LASER TEST REPORT

Single Event Latchups
RHFLVDS31K1
(DC0624)
from
STMicroelectronics

Ref: TRAD/TL/RHFLVDS31K1/0624/STM/WF/0607	***Labège, August 22nd, 2006***
N°QUAL/2005/24529	Bat. Gallium, Voie l'Occitane BP 47471 31674 LABEGE Cedex ☞ : (33) 5 61 00 95 60 Fax: (33) 5 61 00 95 61 E-mail: trad@trad.fr http://www.trad.fr

VISAS

Written by	Verified by	R.Q	Approved by
Name: Date:	Name: Date:	Name: Date:	Name: Date:

Observations:

Rev 0: Creation of document

TO: STMicroelectronics **Mr. Hervé DUPERRAY**	**Ref:** **Project/program:**

CONTENTS

FIGURES

TABLES

1 Introduction

This report presents the results of a laser test program carried on **high speed differential line drivers RHFLVDS31K1** from **STMicroelectronics**.
The main scopes of these tests were to evaluate the **RHFLVDS31K1** would be affected by **S**ingle **E**vent **L**atchup (SEL) and localize the sensitive areas.

2 Documents

2.1 APPLICABLE DOCUMENTS

TRAD proposal ref: TRAD/P/STM/LVDS31/WF/060706.

2.2 REFERENCE DOCUMENTS

STMicroelectronics STLVDS31 datasheet.
EIA JESD57 document.

3 Organization of Activities

The relevant company has conducted the following tasks during this evaluation:

1	Procurement of Test Samples	STMicroelectronics
2	Preparation of test Samples (delidding)	STMicroelectronics
3	Preparation of Test Hardware and Test Program	TRAD
4	Samples Check out	TRAD
5	Laser Test	TRAD
6	Laser Test report	TRAD

Table 1: Organization of activities.

4 Device Description

The RHFLVDS31K1 is a differential line driver which implements **L**ow **V**oltage **D**ifferential **S**ignaling (LVDS). It works with a 3.3V single supply and allows operations up to 400Mbps.

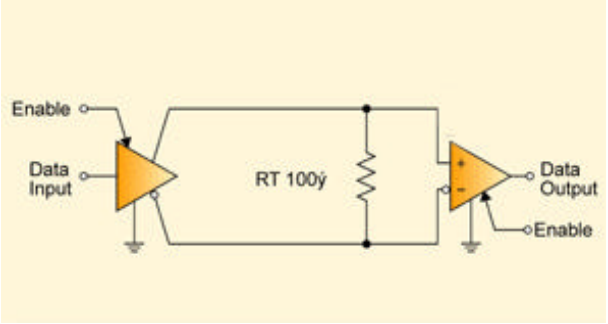

Figure 1: Typical Application Schematic.

5 Parts References

REFERENCES	
Type:	**RHFLVDS31K1**
Manufacturer:	**STMicroelectronics**
Packaging	16 pins Flat Package
PROCESS / TECHNOLOGY	
/	
PARTS PROCUREMENT	
Lot number:	DC0624
Number of PARTS	3

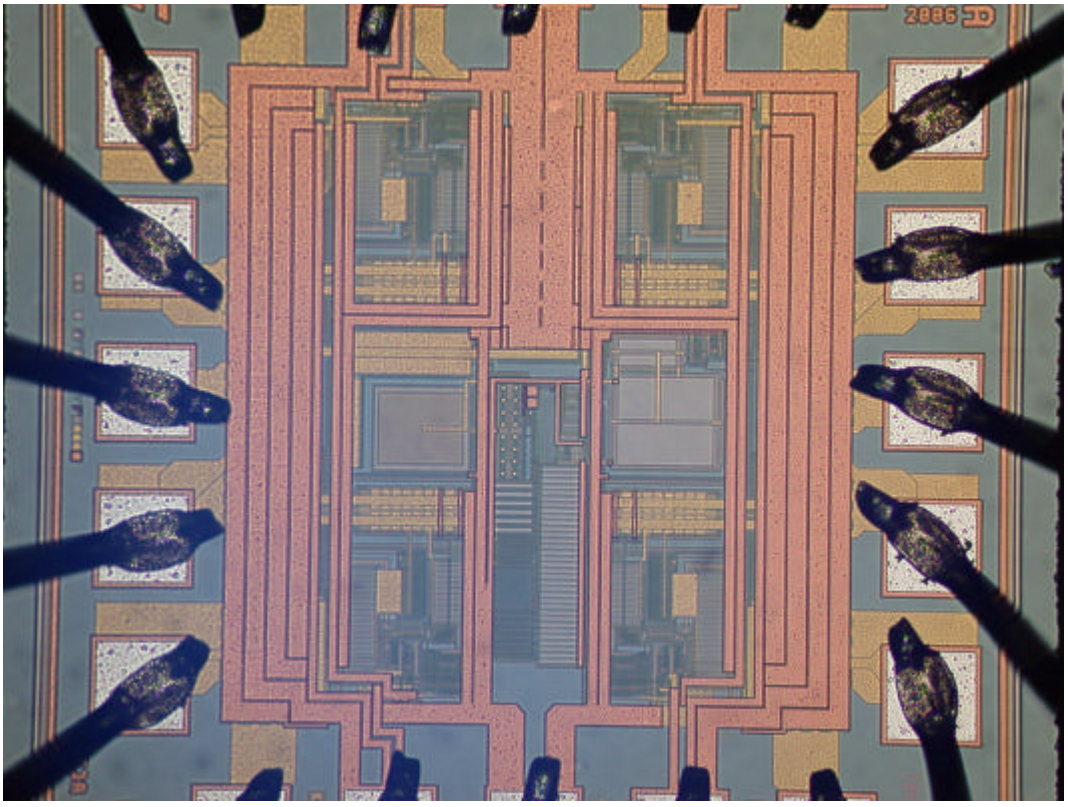

Figure 2: Delidded sample, view1

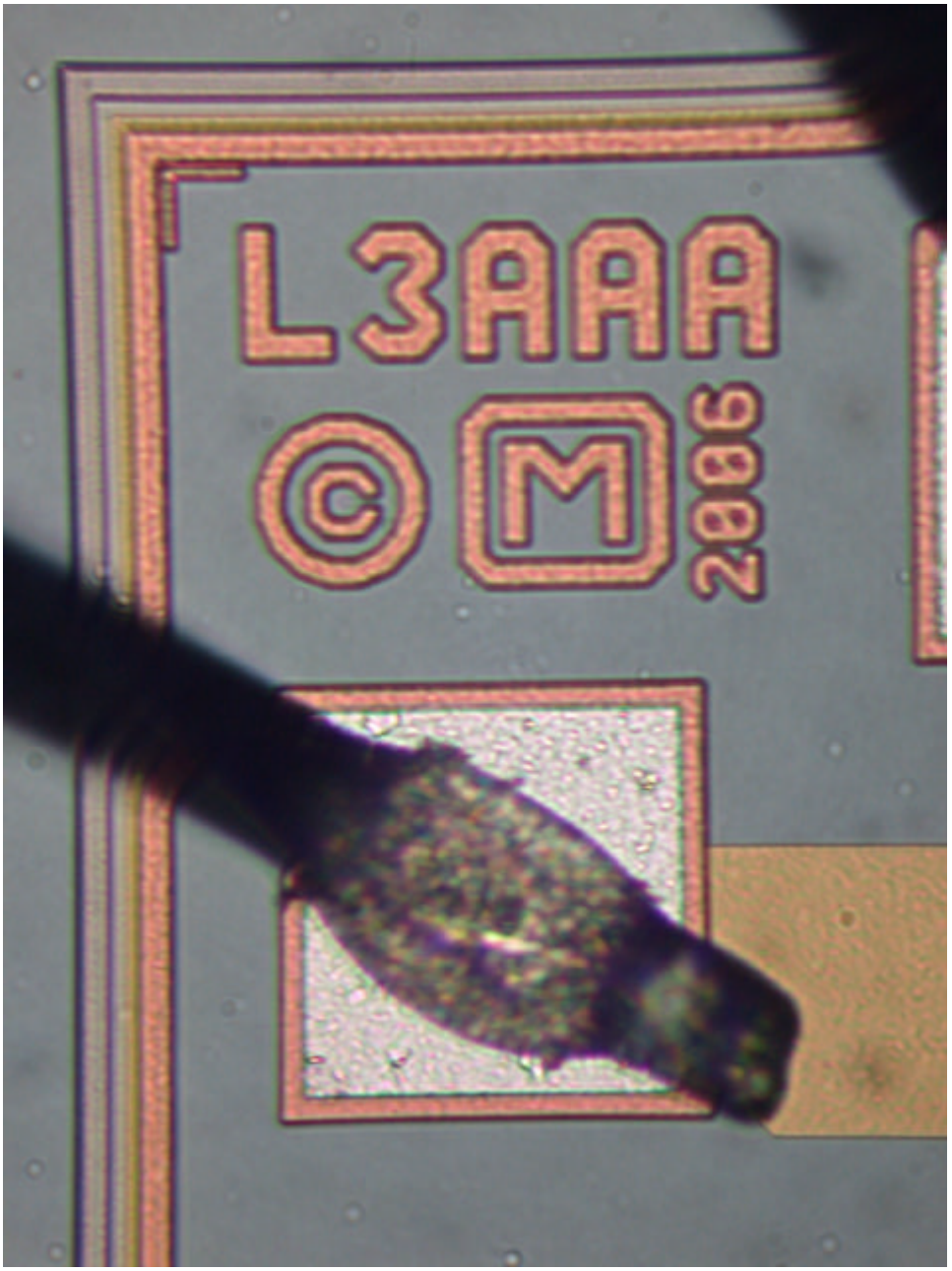

Figure 3: Delidded sample, view 2

6 Test Description

6.1 Procurement of test samples

3 parts were provided by STMicroelectronics.

6.2 Preparation of samples

3 devices were delidded by STMicroelectronics for previous heavy ions tests.
No sample was damaged during this operation.

6.3 Preparation of test board and program

TRAD has developed a specific test program called **APPLI_PRINCIPALE.VI** which performs the event counting and the curve acquisition.

During the heavy ions tests, we have observed single events latchups on RHFLVDS31K1. It's with accordance of the customer that we have investigate the devices in order to determine the sensitives areas by the laser beam.

The test board was specifically designed following the typical application schematic.The board includes 2 RHFLVDS31K1 (8 Emitters) and 2 RHFLVDS32K1 (8 Receivers).

- For the emmiter RHFLVDS31K1, the line input signal is a 50Mhz square waveform, is connected to the RHFLVDS31K1.
- For the receiver RHFLVDS32K1, is connected to the RH-LVDS31 with the typical differential connection, including a 100O resistor between the 2 differential lines of the signal. The scope is connected to the outputs of the RHFLVDS32K1.

This board allows us to test both the RHFLVDS31K1 and the RHFLVDS32K1, here, we have only tested the RHFLVDS31K1. We select the device to test by moving the board to place it be in front of the laser beam. The devices mounted on the board are placed in accordance with the beam focus. The beam cannot hit two devices, so if an event is detected, it can only come from the device hit by the laser beam. We use a latchup monitoring device (GUARD SYSTEM) on the component's power supply to detect SEL and prevent the destruction of the device under test.

This testing system is connected to a compatible Personal Computer through a standard IEE488 communication interface. The PC and the interface control and monitor the test. They receive the output signal and store it in the PC memory.

At the end of each test run, the data are transferred to a floppy disk for storage. An overall description of the test system is given in part 9 (see figure 4).

6.4 Samples Check

A functional test sequence was performed on delidded samples to check that the devices had not been degraded during the delidding operation.

6.5 Laser facility

The test was performed at IXL Bordeaux under TRAD's responsability, the 27th July 2006.
Two delidded samples were irradiated.
The pulsed laser is dedicated to the simulation of heavy ions effects on integrated circuits. One complementary testing method of particules accelerators using a pulsed laser beam has been shown to provide essential information concerning the spatial and temporal dependence of the radiation sensitivity.
The laser source is a Ti:Sapphire (Ti:SA) oscillator (model Tsunami from Spectra-Physics) pumped by a 10W cw laser (model Millenia Xs from Spectra-Physics). The oscillator delivers 100fs or 1ps pulses at a frequency of 80MHz. The pulses wavelength is tunable in the red-NIR region from 730 to 1000nm. This tunability allows adjusting the penetration depth of the laser pulse in the semiconductor material. For front-side testing of silicon devices, a wavelength of 800nm is usually chosen, giving a penetration depth of approximately 12?m, which is sufficient to ensure efficient photo-generation in the active volume of devices. For backside testing, a longer penetration depth is needed to reach the active volume through the silicon substrate.

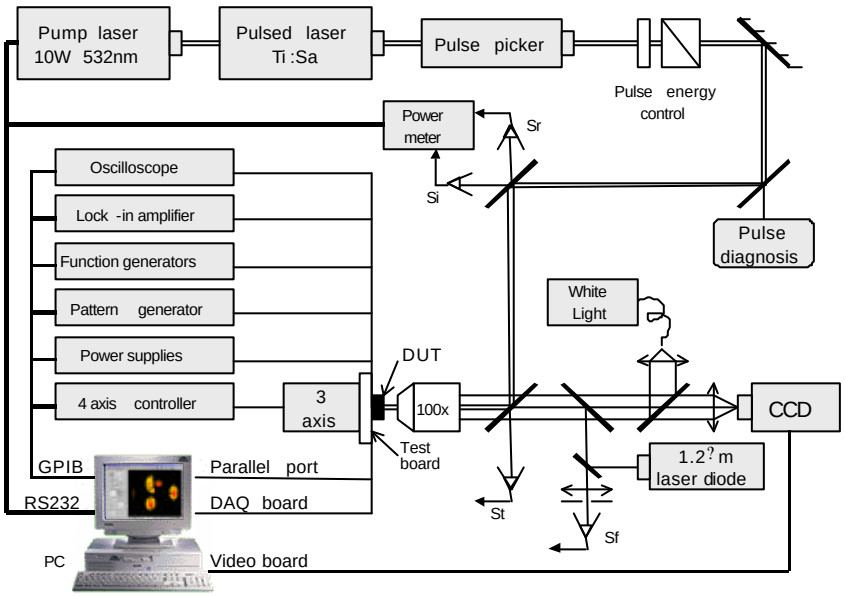

Figure 4: Scheme pulsed laser bench.

Table 2: IXL test bench

7 Device set up

Power Supplies	Module	Voltage (V)
GR-16	RHFLVDS31K1	+3.3V

8 Test Procedure

8.1 Description of the test method

During the test, we have irradiated 3 components.
The test consist to observe the same phenomenon that heavy ions test and in the same time localize the sensitives areas. For this, we applied a laser beam in order to show the scanning identification area on all working surface.
We defines the rectangular window to be scanned on the surface of the DUT. The step used is 1µm for 1.2µm diameter of laser beam for discretizing this window into a "pulse" grid. The scan consists in striking successively the nodes of the grid by a laser pulse, measuring one or several electrical parameters of the DUT and storing the measurements in a matrix representing the grid. 2D plotting of the matrix using a color scale gives a map at each measure. During the test any electrical parameter measurable with a digital oscilloscope is mapped. The measurement is done in synchronization with the laser excitation. In each step of the device, a laser beam of duration 1.1ps for 400 Hz frequency and an energy from 6pJ to 475pJ with wavelength of 800nm is focused.

8.2 Test SEL

The circuit for detection and protection have been ajusted to cut power supply if the current increases more than 2 times of the nominal current (nominal current at 17mA, threshold current at 35mA) the hold time is adjusted at 500µs, the cut-off time is ajusted to 10 ms.

A software detector checks the differents triggering. Each triggering is performed as a SEL (Single Event Latchup) with an identification of the sensitive area.
During the test on laser beam, events appear as an overconsumption, it's an anomaly in the microcircuit caused by an photon strike that lead to a temporary non-functionality. It's necessary to apply a "OFF-ON" power cycle to recover the functionality with a delatcher.

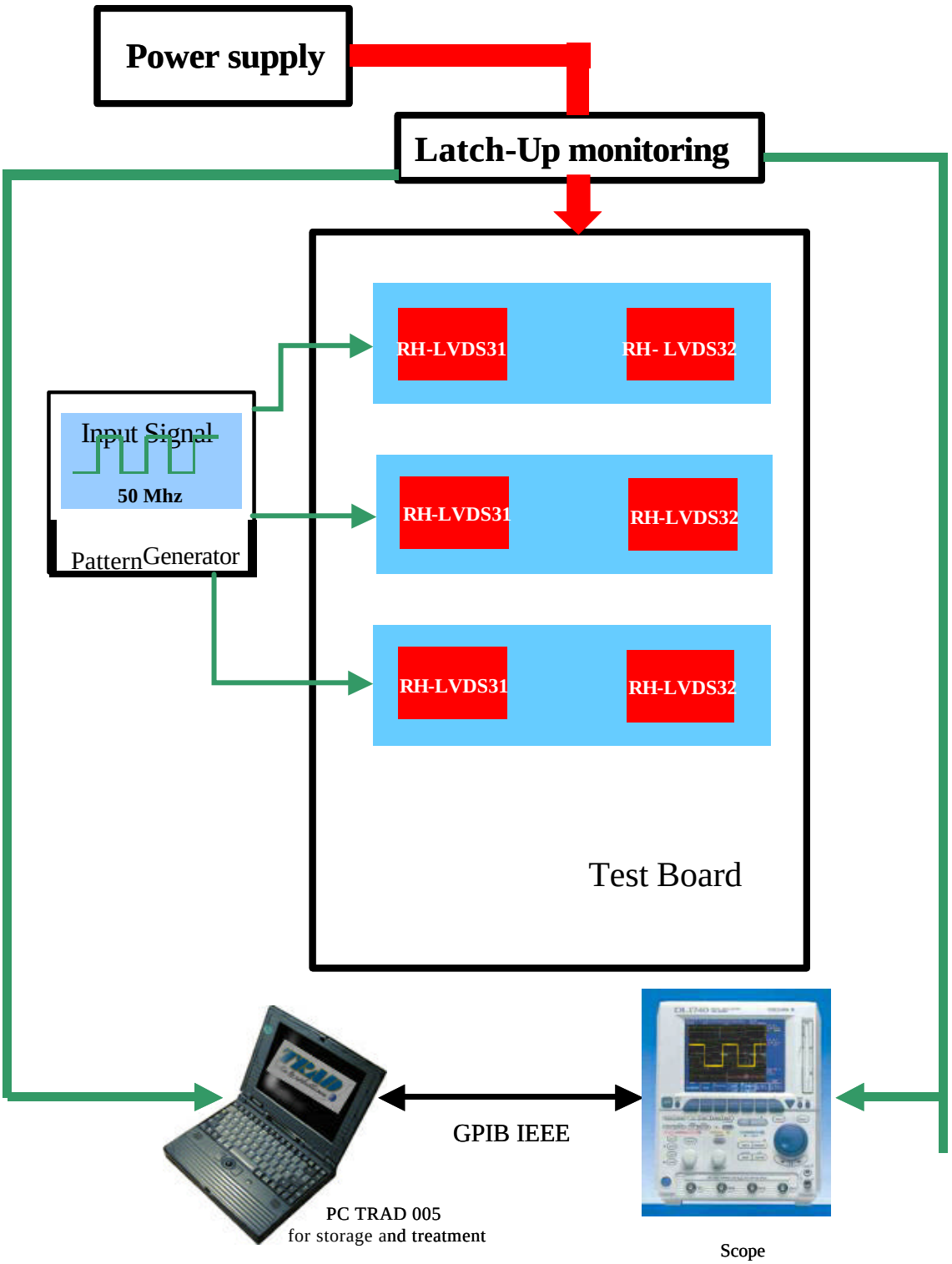

Figure 5: Description of test system.

9 Test Equipment

The tests were carried out with test cards developed by TRAD.

Computer	Laptop TRAD MI-OP11
Test Equipment	GR-16,Guard System,ME-44
Program Test	Appli_principale avec K2001 V2.vi
Board Test	TRAD/CT1/I/RHFLVDS32K1/FPACK/MV/0511

The pattern generator is carried with a 50 MHz Quartz.

10 Results

Latchup threshold 35mA, Hold time 500µs, Cut off time 10 ms.
The typical SEL waveform was as following and was performed with a Energy of 50pJ.

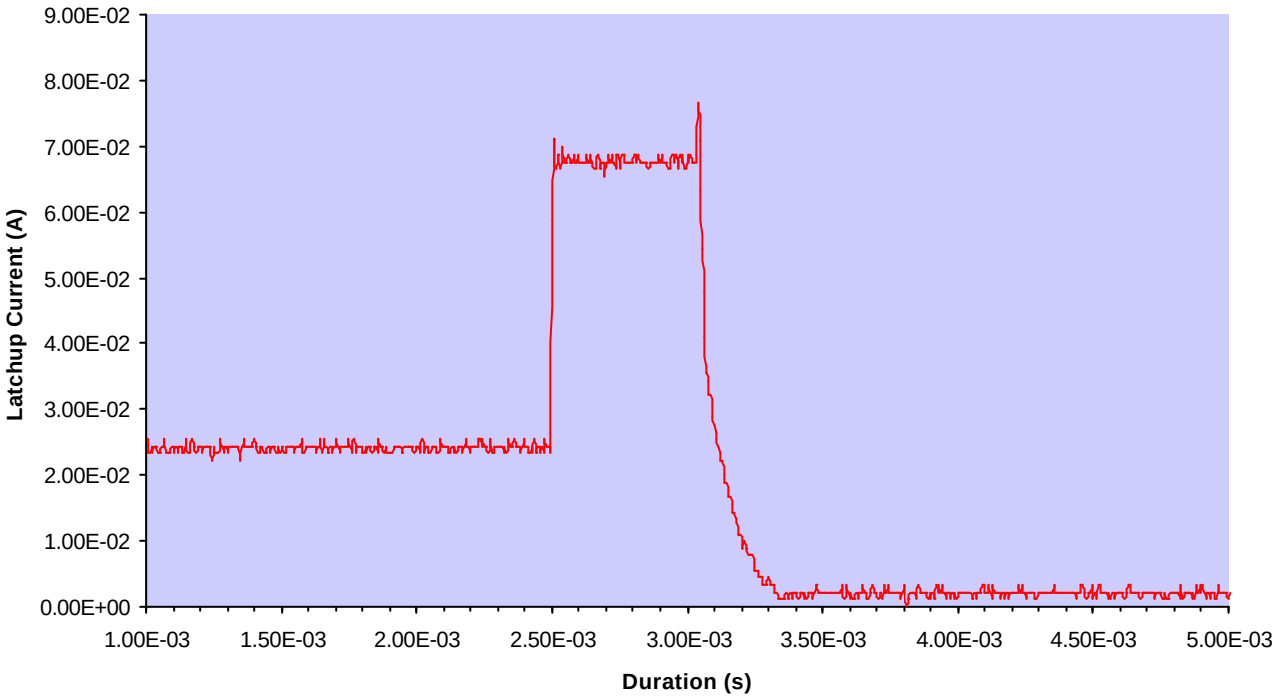

Figure 6: Latchup Curve, Energy 50pJ.

When we observe the Latchup curve the regular power consumption of the RHF-LVDS31K1 is around 17 mA, and the latchup level detected by our latchup monitor is around 70 mA. When a SEL occurs, our GUARD System shuts down the power supplies to avoid damage on the device.

Run	Part	Energy (pJ)	Surface Scanning	Comments
1	1	50	All lead	Research sensitive area
2	1	80	All lead	Research sensitive area
3	2	80	All lead	Research sensitive area
4	2	80	On zone 5 (38µm*34µm)	Localization sensitive area
5	2	50	On zone 5 (38µm*34µm)	Research threshold sensitivity
6	2	50	On zone 1 (36µm*43µm)	Checking sensitive area
7	3	50	On zone 2 (31µm*30µm)	Checking sensitive area
8	3	50	On zone 5 (38µm*34µm)	Localization sensitive area
9	1	50	On zone 5 (37µm*34µm)	Localization sensitive area
10	1	50	On zone 5 (9µm*14µm)	Area more precise

Table 3: Results of scans.

11 APPENDIX

11.1 Test at IXL

11.1.1 SEL Type of cartography

In this case the SEL test was performed with scanning on all lead with laser beam in order to define the different sensitives areas. We have identified five sensitives areas.

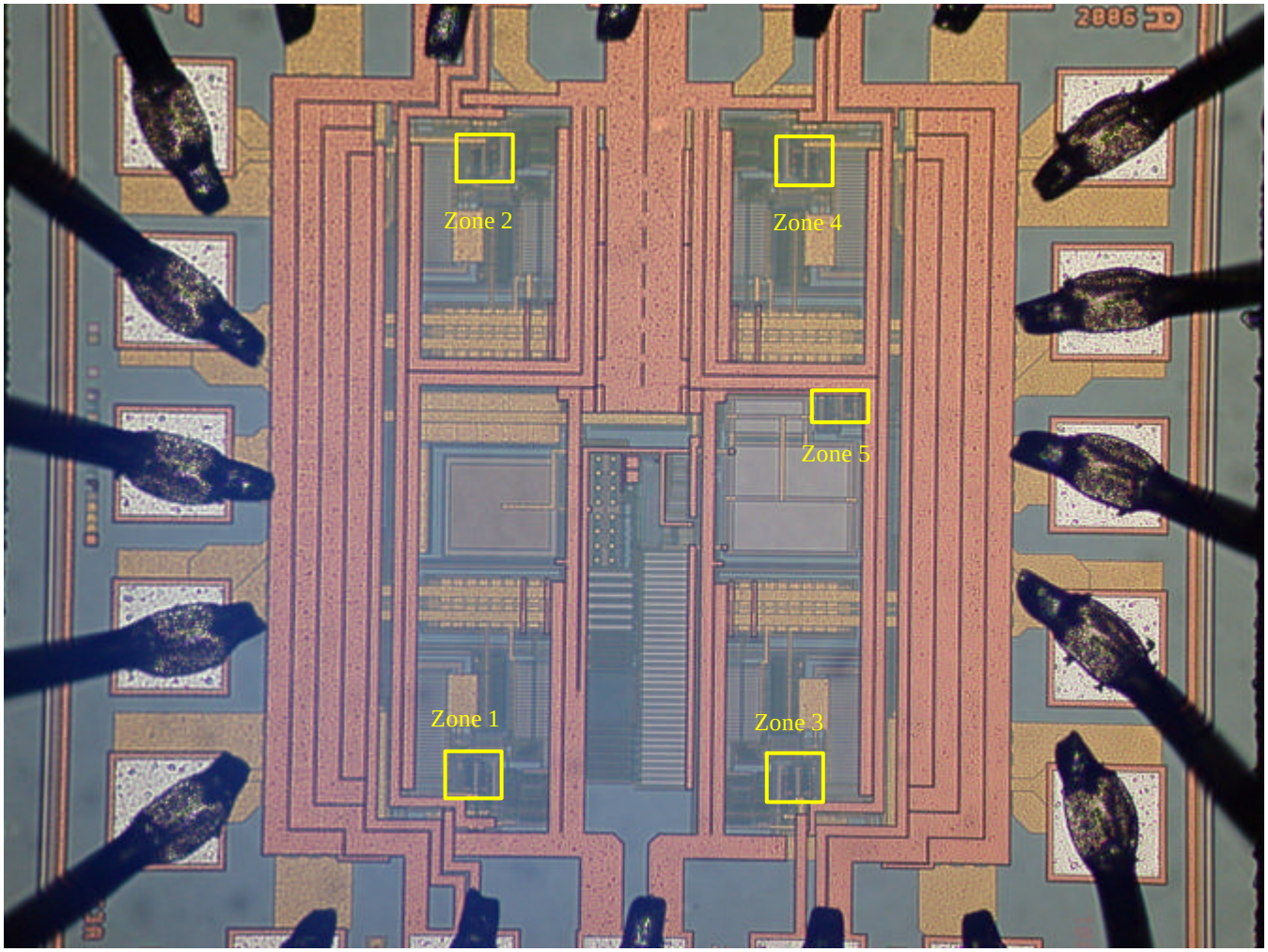

Figure 7 : Identification of the sensitives areas.

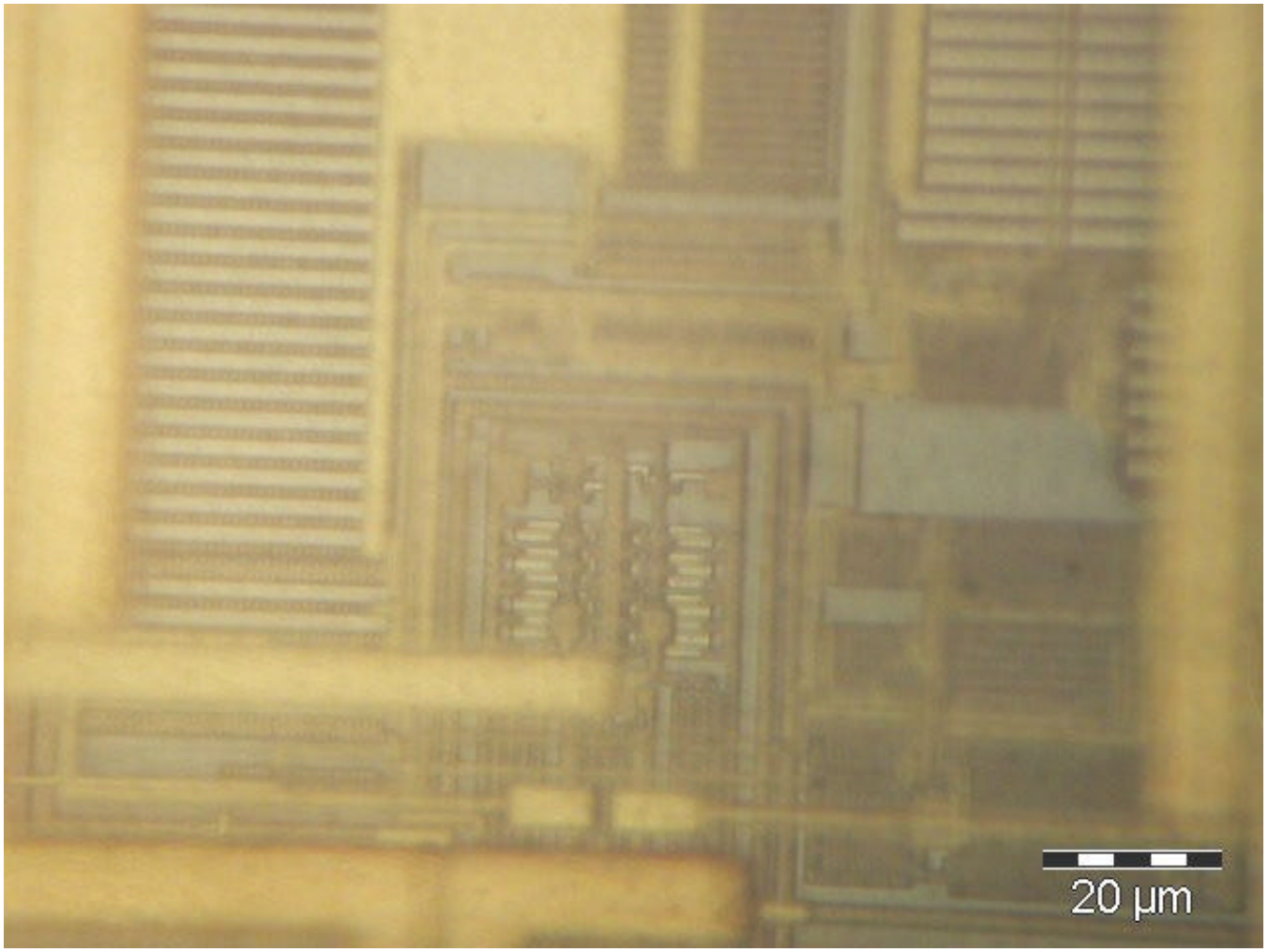

Figure 8 : Not sensitive area for zone 1, 2, 3 and 4 at 50pJ and 80pJ.

One picture only is produce, because the behaviour of the areas 1, 2, 3 and 4 are identical. No latchups events are detected during the tests for beam energy at 50pJ and 80pJ.

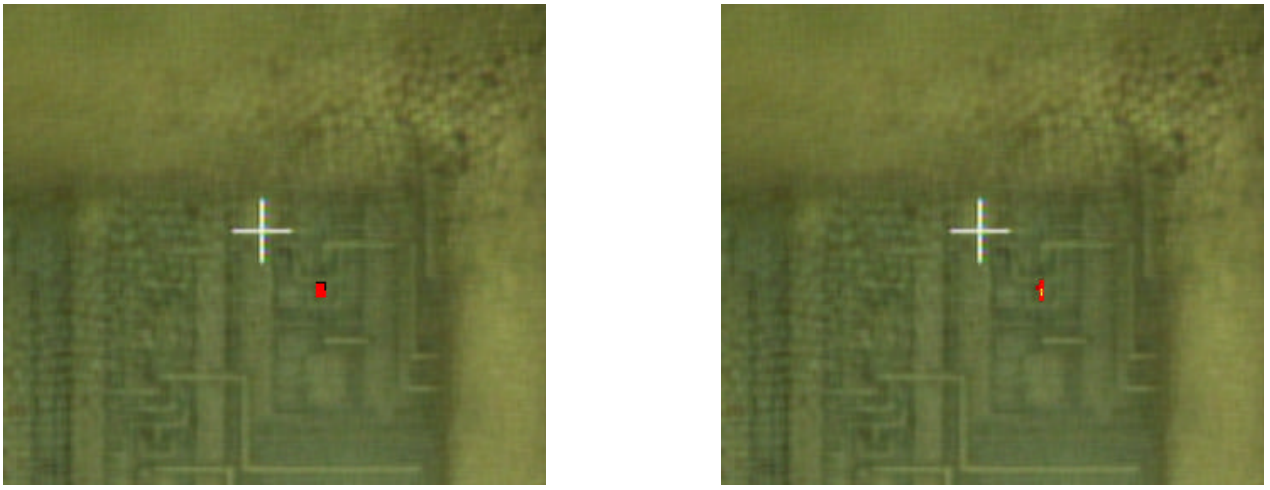

Figure 9 : Sensitive area for zone 5 at 80pJ for parts 1 and 2.

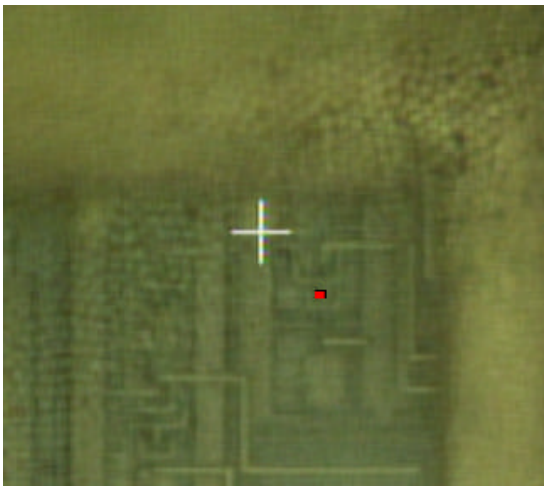

Figure 10 : Sensitive area for zone 5 at 50pJ for part 3.