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APPLICATION NOTE

Automated ESD testing improves product reliability and safety

Robert Bosch GmbH is one of the world's largest original equipment manufacturers (OEMs) of motor vehicle electronic systems. The Gasoline Systems Division's Engineering and Test Center in Stuttgart, Germany is responsible for ensuring the design of safe, reliable electronic systems for millions of automobiles worldwide. Testing for immunity to Electrostatic Discharge (ESD) is a key component of every automotive supplier's test strategy; however as systems become more complex, testing has become more time consuming, costly, and prone to error.

Dr. Wolfgang Pfaff and Udo Ackerman of Bosch have created a unique solution to this problem. By using a robotically controlled ESD test system, they have increased the reproducibility of their ESD test procedures and minimized human error, while addressing an increased demand for testing of complex systems.

The electrostatic charging of objects and people as they come in contact with different materials is both commonplace and unavoidable. Charges of up to tens of thousands of volts often remain even after the charged materials have been separated. These high voltage electrostatic discharges can cause significant damage to semiconductors, compromising their reliability and ultimately threatening the reliability of any system or machine in which they are installed.

Naturally, Electrostatic Discharge (ESD) is a real concern in automotive electronics, where electronic system reliability can literally be a matter of life or death. ESD damage can be prevented by appropriately protecting electronic control units against electrostatic influences during their production, packaging, handling and transportation. However, the most effective means of protection is to design electronic systems with the highest possible intrinsic immunity to ESD. As a result, ESD testing has become a critical part of the product development process for all automotive suppliers.

International standards for ESD immunity testing have been established and are used by all manufacturers. These standards specify that control units and other electronic assemblies be stressed with contact and air discharges up to 25kV to test ESD immunity, and that they be examined afterwards for damage and malfunction.

Manual testing uncertainties cannot be avoided

Until recently, all ESD testing at the Bosch's Gasoline Systems Division Engineering and Test Center in Stuttgart, Germany was performed manually with hand-held ESD simulators.

In a typical manual ESD test of an engine control unit, the technician positions the ESD simulator on each of 154 pins and perform ESD discharge tests, at multiple voltage levels and in both polarities. Ten thousand ESD pulses applied to a single control unit is not uncommon.

Since the pins are only tenths of millimeters apart, it is very difficult to maintain proper alignment with the discharge pin. Precise alignment is critical to prevent the ESD arc from discharging to adjacent pins. Additionally, the approach speed of the tester greatly affects the test results and must be controlled precisely.

Once the test is performed, the results must be documented manually. This testing is time-consuming and monotonous, and therefore highly susceptible to human error. Since the tests must be performed by highly trained lab technicians, it is also very costly.

To address this problem, Pfaff and Ackerman initiated the ESD Automation Project, in which a test cell was outfitted with ESD simulators from Teseq AG of Switzerland and robotic control system from systems integrator imt robot AG of Germany, a systems integrator with which Bosch had cooperated on several other projects.

The robot: Reliable even under extreme conditions

Bosch and imt robot quickly agreed on the main components to be incorporated in the lab automation project: a new Teseq NSG series ESD simulator for robotic applications and a Stäubli six-axis robot. Bosch chose the Stäubli TX 90L for this project because of its precision and flexibility, and because of their past project experiences.

There was a critical issue to consider: How would the robotic system perform in this 'electrically charged' environment? After all, ESD test levels range up to 30 kV. One thing was certain after initial testing in Stäubli's Technical Center – both the TX 90L robot and the CS 8C controller could perform effectively in this unusual environment with 100% reliability.

The Teseq NSG 439 is a specially adapted version of Teseq's proven, highly successful NSG 438 ESD simulator. The NSG 439 features a compact and robust case with mounting options specifically designed for robotic applications. The NSG 439 is programmed for any testing task via its optical serial interface. A key feature of the NSG 438/439 is its easily interchangeable RC networks. A wide range of networks is available, including networks to cover all automotive standards.

Clever software for many different tests

One major hurdle was designing a flexible system that could be reconfigured quickly for a new module type to minimize test startup time. Automotive control modules have diverse enclosures, connector shapes, pin counts and spacing. To operate efficiently, it would be necessary for the system to be easily reconfigured with a new test geometry and new reference points within a short period of time.

Imt robot's Ulixes control software provided the solution. The software, which manages both the movement processes of the Stäubli TX 90L as well as the Teseq NSG 439, allows users to create new test parameters through a graphical interface with pull-down menus, eliminating the need for operators to have robot-specific programming knowledge. Once created, the test parameters are stored in a database. Tests can be documented, modified and used again at any time or in any sequence. Test processes that have been created in spreadsheets or other databases can easily be imported into Ulixes.

Compact robot – compact system

The test unit is installed in a cell with a footprint of 2 x 2 meters, in which the compact Stäubli robot is located in the center in front of the grounded, copper coated test table. There are currently two fixtures for different types of control units installed on the test table. At the start of the test, the control unit is fixed in the holder and the test cell is closed to complete the door interlock.

The pre-configured test procedure is now started. The robot guides the ESD simulator with the test probe to an individual connector pin and applies a series of ESD pulses. This process is repeated for each pin of the connector. This procedure is then repeated with the next higher test voltage. The exemplary precision and track accuracy of the Stäubli six-axis robot is a great benefit for this type of highly repetitive testing. The robot moves to the pre-calculated pin positions with absolute reliability.

It is also possible to apply specific discharges sequentially on different pin groups, power supply connections, sensor inputs, end stage outputs and communications ports. In addition to air discharge, the system also provides a contact discharge option in which the ESD simulator tip is in contact with the connector pin and a relay contact is closed to initiate the discharge. Contact discharge testing eliminates many environmental variables, thereby improving the repeatability of the test.

All test data and parameters such as test voltage, polarity, time interval of the ESD impulses etc. can be easily modified and varied using Ulixes.

"The benefits of automated testing are significant in comparison with manual testing", explains Udo Ackermann. Automated ESD testing is already being discussed in the standards bodies. "We will apply our positive experiences there accordingly" concluded Ackermann.

For further information please contact your local Teseq partner.

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