

Visus Photonics - Visionary Technologies  
New Generation Of Production Ready  
Keyboard-Keypad Illumination Systems



**Razor-Thin Power Efficient HOW<sup>®</sup> Backlights for  
Keypads and Keyboards**

**X10** Higher Luminance than that one of the second best light guide film (LGF) in  
The Market.

# The Visus Advantage

Light sells!



Visus Photonics REVOLUTIONIZES keyboard and keypad illumination giving better, more uniform lighting with almost no energy consumption. Visus light guiding films (LGF) have slashed power consumption by 15 - 50 times and reduced the number of LEDs tenfold just to one LED for most MPs .

Visus delivers light satisfying the most stringent demands of cellular phone, NB and keyboard designers to bedazzle the consumers, while dramatically slashing costs and allowing a far simpler keyboard assembly. Many years of optical, material and manufacturing research have culminated into this patented breakthrough.

In recent years, development efforts for cellular phone lighting were focused on the LCD backlighting. Keyboard illumination technique has been totally neglected and remained unchanged since its inception. As a result, the keyboard illumination consumes more power and uses more LEDs than the LCD backlight and is the primary source of power waste in today's mobile devices.

**Tel Aviv, May 2006.** Visus Photonics has introduced new **HOW™** LED-based high-brightness LCD and keypad & keyboard backlights that offer an exceptional thinness of 0.2 mm or less – much thinner than the slimmest 0.4 mm molded light guide - for a wide array of LCD as well as general lighting applications. Time is ripe to change an ubiquitous so familiar term LGP for LGF – Light Guide Film.

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New backlight technology is disruptive in few major aspects:

- Keyboard and keypad illumination is more uniform with *almost no energy consumption and enhanced front panel design options.* Visus light guiding films (LGF) have slashed power consumption by 15 - 50 times and reduced the number of LEDs tenfold to just one LED for most MPs being order of magnitude better than other LGF products and using least expensive low rank LEDs.
- Ultra-thin Multilayer LGF/LGP are manufactured by continuous extrusion process similar to optical fibers and roll to roll micro-embossing and offer a throughput undreamed of with conventional molding. They are in line with a latest LED miniaturization with 0.2 mm SMT devices already available.
- Available at any size including World's first large keyboard for desktops.
- Flexible, Bondable, Bendable Special optical and material properties of new LGF allow its use with flexible LCDs and to laminate/bond it to any substrate (including a black one).
- A combination of four patented VISUS core technologies has been indispensable for a development of a new product family:
  - ❖ HOW™ Hybrid Optical Waveguides with unique optical architecture
  - ❖ ExFRACTOR™ extractor technology ensuring uniformity with reduced LGF thickness
  - ❖ FoCoupler™ LED optical couplers to collect LED radiation and inject it into LGP
  - ❖ New Face Coupling architecture offered along with a traditional edge coupling scheme
  - ❖ Functional Flat Fiber (FFF) developed in cooperation with Visus's strategic partner

## Two LEDs replace 23 Blue LEDs providing multicolor key and Extra front panel backlighting

### **Enhanced MMI**

Proprietary dual mode LGF gives a designer a possibility to provide both Accent and Silhouette lighting over a whole keyboard area, which until now has been possible only with extended light sources like EL. Enhanced key luminance and Silhouette lighting greatly improve symbol visibility, visual guidance and operator's effective visual field. This allows easier operation of compact alphanumeric keyboards.

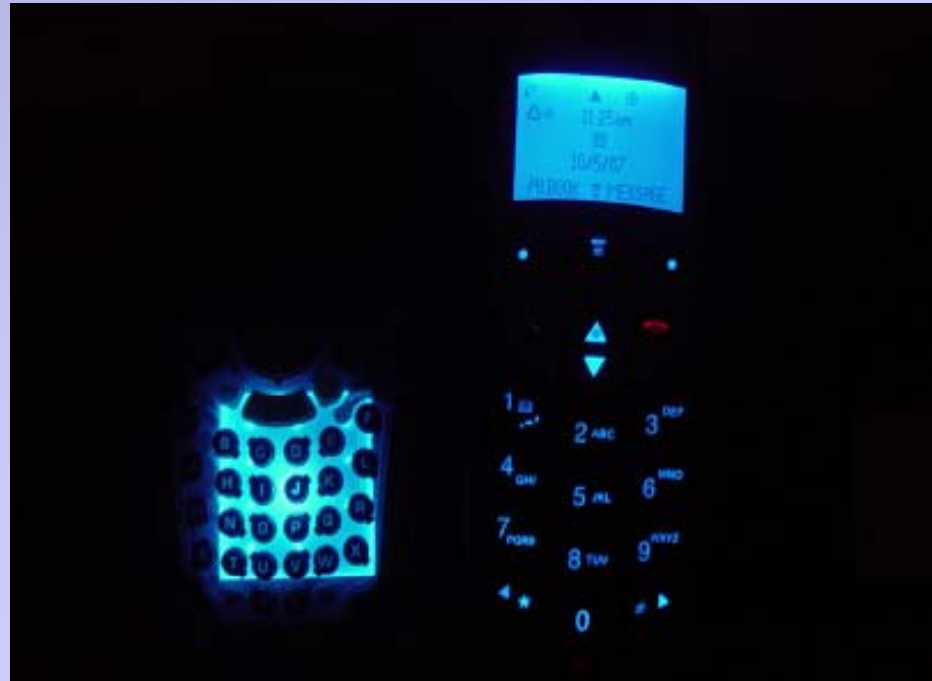






## Another World's First From VISUS Photonics

Ultra Thin Face Coupled Keypad & Keyboard Backlighting  
12-25 keys keypad backlit by a single low cost face-coupled  
Top View standard Blue LED (110 mcd)

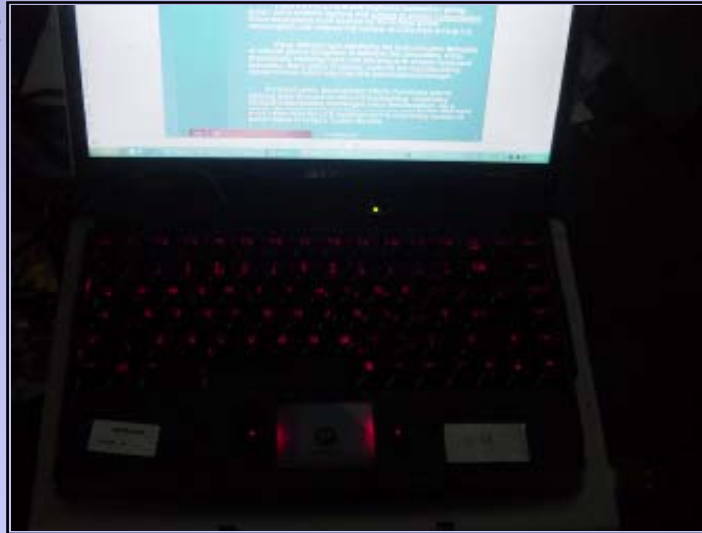


Single top view low rank Blue LED (0.1 x 0.1 mm chip;  $I = 110$  mcd) replaces 25 similar LEDs providing 50% higher ideally uniform luminance and factor x50 higher power efficiency. LED is face-coupled by a patented FoCOUPLER™ foconic optical coupler to a center of 0.2mm ultra thin flexible LGF with directional localized extractors.

**Another World's First**  
**Flexible Backlit Keyboards for Notebooks.**  
**You do not have to keep all room lights on anymore.**

With a width of 0.1 - 0.2 mm these K-BLUs are readily mountable into slimmest devices like notebooks and standard keyboards. Illuminated keyboard is a major ergonomic enhancement easing operation in both lit and dark environments.

Multi-Color option for multilingual keyboards.



State of the art backlit keyboard with multiple red LEDs



Flexible Rubber keypad with plastic keycaps , powered through a standard USB cable.

**Power Efficiency  
(Nit/W)  
Improvement Factor**  
  
**>60**

	Original	Visus multifunctional LGF
Number of LEDS	95 LEDS	6 – 9 LEDS (Reducible to 3 – 5 LEDS on demand)
Power	~4 W	0.3 – 0.6 W
Luminance	3.5 nit	25 - 35 nit

## Touching The Ultimate Bottom



Plummeting power consumption, size and cost of new keypad lighting products from our high-tech pipeline.

**Visus Keyboard Illumination Products offer the following advantages:**

- ✓ Available in any size ranging from MP keypads to large keyboards for notebooks & desktops.
- ✓ Fully qualified by one of the world's leading handset makers after exhaustive AFM testing. Excellent key activation & Uniformity
- ✓ Edge coupled and Face Coupled LGF options
- ✓ Powered by low cost face-coupled Top View standard White & Blue LED
- ✓ Higher keypad luminance - by Factor 20 - 30.
- ✓ Fewer LEDs – by Factor 5 – 10. Just one LED for most MPs. 2-4 for large keyboards.
- ✓ Incredibly Slashed power consumption:
  - ✓ by Factor ~50 for conventional MPs.
  - ✓ by Factor ~10 for most MPs with the best competitive LGF.
- ✓ Multicolor.
- ✓ Ultra Thin Light Guides (down to 0.1 - 0.2 mm) readily mountable into the slimmest devices.
- ✓ Allows dual mode lighting – both silhouette and accent lighting from the same lightguide.
- ✓ Easy assembly & Excellent key activation .
- ✓ Reduced cost.

## Slashing Cost & Power For Your Device: VISUS VS. Competitors

Let us consider a practical example of keypad backlighting (K-BLU) for a typical MP. Recently thin light guide films (LGF) have been offered by some vendors. These films employ at least two SMD edge-coupled high bright side view LEDs. Due to a low light extraction performance of these films a resulting keypad luminance is close to a level accepted in existing devices with 6-10 top view LEDs. However there is no cost reduction since high bright LEDs are much more expensive. With an added cost of the film one can end up with a new K-BLU being even more expensive. Clearly there is only a moderate, if any, reduction of required power.

On the contrary, Visus' K-BLU in view of their superior optical properties offer a significant price and power consumption benefits. Indeed let us consider a typical example of Samsung D-500 MP shown in one of the following slides. This K-BLU uses one SMD edge-coupled high bright side view LEDs with a total power of 51 mW and has a luminance of 20 nits, which is five times higher than 3.5 nits of an existing device. Total power efficiency (nit/W) improvement factor is 38, partially due to a better efficiency of high bright LEDs. In order to maintain an existing 3.5 nits luminance one can substitute high bright LEDs for one low cost white or blue LEDs with an axial intensity of just 150 mcd similar to currently used top view LEDs. Result:

**Power slashed by a factor of 38;  
LEDs cost slashed by a factor of 10;**

Clearly a designer is free to decide on price-performance trade-off and set a target luminance. On top of these benefits extra silhouette lighting (see below) can be provided over a whole keypad area without increasing a number of LEDs and their power.

On special demand from customers Visus can design advanced K-BLUs with just one low cost LED with intensity of ~300 mcd slashing

**LEDs number & cost by a factor of 10  
Power by a factor of ~5**



## Comparison of RAZRs

In daylight



Original      Visus

In the dark



Original      VISUS

Power Efficiency (Nit/W)  
Improvement Factor

>40

	Original Razr (left)	Vs.	Visus enhanced Razr (right)
Number of LEDS	EL		One white LEDS
Power	150 mW		59 mW
Luminance	3.5 nit		60 nit

***Allows dual mode lighting – both silhouette and accent lighting from same light guide.***

## LG Latest MPs.

**VISUS' LGF has factor X10 higher keypad luminance than a second best competitive product.**



Visus      Original



Visus      Original

**Power Efficiency (Nit/W)  
Improvement Factor**

**>40**

	Original LG (right)	Vs.	Visus enhanced
Number of LEDs	12 blue LEDs		One white LED
Power	460 mW		40 mW
Luminance	3.5 nit		60 nit

**Optionally with one low cost face-coupled Top View standard LED (110 mcd)**

*Allows dual mode lighting – both silhouette and accent lighting from same light guide.*

## Comparison of SAMSUNG D-500



Original

Visus

Original

Visus

Power Efficiency (Nit/W)  
Improvement Factor

>40

	Original Razr (left)	vs.	Visus enhanced Razr (right)
Number of LEDS	10 White LEDS		One white Edge-Coupled LED
Power	384 mW		51 mW
Luminance	3.5 nit		20 nit

**Optionally with one Top View 150 mcd LED!**

## MultiColor Visus K-BLU versus Traditional Keypad MP illumination. Nokia



**Visus BLU is brighter (by factor x50) and uses only one RGB LED!**

Technology.



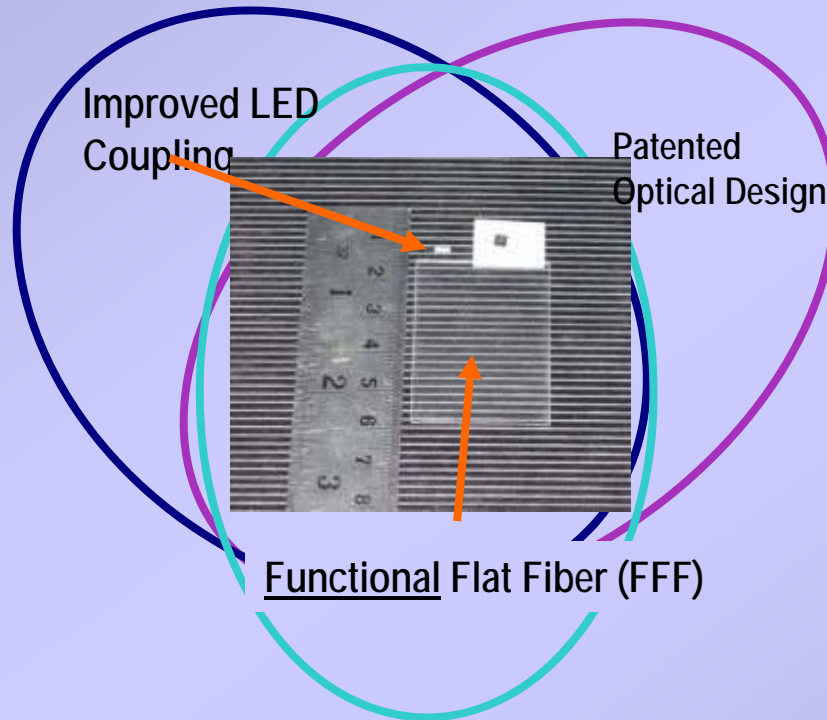
## Innovative Keyboard Illumination from Visus

Visus offers improved Keypad Backlighting Units (K-BLU) for a wide range of electronic devices, which radically change the existing systems:

- 1-2 LEDs instead of 8-25 LEDs. (SMD LEDs).
- ~ 2 - 5 % of the current backlight consumption.
- Ultra Thin (0.1 mm – 0.4 mm). Easily fits the slimmest devices
- Option - a Tri Color system with a full color gamut vs. monochrome system today. (using either RGB or monochromatic LEDs).
- Option - higher keypad luminance to get sunlight readability at reduced power.
- Option - dual mode silhouette and accent lighting over a whole Keyboard area.
- Fully integrated one-part design easy to mount into modern slim devices.
- No E.M.I.

# Visus Revolutionizes Keyboard Illumination

**Available Now**



Revolutionary Keyboard Illumination uses unique patented optical design and special optical materials to fuse three core technologies – LEDs with improved light output, Optical Design and Functional Flat Fiber, to deliver light to **ONLY** where it is needed.

Benefits: power efficiency, cost, simple assembly.

Standards being adopted: Compliant with manufacturer's specs

## Keyboard Illumination: Incredible Energy Waste

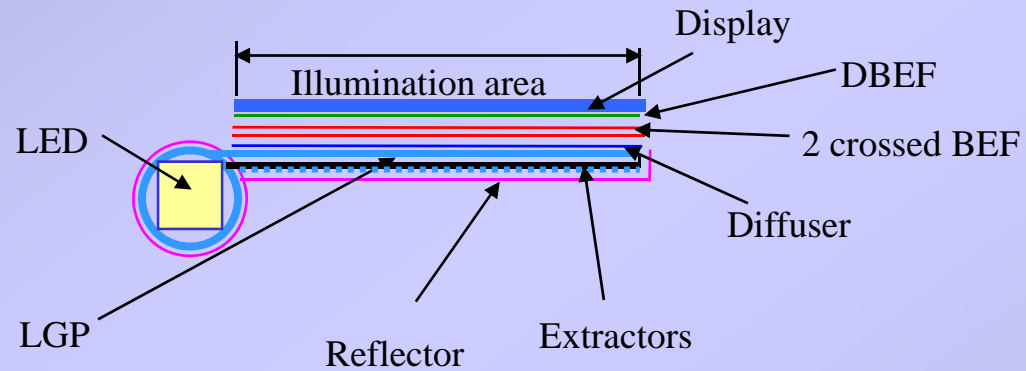
Existing K-BLUs employ “Direct Illumination” method whereby a proximally mounted monochromatic LED directly illuminates each key. As a result only a tiny fraction less than 0.1% of LED’s flux is directed through a particular key with the rest being wasted. Smaller LED lamps have lower luminous efficacy resulting in a further deterioration of overall energy efficiency of the system. Because of the premium on a real estate in compact devices and cost considerations, no multiple RGB LEDs can be incorporated in such a design to provide multicolor illumination.

A need to mount multiple LEDs for each key is another serious shortcoming of “DI” K\_BLUs, adding to cost and mechanical complexity of design.

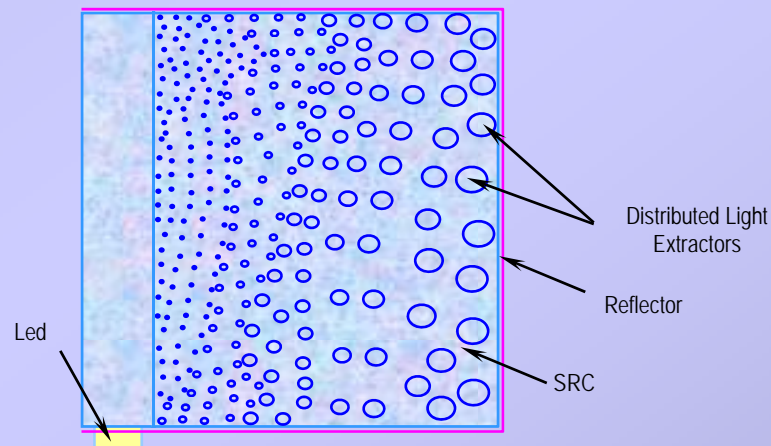
### **Solution: HOW® (HYBRID OPTICAL WAVEGUIDES):**

- Configurable for transfer, distributed injection, and distributed directional ejection of radiant energy.
- Featuring a number of key improvements vs. existing K-BLUs: 50 - 200 um
  
- Considerably higher power efficiency, up to in most configurations!
- Drastically reduced thickness down to a factor 50-100. LGF can be thinner by a factor of 10 than a coupled LED
- Suitable for a broad range of BLUs of any size
- Effective color mixing providing a uniform color over an active display from a single RGB LED triad.
- Integrated design with LED being monolithically mounted (embedded) into an LGF
- Single part BLU eases its assembly into major device and insures high repeatability of lighting characteristics in mass production.

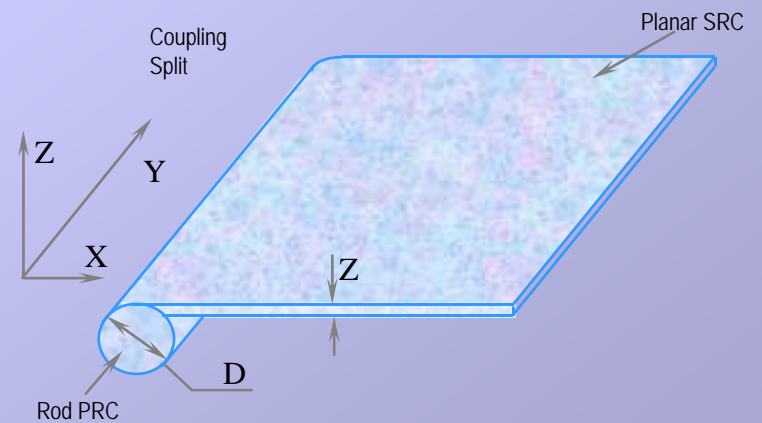
# Schematic view of the preferred embodiment of a HOW<sup>®</sup> backlight



Bottom view of the LGP with distributed flux extractors.



Three dimensional view of the HOW - HOPE



## VISUS' Waveguide Manufacturing Partner

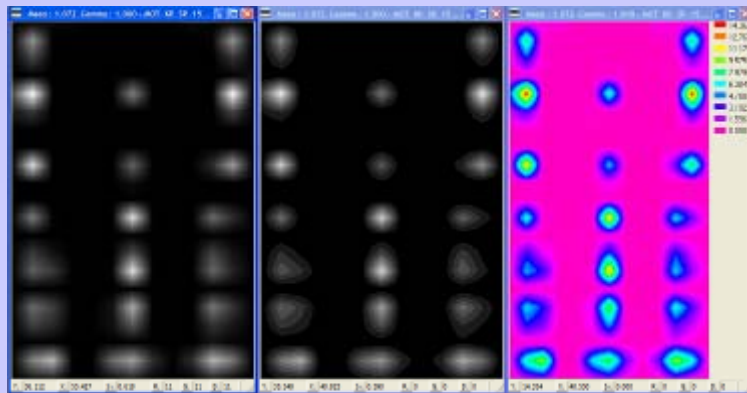
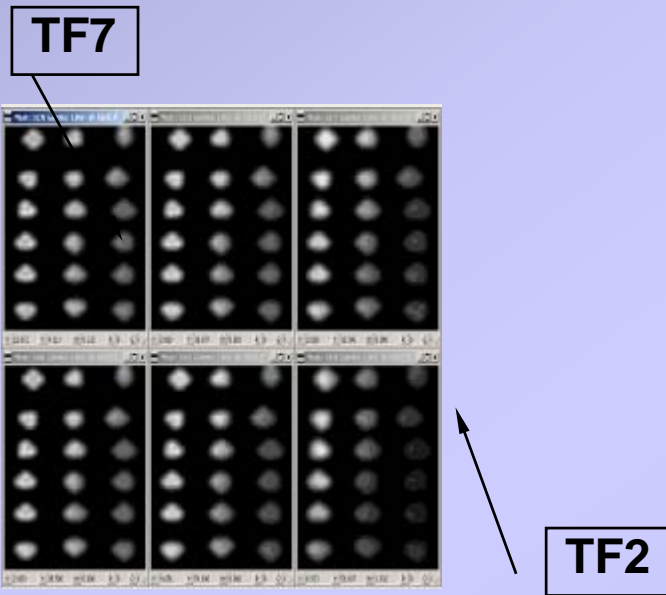


- Our manufacturing partner is part of a large family of companies, based in USA with over 4 million square feet of manufacturing and distribution.
- Product line encompasses a variety of plastic optical products for a range of applications, such as data communications, sensing and illumination.
- Proprietary technology for producing ultra thin flexible waveguides ideally suited for cellular phone illumination.
- Mass production facilities situated in the US. Full production readiness for the unlimited quantity with a lead time of weeks.



# Visus Technology

## Optical Design of an Optimized K-BLU for a Specific Cellular Phone

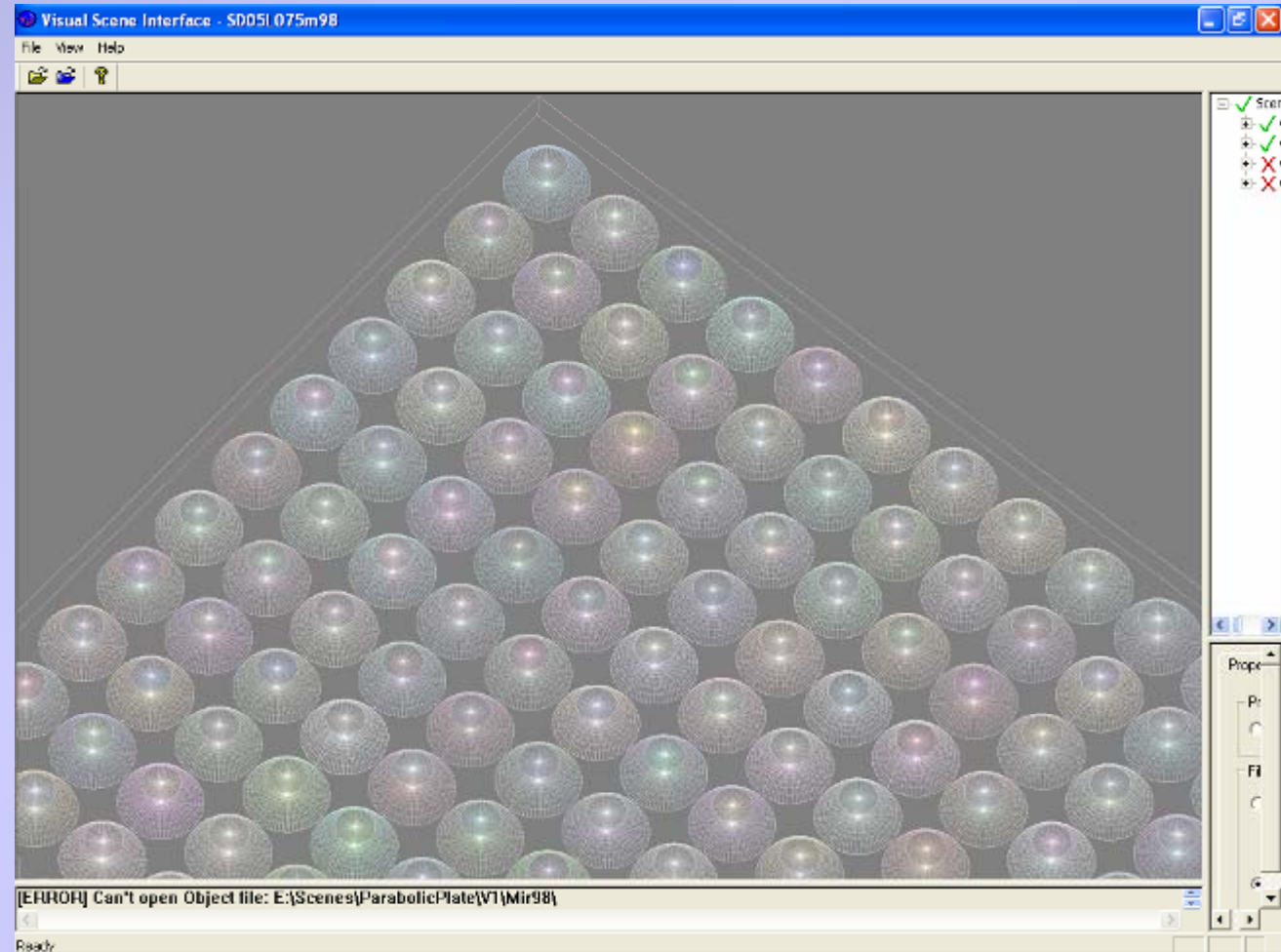


Visus's proprietary KEREN CAD optical design software, through an automatic iterative optimization process, maximizes luminance and uniformity of K-BLUs by simultaneously changing multiple design parameters.

This pictures of computer simulation results illustrates the evolution of successive improvement of luminance output and uniformity starting from the lower right corner (TF2) and going to the upper left corner (TF7).

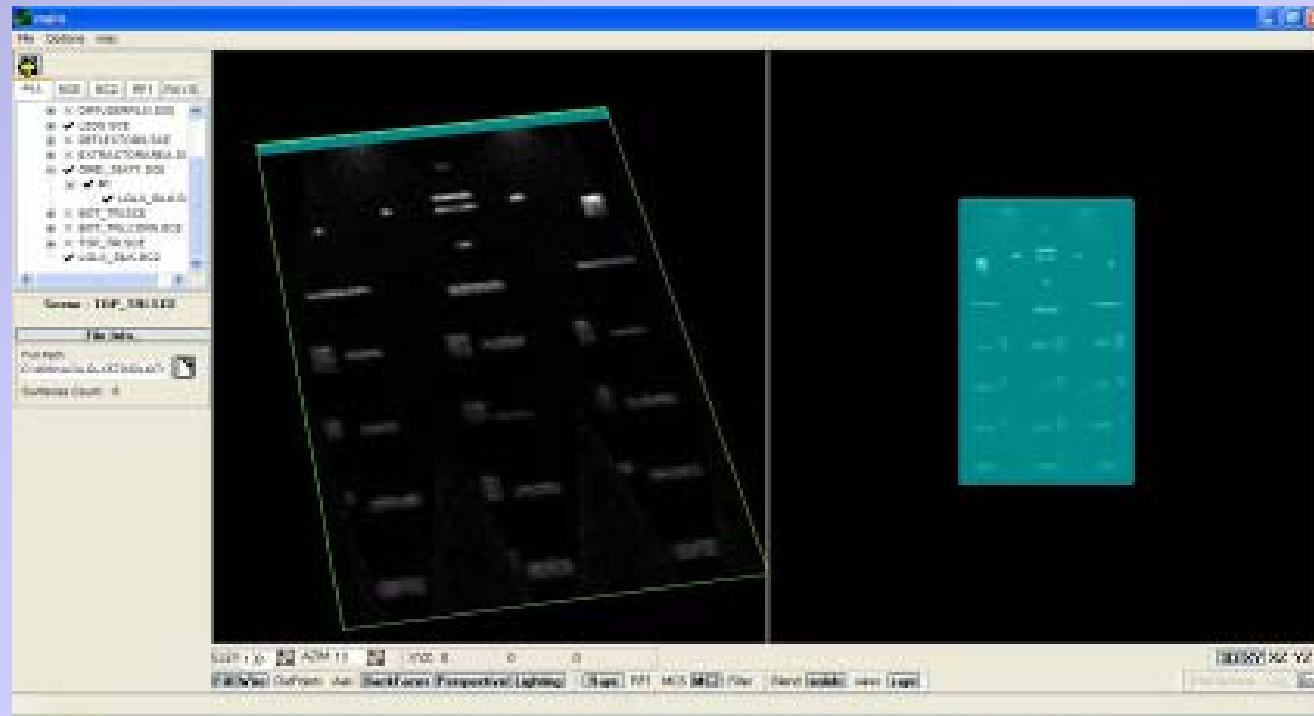
# Visus Technologies

## Example of Light Extracting Micro Structures



## Visus Technology

Optical Design of an Optimized K-BLU for a Specific Cellular Phone Using a Single LED and a large number of patented Activation Hole Extractors And TIR Mirrors To Ensure a Maximal Flux Utilization.



Photoreasistic Luminance By KEREN™  
Software

## 3D View of K-BLU With Backlit Areas

