Irradiation Test of the Single Event Upset Rate of the GLINK Transmitter/Receiver

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March 17, 2001

DUT: HDMP 1022 (TX), HDMP 1024 (RX)
Time: March 3, 2001, 7:00-9:30AM.
Location: Crocker Nuclear Laboratory, UC Davis
Proton beam energy: 63.3MeV
Active irradiation area: 2×2cm
Experimenters: Yong Li, Michael Medve, Carlos Castaneda (UCD)

Summary of Irradiation Test Result

Sample	Proton Fluence ($\times 10^{12}$ /cm^2)†	# of Single-Bit-Errors	# of Link-Downs	Total Single-Event-Upsets	Total Ionizing Dose (Krad)†	Single Event Upset Error Rate (1 SEU per # protons/cm^2)	SEU rate at CSC worst location (1 SEU per # of hours)‡
RX 1	2.65	7368	2004	9372	356.72	2.827×10^8	52.3
RX 2	4.11	11116	2981	14097	553.25	2.915×10^8	53.9
RX 3	4.05	11051	2924	13975	545.34	2.898×10^8	53.6
RX 4	3.91	10179	2784	12963	526.41	3.016×10^8	55.8
TX 1	4.07	11721	1444	13165	548.00	3.091×10^8	57.2

†The statistical error for the total proton fluence and the total ionizing dose is ≈1.6%.
‡The statistical error for the SEU rate at the location of worst radiation of CSC is less than 2%.

The DAQ was started before the *proton beam stop* was lifted and we saw no error without irradiation. After the *beam stop* was lifted and protons were dumped at the DUT, SEU errors were seen immediately. After the scheduled beam time was reached, *beam stop* was placed back into the proton beam to block further irradiation, the GLINK tester was still running perfectly and no more errors were logged. This phenomenon proved that the errors logged were indeed induced by proton irradiation and **the system was robust**.

Some arguments:

- The standard we set for qualifying the GLINK components is one SEU error per 42 minutes, assuming each upset causes link-down and the tolerable data loss is less than 0.1% for the whole CSC system. The tested result is about 70 times better than the standard.
- The fluence of neutrons with E>20MeV at the location of worst radiation of CSC in 10 years is 1.5×10^{12} /cm^2.
- This result definitely qualifies the HDMP 1024 (receiver). The HDMP 1022 (transmitter) should also be qualified, since it is manufactured with the same technology. Unfortunately I didn't have enough good TX samples.

The distributions of link-down time in μs:

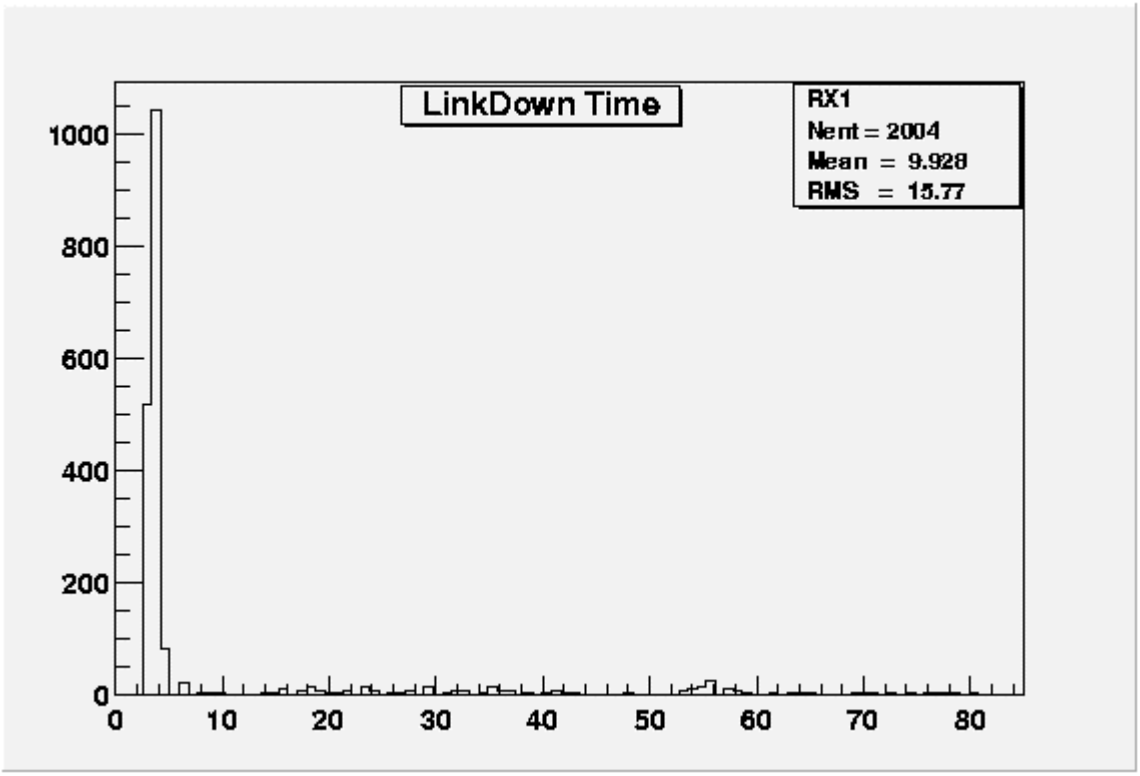

Figure 1. The link-down time distribution of RX1

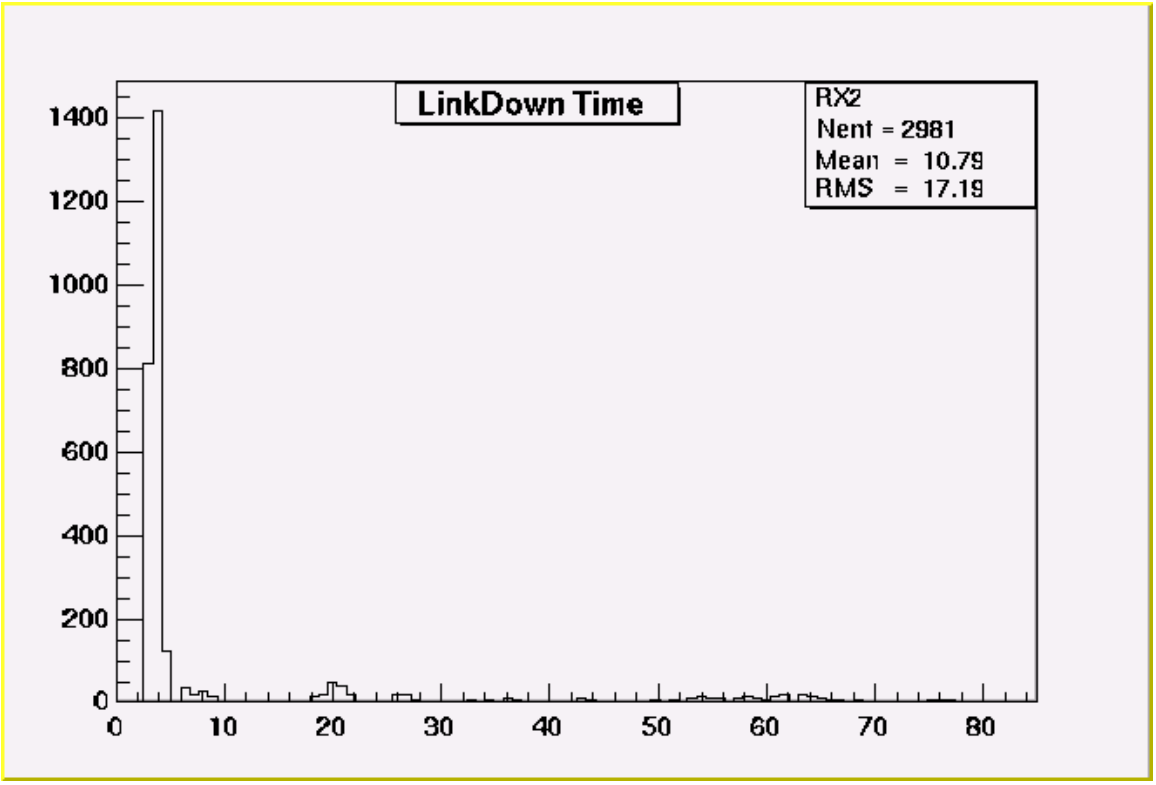

Figure 2. The link-down time distribution of RX2.

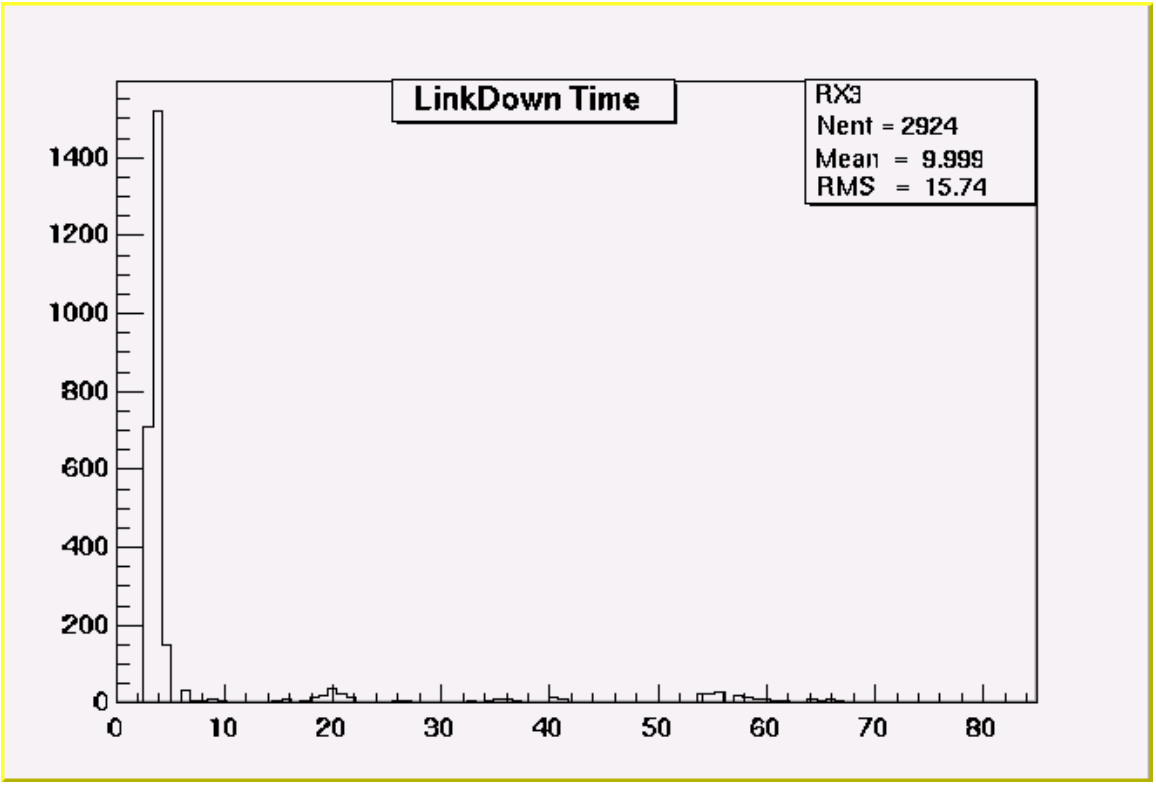

Figure 3. The link-down time distribution of RX3.

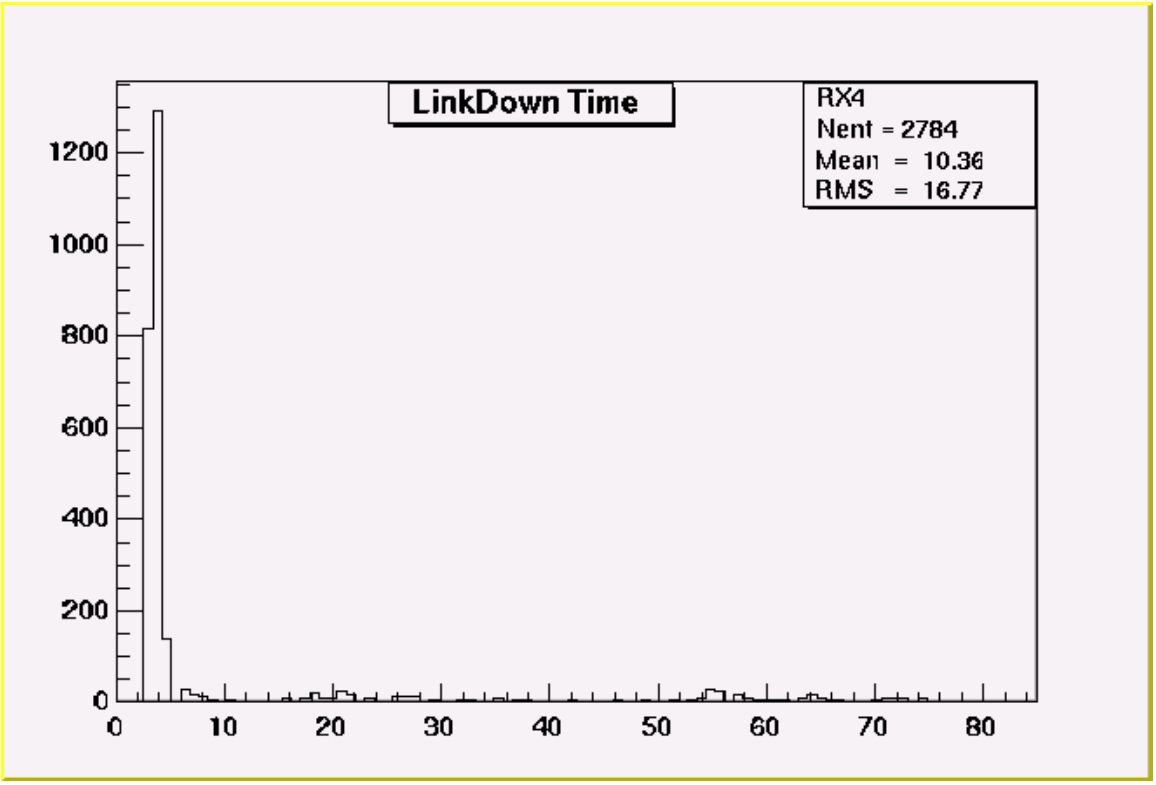

Figure 4. The link-down time distribution of RX4.

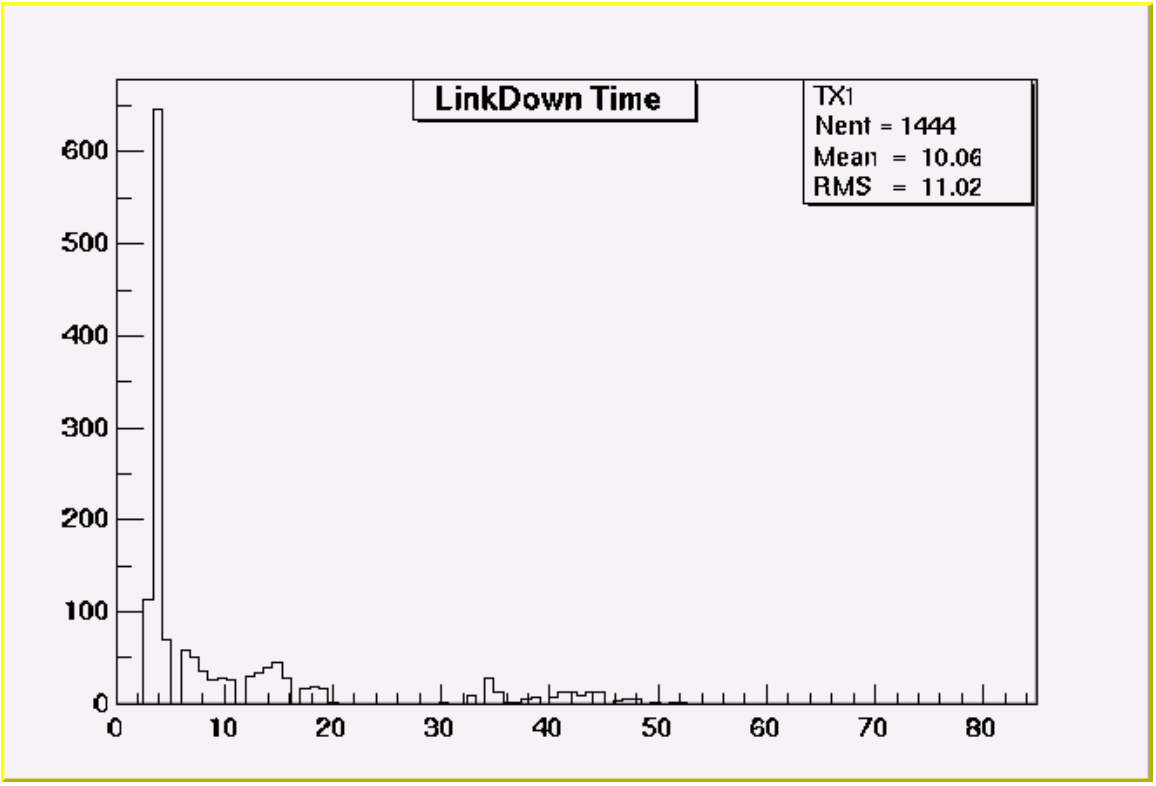

Figure 5. The link-down time distribution of TX1.