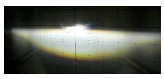
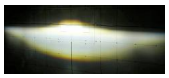
By Daniel Stern

J.W. Speaker, a 50-year-old manufacturer based in Germantown, Wisconsin, USA, have introduced a multiple-optic full-LED high/low beam headlamp designed to the standard SAE 7-inch (180mm) round dimensions used on numerous passenger, cargo, military, and off-road vehicles as well as motorcycles in North America, Great Britain, Australia, Japan, and elsewhere. It has a heat sinking die cast aluminum housing, a hardened glass front cover lens, a built-in fan for thermal management, and four optical elements visible from the front giving a highly technical appearance. The large upper projector lens handles output from a 1x4 emitter array equipped with a stair step "Z-beam" cutoff shield. This optical stack produces the high-intensity hot spot and forms the low beam cutoff. The D-shaped edgewise cylindrical lamps, each in front of its own emitter, provide beam width and homogeneity. The lower projector is for the high beam hot spot, and has a 1x4 emitter without cutoff shield. One optical version of the lamp is certified as complying with SAE requirements for the NAFTA market and is also type approved to ECE regulations for use throughout the rest of the world in right-hand traffic. A second optical version of the lamp has a mirror-image cutoff shield in the low beam optical stack, to produce a left-traffic beam; it is type approved to ECE regulations. 12v and 24v operation is possible.

Additional headlamps based on this optical architecture are in various stages of commercialisation by Speaker; a 165mm x 100mm rectangular standard-fit version is nearly ready, and model-specific Speaker LED headlamps are being incorporated into New Flyer's new Xcelsior transit bus.





Speaker N° 8700 low beam :
se range obscures cutoff at top of hot spot **Speaker N° 8700 high beam**

an Popovic with J.W.Speaker at VISION 2008

DVN: Please briefly introduce yourself and your company. How do you see Speaker within the greater automotive lighting industry?

Dragan Popovic: Me, I have been in the lighting industry more than 25 years. I started at Yugo, then moved to Italy, to France, to Russia. In 1995 I moved to Canada and worked for Autosystems, than moved to Hella in Detroit for 2 years. For the last 8 years, I have been the R&D director here at Speaker, Germantown, Wisconsin, USA.
At J.W. Speaker, we are thinking of ourself as boutique of light. "Resolve the problem for the customer" is primary goal for us. We are mainly interested in high technology products at small to medium volume with short lead times.

DVN: What can you tell us about the optics of the ? 8700 LED headlamp?

DP: We have two design products, one is military and second one is commercial. Military does not look for very high performance so behind D-Lenses are 1x2 light engines. For commercial 7" round behind aspherical lens is Altilon 1x4 light engine from Lumileds. Also behind the D-Lenses are 1x4 light engines from Lumileds as well. The same light engine is behind complex smooth high beam lens. There is some efficiency balance to consider when choosing to use a shield to create low beam cutoff but overall this is not so much compromising. The major problem is efficiency of the aspherical lens. Our D-lens is very efficient around 70-75%

DVN: The lamp circuitry prevents the low and high beam from being lit at the same time -- the unit shuts off if power is applied to both simultaneously. Is this done for beam photometry compliance, or some other reason?

DP: This is done for lamp protection. Considering that all light distribution is done by D-lenses we decide to keep equal number of LEDs on both function low or high. This very much simplifies the driver circuitry and we keep the all characteristics of the low beam in high beam function except the cutoff line. The high beam max intensity is affected by complex lens quality. Production quality of this lens has been a little bit variable, but now our supplier in France has it under control. So you should under current production variation have around 52 000 to 60 000 cd high beam hot spot.

DVN: Lens material choice is obviously a philosophical matter to some degree; What factors decided in favour of glass for this lamp? □

DP: Durability and resistance to scratching over time. LEDs lamps in general have much longer warranty time so PC lenses will not stand long time weatherability. If we add some special military requirements like sand storm resistance or de-icing scrape resistance, clear direction is glass as cover lens. Now for 3D complicated geometry like car head lamps plastic is a necessary evil.

DVN: Lens thawing in cold weather is a particular challenge with LED headlamps, as is thermal management at the emitter junctions. The use of the die-cast aluminum housing as a heat sink is quite elegant. Can you talk about the thermal management technique

incorporated inside this headlamp?

DP: In general we approach with intelligent thermo management at LED light engine by increasing/decreasing the current by regarding the temperature variation of LED. Also, for deicing purposes and condensation/clearing requirements we are using internal the fan to recycle air.

DVN: What created the drive to design an LED lamp of this size and shape?

DP: This shape was developed for the military market at the beginning. Now it's complete and parts are on market, many bus, truck, and motorcycle OEMs are looking to implement this standard shape instead of halogen or HID lamps. Also we have developed 110mm Low and High, 160mm x 110mm Low and High, 160mm x 110mm high/low, 190mm x 125mm high/low, and several custom LED lamp. We are involved in additional LED headlamp projects, such as the New Flyer bus models and the 165mm x 100mm lamp.

DVN: In your view, how can we avoid another disappointment with LED lamps as we have seen with low and slow market penetration of HID headlamps?

DP: LED technology will allow scalable modular design with many years warranty. Also with LED efficiency increasing every year, mass production is just waiting to happen. That development will launch this technology to very affordable levels, and people will have the chance to choose what kind of brightness and level of intelligent lighting they would like to see on their car. Even at the relatively low lumen levels like halogen lamps—300 to 400 lumen on the road—in the next several years one light engine will perform at least double. Next parameter would be energy savings and reduction in CO2. It does go on and on, so all this together will drive the market towards this technology.

DVN: Coming back to the ? 8700: What were the main challenges in its design? What do you learn from its development?
DP: This 7-inch round lamp was a very interesting project but the biggest challenge was design the product in available shape. The lamp had to fit in already existing space on all military vehicles—the "bucket". Then, thermal managing, optical definition, EMI military requirements considering this is a switcher-circuit design, were also very big challenges to resolve. Almost every area of development had something unique and challenging to resolve considering military requirements. One of those were also vibration and lamp structural integrity. Some of our lenses are made of glass and as such they were causing somewhat big problems at certain resonant frequencies. Anyway, this design is very much defined and as improvement we are planning to replace all glass lenses with plastic material—a challenge on its own. This will reduce weight of the lamp and help in all design areas specially on vibration and assembly, but again we have durability to think of.