

89 kWh LITHIUM-ION
BATTERY PACK



38,266.596 s
TIME BEFORE NEXT CHARGE



465.55357 km
SUBURBAN MAXIMUM RANGE

14.6 kWh/100km
ENERGY CONSUMPTION

40.28°C
BATTERY TEMPERATURE

no.6

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Test & Measurement magazine

Meet the next generation in Precision

Colophon

Yokogawa Test & Measurement magazine is published twice a year.

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Plan B – Assendelft,
 creative communication

3 Yokogawa Test & Measurement: Driving sustainable automotive innovation

As the automotive industry heads towards 2030, it finds itself undergoing a historic change, characterized by the major trends in electrification and digitization, autonomous driving and new mobility concepts. But more importantly, by the challenge of further reducing consumption and emissions, lowering the overall impact on the environment. This trend leads to a different level of complexity in developments and manufacturing. Engineers are being faced with the challenge of carrying out whole system diagnostics and characterization to determine safe, reliable and predictable behaviour of the onboard control and environmental electronic systems. To do this, they need to measure many different variables of their designs, in a variety of states, in a flexible way, whilst maintaining the highest levels of precision and accuracy.

At Yokogawa we understand the ever-changing needs from automotive development engineers who require both the accuracy of a measurement system and its precision, where stability and reproducibility ensure that repeated measurements under unchanged conditions show the same results.

This issue of Yokogawa's Test & Measurement magazine focuses on two new products that assist engineers to overcome challenges presented by today's automotive sector: The DLM3000 mixed-signal oscilloscope and the WT5000 Precision Power Analyzer.

The DLM3000 is a new generation of Mixed Signal Oscilloscopes incorporating features that make it ideally suited to the test & measurement requirements of today's automotive environment. It offers the capability for serial bus testing on a number of popular in-vehicle buses, along with dedicated power supply analysis capabilities for testing inverters and other drive-train components of electric and hybrid vehicles.

The WT5000 is the first of a new generation of Precision Power Analyzers that offers exceptional measurement accuracy of $\pm 0.03\%$ combined with stability, noise immunity and plug-in modular flexibility, making it ideally suited to meet the test challenges faced by the developers of electric and hybrid vehicles.

It is our passion to continuously provide our customers with precise measurement insights to develop the next generation of automotive technology.

Kelvin Hagebeuk

Marketing Manager, Test & Measurement
 Yokogawa Europe B.V.



New DLM3000 Mixed Signal Oscilloscope

– Productivity at your fingertips

By Kelvin Hagebeuk, Yokogawa Europe

The new DLM3000 builds on Yokogawa's oscilloscope legacy with new features focusing on quality, flexibility and usability to increase users' productivity and meet the advanced needs of today's automotive and mechatronics designs. The instrument combines the flexibility of a MSO with the capability for serial bus testing on several popular in-vehicle buses, along with dedicated power supply analysis capabilities for testing inverters and other drive-train components. It features the familiar 'look and feel' and small footprint of Yokogawa's earlier MSO series but with a complete hardware redesign for enhanced ease of use and improved productivity required by engineers working on next-generation vehicle designs.

The DLM3000 combines a touchscreen display with internal hardware that offers low residual noise, extensive voltage ranges and a variety of real-time lowpass filters to ensure the fidelity of signals. Channel count and memory depth options, combined with optional power maths and serial bus capabilities, are further features that meet a variety of needs.

The combination of a touchscreen with a traditional panel of oscilloscope controls allows users to seamlessly transition between the two modes of operation, whilst communication and storage options make it easy to access large data sets.

In the multi-channel mixed-signal capability of the DLM3000 series, the fourth analogue input channel can be converted into 8-bit logic, so that the instrument functions as a 3-channel analogue oscilloscope combined with an 8-bit logic analyzer. As a result, up to 11 input signals can be observed simultaneously as three channels of analogue signals and an 8-bit logic input. This means the DLM3000 can be used for the observation of data and control signals, or as a trigger source and for the logic input analysis of I2C, SPI, UART and SENT buses, removing limitations imposed by the four channels of a standard oscilloscope in applications where functioning of multi-channel digital control circuits need to be examined.

The DLM3000 has a bandwidth of up to 500 MHz and a high sampling rate of 2.5 GS/s, making it suited for precision waveform analysis in measurements on fast switching signals in inverter drives.



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The combination of a high sample rate, increased input voltage range and lower voltage per division range all leads to lower residual noise and increased sensitivity.

Dedicated serial analysis function options (/F01 to /F05) are available for embedded systems and in-vehicle bus signal analysis such as I2C, SPI, CAN, CAN FD, LIN, SENT and others.

The logic input can be used for some specific serial buses. Complicated trigger and decode settings such as bit rate and threshold level are automatically detected using the unique serial bus auto setup function. Simultaneous analysis of four different buses can be carried out, with waveforms and analysis results from buses with different speeds being displayed using dual zoom windows.

The 'best-in-class' memory capacity of up to 500 Mpoint allows the instrument to maintain its high sample rate during long-term measurements. A zoom and search function allows users to select and display two zoomed waveforms; with different time axis scales, at the same time.

A history memory function automatically saves up to 100,000 previously captured waveforms in the acquisition memory and subsequently allows rarely occurring abnormal signals to be analyzed using powerful history search tools.

With the DLM3000 Yokogawa is emphasizing its ability to capture and analyze waveforms reliably with detail, precision and superior noise performance and offers valuable measurement insights to engineers involved with electric circuit design in automotive applications.

**Clean signals,
extensive
processing
and ease
of operation**

Why performance is not a matter of size

By Yokogawa Europe in corporation with Michelin Reifenwerke AG & Co KGaA, Holmburg/Saar, www.michelin.de

The portable DL350 ensures quality in tire manufacturing at Michelin. As retirement approaches for Reiner Schultheiss, he fondly reflects on his time as an electrical engineer at the Michelin tire manufacturing plant in Homburg/Saar.

At the moment operations are running smoothly, with 3000 new tires coming off the production line every day as well as some 1800 retreads. But it was not always smooth sailing. Reiner began working at the Michelin tire company in the middle of the 1970's oil crisis. He still remembers the rocketing fuel prices, low sales figures and driving bans on Sundays. A lot has changed since then, thanks in part to Schultheiss's efforts as an electrical engineer responsible for maintenance, troubleshooting and analysis of all the production systems. For major part of his career at Michelin Schultheiss always had a "helper" with him: the OR100 from Yokogawa. That solid measuring device is now being replaced by a Yokogawa DL350.

Production systems run continuously – thanks to isolated analog inputs

In the past, the portable OR100 "saw" every corner of the expansive facility at Michelin. The small device was on top of the toolbox when the maintenance technicians were told:



"Find the fault". Often not an easy task for Schultheiss, because tire production is technically complex. But the Yokogawa OR100 proved its worth as it could record voltages, currents, pressures, temperatures and PLC control signals. Being lightweight and portable, it could be used in almost any corner of the production line. The OR100 was a real favorite of technicians because of one special feature- its isolated analog inputs.

When Michelin discussed a successor device to the OR100, the importance of this feature was greatly emphasized. The choice ultimately fell on the DL350. A good decision for Schultheiss, because in addition to the DL350's modular isolated inputs and ability to record signals from new

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Acquisition of control signals from the PLC.



This plant produces with an extruder the inner rubber layer for truck tires. The rubber band is wound up after short cooling on large rolls and later cut to the required size.

production systems, it could also capture, and record measured values from older systems.

"Since the systems are of different ages, they are equipped with controls ranging from simple contactor controls to logic controls and state-of-the-art electronics. We are responsible for ensuring production systems run as smoothly as possible and are quickly ready for operation again in the event of malfunctions".

"Lightweight" measurement technology makes troubleshooting more convenient

Looking at production with its variety of systems, parts and components, it becomes clear what is expected of the service department. Anyone who has ever gone on a tour of a production facility knows what they are talking about- spacing between the production machines is tight and there is not a single section where nothing moves or turns. Motors are roaring, belts are buzzing - and it's loud. This noise level is an enormous challenge for the engineer, not

to mention the constant heat generated by the machine drives: While pleasantly warm in winter, it's a different story in summer. Having access to a lightweight and portable measuring device allows engineers to act without additional energy expenditure.

Flexible isolated inputs are ideal for fault finding

Schultheiss and his colleagues are now confronted with a new measurement challenge- The measurement of analog control signals from the PLC and the logging of pressure signals and

temperatures from an extrusion system.

A clear pro for the DL350 here is the ability to compare control deviations making this portable measuring device an important contributor to quality control. From monitoring the extruder fill level to temperature thresholds, the DL350 plays a decisive role in ensuring that raw materials are heated to specific temperatures to ensure malleability without degradation. Only when everything is perfect can the liquid rubber be pressed through a die and shaped. >>>



In the tire-cooking, the liquid rubber is inserted from the above into the vulcanization press, then the mold is closed with a lid and the tire brought under pressure and temperature in the final form and consistency.

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The next generation in precision boosts automotive testing

WT5000 Precision Power Analyzer

By Anoop Gangadharan, Yokogawa Europe



Meet the new WT5000 Precision Power Analyzer, the extensible measurement platform that unlocks precision power analysis for electromechanical systems in electric vehicles, renewable energy, home and office appliances and industrial equipment. >>>



>>> Relaxed generation change – in every respect

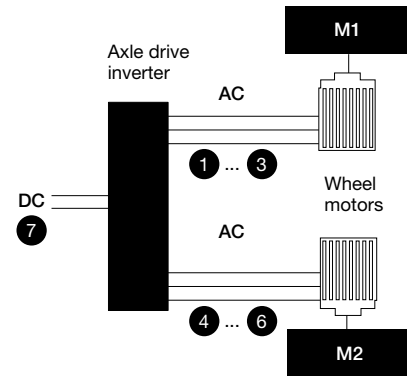
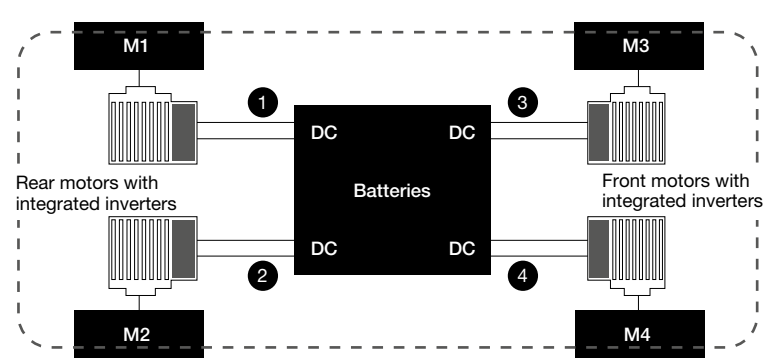
Further advantages include the two acquisition modes of the portable DL350. Whether capturing short snapshots or long-term logging, the control signals provide valuable information for the technology. Also important are options for recording the reference signal from the 550kW extruder drive, logging armature current and voltage and for measuring field current and voltage. This makes troubleshooting efficient and helps to find possible causes for quality losses.

Schultheiss explains how important reliable results and speed are, even for an ‘old hand’.

“Some time ago, an error occurred sporadically on a tire wrapping machine. In order to find it, we had to record various signals over several hours. To do this, we simply hung the DL350 in the switch cabinet, connected it and

started monitoring. With the help of the trigger and analysis functions of the device, we were able to locate a cable break that only occurred in a certain process step in the production process. Without the ScopeCorder, we would probably have searched much longer.”

Since special attention must be paid to cables, where there is movement in production, the scope mode on the DL350 enables the detection of voltage drops and voltage peaks on continuously moving cables – Thus system failures can be avoided. This and many other challenges will be the future responsibility of Stefan Anstett. As an electrical engineer, he follows in Schultheiss’s footsteps. After more than 40 years, Schultheiss is now taking the OR100 symbolically into his well-earned retirement trusting that continuity of manufacturing is in good hands with Anstett and his “helper” the DL350 portable ScopeCorder.



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Modern drive systems with integrated inverters do not allow access to the AC signals. Here one of the main measurement tasks is to measure the overall drive train efficiency from DC to mechanical power. The example shows 4 DC measurements (1 to 4) with the corresponding 4 mechanical power measurements (M1 to M4)

Challenges in the automotive industry

With range anxiety being amongst the biggest barriers to mainstream adoption of electric vehicles, manufacturers are constantly chasing shorter charging times, maximum efficiency and longer travelling ranges. Advances in power semiconductors, charging technologies and drivetrain systems afford manufacturers the opportunity to extract efficiencies across the automotive system. However, to achieve this, engineers will first need to extract accurate and actionable insights across the automotive system throughout the development life cycle. In this article we explore key challenges in testing automotive efficiencies and how next generation measurement platforms can address these with custom measurements and consistent accuracy.

Testing for efficiency

While there are several areas of the automotive system where efficiencies may be extracted, the powertrain and charging system are particularly important. Improvements in charging capacity, charging time, and travelling range require not only a thorough evaluation of battery charging and discharging characteristics but also a holistic electromechanical assessment of the 3 phase motor drive systems that propel the wheels of the electric vehicle.

Moreover, tests on inverter signals need to account for harmonic superimpositions from fast switching circuits thus requiring power analysis at higher frequencies. Minimising

the interference from this switching noise requires isolated inputs, high-speed sample rates, and measurement data gathered over long periods. Ensuring safety, performance and reliability in electric vehicles requires consistently accurate measurements of parameters such as power, energy efficiency, harmonic content, torque and power factor etc over the specified ranges and conditions.

The next generation in precision automotive testing

For such holistic evaluations of battery charging and discharging characteristics, multiphase inverter-motor drivetrains, a power measurement instrument would need to have bidirectional energy measurements at high accuracy, as well as the ability to simultaneously measure multiple motors. With a measurement accuracy of $\pm 0.03\%$, 7 swappable input elements, and motor evaluation function that can evaluate up to 4 motors at a time; the new WT5000 precision power analyzer offers all this and more.

■ **Swappable Modules**

Seven built-in slots for user-swappable power input modules and diverse mainframe options enable users to expand or reconfigure the instrument as their applications and requirements change. Users can swap between 5A or 30A input modules to analyze and compare multichannel measurements on a split screen touch display.



■ **Motor evaluation**

In addition to its versatility in electrical measurements, the WT5000 has the ability to measure torque and speed from up to four separate motors, simultaneously. The motor evaluation function enables measurements of rotational speed and direction, synchronous speed, slip, torque, mechanical power, electrical angle and motor efficiency from an analogue or pulse output of torque sensors or pulse outputs of rotation sensors. This allows a single WT5000 to take synchronous measurements from multiple motors to determine the overall efficiency of a 4-wheel drive.

■ **Reliable, actionable insights**

In addition to swappable input elements, multichannel measurements and multi-motor evaluations, the WT5000 features custom computations, bidirectional integrations (for positive and negative cycle) and dual harmonic analysis up to the 500th order. This means that users can define their own measurement conditions and computations and also perform harmonic measurements up to the 500th order from up to 2 inputs simultaneously. This is important because pure sine-wave PWM signals are not common in motor applications, and mean voltages often differ greatly from the fundamental voltages of a complex waveform. Harmonic measurements should also be accounted for when establishing the values of derived measurements such as active power. The accuracy of the WT5000 is supported by stability, noise immunity and a design that minimises the effects of high-frequency common-mode voltage,

resulting in an excellent CMRR (common-mode rejection ratio) characteristic.

■ **Intuitive and extensible**

A split-screen touch display, accompanied by hardware hotkeys, enables an intuitive experience of the measurement, computation and analysis capabilities of the WT5000; while up to 32 Gb of internal memory allows large quantities of measurement data to be stored. The capabilities of the WT5000 can be extended even further using the powerful WTVIEWER PC software which enables remote measurement and configuration, as well as synchronized multi-unit measurements. This means that complex applications can use up to 4 WT5000 units to access up to 28 power input elements and 16 motors simultaneously.

■ **Reliable today, ready for tomorrow**

With the trend towards faster switching speeds, evolving standards, and the need for multiphase analysis of charging systems, multi-motor powertrains, and subsystems such as ECU, steering and suspension, regenerative braking etc, automotive engineers need versatile test platforms that deliver reliable insights across the development cycle.

With its exceptional accuracy, swappable inputs and multi-motor analysis capabilities, the WT5000 offers automotive engineers a measurement platform that they can count on for years to come.

Helping car manufacturers use LED technology for more than just lighting

Paolo Magni & Jörg Latzel (Yokogawa Europe) explain how cars' LED lights can also improve road safety, vehicle efficiency and traffic management

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Since the '60s LEDs have been used for signalling, indicating the status of printed circuit boards and even data transmissions are taking place. Today LED technology has evolved as we are familiar with it as a solution for modern lighting applications including automotive. Manufacturers are installing them because of their superior quality, energy efficiency and performance compared to incandescent or halogen lamps.



In parallel to this use of LEDs as light sources, car manufacturers have been looking at ways to transfer data about driving conditions and behaviours between cars – an application known as Vehicle to Vehicle Communications or V2V. The aims of V2V are to make driving safer and make road use more efficient (source: allledlighting.com). One approach is to use the LED lights of a car to transmit V2V communications data.

So fast, that it is possible to transmit messages between units without interfering with their primary function in any way. The issue facing the adoption in this application is ensuring the LED V2V system performs in all the different ambient lighting and weather conditions.

One can ask how data communication and transmission can be carried out using headlights and taillights?

The answer is that LEDs are incredibly fast at switching on and off - so fast that it can't be detected by the human eye.

To aid automotive manufacturers to develop these systems, Yokogawa has produced a specific model Optical Spectrum Analyser. The AQ6373B is designed to precisely characterize and test the light emitted by LEDs.

Download and read the full article about this exciting opportunity in V2V communications here.



For more automotive Yokogawa reference material, visit our:

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On this page we have collected together the most updated Yokogawa Test & Measurement automotive related articles, news and videos for your easy viewing. The information will give you insights on how Yokogawa's powerful tools can help you with your measurement challenges on your specific application.



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