How to simulate SFDR/IMD3 vs F_{in}

Marios Neofytou Data converters 2 – DAC design



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APPRILL.

AND E. H

Where innovation starts



 \rightarrow How to setup the FFT (Spectrum) will be shown in the later steps

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Given a simulation time (Tsim), you can define the frequency of a signal based on the number of periods you fit in that time frame

In this example :

 $F_{clk} = \frac{NrPeriodsClk}{T_{sim}} = 1 \; GHz$

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FFT relevant simulation time

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Total simulation time

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→ The extra time is allowed such that you avoid taking incorrect samples for the FFT during start up of the simulation
 → The selection of the input frequencies will be discussed in the following slides.

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FFT relevant simulation time

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Total simulation time

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The following example will help you understand how to setup the FFT :

Lets say : $F_s = 1$ GHz Nfft = 1024 \rightarrow This is the number of FFT points Tsim = Nfft/F_s=1.024us

Now i want to calculate the FFT of the input frequency of 353 MHz.

 \rightarrow First things to consider :

a. My input frequency has to be highly uncorrelated with F_s

b. I have to fit an integer number of periods within the Tsim otherwise leakage will occur



 \rightarrow If you just use 353 MHz as an input frequency then :

NrPeriodsSin1 = 1.024us*353M/s = **361.472** > Not integer > Leakage!



 \rightarrow What you should do is the following :

- a. NrPeriodsSin1 = 1.024us*353MHz = **361.472**
- **b. closestPrimeNumber(**NrPeriodsSin) = 359
- c. F_{in new}= 359/1.024u = 3.50585937500000e+08

 \rightarrow Please keep in mind that even a single digit will make the difference in the FFT





 \rightarrow For the dual tone test :

→ The second frequency should be made such that AGAIN the NrPeriodsSin2 is integer in the relevant simulation time









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- → Right click on the measurement you want then → Send to ADE→ Generic expression
 → Now what is left is to run a parametric Frequency sweep to obtain SFDR vs NrPeriodsSin1/Tsim (=Input Frequency).
 YOU WILL VARY NrPeriodsSin1
- → If you also want the FFT setup, just click on the FFT and then on the calculator. Copy the expression and create a new output on the ADEL



Step 3 : Measurements – IMD3

\rightarrow Same setup as before but now two tones input



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Step 3 : Measurements – IMD3

→Tools→ Calculator





Step 3 : Measurements – IMD3

\rightarrow Enter the following expression:

value(db20(dft(v("/out_diff" ?result "tran") 0.076u 1.100u 1024 "Rectangular" 0
0 1)) 2*VAR("NrPeriodsIn2")/VAR("Tsim")-VAR("NrPeriodsIn1")/VAR("Tsim")
)

- \rightarrow Compare the result with the cursor measurement
- → If its the same copy the expression then go to ADEL → right click on the outputs → Edit :

Name: IMD3 – HF

Expression : paste the expression

Apply and OK

- → Run a parametric sweep on NrPeriodsIn1 : Remember you will have to keep |NrPeriodsIn1-NrPeriodsIn2 | constant
- → You can do that by simply defining NrPeriodsIn2 = NrPeriodsIn1+10(or 20 or 100 depending on the NFFT points and the target frequency difference between the two tones)

Now you are set to GO!

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