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A brief introduction to signal aliasing

The mathematics that emerges from Nyquist-Shannon sampling theory shows that alias signals from sampled data systems appear in frequency zones of width fs/2 (also called Nyquist zone) out to infinity, where fs is the sampling rate. The figure below shows the seven alias images of a 1000 MHz test signal across the first eight Nyquist zones when output from the DAC sampling at a rate of 6 GSps.

The dotted blue curve depicts the classic sinc(x) response typical of a DAC using a standard Non-Return to Zero (NRZ) coding. Here, an output null appears at the sample frequency (6 GHz). The baseband signal at 1000 MHz is presented in the first Nyquist zone but an aliased image also appears at 5.0 GHz (NZ2). Repeated alias images are clearly visible in the third Nyquist zone and beyond.

Applying bandpass filtering to the DAC's output spectrum thus provides the means to project synthetic analog signals into the microwave domain without resorting to expensive analog mixers and local oscillators.

The seven alias images of a 1000 MHz test signal across 8 Nyquist zones @ 6 GSps: