Automatic Design Verification for Vehicle Instrument Panel Clusters with Mx-Suite™

DANLAW®

AUTOMOTIVE MADE SMART

Business Summary

Increasing cost pressure, compressed development timelines, and zero-defect requirements enforced by automotive OEMs, continue to press the demands of Tier-1 supplier software development processes. In addition to these problems, automotive instrument panel cluster (IPC) designs are a major brand identifier for OEMs, so suppliers must be able to effectively deliver increasing variations of functionality and design without compromising quality. The supplier's ability to quickly test IPC electronic control units and their embedded software to meet the quality standards required by OEMs is pushed to the limits. The result of these IPCs not meeting quality standards can potentially damage an OEMs image.

Technical Summary

An automotive supplier anticipated a need to improve development testing of multiple IPC designs and decided that testing automation was the key to boosting throughput and quality. The tester would be required to read gages, sense telltales, and perform low-power switching. The complete IPC functional specifications would not be available until after the tester was built, therefore the solution had to be flexible and scalable.

Solution - Mx-Suite™ drives a custom IPC HIL test stand and video capture unit

Danlaw designed and built a general-purpose hardware-in-the-loop (HiL) tester for IPC validation. Through the use of Mx-Suite software, the supplier was able to quickly configure the HiL tester, generate comprehensive test cases, and validate proper operation of the gauges, readouts, and telltales. Mx-Suite ensured the highest level of software quality, while providing the necessary documentation and test coverage evidence required by the OEM, therefore avoiding costly rework for the supplier.

User Application

The automotive supplier manually tested their IPC products in order to accommodate the number of human factor judgments that had to be made during validation. During development of higher complexity next-generation IPCs, they needed to automate the testing process to keep up with demand. The HiL tester requirements included verifying gauge readings, determining the presence or absence of telltale lights, and recognizing audio tones. In addition, the supplier was interested in monitoring both analog and digital test points within the IPC hardware.

Issue Resolution

The supplier had a company-wide initiative to introduce HiL vehicle simulations as part of IPC validation. Mx-Suite was selected by the supplier for the HiL software because of its ease of use, automatic regression testing capabilities, and ability to integrate with many types of test equipment. The supplier had been successful using Mx-Suite software for software-in-the-loop (SiL) testing for several years, therefore they felt confident in having Danlaw build the HiL equipment.

Mx-Suite and the HiL tester provided the following features:

- CAN interface simulation and monitoring
- LIN interface simulation and monitoring
- MOST interface simulation and monitoring
- USB camera interface for image feature comparison

- Relay actuation via USB
- Data logging and stimulus through commercially-available DAQ cards
- Power suppler control via USB

To automate the observations of the IPC, a novel solution is provided by Danlaw for Mx-Suite. An inexpensive USB camera is used to monitor the position of gauge needles, sense whether telltales are on or off, and capture the image of the PC screen. Third party pattern recognition software is used to segregate the digitized screen image of the IPC into zones and compare the zone images with reference images. To ensure alignment and consistency of the captured images with calibrations, the USB camera and IPC are solidly mounted on a test stand designed to keep mechanical variance to a minimum.

A custom HiL connection transform is provided with Mx-Suite for the HiL tester. The HiL transform is a user-configurable mapping of Mx-Suite test cases to HiL I/O connections. The HiL tester monitors audio signals and measures transitions on other signals. The custom HiL tester transform and interface hardware allows logical grouping of signal monitoring and switching functions, as well as easy reconfiguration of the test hardware. Inexpensive commercial third party hardware is used for sampling A/D, A/D differential, D/A, binary digital, and counter data. A user-accessible breadboard allows custom filtering and attenuation of the white-box test points. The HiL tester also provides the capability to interrupt or connect to power or signal lines, as well as control the testers' power suppliers to the device under test.

Customer Approach

The supplier wanted to perform both white-box and black-box testing without incurring the overhead of using an in-circuit emulator or JTAG debugger. By identifying specific test points in the IPC hardware, signal footprints could be detected that indicated whether some valid or invalid operating conditions were reached. When it was not yet known what the acceptance criteria was for pass/fail conditions, Mx-Suite test cases were used to simulate the vehicle environment and responses were captured by the tool. Through experimentation, successful behaviors were accepted as valid test criteria.

The supplier also wanted to reduce the amount of human interaction required to judge pass/fail conditions. Mx-Suite's automation capabilities solved that issues without any customizations. Once test data was captured by the tool, the human tester accepted the pass/fail criteria so the test could be automatically run the next time.

Test engineers want to be able to easily connect and configure the IPC to the HiL tester. Mx-Suite's intuitive graphical interface helps engineers quickly set up new tests using universally understood engineering conventions. Using Mx-Suite's graphical interface, these test cases were easily grouped into functional scenarios, tagged for inclusion with special reports, and sequenced for execution.

Benefits

The investment in time and money needed to provide full-coverage HiL testing is considerably reduced with Mx-Suite. Mx-Suite provides executive summaries, requirements-traceability, and detailed test cases to prove that software is fully tested. New behaviors can be explored as candidates for additional test cases. The HiL testing framework can be easily reconfigured for new products and can be reused at any time to regression-test future code changes on older products. Mx-Suite allows the supplier to substantially improve testing performance.

About Danlaw

Danlaw is a leading global supplier of technology and services to the automotive and aerospace industries for safer, smarter, and more secure systems. Thirty years ago, we designed software for the first 8-bit Electronic Engine Control module, and today, we continue to develop forward-looking technologies. We focus our efforts on R&D to stay ahead of rapidly changing industry needs in an increasingly connected world. Danlaw is known for ground-breaking tech, efficient development, and adaptive solutions for dynamic environments.

Danlaw's engineering professionals provide embedded electronics solutions to OEMs and Tier-1 suppliers. Our team specializes in embedded systems development and testing for Embedded Control Units, vehicle network communications, infotainment, and telematics. With engineering centers in the USA, Europe, India, and China, Danlaw is one of the largest suppliers of connected products, tools, and services in the world.