10-Gbps True Random Number Generator Accomplished in ASIC

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Poster ID: 016

Design of a 10-Gbps Random Number Recorder

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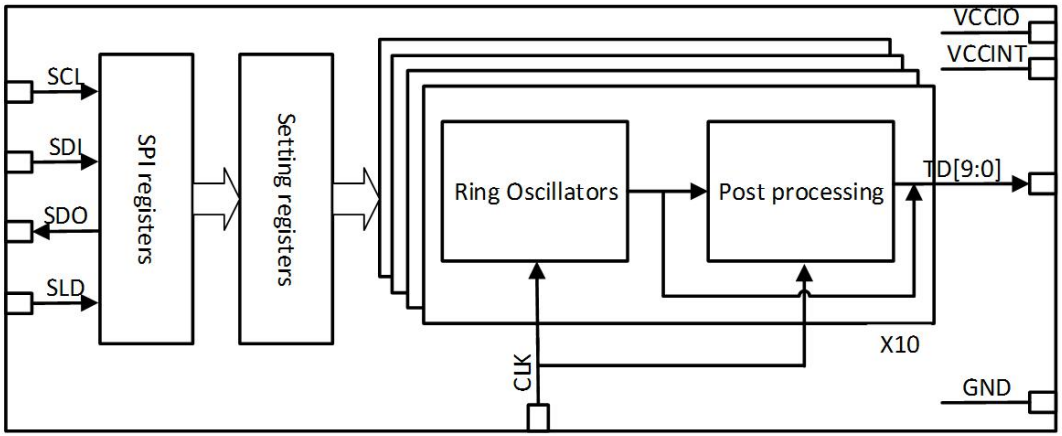
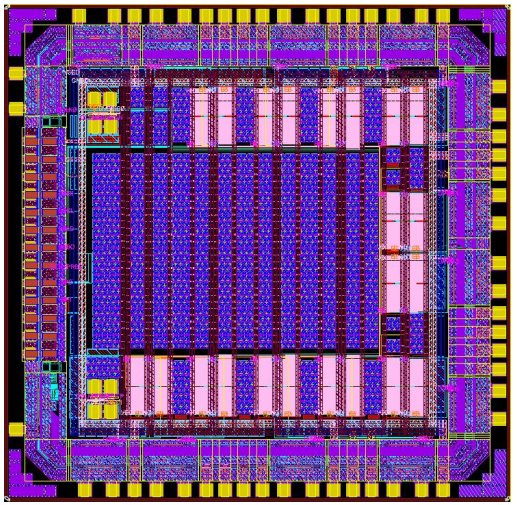
Poster ID: 051

The TRNG2015 is a 10-channel paralleled high speed true random number generator accomplished in ASIC

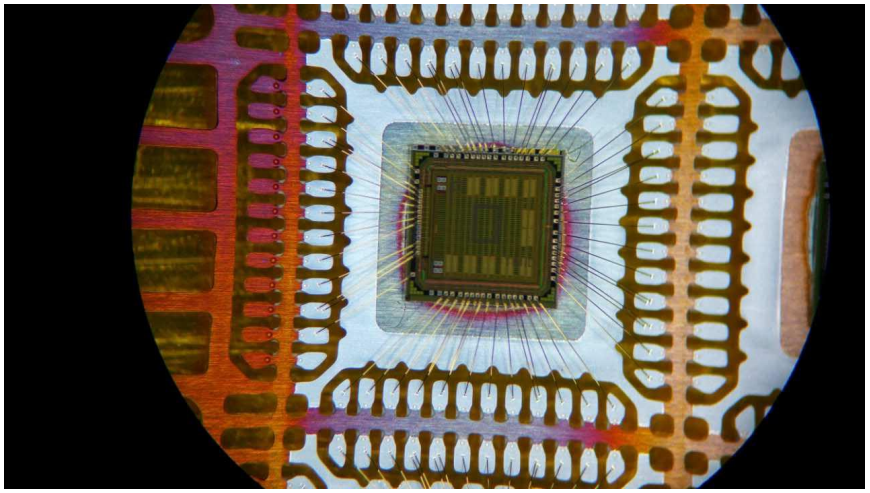


Structure of the TRNG2015

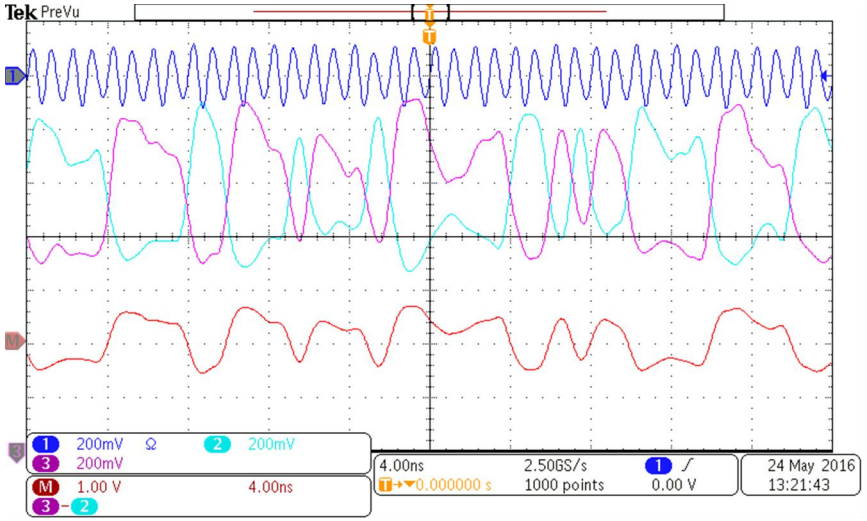
The TRNG2015 uses clock jitters of digital circuit as its entropy source.
The data rate is determined by the off-chip sampling clock.
The whole circuit can be set by SPI bus.



Layout of the TRNG2015



The TRNG2015 is fabricated in a 130 nm CMOS process. Each die occupies an area of 2.5mm x 2.5mm and is assembled in a 6mm x 6 mm QFN48 package.



The data rate of each channel can be as high as 1Gbps. The power dissipation when all the ten channels are fully functional is about 700mW in total.

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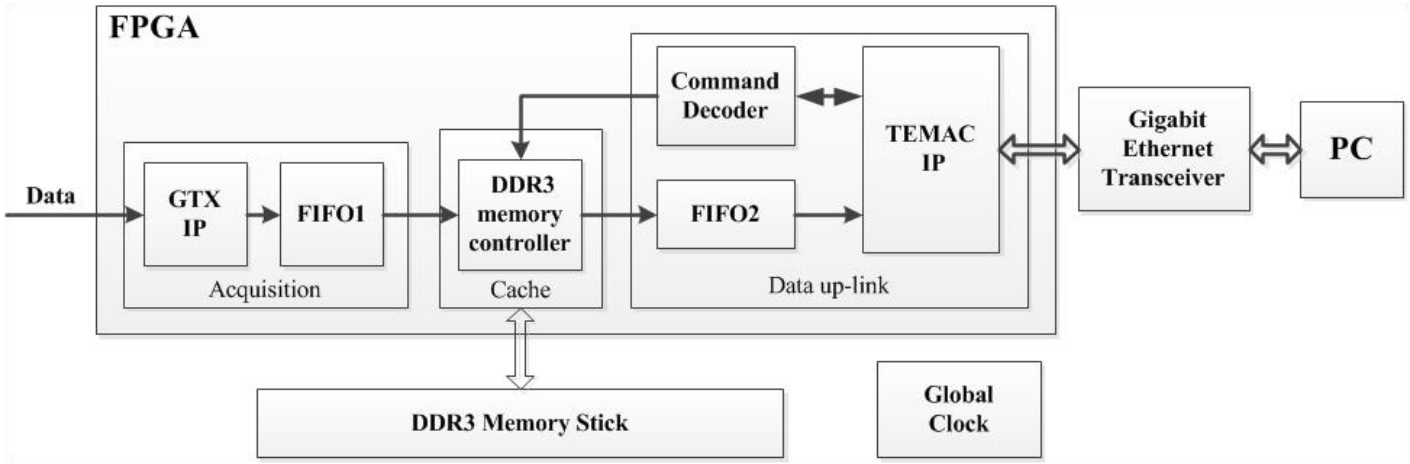

The high speed data acquisition is designed to receive and cache the random number generated by TRNG2015. The prototype is based on a Xilinx Vertex-6 FPGA ML605 evaluation board.

PRBS	Total Bits	Errors	Error Ratio
PRBS7	1.6×10^9	0	$< 6.25 \times 10^{-10}$
PRBS15	1.6×10^9	0	$< 6.25 \times 10^{-10}$
PRBS23	1.6×10^9	0	$< 6.25 \times 10^{-10}$
PRBS31	1.6×10^9	0	$< 6.25 \times 10^{-10}$

Results of bit error ratio test

National Institute of Standards and Technology(NIST)

Statistical Test	P-value	Proportion	Results
Frequency	0.954015	0. 985	Success
Block Frequency (m=128)	0.013380	0. 993	Success
Cumulative sums, worst	0.703417	0. 988	Success
Runs	0.842937	0. 986	Success
Longest run	0.162606	0. 988	Success
Rank	0.811080	0. 995	Success
FFT	0.530120	0. 986	Success
Non-overlapping Templates (m = 9), worst	0.045675	0. 991	Success
Overlapping Templates (m = 9)	0.998376	0.989	Success
Universal	0.011464	0. 994	Success
Approximate Entropy (m = 10)	0.512137	0. 988	Success
Random Excursions, worst	0.045375	0.985	Success
Random Excursions Variant (x = -1)	0.086830	0.987	Success
Serial (m = 16), worst	0.484646	0.984	Success
Linear Complexity (M = 500)	0.450297	0.989	Success

The data recorded from TRNG2015 can pass the NIST tests.

In the NIST tests, data size is 1000 Mbits (1000 sequences with each sequence around 1 Mbits). For 'success' using 1000 samples of 1 Mbits data and signifi cance level = 0.01, the P-value (uniformity of p-values) should be larger than 0.0001 and the proportion should be in the range of 0.99 ± 0.0094392

Poster Session 2

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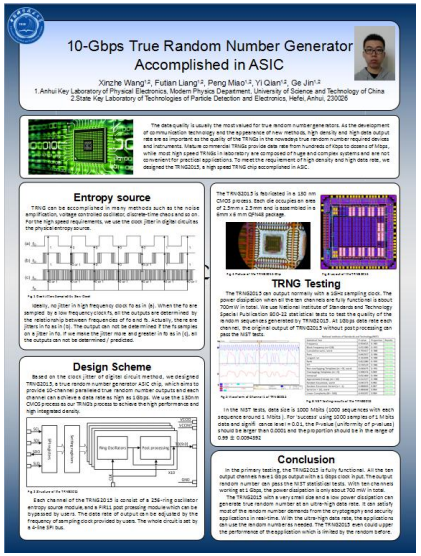

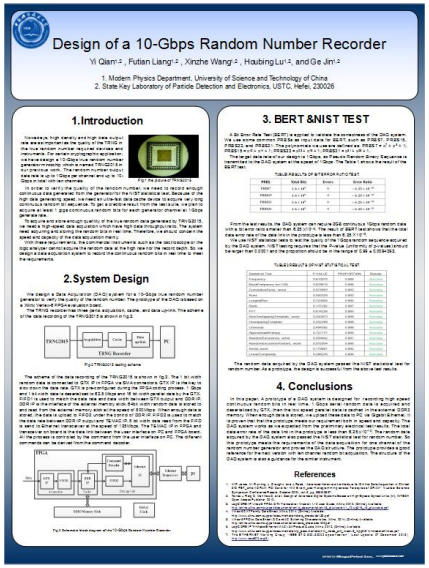

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