POWERFACTORY

PowerFactory 2021

Technical Reference

DC Current Source

ElmDci, ElmDcibi

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POWER SYSTEM SOLUTIONS

MADE IN GERMANY

Publisher:
DIgSILENT GmbH
Heinrich-Hertz-Straße 9
72810 Gomaringen / Germany
Tel.: +49 (0) 7072-9168-0
Fax: +49 (0) 7072-9168-88
info@digsilent.de

Please visit our homepage at:
https://www.digsilent.de

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1 General Description

The *DC Current Source* element is the model of a direct current source. The element can be connected to DC terminals only (Phase technology: DC). It is available both as a single-port and two-ports element.

The models used in the different calculation functions are described in the following chapters. The same load flow model is used in the balanced and in the unbalanced load flow calculation. Furthermore, the same dynamic model is used for the balanced/unbalanced RMS and EMT simulations.

2 Load Flow Analysis

For the load flow analysis the model corresponds to equivalent circuit shown in 2.1. When the internal conductance Gi is set to zero the current source imposes a constant direct current regardless of the voltage across its terminals and thus behaves as an ideal current source.

The user specifies the nominal current of the source in the basic data page of the element. The actual current setpoint is then adjusted in the load flow page in per units of the nominal current together with the parallel conductance $Gi >= 0$.

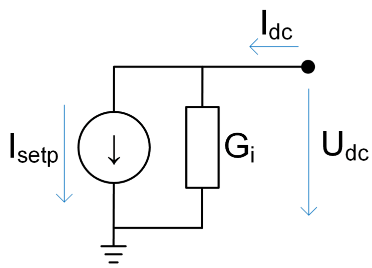

Figure 2.1: *PowerFactory* DC Current Source

The output current is given by the following equation:

$$Idc = isetp \cdot Inom/1000 + Udc \cdot Gi \tag{1}$$

- Udc is the DC voltage on the connected terminal in kV;
- $isetp$ is the current setpoint in $p.u.$;
- $Inom$ is the nominal DC current of the element in A;
- Idc is the resulting DC current flowing through the element in kA;
- Gi is the internal conductance in S.

The current setpoint $isetp$ can be defined as a negative value to generate/inject power.

The equivalent circuit of the DC current source with two terminals is shown in 2.2. The difference to the model with one terminal is that the DC voltage (Udc) is actually the DC voltage difference between the two DC terminals $Udc = \Delta U_{dc} = U_{dc,bus1} - U_{dc,bus2}$.

Note that for DC elements there is no different between the balanced and unbalanced load flow calculation. The same model applies therefore in both cases.

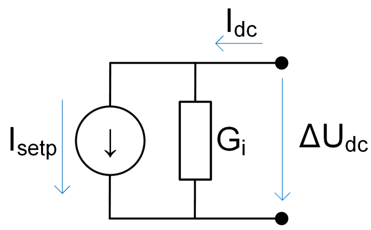

Figure 2.2: *PowerFactory* DC Current Source with two terminals

2.1 QDSL Interface

The following input signals are available to control the DC current source via QDSL model:

- $i0dc$ is the DC Current Input in $p.u.$

If the signal $i0dc$ is connected the DC current setpoint $isetp$ is replaced by the input signal (see equations (1)).

3 Short Circuit Calculation

There is no contribution from the DC current source model to faults neither in DC nor in AC nodes. The DC current source is therefore ignored in the short-circuit calculation according to any of the supported short-circuit methods (complete method, IEC60909, VDE102, ANSI.)

4 Time Domain Simulation

For DC components there is no difference between the electromagnetic (EMT) and the electromechanical (RMS) transient simulations. So the same model applies to both cases.

As shown in Figure 4.1 the model of the DC current source is extended by a shunt capacitance for the time domain simulations.

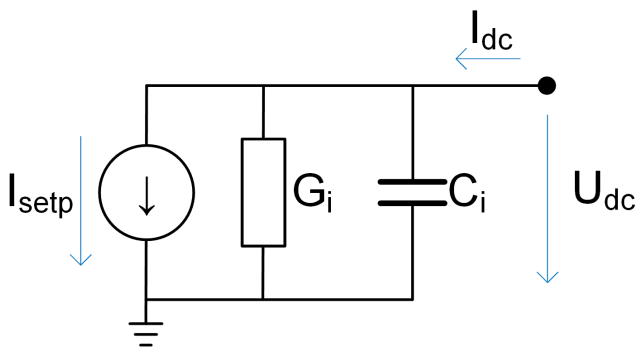

Figure 4.1: EMT and RMS DC Current Source model

Hence the response of the model is given by the following differential equation:

$$Idc(t) = isetp(t) \cdot Inom/1000 + Gi \cdot Udc(t) + Ci \cdot \frac{\partial}{\partial t} Udc(t) \tag{2}$$

with:

- $isetp(t) = i0dc$, $i0dc$ is the DC Current Input signal in $p.u.$;
- Gi is the internal conductance in S;
- Ci is the internal capacitance in μF;

The equivalent circuit of the DC current source with two terminals is shown in 4.2. The difference to the model with one terminal is that the (Udc) is actually the DC voltage difference between the two DC terminals $Udc = \Delta U_{dc} = U_{dc,bus1} - U_{dc,bus2}$.

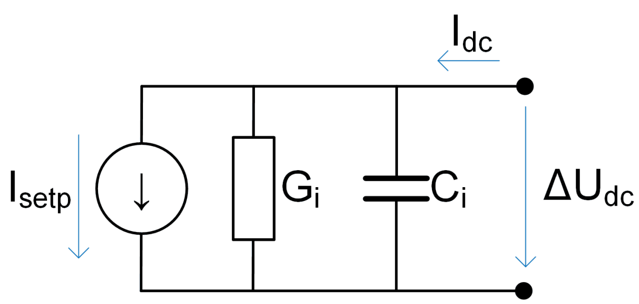

Figure 4.2: EMT and RMS DC Current Source model with two terminals

The option ”Block if part of isolated area” is available on both RMS and EMT simulation pages. If the option is unselected, the DC current source will in-feed current into an isolated DC area (with no DC slack). If the option is selected, the current of the DC current source will drop to zero as soon as its DC area becomes isolated.

4.1 Inputs to the Dynamic Model

For dynamic studies it is possible to externally control the instantaneous value of the current by means of the input signal shown in Figure 4.3. Hence with help of a composite model, the user can inject any desired current waveform into the DC node.

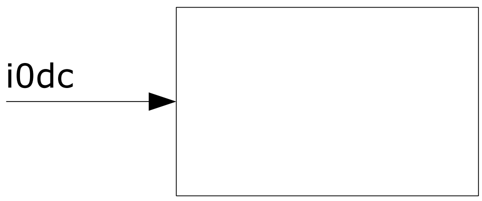

Figure 4.3: Input/Output Definition of DC Current Source (RMS/EMT-Simulation)

Table 4.1: Input Definition of the RMS and EMT Models

Input Signal	Symbol	Description	Unit
i0dc		DC current setpoint	p.u.

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