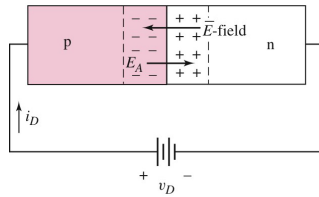
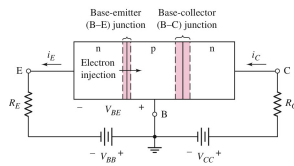


Junction Capacitance



The depletion region of a pn junction acts like a parallel plate capacitor

$$C = \epsilon \frac{A}{d}$$



A BJT has two junctions and it has junction capacitance too. The junction capacitance are usually in the order of pico-Farad.

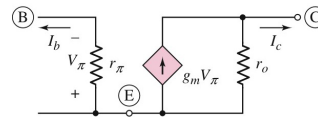
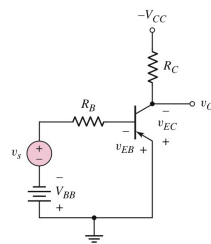
We know $Z_C = \frac{1}{2\pi f C}$

- DC signals are not affected by junction capacitance
- High frequency AC signals can be affected

1

1

Small-Signal Equivalent Circuit

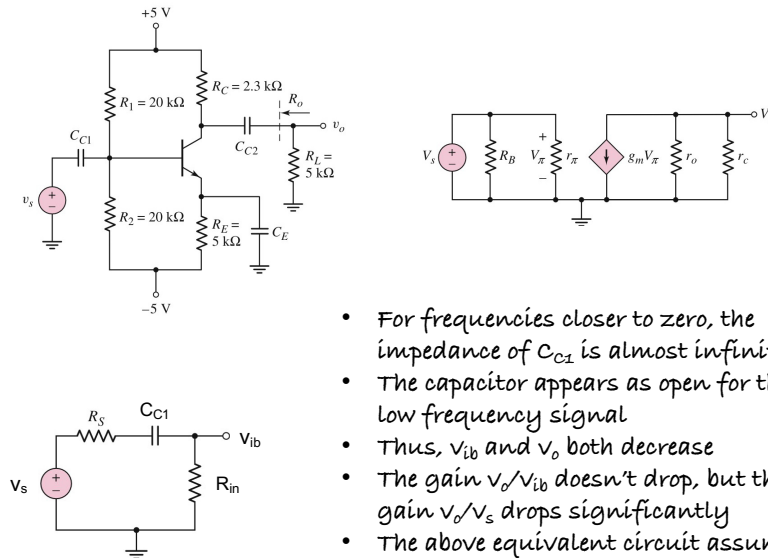


- Junction capacitors are ignored here.
- This is good for lower frequencies.
- How about very low frequencies, i.e., close to zero?

2

2

Effect of Very Low Frequency Signal

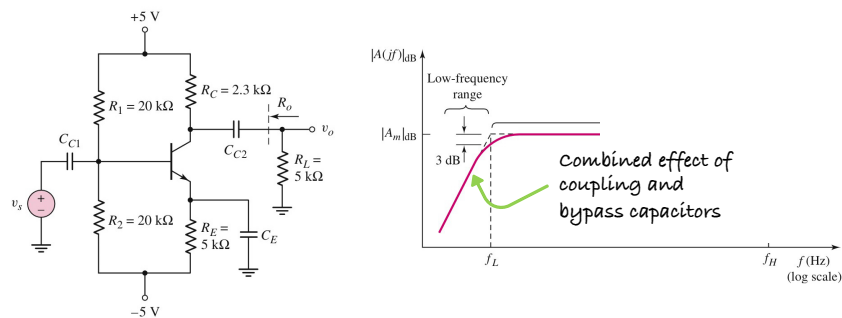


- For frequencies closer to zero, the impedance of C_{C1} is almost infinite
- The capacitor appears as open for the low frequency signal
- Thus, v_{ib} and v_o both decrease
- The gain v_o/v_{ib} doesn't drop, but the gain v_o/v_s drops significantly
- The above equivalent circuit assumes that all external capacitors are shorted

3

3

Effect of External Capacitors at Very Low Frequencies

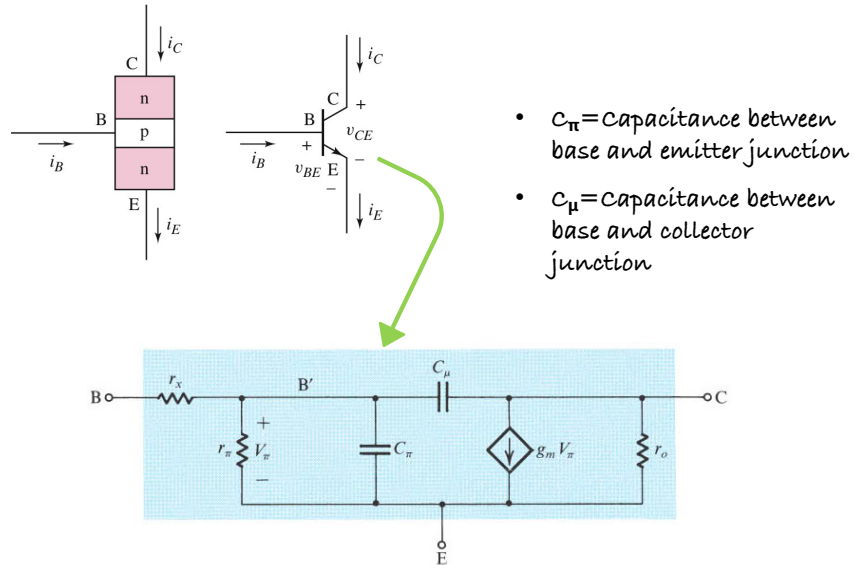


- When all external capacitors become effectively shorted to the signal frequency, the gain becomes steady
- The frequency at which the gain increases to 70.7% of the maximum value is called (lower) cutoff frequency
- This is also called half-power point or 3dB point

4

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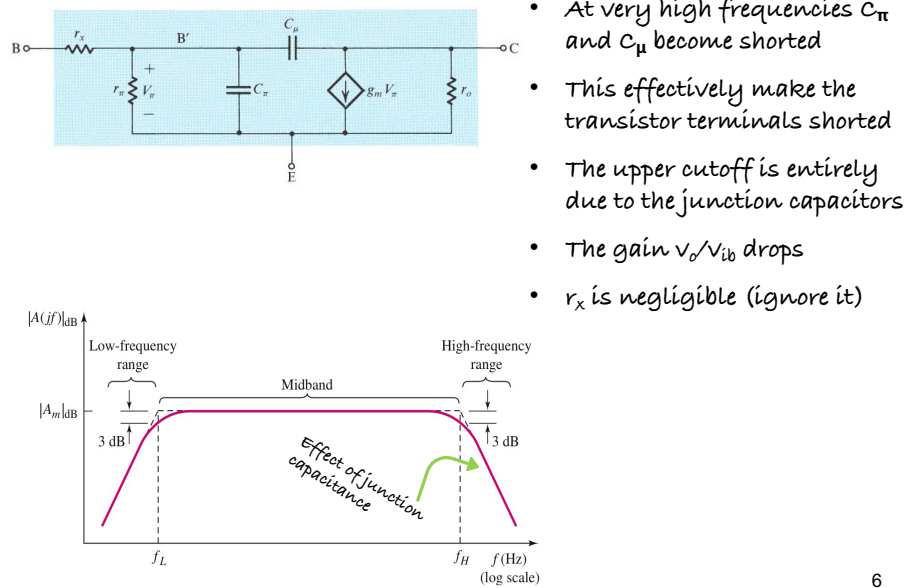
High Frequency Model of a Transistor



5

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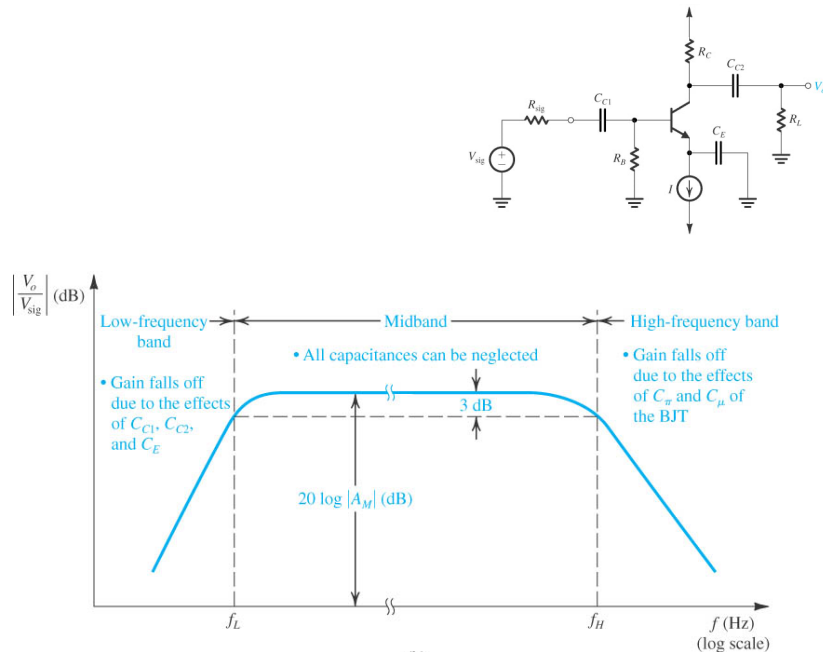
Effect of Junction Capacitors at Very High Frequencies



6

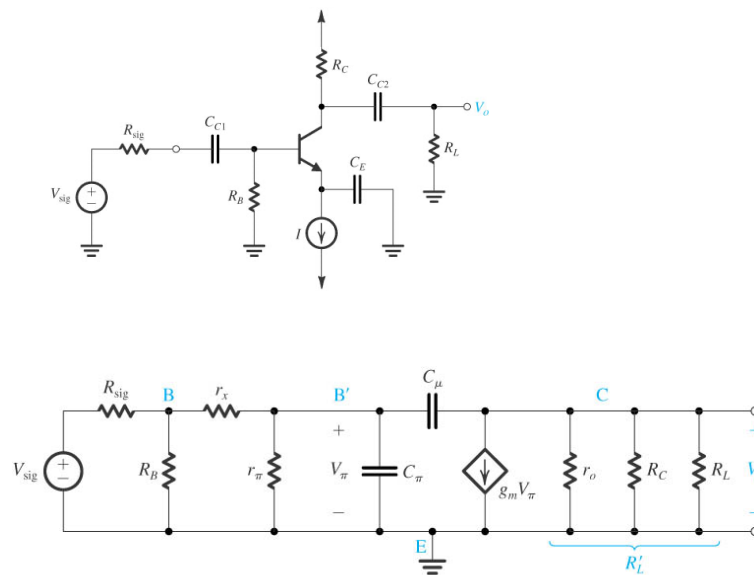
6

Complete Frequency Response Curve



7

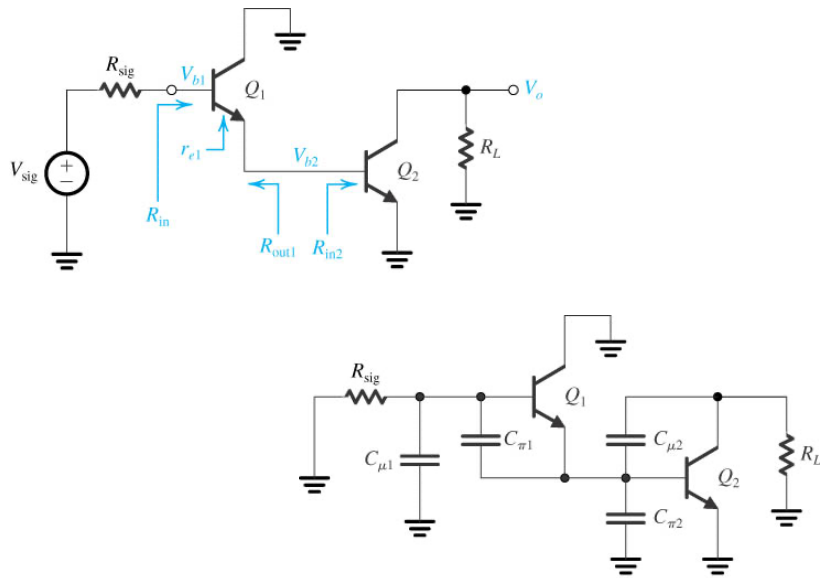
High Frequency Small-Signal π -Model



8

8

Amplifier Circuits at High Frequencies



9

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