

Circuit Design

March 9, 2022

1 Design Tasks

1. Choose an LED from Digikey. Sketch a simple circuit that lights the LED using a DC voltage source and resistor. Choose a DC voltage and a resistor value which ensures that the LED is lit brightly.
2. Using a single generic NPN bipolar transistor (assume $\beta = 100$), design a follower that operates between 0 and 16 volts. Use a voltage divider at the input and an emitter resistor to set the DC operating point such that quiescent bias current is 100 mA and the AC output has the maximum dynamic range. You may assume all capacitors are infinitely large (short circuits to AC) but specify all resistor values. Calculate the input impedance of your circuit.
3. Suppose that input impedance of your circuit is insufficient. Using the same single transistor, loosen one of the other design constraints in order to achieve a factor of ten higher input impedance.
4. Using a single generic NPN bipolar transistor (assume $\beta = 100$), design a common emitter amplifier that operates between 0 and 10 volts. Use a voltage divider at the input and an emitter and collector resistor. Set the DC operating point such that quiescent bias current is 100 mA and the AC output has the maximum dynamic range. Set the gain to five. You may assume all capacitors are infinitely large (short circuits to AC) but specify all resistor values.
5. Choose an operational amplifier on Digikey and design a circuit with a gain of 50 up to 10 MHz using a single stage.
6. Using a single generic operational amplifier, design an active low-pass filter with a corner frequency of 10 MHz and an input impedance of 1 M Ω at 10 MHz.
7. For this design, use (multiple instances) of a generic operational amplifier. Assume that it has a gain-bandwidth product of 100 MHz. Design a circuit that has input impedance of 10 M Ω and a gain of 1000 for frequencies up to 10 MHz.
8. Lookup the specs for the LT3045 linear voltage regulator. Sketch a circuit which configures the LT3045 to deliver a fixed 10 V regulated output.