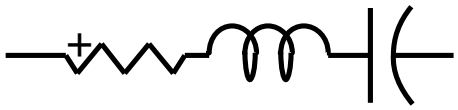
RLC device



Jean Mahseredjian, 2016-05-18 08:28:00

1 Available versions

The RLC device accepts both 1-phase (general) and 3-phase signals. A 1-phase example is shown in Figure 1-1. A 3-phase version is shown Figure 1-2.

Figure 1-1 1-phase version of RLC

Figure 1-2 3-phase version of RLC

The 3-phase version is the equivalent of 3 decoupled branches (one for each phase).

1.1 When changing phases

- When the device is in its 1-phase state and its signal is changed to 3-phase, but the device is not double-clicked, balanced conditions are assumed and the 1-phase quantities are automatically propagated to the new phases. The Netlist is generated for the 3-phase version.
- When the device is in its 3-phase state and its signal is changed to 1-phase, but the device is not double-clicked, phase-a quantities are automatically retained for the 1-phase version. The Netlist is generated for the 1-phase version.

1.2 The generic version of RLC

1.3 Parameters

The generic version of RLC has one or two pins. When only one pin is present, the ground node GND is assumed for the other pin. The generic version of RLC allows entering all required parameters:

- R resistance, any number, 0 means short-circuit, default units are Ω
- L inductance, any number, 0 means short-circuit, default units are H
- C capacitance, any number, 0 means short-circuit, default units are F
- i_0 manual initial current for the inductance, default units are A
- v_0 manual initial voltage for the capacitance, default units are V
- Select nominal frequency checkbox and input field
  - Allows to specify a frequency for converting inductance and capacitance units given in Ohms and Siemens. This frequency is also used in the Frequency scan option.
  - This option overrides the default nominal frequency.
- The Frequency scan option allows to specify parameters active only in Frequency Scan simulations.

1.4 Generic rules

At least one parameter, R, L or C should be non-zero. It is allowed to create a short-circuit branch by setting R, L and C to zero. Although EMTPWorks sends a warning when such a condition is encountered, it can still accept it by automatically replacing the shorted branch by an ideal closed switch. In some situations this can create degenerate numerical conditions, so users must be careful when creating short-circuits.

Only the m-pin can be deleted to create an automatic ground connection. Any pin can be connected to ground.

1.5 Netlist format

This device allows method-based scripting. The object data and methods are described in the script file referenced by the device Script.Open.Dev attribute.

```
_RLC;RLC1;2;2;s1,s2,
1k,1mH,1uS,1mA,1mV,1,60,1,1,2,?v,?i,?p,
```

Field	Description
_RLC	Part name
RLC1	Instance name, any name.
2	Total number of pins
2	Number of pins given in this data section
s1	Signal name connected to k-pin, any name
s2	Signal name connected to m-pin, any name
R	Resistance, default is 0
L	Inductance, default is 0
C	Capacitance, 0 means short-circuit
i_0	Initial current in inductance, 0 means no user defined initial condition
v_0	Initial voltage in capacitance, 0 means no user defined condition

1	1 means Select nominal frequency is on
60	The selected nominal frequency
1	1 means that R is a function of frequency
1	Parameter A
2	Parameter B
?v	Request for voltage scope, sent to scope group vb (branch voltages), optional
?i	Request for current scope, sent to scope group ib (branch currents), optional
?p	Request for power scope, sent to scope group p (branch power), optional

Device data fields are saved in ParamsA, ParamsB and ParamsC device attributes.

If there is only one pin, the second signal name field is not present:

```
_RLC;L1;1;1;busleft,100k,1mH,,0,,
```

For the 3-phase version example shown below (Figure 1-3), the Netlist gives:

```
_RLC;RLC3phasea;2;2;knodea,mnodea,
1,1mH,10uF,0,0,
_RLC;RLC3phaseb;2;2;knodeb,mnodeb,
1,1mH,10uF,0,0,
_RLC;RLC3phasec;2;2;knodec,mnodec,
1,1mH,10uF,0,0,
```

EMTPWorks automatically generates 3 separate (decoupled) RLC devices, one per phase. The phase identification character (a, b or c) is automatically appended to the device instance name and signals.

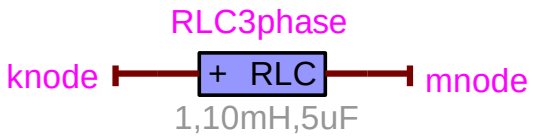


Figure 1-3 3-phase example of RLC

1.6 Other versions

The standard library also provides separate R, L and C only versions of RLC. There are also other combinations, such as R-L or L-C.
The generic rule is that any version of RLC cannot create a short-circuit in the network. The Netlist syntax does not change.

2 Steady-state model

The RLC device is represented in steady-state for automatic harmonic initialization and frequency scan solutions. The steady-state models the RLC device as an impedance at the given frequency:

$$Z_{RLC} = R + j\omega L + \frac{1}{j\omega C} \quad (1)$$

3 Initial conditions

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

4 Frequency Scan model

Similar to the steady-state. The branch impedance is found at each frequency.
The Frequency scan option allows specifying parameters active only during Frequency scan computations.

5 Time-domain model

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