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AtTrack TE 700 – a revolutionary Lightvehicle Concept

Ulrich W. Schiefer, CEO AtTrack GmbH, Holderäckerstraße 23, 70499 Stuttgart, info@attract.de

Carsten Strobel, Chief Design Engineer at AtTrack GmbH

Executive Summary

New solutions in the area of mobility need capable people to create products that meet the right requirements and innovative concepts that embeds them into the mobility landscape. The TE700 developed by AtTrack was especially designed to meet these requirements. Being the sole car worldwide, which has road approval for three people in a row, makes this vehicle very unique.

1 Changing circumstances in mobility

The men-steered, self-owned, combustion engine driven automobile is no longer the sole solution for every problem concerning mobility as it once was. New kinds of vehicles, like battery driven cars and e-bikes, as well as new mobility concepts like car sharing and car pools, are conquering the market and the minds of the public and the industry.

New ideas appear every day, but ideas alone are rarely enough to make an impact. After the initial idea, three factors are important to meet the changing circumstances and develop new mobility solutions:

- Skilled peoples and resourceful institutions, who are willing to think in new ways, have the creativity to find innovative solutions and have the capability to realize them.
- A product that meets the needs of the time.
- A concept that embeds the product into the current mobility structures.

2 AtTrack GmbH

The AtTrack GmbH is a company founded by Dr. Ulrich W. Schiefer in 2004. With the goal, to create new solutions in the mobility landscape. Therefore it offers development and consulting services, is an active member in clusters like the e-mobility-cluster in Baden-Württemberg and it is realizing own projects, or in cooperation with partners.

3 AtTrack TE 700 – the idea

The TE700 is AtTrack's latest battery driven E- vehicle. It is based on the idea of a light, easy to drive vehicle, that combines the driving pleasure of an open, highly agile vehicle (even a motorcycle) with the safety and the comfort of a four wheeled vehicle, while having a low energy consumption.

The probably most important question was, whether it is possible to create a car, which also provides driving pleasure when driving slowly! There is such a product in the motorcycle field, which is the Harley Davidson motorbike, but no such thing in the field of cars.

The engineers at AtTrack followed this idea and used their experience in areas like racecars, electro mobility and lightweight construction, as well as keeping in close touch to all involved industry partners.

Finally, the product appeared to be a crossover of a convertible and a motorcycle.



Figure 1: The styling concept of AtTrack TE 700

4 AtTrack TE 700 – an all new mobility concept

The use cases of a vehicle like the TE 700 are versatile, because it fills a void in the vehicle landscape. It's easy to use design and the low energy consumption make it an efficient way to get from one place to another that can ideally be used in mobility concepts such as car sharing. Because of its compact design, great relative payload capacity and flexibility in use, it can be used for utility services (effortless egress-ingress), just transportation (payload) and recreational fun like a motorcycle.

5 The styling concept

The AtTrack TE 700 has an incomparable silhouette. Overall low, the vehicle highlights the driving capabilities – it seems to suck itself to the road surface. The tiny silhouette makes sure, that there is minimal aerodynamic driving resistance in order to get a very good range.

In front, you can see and feel the tiger, which braces itself on its front legs in order to be prepared for the next jump! Tilting all major graphics towards the front, gives a dynamic and ready to jump image.

However, like at the motorcycle, the whole optical experience only evolves in the combination of vehicle and passengers!

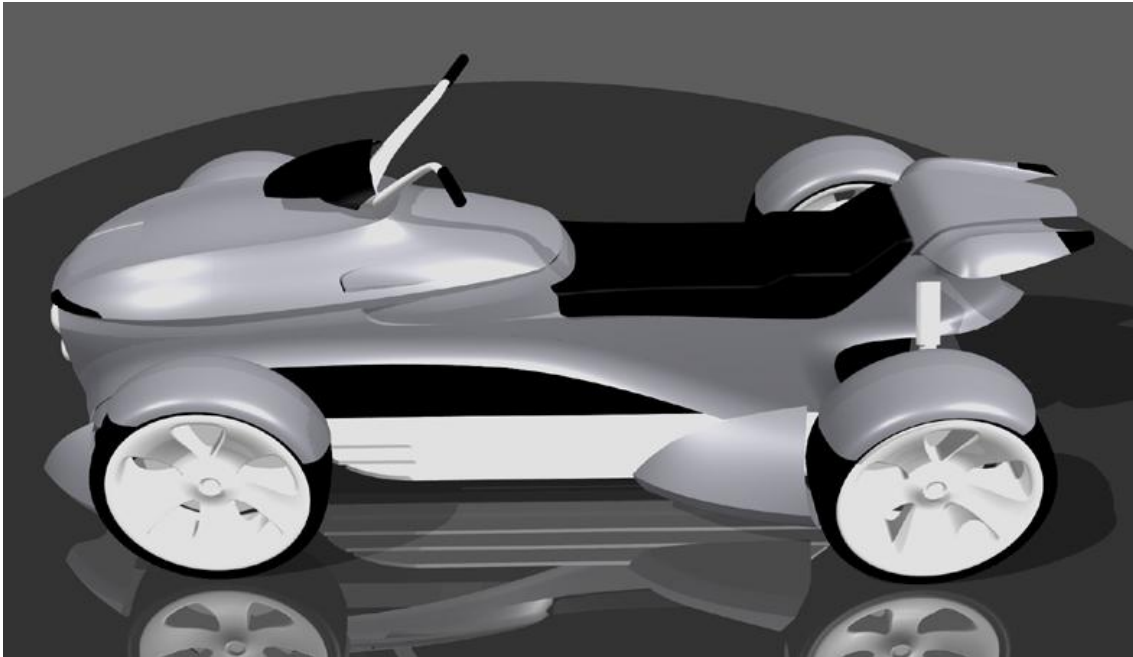


Figure 2: The styling concept of AtTrack TE 700

6 The light weight design

Homologation target was EC Class L7. In order to stay in the given weight limit, the car has to be very light.

Lightweight design on component level is by far not good enough to fulfil these aggressive weight targets, in particular, as we designed the AtTrack TE 700 as a three seater [1]. Therefore we also need a very demanding payload factor and a high structural stiffness in order to make it safe and easy to control. Many preanalyses have clearly shown that only system lightweight design can fulfil the requirements. Consequent layout of the tubular frame with an emphasis of seamless load transmission from every single wheel into the whole structure are one side of the medal. The other is to also feed the inertia forces of the single heavy loads such as the passengers, the battery and the motor in a way that there is no bending of the loadbearing structure even under heavy road load conditions for example in landing after a lift off.

Beyond that, it was tried to minimize the weight of the body panels in using ABS all around and trying to minimize the thickness of the panels.

Particular components were designed in the mood of functional integration such as the footplates, which have also side impact caring functions. They are built in sandwich method. The reinforcement is made from glass the rest in is Polyethylenterephthalat, again the core is from hexagonal cores.

7 The vehicle concept

To provide the customer with best value for money, requires to make best use of the EU L7 regulations. What does that mean? Definitely the regulations allow for another vehicle concept that just downsizing one of the well-known package concepts of standard road cars such as a Golf or a Focus. And that is particularly valid in case of an electric drive line.

To cope with that we created a vehicle with a “central beam steel frame”.

This central beam is of elementary importance for all and anything in the car. It is not only the central bending and torsion reacting main spine of the car, but also covers and protects the whole traction battery in its inside.

In the same time, the passengers sits on top of it. The vertical load of the passengers is directly feed via the seat structure into the steel tubes on top of it.

The target was to carry three persons. As to our knowledge, the AtTrack TE 700 is the only road vehicle that has a three in a row seating order. The people sit like on a motorcycle on a saddle.

The Mahle motor is located close to the driven rear axle and has a transverse east west mounting scheme, the torque is feeded via a one-step gearbox into the differential and then via driveshafts to the wheels.

8 The Suspension

The front axle is a double wishbone layout with a cast aluminium A-arm on top and a welded steel arm on the lower end [1] .

The coil over dampers are from Ikon. Their top end is tilt towards the steel frame and feed the damper loads directly into the top A-arm.

The cast uprights hold the disc brakes on the front axle. Aluminium alloy wheels are mounted according to automotive standard in the size of 5,5 x 15.

The rear axle is of McPherson type, which feeds its damper loads via a massive upper traverse into the tubular steel frame.

9 The Vehicle Behaviour

The vehicle provides the passengers with an outstanding driving behaviour.

Provided with low centre of gravity the vehicle stays below the tilt limit even in extreme driving manoeuvres.

Longitudinal c of g and low polar moments of inertia cause the car to behave neutral up to the grip limit. Steering behaviour stays also neutral up the grip limit.

10 The Electric drive

The electric motor is a three-phase asynchronous induction motor with a squirrel-cage rotor from Mahle [4]. It is a brushless type of motor as electrical power is transmitted from the stator to the rotor by induction. The stator consists of a stack of welded laminations with a three-phase winding inserted in to the stator slots, which defines the number of motor poles. Around the surface of the rotor stack, there are aluminium bars, which are connected together by a shorting ring at each end of the rotor.



Figure 3: Mahle AMV7122 AC induction motor

AEK1350 H48V 400A T5 is a 3 phase AC induction motor controller [4]. The Controller is designed to operate with a low voltage DC link supply < 60 V DC with a maximum of 4 kW continuous output power and a maximum of 15 kW peak power, depending on battery type and voltage. It generates 3 phase modulated voltages with indirect vector control, which is commonly used to run induction motors. Smooth acceleration, high torque, speed, efficiency and regenerative vehicle braking with low maintenance costs are the main advantages of the Mahle induction motor drive.

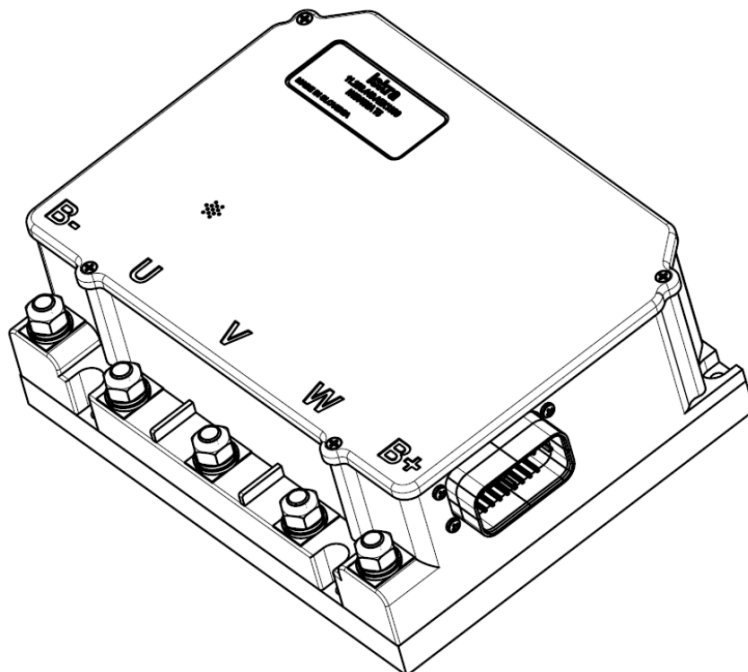


Figure 4: Mahle AC controller AEK1350

The battery is of LiIon type and has a capacity of 5.5 kWh. Its dedicated design is particularly made to fit into the width requirements of the tubular steel frame.

The Mahle drive is a very competitive package. The motor has an easy play with the light vehicle, the controller allows for high starting currents, which provide a high acceleration from standstill. The throttle gives a very good feel of controllability. Recuperation and other fine tuning aspect allow for a very high range of about 80-90 km in relation to the quite small battery package.

11 Conclusion

AtTrack succeeded to set up a competitive car with a high customer value, Carrying three persons and providing considerable luggage capacity is unprecedented.

This was possible through the courage to leave conventional vehicle concepts and making maximal use of the possibilities of the light vehicle certification class L7. The potpourri of a clever package concept, a sophisticated overall lightweight concept and a fine drive package allowed to provide this combination of a very high utility value and very emotional and good drivability capabilities.

Acknowledgments

Fig. 1, Fig. 2 AtTrack, Fig. 3, Fig 4 Mahle

References

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Authors



Dr. Ulrich W. Schiefer, MBA holds a Diploma in Air- and spacecraft engineering of the University of Stuttgart and a doctors degree from the same University. His MBA he absolved at Kellogg, Northwestern University. He worked at big OEMs such as BMW, Daimler, Ford, Porsche for more than 20 years and had responsibilities such as Motorsport director for BMWs Le Mans Race Activity, Aston Martins board member for development. At BMW he was developing the new innovation centre and the predecessor BMW Z22 of the BMW i3. Actually he is board member of several technology companies and responsibly runs his own company AtTrack.

Carsten Strobel studied Aircraft engineering at the University of Stuttgart and worked at such renowned companies as Airbus in the helicopter branch. Nowadays he is head of vehicle design at AtTrack.

