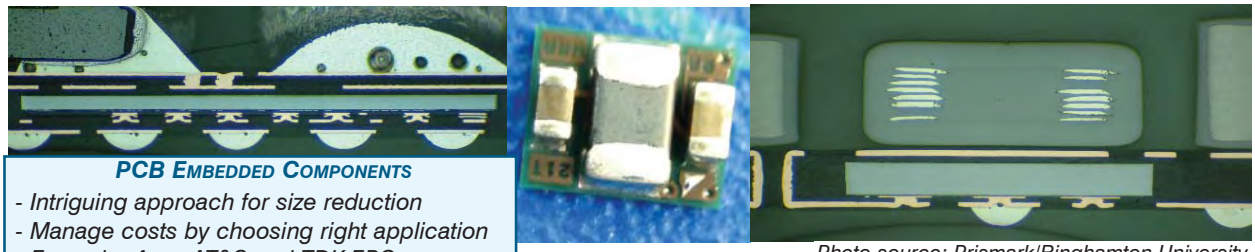
The Prismark Wireless Technology Report

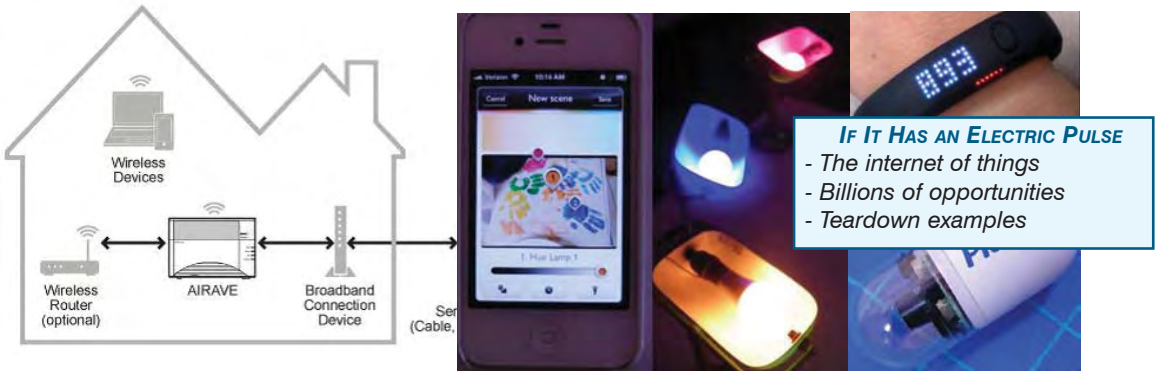
A Quarterly Market and Technology Analysis of RF Wireless Systems, Modules and Components from 100MHz to 100GHz

March 2013

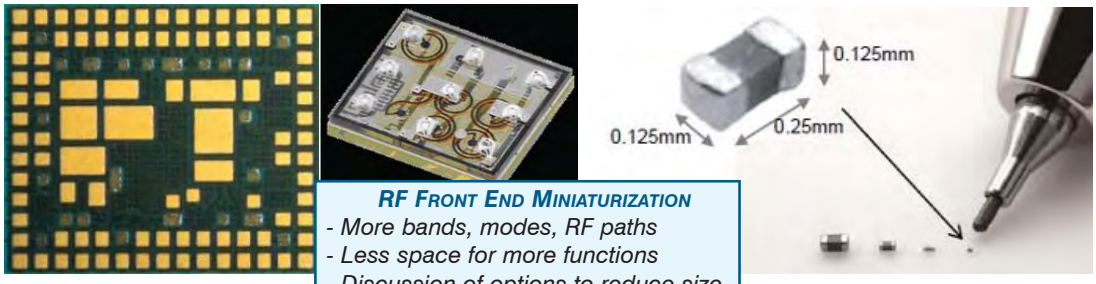


PCB Embedded Components
- *Intriguing approach for size reduction*
- *Manage costs by choosing right application*
- *Examples from AT&S and TDK-EPC*

Photo source: Prismark/Binghamton University



If It Has an Electric Pulse
- *The internet of things*
- *Billions of opportunities*
- *Teardown examples*



RF Front End Miniaturization
- *More bands, modes, RF paths*
- *Less space for more functions*
- *Discussion of options to reduce size*

A valuable source of competitive intelligence and trend analysis for technology and business development executives. Targeted at wireless systems designers, RF semiconductor houses, board and package assemblers, as well as their component suppliers.

PRISMARK PARTNERS LLC

Consultants to the Electronics Industry
Business Opportunity from Technology and
Market Changes

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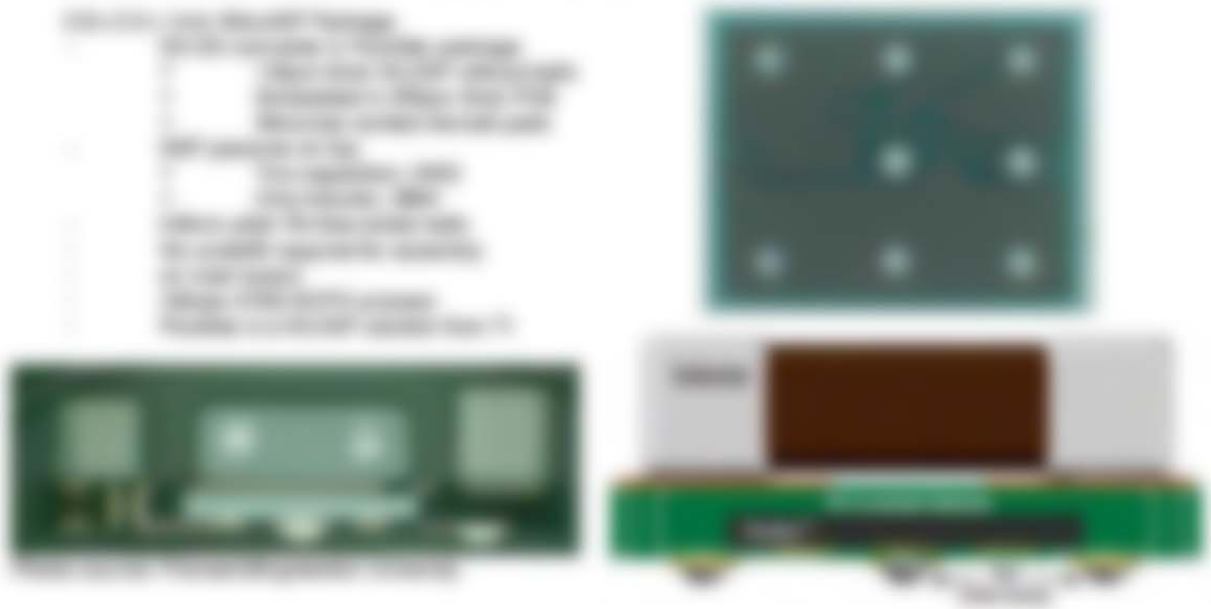
THE PRISMARK WIRELESS TECHNOLOGY REPORT – March 2013

Table of Contents

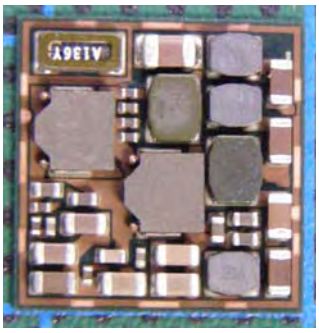


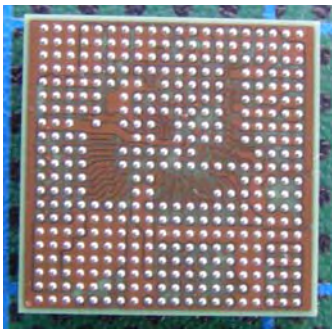
TDK SESUB

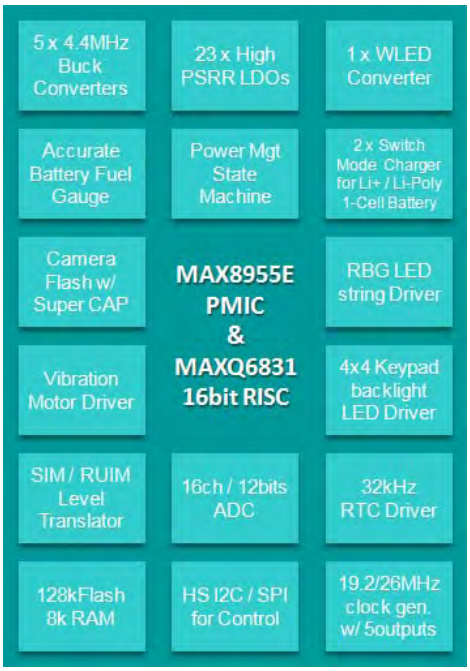
TDK is a global supplier of electronic components, with R&D and manufacturing facilities in Japan, Asia, Europe and America. The company has developed core competencies that range from materials and process technology, to simulation, production and device and module technologies. In the following PCB embedding example, TDK designed the module, embedded the die and assembled the module.

TDK has developed its own proprietary PCB embedding technology, called SESUB—Silicon Embedded in SUBstrate. One of the first high volume products to use this technology is a power management module used in some versions of the new BlackBerry Z10. The power management module can be used for Qualcomm Snapdragon, TI OMAP4, and NVIDIA TEGRA chipsets with different firmware. It is based on two MAXIM die, the MAX8955E power manager and the MAXQ6831 16-bit RISC controller, that are embedded into the PCB of the module. The module measures 11mm x 11mm x 1.63mm—a reduction of 60% compared to a discrete PCB layout—and uses 380 LGA pads at 0.5mm as the external interconnect.

TDK POWER MANAGEMENT MODULE

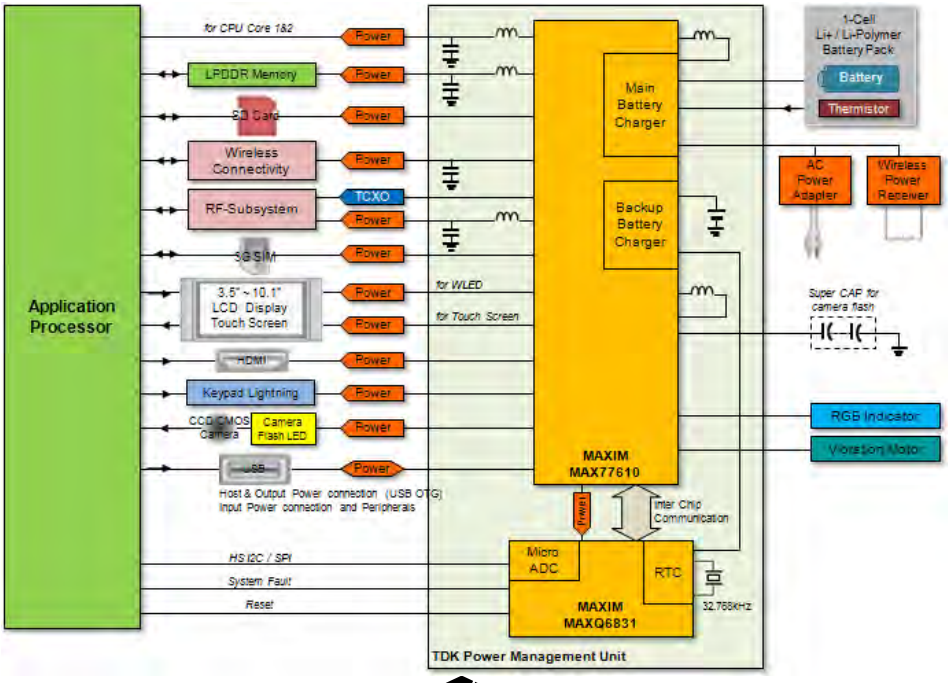






The module constitutes the smartphone's main system power manager, as well as the system's battery charger. Among others, it includes five 4.4MHz buck converters, twenty-three low-noise LDO (Low Drop Out) regulators, a real-time clock with 32kHz crystal, converter for the camera flash LED and LED for the display and touch screen. The following simplified block diagram shows the TDK power management module supporting the applications processor, wireless section, memory and other parts of the smartphone.

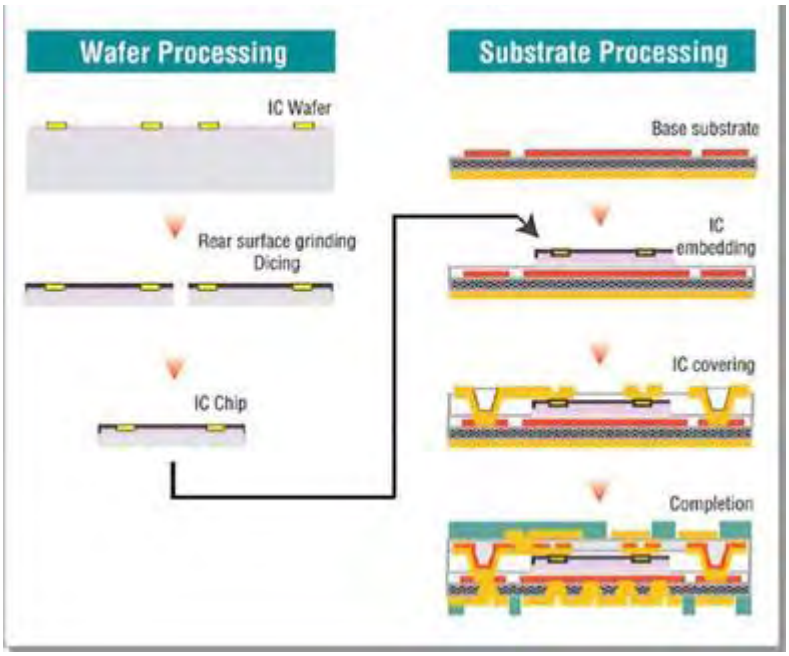
TDK POWER MANAGEMENT MODULE IN SMARTPHONE



The TDK power management module was designed in cooperation with TDK, Maxim, and BlackBerry, whereby TDK buys the IC and is the module's product owner. In other cases, the customer provides the die and TDK embeds it. The die are delivered by Maxim as tested wafers with 4μm copper on the die pads to TDK. TDK then thins the wafers to 50μm, singulates them, and embeds them using its SESUB process.

In the TDK's SESUB process, the die is first mounted face-up onto a two-layer PCB core. An additional copper foil is then laminated over the die and PCB core, forming an additional copper layer through which microvias can be formed to contact the die bond pads and the initial PCB core. This therefore creates the die interconnects and the side-to-side interconnects. The TDK SESUB process is ready for die with a minimum pitch of 80μm in volume production, and TDK is planning to introduce 50μm minimum pitch capability. The process flow is shown below.

TDK SESUB PROCESS FLOW



Since the copper layers that form the interconnects to the embedded die are defined photolithographically, they can have any shape. For example, for high current connections, the vias and traces can be larger, thus reducing resistance and improving performance. Thinner and wider traces and vias can be mixed in the same design for best optimization, but early collaboration between the IC designer and TDK is preferred.

Conclusion

Portable products such as smartphones continue to demand size reduction, and PCB embedding is a powerful option to accomplish this, with size reductions in the order of 50% not being unusual. It is one option among many, however, and it is not appropriate for all applications.

In particular, the final yield is the critical determinant of overall cost, and therefore the embedded component and the PCB it is embedded in have to be carefully chosen.

The industry has gone through a tough learning curve, but companies such as AT&S and TDK are now ready to work with partners to design and provide highly-integrated, small form factor assemblies based on PCB embedding technology.