Universidade do Vale do Itajaí
Computer Engineering
Basic Electronics

Fourth Assignment for Basic Electronics

Student: Lucas Mateus Gonçalves
Teacher Advisor: Walter Antonio Gontijo

August
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Conteúdo

1 Objective

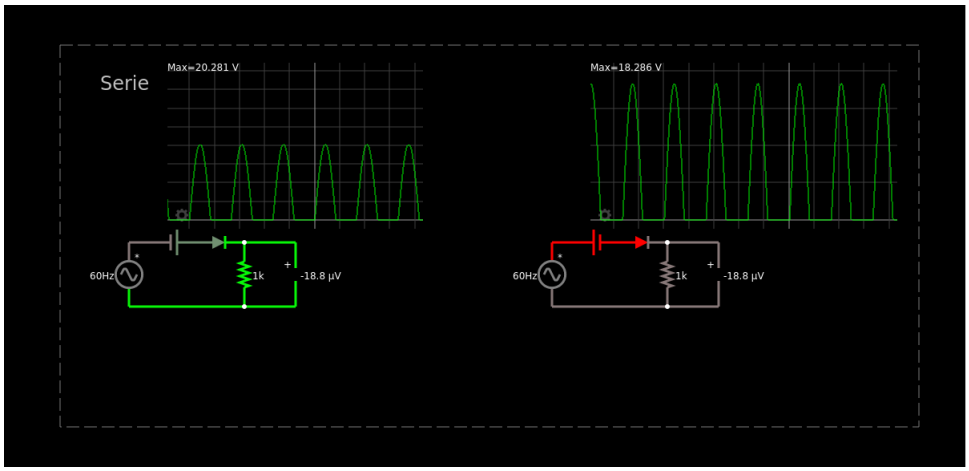
The analysis of multiple electrical circuits containing ideal and non-ideal diodes, capacitors, Alternating and direct current power supply's.

2 Introduction

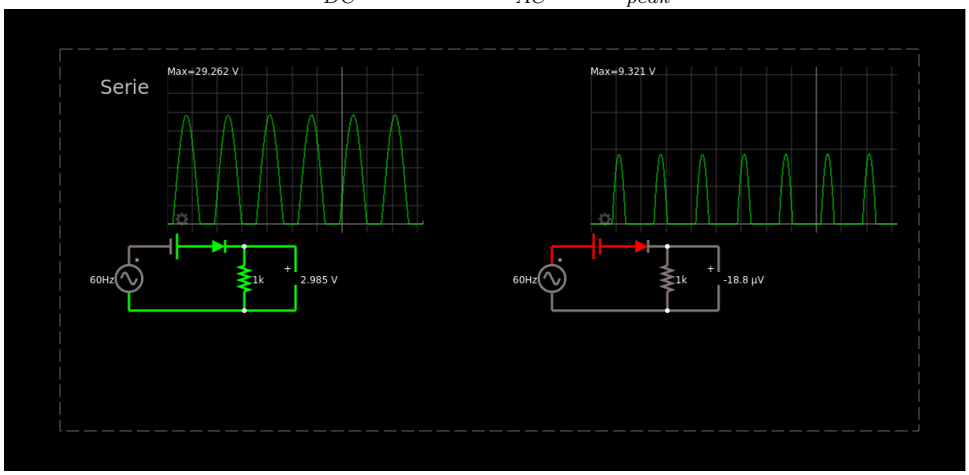
This paper has the purpose of describing multiple circuits with diodes, demonstrating common and desired circuit behaviours such as *Clipping* and *Signal limiting*.

3 Development

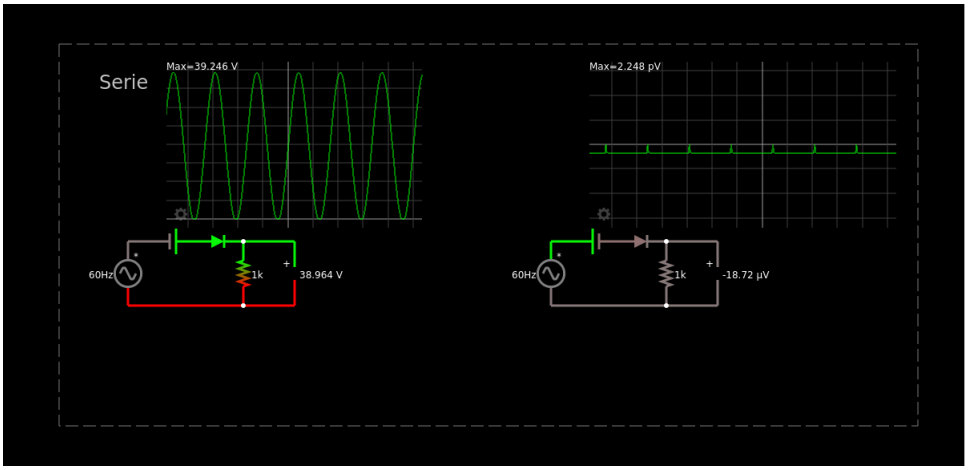
3.1 Diode Clipper with linear supply



$V_{DC} = 1V$ —— $V_{AC} = 20V_{peak}$



$V_{DC} = 10V$ —— $V_{AC} = 20V_{peak}$



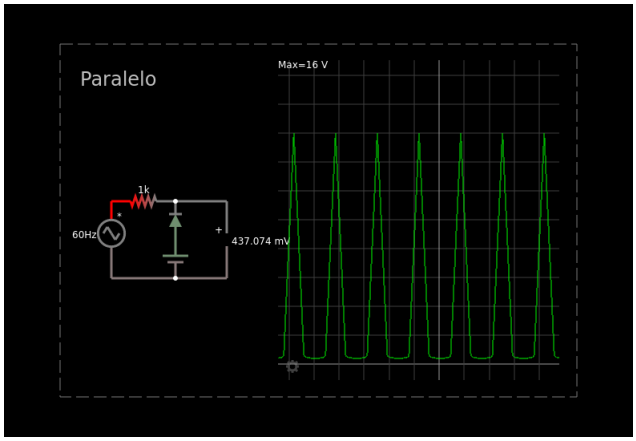
$V_{DC} = 20V$ —— $V_{AC} = 20V_{peak}$

The circuit shows the *Voltage clipping* effect, where the positive side of the wave is allowed through. The series power supply is not necessary for the effect but it demonstrates how much of the wave is allowed through.

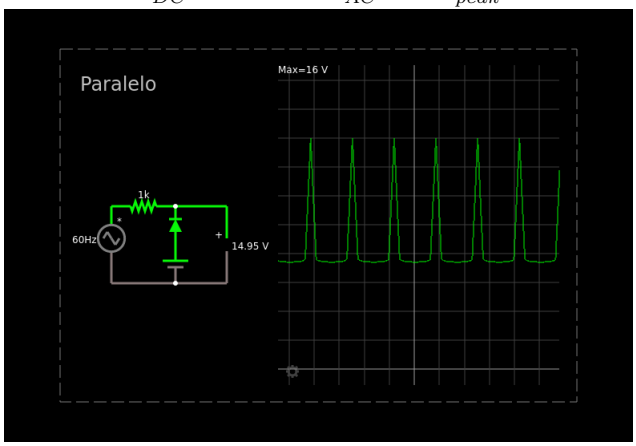
As the V_{DC} rises towards the diode, more of the wave is *pushed up* in voltage, making it through the diode.

The opposite when against it, to the point where when the V_{DC} is as high as the peak V_{AC} no current is allowed through except the reverse current of the *non-ideal* diode.

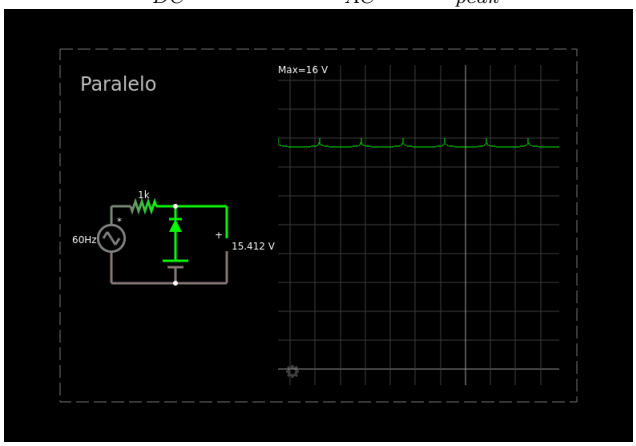
3.2 Diode Clipper with parallel supply



$V_{DC} = 1V$ —— $V_{AC} = 16V_{peak}$

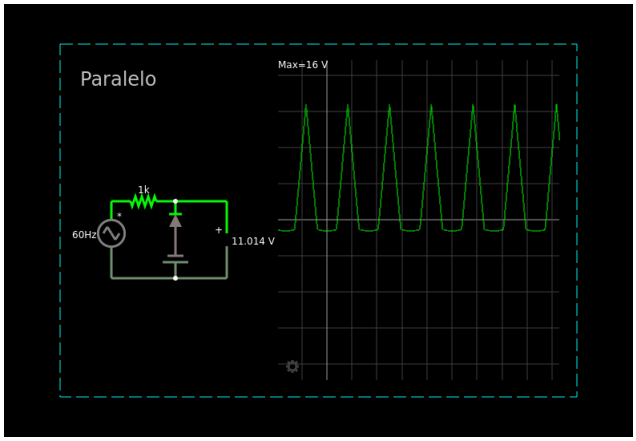


$V_{DC} = 8V$ —— $V_{AC} = 16V_{peak}$

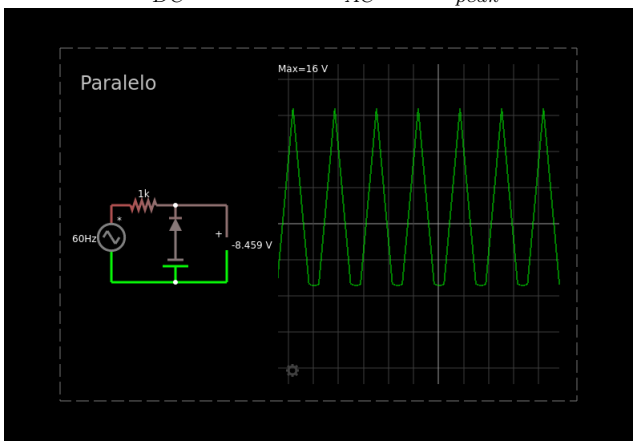


$V_{DC} = 16V$ —— $V_{AC} = 16V_{peak}$

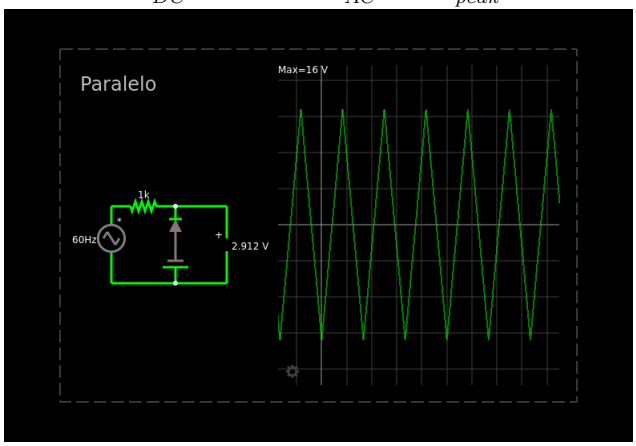
While the *Linear Clipper* can increase the amplitude and *shift* the signal, the *Parallel Clipper* can *drown out* part of the signal completely. The lower voltage V_{AC} signal is replaced by a constant V_{DC}.



$V_{DC} = 1V$ —— $V_{AC} = 16V_{peak}$



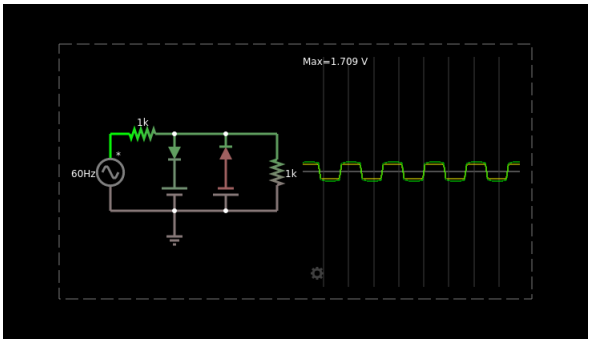
$V_{DC} = 8V$ —— $V_{AC} = 16V_{peak}$



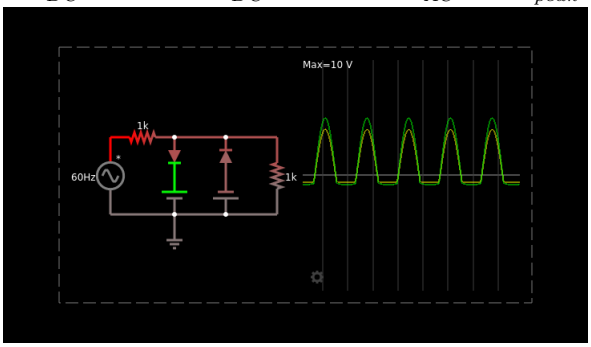
$V_{DC} = 16V$ —— $V_{AC} = 16V_{peak}$

The diode serves to impede the polarity change, however with the V_{DC} supply the voltage the signal V_{AC} has to supply for the diode to activate is higher, thus allowing some of the signal to pass through before clamping.

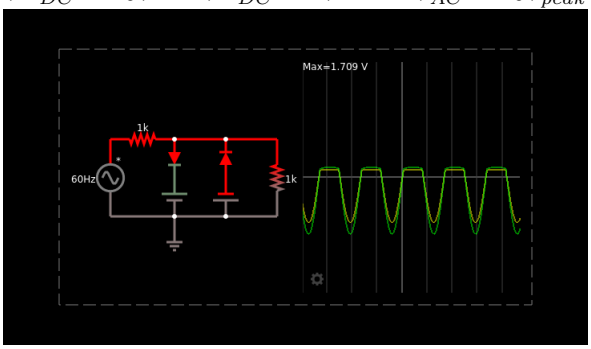
3.3 Diode Clipper with multiple parallel supplies



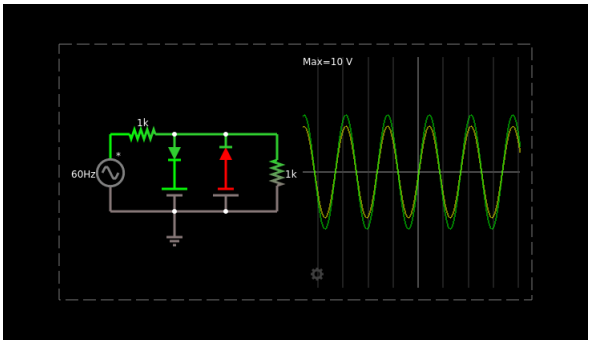
$V1_{DC} = 1V$ — $V2_{DC} = 1V$ —— $V_{AC} = 20V_{peak}$



$V1_{DC} = 10V$ — $V2_{DC} = 1V$ —— $V_{AC} = 20V_{peak}$



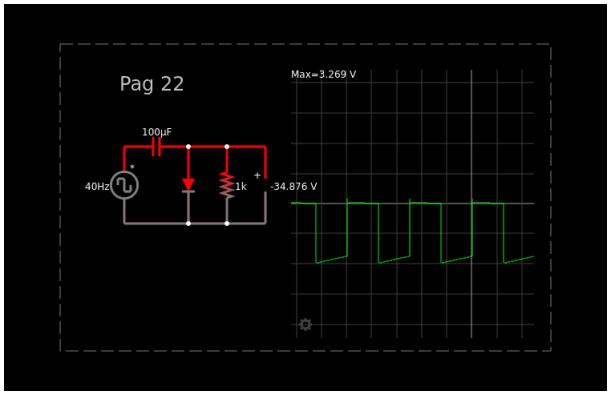
$V1_{DC} = 1V$ — $V2_{DC} = 10V$ —— $V_{AC} = 20V_{peak}$



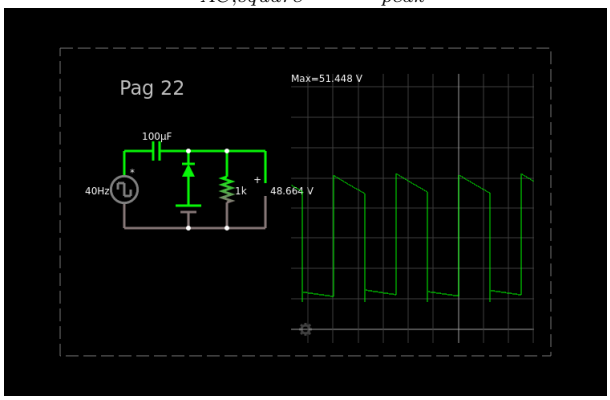
$V1_{DC} = 10V$ — $V2_{DC} = 10V$ —— $V_{AC} = 20V_{peak}$

This circuits eliminates part of its initial signal by increasing its corresponding V_{DC} supply. The signal can be entirely removed by changing the V_{DC}'s to $-0.7V$, *leakage current* not withstanding of course.

3.4 Voltage clamp with capacitors



$V_{AC,square} = 20V_{peak}$



$V_{DC} = 10V$ $V_{AC,square} = 20V_{peak}$

The clamp serves to double the voltage of the signal V_{AC} by charging the capacitor every negative cycle. The Second circuit shows a V_{DC} supply holding the base voltage above zero at $10V$.

Keep in mind that the capacitor has to charge to behave properly, this means that the initial state of the circuit is undefined until stable.

4 Conclusion

This paper has shown multiple ways to manipulate and eliminate and amplify AC signals using diodes, capacitors and power supplies.

Although these circuits require multiple power supplies to replicate, they can be made of the same signal they are manipulating, by passing them through a *full bridge rectifier* and a *capacitor inductor* filter the desired V_{DC} can be acquired easily.