Hot-Plug Problem & its Solution

in SCSI Systems

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Developed by
Tyco Electronics (a.k.a. AMP)
The Hot-Plug Problem ...

- Why am I here instead of at SFF?
  - this is a connector, right?
The Hot-Plug Problem ...

- Right! But ...

  - the **Hot Plug** Problem is a **System Problem** that requires a **System Perspective**.

  - Once the solution is accepted, the connector specification will be taken to SFF.
The Hot-Plug Problem ...

Bus Path (Media) Showing Energy Depletion on a Signal Line
The Hot-Plug Problem ...

• Is there \textit{REALLY} a Hot Plug Problem?

• Why haven’t we seen it?

... and if there is such a problem, \textit{we already fixed it!}
The Hot-Plug Problem ...

Card Makes contact here

Touch BOTH lines of the Differential pair AT THE SAME INSTANT

Victim Differential Signal
The Hot-Plug Problem ...

But that’s not reality ...

<table>
<thead>
<tr>
<th>Select Velocity Range:</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.0 Ft/sec</td>
<td>0.2 mils/</td>
</tr>
<tr>
<td></td>
<td>0.0240 mils/</td>
<td>0.0024 mils/</td>
</tr>
<tr>
<td>Contact Point Variation (CPV):</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td></td>
<td>1.0 mils</td>
<td>5.0 mils</td>
</tr>
<tr>
<td></td>
<td>41.67 usec</td>
<td>2083.33 usec</td>
</tr>
</tbody>
</table>
The Hot-Plug Problem ...
The Hot-Plug Problem ...

Card Makes contact here

Victim Differential Signal

Disturbance settles out of the 100mv band here
The Hot-Plug Problem ...

Card Makes contact here

Victim Differential Signal

WFM.1 VDVICT vs. TIME in Secs
The Hot-Plug Problem ...

Termination
Slot #1
Source: Slot #2

Hot-plugged Daughter Card: Touching V+ first

Hot-plug Backplane: Slot #3
Victim Card: Slot #4
Slot #5
Termination
The Hot-Plug Problem ...
The Hot-Plug Problem ...

Victim Differential Signal

Expanded time scale

4.0ns

1.5ns
The Hot-Plug Problem ...

Card Makes contact here

Disturbance settles out here

2.1ns

6.1ns

Victim Differential Signal
The Hot-Plug Problem ...

- We have another System issue ...
  - When, exactly, does the disturbance occur?

- This gets us into probabilities ...
The Hot-Plug Problem ...

- Criticality depends on - Type of Signal line
  - synchronous
    - did it ‘hit’ the sample period?
    - did the edge get out of spec?
  - asynchronous (level sensitive)
    - did the edge get out of spec?
    - is the magnitude great enough to cause a problem?
    - can the line cause a problem at that time?
The Hot-Plug Problem ...

- The net result?
- A detectable error will not occur every time.
- It is very difficult to capture hard evidence.
- The system works ‘most of the time.’
The Hot-Plug Problem ...

• What must a system developer do?
  • Use good design practices
    – minimize reflections, noise, attenuation, ...
  • Use Simulation and Testing
    – identify possible problems and investigate them
The Hot-Plug Solution ...

- You must limit the rate at which energy is taken from the bus.

- Resistive Tip Contacts do that.
The Hot-Plug Solution ...

- Modify the SCA-2 Plug ...
The Hot-Plug Solution ...

Termination

Slot #1

Source: Slot #2

Hot-plugged Daughter Card:
Touching V+ first

Simple Resistive Tip Model

Slot #3

Hot-plug Backplane:

Slot #4

Victim Card:

Slot #5

Termination

The Hot-Plug Solution ...
The Hot-Plug Solution ...

[Graph showing Hot-plugged Card Signal and V+ Bus Signal]

- Touch
- 1 microsecond

VCARD in Volts
- 0
- 450.0M
- 850.0M
- 1.250
- 1.650
- 2.050

VPHP in Volts
- 0
- 400.0M
- 800.0M
- 1.250
- 1.650
- 2.050

WFM.1 VCARD vs. TIME in Secs
- 100.0N
- 300.0N
- 500.0N
- 700.0N
- 900.0N
The Hot-Plug Solution ...
The Hot-Plug Solution ...

Source: Slot #2

Termination Slot #1

Slot #3

Victim Card: Slot #4

Slot #5

Termination

Hot-plugged Daughter Card: Touching V+ first

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The Hot-Plug Solution ...
The Hot-Plug Solution ...
The Hot-Plug Solution ...

Resistance Profile

V+ Bus Signal at Hot-Plug Slot

Differential Bus Signal at Victim Slot (Shifted)

Touch Gold
The Hot-Plug Solution ...

- There *REALLY* is a Hot Plug Problem!
- It is difficult to identify (but not impossible)
- ... and there is a Solution!
The Hot-Plug Solution ...

- We have a Hot Plug Safe product.
  - it is for a different bus
  - it is currently under a confidentiality agreement
  - it will be jointly announced at
    - DesignCon 2000 (San Jose, CA)
    - Bus and Board Conference (San Diego, CA)
The Hot-Plug Solution ...

- Why did we make a Product for another bus standard when we had started with SCSI?
- Because we had a major customer that ...
  - identified the problem in their product
  - worked with us to establish the solution
  - and is committed to using our product
The Hot-Plug Solution ...

- The product has passed Verification Testing:
  - Bellcore, uncontrolled environment, Mixed Flowing Gas
  - Durability

- The product is currently in Qualification Testing:
  - Bellcore, uncontrolled environment, Mixed Flowing Gas
  - Durability
  - Temperature / Humidity
The Hot-Plug Solution ... 

- Tyco Electronics (a.k.a. AMP) has your Hot Plug Solution