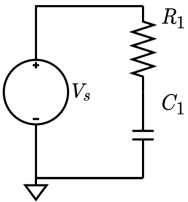


# Resistor-Capacitor circuits

## 1. Capacitive low-pass filter

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

```
ans =  
'Vin 1 0 DC 5  
R1 1 2 1000  
C1 2 0 0.0001  
,
```



```
ELAB.analyze(circuit)
```

Symbolic analysis successful (0.199112 sec).

Maybe you want expressions for node voltages.

```
circuit.symbolic_node_voltages
```

```
ans =  

$$\begin{pmatrix} v_1 = V_{in} \\ v_2 = \frac{V_{in}}{C_1 R_1 s + 1} \end{pmatrix}$$

```

Or the numerical currents for all elements in this particular circuit in relation to the s-domain.

```
ELAB.evaluate(circuit)
```

Numerical evaluation successful (0.0502005 sec).

```
circuit.numerical_element_currents
```

```
ans =  

$$\begin{pmatrix} i_{R1} = \frac{s}{2000 \left( \frac{s}{10} + 1 \right)} \\ i_{C1} = \frac{5}{\frac{s}{100000} + \frac{1}{10000}} \end{pmatrix}$$

```

Say we want the numerical transfer function, where the output is the voltage across the capacitor.

```
TF = ELAB.ec2tf(circuit, 1, 2)
```

Transfer function object created successfully (6.355180e-02 sec).

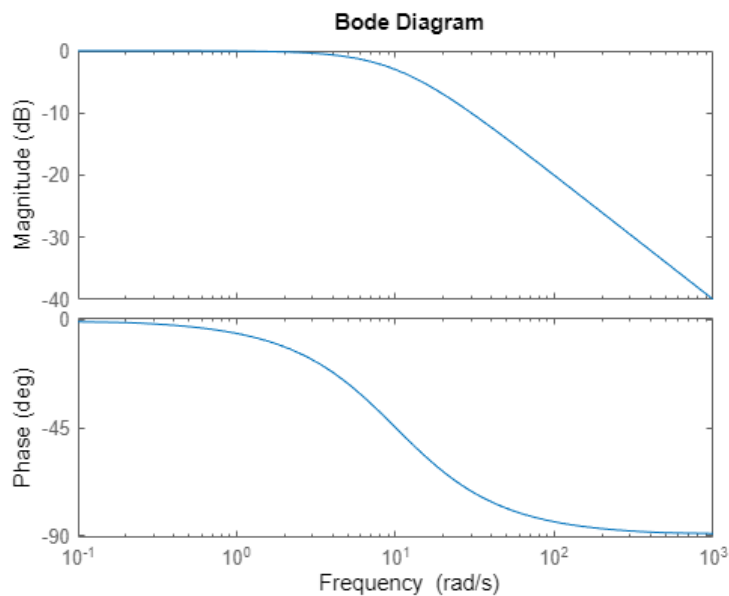
TF =

$$\frac{10}{s + 10}$$

Continuous-time transfer function.

Matlab can then be used to visualize the circuit behavior as with any other system. Plotting the Bode diagram, we see that this is infact a low-pass-filter.

```
bode(TF)
```

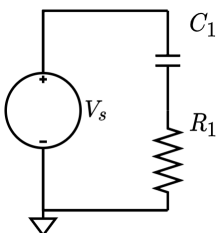


## 2. Capacitive high-pass filter

We can repeat the process with a variation of the circuit, where the capacitor comes before the resistor.

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

```
ans =  
'Vin 1 0 DC 5  
R1 2 0 1000  
C1 1 2 0.0001  
,
```



```
ELAB.analyze(circuit)
```

Symbolic analysis successful (0.215119 sec).

```
circuit.symbolic_node_voltages
```

```
ans =
```

$$\begin{pmatrix} v_1 = V_{in} \\ v_2 = \frac{C_1 R_1 V_{in} s}{C_1 R_1 s + 1} \end{pmatrix}$$

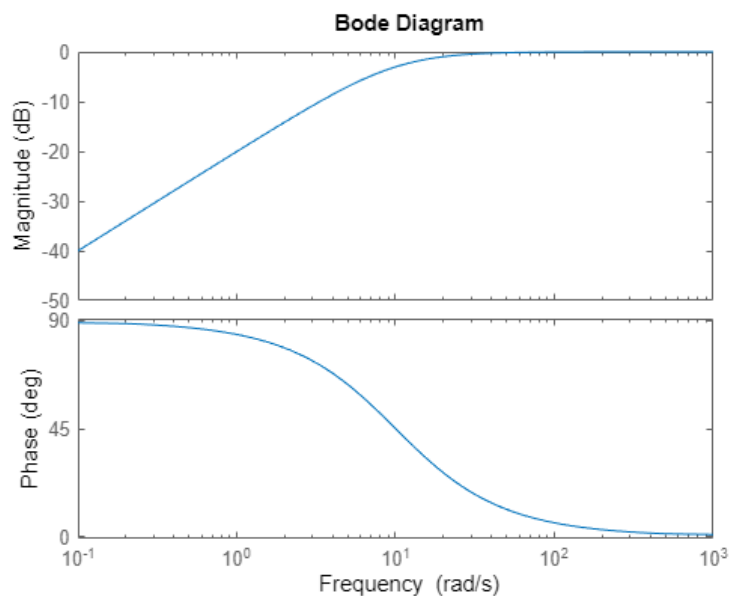
```
TF = ELAB.ec2tf(circuit, 1, 2);
```

Numerical evaluation successful (0.0404325 sec).

Transfer function object created successfully (7.198130e-02 sec).

Plotting the Bode diagram, we see that this rc-configuration acts as a high-pass filter.

```
bode(TF)
```

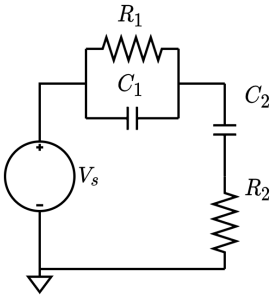


### 3. Arbitrary RC-circuits

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

```
ans =
```

```
'Vs 1 0 AC Vs  
R1 1 2 10000  
R2 3 0 20000  
C1 1 2 0.0000001  
C2 2 3 0.0000005  
,
```



```
ELAB.analyze(circuit)
```

Symbolic analysis successful (0.398497 sec).

```
ELAB.ec2sd(circuit,1,2)
```

Symbolic transfer function calculated successfully (4.830500e-03 sec).

ans =

$$\frac{v_2}{v_1} = \frac{(C_1 R_1 s + 1)(C_2 R_2 s + 1)}{C_1 R_1 s + C_2 R_1 s + C_2 R_2 s + C_1 C_2 R_1 R_2 s^2 + 1}$$

```
TF = ELAB.ec2tf(circuit,1,2)
```

Numerical evaluation successful (0.113802 sec).

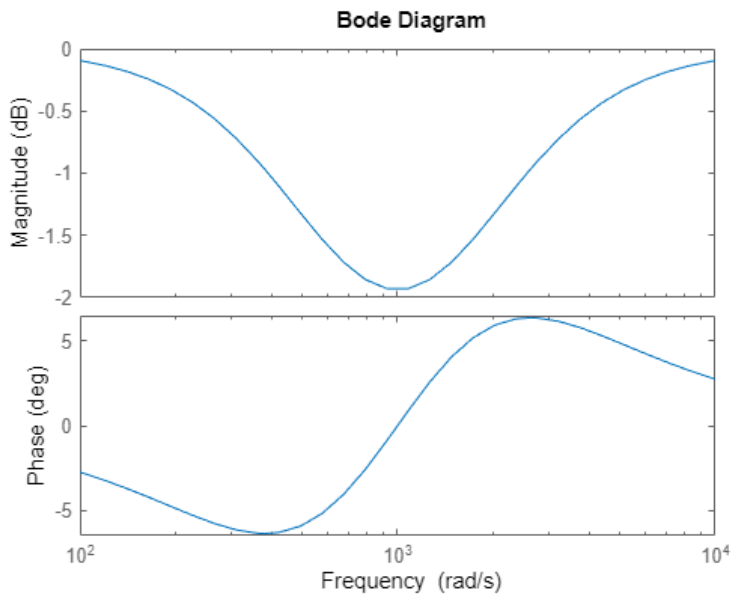
Transfer function object created successfully (1.653692e-01 sec).

TF =

$$\frac{s^2 + 2000 s + 1e06}{s^2 + 2500 s + 1e06}$$

Continuous-time transfer function.

```
bode(TF)
```



As is apparent from the bode-plot, this particular circuit acts as a band-stop filter.