Structural change of API in testing technology

A fully comprehensive test concept for complex electronic assemblies usually includes various test and measurement procedures. The objective is, to ensure that all the connections and functions of a PCB are reliable for its later use. For this purpose, each test technology and each measuring instrument offers its own user interface in the form of software tools or control elements directly on the device, which enable autonomous control. This immediate access may well be practical in the development or debug phase, in order to use the resources manually and to be able to view results immediately. However, this is not suitable for use in the manufacturing sector, where the task is to apply a defined test plan to a large numbers of test items and to log the results in a structured manner. This repetitive process consists of many individual steps and has a considerable potential for operator error and can also be very time-consuming. Careless execution or incorrectly filed test results pose risks to the quality of the final product.

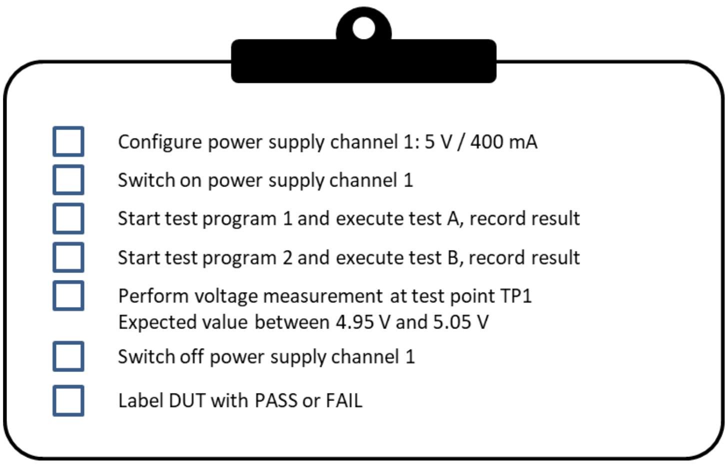

Figure 1: Control sheet for manual testing

This situation can be resolved by an automated control of the test steps through the use of an appropriate API. The abbreviation API stands for Application Programming Interface and is often associated with complicated programming that requires experienced developers. In practice, however, it means nothing more than a way to remotely control software or an instrument - i.e. to be able to call up functions from outside. How cumbersome these calls actually are is essentially up to the provider itself. Examples are, on the hardware side, specific RS-232 command sets or special instrument drivers and, on the software side, DLL interfaces or different variants of inter-process communication. As different as these methods are, they have the basic idea in common that functions are to be called and results fetched. With suitable control software, also known as a sequencer, individual test steps and an entire test plan can be created that performs the specified tests using the respective API. This form of automation has already become the standard for obtaining reliable test

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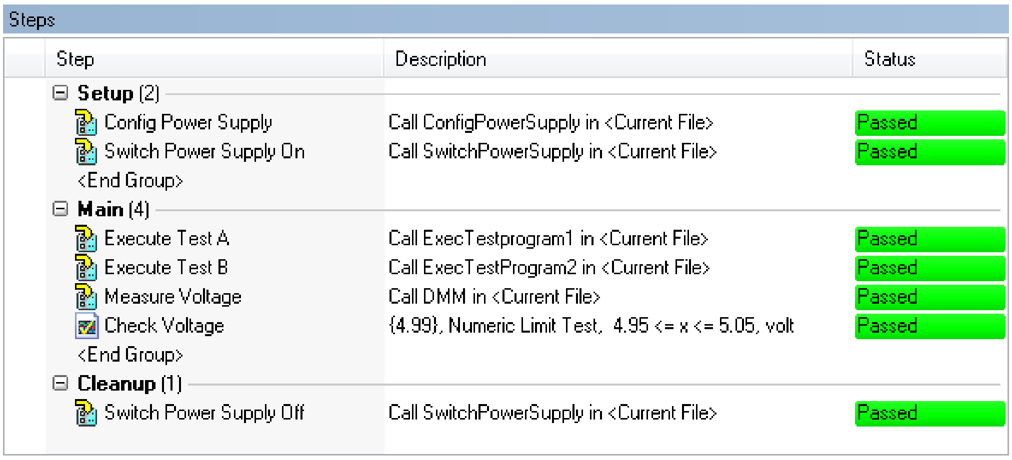
results and ensuring a specific cycle time. Production staff only need to use one user interface and do not have to worry about the details of the individual resources.



Steps

Step	Description	Status
Setup (2)		
Config Power Supply	Call ConfigPowerSupply in <Current File>	Passed
Switch Power Supply On	Call SwitchPowerSupply in <Current File>	Passed
<End Group>		
Main (4)		
Execute Test A	Call ExecTestprogram1 in <Current File>	Passed
Execute Test B	Call ExecTestProgram2 in <Current File>	Passed
Measure Voltage	Call DMM in <Current File>	Passed
Check Voltage	{4.99}, Numeric Limit Test, 4.95 <= x <= 5.05, volt	Passed
<End Group>		
Cleanup (1)		
Switch Power Supply Off	Call SwitchPowerSupply in <Current File>	Passed

Figure 2: Test steps in a sequencer

The architecture of the API has evolved over time, new interfaces have been introduced, standards have been defined and in some cases entire command sets have been standardised for certain device classes. The focus shifted more and more from the original offline communication within a computer to network-based technologies.

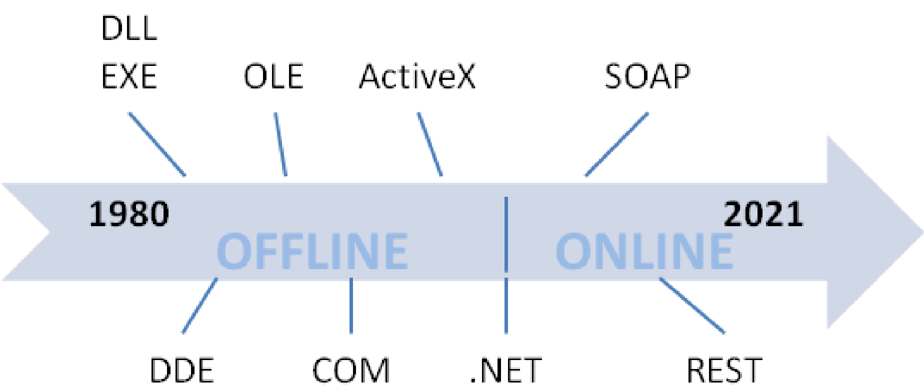


Figure 3: Introduction of different communication methods

While these innovations were always designed to simplify integration into a control software and access to the individual functions, a decentralised basic structure of the overall system remained in place for a long time: A test computer is set up by installing and configuring the control software and all other test programs and device drivers. With this self-contained, stationary system, the testing task is carried out according to the specifications.

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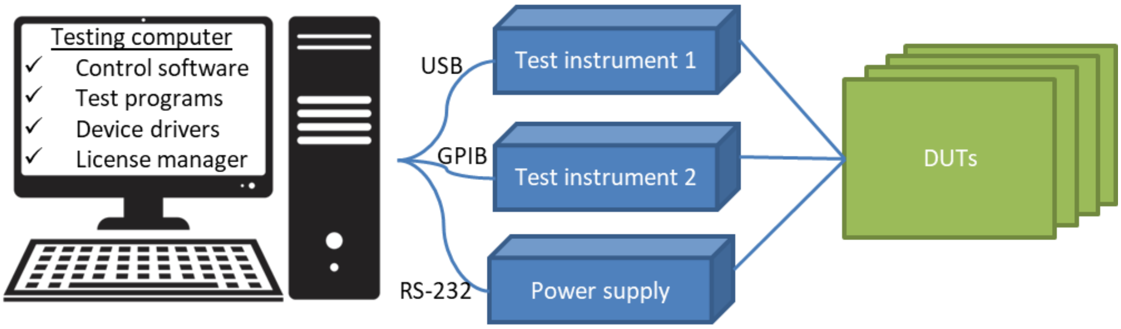

Figure 4: Decentralised test station

At first glance, this structure seems comprehensible and was originally also due to the restrictions of the API and the hardware interfaces, which precluded a different arrangement. This results in some disadvantages that become more and more obvious as the number of components increases. The commissioning and maintenance of the testing computer becomes more time-consuming, the computer load increases and the numerous system interventions eventually endanger stability. Failures or delays are to be avoided in production. In addition, the entire testing computer must be duplicated for each additional test station, and the operating system architecture is also important - every test program and every device driver must be compatible with the testing computer.

To counteract these issues, this combined management of all components on one system is dissolved. From the hardware point of view, this has already been done in many areas by implementing an Ethernet interface. Instead of USB or even plug-in cards in PCIe format, which presume the installation of a device driver, the connection is made via a network connection that is immediately ready for use. In order to decouple the software, an API is required that supports the corresponding network technologies and thus enables the distribution of the systems.

PHYTEC Messtechnik GmbH has experienced such a structural change. A testing concept was developed to test different System on Module (SOM) assemblies at the end of the production line. JTAG / Boundary Scan from GÖPEL electronic GmbH and function test are used as test strategies. At the end of the test, the modules are programmed with a boot loader and provided with a serial number. The previous system configuration has been in use for 10 years and consists of a testing computer, a master unit with fixture for the special DUT and a JTAG controller.

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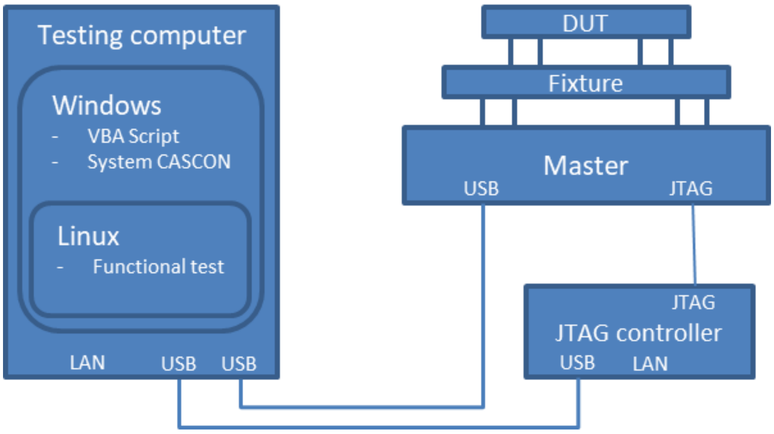

Figure 5: Previous (decentralised) test station at PHYTEC Messtechnik

Microsoft Windows is used as the operating system for the test station. The sequence control is executed as a VBA script under Microsoft Access. The Boundary Scan Software System CASCON is installed locally on the testing computer and accesses the JTAG controller connected via USB. A DLL API is integrated to select and start the project and the individual test steps or complete batches. Based on the return values, the test result is generated and stored in the database for documentation. For the subsequent functional test, the services of a Linux operating system are required, which is set up as a guest system in a virtual machine and addressed by the sequence control via Telnet. According to the previous experience of PHYTEC Messtechnik GmbH, Windows is not suitable for automated sequence control, VBA is difficult to manage and the overall system requires high efforts in case of updates. This resulted in the need to redesign the software landscape with the following requirements:

- Linux operating system
- Sequence control with the script language Python
- Outsourcing of System CASCON to a server and control via network API
- Connection of the JTAG controller via Ethernet

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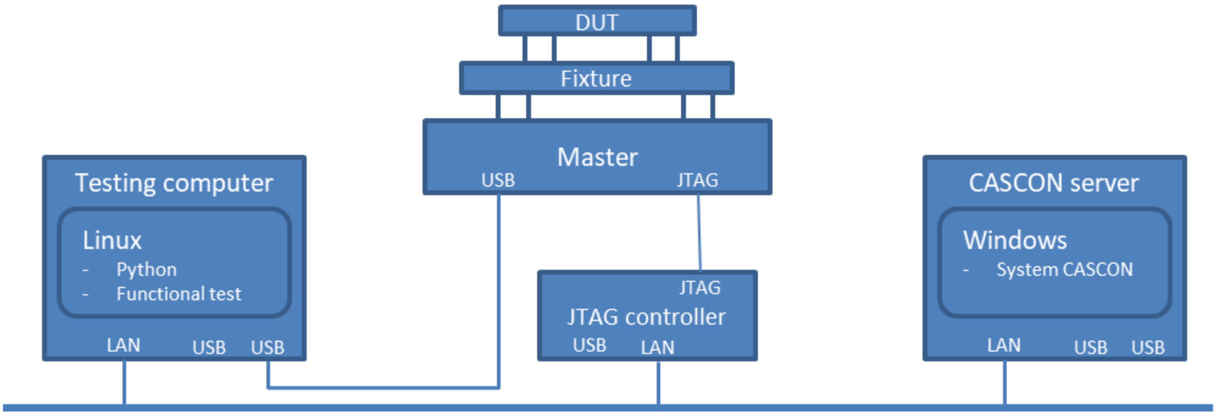

Figure 6: New test station at PHYTEC Messtechnik with network control

In this new concept, the testing computer was reduced to a thin client from the point of view of the boundary scan test, which no longer has to provide any resources, but only communicates with the centrally organised server computer. Such management requires a corresponding API, which is available through a SOAP web service. SOAP stands for Simple Object Access Protocol and is a network protocol based on XML messages, which is considered an industrial standard of the W3C. This arrangement may seem to be an excessive overhead for a single test station but offers decisive advantages even in this case. The testing computer is not stressed by additional software and is accordingly less susceptible to faults. In addition, the commissioning and maintenance of two separate, dedicated computers is significantly easier than with a combined system containing all components.

Fig.7: Test station at the company PHYTEC Messtechnik GmbH

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Further advantages arise when setting up additional test stations. Currently 18 JTAG controllers are used in the described environment, three of which have already been converted to web service control. With the introduction of new products, more decentralised test stations will be added to the network structure. Since a CASCON server is able to manage several JTAG controllers, only the internal configuration has to be adapted there. Thus, only the slim testing computer and the actual test setup consisting of the master unit and the JTAG controller are duplicated. Other forms of scaling, such as the control of several JTAG controllers via one testing computer, can also be realised in this way and thus offer further degrees of freedom.

Fig.8: Test setup

Conclusion: An API is an essential component in test engineering and enables reliable, automated processes that are absolutely necessary for the quality assurance of electronic assemblies. It not only serves as a control unit for the respective test technologies and measuring instruments, but also has a considerable influence on the conceptual design of the entire test setup and the associated infrastructure. The range of available interfaces in both hardware and software determine how resources can be managed and networked. It is worth considering these possibilities and giving more importance to the API.

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