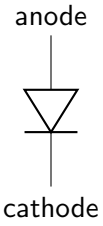
Lab 6: Diodes

Before you begin today's lab

- In this lab, we will use the variable supply on your protoboard. Use a multimeter and the knobs at the top of the protoboard to set V_+ (yellow rail) to $+15\,\mathrm{V}$.



Diode Circuits

(a) Why do we call a diode a nonlinear device? Does it have a resistance/reactance? How does this differ from components such as resistors or capacitors? (It might help to draw a plot of I vs V below.)

(b) It is always good to check the "Absolute Maximum Ratings" section of the datasheet before you use any unfamiliar component. Open the datasheet for the 1N4148 diode (look it up!) and check what currents and voltages you should avoid subjecting the diode to. We are unable to make any voltages greater than 15 V at the moment, so voltages won't be a danger here. However, your power supply can put out considerable current (at least an ampere). So, to avoid violating the "Forward continuous current" limit in that scary table.

What is the smallest possible resistor we should have in series with our diodes, if we want to be protected up to our power supply's 15 V limit?

(c) Small diodes (i.e., those intended for low currents) are known as "signal diodes," and do tasks like eliminating one polarity from a signal that goes both plus and minus. Look at the circuit of Figure **??** (ignoring the dashed capacitor for now) and predict what it will do to an incoming signal.

Then wire it up and drive it with a 1 kHz, 6 Vpp (peak-to-peak) sine wave.

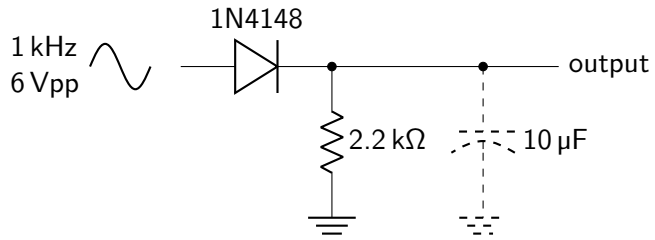


Figure 1: Half-wave rectifier circuit. The dashed capacitor will be added in part (d) below.

Observe the input and output (use CH1 and CH2) on the 'scope, and sketch the waveforms. Does the output match your prediction?

(d) Now add a 10 µF electrolytic capacitor in parallel with the 2.2 kΩ resistor. **Careful:** this component is polarized; make sure you connect it with the side marked "+" at the higher voltage. Sketch the output waveform below, and explain why it changed from what you saw above.

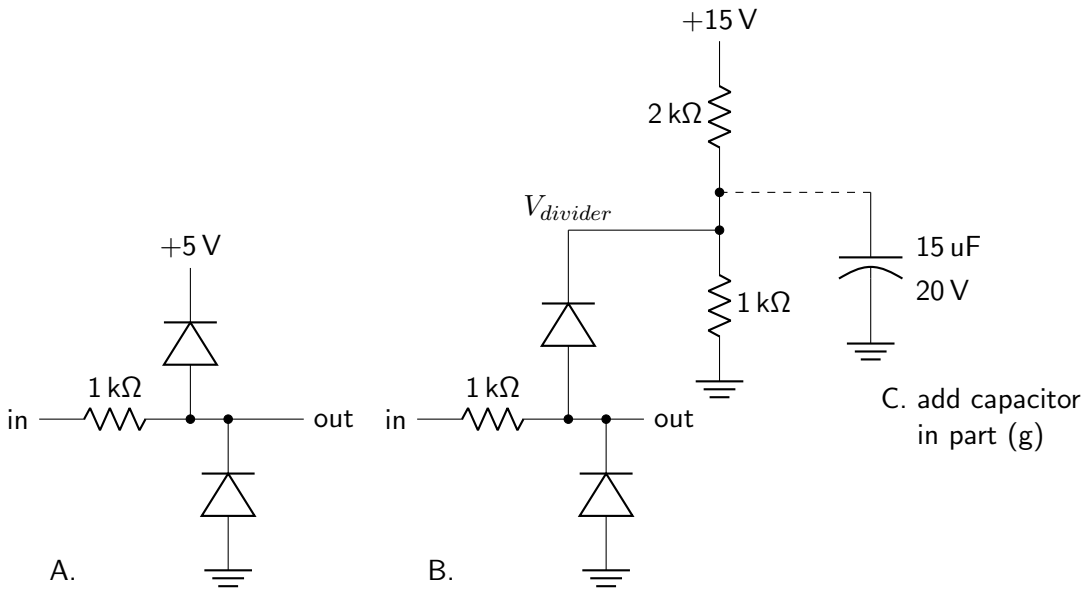


Figure 2: Signal clamp circuits. Be sure to observe the polarity of the capacitor in circuit C.

(e) Diodes are often used in protection circuits to limit or "clamp" voltages within certain values, to protect later stages of a circuit from unwanted voltage levels. Build the circuit of Figure **??**A. What limits does this circuit place on the output voltage? Predict below, then drive the circuit with a large amplitude sine wave from the Siglent function generator to check its performance.

(f) Modify your circuit to the configuration of Figure **??**B (omit the 15 µF capacitor for now). Should it work the same, given that the voltage divider is configured to generate +5 V? Try it out (and expect to be surprised). Explain what's happening.[1]

[1] Hint: Input and output impedance!

(g) Now add the 15 µF capacitor (Figure **??**C) and test it again. explain what's happening now, perhaps invoking the concept of reactance.