To toggle on/off the raw code, click here.

DSM Design Notebook

DSM Equation Derivation

Derives the delta-sigma modulator signal and noise transfer functions.

Table I DSM transfer functions.

Symbol	Description	Value
g(z)	Forward path transfer function.	$\frac{a_0(z-1)^2+a_1(z-1)+a_2}{(z-1)^3}$
h(z)	Feedback path transfer function.	1
cltf(z)	Closed loop transfer function.	$\frac{1}{z}$
oltf(z)	Open loop transfer function.	$\frac{a_0(z-1)^2+a_1(z-1)+a_2}{(z-1)^3}$
ntf(z)	Noise transfer function.	$\frac{(z-1)^3}{a_0(z-1)^2+a_1(z-1)+a_2+(z-1)^3}$

Table II. Target pole and zero locations.

Variable	Value
px0	(0.5+0.5j)
px1	(0.5-0.5j)
px2	(0.5+0j)

Table III. Calculated filter coefficients.

Variable	Value
a1	1.000000
a0	1.500000
a2	0.250000

Table IV. Designed digital filter coefficients.

Variable	Description	Value	Units
fs	Sample frequency.	20000000	Hz

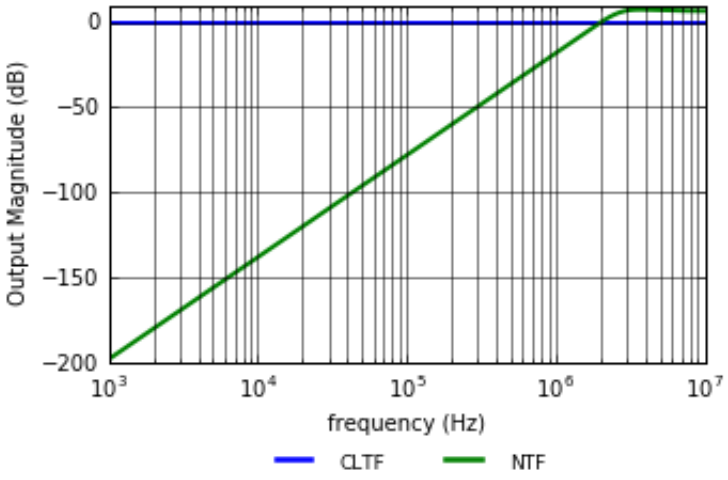

Fig. 1 Calculated DSM closed loop and noise transfer functions.

Save Figure1

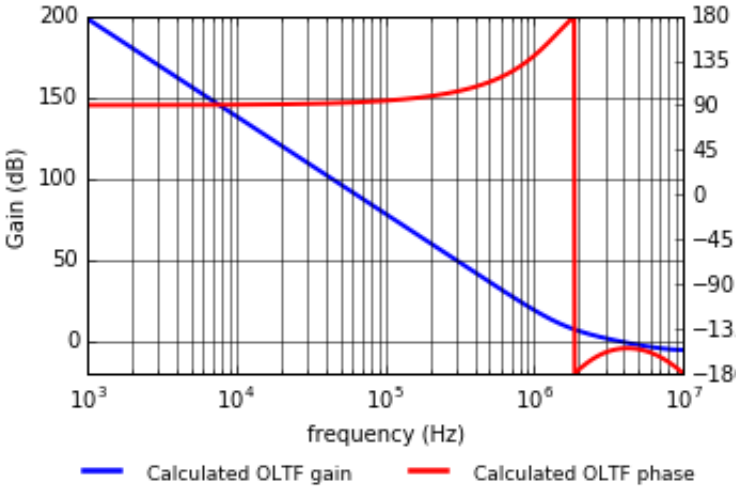

Fig. 2 Calculated DSM open loop gain and phase.

Save Figure2

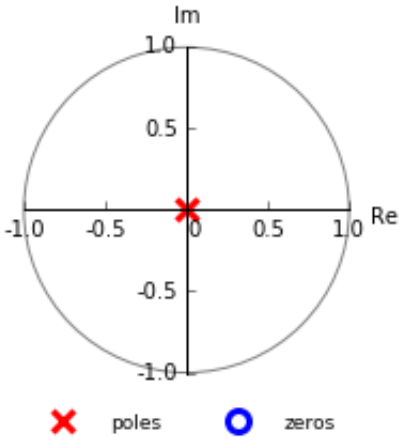

Fig. 3 Calculated DSM CLTF pole-zero plot.

Save Figure3

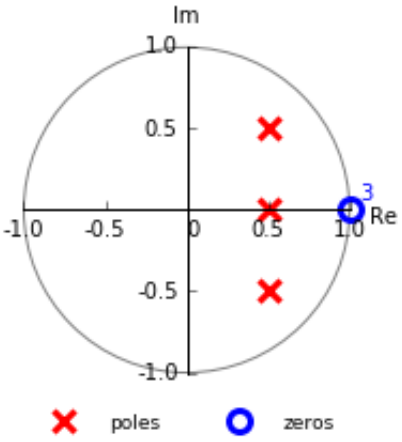

Fig. 4 Calculated DSM NTF pole-zero plot.

Save Figure4

Measurements

Reads output file and makes measurements from data.

Table IV. Output measurement parameters.

Variable	Description	Value	Units
fs	Sample frequency.	20000000	Hz
dlen	Data length.	65536	#
mlen	Measure length.	65536	#
pseg	Pwelch method segments.	16	#

Output Tables

Table V. DSM output measurements.

Symbol	Description	Value	Units
out_{max}	Maximum output value	2	#
out_{min}	Minimum output value	-3	#
out_{mean}	Mean output value (65536 samples)	-0.499969	#
$peak_{max}$	Maximum PSD peaking	7.593	dB

Plots

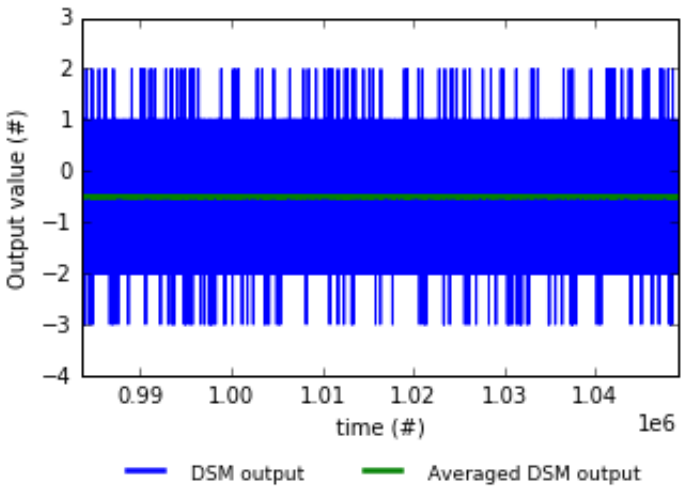

Fig. 5 DSM actual and average output vs. time step.

Save Figure5

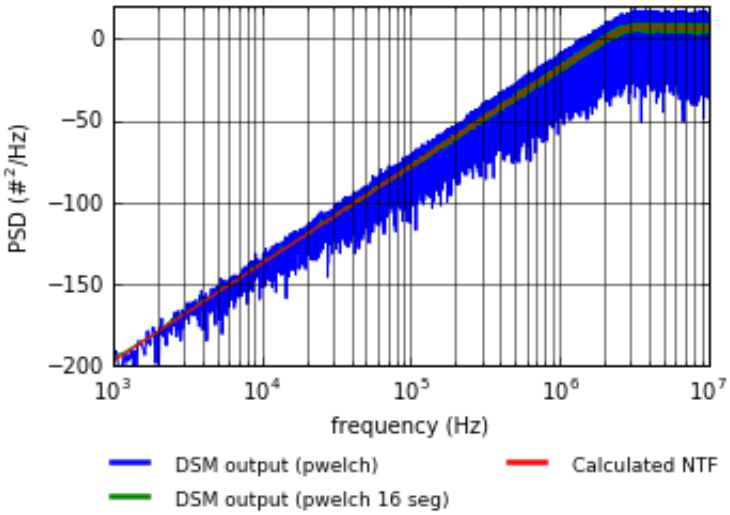

Fig. 6 DSM output PSD.

Save Figure6

Python/Jupyter Compatibilty

Lists all modules obtained from globals(). Doesn't necessarily capture all modules in use.

Table VI. Imported python/jupyter modules.

Module	Version
Python	2.7.11
matplotlib	1.5.1
IPython	4.1.1
sympy	0.7.6.1
numpy	1.10.4
ipywidgets	4.1.1
types	