WHITE PAPER

Use Cases for Data Acquisition Systems in Automotive Applications

From power devices to gigafactories

KEYSIGHT

Overview

Data acquisition (DAQ) systems are gaining momentum in the automotive sector due to fast-growing industry segments including E-mobility, advanced driver assistance systems (ADAS), connected car, and autonomous driving. Reason is simple. DAQs are cost effective and versatile. Automotive engineers use DAQ systems for three main purposes: characterizing products, monitoring processes or products, and controlling test processes.

What is a DAQ?

A DAQ system consists of a collection of hardware and software for sampling physical parameters such as voltage, current, temperature, and strain with a sensor or transducer. The system enables engineers to condition and convert samples into digital data for capture and analysis.

Figure 1 below shows the DAQ measurement flow from a physical system to a DAQ or PC for analysis. Some DAQ systems have a built-in 6.5-digit digital multimeter (DMM) and signal conditioning circuitry which simplifies setup; users do not need to look for a DMM or a signal conditioning card to make the measurements.

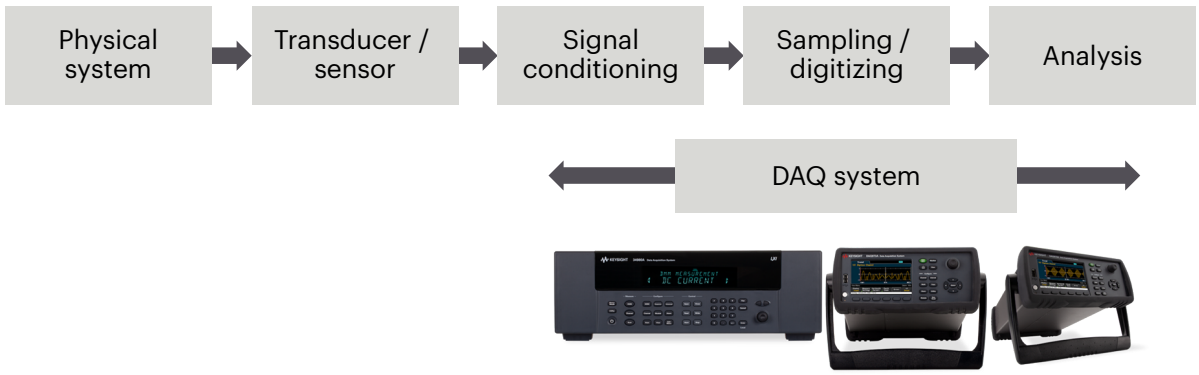


Figure 1. DAQ samples physical parameters for capture and data analysis.

Applications and Use Cases

In this section, we will look closely at automotive applications and use cases ranging from power device characterization to battery cell testing in gigafactories that rely on DAQ systems.

1. Battery cell voltage and temperature testing in Gigafactories

Gigafactories around the world produce lithium ion (Li-ion) batteries at gigawatt hours (GWh) to meet the demand for battery-powered vehicles that include electric vehicles (EVs) and hybrid electric vehicles (HEVs). DAQ systems monitor, test, and profile batteries for these types of vehicles.

A key parameter to measure is temperature as charge and discharge currents increase the temperature of batteries. While Li-ion batteries tend to be efficient and have a normal lifespan at room temperature, their lifespan is greatly reduced outside of this temperature window. Besides temperature, it is also important to measure battery cell voltage since voltage varies with temperature and other reasons such as quality control.

Specific automotive customer use case

A Swedish battery developer and manufacturer that specializes in Li-ion technology for EVs builds and operates gigafactories for Li-ion cell production. The developer decided to integrate a DAQ system with a Scienlab solution for testing Li-ion batteries. The developer selected Keysight's BT2200 Scienlab charge-discharge platform to configure Li-ion cell formation, the SL1007A Scienlab battery test system, and Scienlab Energy Storage Discover (ESD) software to perform extensive standard-compliant and individual tests.

The Keysight DAQ970 data acquisition system and DAQM902A 16-Channel Multiplexer modules, along with the Scienlab cell test channels test Li-ion cell temperature and voltage. Since each test channel (one battery cell per test channel) requires 4 temperature probes, the process can accelerate quickly when there are 200 test channels or more. The battery developer selected the DAQM902A modules for its high throughput and high-speed performance.

Key DAQ criteria

- Easy integration with temperature chamber
- Easy integration with Scienlab solution
- High channel density, speed, and scalability

Recommendation

- DAQ970A Data Acquisition System
- DAQM902A 16 Channel Multiplexer (2/4-wire) Module

2. Power Electronics Devices Characterization

Modern DAQ systems have fast sampling digitizers that enable dynamic measurement, making them a lower cost alternative to many applications. A useful application of DAQ with this feature is power electronics characterization.

Specific automotive customer use case

A Europe-based automotive power electronics manufacturer sought a cost-effective solution to allow it to characterize the thermal resistance of power metal-oxide-semiconductor field-effect transistors (MOSFETs). This parameter is important because it dictates many operational parameters and the lifetime of the device. The OEM wanted a DAQ solution that could perform fast, continuous, and synchronous measurements of both current and voltage. The manufacturer selected the Keysight DAQ970 system, DAQM909A Digitizer Module, and a source measure unit (SMU) as its solution.

Key DAQ criteria

- Synchronous measurement across channels
- Fast sampling digitizer
- High measurement resolution

Recommendation

- DAQ970A Data Acquisition System

3. Routing test signals in automated production testing

Engineers commonly use DAQ systems for automated testing of products on the production line, and use switching modules to route test signals from various instruments. Figure 2 shows the routing for a DMM, function generator, and power supply and how they connect to the DAQ switch module and device under test (DUT). For example, this setup performs functional testing on a Body Control Module.

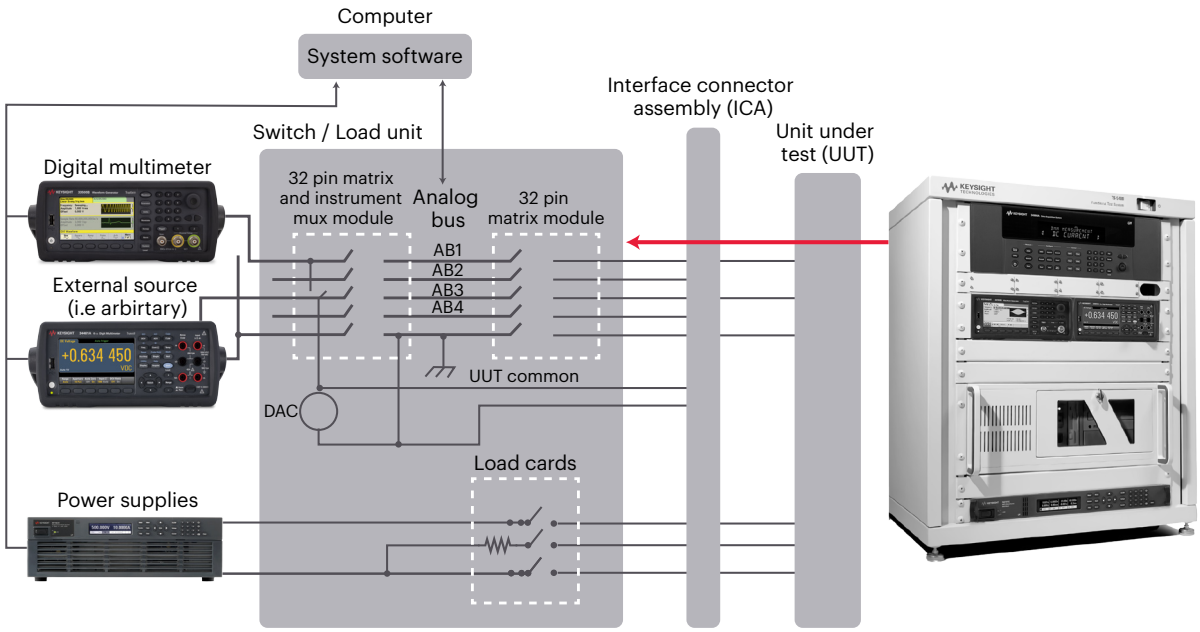


Figure 2. DAQ used for signal routing of instruments in automated production testing.

Specific automotive customer use case

A Hungarian automotive manufacturer sought maximum flexibility for automated functional testing of low power automotive electronics such as electronic control units (ECUs) for controlling internal lighting and switches, LED boards, and EV control boards. The manufacturer chose the Keysight 34980A multifunction switch/measure mainframe with module inverters because it is a standard DAQ platform with versatile spare capabilities. The manufacturer can take advantage of the capabilities as various needs arise.

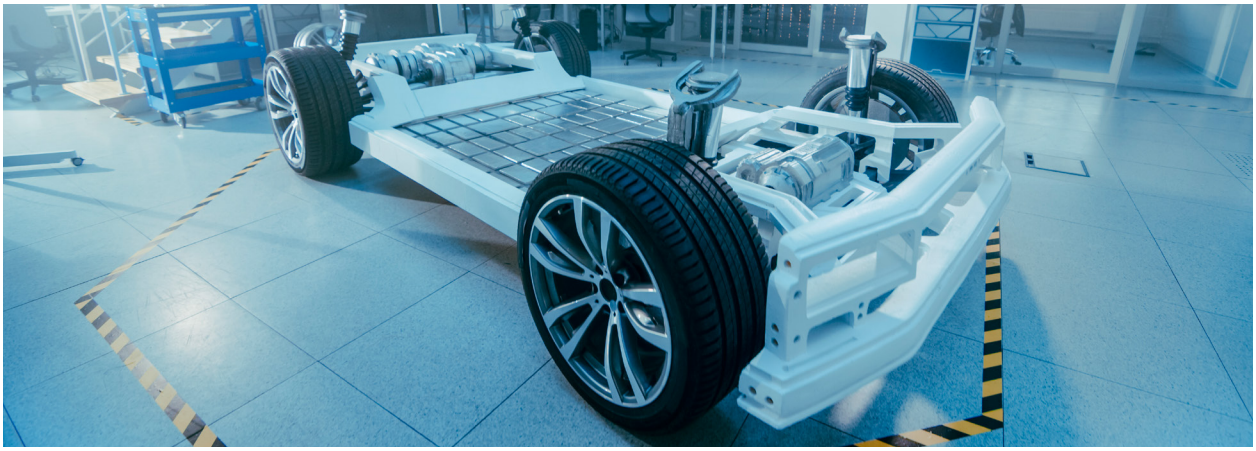
The 34980A holds up to 8 plug-in modules from a choice of 21 modules, allowing for customized and flexible configuration as the application requires. More specifically, the manufacturer appreciates the built-in local area network (LAN) extensions for instrumentation (LXI) graphical web interface. The interface is particularly helpful when debugging the test program because it enables the manufacturer to easily control and switch instruments without having to install third-party software or drivers.

Key DAQ criteria

- High density / capacity of channels for more product testing or multiple locations
- Connection capability so customer can connect to company network
- Built-in LXI graphical web interface for remote troubleshooting and control

Recommendation

- 34980A Multifunction Switch/Measure Mainframe and Modules



Summary

We have only described some applications of how DAQs are used in automotive along with specific customer use case and key criteria for choosing the DAQ for the application. There are many more applications of DAQs in the automotive industry which we did not cover, such as vibration and acoustic measurement, durability testing, engine monitoring, and so on. Contact Keysight to find the right solution to meet your testing needs.

Resources

- DAQ970A Data Acquisition System
- 34980A Multifunction Switch/Measure Mainframe and Modules
- DAQM902A 16 Channel Multiplexer (2/4-wire) Module
- BV0006B PathWave BenchVue Data Acquisition App
- Scienlab Battery Test System

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