

Automotive lighting design with LEDs puts the ‘super’ into the Ford Super Chief concept vehicle

A variety of innovative LED lighting designs have been implemented on Ford’s recent concept vehicle, and these could soon appear on production vehicles, according to lighting designer **Robert Miller**.



Figure 1. The front of the Ford Super Chief concept has white LED forward and fog lights, as well as amber “transparent chrome” running lights on the roof. The front indicator and door handle lights are made with LED light guides. The rear features horizontal light guides, as well as multiple LED brake light units on the roof.

Concept lighting poses significant challenges to any automotive designer. It also poses a challenge to the person who is tasked to create this lighting and bring it to life. When Ford created the 2006 Super Chief concept vehicle, it insisted on the most advanced LED technology to “push the visual appeal” to the highest level. The implemented lighting technology had to be in line with reality, and likely to appear on production vehicles within several years. The challenge was to infuse new LED and light-management technology into the vehicle, creating visual interest and stimulation.

Exterior and interior lighting is becoming much more sophisticated and often has several unique visual elements operating simultaneously. Customers who view concept cars are often heard to say: “Great ideas and looks, but it never seems to find its way in to real cars.” The key is to blend new “eye candy” features with real design and production-worthiness, using the latest LEDs and the most innovative light-management technologies available. Together, all of these elements create visually interesting products with lighting that greatly enhances the overall vehicle design.

From its exterior statement, the design of the Super Chief firmly cements together the image of beauty and sophistication that draws the consumer into the entirely new look and feel of this vehicle. Innovative lighting – for example lighting areas on the vehicle that you would never expect – further instills visual interest.

The use of “transparent chrome” that suddenly comes alive with

color when energized by LEDs achieves just such a “stealth” lighting effect. This look was one of the most commented-on elements of the exterior lighting and was very popular with the public. These lighting statements were used in the amber running lights on the roof of the vehicle, the wing mirrors and the roof-mounted rear brake-light (CHMSL) areas.

Roof lighting kept under glass

Making this lighting design even more spectacular are the high-brightness LEDs located under the glass roof, which dominates the entire top of the vehicle. The LEDs were located inside the vehicle, with fret lines positioned to allow light to pass through the glass directly to the transparent chrome bezels. The bezels were placed on the outside surface of the glass (figure 2a). The result is a clean, simple design with full protection of the lighting module, and the brightness is controlled using a tunable electronic LED driver.

Another area where transparent chrome is utilized is in the wing mirrors, which contain amber turn indicators (figure 2). In the off state the mirror edge looks like chrome, but when the turn signal or running lights are energized the chrome surfaces come alive with amber light.

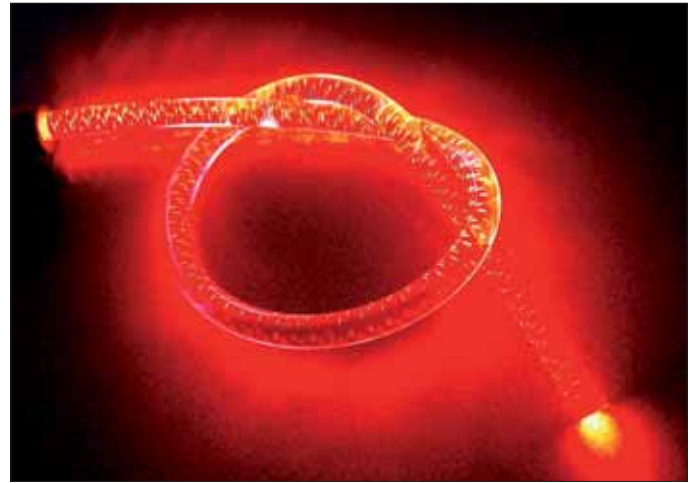
A similar approach is used for the rear lighting, which uses custom LED light-management optics. The entire lighting area emits a smooth, even light with absolutely no hot spots in any of the displays (figure 1). This look was achieved with light guides from iLight



Figure 2. Stealth lighting using transparent chrome. Left: one of several chrome bezels placed on the outside front of the glass roof. The LED lighting is beneath the glass. Middle and right: wing mirrors with amber LED indicators.



Figure 3. Door handles containing a custom-made LED light-guide are a hugely popular feature of the Ford Super Chief concept.



3M's Precision Lighting Element material emits LED light over lengths of up to 4 ft, even when tightly bent.

Technologies with a series of modifications, including the use of high-power LEDs to increase the lumen output. The resulting effect dazzled viewers with light that looked bright and even, and that exhibited a three-dimensional appearance.

The Ford Super Chief has four beautifully designed chrome door handles that beg to be touched. At autoshow we often saw people reaching out to try to touch them while the vehicle slowly rotated away from them. We were asked by Ford Design to make the handles amber in color, and to create a light-management optic that was bright and had an even, diffuse output. We decided on a matt finish so that the amber light would contrast with the shiny chrome of the door handle.

This posed significant design challenges, which we overcame by using 3M Vikuiti series of films and LEDs supplied by Osram Opto. In essence we created a very efficient precision light guide that worked in a very small area. Some people actually thought that it was neon, achieving one of our goals for this fixture.

Forward lighting

For forward lighting it was decided to use LEDs with the most unique style available. We needed LEDs that were bright and emitted a cool white 6500 K temperature output. Ford's mission was to create a truck with a "bold visual statement" and ours was to involve lighting in that design. Very large lenses that complement the front design of the veh-

icle represent the future design direction that Ford wished to implement with the Super Chief.

The task was to somehow deliver more than 1600 lm of light output, as well as color and visual interest in both the "on" and "off" states. We decided on Lamina Ceramic's BL-2000 seven-cavity light engines, because these LEDs provide the required visual interest when the lights are off. We used eight light engines for each side (16 in total), clustered into four groups. Each group of four was mounted on a heat sink and had a specially designed optic containing four lenses (figure 4). The optics were milled out of solid 8 x 6 inch blocks of acrylic and each took almost 60 h of milling and polishing time.

For the turn signals that appear in the middle of each headlight, we utilized the same neon-like appearance as found in the door handles, tying the two visual elements together.

Another assignment was to design a thermal management system for the lights that would become the focal point for the back side of the hood and would complement the inside design of the engine compartment (figure 5). Ford designers not only wanted to see the heat sinks but also wanted them to be beautiful. We accomplished this by taking the designers' initial thoughts and renderings and then modeling and applying our own designs to make the lights a reality.

For the fog lights we custom-designed four units (figure 6) that were joined together to create two sets, one for each side of the vehicle. Four



Figure 4. Heat sink block, lens block and reflector for high-power LED headlights.

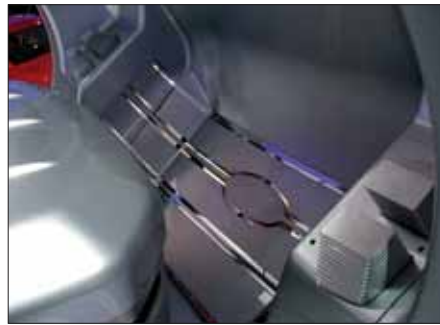


Figure 5. Interior of engine compartment, showing the four headlight heat sinks.



Figure 6. White LED fog light units using Osram Ostar Projection LEDs.

Osram Ostar Projection LEDs were used to closely match the 6500 K output of the BL-2000 LEDs, so that all of the lights would be uniform in color. We built a dimmable electronic driver so that any brightness level could be dialed in for any type of situation. The end result was spectacular forward lighting showcasing the boldness and robustness of the Super Chief design.

The future of light management

We are likely to see an explosion of new lighting applications and ideas in future concept and production vehicles. Light-management materials such as 3M's Precision Lighting Element (PLE) material, will dominate future designs. PLE material is unique and flexible, and it emits LED light over lengths up to 4 ft – better than any other technology to date. Even when it is tightly bent, the light is constant and uniform. 3M successfully developed a proprietary material and a unique way of microreplicating the light-ejection slots on this material for efficient, beautiful light management. The company suggests that it may be possible to customize the ejection slots with other designs to offer different looks, texture and light-output options. This will open up many new branding opportunities for vehicle OEMs.

Summary

Ford's 2006 Super Chief was a complete success and did what concepts are supposed to do – turn ideas into reality. Expect to see lighting that emulates what was done on the Super Chief in future concepts, as well as in production vehicles in the not-so-distant future. Controlling and giving light a "personality" that lives in the space of a vehicle is a trend that designers are working towards.

Considering whether LEDs will grace the entire vehicle, it's not a question of if but when. As LEDs become brighter and more cost-effective, parallel improvements are required in light management and techniques needed to differentiate design tastes. Concepts drive production, so you should see some very exciting lighting designs appearing in the next series of international autoshows.

About the author

Robert Miller (tel: +1 734 255 0300, e-mail: lightjet@mindspring.com) is a consultant and former owner of BrightLights Technologies, LLC. He has successfully designed and delivered more than 100 advanced lighting programs and completed in excess of 20 complete automotive concept vehicles over the last 10 years. Along with his automotive lighting design experience, he has successfully created many other innovative lighting products from flashlights to track lighting utilizing advanced LED technologies.

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