RF-SoP using differential ports for WLAN

Microwave Circuit and System-on-Package Lab.
Graduate Inst. of Electronics Engineering,
National Taiwan University
盧信嘉

RF-SoP approaches

- Replace discrete components with embedded ones for size and area reduction.
- Addition of more functional blocks, such as an antenna or filters to the module.
- Optimize performance by replacing on-chip passives with high-Q passives embedded in package.

LTCC

- LTCC: low temperature cofire ceramic
- Multi-layer, vias, blind vias, buried resistors
- Passive elements, transmission lines can be placed inside or on surface of LTCC.
- Active elements on surface

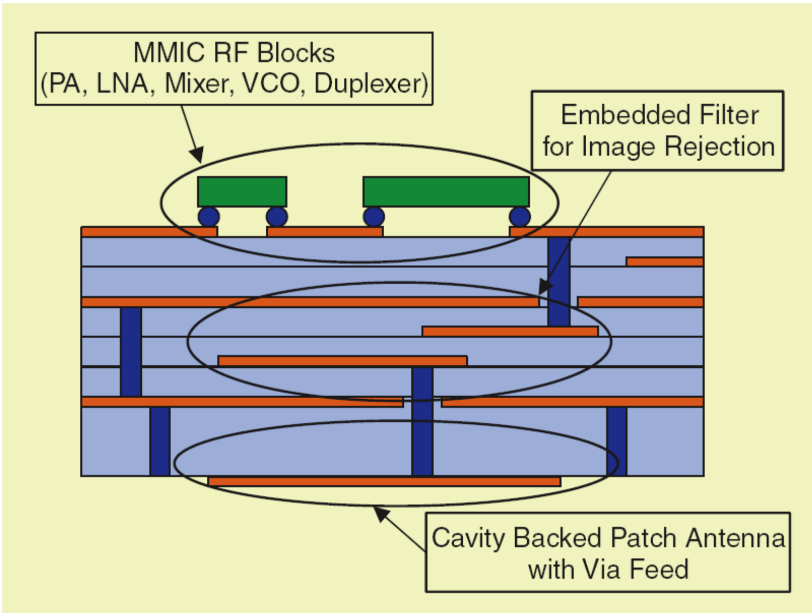
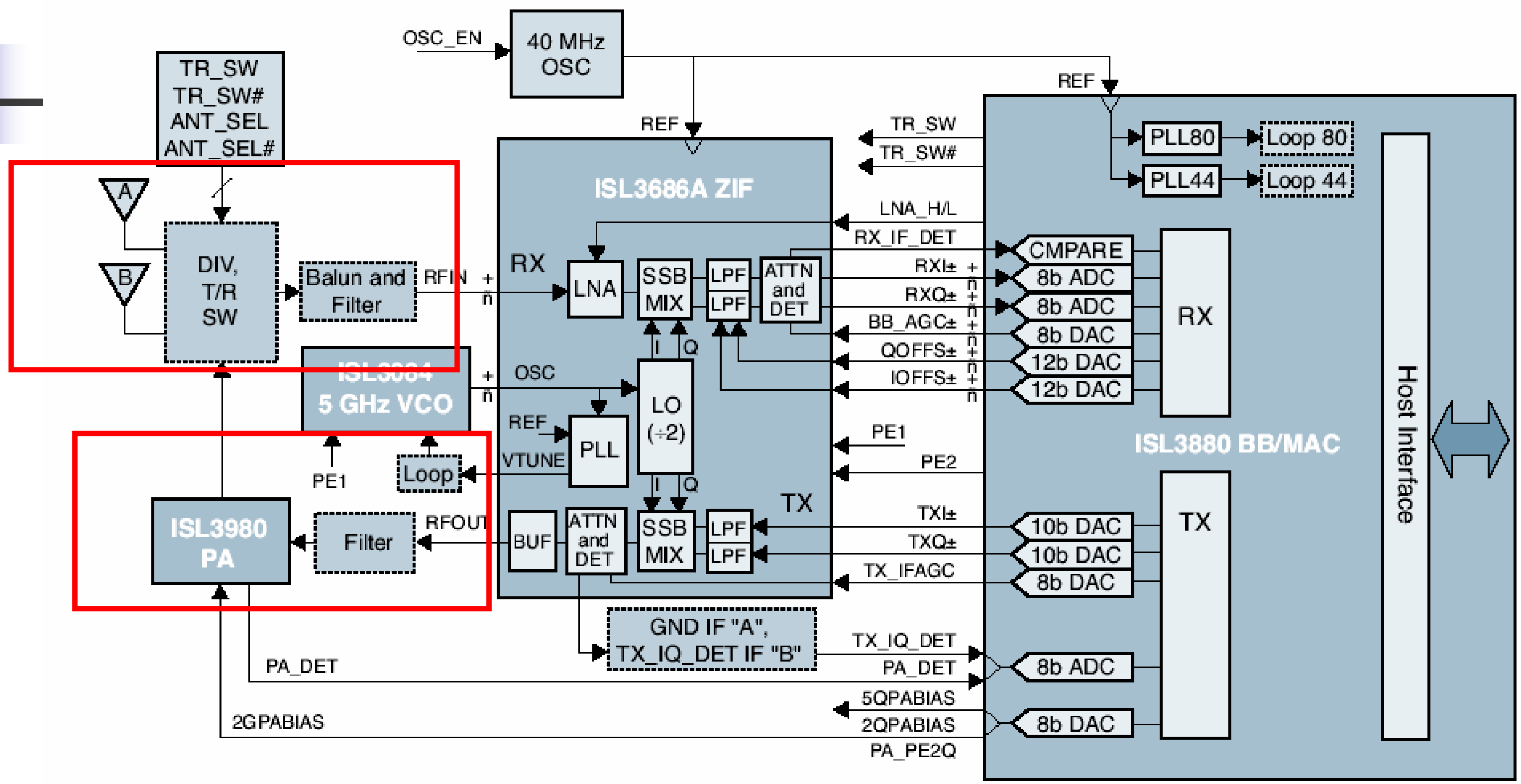


Figure 17. *3D integrated module with CBPA and embedded filter.*

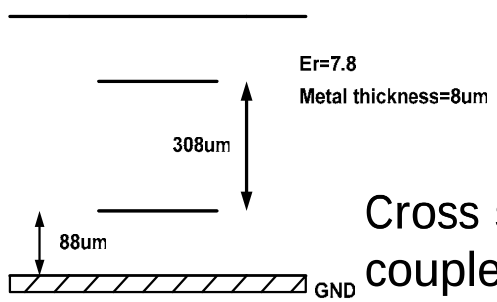


PRISM GT Block Diagram

- Block diagram of Conexant's Prism GT chipset.
- Balanced input or/and output at chipset.
- We will work on components inside the red boxes by using differential transmission lines

Why use balanced circuit?

- Eliminate baluns
- The differential operation could suppress the common mode interference.
- The virtual ground terminal would be compatible with the poor grounding of compact circuit.
- Antennas can also has differential feed.
- Broadside coupled stripline or microstrip line are chosen for same area occupation as single ended circuits.

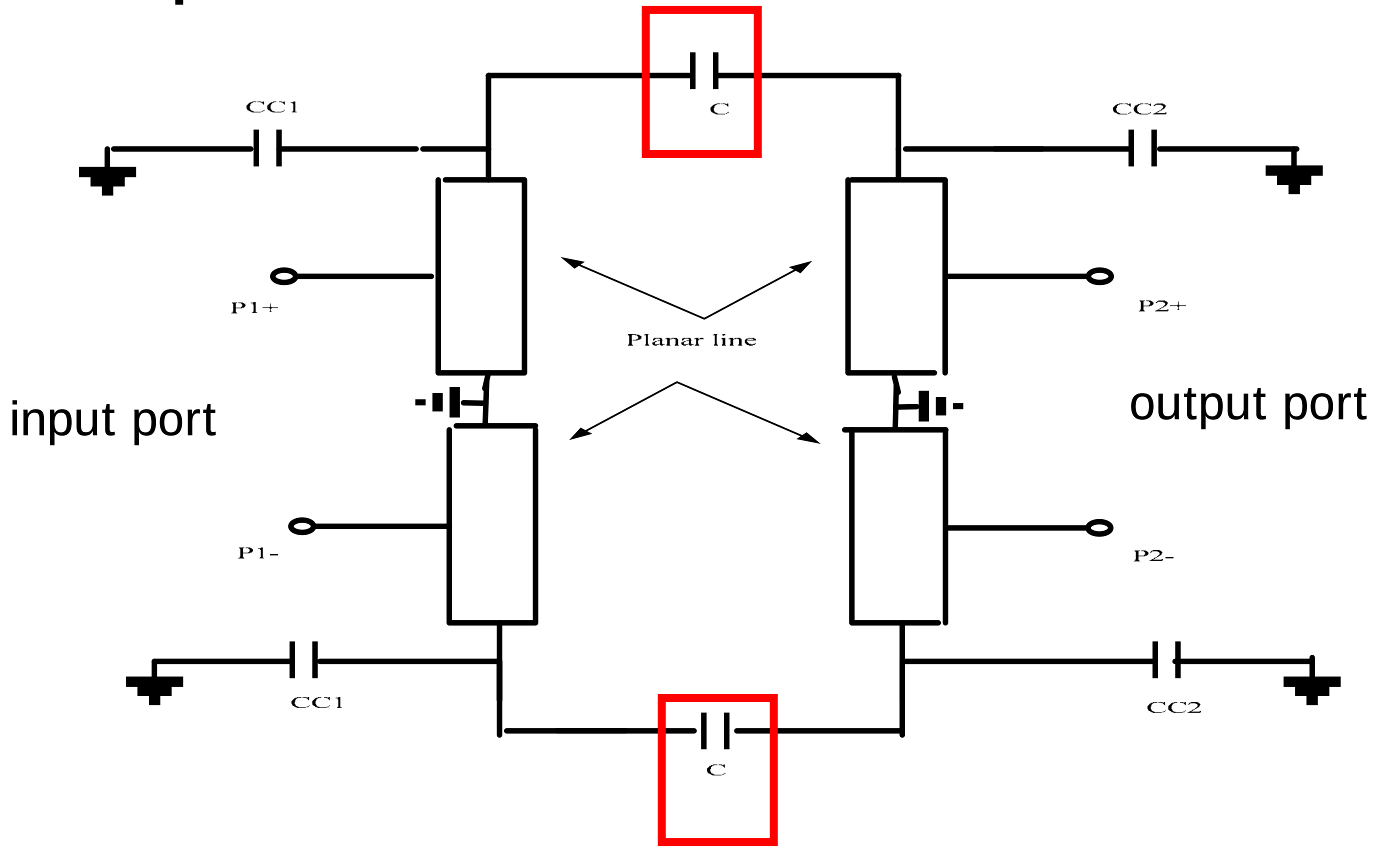


Cross section of a broadside coupled strip line

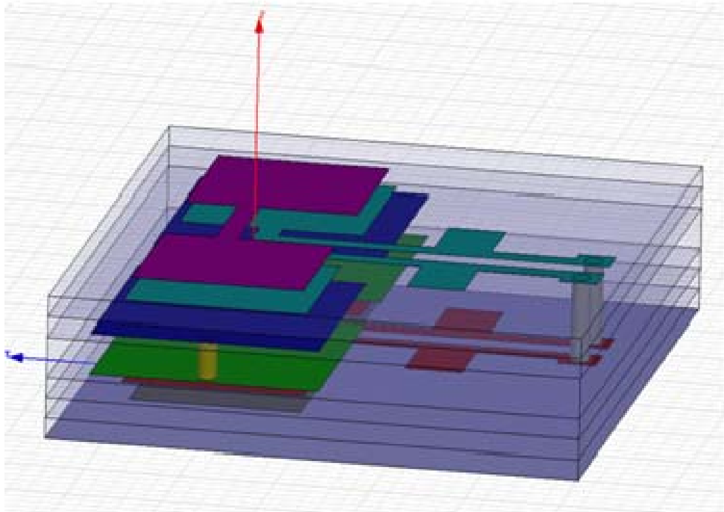
1. Differential bandpass filter

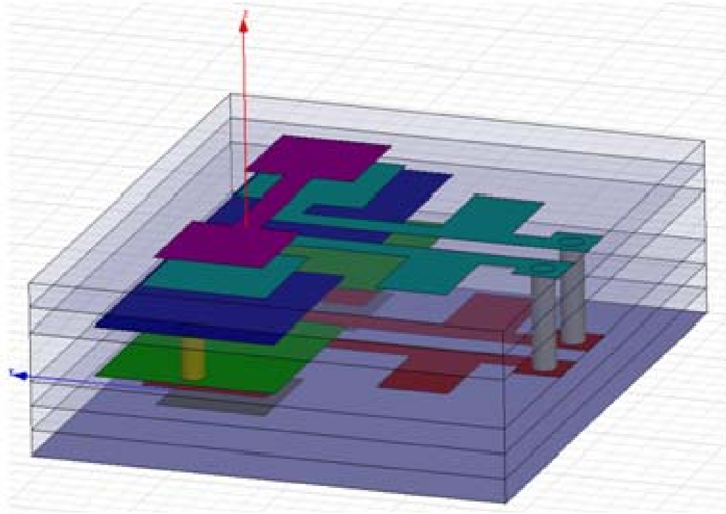
負責同學:蔡昆宏

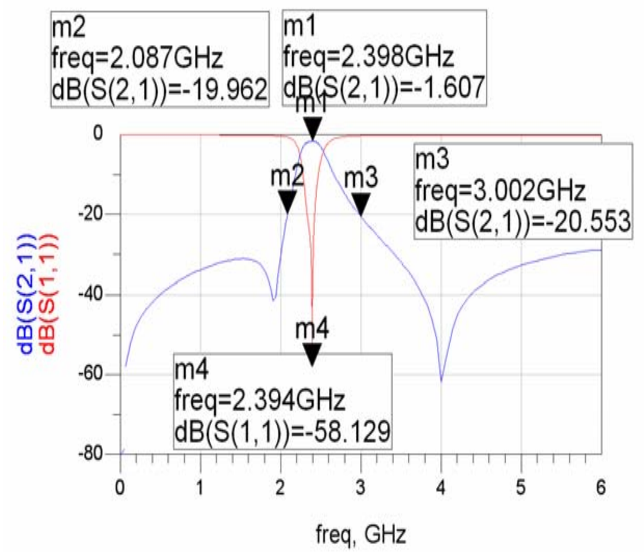
- Coupled transmission line
- Capacitor for additional zero

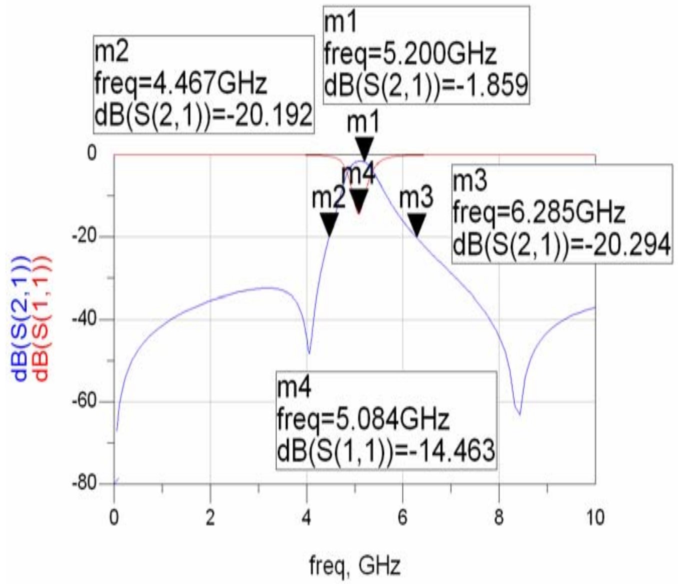


3D layout and simulation results









Performance comparison

	S11	S21	Attenuation of -20dB
BPF@2.4GHz	-28dB	-1.3dB	1.9GHz，3GHz
BPF+CAP.@2.4 GHz	-58dB	-1.6dB	2.1GHz， 3GHz
BPF@2.4GHz at [1]	-33dB	-2.2dB	2GHz， 3GHz
BPF@5.2GHz	-29dB	-1.1dB	4GHz， 6.2GHz
BPF+CAP.@5.2 GHz	-14dB	-1.8dB	4.46GHz，6.2GHz
BPF@5.8GHz at [1]	-13dB	-2.5dB	4.8GHz，6.8GHz

- [1] Young-Joon Ko, Jae Yeong Park, Jin-Hyung Ryu, Kyeong-Hak Lee, and Jong Uk Bu, “A miniaturized LTCC multi-layered front-end module for dual band WLAN(802.11a/b/g) applications,” *IEEE MTT-S Diggest*, pp.536-566, June 2004.

2. Differential T/R Switch

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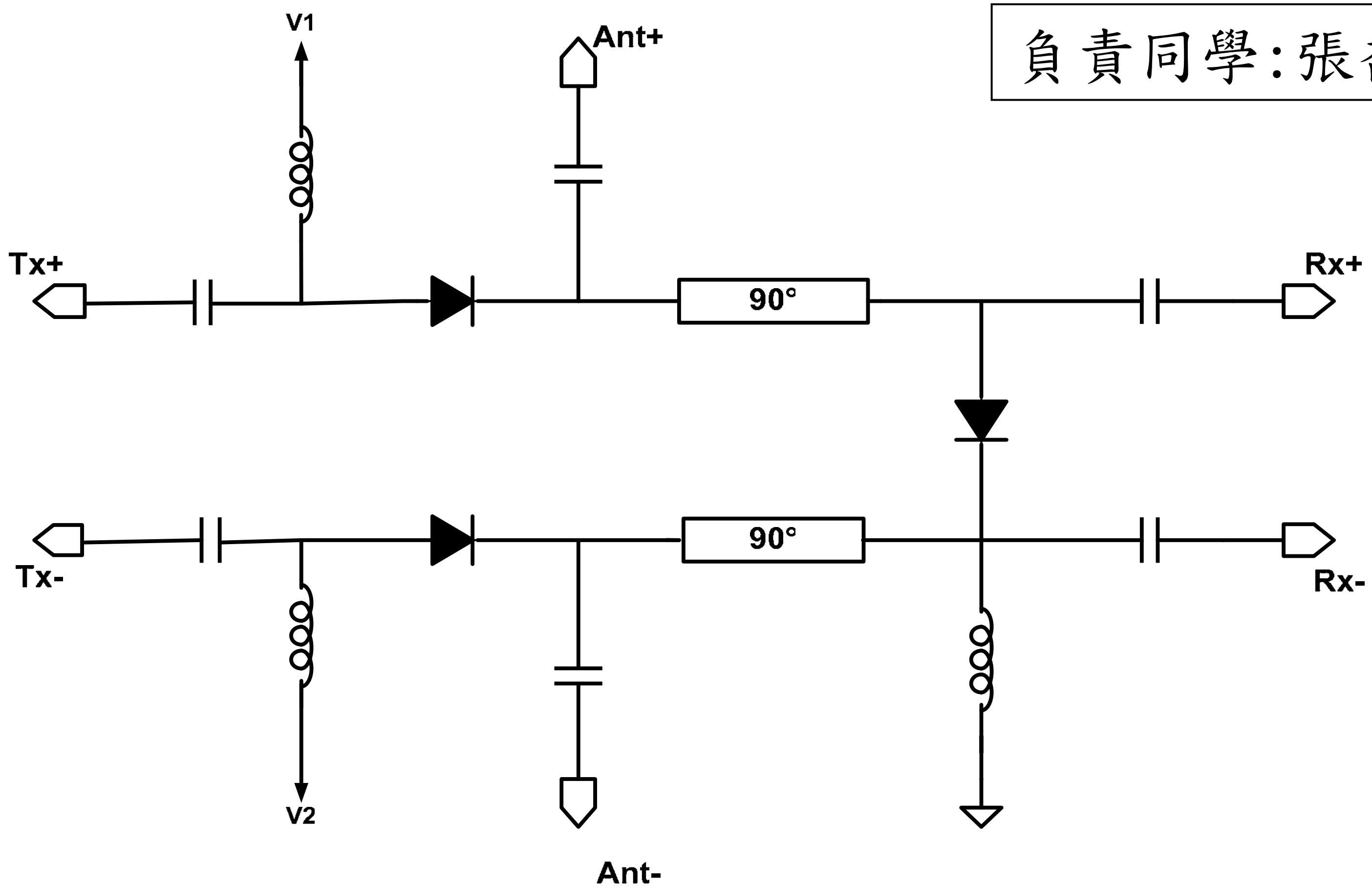
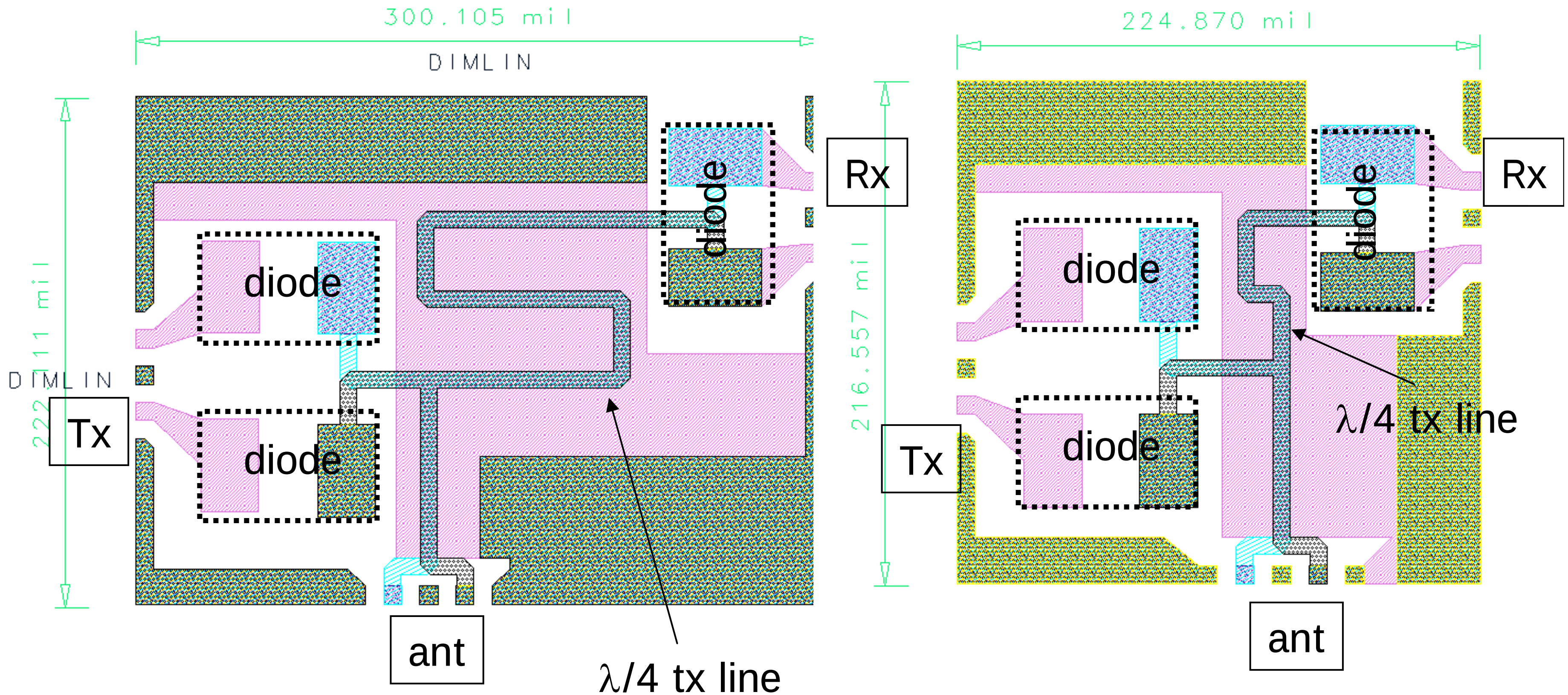


- Three PIN Diodes
- No DC Power consumption at Receiving Mode

LTCC Layout @2.45GHz and 5.2GHz



2.45GHz

5.2GHz

802.11 a/g Simulation Data

802.11g	Mode	
Parameter	RX(0V)	TX(3mA)
Insertion Loss@2.45GHz	0.5dB	1.84dB
Isolation TX/RX	45.9dB	45.9dB
Isolation ANT/RX	--	30.16dB
Isolation TX/ANT	46.2dB-	--
Power Handling	23dBm	23dBm

802.11a	Mode	
Parameter	RX(0V)	TX(3mA)
Insertion Loss@5.25GHz	2.5dB	1.836dB
Isolation TX/RX	45dB	18.5dB
Isolation ANT/RX	--	17.6dB
Isolation TX/ANT	42dB	--
Power Handling	23dBm	23dBm

3. Differential Self-biased PA for 802.11a

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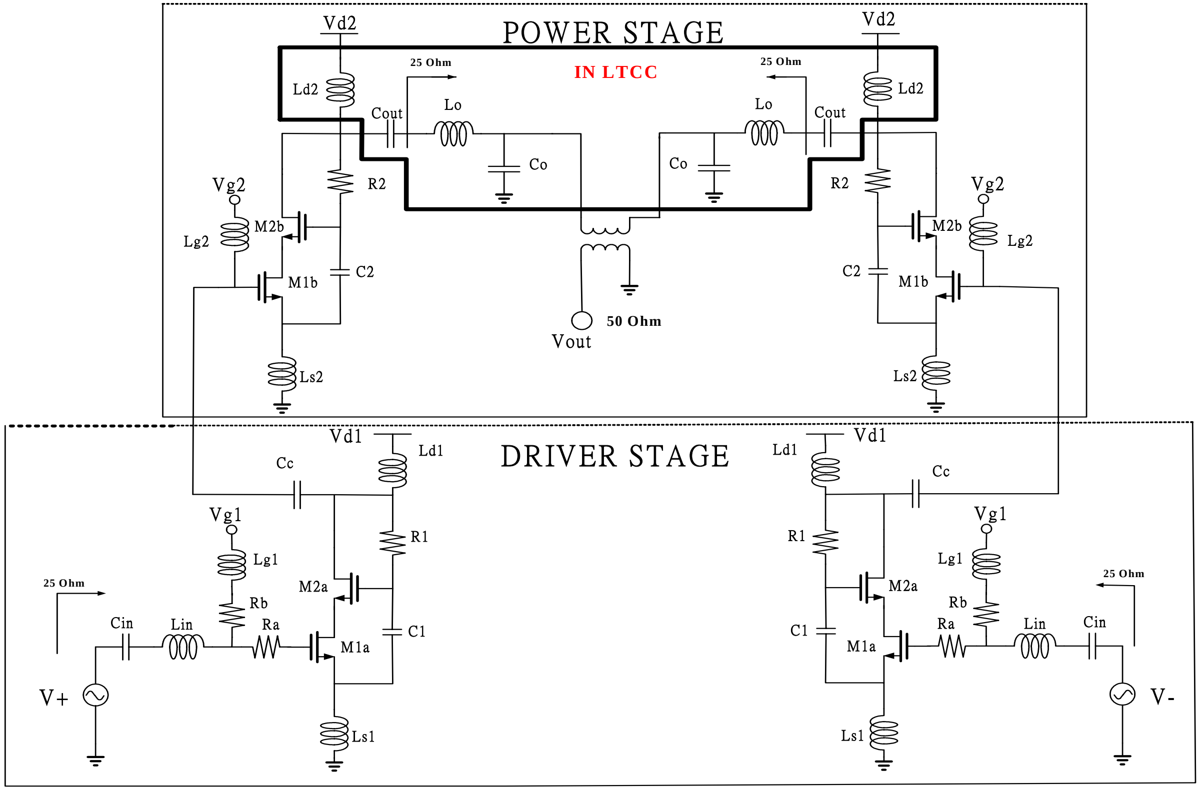
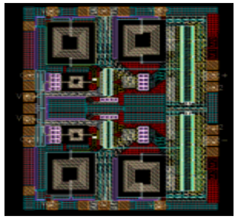
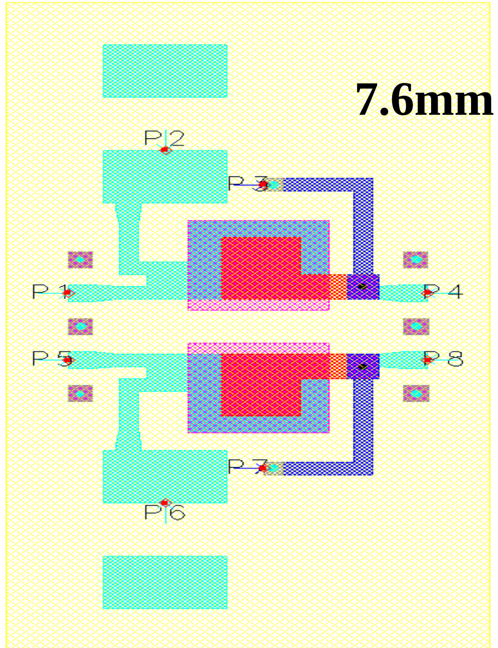
- Two stage differential PA , TSMC 0.18 CMOS process
- Output and input both match to 50 Ω
- Driver stage is class A, power stage is class AB



Layout and simulation results





Technology	WLAN 802.11a 規格[1], [6]	TSMC 0.18um 1P6M RF_CMOS
Supply Voltage	1.8 V	1.8 V
Center Frequency	5.25GHz	5.25 GHz
Output Power (Psat)	>23 dBm	23.2 dBm
Power Added Efficiency (PAE) @ Pout = 23.2 dBm	>15 %	38 %
Output P1dB	>19 dBm	19.497 dBm
Output IP3	>26 dBm	28.8734 dBm
Power Gain @ Pin = -12.5dBm	20 dB	19.5 dB
DC current of driver stage		70.64mA
DC current of power stage		72.8mA