Dynamic Analysis by Laser Stimulation (DALS)

With the recent miniaturization and high performance in LSIs, the failure mode itself has become more complex. Not only the analysis of current leakage failures in static mode, but also the one of functional failures in combination with LSI testers has become necessary.

Dynamic Analysis by laser stimulation is a newly introduced method to localize functional failures in a LSI by observing its operating status (Pass/Fail) change. This document describes the optional function "Dynamic Analysis function kit (DA function kit)" to carry out such innovative analysis with uAMOS and PHEMOS.

Overview of Dynamic Analysis by Laser Stimulation

Each device has a characteristic of the "drive voltage-operating frequency (Shmoo Plot)" which expresses the operating status (Pass/Fail). In case of a device having functional failures, it shows different characteristic compared to a good one (see the figure below). When driving a device under the conditions around the Pass/Fail boundary and irradiating it by 1.3 μm laser, the characteristics of the Shmoo Plot changes at a failure points (defective transistors, voids, etc.) due to the thermal effect by laser irradiation. That leads the change of Pass/Fail status of the device. By reading the status change as a signal and expressing it as an image, the location related to the functional status change can be identified.

With the "DA function kit", localization of the root cause of functional failure can be done much quickly and easily.

Analysis examples

Analysis of an SRAM having insufficient voltage margin

For a SRAM that becomes defective over 4 V at VDD, DALS analysis was carried out. The Pass/Fail changes was detected due to laser heat at three locations. Failure mechanism was further investigated with one signal. A change from Fail to Pass was indicated in a transistor of the timing circuit. A delay generated in the transistor switching turns the device into normal operation (Pass).

Including the results of the investigations done on the other two locations, the cause was defined as insufficient timing margin between the sense amplifier signal and the word line signal. The problem was fixed by adjusting the timing of the sense amplifier signal slower and the word line signal faster.

Data furnished by: Mr. Seigo Ito, Fujitsu Corporation
In order to carry out Dynamic Analysis by Laser Stimulation, Dynamic Analysis function kit (A9771) shall be added on µAMOS or PHEMOS series.

* In case of retrofitting this kit, modification of the system may be required.

**Features**

- Tester signal (Pass/Fail) input and imaging
- External control of the scanner by tester signals (loop trigger)

* Refer to the right figure for tester connections.

Three ports are prepared as tester signal inputs (Port shall be selected depending on analysis mode)

<table>
<thead>
<tr>
<th>Tester signal</th>
<th>Pass/Fail signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tester trigger</td>
<td>Timing trigger for data latch</td>
</tr>
<tr>
<td>Loop trigger</td>
<td>External control of the scanner with test loop trigger</td>
</tr>
</tbody>
</table>

* Inputting Pass/Fail signal into the tester signal connector is the minimum set-up to carry out dynamic analysis.

**Scan specification**

<table>
<thead>
<tr>
<th>Number</th>
<th>Max. 30</th>
<th>Max. 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size*1</td>
<td>16 to 512 (same in X and Y axis)</td>
<td>16 to 512 (same in X and Y axis)</td>
</tr>
<tr>
<td>Position</td>
<td>Any position within the field of view.</td>
<td>Any position within the field of view.</td>
</tr>
<tr>
<td>Scan direction*2</td>
<td>0°, 90°, 180°, 270°</td>
<td>0°, 90°, 180°, 270°</td>
</tr>
<tr>
<td>Pixel rate*2</td>
<td>128 to 128,000 µs/pixel</td>
<td>128 to 128,000 µs/pixel</td>
</tr>
</tbody>
</table>

*1: In multiple of 16.
*2: Each area can be set independently.

**Analysis examples**

- Set up 3 scan areas and execute scanning only in these areas.
- Detects DALS signal in each set area.
- Set up 3 scan areas and 1 laser masked area.
- Laser scan skips the masked area.

**Features**

- Multi Area Scan
- Laser scan area can be set up to 30 areas with necessary size, scan speed and direction, which makes measurement time much shorter compared to whole area scan.
- Laser mask
- Laser mask area can be set up to 30 areas to skip scanning.

**Input voltage range** ± 5 V (in analog mode)

**Input level** 1.5 V (voltage level during trigger detection)

**Input impedance** 50 Ω

**Minimum trigger width** Trigger width min. 100ns to max. 10ns

Reference document