Delta-Sigma Conversion

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ET 4801 Project Report
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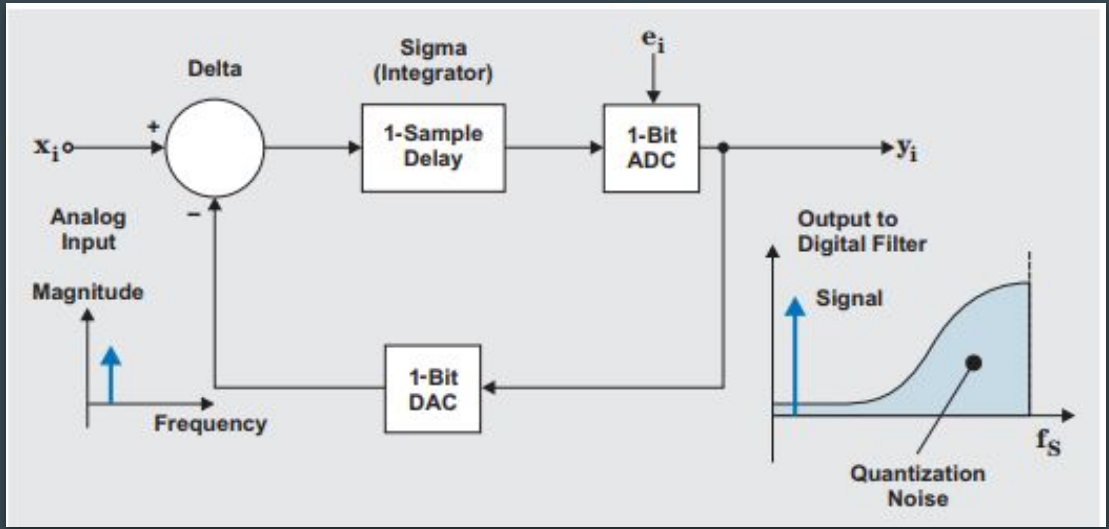
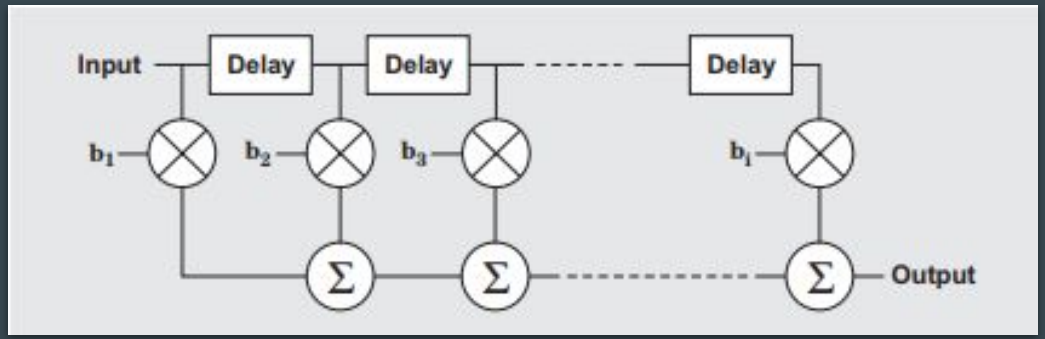
Delta-Sigma Conversion

1. Oversampling Modulator
    a. 1-Bit ADC
    b. High Pass Filter
2. Digital/Decimation Filter
    a. Low Pass Filter
    b. Decimation Filter

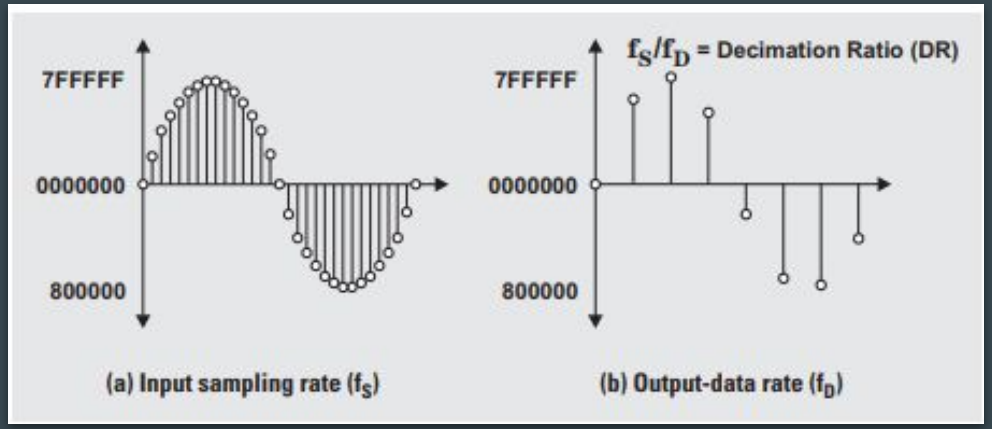
First Order Delta-Sigma Modulator in the Frequency Domain



First-Order, Low-Pass Averaging Filter



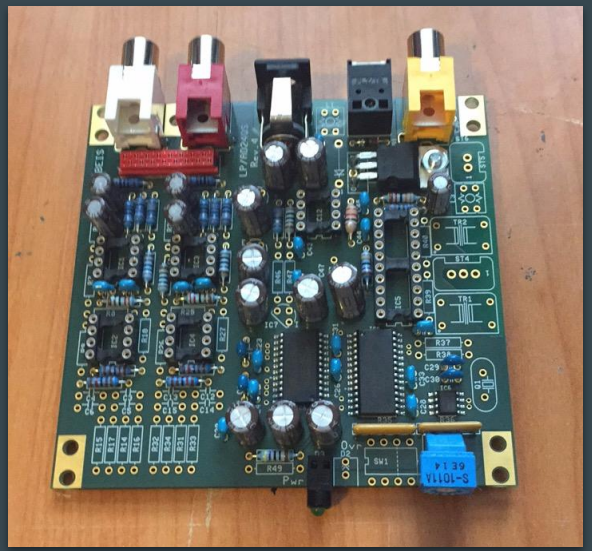
Digital/Decimation Filter Input and Output

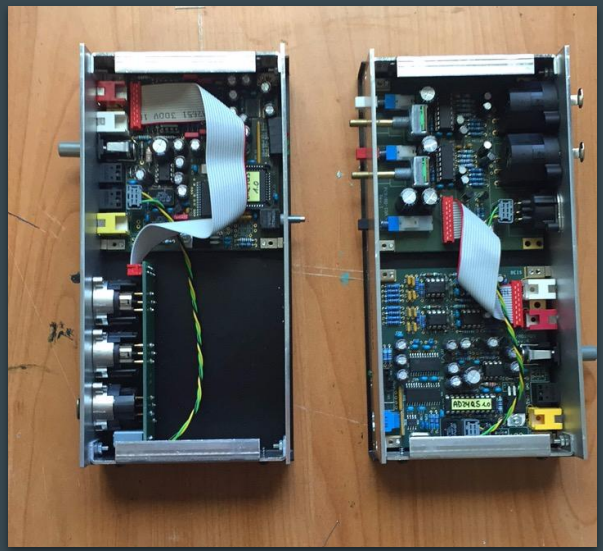


Beis AD24QS and DA24QS

- AD24QS
  - Cirrus Logic CS5361
    - Fifth-order, multi-bit modulator
    - 24 bit resolution stereo conversion
    - Low THD
    - 114 dB Dynamic Range
- DA24QS
  - Cirrus Logic CS4398
    - 24 bit resolution
    - Low THD
    - 120 dB Dynamic Range

Construction





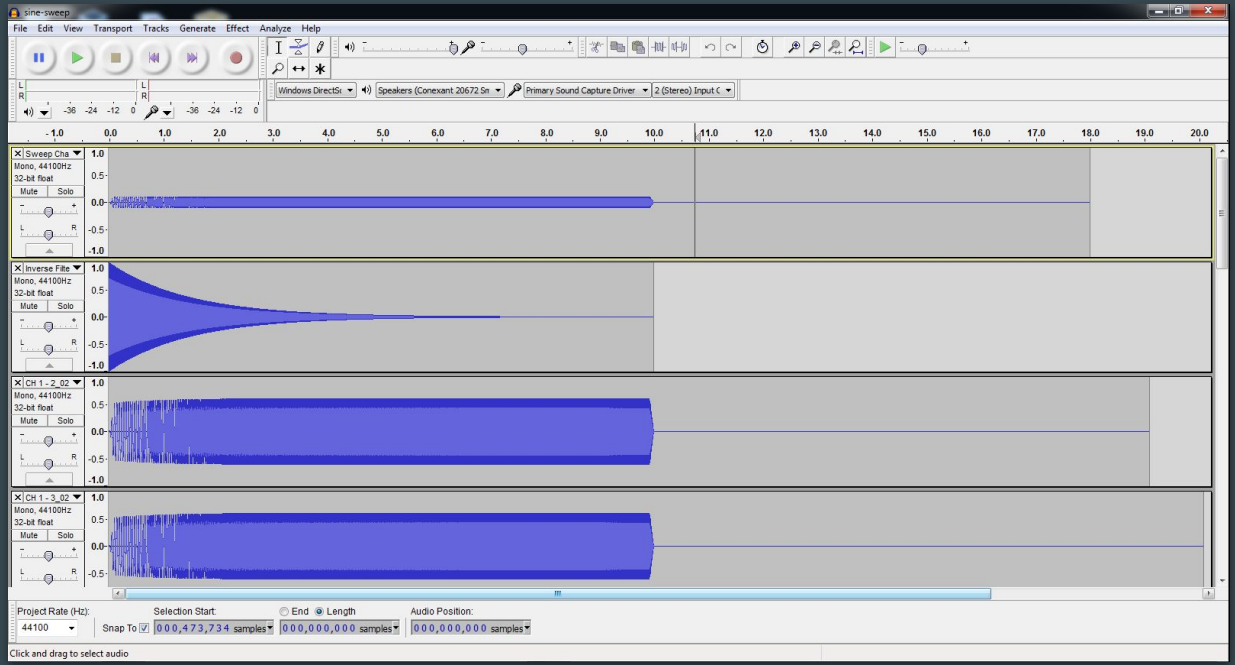
Completion


BEIS
DA24QS
Input
SS QS Err Cpy
DS Pro n.A. Em
BEIS
AD24QS
Left
Right
Pwr Ovr
Sample Rate

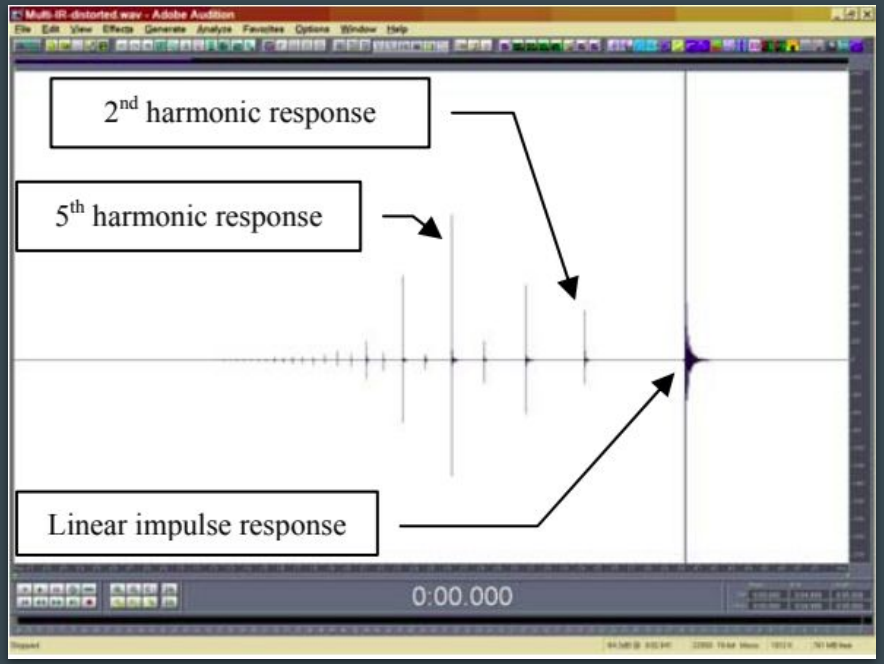
Testing THD

$$THD = \frac{\sqrt{\sum_{n=2}^{\infty} V_{n\_rms}^2}}{V_{fund\_rms}}$$

Exponential Sine Sweep



After Applying Reverse Filter



Experimental Setup

Calculating Offsets

$$T = \left(\frac{2\pi M}{k-1} - \frac{\pi}{2}\right)\frac{\ln f_2/f_1}{2\pi f_1},$$

T = time in seconds of fundamental, M = Length of sine sweep (s), k = kth harmonic
f1= start frequency of sweep, f2 = end frequency of sweep

$$\Delta n_k = \frac{T f_s \ln k}{\ln(f_2/f_1)}$$

nk = sample offset from fundamental, fs = sample rate
(Paiva et al.)

Harmonic	Offset (sample)	Harmonic	Offset (sample)
2	7450.898974	16	29803.5959
3	11809.39547	17	30455.27269
4	14901.79795	18	31069.68992
5	17300.45166	19	31650.87875
6	19260.29444	20	32202.24961
7	20917.31791	21	32726.71338
8	22352.69692	22	33226.77447
9	23618.79094	23	33704.60314
10	24751.35063	24	34162.09239
11	25775.8755	25	34600.90332
12	26711.19342	26	35022.50147
13	27571.6025	27	35428.18641
14	28368.21688	28	35819.11586
15	29109.84713	29	36196.32561

THD

Sweep	Channel 1	Channel 2
1	0.001679225197	0.001901753808
2	0.001542641613	0.001506403164
3	0.002207576775	0.001602943836
AVG	0.001809814528	0.001670366936

Works Cited

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