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WLAN mit modularer Testlinie qualifizieren

WLAN Certification Using a Modular Test Line

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Looking beyond the visionary depictions of Car-to-X technologies, almost nothing seems impossible. However, it is necessary to make these techniques more safe. The vehicle's network can only be as safe as the processes used for its development, manufacturing and logistics in addition to the hardware and software products used to produce the series. This makes the need for traceability an even more sensitive issue for functional testing. MCD Elektronik would like to provide some insight into their test processes for WLAN modules.

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APPLIED CASE STUDY

Among other things, wireless internet access LTE modules are responsible for providing passengers with access to WLAN functionality during long bus trips. Such WLAN hotspots ensure stable connections with the global network when traveling in luxury vehicles. One manufacturer of such modules contracted MCD Elektronik in Württemberg (Germany) with the development of an entire test line for production.

The challenges associated with such customer projects include:

- covering all potential errors using combined tests, which also need to be performed at various testing stations
- povіding special instruments for making contact using radio-frequency signals as well as customer-specific USB connections and plugs
- using a trend analysis report to summarize and evaluate the test data
- keeping the capability of extending testing options for future, and even for unusual, products in mind
- delivering quickly, such as within the twelve week period used as a reference.

THE TEST PROCESS

There are three steps to the test process. The printed circuit boards are initially tested using the boundary scan (BSCAN) tester, **FIGURE 1**, before they are inserted into their housing, then programmed and tested for functional capability using the integrated functional tests. At the second station, the end-of-line (EOL) tester checks the entire component construction using high-frequency tests through an interface adapter and the device-specific labels are printed and tested by re-scanning the barcodes. The image processing tests, the completed devices and the code cards and labels are printed for packaging and shipping documents (third station). The completeness of the associated documentation is tested and the modules are approved for shipping.

MODULARITY

MCD delivers its test systems with various modules at various stages of construction. For this reason, there will be several printed circuit board variations, which will be mounted in different sizes of housings specific to the products. However, the same test line should be able to test all variations of the product. At MCD, the decision was to place the flat PCB in contact with the BSCAN tester using a dual-probe plate. With the EOL tester, the component has been constructed as an interchangeable unit in a RF-resistant housing. The packaging tester was designed to be so universal that it can detect and test both variations using one universal test adapter.

MANUFACTURING CONTROL

Manufacturing control has been implemented using the "TestManager". Before each new test step, the acceptance of the module by the preceding test is first ensured. The test results are logged using an SQL database and queried before starting each new test. At the same time, test reports are stored on a server in XML format, which makes seamless tracing and documentation of the batches possible.

A hardware module from our strategic partner, Göpel electronic, is used for the boundary scan test. The MCD BSCAN "ToolMonitor" was developed as part of our collaboration with this partner. The program serves to connect the testing bench control system and the BSCAN hardware. The ToolMonitor provides the ability to perform the boundary scan test at the same time as other tests. All tests sequences are created in advance. Afterwards, they are tested and finally can be implemented efficiently over the course of testing by the TestManager. The interchangeable unit allows for two insertion positions for various sizes of component printed circuit boards, **FIGURE 2**. All relevant measurement points on the printed circuit board can be reached using the probe plate. However, first the component is programmed with its firmware through a USB connection. An LED analyzer tests the LEDs for color and intensity. The brightness comparison test ensures uniform illumination within the vehicle. The buttons on the component are also tested. To do this, they are pressed by programmable pneumatic pins and their switching operation is tested.

FUNCTIONAL SAFETY

A function test checks the component's interfaces using an appropriate counterpart.

The equipment has been developed by MCD and, among other things, used with six-port USB hubs so that the USB

FIGURE 1 The first test station has been set up to test two sizes of components; a probe plate will make the connection with the printed circuit board; the fiber-optic cables for monitoring the LED displays can be seen at the top of the figure

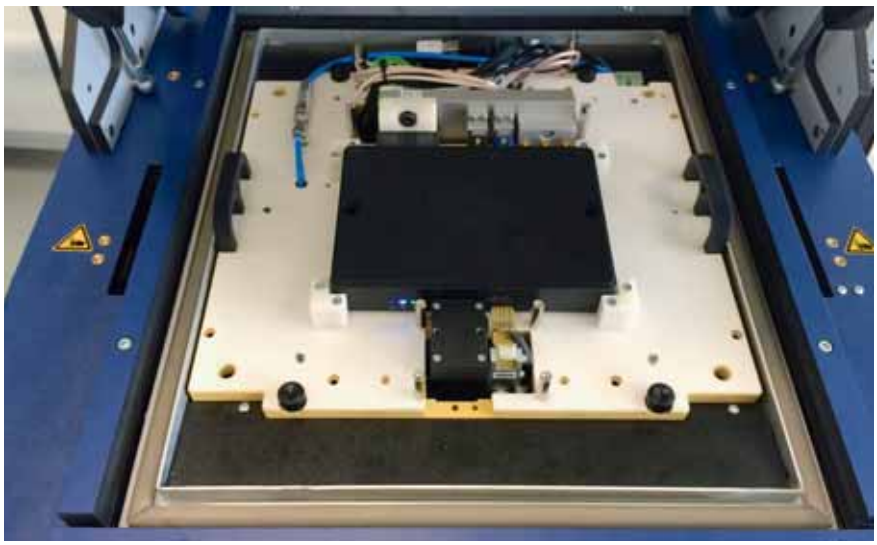

FIGURE 2 The RF connections have been connected with the module to be tested; the USB connection (front, right) has not been connected yet

functions can be tested easily. Using the USB protocol, the required counterparts can be activated and deactivated by software commands. Doing this allows the control computer's interfaces to be connected and disconnected safely and quickly. Before this development, the test coverage of the components was checked on the basis of the so-called "Test coverage report tools" from MCD. By optimizing the required test points and stimulations, the best possible test coverage can be realised in advance. Any component test areas that could not be reached will have been tested completely by an additional functional test. The first test station's entire test can be controlled using MCD´s TestManager. The operating personnel interact with the TestManager using a screen and keyboard or barcode scanner.

As soon as the printed circuit board component has been mounted in the vehicle-specific housing, it can subsequently be tested by the EOL test. The components are ready for use and can be accessed using the default password from the WLAN communication interface. The component to be tested is then individually encapsulated in an RF-resistant mounting so that other components cannot interfere. Doing this insulates against external influences such as WLAN routers, cell phones with various communications interfaces (such as GPS) and other radio-frequency signals from the components to be tested, as well as ensuring that signals generated by the device under test will not interfere in the manufacturing environment. Two interchangeable units are available for various sizes of housings. Contact is made with RF signals so that performance measurements and various communications standards (like GSM, 3G, LTE and WLAN) can be monitored. Contact with the USB and SIM cards as well as the vehicle and USB connections will be made automatically using special connection instruments developed by MCD.

As with any module that is used in vehicles, the measurement of the closed-circuit current is important. The values will generally be in the range of several µA. In addition to testing the function of the USB connections, the quality of the data signals must also correspond to the specifications of the standard. The connections' charging currents will also be tested for various applications and, in part, calibrated electronically. The devices under test must automatically recognize the connected components based on diagnostics and adjust their settings according to the specifications of the standard. Special WLAN channels will be used for the radio-frequency tests for communicating with the device under test. The testing environment will also provide a special WLAN server. Both the device under test and the test software will be able to access this server and either execute the required test sequences or retrieve the test results. The performance measurements will be determined for the telecommunications interfaces as well as WLAN and Bluetooth using special measuring equipment. If the component to bem tested passes the function tests, a random generator will assign a password to the component. A connected label printer will create a label with the barcode appropriate to the component. However, before the operating personnel attaches the label to the component, they will check if the label really agrees with the component using a barcode scanner.

PACKAGING TEST

The last station of the test line is the packaging. A camera system and the MCD image processing software will be used to test the printing and the equipment. An additional ToolMonitor also provides an integrated scripting engine for the imaging processing software. The script program will perform the visual tests parallel to the other tasks. Doing this significantly speeds up the testing process and the corresponding specialist can develop the visual test step at the same time. The light-resistant adapter is appropriate for all of the various modules. The image processing system with integrated illumination will scan the module. It tests if the prescribed front panel that has been constructed for the respective vehicle is error free, as well as if the SD card has been removed from the socket. A label printer and a code card printer will then generate the label for the module and the carton, as well as a code card with the individualised password for the component for the vehicle owner. The customer can make changes to the design and the label layout using the MCD label generator.

All testing stations can exchange and synchronise their data automatically using upload/download systems. Doing this avoids manual procedures that might become a source of errors. The MCD "DataManager" will analyse the process capability and corresponding acceptance reports will be generated according to customer specifications. This will become the basis for the Cpk values (process capability index) for the automobile industry and the respective manufacturers.

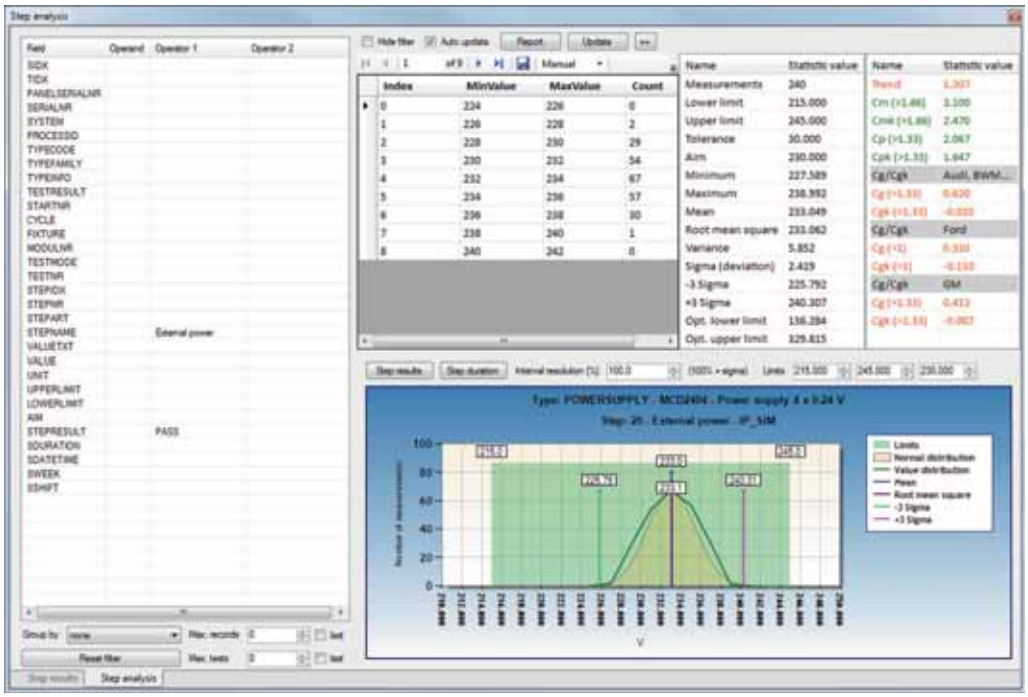

FIGURE 3 Analysis of the measured values shows the distribution of the individual measurements; in this case, all measurement results are within the specified thresholds

ANALYSIS OF THE MEASURED DATA

Furthermore, the DataManager will monitor selected measurement values for stability and trends, **FIGURE 3** (above). Doing this allows detection of errors in the testing equipment as well as detection of changes in the device under test or the components used. Using the "Drift Analysis", **FIGURE 4** (below) allows trends in the measured data to be discovered in a completely automated manner. A failure can be discovered before it arises through the preparation of this data. In combination with a corresponding equipment control system, intelligent manufacturing of products for the purpose of the Industry 4.0 specifications becomes possible. By recording the activation and execution times, even mechanical errors in the test equipment will be detected early and can be corrected by preventative action, before the equipment suffers downtime.

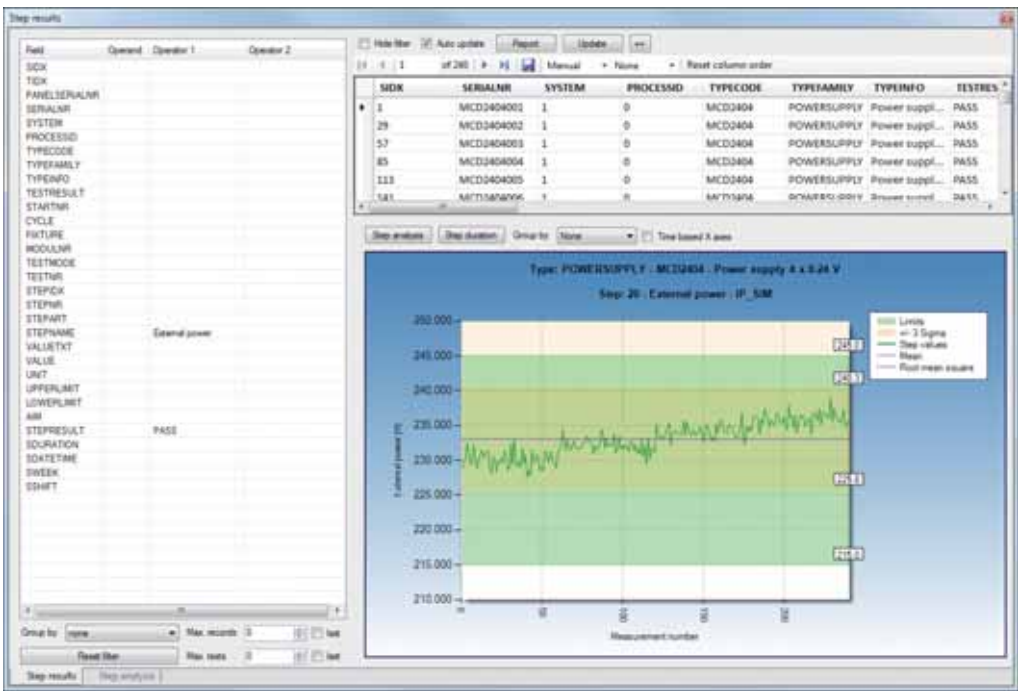

FIGURE 4 The trend analysis report shows the gradual drift of the measured values

TEST SYSTEMS
FOR ELECTRONIC PRODUCTION

MCD ELEKTRONIK GMBH

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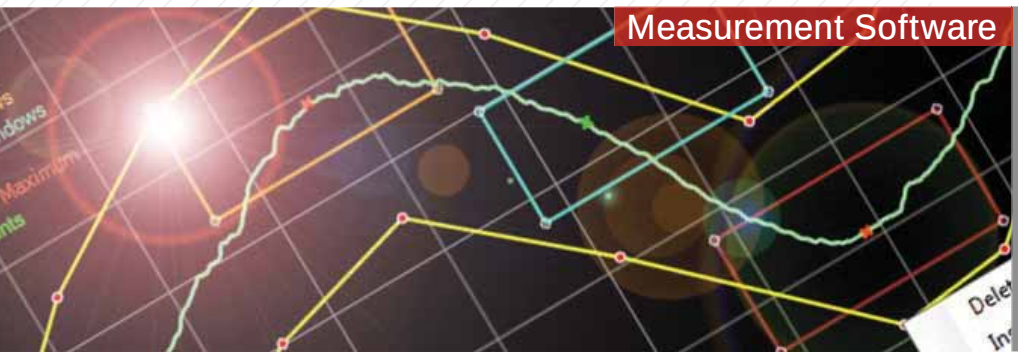
MCD Elektronik GmbH is a world's leading supplier of measurement and control systems, committed to providing the world's most complex testing and automotive technology. MCD integrates R&D, sales, production and service into one, providing customized test and measurement solutions varying from FCT, BSCAN and EOLT systems to completely automated test lines for production for high-tech enterprises from various industries, such as the automotive, medical, aerospace and electronic machinery industries. The company was founded in 1983. Pioneering for more than 30 years of development and innovation, MCD has established global cooperation with many leading OEMs, Tier 1 and Tier 2 suppliers. It can provide its customers with a diversity of test solutions which combine mechanics, electronics and software fit to meet the customer's expectations.

Modular Measurement

- Powerful measuring- and control unit
- Measuring systems controlled by a PC
- For all kinds of complex test systems
- Connection Possibilities:
  - Function Test
  - End-of-Line Test
  - Signal Generation and Analysis
  - Test Systems with Integrated PC
  - Repair Systems



Measurement Software

- Comfortable and easy standard software development kit for the creation of applications for test systems
- Efficient acquisition and evaluation of specific test data
- Simple, modularly scalable, inexpensive
- Application for screening systems, board testing, final inspection and process control and many more

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