**AC → DC: Using a full-wave diode rectifier circuit**

(used in the music system final project)

The 20:1 turns ratio transformer here reduces the rms voltage from the wall outlet – 120 V – by a factor of 20 to in volts rms. The voltage across the load resistor still has positive and negative values.

![Diagram of a full-wave diode rectifier circuit with a 20:1 transformer and a 50Ω resistor](image)

**Figure 0.1** Step-down transformer power supply
Putting a single diode in the circuit eliminates the negative-going voltages, but is inefficient because of that, and the output voltage is not a steady value as a function of time.

Figure 0.2 Half-wave-rectifier power supply
Using four diodes connected as shown produces only positive-going voltages (more efficient) but the voltage is not steady – it has very large “ripple”.

Figure 0.3  Full-wave-rectifier power supply
To see how the four-diode (full-wave rectifier) works, look first at the voltage polarity across the load resistor. When the top of the transformer secondary is positive, the two diodes shown are forward biased and the current is downward through the load resistor. When the top of the transformer is negative with respect to the bottom, these two diodes are reverse-biased and pass no current.

Figure 0.4  Positive transformer output causes the pair of diodes shown to conduct in the fullwave-rectifier power supply.
When the top terminal of the transformer is negative, The other two diodes are forward-biased and pass Current through the load resistor from top to bottom, Filling in the missing parts of the output waveform.

Figure 0.5 Negative transformer output causes the other diode pair to conduct.
The output can be filtered by adding a capacitor across the load resistor, reducing the ripple significantly. The time constant RLC needs to be large compared with the period of the AC part of the output waveform. What is the frequency of that AC part? And what is its period?

Figure 0.6 Filtered full-wave-rectifier power supply
To get a really steady voltage out we can add an integrated circuit regulator to the circuit.

![Regulated power supply](image)

Figure 0.7 Regulated power supply