Application Note

Abstract:

Powering-up a board under test on the Medalist i3070 Series 5 in-circuit tester is the pre-condition before the execution of any digital tests on the integrated circuit (IC). ICs on boards may be internally powered by on-board regulators. The on-board regulators can be affected during the testing or debugging procedures, which may cause the regulators to switch off unintentionally due to interference to its enable pins.

This increases the potential difference between the driven signal pins and the internal voltage rail of the IC and thus, can potentially cause damage to the IC pins (protection circuit), as driving continues without power on the voltage rails. The IC will be electrically stressed if testing continues under this “over voltage” condition.

This will incur a lot of rework, manpower and material cost if the IC malfunctions.
Introduction

The Keysight Technologies, Inc. Medalist i3070 Series 5 in-circuit test system offers a new safety feature called the power monitoring circuit (PMC) that will monitor and react to the above conditions. The objective is to save cost for manufacturers, without compromising test coverage or capabilities.

The PMC is a new safety feature to enable real-time monitoring of the power nodes of the IC to prevent any overdrive current to the pins of the IC if the power to the IC is accidentally turned off. Testing will stop and a failure message will be displayed when the power drops below a user-defined threshold. This feature can be enabled during debugging as well as during mass production.

Prior to the availability of PMC in the market, the industry practice was to use powered analog test.

Figure 1 above shows the PMC that is available in the analog stimulus response unit (ASRU) revision N card. Up to three devices under test (DUT) power supply voltages can be monitored during digital testing per ASRU revision N card. Different voltage limits can be set for each channel. Digital tests such as boundary scan, digital in circuit and mixed test will be halted upon the detection of a power failure during test, to prevent the back-drive current that can cause damage to ICs.

Prior to the availability of PMC in the market, the industry practice was to use powered analog test.

Figure 2 shows an example whereby the 3.3 V power node output from the voltage regulator is tested through a powered analog test. This test only checks the voltage at the particular instant after powering up. There isn’t any concurrent real time power voltage monitoring on the PCBA voltage regulator during digital testing of U1 and U2. The regulator can be affected during testing or debugging and will switch off unintentionally due to unexpected reasons like shorts or noises on its enable pins.
Applying PMC Monitoring On Power Rails

To detect voltage failure of “3.3 V” power node

The following example is based on the assumption of using PMC Channel 1 on the ASRU revision N card:

1. With reference to Figure 3, connect “3.3 V” node to “Vin_H” of PMC channel 1. Mint pin/personality pin location is 213173.

2. Connect “GND” node to “Vin_L” of PMC channel 1 (Mint pin/personality pin location is 213174).  
   Note: the BRC is set to 213173 and 213174 above, because the PMC channel uses ASRU revision N card in module 3. For complete listing of PMC associated BRC, please refer Appendix A.

3. Enable the PMC setting in the testplan.

   sub Setup_Power_Supplies (Status_Code, Message$)
   global PMC_On
   cps
   sps 1, 12.0, 2 optimize
   ....
   if PMC_On the
   spmc 1, 3.0 ! <PMC Channel Id>, <Voltage Trigger Limit>
   spmc interrupt on !<on/off>
   ....
   end if
   subend

   Note: For a complete listing of new Bt-Basic PMC commands and their details, please refer to Appendix A.

4. The potential difference between “3.3 V” and “GND” is 3.3 volts. In this example, the PMC voltage trigger setting is 3.0 volts. If voltage on the “3.3 V” node drops below 3.0 V, PMC will be triggered to stop U1 and U2 digital tests.
Applying PMC Monitoring On Power Rails

To detect over voltage of “3.3 V” power node

Figure 4. PMC connection to detect over voltage

1. With reference to Figure 4, select an unused DUT power supply channel (example: channel 4) and connect the high output to “Vin_H” of PMC channel 1. Mint pin/personality pin location is 213173.

   Note 1: the BRC is set to 213173 and 213174 above, because PMC channel uses ASRU revision N card in module 3. For complete listing of PMC associated BRC, please refer Appendix A.

2. Connect the Low output of the DUT power supply to the board ground (GND node) so that both reference to the same potential.

3. Connect “3.3 V” node to “Vin_L” of PMC channel 1. Mint pin/personality pin location is 213174.

4. Enable the PMC and voltage setting in the testplan.

   sub Setup_Power_Supplies (Status_Code, Message$)
   global PMC_On
   cps
   sps 1, 12.0, 2; optimize
   sps 4, 5.0, 1; optimize
   ....
   if PMC_On the
   spmc 1, 1.5 ! <PMC Channel Id>, <Voltage Trigger Limit>
   spmc interrupt on   !<on/off>
   ....
   end if
   subend

   Note: For a complete listing of new Bt-Basic PMC commands and their details, please refer to Appendix A.

5. The potential difference between “sps 4” and regulator output (“3.3 V” node) is 1.7 volts for normal operation. If voltage at the “3.3 V” node rose to 3.6 volts such that the new potential difference between the “sps 4” and “3.3 V” is 1.4 volts, which is lower than the voltage trigger limit setting at 1.5 volts, the PMC will be triggered to stop the U1 and U2 digital tests.
Conclusion

The Medalist i3070 Series 5 in-circuit test system with its new PMC feature can prevent potential damage to the ICs from unexpected voltage failure or over voltage. It can also help users to identify causes of failures during debugging, such as whether digital tests failed are due to power-up or digital test issues.

The i3070 Series 5. Saves cost. No compromise.

Appendix A

<table>
<thead>
<tr>
<th>Module</th>
<th>Channel</th>
<th>Vin_H</th>
<th>Vin_L</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Channel 1</td>
<td>213173</td>
<td>213174</td>
</tr>
<tr>
<td></td>
<td>Channel 2</td>
<td>213175</td>
<td>213176</td>
</tr>
<tr>
<td></td>
<td>Channel 3</td>
<td>213177</td>
<td>213178</td>
</tr>
<tr>
<td>2</td>
<td>Channel 4</td>
<td>201173</td>
<td>201174</td>
</tr>
<tr>
<td></td>
<td>Channel 5</td>
<td>201175</td>
<td>201176</td>
</tr>
<tr>
<td></td>
<td>Channel 6</td>
<td>201177</td>
<td>201178</td>
</tr>
<tr>
<td>1</td>
<td>Channel 7</td>
<td>123173</td>
<td>123174</td>
</tr>
<tr>
<td></td>
<td>Channel 8</td>
<td>123175</td>
<td>123176</td>
</tr>
<tr>
<td></td>
<td>Channel 9</td>
<td>123177</td>
<td>123178</td>
</tr>
<tr>
<td>0</td>
<td>Channel 10</td>
<td>111173</td>
<td>111174</td>
</tr>
<tr>
<td></td>
<td>Channel 11</td>
<td>111175</td>
<td>111176</td>
</tr>
<tr>
<td></td>
<td>Channel 12</td>
<td>111177</td>
<td>111178</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Command</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>spmc &lt;channel&gt;, &lt;voltage limit&gt;</td>
<td>Use PMC and set voltage limit for a channel. Example: spmc 2, 3.3 Use PMC on channel 2 and set a 3.3 V limit.</td>
</tr>
<tr>
<td>spmc &lt;channel&gt;, off</td>
<td>Turns off PMC for a channel. Example: spmc 10, off Turns off PMC channel 10.</td>
</tr>
<tr>
<td>spmc &lt;off/reset&gt;</td>
<td>Turns off or reset failure flags for all channels. Example: spmc off Turn PMC off for all channels.</td>
</tr>
<tr>
<td>spmc interrupt &lt;on/off&gt;</td>
<td>Turns interrupt on/off for all channels. Example: spmc interrupt on Turn interrupt on for all channels.</td>
</tr>
<tr>
<td>rpmc &lt;channel&gt;, &lt;flag&gt;</td>
<td>Reads the failure flag for a channel. Example: rpmc 1, V_Flag Read channel 1 failure flag and store in variable “V_Flag”</td>
</tr>
</tbody>
</table>
myKeysight

www.keysight.com/find/mykeysight
A personalized view into the information most relevant to you.

www.lxistandard.org

LAN eXtensions for Instruments puts the power of Ethernet and the Web inside your test systems. Keysight is a founding member of the LXI consortium.

Three-Year Warranty
www.keysight.com/find/ThreeYearWarranty
Keysight’s commitment to superior product quality and lower total cost of ownership. The only test and measurement company with three-year warranty standard on all instruments, worldwide.

Keysight Assurance Plans
www.keysight.com/find/AssurancePlans
Up to five years of protection and no budgetary surprises to ensure your instruments are operating to specification so you can rely on accurate measurements.

Keysight Channel Partners
www.keysight.com/find/channelpartners
Get the best of both worlds: Keysight’s measurement expertise and product breadth, combined with channel partner convenience.

For more information on Keysight Technologies’ products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

Americas
Canada (877) 894 4414
Brazil 55 11 3351 7010
Mexico 001 800 254 2440
United States (800) 829 4444

Asia Pacific
Australia 1 800 629 485
China 800 810 0189
Hong Kong 800 938 693
India 1 800 112 929
Japan 0120 (421) 345
Korea 080 769 0800
Malaysia 1 800 888 848
Singapore 1 800 375 8100
Taiwan 0800 047 866
Other AP Countries (65) 6375 8100

Europe & Middle East
Austria 0800 001122
Belgium 0800 58580
Finland 0800 523252
France 0805 980333
Germany 0800 6270999
Ireland 1800 832700
Israel 1 809 343051
Italy 800 599100
Luxembourg +32 800 58580
Netherlands 0800 2233200
Russia 8800 5009286
Spain 0800 000154
Sweden 0200 882255
Switzerland 0800 805353
Opt. 1 (DE)
Opt. 2 (FR)
Opt. 3 (IT)
United Kingdom 0800 0280637

For other unlisted countries:
www.keysight.com/find/contactus
(BP-06-09-14)