

Technological Leap Provides LED Alternative to MR16 Halogen Lamps

For decades the MR16 halogen lamp has been the top pick for lighting designers due to its small size, style, crisp-warm tone and highly directional light quality. Technical innovations in energy efficient lighting have not provided a comparable energy efficient alternative to the MR16 halogen lamp – until now. An exciting new solid-state lighting product using GaN on GaN technology has recently been developed with performance comparable to generic MR16 halogen lamps. This ALG Connections piece highlights an excellent [white paper written by James R. Benya, PE, FIES, FIALD](#) that critically reviews a new LED family of MR16, 12-volt AC lamps.

The benefits of solid-state lighting (SSL or LED) products are that they demonstrate energy efficiency, long life, good lumen maintenance, wide temperature range, instant starting, full range dimming and superior color. However, while individual LED sources are reasonably close to a point source, they have low lumen density per point, requiring the use of multiple point sources to create a highly directional lamp. Multiple point sources create multiple shadows and in some cases colored shadows that are considered undesirable in display applications.

The lumen density of an LED is directly related to the structure of its crystal layers. LED's that generate white light for architectural lighting use Gallium Nitride (GaN) as the semiconductor material. To make an LED, crystal layers of GaN are typically grown on a sapphire or silicon carbide substrate material. Due to differences in material properties between GaN and these

materials, the GaN crystal grows imperfectly on such foreign substrates, and produces a high incidence of imperfections which reduce the light generation efficiency of the LED.

A new scientific innovation for LED technology is the ability to grow GaN crystals on its native GaN substrate ("GaN on GaN"). The crystal grows much more perfectly, can accommodate much higher power densities, and allows the LED to emit up to ten times more light from the same crystal area. GaN on GaN technology is also more heat tolerant than other substrate types, allowing smaller emitters and better point source-like behavior.

New commercial LED products using GaN on GaN technology have been developed by Soraa as a family of MR16, 12-volt AC lamps. Depending on the version, the lamp family's performance approaches that of generic 50-Watt MR16 halogen lamps and is comparable to 30-35 watt premium or IR halogen lamps. The products include integral drivers that operate well on a number of combinations of transformers and dimmers.

To further increase efficiency compared to other diode types, this new family of products uses a design that mitigates LED "droop", a phenomenon observed in GaN-based LEDs wherein efficiency drops as power density is increased. This design allows the GaN on GaN LEDs to maintain high efficiency at high operating power densities, and produces a very bright, point-source-like light source comparable to MR16 halogen lamps.

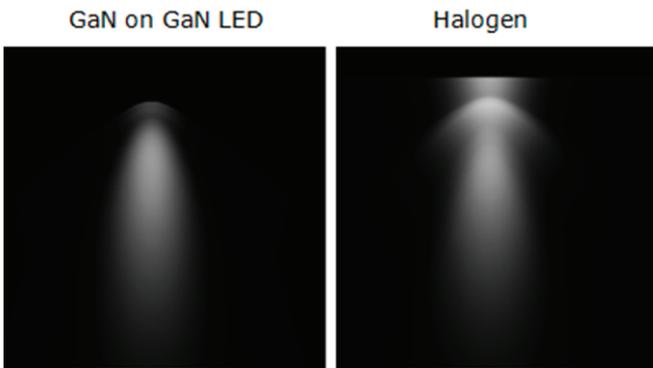
ABOUT ALG Connections

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Images courtesy of Soraa.

The Soraa MR16 products employ a violet-pumped, 3-phosphor white LED configuration, the result of which is a full-visual-spectrum (400-700 nm) white light source. The presence of the violet emission excites fluorescents or “whitening agents” in common white materials, rendering them truly white and achieving a closer match to the blackbody than the conventional two phosphor “blue pumped” LED. Lamp color rendering for this family of products is available in standard and high CRI versions. The standard version is offered at either 2700K or 3000K and 80 CRI. The high CRI version (Soraa Vivid) is offered at either 2700K or 3000K with 95 CRI and deep red R9 95 rendering that is achieved by employing a specific deep-red (long wavelength) phosphor selection unique to this product.

This new product family of MR16 lamps is a significant leap in LED technology, with performance that rivals common halogen MR16 and the best LED light engines with remote drivers. For a wide variety of current MR16 applications, these lamps are respectable alternatives to and perhaps even improvements upon halogen, and provide benefits of lower energy use and longer lamp life without sacrificing color or candlepower performance.

For a full review of MR16 lamp technologies including the new GaN on GaN LED product family of MR16 lamps, read the detailed white paper written by ALG author James R. Benya titled *A Critical Advance in MR16 Lamps* published May 6, 2012.

ALG Online has an entire [section dedicated to LEDs](#), covering the fundamental technical aspects of LED source technology. LED structure, LED array characteristics, and various aspects of LED performance are presented to give the reader a basic understanding of conditions that can affect overall efficiency and light output. Emphasis is given on exploring LED system performance, with descriptions of electronic drivers and the various relationships of system components. This section concludes with application guidelines for the use of white-light LEDs.

Soraa Vivid 95 CRI Comparative Spectral Signature

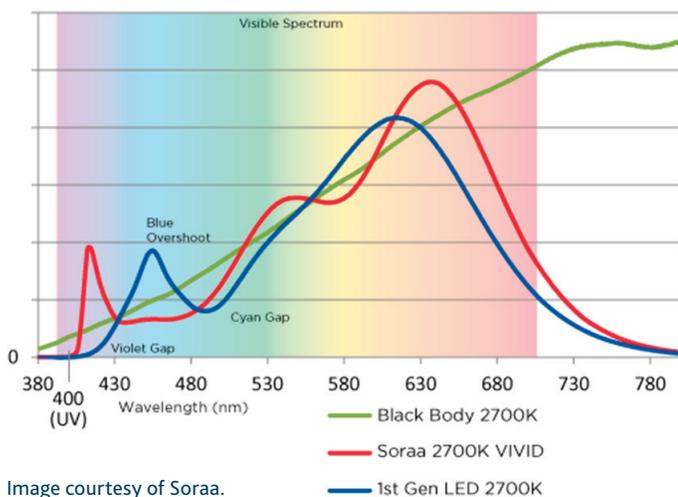


Image courtesy of Soraa.