

Compact Random Number Generators

Ukalta's fading channel simulation IP can be combined with our Gaussian noise generator and pseudo-random data sources to construct a complete bit-error rate test suite at the baseband level.

Random Number Generator IP Core Features

- Generate uncorrelated Gaussian or uniform samples
- Gaussian distribution generators accurate up to $\pm 7.1\sigma$ with a flat (white) power spectral density
- Ultra-compact on FPGAs: generating 400 million Gaussian samples per second using only two block memories and fewer than 300 logic resources
- Repetition periods from 2^{88} to 2^{19937} samples

Product List

For purchasing or to obtain more detailed information on the products below or any other services, please contact Ukalta Engineering.

Part number	Description
UEMU-1x1	1x1 full-duplex fading channel emulator
UEMU-2x2	2x2 full-duplex fading channel emulator
UEMU-N	Multi-node fading channel emulator
USCH-FF*	Frequency-flat fading channel IP core
USCH-FS*	Frequency-selective fading channel IP core
USCH-GEO*	Geometric fading channel IP core
UMCH-FF*	Frequency-flat MIMO fading channel IP core
UMCH-FS*	Frequency-selective MIMO fading channel IP core
UMCH-GEO*	Geometric MIMO fading channel IP core
UGNG31	$\pm 3.1\sigma$ Gaussian noise generator IP core
UGNG57	$\pm 5.7\sigma$ Gaussian noise generator IP core
UGNG71	$\pm 7.1\sigma$ Gaussian noise generator IP core
UPNG	Library of pseudo-random uniform number generator IP cores

* Fading channel IP cores are available with the standard Jakes' PSD (-JKS option) or with an arbitrary user-defined PSD (-USD option)

Contact Information

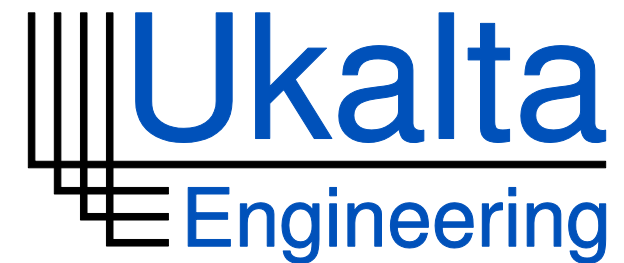
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*Wireless Test and Verification
Product Overview*

Wireless Product Verification

Ukalta provides innovative solutions for the verification and testing of wireless communication systems. Typical performance validation scenarios encountered during the development of wireless products involve extensive over-the-air testing or costly bench-top equipment. Ukalta improves wireless performance validation through the provision of cost-effective channel simulation technology, available as stand-alone emulators or in the form ultra-compact IP cores for FPGA-based prototyping and simulation.

Full-Duplex Fading Channel Emulators

Ukalta has developed a line of protocol agnostic wideband channel emulators for low data-rate systems. These cost-effective emulators are suitable for verification of single and multiple antenna products. With full-duplex RF interfaces Ukalta's fading channel emulators are ideal for testing wireless products operating over unlicensed radio bands, such as medical instruments and Zigbee and Bluetooth devices.



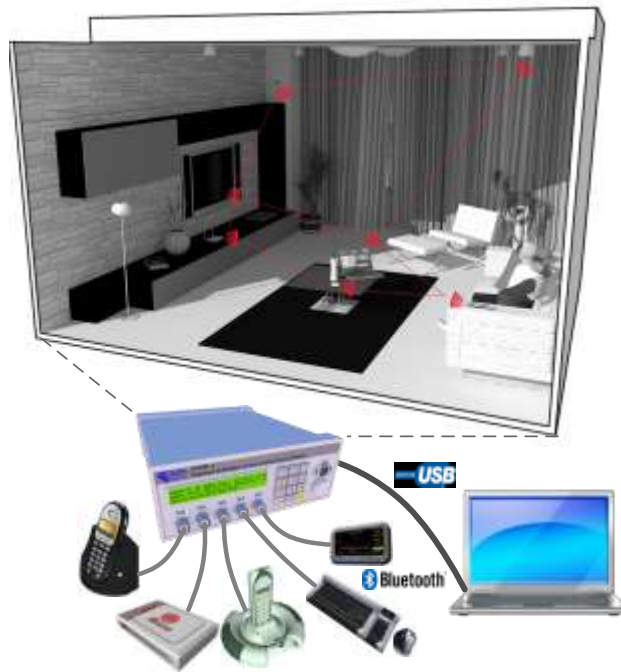
Ukalta SISO and 2x2 MIMO fading channel emulators

Fading Channel Emulator Features

- **Full-duplex** fading channel emulation for two devices in single antenna or 2x2 MIMO configurations
- **Wideband:** 100 MHz bandwidth
- Operational frequency range: **50 to 2500 MHz**
- Input signal level: **-50dBm to +20dBm**
- Doppler frequency: **0 to 2000Hz in 0.01Hz steps**
- Supports Rayleigh and Rician small-scale fading and exponential path loss large-scale fading
- Can be configured for isotropic and non-isotropic scattering
- Optional support for accurate ray-tracing models

Multi-node Fading Channel Emulator

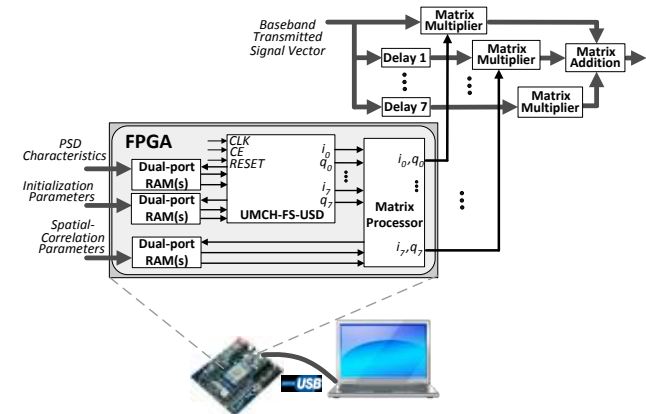
The coexistence of wireless devices that use shared spectrum is problematic and prone to radio interference, often resulting in severe degradation in the performance of communication systems. Ukalta has developed a multi-node emulator platform that is ideal for coexistence testing of multiple wireless communication systems under diverse flat-fading channel conditions. With this platform the product under development can be tested in the presence of multiple interfering RF devices, aiding designers in ensuring that their system is versatile and robust in the presence of interference from other radio systems. Ukalta's multi-node fading emulator simplifies the development of wireless products by eliminating the need for custom-built testbeds and extensive over-the-air testing, reducing cost and time-to-market by providing system designers with repeatable emulation of wireless conditions.



The Ukalta multi-node fading channel emulator accurately replicates diverse scenarios for coexistence testing inside a single device

Channel Simulation IP Cores

Performance verification of wireless systems and optimization of baseband algorithms often requires extensive software simulation and verification with RF fading channel emulators. Ukalta offers a complete suite of ultra-compact IP cores that are ideal for performance evaluation of the baseband processing modules at speed on FPGAs. Early testing of the baseband algorithms on FPGA hardware under realistic channel conditions offers significant reductions in simulation turn-around time and prevents costly chip redesigns.



A 2x4 MIMO fading channel simulator with user-defined PSD and spatial correlation

Fading Channel Simulation IP Core Features

- Frequency-selective fading with parameterizable delays between paths
- Generates statistically-accurate Rayleigh, Rician, Nakagami- m , and Weibull fading samples
- Fully-controllable parameters, such as Doppler frequency and Rician K-factor
- Simulates standard Doppler power spectral densities (PSDs) such as Jakes' and Bell spectrums as well as user-defined PSDs
- MIMO channel support with analytical spatial correlation models such as Kronecker, Weichselberger, and full correlation
- Supports geometric fading models such as single- and double-bounce using one and two-ring models and geometric-elliptical model