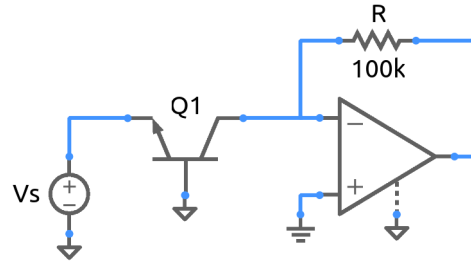


opamp_antilog.sqproj



In a BJT operating in the active mode, the collector current I_C is an exponential function of the base-emitter voltage V_{BE} , given by

$$I_C \approx I_{CS} \exp\left(\frac{V_{BE}}{\eta V_T}\right), \quad (1)$$

where $V_T = k_B T / q$ is the thermal voltage. In the circuit shown in the figure, assuming the Op Amp to be operating in the linear region, the collector of the BJT is at virtual ground, and the BJT operates in the active mode as long as the B-E junction is forward biased. For this condition, we can write

$$V_{\text{out}} = I_C R = R I_{CS} \exp\left(\frac{V_{BE}}{\eta V_T}\right) \equiv k_1 \exp\left(\frac{-V_s}{\eta V_T}\right). \quad (2)$$

Exercise Set

1. Run the simulation. Plot V_{out} (log scale) versus V_s (linear scale). Comment on the plot. Estimate the value of I_{CS} .
2. How will the plot change if R is changed from 100 k Ω to 10 k Ω ? Verify with simulation.

References

1. J. Millman and A. Grabel, *Microelectronics*, McGraw-Hill, 1988.