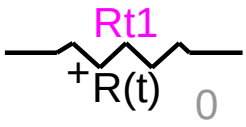
R(t) device



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1 Available versions

The “R(t) device” accepts both 1-phase and 3-phase signals. The 3-phase version is the equivalent of 3 decoupled branches (one for each phase). The only difference is that in the 3-phase version it is allowed to request scope data for the extra phases.

1.1 When changing phases

It is allowed to switch from 1-phase to 3-phase or from 3-phase to 1-phase. The user must only verify the scope requests according to requirements.

2 Description

This device can be used to represent a time varying resistance R(t) specified point-by-point as a piecewise linear characteristic. An example is shown in Figure 1. Linear interpolation is used between the data points.

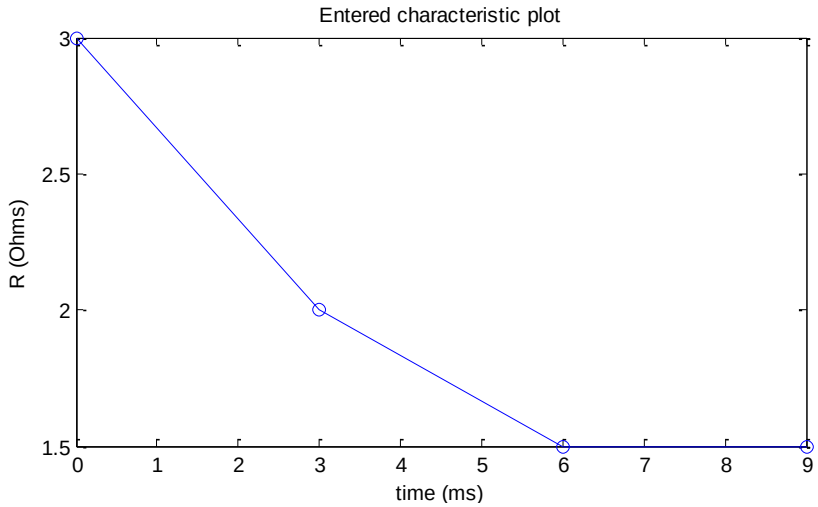

Figure 1 Time varying resistance characteristic

2.1 Parameters and Rules

The Data tab allows entering all required parameters:

- **V_{start}** The device becomes connected when the absolute value of its voltage becomes greater or equal to V_{start}
- **Y_{ss}** Steady-state admittance. When the admittance Y_{ss}= 0 this device is disconnected in steady-state. When Y_{ss} > 0 the device is represented by the linear admittance Y_{ss} in the steady-state solution and V_{start} = 0 (forced).
- **Characteristic** Allows entering R(t). The following conditions must be verified:
  - The time t values must be strictly positive.
  - If the first time-point is not 0, it will be forced to 0 by EMTP.
  - Negative and 0 values of R(t) are tolerated, but they might create numerical instability conditions specially when the 0 value is found on an exact simulation time-point.
  - Entering more than one value of R for a given value of t is illegal. The number of characteristic rows can be increased by selecting a row (click on the row number) and hitting the “Insert key”.

It is not allowed to delete any pins. Since this device drawing is automatically redrawn by its script, it is not allowed to make changes through the Symbol editor or to perform device attribute or pin attribute changes.

When it is required to observe model data using a control device, then the available observables can be selected in the Observe tab. The device drawing will change automatically to provide the requested visible pin observables through a bundle. Since this device can be 3-phase, the bundle can contain observables for all phases. The phase character is used to identify the selections. The 1-phase character is “a” (phase-a).

3 Netlist format

The Netlist format can be explained using the following example:

```
_Rt;Rt1;3;3;s11,s10,s12Ra,
1,10kV,0,1ms,1,?v,?i,?p,>R,
0 3
3 2
```

```
6 1.5
9 1.5
```

Field	Description
_Rt	Part name
Rt1	Instance name, any name.
3	Total number of pins
3	Number of pins given in this data section
S11	Signal name connected to k-pin, any name
S10	Signal name connected to m-pin, any name
s12Ra	Observable signal name. In this case only the resistance is observed. The number of extra signals is equal to the number of requested observables.
Nobs	Number of observables
V_{start}	See Parameters above
Y_{ss}	See Parameters above
units	Units for time in characteristic
units	Units for resistance in characteristic
?v, ?i, ?p	Optional scope requests.
>v, >i, >p, >R	Optional observable requests.

In the 3-phase case, EMTPWorks automatically appends the phase characters and creates 3 separate devices sharing the same data. The extra phase lines are used to carry scope and observable requests in addition to connectivity.

The comma separated data fields are saved into ParamsA, ParamsB and ParamsC attributes of this device. The current-voltage characteristic is saved into the ModelData attribute.

4 Steady-state model and Initial conditions

The steady-state model is a linear admittance when a non-zero Y_{ss} value is entered. It becomes disconnected when the time-domain solution is entered. It can be used to force initial conditions into the surrounding network and continuity from steady-state into time-domain when the time-domain initial operation is predictable by the user.

5 Frequency Scan model

When a non-zero Y_{ss} value is entered it is used to represent this device for all frequencies of a frequency scan.

6 Time domain representation

In the time-domain solution this device is a time-varying resistance. Resistance is found using a lookup table and interpolation. No iterations are needed.