Oversampling Example

Given: 2nd order analog filter $H_2(j\Omega) = \frac{(200\pi)^2}{(j\Omega + 200\pi)^2}$

Signal BW $-50 < f < 50$ Hz

Evaluate $|H_2(j\Omega)|$ for: anti aliasing filter,
zero-order hold anti-imaging filter

1) Sampling frequency = 300 Hz
2) Sampling frequency = 2400 Hz (8x oversampling)

Ideal antialiasing filter

$$|H_a(j\Omega)| = \begin{cases} 1 & , \ |\Omega| < 100\pi \\ 0 & , \ |\Omega| > \Omega_s - 100\pi \end{cases}$$

1) $\Omega_s = 600\pi$; 2) $\Omega_s = 4800\pi$

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Passband constraint same for 1) + 2)

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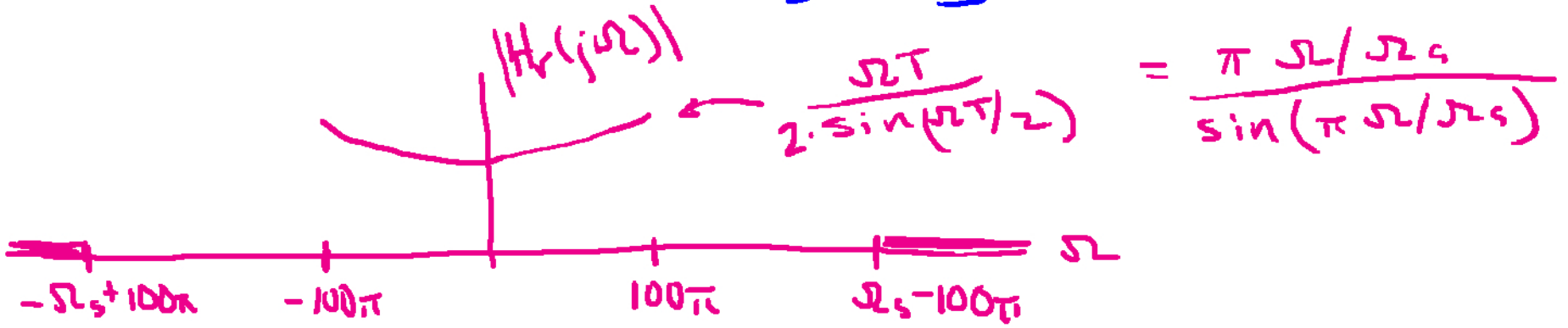
Stopband actual

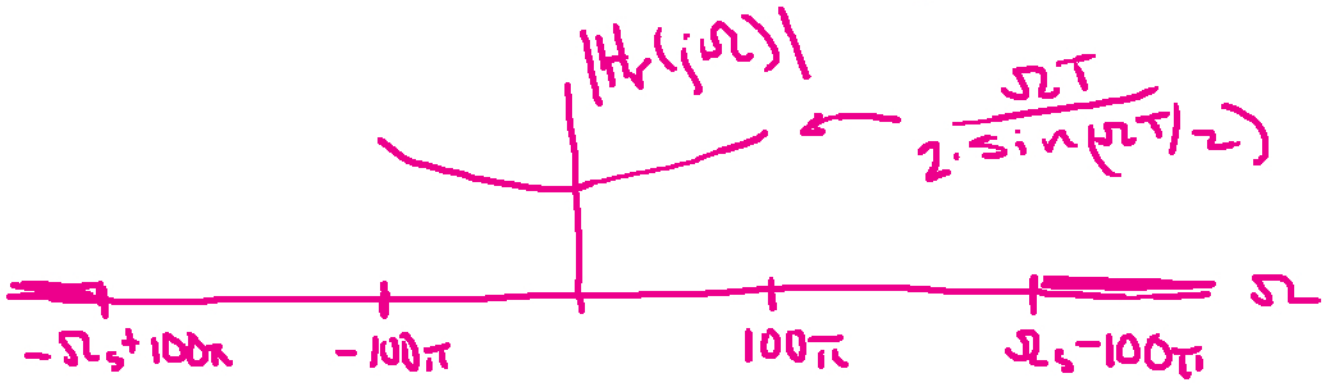
1) $|H_2(j500\pi)| = \frac{(200\pi)^2}{|200\pi(j^5/_2 + 1)|^2} = \frac{4}{29} \approx 0.14$

2) $|H_2(j4700\pi)| = \frac{(200\pi)^2}{|200\pi(j\frac{47}{2} + 1)|^2} = \frac{4}{47^2 + 4} \approx 0.002$ (76 x atten. of 1)

Ideal Anti-imaging Filter



Ideal Anti-imaging Filter

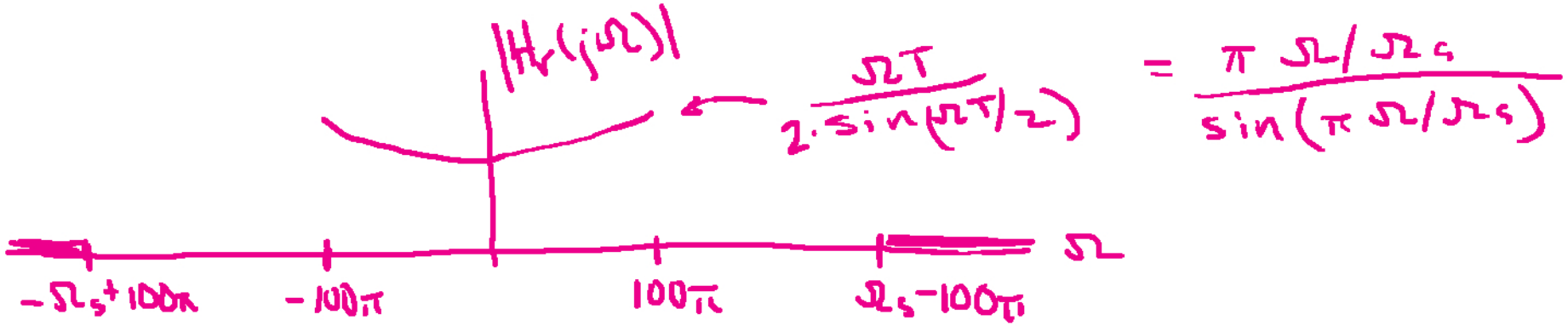


1) $\Omega_s = 600\pi$; Desired gain at $\Omega = 100\pi$ $|H_r(j100\pi)| = \frac{\pi/6}{\sin(\pi/6)} \approx 1.05$

Actual filter: $\Omega = 100\pi$, $|H_2(j100\pi)| = 0.8$

Stopband $\Omega = 500\pi$, $|H_2(j500\pi)| \approx 0.14$

Ideal Anti-imaging Filter



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Actual filter: $\Omega = 100\pi$, $|H_2(j100\pi)| = 0.8$

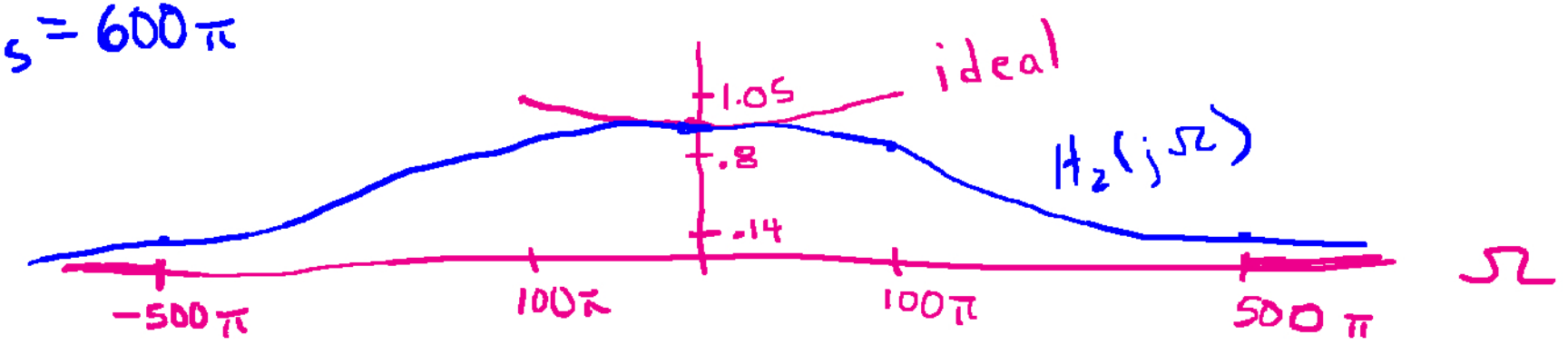
Stopband $\Omega = 500\pi$, $|H_2(j500\pi)| \approx 0.14$

2) $\Omega_s = 4800\pi$; Desired gain at $\Omega = 100\pi$ $\quad |H_r(j100\pi)| = \frac{\pi/48}{\sin(\pi/48)} \approx 1.007$

Actual filter: $\Omega = 100\pi$, $|H_2(j100\pi)| = 0.8$

Stopband $\Omega = 4700\pi$ $\quad |H_2(j4700\pi)| \approx 0.002$ (≈ 76 more atten than 1)

1) $\Omega_s = 600\pi$



2) $\Omega_s = 4800\pi$