A 230-260GHz Wideband Amplifier in 65nm CMOS Based on Dual-Peak G_{max}-core

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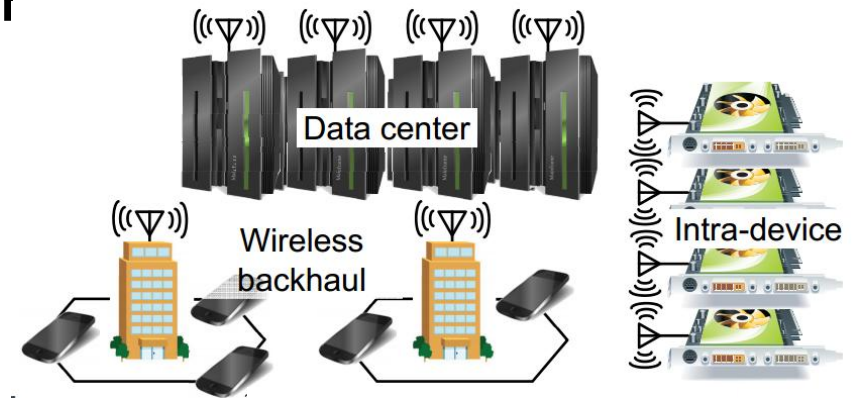
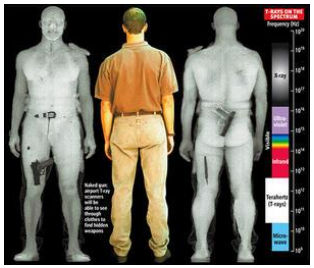
NICE NANO INTERGRATED CIRCUIT EXPERTISE

Terahertz Applications

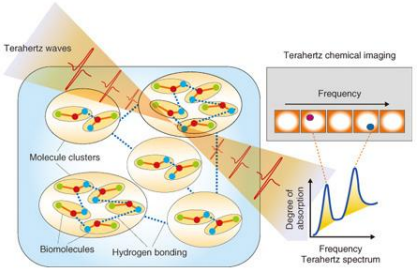
- ❑ High data rate communication
- ❑ Bio / molecular spectroscopy
- ❑ Imaging
- ❑ Compact range radars



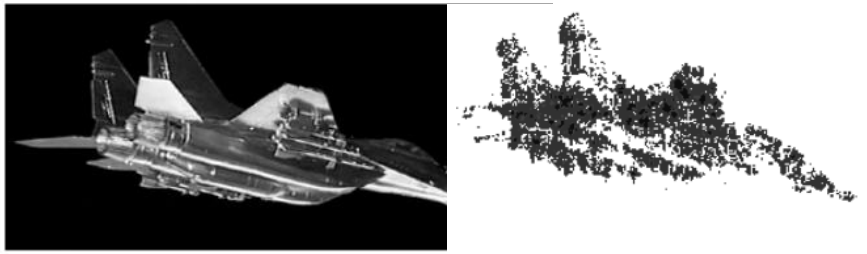
Communication



Imaging



Spectroscopy

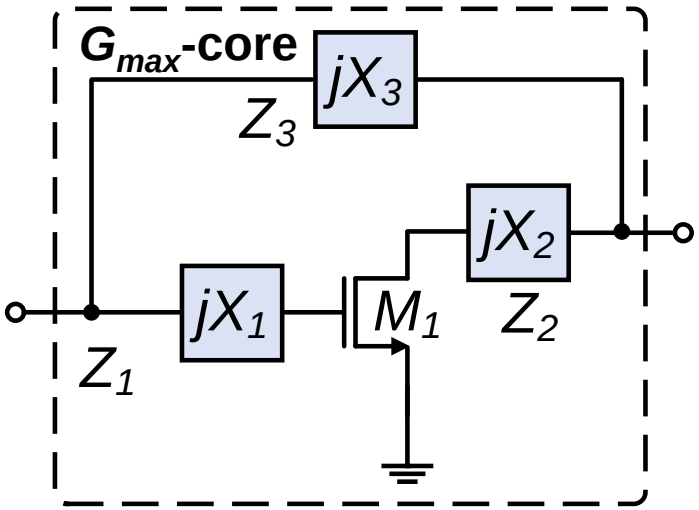


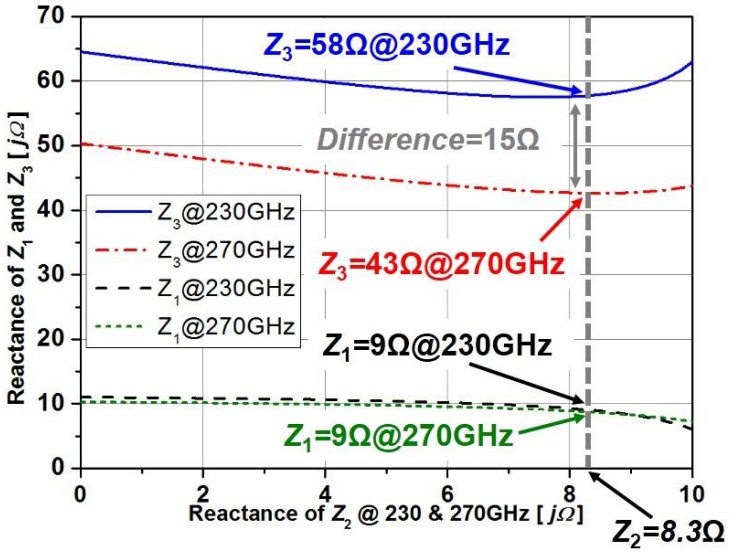
Radar

High gain and wideband sub-THz amplifier is a key block of these systems!

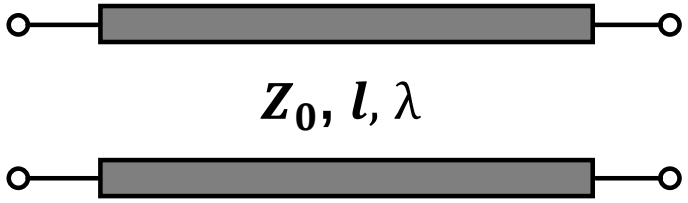
Embedding Network for G_{max}-core

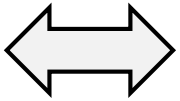
- Two target frequencies : f_L=230GHz and f_H=270GHz

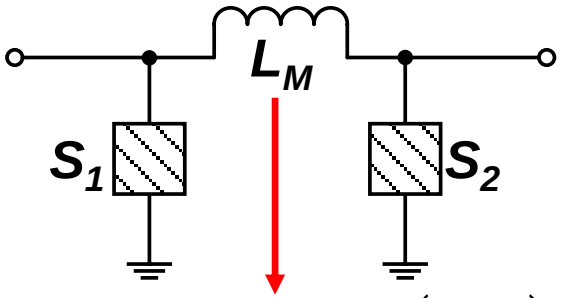




- Same physical length *TL* can show different reactance @ two different frequencies







$$j\omega L_M = jZ_0 \sin\left(\frac{2\pi}{\lambda} l\right)$$

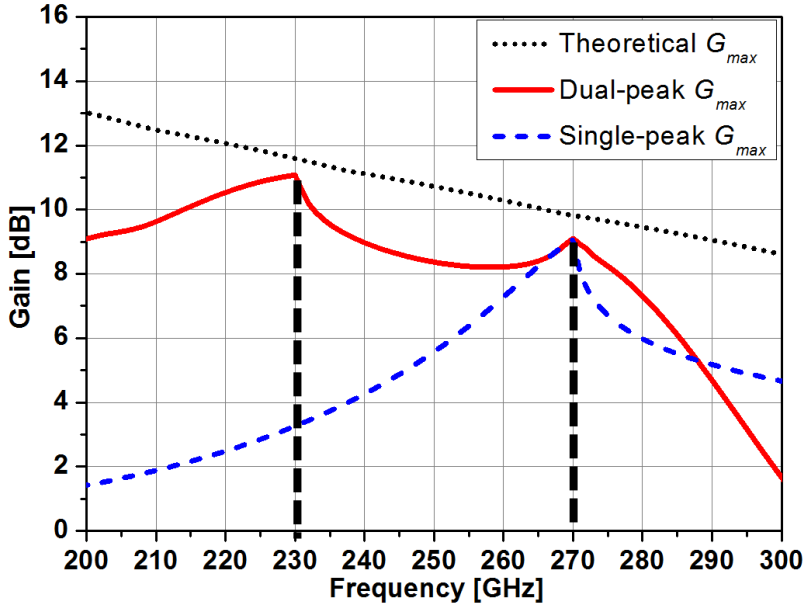
Z_0 : characteristic impedance of *TL*

l : physical length of *TL*

λ : wavelength of *TL*

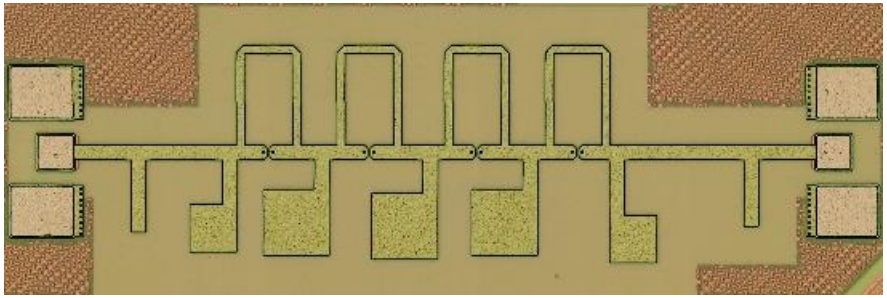
Dual-peak G_{max}-core & Chip Photo

❑ Two target frequencies : f_L=230GHz and f_H=270GHz



- Power gain boosting to G_{max} @ f_L and f_H
- Pseudo gain booting @ frequency between f_L and f_H

❑ Chip photo



- 65nm CMOS process
- Active area : 330x160 μm^2
- Total area : 590x240 μm^2

Performance Comparison

References	This work	JSSC 17	MTT 13	MWCL 16	EL 11	TST 15
Technology	65 nm CMOS	65 nm CMOS	40 nm CMOS	90 nm CMOS	65 nm CMOS	40 nm CMOS
f_{max} (GHz)	395	352	275	300	N/A	400
f_o (GHz)	227.5-257.2	257	213.5	205	200	197-288 (Multiband)
Topology	4 CS stages	4 CS stages	9 CS stages	5 CS stages	5 Diff. Cascode	5 CS stages
Gain [dB]	12.4±1.5	7.7±1.5	9±1.5	9±1.5	6.6±1.5	14.8±1.5
Gain/stage [dB]	3.1±0.375	1.93±0.375	1±0.17	1.8±0.3	1.12±0.3	2.96 ± 0.3
DC Power [mW]	23.8	27.6	42.3	39.1	108	-
3dB-Bandwidth [GHz]	29.7 (12.3%)	12.2 (4.7%)	13 (6%)	9.7 (4.7%)	4 (2.1%)	10.1 (<5%)
P_{sat} [dBm]	-4.94~-3.31	-3.9	-3.2	-1.6	< -10	6.1
OP_{1dB} [dBm]	-6.72~-5.09	-5.5	-7.2	-5.8	-	1
*MAX PAE [%]	1~1.56	1.35	0.75	-	< 0.09	-