# Lecture-1

Frequency Response of BJT Amplifiers

# The Decibel (dB)

- A logarithmic measurement of the ration of power or voltage
- Power gain is expressed in dB by the formula:

$$A_P = 10 \log a_P$$

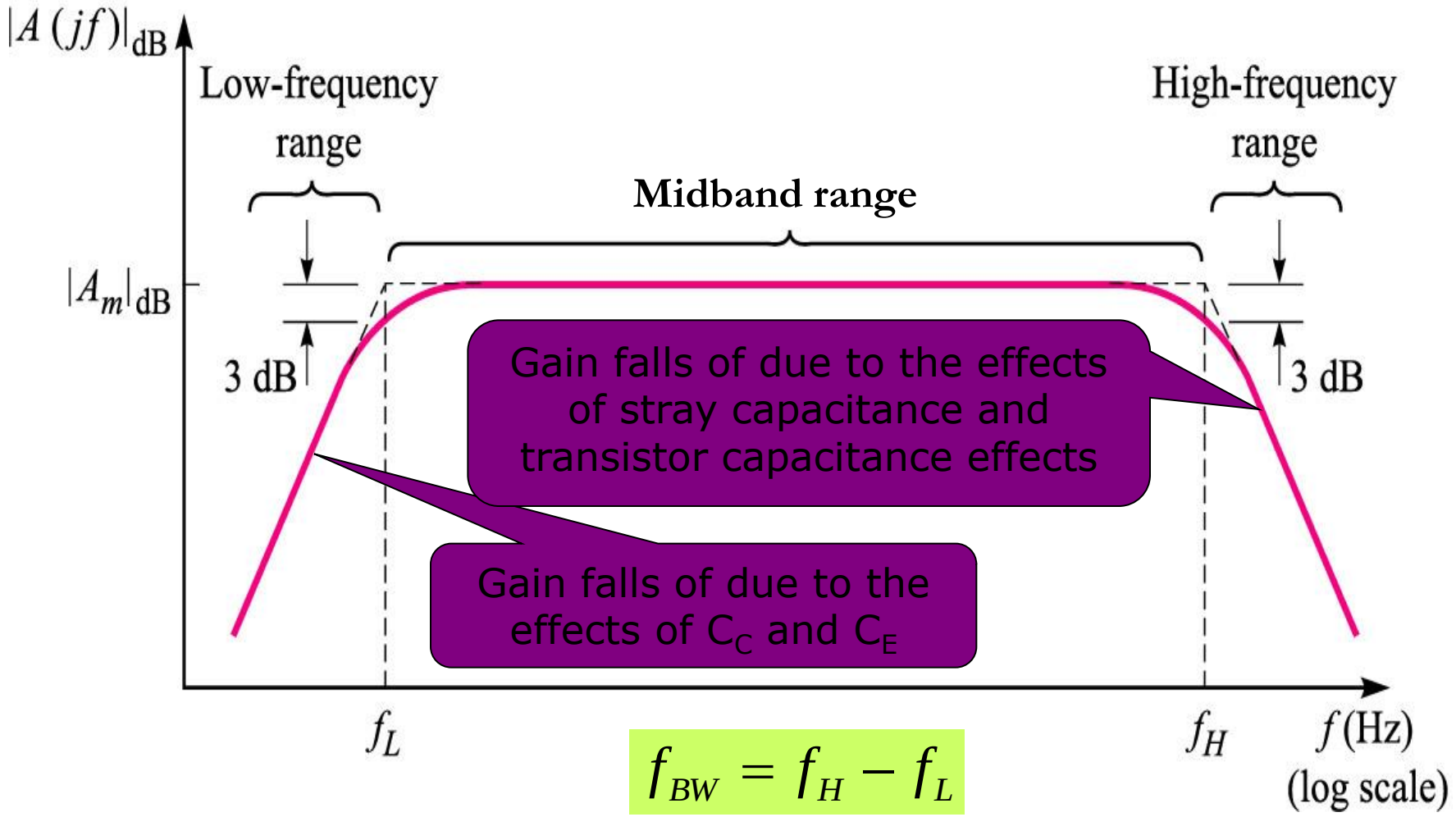
where $a_p$ is the actual power gain, Pout/Pin

Voltage gain is expressed by:

$$A_{V(dB)} = 20 \log a_v$$

- If $a_v$ is greater than 1, the dB is +ve, and if $a_v$ is less than 1, the dB gain is –ve value & usually called *attenuation*

# Amplifier gain vs frequency




$$f_{BW} = f_H - f_L$$

# Definition

- Frequency response of an amplifier is the graph of its *gain versus the frequency*.
- *Cutoff frequencies* : the frequencies at which the voltage gain equals 0.707 of its maximum value.
- *Midband* : the band of frequencies between $10f_L$ and $0.1f_H$ where the voltage gain is maximum. The region where coupling & bypass capacitors act as short circuits and the stray capacitance and transistor capacitance effects act as open circuits.
- *Bandwidth* : the band between upper and lower cutoff frequencies
- Outside the midband, the voltage gain can be determined by these equations:

$$A = \frac{A_{mid}}{\sqrt{1+(f_1/f)^2}}$$

Below midband

$$A = \frac{A_{mid}}{\sqrt{1+(f/f_2)^2}}$$

Above midband

# Lower & Upper Critical frequency

- Critical frequency a.k.a the cutoff frequency
- The frequency at which output power drops by 3 dB. [in real number, 0.5 of it's midrange value.
- An output voltage drop of 3dB represents about a 0.707 drop from the midrange value in real number.
- Power is often measured in units of dBm. This is decibels with reference to 1mW of power. [0 dBm = 1mW], where;

$$10\log\left(\frac{1\text{mW}}{1\text{mW}}\right) = 0\text{dBm}.$$

# Gain & frequencies

- *Gain-bandwidth product* : constant value of the product of the voltage gain and the bandwidth.
- *Unity-gain frequency* : the frequency at which the amplifier's gain is 1

$$f_T = A_{mid} BW$$

# LOW FREQUENCY

- At low frequency range, the gain falloff due to coupling capacitors and bypass capacitors.
- As signal frequency $\Downarrow$ , the reactance of the coupling capacitor, $X_C$ $\Uparrow$ - no longer behave as short circuits.