A seminar by IEEE Sweden Electron Devices Chapter

22 nm Fully Depleted SOI RF Technology

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Abstract

RF CMOS technology continues to scale to smaller lithographic nodes. The IoT with billions of connected devices will require wireless connectivity, faster processing, faster data rates, longer battery life and lower cost. For the wireless connectivity, especially IOT, low power, cost, and RF performance are the most important considerations. Compared to Bulk planar CMOS, Partially Depleted SOI, and FinFET the FDSOI technology offers a unique combination of low cost, low power, and RF performance which nicely meets these targets. This presentation will focus on the RF performance.

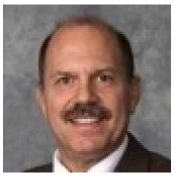
The digital low power performance of the technology comes from the absence of a drain to source leakage path and a steep sub-threshold slope and the low source/drain capacitance to substrate. The thin silicon and SiGe channels of 7nm prevents a leakage path and provides a fully depleted channel with superior electrostatics. The steep sub-threshold slope of 85 mV/decade enables a low threshold voltage to be maintained with low leakage. 22FDX transistors have excellent electrostatics compared to bulk, providing reduced Drain Induced Barrier Lowering (DIBL) and low output conductance (gDS). The HiK Metal Gate stack and short gate length (Lg) provide high transconductance (gM ~ 2mS/um). The high gM, and low gDS gives a high self gain, important for all RF/Analog applications.

The FDSOI transistor is architected for effective body biasing. The Back Gate Bias (VBG) enables reducing the threshold voltage (FBB) for increased current drive or increasing the threshold voltage (RBB) for decreased leakage. Using the back gate to lower Vt expands the voltage range over which a high gM is found. This expanded dynamic range is also true for fT and fMAX. This is an opportunity for novel circuit design techniques using feedback.

The RF performance of 28nm FDSOI has been published by Lucci as fT= 380 GHz and fMAX= 390 GHz (2015 IMS Symposium). This combination of high fT and fMAX is amongst the highest achieved for any RFCMOS technology and clearly demonstrates the performance potential of FDSOI technologies.

In summary, FDSOI makes an excellent RF technology.

Bio



David Harame joined GLOBALFOUNDRIES in 2014. David is a Global Fellow and the Chief Technical Officer for RF Development and Enablement. Prior to GLOBALFOUNDRIES worked for IBM where he was an IBM Fellow and was also the CTO for RF Development and Enablement. David has worked in the area of RF technology for over 30 years. In 2005 David was awarded the IEEE Daniel E Noble Award "For the development of manufacturable Silicon Germanium, HBT Bipolar and BiCMOS technologies." He also received the IEEE BCTM Award for his work in SiGe BiCMOS. David is an IEEE Fellow. He is the lead organizer for the 2016 ECS SiGe, Ge, and Related Compounds: Materials, Processing, and Devices symposium.