

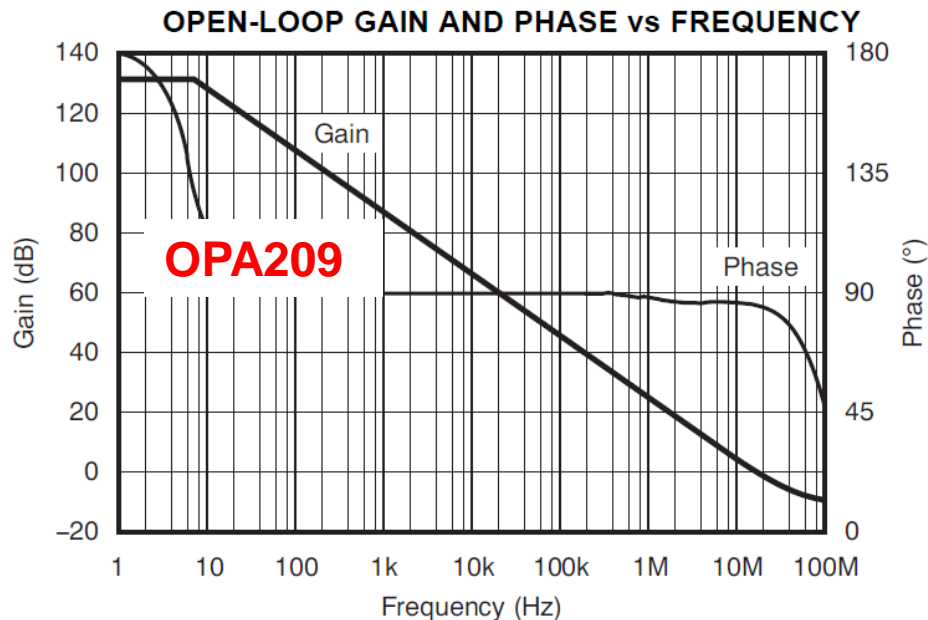
# 帯域幅 4

## TIプレジジョン・ラボ - オペアンプ

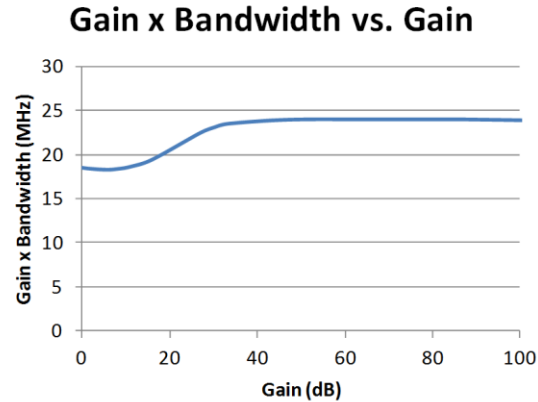
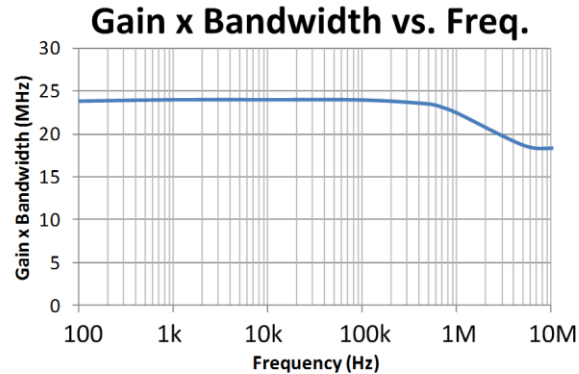
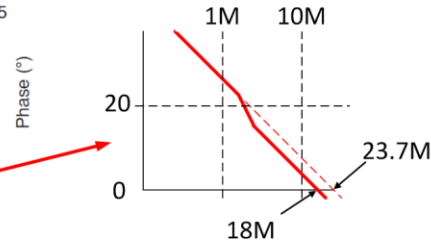
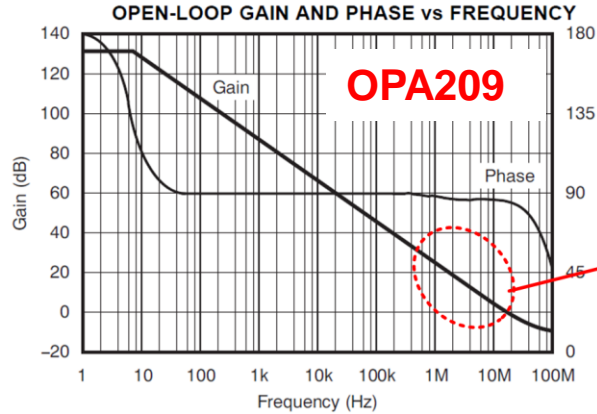
Art Kay, Pete Semig, and Tim Green

# ゲイン帯域幅の変化

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Gain Bandwidth Product GBW	Gain = +1		18		MHz

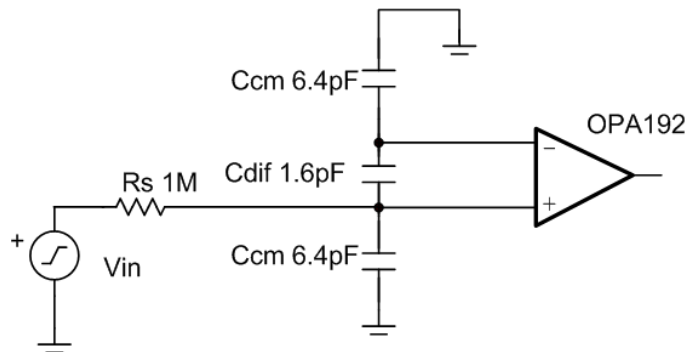


# ポール/ゼロ組み合わせによる変曲点



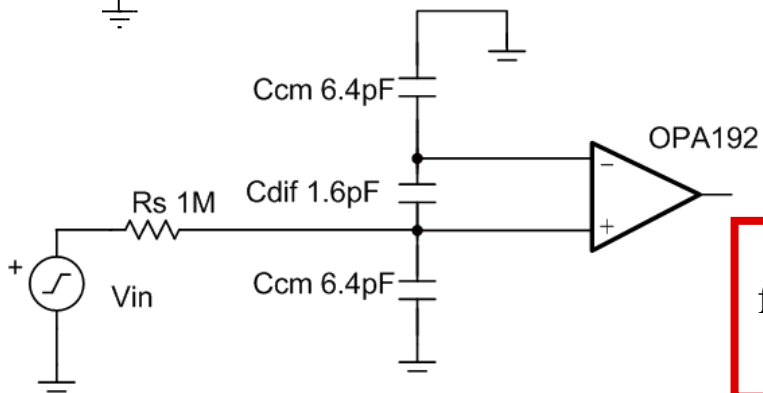
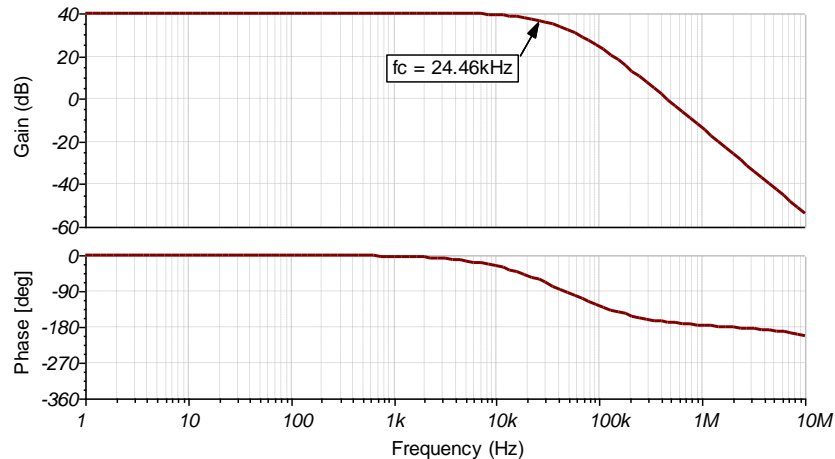
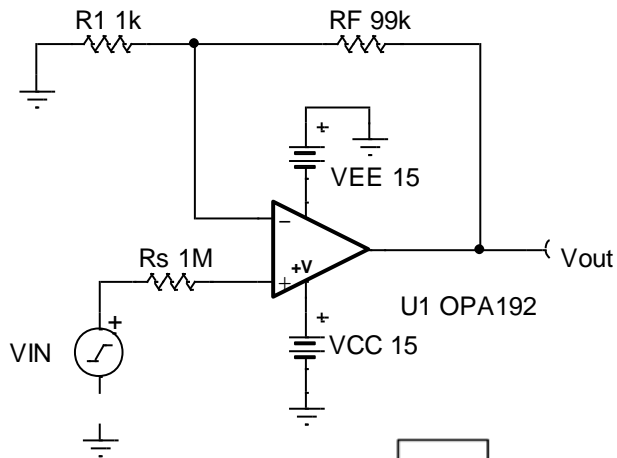
# 入力容量

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Z <sub>ID</sub>	Differential		100  1.6		MΩ  pF
Z <sub>IC</sub>	Common-mode		1  6.4		10 <sup>13</sup> Ω  pF



$$f_c = \frac{1}{2 \cdot \pi \cdot R_{in} \cdot C_{cm}} = \frac{1}{2 \cdot \pi \cdot (1\text{M}\Omega) \cdot (6.4\text{pF})} = 24.87 \text{ kHz}$$

# 入力容量



$$\frac{\text{GBW}}{G_{cl}} = \frac{10\text{MHz}}{100} = 100\text{kHz}$$

$$f_c = \frac{1}{2 \cdot \pi \cdot R_{in} \cdot C_{cm}} = \frac{1}{2 \cdot \pi \cdot (1\text{M}\Omega) \cdot (6.4\text{pF})} = 24.87\text{ kHz}$$

# ゲイン演算

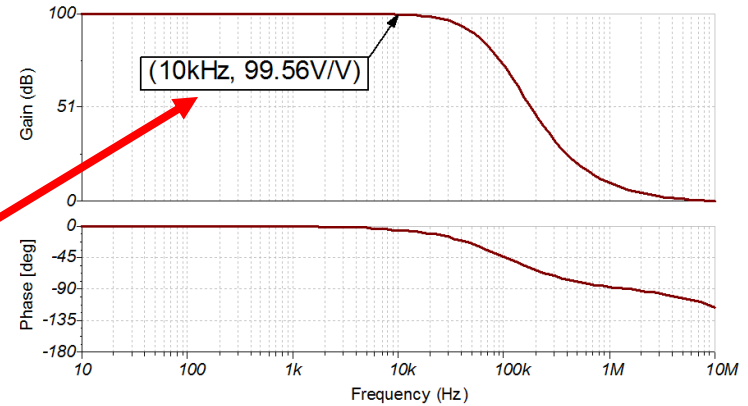
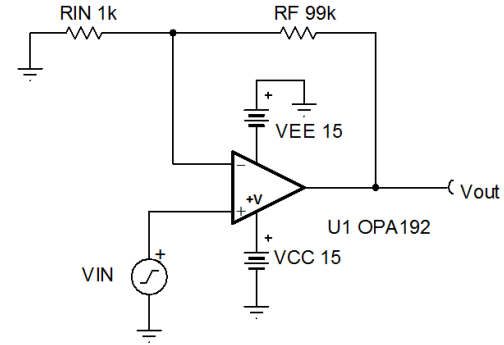
$$G_{CL}(f) = \frac{G_{cl\_dc}}{\sqrt{1 + \left(\frac{f}{f_{dom}}\right)^2} \cdot \frac{1}{(1 + \beta \cdot A_{ol\_dc})^2}}$$

$$G_{cl\_dc} = \frac{A_{ol\_dc}}{1 + \beta \cdot A_{ol\_dc}} = \frac{10 \cdot \frac{126}{20}}{1 + \frac{1}{100} \cdot 10 \cdot \frac{126}{20}} = 99.995$$

$$f_{dom} = \frac{GBW}{10 \cdot \left(\frac{A_{ol\_dc}}{20}\right)} = \frac{10MHz}{10 \cdot \left(\frac{126}{20}\right)} = 5.012 \text{ Hz}$$

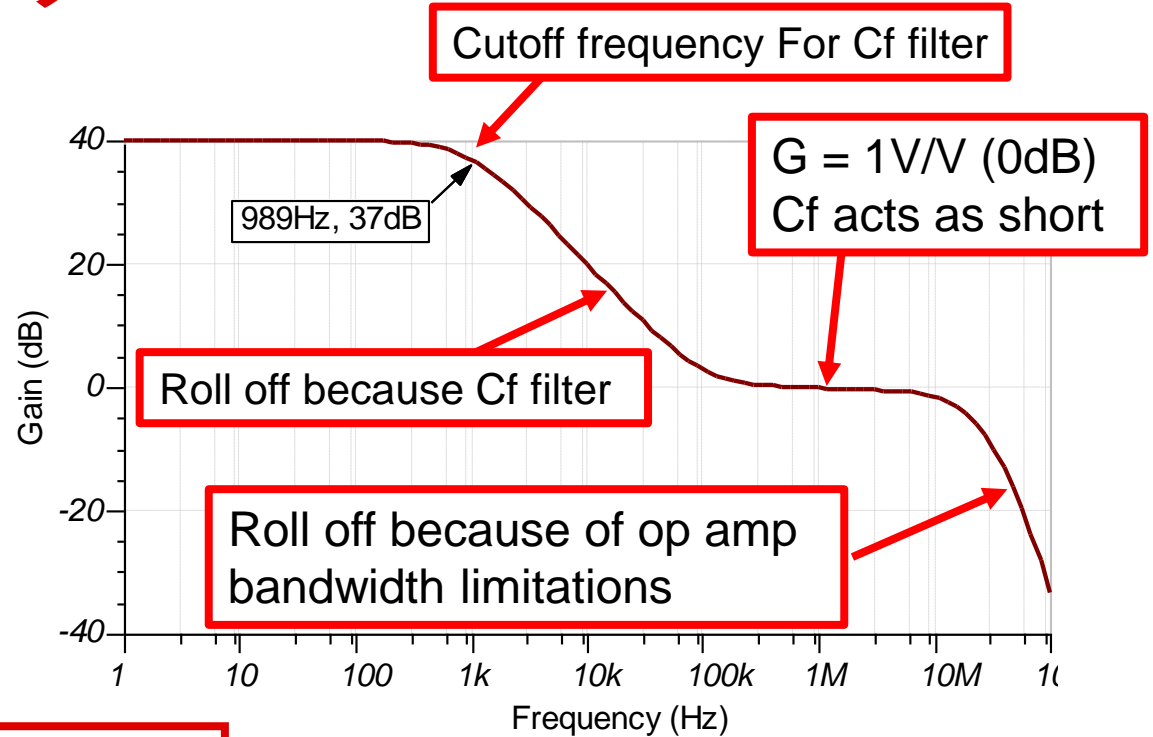
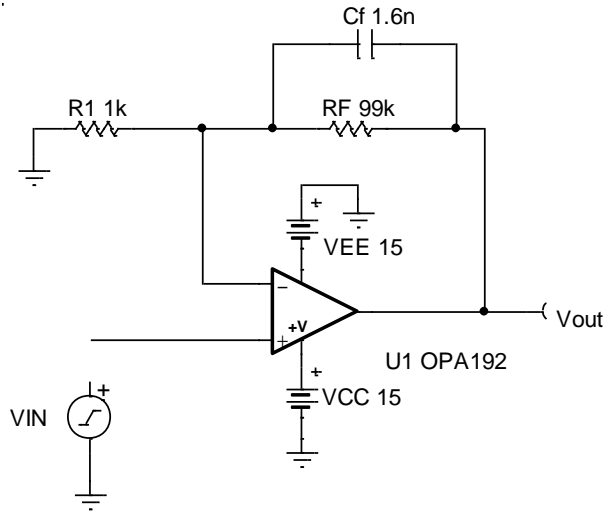
$$G_{CL}(f) = \frac{99.995}{\sqrt{1 + \left(\frac{f}{5.012 \text{ Hz}}\right)^2} \cdot \frac{1}{\left(1 + \frac{1}{100} \cdot 10 \cdot \frac{126}{20}\right)^2}}$$

$$G_{CL}(10kHz) = 99.50$$



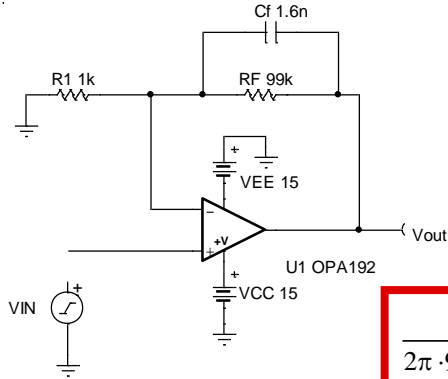
Closed  
loop  
gain at  
10kHz

# 帯域幅制限：フィルター

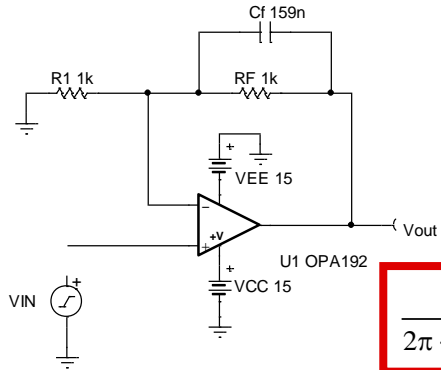
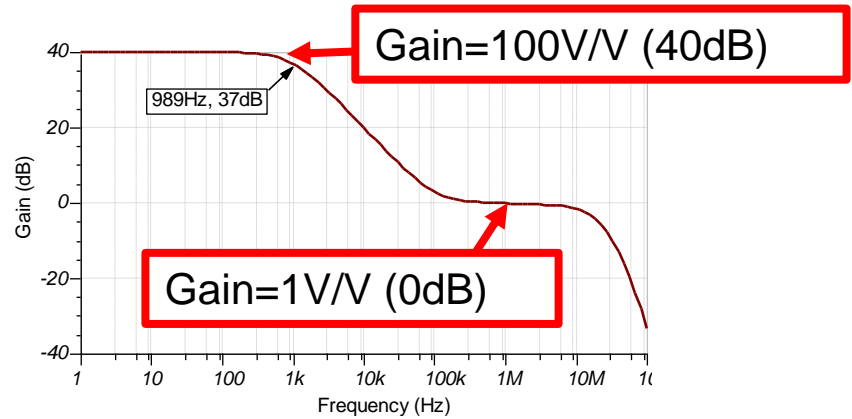


$$f_c = \frac{1}{2\pi \cdot R_f \cdot C_f} = \frac{1}{2\pi \cdot 99\text{k}\Omega \cdot 1.6\text{nF}} = 1.005 \times 10^3 \text{ Hz}$$

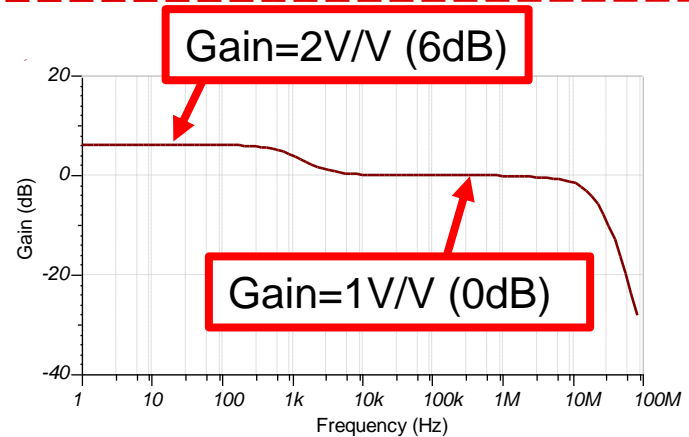
# フィルター: Large vs. Small Gain



$$\frac{1}{2\pi \cdot 99\text{k}\Omega \cdot 1.6\text{nF}} = 1.005 \times 10^3 \text{ Hz}$$

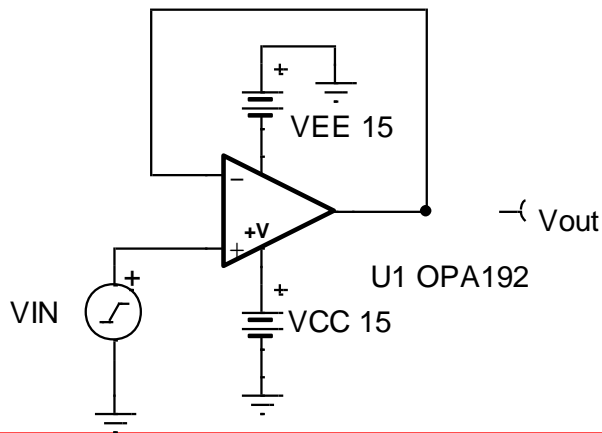


$$\frac{1}{2\pi \cdot 1\text{k}\Omega \cdot 159\text{nF}} = 1.001 \times 10^3 \text{ Hz}$$





# スルーレート – フルパワー帯域幅



Maximum peak output based on Slew Rate & Input Frequency

$$V_{p\_max} = \frac{SR}{2 \cdot \pi \cdot f} = \frac{20 \frac{V}{\mu s}}{2 \cdot \pi \cdot (1MHz)} = 3.183 \text{ Vpk} \quad \text{or} \quad 6.3 \text{ Vpp}$$

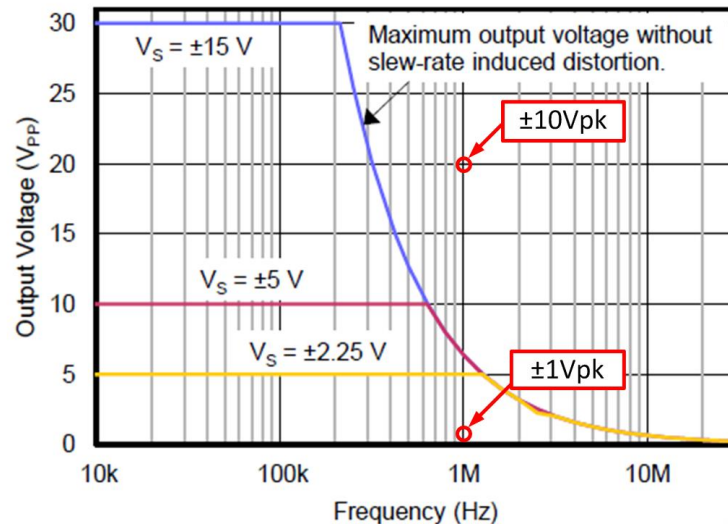
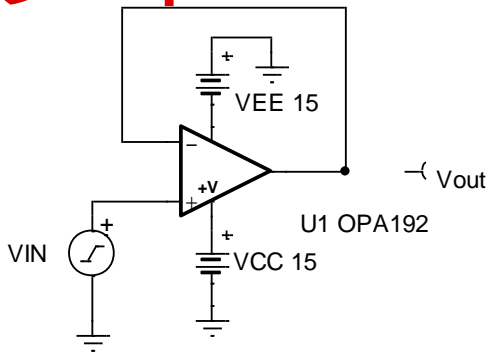
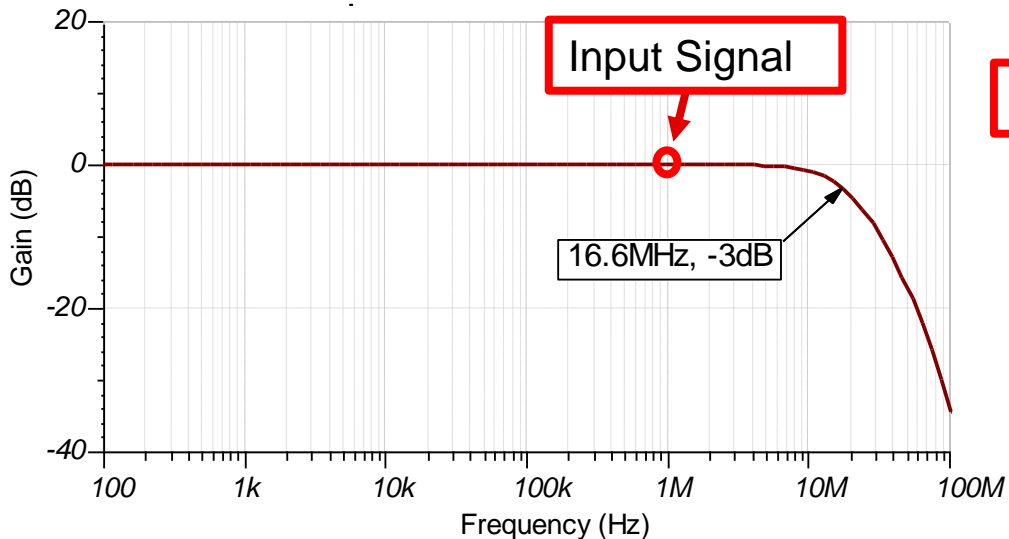
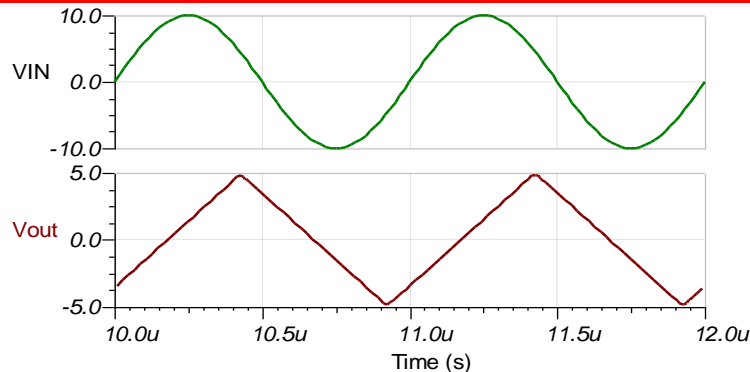


Figure 37. MAXIMUM OUTPUT VOLTAGE vs FREQUENCY

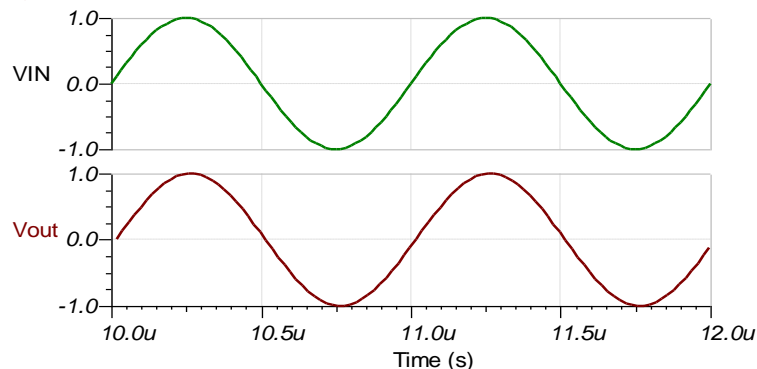
# スルーレート



Output should be 10Vpk but isn't because of SR limit.



Output is approximately 1Vpk as expected.



ありがとうございました