

# Prospects for Power Measurement Solutions

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*In recent years, people are working harder to save energy in line with efforts to curb environmental problems including global warming. Yokogawa Meters & Instruments is assisting such efforts by developing and supplying power meters that can precisely measure the power consumption and efficiency of devices. We have also been improving our power measurement solutions by, for example, complying with international energy-saving standards, measuring the efficiency of inverters that effectively save energy, and helping to improve the power consumption of electric vehicles (EV), for which demand is increasing.*

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## INTRODUCTION

Power supply shortage is becoming a global concern in recent years. To solve it, decentralized power generation systems with solar power, wind power, biomass, geothermal power, and other new energy sources are being innovated. However, they would not be able to survive as businesses without financial help from governments or municipalities.

Meanwhile, many countries are promoting the standardization of energy-saving designs mainly of home appliances and office equipment in order to enhance the effective use of electricity. Even countries with low power rates are strengthening regulations on standby power consumption to reduce power consumed while electronic equipment is not being used.

The development of electric vehicles (EV) and their infrastructure is accelerating as a promising measure against environmental issues including global warming and the depletion of resources such as fossil fuels.

Yokogawa has been providing the WT series high precision power analyzers, which help energy-saving technologies and products to be developed. This paper introduces the present situation of power measurement solutions, which are crucial for these urgent energy-saving measures, and their future. Figure 1 shows the WT series power analyzers and CT series current sensors.



**Figure 1** WT series power analyzers and CT series current sensors

## PROVIDING SOLUTIONS TO FIELDS REQUIRING ENERGY CONSERVATION

### Solutions for Standard Conformity

In Europe, the ErP Directive, an eco-design requirement for energy-related products, has come into effect. The target products are consumer electronics, office automation equipment, lighting, and heaters, etc., but not transport equipment. Regulations on standby power have also been strengthened. The allowable limit will be tightened from 1.0 W to 0.5 W in January 2013. When IEC62301 (Ed2.0), a more strict standard, is applied in March 2014, much more precise measurements and assessments will be required.

To help develop target products that conform to standards, Yokogawa released the WT series power analyzers that can precisely measure electric power of 0.5 W or smaller. The dedicated software for measuring standby power offers a measuring solution to help conform to standards. During

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the development phase, we closely communicated with the standards organization to enhance marketing.

Conformance tests are carried out with power supplies with little distortion. Therefore, the measurement instrument should also work well with low distortion AC power supplies.

Meanwhile, a standard for harmonic current applicable to target products was established in the 1990s to reduce waveform distortion in the commercial power network. The allowable distortion of the current is specified in IEC61000-3-2 and IEC61000-3-12. To satisfy these requirements, waveform distortion including interharmonics must be precisely measured. Thus, Yokogawa has equipped its top-end model with a measuring function for this purpose, and offers it as a solution for the conformance test. Applicable standards are revised every several years. To keep up with these new revisions quickly, Yokogawa has developed dedicated software for testing and evaluating this function and has been revising it repeatedly.

In this conformance test, stable power supplies with little distortion are required. Thus, Yokogawa is planning to provide total solutions for power measurement by covering such power supplies.

#### **Solutions for Evaluating Inverters**

Air-conditioning equipment is said to consume about 30 percent of the electricity supplied to households and offices. To suppress the power consumption in widely-used air conditioners, the control of compressors and motors has become more sophisticated. Its core component is the inverter for drive systems. Switching speed, rising speed at pulse edges, and frequency for driving motor rotation are increasing. To keep pace with this trend, the WT1800, Yokogawa's latest power analyzer, has improved the sampling frequency to 2 MS/s, ten times higher than conventional ones, achieving precise measurement by accurately tracking signal changes. The WT1800 is also equipped with a function indispensable for evaluating inverters, a simultaneous harmonics measuring function that can measure fundamental frequency components of voltage waveforms in addition to other power related parameters such as total voltage, current and power.

In electric power conversion or other fields, inverters are expected to increase in rising speed at pulse edges and fundamental frequency. To respond to this trend, Yokogawa will improve its products to feature higher sampling rates and wider bandwidth measurements.

#### **Solutions for Improving Electric Mileage of EVs**

Various EVs have become available both inside and outside Japan. When developing power motors in EVs and the inverters driving them, improving electric mileage is the most crucial issue. Efficiency seems to have significantly

improved during steady states such as constant speed running. To improve efficiency during actual driving with frequent changes in speed and torque, precise measurement is required during transient phases. However, conventional power meters can measure only one or two points during the phase because their data update rate is 50 ms at a maximum, resulting in insufficient evaluation.

The latest WT1800, equipped with a newly developed high-speed data capturing function, can measure data every 1 ms at maximum (when synchronizing with external signals) and precisely track quick fluctuations of DC and the signals of a three-phase motor.

In general, when measuring AC voltage, current and electric power, their RMS values or MEAN values are calculated every cycle of the waveform. However, our high-speed data acquisition function can measure changes within a cycle by using Yokogawa's original signal processing technology without requiring the complete data for one cycle. In addition to the measurement of voltage, current, and electric power, the motor evaluation function can simultaneously measure changes in the rotation speed and torque of a motor. (It allows A-phase, B-phase, and Z-phase inputs, and then also makes it possible to detect the rotation direction and measure the electrical angle.) Measuring both the electrical input and mechanical output at the same time enables a comprehensive evaluation of the efficiency.

For example, when accelerating an EV, large current is required to quickly raise the output of the motors. Required current may reach up to about 1000A. Therefore, sensing technology for EVs must deal with such significant changes in current with wide dynamic range and bandwidth.

Although Yokogawa's CT series can measure current of up to a 1000 A peak, Yokogawa is planning to develop sensors for larger currents and wider bandwidths for construction machinery and other fields where hybridization (driven by both fuel and electricity) is under way.

#### **CONCLUSION**

As power-saving activities are on the increase worldwide including emerging countries, the need for precise measurement of electric power is expected to increase. More energy-saving efforts are required for the development of home appliances and office equipment. Laws and regulations to reduce standby power consumption are being strengthened in many countries. High-speed measurement of larger currents with wider bandwidth is needed for driving inverters with high-speed switching. By addressing these factors, Yokogawa aims to provide power measurement solutions that will enhance power-saving efforts in the development of products and infrastructure.