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DECLARATION OF GERARD P. GRENIER

I, Gerard P. Grenier, am over twenty-one (21) years of age. I have never been convicted of a felony, and I am fully competent to make this declaration. I declare the following to be true to the best of my knowledge, information and belief:

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8. The article below has been attached as Attachment A to this declaration:

A.	S. Jeon et al., "A Scalable 6-to-18 GHz Concurrent Dual-Band Quad-Beam Phased-Array Receiver in CMOS", IEEE Journal of Solid-State Circuits, Vol. 43, Issue 12, December 2008.

9. I obtained a copy of Attachment A through IEEE Xplore, where it is maintained in the ordinary course of IEEE's business. Attachment A is a true and correct copy of the Attachment, as it existed on or about May 3, 2018.

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11. S. Jeon et al., "A Scalable 6-to-18 GHz Concurrent Dual-Band Quad-Beam Phased-Array Receiver in CMOS" was published in IEEE Journal of Solid-State Circuits,

Vol. 43, Issue 12. IEEE Journal of Solid-State Circuits, Vol. 43, Issue 12 was published in December 2008. Copies of this publication were made available no later than the last day of the publication month. The article is currently available for public download from the IEEE digital library, IEEE Xplore.

12. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001.

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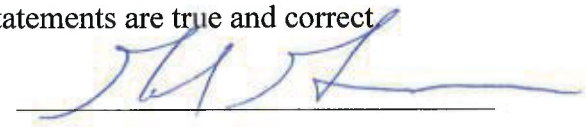
Executed on: 5 November 2018



ATTACHMENT A

A Scalable 6-to-18 GHz Concurrent Dual-Band Quad-Beam Phased-Array Receiver in CMOS

7 Author(s)

Sanggeun Jeon ; Yu-Jiu Wang ; Hua Wang ; Florian Bohn ; Arun Natarajan ; Aydin Babakhani ; Ali Hajimiri

View All Authors

Abstract:
This paper reports a 6-to-18 GHz integrated phased- array receiver implemented in 130-nm CMOS. The receiver is easily scalable to build a very large-scale phased-array system. It concurrently forms four independent beams at two different frequencies from 6 to 18 GHz. The nominal conversion gain of the receiver ranges from 16 to 24 dB over the entire band while the worst-case cross-band and cross-polarization rejections are achieved 48 dB and 63 dB, respectively. Phase shifting is performed in the LO path by a digital phase rotator with the worst-case RMS phase error and amplitude variation of 0.5deg and 0.4 dB, respectively, over the entire band. A four-element phased-array receiver system is implemented based on four receiver chips. The measured array patterns agree well with the theoretical ones with a peak-to-null ratio of over 21.5 dB.

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