

## Introduction

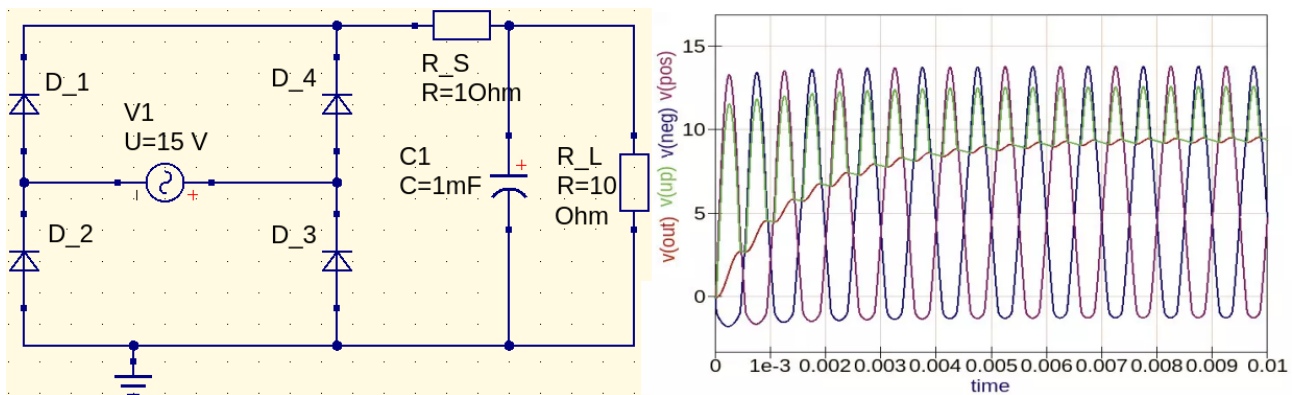
Understanding and teaching abstract concepts like currents and voltages has always been difficult, since one can not touch or see electricity.

Mechanical engineers have it a bit better: Not only can you touch and see a steel construction, but our colleagues also have computer programs with which they can view their constructions. They can see directly which parts belong together and how they work together.

In electrical engineering, we can also draw circuit diagrams with computer programs, but analyzing how the parts of the circuit work together used to be possible only with awkward paraphrases and line diagrams.

## For pupils and students

Have you ever been in a lecture about a circuit and got stuck just because you didn't know what which line stood for? Or because it was not clear to you why the course of one curve influences the course of another curve as shown?



*1st image: Circuit diagram and curve diagram are the classic representation of circuits. But unfortunately not an intuitively understandable representation.*

Don't worry, it's often like that - many of your classmates have the same problem. And it was the same for me at school. And then in my studies, too. And afterwards, in my work as an electrical engineer, too.

Most of the time this getting stuck on these meanings of curves costs more time and nerves than all the rest of the schematic analysis together. This annoyed me so much that at some point I wrote an own schematic analysis program. But this new program should not only output lines, but it should show you where which voltage is applied, and which current flows along where. So that we can understand circuits and how they work faster and easier.

After all, it is not our job to assign values and components to each other. Machines can do that much more reliably and much faster. Our task is to understand the circuit from these assigned values. And then to create something better from what we have understood. That's what we humans are good at.



## For teachers, tutors and professors

How often have you explained a circuit, but then realized that hardly any of your students follow along with the lecture? And that you then explain the same thing again in more detail, but even more words only help a bit?

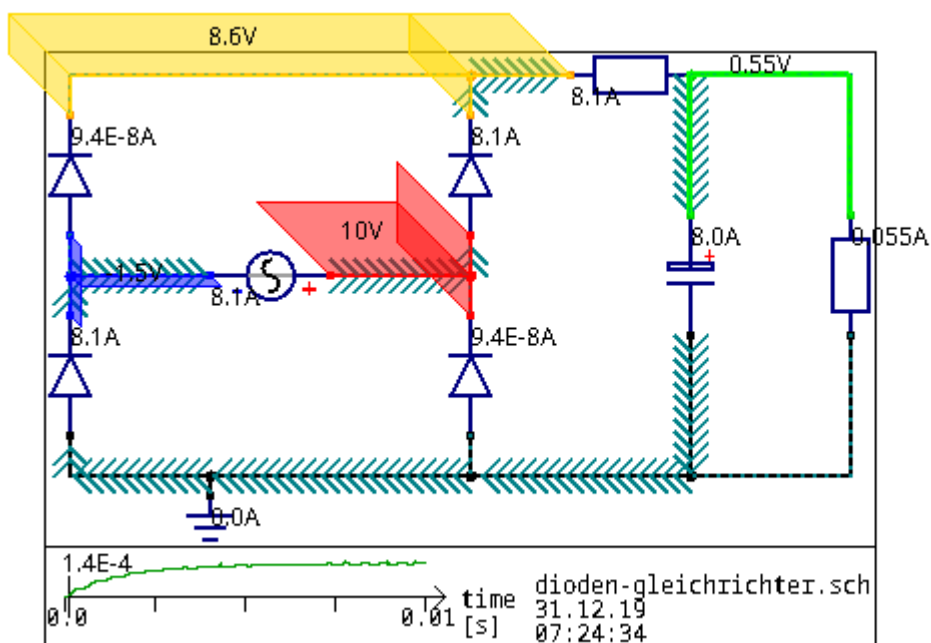
Often the problem of understanding in electrical engineering is not the circuit itself. The biggest problem is the assignment of lines to components:

Most of the time it is not clear to the students which current curve stands for which current through which connection of which component. Or which voltage curve represents which voltage drop across which component. It is then even more difficult to recognize correlations between the curves and to understand the operating principle of the respective circuit.

This problem exists in all areas of electrical engineering. No matter if you explain the basics, or a certain digital circuit or an OpAmp circuit. Or analyzing a motor control unit with your colleague. You almost always get hung up on the waveforms and the associated assignment and interpretation.

Creating an animation with the CNS requires only a few clicks<sup>1</sup>, and the CNS draws voltages and currents where they belong in the circuit diagram.

Show your students the animation, then a brief explanation of why the voltages and currents behave as shown will suffice.



*2nd image: With the Circuit Navigation System you can see directly what is happening in the circuit. So understanding and explaining is much easier.*

So you can save yourself a lot of work if you don't have to explain each circuit several times, but let the computer explain the most cumbersome part for everyone. And you can achieve a better understanding among your students despite the saved work.

1 There is a video tutorial for this at [https://www.youtube.com/watch?v=6\\_YSKPtffQU](https://www.youtube.com/watch?v=6_YSKPtffQU)



## For those whose curriculum has been thrown into disarray by Corona

Teaching and learning electrical engineering has always been cumbersome enough, but with the changes brought about by the Corona pandemic, it has become even more difficult:

Whereas before you had at least a large whiteboard for classroom display, now with online classes a small screen has to suffice.

So here the space for the presentation has to be used well. And what better way to do this than by integrating the CNS into the schematic?

With the Corona pandemic, lab practicals are repeatedly cancelled at some schools and universities.

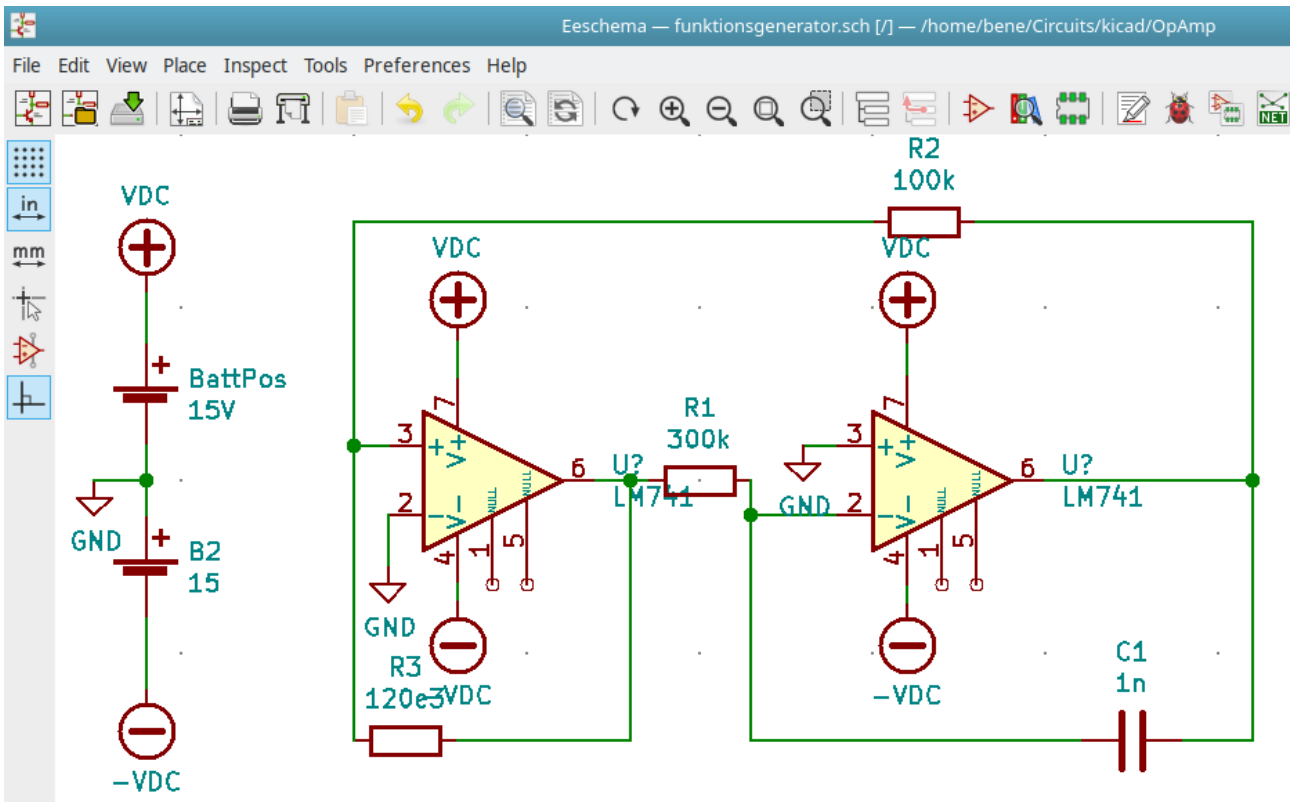
This is a pity insofar as the practicals on the devices often allow a deeper understanding of the respective circuits. After all, if you do something yourself and see how it works, you can usually understand it better.

This deeper understanding can fortunately also be achieved Corona-safely on the screen with the CNS and KiCad:

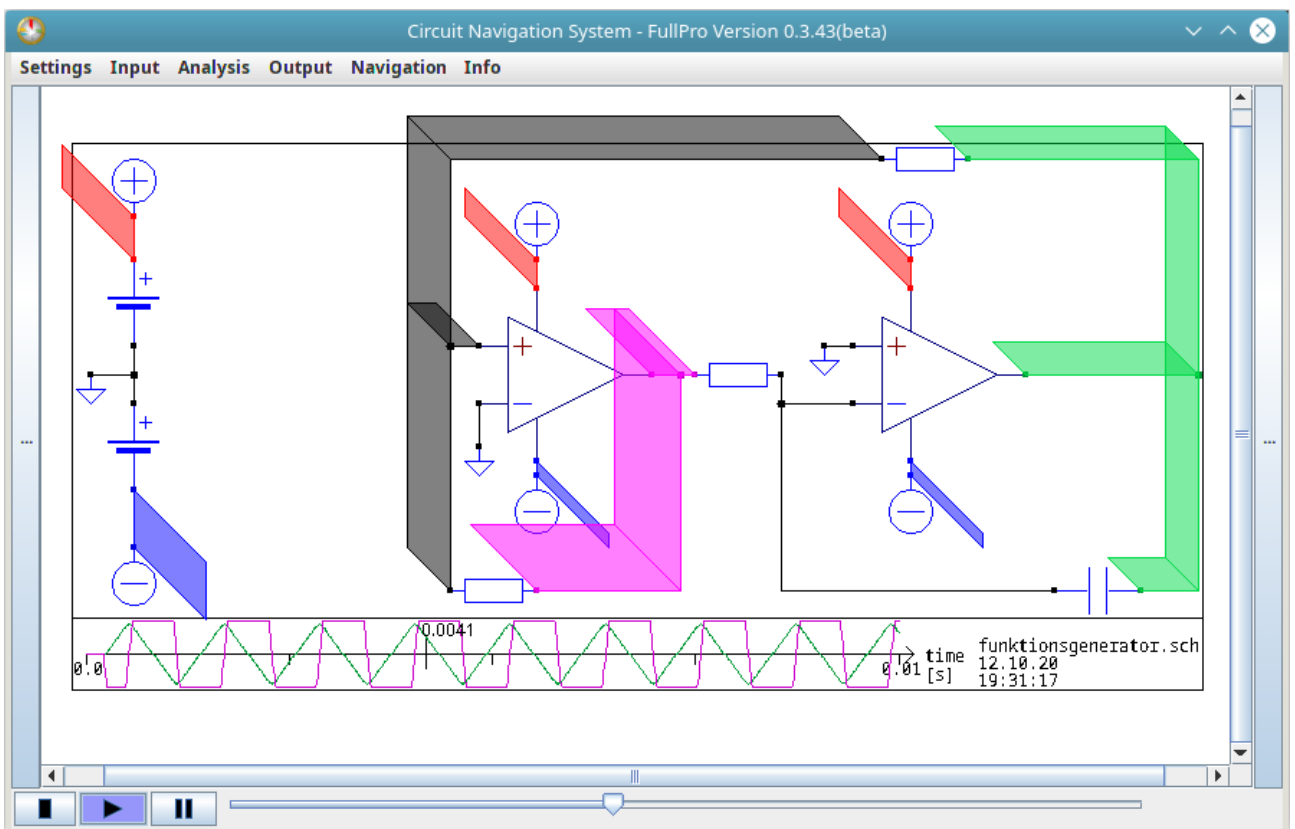
You can also build a circuit with KiCad Eeschema, and then see in CNS how it works.

Sometimes building and analyzing on the screen leads to a not quite as good understanding as the real building, because you don't have it physically in your hand, and sometimes it leads to an even better understanding, because you can see the whole result in the CNS.





3rd image: A triangle-rectangle generator in KiCad Eeschema, a free schematic editor



4th image: Display your circuit as an animation video in CNS. This way you can see all currents and voltages.



## Conclusion

Use the Circuit Navigation System to create animated films about circuits.

If you use the animation of the CNS in lectures about electrical circuits, you save more work in explaining than you need to create the animation.

And those who are presented with such an animation will find it much easier to keep track of currents and voltages than would be possible with conventional diagrams.

Try it out, you can download a free version at <https://www.cirnavsys.com/download>



## Appendix

Image sources:

1st image: Circuit diagram and voltage curves of a diode rectifier. Created with the "Quite Universal Circuit Simulator" in short QUCS. This figure is in the public domain.

2nd image: Diode rectifier in the Circuit Navigation System.

This circuit is available as an animation at: <https://www.youtube.com/watch?v=cIJJMBWNeal>  
This figure is in the public domain.

3rd image: Circuit diagram of a triangle-rectangle generator.

This circuit is available as an animation at: <https://www.youtube.com/watch?v=EvZYZc4WSK>

Created with the KiCad software suite, more specifically with the KiCad Eeschema schematic editor. KiCad is a free software.

More info about KiCad, see <https://kicad-pcb.org>

This figure is in the public domain.

4th image: Triangle-Rectangle-Generator in the Circuit Navigation System

More info on CirNavSys, see <https://www.cirnavsys.com>

This figure is in the public domain.

