Temperature Dependence for Irradiated Packages

Gilles Mahout and Tony Weidberg

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Introduction

Two of the phase 2, Marconi opto-packages have been irradiated to 3 10^{14}p/cm^2 with 24 GeV protons at the CERN PS. One package has been annealed at a temperature of –20^{0}C and the temperature dependence of the performance of the PIN diode and the two VCSELs have been measured. The opto-package was mounted on a dog-leg cable and bonded out to DORIC4 and VDC ASICs. The VDC input channels were pulsed with 20 MHz LVDS clock signals.

PIN Diode

The responsivity versus PIN bias voltage was measured as a function of bias voltage at different temperatures in the range –20^{0}C to +20^{0}C. The PIN diode was illuminated with VCSEL light at a wavelength of 850 nm. The results are shown in Figure 1 below.

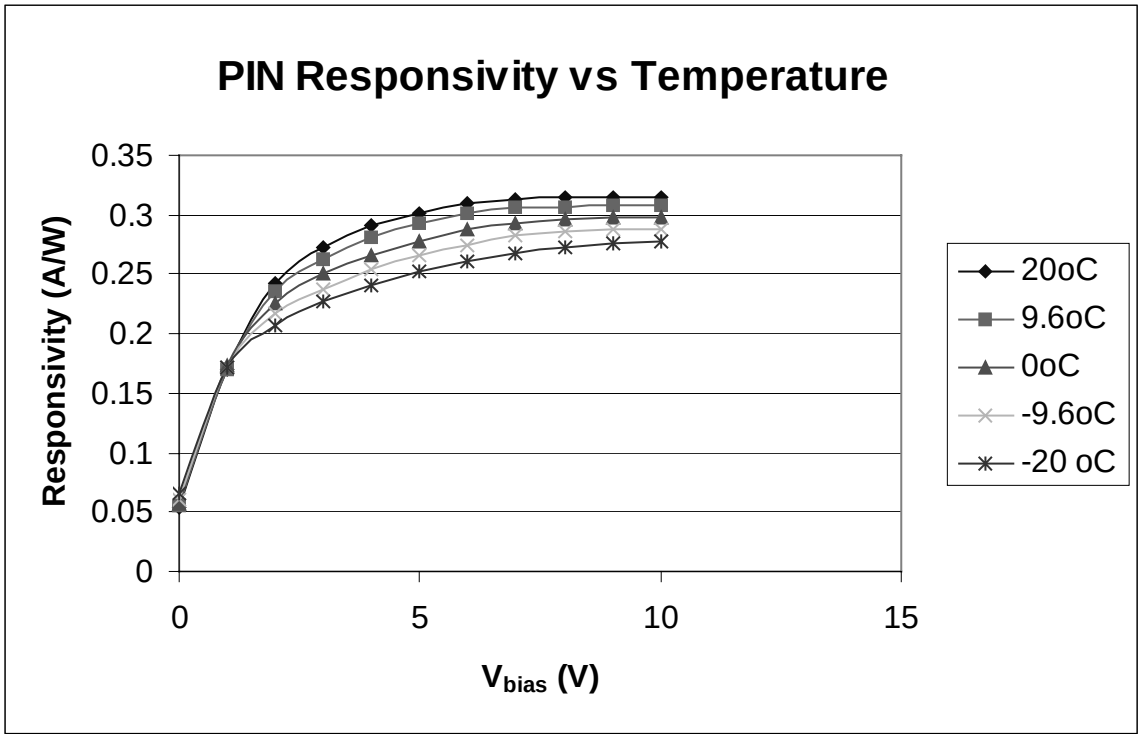

Figure 1 PIN diode responsivity versus bias voltage at different temperatures.

There is a small but significat decrease in responsivity as the temperature is decreased, which can be simply understood from the decrease in the carrrier

concentration. The full depletion voltage increases as the temperature is decreased and this effect is not yet understood.

VCSELs

The LI curves for the two VCSELs were measured at different temperatures and the results shown in Figures 2-3 below.

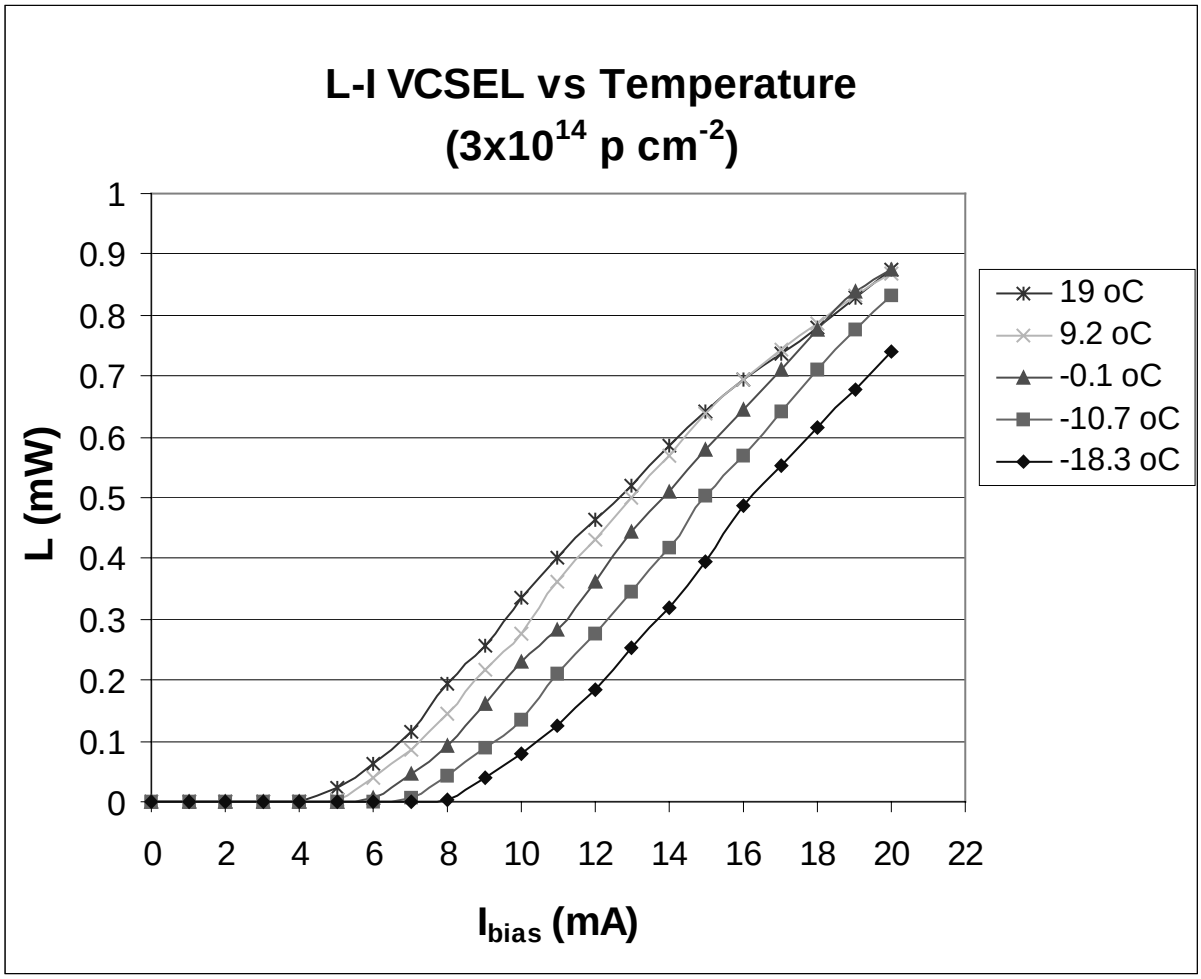

Figure 2 LI curves for VCSEL(channel furtherest from PIN diode) at differenet temperatures.

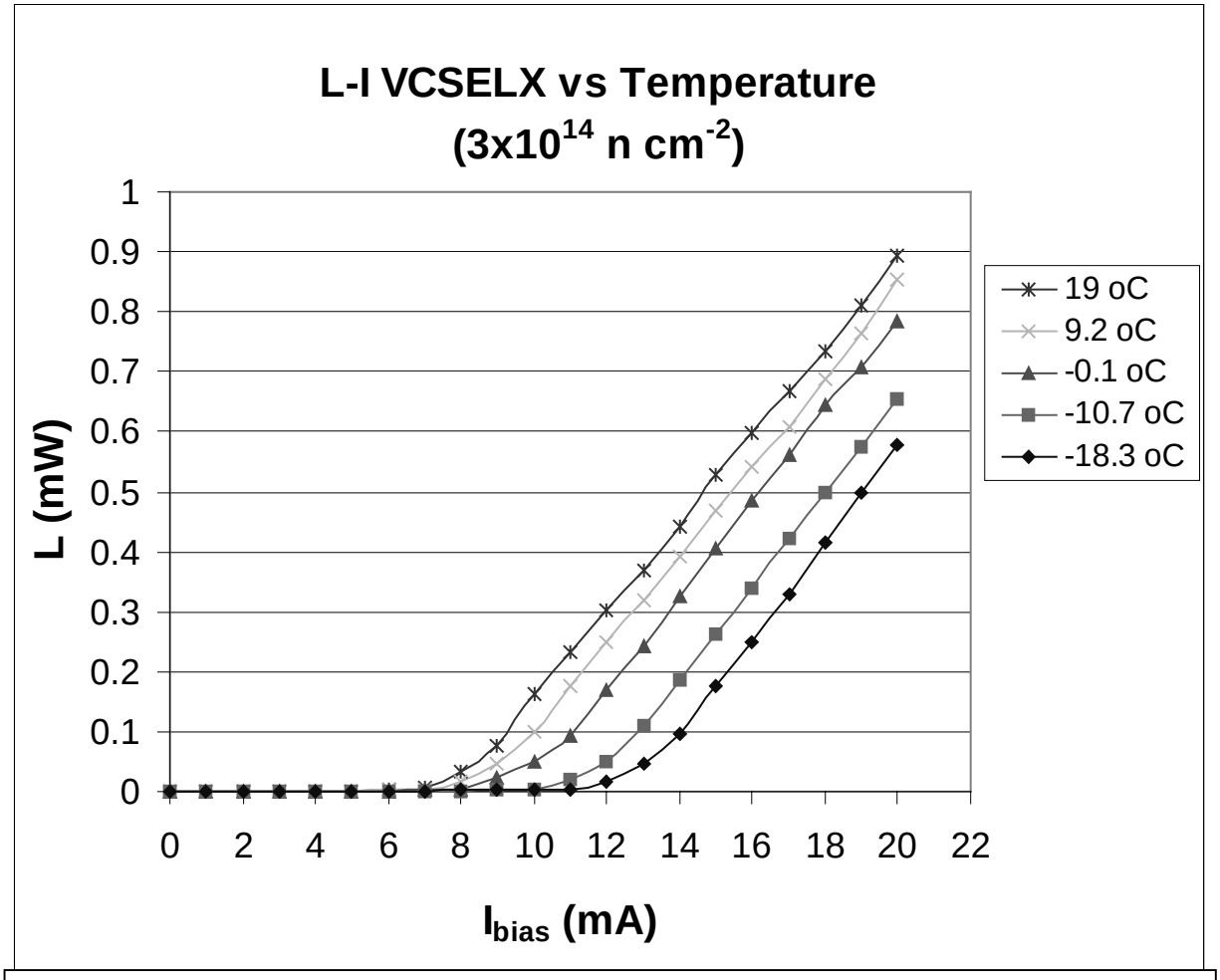

Figure 3 LI curves for VCSEL (channel nearest to PIN diode) at differenet temperatures

The results show that there is an increase in the threshold current of about 4 mA as the temperature is decreased from $+20^0$C to -20^0C. No such effect was observed with unirradiated Honeywell VCSELs[i] nor with irradiated SANDIA VCSELs[ii]. This effect is also not yet understood.

Conclusions

Changes in the performance of irradiated PIN diodes and VCSELs have been measured. While not all the effects are understood, the device performance is still within the ATLAS specifications over the temperature range from $+20^0$C to -20^0C.

[i] Performance of VCSELs for SCT links, I. Manic and T. Weidberg, ATLAS-INDET-98-213.

[ii] J. Beringer et al, Radiation hardness and lifetime tests of irradiated LEDs and VCSELs, NIM A435(1999) 375.