

SYSTEMS BASED POWER ELECTRONICS INTEGRATION TECHNOLOGY—A RESEARCH PERSPECTIVE

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The Center for Power Electronics Systems (CPES) at the Virginia Polytechnic Institute and State University, USA, was founded as an Engineering Research Center by the National Science Foundation of the USA and funded from 1998 to 2008. At the inception of the Program it was decided to investigate integration technology for all power processing functions in a power processing system – and not only for the switching power semiconductors as is current practice. It was further decided to concentrate on planar, non-wire-bond technologies, to develop a planar integration technology that will enable integration of the entire power processing system. This will generate a common technology base for the integration of the entire system, as well as establish common thermo-mechanical behavior and failure modes for all integrated modules.

The account of this decade of research has been recorded in two books*, containing reprints of more than 150 research papers from the Program, accompanied by introductions and program explanations. These books are available on CD- obtainable from CPES- so that course attendees can use them as material for further study after the course.

In terms of functional partitioning in power electronics systems, the system has a power switching function (power semiconductors), an electromagnetic energy storage and transforming function (magnetics and capacitors) and an electromagnetic filtering function. The discussed integration technology incorporates all these functions by using the same planar technology to construct active integrated power electronics modules, passive electromagnetic integrated power electronics modules and filtering integrated power electronics modules. The filtering module work includes integrated EMI filters of the LC type as well as the absorptive transmission line type. The actual hybrid technology, materials and processes are discussed, while the common thermo-mechanical behavior, failure modes, electromagnetic behavior and the extensive modeling of all these aspects are covered. Applications to integration of systems for power levels in the range of 100W to 1.5 kW are discussed.

For low power levels (less than 100W), Low Temperature Co-fired Ceramic Technology has been developed for very thin passives and inductors as substrates for active circuits. Applications to voltage regulator modules (VRM's) and other small point of load converters are illustrated

*J.D. van Wyk (Ed.) Systems based power electronics integration technology: Book I: Integrated packaging in the CPES program and active integrated power electronics modules, 618 pp. Book II: Passive integrated power electronics modules and filtering integrated power electronics modules, 558 pp

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