The BestTest Newsletter

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This Issue's Feature Articles

Product/Service Focus

This issue's focus is **Switching Products**. You can view and add to our existing list of Test Products/Services, Test Vendors, Test Literature, Test Definitions

What's New in Test

Announcement

- 1/12/2006 Industry Steps Toward 802.11n
- 1/12/2006 Semiconductor Test Spin-off to Be Called Verigy
- 1/12/2006 VXI Technology Launches LXI Seminars
- 1/5/2006 Best-In-Test Award won by GÖPEL electronic's Boundary Scan Hardware Platform SCANFLEX®
- 1/4/2006 Test & Measurement World Names NI Flexible-Resolution Digitizer Best in Test
- 1/2/2006 Readers Honor Seven (Test) Products As Best of 2005
- 12/23/2005 Teradyne wins Best-in-Test(TM) award
- 12/22/2005 ASSET(R) Earns Third Consecutive ``Best in Test'' Award with DFT Analyzer(TM)
- 12/19/2005 Contract Manufacturer Barric partners with XJTAG for boundary scan solution
- 12/16/2005 'Long' Distances Measured With Picometer Accuracy

Magazine Article

- 1/2/2006 Capturing and Evaluating High-Frequency Signals
- 1/2/2006 Communications Test Advances
- 1/2/2006 Removable Shielding Technologies for PCBs
- 1/2/2006 The Finer Points of Test
- 1/2/2006 Trends in Vibration Test
- 12/16/2005 Build a USB-based GPIB controller

Product Release

- 1/15/2006 onTAP Boundary Scan Software Download Available
- 1/10/2006 EXFO Introduces Handheld OTDR For FTTx Test Applications
- 12/20/2005 50MHz waveform generators include PLL capabilities
- 12/20/2005 ATE pin-driver chip provides differential drive and receive
- 12/20/2005 Kozio provides hardware validation through the entire product life-cycle
- 12/20/2005 Microwave Antenna Path Alignment Made Simple
- 12/16/2005 Highly Accelerated Thermal Shock (HATS(TM)) test system implemented at PCB manufacturer
- 12/16/2005 World's first certified and licensed LXI products announced

Report

- 1/3/2006 CEA: No Slowdown in Consumer Electronics
- 12/30/2005 2005: A Time of Change for ATE
- 12/21/2005 Gartner: Chip Equipment (and ATE) Recovery in 2006

How to Select the Right Switching Products

Tee Sheffer, President, Signametrics

Almost every test system includes some kind of switching module which routes signals to instruments to be measured and/or processed. There is no one product that can do it all. Various requirements imposed on the switching module may conflict with each

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Cable Test Systems, Inc.
Chroma USA
Evaluation Engineering
International Test Conference
IPC - APEX Conference Organizers
Powell-Mucha Consulting, Inc.
Test & Measurement World

Want to trade links?
We'll list yours here and you list ours at your site.

Test Vendors

We now have 1946 test vendors listed in the Test Vendor Directory. Check for accuracy.

The following companies have recently placed advertising with us:

Vendors:

A.H. Systems, Inc.
A.T.E. Solutions, Inc.
Capital Equipment Corp.
CEIBIS Cody Electronics
ESPEC North America
FTS Systems, Inc.
Geotest
Intellitech Corporation
Invisar, Inc.
JTAG Technologies, Inc.
Madell Technology Corporation
Measurement Computing
MPI Melting Pressure
Pickering Interfaces
ProbeStar, Inc.
Q-Star Test nv
Tabor Electronics
Tecpel Co., Ltd.

other. Also, some of the requirements may be poorly understood. This article will attempt to outline the various attributes and suggest ways to handle them.

Let's look at some switching requirements, some familiar and some not:

Because the requirements are so diverse, most systems end up with multiple types of switches in them. Unfortunately, there is no universal switch that does everything well.

- To switch many general-purpose inputs and outputs, you need to think about high density, single-pole switching.
- If you have high voltages and/or high power inputs you need suitable voltage and current capabilities.
- If you have RF signals, you need low-loss, high-isolation, high-bandwidth switching.
- If you require high throughput, you may need fast switches that use reed-relays or solid-state switches.
- For high accuracy or low-signal-level applications compatible with 4-digit, or better, DMMs, instrumentation switches are required, and Signametrics has them.

If you have Mega Ohm signals you need very low noise and low leakage. Signametrics specializes in this area.

- The relays on switching modules are mechanical devices and are less reliable than electronics. Is the switch designed with some self-test capability to help with troubleshooting? Signametrics switches are designed with extensive self-test.

Why should you care about noise and DC voltage errors?

If they were important wouldn't all the vendors specify them?

The answer is that they are only important in high-accuracy instrumentation applications.

If a switch is not specified for RF isolation, flatness and bandwidth, it probably isn't designed for RF applications. Similarly, if a switch is not specified for noise and DC voltage errors it probably was not designed for instrumentation.

Of course, the salesman will be happy to take your order and he will answer your questions as best he can, but he may have no training in this area.

Where do DC voltage errors come from?

Most switching products use electromagnetic relays to do the switching. Magnetic relays depend on an iron-alloy movable part that is moved by energizing a coil.

That iron-alloy moving part is soldered to a copper wire or circuit board. Iron and copper form a thermocouple with 12 micro Volts/^{O}C output. Most switch modules have a few degrees of temperature difference across the relays. Since multiple relay contacts may be associated with a channel selection, it is not unusual to have a voltage error that is as high as several hundred microvolts. If it is not specified, that means it is uncontrolled. The Signametrics SMX4032 uses special relays and careful circuit layout to keep these errors less than 1 micro Volt.

How do small DC voltage errors become big measurement errors?

Today's Digital Multimeters are capable of making measurements accurate to a few micro Volts, but the wrong switching card can contaminate the signal that the DMM sees. This also applies when you measure resistance. The 4-wire resistance measurement can eliminate errors due to resistance in the measurement path, but it can NOT eliminate DC Voltage errors. Ohms Law tells us that R=V/I. Since most DMMs use a fixed current source to measure resistance, any error in voltage will cause an error in the resistance. To measure 1 Ohm with an uncertainly of 2% (±20m Ohm) using a 1mA test current, you must keep the total thermal voltage error to below 20 micro Volt. Which Means you will need an instrumentation type switch. For an example of such a switch, take a look at http://www.signametrics.com/products/smx4032.htm

How does noise get into a relay switch?

In most switching cards the relay coil is driven directly from the switching power supply that powers the chassis, which also powers the digital logic and is noisy. That noise is easily coupled capacitively and inductively into the signal path (the coil is near the movable part of the relay) unless precautions are taken. The Signametrics SMX4032 uses a high-isolation low-noise power supply and low coupling relays to minimize this noise from the coils. It also optically isolates all control signals from the computer bus.

Where can you get all the information you need?

Talk to multiple vendors about their products. Talk to technical support, not only to the sales person. Consider emailing your questions to techsupport@signametrics.com

Events/Announcements

2/8 - 2/10
APEX 2006
2/27 - 3/3
Measurement Science Conference
5/7 - 5/10
ESTECH 2006
1/17 - 1/19
SMTA Pan Pacific Microelectronics Symposium
1/17 - 1/19
DELTA 2006 - IEEE Workshop on Electronic Design, Test & Applications
1/18 - 1/20
ElectroTest Japan
1/18 - 1/20
InterNepcon Japan
1/23 - 1/25
Lead Free: Myths and Realities

Teradyne Assembly Test Division

Tiepie Engineering

Wavecrest Corp.

WesTest Engineering Corp.

Yokogawa Corp. of America

Z World

Products/Services:

A.T.E. Solutions, Inc.

- Consulting Services
- Consulting, Training and Books
- The Testability Director
- The Testability Director 3.2

Auriga Measurement Systems, LLC

- Microwave/Millimeter Wave Test Systems

Capital Equipment Corporation

- webDAQ/100

CheckSum LLC

- Analyst ems

Digitaltest

- CONDOR MTS500

FEINFOCUS

- COUGAR-VXP

Flynn Systems Corp.

- onTAP® Boundary Scan Software

Geotest Inc.

- ATEasy

GOEPEL electronic GmbH

- SCANPLUS Board Grabber

ICS Electronics

- 488-USB

Intellitech Corp.

- Eclipse
- PT100 Parallel Tester
- PT100 Rack
- Scan-Ring-Linker & multi-PCB linker
- SystemBIST
- SystemBIST

Interpoint Corp.

- LCM120

JTAG Technologies, Inc.

- JT 3710/PXI
- JT 37x7 DataBlaster
- boundary-scan controllers

Norvada, LLC

Professional Testing DBA Pro Test

- Environmental Testing

Quad Tech

- Guardian 1030S Multi-Purpose AC/DC/IR/SC Hipot Tes

Quantum Change, Inc.

- The TILE EMC Software

Ricreations, Inc

- UniversalScan

Signametrics

- SMX2040 series

Symtx, Inc.

SyntheSys Research, Inc.

- BERTScope™ 12500A

Tabor Electronics

- Model 5200 Arbitrary Waveform Generator

Tesla

Articles like this one can help you to know what questions to ask.

Switching Basics in RF Applications

Bob Stasonis, Sales & Marketing Manager, Pickering Instruments and American Society of Test Engineers

Signal Switching, or Signal Management as I like to call it, is needed for many reasons in test – for example, applying power to the Unit Under Test (UUT), connecting loads and sharing resources. The latter is one that initially, in many test engineer's minds, is only considered when multiple UUTs are being tested – test one UUT and switch the test to the next, and so on. But the sharing of resources is almost always possible in a single UUT environment as well.

No matter what the application, the same questions apply in selecting the signal management section of the test system – voltage, power, I/O count, etc. When the application moves into RF and Microwave Applications, additional questions must be answered. In this short article, I'll give you some things to think about.

When selecting switching, there are several questions to ask and parameters to consider:

- **What are the basic parameters?** This includes voltage, current, and bandwidth. Also consider the continuous power requirements.
- **What is the purpose of switching**? That will determine whether basic relays, multiplexers, or a full cross point matrix are required.
- **Be very aware of your entire measurement channel.** This means you must look at the test specifications and the planned measurement path – this included the test fixture, ITA (Interface Test Adapter), cabling, connector types, switching, and the instrument in the path. Too often a test engineer selects an RF/Microwave switch based on the specified insertions losses and does not consider the rest of the measurement path. They find out too late that they should have specified a more accurate switch as the insertion loss of the switch equals the engineering spec for the entire measurement channel!
- **Cascade Effect** – Adding to the above caveat, in large I/O applications, it may be necessary to connect, or cascade, several Multiplexers or Matrices together to get the desired configuration. For example to create a 256 channel multiplexer in PXI, there may be as many as three multiplexers in series to get the configuration necessary. Careful selection of multiplexers and keeping interconnect cables as short as possible is critical to minimize losses here.
- **Cables and Connectors** – where possible, try and specify the connectors to be the same type on both ends. In other words, if the RF Signal Analyzer uses SMA connectors, try and purchase switching with the same type of connector. This makes the purchase of cables easier. Also, in some instances, the connector in question may be optimized for a particular diameter cable. There could be a possibility where the two ends of a cable with different connectors would require different size cables, making the cable build awkward and possibly inadequate for your testing requirements.
- **Accuracy and Switching bandwidth** – If your measurements are at the extreme end of the bandwidth of a switch, you may need to look at a higher bandwidth switch. So if you're trying to measure a 3 GHz signal to an accuracy of 0.5 dB or better, a 3GHz switch may not be adequate. A 4 GHz Microwave switch may be needed.
- **Size** – The higher the bandwidth, the relays required in signal management are physically larger. Also, the interconnections, or "plumbing" as it get's to be in Microwave applications, require more space in order to minimize crosstalk. So your test system size can be greatly influenced by the switching system in high frequency applications.

Sources for RF Switching Knowledge

In order to make you more "dangerous" – more knowledgeable – there are many places to turn for reference material. Several vendors provide reference material. National Instruments, and Pickering Interfaces, for example, offer guides to switching basics. As Pickering's switching information is available in a hard copy, I find it handy when I don't have easy access to the Internet. Typing "RF Switching Basics" into Google provided 178,000 hits! So the information is out there.

Equally important, you should find a vendor with the right products and knowledge who can assist you in your selection. High frequency switching can be somewhat of a "Black Art". So an expert can be helpful.

Hopefully, I've given you some things to ponder. To paraphrase an old axiom, "Your test is only as good as the weakest link". Hopefully, signal management will not be that link.

An Integrated High Power Switching Solution

Jon Semancik, Marketing Manage, VXI Technology, Inc.

Automatic functional test systems often contain an expensive array of instrumentation

2/6 - 2/9
DesignCon

2/8 - 2/10
Semicon Korea 2006

2/13 - 2/16
3GSM World Congress

3/2 - 3/4
Winter Summit 2006

3/5 - 3/10
OFC/NFOEC 2006 by the Optical Society of America

3/6 - 3/10
Test Track at Design, Automation and Test in Europe (DATE 2006)

3/7 - 3/8
MICROTECH 2006, Design, Manufacturing and Test

3/7 - 3/9
EMV 2006

3/26 - 3/31
PCB Design Conference West

3/26 - 3/30
International Reliability Physics Symposium

3/27 - 3/29
International Symposium on Quality Electronic Design

4/3 - 4/6
IEEE Wireless Communications & Networking Conference (WCNC)

4/3 - 4/6
SAE 2006 World Congress

4/4 - 4/6
Aerospace Testing Expo 2006 Europe

4/4 - 4/7
Test & Measurement China

4/9 - 4/12
13th International Test Synthesis Workshop

4/18 - 4/21
IEEE Workshop on Design and Diagnostics of Electronic Circuits and Systems

4/30 - 5/4
24th IEEE VLSI TEST SYMPOSIUM (VTS 2006)

5/2 - 5/4
International Conference on Embedded Technology

5/9 - 5/11
Vision Show East 2006

5/16 - 5/19
AUTOMOTICA

5/16 - 5/17
Boundary Scan Days

5/21 - 5/25
11th IEEE European Test Symposium 2006

5/30 - 6/1
SMT/Hybrid/Packaging 2006--System Integration in Micro Electronics

6/4 - 6/8
Globalcomm 2006

6/6 - 6/8
Sensors Expo

6/11 - 6/16
IEEE MTT-S/International Microwave Symposium

6/11 - 6/14
Southwest Test Workshop (SWTW 2006)

New Definitions

New terms added to the Test Definition section:

arbitration

Asserted

Backplane

Basic Input/Output System

Block-mode Transfer

Bus

Bus Error

Bus Error Signal

Automatic functional test systems often contain an expansive array of instrumentation for stimulus and measurement functions, but the critical link is clearly the switching subsystem. The wide variety of signals that must be routed to a typical unit under test (UUT) requires a flexible switching subsystem that is capable of combining different switch topologies such as multiplexers, matrixes, coaxial, microwave, discrete and power. While many solutions can easily perform low level signal routing, few are capable of integrating high power switching into a single platform without external relays.

High power switching presents several challenges normally not associated with signal level routing such as high current levels, high voltage levels, electrical noise, arcing, and an understanding of what types of signals should be switched. The physical size of high current relays is one example why certain platforms are unable to accommodate these applications effectively. A typical low current 2 Amp relay will occupy a footprint of approximately 0.8" x 0.4" x 0.4", compared with a 25 Amp relay where the footprint will increase to 1.0" x 1.0" x 1.0". The size of interface connector pins and connections from the pin to the relay are also major contributors to the physical design constraints.

Therefore, the high current requirements will drive the density of the solution, and platforms with restricted component surface area will be severely limited in there ability to provide a reasonable density. Certain open architecture solutions, such as the VXIbus provide significant surface area advantages permitting high-current, high-density solutions in a single card slot. For example the SMP2012 switch card, manufactured by VXI Technology, is configured to provide 20 SPST, 30A relays in a single slot.

Switching solutions designed for high voltage present a slightly different challenge. The actual relay is typically not much larger than the 2A relay mentioned above, but surface area again becomes a consideration. If the dielectric constant between adjacent traces or connector pins is exceeded by high voltages, the result will be arching. This arching will depend not only on the physical layout and spacing, but on other operational conditions such as temperature and relative humidity.

Another common issue arises when low level signals are routed through power switches. Power relays are designed with specialized contact material capable of handling the high current flow. As a result a minimum current must flow between the two contacts to cause an arching condition that effectively burns off any oxidation that may have built up; a typical current to ensure operation would be between 100 mA and 1A. Therefore, if low level continuity testing is performed for self-test purposes, this minimum current must be applied. Most power switches are not intended for this dual purpose role.

There are several special purpose relays that are designed to switch both power and signal levels. These relays are typically hermetically sealed to minimize the effects from contamination and oxidation, and utilize a custom contact composition. The physical requirements for this type of high current switch will drive the density of the solution just as before.

Another alternative for high current switching currently available on the market utilizes solid state relays rather than mechanical. One clear advantage of these switches is the infinite switching life resulting from the elimination of mechanical parts or contacts that degrade from actuation. Switching times are generally improved as well; mechanical switching times are approximately 15 mS and solid state actuation is approximately 2 mS. One parameter that must be noted when implementing solid state power switching is the typical leakage current associated with solid state devices. The UUT must be evaluated to determine if the minimal leakage will have any unexpected effects on the test results. Again the VXIbus is ideal for these high current applications and VXI Technology's SMP2104 can be configured to provide 20 SPST, solid state 20A relays in a single slot.

Other essential safety features provided by some manufacturers is a front panel failsafe interrupt. The very nature of the signals being switched dictates that safety should be a fundamental concern. A front panel failsafe interrupt is designed to open all relays automatically if a fault condition occurs. VXI Technology incorporates this feature in the high power SMIP/I switch family.

High power switching requirements pose a challenging implementation problem for most functional test systems, especially when the designer is striving to utilize a common switching subsystem and common software drivers. Analysis of the alternatives will clearly point to the open architecture VXIbus platform as the best all around solution for high-density, high-performance switching. No other platform can match the channel densities, signal variety, and high power capabilities offered by this platform.

Next Issue's Product/Service Focus

In our next issue of Product/Service Focus we will cover **Automatic Test Equipment/In-Circuit Testers**. You can add or upgrade a listing before the next issue comes out.

We now have 2114 test terms in our Test Definition section.

Share your definitions with the test community.

If you would like to include an exclusive article on how to best select **Automatic Test Equipment/In-Circuit Testers**, please contact LouisUngar@ieee.org.

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