

AUTOMOTIVE ELECTRONICS

TEST AND MEASUREMENT SOLUTIONS

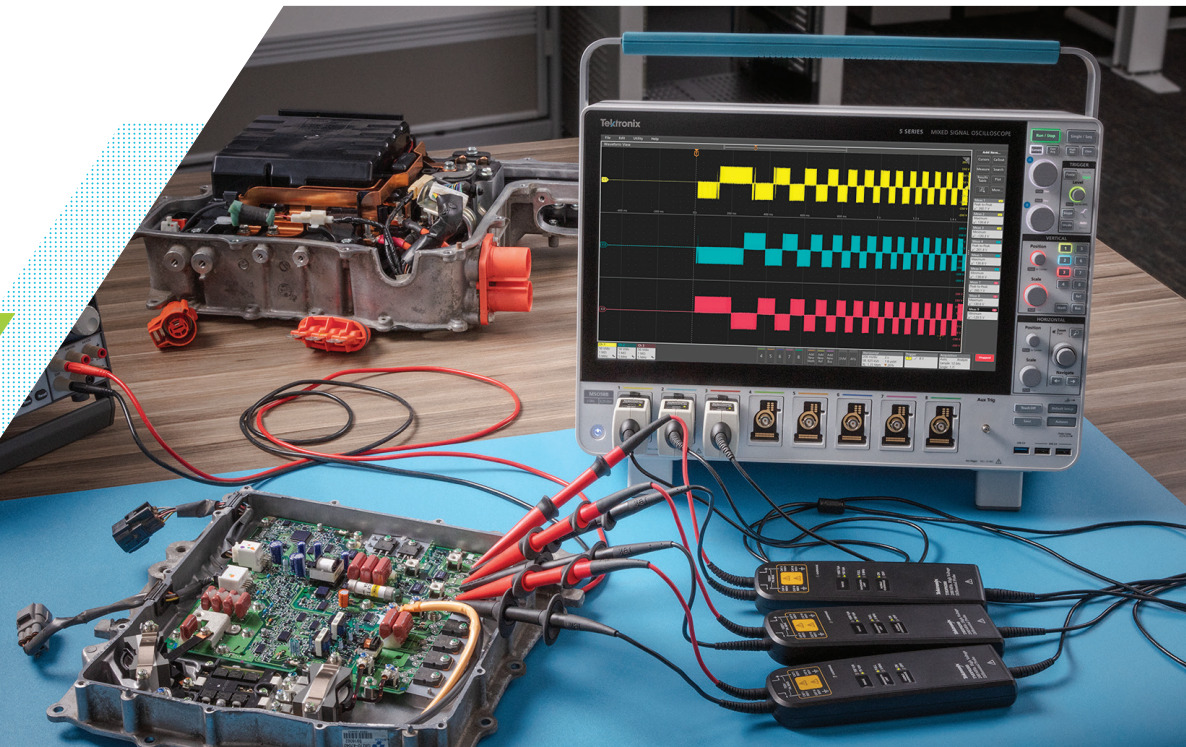


SOLUTIONS FOR AUTOMOTIVE TECHNOLOGIES

Accelerating the future of mobility with innovative test and measurement solutions.

The pace of digital transformation in the automotive industry has never been faster. Advances in high-speed data communications, power electronics and battery technology are enabling higher performance resulting in safer, more efficient vehicles while creating new challenges for engineers. Tektronix exists to provide you with instrumentation solutions to address today's automotive challenges and those to come.

- /// EV Powertrain
- /// EV Charging
- /// In-Vehicle Networks
- /// EMI/EMC



TRACTION INVERTER AND MOTORS

Designers are incorporating SiC MOSFETs with faster switching and lower on-resistance than silicon switches. Combined with creative topologies, tightly integrated packaging and advanced thermal management systems these wide bandgap semiconductors are enabling engineers to achieve new levels of power density and conversion efficiency.

Tektronix solutions are ready to help engineers meet these ambitious goals by enabling accurate, repeatable measurements and providing new insight into inverter system performance for validation and debugging.

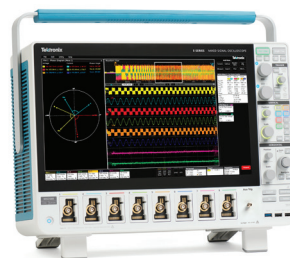
Look to Tektronix for

- 3-Phase PWM inverter output measurements
- Motor torque and speed measurements
- Control system analysis (DQ0) measurements
- Double pulse testing for SiC MOSFET characterization

Learn about SOLN-IMDA-EV

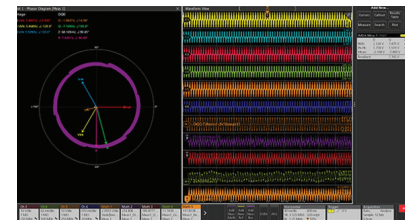
An ideal configuration for traction inverter testing

RECOMMENDED EQUIPMENT



5/6 Series MSO Oscilloscopes

Up to 8 high-resolution inputs and support for advanced inverter measurements.



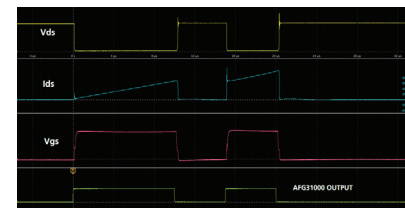
Inverter, Motor and Drive Analysis Software

3-phase PWM, speed, torque and DQ0 measurements on the 5/6 Series MSO.



AFG31000 Arbitrary Function Generator

Generate arbitrary or standard functions, including easy double pulse gate drive signals.

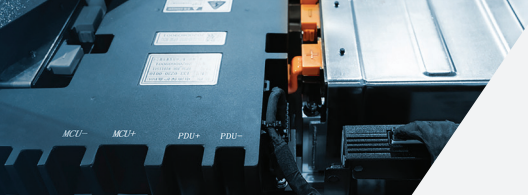


Double Pulse Testing Software

Automates switching loss, timing and reverse recovery measurements on 5/6 Series MSO oscilloscopes.

PROBES

- **IsoVu Optically Isolated Probe**
Accurate measurements on challenging high-side gate drive signals.
- **Oscilloscope Current Probe**
AC/DC probes measure hundredths or hundreds of amps.
- **High-voltage Differential Probes**
Confidently and accurately measure floating voltages up to 1500 V.



EV BATTERY TESTING

Building battery systems to operate without fail in grueling conditions demands thorough testing, as engineers work to create light, safe, cooler and more energy-dense battery packs.

Keithley precision DMMs, SMUs and switching systems deliver precise, accurate measurements for faster OCV, weld resistance and environmental testing for bench tops to automated test racks.

Look to Keithley for

- Open circuit voltage (OCV) measurements
- Weld resistance testing
- Temperature logging
- Charge/discharge cycling
- DC internal resistance
- Electrode resistance
- Insulation resistance

RECOMMENDED EQUIPMENT



2400 Graphical Touchscreen Series SMU

Precisely source and measure for tests like DC internal resistance. Go beyond the charge capability of a power supply with sink capabilities for discharging. Touchscreen front panel and flexible remote communication.



DMM7510 Digital Multimeter

7.5 digit resolution and superior accuracy on the 10 V range enable you to see trends sooner for critical tests like self-discharge and battery grading. Accurate and reliable OCV measurements mean you spend less time collecting data and more time analyzing battery behavior. Large touchscreen front panel and several communication options for bench top testing to automated test racks.



3700A Systems Switch/Multimeter

Six configurable switch card slots, for a maximum of 576 two-wire channels. Combine an SMU with the optional 7.5 digit built-in DMM for high precision busbar weld testing. Or configure as a switch only box with high voltage, high density OCV.

EV SUPPLY EQUIPMENT

Charging station availability and charging rates are key drivers for the adoption of electric vehicles. Demanding reliability, operating current, cost targets and design schedules require careful but efficient debugging and validation.

Oscilloscopes equipped with advanced power analysis software simplify measurements on every stage of DC fast charging stations - from AC inputs, to power factor correction, to DC conversion and output.

Look to Tektronix for

- Power quality, power factor and harmonics measurements on AC inputs
- Switching loss analysis
- In-circuit, dynamic magnetics measurements
- Double pulse testing for SiC MOSFET characterization
- EMI troubleshooting

RECOMMENDED EQUIPMENT



5/6 Series MSO Oscilloscope

Up to 8 high-resolution inputs and support for advanced power converter measurement.



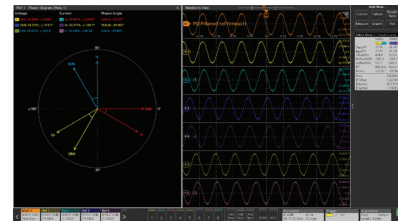
3 Series MDO Oscilloscope

Offers bus decoding, logic channels and spectrum analyzer up to 3 GHz.



DMM6500 Digital Multimeter

Get accurate testing insights fast with 6.5 digit resolution via the touchscreen front panel or the PC with a variety of remote communication options.



Inverter, Motor and Drive Analysis Software

Facilitates measurements on 3-phase power systems.



Advanced Power Measurement and Analysis Software

Automated measurements for AC/DC converters from input to output.

PROBES

- **High-voltage Differential Probes**
Confidently and accurately measure floating voltages up to 1500 V.
- **Oscilloscope Current Probe**
AC/DC probes measure hundredths or hundreds of amps.

AUTOMOTIVE ETHERNET

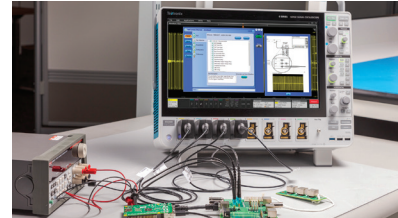
As cars move towards autonomy and electrification, one thing is certain: the amount of data flowing through them will only increase. Designers are turning to automotive Ethernet, which offers fast, full-duplex communication over a single twisted-pair cable. These higher data rates drive the need for compliance testing to verify interoperability. And full duplex communication complicates signal decoding.

Tektronix oscilloscopes, equipped with analysis software, can help confirm compliance with industry standards, validate performance and observe bus traffic.

Look to Tektronix for

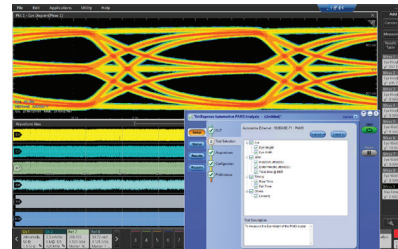
- Verifying 100BASE-T1/ 1000BASE-T1 compliance
- Characterizing automotive Ethernet performance with advanced measurements and analysis
- Checking latency with timing measurements
- Separating traffic between ECUs in full-duplex mode
- Protocol decoding

RECOMMENDED EQUIPMENT



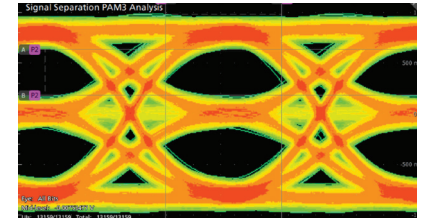
5/6 Series MSO Oscilloscopes

Compliance testing and jitter analysis tools provide confidence in automotive Ethernet designs.



Automotive Ethernet Debug & Compliance

Non-intrusively verify compliance to 100BASE-T1, 1000BASE-T1, MultiGBASE-T1 and 10BASE-T1S standards.



Signal Separation Software

Unique approach isolates upstream and downstream traffic without cutting cables.

SOFTWARE

- **Advanced Jitter Analysis**
Validate performance and isolate jitter sources
- **Protocol Decoding Software**
Decode 100BASE-T1

PROBES

- **Current Probes**
Combine with signal separation software to isolate upstream and downstream traffic.
- **Low-Voltage Differential Probes**
High-fidelity signal transmission with low loading.



SERIAL BUS DECODING

Vehicle operation depends on accurate, timely data communications among ECUs, sensors, switches and actuators. Common buses like CAN, CAN FD, LIN, FlexRay, SENT and PSI5 offer proven performance.

In order to validate and debug one or more ECUs, engineers must be able to correlate bus activity with signals from ECUs and sensors.

Tektronix oscilloscopes offer easy-to-set-up automotive bus decoding with waveform displays to check signal integrity, bus traffic to see transfers and time-stamped tables for measuring system timing.

Look to Tektronix for

- Simplify decoding for CAN, CAN FD, LIN, FlexRay, SENT and PSI5
- Indicate signal quality
- Help debug
- Provide system visibility

RECOMMENDED EQUIPMENT



4/5/6 Series MSO Oscilloscopes

Wide range of bus support packages and high channel count provide best visibility.



3 Series MDO Oscilloscope

Automotive bus decoding with low noise and built-in spectrum analyzer.



2 Series MSO Oscilloscope

Portable, battery-powered oscilloscope with CAN, LIN and SENT decoding.



Differential Voltage Probes

Perfect for measuring buses that use differential signaling, such as CAN.

TROUBLESHOOTING AND PRE-COMPLIANCE SCANNING

Critical high-speed data flows throughout today’s vehicles over wired and wireless connections, even as EV power systems switch higher voltages and currents. EMI must be managed not only for regulatory compliance, but also to ensure signal integrity.

Pre-compliance EMI scans build confidence and help designers isolate potential problems before formal testing. For troubleshooting interference problems, seeing signals in both the time domain and frequency domain helps connect cause and effect.

Real-time spectrum analyzers are ideal for finding elusive RF anomalies and performing pre-compliance EMI scans. Oscilloscopes with synchronized spectrum analysis capabilities provide visibility of multiple signals in the time and frequency domains for faster troubleshooting of tough interference problems.

Look to Tektronix for

- Capturing elusive RF anomalies
- EMI pre-compliance testing
- Interference and noise troubleshooting

RECOMMENDED EQUIPMENT



RSA306 USB Spectrum Analyzer

Compact and portable real-time spectrum analysis up to 6.2 GHz.



RSA600 USB Spectrum Analyzer

Compact bench-top real-time spectrum analysis.



RSA500 Series Real-Time Spectrum Analyzers

Portable, rugged real-time spectrum analyzer up to 18 GHz.



4/5/6 Series MSO Oscilloscopes

Spectrum analysis synchronized with time-domain waveforms for fast debugging.



3 Series MDO

All-purpose bench oscilloscope with built-in spectrum analyzer.

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