3. Building your own electronic models in Wolfram SystemModeler

This video takes an in-depth look at how to build dynamic electronic systems models using the SystemModeler software. The example of a voltage divider network is used to explore each of the steps in the process, demonstrating how such models are important tools for understanding, design and analysis in VCE Systems Engineering.

Transcript

**Colin:** [00:00:18] In this video, we're looking at how to build your own electronic model in SystemModeler. For this example, we'll build a voltage divider network. First thing you'll notice is that the model comes up with a grid and we should, of course, first of all, save this to a location. So I'm going to save this straightaway into Wolfram Mathematica folder. We don't want to save it anywhere else. It needs to go in this particular folder. Otherwise, the program later on won't be able to find it. So Wolfram Mathematica and I'm going to call the Volt the project, I know that makes sense to me, which is Volt, divider and save. So now it's got a name. And as we save it regularly throughout the project, we'll make sure it won't lose anything.

**Colin:** [00:01:14] But we need to do now is to go into the more Modelica Library to pull the components we need. For this particular model, we need to use the electrical components and we'll go to analog and we'll pick the basic in order to find our resistors. So I'm going to pull a resistor across we need two of those. The other thing I need to pull across will be the ground. So there's a reference for measurement of all the voltages. So I've pulled it across as well.

**Colin:** [00:01:46] Then from there I need to go to sensors because I'm going to put two voltage sensors in and I'll pull two of those across. And we're just populating the class at the moment and we can change positions of things later on.

**Colin:** [00:02:05] The last thing I'll need for this is a source and I'll pick a ramp source for this one because the ramp source helps really illustrate how a voltage divider network works. So I'm going to take the ramp voltage and pull that across as well.

**Colin:** [00:02:20] And I can move these components by just clicking on them. And if I want to rotate them, I can highlight the component and pull my cursor away and there will be a curved double headed arrow cursor and that will allow me to be able to change the orientation of the component. So I'm going to move my resistors and rotate them. They do lock in for every 90 degrees. I'm going to move more voltage sensor also. And one reason we want to orient things is to make the wiring diagram a little easier to follow. It doesn't affect functionality.

**Colin:** [00:03:02] And I'm going to move my voltage source also. Everything's moved. Now I can wire them up. We need to go to this icon here, which is called the Connection Line Tool. Click on that and you'll notice that each component has got an open square and a close blue square. As we move the icon from the connection tool, we'll notice that the icon becomes a heavy cross that shows us we've got a connection to the terminal and we can click on that and pull it across to the components. Connected the ramp supply to the first resistor, first resistor, now to the second resistor. The second resistor to the ground. And then that resistor. Sorry that ground across to the voltage source.

**Colin:** [00:03:58] The next thing I need to do is to have my voltage measurement tools wired in parallel with the devices that they're measuring the voltage drop across.

**Colin:** [00:04:08] So I move my cursor to the heavy black cross and pull it across. Connecting the first voltage sensor across the first resistor and the second. And connecting the second terminal of this second voltage measurement device to the second resistor. So they're wired in parallel. What we need to do now is just to check everything is wired correctly. So if we move our cursor across this yellow circle with the green tick called validate class. I click on that and it will check the drawing and give a statement to say that the validation has been completed successfully, which means all the wiring is correct.

**Colin:** [00:04:56] What we want to do now is to give values to the components which we can give values to. So I'm going to go to the ramp voltage. If I click on that, a number of fields appear. The ones we're interested in at the moment are the start time, the voltage at the end of the ramp and the duration of the ramp. We're going to pick a start time of zero, a voltage of 24 because it has lots of factors and a duration of 20 seconds for this experiment. I'll Then click on resistor number one, and the only field I'm interested in at the moment is the resistance and I'm going to put in 10000 ohms for that one. I'll click on resistor to and I'll put 20000 ohms for that one. You'll notice that if I click on the voltage measurement devices, there are no fields to change. Nor is there a field to change for the ground. Now that I've done that, I can click on this grey box with the blue arrow to simulate the class. This will give a simulation of the experiment. It comes up with no experiment, annotation found, you can ignore that and just go straight to simulation. Wolfram SystemModeler take some time to get into this simulation center and build the experiment.

**Colin:** [00:06:25] Now, here are a few things we need to change. We need to go into settings. In settings, we can pick a start time and stop time. I'm going to change the stop time from default 10 seconds to 20 seconds. Also, we need to synchronize the experiment with real time. So I tick that box. The next thing I need to look at is plot. So plot will put all the components listed with all the variables that can be plotted from those particular components. And the things I'm looking at at the moment are the the RAM voltage. And if I click on that, I'm going to click on the height of the ramp. Then I'm going to click on the voltage sensor one click on voltage, and then I'm going to click on voltage sensor two and click on voltage for that.

**Colin:** [00:07:29] I'm now going to run the experiment by clicking on the simulate button.

**Colin:** [00:07:41] So you'll see that at the moment we have the readings from the two voltage sensors coming up quite nicely, but the ramp voltage isn't. So let's go back to ramp voltage and rather than go for height of ramp, we'll change that to go to the voltage drop. So I'm going to change that now and run a simulation again.

**Colin:** [00:08:12] And as the experiment runs, you can see that the voltages across the two resistors change in proportion to their resistances relative to the signal source.