

1<sup>st</sup> March 2010

## **Exemplary performance and efficiency: Harman International Automotive Division presents groundbreaking sound technology in the electric sports car 2010 from RUF Automobile**

- Infinity® GreenEdge® sound system unites low energy consumption with brilliant sound
- HALOsonic™ - Electronic Sound Synthesis (ESS) uses electronically generated engine sounds to increase safety and enhance the driving experience

*"I swear by the Infinity® loudspeaker system. Ever since the 1980's, Infinity sound systems have been a permanent fixture in my home and offices," explains Infinity® fan Alois Ruf, whose renowned car manufacturing business develops and produces the electric sports car. Thus, the technical components from Harman International were the obvious choice of the specialist for his electric sports car project.*

*In a project involving close cooperation between engineers and acoustic experts, Harman International has integrated brilliant Infinity® sound in the zero-emissions eRUF while also achieving maximum energy efficiency. The powerful Infinity® GreenEdge® sound system uses eleven precisely positioned speakers and a powerful amplifier to produce the most intense listening experience possible. Thanks to the electronically generated sounds produced with HALOsonic™ technology, the electric sports car has also been given an acoustic identity of its own. The actively generated sounds are particularly important in increasing safety and also enhance the driving experience.*

The electric sports car from RUF Automobile GmbH really is in a class of its own: instead of a six-cylinder engine, a 270 Kilowatt (367 HP) three-phase motor can be found in the back of the electric sports car, ensuring emissions-free driving. With a top speed of 250 km/h and an acceleration from zero to 100 km/h in around five seconds, the car's driving performance is sure to please its discerning clientele. An initial small-scale series of the groundbreaking eRUF is planned for 2010.

### **Infinity® GreenEdge® sound system: brilliant sound and energy efficiency**

Infinity® GreenEdge® elements are characterized by a high degree of energy efficiency. The excellent overall energy balance is achieved through the intelligent linking of reduced weight in all components with a high degree of efficiency in the amplifier and sound transducers.

In a move designed to give the sound platform in the electric sports car a truly unique character, the Infinity® specialists decided on an arrangement of eleven speakers in all. A Kevlar® mid-range speaker is used as the center speaker in the instrument panel. In addition, there are two metal matrix tweeters and two mid-range speakers in the front sections of both door panels, left and right, as well as a powerful carbonfiber woofer in both the driver and front passenger doors. The Infinity® experts installed four more sound transducers in the rear, a tweeter behind both the driver and front passenger seats and two more mid-range speakers connected in parallel. A common feature of the new speaker generation is the Neodymium magnet system, which also helps further reduce the overall weight.

The Infinity® GreenEdge® audio system also has a powerful DSP amplifier under the front passenger seat. The amplifier achieves exemplary efficiency of over 90 percent compared with 35 to 50 percent in conventional models. This efficient use of energy means that almost no waste heat is given off, so that classic cooling can be effectively done away with. Instead, compact lightweight housings are used, which reduce the weight.

Because Harman's acoustic specialists were entrusted with the development of the audio system at a very early stage of the car's design, it was possible to calculate the best possible installation position for each speaker and for the amplifier and to adjust these carefully. Every single component of the entire system has been tested over and over again. This has resulted in powerful bass sounds, natural mid tones and crystal-clear top notes.

### **HALOsonic™ - electronically generated engine sounds increase safety and enhance the driving experience**

Pioneering HALOsonic™ technology meets many of the key requirements for the future generation of hybrid and electric cars. HALOsonic™ generates synthetic engine sounds, which serve to warn pedestrians and cyclists that the normally almost silent car is approaching. Studies carried out in the University of California have shown that the human ear only perceives hybrid and electric cars within a radius of three meters. Accordingly, critical situations include parking and driving off, as well as emerging from side streets and off-street parking, as people fail to realize that the cars are in motion because there is no engine noise. Older people, people with visual impairment, children and cyclists are the groups at particular risk. A minimum noise level is already being considered in the USA, Japan and Europe, so that the introduction of environmentally friendly, almost silent electric and hybrid cars does not become a new source of danger to other road users.

“Safety is our prime concern, which is why an engine sound must be generated that unmistakably warns other road users that an electric car is approaching and that gives the car a special acoustic identity,” says Alois Ruf.

Alois Ruf has purposely chosen a modern engine sound for the exhibition car. The engine noise is transmitted externally by means of two high-efficiency speakers behind the front and back bumpers. The positioning of the speakers required a lot of care and attention because these are continuously exposed to climatic variations, as well as water and dirt.

The sound transducers focus the sound generated by the HALOsonic™ technology in the direction of travel. This means that the noise level remains pleasantly low for other road users who are not located within the direction of travel.

The backward-facing sound transducer also warns passers-by behind the car, who are potentially at risk while eRUF is performing reversing or parking maneuvers. HALOsonic™ technology is activated as soon as the driver starts the ignition. This is how the electric sports car signals to other road users that it is about to move off at any moment. For authenticity, the engine sound generated varies with the vehicle speed. This means that pedestrians, cyclists and children can intuitively estimate the direction from which the car is approaching, as well as its speed.

Electronic sound synthesis is also used inside the car, and here too the electronically generated engine sounds ensure safety, while at the same time enhancing the driving experience. The eRUF specific internal sound is generated by the Infinity® GreenEdge® audio system, offering perfect integration without adding weight or requiring more space.

As well as the modern sound specially generated for the exhibition car, the HALOsonic™ technology can also be used to simulate other electronically generated engine noises. This means, for example, that fans of the six-cylinder Boxer engine can choose a sporty sound that emulates the original.

The range of services of the Harman International Automotive Division includes the development, design and production of pioneering state-of-the-art systems for audio, entertainment, information and communication technology for the automobile industry. Harman International Industries Incorporated ([www.harman.com](http://www.harman.com)) develops, produces, markets and distributes a wide range of high-end audio and infotainment systems for the automotive, consumer and professional sector. Harman International is well-established in North and South America, Europe and Asia and employs around 10,000 people worldwide. The Harman International family includes internationally renowned brands such as AKG®, Audioaccess®, Becker®, BSS®, Crown®, dbx®, DigiTech®, DOD®, Harman Kardon®, Infinity®, JBL®, JBL Professional®, Lexicon®, Mark Levinson®, Revel®, QNX®, Soundcraft®, and Studer®. Its shares are traded on the New York Stock Exchange under the code “HAR”.

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