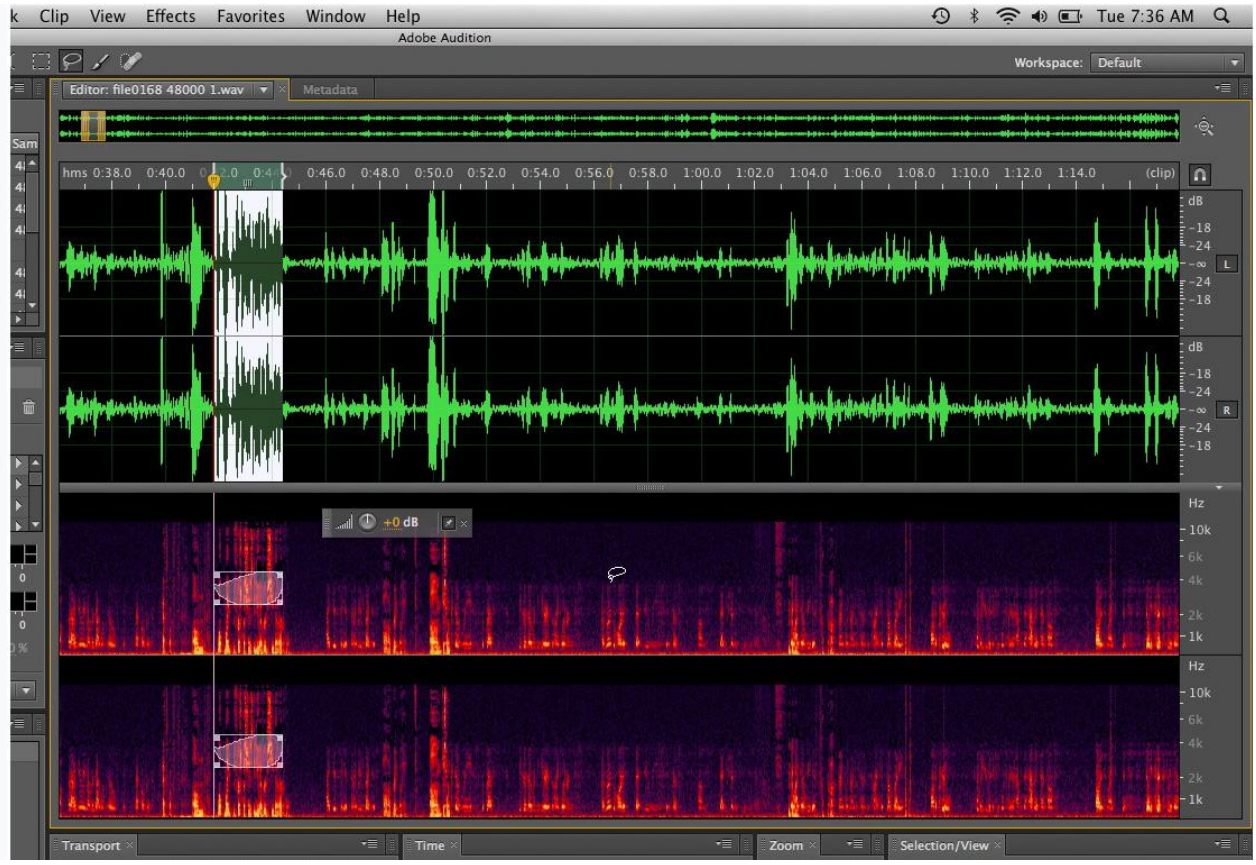
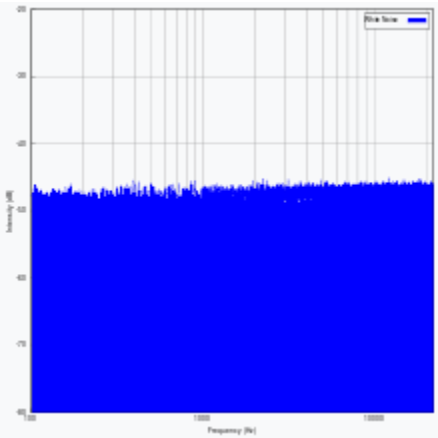
Colors of noise

In audio engineering, electronics, physics, and many other fields, the **color of noise** refers to the power spectrum of a noise signal (a signal produced by a stochastic process). Different colors of noise have significantly different properties: for example, as audio signals they will sound different to human ears, and as images they will have a visibly different texture. Therefore, each application typically requires noise of a specific color. This sense of 'color' for noise signals is similar to the concept of timbre in music (which is also called "tone color); however in music it is almost always used for sound, and may consider very detailed features of the sound spectrum.



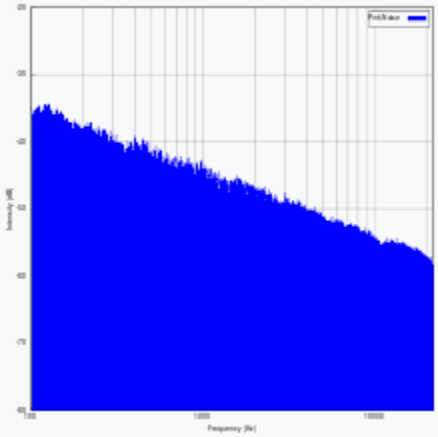
White noise



White noise spectrum. Flat power spectrum.

White noise is a signal (or process), named by analogy to white light, with a flat frequency spectrum when plotted as a linear function of frequency (e.g., in Hz). In other words, the signal has equal power in any band of a given bandwidth (power spectral density) when the bandwidth is measured in Hz. For example, with a white noise audio signal, the range of frequencies between 40 Hz and 60 Hz contains the same amount of sound power as the range between 400 Hz and 420 Hz, since both intervals are 20 Hz wide

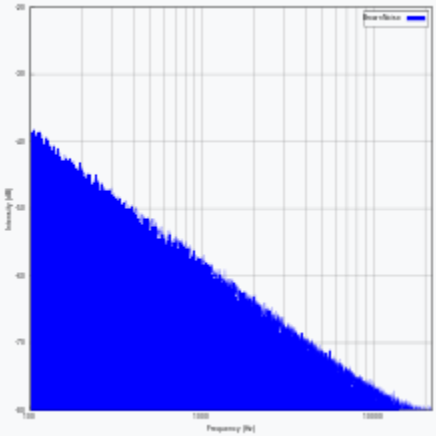
Pink noise



Pink noise spectrum. Power density falls off at 10 dB/decade (−3 dB/octave).

The frequency spectrum of pink noise has equal power in bands that are proportionally wide.[2] This means that pink noise would have equal power in the frequency range from 40 to 60 Hz as in the band from 4000 to 6000 Hz. Since humans hear in such a proportional space, where a doubling of frequency (an octave) is perceived the same regardless of actual frequency (40–60 Hz is heard as the same interval and distance as 4000–6000 Hz), every octave contains the same amount of energy and thus pink noise is often used as a reference signal in audio engineering.

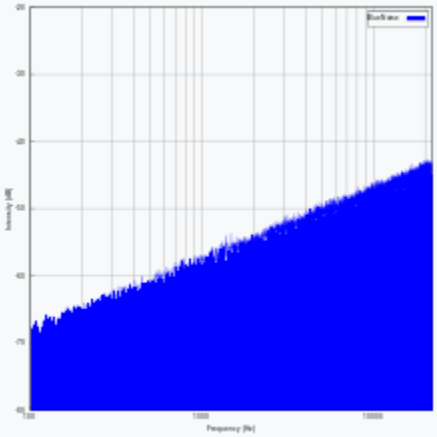
Brown(ian) noise



Brown spectrum (−6 dB/octave)

The terminology "red noise", also called Brown noise or Brownian noise, will usually refer to a power density which decreases 6 dB per octave with increasing frequency over a frequency range. In areas where terminology is used loosely, "red noise" may refer to any system where power density decreases with increasing frequency.

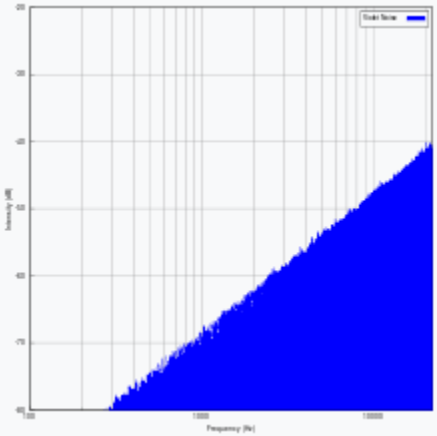
Blue noise



Blue spectrum (+3 dB/octave)

Blue noise is also called azure noise. Blue noise's power density increases 3 dB per octave with increasing over a finite frequency range.

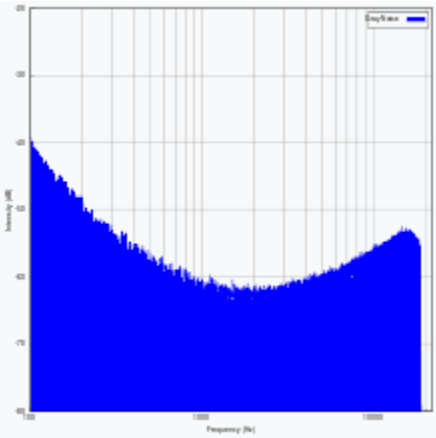
Violet noise



Violet spectrum (+6 dB/octave)

Violet noise is also called purple noise. Violet noise's power density increases 6 dB per octave with increasing frequency

Grey noise



Grey spectrum

Grey noise is random white noise subjected to a psychoacoustic equal loudness giving the listener the perception that it is equally loud at all frequencies. This is in contrast to standard white noise which has equal strength over a linear scale of frequencies but is not perceived as being equally loud due to biases in the human equal-loudness contour.

Other Types of Colors

Red noise

- A synonym for Brownian noise, as above[11][12]
- Similar to pink noise, but with different spectral content and different relationships.

Green noise

- The mid-frequency component of white noise, used in halftone dithering
- Bounded Brownian noise
- Vocal spectrum noise used for testing audio circuits
- Joseph S. Wisniewski wrote that "green noise", as marketed by producers of ambient sound effects recordings, is "supposedly the background noise of the world." It is noise that simulates the spectra of natural settings, without man-made noises. It is similar to pink noise but it has more energy in the area of 500 Hz.

Black noise

Black noise is also called silent noise.

- Silence
- This is used to model the frequency of natural disasters.
- Noise that has a frequency spectrum of predominantly zero power level over all frequencies except for a few narrow bands or spikes.