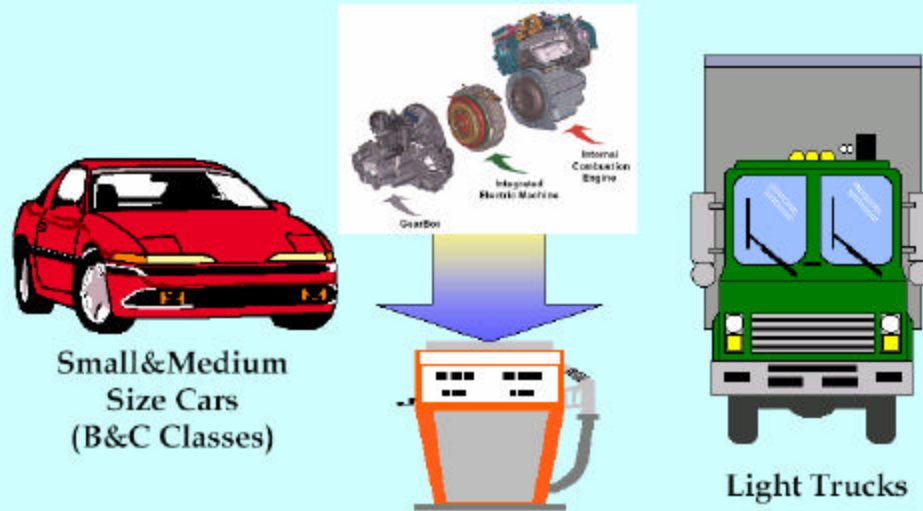


Electrical Drive of a Hybrid Car with Permanent Magnet Synchronous Motor

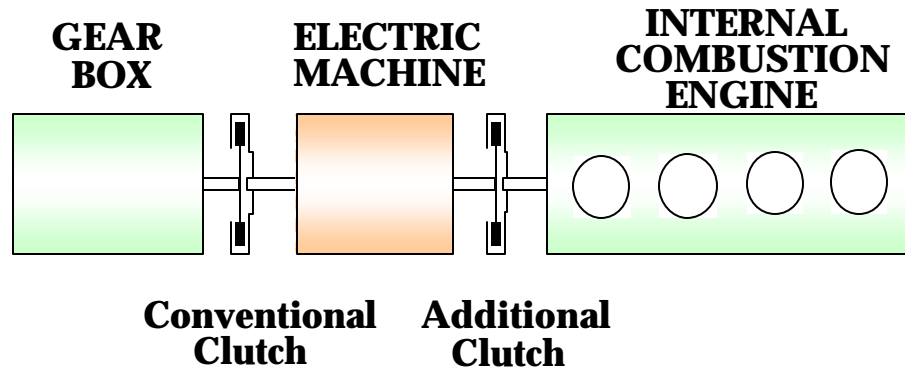
- Professor R. Magureanu
- PhD Student M. Priboianu
- PhD D. Creanga

SCENARIO & OBJECTIVES

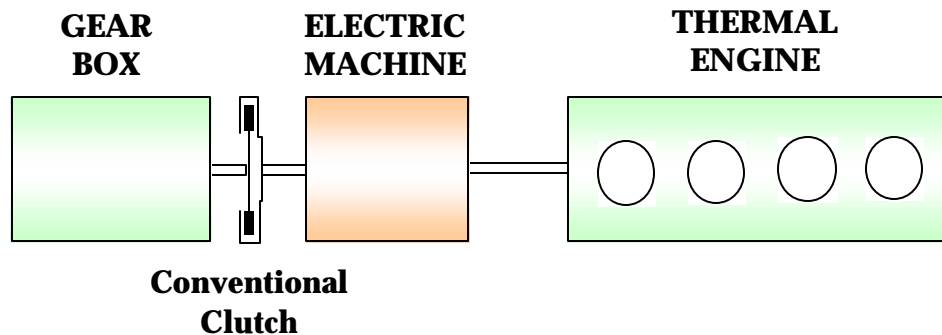


Vehicle Class	Small & Medium Size Cars (B & C Class)	Luxury Class (High Class)	Light Trucks (Delivery Vehicles)
Application specified by	CRF	VOLVO	VOLVO & CRF
Main targets of the hybrid configuration	Strong reduction of consumption through the ICE downsizing and torque booster through the electric machine contribution. Reduction of noxious	Increase of comfort and safety. Over-boosting at low speed. High power generation at high efficiency.	Strong reduction of consumption using an ICE with a torque roughly equivalent to the High Class configuration one and an electric machine similar to the B&C Class configuration.

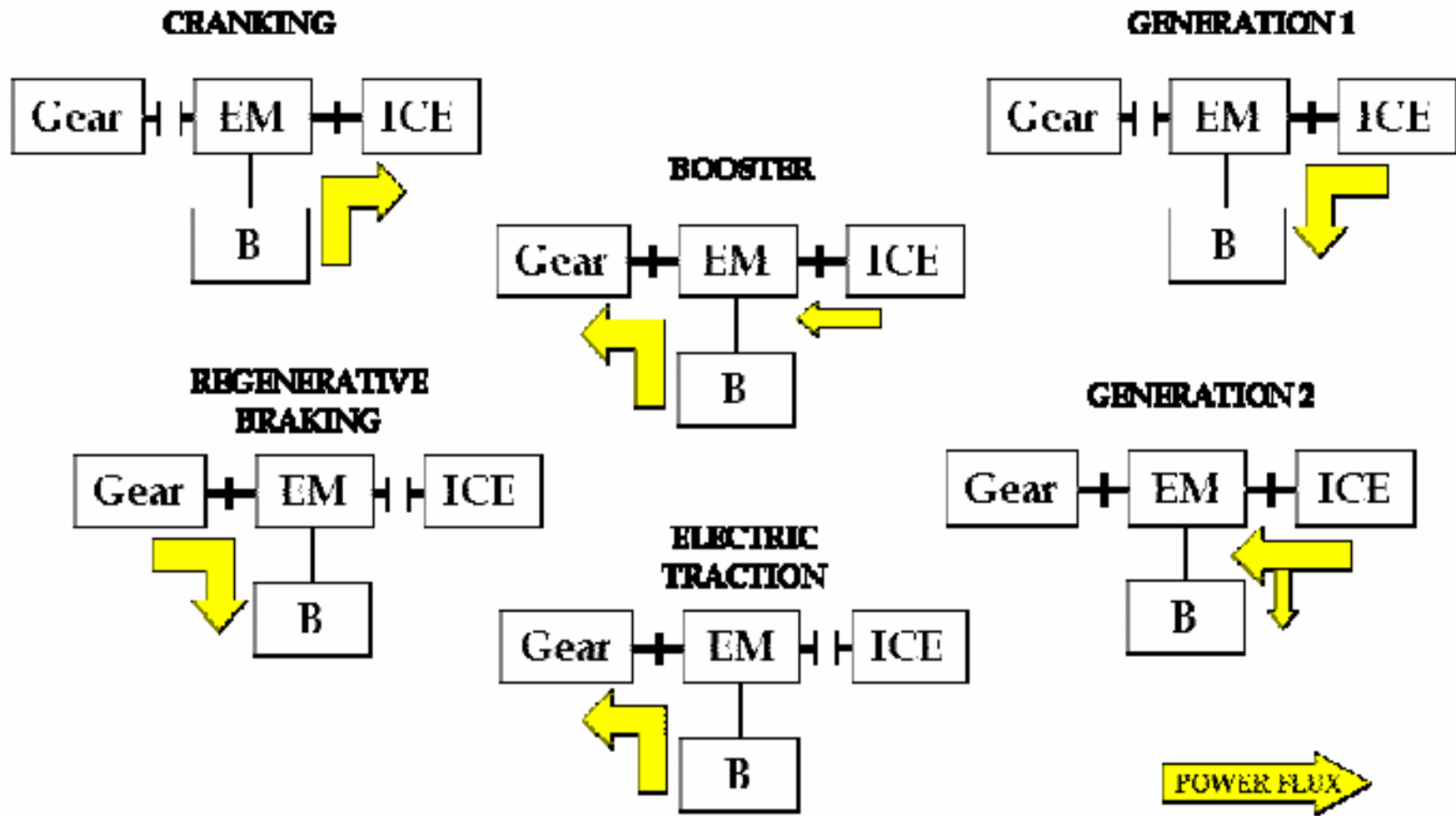
Power train mechanical configuration



with two clutches

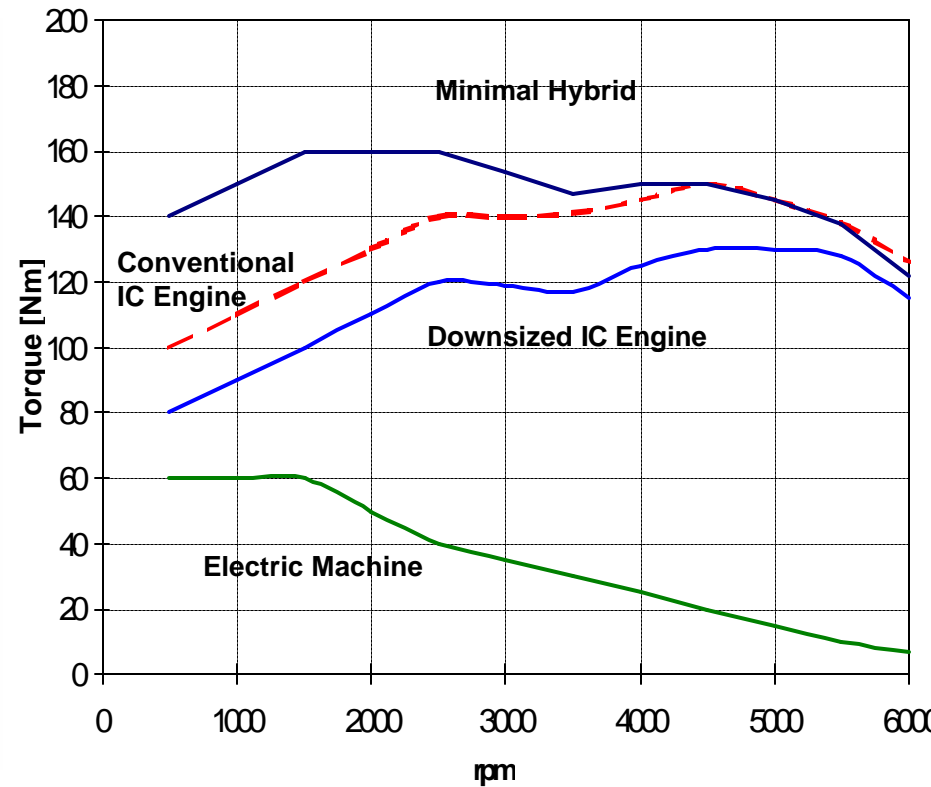
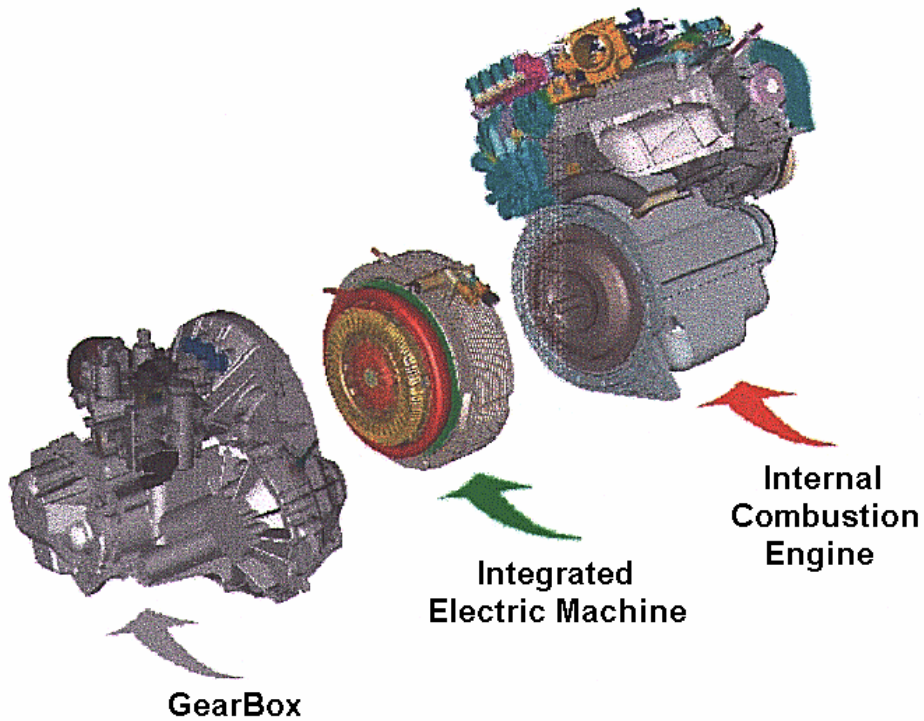


with single clutch



Operation modes

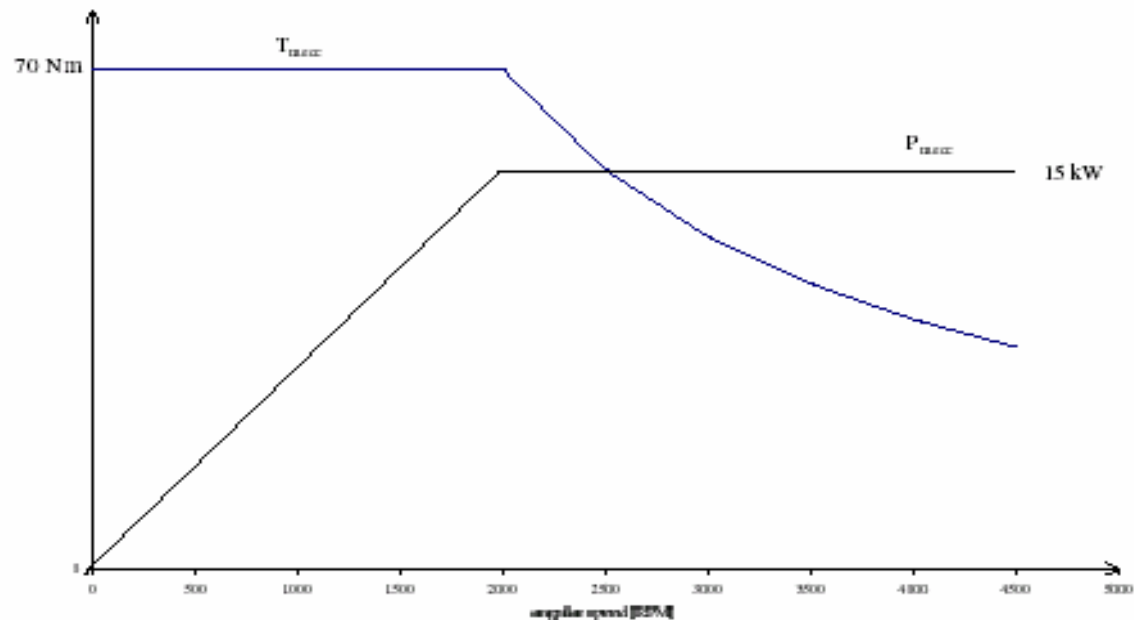
Integrated motor-generator for mild hybrid electric vehicle



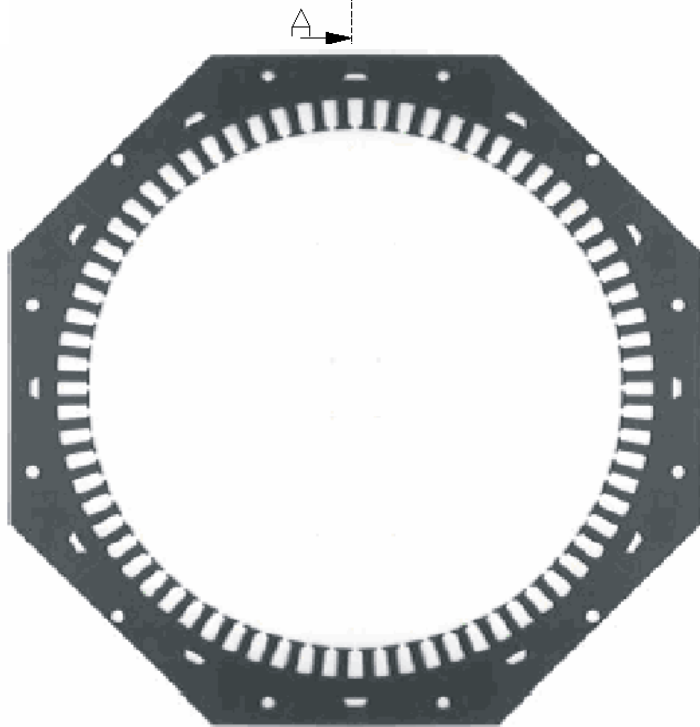
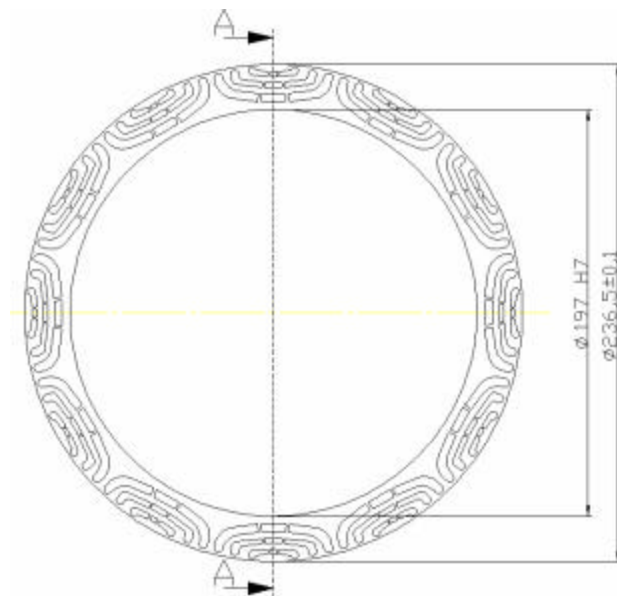
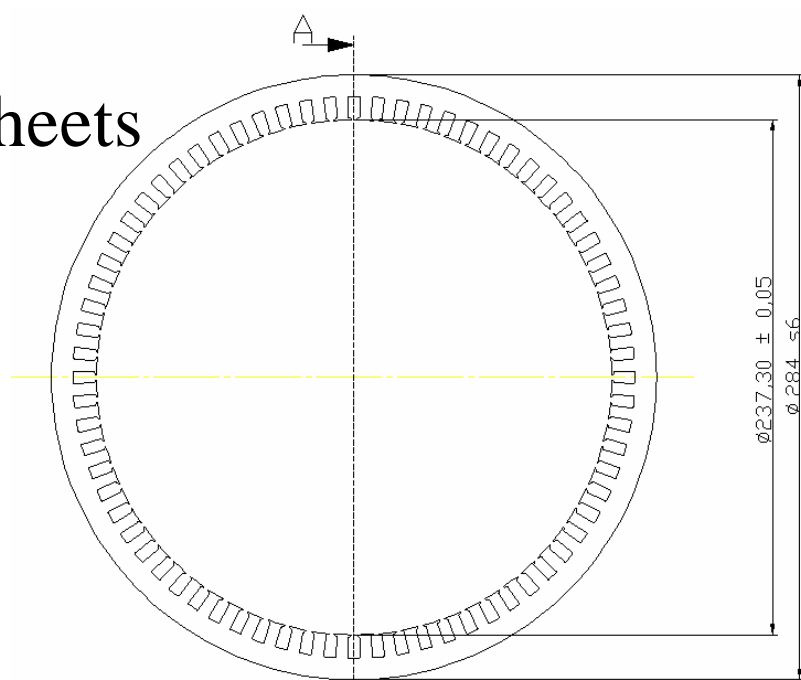
Performance requirements for C class vehicles

Circuit section		Mode	Motor	Generator
Electric machine shaft	Torque [Nm]	Transient (S2 - 1 min)	70	
	Mechanical Power [kW]		15	
DC Battery	Electric Power [kW]	Transient (S2 - 1 min)		15
		Continuous (S2 - 60 min)		3.5

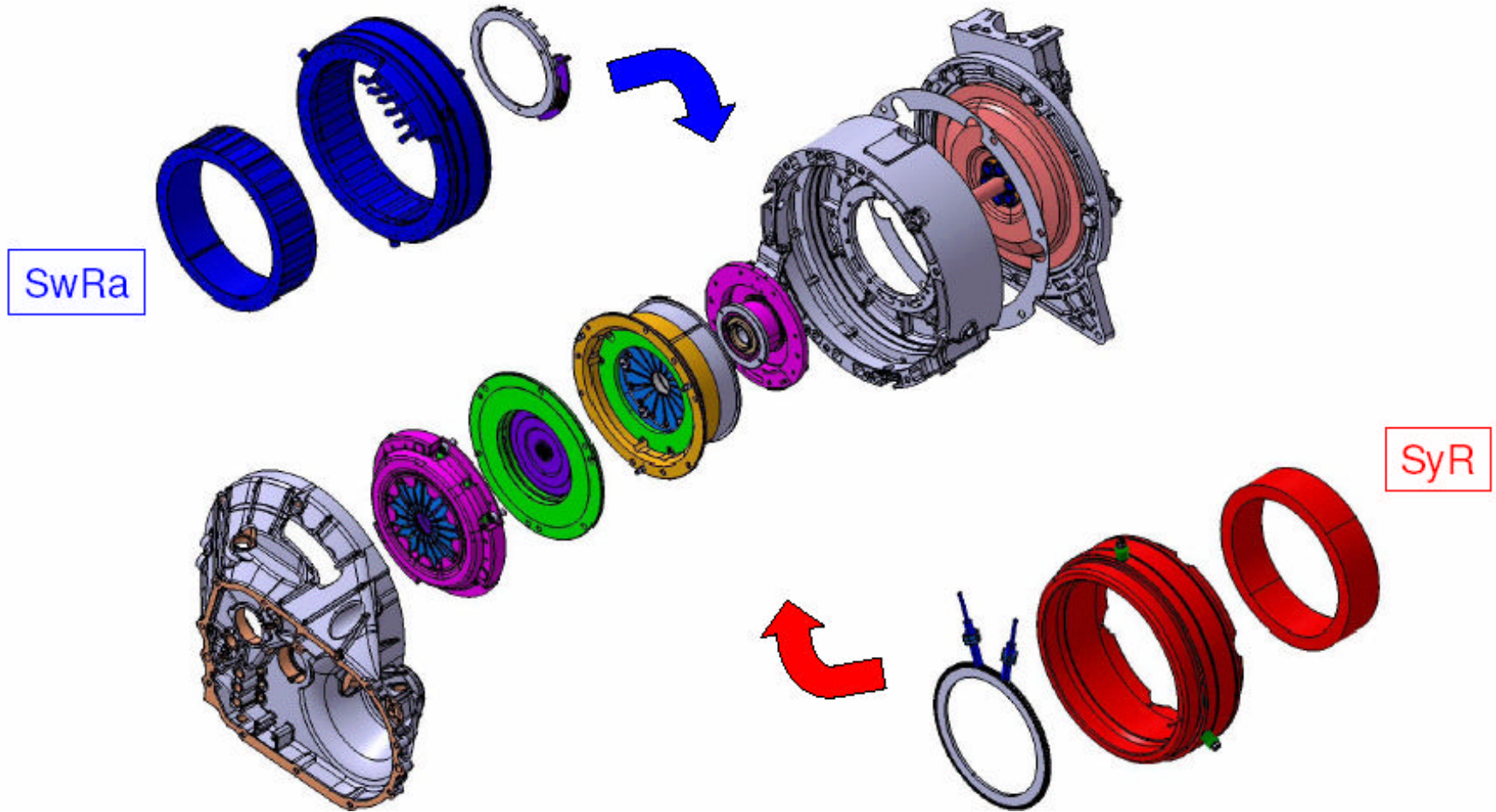
Motor mode: (S2-1 min) performance vs. speed @ battery minimum voltage



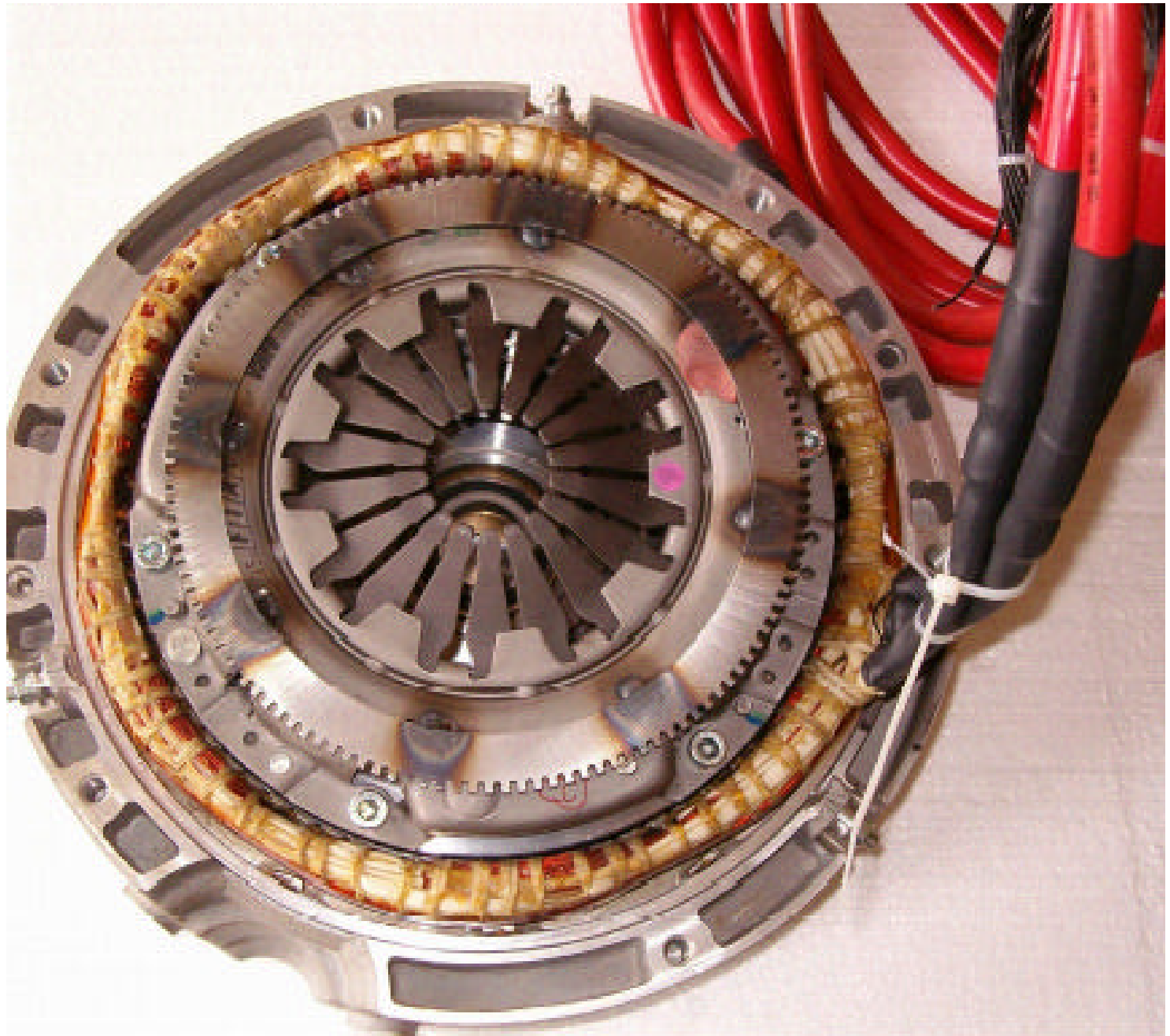
Iron sheets

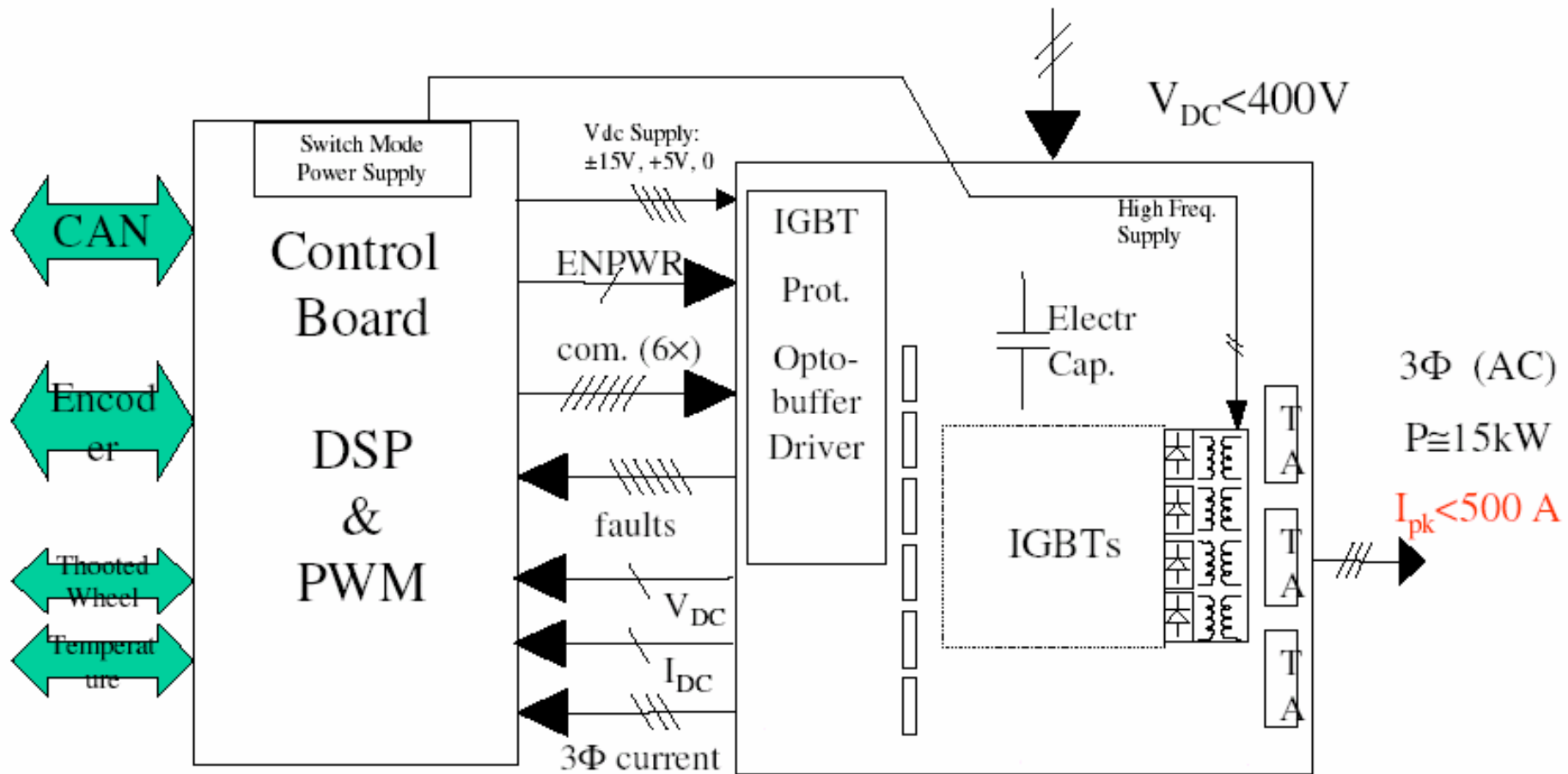


Mechanical configuration

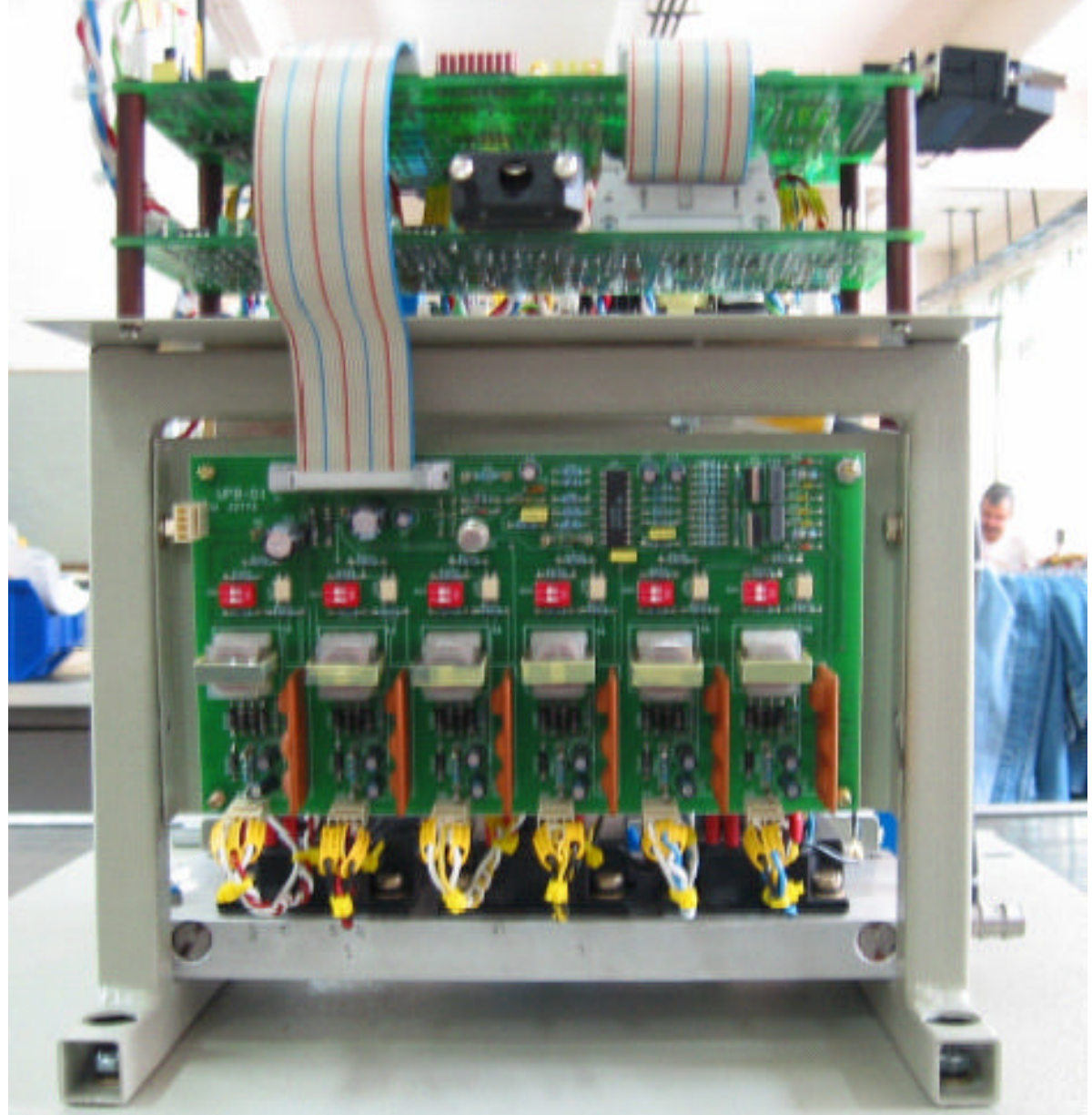
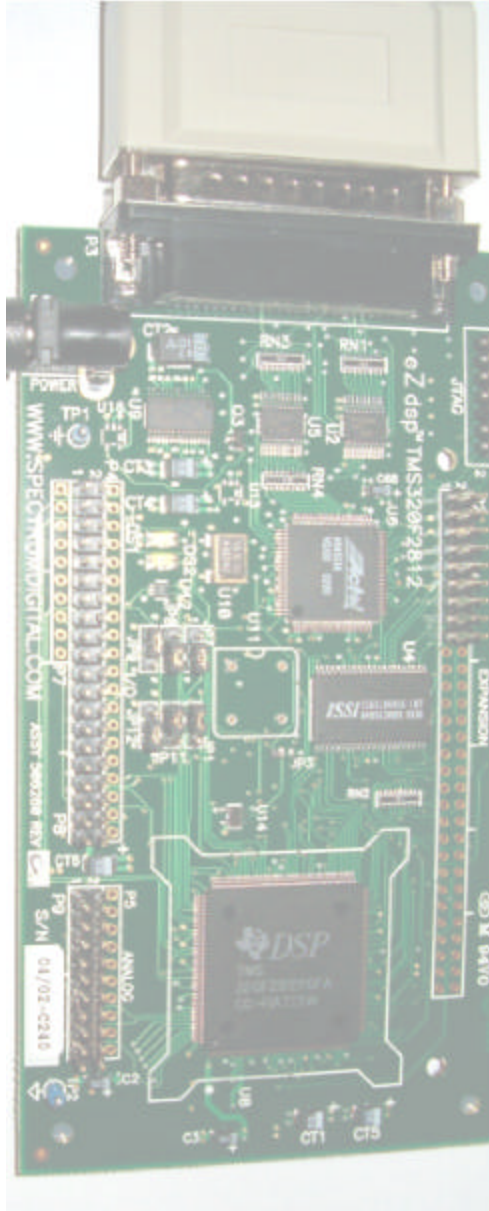


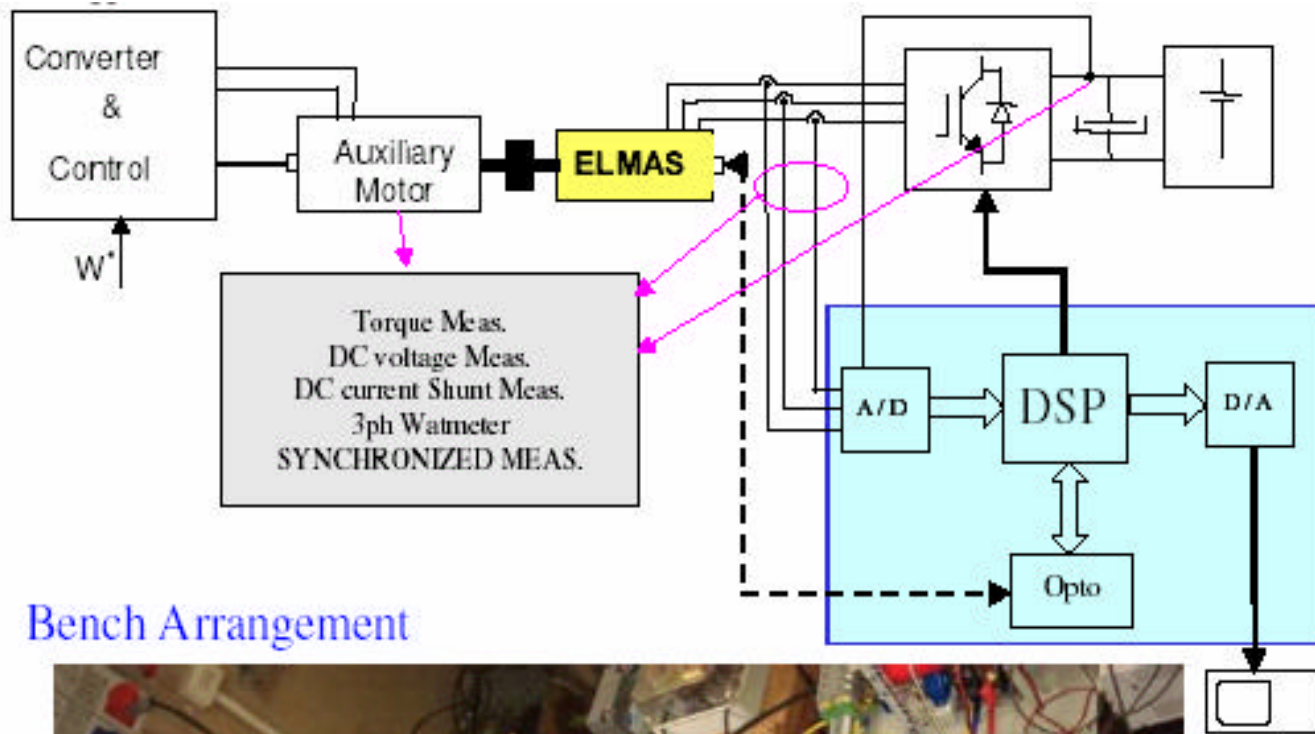
ICPE S.A. Bucharest Motor





The DSP controller and the inverter

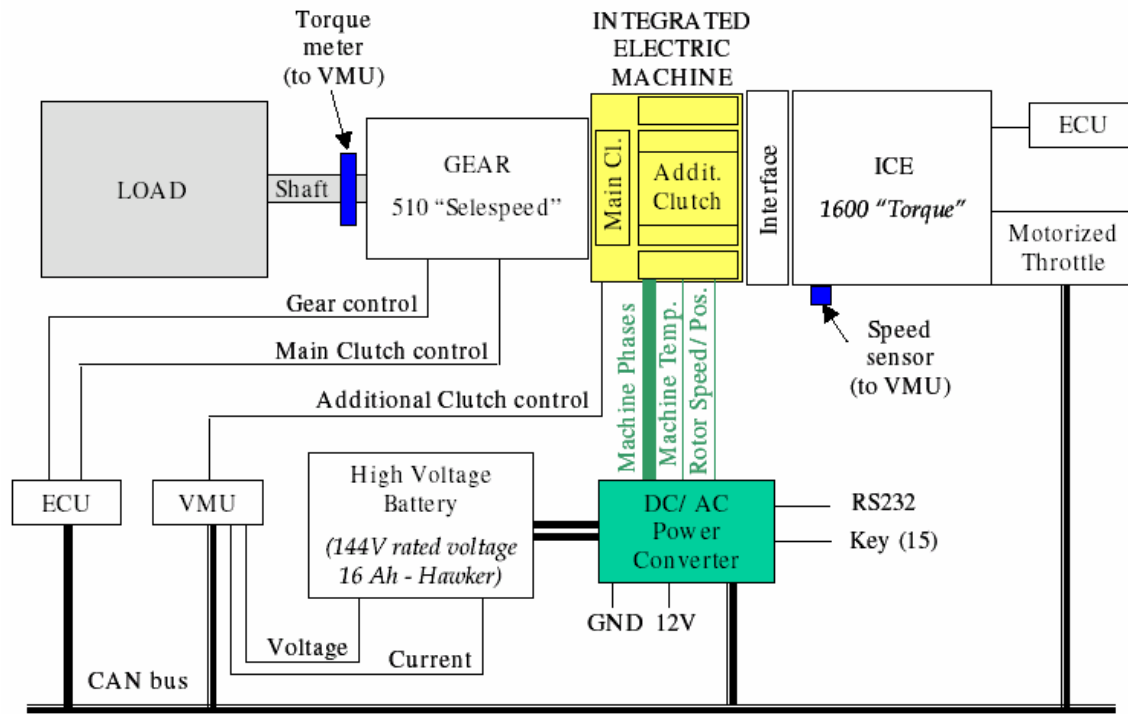




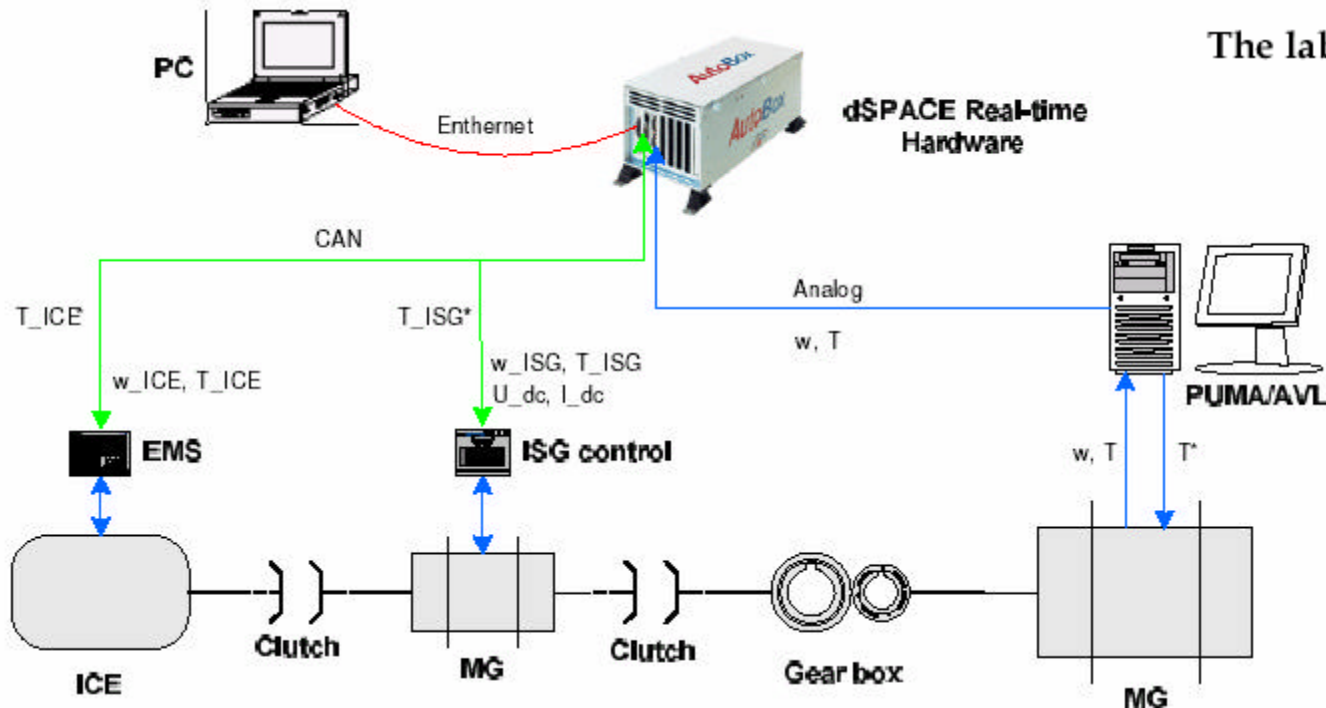
Bench Arrangement

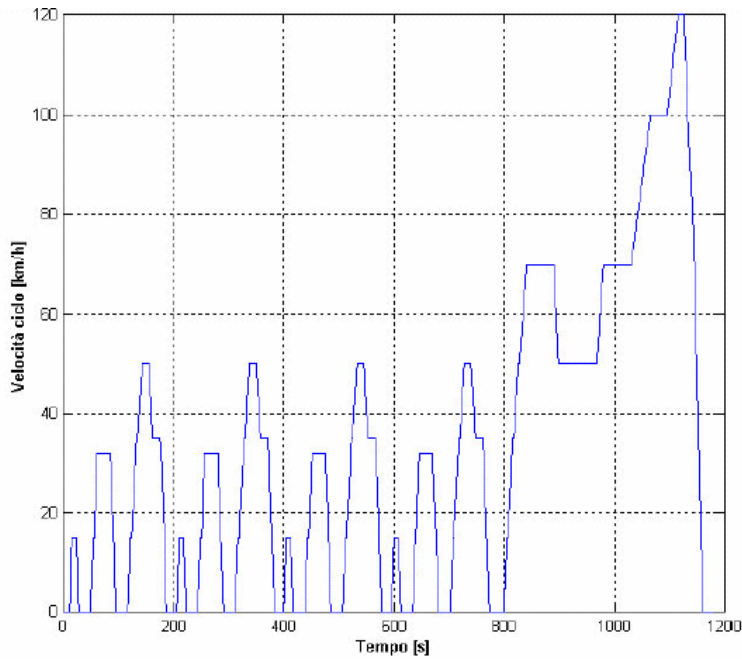


Test bench general lay-out

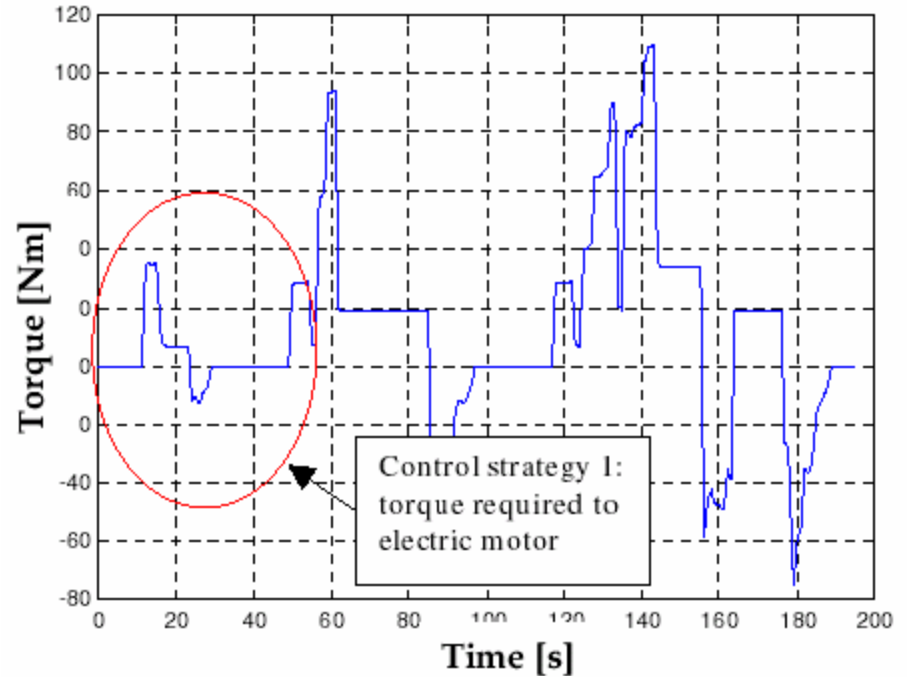


The laboratory control system set-up.





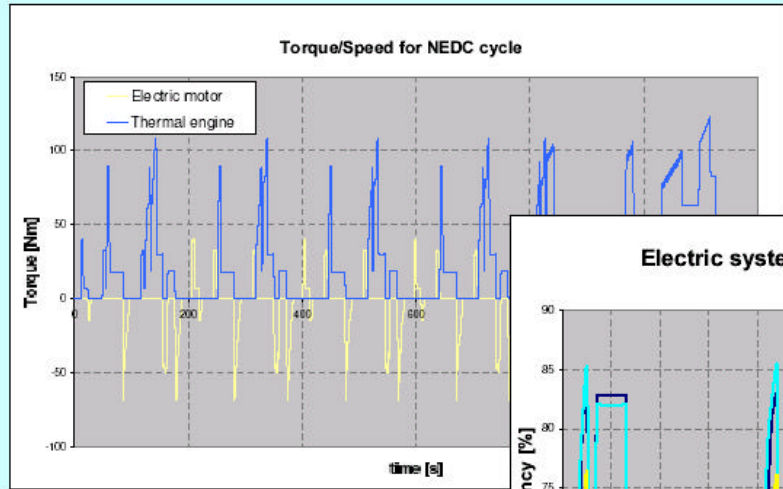
NEDC driving cycle



Torque required to the electric motor (ECE cycle)

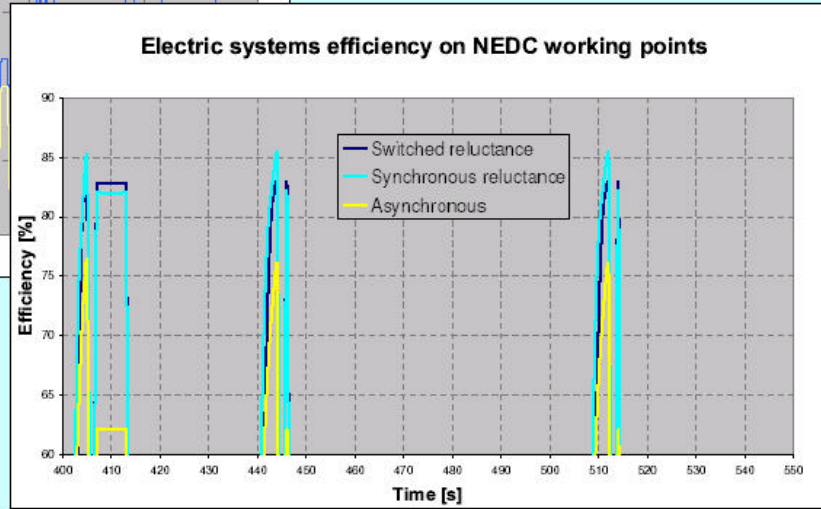
Speed and Torque for NEDC Driving Cycle

WP5 – TESTING Consumption calculation (NEDC)



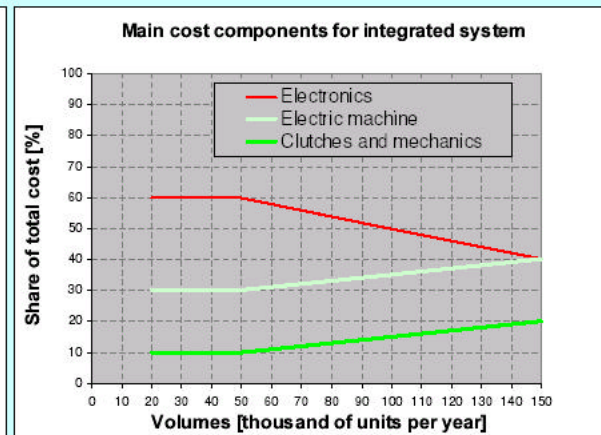
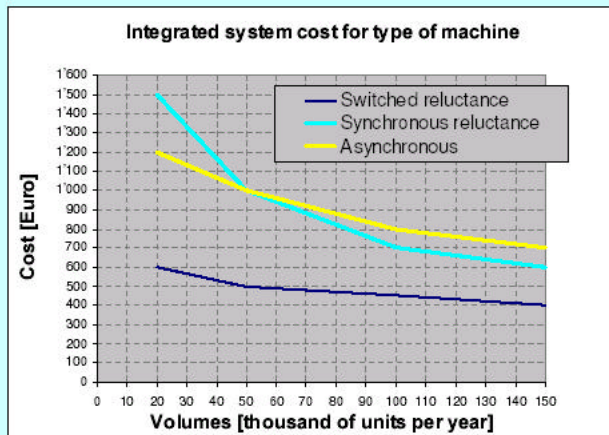
4% consumption and CO2 emissions reduction respect to asynchronous

Asynchronous mean efficiency: 64% traction; 56% generation
 SwR and SyR mean efficiency: 73% traction; 74% generation



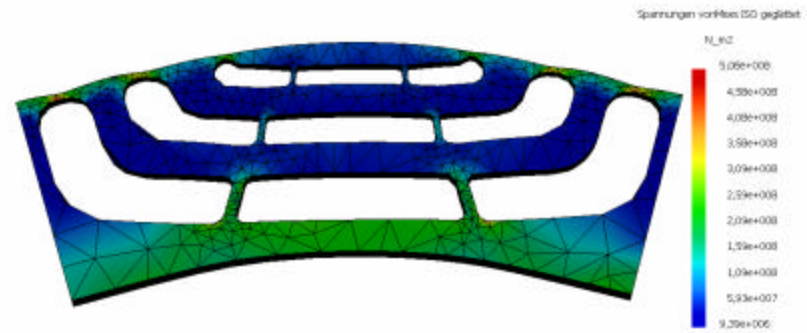
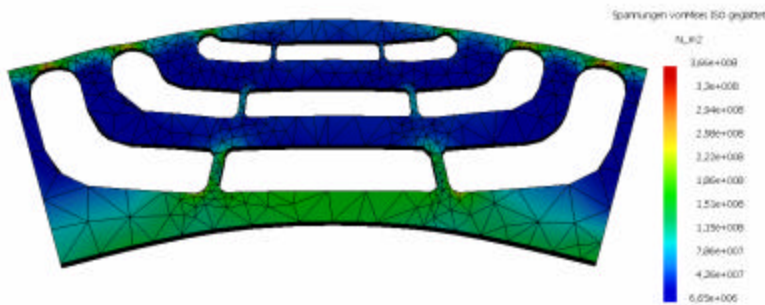
WP6 – EVALUATION

Envisaged cost trends

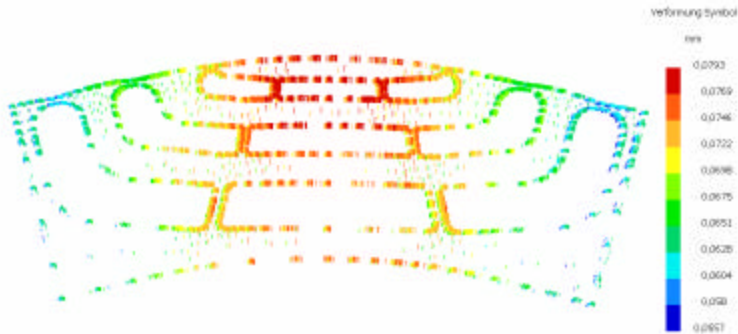


Motor performance

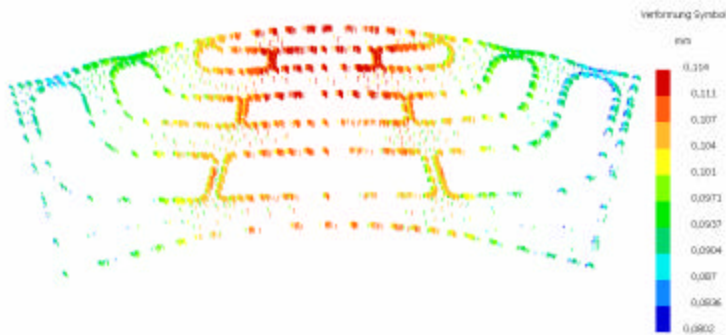
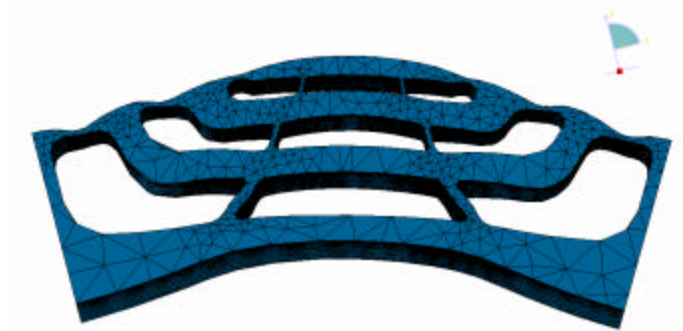
Mechanical computation (strength and elongation)



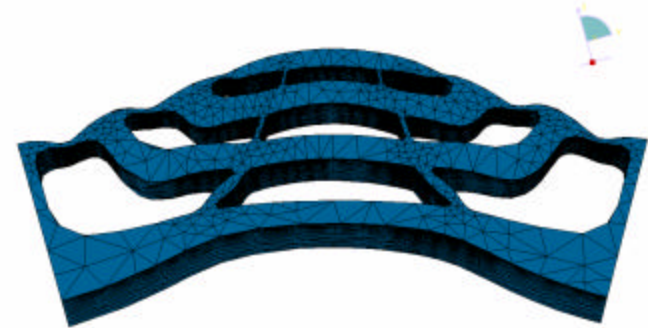
Mechanical Behavior at Different Speeds



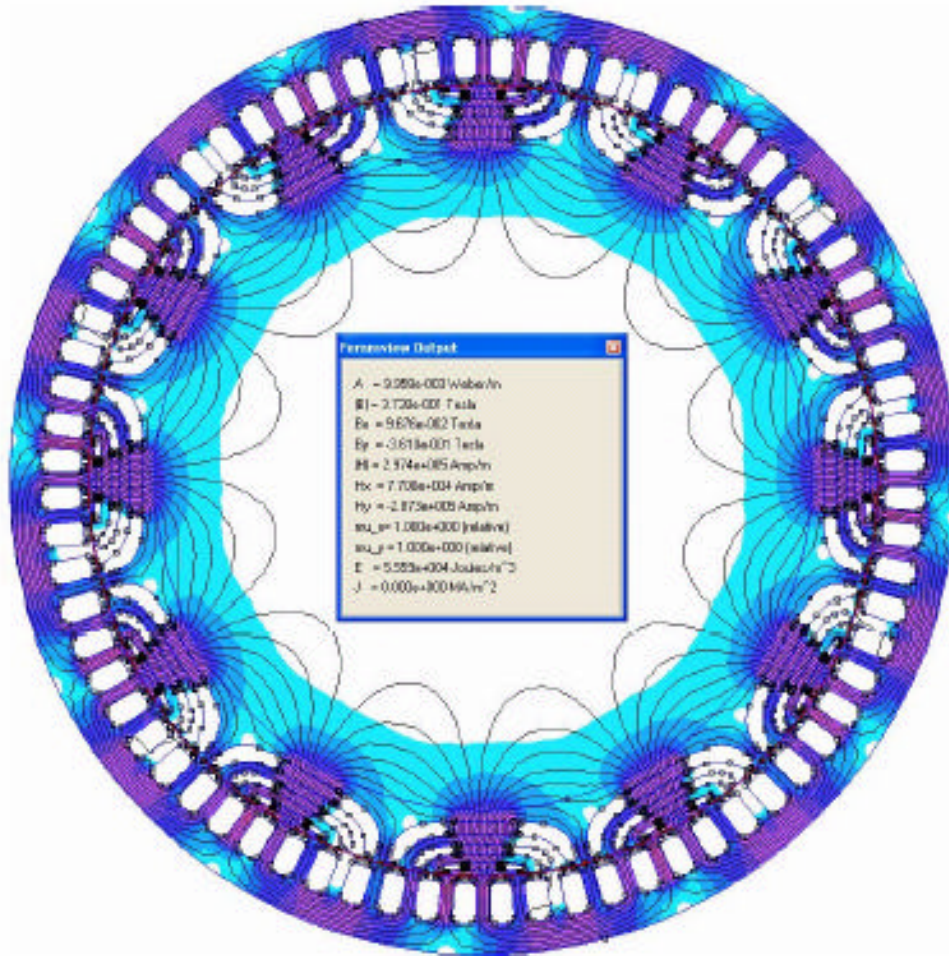
7500 rot/min



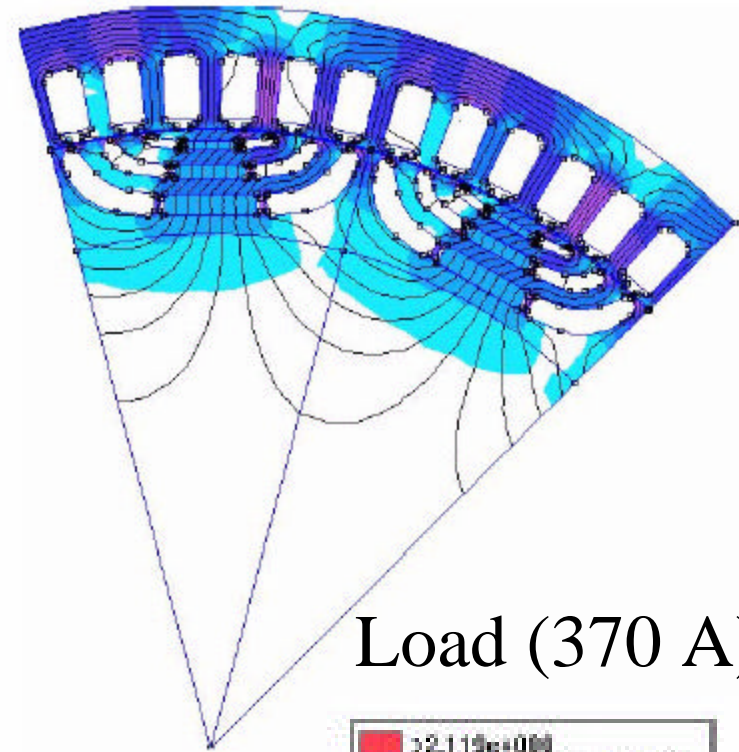
9000 rot/min



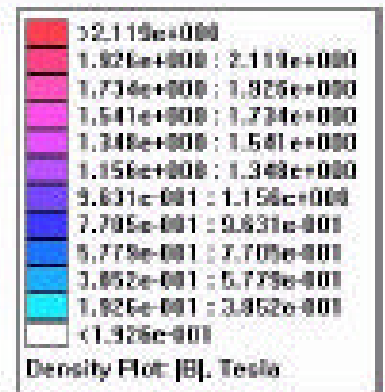
Magnetic Field Computation



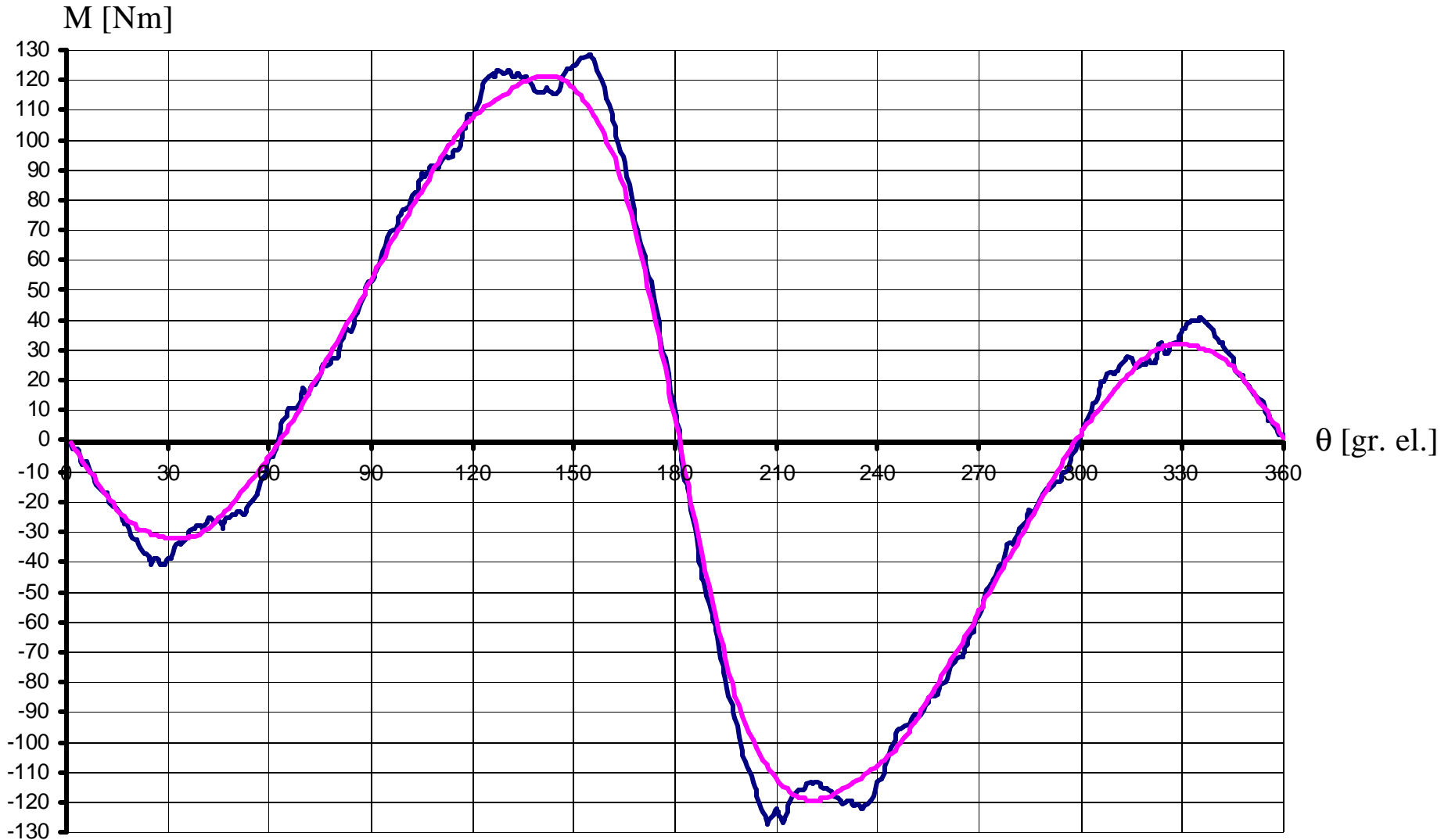
No Load



Load (370 A)



The Electromagnetic Torque



- Compensated - Uncompensated

The Stator



The Rotor

