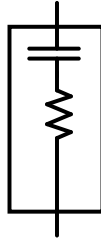


Damped filter



Damped filter.....	1
1 Available versions	1
1.1 When changing phases	1
1.2 The generic version of "Passive Filter: Damped"	2
1.2.1 Parameters.....	2
1.2.2 Generic rules.....	3
2 Steady-state model	5
3 Initial conditions.....	6
4 Frequency Scan model.....	6
5 Time Domain model	6
6 Credits	6

Jérôme Cornau, 12/1/2017 10:50 AM

1 Available versions

Available versions are shown in Figure 1-1. This device can be 1-phase, 3-phase Wye, 3-phase Wye grounded or 3-phase Delta.

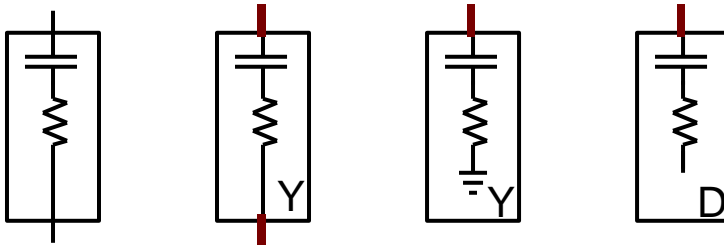


Figure 1-1 Available versions

1.1 When changing phases

It is allowed to change the line type attached to the 1-phase or 3-phase versions of this device. Although it can be ambiguous and should be used with care, EMTP tries to accommodate by applying the following rules.

- When the device is in its 1-phase state and its signal is changed to 3-phase, but the device is not double-clicked (followed by a click on the OK button), balanced conditions are assumed and the 1- phase quantities are automatically propagated to the new phases.

- When the device is in its 3-phase state and its signal is changed to 1-phase, but the device is not double-clicked (followed by a click on the OK button), phase-a quantities are automatically retained in EMTP for the 1-phase version.

1.2 The generic version of “Passive Filter: Damped”

1.2.1 Parameters

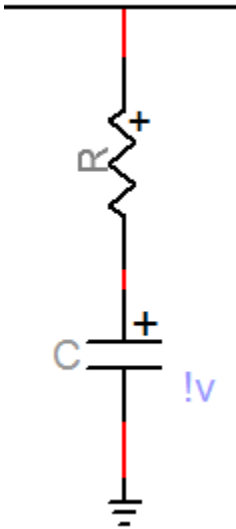


Figure 1-2 Filter model

The generic version of Damped filter has one pin.

The parameters are:

Data Type	way the filter data are entered (Circuit parameters or filter parameters)
Nominal Voltage	nominal voltage of the bus the filter is connected to
Power frequency	frequency of the bus the filter is connected to
Circuit parameters	
R	value of filter resistance
C	value of filter capacitance
Filter parameters	
Reactive power	reactive power produced by one capacitance at nominal frequency and nominal voltage
Tuned harmonic order	harmonic order of tuned frequency

A graphic representation of module and angle of the impedance of the filter is also provided. Some graphic options are allowed concerning the x-axis format:

Harmonic / Frequency

Logarithmic scale /

Linear scale

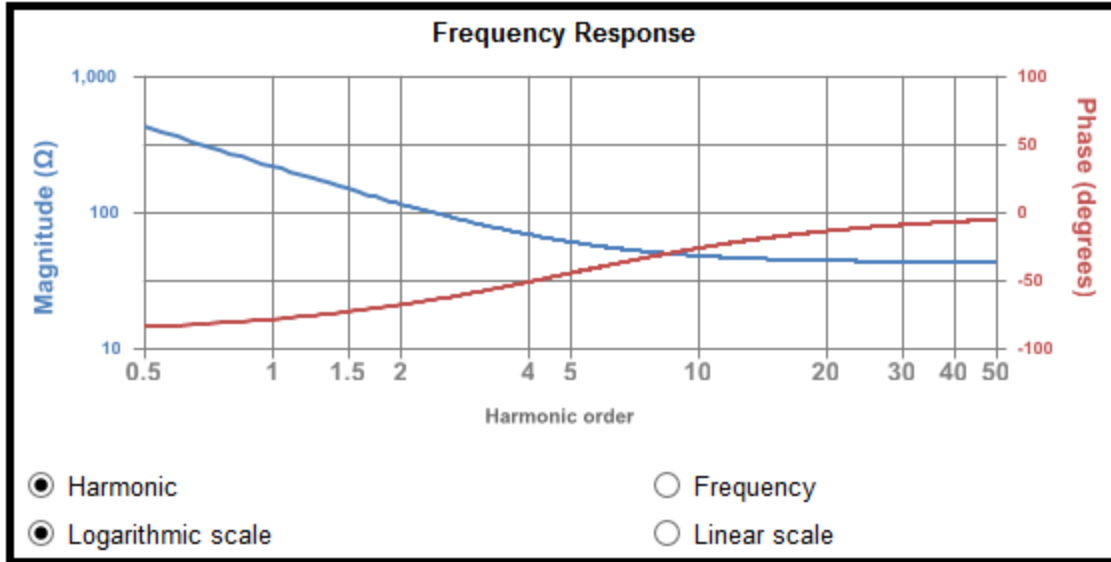


Figure 1-3 Filter impedance

1.2.2 Generic rules

The filter parameters are calculated when the circuit parameters are changed and viceversa.

Netlist format

1-phase

```
@PassiveFilterDamped_bf4e4917;DA1;1;s3,
```

```
C=0.00001243398;
va_scope='0,';
vb_scope='0,';
vc_scope='0,';
ia_scope=0,0,0,0,0,,60,,0,0,;
ib_scope=0,0,0,0,0,,60,,0,0,;
ic_scope=0,0,0,0,0,,60,,0,0,;
ParamsA_R='42.6667,0,0,0,0,,60,,0,0,';
ParamsB_R='42.6667,0,0,0,0,,60,,0,0,';
ParamsC_R='42.6667,0,0,0,0,,60,,0,0,';
vC_A=0;
vC_B=0;
vC_C=0;
```

Field	Description
@PassiveFilterDamped_bf4e4917;DA1;1;s3,	Type of filter model. NB: It is different in 1-phase and in 3-phase
DA1	Instance name, any name.
1	Number of signals attached to the pin
s3	Signal connected to the phase a of the pin
C=0.00001243398;	Value of the capacitance in F
va_scope='0,';	1 means phase a voltage can be plotted
vb_scope='0,';	1 means phase b voltage can be plotted (unused in 1-phase)
vc_scope='0,';	1 means phase c voltage can be plotted (unused in 1-phase)
ia_scope=0,0,0,0,0,,60,,0,0,;	"ParamsA" attribute of series measurement resistor. (used for delta winding)

ib_scope=0,0,0,0,0,60,,0,0,;	"ParamsB" attribute of series measurement resistor. (used for delta winding)
ic_scope=0,0,0,0,0,60,,0,0,;	"ParamsC" attribute of series measurement resistor. (used for delta winding)
ParamsA_R='42.6667,0,0,0,0,60,,0,0,';	"ParamsA" attribute of resistor.
ParamsB_R='42.6667,0,0,0,0,60,,0,0,';	"ParamsB" attribute of resistor.
ParamsC_R='42.6667,0,0,0,0,60,,0,0,';	"ParamsC" attribute of resistor.
vC_A=0;	Initial capacitance voltage of phase a in V
vC_B=0;	Initial capacitance voltage of phase b in V (unused in 1-phase)
vC_C=0;	Initial capacitance voltage of phase c in V (unused in 1-phase)

Please note that subcircuits must be defined in the Netlist. They are defined by:

3-phase Wye:

```
<PassiveFilterDamped_b9fbdf5;6;s21a,s21b,s21c,s1a,s1b,s1c,
_RLC;C2a;2;2;s9a,s1a,
0,0,#C#,0,#vC_A#,60,,0,0,
_RLC;C2b;2;2;s9b,s1b,
0,0,#C#,0,#vC_B#,60,,0,0,
_RLC;C2c;2;2;s9c,s1c,
0,0,#C#,0,#vC_C#,60,,0,0,
_RLC;ia;2;2;s21a,s9a,
#ParamsA_R#
_RLC;ib;2;2;s21b,s9b,
#ParamsB_R#
_RLC;ic;2;2;s21c,s9c,
#ParamsC_R#
_VM;va;2;2;s21a,s1a,
#va_scope#
_VM;vb;2;2;s21b,s1b,
#vb_scope#
_VM;vc;2;2;s21c,s1c,
#vc_scope#
>
```

3-phase Wye grounded:

```
<PassiveFilterDamped_b9bd8d3c;3;s21a,s21b,s21c,
_RLC;C2a;2;2;s9a,,
0,0,#C#,0,#vC_A#,60,,0,0,
_RLC;C2b;2;2;s9b,,
0,0,#C#,0,#vC_B#,60,,0,0,
_RLC;C2c;2;2;s9c,,
0,0,#C#,0,#vC_C#,60,,0,0,
_RLC;ia;2;2;s21a,s9a,
#ParamsA_R#
_RLC;ib;2;2;s21b,s9b,
#ParamsB_R#
_RLC;ic;2;2;s21c,s9c,
#ParamsC_R#
_VM;va;2;2;s21a,,
#va_scope#
_VM;vb;2;2;s21b,,
```

```
#vb_scope#  
_VM;vc;2;2;s21c,,  
#vc_scope#  
>
```

3-phase Delta:

```
<PassiveFilterDamped_53e88562;3;SIG1a,SIG1b,SIG1c,  
_RLC;C1;2;2;s5,SIG2c,  
0,0,#C#,0,#vC_A#,60,,0,0,  
_RLC;C2;2;2;s9,SIG2b,  
0,0,#C#,0,#vC_A#,60,,0,0,  
_RLC;C3;2;2;s8,SIG2a,  
0,0,#C#,0,#vC_A#,60,,0,0,  
_RLC;C4a;2;2;SIG2a,,  
0,0,0.01nF,0,0,,60,,0,0,  
_RLC;C4b;2;2;SIG2b,,  
0,0,0.01nF,0,0,,60,,0,0,  
_RLC;C4c;2;2;SIG2c,,  
0,0,0.01nF,0,0,,60,,0,0,  
_RLC;ia;2;2;SIG1a,SIG2a,  
#ia_scope#  
_RLC;ib;2;2;SIG1b,SIG2b,  
#ib_scope#  
_RLC;ic;2;2;SIG1c,SIG2c,  
#ic_scope#  
_RLC;ia;2;2;SIG2a,s9,  
#ParamsA_R#  
_RLC;ib;2;2;SIG2b,s5,  
#ParamsB_R#  
_RLC;ic;2;2;SIG2c,s8,  
#ParamsC_R#  
_VM;va;2;2;SIG1a,,  
#va_scope#  
_VM;vb;2;2;SIG1b,,  
#vb_scope#  
_VM;vc;2;2;SIG1c,,  
#vc_scope#  
>
```

1-phase:

```
<PassiveFilterDamped_bf4e4917;1;s1,  
_RLC;C1;2;2;s18,,  
0,0,#C#,0,#vC_A#,60,,0,0,  
_RLC;i;2;2;s1,s18,  
#ParamsA_R#  
_VM;v;2;2;s1,,  
#va_scope#  
>
```

2 Steady-state model

The Damped filter device is represented in steady-state for automatic harmonic initialization and frequency scan solutions.

The steady-state model consists of one resistance, one inductance and one capacitance connected in series.

The impedance is given by:

$$Z(\omega) = R + \frac{1}{jC\omega}$$

3 Initial conditions

Automatic initial conditions are found from the steady-state solution. Manual initial conditions can be provided for the inductance currents and for the voltages of the capacitor.

4 Frequency Scan model

Similar to the steady-state. The branch impedance is found at each frequency.

5 Time Domain model

The device is discretized according to the integration time-step and solved at each simulation time-point.

6 Credits

The Power Quality Toolbox is based on the initial work done by Powersys for Electricité de France (EDF).