

# Measurement Solutions

Measurement Solutions  
for Vehicle Development

To meet the three essential requirements for automobiles – safety, environmental friendliness, and comfort – the amount of electronic components in vehicles is increasing at a rapid pace. In pursuit of better gas mileage, the development of electric vehicles (EVs) and hybrid electric vehicles (HEVs) is ongoing, as is research into fuels cells, whose energy density exceeds that of the engines powering EVs and HEVs. In the meantime, the fields of in-vehicle data communication and computerization are progressing rapidly as cars are being increasingly equipped with more electrical equipment for greater comfort and safety. With the aim of supporting future automobile development and evaluation, Yokogawa Electric offers various categories of measuring instruments in five fields: "Hybrid EV," "Fuel cell," "In-vehicle LAN," "Vehicle Components," and "Intelligent Transport System (ITS) equipment."





We provide a wide variety of test equipment solutions – such as waveform measuring instruments, power meters, and signal generators – to meet your development and evaluation needs

Measurement Solutions

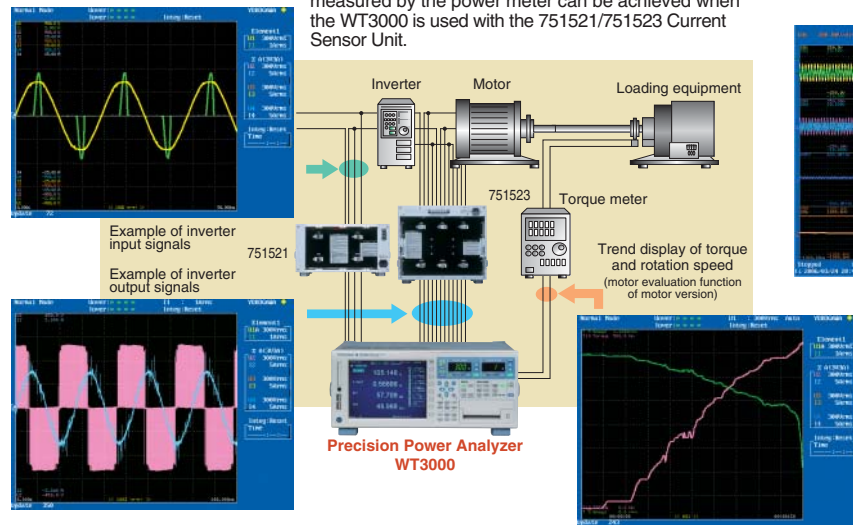
## Hybrid and EV Development

### ● Motor and inverter I/O efficiency measurements and harmonic waveform analysis

Highly accurate measurements can be made using the WT3000, which boasts the world's highest measurement accuracy of  $\pm 0.06\%$ . Capable of being equipped with four input elements, the WT3000 can measure input signals simultaneously with output signals, and harmonic waves simultaneously with normal waves. In addition, the WT3000 can be used for the evaluation of inverter/driver conversion efficiency and pulse width modulation (PWM) signals. (Using the three-phase model, as of August 2006)

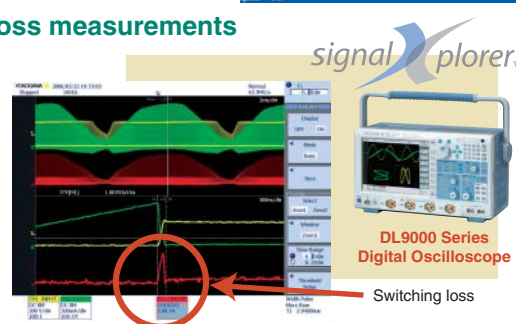
### ● Large current measurements

Large-current measurements, which cannot be directly measured by the power meter can be achieved when the WT3000 is used with the 751521/751523 Current Sensor Unit.



### ● Device switching loss measurements

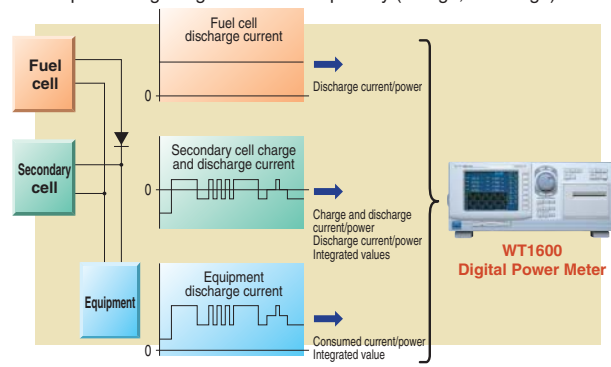
For the design and evaluation of a driving inverter circuit, the high-speed digital oscilloscope DL9000 Series is useful. After the simultaneous measurement of the device voltage and current, the switching device loss can be measured using one of the DL9000's 4 math channels.



## Fuel Cell Development

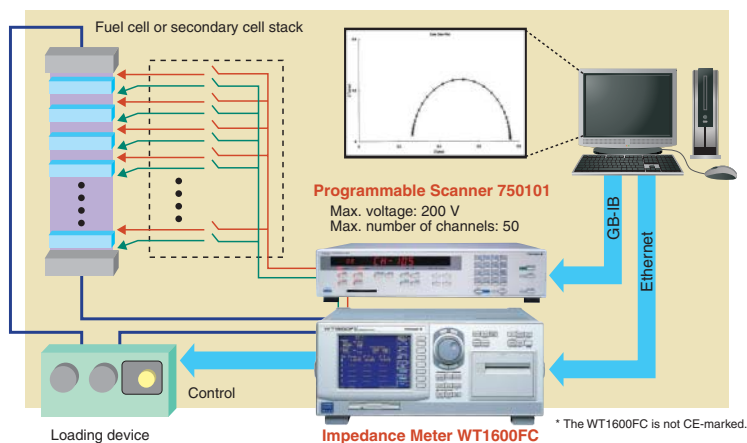
### ● Separate measurement of charge and discharge status of fuel cell and secondary cell

The WT1600 accurately performs separate measurements of the charge and discharge status of a fuel cell and a secondary cell. It is capable of measuring voltage, current, and power at up to six points and performing integration for each polarity (charge, discharge).



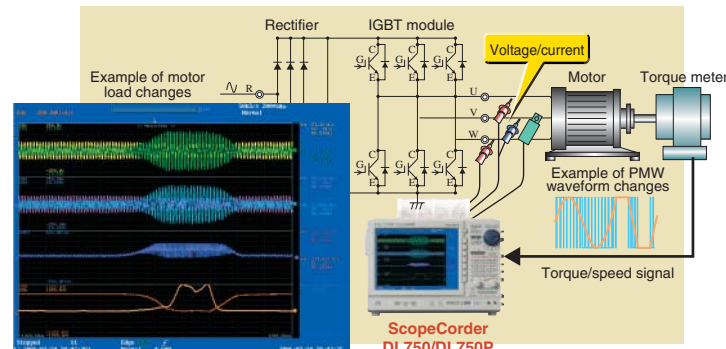
### ● Measurement of cell/stack impedance

For quantitative evaluation of internal loss, the WT1600FC measures the impedance of a cell/stack of fuel cells and secondary cells of all capacities – from a single cell (small capacity) to a full stack of cells (large capacity). Impedance measurements can be performed for two channels at one time.



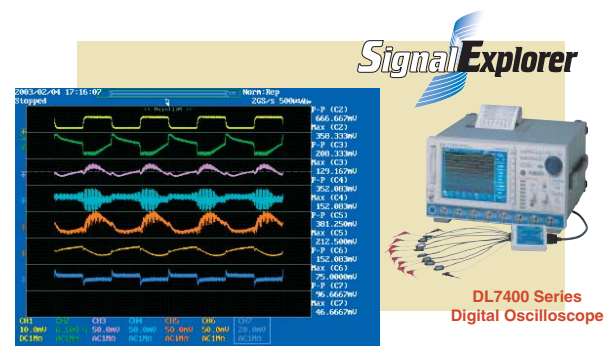
### ● Measurement of motor characteristics (torque, speed, temperature, distortion, etc.)

The DL750/750P can simultaneously measure multiple signals and display their waveforms. Based on measurements of signals from up to 16 channels, motor characteristics such as torque, speed, temperature, and distortion can be determined. Most notably, the waveform calculation function of the DL750/750P calculates the sum of instantaneous power values, enabling the observation of changes in three-phase power values.



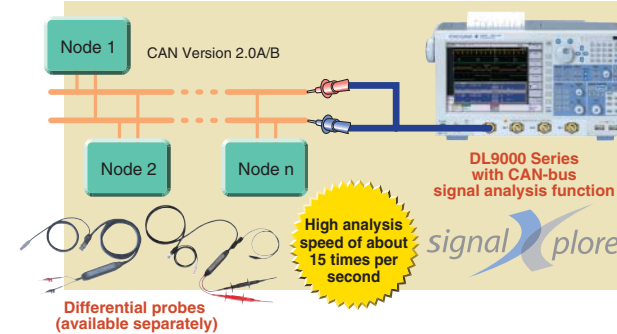
### ● Measure three-phase I/O voltage and current with a single instrument

Combining 8 analog inputs and 16-bit logic inputs, a single DL7400 unit can simultaneously measure three-phase I/O voltage and current. The DL7400 can monitor the waveforms for ripples and the transient responses of output voltages caused by load changes.



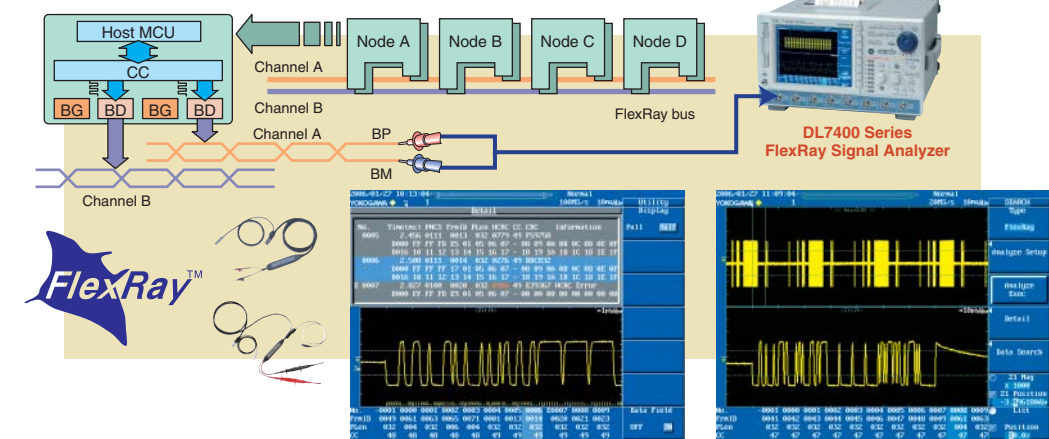
### ● CAN-bus waveform observation and protocol analysis

The DL9000 with CAN-bus triggers and protocol analysis functions, captures and displays the physical layer waveforms and decodes the CAN protocol in real time. Triggers can be set for specific CAN events or for CAN events in combination with input signals on other channels (for example a sensor output).



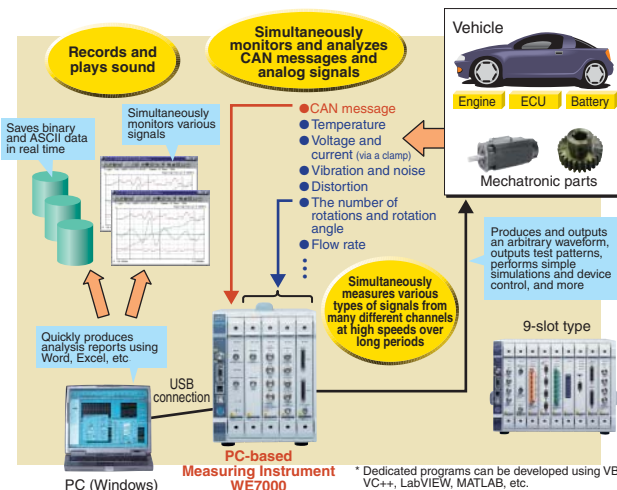
### ● FlexRay protocol analysis and waveform observation

By using FlexRay triggers, a single DL7400 unit can perform physical layer waveform observation and protocol analysis of FlexRay bus signals. The results of data protocol analysis and signal waveforms can be displayed on the same screen to monitor the interrelationship. The timing and period of data transmission can also be checked in relation to the waveform. Dedicated CAN-bus triggers and the CAN protocol analysis functions are also available as options.



### ● Test and evaluation of vehicle engines, ECU, batteries, mechanism controllers, etc.

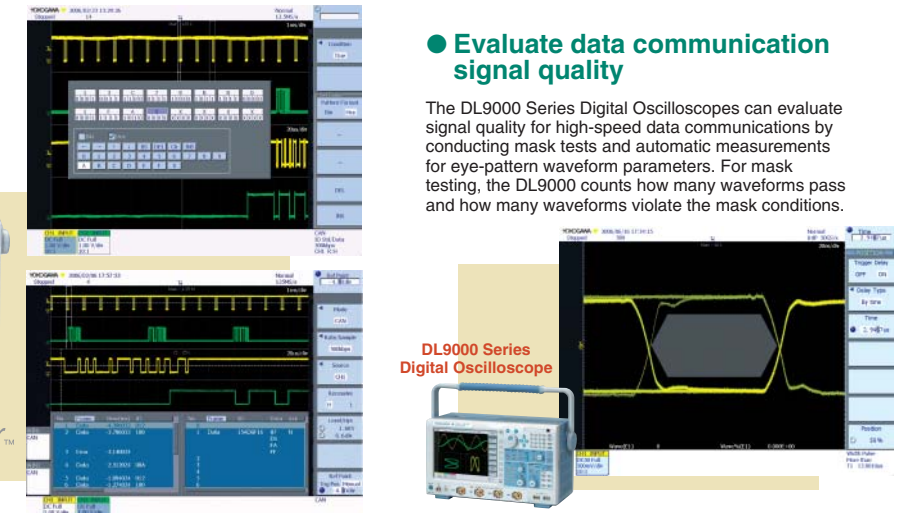
A single WE7000 unit can simultaneously monitor and analyze the various signals required for testing and evaluating vehicle engines, ECU, batteries, mechanism controllers, and the like. Due to the ease of changing and adding input modules, data can be quickly saved to a PC for efficient measurements.



## Development of In-vehicle LAN

### ● Evaluate data communication signal quality

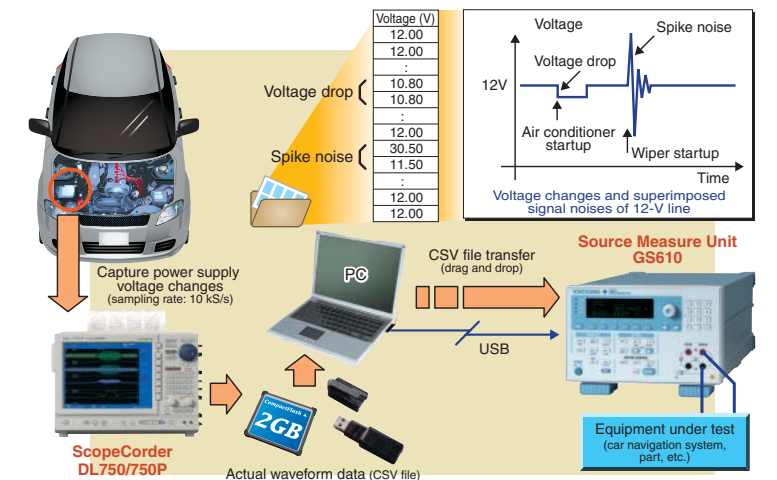
The DL9000 Series Digital Oscilloscopes can evaluate signal quality for high-speed data communications by conducting mask tests and automatic measurements for eye-pattern waveform parameters. For mask testing, the DL9000 counts how many waveforms pass and how many waveforms violate the mask conditions.



## Evaluation of Vehicle Components

### ● Simulate voltage change and noise, and measure the results

The GS610 is a highly accurate, programmable voltage/current source with a measurement function. For example, it can be programmed to output a signal representing a power supply voltage drop at the startup of an air conditioner, as well as a signal indicating a spike noise waveform at the startup of a wiper motor. As the GS610 can re-create power supply voltage changes of actual vehicles in a laboratory, a noise test can be conducted on devices under test without installing them in the vehicle.

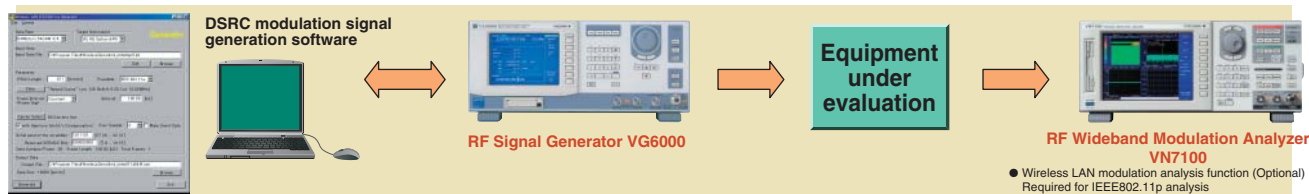




## Evaluation of ITS Equipment

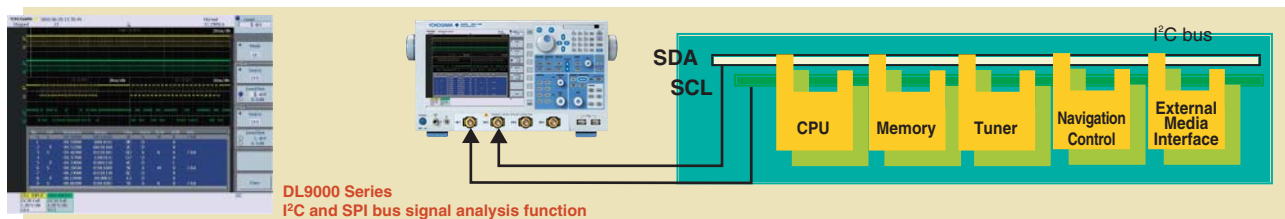
### ● Generation and analysis of RF signals

The RF Signal Generator and the RF Signal Analyzer can evaluate the dedicated short-range communication (DSRC) function required for ITS equipment. To generate an RF signal using the VG6000 RF Signal Generator, a PC is used first to compile modulation signal data so that the data is compliant with various standards. The VG6000 RF Signal Generator modulates the data and outputs it. The VN7100 RF Modulation Analyzer down-converts RF signals output from the equipment under evaluation into baseband signals for analog/digital (A/D conversion), and loads them into the internal memory.



### ● Evaluation of Internal I<sup>2</sup>C and SPI Buses for Car Navigation and Audio Systems

The DL9000 Series performs protocol analysis and observation of the signal waveforms of general-purpose I<sup>2</sup>C and SPI serial data buses, which are widely used as internal buses for car navigation and audio systems. As the DL9000 Series can simultaneously observe protocol analysis data and waveform signals, it enables users to quickly troubleshoot and identify malfunctions.



Please refer to the following web sites for details of each product.

DL9000	<a href="http://www.yokogawa.com/tm/DL9000/">http://www.yokogawa.com/tm/DL9000/</a>	WT3000	<a href="http://www.yokogawa.com/tm/WT3000/">http://www.yokogawa.com/tm/WT3000/</a>	VG6000	<a href="http://www.yokogawa.com/tm/wireless/vg6000/tm-vg6000_01.htm">http://www.yokogawa.com/tm/wireless/vg6000/tm-vg6000_01.htm</a>
DL7440/DL7480	<a href="http://www.yokogawa.com/tm/DL7400/">http://www.yokogawa.com/tm/DL7400/</a>	WT1600	<a href="http://www.yokogawa.com/tm/WT1600/">http://www.yokogawa.com/tm/WT1600/</a>	VN7100	<a href="http://www.yokogawa.com/tm/VN7100/">http://www.yokogawa.com/tm/VN7100/</a>
DL750/DL750P	<a href="http://www.yokogawa.com/tm/DL750/">http://www.yokogawa.com/tm/DL750/</a>	WE7000	<a href="http://www.yokogawa.com/tm/WE7000/">http://www.yokogawa.com/tm/WE7000/</a>	GS610	<a href="http://www.yokogawa.com/tm/GS610/">http://www.yokogawa.com/tm/GS610/</a>

### Yokogawa's Approach to Preserving the Environment

- Yokogawa's electrical products are developed and produced in facilities that have received ISO14001 approval.
- In order to protect the global environment, Yokogawa's electrical products are designed in accordance with Yokogawa's Environmentally Friendly Product Design Guideline and Product Design Assessment Criteria.

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#### Note



- Before operating the product, read the user's manual thoroughly for proper and safe operation.

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