Renewable Energy Testing

A new versatile instrument combines the benefits of a high-speed oscilloscope and those of a traditional data-acquisition recorder in a single, portable instrument. It also incorporates a number of features that make it suited to tests on renewable energy systems. **Kelvin Hagebeuk, Yokogawa Europe, Amersfoort, Netherlands**

As an oscilloscope, the DL850 ScopeCorder (Figure 1) brings features like high sample rate, special triggers to capture transient events and analyses tools; as a data-acquisition recorder it implements high channel count (up to 128 channels), isolated high-voltage inputs (with up to 1kV optical isolation), and the ability to record to a hard disk or through a network to a PC.

This combination of features makes the instrument particularly suited to carrying out tests on renewable energy systems: in particular, on the inverters and associated power electronics used with wind, solar and tidal power generators. The ScopeCorder, with its multi-channel synchronisation, isolated inputs and 100 MegaSamples/second sample rate, is a tool to capture signals coming from these inverters along with control signals and other parameters - from electromechanical and temperature sensors, for example. These signals can then be viewed simultaneously so that 'cause and effect' analyses can be carried out.

Inverter measurements

Inverters used in renewable energy systems - as well as other applications including transport - are increasingly incorporating faster, higher-voltage devices which require isolated high withstand voltage measurements at higher sampling rates, as well as the ability to simultaneously measure greater numbers of signals for longer periods of time.

Traditional waveform measuring devices like digital storage oscilloscopes have limited capability for high-voltage inverter measurements because they lack the separately isolated inputs together with high-voltage isolation and high 12-bit resolution. Other waveform measuring solutions often require external (active) signal conditioning to achieve high-voltage isolation.

The DL850 ScopeCorder, on the other hand, uses a technology known as isoPRO® in its high-voltage measuring module to provide 100MS/s sampling with 1kV isolation and 12-bit resolution with no need for external active signal conditioning devices. isoPRO technology employs a system whereby digital data is converted to optical signals using a laser diode, with the data then being transferred via optical fibre to the instrument. As the data transfer rate of the

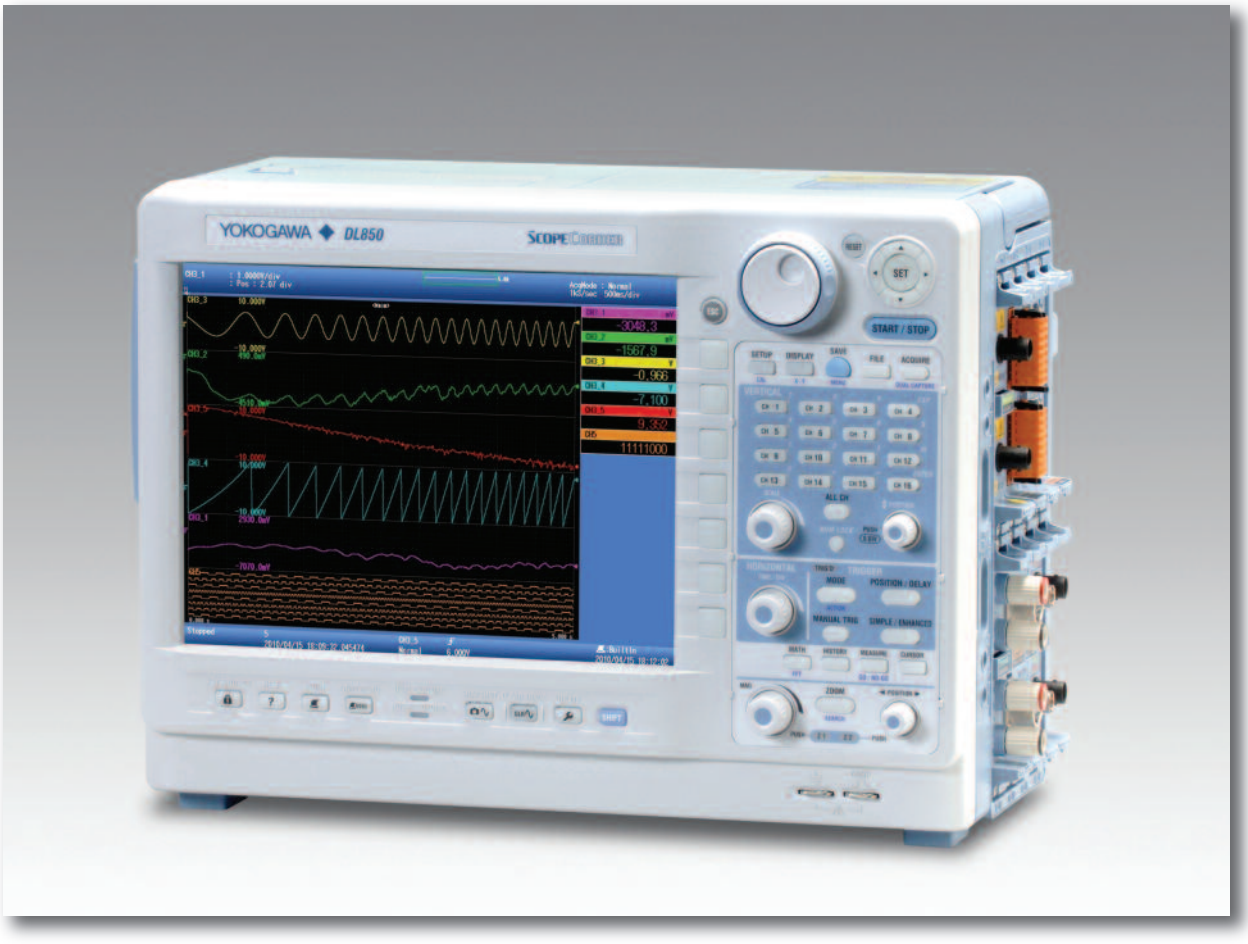

Figure 1: **The Yokogawa DL850 ScopeCorder signal waveform recording and measuring instrument**

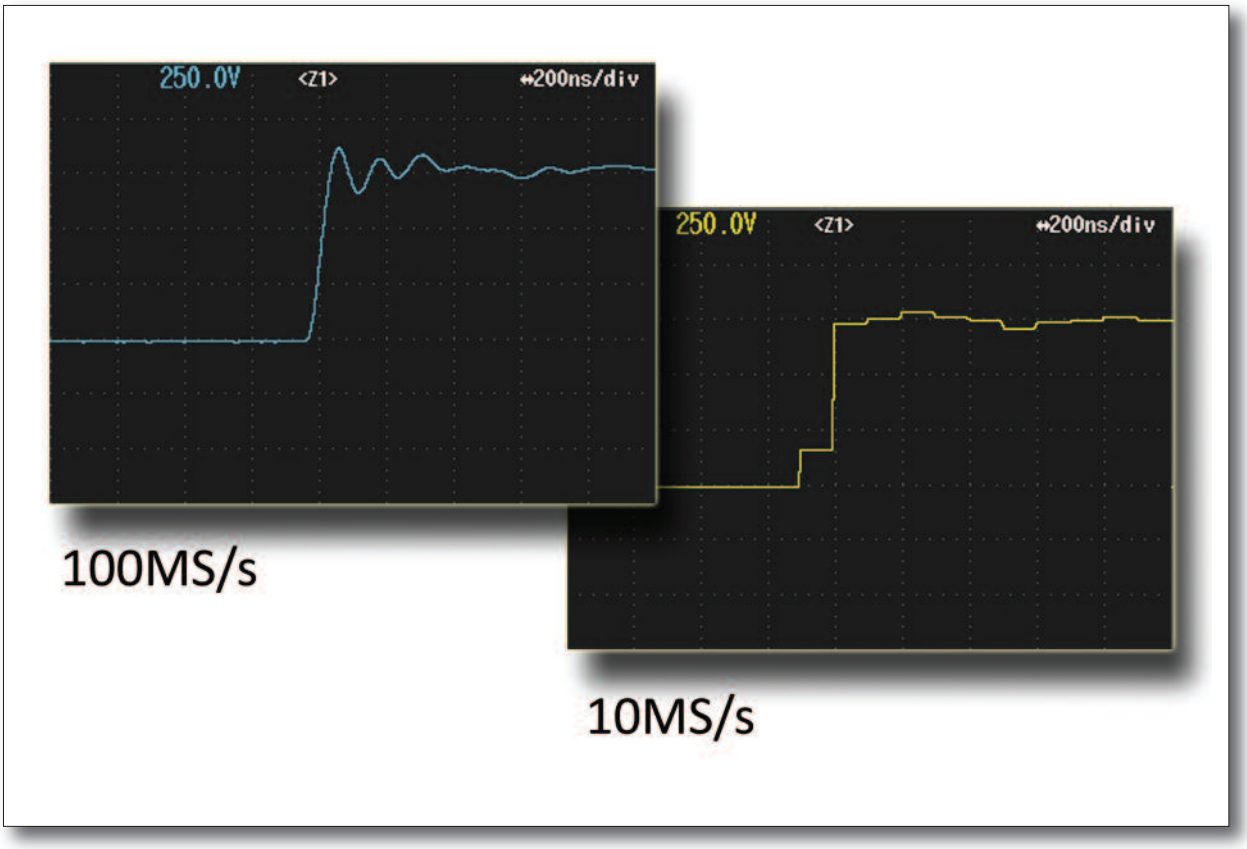

Figure 2: Comparison of measured inverter pulse waveforms using 100MS/s and 10MS/s sampling

laser diode is extremely high, large amounts of data can be transferred on a single device, and as a result the area of isolation becomes very small. Also, because optical fibre itself is an insulator, and the distance of signal transfer along the optical fibre is sufficient to provide the appropriate insulation, an insulating distance between the signal input and the main unit is provided even at a high voltage of 1kV. Using isoPRO technology, it becomes possible to package two channels of 100MS/s, 1kV high withstand voltage isolation measurement circuits in a compact module measuring approximately 100mm _ 200mm.

Figure 2 shows a pulse waveform of an inverter signal using this module. On the left is the measured result at 100MS/s, and on the right is the result using the predecessor 10MS/s module. It is clear that measurements with the 100MS/s high-speed isolation module provide more pulse details.

A further benefit of this technique is that it provides excellent noise rejection. Because the high voltage of inverters is switched at high speed, noise is necessarily introduced along the path of measurement. In the high-voltage isolation module, however, excellent noise rejection performance results in good CMMR (common-mode rejection ratio) values and also means that the floating voltage switching waveforms which are typical for inverters and devices such as IGBTs can be captured with high precision.

Moreover, using on-board analysis tools like cursor and waveform parameter measurements provides direct insight into the behavior of the total system. This combination of features contrasts with the limitations of a standard oscilloscope, which typically offers limited channel count (often only four inputs), 8-bit resolution, non-isolated inputs, no high-voltage inputs and limited memory.

Applications

In Europe, ScopeCorders are now being used for power-inverter testing in wind power development, but they have also found application in the areas of field service and maintenance. A typical field application is looking for voltage drops or transients, for which the ScopeCorder can be set up with special trigger conditions. For example, a special AC power-line trigger can be set so that, in the event of a voltage drop or glitch, the instrument will trigger on that glitch and capture that event. In this case the instrument will capture not just the basic voltage signal but also other parameters like current, temperature, turbine speed and logic control signals. As the ScopeCorder has the ability to bring all signals together in one measuring device incorporating on-board analysis tools, this will give easier and quicker insight into the cause of this transient event.

In this way, the ScopeCorder is being used as a tool to map the total behavior of the alternative energy source and its components.