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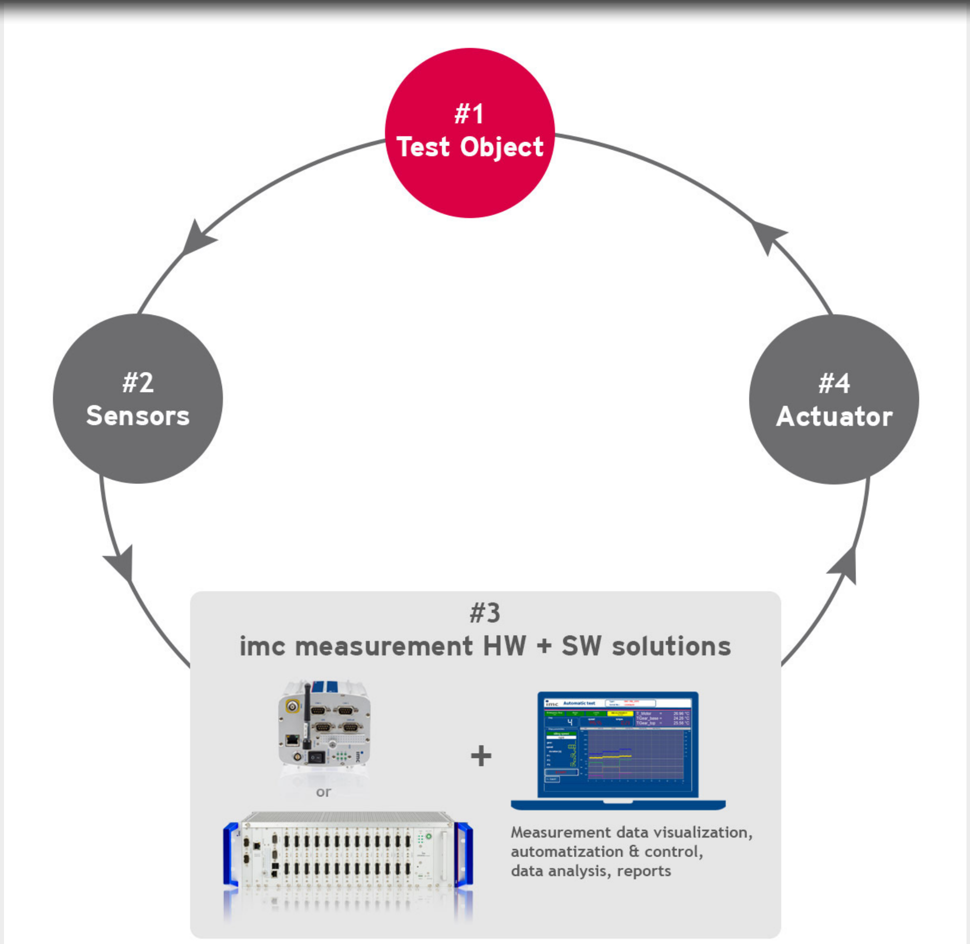

Integrated Component Test Stands with imc STUDIO

Test automation, real-time control and measurement data analysis in a single integrated system

imc Test & Measurement

Application Note // By Martin Riedel, Product Marketing Expert, imc Test & Measurement

APPLICATION NOTE

Introduction

Modern vehicles contain very many electromechanical components and sub systems. To a large extend, different specialized suppliers develop and manufacture them upon contract. Before these components can be released for installation at an assembly line of the vehicle manufacturer, they must undergo extensive functional and load tests by the supplier during the development phase. In addition, systematic end-of-line checks ensure stable quality during mass production.

Component test stands are used for such types of tests. For test engineers and system integrators to implement and operate such test stands, the careful choice of measurement and control technology including hardware and software tools, is of crucial importance. Not only the implementation but also routine operation and regular adaptations to changing test requirements, need to be efficient and cost effective.

Automatic start-stop system: Ecological solution provided by highly stressed “in-line relay”

A typical example of this scenario are electric starters for intelligent start/stop control of car engines. Such systems, implemented in many current vehicles, detect an idle state, at a red light for example. The transmission not being engaged, and certain ABS signals indicate that the vehicle is at a standstill. If the battery management system approves sufficient energy reserves for the next start-up operation, then the engine is automatically switched off. If the traffic light then returns to green, the driver actuating the clutch, will immediately trigger the starter to crank the engine. This requires a magnetic cou-pling clutch, which can activate the starter very quickly: a so-called “in-line relay”.

In fact, a smart and ecological solution can easily help avoid unnecessary emissions and reduce energy consumption without any loss of comfort or time. With such a highly loaded component, it becomes immediately clear how important reliability, long life and safe functionality are under different operating and load conditions. These criteria must be determined and optimized in systematic tests on component test stands.

For example, endurance testing can be conducted on test stands, imposing specified loads and controlled ambient conditions. In this case, the starter relays are loaded with a controllable magnetic particle brake, which can simulate defined load profiles, e.g., typical engaging actions with either tooth-tooth or tooth-gap positions between the starter pinion and the combustion engine. The process is extensively covered with instrumented sensors that measure shift displacements, currents, voltages, speeds and temperatures. The data acquisition results of that tests are analyzed live, yielding characteristic parameters such as release voltage, switch-off energies, relay heating, etc. The system records these data and such long-term tests can last for several weeks.

Manifold and demanding requirements on the component test stand

A major challenge for such test stands is that not only measurement data from different sensors and vehicle buses (e.g., CAN data from ECUs) must be acquired, but also the actuators involved (switches, brakes, supply voltages) must be controlled and regulated under real-time conditions. This is all embedded within a cyclic process of test automation, which obeys real-time conditions and, on the other hand, needs to interface with its results and test protocols to database systems.

Such diverse requirements call for an integrated solution. In particular, both the acquisition of the test object data as well as the real-time open- and closed-loop control, which rely on that very same measured data, should be integrated in one single system. This avoids unnecessary interfaces and creates clear structures that allow for flexible modifications at any time.

The imc CRONOS measurement and control system achieves this goal by embedding the functionality of a real-time controller. While conventional solutions often apply such function in the form of an external PLC, the imc system provides it as an integral part of the modular measurement system.

The system can therefore be equipped not only with modules such as measuring amplifiers, digital IO or fieldbus interfaces, but also with a real-time processor platform. It has full access to all measurement channels, digital inputs and outputs, CAN or fieldbus data, and can generate analog control signals, set point and load profiles and implement closed-loop control structures such as PID.

FIGURE 1.
imc CRONOScompact modular measurement and control system in 19" rack version

High-level design vs. "real-time execution"

The potential of this integrated measurement and control system with all the necessary functionalities is fully exploited by the imc STUDIO software, that likewise constitutes an integrated solution. With minimal effort, the software enables the realization of complete applications at a very high abstraction level. No programming is used. In contrast, the "Automation" component of imc STUDIO offers a graphically oriented design tool that allows the test automation task to be defined and mapped as a state model. In this way, the test sequence can be structured into clear steps in which, for example, certain load profiles are generated and controlled, and test phases are terminated and transitioned, based on flexibly defined conditions.

Such conditions can include, for example, an adequate settling of certain parameters to within specified tolerance bands. Even more complex conditions can be based on live-calculated analysis algorithms, whereby specific relevant "time frames" can be specified, as the scope for performing the evaluations.

This sequential and loop-oriented flow is completed by an always active background monitoring. Relevant variables are continuously supervised for fault, error and alarm conditions and corresponding exception procedures launched immediately.

What is crucial in this concept is that the design is done comfortably on the PC, but the resulting sequences are reliably executed in the device, on a dedicated processor platform for which the corresponding real-time code is automatically generated.

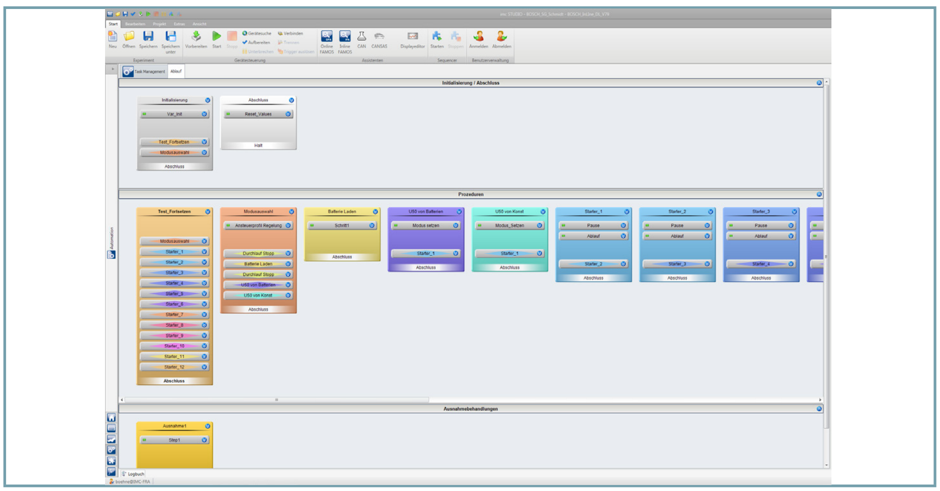

FIGURE 2.
imc STUDIO Automation: Graphic display of the test automation allows adaptation and expansions at any time

Rescuing the test engineer from the "swamp" of low-level programming

As a result, the responsible engineer does not need to deal with programming at a low level. He can fully concentrate on his core competence: the expertise on the product to be tested, the test methodologies and interpretation of the results. This also facilitates documentation, maintainability and flexibility. In this way, such a test stand can be adapted at any time to constantly changing requirements, new product variants, or extended test scenarios.

It is especially efficient when future operators themselves can adopt such modifications. A flexible user interface allows for easy adaptations “on the fly”, without the need to involve the test stand developers or even external service providers, when often only marginal changes are to be made.

imc STUDIO supports this task by a drag & drop approach, not only for the automation sequence control, but also for the user interface. A customized GUI can be created by mere drag & drop of standard components. The designer can combine and configure for the desired functionality, via simple drop-down menus on the respective element.

The standard functions of this modular system and toolbox also include interfacing to external SQL databases, data export in various formats and import of parameter lists in Excel formats which can be used to flexibly modify test sequences.

Functionality, which goes beyond the extensive selection of standard components, can be complemented at any time by means of an integrated scripting environment. For example, a framework with functions and templates is provided to support easy integration of further external hardware, e.g., climatic chambers, laboratory instruments or other infrastructure on the test bench.

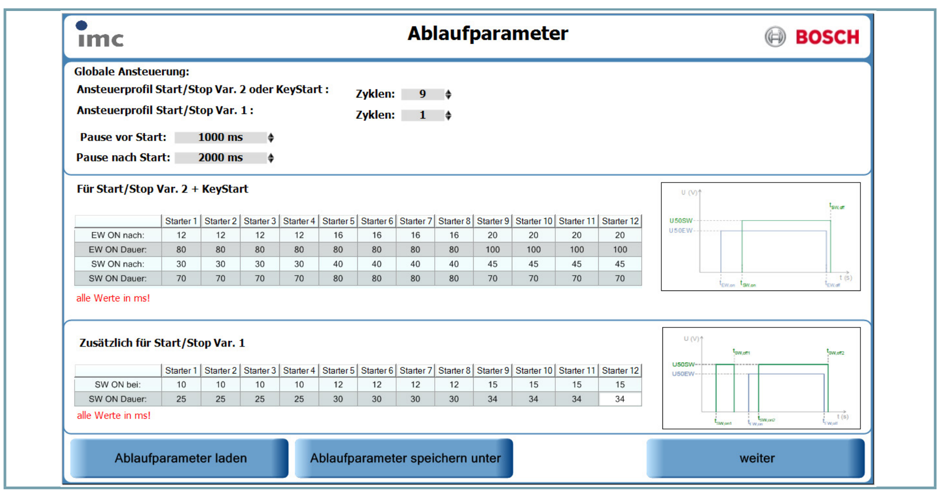

FIGURE 3.
User interface for defining the test and sequence parameters, which can be specified individually for each starter

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FIGURE 4.
Control panel with results of a recent endurance test

Cost of ownership:
considering all factors in the lifecycle of the test stand
The productivity of a component test bench is mainly determined by the following factors, which are promoted by an integrated solution:

- Efficient and powerful hardware that integrates PLC functionality, allows fast control loops, thus shortening test cycles and maximizing throughput.
- Well-structured and user-friendly design tools simplify the implementation and enable independent maintenance and enhancements in the future. In practice, this is often one of the major cost factors.

- The ability to facilitate changes on the level of operators and test engineers rather than programming departments or external services is a key aspect for sustainable solutions.
- Intuitive and easy-to-use GUIs with user guidance, which ensure smooth and trouble-free operation by the personnel, thus yielding a long service life.
- Comprehensive analyses and documented reports, which minimize the additional effort involved in evaluating the results.