Cloud Testing Service
External Power Supply Control

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Outline

• Existing Verification Environment @Xilinx

• Cloud Testing Service Approach

• Power Control Requirements

• Power Supply Control Implementation

• Xilinx-CTS Collaboration

• How “The New Pattern Verification” Environment Works

• Next Steps, Q&A and Wrap-up
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Existing Evaluation Environment @Xilinx

- Remote Log-in to Mother Board Computer from User PC’s.

- Operating System on Mother Board is Linux

- Mother Board issues Commands/Script for controlling Mother Board
  - HW Resources (Digital Pins, Pattern Execution)
  - Power Supply Units
  - Capture PASS/FAIL Result, Power Supply Current, etc.

- Does not use PMBus I/F connector on the Mother Board.

- There are two types of Power control device via PMBus on Mother Board
  - Device A → Voltage Regulator
  - Device B → Current Measurement
Existing Evaluation Environment

A). Control H/W resources
B). Capture Results
C). Control External Power Supply

Remote Log-in

Power Supply Unit
Ex). 12V@100A
Next Gen Device Evaluation Needs

• Faster Pattern Execution

• Capability to Shmoo Power vs Frequency

• Easy Failure Analysis with LVP (Laser Voltage Prober)

• Modify Timing Levels & Pattern to Debug DUT

• Easy Maintenance of Hardware
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Cloud Testing Service – HW Concept

ATE + Bench + **Test SW IP = CTS**
All-in-one
CloudTesting™ Station CX1000P

- Instrument
- Power Supply
- Device & Vector Generator
- Signal Generator
- Digital Multi Meter
- External Instruments
- LabVIEW/GPIB/I2C/PMBus
- External Modules
Cloud Testing Service - Usage

1. Download IPs for a monthly fee
2. HW provided free with rental contract
3. Buy your cables and DUT I/F
4. Ready to test in a few hours
CTS – Hardware Models To Choose From

CX1000P

- I/O: 32ch
- DPS: 2ch
- PMU: 1ch
- AWG: 1ch
- DGT: 1ch
- RVS: 2ch

CX1000D

- I/O: 128ch
- DPS: 8ch
- PMU: 4ch
- AWG: 4ch
- DGT: 4ch
- RVS: 8ch

CX1000D S2-LINK

- I/O: 256ch
- DPS: 16ch
- PMU: 8ch
- AWG: 8ch
- DGT: 8ch
- RVS: 16ch

1. Small Footprint
2. Air Cooled
3. Office Power Outlet
   100V-240V
4. Configurable Architecture
   • MCU
   • FLASH
   • ........
### Flash Memory Test (Firmware Upgrade)

#### CX1000P
- I/O: 32ch
- DPS: 2ch
- PMU: 1ch
- RVS: 2ch
- ALPG: 200/400 Mbps

#### CX1000D
- I/O: 128ch
- DPS: 8ch
- PMU: 4ch
- RVS: 8ch
- ALPG: 200/400 Mbps

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**[To access entire address space of memory card]**
- Read/Write the memory at max rate of 400 Mbps.
- The ALPG is compatible with Advantest memory tester T5xxx.
- Test any size memory by single data path.
- Built-in Source Synchronous Test capability.

**[Failure analysis environment for memory has]**
- 32 GB of failure analysis memory.
- Generates CRC for SD card and MMC.
- Drive/compare 1MB of random and deterministic data.
- Test/Skip failing blocks of Flash memory.
Interactive GUIs Connecting Everything

CAD/CAE Data

1st Silicon Test Chip

ATPG

STILReader/STILWriter/CATVert

Pattern Viewer Tool

Logic Analyzer Tool

SHMOO Plot Tool

Oscilloscope Tool

Download IP’s (Plug-In)

Analysis Tool Linkage

Testing IP’s in Cloud

Platform IP Measure Algorithm IP’s

Debugging

Pattern Pin Mapping Pin Condition
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Power Control Requirements

• Integrate PMBus I/F protocol in CX1000D system
  - Two new custom software for controlling the external power supply via I2C I/F
    • Define Voltage condition parameter via PMBus command
    • Check PMBus status via PMBus Command

• Implement PMBus alert signal to check using LED circuit on I/F Board.

• Implement voltage regulator power on/off via external relay unit.

• Support voltage regulator devices control via PMBus I/F.

• Provide Seamless GUI For Power vs Frequency Shmoo
What’s PMBus?

PMBus

<table>
<thead>
<tr>
<th>Items</th>
<th>Value</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revision</td>
<td>Rev 1.2</td>
<td>Based on PMBus 2.0</td>
</tr>
<tr>
<td>Clock Speed</td>
<td>100KHz</td>
<td>CX1000D has 100KHz I2C I/F</td>
</tr>
<tr>
<td>Pin Count</td>
<td>PMBCLK, PMBDATA, PMBALERT, PMBCtrl</td>
<td>I2C SCL, I2C SDA</td>
</tr>
<tr>
<td></td>
<td>Control On/Off via Relay on Mother Board</td>
<td></td>
</tr>
</tbody>
</table>

Command Lists

<table>
<thead>
<tr>
<th>CLEAR_FAULTS</th>
<th>IOUT_CAL_GAIN</th>
<th>POWER_GOOD_ON</th>
<th>READ_VOUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOUT_COMMAND</td>
<td>VOUT_OV_FAULT_LIMIT</td>
<td>POWER_GOOD_OFF</td>
<td>READ_IOUT</td>
</tr>
<tr>
<td>VOUT_TRIM</td>
<td>VOUT_UV_FAULT_LIMIT</td>
<td>STATUS_WORD</td>
<td>READ_TEMPERATURE_1</td>
</tr>
<tr>
<td>VOUT_MAX</td>
<td>IOUT_OC_FAULT_LIMIT</td>
<td>STATUS_VOUT</td>
<td>READ_TEMPERATURE_2</td>
</tr>
<tr>
<td>VOUT_MARGIN_HIGH</td>
<td>VIN_OV_FAULT_LIMIT</td>
<td>STATUS_IOUT</td>
<td></td>
</tr>
<tr>
<td>VOUT_MARGIN_LOW</td>
<td>VIN_UV_FAULT_LIMIT</td>
<td>STATUS_INPUT</td>
<td></td>
</tr>
<tr>
<td>FREQUENCY_SWITCH</td>
<td>TON_DELAY</td>
<td>STATUS_TEMPERATURE</td>
<td></td>
</tr>
<tr>
<td>VIN_ON</td>
<td>TON_RISE</td>
<td>STATUS_CML</td>
<td></td>
</tr>
<tr>
<td>VIN_OFF</td>
<td>TOFF_DELAY</td>
<td>STATUS_OTHER</td>
<td></td>
</tr>
<tr>
<td>INTERLEAVE</td>
<td>TOFF_FALL</td>
<td>READ_VIN</td>
<td></td>
</tr>
</tbody>
</table>
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• **Power Supply Control Implementation**

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CTS Xilinx Collaboration

• Software High Level Spec – Xilinx + CTS

• Interface Board Design & Fab - Xilinx.

• PMBus IP Design & Implementation – CTS.

• Bring up of Test Flow – Xilinx + CTS.
Software Specification

<table>
<thead>
<tr>
<th>Test Item</th>
<th>IP Name</th>
<th>Type</th>
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<tbody>
<tr>
<td>1 Power Sequence Control for Built-in Power Supply Units</td>
<td>“RelayControl_IP”</td>
<td>Standard IP</td>
</tr>
<tr>
<td>2 Power Supply Units Parameter Setting</td>
<td>“XLNX_conditionSetting_IP”</td>
<td>Custom IP</td>
</tr>
<tr>
<td>3 Power Supply Units Status Read</td>
<td>“XLNX_statusRead_IP”</td>
<td>Custom IP</td>
</tr>
<tr>
<td>4 Continuity Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Function Test</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1. Required all of Power Supply Unit pins are opened.
*2. Shmoo execution is available on this IP's
PMBus Command, the execution sequence

Start

Initialize I2C Bus I/F in CX1000D

Loop Start

CLEAR_FAULT

PMBus Command Execution

Loop End Each PMBUS device

End

Start

Write Parameter value

PMBus Status Check

Pass

Read Parameter value

Write value is correct?

Pass

FAIL

PASS

Return

Stop

Each PMBUS device

Write value is correct?

Pass

FAIL

PASS

Return

Stop
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CX1000D Test Condition Image
CX1000 Flow Image
CX1000 Shmoo Image

Select another Power Supply Tracking
Check condition from Built-in Power Supply

Log Format

Power Supply Name
Slave Address
Device Type (Device C or Device A)
Input Reference Voltage (READ_VIN)
Power Supply Voltage (READ_VOUT)
Power Supply Current (READ_IOUT)
Temperature (Inside) (READ_TEMPERATURE_1)
Temperature (Outside) (READ_TEMPERATURE_2)
CTS VS Xilinx Board Testing Environment

• Portable – Small Foot Print, Powered from wall outlet.
  ✓ Easy Failure Analysis with LVP (Laser Voltage Prober).
• Expandable – Easy to add many capabilities.
• No Maintenance Charges – Replacement unit shipped free.
  ✓ Easy Maintenance of Hardware.
• Quick Bring up Test Program – CTLab (GUI + CSV).
  ✓ Modify Timing Levels & Pattern to Debug DUT.
• Power vs Frequency Shmoo
  ✓ Capability to Shmoo Power vs Frequency.
• Faster Test Rates (100MHz vs 100KHz)
  ✓ Faster Pattern Execution.
• Floating Licenses - Everyone can use CTS.
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Next Steps

• Release Generic PMBus IPs

• GPIB Control For Power Supplies

• LabVIEW Control For Power Supplies