Component: Voltage Regulator

**Notes:**

* **The variable names for DiTTo in the first column are exactly copied from DiTTo in order to get the parameters in DiTTo easily.**
* **For ePHASORSIM, the symbols in the third column are put exactly same as the ePHASORSIM user guide and the demo examples.**
* **The DiTTo parameters which match the ePHASORSIM’s parameters are put in the same rows.**
* **If one or more parameters which are available in ePHASORSIM but not in DiTTo, in that case the corresponding columns of the Ditto are left empty or necessary suggestions are provided.**
* **The parameters which are available only in DiTTo but not in ePHASORSIM, in that case the corresponding columns of the ePHASORSIM are left empty.**

**Additional notes for voltage regulator:** In ePHASORSIM demo example of IEEE 13 node test feeder, voltage regulator is designed as a three phase transformer. In the test feeder diagram, voltage regulator is connected between bus-650 and bus-632. Transmission line is also connected between the bus 650 and 632. From observation of the ePHASORSIM demo example of IEEE 13 node test feeder, an imaginary bus is assumed between the bus -650 and bus-632, named it as Bus-651. The regulator is connected between the bus-650 and bus-651. The transmission line is conned between bus-651 and bus-632.

By drawing analogy, for mapping, three phase transformer data information is used for voltage regulator in ePHASORSIM.

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| --- | --- | --- | --- | --- | --- | --- |
| Ditto | | ePHASORSIM | | | |  |
| Name of the variable | Description | | Symbol | Description | Unit | Default value |
| name | Name of the regulator object | | ID | Transformer name | Name must be unique |  |
| num\_phases | The number of phases that the regulator handles | | bus a | Primary bus: phase A | Name must be unique |  |
| bus b | Primary bus: phase B | Name must be unique |  |
| high\_num\_phases | The number of phases that the high end of the regulator has | |  |
| bus c | Primary bus: phase C | Name must be unique |  |
| high\_phases | '''A list of the phases (A, B, C, N, s1, s2) that the high side of the regulator has | |  |
| high\_nominal\_voltage | The nominal voltage of the high end of the regulator | | kV (ph-ph RMS) | Primary winding nominal voltage (phase to phase (RMS)) | Unit: kV | Important information: the secondary side voltage is used exactly same for the both primary side and the secondary side. |
| This parameter is unavailable in DiTTo; |  | | kVA\_base | Nominal power in primary side | Unit: kVA |  |
| linedrop\_resistance | The line drop resistance for normal (forward) powerflow | | R\_w0 (pu) | Primary winding resistance. Here w0: means primary winding | Unit: p.u. |  |
| reverse\_linedrop\_resistance | The line drop resistance for reverse powerflow. | |  |
| high\_connection\_type | This is the type of connection that the regulator connects to on the high side | | conn | Primary winding connection type | ‘wye’ and ‘delta’ |  |
| num\_phases | The number of phases that the transformer handles | | bus\_a | Secondary bus: phase A | Name must be unique |  |
| low\_num\_phases | The number of phases that the low end of the transformer has | | bus\_b | Secondary bus: phase B | Name must be unique |  |
| low\_phases | '''A list of the phases (A, B, C, N, s1, s2) that the low side of the transformer has | | bus\_c | Secondary bus: phase C | Name must be unique |  |
| low\_nominal\_voltage | The nominal voltage of the low end of the regulator | | kV (ph-ph RMS) | Secondary winding nominal voltage (phase to phase (RMS)) | Unit: kV | Important information: the secondary side voltage is used exactly same for the both primary side and the secondary side. |
| This parameter is unavailable in DiTTo; |  | | kVA\_base | Nominal power in secondary side | Unit: kVA |  |
| linedrop\_resistance | The line drop resistance for normal (forward) powerflow.''' | | R\_w1 (pu) | Secondary winding resistance. Here w1: means secondary winding | Unit: p.u. |  |
| reverse\_linedrop\_resistance | The line drop resistance for reverse powerflow. | |  |
| low\_connection\_type | This is the type of connection that the transformer connects to on the low side | | conn | Secondary winding connection type | ‘wye’ and ‘delta’ |  |
| linedrop\_reactance | The line drop reactance for normal | | X (pu) | Total reactance | p.u. |  |
| reverse\_linedrop\_reactance | The line drop reactance for reverse power flow. | |  |
| tap\_position | This is the starting tap changer position for the regulator. It should be in the range between highstep and lowstep | | Tap A | Initial tap position for phase A | Integer between Lowest and  Highest Tap | 0 |
| tap\_position | This is the starting tap changer position for the regulator. It should be in the range between highstep and lowstep | | Tap B | Initial tap position for phase B | Integer between Lowest and  Highest Tap | 0 |
| tap\_position | This is the starting tap changer position for the regulator. It should be in the range between highstep and lowstep | | Tap C | Initial tap position for phase C | Integer between Lowest and  Highest Tap | 0 |
| lowstep | The lowest possible tap step position from neutral | | Lowest Tap | The lowest tap position | Integer value | -16 |
| highstep | The highest possible tap step position from neutral | | Highest Tap | The highest tap position | Integer value | 16 |
|  |  | | Min Range (%) | Max voltage buck | 0 < value < 100 | 10 |
| voltage\_limit | The maximum voltage allowed on the PT secondary | | Max Range (%) | Max voltage boost | value > 0 | 10 |
| pt\_ratio | The voltage (potential) transformer ratio used to step down the voltage for controller | |  |  |  |  |
| ct\_ratio | The current transformer ratio used to define the current ratio for a controller | |  |  |  |  |
| delay | The delay in seconds for first tap change operation | |  |  |  |  |
| ltc | A flag indicating whether or not the transformer is a load tap change | |  |  |  |  |
| bandwidth | This is a value indicating the bandwith around the band center (which may be the nominal voltage). | |  |  |  |  |
| bandcenter | This is the target value for the regulator. This should often be the nominal voltage | |  |  |  |  |
| phase\_shift | This is the phase shift that the regulator causes in degrees in the range [0,360). | |  |  |  |  |
| high\_has\_neutral | A boolean to describe whether or not the high regulator end has a neutral line | |  |  |  |  |
| low\_has\_neutral | A boolean to describe whether or not the low regulator end has a neutral line | |  |  |  |  |
| windings | This is a list containing one element for each winding in the voltage regulator. | |  |  |  |  |
| positions | This parameter is a list of positional points describing the regulator (typically just one). | |  |  |  |  |
| high\_from | The node which connects to the 'from' end of the regulator | |  |  |  |  |
| low\_to | The node which connects to the 'to' end of the regulator | |  |  |  |  |
| connected\_winding | The winding number that the voltage regulator attaches to | |  |  |  |  |
| connected\_transformer | The name of the transformer that the voltage regulator is attached to | |  |  |  |  |
| pt\_phase | The phase number being used to monitor the voltage | |  |  |  |  |

Example: in ePHASORSIM

