

Shorting and open-circuiting elements

Let's load in an arbitrary circuit, in this case an op-amp circuit.

```
circuit = Circuit('circuits/rc_op_amp.txt');  
circuit.list
```

```
ans =  
  'Vs 1 0 AC Vs  
  R1 1 2 20000  
  R2 3 4 20000  
  C1 2 3 C1  
  C2 3 4 C2  
  O1 0 3 4  
,
```

We may be interested in its transfer function.

```
ELAB.ec2sd(circuit,1,4)
```

```
Symbolic analysis successful (0.422004 sec).  
Symbolic transfer function calculated successfully (4.302901e-01 sec).  
ans =
```

$$\frac{v_4}{v_1} = -\frac{C_1 R_2 s}{(C_1 R_1 s + 1)(C_2 R_2 s + 1)}$$

We see two poles at $s = -1/R_1 C_1$ and $s = -1/R_2 C_2$

1. Shorting

Suppose, we want to know what happens, if we short C_1 . We get a reference to the capacitor in question, just to look at how it's defined. This is not necessary.

```
C1 = circuit.Capacitors(1)
```

```
C1 =  
  Capacitor with properties:  
    capacitance: C1  
    impedance: 1/(C1*s)  
    anode: 2  
    cathode: 3  
    v_across: Vs/(C1*R1*s + 1)  
    i_through: Vs/(C1*(C1*R1*s + 1))  
    num_terminals: 2  
    id: 'C1'  
    terminals: [2 3]
```

Shorting is as simple as calling a function.

```
circuit.short(C1)
```

The circuit now looks like this. Note, that the nodes have been appropriately relabelled. This has be taken into account, when finding the new transfer function.

```
circuit.list
```

```
ans =
'Vs 1 0 AC Vs
R1 1 2 20000
R2 2 3 20000
C2 2 3 C2
O1 0 2 3
'
```

```
ELAB.ec2sd(circuit,1,3)
```

Symbolic analysis successful (0.367016 sec).
 Symbolic transfer function calculated successfully (3.747496e-01 sec).
 ans =

$$\frac{v_3}{v_1} = -\frac{R_2}{R_1 (C_2 R_2 s + 1)}$$

We see that shorting C_1 will remove the pole at $s = -1/R_1 C_1$ as expected.

2. Open-circuiting

Suppose we want to know what would have happened, if we open-circuited the second capacitor C_2 instead. We can reload the original circuit. We skip getting a reference to the element this time.

```
circuit = Circuit('circuits/rc_op_amp.txt');
circuit.open(circuit.Capacitors(2));
circuit.list
```

```
ans =
'Vs 1 0 AC Vs
R1 1 2 20000
R2 3 4 20000
C1 2 3 C1
O1 0 3 4
'
```

```
ELAB.ec2sd(circuit,1,4)
```

Symbolic analysis successful (0.333732 sec).
 Symbolic transfer function calculated successfully (3.400116e-01 sec).
 ans =

$$\frac{v_4}{v_1} = -\frac{C_1 R_2 s}{C_1 R_1 s + 1}$$

This time, the pole at $s = -1/R_2 C_2$ was removed.