Wide Band Gap

Wide band gap (WBG) materials, such as silicon carbide (SiC) and Gallium Nitride (GaN), used for the fabrication of electronic components represent cutting edge technology because these materials allow significantly higher performance and durability while demanding less power, weight and space. The wireless telecommunications, computing, and power industries will see widespread use of these devices in the future. SiC and GaN based microwave devices enable an array of power amplifier semiconductor devices designed to meet the full spectrum of the wireless infrastructure market, especially second and third generation wireless solutions, in addition to lower frequency applications. In addition, WBG devices have great potential in military applications such as communications and data links, EW related opportunities, sea and air radar, and RF amplifiers, etc. However, due to the application requirements, the commercial applications of current wide band gap devices do not directly address DoD system needs.

Since 2001, ACI has been actively working and partnering with a diverse group consisting of multiple WBG materials and device suppliers, system integrators, and program management and end users from numerous government agencies. ACI has been organizing a wide band gap technology transition panel consisting of participants from all the elements of a vertically integrated team. This working panel provides an excellent forum for technology transfer that connects the capabilities of the commercial and defense sectors with DoD requirements. The main objectives of this transition panel are:

- to integrate WBG technology to provide real component solutions to the Navy and DoD
- develop cost conscious solutions for WBG implementation
- keep pace with new WBG material and process development.

To date, six panel meetings have been held on a bi-annual basis with an average of 50 attendees. The most recent meeting was held in Washington DC in August, 2004.

In order to facilitate rapid dissemination of information related to WBG device, packaging, and thermal management technology, ACI has been taking the innovative approach of the technology transition process to allow insertion and commercialization of WBG devices into both DoD weapon systems and commercial applications.

One example of these efforts is the Link-16 program. In 2002, ACI, Rockwell Collins, Northrop Grumman, Cree, Nitronex, Thermacore Corp. and k-Technology teamed together to provide SiC MESFETs and SITs and GaN HEMT technology to improve the performance of the Link-16 data-link system while reducing the size and cost of the system.

ACI has partnered with other organizations and also worked independently under Navy Mantech contracts in researching WBG technology. ACI recently completed a survey that assessed the current status of WBG technology in the context of DoD requirements. The purpose of the survey was to define future investment recommendations to expedite technology insertion into DoD systems. ACI has also completed a program to document the strategic areas of commercial leveraging for WBG devices. This year-long project defined critical areas of commercial product design and development, identified commonality in DoD and commercial performance requirements, and analyzed COTS thermal management systems for implementation into DoD systems.

Currently, ACI is in the final stages of a two-year program with the following objectives:

- identify military applications and target specific programs for early insertion of WBG devices
- investigate commercially available thermal management solutions
- determine a consensus of deficiencies and needs of leveraging opportunities
- develop an implementation guideline for weapon system
- explore Navy system packaging requirements

establish commercial partnership to demonstrate suitable packaging solution for WBG and leverage commercial packaging into DoD WBG systems

Finally, and most recently, as part of a Memorandum of Agreement between DARPA, ONR and PEO Carriers regarding the use of Wide Band Gap Semiconductors for Ship's High Power Distribution, a multi-year program has been established to focus the research and development efforts. The ultimate goal of this program is the realization of a Solid State Power Substation (SSPS) operating at 2.7 MVa and 20 KHz. The first demonstration vehicle is a 10Kv, 110A SiC based Power Module for insertion in the SSPS. ACI and the Penn State Electro-Optical Center, as the Navy's Centers of Excellence for electronics and optical technology, are teamed together to work with the selected vendors and provide guidance and assistance to evaluate and mitigate the risks associated with a new technology development program.

For more information on WBG iniatives at ACI, please contact info@aciusa.org.