SMART DEVICES REQUIRE SMARTER AUTOMATED TEST SYSTEMS
Choosing a Switching Architecture
Switching Architectures

- No Switching
- Switching in Test Rack Only
- Switching in Test Fixture Only
- Switching in Test Rack and Test Fixture
No Switching

- One UUT channel per instrument
- Optimizes throughput and signal integrity
Switching in Test Rack Only

- Multiple UUT channels per instrument
- Optimizes cost and flexibility
Switching in Test Fixture Only

- Multiple UUT channels per instrument
- Optimizes signal integrity in switched systems
Switching in Test Rack and Test Fixture

- Optimizes signal integrity and flexibility in switched systems
## Switching Architecture Overview

<table>
<thead>
<tr>
<th></th>
<th>Flexibility</th>
<th>Throughput</th>
<th>Cost</th>
<th>Low-Level Measurements (mV, µA, mΩ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Switching</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Switching in Test Rack</td>
<td>☐</td>
<td>☐</td>
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<td>☐</td>
</tr>
<tr>
<td>Switching in Test Fixture</td>
<td>☐</td>
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<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Switching in Test Rack and Fixture</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
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</tr>
</tbody>
</table>
Choosing a Switch Topology
General Purpose Relays

- Connect ‘poles’ to ‘throws’

<table>
<thead>
<tr>
<th>FORM</th>
<th>TASK</th>
<th>OPEN</th>
<th>DURING OPERATION</th>
<th>OPERATION COMPLETE</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>Form C</td>
<td><img src="image" alt="Form C Diagram" /></td>
<td><img src="image" alt="Form C Diagram" /></td>
<td><img src="image" alt="Form C Diagram" /></td>
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<tr>
<td></td>
<td>N.C.</td>
<td>COM</td>
<td>N.O.</td>
<td>N.C.</td>
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<tr>
<td>B</td>
<td>Form D</td>
<td><img src="image" alt="Form D Diagram" /></td>
<td><img src="image" alt="Form D Diagram" /></td>
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<td></td>
<td>N.C.</td>
<td>COM</td>
<td>N.O.</td>
<td>N.C.</td>
</tr>
</tbody>
</table>
Multiplexers

- Connects one DUT channel to an instrument (or vice versa)
Single-Wire Measurements

- Shared ground reference for all channels
Multi-Wire Measurements

- Multiple wires per channel
Multiplexer Expansion

- Connect COMs to form larger muxes or sparse matrices
RF Multiplexer Expansion
Matrices

- Connect any DUT channel to any instrument or another channel

```
C0  C1  C2  C3  C4
R0
R1
R2
R3
```
Matrix Expansion

- Connect rows and/or columns to create larger matrices
DEMO: Matrix Expansion
# Matrix Optimization

- **Arrangement #1**
  - Instruments on rows
  - Channels on columns

- Optimizes test time
- Increases cost
Matrix Optimization

- Arrangement #2
  - Instruments and channels on columns
- Optimizes cost
- Increases test time
Choosing a Relay Type
Relay Types

- Armature Relays
- Reed Relays
- Solid State Relays (SSRs)
- Field Effect Transistors (FETs)
Armature Relays

- Optimize signal power and signal integrity
- Slow actuation and short lifetime
Reed Relays

- Optimize package size
- Average switch speed/lifetime and signal power/integrity
Solid State Relays

- Optimize package size and lifetime
- Average speed and signal power/integrity
Field Effect Transistors

- Optimize package size, speed, and lifetime
- Low signal power
# Relay Type Overview

<table>
<thead>
<tr>
<th>Capability</th>
<th>Armature</th>
<th>Reed</th>
<th>FET</th>
<th>SSR</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-Power</td>
<td>●</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>High-Speed</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Small Package Size</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Low Path Resistance</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Low Thermal Offset</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Extended Lifetime</td>
<td>○</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
DEMO: Increasing Switch Throughput
Switch Handshaking Demo
Mass InterConnect and Fixturing Considerations

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Virginia Panel Corporation
Business Development Manager
jhopp@vpc.com
Advance planning and thorough design consideration can improve the overall test experience with a Mass InterConnect solution for the life of the deployed Automatic Test Equipment (ATE).

Dedicated to providing solutions for:
What is Mass Interconnect?

- Receiver
- ITA
- Cable Assembly
- UUT (Unit Under Test)
- Test Equipment
Mass InterConnect Components

INTERCHANGEABLE TEST ADAPTER (ITA)

RECEIVER

ENCLOSURE

ITA PATCHCORDS

ITA MODULES

RECEIVER

RECEIVER MODULE

CABLE ASSEMBLY

RECEIVER PATCHCORDS
Creating Order Out of Wiring Chaos

From Chaos.....

To Order....
Why a Mass InterConnect?

- Frequent DUT/UUT Changeover
- Cable Management Issues
- Intense Mating Cycle Requirements
- Pairs well with switching
- Connects to peripheral/auxiliary resources
VPC Maximizes ROI for Test Assets

One-to-Many Test Configuration. A single receiver module configuration can be used to test multiple units under tests.
Choosing the Right Solution Design

1. Define System Hardware
2. Determine Resources to Route from the ATE to the Test Interface
3. Define Cable I/O Structure Based Upon Test Requirements
4. Determine if a Mass Interconnect is Suitable for Your Application
5. Use Cable Assemblies
6. Cables and/or PCBs
7. Determine Mass Interconnect Approach
8. Choose Mounting Hardware
9. Install Interface Components
10. Define Fixture Requirements
Choosing the Right Solution Design

CHOOSE CONNECTION TYPE

CABLES

HYBRID

PCB

Cable Solutions

PCB Adapter Solutions

Pull-Thru Adapters
## Choosing the Right Solution Design

<table>
<thead>
<tr>
<th>Feature</th>
<th>CABLES</th>
<th>MASS INTERCONNECT WITH CABLES</th>
<th>MASS INTERCONNECT WITH PCBS OR FLEX CIRCUITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent Changeover Between DUTs</td>
<td>⬜️</td>
<td>⬜️</td>
<td>⬜️</td>
</tr>
<tr>
<td>Optimized for Design and Characterization</td>
<td>●</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Optimized for Verification and Validation (V&amp;V)</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Optimized for Test Production</td>
<td>○</td>
<td>○</td>
<td>●</td>
</tr>
<tr>
<td>Signal Quality</td>
<td>◐</td>
<td>◗</td>
<td>◗</td>
</tr>
<tr>
<td>Continuity of Performance (System to System)</td>
<td>○</td>
<td>◗</td>
<td>◗</td>
</tr>
<tr>
<td>Ease of System Maintenance and Upgradability</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>System Reconfiguration (vis-à-vis Scalability)</td>
<td>○</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Ease of Duplication (vis-à-vis Global Deployments)</td>
<td>○</td>
<td>◗</td>
<td>◗</td>
</tr>
<tr>
<td>Instrument to Module Pin Efficiency</td>
<td>○</td>
<td>●</td>
<td>◗</td>
</tr>
<tr>
<td>Repairability in the Field</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
<tr>
<td>Instrument Card Rev. Control Tolerance</td>
<td>●</td>
<td>●</td>
<td>○</td>
</tr>
</tbody>
</table>
Choosing the Right Solution Design

- Flexible
- Rugged and Easily Duplicated

- DESIGN AND CHARACTERIZATION
- VERIFICATION AND VALIDATION
- PRODUCTION TEST
Choosing the Right Solution Design

“Help Me Avoid This Test Nightmare”
Configuring a Mass InterConnect Solution

1. Select your card’s manufacturer
2. Select your instrument card
3. Select your preferred solution design

Solution designs are a complex as a customer requires. Engage an expert early in the design process for suggestive guidance.

Solutions are already available for a wide array of instrument cards on vpc.com
Choosing the Right Solution Design

“Help Me Avoid This Test Nightmare”
Sample Wired Solution – NI PXIe-2527
Application Examples

Cabled 12 Module Solution with Slide Mount Kit
Application Examples

PCB Direct Connection to Instrument Card
Application Examples

High I/O Example
50 Module Solution

National Instruments
VPC is a proud member of the PXI System Alliance and partners with more than 25 card companies.

Customers can use our Mass InterConnect products regardless of their PXI module vendor.
New PXIe Tech and Solutions

VPC is continually improving technology and design to keep up with the demands of new high speed digital PXI modules:

- PXIe-6591 (High Speed Serial Module) – 10.31 Gbits/s
- PXIe-6592 (High Speed Serial Module) – 12.5 Gbits/s
- PXIe-7902 (High Speed Serial FPGA Module) – 12.5 Gbits/s
New PXIe Tech and Solutions

- Modular PCB
- Strain-relieved
- Intermixed with patchcords
- Compatible with numerous COTS high speed protocols

Blank Inserts for Module Spacing

VTAC Right Angle Retention Insert

VTAC Pass-Thru Insert

VTAC Right Angle Insert

Cat 6
New PXIe Tech and Solutions

VTAC Pass-Thru Insert

Retention Bracket

USB 3.0

VTAC Right Angle Insert
Let’s continue the conversation!

Come by the exhibit hall and visit booth #318A to discuss your future test project.
SMART DEVICES REQUIRE SMARTER AUTOMATED TEST SYSTEMS
Further **Resources**

- Fundamentals of Building a Test System
  - Example topics:
    - **Switching and Multiplexing**
    - **Mass Interconnect & Fixture Considerations**
    - Modeling the Total Cost of Ownership (TCO) of a Test System
    - Test Executive Software
    - Hardware and Measurement Abstraction Layers
    - Rack Layout and Thermal Profiling
    - Software Deployment
    - Test System Maintenance

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