PowerFactory and DSL models

Presentation at DTU

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Three main simulation types

1. Electro Magnetic Transients (EMT)
    1. All state variables of the system are modeled
    2. Both AC and DC transients are considered
    3. Suitable for simulation of fast transients
2. Root Mean Square (RMS) (Fundamental frequency)
    1. Only the fundamental frequency part is considered.
    2. The differential equations of the network are reduced to algebraic equations by elimination of the corresponding state variables.
    3. Machine fluxes, Machine rotor speeds and controllers are modeled as state variables
3. Load Flow
    1. An equilibrium where the derivatives of all state variables are zero is found.

Different Power System Simulation Tools

	EMT	RMS	LoadFlow
PSCAD®	Yes	(Yes)	No
SIMPOW®	Yes	Yes	Yes
PowerFactory®	Yes	Yes	Yes
PSS/E®	No	Yes	Yes

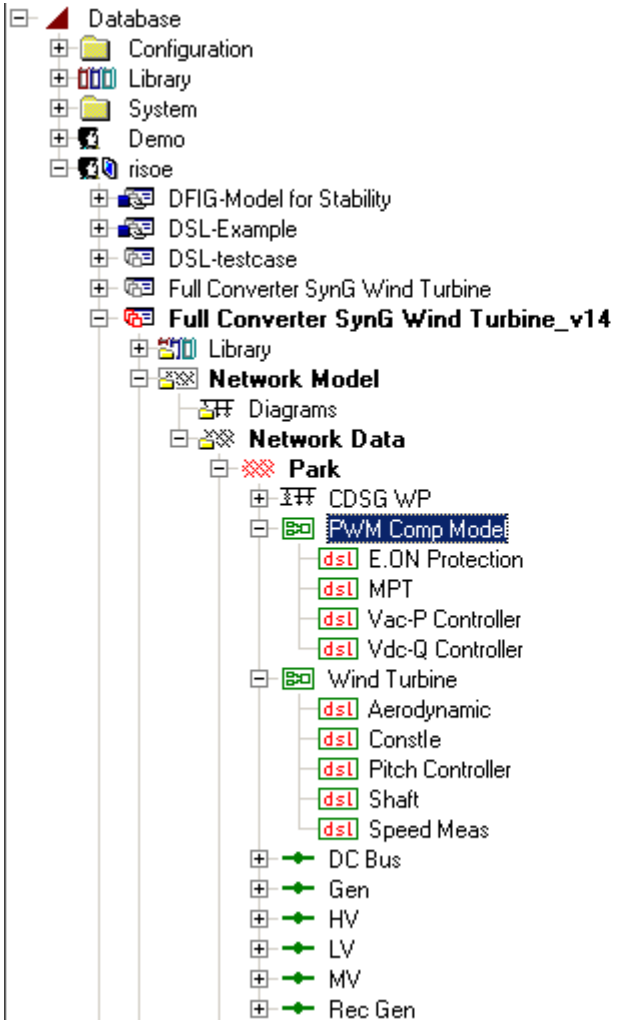
PowerFactory

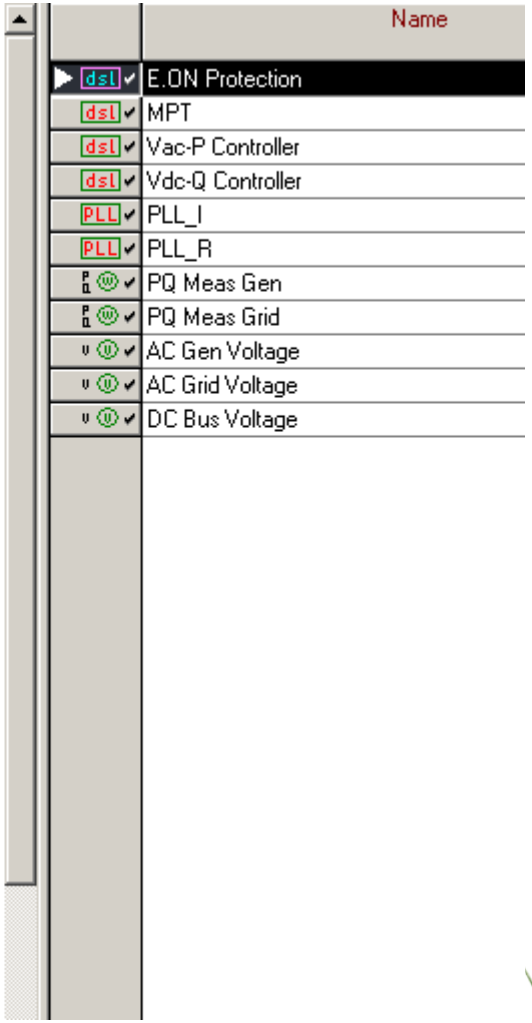
- Power Factory is an integrated power system analysis tool from the German company DIgSILENT (DIgital SImuLator for Electrical NeTwork)
- The development of DIgSILENT software began in 1976.
- DIgSILENT Version 7 was the world's first power system analysis software with an integrated graphical one-line interface.
- One of the other strengths of the program was the object oriented database structure.

Features (from their web site)

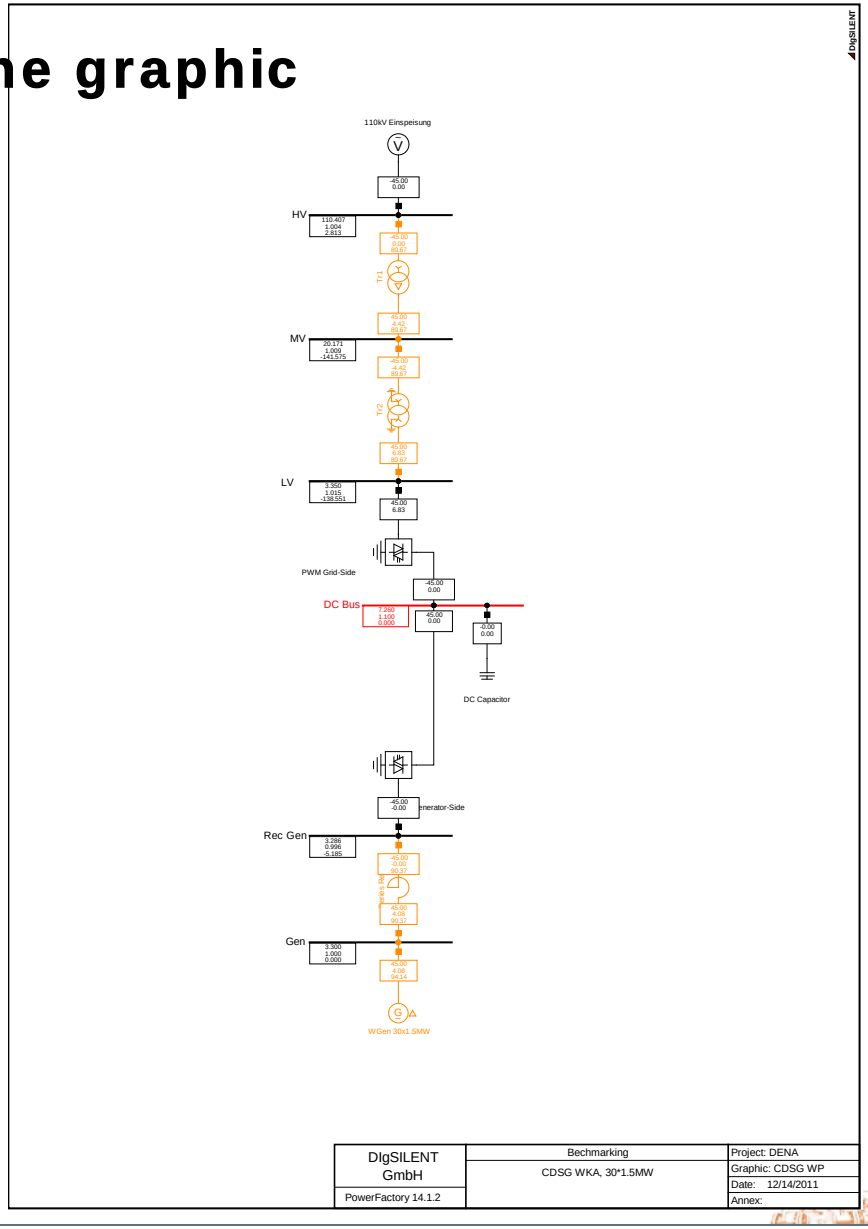
- Load Flow and Fault Analysis of complete AC/DC network representation, and allows meshed and mixed 1-, 2-, and 3-phase AC and/or DC networks to be modeled.
- Dynamic Simulation
- EMT Simulation
- Voltage Stability Analysis
- Eigenvalue Analysis
- System Identification
- Protection Analysis:
- Harmonic Analysis
- Reliability Analysis
- Production Planning
- Contingency Analysis
- Power Electronic Device Modeling
- Grounding
- A/D Interfacing
- Interface for SCADA/GIS/NIS
- Compatibility with other software systems such as PSS/E & PSS/U
- Multi-User Database and User Accounting
- Low Voltage Network Analysis
- Distribution Network Optimization
- IEC Cable Sizing
- Advanced Tools: Optimal Power Flow and Production Planning

Data base structure



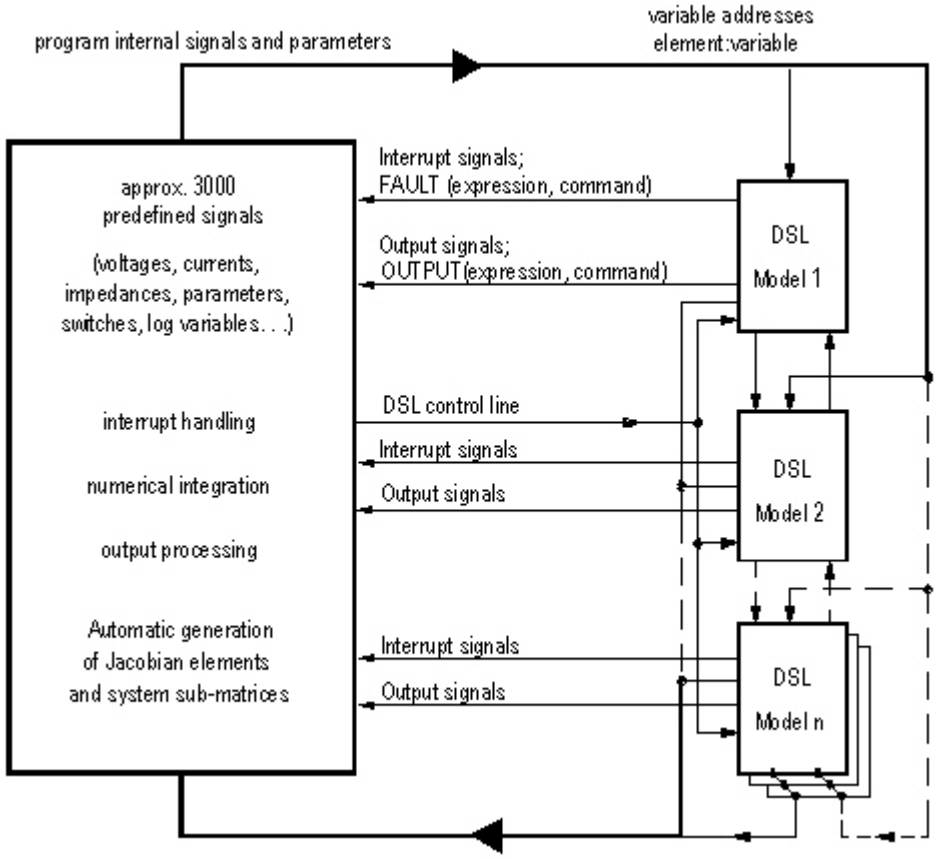


Single line graphic

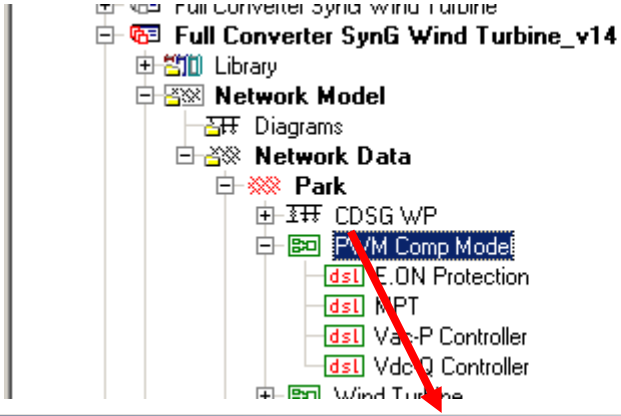


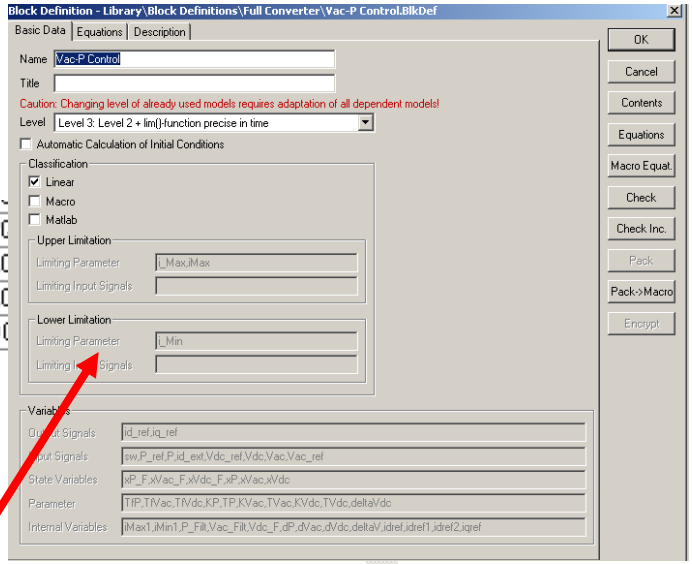
DSL-models

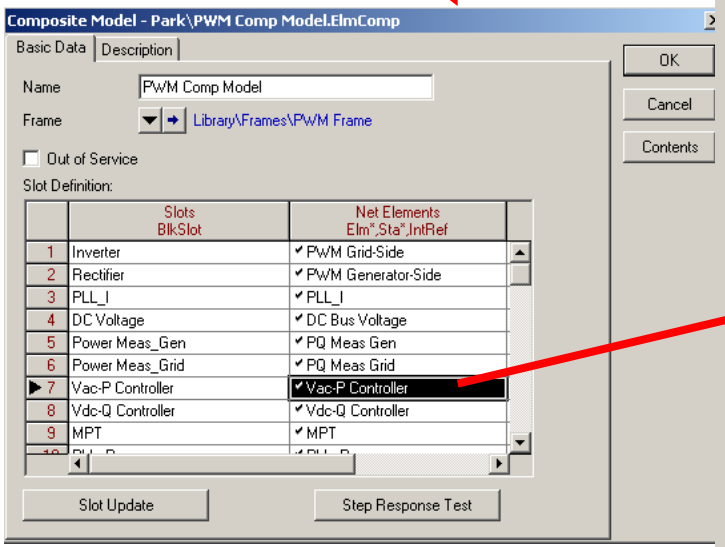
DIgSLENT Simulation language

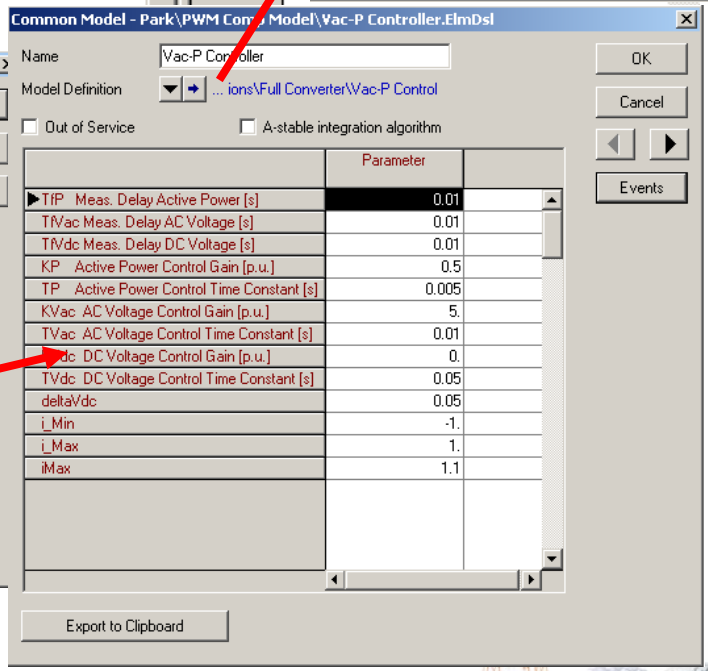


Structure


Full Converter SynG Wind Turbine_v14
Library
Network Model
Diagrams
Network Data
Park
CDSG WP
PWM Comp Model
E.ON Protection
MPT
Vac-P Controller
Vdc-Q Controller

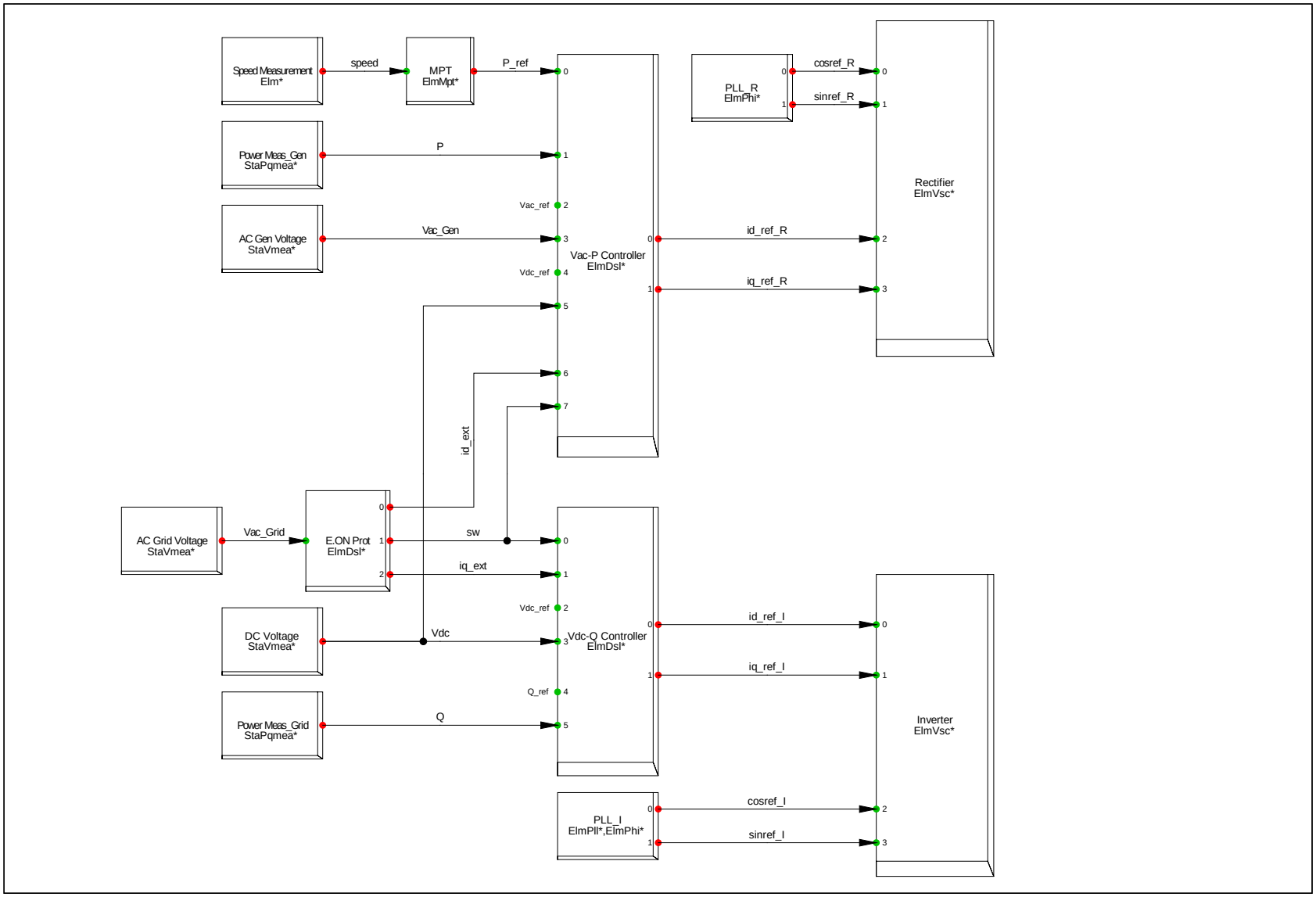

Block Definition - Library\Block Definitions\Full Converter\Vac-P Control.BlkDef
Basic Data
Equations
Description
Name
Vac-P Control
Title
Caution: Changing level of already used models requires adaptation of all dependent models!
Level
Level 3: Level 2 + lim()-function precise in time
Automatic Calculation of Initial Conditions
Classification
Linear
Macro
Matlab
Upper Limitation
Limiting Parameter
i_Max,iMax
Limiting Input Signals
Lower Limitation
Limiting Parameter
i_Min
Variables
Output Signals
id_ref,iq_ref
Input Signals
sw,P_ref,P,id_ext,Vdc_ref,Vdc,Vac,Vac_ref
State Variables
xP_F,xVac_F,xVdc_F,xP,xVac,xVdc
Parameter
TfP,TfVac,TfVdc,KP,TP,KVac,TVac,KVdc,TVdc,deltaVdc
Internal Variables
iMax1,iMin1,P_Filt,Vac_Filt,Vdc_F,dP,dVac,dVdc,deltaV,idref1,idref2,iqref
OK
Cancel
Contents
Equations
Macro Equat.
Check
Check Inc.
Pack
Pack->Macro
Encrypt


Composite Model - Park\PWM Comp Model.ElmComp
Basic Data
Description
Name
PWM Comp Model
Frame
Library\Frames\PWM Frame
Out of Service
Slot Definition:
Slots
BlkSlot
Net Elements
Elm*,Sta*,IntRef
1 Inverter — PWM Grid-Side
2 Rectifier — PWM Generator-Side
3 PLL_I — PLL_I
4 DC Voltage — DC Bus Voltage
5 Power Meas_Gen — PQ Meas Gen
6 Power Meas_Grid — PQ Meas Grid
7 Vac-P Controller — Vac-P Controller
8 Vdc-Q Controller — Vdc-Q Controller
9 MPT — MPT
Slot Update
Step Response Test
OK
Cancel
Contents

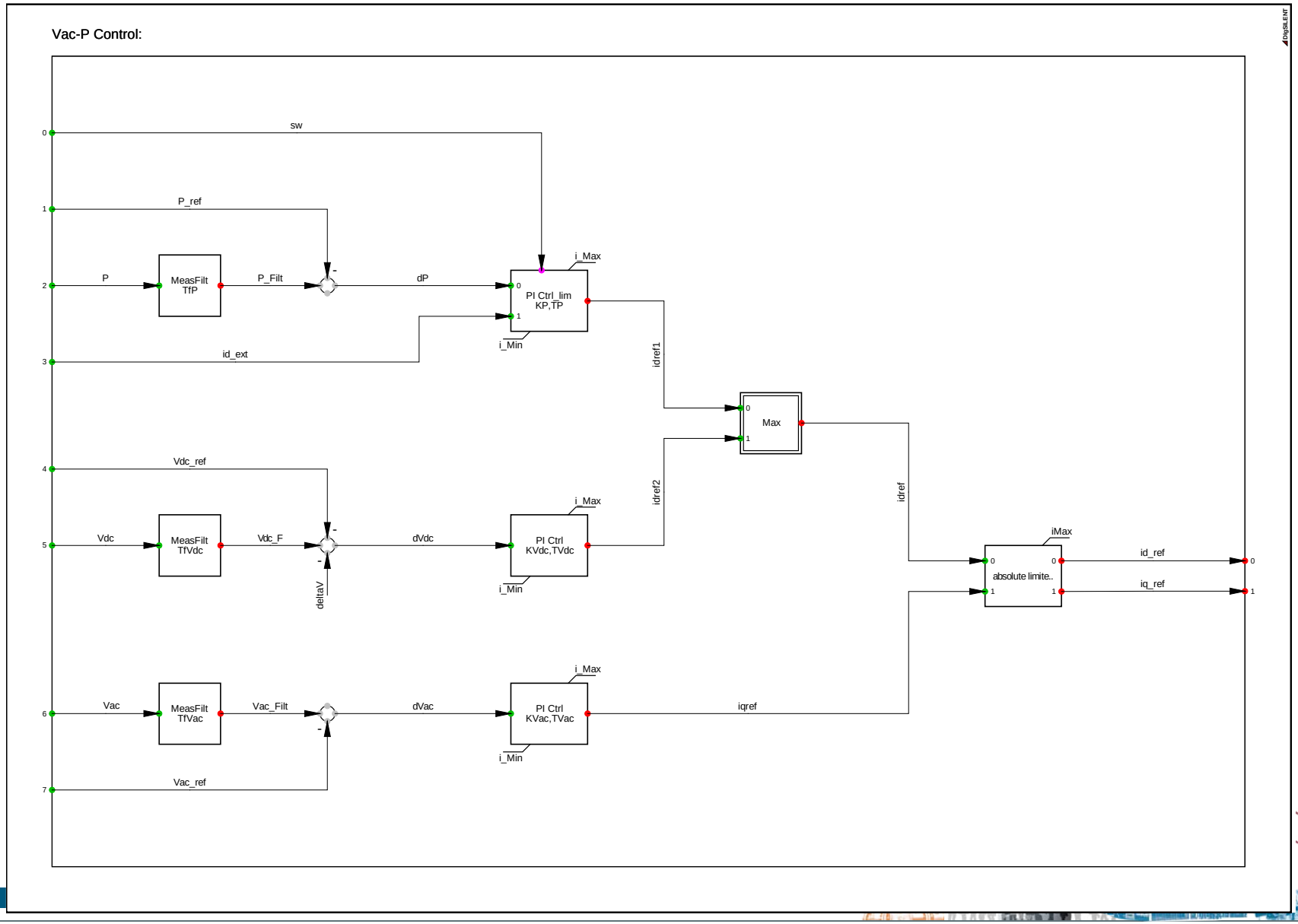

Common Model - Park\PWM Comp Model\Vac-P Controller.ElmDsl
Name
Vac-P Controller
Model Definition
... ions\Full Converter\Vac-P Control
Out of Service
A-stable integration algorithm
Parameter
TfP Meas. Delay Active Power [s] 0.01
TfVac Meas. Delay AC Voltage [s] 0.01
TfVdc Meas. Delay DC Voltage [s] 0.01
KP Active Power Control Gain [p.u.] 0.5
TP Active Power Control Time Constant [s] 0.005
KVac AC Voltage Control Gain [p.u.] 5.
TVac AC Voltage Control Time Constant [s] 0.01
KVdc DC Voltage Control Gain [p.u.] 0.
TVdc DC Voltage Control Time Constant [s] 0.05
deltaVdc 0.05
i_Min -1.
i_Max 1.
iMax 1.1
Export to Clipboard
OK
Cancel
Events

Composite frames

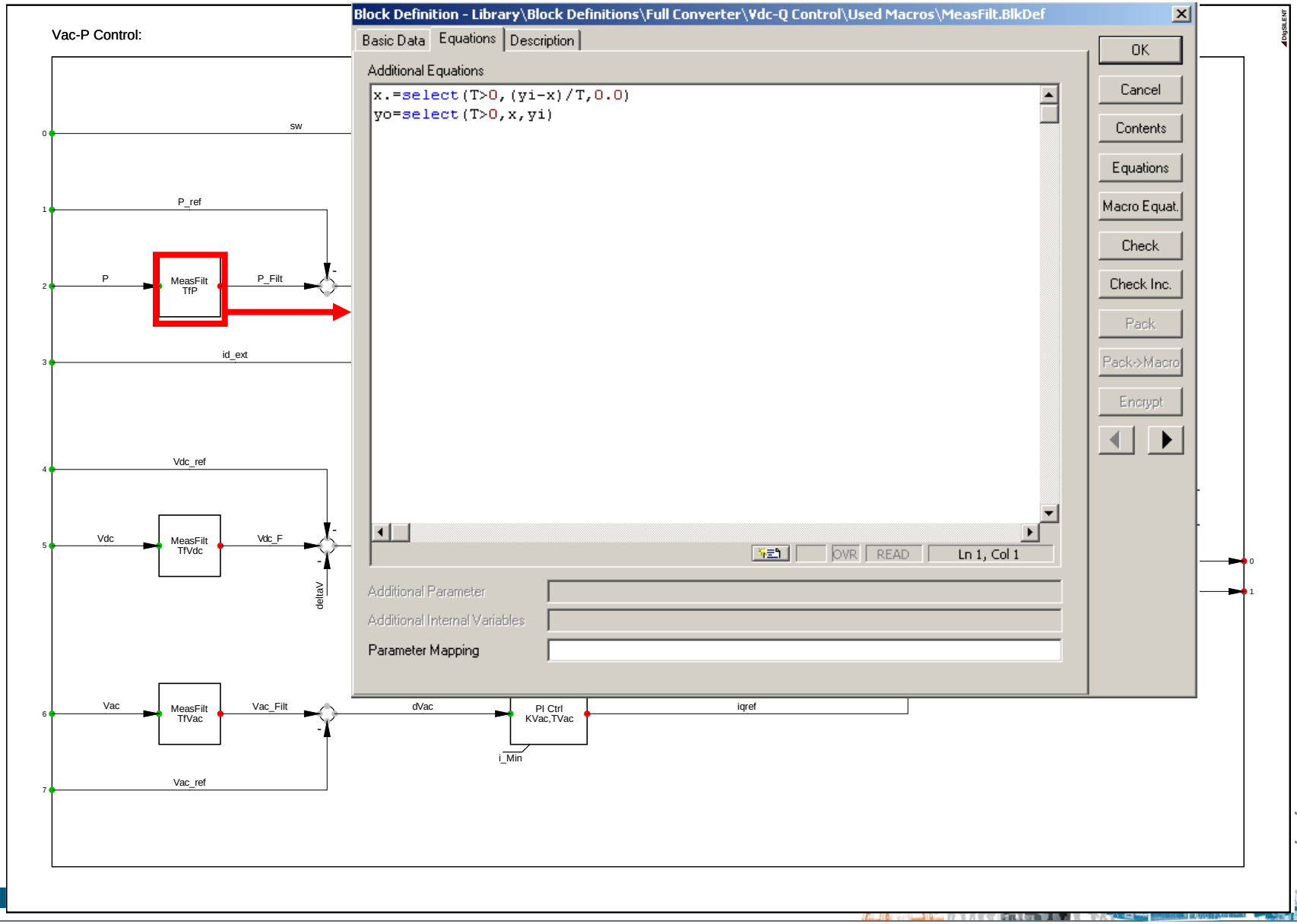
PWM Frame:



Composite model

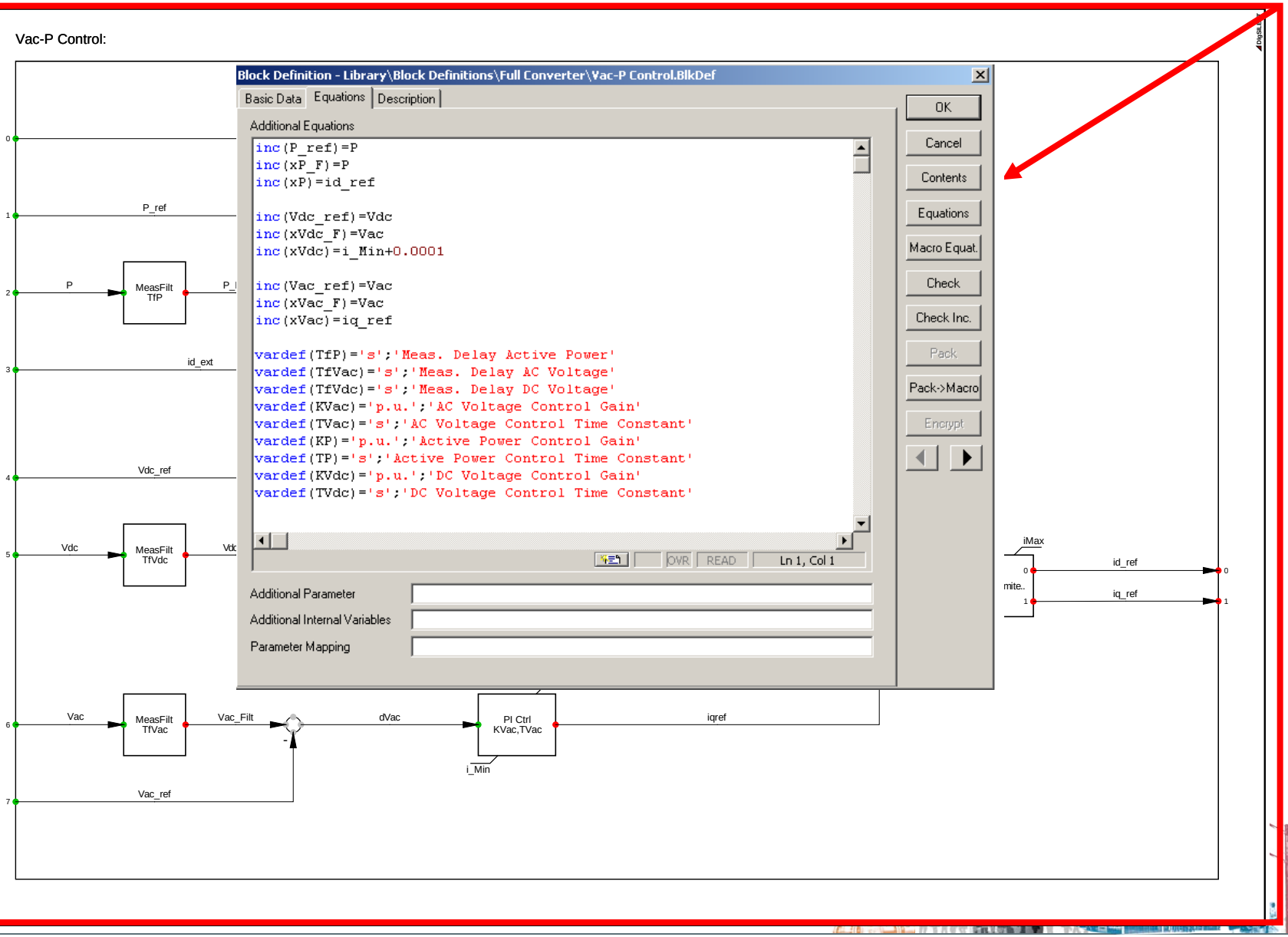


First order filter

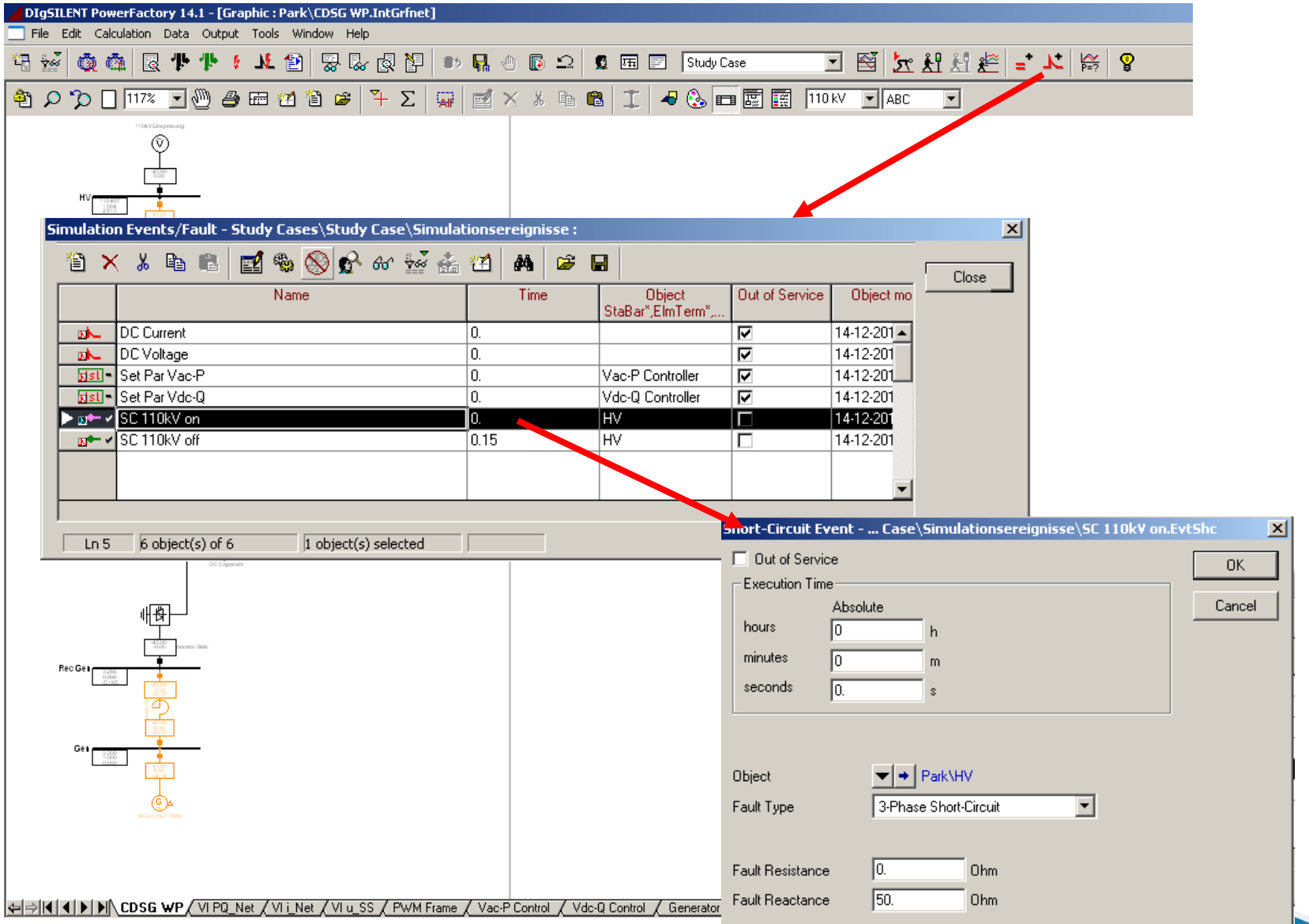


Initialization

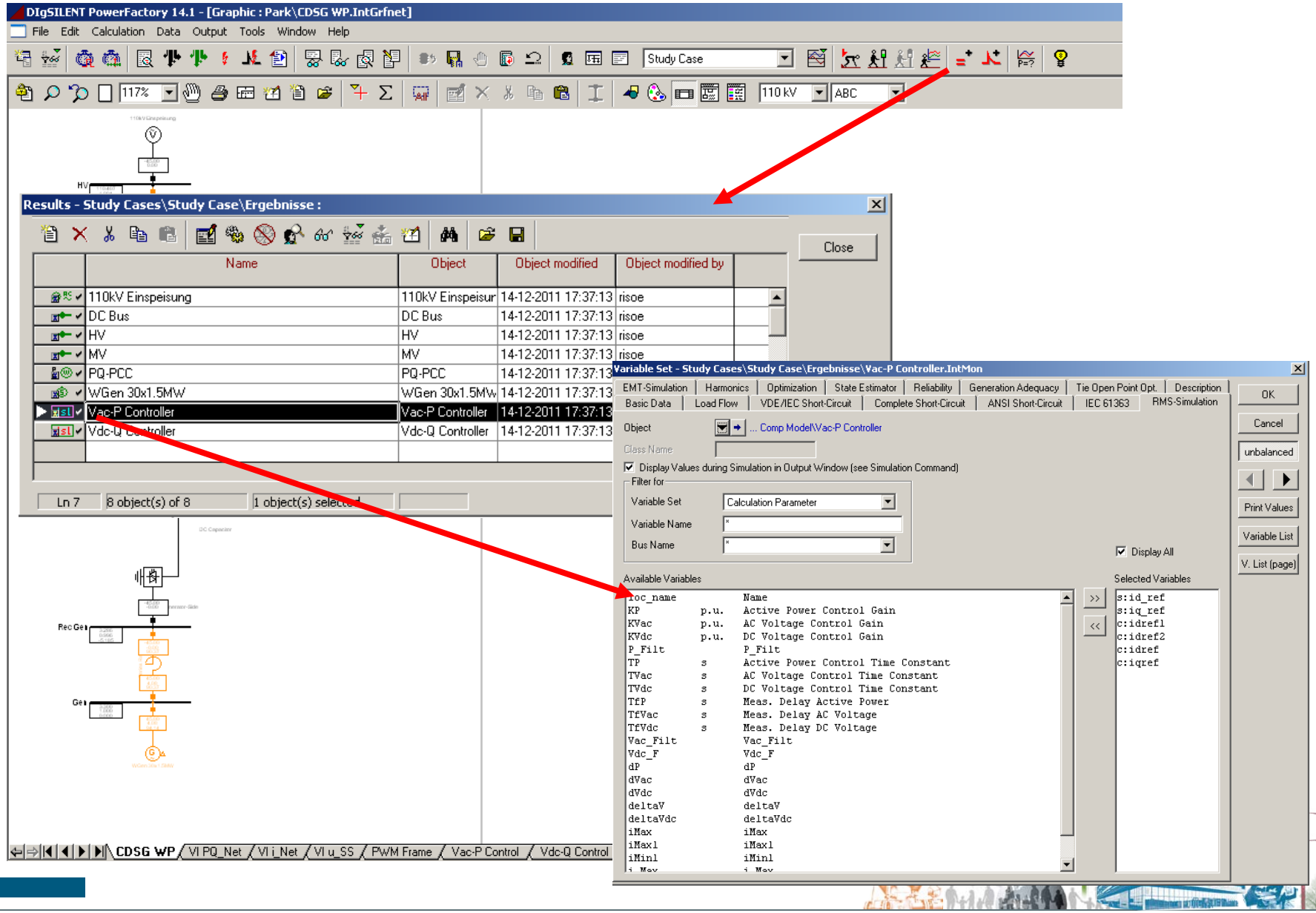
Vac-P Control:



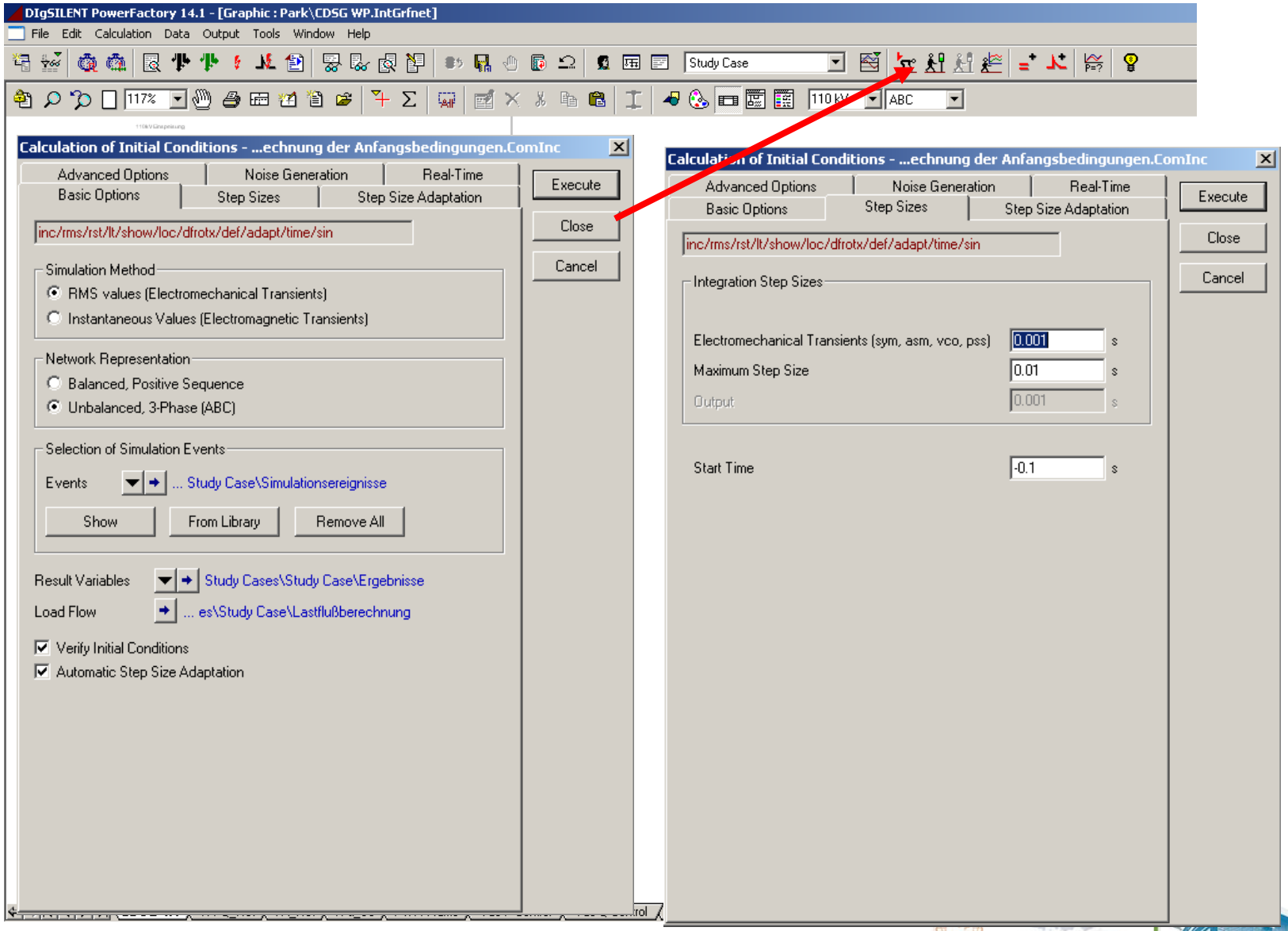
Defining events



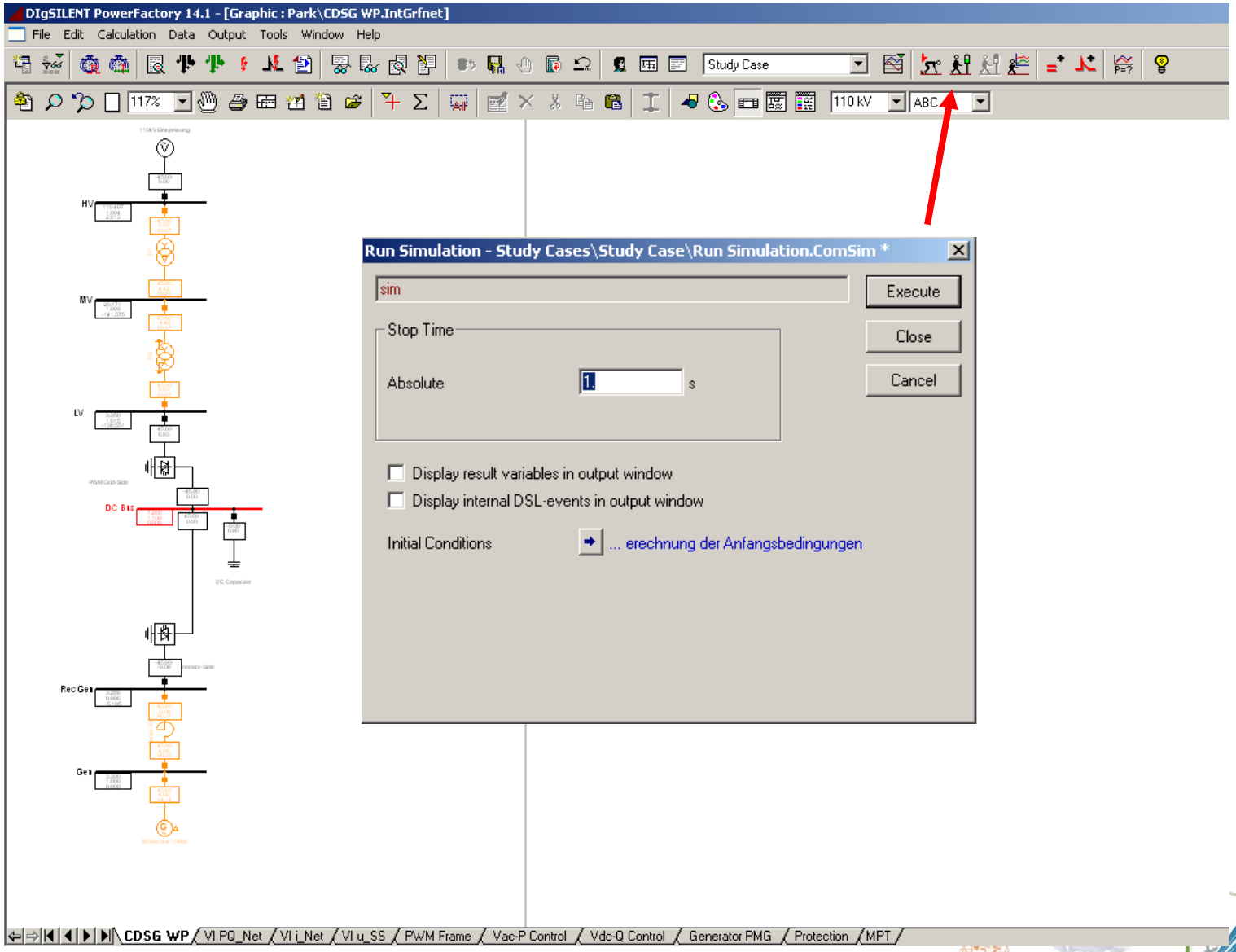
Defining results to record



Initializing the model



Starting the simulation



Plotting the results