Viable Solutions to Customized Product Testing

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From design validation to the production floor to on-site diagnostics, testing is a critical component in the product development process -- which basically involves identifying potential problems in order to address and-resolve them. Finding a piece of test equipment that will address all of a product's testing needs, however, is a dilemma that frequently leads to creating a custom, product-specification defined, rack-and-stack. This often results in a solution that resembles a "hot mock-up" or "plug-it-in-and-try-it-method" that's expensive to maintain.

In addition to significantly increased costs that are often more difficult to capture, other issues inherent with such solutions can include a lack of self-test capabilities or calibrations, an inability to certify to NIST (National Institute of Standards and Technology), poor GR&R (Gage Repeatability and Reproducibility) results, and partial or no documentation. When test engineers spend significant time satisfying a range of test equipment requirements, it can detract from their efforts to address other critical aspects such as decreasing test time, increasing production yields, interfacing to factory information systems as well as maintaining the integrity of the complete test process.

Specialized, test systems that are proprietary can offer a mature, highly integrated platform. For fundamental testing techniques such as electronic in-circuit testing and functional end-of-line testing, proprietary equipment may be reused, reconfigured and redeployed for different products to leverage the testing investment. Tools and utilities available on the open market provide easy solutions to NIST traceability, worldwide deployment, self-testing and maintenance.

Viable Alternatives

There are alternatives to "hot mock-up" or specialized, proprietary test systems worth exploring to enhance and customize the capabilities of your existing test equipment. Highly integrated platforms rooted in open architecture now offer a vast array of feature sets commonly found in proprietary test systems. As a result, open systems have become more flexible and economical. The three most viable options, starting on the low end of the cost continuum, are fixture additions, tester additions and interface adapters. The capability to place and define tester resources such as protocol, switched loads and industrial control in added components or adapters actually helps contain costs and improve overall quality. Additionally, they more easily resolve challenges introduced such as when the test equipment is remotely located or lacks a required resource.

Fixture Additions

Fixture design represents the least expensive opportunity to address some difficult parametric issues. For example, in applications involving environmental chamber testing or dense floor plans, the distance between the test equipment and the product may be ten

feet or more. This presents a challenge when loading high-current or high-speed devices due to voltage drops or cross-talk. For the same reasons, precision, high-wattage loads are difficult to calibrate or specify. One solution is to locate high-current loads inside the fixture, closer to the DUT (device-under-test), and if needed, switch them remotely via USB, LAN or GPIB. By utilizing a remote loading technique, you can avoid the cost of lengthy and heavy, high-current cables, which will also make factory floor layout changes easier.

Another option involves modularizing the industrial control and placing the test control module in the test equipment cabinet or within the mechanical fixture interface. If it is feasible to design a common industrial control, that control design may be leveraged in an "off-the-shelf" manner by placing it in the fixture as well. This modular approach reduces maintenance costs by streamlining documentation and training requirements and through embedded diagnostics capabilities.

Tester Additions

An intermediate test adapter placed between incompatible existing test equipment and fixtures can enhance or even provide new test capabilities. Capabilities such as high-density loading, logic level adapting, signal shaping and protocol conversion can adapt or organize existing equipment resources to standardize the resource presentation for reuse. Commonly referred to at Digalog Systems as a "Resource Gateway," this component offers a high level of innovation and creativity for specifying custom test resources.

Tester resources such as protocol adapters, vision systems, bench-top equipment, or LAN, USAB, PCI, PXI, VXI and LXI-based instruments can be developed internally or purchased from third-party vendors to expand the capabilities of existing equipment or even less expensive generic testers. The latter approach is particularly valuable when the tester component can be completely managed by a supplier whose core focus is to provide and support its product.

However, in this scenario it is important to carefully consider the level of capabilities with which these resources should be integrated. Every resource added without the ability to self-test, calibrate or certify to NIST standards yields more of a mocked-up, proprietary type of platform that is more difficult to maintain. Calibrations and certifications are critical to fulfill Quality System commitments, while self-test capabilities and a complete documentation set are driven by maintenance or support requirements most commonly found when equipment is installed at multiple locations.

For specific test capabilities that may not be available on the open market, a Resource Gateway offers an extremely versatile test solution. The off-the-shelf components are routed to the Resource Gateway where they are utilized and integrated with application-specific hardware and software for a seamless interface to the DUT. As is the case with any proprietary hardware or software, documentation is the cornerstone for successful deployment and support of the test solution.

Additional test requirements may be addressed in the Resource Gateway with microcontrollers. A specialized test solution capable of autonomous operation, microprocessors are extremely cost-effective for distinguishing good product from a bad and reporting a pass or fail condition. Additional methods for low-cost, yet innovative solutions continue to emerge such as FPGA (Field Programmable Gate Array)-based test system technology. As FPGA capabilities and development tools become more economical, the ratio of cost to performance becomes highly favorable.

Interface Adapters

While higher on the cost continuum, interface adapters have been successfully used to emulate one or several tester platforms with a single tester platform. When a platform is too proprietary to a specific vendor and/or is obsolete, a solution such as a hardware adapter coupled with a software interface library, offers greater flexibility to companies that have a substantial investment locked into tooling for a particular test platform.

To date, Digalog Systems has replaced as many as four system platforms with a single test platform, utilizing four interface adapters. The net result is getting the performance of five tester platforms for the cost of a single platform and some non-reoccurring engineering costs. Maintenance costs are also reduced from stocking fewer spare parts. In addition, eliminating the need for troubleshooting and certification procedures specific to different test platforms simplifies training for maintenance and metrology personnel and helps reduce equipment downtime.

Conclusion

Test solution challenges have become less threatening as tool sets have grown. Highly competitive test tool providers continue to search for new ways to increase testing capabilities while LAN, USB and similar device platforms continue to drive costs down by requiring less overhead for high-speed data transfer. With high-paced advancements from FPGAs to high-speed protocol platforms to interconnect-technology, it is essential that test engineers keep abreast of and open to new innovations.

Producing a customized test solution that meets all your specific application requirements does not have to involve the purchase of new or elaborate equipment. Inexpensive add-on components can readily address a variety of needs, yet avoid the challenges and costs often inherent with high capability, test equipment. Essentially, the power of an engineer's innovation is still our most valuable resource for viable solutions to customized testing.

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Patrick Beaver has 12 years of test solution architecture experience with Digalog Systems. Digalog is an engineering-driven company that has developed high quality board and module test solutions for some of the largest electronics manufacturing facilities in the world. In addition to off-the-shelf equipment, Digalog offers custom test solutions for functional, digital, and in-circuit testing.

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