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Microwave and Millimeter Wave Circuits and Devices, CAD 2

A Fully Integrated Variable Gain Amplifier for X-band Application	1824
<i>Jageon Koo, Junhyung Jeong, Yongchae Jeong,</i>	
X-band GaN Power Amplifier Using Interposer-based MMIC	1825
<i>Junhyung Jeong, Jageon Koo, Yongchae Jeong,</i>	
Accurate Design of a W-band Full Band Frequency Tripler Based on Anti-parallel GaAs Schottky Varistor Diode Pair	1826
<i>Jiangling Dou, Jinping Xu, Shu Jiang,</i>	
Design of a Compact Fractional-N PLL-based Frequency Synthesizer for Dual-band DBS Applications	1827
<i>Zhiqiang Liu, Jinping Xu, Gang Liu, Yunlong Pan,</i>	
Power Limiter Based on Reflected Phase Shifter with Ferroelectric Varactor	1828
<i>Olesya T. Drak, Alexey N. Vasiliev, Anton I. Zadorozhny, Andrey V. Tumarkin, Victor D. Draznin,</i>	
Analog Varactor Phase Shifter	1829
<i>Artem Vilenskiy, Mikhail Makurin,</i>	
Design of a Wideband CMOS Variable-gain Low Noise Amplifier	1830
<i>Chen Fan, Zhigong Wang, Rong Wang,</i>	
Design of a High Speed SP4T Switch at Ka-band	1831
<i>Le Ren, Jian Zhang, Jinping Xu,</i>	
Design of LLC Converter Using Method Figure of Merit for Perspective Semiconductors and Magnetic Components	1832
<i>Boris Kozacek, Michal Frivaldsky, Viliam Jaros,</i>	
Design Approach for Microstrip PIN-diode Phase Shifters with Equalized Losses	1834
<i>Roman Semernya, Artem Vilenskiy, Vladimir Litun, Sergey Chernyshev,</i>	
Impact of Geometrical Parameters on Performance of MWCNT Based Chip Interconnects	1835
<i>M. Kaur, N. Gupta, Arun Kumar Singh,</i>	
A Novel Design for Large-division-ratio Ring Coupler	1837
<i>Xuchun Zhang,</i>	

X-band GaN Power Amplifier Using Interposer-based MMIC

Junhyung Jeong, Jageon Koo, and Yongchae Jeong

Division of Electronics and Information Engineering, IT Convergence Research Center
Chonbuk National University, Republic of Korea

Abstract— Nowadays high power amplifier (PA) is an important element in RF wireless communications and radar systems. In order to achieve high power, high efficiency, and miniaturization, monotonic microwave integrated circuit (MMIC) designs with various dielectric materials and GaN transistors (TRs) are mainly performed. GaN process has high output power characteristic by high breakdown voltage, but it is mainly used TR die only because of high process cost. The MMIC technique is mainly used for the input/output matching circuits. A design method using a GaAs/Si substrate integrated passive devices (IPD) and a technique using high dielectric constant composite substrate are mainly used [1, 2]. However, these methods must use bonding wires to connect the GaN TR and the input/output matching circuits. The bonding wires degrade PA performances in the X band and difficult to stack the devices.

Figure 1 shows the proposed silicon interposer-based MMIC structure. Input and output matching circuits have the advantages of design freedom and reduce production cost by using standard silicon IPD process. The copper plate of the bottom is used for the grounding and heat dissipation characteristics of the GaN TR. In addition, the disadvantages of the bonding wire can be overcome because the GaN TR is embedded in a silicon interposer wafer.

To demonstrate the usefulness of the proposed interposer-based MMIC, a 70 W PA was simulated using CGHV1J070D of Cree Inc.. At 10 GHz, the output power and drain efficiency of simulated PA are obtained 49.5 dBm and 51.2% at the saturation point, respectively.

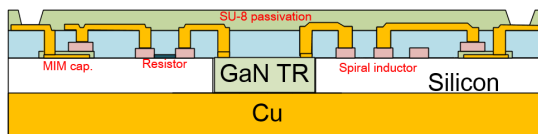


Figure 1: Fabrication layer of PAs using interposer-based MMIC.

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