$$v_c = vfin - (vfin - vin)e^{\frac{-t}{RC}}$$

$$apa = \frac{v_{max} + v_{min}}{2}$$

$$Tilt_{\%} = \frac{v_{max} - v_{min}}{apa}$$

$$AWV = \frac{(+APA \times PW) + (-APA \times PS)}{Period}$$

$$Bandwidth = \#\ of\ Harmonics\ \times Fundamental$$

- $\#\ of\ Harmonics = \frac{Bandwidth}{Fundamental}$
- $Fundamental = \frac{Bandwidth}{\#\ of\ Harmonics}$

$$F_{CH} = \frac{0.35}{t_r}$$

$$F_{CL} = \frac{fractional\ tilt}{2\pi(pw)}$$

$$\#of\ cycles? = \frac{5\tau}{Period}(cycles)(\text{Stabilization})$$

- $v_{max} = \frac{v_{gen+}}{1+e^{\frac{-t}{RC}}}$
- $v_{min} = v_{gen+} - v_{max}$

$$Integration,\ time = \frac{1}{10}\tau$$

$$Differentiation,\ time = 10\tau$$

$$v_{inst} = VmaxSin(360Ft\ \pm \theta)$$

$$Diode\ Static\ Resistance,\ R_D = \frac{V_F}{I_F}$$

$$Diode\ Dynamic\ Resistance,\ r'd = \frac{26mv}{I_F}$$

$$t_{rr} \le \frac{time_{rise/fall}}{10}$$

$$time_{rise/fall} \ge 10 \times t_{rr}$$

$$F_{CH} = \frac{0.35}{t_r}$$

$$F_{CL} = \sqrt{(F_{C1})^2 + (F_{C2})^2 + (F_{C3})^2 \ldots}$$

$$C_{TotalIN} = Cgen + Cstray + Cprobe + CmillerIN + CBG$$

- $CmillerIN = CBC(1 + \Delta v_{CE})$
- $CBC \approx Cobo$
- $CBG = CBE(1 - \Delta v_{CC})$
  - $CBE = \frac{1}{(2\pi)(r'e)(f_T)}$

$$C_{TotalOUT} = CMillerOUT + Cstray + Cprobe$$

- $CMillerOUT = CBC(\frac{1+\Delta v_{CE}}{\Delta v_{CE}})$

$$FCH_{Total} = \frac{0.35}{\sqrt{(\frac{0.35}{FCH_{IN}})^2 + (\frac{0.35}{FCH_{MID}})^2 + (\frac{0.35}{FCH_{OUT}})^2}}$$

$$\frac{Vout}{Vin} = \frac{1}{\sqrt{1 + (\frac{f_1}{f})^2}}$$

$$Vout\%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1 + (\frac{f_1}{f})^2}}$$

$$\Delta v_{dB} = 20log\frac{1}{\sqrt{1 + (\frac{f_1}{f})^2}}$$

$$\theta = Cos^{-1}\frac{1}{\sqrt{1 + (\frac{f_1}{f})^2}}$$

$$Vout\%\ of\ Vin = 100\% \times \frac{1}{\sqrt{1 + (\frac{f}{f_2})^2}}$$

$$\Delta v_{dB} = 20log\frac{1}{\sqrt{1 + (\frac{f}{f_2})^2}}$$

$$-\theta = Cos^{-1}\frac{1}{\sqrt{1 + (\frac{f}{f_2})^2}}$$

$Beta = \frac{IC}{IB}$ $\quad$ $Alpha = \frac{IC}{IE}$ $\quad$ $Alpha = \frac{Beta}{Beta+1}$

$Emitter\ Peaking\ improvement\ factor = 1.72658$

Shunt Peaking Optimal Flatness improvement factor = 1.414

$CMRR_{dB} = 20Log(\frac{\Delta vcm}{\Delta vdiff})$

$OpAmp\ fch = \frac{FAB}{\Delta v}\ OR\ \frac{Slew\ Rate}{2\pi Vp}$

$Zin\ Invertin\ Op\ Amp\ = (RI + Rmiller)//[Zin_{dev}\left(1 + \Delta vol\left(\frac{RI}{RI + RF}\right)\right)]$

- $Rmiller = \frac{RF}{1+\Delta vol}$

$Zout\ Inverting\ Op\ Amp\ = \frac{Zout_{dev}}{(1 + \Delta vol(\frac{RI}{RI + RF})}$

$Zin\ Non - Invertin\ Op\ Amp\ = Zin_{dev}\left(1 + \Delta vol\left(\frac{RI}{RI + RF}\right)\right)$

$Zout\ Non - Inverting\ Op\ Amp\ = \frac{Zout_{dev}}{(1 + \Delta vol(\frac{RI}{RI + RF})}$

$2nd\ Order\ Active\ Filtering$:

- Low-Pass
  - $R1 = R2\ \&\ C2 = 2C1\ \&\ f_C = \frac{1}{2\pi\sqrt{R1\times R2\times C1\times C2}}$
- High-Pass
  - $C1 = C2\ \&\ R1 = 2R2\ \&\ f_C = \frac{1}{2\pi\sqrt{R1\times R2\times C1\times C2}}$
- $Q = \frac{f_R}{BW}$

Switching Transistors:

- $t_{on} = t_d + t_r\ \&\ t_{off} = t_s + t_f$
- $t_{on} = 0.1RC_C$
- $C_C = \frac{t_{on}}{0.1R}$
- $t_{re} = 2.3(R \times C_C)$
- $fmax_{CC} = \frac{1}{2t_{re}}$