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1)

$P_2 \rightarrow$ output power

$P_1 \rightarrow$ input power

$G = \log_{10} \frac{P_2}{P_1}$ bel → (unit)

$V_2 \rightarrow$ output Voltage

$V_1 \rightarrow$ input Voltage

Generally P_2 is proportional with $(V_2)^2$
P_1 is proportional with $(V_1)^2$

$G_{dB} = \left[\log_{10} \frac{P_2}{P_1}\right] \times 10$ dB → decibel

$$G_{dB} = 10 \log_{10} \frac{P_2}{P_1} = 10 \log_{10} \frac{\frac{(V_2)^2}{R_i}}{\frac{(V_1)^2}{R_i}} = 20 \log_{10} \frac{V_2}{V_1} \text{ decibel}$$

Gain in dB $\boxed{G_{dB} = 20 \log_{10} \frac{V_2}{V_1}}$ $G = \frac{V_2}{V_1}$ (linear value)

Bode plot drawing approximately $G_{dB} = 20 \log_{10} \frac{V_2}{V_1}$ in logaritmic scale (Magnitude response)

Phase response = $\angle G$ in logarithmic scale

vantage of bode plot ! Magnitude responses are multiplied in

$|A_{v_T}| = |A_{v_1}|\,|A_{v_2}| \ldots |A_{v_n}|$ cascade connection in linear scale if logarithmic scale and gains in terms of dB are used

$$G_{dB_T} = G_{dB_1} + G_{dB_2} + \ldots + G_{dB_n}$$

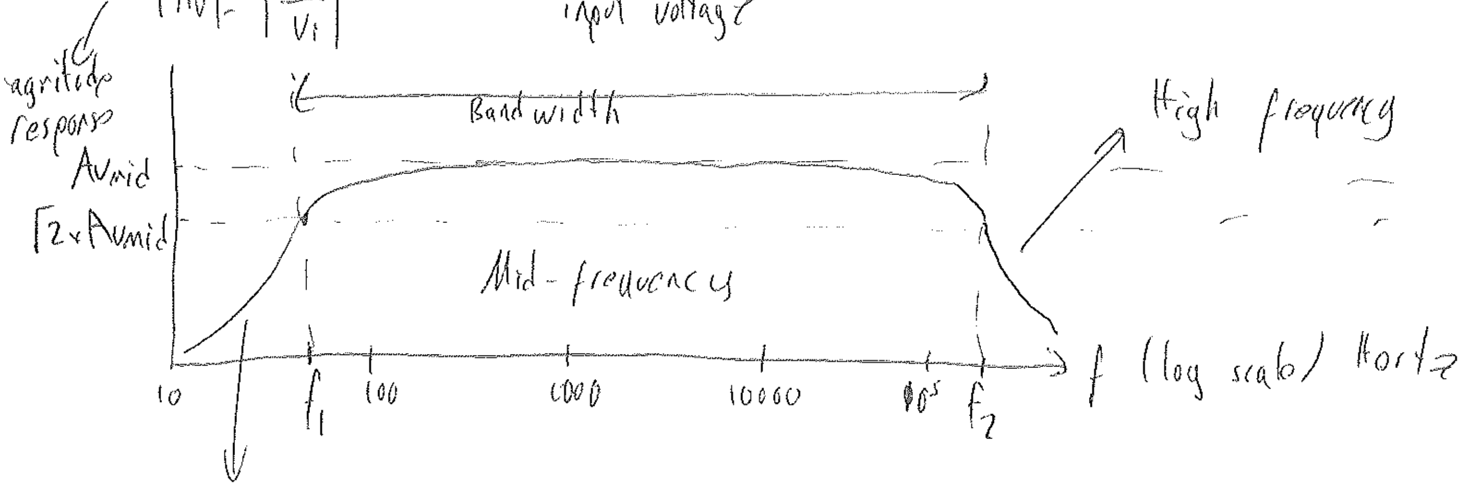
↳ in bode plot gain response in dB should be added

General frequency considerations

At low frequencies, we shall find that the coupling and bypass capacitors can no longer be replaced by short-circuit approximation because their reactance values increase in low frequencies

RC coupled amplifiers (shows bandpass characteristics)

$|A_v| = \left|\frac{V_o}{V_i}\right|$ → Gain = $\frac{\text{output voltage}}{\text{input voltage}}$



↳ the drop in RC-coupled amplifiers is due to the increasing reactance of C_C, C_S, C_E

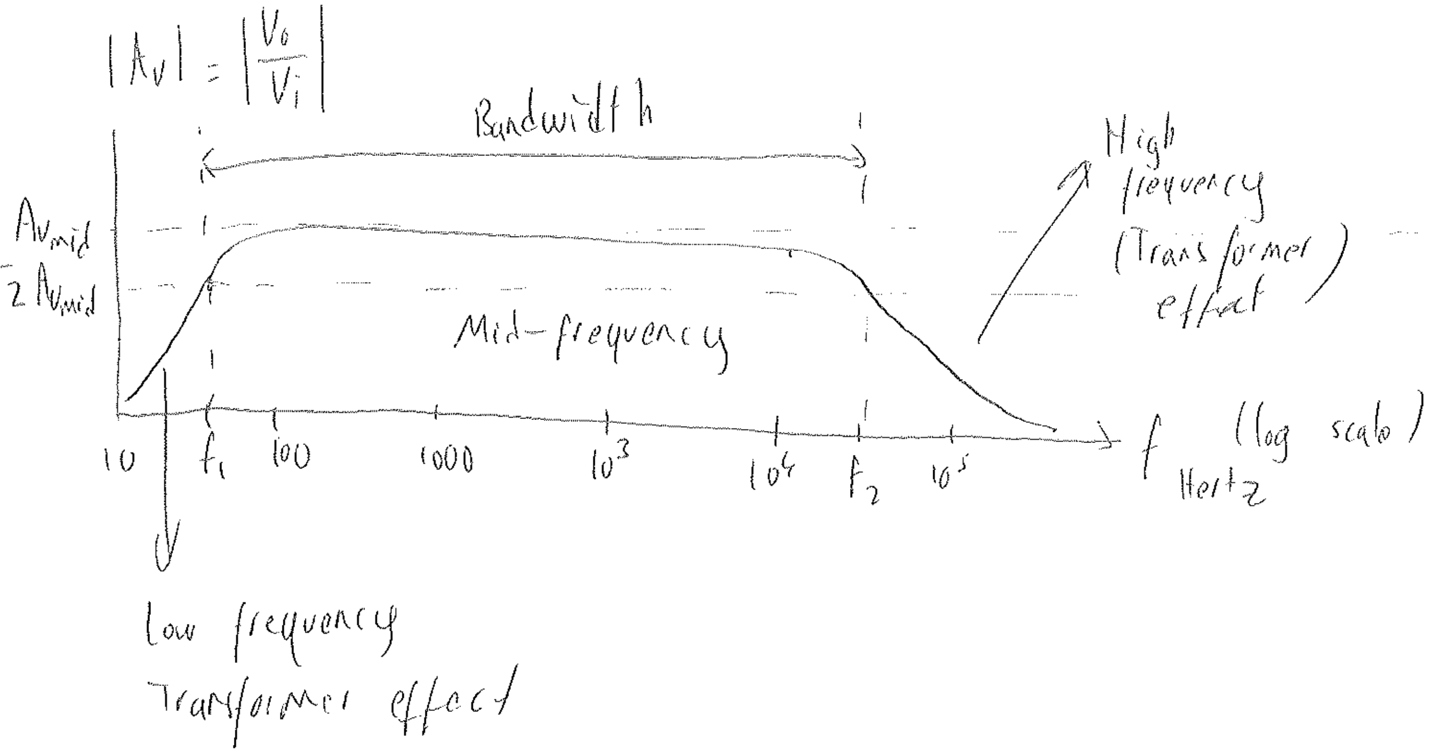
C_C → collector capacitance (BJT)
C_S → source capacitance (FET)
C_E → emitter capacitance (BJT)

Avmid = Midband gain

= 0.707 = $\frac{1}{\sqrt{2}}$

X In higher frequencies parasitic capacitances of the network (circuit) and active devices and frequency dependence of the gain of the BJT or FET or tube decreases magnitude response

Transformer-coupled amplifier



The drop in the gain at the low frequencies at the transformer coupled system (amplifier) is due to "transformer action". The transformer and its corresponding equivalent circuit behaves a short circuit at Low frequencies (at the input terminals of the transformer) as it has very low magnitizing ~~inductance~~ inductive reactance values at low frequencies

$(X_L = 2\pi f L)$

reactance
due to inductive element L

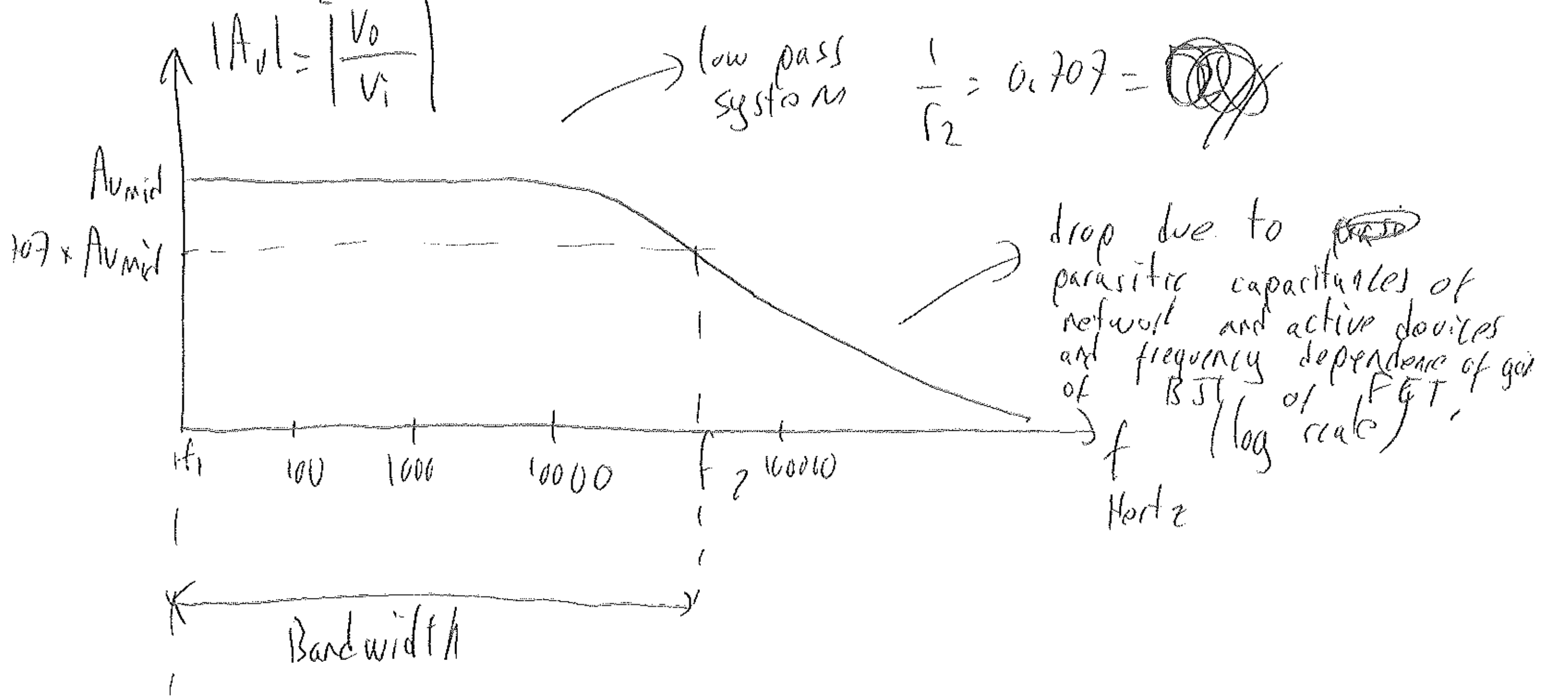
Hence the gain when f=0 Hertz is 0 as there is no longer a charging flux established through the core to induce a secondary or output voltage

At high frequencies stray capacitance between the turns of primary and secondary windings drops the magnitude response drastically

Direct - coupled amplifier

* There are no coupling or bypass capacitors to cause a drop in gain at low frequencies.

* Hence it is a nearly constant response until corner frequency f_2 (cut-off frequency)



low pass system $\frac{1}{f_2} = 0.707 =$

drop due to ~~passo~~ parasitic capacitances of network and active devices and frequency dependence of gain of BJT or FET.

Power at midband (mid-frequencies)

$$P_{o_{mid}} = \frac{|V_o|^2}{R_o} = \frac{\left|V_i^2 \frac{V_o^2}{V_i^2}\right|}{R_o} = \frac{|V_i Av_{mid}|^2}{R_o}$$

at the cut-off (half power requency)

$$P_{o_{HPF}} = \frac{|\frac{1}{\sqrt{2}} Av_{mid} V_i|^2}{R_o} = 0.5 \frac{|Av_{mid} V_i|^2}{R_o}$$

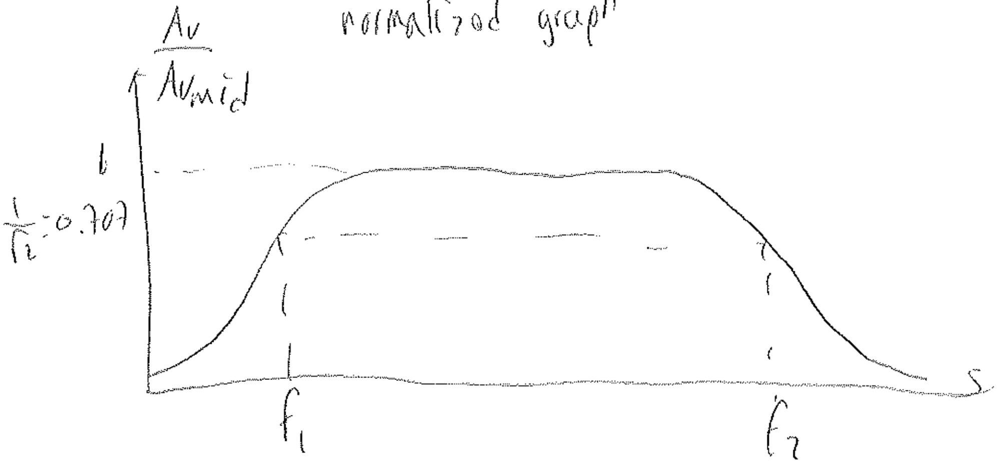
Then $P_{o_{HPF}} = 0.5 P_{o_{mid}}$

bandwidth $= |f_2 - f_1|$

Normalization of magnitude response

divide $|A_v|$ by a factor of $A_{v_{mid}}$

normalized graph



f_1 ; f_2 → cut off (half power) frequencies