Alternate energy: Trends and dependence on electronics in power conversion

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With prosperity rising at a global level the demand for energy has been increasing significantly over the last decade. However, there are concerns of energy supply and distribution to many areas of the world with little or no infrastructure. Furthermore, using fossil fuel as the main energy supply in the long run has been strongly debated. The result is increased activity and proliferation of employing sustainable/alternate energy sources on all fronts: technology, economics, regulations and policies.

This article highlights the trends in alternate energy using solar as the focus with a brief breakdown of the solar value chain. This is followed by a discussion in the backend of the power conversion value chain, known as balance of systems. The inverter is a key segments of this value chain, whose building blocks are increasing in analog and digital electronics.

Alternate energy: Solar
Alternate energy sources, the heart of distributed generation have been around for several decades. During the last decade, there has been an unprecedented growth in the alternative energy market, similar to what we have seen in the Internet industry. A recent report by Clean Edge [1] highlights that the overall alternate energy market has grown by 30 percent with solar witnessing the highest compounded annual growth rate of 39.8 percent over the last decade.

The solar market is becoming attractive primarily due to significant technological improvements such as cell efficiency and secondly, due to gradual and predictable cost reduction heading close to grid parity in many parts of the world over the next few years where growth is expected to be strong.

Solar value chain
The front-end of the value chain is dictated by the manufacture of solar cells and modules. The backend is dominated by balance of systems that include racks, support systems, wiring and inverters. Power conversion, which is a key component of balance of systems, is primarily the inverter. Inverters traditionally have existed for a long time in industrial applications such as motor drivers. Now it is being challenged in its use in the alternate energy space in terms of improved efficiency, smaller size, lower cost, and increased lifetime. These challenges are set forth from the recent demand from consumers looking to install solar panels in their homes. Additionally, consumers have a growing interest in utility companies looking to supplement their supply using large scale solar farms. Figure 1 shows an example of the emerging market in this system: the micro-inverter.

For solar to become viable, the cost-per-watt of electricity generated by solar needs

to be equal or lower than traditional energy sources. This concept, known as grid parity, has already been reached in developed countries in Europe. It is expected to reach many parts of the US such as California over the next few years. Furthermore, with the solar panels lifetime guaranteed to be at-least twenty five years, it is expected that the whole system guarantee is the same – which in turn puts the onus on inverter systems.

ICs in inverters

Inverters are increasingly getting stronger in IC (integrated circuit) content – both analog and digital at a component level. Digital content largely is embedded controllers whose goal is to maximize the system efficiency through power management control and maximum power point tracking. Analog content is dominated by power management ICs, such as FETs and IGBTs, gate driver ICs required to turn the switches on or off, current sensing ICs, and bias supply ICs needed for system housekeeping. Furthermore, there is a need driven by standards that mandates requirements in these components to protect digital and control ICs from the high-power switches. As a result, existing isolation technologies and many others that are evolving over time have gained a lot of attention towards implementing these protection features in gate driver and current sensing ICs.

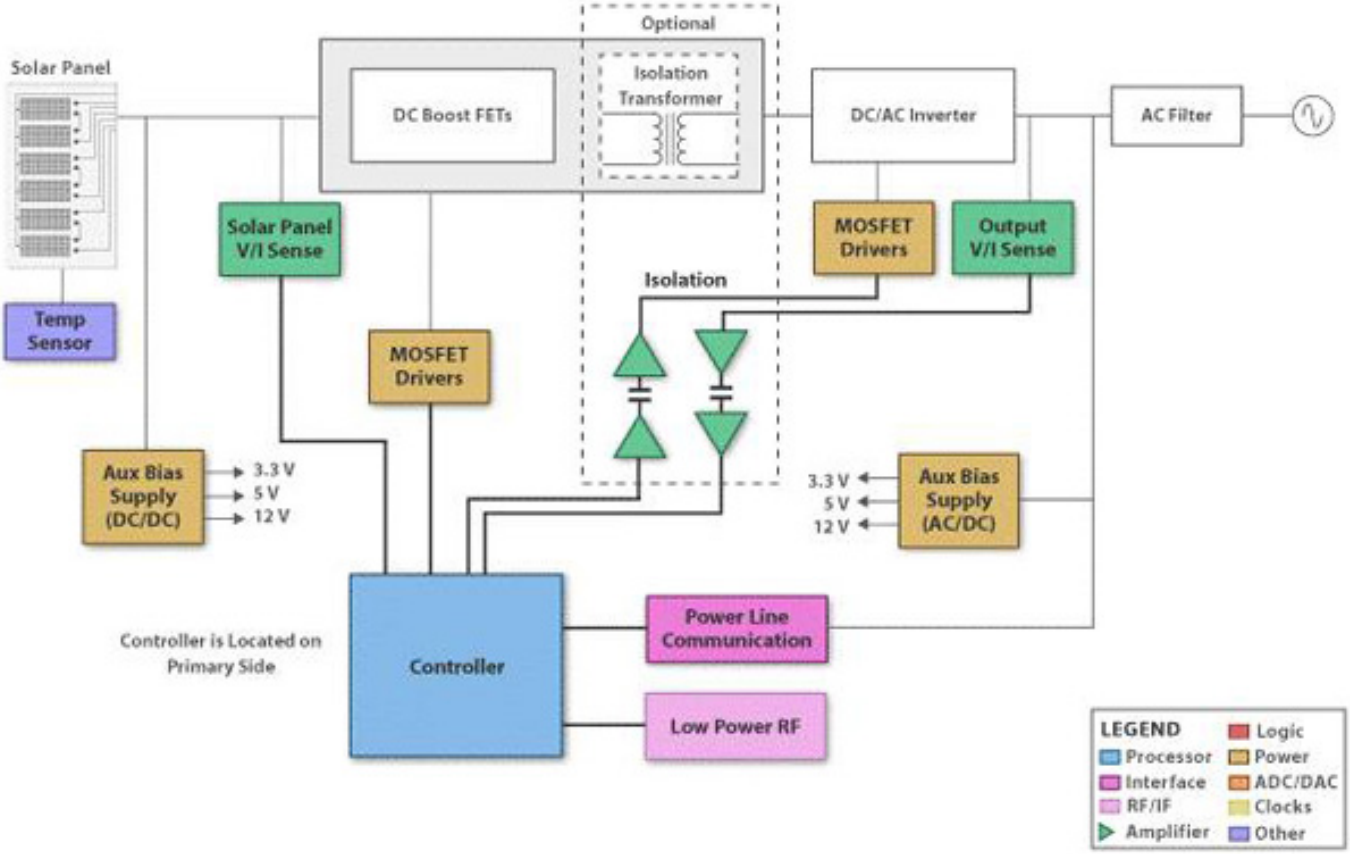

Figure 1. The micro-inverter with IC components.

Reference

1. Clean Energy Trends 2010, Clean Edge, by Ron Pernick and Clint Wilder with Dexter Gauntlett and Trevor Winnie, April 2010 Update.

About the author

Nagarajan Sridhar is a product marketing manager focusing on the renewable energy market segment in the Power Management business group in Texas Instruments. His prior roles include being a founding member of the Solar Energy Lab at TI and yield engineering and operations manager in process technology development for nearly a decade. He has a B. Tech degree from the Indian Institute of Technology, Madras, MS and Ph.D. from State University of New York at Buffalo majoring in photovoltaics and an MBA from Indiana University, Bloomington.

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