

Design of a 2.4 GHz High-Performance Mixer with Current Bleeding Topology

Wah Ching LEE[^], Kim Fung TSANG*

[^]Department of Electronic & Information Engineering, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China.

*Department of Electronic Engineering, City University of Hong Kong, 83 Tat Chee Avenue, Kowloon, Hong Kong SAR, China.

enwclee@polyu.edu.hk, ee330015@cityu.edu.hk

Abstract— The important characteristics of a mixer including high conversion gain, low noise, high dynamic range, low third-order intermodulation distortion and low unwanted leakage signals between ports have been reconsidered. A double balanced Gilbert-cell with a class-A amplifier bleeding mixer (DBGC CAAB mixer) is designed and implemented. The voltage gain of 14 dB at class-A amplifier is used to magnify the local oscillator (LO) signal. Current of class-A amplifier is injected into the Gilbert mixer as a bleeding current to improve the performance of the trans-conductor stage. The DBGC CAAB mixer achieves a conversion gain of 17.5 dB at -14 dBm LO power, and the noise figure is suppressed from 45 dB to 10.7 dB. It is important to stress that the new configuration has a third-order intermodulation (IIP3) at -9 dBm which is considered to be insignificant. The DBGC CAAB mixer is implemented by using 0.18- μ m RFCMOS technology and operates at the 2.4 GHz ISM application with 10 MHz intermediate frequency. The power consumption is 12 mA at 1.5 V supply voltage.

Keywords— Double balance Gilbert-cell, Current Bleeding CMOS Mixer.



Wah Ching Lee received his B.Sc.(Hons) degree from the department of Electronic Engineering, University of Essex, M. Phil. degree from the department of Electrical and Electronic Engineering, the University of Hong Kong and PhD degree from City University, Hong Kong. He joined the Department of Electronic and Information Engineering, the Hong Kong Polytechnic University in 1987 and is now an Assistant Professor. As a result of request from industries, Dr. Lee's current research interests include front-end radio frequency circuit design and signal processing.

Dr. Lee actively involves in professional activities. In particular, he serves as a reviewer and Session Chairman for many international conferences. He is a committee member of "Radio Spectrum and Technical Standard Advisory Committee member" (SSAC), OFCA, Hong Kong Government, a committee member of Electronics and Communications Section, The Institution of Engineering and Technology (IET-HK) and the past-Chairman of China Institution of Engineers (CIE) Hong Kong. He awarded the Institution of Electronic and Radio Engineers (IERE) Paper Contest in 1986 and the merit paper award of ICE-C 2014. Dr. Lee is a Chartered Engineer of IET.



Dr KF Tsang (M'95-SM'2014) is currently Associate Professor of the Department of Electronic Engineering, City University of Hong Kong. He has been working closely with industry since 1988 when he joined CityU. He has helped to design and develop the 3G CAT decoder, strongly encrypted wireless links for utilities, a portable GSM cellular phone, mobile phone infrastructure, a wireless home/office automation system, a security system, pager, two-way radios including FRS and PMR, the investigation of electromagnetic interference, among others. He has been working actively on RFID (ZigBee), LTE as well as WiMax development. Applications including ZigBee Telehealth systems, ZigBee energy management systems, WiMax CPE, a security system, LTE amplifiers, and building automation. Dr Tsang is now working on Lora Network for Smart City applications.

Dr. Tsang has published about 200 technical papers and four books/chapters. He has been actively engaged in professional activities including the Interviewer for CEng IET (2002 till date), the Chairman of IET Electronics Section 2003-5, The Chairman of IEEE Consumer Electronics Hong Kong Chapter 2008, the Chairman of Chinese Institute of Electronics Hong Kong 2006 -2010, the Chairman of the "Internet of Things Special Users Group Hong Kong" (2015 -date), the Chairman of HKIE Electronics Division (2015 -16), the Chairman of Technical Committee "Cloud and Wireless Systems for Industrial Applications" of the IEEE Industrial Electronics (IE) Society (2015 -date). To help promotion of IoT activities and offer expert advice and recommendation to the Hong Kong government, KF has been made the Founding member of the Smart City Consortium (SCC) as well as the Chairman of "Internet of Things" Committee.

Dr. Tsang is a Fellow of the HKIE, Senior Member of the IEEE, an Associate Editor and Guest Editor of the IEEE Transaction of Industrial Informatics, an Associate Editor of the IEEE Industrial Electronics Magazine, and an Editor of the KSII Transactions on Internet and Information Systems.