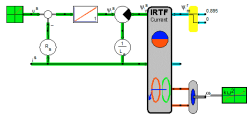
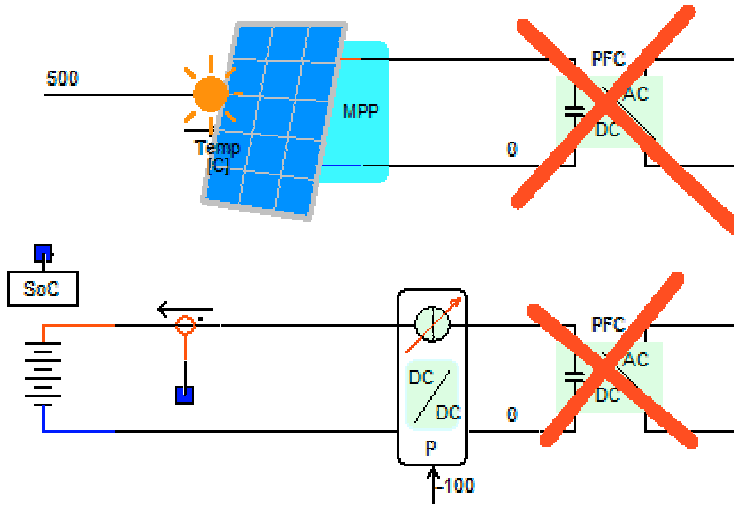


Combi-Cable in DC-netten

dr ir P.J.van Duijsen

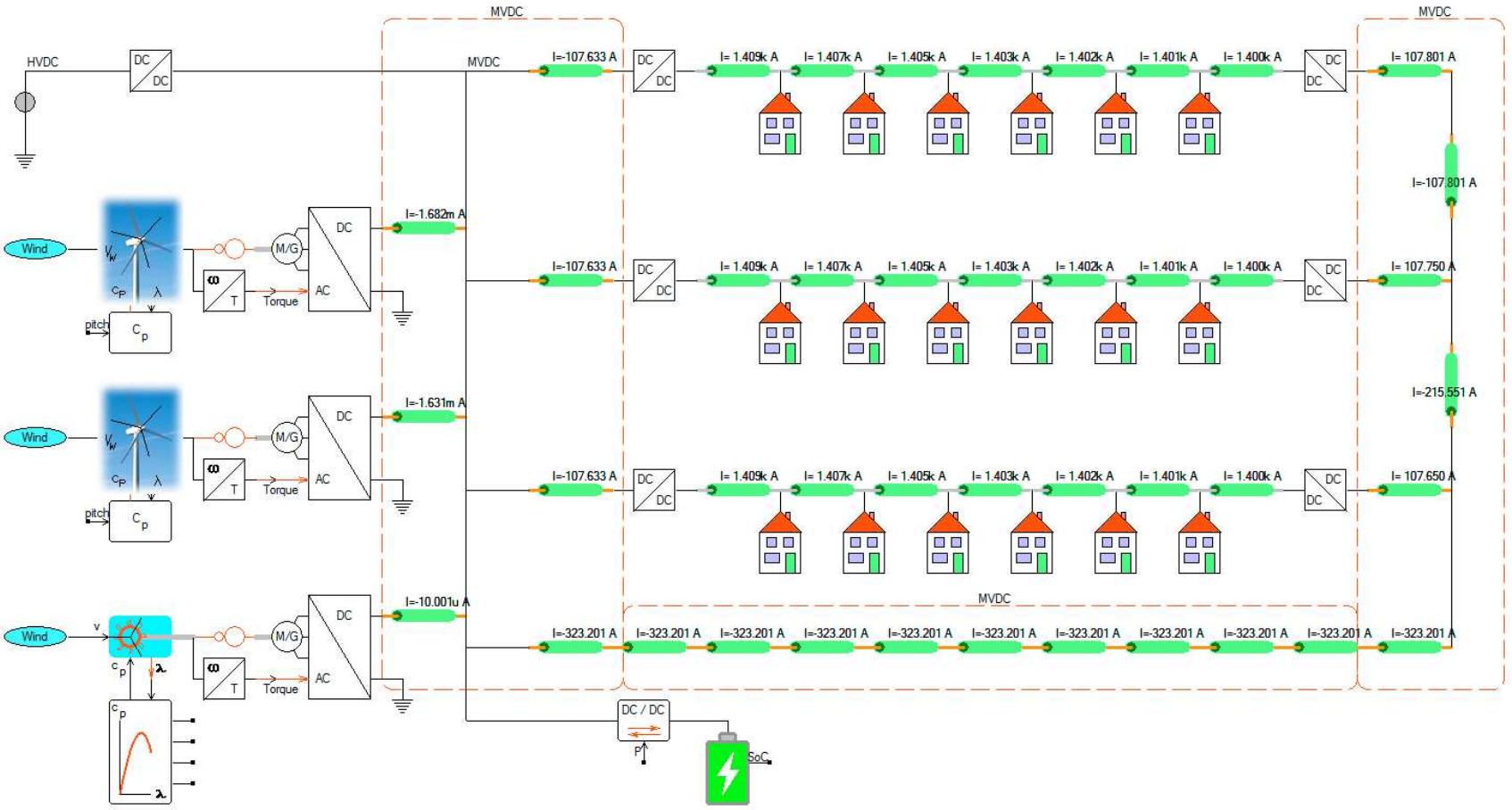


Learning by Simulation

Simulation Research
The Netherlands

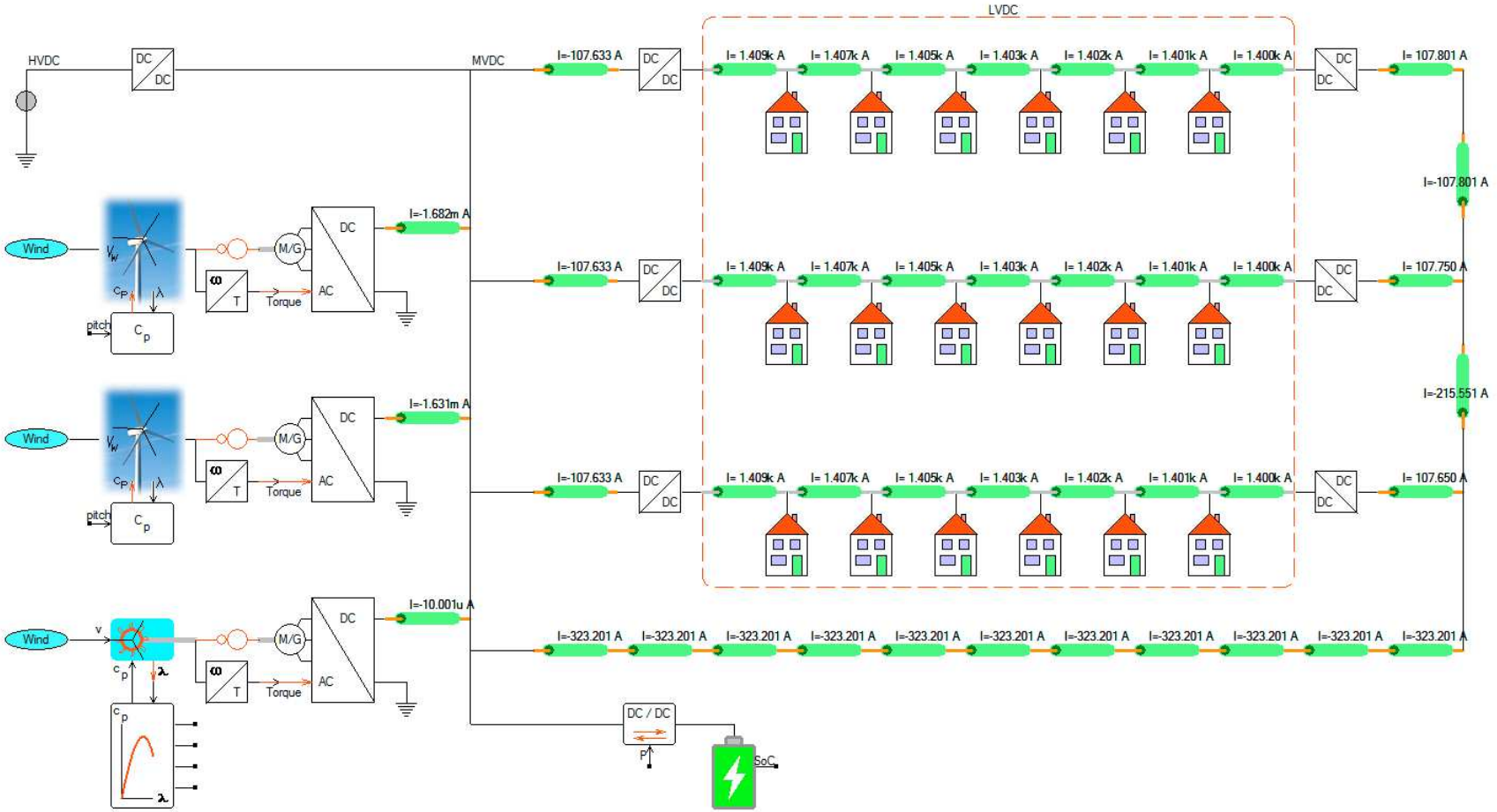
Welke Netten: MVDC

Caspoc
A simulation Experience



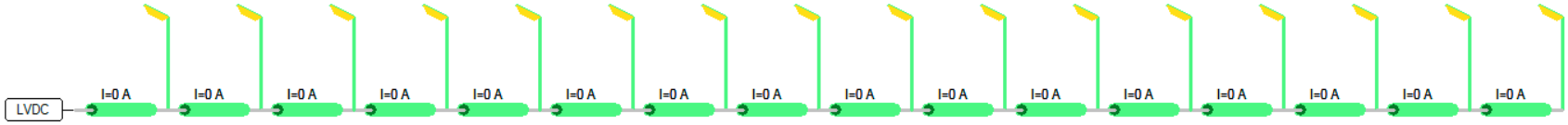
Welke Netten: LVDC

Caspoc
A simulation Experience



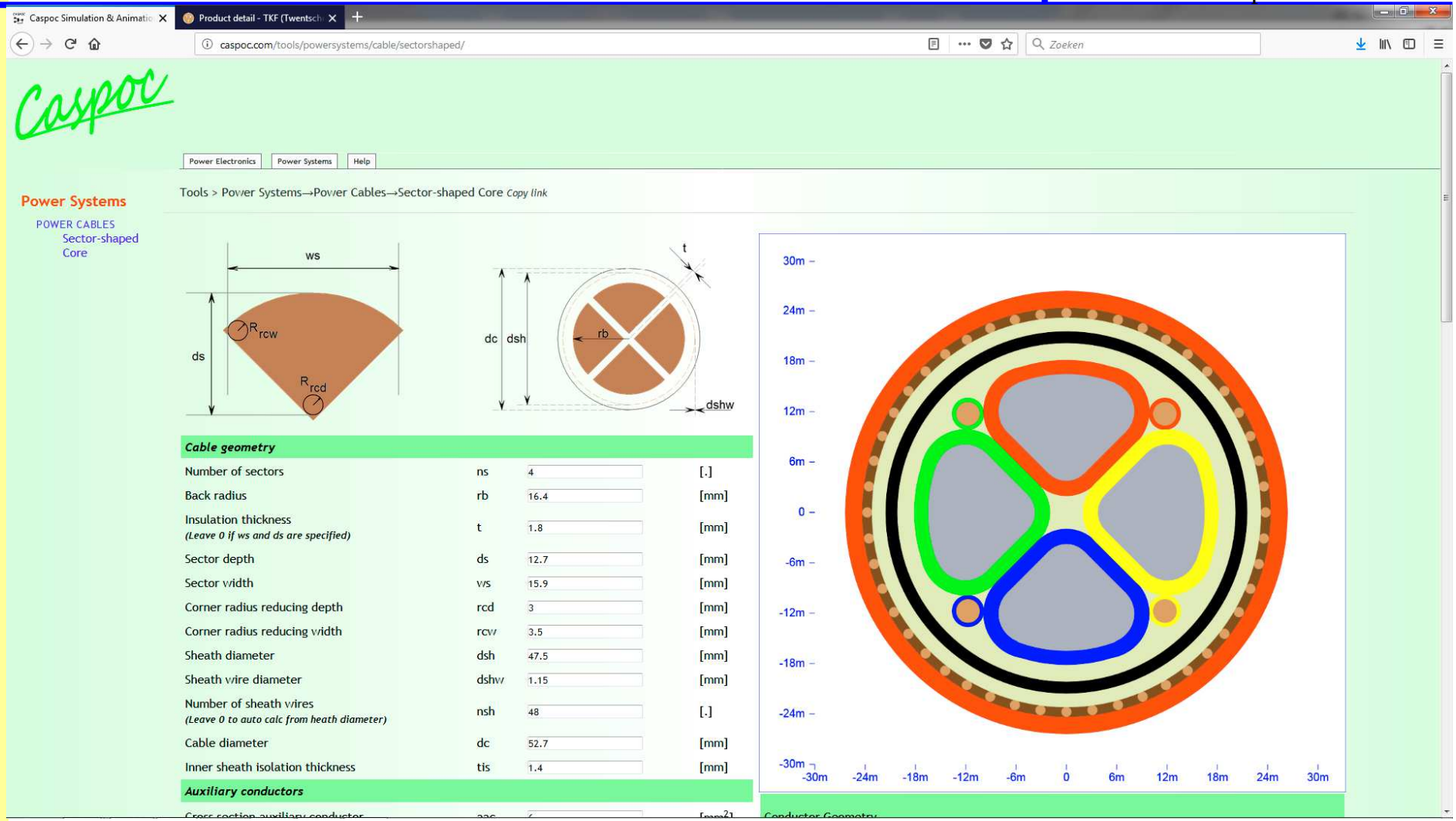
Welke Netten: Straatverlichting

Caspoc
A simulation Experience

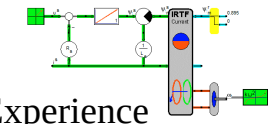


Cable Design tool

Caspoc
A simulation Experience

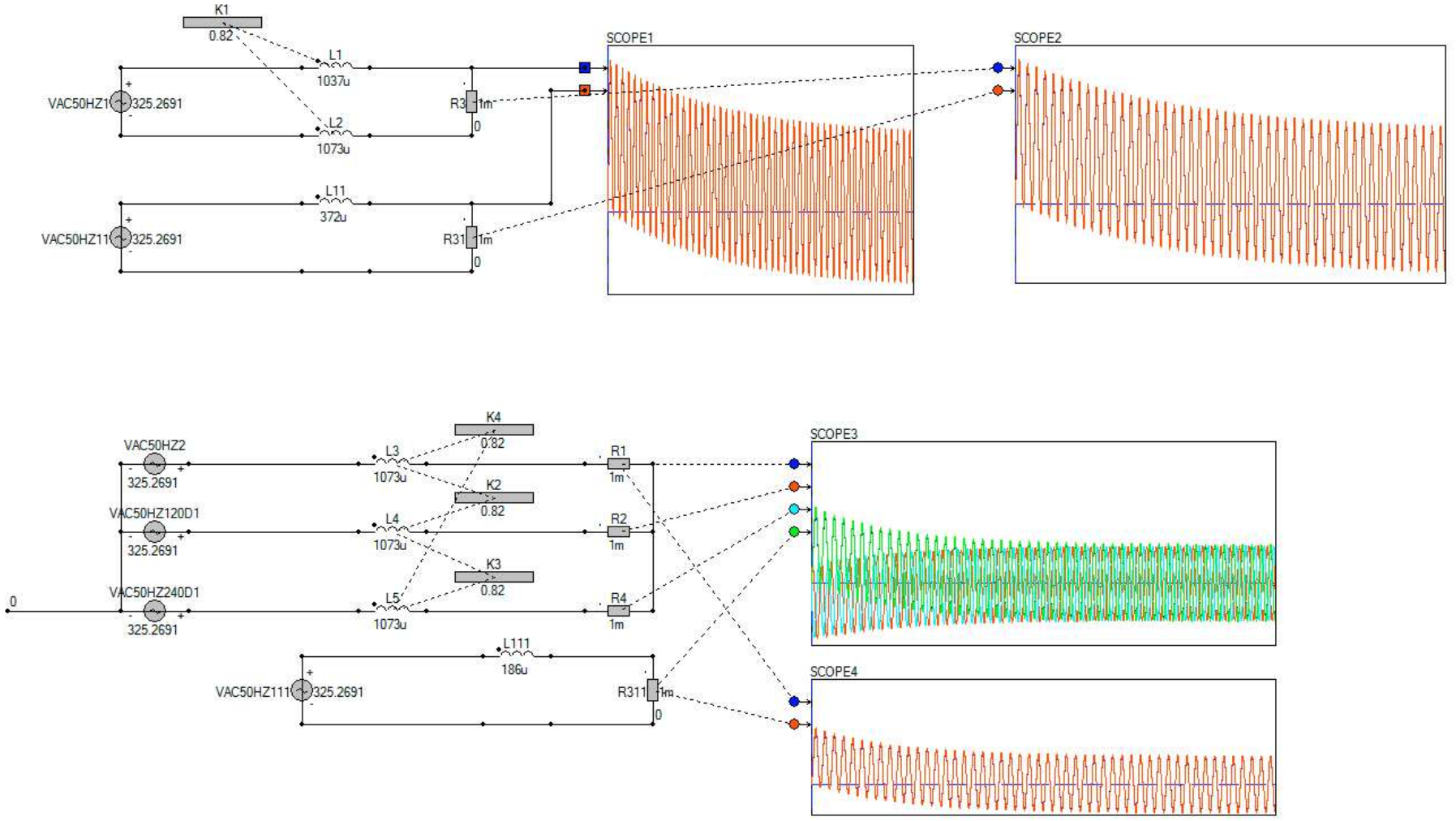


Calculate LCR

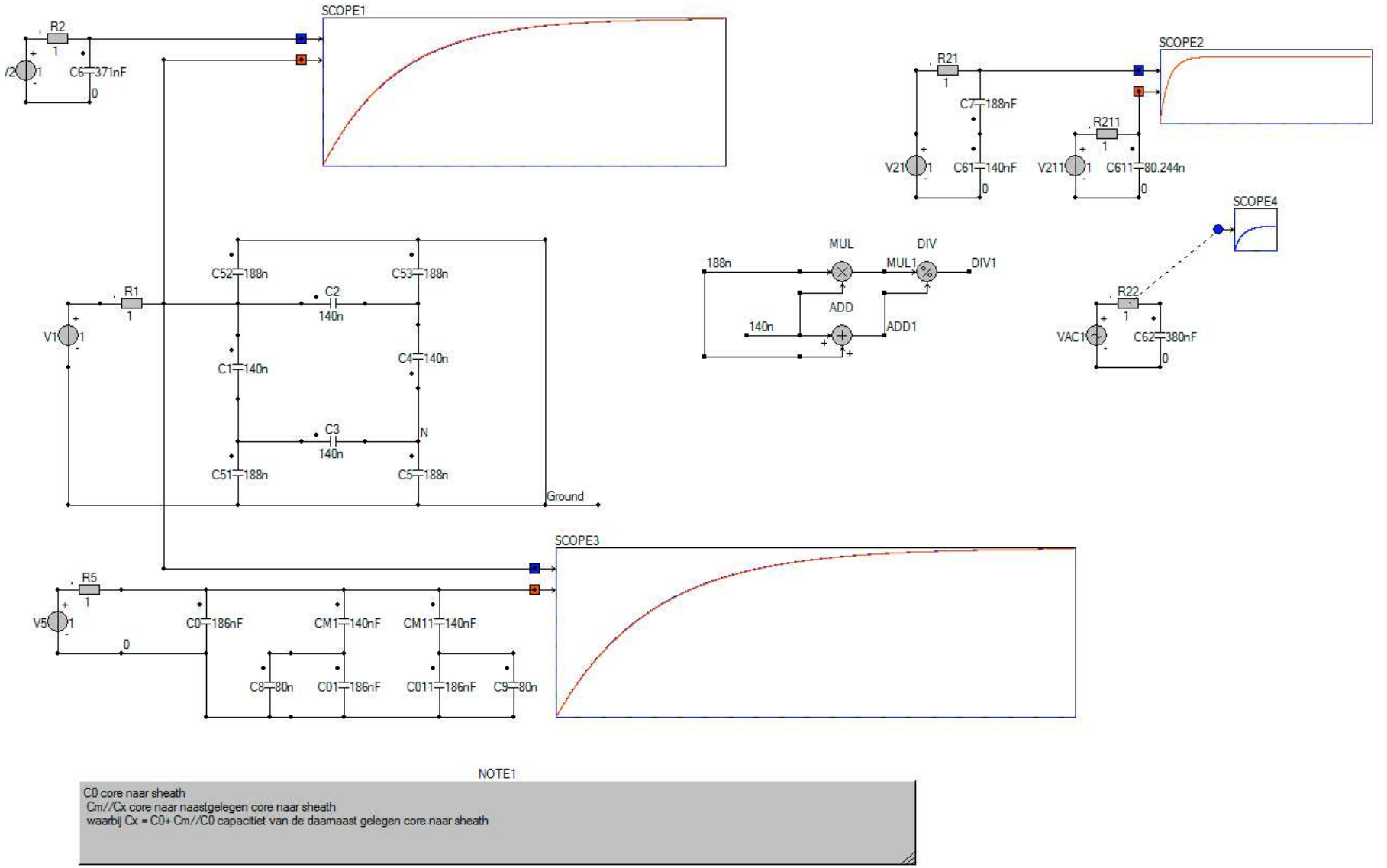


Nominal conductor diameter	d	13.4 [mm]
Nominal conductor cross section	nccs	140.935 [mm^2]
Geometric Mean Radius	GMR	5.6 [mm]
Geometric Mean Diameter	GMD	14.2 [mm]
Sector height	ds	12.6 [mm]
Sector width	ws	16.1 [mm]
Conductor Resistance		
Resistance copper wire	R_{CU}	126.5 [mΩ/km]
Resistance Aluminium wire	R_{AL}	200.2 [mΩ/km]
Conductor Inductance		
Self-Inductance	L_c	1037.6 [µH/km]
Mutual-Inductance	Lm_c	851.3 [µH/km]
Mutual-Inductance diagonal	$Lm2_c$	781.8 [µH/km]
Cable-Inductance(Given in datasheet)	L_{cable}	186.3 [µH/km]
Impedance	Z_c	58.516 [mOhm/km]
Conductor Capacitance		
Capacitance conductor-conductor	C_m	97.4 [nF/km]
Capacitance conductor-sheath	C_0	150.2 [nF/km]
Effective Capacity to Neutral(Given in datasheet)	C_{tot}	283 [nF/km]
Sheath Resistance		
Resistance sheath	R_{sheath}	357.7 [mΩ/km]
Sheath Inductance		
Self-Inductance	L_{sh}	932.8 [µH/km]
Mutual-Inductance Conductor-Sheath	Lm_{sh}	748 [µH/km]
Auxiliary Conductor		
Resistance copper wire	$Raux_{CU}$	2972.5 [mΩ/km]
Self-Inductance auxiliary	L_{aux}	1366.8 [µH/km]
Mutual-Inductance auxiliary-core	Lm_{aux}	887.5 [µH/km]
Mutual-Inductance aux-aux	M_{aux}	138.6 [µH/km]
Aux-core Capacitance	$C_{aux\text{-}core}$	66.118 [nF/km]
Aux-sheath Capacitance	$C_{aux\text{-}sheath}$	78.518 [nF/km]
Coupling factors		
Coupling Core-Core	k_{cc}	0.82
Coupling Core-Core diagonal	k_{ccd}	0.754

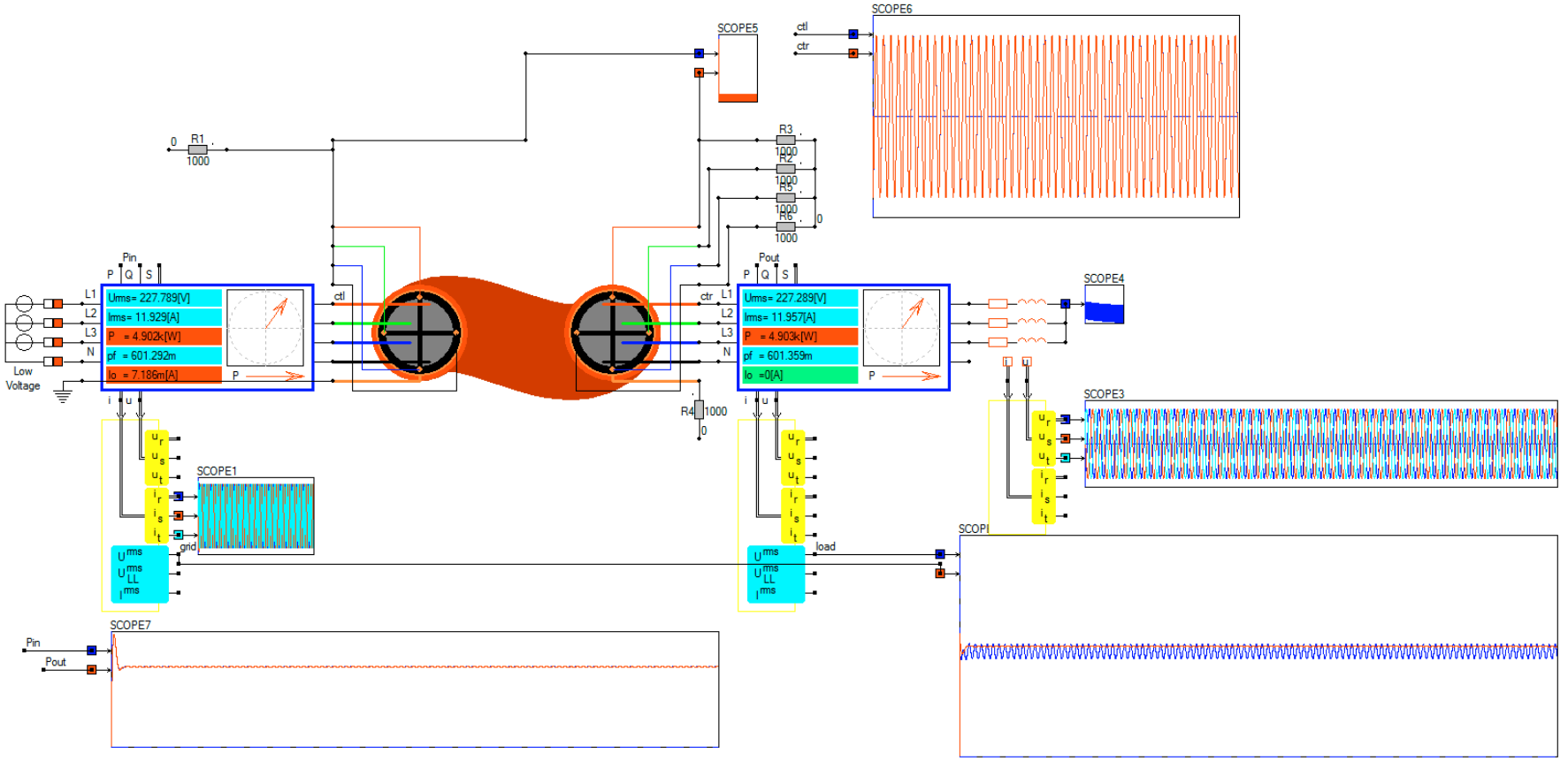
Inductance



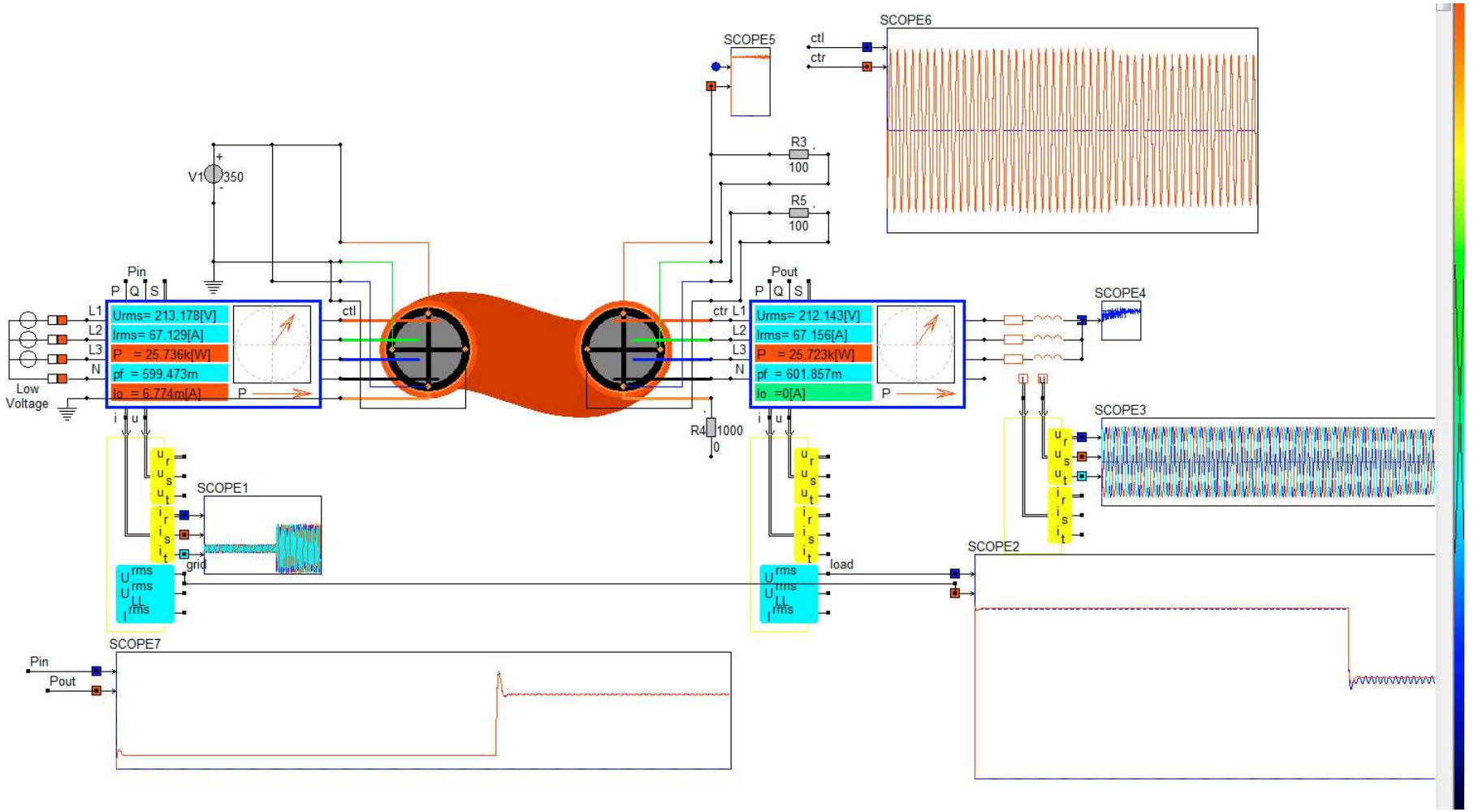
Capacitance



Simulation

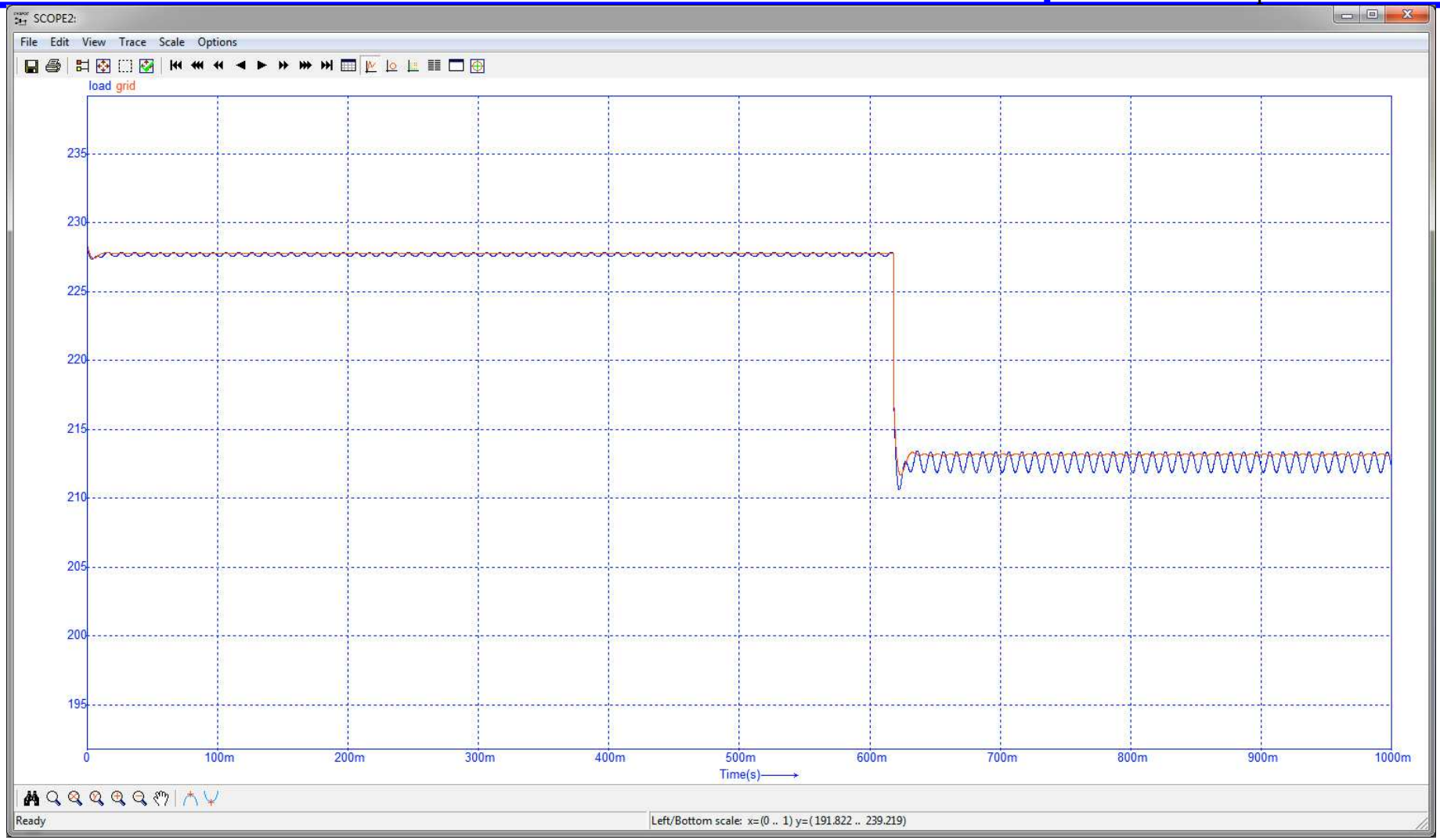


Change load from 5kw to 30kw



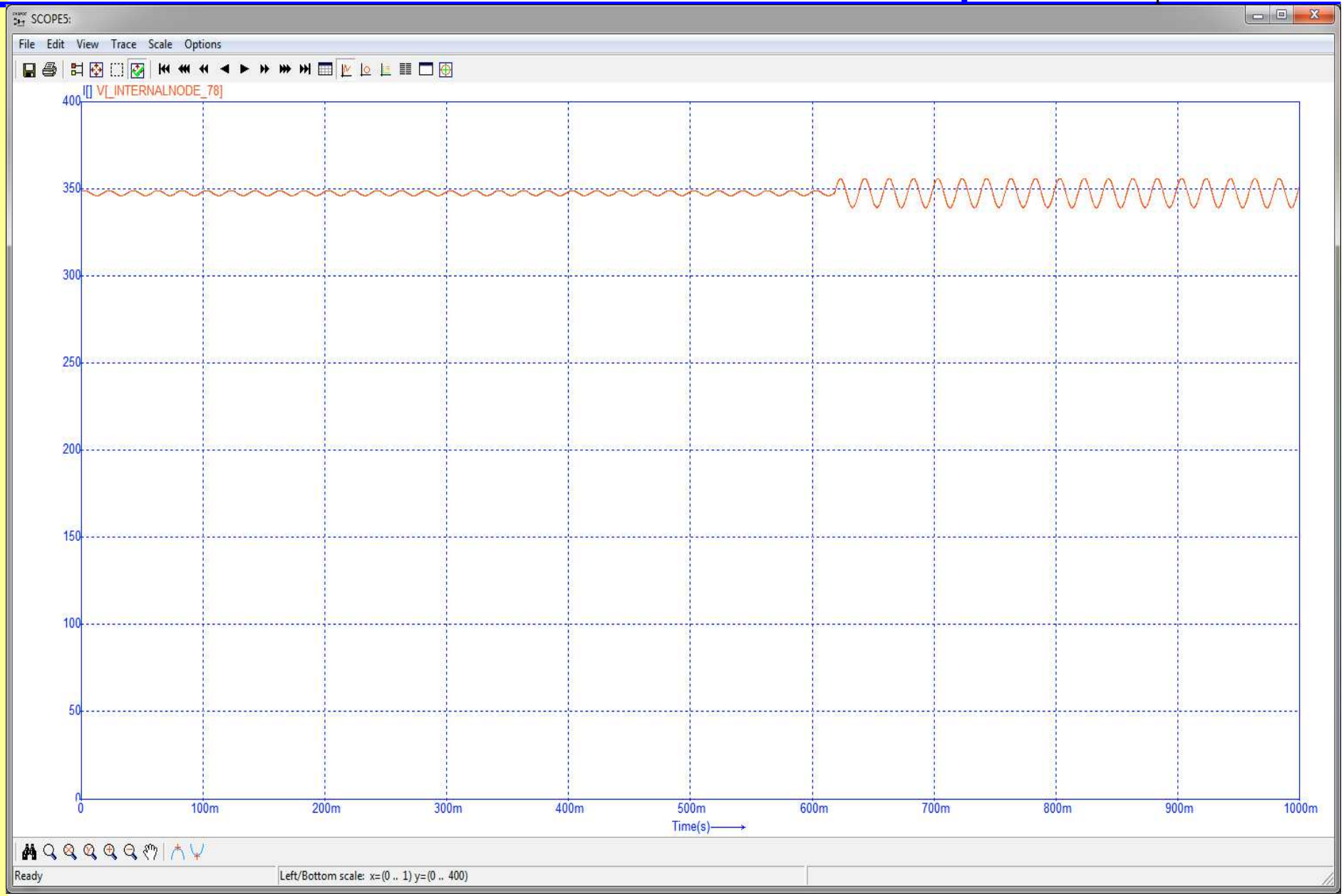
- More ripple on virtual neutral
- Higher ripple voltage on the auxilairy cores

Ripple on RMS input/output voltage



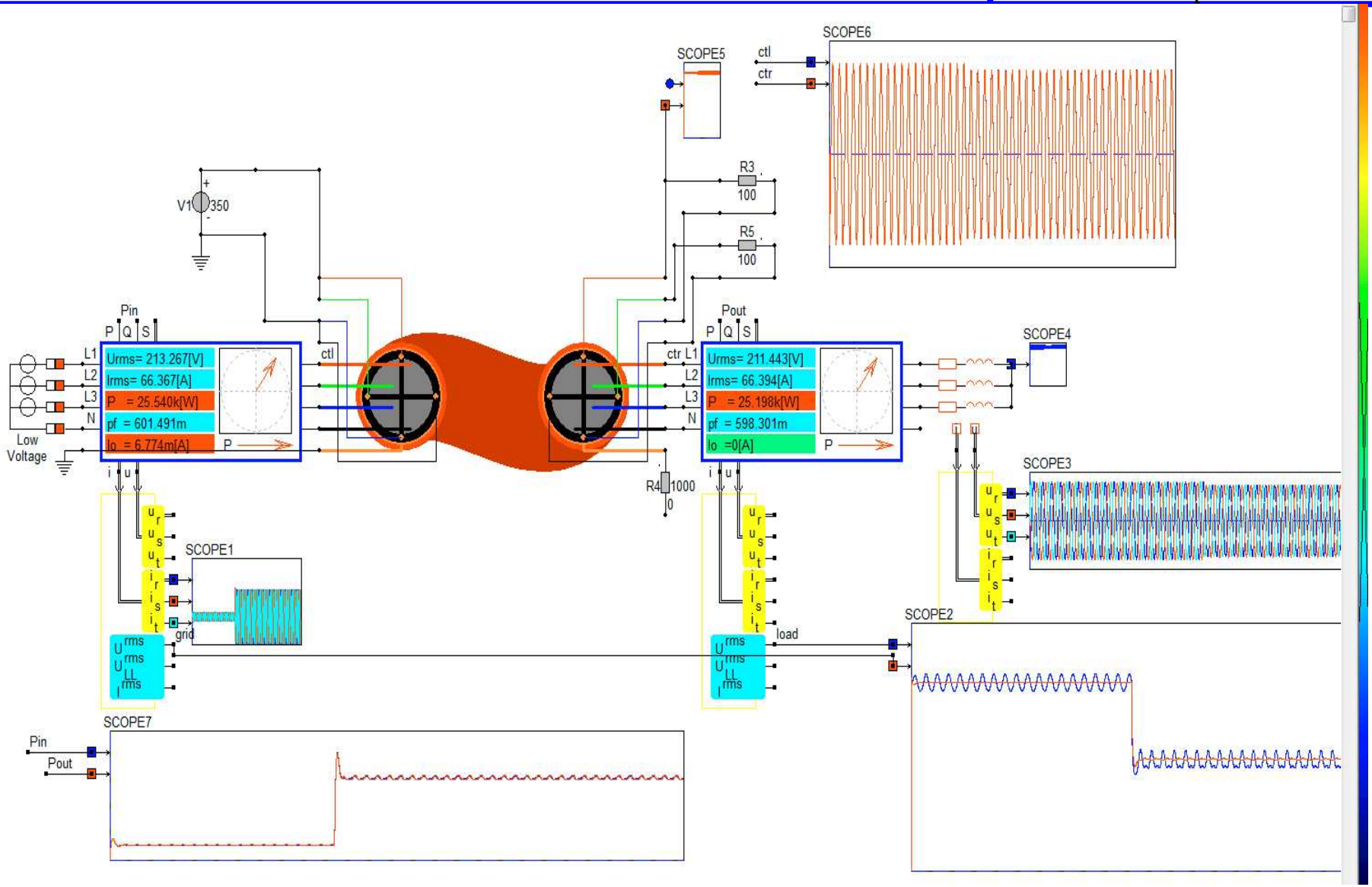
- RMS input/ouput voltage

Ripple on Auxilairy core

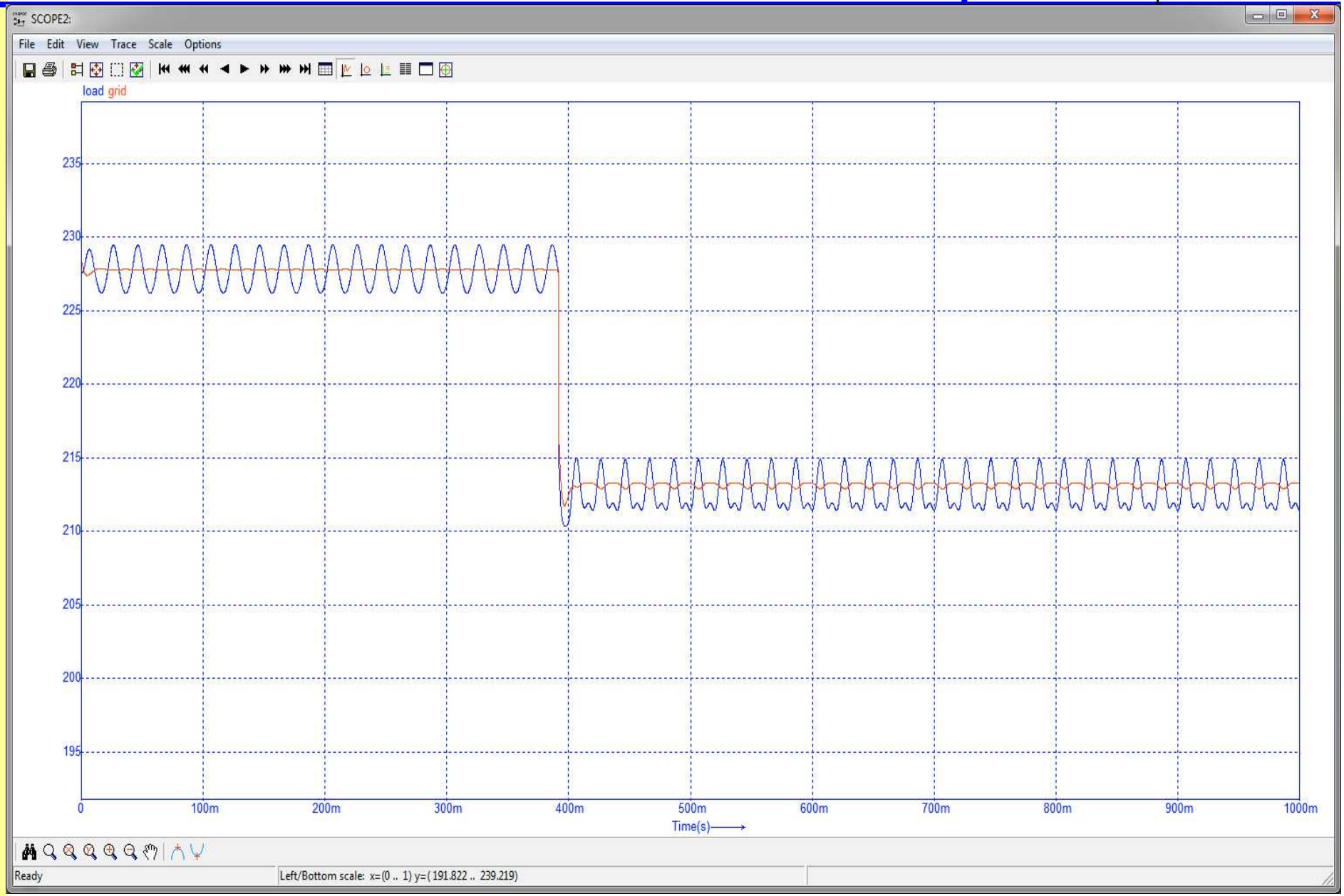


Change auxilairy core connection

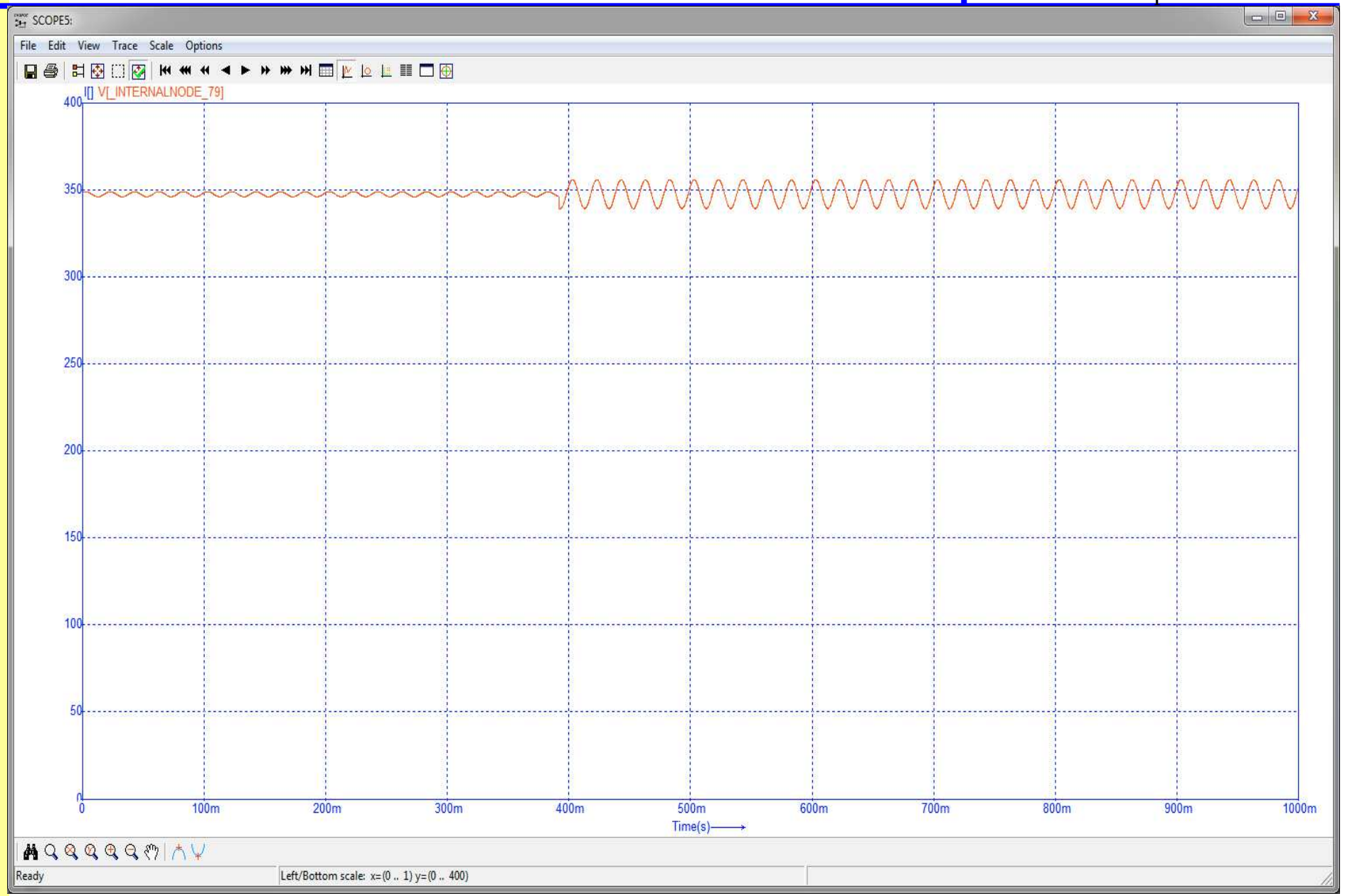
Caspoc
A simulation Experience



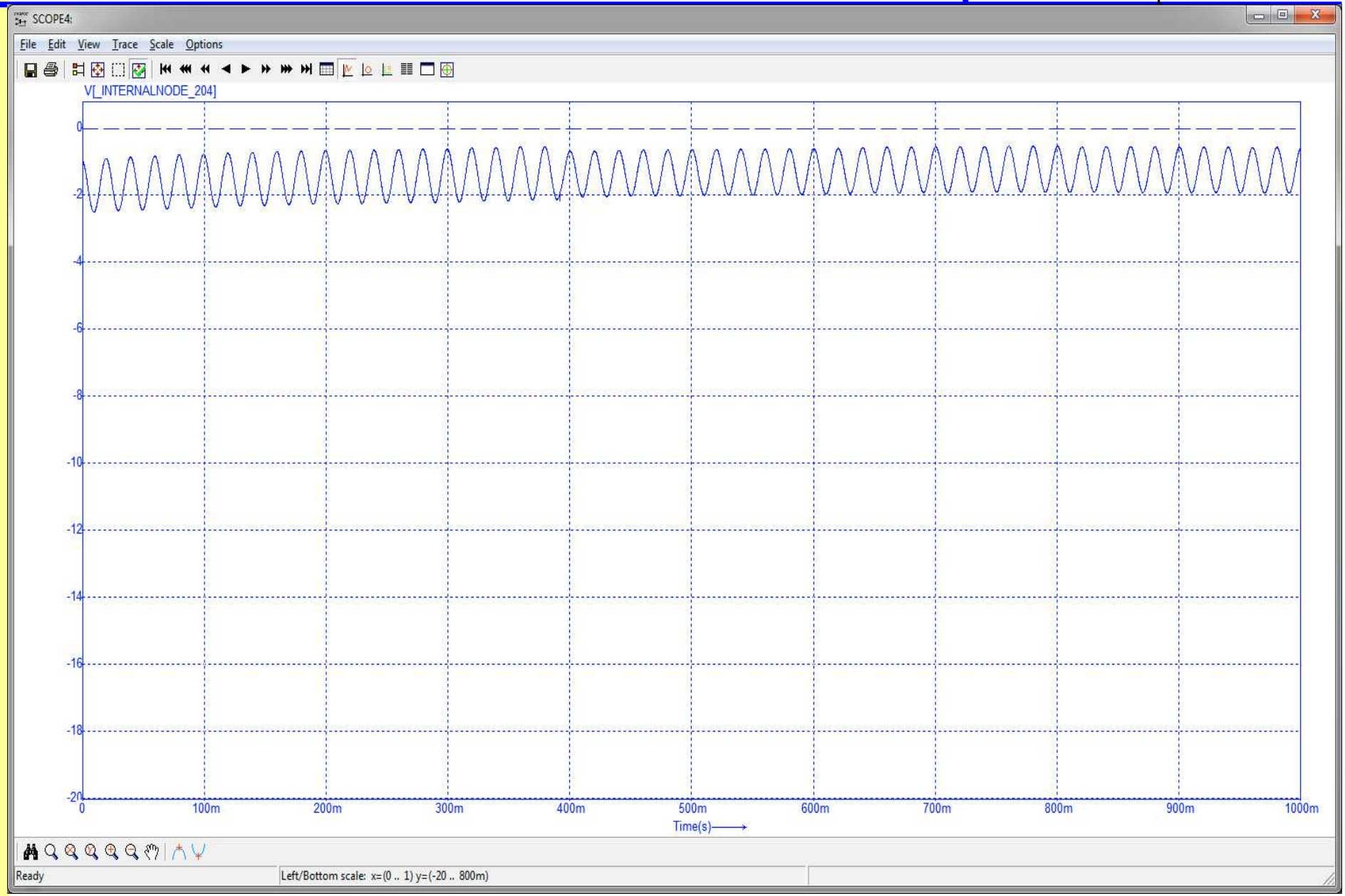
RMS input/output voltage



Voltage Auxilairy core



Voltage virtual neutral load



- Vragen?