

# Speeding Production Line Test Development and Execution at Motorola AIEG (Europe)

Application Note 1469

## Automotive Electronics Production Test System Case Study

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### Customer

Motorola AIEG (Europe) –  
Stotfold, UK and Angers, France

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### Challenges

- Improve throughput
  - Reduce test development time
  - Meet increased customer expectations
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### Solutions

Implement a total of ten Agilent TS 5400 automotive electronic test systems running under the TextExec SL test development environment

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### Results

- Test development simplified
- Test development time reduced
- Capacity of the test group increased without headcount
- Increased manufacturing throughput

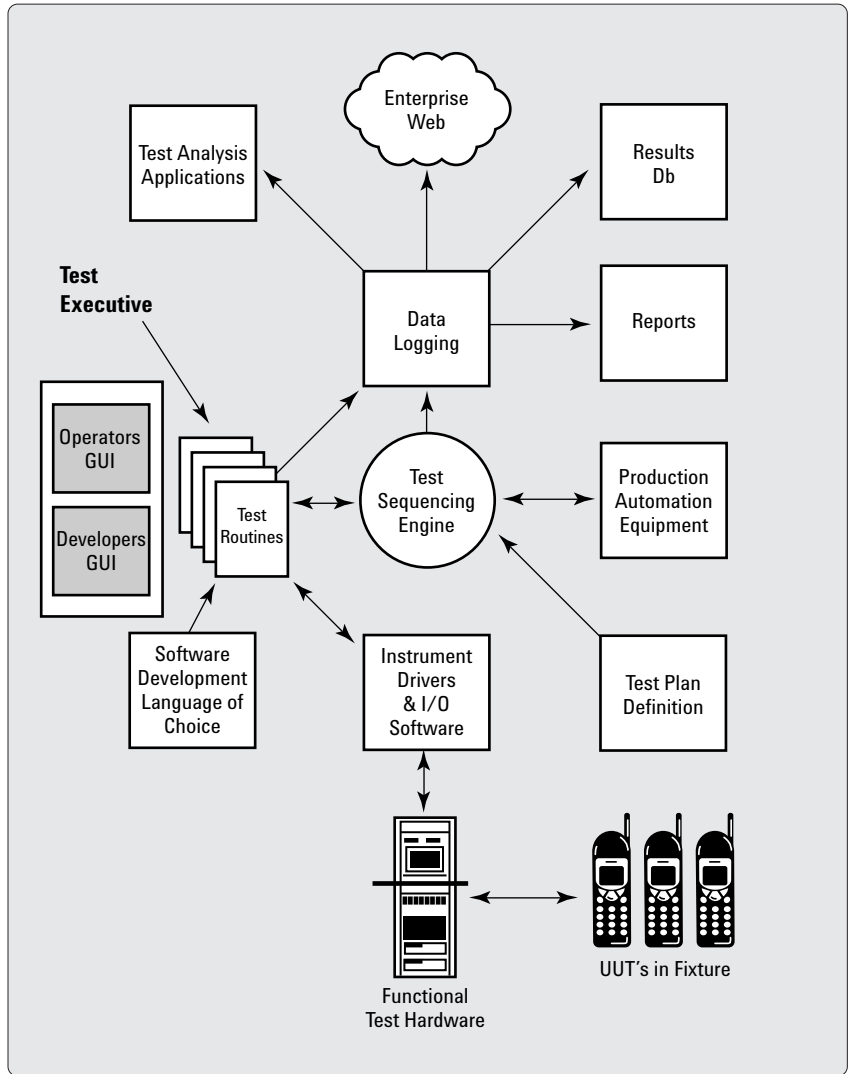
It is rare indeed when a new software product is announced that has already been preproven in some 2000 installations worldwide. This however was precisely the case when Agilent Technologies announced the availability of TestExec SL as a stand-alone test executive software platform on August 1st, 2000.

TestExec SL is based on technology first developed in 1995 and embedded in several Agilent test sets, including the TS-5400 for automotive electronics, the TS5500 for wireless handset testing, and various custom systems. These systems are now installed and operating in manufacturing sites all over the world.



**Agilent Technologies**

TestExec SL simplifies considerably the development of test executives. A test executive is a management system for automating the execution of functional tests on a unit under test (UUT) and reporting the results **Figure 1**. Its capabilities include test sequencing, limit checking, data logging and export, operator run-time interface, and other functions. An effective test executive program features a modular component architecture, quick and easy system configuration, common instrument support, and extensive measurement routine libraries. Users expect powerful configuration tools that allow them to make simple measurements without writing extensive software routines.



**Figure 1.** Typical functions of a test executive. Users must be able to configure each module for application-specific needs.

**Motorola's challenge:  
obsolescence**

To get an idea of how TestExec SL works in practice, consider the experience of Motorola AIEG (Europe)'s automotive electronics manufacturing facilities in Stotfold, UK and Angers, France.

Motorola AIEG (Europe) designs and produces electronic modules for a variety of automotive functions, including engine management, chassis/body control, climate control, and – the newest bright star in the automotive universe – telematics, which enables the vehicle to report its position and mechanical condition in realtime to a central dispatch system for road service.

Motorola had been using Hewlett-Packard workstations running its own test software developed on the HP (i.e., Rocky Mountain) Basic platform to control the testing of engine

management modules. The workstations were becoming obsolete and Motorola AIEG Strategic Test Development were looking for improvements in operating and test execution speed as well as speed of development using that platform, the ultimate goal being increased throughput.

With the announcement of the availability of the significantly improved Series 2, Motorola decided to put to the test. "We had it in mind for a project that was coming up," says Motorola's Test Engineering Specialist Phil Heredge, "so we went ahead and ordered it. I believe we received the first one off the production line."

"Phil and his manager, Adrian Carter, took a walk-before-we-run approach to the acquisition of

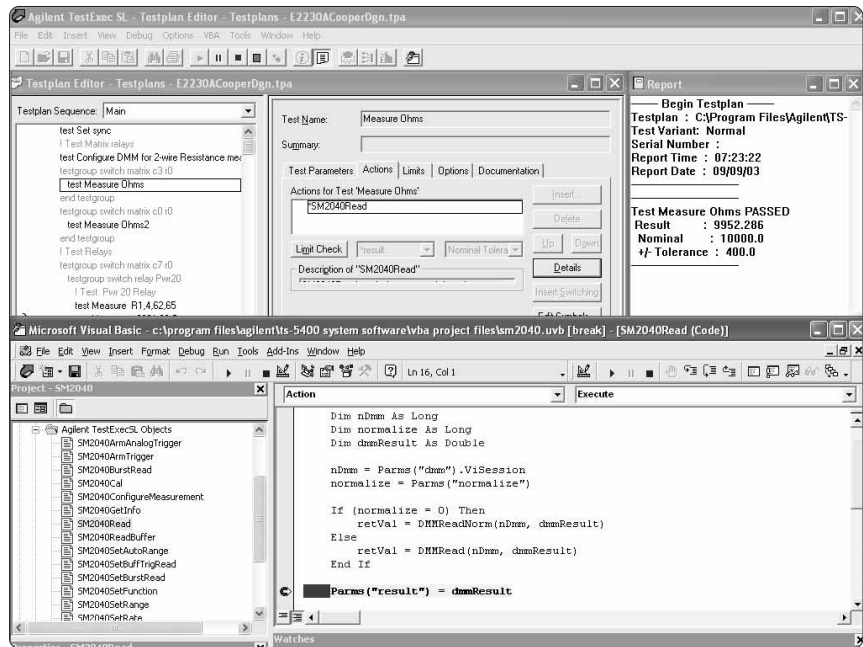
test systems," says Steve Stetler, Agilent Application Engineer. "We were initially successful in introducing one system into Motorola Stotfold that tested the Air Condition Control Module. We worked with Workstation Source, a third-party contractor who handled the quite elaborate mechanical fixturing."

Motorola was looking for low cost, high throughput, reliability, and an easy-to-use development environment. The last point was critical and the system answered the need nicely. Bundled with the system was the TestExec SL software environment. "There were a lot of features we liked," says

Heredge. “Running on Windows NT®, we found it was pretty stable. It provided a good development environment – intuitive and easy to learn. We were able to generate solutions for the factory floor in a significantly reduced number of weeks. And there’s a lot of reuse of modules and code with TestExec SL.”

Agilent TestExec SL uses a hierarchical structure to define and execute tests run on a UUT. The highest level is the testplan, which defines unique test sequences for different types of UUTs. Within a testplan, users can define testgroups to create logical associations of a series of tests performed on a specific module within the UUT. With TestExec SL, testgroups can be embedded within other testgroups. Flow control (do loops, if-then-else, etc.) can be defined at this level.

“TestExec SL is the sequencing engine for the test systems,” says Heredge. “It sequences each test in order, it deals with limits handling, and generates a result. And we use the environment to develop the



**Figure 2.** The main window of a typical test developer interface. The window frame on the left summarizes the hierarchical definition of the testplan. The middle frame displays details about the selected test. The right frame shows a summary of results from executing the testplan. Watch and Trace frames, used for debugging, are also displayed along the bottom. The entire screen presentation can be customized as desired.

tests for it to sequence. TestExec SL comes with libraries of what Agilent terms ‘actions’. Each test is a series of actions. Agilent supplies a large number of pre-written actions with TestExec SL, which means you can be up

and running, controlling test systems, and testing product in a short space of time.”

Actions are the fundamental building blocks of a testplan **Figure 2.** They tell an instrument to take a measurement and

report the results. TestExec SL users can define the actions themselves or modify them from a standard library. One example of an action is switching, which configures an electrical path between the UUT in the fixture and the instrument.

### **Hierarchical switching**

The Switch Manager incorporated into TestExec SL is a powerful tool that simplifies the task of configuring complex switching topology between instruments and UUTs. The Switch Manager interface resembles a directory structure similar to Windows Explorer. “You start off with the unit pin,” says Heredge, “and then your sub-directories might show where that pin can connect to and then where those pins can connect to and

so on. It expands out like a tree. So it’s sort of graphical but it’s still tabular-based text, extremely powerful.”

“Most of the time when people buy TestExec SL out of the box, they have some switching in their test setup that they need to control,” says Steve Stetler. “Usually it’s their GPIB or VXI matrix boxes. And with TestExec SL, using a simple text file, it’s relatively easy to add definitions so you can customize your switching topology to meet your needs.”

Test engineers have the added benefit of developing tests in the programming language they prefer. TestExec SL supports tests developed in Agilent VEE Pro and Basic for Windows,

National Instruments’ LabVIEW and LabWindows/CVI, and Microsoft C/C++. Microsoft Visual Basic can also be used to link TestExec SL to a user’s interface applications.

TestExec SL’s open architecture also allows users to quickly and easily interface external applications and devices with the test executive software to get information where and when they need it. TestExec SL’s modular software architecture is based on Microsoft DCOM to provide a standardized framework for interfacing with other software applications, often without writing new code. In some cases, users can replace existing functions with their own or third-party software modules.

When connecting specifically to instruments, users have access to extensive driver libraries in programs like VEE Pro and LabVIEW. They can also take advantage of plug and play drivers and TestExec SL's support for message-based instruments. Most VXI-based instruments can be interfaced without writing additional software. Simple text-based commands are used to control instruments. "We've written instrument drivers for non-Agilent instruments to use under TestExec SL," says Heredge. "So it's a sufficiently open architecture from that point of view."

### **Solutions**

Within Europe, Motorola now has a total of ten systems in place, testing engine management, climate control, and telematics products. "Among other tasks, they're using our system to test a full-blown ECU (engine control unit), in approximately 30% of the time that the previous generation of ECU's took on other platforms" says Agilent's Stetler.

Adds Heredge, "There are lots of outputs for driving fuel injection, ignition coils, relays, and other solenoid valves. We use a strategy called ECU-assisted testing. The unit under test has embedded test software within it, which means we can say to the unit, 'turn this output on, that one off.' And we can test it under extreme conditions. We can load it very heavily and turn it

on, and we can check that it will turn on into the top end of its operating range. On the other hand, we can read the inputs, put on a temperature sensor input and say, what do you measure on that input. What do you measure on this switch input."

Motorola also looks at high-, mid-, and low-range inputs, as well as fault condition checking on inputs. "We'll short-circuit to the power rails and check if the UUT detects it correctly," says Heredge. "Same with the outputs. We'll turn them on into short-circuit conditions and check that the unit reads back a fault. And so on." Motorola can perform the full spectrum of tests necessary to satisfy themselves that the unit will function correctly in situ.

Another one of TestExec SL's most useful features is its 'live' instrument panels. "When you're debugging a test," notes Heredge, "you can call up, say, an oscilloscope front panel and look at waveforms, and then carry on with your debugging. It's quite powerful."

### **Results and Benefits**

Agilent is now working with Motorola on the new telematics modules. The module combines the functions of GPS, GSM, and fault monitoring. And TestExec SL is the platform on which all the tests will be built.

Phil Heredge sums up Motorola's experience with TextExec SL this way: "Our test engineers quickly learned this intuitive development environment. Migrating to this platform allowed them to concentrate on value added tasks rather than source code generation. TestExec SL's many good features include a hierar-

chical switching path editor, live instrument panels, and the ability to add or remove debug features without compilation. With debug speeded up, we have significantly reduced the time required for developing a functional test solution for manufacturing."

And the benefits: "On the Basic-type platform we were using before, with the number of projects we're currently launching, we wouldn't be able to fulfill the customer's needs. And finally, we've been able to test a lot more products without increasing the test development headcount."

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