Pomerači faze reflektivnog tipa

[13M071MMT] - Milimetarski talasi

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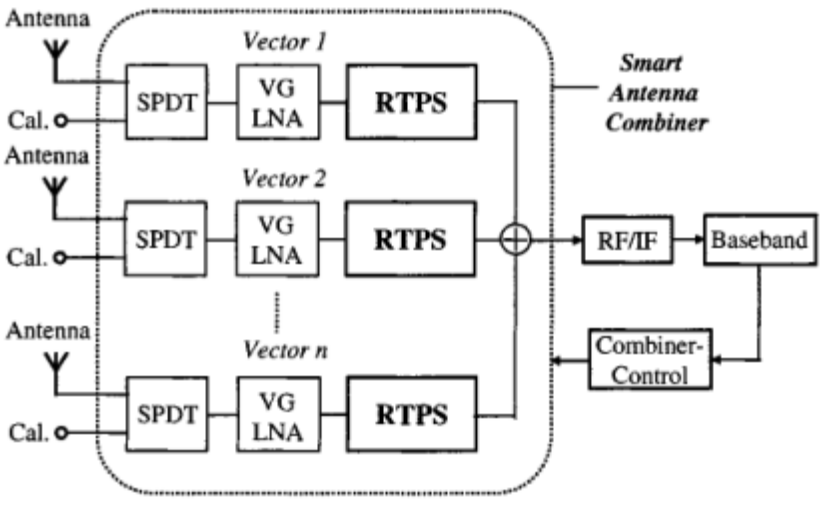
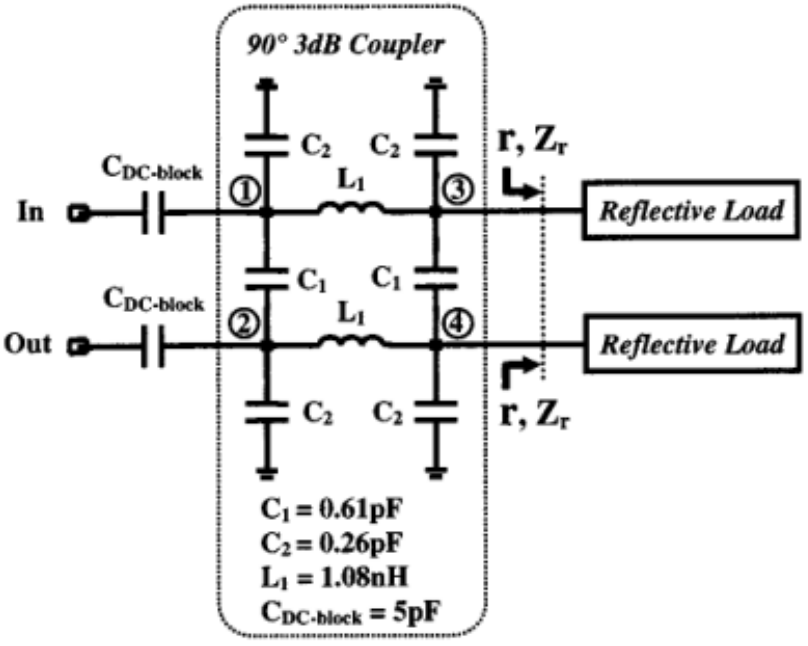
Uvod

Sadržaj prezentacije

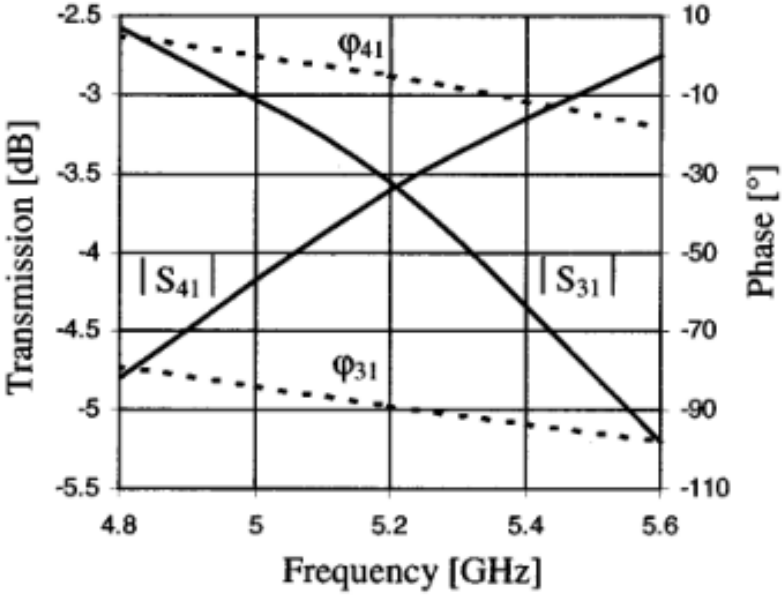
- Pomerač faze reflektivnog tipa sa 360^o opsegom za *smart* antenske sisteme za C-opseg u 0.6 μm GaAs MESFET tehnologiji (2002)
- 16-elementni fazirani niz kao prijemnik za opseg oko 60 GHz u IBM 0.12 μm SiGe BiCMOS tehnologiji (2011)
- Pomerač faze reflektivnog tipa sa konstantnim gubicima za oko 24 GHz u 0.18 μm CMOS tehnologiji (2015)

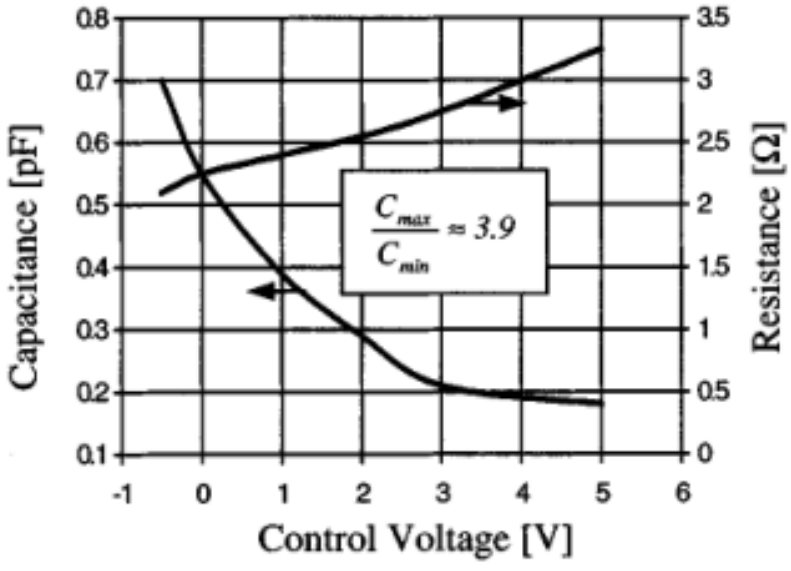
Prijemnik i hibridni sprežnjak



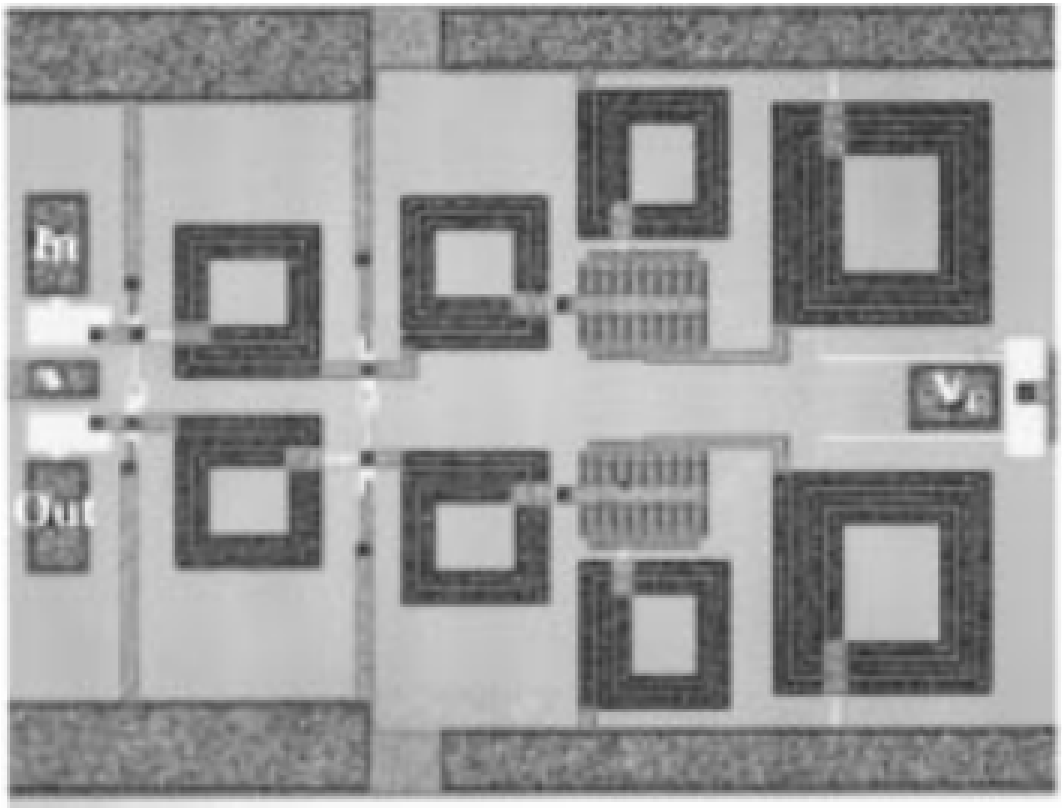


S parametri


-2.5
-3
-3.5
-4
-4.5
-5
-5.5
Transmission [dB]
10
-10
-30
-50
-70
-90
-110
Phase [°]
φ41
φ31
|S41|
|S31|
4.8
5
5.2
5.4
5.6
Frequency [GHz]

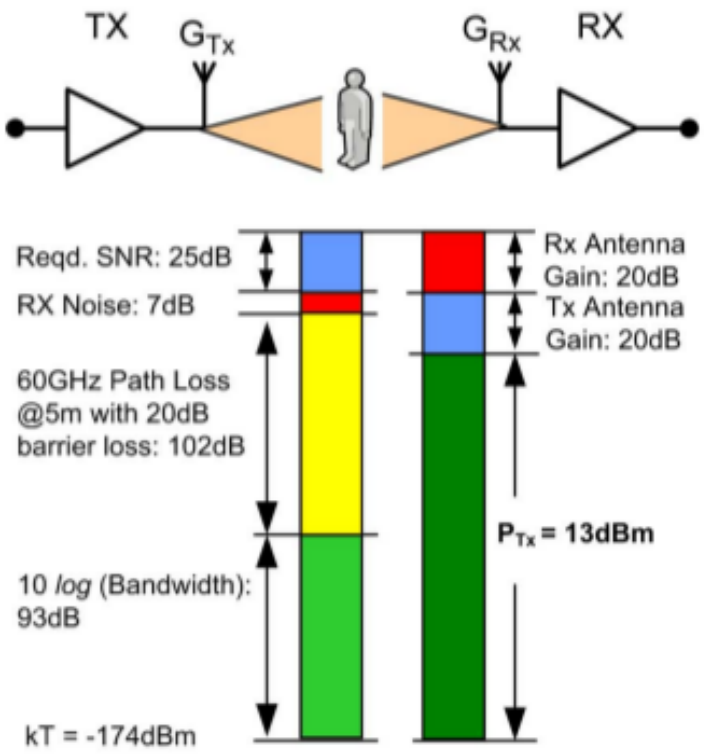

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
Capacitance [pF]
3.5
3
2.5
2
1.5
1
0.5
0
Resistance [Ω]
$\frac{C_{max}}{C_{min}} \approx 3.9$
-1
0
1
2
3
4
5
6
Control Voltage [V]

Lejaut RTPS-a 0.85mm^2 x 1.1mm^2

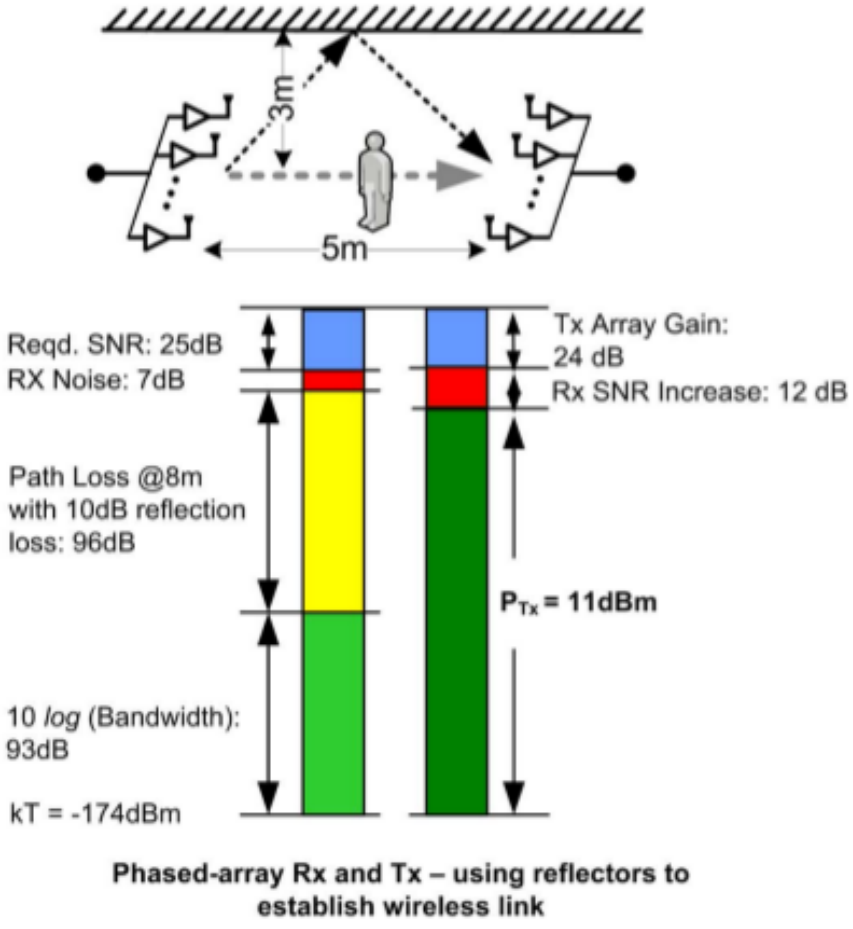


učestanost	5.15 GHz - 5.7 GHz
opseg faznog pomeraja	90^o / 360^o
gubici	-3.2 dB /-9 dB
varijacija gubitaka	/
S11	/
potrošnja	0
površina na čipu	0.9 mm^2

Poređenje bežičnih linkova antenskog elementa i antenskog niza

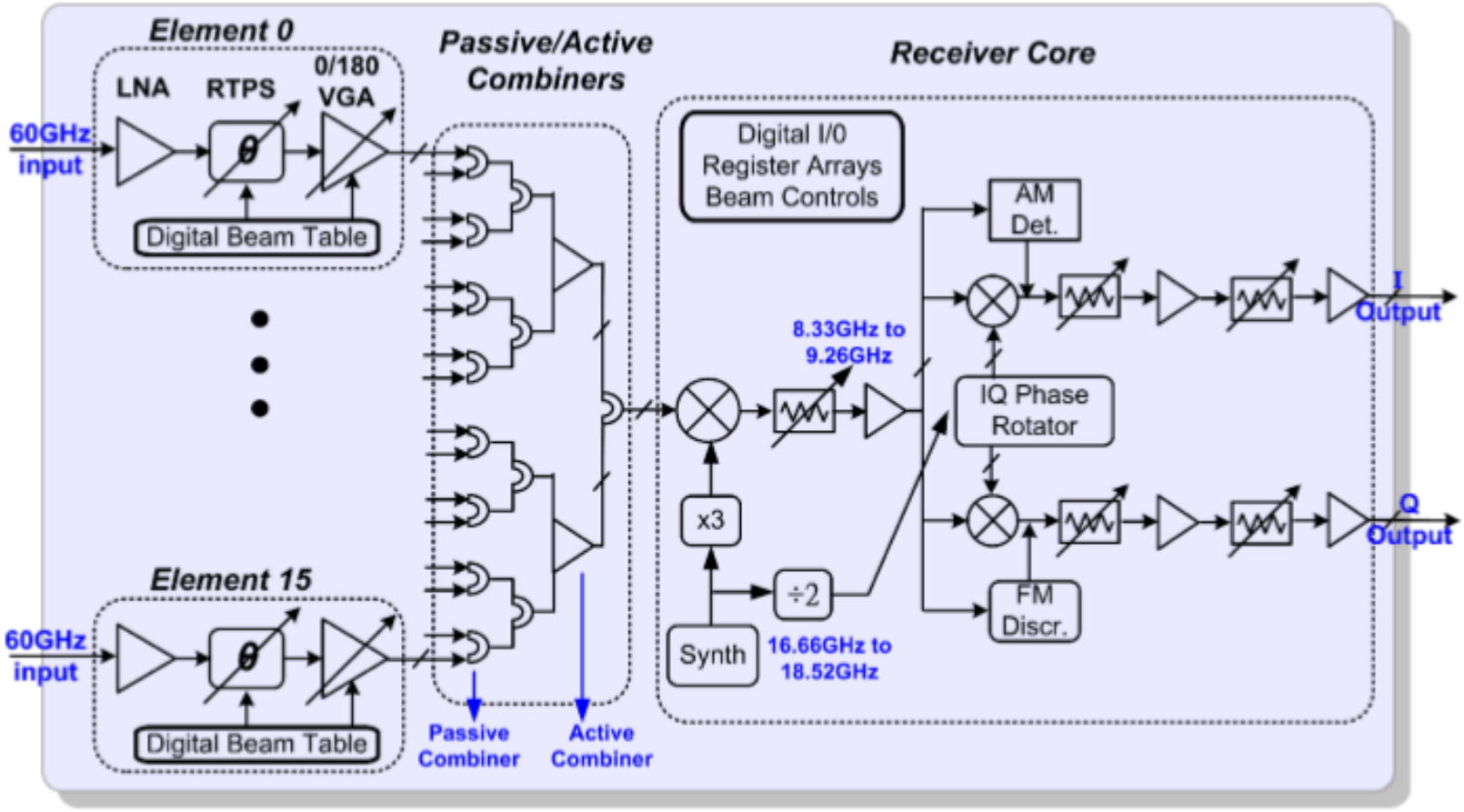


Single-element with high-gain antenna

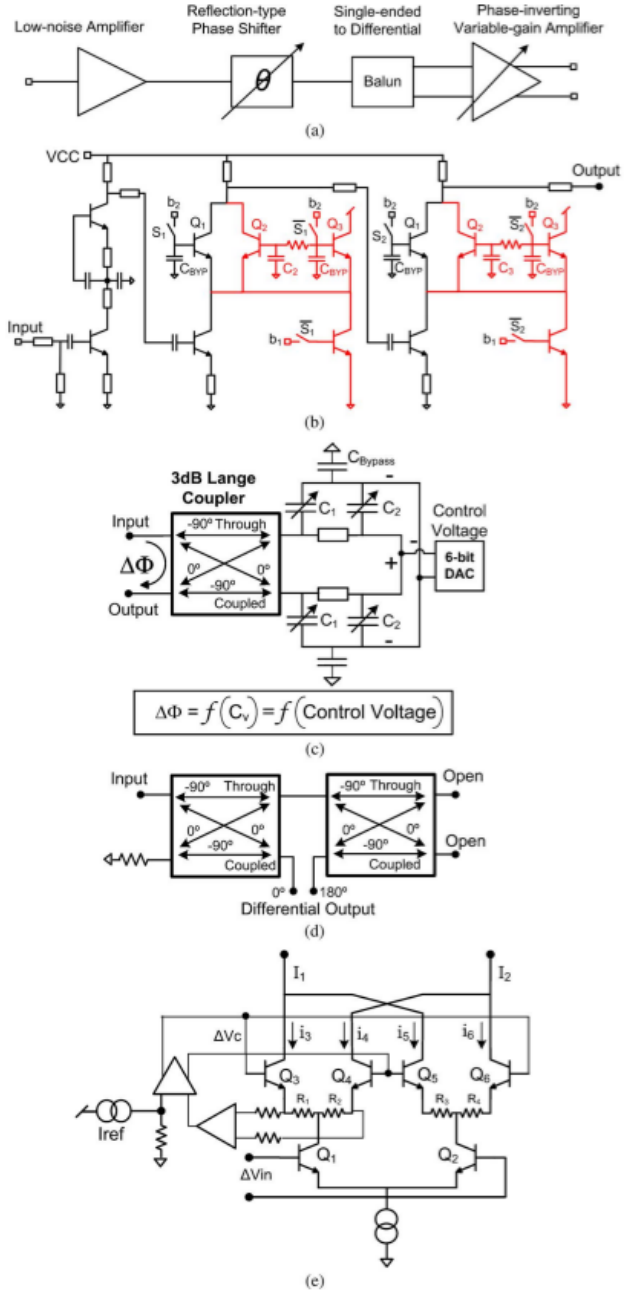


Phased-array Rx and Tx – using reflectors to establish wireless link

Arhitektura prijemnika

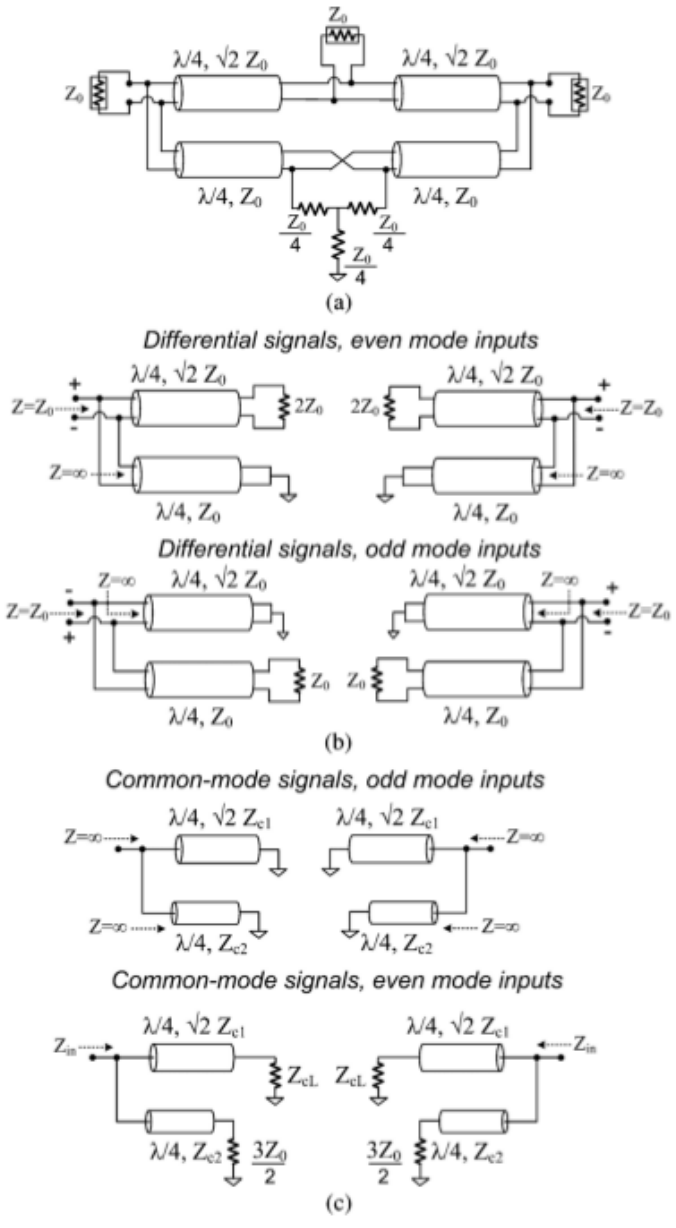


Arhitektura prijemnika



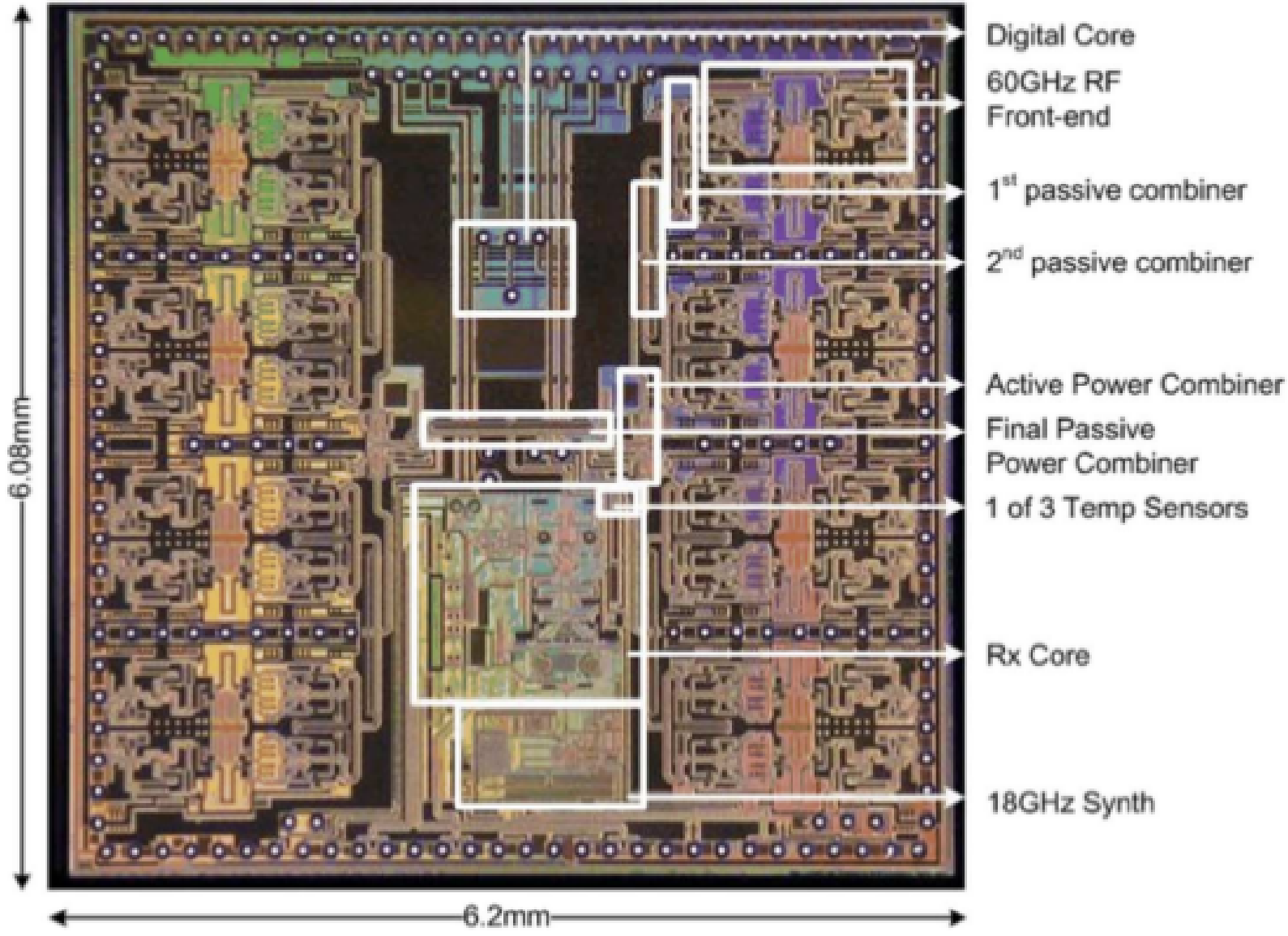
- a - *RF front end*
- b - *LNA*
- c - *RTPS*
- d - *Lange- Lange BALUN*
- e - *PIVGA*

Gysel kombajner



pasivni *combiner*
analiza ponašanja
i izolacije

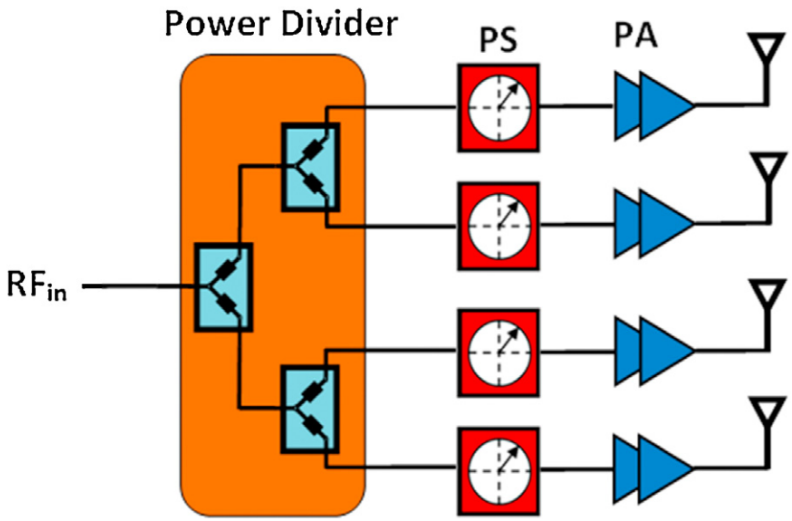
Lejaut prijemnika fazirani niz



Pregled rezultata

učestanost	57.2 - 65.9 GHz
opseg faznog pomeraja	360^o

Beamforming predajnik



Specifikacije:

- varijacija slabljenja u odnosu na fazni pomeraj
- potrošnja

Hibridni sprežnjak

$$\phi = -\frac{\pi}{2} - 2tan^{-1}(\frac{X}{Z_0})$$

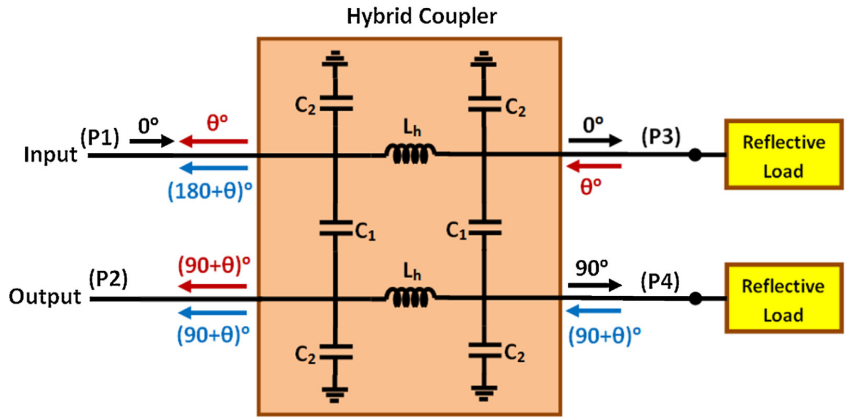
$$\Delta\phi = 2[tan^{-1}(\frac{Z_{max}}{Z_0}) - tan^{-1}(\frac{Z_{min}}{Z_0})]$$

Vrednosti *lumped* elemenata:

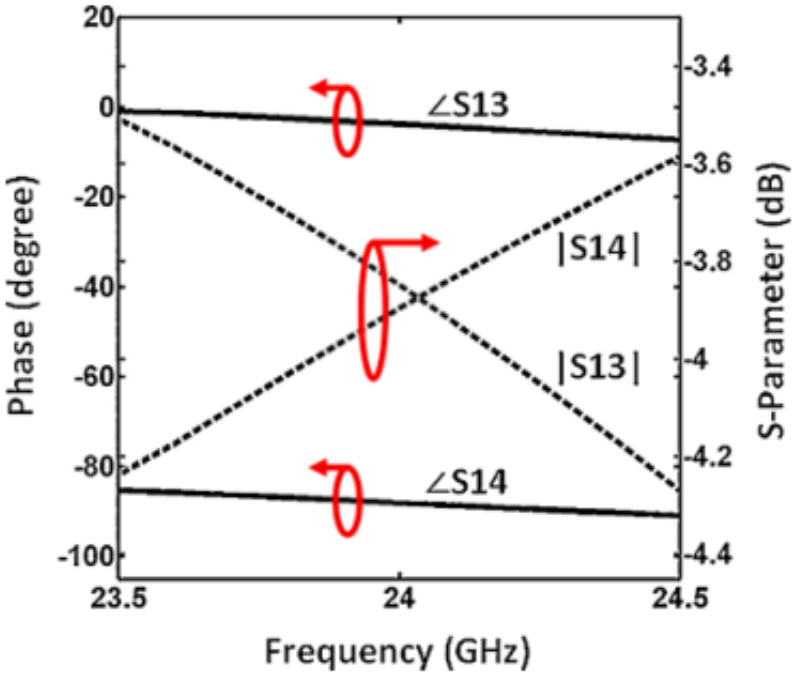
$$L_h = \frac{Z_0}{\sqrt{2}\omega_0}$$

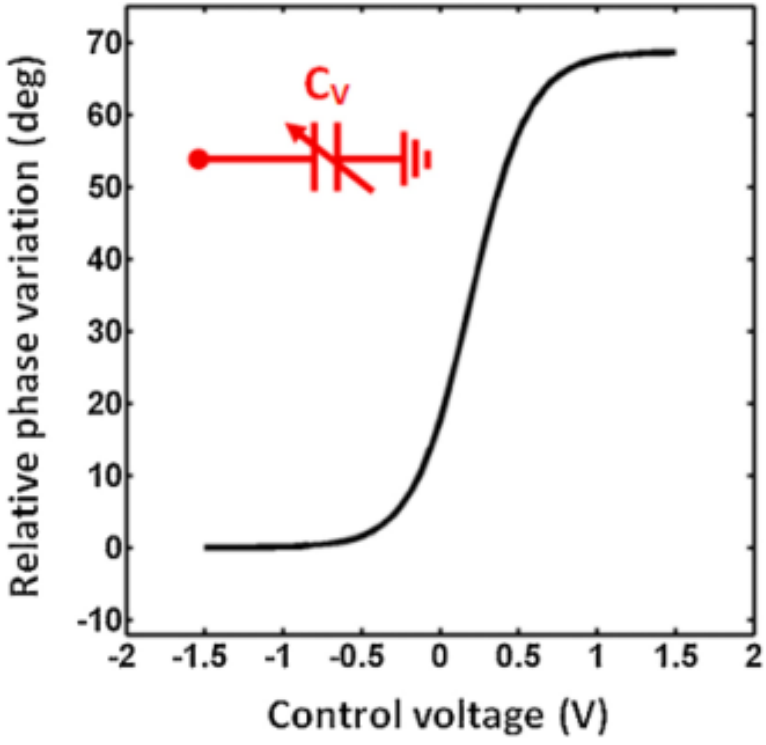
$$C_1 = \frac{1}{\omega_0 Z_0}$$

$$C_2 = \frac{1}{\omega_0^2 L_h} - C_1$$

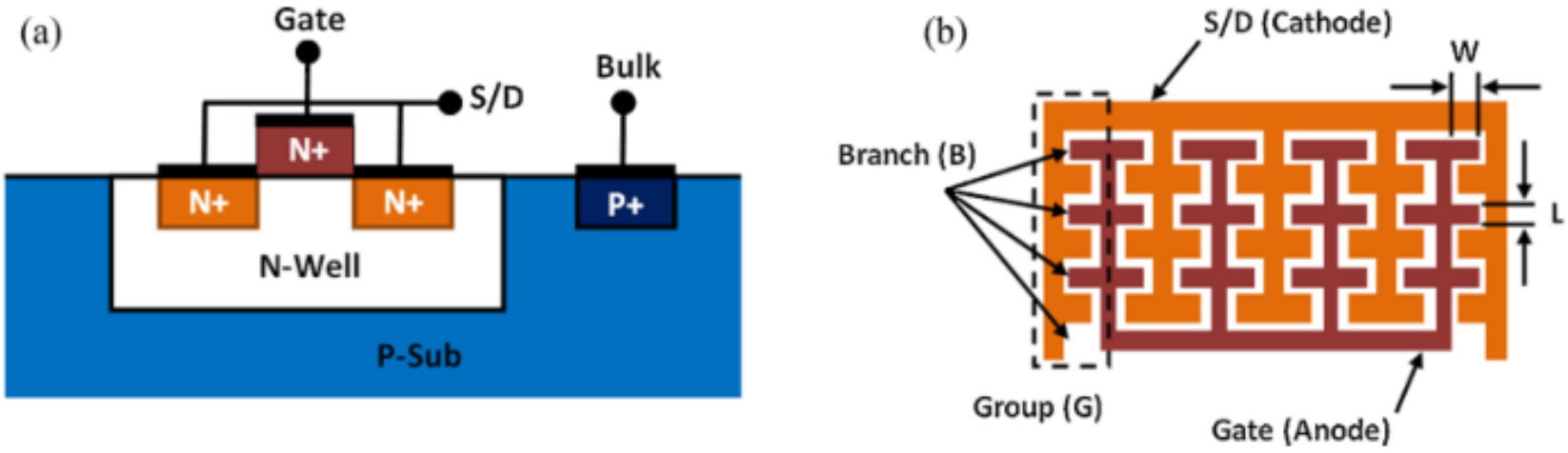


Rezultati simulacija



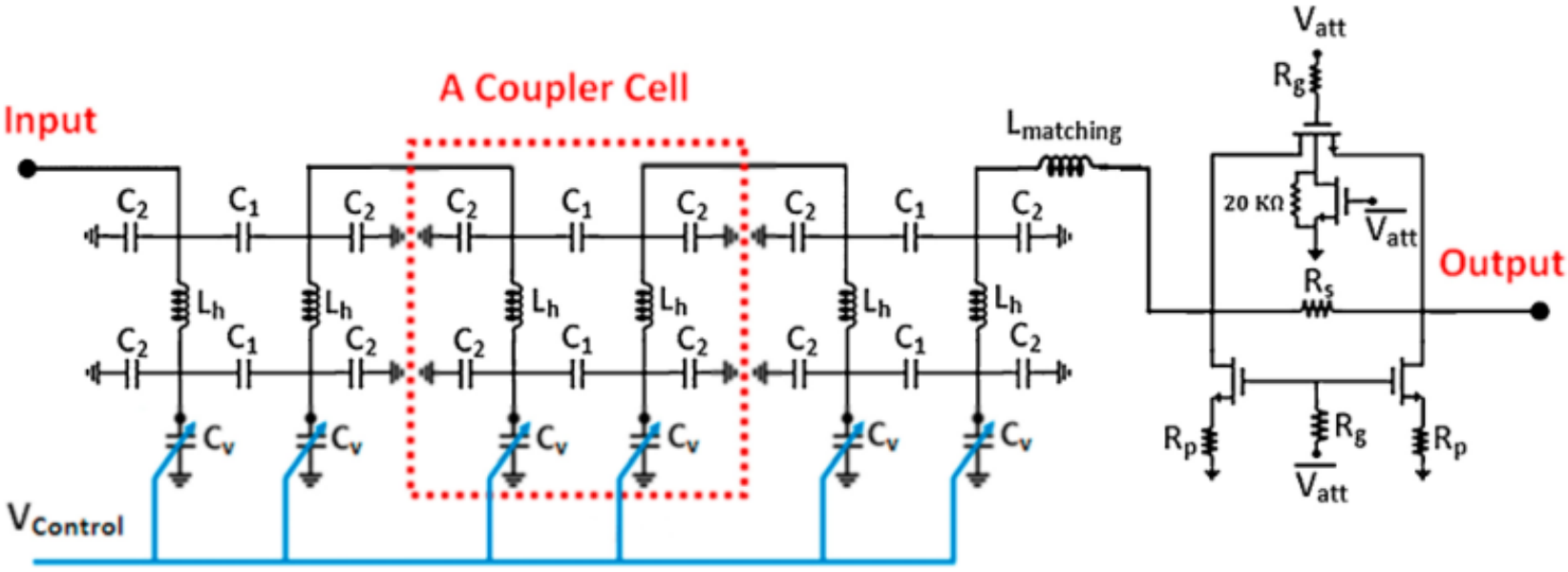


AMOS varaktor

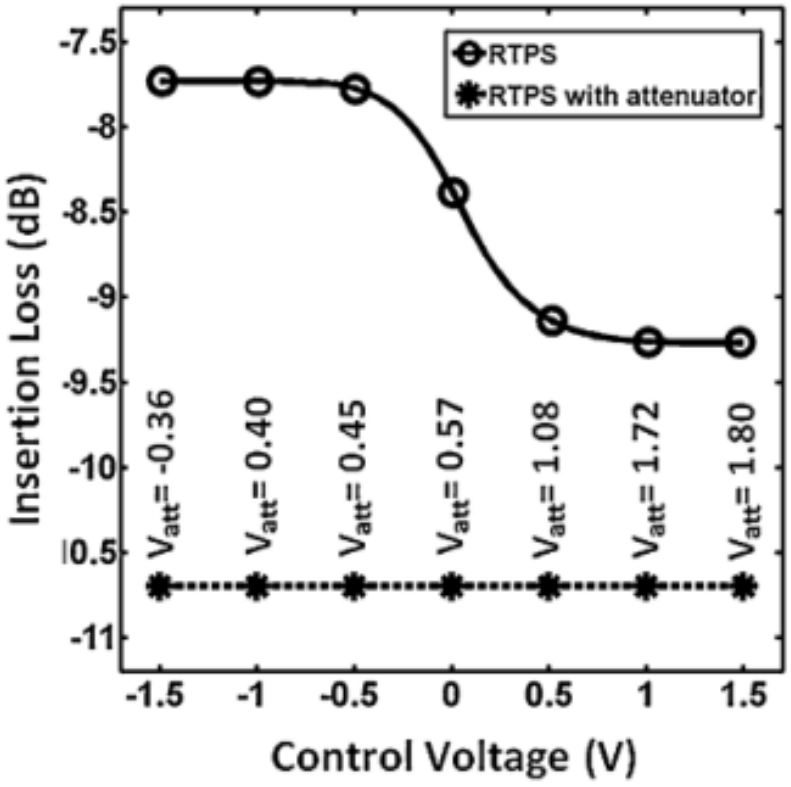


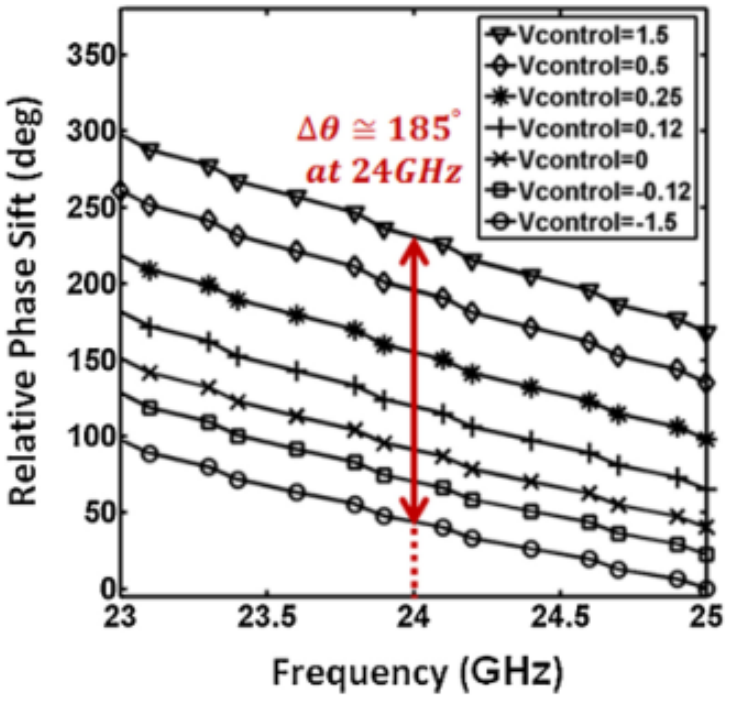
Varaktor ima opseg za podešavanje of 80 fF do 240 fF, sa prosečnom parazitnom otpornošću od 1.5 Ω i prosečnom parazitnom kapacitivnošću 8 pH.

Shema sprežnjaka i atenuatora

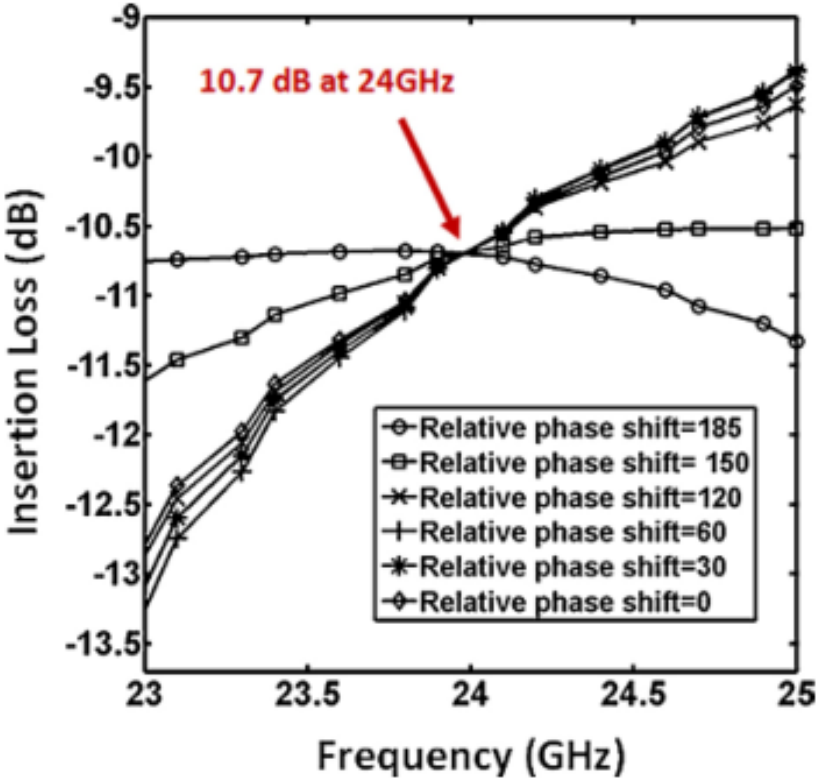


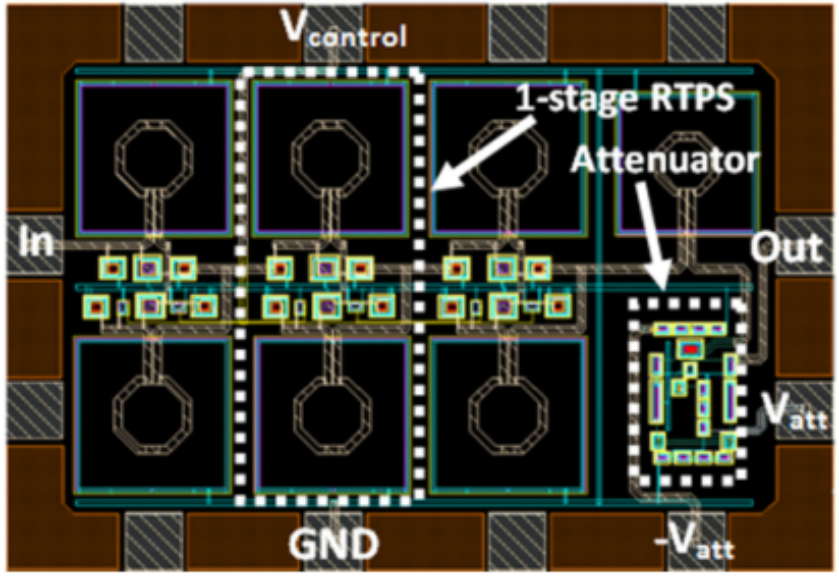
Rezultati simulacija





Rezultati simulacija i lejaut





Pregled rezultata

učestanost	24 GHz
opseg faznog pomeraja	185^o
maksimalni gubici	10.7 dB
varijacija gubitaka	0
S11	< 15 dB
potrošnja	0
površina na čipu	0.7 mm^2

Dodatno čitanje I


F. Ellinger, R. Vogt, and W. Bachtold.
Ultra compact reflective type phase shifter MMIC at C-band with 360^o phase control range for smart antenna combining
IEEE J. Solid-State Circuits, vol. 37, no. 4, pp. 481–486, Apr. 2002.


A. Natarajan, S. Reynolds, M. Tsai, S. Nicolson, J. Zhan, D. Kam, D. Liu, Y. Huang, A. Valdes-Garcia, and B. Floyd.
Fully-Integrated 16-Element Phased-Array Receiver in SiGe BiCMOS for 60-GHz Communications
IEEE Journal of Solid-State Circuits, vol. 46, no. 5, May. 2011.


M. Askari, H. Kaabi, Y. S. Kavian.
A 24 GHz reflective-type phase shifter with constant loss in 0.18 μm CMOS technology
AEU - International Journal of Electronics and Communications 69:1134-1142, May. 2015.