

Summary of Proton Test on
the Chip Express QYH530 at
Indiana University

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Test Facility

The Chip Express QYH530 was tested at the Indiana University Cyclotron Facility (IUCF). The proton energy was 193 MeV and the flux was set at approximately 1×10^9 p/cm²/sec. The total fluence for each device was determined by the total dose response of the device and its affect on the current draw; details for each device including bias are given in the tables below. The device was irradiated normal to the beam.

Device Under Test

The devices were in a PGA180 package and were active during irradiation. Upsets and currents were monitored in real-time with the device being clocked at 1 MHz. The stimulation pattern was a 500 kHz square wave. The test pattern used contains 1200 flip-flops. The QYH500 architecture only has routed flip-flops; there are no hard-wired or I/O module flip-flops.

Sample devices were taken from two lots, a “DITS-2” flight lot and a production lot used for shielding experiments; no radiation shields were used on any of the devices in this test. All devices were processed with Chip Express’ One-Mask technology with no laser programmed devices tested during these runs. These devices had already been subjected to heavy ion tests at Brookhaven National Laboratory.

Test Results

The following table summarizes the device, bias conditions, and irradiations.

S/N	Lot	Bias (Volts)	Total Dose kRads (Si)	Upsets	Fluence (p/cm ²)
QYHD1	DITS-2	4.5	18.9	0	0.3 x 10 ¹²
QYHD2	DITS-2	3.3	25.1	0	0.4 x 10 ¹²
QYHD3	DITS-2	3.3	25.1	0	0.4 x 10 ¹²
QYH55	LOT OF 70	3.3	25.1	0	0.4 x 10 ¹²
QYH56	LOT OF 70	3.3	25.1	0	0.4 x 10 ¹²

Five devices were irradiated, one with a 4.5V bias and four with a 3.3 bias with no upsets for all of the runs. An estimate of an upper bound for the cross-sections can be computed, assuming a single upset, as $0.5 \times 10^{-15} \text{ cm}^2/\text{flip-flop}$. There was no clock upset detected in any of the devices.

The device's total dose performance was good, even though the devices had been previously irradiated. Nevertheless, the following table and figure shows radiation-tolerant performance. The dose rate was high at 216 kRads (Si) / hour.

Table 1. Static current after each run in mA.

Note: Devices previously irradiated with heavy ions.

	6.3 kRads (Si)	12.6 kRads (Si)	18.8 kRads (Si)	25.1 kRads (Si)
QYHD1	0	1.7	31.6	
QYHD2	0	0.6	8.5	35.9
QYHD3	0	0.0	7.3	32.9
QYH55	0	0.2	5.1	25.5
QYH56	0	0.0	3.3	23.3

QYH530 193 MeV Proton Test

Flux = 1×10^9 p/cm²/Sec

S/N QYHD2 - DITS-2 Lot

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