Devices & Power Electronics

MICROWAVE AND RF HIGH POWER SEMICONDUCTOR CONTROL DEVICES

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Semiconductor control devices are found in a large variety of wireless communication systems (such as cellular radio base stations and handheld units), radar protection circuits, phased array antennas and antenna diversity switches (another cellular radio application). The current research effort at Villanova focuses on measuring and modeling the linear and nonlinear behavior of these semiconductor devices in medium to high power microwave and RF control applications. The semiconductor control devices most recently under study include PIN diodes (both silicon and GaAs), Gallium Nitride (GaN) high power metal-semiconductor FETs (MESFET), and silicon metal-oxide-semiconductor FETs (MOSFET). The circuit topologies using these devices include telecommunication switches, variable attenuators and limiters. Dr. Caverly was the first to quantify the levels of distortion in PIN diode and FET-based switches and attenuators, and has made significant contributions that allow users and designers of these devices to predict their performance in a variety of microwave and RF applications. He and his research team are also the first to look at the new GaN technology for high power telecommunication system control. He has recently reported that GaN devices are suitable for control in the 50 to 100 watt range. His models have been incorporated in commercial microwave circuit and system simulators such as Advanced Wave Researchýs Microwave Office, and his models fit other popular circuit simulators as well. His work is also found in application notes on PIN diode control distributed by various companies throughout the world.

Funding is needed to expand this highly successful research area into two new and broad areas: the first is investigating FET-based silicon-germanium (SiGe) for high frequency control; and secondly, investigating microwave MEMS (micro-electromechanical systems) circuits such as switches and phase shifters. Specifically, the areas of interest are in modeling the level of harmonic and intermodulation distortion introduced into microwave circuits and systems by these devices. A number of agencies are interested in both of these technologies, both of which fall under various nanotechnology initiatives.