

# IONOS SIM HF/VHF Channel Simulator Specifications

Rev Nov 17, 2020 (Firmware rev 2.03)

**Description:** IONOS SIM is a self-contained audio DSP based ionospheric simulator based on the Watterson Model [1] for ITU/CCIR standardized HF and VHF propagation paths. It uses the Teensy 4.0 CPU (ARM Cortex-M7 processor at 600 MHz) and Teensy Audio DSP Library.

**Primary Use:** The development, characterization, maintenance and comparison of HF and VHF modems and protocols including “sound card” protocols.

**Channels Modeled:** **WGN** (White Gaussian Noise: Spread 0 Hz, Delay: 0 ms); , **MPG** (CCIR Multipath Good) Spread .1 Hz, Delay .5 ms ; **MPM** (CCIR Multipath Moderate) Spread .5 Hz, Delay 1 ms; , **MPP** (CCIR Multipath Poor) Spread 1 Hz, Delay 2 ms; **MPD** (Multipath disturbed) Spread 2 Hz, Delay 4 ms; **Flat Fading** 0-40 dB, Fade Rate: .1-20 Hz; **Fixed Freq offset** +/- 200 Hz, 10 Hz steps; **Slow FM deviation** +/- 1-200 Hz, Rate .1 to 20 Hz; Multipath update rate 64x Doppler spread. Fade, offset, and FM can be combined with mode WGN.

**Audio Paths:** WGN: 1 path. Multipath: 2 or 4 I&Q paths. Input to Output Delay: Min 3.5ms (WGN); Max 8 ms (Multipath Disturbed). Multipath 2 paths: I2, Q2 Paths delayed by .5, 1, 2, or 4 ms.

Multipath 4 paths: I2,Q2 Paths delay by .25, .5, 1, or 2 ms I3,Q3 paths delayed by .5, 1, 2, or 4 ms.

I4,Q4 paths delayed by .75, .1.5, 3, or 6 ms

**Connections Modeled:** 1 Simulator: Half duplex, both sides, symmetric channel models. 2 Simulators: Full Duplex both sides: symmetric or asymmetric channel models.

**Bandwidths:** 3 KHz: 300 Hz to 3.3 KHz, 6 KHz: 300 Hz to 6.3 KHz. +/- 1dB **Sampling rate:** 44.1 KHz

**Noise modeling:** WGN filtered to 3 KHz or 6 KHz bandwidth. S:N -40 to +40 dB, 1 dB steps.

**Inputs:** Ch1, Ch2 via standard Stereo 1/8” (3.5 mm) jack. AC coupled. Input protection. Impedance > 50KOhms. Nominal input range: 10 – 1800 mv p-p. Manual input level control. Internal simulator level and input crest factor (CF) displayed.

**Outputs:** Ch1, Ch2 via standard Stereo 1/8” (3.5 mm) jack. AC Coupled. Short circuit protection. Impedance 150 Ohms. Nominal output range 10 - 1800 mv p-p. Manual output level control.

**Power Required:** Nominal 5 v (internally reg. to 3.3 V) via micro USB connector. < 200 ma.

**Display:** 320H x 240V pixel color TFT for Text and Graphics. (parameter settings, input level/CF, 3 & 6 KHz Spectrum Display)

**Modes:** Self-Test and Calibration verification to +/-1 dB Across operating BW; Setup modes and parameters;

**User Parameter settings and control:** Two Incremental encoders (Mode, Parameter) each with push toggle. Alternate USB serial ASCII commands for automated operation (4800-115200 baud).

**Size:** 6.1” (155 mm) L x 4.7” (120 mm) W x 1.4” (36 mm) H (excluding knobs).

**Alternate Functions:** Integrated Busy Channel Detector (experimental). Uses only serial USB ASCII command interface with host program.

[1] Watterson, C.C., J.R. Juroshek, & W.D. Bensema. 1970 Experimental confirmation of an HF channel model IEEE Transaction of Communication. Technology. Vol COM-18. Pp 792-803 Dec 1970