Intro to SafeTest™ Protection Technologies and TestStation LH™ Webinar Q&A

Q. How does Teradyne's TestStation differ from other in-circuit testers (Agilent and TRI) in its abilities to accurately and safely test low voltage technologies?

The TRI tester uses a simple low-cost pin design (similar to Teradyne's Z18XX) that has a high output impedance driver, shared logic level assignments, and a shared PC controller. This design makes it difficult to test low voltage technologies accurately and reliably. The TRI tester also does not have the backdrive current measurement, programmable backdrive thresholds, and multi-level digital isolation features that guarantee safe testing and accurate diagnostics of digital components.

Agilent's and Teradyne's in-circuit testers share capabilities that make it easier to accurately and safely test low voltage technologies. These features are:

?? Low impedance drivers that make it possible to accurately test low voltage technologies, even under backdrive conditions. The TestStation UltraPin driver and sensor accuracy (+/- 45mV) is approximately twice as accurate as Agilent's driver and receiver accuracy specification (+/- 100mV), but this accuracy variation is only likely to make a difference when testing very ultra low voltage technologies.

?? Agilent and Teradyne also both have per pin programmable logic levels that allow each device pin to be assigned the voltage values that are appropriate for the pin technology. This eliminates the test compromises, potential over-voltage conditions, and fixture complexities that are required on less capable in-circuit testers (like TRI) that must share logic assignments (groups of 32 pins must share the same logic level assignments).

?? Finally, both Agilent and Teradyne have dedicated digital controllers that minimize backdrive and test times and execute test vectors with consistent and repeatable timing.

However, the Test Station's UltraPin design and safe testing features have the following capabilities that make it unique:

?? The TestStation has built-in hardware and software that measures backdrive current in real time and identifies test conditions like faulty enable pins, components that are not properly disabled, and improper device initialization sequences.

?? The TestStation's programmable backdrive current and duration thresholds protect sensitive device technologies from being overstressed when there are fault conditions on the board, and they can be used to identify faults (like faulty device enable pins and marginal output transistors) that are missed by other in-circuit testers.

?? The TestStation has automatic driver verification, which verifies that each driver used during the test achieves its programmed voltage. Driver verification does not happen automatically on the Agilent tester because of Agilent's split pin architecture (two pin resources are required to perform the driver verification).

?? The TestStation has multi-level digital isolation software prevents potentially dangerous voltage spikes from occurring. It automatically disables and inhibits all output or bi-directional pins on a net prior to connection of a digital driver. Smart isolation sequence orders prevent voltage spikes from occurring during the test initialization and test vector disconnect sections of the device test.

Q. How does Agilent's Safeguard software compare with Teradyne's backdrive current measurement and control capabilities?

Agilent's Safeguard software tries to predict backdrive currents and time by examining board topology and safeguard files that contain information about device logic families, backdrive currents, package types, thermal characteristics, etc. Based on its analysis, the Safeguard software prevents the run time from exceeding this maximum "safe" time limit. We believe that this approach is ineffective in most situations for the following reasons:

?? Safeguard's analysis is only as good as the information that is contained in the safeguard data files. Much of the information that is required in these files is not specified in device data sheets, and it is hard to obtain the information from device manufacturers. If any of the information in these files is incorrect, the prediction will be wrong.

?? Maintaining the information in the safeguard data files is time consuming because the information is constantly changing due to new packaging technologies and shrinking silicon geometry.

?? Safeguard's analysis assumes that all device isolations are working properly and that the board under test has no defects. It cannot predict what will happen when a device is not properly isolated. It cannot report backdrive currents that occur as a result of faults on the board, and it cannot protect devices on the board from excessive backdrive currents when these faults do occur.

?? It cannot measure actual backdrive currents; therefore, there is no way to determine if the predicted backdrive currents are accurate.

We believe TestStation's backdrive current measurement and control capability is a more powerful and effective solution for the following reasons:

?? TestStation's backdrive current measurement software does not require any complicated data files. It does not need to predict backdrive currents and duration because it measures them directly using the test equipment. This removes the requirement for complicated data files and eliminates the chance of incorrect data causing inaccurate backdrive predictions.

?? There are no data files to maintain or change when new device technologies and packages are introduced.

?? TestStation's backdrive current measurement software can identify when backdriving occurs due to missing isolation code, bad isolation code, bad parts, or UUT fault conditions.

?? TestStation's backdrive current measurement software protects devices from excessive backdriving that can be caused by faults on the PCB and identifies these faults so that they can be repaired.

?? TestStation measures actual backdrive currents using the tester instrumentation.

Q. How easy are Teradyne's backdrive current measurement tools to use?

The backdrive measurements tools were designed to be simple and fast. During digital device debug users can click on a button or enter a command to get a report that details the amount of backdrive current required to drive each net used by the test. The report only takes seconds to generate, and it quickly identifies nets that are not properly disabled due to circuit design or inadequate program isolation. A separate option allows users to generate a backdrive report for all the devices on the board.

The Test Quality Allfault report also includes the measured backdrive information, so that along with the pin fault coverage information, users can see which device tests and specific pins require excessive backdrive currents.

To prevent the tester from applying excessive backdrive currents, users can learn the backdrive currents from a known good board and then set programmable backdrive current and time thresholds based on the known good values. During production testing, any device pin that exceeds its programmed current and time threshold are flagged by the hardware and reported by the TestStation diagnostic software.

Q. Are Teradyne's customers using the backdrive measurement features yet and how are they being received?

Teradyne included the patented backdrive current measurement capabilities and low output impedance characteristics in their custom UltraPin design based on feedback from several manufacturers of high quality, high reliability products who were concerned about false failures and potential violation of device specifications.

Since the UltraPin was introduced in 2000, many manufacturers who use TestStation in-circuit testers have come to realize the value of these capabilities. They are using the backdrive measurement and control features to help them debug their test programs and identify PCB faults that previously went undetected. We have been encouraged by positive feedback, such as the following statement received from one of our customers:

"We quickly realized how powerful this new backdrive measurement capability is. It provides insight where none was possible before and helped locate potential problems with ease. We believe that this new functionality will be extremely useful in the future and that our stringent quality requirements will be aided and even improved with the new hardware/software."

Q. Can the TestStation LH test Low Voltage Differential Signal (LVDS) technology that has a voltage swing of 250mV to 400mV?

The UltraPin sensor used by the TestStation LH has a voltage input error of +/- 40mV, which allows it to easily detect the 150mV voltage differential between a low and a high LVDS output. Conventional testers that typically have voltage input errors greater than 300mV could not successfully distinguish between the high and low.

The UltraPin™ driver has a no-load voltage error of 45mV, which also allows it to accurately drive the input low and high voltages required by LVDS technology. Conventional ICT drivers would have intermittent success meeting the LVDS drive voltage requirements because they typically have a no-load voltage error of 100mV, and the voltage error increases dramatically when the driver is exposed to a load condition or must backdrive another IC output.

Q. Can existing 228X and TestStation™ models be upgraded with the UltraPin and SafeTest Protection Technologies?

The UltraPin pin board technology cannot be retrofitted to older GR228X tester models, but Teradyne does offer attractive trade-in programs that allow users to trade-in their older GR228X test systems for the latest TestStation LH and 12X models that include UltraPin and SafeTest technologies.

Customers that have TestStation models that are configured with older Combo pin board technology can purchase an upgrade package to replace the Combo pin boards with new UltraPin pin board technology.

Teradyne offers five different UltraPin boards to satisfy varying customer requirements for pincount, price, and program compatibility. Two high-density board versions of the UltraPin can be installed to achieve a maximum pincount of 4096 on the TestStation LH and 7680 on the TestStation LX. Both the TestStation LH and the TestStation LX share all of the SafeTest protection features.

Q. Do all the TestStation LH models use multiplexing?

As mentioned above, the TestStation LH can be configured with any one of five different pin cards. Each of the pin cards has a different multiplexing ratio and density combination so that we can configure the system to meet their requirements. The five different multiplexing/pin density combinations are:

Ultra128 – 1 to 8 multiplexing / 128 pins per board
Ultra124 – 1 to 4 multiplexing / 128 pins per board
Ultra121 – 1 to 1 multiplexing (all real pins) / 128 pins per board
Ultra128L – 1 to 8 multiplexing / 256 pins per board
Ultra124L – 1 to 4 multiplexing / 256 pins per board

Q. What are the Clock Drive capabilities of the TestStation LH System?

The TestStation LH has an optional Clock/Sync/Trigger (CST) module for executing high speed sophisticated digital test vector patterns. The CST provides 16 clock driver and 8 clock sensor signals that can be programmed from 20Khz to 20Mhz. Twenty-eight (28) Trigger pins can also be used to delay test vector execution until specified trigger conditions are satisfied.

Up to four independent timing sets can be defined by the user so that different timing can be applied on each test vector as required.

Q. Is there any way to add more supplies to the TestStation LH if we require more than 10 user power supplies?

The TestStation LH can be configured with a second user power supply rack that allows the system to be configured with an additional seven user power supplies (for a total of 17). If this custom configuration is requested, the tester PC will be removed from the inside of the LH to make room for the additional supplies and placed externally to the system. In addition, the built-

in hardware and software support for the IEEE-488 standard allows users to connect and control additional GPIB power supplies.

Q. What is the specification of the System Frequency Test Module (SFTM)? How high a frequency can be measured?

The SFTM instrument on the TestStation LH can use a high-frequency direct connect method to the tester receiver that allows frequency measurements of signals up to 100Mhz. For convenience, the SFTM measurement pins can also be routed to any pin on the tester through the tester backplane and pin board scanning subsystem. When connecting through the pin board scanning subsystem, the maximum frequency is limited to approximately 1Mhz.

Q. I assume the TestStation LH is a combination of GenRad and Teradyne technology. Which tester is it closest to in the product lineup?

The TestStation LH is closest to the GenRad TestStation 12X product. It is directly compatible with test programs and most fixtures that are running on GR228X and TestStation test systems, and the software program development environment is based on GenRad's GR228X/Navigate™ user interface.

Certain elements of the TestStation LH, however, are based on Teradyne products, like system power supplies, mechanical frame, and tester panels. As time goes on, the ICT products will be further consolidated to use the best features of the combined products.

Q. How does the user program the TestStation LH, and how easy is it to convert programs from the Teradyne Z18XX tester to the TestStation LH?

The TestStation LH has powerful Automatic Test Generation (ATG) software that automatically generates the TestStation LH program using information from device test libraries. The first steps consist of creating a circuit description file for the target board (using Teradyne's powerful Design-to-Build™ [D2B] and Alchemist™ CAD Preparation software) and device models for components on the board that are not in the TestStation library (using TestStation's model creation tools).

Once this information is available, the test generator automatically creates a test program that typically has 80% or greater fault coverage. A simple, high-level test language then allows users to customize or add additional test code as needed to improve fault coverage. Finally, the TestStation software has extensive tools to automate the debug process and measure the program fault coverage and test quality.

Z18XX test fixtures and programs are not compatible with the TestStation LH tester, but a member of Teradyne's Support Network (TSN) does sell software and fixture converters that can generate TestStation circuit description files from Z18XX program files. Using this software would make it possible for users to re-use their Z18XX fixtures with a re-generated TestStation LH program. For information on our TSN members, go to our web site at: http://www.teradyne.com/cgi-bin/atd/partsearch.pl?where=all