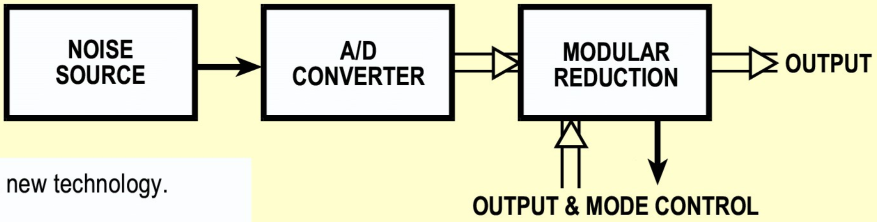
*x*RNG High Performance Random Number Generators

Add hardware true random number generation (RNG) to your application with our simple, inexpensive method.

If you can provide a noise source, an A/D converter, and a little bit of logic, then you can use our xRNG method.*



The purpose of this brief is to introduce a new technology.
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FEATURES

- NON-DETERMINISTIC (TRUE RANDOM OUTPUT)
- HIGH SPEED
- UNIFORMLY DISTRIBUTED OUTPUT
- SMALL BIAS
- SYNCHRONOUS
- REQUIRES NO CALIBRATION
- LOW COST

APPLICATIONS

- COMPUTER PLATFORM SECURITY
- SECURE INTERNET E-COMMERCE
- CRYPTOGRAPHY
- SECURITY KEY GENERATION
- ELECTRONIC GAMES
- COMPUTER MODELING
- ARTIFICIAL INTELLIGENCE

*x*RNG is a high-speed, hardware-based true random number generator (RNG) method which provides digital systems with unsurpassed performance, security, and value. The method is particularly well-suited to applications which already entail an analog-to-digital converter.

High-Performance computing applications will benefit from the extremely small bias, which can now be provided for true-random sequences generated synchronously at extremely high speed: high-quality numbers at up to PECL speeds.

Low-Cost security applications, such as personal computers, internet appliances, smart cards, cellular telephones, automotive remote key hubs, and other low-to-moderate speed applications, will benefit from the extremely small bias, which can now be provided for true-random sequences generated at moderate-to-high speed at low cost.

SOURCES

1. Intel Platform Security Division. (1999) *The Intel Random Number Generator.*
2. Rand Corporation. (1966) *A Million Random Digits with 100,000 Normal Deviates,* The Free Press. Glencoe Illinois.
3. Schmidt, H. (1970) Quantum-mechanical random-number generator. *Journal of Applied Physics, 41,* 462-468.
4. U.S. Patent No. 4,853,884 8/1989 Brown et al. (Motorola) Random Number Generator with Digital Feedback
5. U.S. Patent No. 5,224,165 6/1993 Reinhardt et al. (Hughes Aircraft) High Speed Word Generator
6. U.S. Patent No. 5,961,577 10/1999 Soenen et al. (Texas Instruments) Random Binary Number Generator
7. U.S. Patent No. 5,963,104 10/1999 Buer (VLSI) Standard Cell Ring Oscillator of a Non-deterministic Randomizer Circuit

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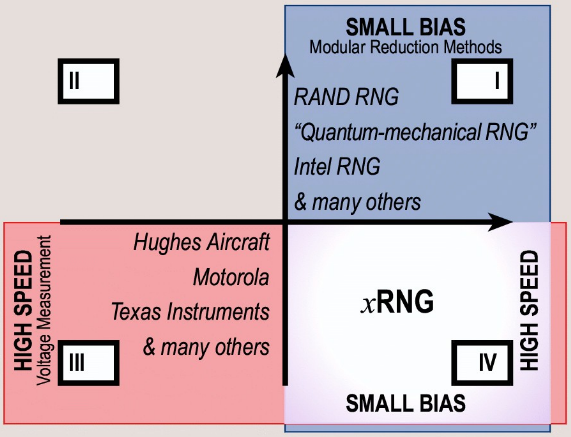
Get High Speed *and* Small Bias with *x*RNG

xRNG technology combines the high speed of voltage measurement with the small bias of modular reduction. Designers no longer have to choose between small-bias (quadrant I) and high-speed (quadrant III). With xRNG, designers can now have both in quadrant IV.

Quadrant I small-bias designs measure time with a modulo-counter. In 1947, RAND used a random pulse source to stop a 5-bit counter.[2] Today, the Intel RNG released in the 810 Chipset uses a random source and a 1-bit counter.[1] However, "it takes time to measure time."

Quadrant III high-speed designs measure voltage with a comparator. However, the median of a random voltage wanders, so that the 1-bit output has an unstable bias requiring correction. For example, Hughes Aircraft[5] and VLSI[7] exclusive-or the outputs from many 1-bit RNGs.

Quadrant IV xRNG designs measure voltage with an analog-to-digital converter for high speed and use modular reduction for small bias.



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