CW 19 summary

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Contents

1 Understanding RF Specifications

1.1 Basic Terminology

Digitizer Amplitude Error
The following formula provides the dampening or attenuation factor E of the digitizer:

$$E = 1 - \frac{R}{\sqrt{1+R^2}} \tag{1}$$

A X-Hz digitizer is defined to have $E = \frac{1}{\sqrt{2}}$ at the frequency X, which implies $R = 1$ for the frequency X. X is called bandwidth of the digitizer in this context, and R is the ratio of the digitizer bandwidth and the maximum frequency of interest $\frac{f_d}{f_i}$.

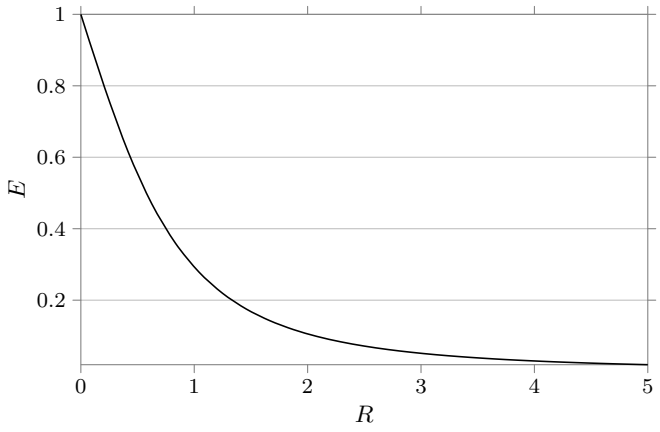

Figure 1: Digitization error verus bandwidth ratio

It is recommended by NI to have X be 3 to 5 times higher than the frequency of interest. This corresponds to errors or dampening between 1.94% and 5.13%

Rise Time
Rise time is defined as the time a signal needs to rise from 10% to 90% of its steady-state or periodic maximum.

- The rise time of a simple RC-circuit is about $\frac{0.35}{RC}$.
- The formula to calculate the total rise time of a digitized signal is:

$$T_{r_t} = \sqrt{{T_{r_s}}^2 + {T_{r_d}}^2}$$

- In order to minimize rise time errors NI recommends to have T_{r_d} be around $\frac{1}{3}$ and $\frac{1}{5}$ of T_{r_s}.

Nyquist Theorem
The bandwidth of the digitizer must be at least 2 times the maximum frequency of the signal to avoid aliasing.

$\Leftrightarrow$ To extinguish aliasing in the passband one either has to make sure the Nyquist Theorem is matched or apply a lowpass filter to limit the signal's bandwidth.

Phase Noise

Resolution Bandwidth

Noise Density

Dynamic Range

Voltage Standing Wave Ratio (VSWR)

Frequency Response

Modulation Error Ratio (MER)

Error Vector Magnitude (EVM)

Third-Order Intercept (TOI)

2 Physical Layer Challenge

3 Good to Know...

3.1 Python

3.2 LaTeX

I learned...

- ... when to use input or include
- ... some tikz basics