Towards an energy efficient future

Driven by the energy crisis and global warming, governments, businesses and consumers are identifying ways to reduce consumption and improve efficiency. This article explores some of the trends, technologies and challenges before introducing measurement considerations for complying with international efficiency standards.

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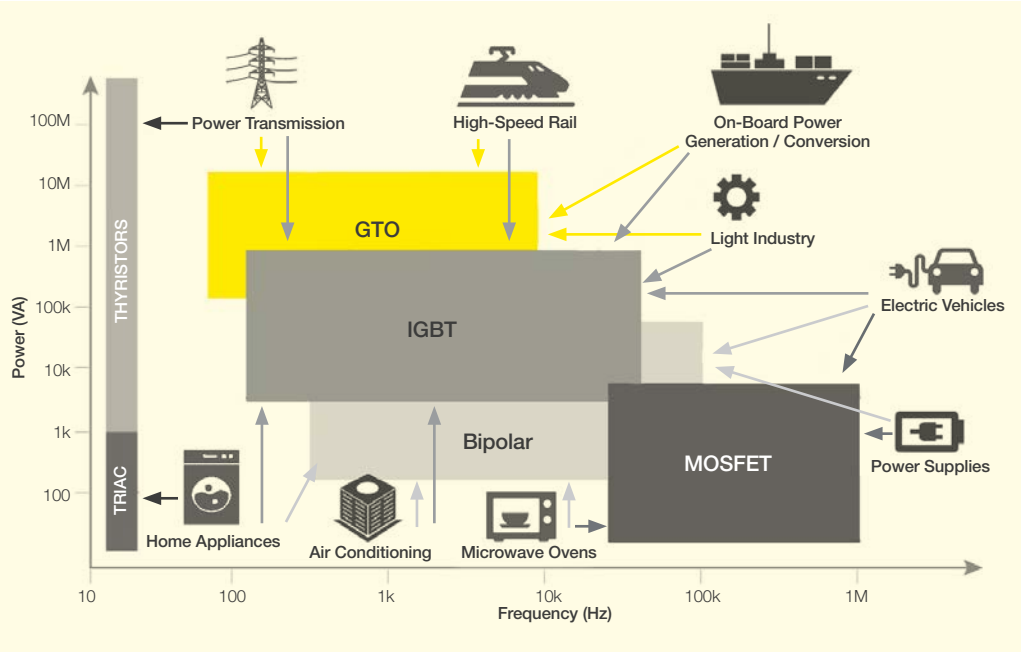
With the increasing emphasis on reducing global warming and carbon footprints, it has become important for governments, businesses and consumers to contribute towards energy efficiency. Initiatives such as the European energy efficiency directive have encourage optimized generation and use of energy. Volatile prices of fossil fuels, increasing energy demand to support economic growth and the prospect of government led efforts to reduce carbon emissions suggest that energy will be of increasing relevance to companies' cost structure and operating models in the years ahead. Both business and consumers today demand more energy efficient products and eservices. In the energy industry itself the demand for innovative, climate friendly technologies to produce heat and power is also growing.

Evolving markets and technologies

From nationwide efficiency goals to sustainable business practices and domestic usage, there is not only greater adoption of energy-efficient technologies in homes, businesses and transport but also an increase in the percentage of our energy needs being served by renewable energy. To remain competitive, businesses today will need to identify the products and markets arising from new energy trends and develop capabilities to address these markets. They will also need to find viable energy saving opportunities in their own organizational processes. To this end some of the trends we are seeing today across industries are:

- Increased electrification of the power train and rise in popularity of hybrid, electric, plug-in and fuel-cell based transportation technologies despite the dominance of the Internal combustion engine (ICE)
- Fast switching speeds in modern power electronics have enabled greater efficiencies and component miniaturization in home and office appliances and mobile technologies paving the way for connected devices and the Internet of things.
- Increased adoption of energy efficient automation and control, motors and drives, IT infrastructures and heat recovery are bringing significant cost savings for business and industry.
- Greater adoption of renewable energy technologies as the EU races towards achieving its 20% renewables target by 2020.
- Rapid and widespread adoption of LED lamps offering up to 5 times more efficiency than their incandescent or fluorescent predecessors.

These trends have been driven by advances in power electronics and semiconductor technology that have enabled unprecedented control over the flow of electrical energy from source to match the requirements of the load. From a manufacturer's standpoint, choosing the right semiconductor devices is crucial in achieving the right frequency and switching behaviors to optimize the overall efficiency and performance of an application.



(Source: modified from the figure 1 www.appliedmaterials.com/ja/nanochip/nanochip-fab-solutions/december-2013/power-struggle)

Figure 1 - Semiconductor technologies used in modern power electronics. Power supplies operating at high frequencies (>100kHz) use fast switching of MOSFETs while the low conduction losses of IGBT switching circuits are better for controlling motor rotations speeds at frequencies less thatn10kHz.

New Challenges

But with new technological advances come new challenges. High speed switching circuits may have brought greater opportunities in efficiency and component miniaturization, but they have also introduced harmonic interferences at high frequencies that, if left unchecked, can have damaging effects.

Meanwhile standby power consumption from an estimated 4.6 billion products is expected to reach over **50TWh** of electricity in 2020 – equal to the total consumption of Greece. While the International Energy Agency's One Watt Initiative helped bring this down; standby power or vampire power remains a global concern.

In the energy transmission industry, Inaccuracies in no load testing of transformers at power factors as low as 0.001, can introduce unspecified losses and invite hefty fines. For these reasons, standards and regulations are assuming increasing importance in the electrical and electronics industries because of the increased focus on energy efficiency, energy conservation and renewable energy.

Standards and compliance

To reduce energy consumption and improve energy efficiency of consumer and industrial equipment, governments and regulatory authorities are establishing new standards for energy consumption of various classes of equipment. Industries today already need to comply with a number of standards from international bodies such as International electro technical commission (IEC), California Energy Commission (CEC) and European Commission to ensure product efficiency, safety, comfort and productivity for homes and businesses. Appliance manufacturers have to prove that their products comply with these standards and often carry energy efficiency labels to show that they meet these requirements.

These standards have significant implications on production processes and product usage. Standards such as IEC 62301 for standby power consumption, IEC 61000-3-2 for Harmonics and IEC 61000-3-3 for Flicker define limits for different classes of electrical and electronic equipment that affect both market validation (fit for use) and product differentiation. Non-compliance can invite hefty fines, product recalls, loss of market share and brand equity or even legal proceedings. This raises the importance of getting it right when it comes to measurement solutions to ensure compliance or prove competitive advantages.

Measurement strategy

Thus with evolving markets and greater diligence in energy efficiency, there is unprecedented need for accurate and reliable measurements in order to ensure energy efficient designs, improved production and enhanced product quality. However, given the diverse operating conditions and objectives of different development stages, measurement needs can vary or evolve across the development cycle.

Thus in order to achieve long term return on investments in measurement technology it becomes important to assess them against the stage based measurement objectives of your application. This will help determine how to equip development and testing teams with the right insights, functionality and accuracy needed for making data driven decisions across the product lifecycle.

For example isolated tests of individual components in early development stages may only need waveform analysis at limited accuracy but when a multicomponent system needs to be tested, the objective is to optimize the system rather than a single component. This calls for sophisticated multichannel, multi parameter measurements. During compliance testing however, the accuracy of the measurement becomes far more significant, as the product needs to prove its adherence to standards before production line testing.

Getting it right

Power Measurement is an important element of quality control with its accuracy increasing in importance from the design phase through to production and compliance testing. Power measurements in compliance testing in particular should not only be guaranteed for accuracy, but also be repeatable and stable over time for the specified ranges. With a variety of instrument classes and varying methods of specifying accuracy, it is important to understand the sources of inaccuracies to assess the reliability of a measurement.

However, one can gain quantifiable confidence in a measurement system through regular accredited calibration of an instrument's performance against a standard of known accuracy. Whether the end product is an automotive power train, a wind turbine, an industrial drive or compact inverter for a consumer product, power measurement solutions will play its part in ensuring product quality, reliability and compliance across the various stages of design, development and manufacture.

To learn more about key factors that affect power measurement accuracy and how to be mindful when choosing a measurement instrument read the article on Choosing a Power measurement instrument that is right for you.

About Yokogawa Test & Measurement

Yokogawa has been developing measurement solutions for 100 years, consistently finding new ways to give R&D teams the tools they need to gain the best insights from their measurement strategies. The company has pioneered accurate power measurement throughout its history, and is the market leader in digital power analysers.

Yokogawa instruments are renowned for maintaining high levels of precision and for continuing to deliver value for far longer than the typical shelf-life of such equipment. Yokogawa believes that precise and effective measurement lies at the heart of successful innovation - and has focused its own R&D on providing the tools that researchers and engineers need to address challenges great and small.

Yokogawa takes pride in its reputation for quality, both in the products it delivers - often adding new features in response to specific client requests - and the level of service and advice provided to clients, helping to devise measurement strategies for even the most challenging environments.

The guaranteed accuracy and precision of Yokogawa's instruments results from the fact that Yokogawa has its own European standards laboratory at its European headquarters in The Netherlands. This facility is the only industrial (i.e. non-government or national) organisation in the world to offer accredited power calibration, at frequencies up to 100 kHz. ISO 17025 accreditation demonstrates the international competence of the laboratory.

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