



TUTORIAL 5290

Higher Integration Drives the Newest Generations of Smartphones

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Abstract: This article discusses future trends in the design of smartphones and other consumer products. The discussion focuses on the importance of integration, which saves valuable PCB space and drives down costs.

Like so many of us, I start my day by checking for important emails. I then check the Internet to make sure that my next flight is on time and, if I see a problem, I need to make some calls. Today I use one device, a smartphone, to do all this.

In a very short time, people around the world have bought these multimedia devices because of the extra services that they provide. Today we no longer rely on our smartphones to simply communicate. In fact, it seems that smartphones can do something new almost every day. With a growing number of features and applications, a smartphone has become a PC, stereo system, camera, movie theater, GPS, and gaming device that fits neatly in our pocket or handbag. With all their growth and potential, there is no doubt that sales of smartphones will continue to surge throughout 2012 and beyond.



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Systems integration is a term that we see more often, as it is what enables a smartphone to perform its range of tasks and still be small and thin enough to fit in your hand. Early on, Samsung partnered with Maxim to develop a high-integration power-management IC, a Power SoC, for its newest generation of smartphones. The single-chip Power SoC is part of Maxim's TINI® family of highly integrated SoCs and audio codecs. A Power SoC reduces printed circuit board (PCB) space by approximately 50%, lowers heat and power dissipation, extends battery life, and cuts costs. Samsung's strategic smartphone is truly the culmination of our partnership.

More often than not, if a smartphone is used to its full potential, it must be charged daily. Maxim's Power SoC has certainly reduced this power consumption, but even further reduction is necessary so the battery charge lasts longer. We know that optimizing communications among the various processors in the phone will save considerably more power. Here is both the problem and the opportunity. A handset's peripheral processors (i.e., the GPS, Bluetooth®, RF transceiver, and multimedia DSP) may get turned on when they are not needed, or they can be on at full power when they are only needed in a reduced power state. The answer to power savings is active, dynamic control of these processors. The Power SoC *will* save more power if these processors are only turned on when needed and only to the level necessary for each application.

This discussion of systems processors clearly illustrates the need for more integration. In the future, the probability of integrating interrupt-based processors into the Power SoC is very high, as mixed-signal process technology reaches 90nm or below. Then the SoC will offload many functions typically handled by the applications processor, which can remain asleep longer and thus lower its power usage.

Sensors will be another big focus, because they will revolutionize the mixed-signal architecture of a smartphone. Already, inertial and motion sensors sense the orientation of a handset to set up or rotate a display. Going forward, we will see more sensors in smartphones, as these devices try to understand the environment around us and adjust their behavior automatically without human intervention. Always-on sensors will create a big drain on the battery if the main applications processor must stay on continuously to process data. To save power, sensor processing functions can actually be integrated into the next-generation Power SoC and significantly reduce overall power consumption. As a matter of fact, combining an interrupt-based processor and a sensor-based processor into one Power SoC makes perfect sense to reduce cost and improve battery life.

All of these additional smartphone functions and features are possible through integration. This brings me back to one of Maxim's biggest customers and collaborators, Samsung, which understands well the importance of high integration in circuit design. Samsung was one of the first smartphone makers to customize the Power SoC to maximize performance and minimize size, while reducing

cost, in its strategic Android smartphones and tablets. We see more and more smartphone makers following Samsung's lead in developing their own Power SoCs, enabled by integration.

So, my story is integration. In fact, that is the basis for Maxim's new TINI ICs. The pivotal Power SoC and other TINI products are highly integrated solutions for consumer products. The TINI TV Cam and TINI Remote Cam are full-featured SoCs that enable a camera to fit right inside the TV bezel or just about anywhere you want a camera to go. TINI Audio Codecs merge high-performance audio blocks with Maxim's proprietary FlexSound™ processor to overcome integration challenges and ensure the best audio experience. A TINI Touch-Screen Controller SoC with TacTouch™ technology integrates the industry's highest SNR capacitive touch analog front-end (AFE) with full backend processing to provide breakthrough immunity to AC charger and LCD noise without external components. These TINI parts represent the highest level of analog/mixed-signal integration available. They allow designers to make their products, like the next generation of smartphones, even smarter with new capabilities and functions.

Maxim has a long, successful history in integration and, in fact, it is in our company name, "Maxim *Integrated* Products." We realized the success of our integration expertise years ago with notebook products and then progressed to cell-phone products. As the latest integration challenge, smartphones represent a natural progression for us.

What do I see in the future? Even more demanding power requirements as application processors move to faster clock speeds. And with multicore processors, even higher power levels will be required. Demand for higher battery capacity will continue to increase. Energy harvesting will be needed, so we are not totally dependent on wall power. We will be charging our batteries from solar, RF, thermal, magnetic, and motion—and all of the circuitry will require more precious board space, once again making integration more necessary.

That is the future of smartphones and other consumer devices, driven by integration, as I see it. As for Maxim, we will continue working with pioneering companies like Samsung. We will continue to provide industry-leading solutions for power, audio, video, touch, interface/connectivity, and sensors for next-generation smartphones and tablets.

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