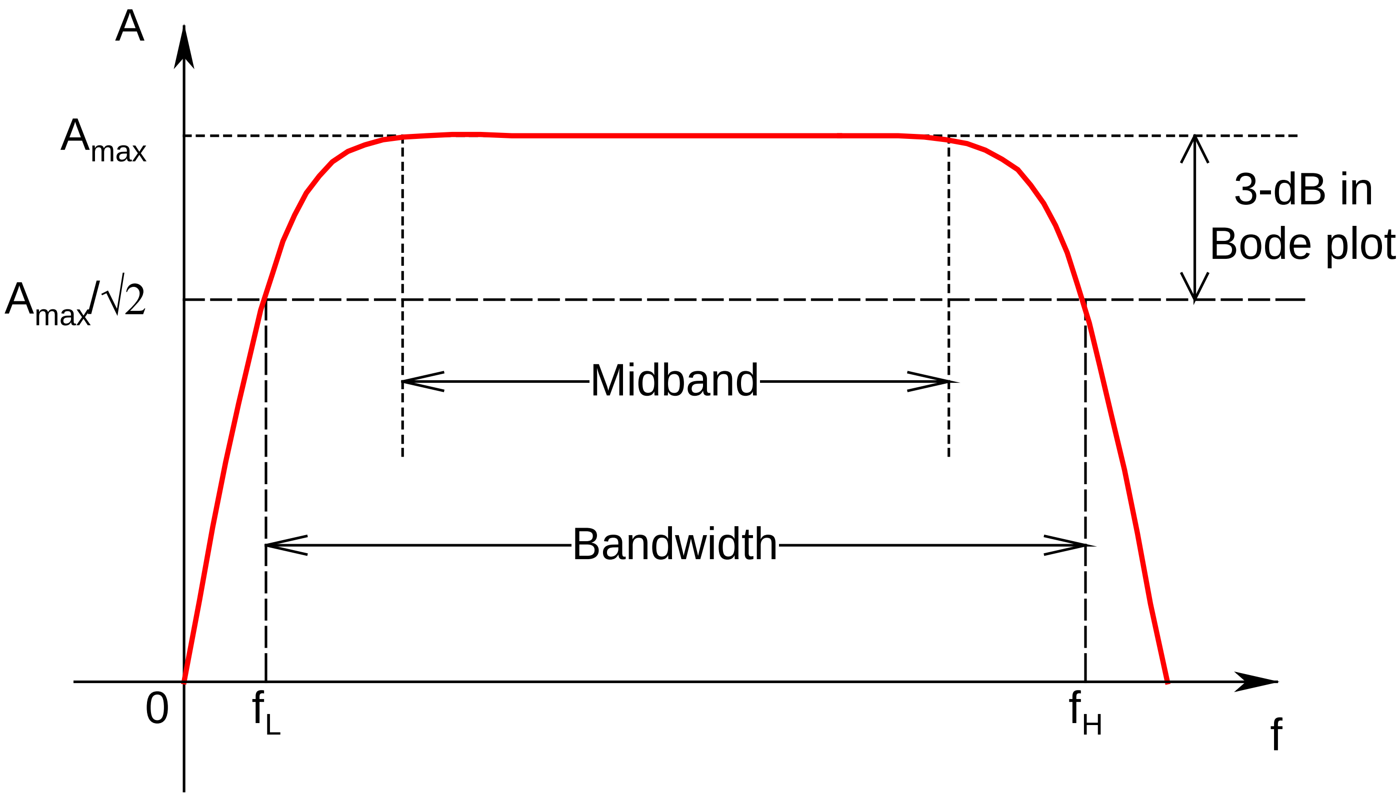
FREQUENCY RESPONSE

- So far, considered ***midband analysis***, where ***all capacitive effects were neglected***
  - ***Voltage/current gain was independent of frequency***
- In ***practical amplifier circuits***, however, the ***gain would depend on frequency***
- ***Characterized by***:
  - ***Lower Cutoff Frequency*** (f_L)
    - ***Contributed by external capacitors*** (C_E, C_B, C_C)

- ***Upper Cutoff Frequency*** (f_H)
  - ***Contributed by device capacitances*** (***for BJTs***: C_π, C_μ; ***for MOSFETs***: C_{gs}, C_{gd}, C_{sb}, C_{db})
- These capacitors create ***charge storage effects***, and ***introduce time constants*** into the circuit
- ***Discrete circuits show both f_L and f_H***
- ***IC stages show only f_H***, since most of them are ***direct coupled*** without the need for any ***external capacitors***



f_L: Lower Cutoff Frequency

f_H: Upper Cutoff Frequency

Bandwidth = $f_H - f_L$

- ***Exact analysis extremely complicated***
  - Most often, results in ***very complicated expressions***, ***completely hiding the physical feel of the phenomenon***
  - ***Makes debugging extremely difficult***
    - For example, a circuit having ***4 capacitors***, will have a ***fourth-order transfer function***, which needs to be ***solved*** to get all the ***poles and zeros*** of the system
  - However, there are ***techniques***, which make these ***analyses*** extremely ***trivial***
    - ***Not accurate***, but ***extremely simple***, and makes ***debugging easy***

- ***Techniques***:
  - ***Infinite-Value Time Constant (IVTC) Method***
    - ***Used for obtaining f_L***
  - ***Zero-Value Time Constant (ZVTC) Method***
    - ***Used for obtaining f_H***
- These techniques are ***extremely easy to apply***, and the results are ***quite close to actuals***
- However, there is ***one limitation*** of these techniques