ECE 2100 Lecture Notes 2/12/03

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2/11/03,
2/13/03

Stuff

The lab starting this week will be about clippers limiters and doublers in stead of power supplies. (We can't find the transformers & are short on voltage regulators.) Therefore, I'll talk about those things first and real power supplies later. Today's textbook section is 3.8.

HW #9, due W, 2/12

Ch. 3, Ex3.1 - Ex3.5, Repeat Ex3.1 - Ex3.5 using the 0.7V drop model of the diode.

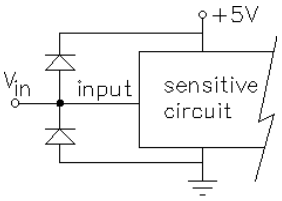
HW #10 handout, due F, 2/14

Ans: 2. -8V, 8. 0mA 13.75mA 2.75V

Limiter or Clipper Circuits

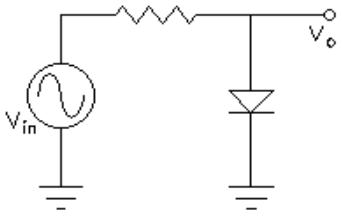
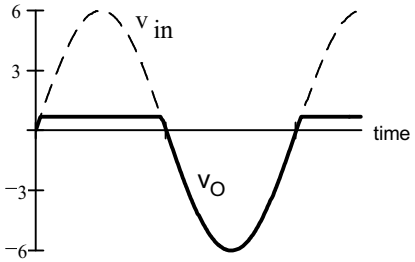
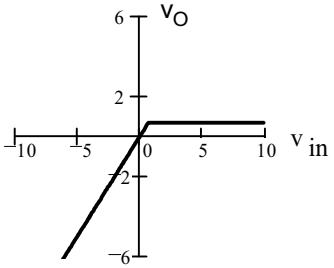
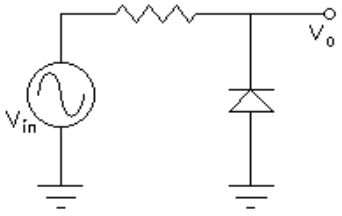
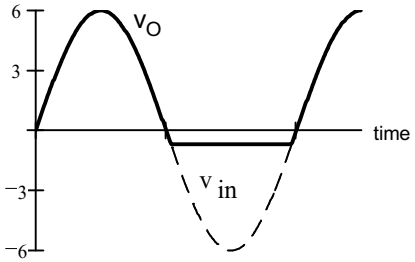
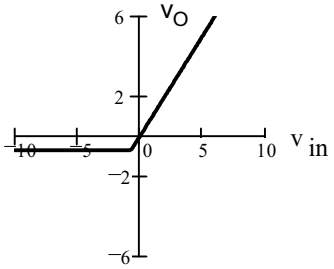
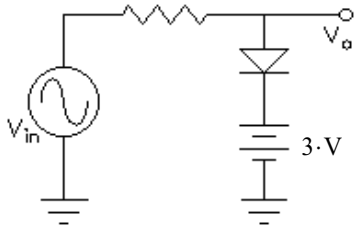
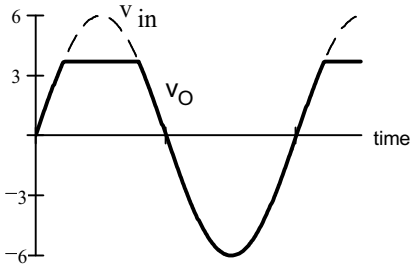
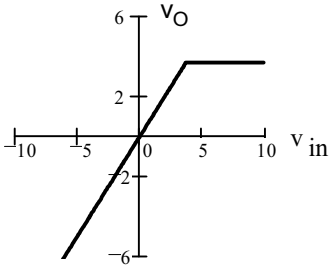
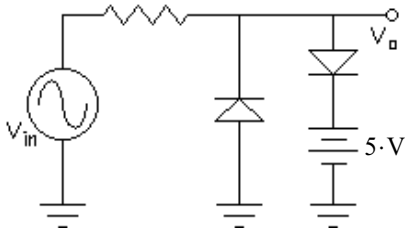
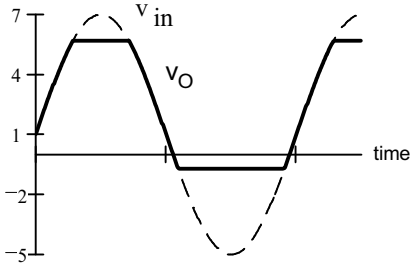
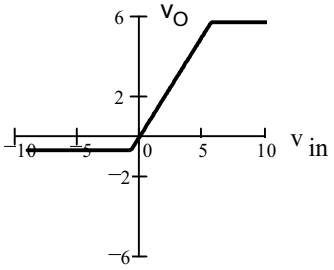
You've seen that there are limits to the output voltage of an amplifier. Limits are not altogether bad. They can protect other devices that are hooked to your circuit. Simple limiter circuits can be made with diodes.

A common input protection to protect circuit from excessive input voltages such as static electricity.

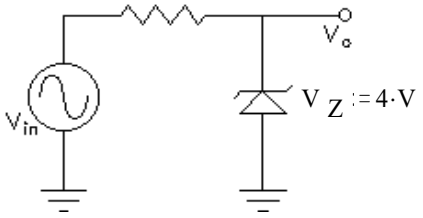
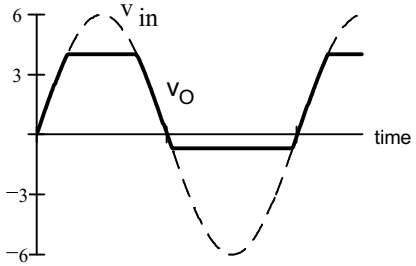
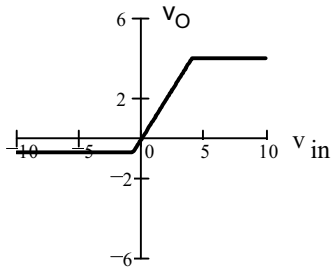
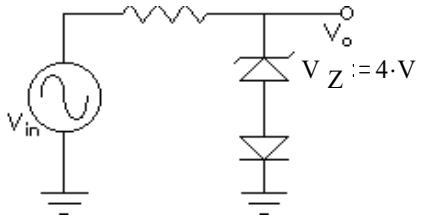
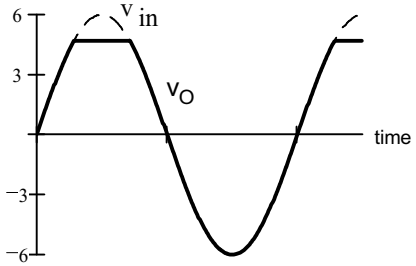
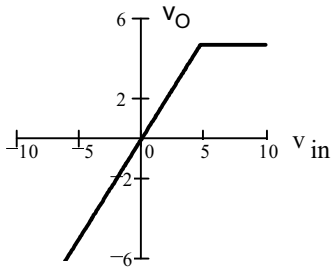
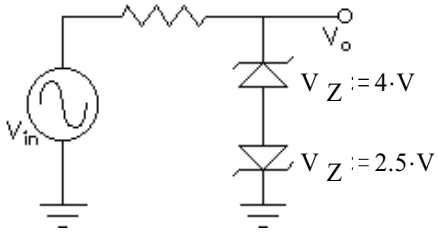
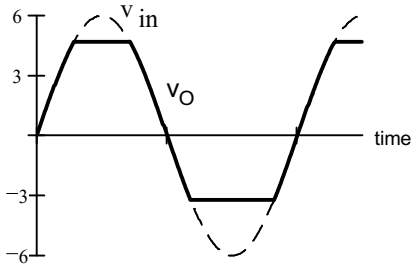
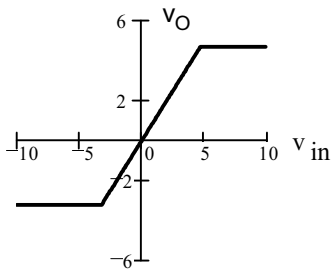
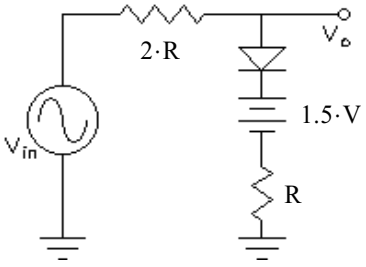
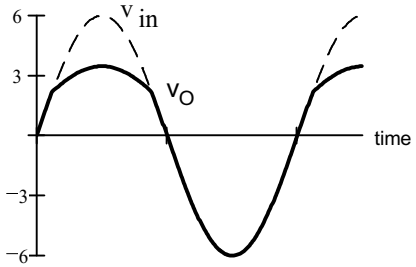
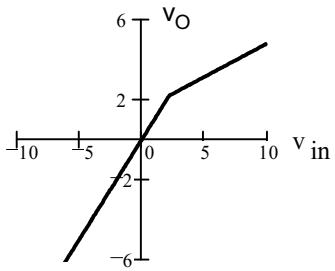


The input to the box marked "sensitive circuit" can't get higher than the positive supply + 0.7V or lower than the negative supply - 0.7V.

Let's look at more general cases

Circuit	Waveforms in & out	Transfer Characteristic
		
		
		
		

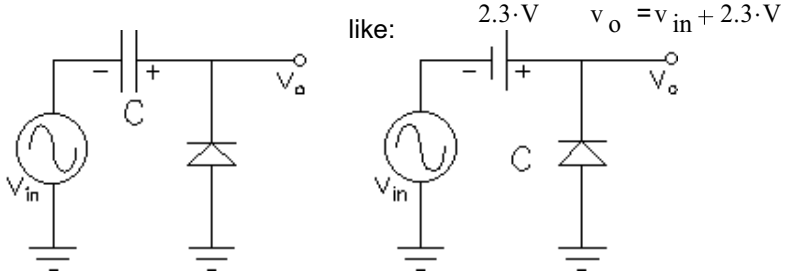
Notice that this is exactly the same as the first circuit, the one hooked to the "sensitive circuit"

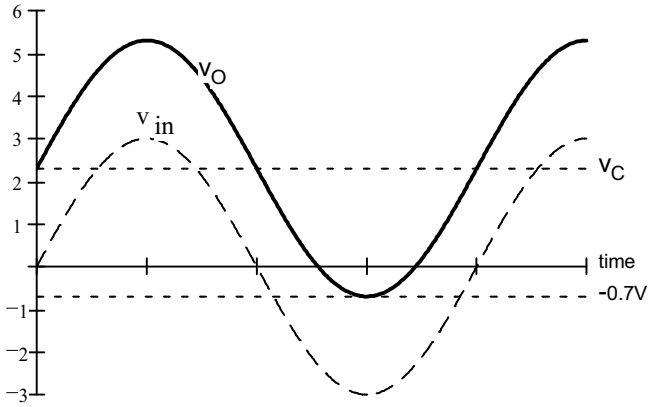
Circuit	Waveforms in & out	Transfer Characteristic
		
		
		
		

And the possibilities go on and on....

DC Restorer

The capacitor charges up to a DC voltage equal to the negative peak, less 0.7V. Then it has no way to discharge, so it may as well be considered a constant DC source.

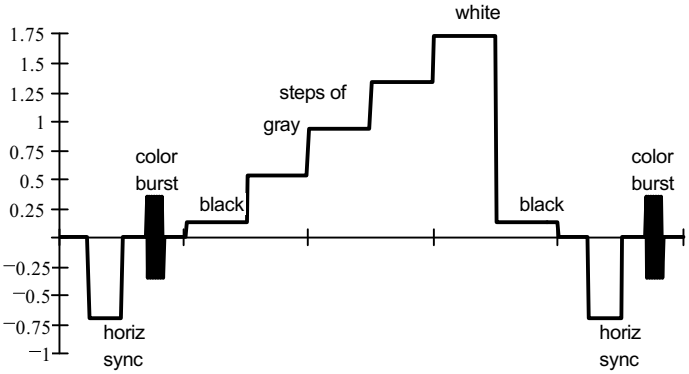


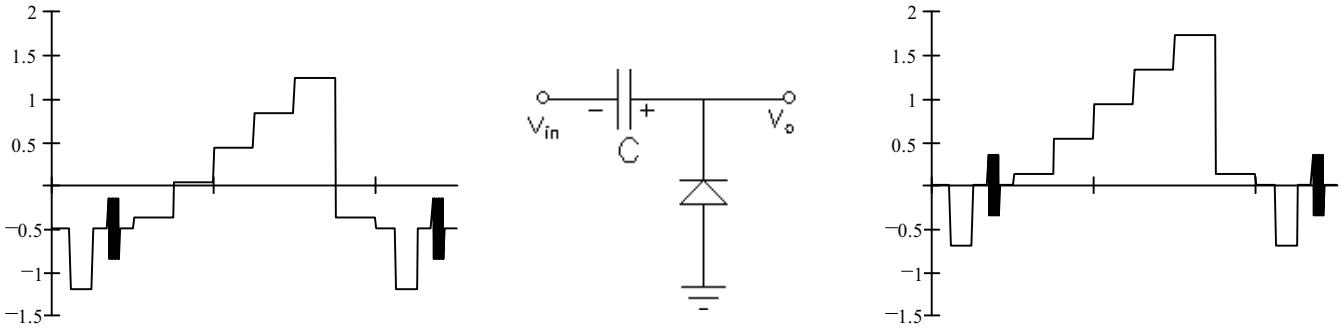


What good is it?

Amplifier circuits commonly have to be biased at DC voltages in order to work, so it's also common to connect one stage to another though a "coupling capacitor". The capacitor isolates the DC voltages of one stage from the DC voltages of the next stage. Coupling capacitors are also used to isolate one piece of equipment from another. Due to the ways that AC power is distributed and variations in the power supplies, the grounds of the two pieces of equipment may be very different.

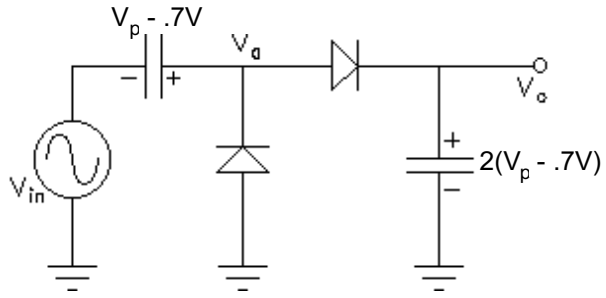
But what about a video signal, whose average DC value can change significantly depending on the overall brightness of the picture? If you filter out all the DC, then a black picture will "rise" to a washed-out gray. This is where the DC restorer circuit is useful.



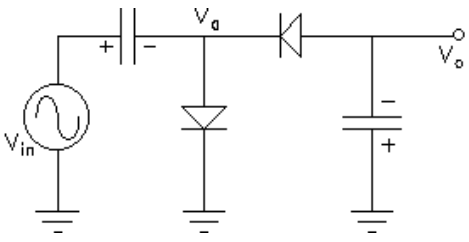


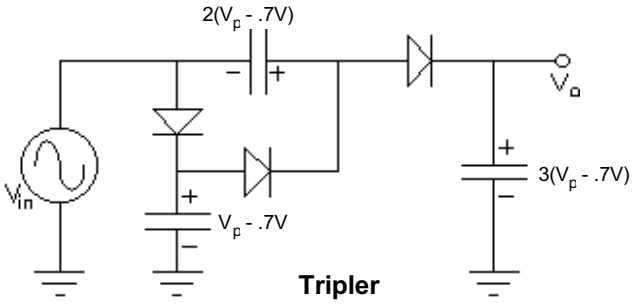
Voltage Doubler

Add a rectifier circuit to the restorer. Outputs a DC voltage roughly double the peak of the AC input.

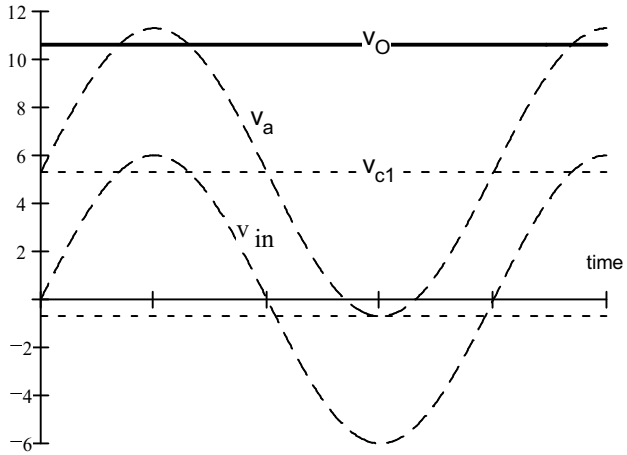


Turn diodes around for negative output voltage.





Tripler

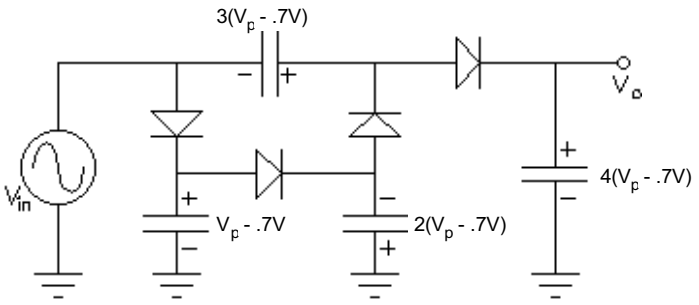


Doubler Waveforms after they've become stable. To see how they build up from zero (for negative doubler), look at Fig. E3.33, p.205 in textbook.

If you place a load on either the restorer or the doubler then the capacitors will discharge during each half cycle and performance can degrade badly.

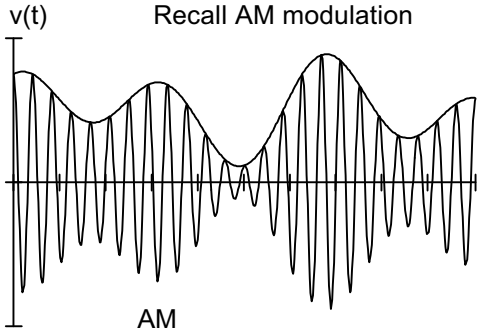
Higher multiplications are also possible

These voltage multiplier circuits are widely used in high voltage power supplies, like those needed to power cathode-ray display tubes (CRTs), x-ray tubes & gas lasers.



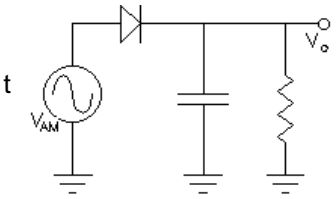
Quadrupler

AM detector

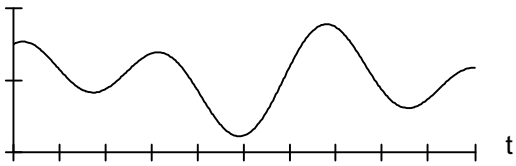


Recall AM modulation

A simple rectifier circuit



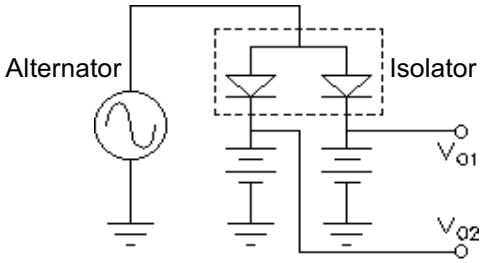
Returns the modulation signal



And a coupling capacitor can remove the DC

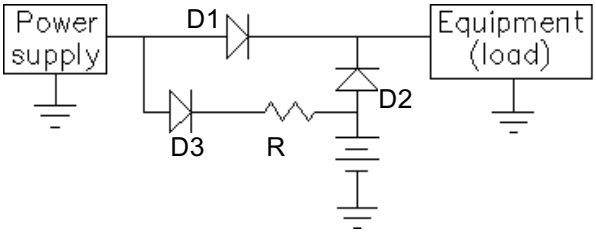
Battery Isolator

Like you might find in an RV. One alternator is used to charge two batteries. When the alternator is **not** charging, the batteries and the circuits they are hooked to should be isolated from one another. If not, then one battery might discharge through the second, especially if second is bad. Also, you wouldn't want the accessories in the RV to drain the starting battery, or your uncle George from South Dakota might never leave your driveway.



Battery Backup Power

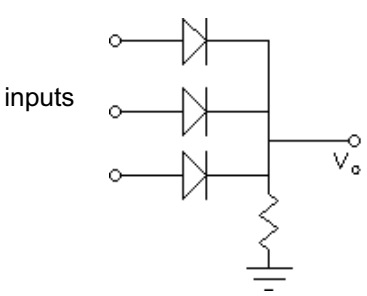
Normally the power supply powers the load through D1. However, if it fails, the load will remain powered by the battery through D2. Finally, D3 and R may be added to keep the battery charged when the power supply is working. These sorts of circuits are popular in hospitals.



Diode Logic Circuits

Actually, both of the previous circuits are logic circuits as well.

"OR" gate



"AND" gate