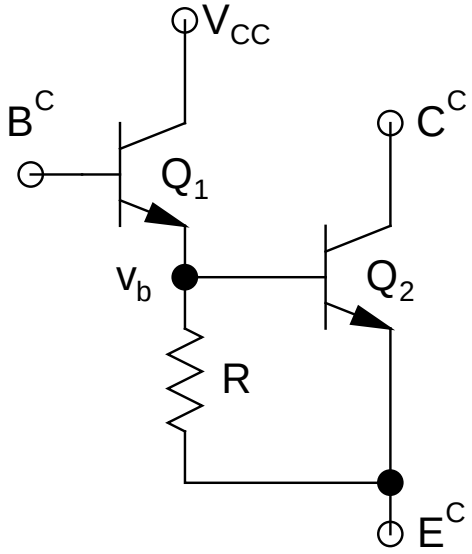
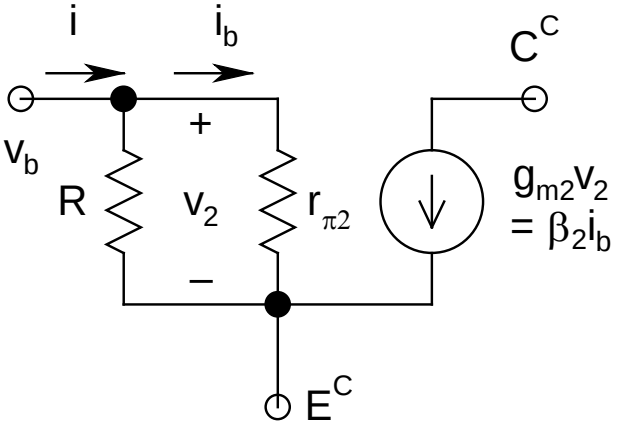
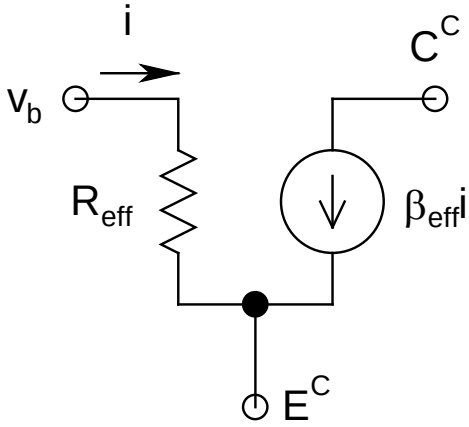
- ***Need to jack up β_1***
  - ***How about using a keep-alive resistor*?**



Darlington with Keep-Alive Resistor R



ac Midband Equivalent of Q_2-R Combination



Simplified Equivalent of Q_2-R Combination

- ***R drains a constant DC current of ~ 0.7/R***
- ***This current is supplied by Q_1, along with I_{B2}***

  $\Rightarrow I_{C1}\uparrow \Rightarrow \beta_1\uparrow$
- ***However, this technique also changes β_2***
- ***Analysis***:

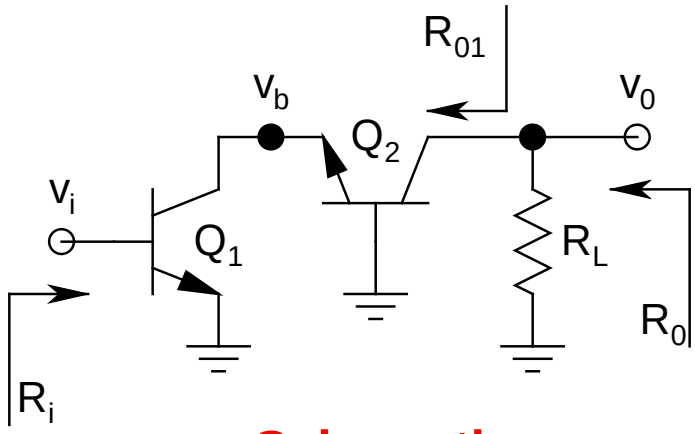
  $i_b = Ri/(R + r_{\pi 2})$

  $\Rightarrow i_c = \beta_2 i_b = \beta_2 Ri/(R + r_{\pi 2}) = g_{m2} r_{\pi 2} Ri/(R + r_{\pi 2})$

  $= g_{m2}(R \| r_{\pi 2})i = g_{m2} R_{eff} i = \beta_{eff} i$

  $\beta_{eff} = g_{m2} R_{eff} < \beta_2 \qquad (R_{eff} = R \| r_{\pi 2})$
- ***Note***: $r_{E2,eff} = R_{eff}/\beta_{eff} = 1/g_{m2} = r_{E2}$ (***unchanged***)

- ***npn Cascode***:
  - ***CE***, followed by ***CB***
  - Known as ***Wideband Amplifier***, due to its ***superior frequency response characteristic***



ac Schematic

  - ***Generally, both Q_1 and Q_2 are biased with the same I_C***
  - ***Assuming Q_1-Q_2 have same β***:

    $r_{E1} = r_{E2} = r_E$ and $r_{\pi 1} = r_{\pi 2} = r_\pi$

- ***This circuit can be analyzed by inspection***
- $R_i = r_{\pi 1}$
- $v_0/v_b = +g_{m2}R_L = R_L/r_{E2}$ (***CB Stage***)
- $v_b/v_i = -r_{E2}/r_{E1} = -1$
  - ***CE Stage with R_i of Q_2 (= r_{E2}) as its load***
- Thus, $A_v = v_0/v_i = -R_L/r_{E2}$
- ***Note that A_v is same as that for a CE stage, however, the bandwidth of this circuit is far superior than a CE stage***