Elevated Temperature Pulsed-Laser Irradiation Test Plan for the ISL28196 Voltage Comparator

Test date: March 16th, 2010

PI: Dakai Chen, MEI Technologies Inc.
TE: Anthony Phan, MEI Technologies Inc.

I. Introduction

The purpose of this study is to examine the pulsed-laser induced single event transient (SET) susceptibility at room temperature and at elevated temperatures for the ISL28196 voltage comparator manufactured by Intersil Corporation.

II. Device Description

The ISL28196 is a micropower comparator optimized for low-power applications. The part typically consumes 2.5 µA of supply current, and features a propagation delay of 150 µs. Table 1 displays the part and test information. Figure 1 shows the pin configurations.

Table 1. Test and part information

Part Number	ISL28196
Manufacturer	Intersil Corporation
Package markings	BMJ5 (top), GABM (bottom)
Lot date code	0724
Quantity tested	1-5
Part Function	Voltage comparator
Part Technology	CMOS
Package Style	6-pin SOT-23
Test Equipment	Keithley 4200 parameter analyzer, power supply

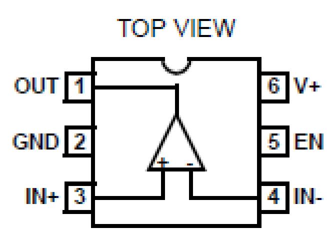

Figure 1. Pin configurations for the ISL28196.

III. Test Facility

The testing was conducted at the Naval Research Laboratory with a YLF laser. The laser beam characteristics are listed in Table 2 below.

Table 2. Laser characteristics.

Wave Length	590 nm
1/e penetration depth	2 µm
Beam diameter	1.7 µm

IV. Test Method

The bias circuit schematic is shown in Figure 2. A block diagram of the test setup is shown in Figure 3. A power supply provides power and input voltages to the device. The oscilloscope is connected to the output to monitor the output voltage levels, and record any SETs above the threshold. The elevated temperature test setup requires a power supply, multimeter, thermal pad, and thermistor. The power supply outputs voltage to the thermal pad, which is attached to the device. The temperature increases as the voltage is increased. A multimeter measures the resistance of the device through a thermistor, which is also attached to the device. The resistance is converted into temperature by a program controlled by a laptop computer. The computer manages the amount of power applied to the device and the temperature of the device.

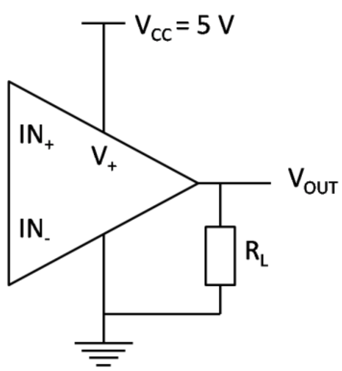

Figure 2. Circuit bias schematics during laser irradiation.

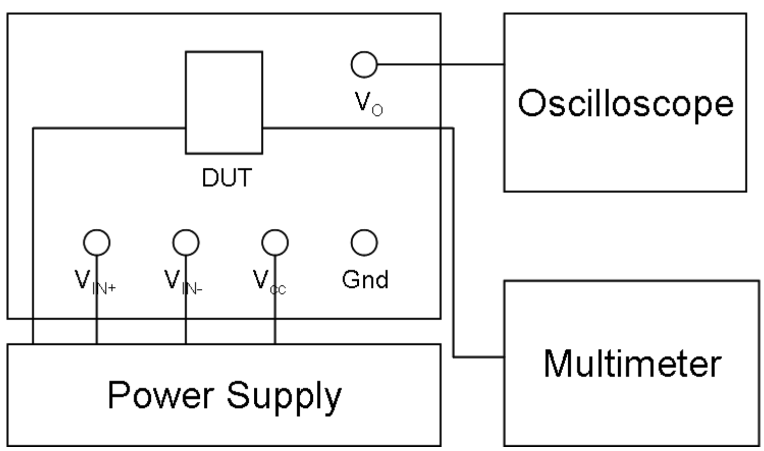

Figure 3. Block diagram of the test setup.

Test Conditions

Testing Temperature:	Room temperature (25°C), 50°C and 75°C.
Power supply (V_{cc}):	V_{cc} = 5 V
Input voltage (V_{in}):	V_{in+} = 2.505 V to 3.5 V, V_{in-} = 2.5 V
Parameters of interest:	(1) Amplitude and width of SETs. The trigger voltage level was adjusted appropriately according to the transient levels observed during the experiment (2) The supply and input currents were monitored

V. Results

We observed transients at several different locations on the chip. We note that we used the AC mode on the oscilloscope to better observe transients. So the 0 V level corresponds to 5 V DC for the output. Throughout the experiment, we applied various laser energies of 25, 63, and 125 pJ. Figure 4 shows the SET characteristics for one location at various laser energies. The Full-Width-at-Half-Maximum (FWHM) pulse width is approximately 60 ns. However it is difficult to obtain a precise value for the pulse width due to the oscillations. The amplitude was approximately – 3.4 V. The pulse width and amplitude increase with increasing laser energy.

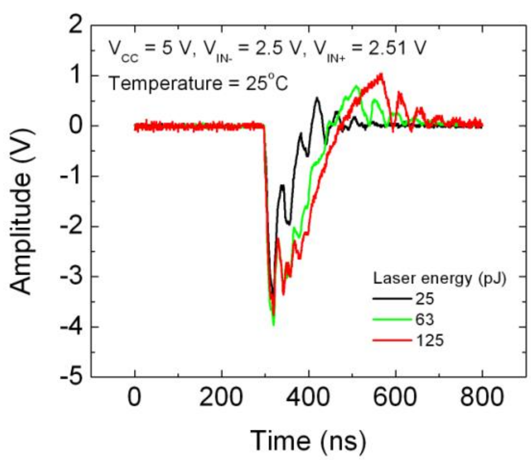

Figure 4. SETs of the ISL28196 voltage comparator, for laser energies of 25, 63, and 125 pJ, with the device operating at output high.

Figures 5 and 6 show SETs at a different location. The SET amplitude exceeds the 5 V power supply limits, so the transients saturate. The pulse width at 2.5 V is approximately 10 µs, at room temperature. Figure 5 shows the effects of different input differential voltages on the SET at room temperature. As the differential voltage is increased from 0.005 V to 1 V, the transient becomes much smaller, due to the reduced sensitivity. The pulse width is reduced from ~ 10 µs to 3 µs. Figure 6 shows the effects of increasing temperature on the SET. The SET becomes much smaller as the temperature is increased from 25°C to 50°C. We no longer observe any transient at 75°C.

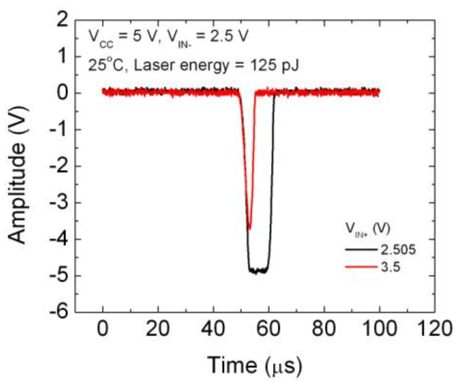

Figure 5. SETs of the ISL28196 voltage comparator at input voltage differentials of 0.005 V and 1 V, for a laser energy of 125 pJ, with the device operating at output high.

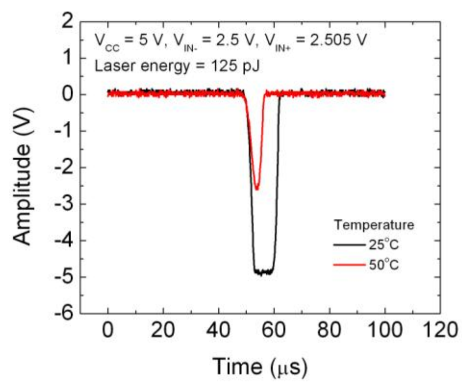

Figure 6. SETs of the ISL28196 voltage comparator at 25°C and 50°C, for a laser energy of 125 pJ, with the device operating at output high.

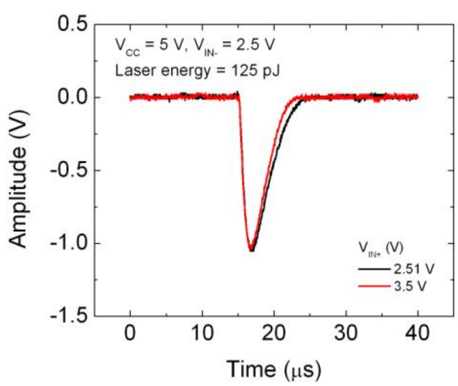

Figure 7. SETs of the ISL28196 voltage comparator at 25, 50, and 75°C, for a laser energy of 79 pJ, with the device operating at output high.

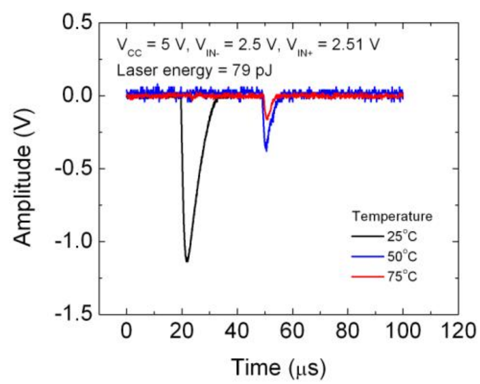

Figure 8. SETs of the ISL28196 voltage comparator at input voltage differentials of 0.01 V and 1 V, for a laser energy of 125 pJ, with the device operating at output high.

Figures 7 and 8 show SETs from a different location. The pulse amplitude is ~ 1.1 V at room temperature, with laser energy of 79 pJ. The FWHM pulse width is ~ 6 µs. Again we examine the effects of altering the differential input voltage. However, unlike the SETs in figures 5 and 6, the SETs here do not change as the input differential voltage is increased from 0.1 V to 1 V, as shown in Figure 7. We also examined the effects of increasing temperature. The SETs significantly reduced in size as the temperature is increased from 25°C to 50°C, similar to the previous SETs.

VI. Conclusion

We have examined the laser-induced SETs on the ISL28196 micropower voltage comparator. The SETs varied in shape and magnitude depending on the location. The SET characteristics also depended on the differential input voltage and temperature. The most significant transients at room temperature have amplitudes exceeding 5 V, and pulse widths of approximately 10 µs, for laser energy of 125 pJ.

The effect of changing the differential input voltages varied depending on strike location. In one instance, increasing the differential input voltage reduced the SETs sensitivity, while we observed no effect at another location. On the other hand the SETs significantly reduced in size as the temperature is increased for all the examined locations. This suggests that the sensitivity to SETs increase with increasing temperature.

Additional laser tests or heavy ion tests may be necessary to better determine the energy thresholds or linear energy transfer thresholds of the SETs.