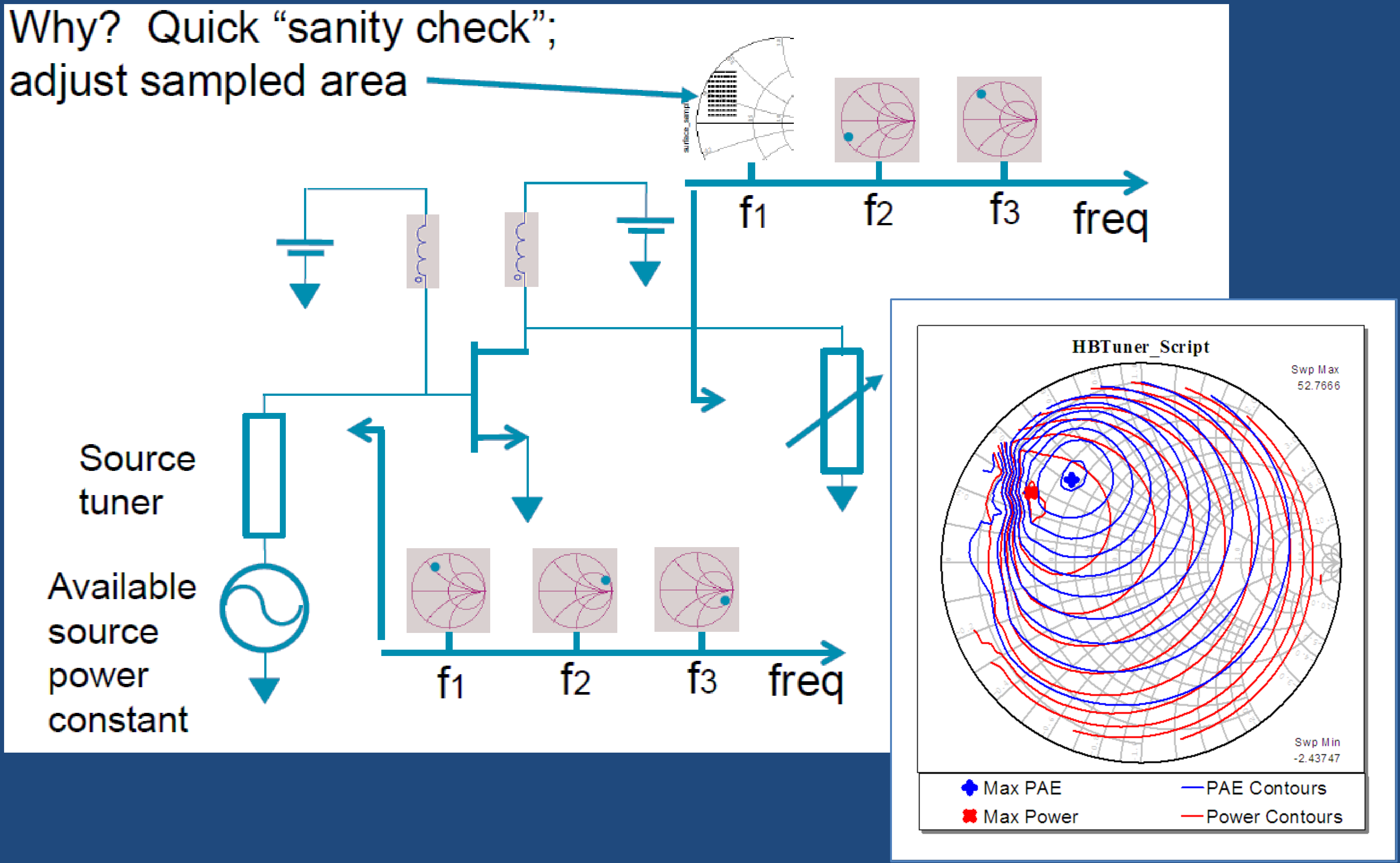




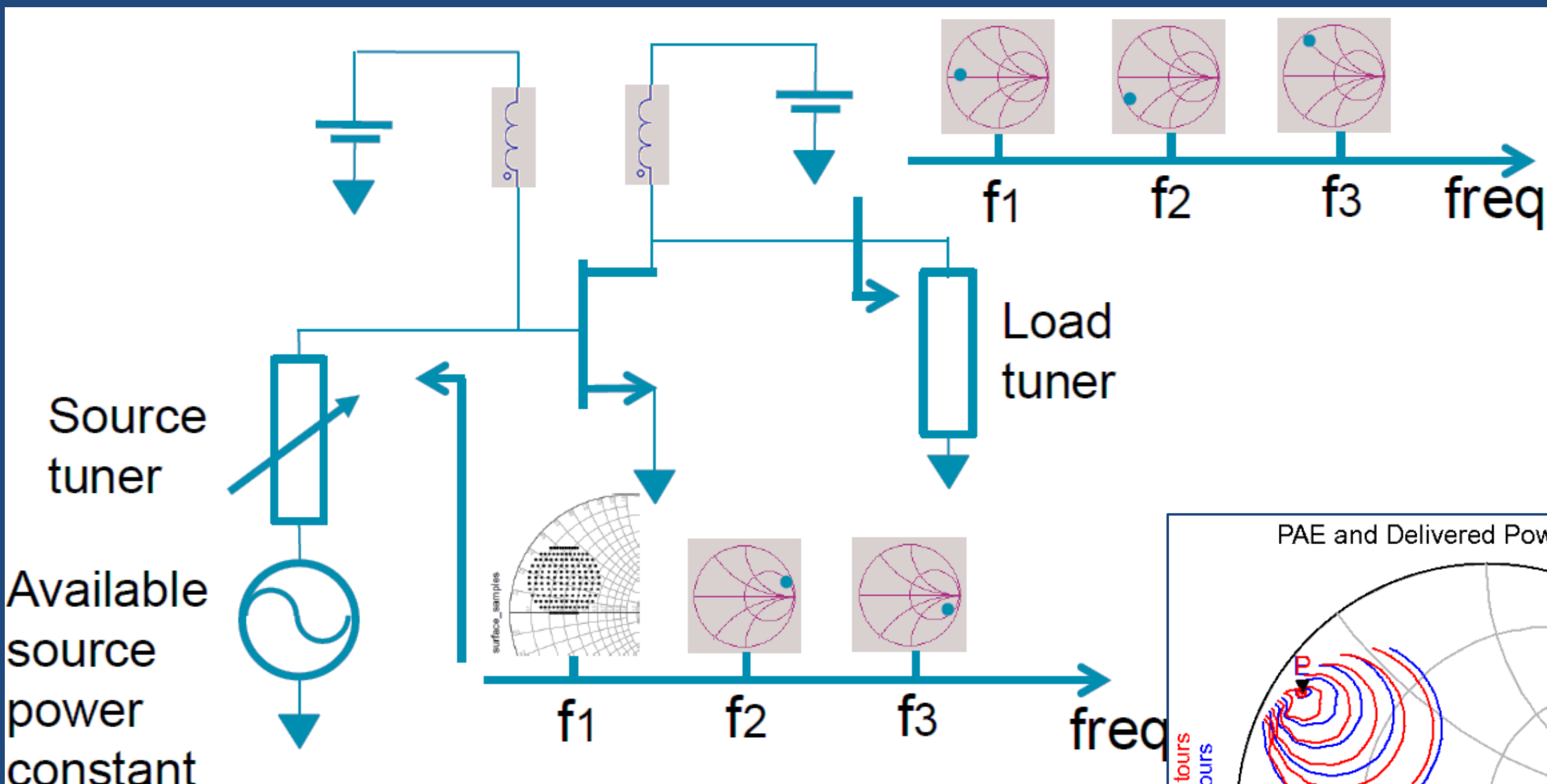
- La performance del dispositivo depende de las impedancias de carga y de fuente para cada armónico

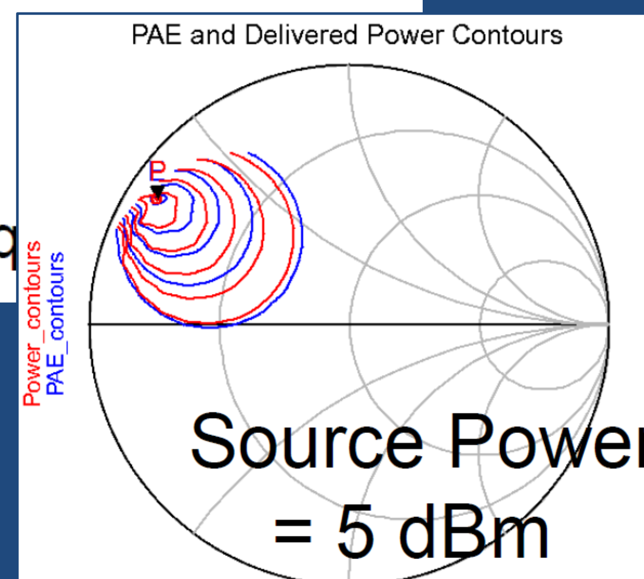


- Se evalúa el comportamiento de un parámetro del circuito variando solo la impedancia de la cual se quiere conocer su influencia sobre un área de la carta

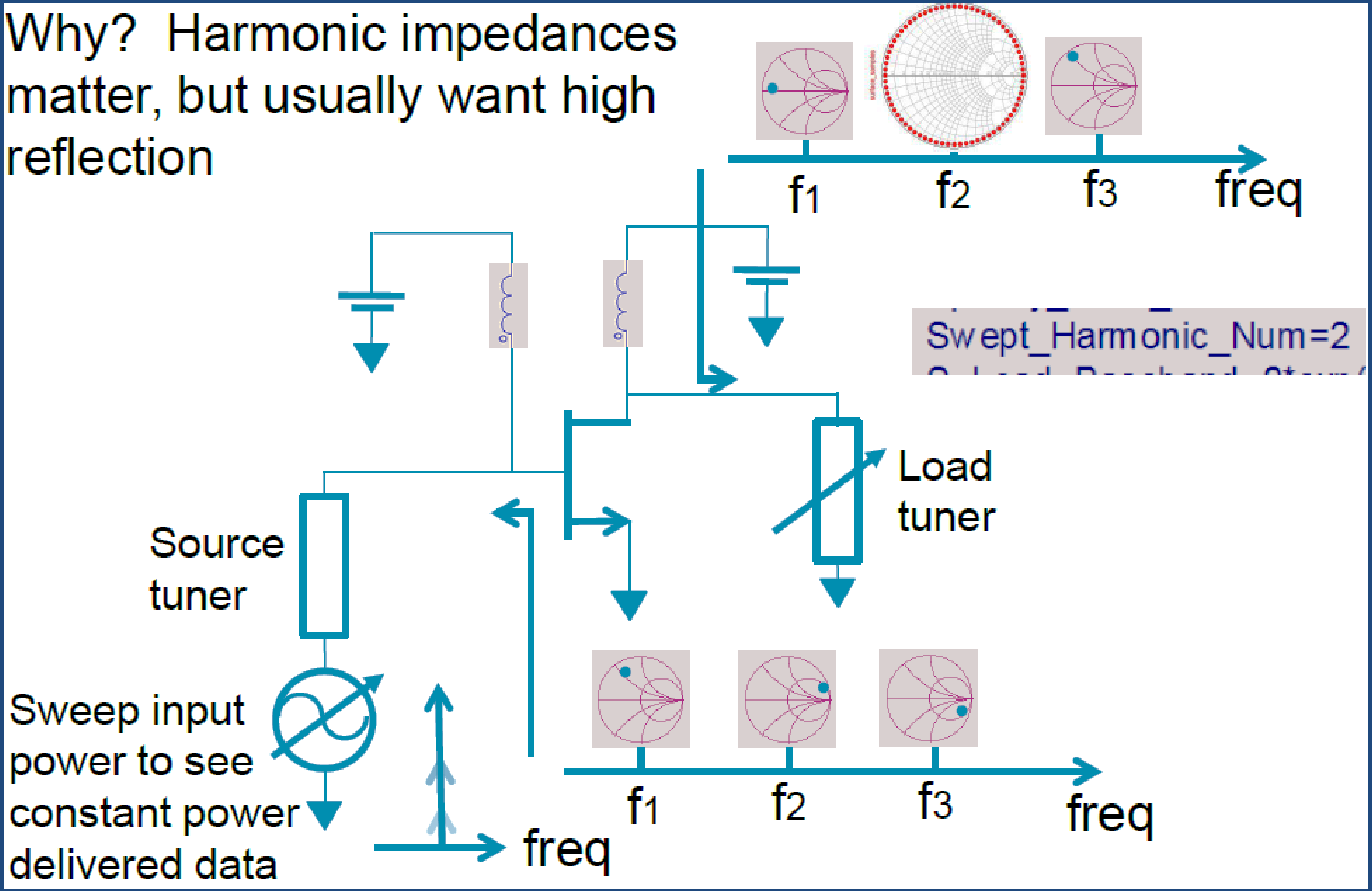


- Normalmente la impedancia de fuente que da mejor rendimiento también provee mejor potencia de salida

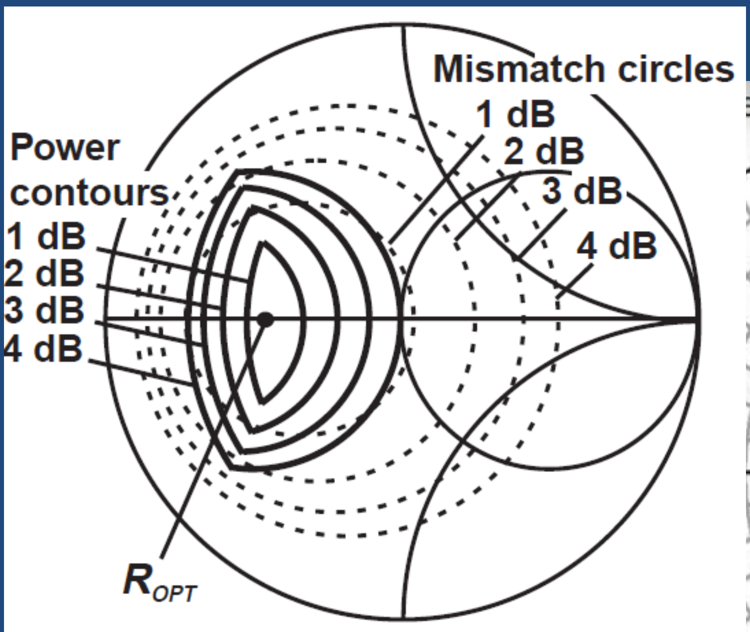


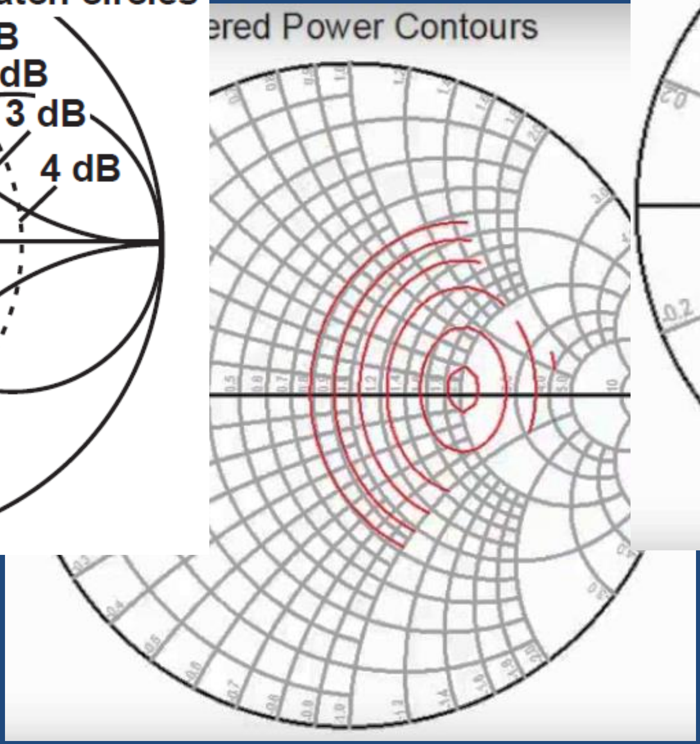


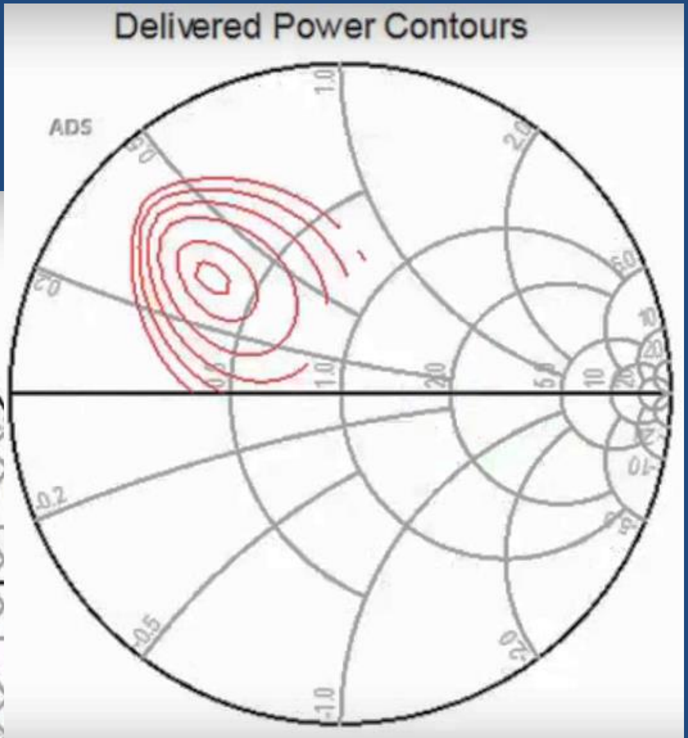
- Sintonizar adecuadamente las impedancias en las f armónicas aumenta el rendimiento



- La teoría predice que los contornos de Pout o PAE constante en baja f siguen la líneas de resistencia o conductancia constante*
- En alta frecuencia los parásitos se tornan significativos y los contornos se alejan del eje real

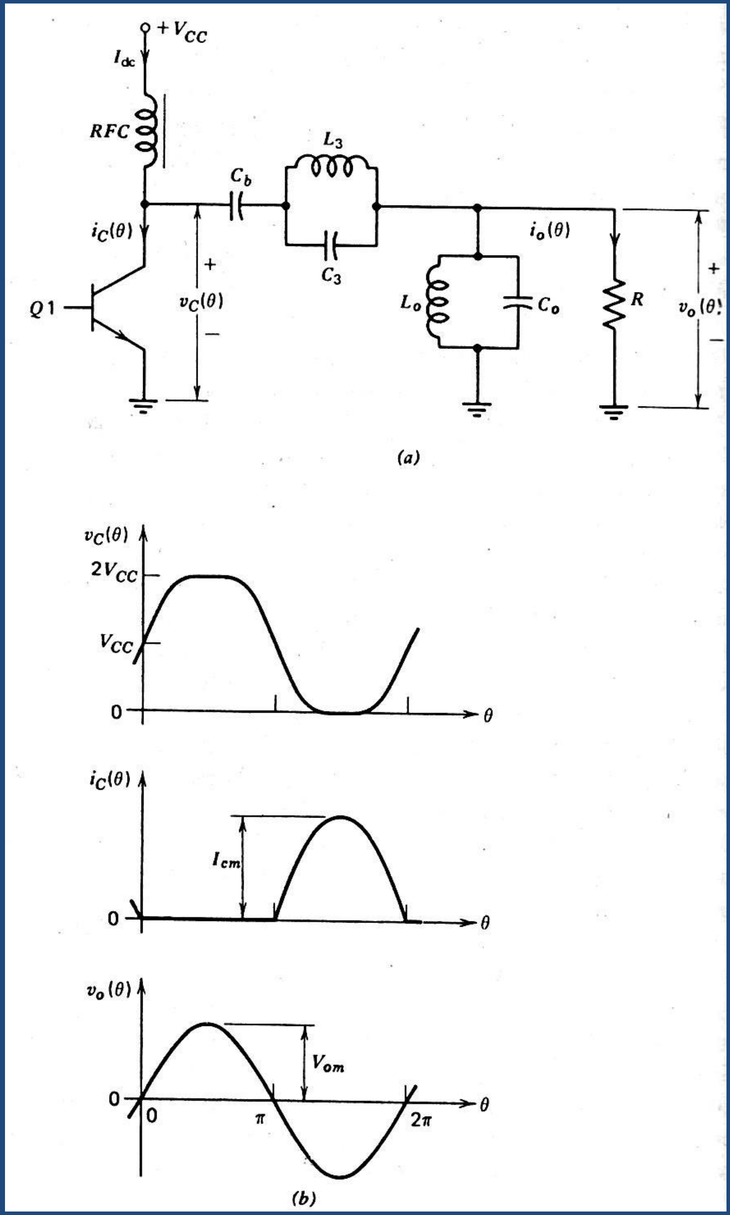


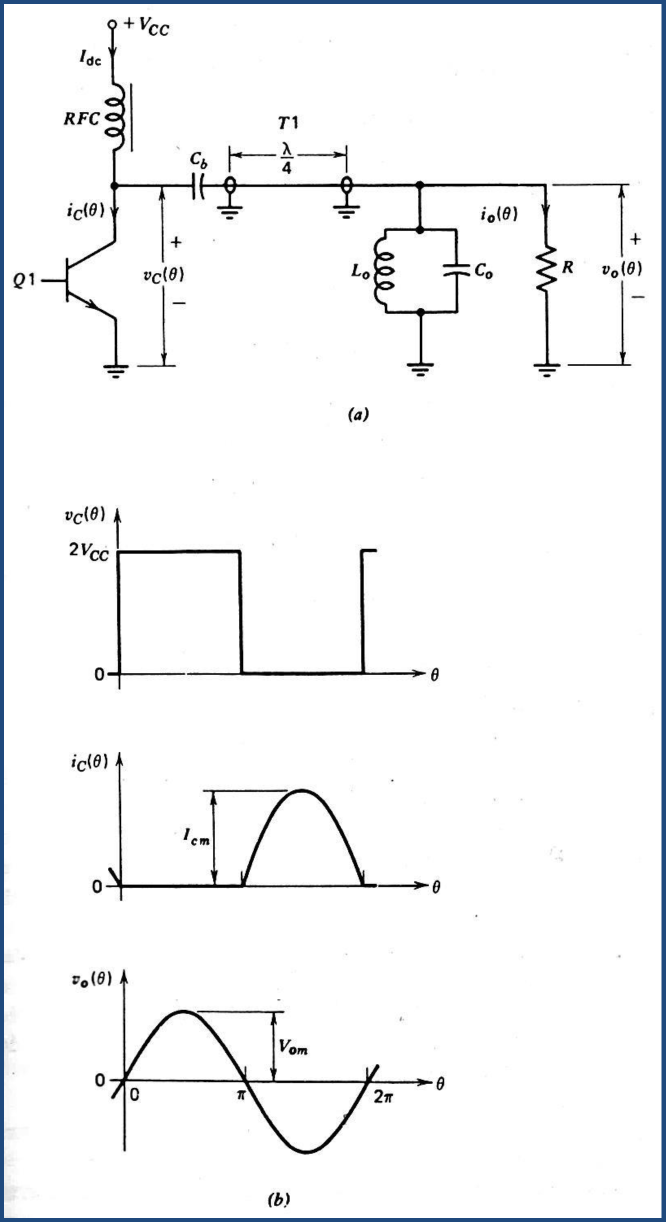




*RF Power Amplifiers for Wireless, Steve C._Cripps, SecondEdition(2006)

- Amplificador Clase F: η teórico, izq. 88,4%, derecha 100%





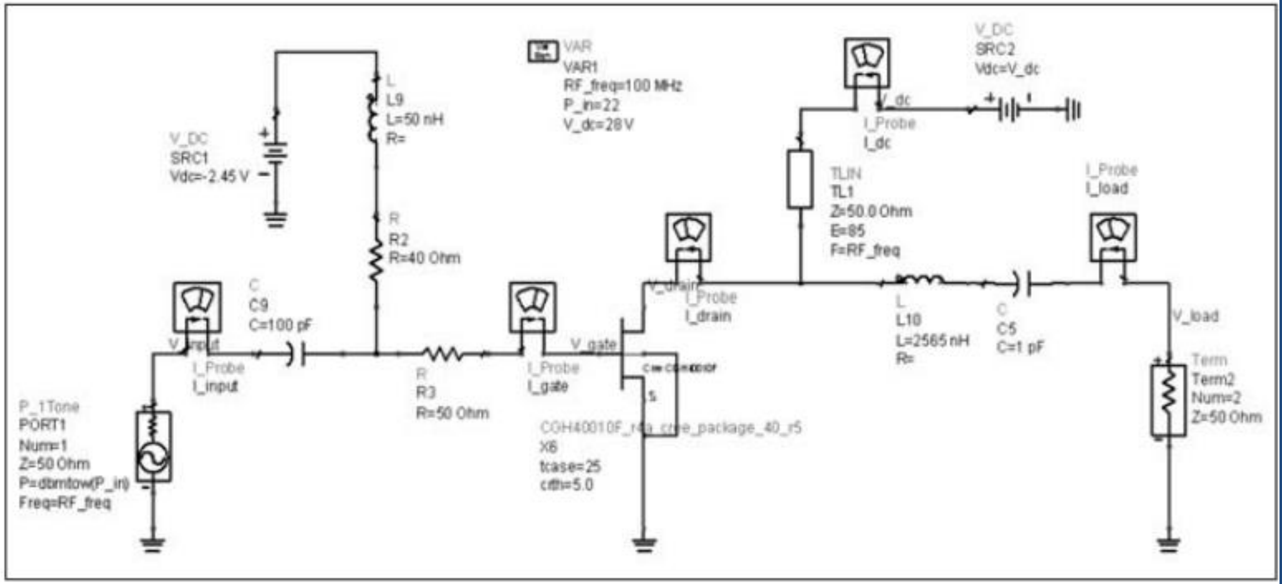
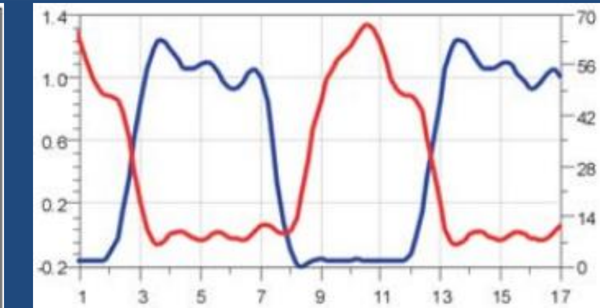
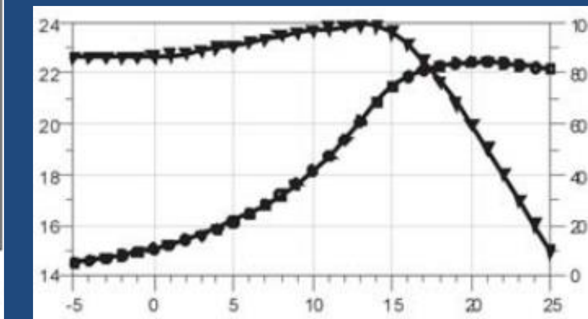
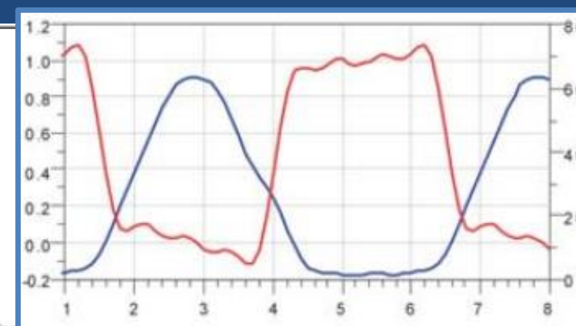


Figure 1 · Circuit schematic of Class F GaN HEMT power amplifier with shunt quarterwave line.







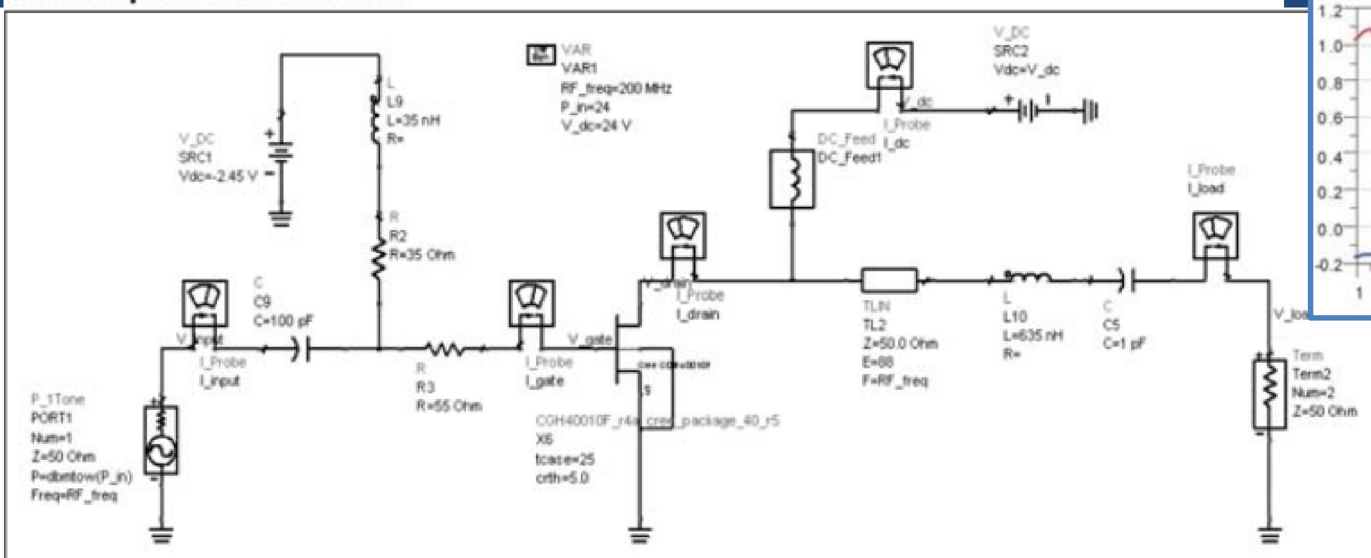


Figure 3 · Circuit schematic of inverse Class F GaN HEMT power amplifier with series quarterwave line.

- La síntesis de redes de adaptación es un problema complejo

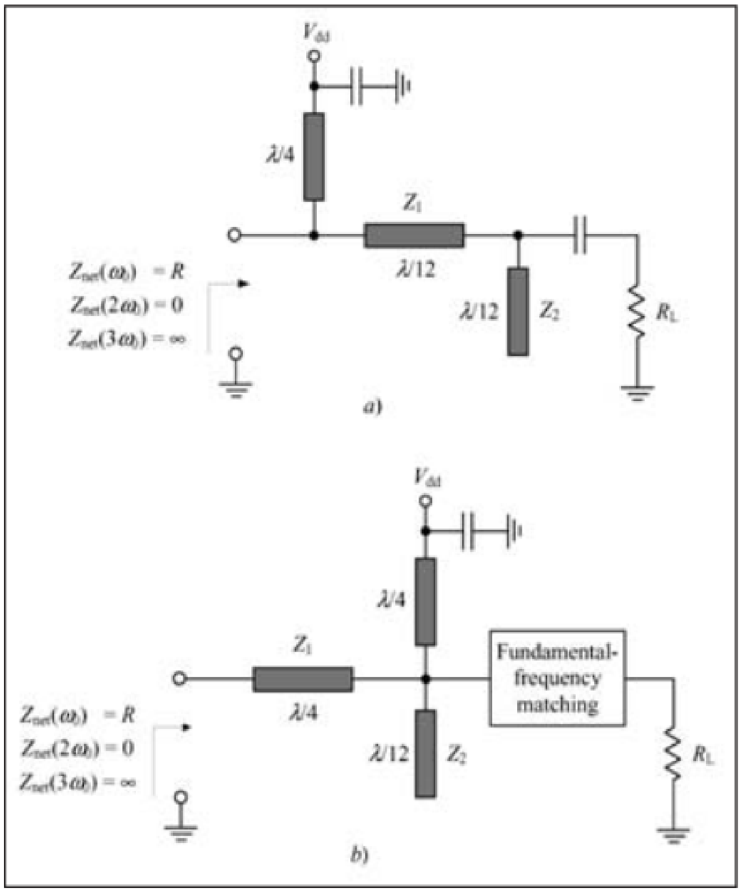


Figure 5 · Idealized transmission-line Class F load networks.

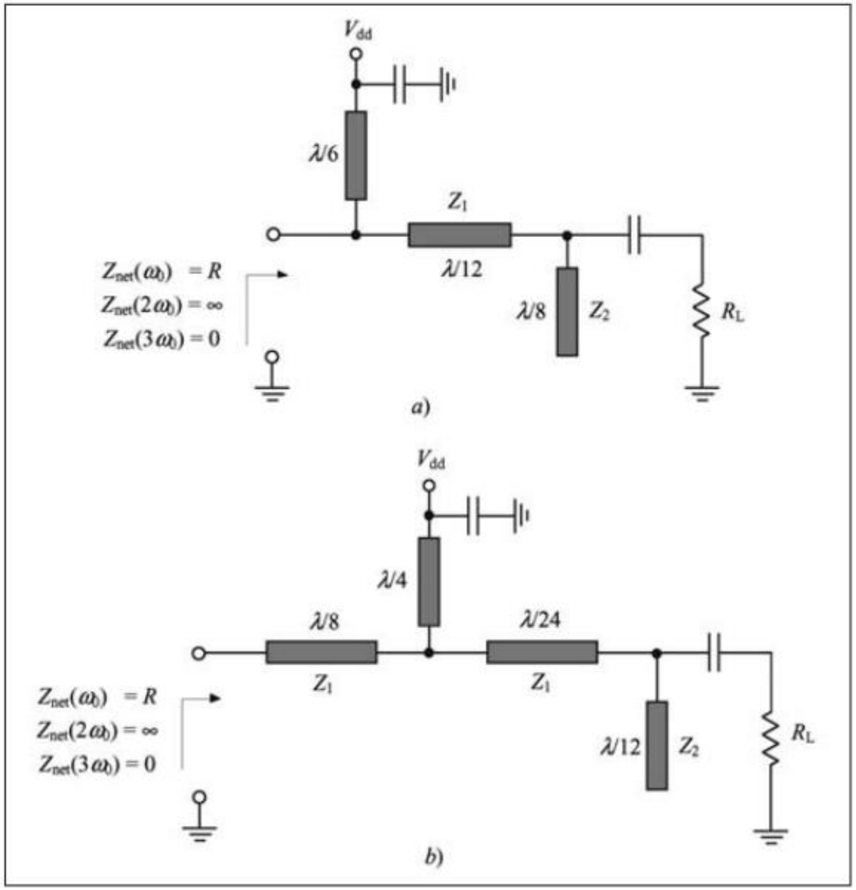
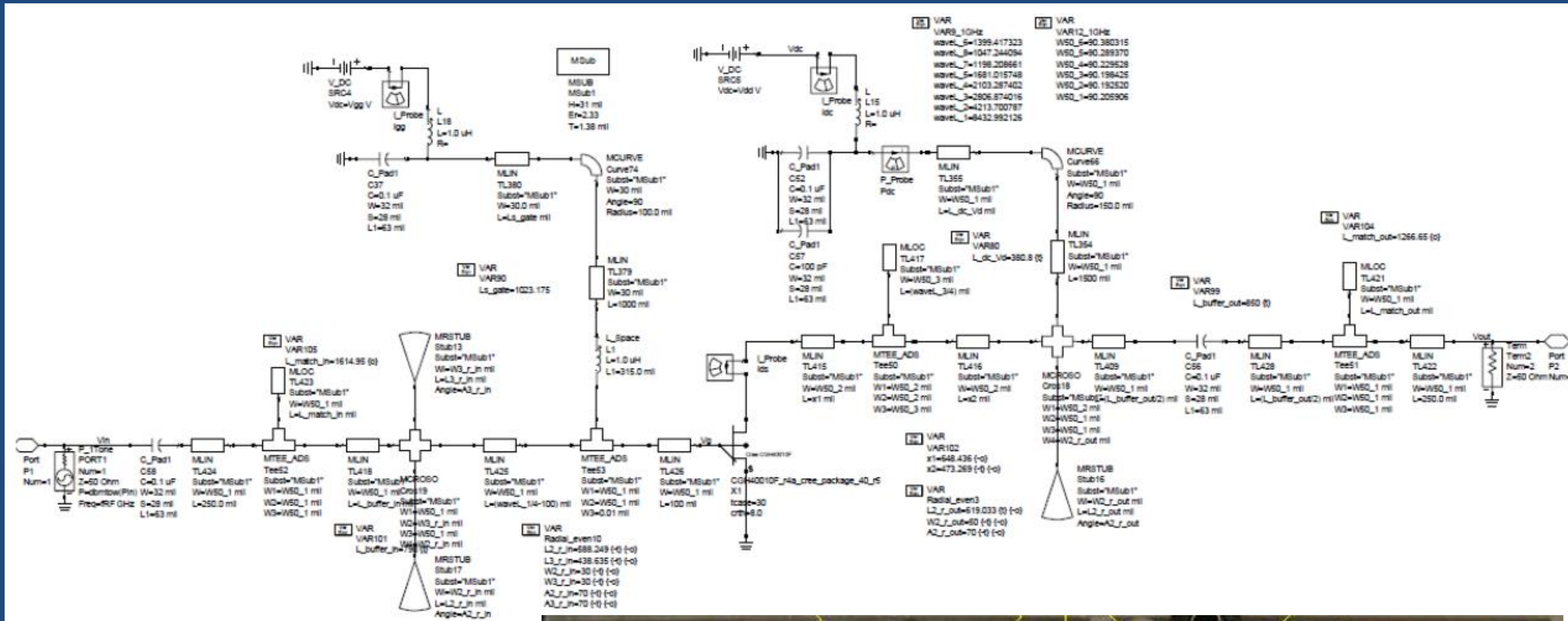
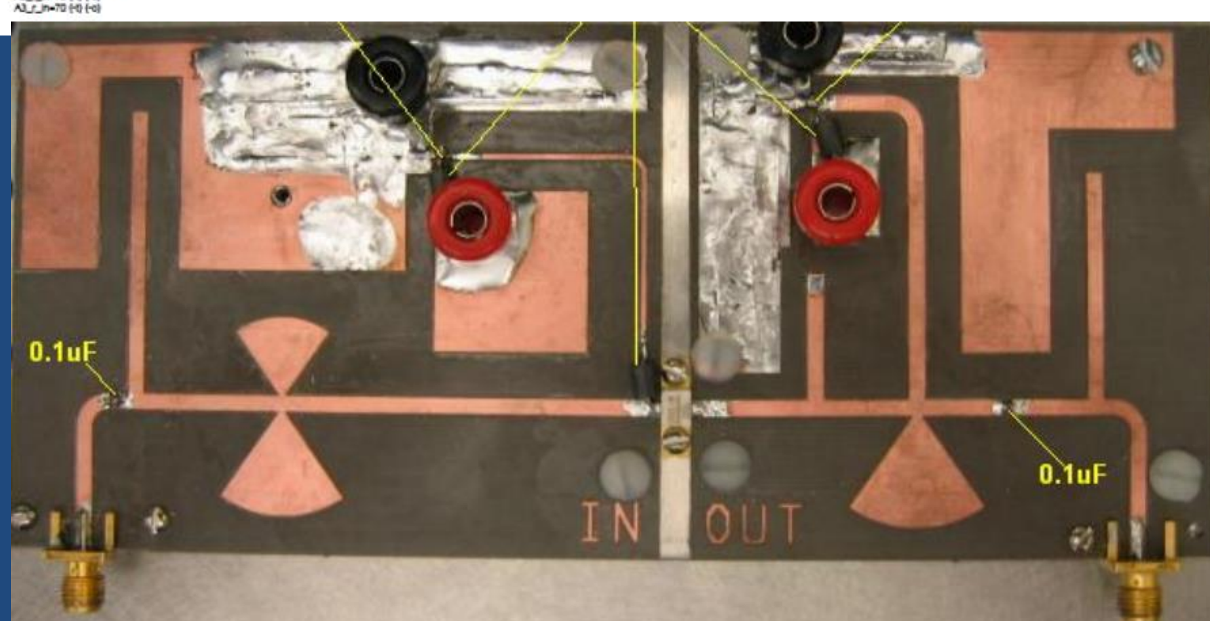


Figure 6 · Idealized transmission-line inverse Class F load network.

* Tomado de Load Network Design Technique for Class F and Inverse Class F Pas By Andrei Grebennikov, Bell Labs, Alcatel-Lucent

AP de RF – Load Pull: Amplif. Clase F, tesis de Tsang





*A Master Thesis presented to the Faculty of California Polytechnic State University, San Luis Obispo In Partial Fulfillment of the Requirements for the Degree Master of Science in Electrical Engineering By Kai Shing Tsang August 2010

- Dispositivo

10W=40dBm

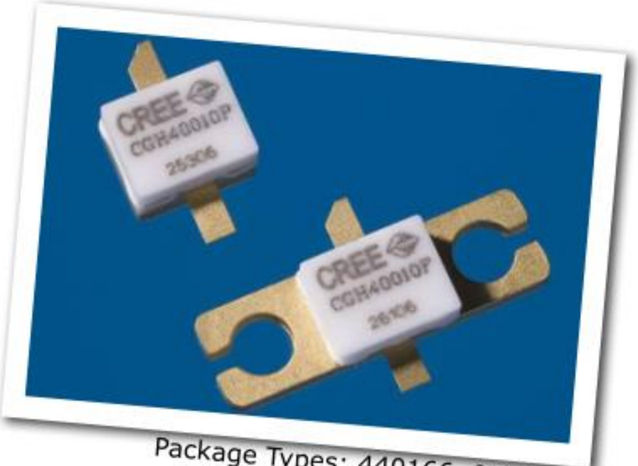
13W=41,1dBm

CREE

CGH40010

10 W, RF Power GaN HEMT

Cree's CGH40010 is an unmatched, gallium nitride (GaN) high electron mobility transistor (HEMT). The CGH40010, operating from a 28 volt rail, offers a general purpose, broadband solution to a variety of RF and microwave applications. GaN HEMTs offer high efficiency, high gain and wide bandwidth capabilities making the CGH40010 ideal for linear and compressed amplifier circuits. The transistor is available in both screw-down, flange and solder-down, pill packages.



Package Types: 440166, & 440196
PN's: CGH40010F & CGH40010P

FEATURES

- Up to 6 GHz Operation
- 16 dB Small Signal Gain at 2.0 GHz
- 14 dB Small Signal Gain at 4.0 GHz
- 13 W typical P_{SAT}
- 65 % Efficiency at P_{SAT}
- 28 V Operation

APPLICATIONS

- 2-Way Private Radio
- Broadband Amplifiers
- Cellular Infrastructure
- Test Instrumentation
- Class A, AB, Linear amplifiers suitable for OFDM, W-CDMA, EDGE, CDMA waveforms

- Valores máximos

CREE®

Absolute Maximum Ratings (not simultaneous) at 25°C Case Temperature

Parameter	Symbol	Rating	Units	Conditions
Drain-Source Voltage	V_{DSS}	84	Volts	25°C
Gate-to-Source Voltage	V_{GS}	-10, +2	Volts	25°C
Storage Temperature	T_{STG}	-65, +150	°C	
Operating Junction Temperature	T_J	225	°C	
Maximum Forward Gate Current	I_{GMAX}	4.0	mA	25°C
Maximum Drain Current[1]	I_{DMAX}	1.5	A	25°C
Soldering Temperature[2]	T_S	245	°C	
Screw Torque	τ	60	in-oz	
Thermal Resistance, Junction to Case[3]	$R_{\theta JC}$	8.0	°C/W	85°C
Case Operating Temperature[3,4]	T_C	-40, +150	°C	

Note:
[1] Current limit for long term, reliable operation

*Simular con AWR AmplClaseF2.emp