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Optimisation and Design of Display Backlighting

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Product Example - 12.1” LCD



12.1” LCD - Standard module used in ATM (cash machines), notebooks, and similar applications.

Typical brightness of 450 cd/m² (nits)

Requirement - To be high brightness “sun-light readable” display

“This is a display from a major manufacturer!”

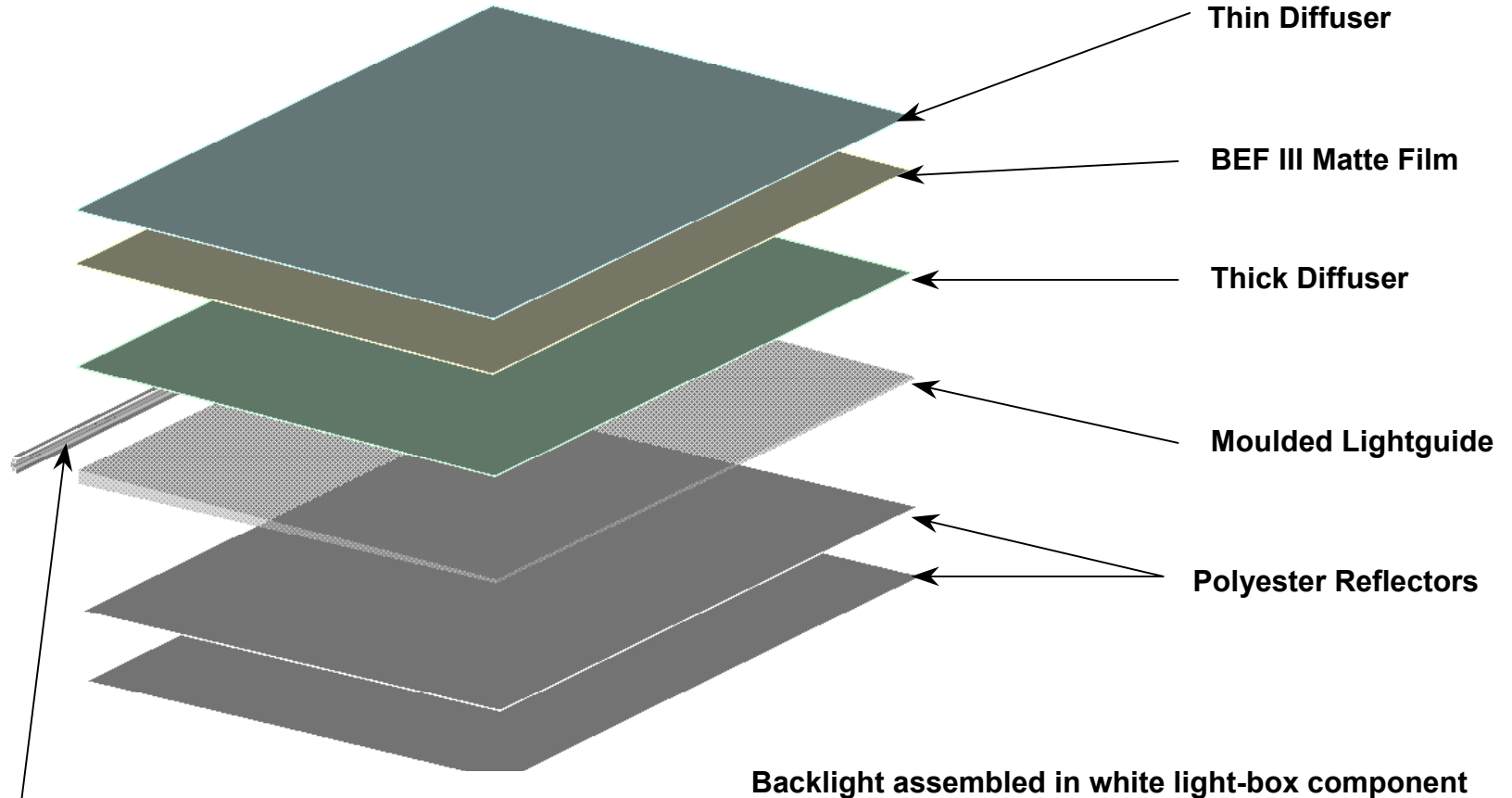
“They must know what they’re doing.”

“You can’t possibly make it any brighter!”

Product Example - 12.1" LCD



Existing Backlight Module Assembly



2 x CCFL Tubes in Al Reflector

Backlight assembled in white light-box component

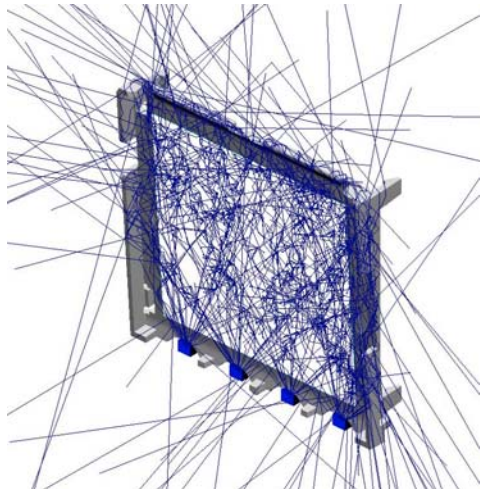
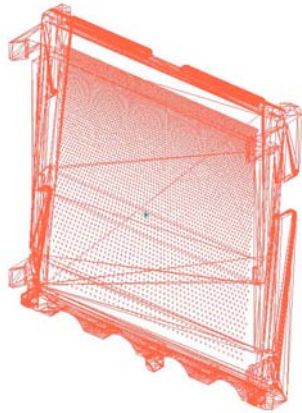
Product Example - 12.1" LCD



- Technology 2-3 years old!
- Remove two layers of white reflector material and replace with a single layer of a more efficient material to prevent light bleed, shadowing and provide improved light recycling - improvement 10%.
- Optimised design of the lightguide component light control pattern - improvement 5%.
- Optimising the light control pattern for improved evenness, diffusers can be removed - improvement 20%.
- Improvement of the CCFL reflector and the light input characteristics - improvement 2-3%.
- Increase in brightness from 450cd/m^2 to 630cd/m^2 - This is with NO change to CCFL or drive.

Yes, POL can make it brighter!
Overall, an improvement of >40%
can be achieved.

Optimisation Process



3D CAD models are transferred directly to 3D raytracing environments

Light source simulation models are assembled

Material and surface finish scatter parameters are defined

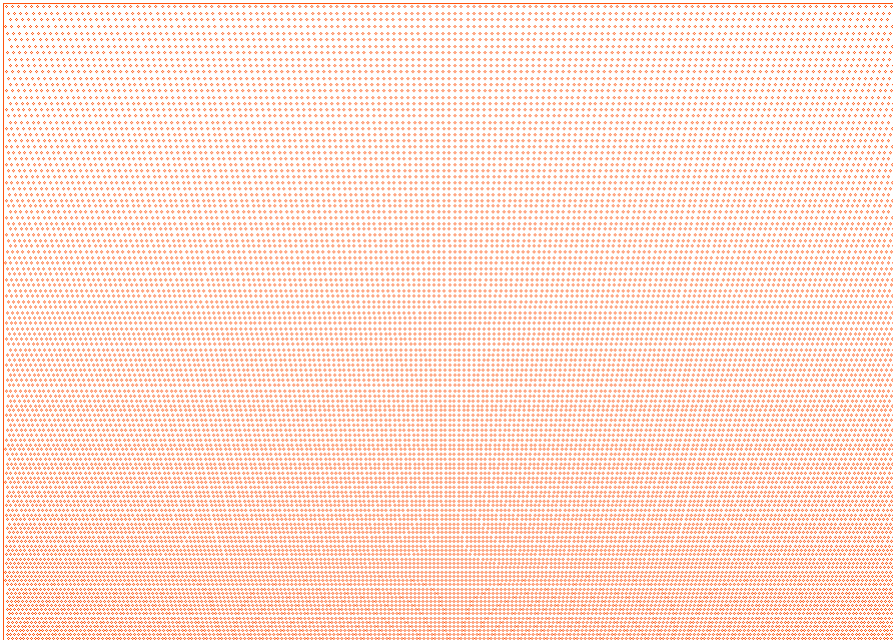
Light control texture pattern area constructed

3D raytracing analyses launch typically >10 million rays.

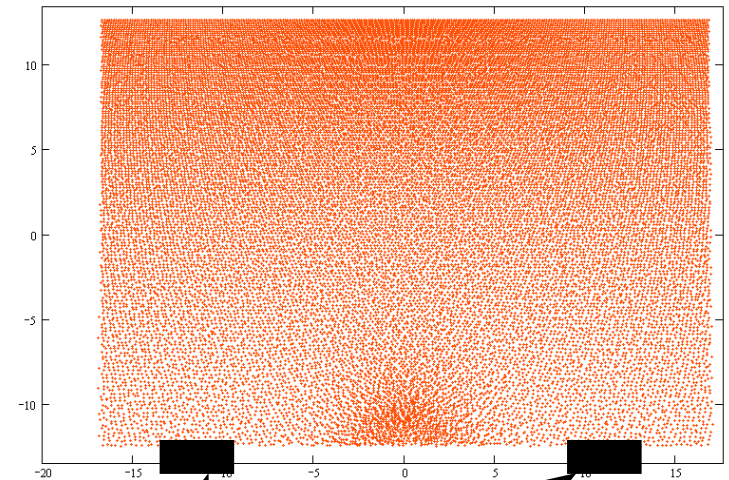
Radiometric target surfaces collect illumination performance data.

“Real-world” performance simulation

Optimisation Process



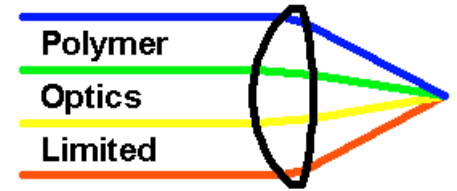
Typical Laptop Display Light Control Pattern
for CCFL Light Input



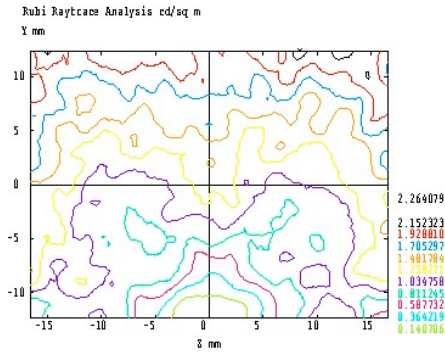
Typical Mobile Phone Light Control Pattern

LED Positions

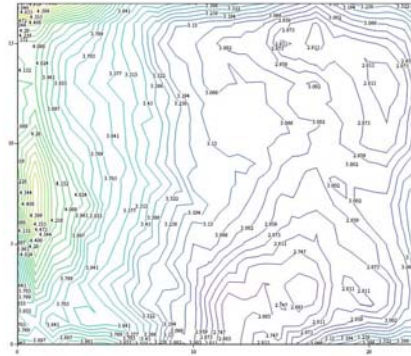
Optimisation Process



Analysis



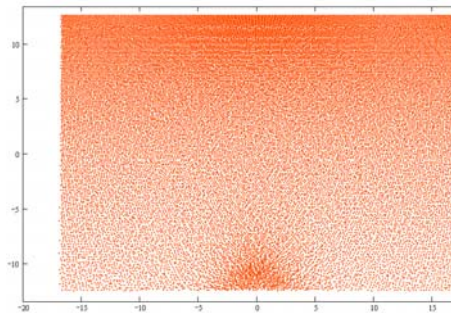
Measurement



**Closed-loop design
and performance optimisation**

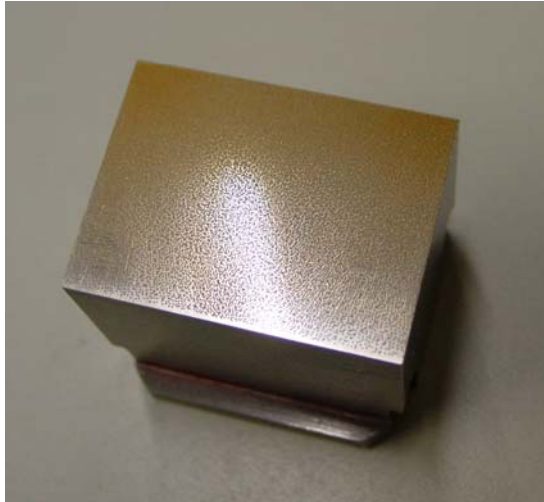


Optimised Display



Pattern Iteration

Manufacturing Processes

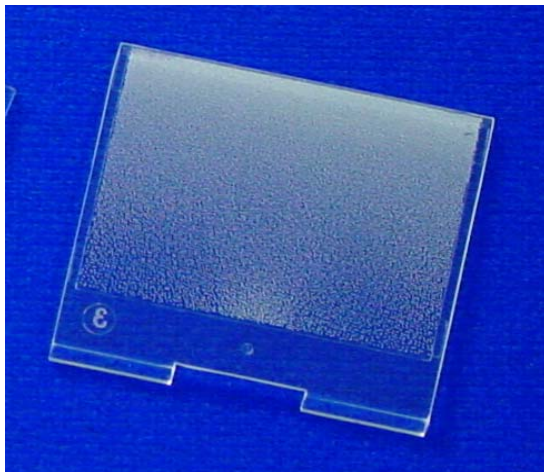


Laser Patterning of Tool Surfaces

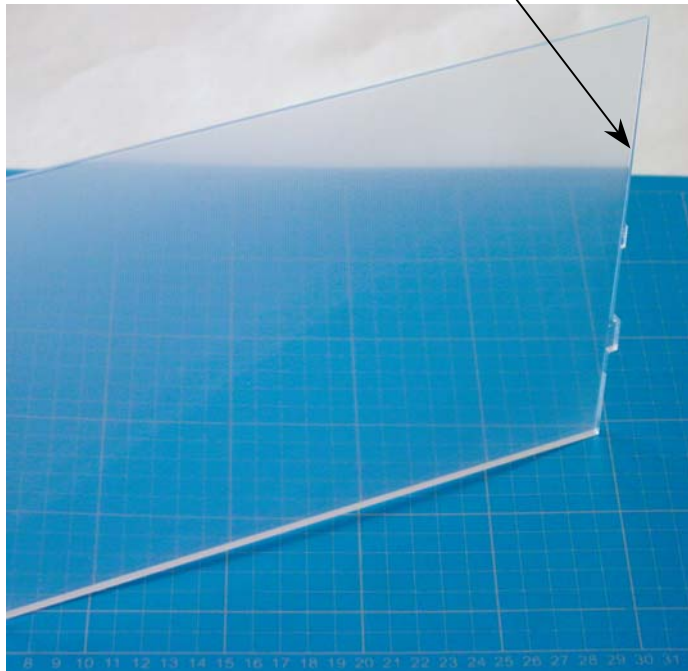
Medium to high volume manufacture by injection moulding

Small to medium sized components up to 400mm

Multi-cavity tooling with very high repeatability



Manufacturing Processes



Direct Laser Patterning of Lightguides

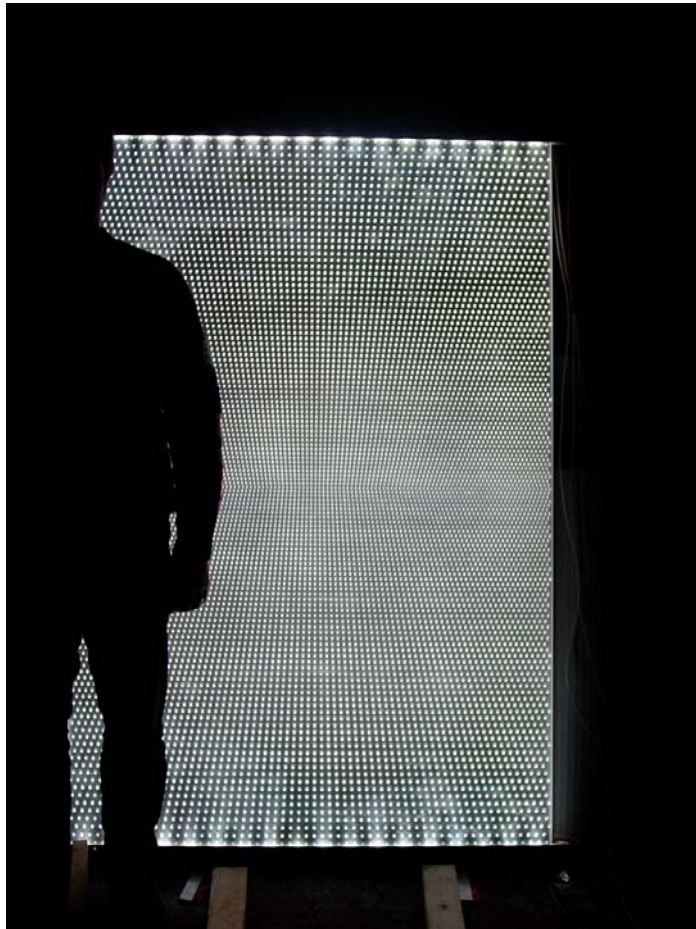
Low to medium volume manufacture

Medium sized components up to 400mm

Low investment cost - ideal for prototyping

Very high repeatability part to part

Manufacturing Processes



1800mm x 1200mm Signage Backlight

Direct Pattern Machining of Lightguides

Low to high volume manufacture

Medium to large sized components up to 4 metres

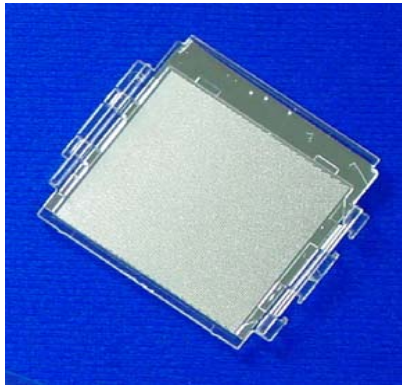
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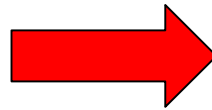
Manufacturing Processes



Size



Mobile phone size



4m x 3m LED Illuminated Bill-board
(Courtesy of www.ambisol.co.uk)

Volume

1 off



Volume Production
(up to many millions)

Manufacturing Processes



Sainsbury's Store

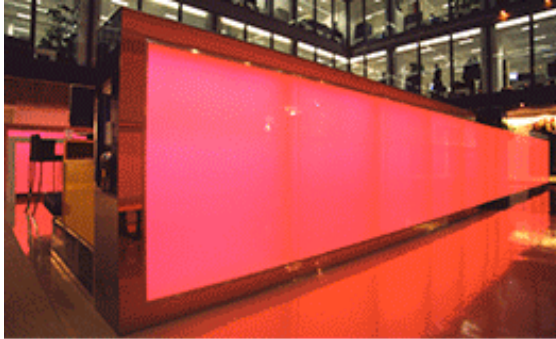
Team Valley, Newcastle upon Tyne

Courtesy of www.ambisol.co.uk



Total of 100m² of LED Illuminated Backlight Panels

Manufacturing Processes



Colour Changing Wall
at Head-office of Major Film Studio
Central London

Courtesy of www.ambisol.co.uk

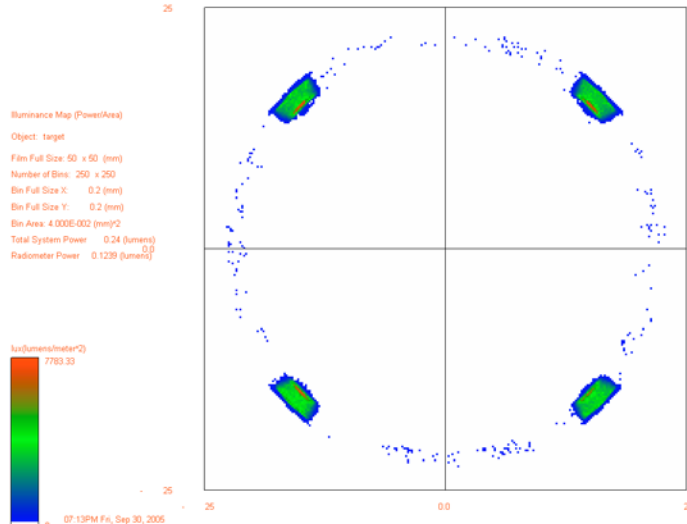
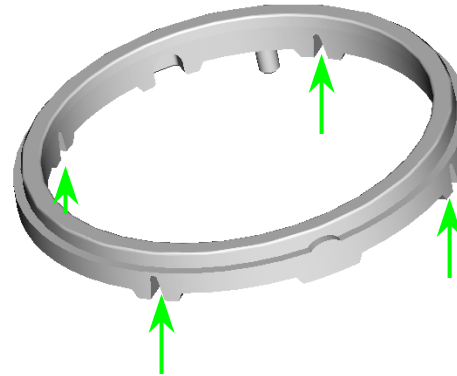
Light Control Patterns
can also be applied to glass panels for
Architectural Applications

Other Displays

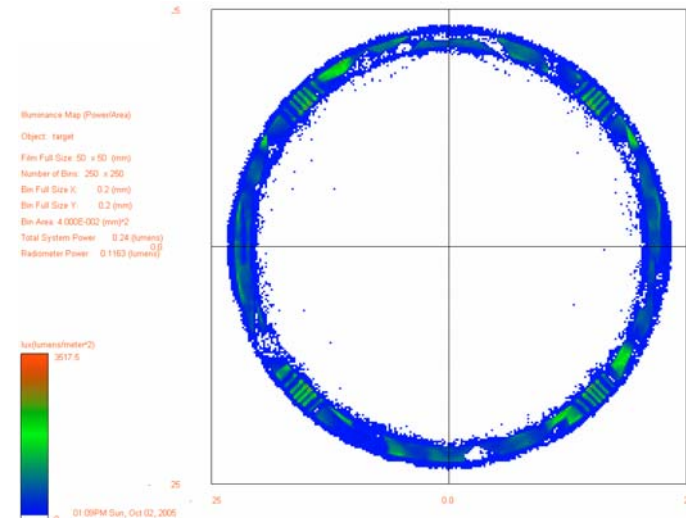


Remote Control Unit
Illuminated Button Surround

Illuminated with 4 LEDs where shown



Original Customer's Design

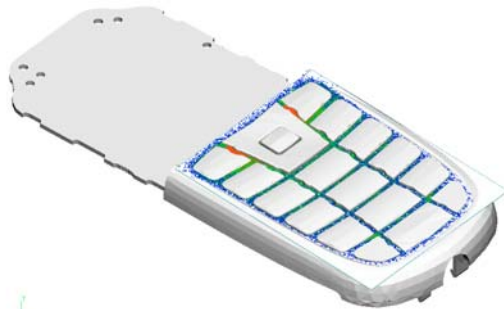


POL Improved Design

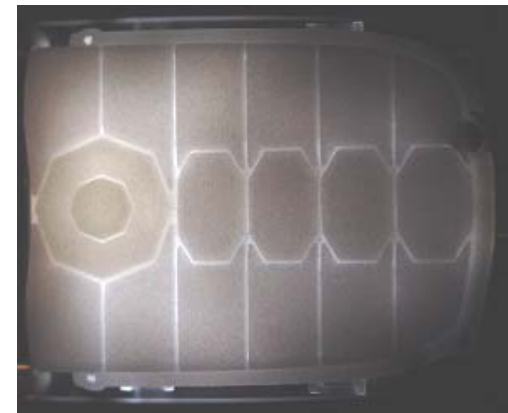
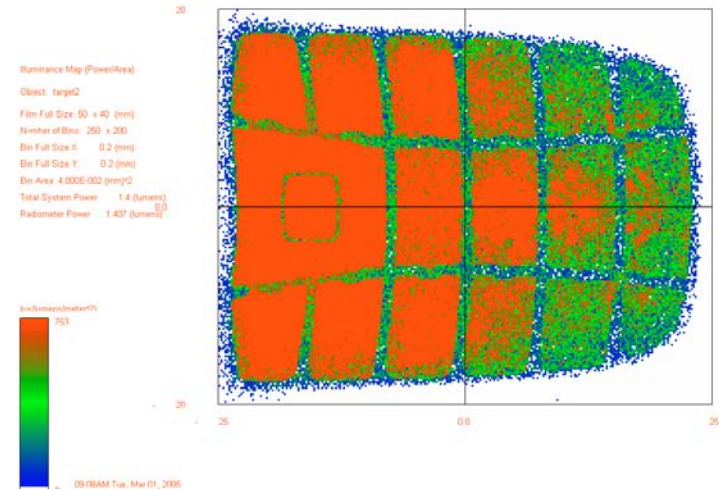
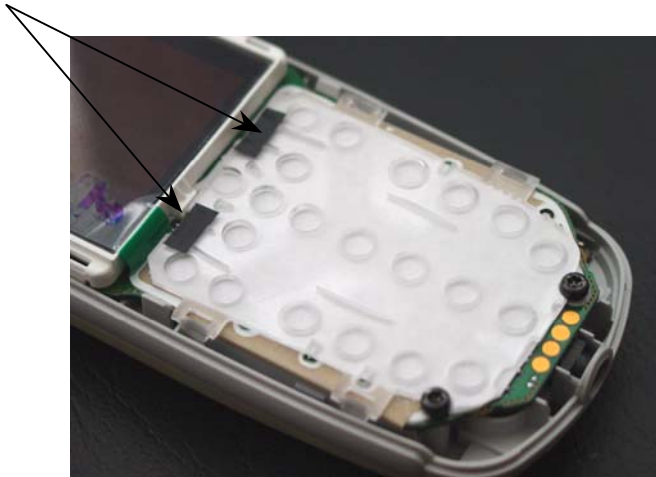
Other Displays



Mobile Phone Elastomeric Keypad Illumination



LED Positions

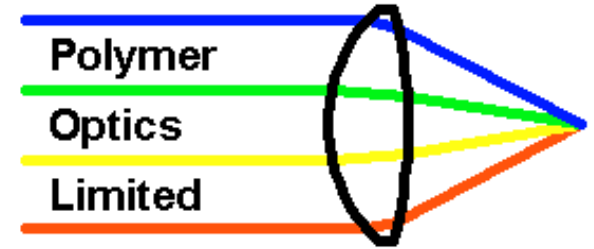
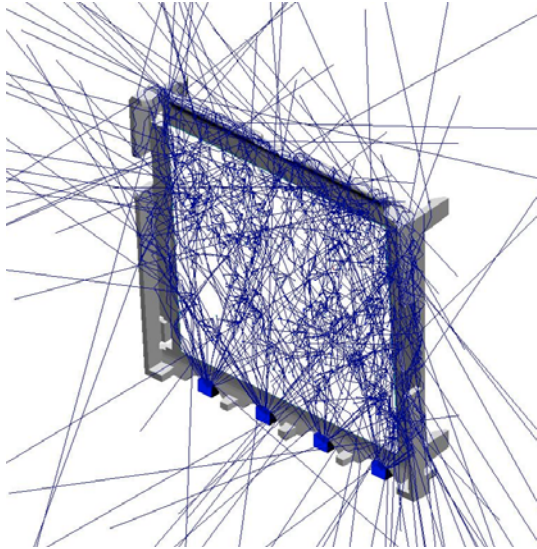


Summary



- POL continue to develop advanced optical design and analysis techniques for display illumination systems.
- Laser Machining is used for initial prototyping, development tooling, multi-cavity production tooling, or product production.
- POL have developed direct machining techniques for plastics and glass to produce large area lightguides in volume.
- Product sizes can be developed from millimetres to metres
- Processes can be scaled in production volume from 1 to infinity

The Bright Solution - From Concept to Volume Production



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