

Radiation tests of the Texas Instruments TLK2501 in the Tevatron Tunnel

Abstract

This document describes a test of the Texas Instruments TLK2501 Transceiver in the Tevatron tunnel. The main purpose of the test was to investigate the sensitivity to radiation-induced single event upsets/latchups, as the device has previously shown a good resistance to total dose. The test device was installed at the foreseen location of the front end electronic for the Tevatron IPMs. Over a period of more than half a year, only a hand-full of events were seen.

Background

For the Tevatron IPM, it is foreseen to place the front end electronics inside the tunnel. The information will be sent to the surface building in digital form. The most efficient way to do this is on a serial link, using e.g. an optical fiber. The TLK2501 is a 1.5-2.5 Gbit/s serializer/deserializer that could be used for this purpose. However, in order to be used in the Tevatron, it has to withstand the radiation levels. The chip has already been tested for sensitivity to total dose, and found to be quite radiation hard (order Mrad). Another concern is single event upsets, caused e.g. by charged particles hitting sensitive locations on the chip. This is what the test was designed to measure.

Test setup

The test setup consisted of two TLK2501EVM evaluation boards from Texas Instruments. One was installed in the Tevatron tunnel, and one in the E0 surface building. The downstairs board was set up to generate and transmit a pseudorandom bit stream to the upstairs board thru an optical fiber. The upstairs board checks this bit stream for errors and puts out a logical error signal that was monitored by two counters. Both the error signal and its inverse were monitored so that extended downtimes can be detected.



Figure 1 Photo of the “scarecrow” radiation monitor location. The vertically movable platform is placed at the approximate future location of the IPMs. The TLK2501 test board was tie-wrapped to the detector (not visible in the photo).

Results

Six events were seen over a period of about 200 days, spanning the latter part of the FY04 run. In this case, an event is defined as an increase in the counter value. Some events had more than one count of increment, indicating that a burst of errors occurred within a data collection interval. The events did not correlate to exceptionally high losses, such as during scraping. The average radiation at the specific location in the tunnel has been measured to 0.3 rads/h during stores

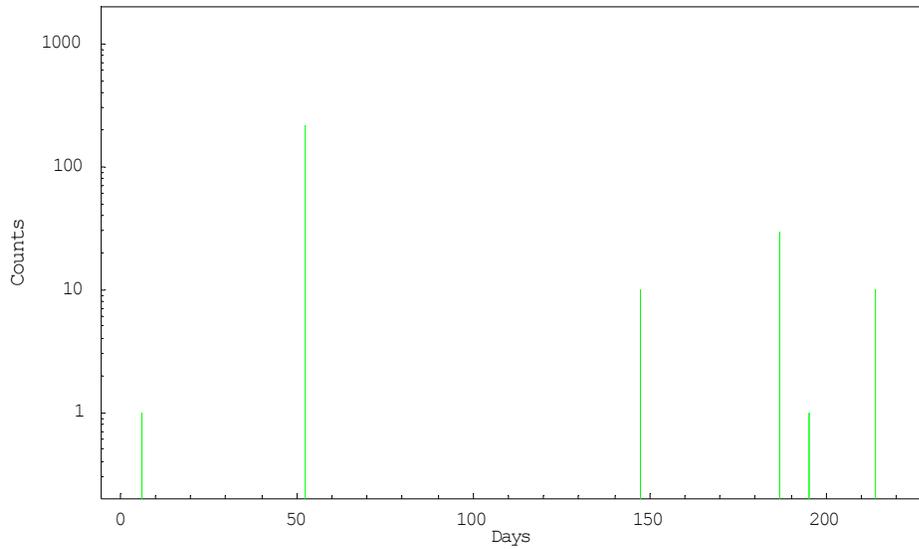


Figure 2 Incremental counts on the error counters. Most events has more than one count.

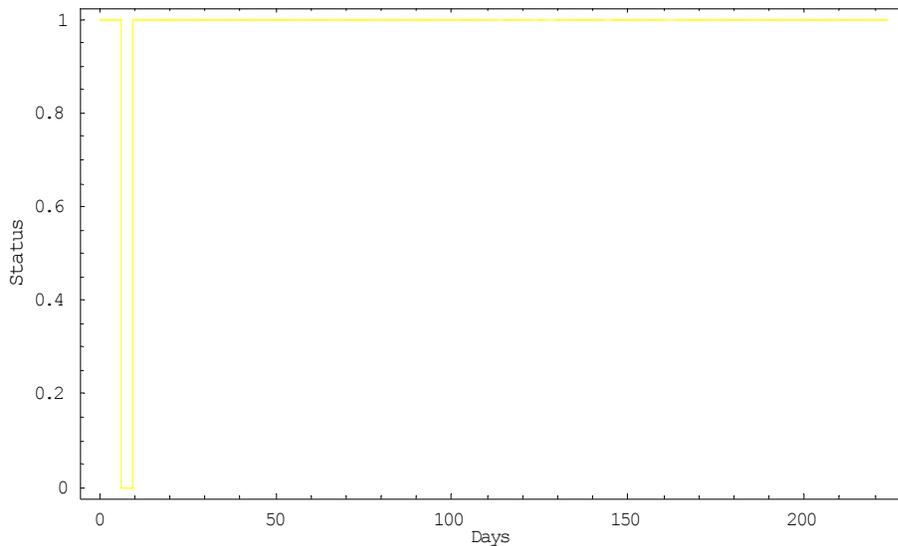


Figure 3 Setup status indication (difference between error counters). 1 indicated that the error bit it currently true, and zero that it is false. Only one case of suspected latchup was observed. This cleared with by cycling power to the downstairs card. The other error events recovered automatically.

Conclusions

The observed rate of observed single event upsets for TLK2501 in the Tevatron tunnel is very low, and should not affect operation.