A Ka-band 35-dBm $P_{0.1dB}$ Low-loss Monolithic SPDT Switch using Anti-series Diode Connection

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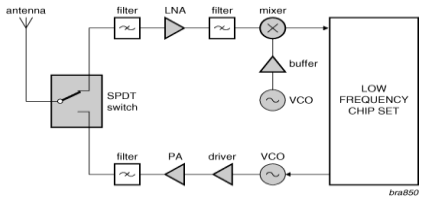
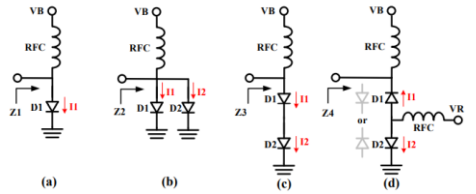
Introduction



- A high power low-loss high-isolation switch is crucial for the transceiver, especially for millimeter-wave 5G mobile applications.
- The input P1dB of the GaAs HEMT or CMOS switch is usually lower than 30 dBm due to the device characteristic.

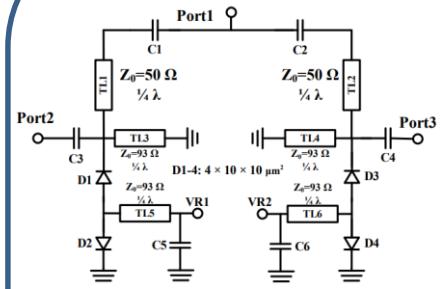
New Insight



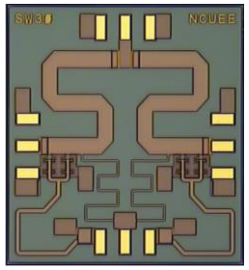
- Negative body bias technique
- Innovative topology:
  Anti-series diode connection

P1dB of the switch is a key specification for the transmitter operation since it limits the maximum RF output power.

Circuit Design



Schematic

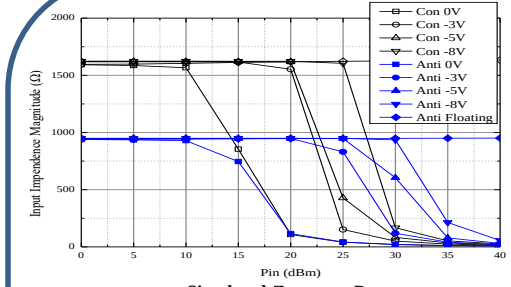


Chip photo (1×1 mm²)

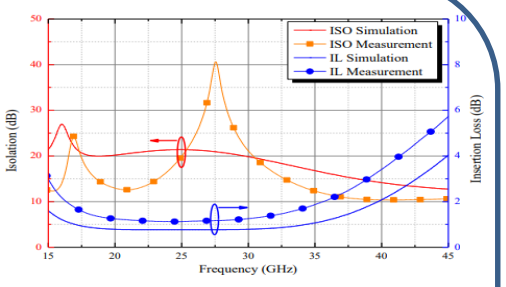
- PIN Diode
  - ➢Size: 10×10 μm² each
  - ➢Turn-on resistance: 3 Ω
  - ➢Turn-off capacitance: 25 fF
- DC Block: C1, C2, C3, C4
- Bypass capacitor: C5, C6
- Quarter-wavelength TL: TL1, TL2
- RF Choke: TL3~TL6

- ☐ The input impedance of diodes is very high when diodes are turned off
- ☐ When increasing the RF power, the input impedance decreases due to the rectification. Therefore, the insertion loss (or P1dB) and isolation are both degraded under the high-power condition.

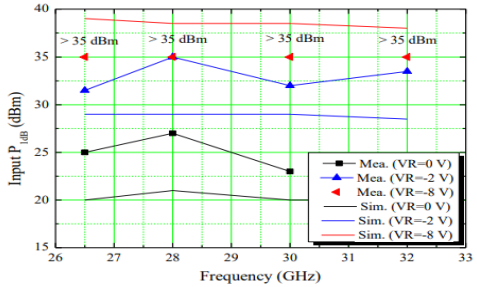
Experimental Result



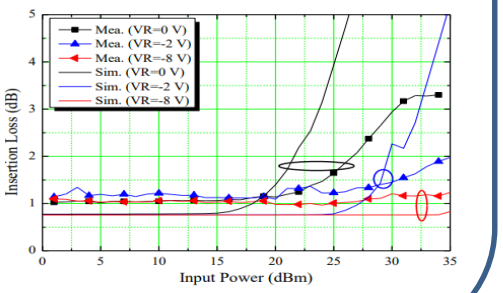
Simulated Z_{in} versus P_{in}



Simulated and measured IL&ISO



Simulated and measured IP_{1dB} versus frequency with various VR



Simulated and measured IL versus P_{in} with various VR @28 GHz

Conclusion

The anti-series diode-connection featuring:

- ✓ High Isolation
- ✓ Low insertion loss
- ✓ High power handling
- Therefore the proposed switch is suitable for advanced transceiver

- ◆ This work has the lowest insertion loss and highest 1 dB compression point among all the reported microwave and mm-wave monolithic switches.