

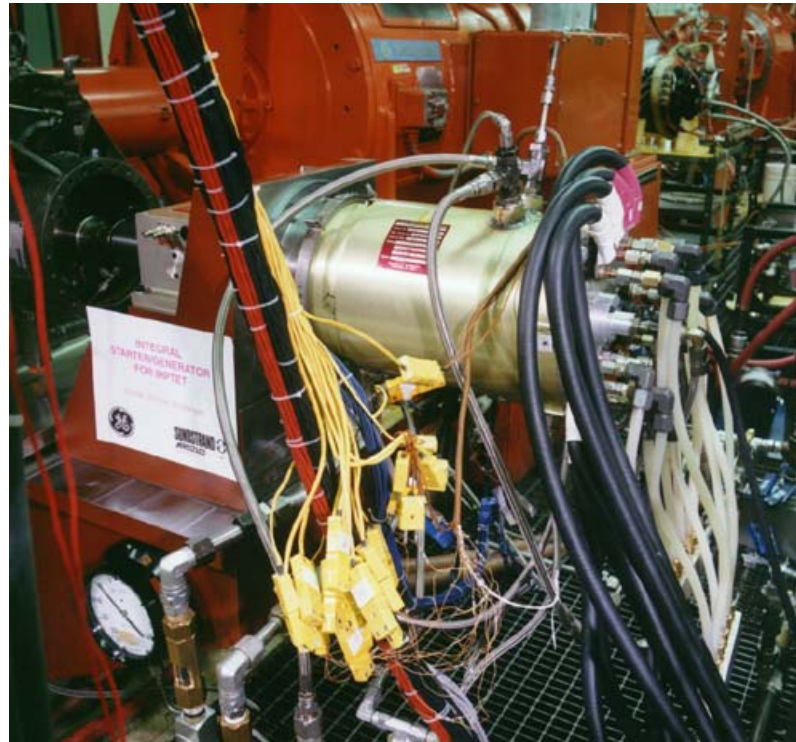
# Analysis of a Dual Channel Switched Reluctance Motor/Generator

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# Overview

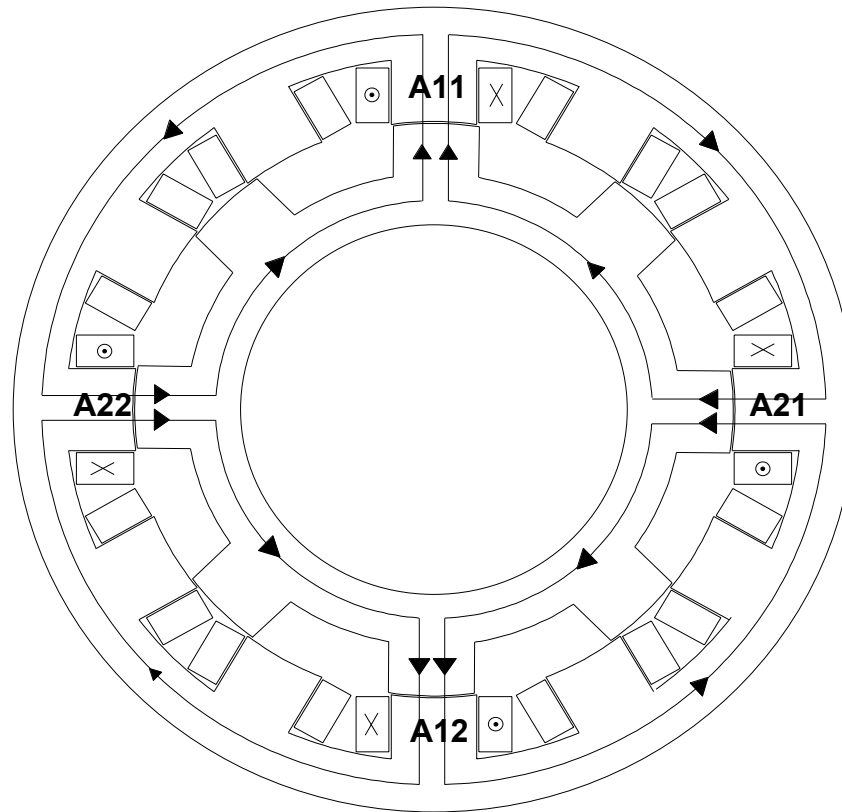
- Static Analysis of Torque and Flux Linkage
- Dynamic Analysis of the Switched Reluctance Machine operating in Motor Mode
- Dynamic Analysis of Switched Reluctance Machine Operating in Generator Mode
- Comparison to System Simulation in SIMPLORER

# SRM Motor/Generator



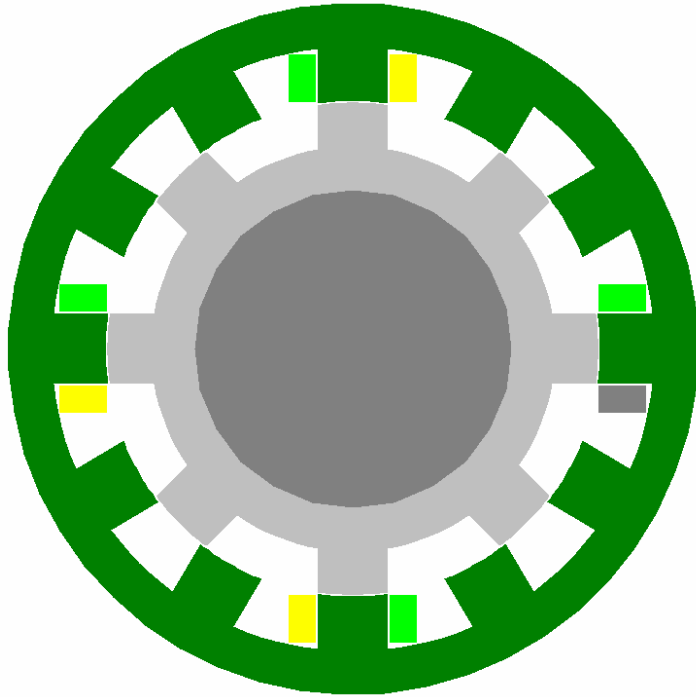
Single SRM that generates the power for the two independent power channels.

# Dual Channel SRM



Three-phase, two repetition experimental SRM with the flux paths indicated for A phase of both channels.

# Static Analysis

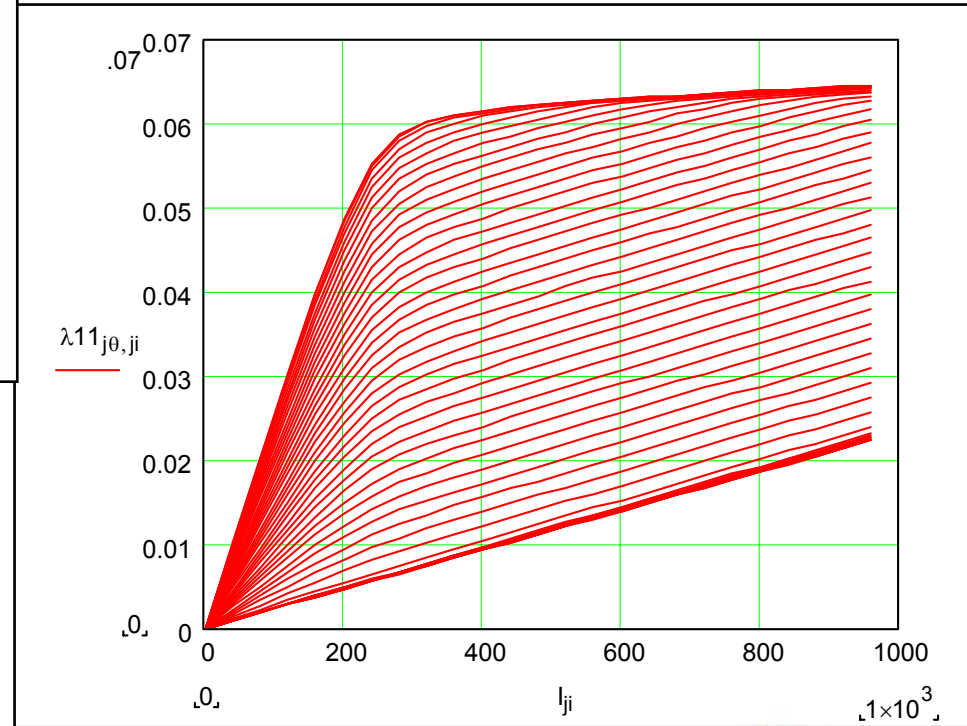
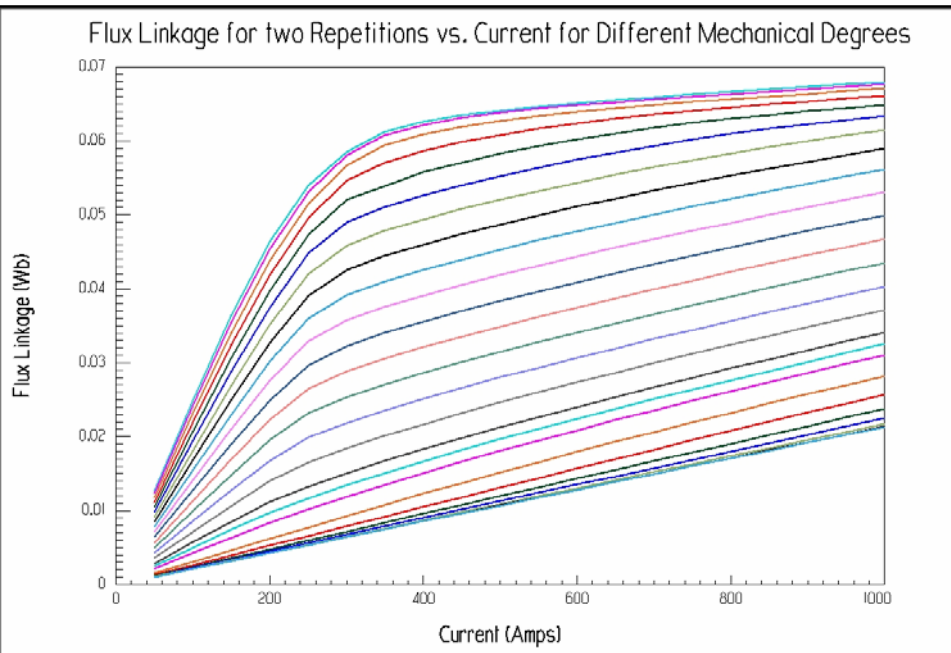


Calculated static torque and flux linkage while exciting one phase at a fixed current versus rotor position

# Parametric Analysis

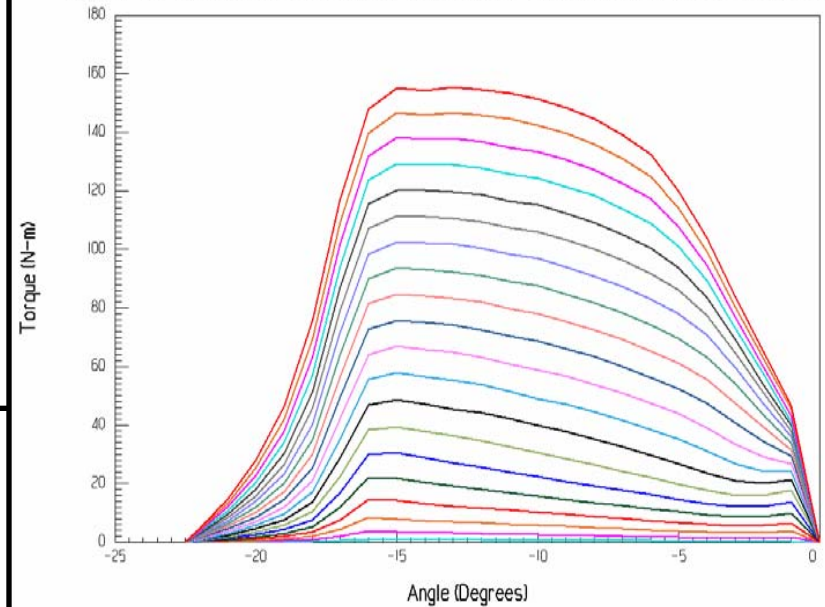
Setup	Angle	I_A	Torque (Nm)	Flux [phap1s11]	Flux [phap1s12]
setup486	-22.5	50	0.000495272	0.000838363	0.000838327
setup26	-22	50	0.137995	0.000839827	0.000839805
setup46	-21	50	0.437475	0.000854038	0.00085404
setup66	-20	50	0.814375	0.000884806	0.000884806
setup86	-19	50	1.39715	0.000938608	0.000938605
setup106	-18	50	2.50475	0.00103258	0.00103247
setup126	-17	50	5.7113	0.0012202	0.0012202
setup146	-16	50	11.402	0.00168164	0.00168164
setup166	-15	50	11.3685	0.00224502	0.00224637
setup186	-14	50	11.4569	0.002807	0.0028072
setup206	-13	50	11.2434	0.00336667	0.00336672
setup226	-12	50	11.3326	0.00392245	0.00392248
setup246	-11	50	11.1469	0.00447676	0.00447594
setup266	-10	50	10.9869	0.00502175	0.00502177
setup286	-9	50	11.0822	0.00556443	0.00556449

# Results – Flux Linkage

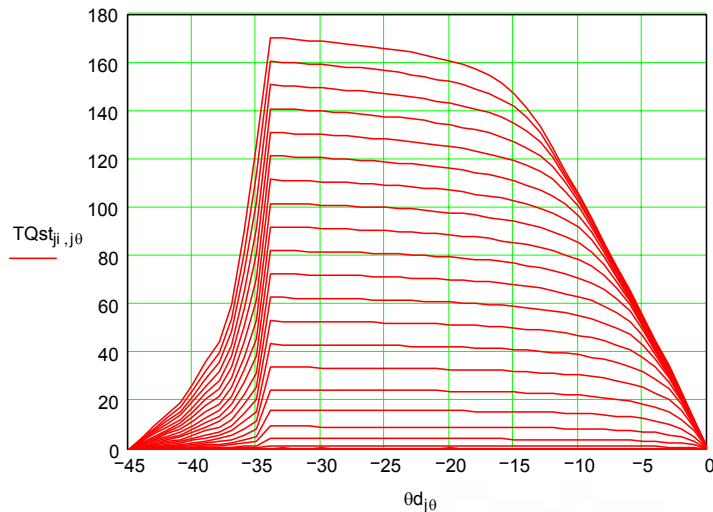


# Results – Torque

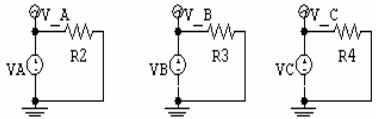
Torque for one Repetition vs. Rotor Position for Various Currents (50 to 1000 Amps)



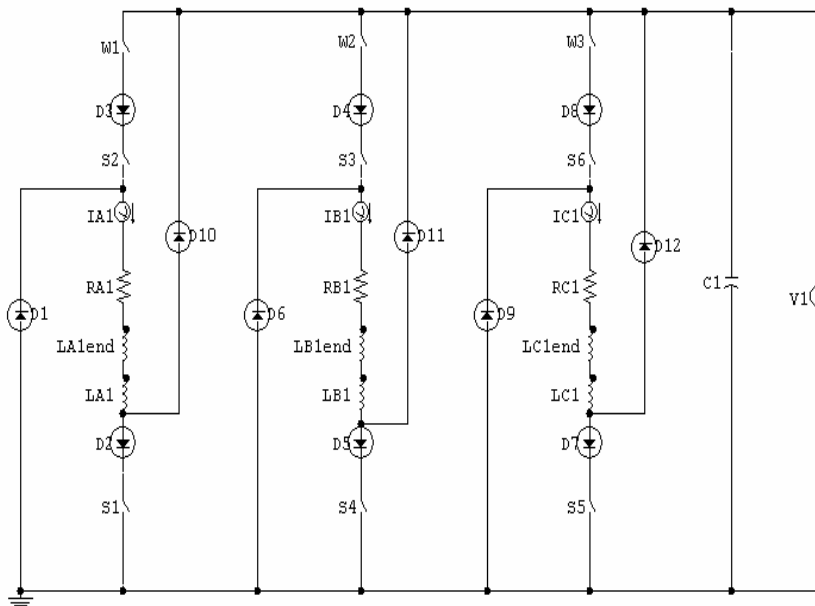
EISG Static Torque I<sub>max</sub> 1000A, 50 A steps



# Transient Analysis - Circuit Layout



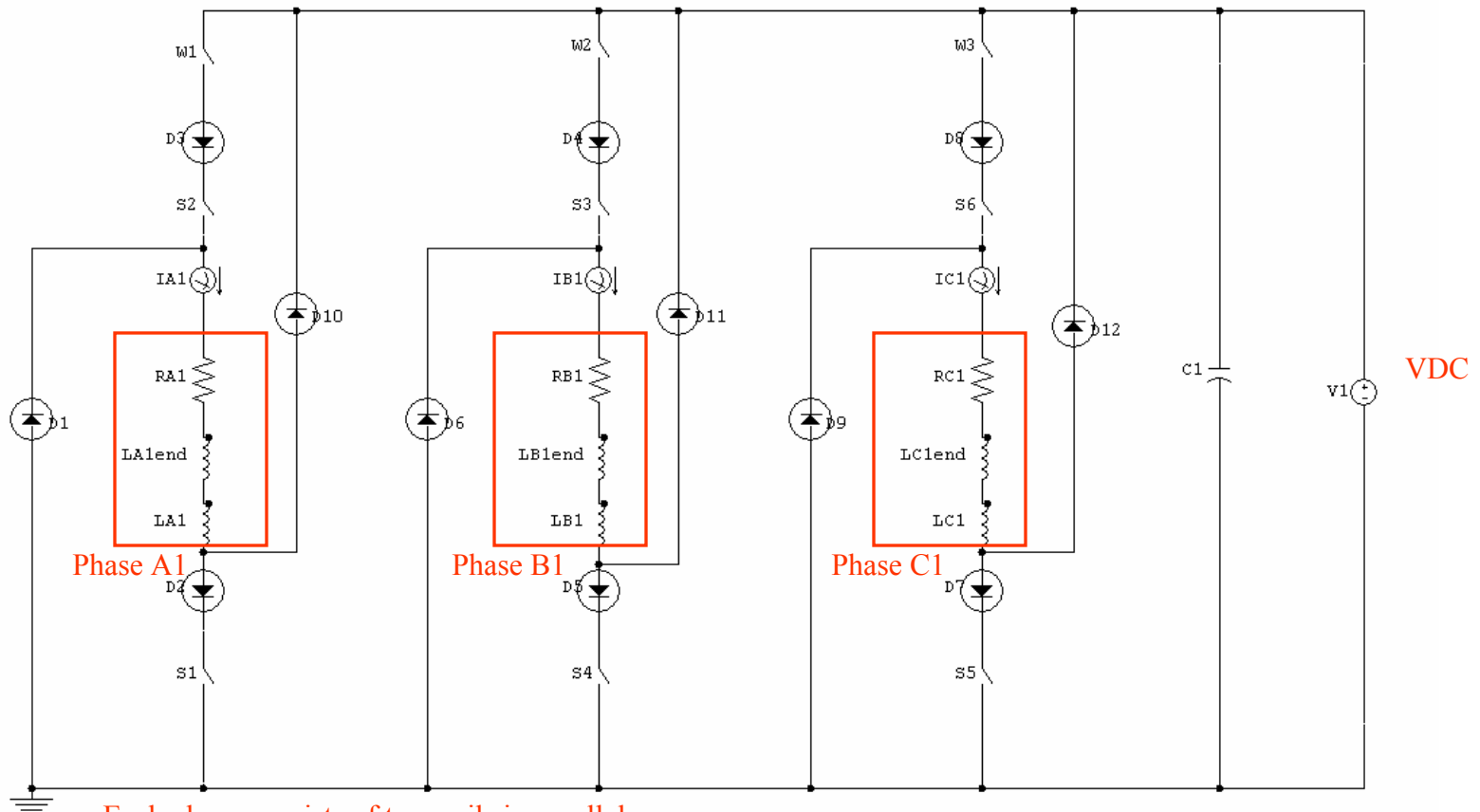
Channel #1



Channel #2

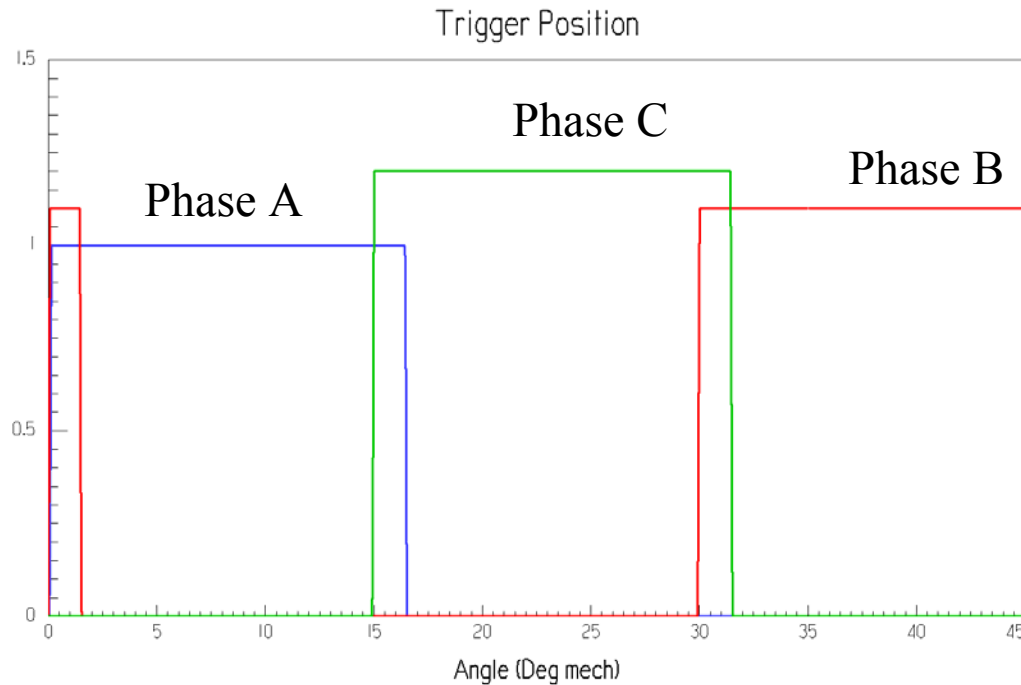
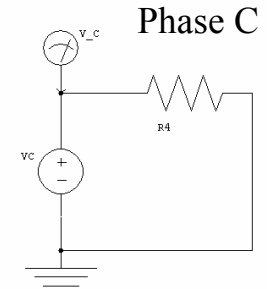
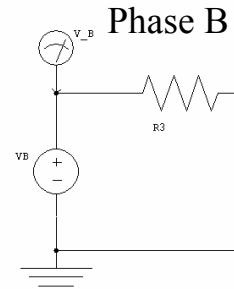
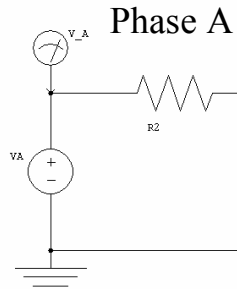


# Circuit Layout – One Channel



# Subcircuits to Define Trigger Point

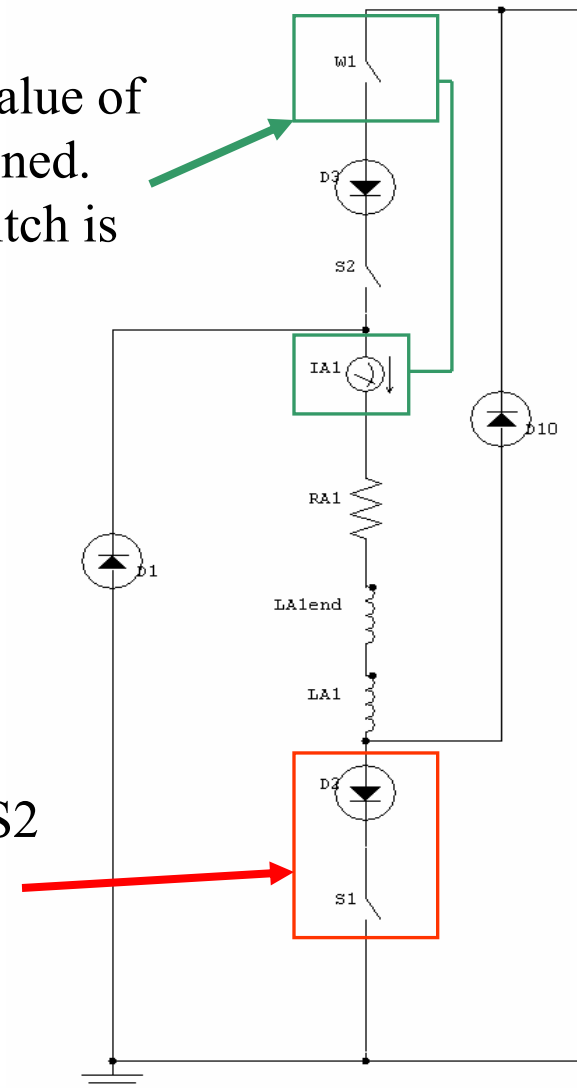
Pulsed Voltage Source as a function of Position



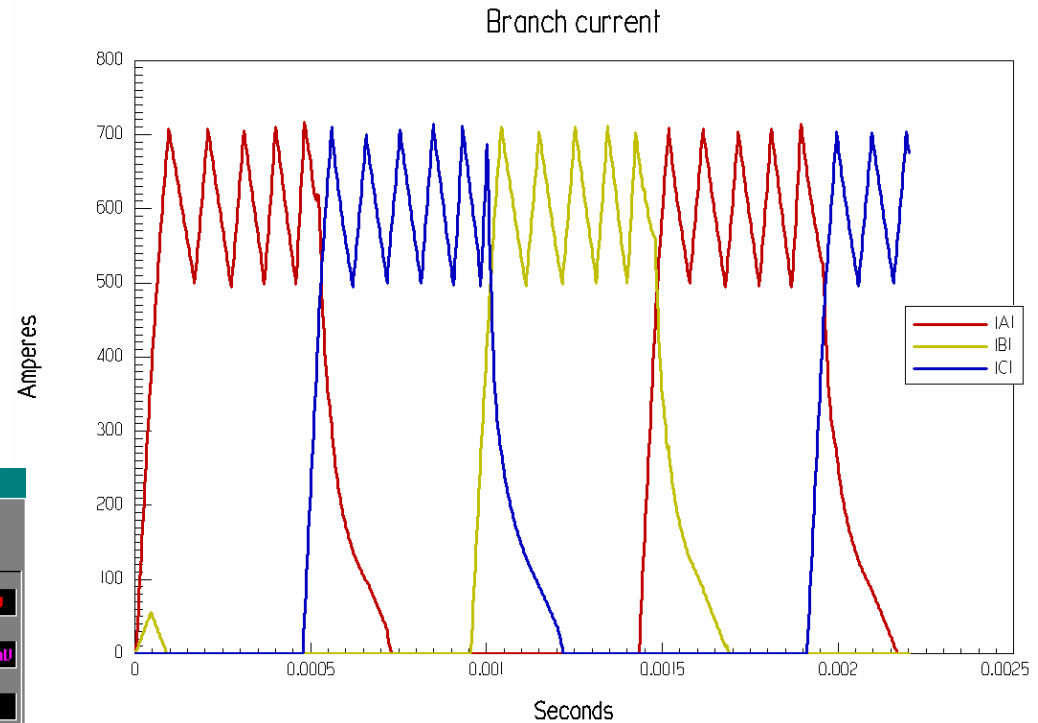
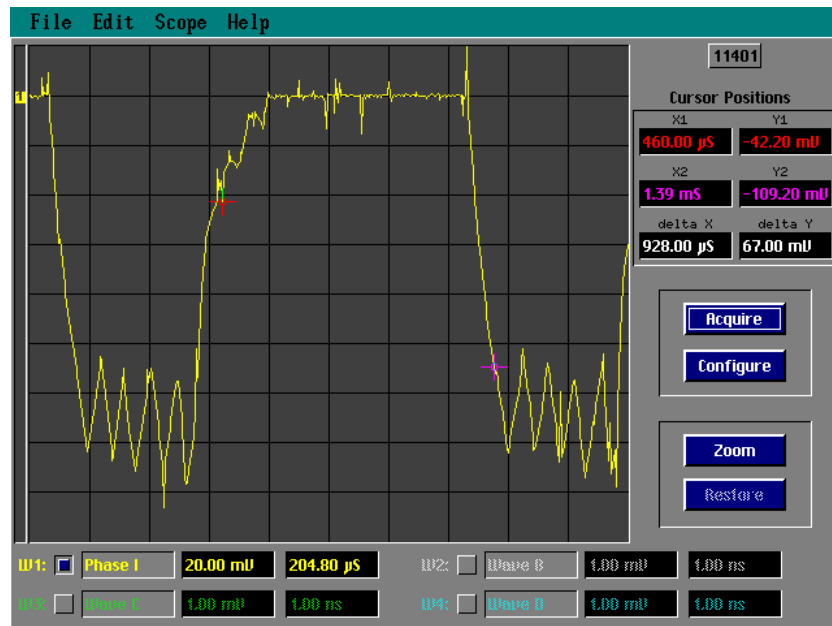
# Current Control with Hysteresis

W1 is a current controlled switch. When the value of  $I_{A1}$  is greater than 700 amps, the switch is opened. When the current falls below 500 amps the switch is closed.

Diode and Switch act as a transistor. S1 and S2 are voltage controlled switches that use the voltage from Phase A subcircuit to determine ON/OFF state.



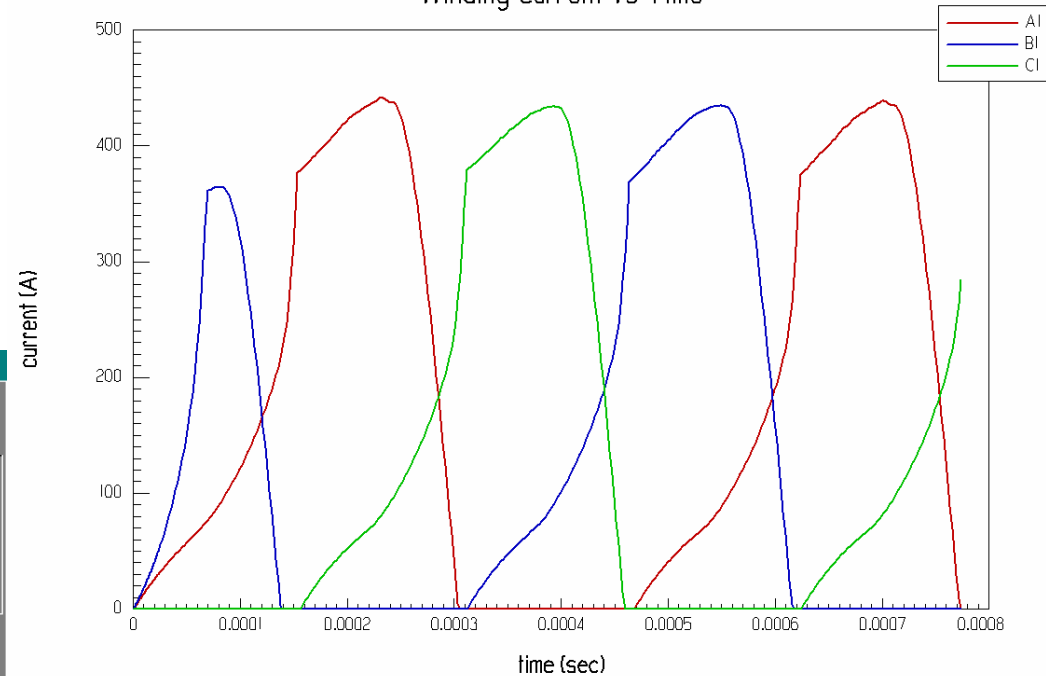
# Transient Results



Comparison of the phase current at 5,232 rpm with a 700A peak current. The measured current scales are 100A / division and 204.8  $\mu$ s / div. The measured current is inverted.

# Transient Results

Winding Current vs Time



Comparison of the phase currents at 16,000 rpm. The measured current scales are 100 A / division and 102.4  $\mu\text{s}$  / div. The measured signal is inverted.

