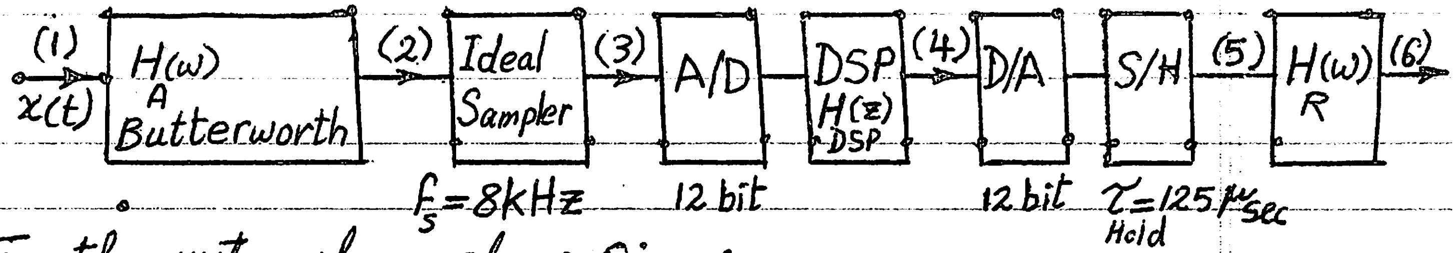
PROJECT #1 EEE 5513



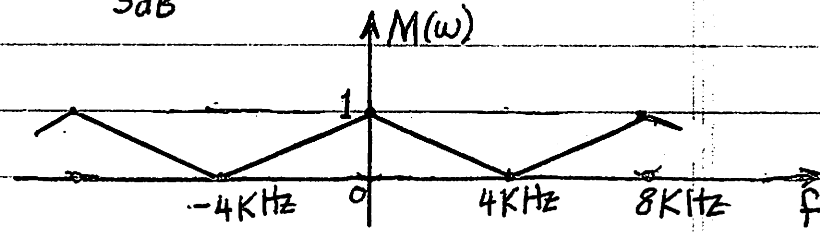
For the system shown above, Given:

at (1): $|X(\omega)| = 1$, $\angle X(\omega) = 0$

$H_A(\omega)$ = antialiasing LPF, Butterworth, $f_{3dB} = 2$ kHz, order to be determined

$H_R(\omega)$ = reconstruction filter

$H_{DSP}(z)\Big|_{z=e^{j\omega T}} = M(\omega)e^{j\theta(\omega)}$



$M(\omega)$ is shown, opposite, $\theta(\omega) = 0$

The useful band of input signal $x(t) = 0 \to 2$ KHz

The pdf of the jitter is shown opposite

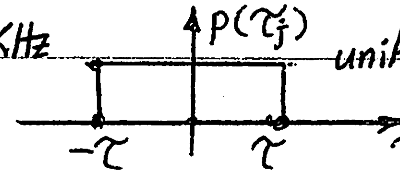


Fig. 3

Find:

a – For a $(S/N)_{aliasing} \geq 60$ dB over $0 \to 2$ KHz, find the order of $H_A(\omega)$

b – Sketch the signal spectrum (magnitude & phase) at (2)

c – 〃 〃 〃 〃 〃 〃 at (3)

d – 〃 〃 〃 〃 〃 〃 at (4)

e – 〃 〃 〃 〃 〃 〃 at (5)

f – Find the maximum value of τ in Fig. 3 (worst case analysis) such that $\left(\frac{S}{N}\right)_{jitter} \gg 60$ dB

g – Compute $(S/N)_{quantiz}$ in dB (State your assumptions)

h – For $\tau_{hold} = 125\ \mu sec$, sketch $H_{R\,ideal}(\omega)$ (magnitude only)

i – Sketch the signal spectrum at (6) assuming ideal $H_R(\omega)$

Butterworth, LPF, 6th order, $\omega_0 = 1$ rad/sec (3 dB frequency)

$$H(s)_{\substack{\text{norm.}\\ 1\,\text{rad}\\ 3\,\text{dB}}} = \frac{1}{s^6 + 3.86370\,s^5 + 7.46410\,s^4 + 9.14162\,s^3 + 7.46410\,s^2 + 3.86370\,s + 1}$$

$$\omega_c = 2\pi \times 2 \times 10^3 = 12{,}566.4 \text{ rad/sec}$$

$$H\left(\frac{s}{12566.4}\right) = \frac{1}{D(s)_{\text{denorm.}}}$$

$$D_{\text{denorm.}} = 2.53942 \times 10^{-25} s^6 + 1.23296 \times 10^{-20} s^5 + 2.99319 \times 10^{-16} s^4 + 4.60671 \times 10^{-12} s^3 + 4.72667 \times 10^{-8} s^2 + 3.07463 \times 10^{-4} s + 1$$