Radiation hard optocouplers

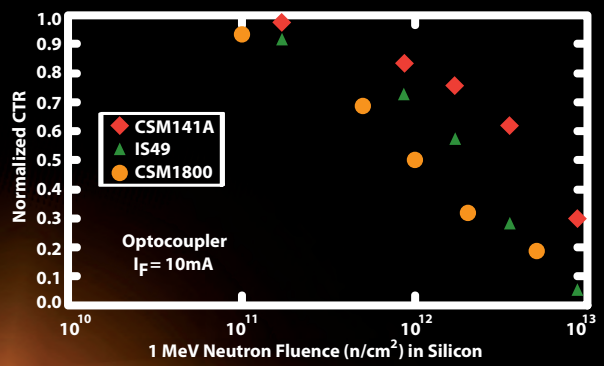
ISOCOM®
LIMITED

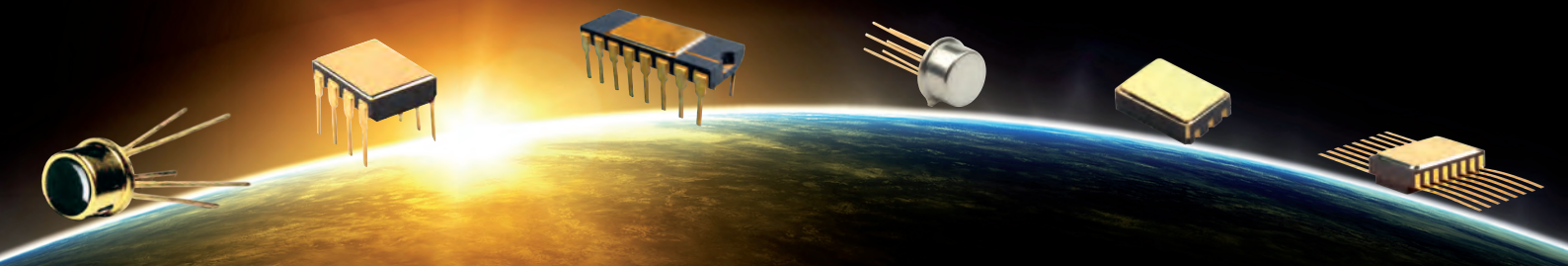
PROTON DISPLACEMENT DAMAGE MEASUREMENTS IN OPTOCOUPLER FAMILIES

Research was carried out by the Jet Propulsion Laboratory at California Institute of Technology under contract with the National Aeronautic Space Administration (NASA) on Isocom optocoupler families. JPL used the concept of non-ionizing energy loss (NIEL) to define an equivalent 1-MeV neutron fluence to interpret displacement damage. In other words, radiation environments of protons, neutrons and electrons are regarded as equivalent if they produce the same non-ionizing dose when proper NIEL factors for protons, neutrons and electrons are used to calculate the dose. DD measurements were performed with proton beam at the $1x10^{11}$, $5x10^{11}$, $1x10^{12}$, $2x10^{12}$ and $5x10^{12}$ equivalent 1-MeV neutron fluences in Silicon.

The IS49 and CSM141A devices were tested at the University of Indiana, Bloomington, cyclotron (IUCF) using 200-MeV protons. The CSM1800 device was tested at University of California Davis (UCD) and Canada's National Laboratory for Particle and Nuclear Physics (TRIUMF) using 65-MeV and 105-MeV protons, respectively. Five devices of each of the optocouplers were provided for radiation testing. The devices were exposed at room temperature to a series of radiation steps with electrical and optical measurements made before irradiation and between each step. All parts were in an unbiased condition during irradiation (all pins grounded) because DD effects are, to first order, insensitive to bias conditions during irradiation.

The graph below summarizes the result of radiation tests performed on Isocom optocouplers. After each irradiation level, the optocoupler CTRs were measured for a set of values of the forward current (I_F) through the LED, using the HP 4156 Semiconductor Parameter Analyzer. The test results demonstrate the parts have a lower degredation using an I_F10mA but have a lower operating margain when used with a low forward current, which does help the reliability of the LED.





For more information please contact us

Tel: +44 (0) 191 4166546 Email: sales@isocom.uk.com Web: www.isocom.uk.com

ISOCOM®
LIMITED

EUROPEAN MANUFACTURER of High Reliability OPTOCOUPLERS

LED degradation has a super linear dependence on displacement damage.

Where CTRo is the pre-irradiation optocoupler gain, CTR is the gain after irradiation. The alternate plotting format on the left side of figures 2, 4 and 6 is the function of fluence. A subset of the data shown in figures 1, 3 and 5, using test values of I_F 2 and 10 mA are plotted in this format producing figures 2, 4 and 6, using a value of n that produces a best fit to a straight line with unit slope in log-log plot.
The best fitting n for this data set is 1/3, which is appropriate for heterostructure LED used in the device.

Transistor Family

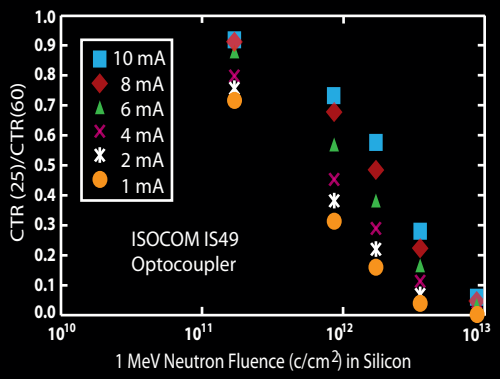


Fig. 1. Normalized CTR versus the radiation level for the IS49.

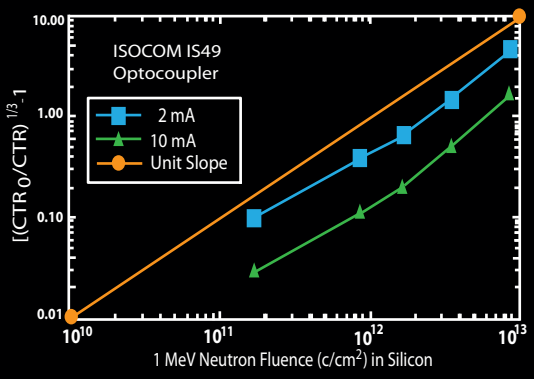


Fig. 2. Values of $[(CTRo/CTR)^{1/3} - 1]$ for $I_F = 2$ and 10 mA for IS49.

High Speed Family

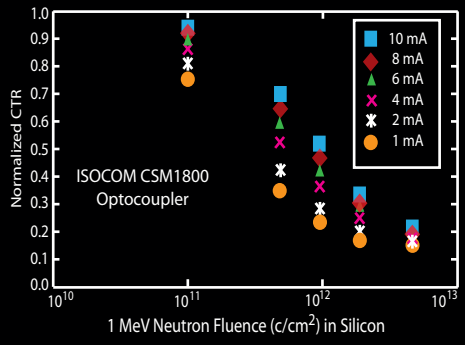


Fig. 3. Values of [(CTRo/CTR)1/3 – 1] for $I_F = 2$ and 8 mA for CSM1800.

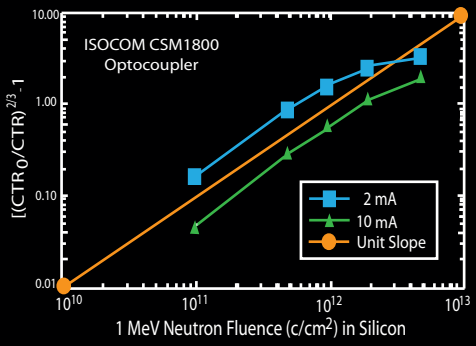


Fig. 4. Values of [(CTRo/CTR)1/3 – 1] for$I_F = 2$ and 10 mA for CSM1800.

High Gain Family

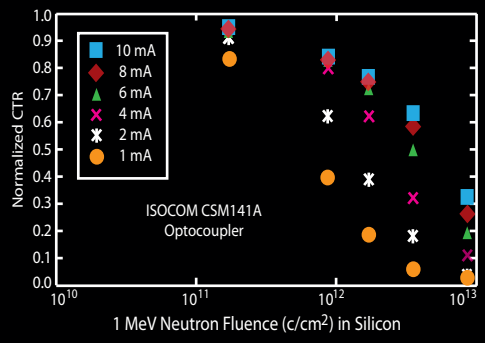


Fig. 5. Normalized CTR versus the radiation level for the CSM141A.

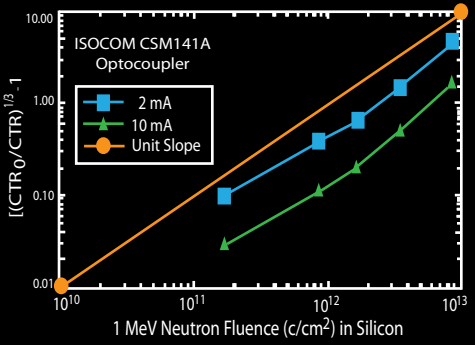


Fig. 6. Values of [(CTRo/CTR)1/3 – 1] for $I_F = 2$ and 10 mA for CSM141A.

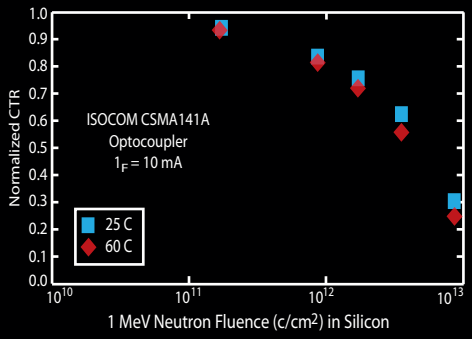


Fig. 7. Normalized CTR versus the radiation level for room temperature and 60°C for CSM141A.