The Need for Embedded Intelligence in ATE

Co-Author/Presenter: Christopher Ziomek
Co-Author: Donald Jenkins
ZTEC Instruments, Inc.
Overview

• Cost of test introduction
• Intelligent instrumentation vs. non-intelligent data acquisition
• Embedded intelligence in modular ATE
• Mask testing demo
• Video signal analysis demo
• Conclusion
Cost of Test

- Exponential increase in electronic complexity
- Little increase in testing efficiency
  - Increased test instrument performance
  - Added complexity of comprehensive test
- Significant cost-of-ownership increase
  - Capital equipment expense
  - Development scope & complexity
  - Maintenance & upgrade costs
Transistor Count in Intel Microprocessors

Source: First Monday, 2002
Escalating Cost of Test

Relative Costs of an Integrated Circuit

Source: 3MTS, San Jose, CA, 2003
Modular Instruments

• Modular instruments well-suited to ATE
  – High-density instrumentation
  – High data transfer rates
  – Integrated power, cooling, software, etc.

• Non-intelligent data acquisition is **NOT**
  – Thick layer of host software
  – Development burden upon test engineer
  – Vast increase in required data throughput
  – Some advanced testing not possible
Embedded Intelligence

• Provide benchtop test & measurement capabilities inside modular hardware
• Oscilloscope example:
  – Complete analog & trigger processing
  – Standard measurements
  – Waveform math & transformation
  – Multi-waveform capture
  – Pass/fail limit testing
  – Compliance mask testing
Test System Architecture

- Digital Stimulus
- Analog Stimulus
- Test Bus
- DUT
- Digital Capture
- Analog Capture
- System Controller
## VXI Test Results

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Host PC Measurement</th>
<th>Instrument Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>30.5 ms</td>
<td>7.6 ms</td>
</tr>
<tr>
<td>2</td>
<td>2.8 ms</td>
<td>1.8 ms</td>
</tr>
<tr>
<td>3</td>
<td>2.2 ms</td>
<td>1.6 ms</td>
</tr>
<tr>
<td>4</td>
<td>1.9 ms</td>
<td>1.5 ms</td>
</tr>
<tr>
<td>5</td>
<td>119.2 ms</td>
<td>25.7 ms</td>
</tr>
<tr>
<td>6</td>
<td>1.8 ms</td>
<td>1.5 ms</td>
</tr>
</tbody>
</table>

Source: ZTEC, Autotestcon, 2004
## PCI/PXI Test Results

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Host PC Measurement</th>
<th>Instrument Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31 ms</td>
<td>24 ms</td>
</tr>
<tr>
<td>2</td>
<td>842 ms</td>
<td>83 ms</td>
</tr>
<tr>
<td>3</td>
<td>8544 ms</td>
<td>617 ms</td>
</tr>
<tr>
<td>4</td>
<td>37 ms</td>
<td>24 ms</td>
</tr>
<tr>
<td>5</td>
<td>839 ms</td>
<td>83 ms</td>
</tr>
<tr>
<td>6</td>
<td>8556 ms</td>
<td>611 ms</td>
</tr>
</tbody>
</table>

Source: ZTEC, Autotestcon, 2004
Distributed Embedded Test

- Test engineer
  - Focus on application
  - Not on standard test & measurement
- Advanced ATE examples
  - Compliance mask testing
  - Video signal analysis
Mask Testing Demo

• Compliance testing for wired communication
  – Standard or non-standard serial datacom
  – ITU G.703 T1 test example (1.544 Mbps)
• Upper and lower waveform boundary conditions
• Capture & analysis of thousands of waveforms
• Intermittent failure capture & statistics
Input Setup
Trigger Setup
Upper Mask Loaded (REF1)
Lower Mask Loaded (REF2)
Captured Pulse + Mask
Mask Test Results

Test count is 10000. Fail count is 17.
Failed Waveform Stored
Measurements on Failed Waveform
Envelope (red) of Failed Waveform
Video Signal Analysis Demo

- Video signal capture & analysis
  - PAL, NTSC, SECAM
  - User-defined, non-standard video
- Oscilloscope video frame synchronization
- Standard video signal measurements
  - Sync pulse width
  - White level
  - Color level
Standard Color Bar Test Pattern
Video Signal Introduction (Many Lines)
Video Signal Introduction (One Line)
Zoom in on Color Burst
Input Setup (Color Bar Test Pattern)
Trigger Setup
Full Scale ~100 IRE
Save Waveform to Ref1
Measure Sync Pulse Width
Measure White Level Using Cursors
Measure Magenta Level using Cursors
Conclusion

• Embedded intelligence in ATE
  – Comprehensive test solution
  – Faster test development
  – Shorter test times
  – Reduce total cost of test
About ZTEC

• Located in Albuquerque, NM
• Founded in 1996
• Manufacturer of innovative modular instrumentation products with a focus on PCI, PXI and VXI
• Products used in military, aerospace, commercial manufacturing, and scientific test and measurement applications
ZTEC Instruments
7715 Tiburon St. NE
Albuquerque, NM  87109
Phone: (505) 342-0132
Fax: (505) 342-0222
www.ztec-inc.com