eRUF Concept Model A 2008
"Emotion without Emission"

Ruf Automobile GmbH, internationally well known manufacturer for high performance automobiles and the producer of the famous CTR-series is now introducing the first electrically powered sports car from Germany.

The fundamental ideas that lead to the development of the eRUF concept vehicle came from Alois Ruf. The car maker from the Bavarian town of Pfaffenhausen had a vision of a simple energy transfer concept: his hydroelectric power plants, which feed 35 million kW hours of electricity annually into the German electrical network, could also more or less directly power modern autos. 35 million kWh is enough energy to power one of the prototypes eRUF as described below for 3500 journeys around the globe – or 3500 of the cars one time around the world each.

The idea seemed even more inspiring, as it would be possible for him to connect cars directly to the emission-free power plants for charging and drive away on the water-generated power.

The eRUF Model A concept car is the first prototype to lead the technical development away from the combustion engine.
Actually, for the first time an electric motor is being used which comes to fitting into the Ruf model range.

The three-phase AC motor's performance easily puts many conventional conbustion engines to shame. It produces its maximum 650 Nm torque output from 0 rpm onwards. This power rips into the drive shafts so impressively during acceleration, that one is immediately reminded of the extremely powerful Ruf Rt 12
It is actually enough simply to put the car in 6th gear and press down the accelerator pedal (an "amp pedal", not a "gas pedal" in this car!), and drive off.

The eRUF Model A has such impressive acceleration that the project goal of 0-100 km/h in under 7 seconds was achieved.

The maximum power output is around 204 hp if you translate it into combustion engine terms. In direct connection to Volt and Ampere the maximum output level of 150 kW is a useful figure.

A short discourse regarding efficiency might be helpful at this point: a highly-developed, modern petrol engine uses around 75 percent of the energy in its tank to heat the engine coolant and exhaust gas and only 25 to 30 per cent for actual propulsion. A diesel manages to convert a respectable 35 to 40 percent of its fuel energy into motion. The permanent magnet electric motor, on the other hand, is a model of high efficiency: it offers over 80 percent efficiency over the majority of its power range, extending 90 per cent in the upper end of its power range.

Ruf engaged CALMOTORS in Camarillo, California, specialized in the implementation of hybrid electric and electric only power train designed to combine the latest generation of lithium-ion batteries with its motor.
Since the 150 kW electric motor unit is very compact, there is a lot of room for batteries in the Ruf's bodywork.

The Axeon iron-phosphate, lithium-ion batteries currently in use weight 5.6 kg and deliver 160 Ah each. This means each one could theoretically deliver 160 amperes of electricity for one hour under normal temperatures or 1 ampere for 160 hours.
The generation of batteries available from Axeon represents by no means the end of the developmental curve. Current performance improvements in battery technology indicate that end of this improvement spiral is nowhere near.

The driving current in the eRUF is regulated by an electric "drive-by-wire" accelerator pedal. It is not the first electrical accelerator in a Ruf model. Other Ruf models also provided load control via potentiometer-pedals, nicely dosed for their powerful engines.

The power and torque produced by the 3-phase motor can be used to recover just as much power as it can put out. When coasting, the motor becomes a generator producing electricity to charge the batteries. The torque and electrical amperage ratings below are therefore to be understood as theoretical absolute maximums and minimums.

The 96-cell battery system is constantly monitored by an intelligent bus system from Axeon. Each individual cell is coupled with a sensor that sends critical information on cell temperature and voltage to the central control system. If irregularities appear during operation, the system can react within milliseconds to bring the values back in line, effectively preventing critical lithium-ion overheating behaviour during charging.

Tech specs for the eRUF model A, status of September 2008
All data are preliminary data as specified for the eRUF Model A

Drive Performance

- Acceleration 0-60 mph — under 7.0 sec (development target)
- Vmax — 160 mph, 225 km/h
- Cw — 0.28
- Roll resistance — 0.014
- Driving range — approximately 250 – 320 km, depending on performance level
- Specific power pick-up — 21 kW / 125 km/h

Vehicle data

- Engine power — 150 kW / 204 PS
- Max torque — 650 Nm 7 0 rpm
- Weight — 1910 kg (preliminary data)
- Battery weight — 550 kg

Motor Data

- Max torque — + 650 Nm to -650 Nm
- Power — + 150 kW to -150 kW (peak level)
  + 204 hp to -204 hp
  100 kW / 136 hp continuous
- Currency — 300 – 420 Volt
- Current level — max 550 A
- Rpm level — max 5000 rpm
- Operating system — brushless three phase alternating current with permanent magnets

Dimensions

- Diameter — 405 mm
- Length — 241 mm
- Weight — 91 kg
- Specific weight — 1,65 kW / kg, 2,25 hp / kg
- Coolant flow — 8 L /min max

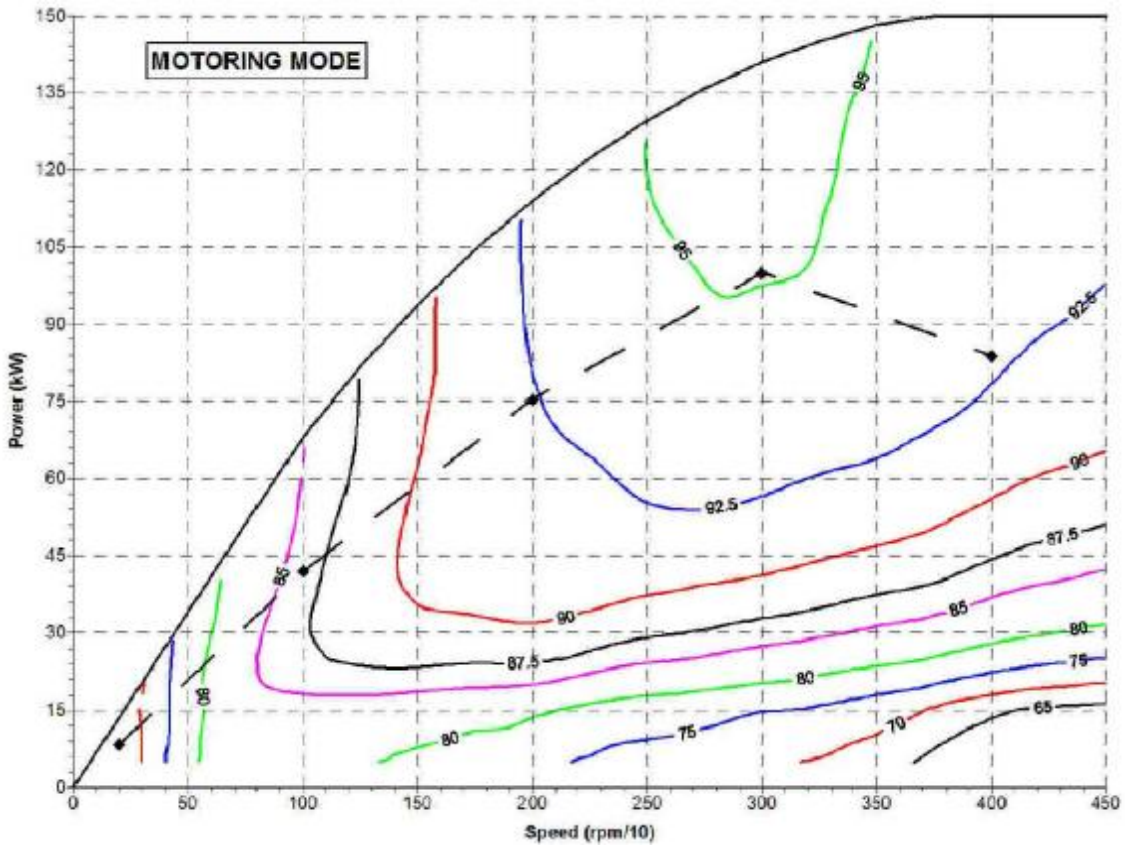
Battery System

- Type — Lithium-Ion, iron-phosphate base
- Manufacturer — Axeon plc, GB
- Stored Energy (96 units) — 50,72 kWh
- Nominal Voltage — 317 Volt
- Maximum discharge — 480 A
- Max Power — 152,16 kW = 210 PS
- Charging current, max. — 16 A
- Charging time — 10 hours

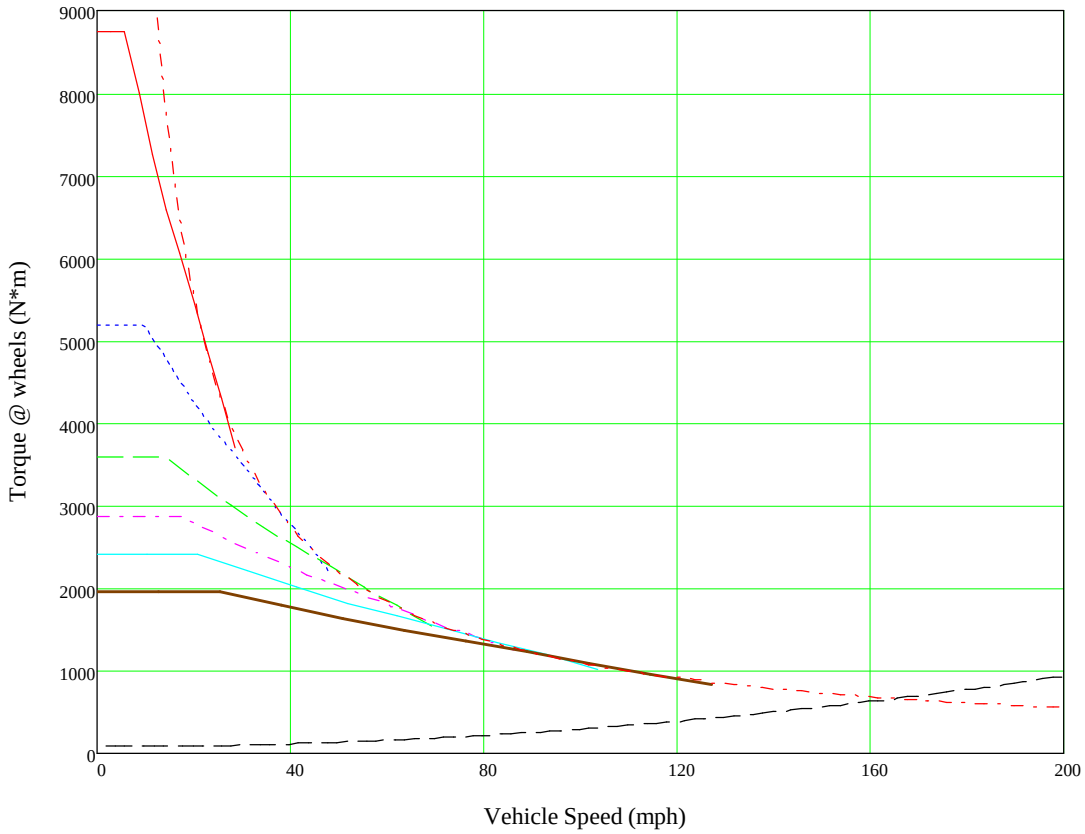
Single Battery Cell Data

- Capacity 160 Ah
- Operating voltage 4,25 V charging, 2,5 Volt discharging
- Nominal Voltage 3,3 Volt
- Max. Temperature Level 80 °C
- Life cycle 3000 charging cycles
- Self-discharge under 3 % per month
- Weight per Unit 5,6 kg

Power-Diagram Efficiency / Engine Speed x 10



Wheel Torque vs Speed



Torque Diagram for the 650 Nm-unit as used for the eRUF

Pfaffenhausen, 10/10/2008