

Carbon Nanotube Field Effect Transistor (CNT FET) Technology to Support National Security Space System Applications

Supporting/Contributing Agencies: National Reconnaissance Office

A critical need exists to improve satellite receiver front end performance for a variety of applications that include communications, imaging and signal acquisition. One of the most limiting features associated with operation of receiver systems is the non-linear behavior of components that process signals. Indeed, this non-linear behavior results in the generation of spurious signals that interfere with the detection of small, but critical signals and greatly limits performance, often identified as Spurious Free Dynamic Range (SFDR) with units of decibels.

CNT FET technology R&D has shown that these devices can provide almost linear operation over a wide range of input signal strengths, at low power operation, and thus, significantly improve the SFDR associated with receiver performance. These front end improvements can be directly translated to overall improvements in satellite system performance such as the detection of lower power signals, smaller satellite antenna size, lower system operating power requirements and the ability to discern very low strength signals in cluttered signal environments.

At present, efforts to develop and demonstrate CNT FET based very low noise linear amplifiers and signal mixers (circuits that combine two frequencies to produce a third frequency that is more amenable to signal processing) are in progress at Northrop Grumman Electronics Systems. Moreover, initial analysis indicates that a CNT FET mixer can provide as much a 40db improvement (a factor of 10,000) in SFDR, when compared to standard silicon based or gallium arsenide (GaAs) technology used for these types of applications. This would provide dramatic improvement in overall system performance. Additionally, it is envisioned that this same CNT FET technology can be used to fabricate devices that translate analog to digital signals (analog to digital converters) to support onboard processing with similar benefits. As a further benefit CNT FET technology should also be radiation resistant and thus, enhance satellite survivability.

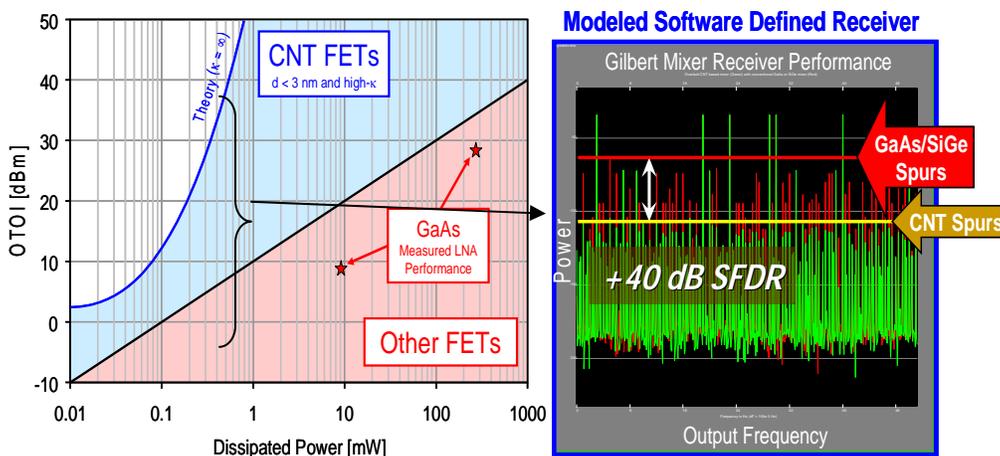


Figure 1 – CNT FET Operation versus GaAs Comparing Operating Range as a Function Power

References/Publications

H. Zhang, et. al., “Low-Power High-Speed Carbon Nanotube Field Effect Transistors for Defense RF Electronics,” GOMAC Conference, 22 March 2006.