Brainstorm: Smart Grid & Alternative Energy

Edited by Jason Lomberg, Technical Editor

What impact is the build-out of the smart grid having on the electronics industry?

John Pitrus, Analog Devices, www.analog.com **[1]**

One of the most significant impacts is the large increase in demand for better electricity meters and more sophisticated energy measurement components. For example, we have already witnessed energy meter IC improvements that include higher accuracy, support for more measurement parameters and enhanced capabilities to protect against electricity theft. A new area of innovation is the ability to measure power quality accurately and cost effectively.

As different types of loads connect to the grid at an accelerating pace, they can cause significant power quality problems in the form of excessive harmonic currents, which can overheat power transformers and false-trip protective relays. In response to this trend, energy meter ICs can now measure harmonic content in real-time and enable utilities and their customers to take corrective action.

Another important impact felt by the build-out of the smart grid is more focus and investment in communications technologies that are deployed in energy meters and sensors. Two-way communications is what makes energy meters and sensors “smart” and allows them to share data with utilities, service providers and consumers in real-time. Currently the world market is fragmented. Different regions are deploying different communications technologies, including RF mesh and star networks, powerline-carrier and, to a limited degree, cellular. Also communications technologies for the smart grid are very different from other application because they must cover harder to reach locations such as basements and will span 10 to 20 years of useful life for the utility companies.

A third impact is the emergence of distributed generation and micro grids. These types of applications present new technical challenges and opportunities for design engineers within the electronics industry. Distributed generation sources like solar or wind are intermittent and require storage in order to integrate into the existing

grid. A new wave of products address the challenges of energy storage, such as monitoring battery cell voltages and currents, providing isolation between high voltage and battery voltage domains and safe-guarding the system against hazardous or damaging conditions.

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Over the past decade, data centers underwent an evolution as computing and data storage capacities increased significantly. Today's data centers have emerged as an important business asset. They also are well known for using an inordinate amount of a utility's energy assets, but because IT operations have become a crucial aspect of most organizational operations, many groups have just accepted this expensive fact. But as capacity and density have increased, energy use has attracted scrutiny as the utility bill has risen to the top of the list of operating expenses for many data centers.

Already an integral part of the data center, today's power and cooling infrastructure systems are becoming increasingly intelligent and efficient. These intelligent, controllable power and cooling systems—especially when deployed with the industry's latest Data Center Infrastructure Management (DCIM) solutions—can help data centers better integrate with the Smart Grid to provide users with better control, reliability, efficiency and sustainability of electrical equipment. Specifically, dynamic UPS systems can help facilitate the adoption of a number of sustainable best practices, including Smart Grid integration.

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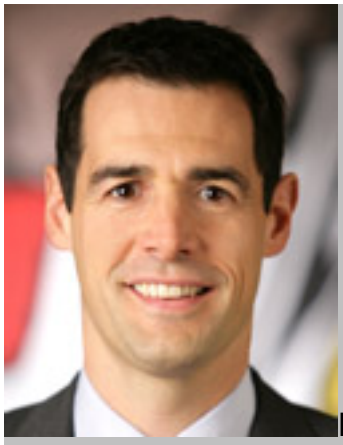
The smart grid opens doors for the electronics industry to add communications in embedded devices that historically were isolated from the world. One of the underlying benefits of the smart grid is empowering consumers to better manage energy usage. For this to happen, power-hungry products need awareness of their energy consumption, near-term needs (i.e., one hour from now), and current conditions of the energy supply. Last July, portions of the United States experienced a massive heat wave that caused a spike in demand at a time when supplies are most constrained, due to de-rating at temperature. If just half of the population had HVACs and major appliances capable of receiving signals to temporarily reduce energy usage, rolling outages could've been reduced. Warning signals from utilities

can arrive via a variety of existing infrastructure, such as a household Internet connection or a utility's meter-reading network. The most popular technologies are Wi-Fi (802.11), 2.4 GHz ZigBee networks, and sub-GHz radios. Adding wireless communications to products continues to get easier with the availability of certified hardware modules and free, downloadable networking software. As connectivity continues to grow in the embedded market, consumers and businesses will no longer have to manually manipulate loads. Instead, the handful of power-hungry products will intelligently manage consumption during challenging times for the energy grid.



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As a supplier in the Smart Grid industry, it's well understood that the knowledge of accurate voltage and current measurement is no longer enough to support market demands. With the growing needs of robust and reliable network infrastructures, security requirements, harmonics analysis and other new features in Smart Grid applications, electronics suppliers must provide expertise and IP in each of these areas. This has resulted in several company acquisitions or mergers of traditional energy experts and communication providers as well as large extensions of existing companies. Further down the supply chain, semiconductor companies must change from being simply a chip supplier, to become a full solution provider – solutions for sub-applications in the segments of grid infrastructure, utility meters and smart homes/buildings.

The basis for this is a broad digital and analog portfolio including a variety of wired and wireless communication chips. However, this is not enough. Differentiation in this market comes from the capability to provide reference designs and software algorithms for metrology and communication together with application support. Some semiconductors companies are going beyond offering solutions by working with utility companies or appliance providers to test their solutions in a real environment. The growing requirements in Smart Grid driven by a variety of environmental, political and technology stakeholders will continue to require changes along the supply chain.

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