

Adopting the PXI Architecture for Semiconductor Test Applications

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Agenda

- Marvin Test Solutions background
- Semiconductor market and trends
- PXI for semiconductor test
 - PXI background & market
 - System power requirements
 - UUT interfacing
 - Software
 - Digital subsystem requirements

Marvin Test Solutions

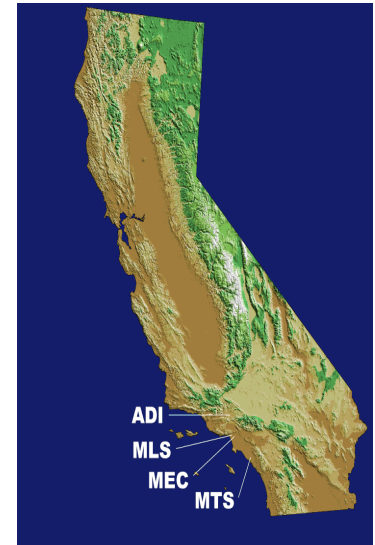
New Name / Same Aim

- Formerly Geotest – Marvin Test Systems
 - Simplified name strengthens the company's association to The Marvin Group, known for its 50-year history in aerospace, and our focus on test solutions
- Continued focus providing innovative products and solutions, coupled with the excellent, long-term support we are known for
- Vertically integrated test company that addresses test challenges without compromise



Part of The Marvin Group

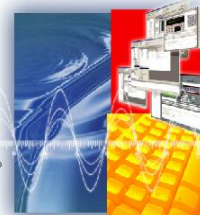
- Established in 1963, the Marvin Group is an aerospace firm with five main divisions, all located in Southern California
- Privately owned U. S. corporation
- Over \$380M in sales in 2012 and a current funded backlog of over \$1.6B USD
- More than 1200 employees
- Established supplier to the commercial and military aerospace markets world-wide



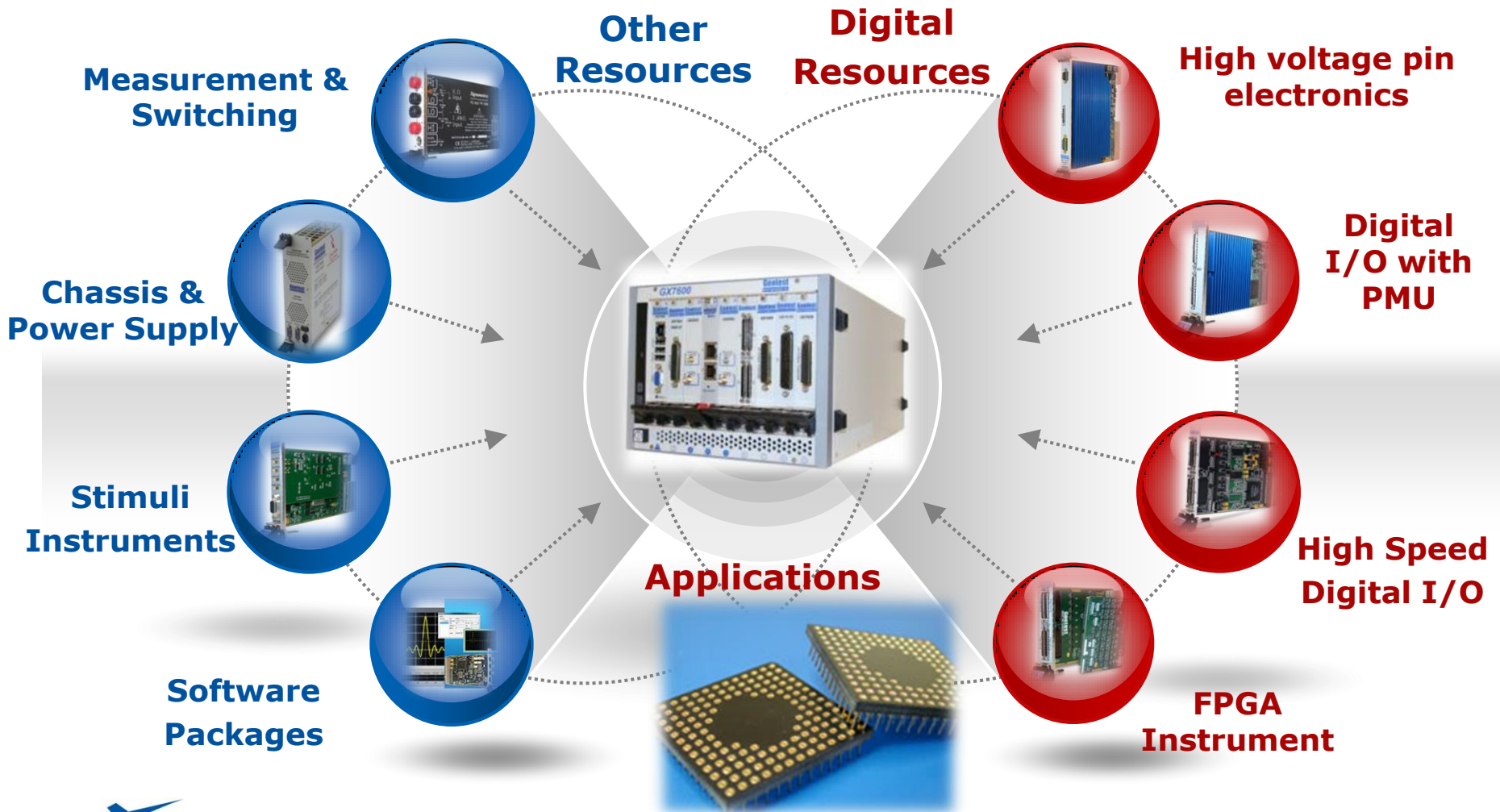
The
Marvin Group

Products

- PXI Products
 - Over 200 PXI and PXIe products including chassis, controllers, and mixed signal test instruments
 - Specialized, ATE-focused products and custom instrumentation
- Preconfigured PXI systems for functional and semiconductor test applications
- Software Products
 - Test Executive (**ATEasy**)
 - Importing & converting STIL, WGL, VDC/EVCD files (**DIOEasy-FIT**)
 - Vector editor (**DIOEasy**)
 - Analog waveform editor (**WaveEasy**)
 - Laser Post Processor (**DtifEasy**)



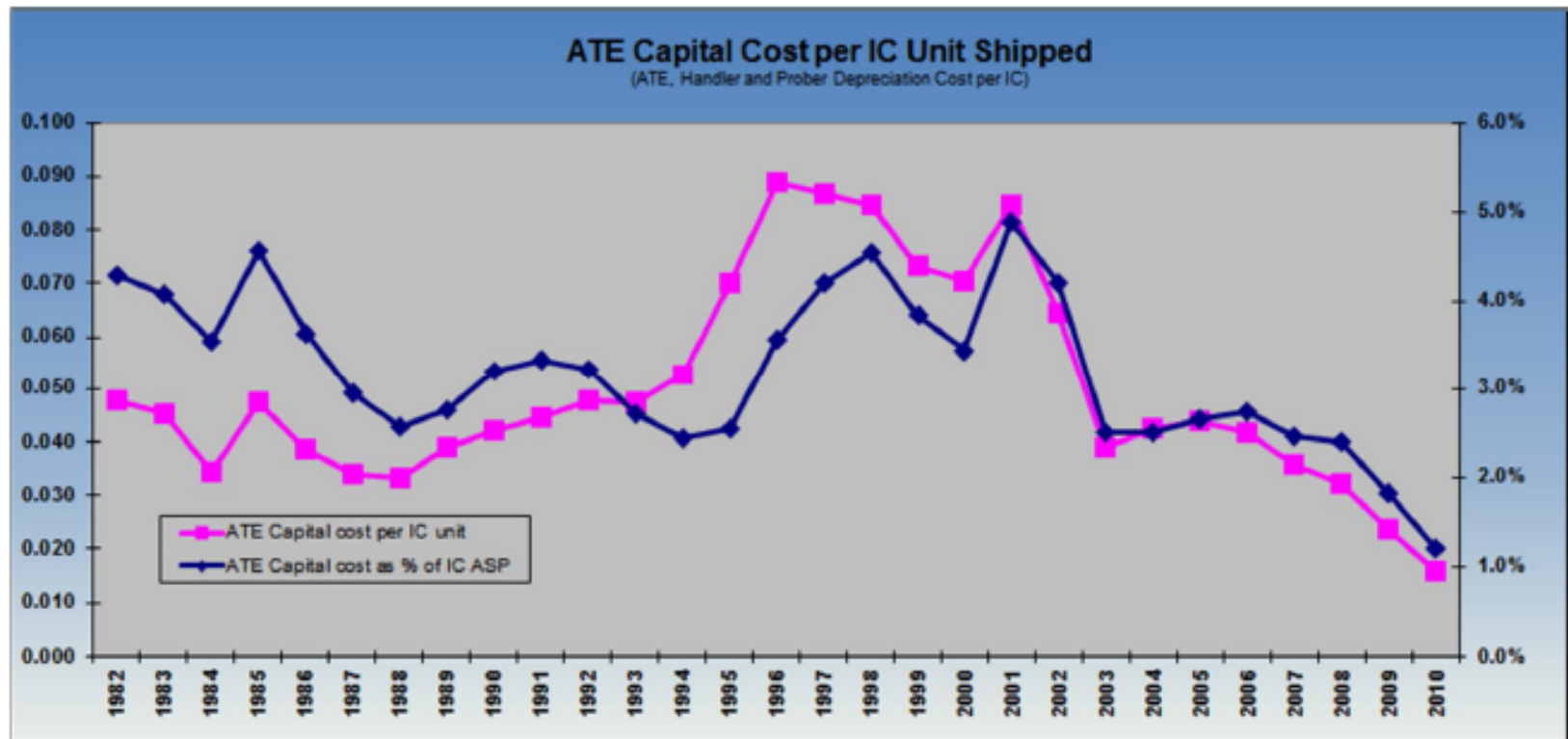
PXI Product Portfolio



Semiconductor Market & Trends



- OEMs, packaging / test vendors & fabless semiconductor vendors need to lower their test costs
- Test share of IC cost continues to decline
- PXI capabilities: Flexible and cost effective solutions for digital , mixed-signal, and RF test



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Semiconductor Test Requirements



Tests Requirements	Prototype, Pilot Phase:, Design Verification Tests, Failure Analysis	Production Test: Test for process induced faults
Functional	Extensive, multiple files / vectors	Limited, test time constrained
DC parametric	Limited or complete test, depending on customer / application	All pins checked for DC parameters
Performance vs. power supply, temperature and data rate	Extensive	Limited, "corner cases" checked at ambient temperature only
Test throughput	Minutes to hours, single device testing	Seconds, may require multi-site testing
Devices tested / characterized	10's to 1000's	1000's to millions
Test system & cost	PXI-based ATE \$50K - \$100K typical	Production IC Test System \$500K and up

Primary focus

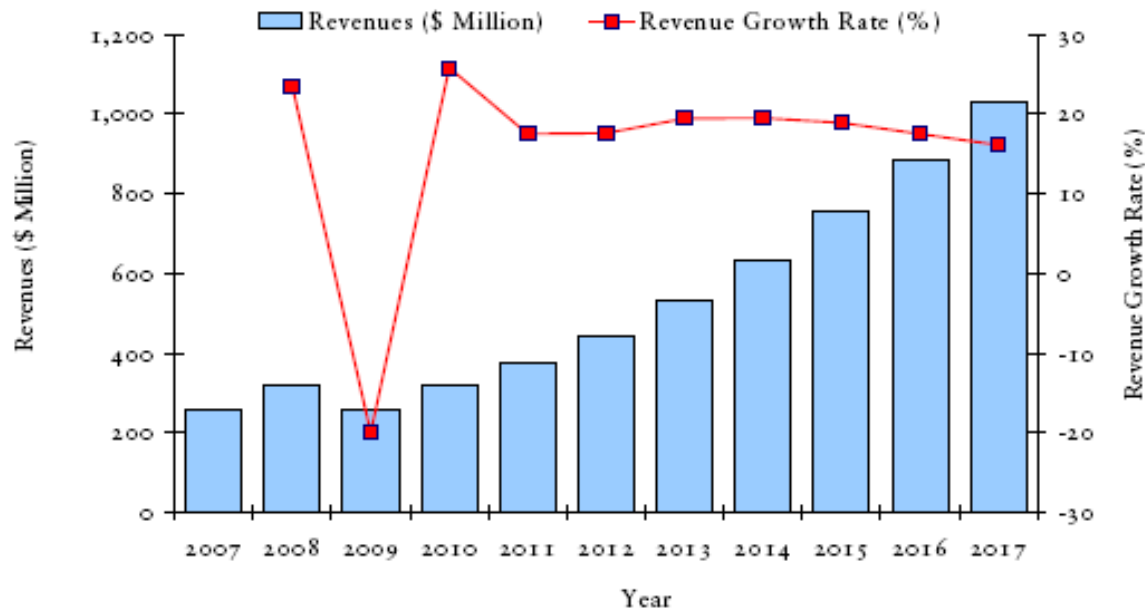
Why PXI for Semiconductor ATE?

- Cost effective
- Product capabilities: high performance instrumentation and bus bandwidth
- Flexible & robust open architecture
- Wide market adoption – drives product development and pricing



PXI Market Growth

- >18% CAGR from 2010 – 2017
- \$1B in revenue by 2017

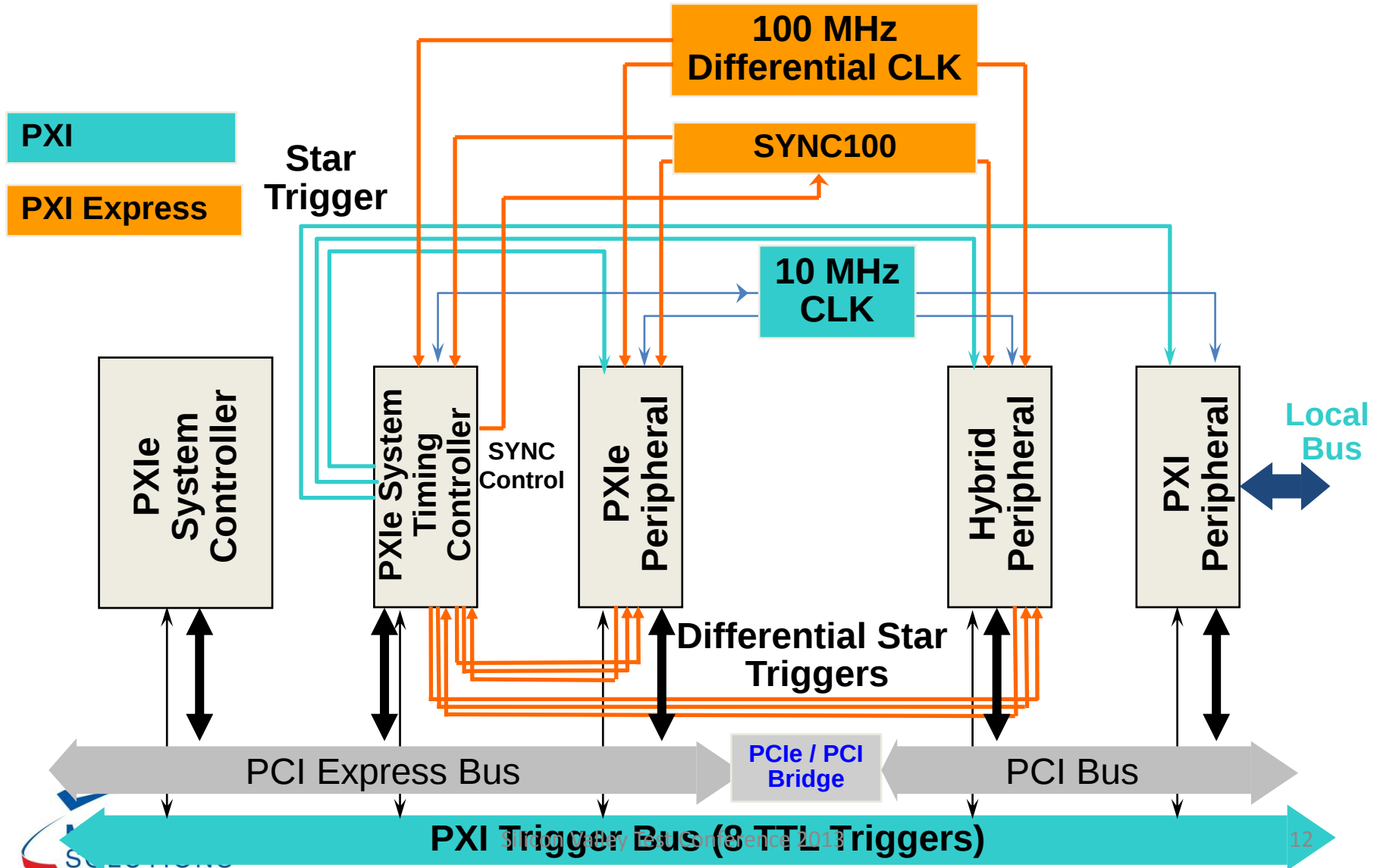


Frost and Sullivan, 2011
% growth based on 2010 as base year

PXI Architecture – A Robust Standard for ATE

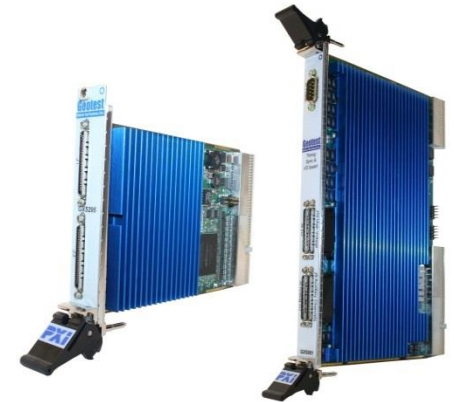
- Timing / Synchronization
 - Triggering and clocking resources for coherent mixed signal testing
- Flexible / high performance architecture
 - 2 GB/s data rate per slot
 - Peer to peer communication for high speed data processing
 - High power / high density platform - “high functional density”
- Software – Flexibility & Open Architecture
 - Windows based environment supports many APIs -COM, VB, LabVIEW, .Net, C, etc.
 - Users can select from off the shelf test executives or create their own
 - Third party and OEM software tools for importing digital test vectors – i.e. STIL, WGL, VCD

PXI & PXI Express Architecture



PXI System Power

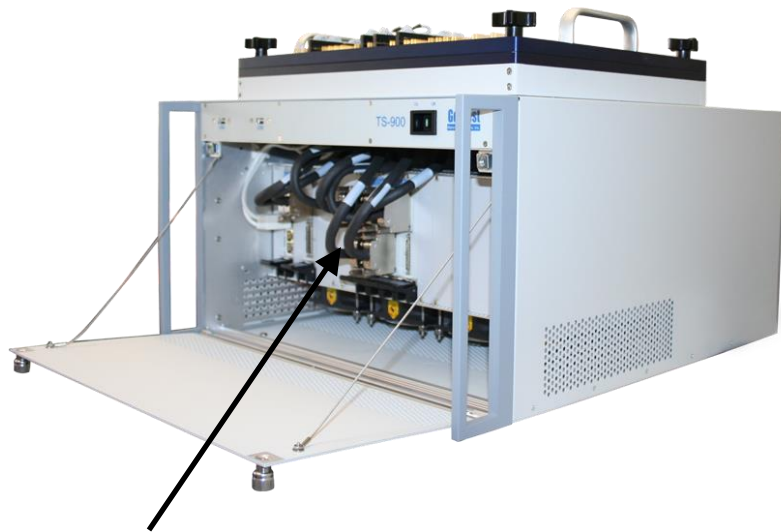
- PXI is limited to 30 watts per slot – True or False?
 - A PXI chassis MUST supply AT LEAST 25.6 watts per slot
 - There is no specific limit about maximum dissipation or thermal management requirements for a PXI chassis!
 - The electrical limit for power per slot for a PXI card is 125 watts
 - ✓ The challenge is thermal management
- PXI performance digital:
 - 3U PXI digital I/O cards offer 32 channels with PMU
 - Maximum dissipation: 60 watts
 - High power PXI chassis provide the power and cooling for 512 I/O channels



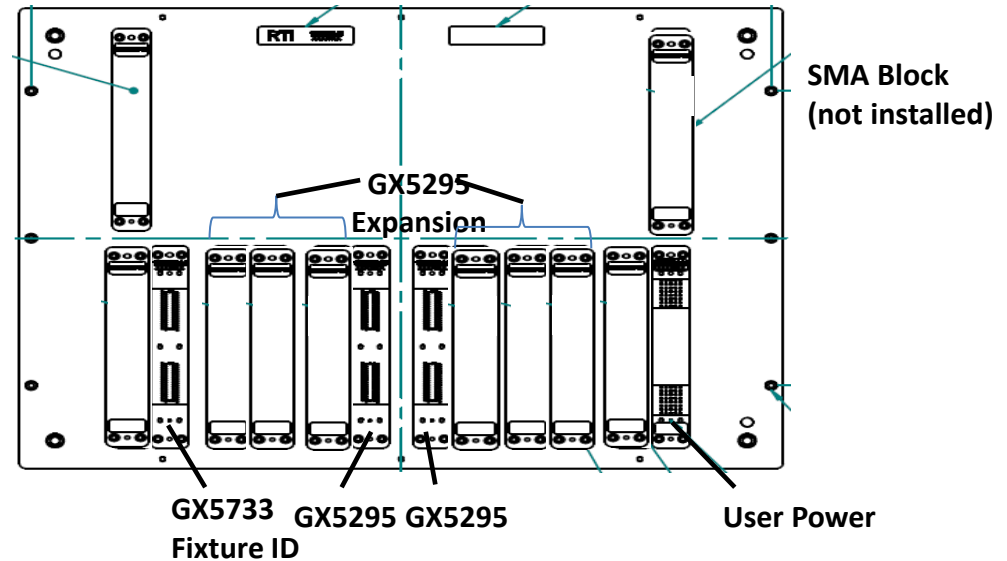
Instrument / UUT Interface

- The challenge: Interfacing PXI instrumentation to a performance “ATE-like” test interface
- Requirements:
 - Controlled impedance
 - Modular / flexible / expandable, customer configurable
 - Accommodate digital, analog, RF
- Ability to retain existing investment in DUT or personality interface boards

Modular Receiver



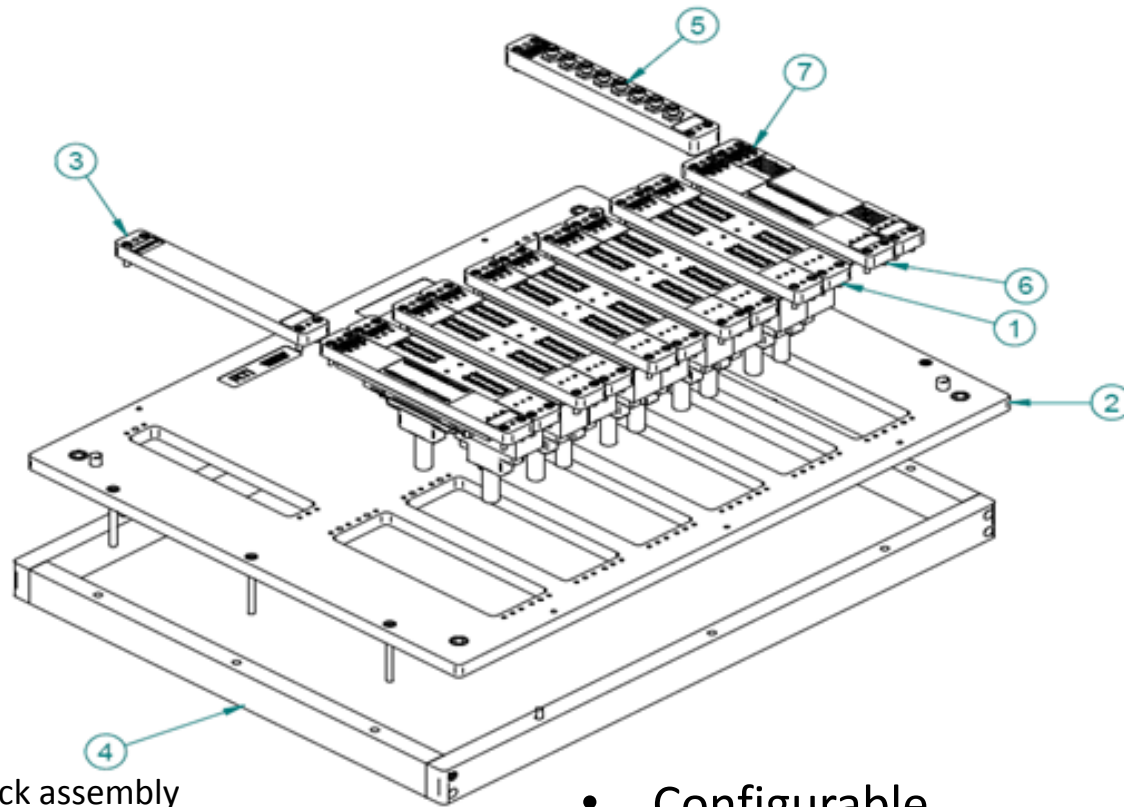
Cabled / connectorized
interface to receiver
blocks



Modular pin blocks,
field configurable



Modular Receiver Details

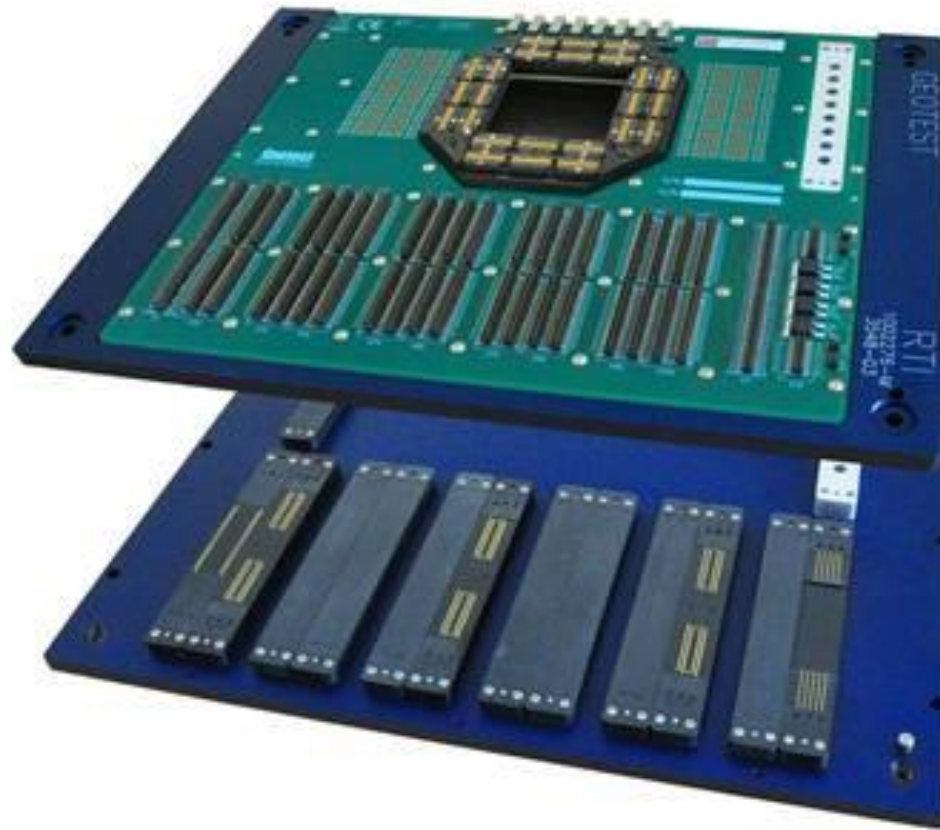


- Item 1: VHDC pin block assembly
- Item 2: Receiver plate
- Item 3: Blank pin block
- Item 4: Receiver frame
- Item 5: SMA connector block
- Item 6: DB78 pin block assembly
- Item 7: DB25 (UUT power) pin block assembly

- Configurable
- Can be upgraded in the field
- Supports up to 512 digital channels
- Blind mate RF option
- Handler compatible option

Load Board Example

Sentry DUT Board Converter

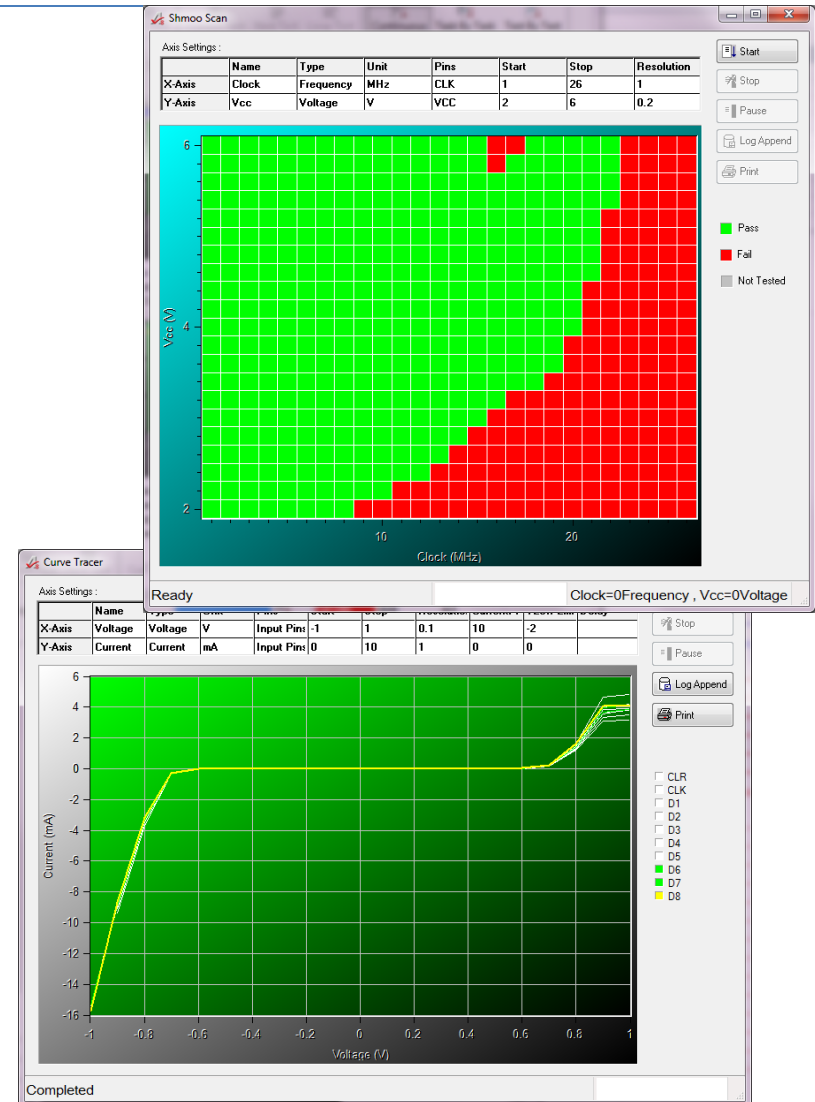


Software for Semiconductor Test

- Windows based PXI architecture supports a range of programming environments
 - C, C++, .NET
 - LabWindows
 - LabVIEW
 - ATEasy
- Specific semiconductor test tools:
 - Test library for DC parametric tests
 - Shmoo and I-V curve plotting
 - Digital vector importing for STIL, WGL, VCD, etc.

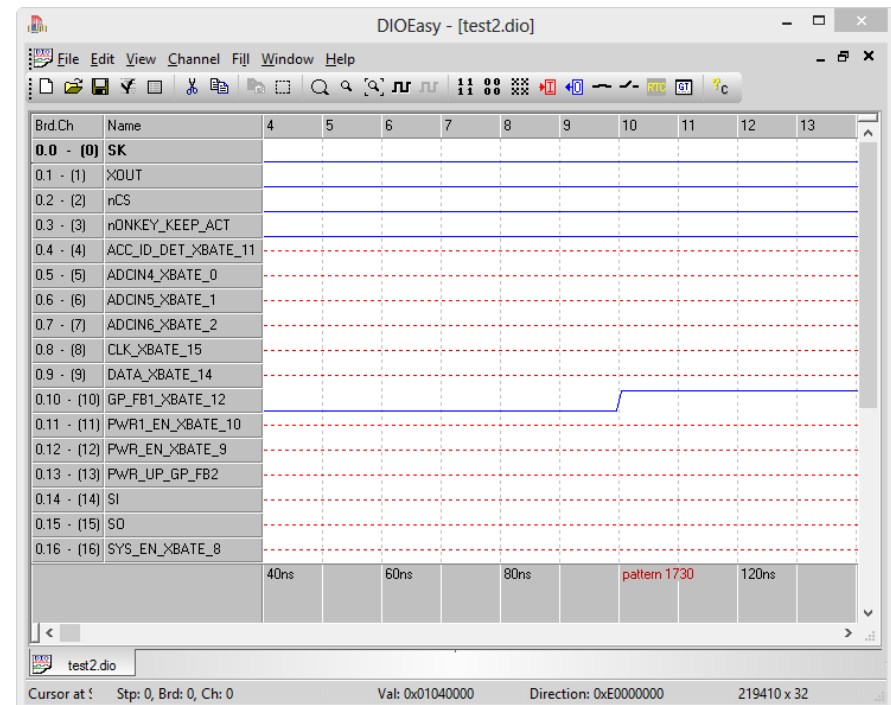
Semiconductor Test Software Features

- Device Pin and Pin group mapping capability – simplifies test program development and reuse
- Pre-defined DC Parametric tests – simplifies test program creation
 - Open and Shorts
 - Input Leakage (IIL, IIH)
 - Input Voltage Threshold (VIH, VIL)
 - Output Short Circuit (IOSH, IOSL)
 - Output Voltage Threshold (VOH, VOL)
 - Power Consumption (IDD, IDDQ)
- Shmoo test capability - Automated and Interactive
- I-V Curve test capability - Automated and interactive Tool



Digital Waveform Display & Edit

- Graphical interface and waveform display / edit / compare software tools
- File Import Option:
 - Import WGL, STIL, VCD/eVCD vectors
 - Pin Remapping capability
 - Include /Exclude pins
 - Automated conversion profiles
- Panel application offers interactive control of digital instruments



PXI Products for Semiconductor ATE - Digital Test

- Multiple vendors offering performance digital instrumentation
- 200 MHz vector rate with PMU per pin and per pin programmability
- High channel density: 32 channels per card, 512 channels in a single 3U PXI chassis
- Cost effective: \$250 / channel
- User FPGA cards for custom interfaces



PXI Digital Instrumentation for Parametric and Functional Test

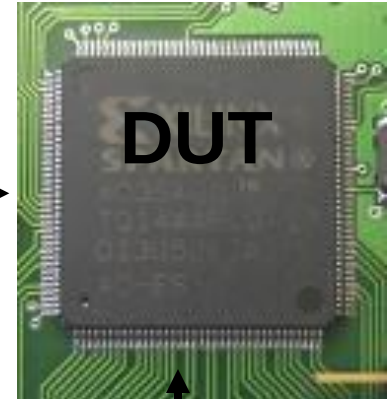


Digital
Instrument
• 100MHz

Multiplexer /
Switch

PMU or SMU
(Source / Measure Unit)

- -2 to +7 Drive / Sense
- Terminations: PU / PD
- 3 state drive
- Real time compare



Power
Supply



GX5295

- **Combining the digital and PMU :**
 - **Faster test time**
 - **Lower cost**
 - **Eliminates switching**

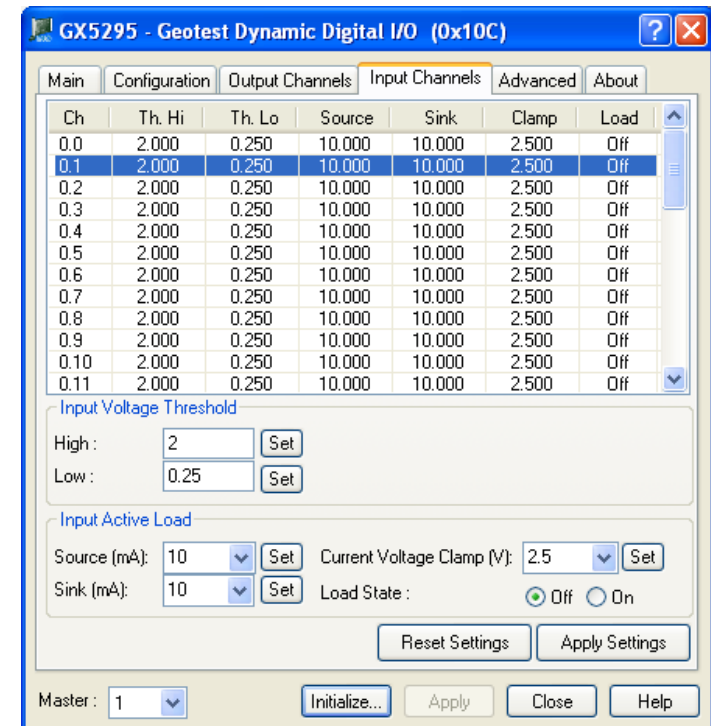


- Timing per pin with multiple time sets
 - Simplifies vector import / conversion process
 - Enhanced capability for AC device characterization
 - Simplifies bus emulation / device timing
- Data formatting
- More flexible sequencer



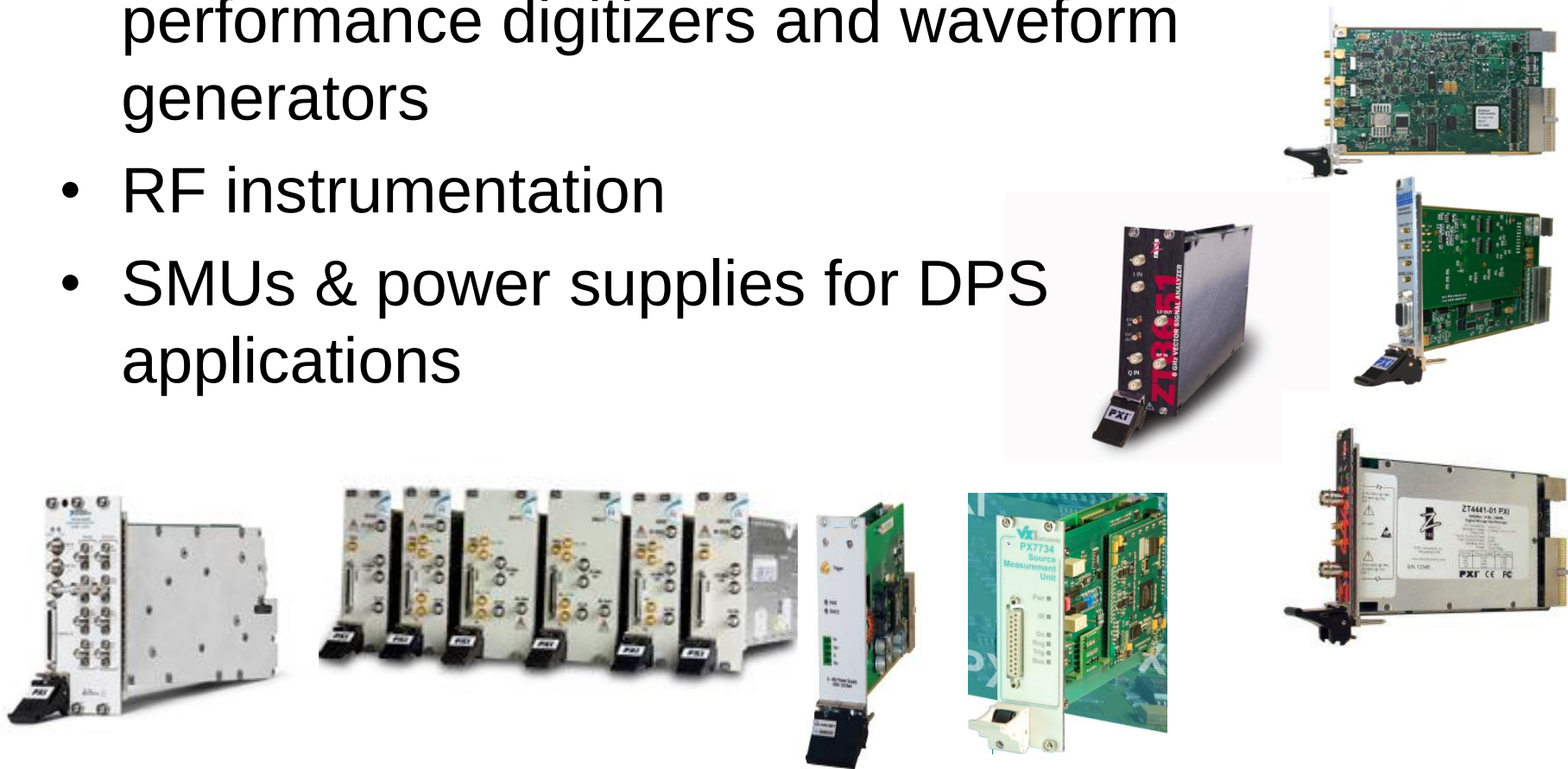
Semiconductor Test – Using PXI Instrumentation

- Verify functionality
 - Generate or import test vectors
 - Test vectors can be large (megabytes) - requires deep memory
- Verify DC parameters
 - Opens / shorts test – verifies fixture / UUT connection
 - Input and output characteristics
 - Sink / source currents and voltages for all signal pins
- Maximize test throughput
 - Real-time compare for digital test
 - “Per-pin” DC measurement (parametric measurement unit or PMU)



Other PXI Products: Analog & RF Instrumentation

- Multiple vendors producing high performance digitizers and waveform generators
- RF instrumentation
- SMUs & power supplies for DPS applications



Example PXI System

Complete system for device test:

- User supply
- 64, 100 MHz digital channels (expandable to 512) with PMU per pin
- 64 static digital channels
- Vector conversion tools & test executive
- Receiver interface with self-test
- High power chassis



Assessment Summary:

Using PXI for Semiconductor ATE



Feature	Performance / Capability	Comments
Digital test	Good, support for up to 512 channels in one chassis	Trend is to higher performance digital products with better timing resolution / performance & lower cost
Analog	Good / Excellent, voltage output can be a limitation	Trend is to more features and performance
RF	Good / Excellent, processing moving to on-instrument	Products rival box instrumentation specs
Software tools	Fair / Good, closed vs. open architecture challenges suppliers	Vendors working to improve usability and efficiency of program development
SMU / DPS	Fair / Good, low current measurements are a challenge	Current capability is limiting for some applications

Summary

- PXI products and systems offer a cost effective platform for semiconductor test
 - Open hardware and software architecture
 - Access to a broad portfolio of PXI products from multiple vendors
- Market acceptance and adoption of PXI is driving product advancements for semi and other markets
- FA, verification and fabless semiconductor users see PXI as a viable, cost effective solution for ATE



Thank You!



- Discussion / Questions

