Laser Displays: Life-Like Displays

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Lasers (solid state lighting) are enabling projection display from cell phones ... to TV ... to digital cinema

For the consumer, laser-lighting offers a unique viewing experience
Life-like images - a “True Color Display” (>90% of what the eye can see)
Identical images from all laser-based displays

For consumer electronics manufacturers
A highly competitive display solution (low-cost with a long life time)
A novel and long-term solution
This talk answers the following key questions:

- What is a laser?
- Why NECSEL™?
- Why do I want lasers in my Projection TV?
- What are the target markets for lasers?
- Why do I want lasers in my LCD backlight unit?
- How do lasers maximize the HDTV experience?
- How do lasers penetrate PTV and enable all projection display applications?
Lasers are a unique light source

Lasers are an extremely bright, reliable, efficient, small, and cost effective source of light

Displays companies have wanted lasers for a long, long time …
What is a Laser?

Completely different than lamps or LEDs … We know beam propagation characteristics:
1.) beam waist ($w_o$)
2.) beam divergence ($\theta$)
3.) waist location ($z$)

"Lasers", A.E. Siegman Chapters 16 & 17

Gaussian beams

Geometry and behavior defined by a few key parameters:
1.) beam waist ($w_o$)
2.) beam divergence ($\theta$)
3.) waist location ($z$)
Narrow spectral width (< 1 nm)
Predictable aberrations, use digital correction with cheap spherical optics
Enables thin designs (10:1 screen to thickness ratio)

Extremely bright (> $10^5$ W/mm²str)
LED and Lamp < 1 W/mm²str

High quality beam ($M^2 < 1.5$)
Small spots, efficient fiber-coupling

Instant-On & Direct Modulation

Highly Polarized

Completely different than lamps or LEDs …
Displays companies have wanted lasers for a long, long time …

Any technology so far was:
- Too expensive!
  - (DPSS....)
- Lacking power or wavelength!
  - (Semiconductor lasers....)
Why Necsel Lasers?

LASER DESIGN CONSIDERATIONS

Wafer scale manufacturing and testing enables low cost & high volume

* Novalux Extended Cavity Surface Emitting Laser

Very unique laser low-cost technology - high volume
Why Necsel Lasers?

Wafer scale manufacturing and testing enables low cost & high volume

Mass Volume - Low Cost
- All components wafer produced
- Fully tested at wafer level (high yields)
- Automated line assembly
- Cost similar to UHP lamp at 1 million/year with higher cost compressibility
- Cost model validated by several CE companies

* Novalux Extended Cavity Surface Emitting Laser

Very unique laser low-cost technology - high volume
Why Lasers for Projection Display?
Why Lasers for Projection?

Lasers are the ONLY light source that produce saturated primary colors that reach **over 90%** of what your eye can see.

- Lamp-based ~ 40 – 45%
- LEDs ~ 55 – 60%
- LCD and Plasma TVs ~ 40 – 45%

**Color stability and consistency**

Very unique laser low-cost technology - high volume
RELIABILITY

Reliability has a “life time” aspect:
- **Lamps** – get replaced twice a year and fade in power
- **Lasers** – “life time” is >30,000 hours at 100% power

Reliability has an “endurance” aspect
- Lasers have constant power and constant wavelength over time & temperature
- For the first time ever, your D-Cinema picture will never change!

Life-like images … Forever!!
Why Lasers for Projection?

POWER SCALABILITY FOR ALL SIZES

Necsel™ * Lasers are scalable in power

Same design
Same package
Same colors
Low cost volume manufacturing

Viewers will see true color images of the highest quality ever seen – even on the largest screens.

* Necsel: Novalux extended cavity surface emitting laser

Same RGB Laser Packages for All Size Projectors
Why Lasers for Projection?

MODULARITY

Lasers are compact modules

Group lasers to get to 20,000 lumens

Easily integrated and serviced

Fiber-coupling can only be done with laser light sources
Laser TV –
The Ultimate Big Screen Experience

- Life-like true-color images
- No screen size limits
- ¼ power consumption of plasma
- ½ weight plasma & LCD TVs
- As thin as plasma & LCD TVs
- Highest resolution

* Color in % of what human eye can see
A Disruptive Light Source

- 50K hours full power with no color shift
- 30% cost reduction from existing RPTV
- $\frac{1}{2}$ cost of plasma and LCD for > 50”
Why Lasers for TV?
COST

What are the real cost problems in Microdisplay?

- Lamp Replacement
- Optics
- Microdisplays

Why Lasers for TV?
Why Lasers for TV?

COST

Lasers Provide Solutions

- Never Needs Replacement
- Fewer Optics
- Smaller Microdisplays

DLP – LCD - LCOS
Why Lasers for TV?

LOWER-COST PROJECTORS

Fewer Optics Makes Simpler Light Engines Possible

Cost Decrease potential
> 30%
DLP, 3LCD, and LCOS

Reduces illumination optics, microdisplay, projection optics, & light source costs
Why Lasers for TV?

BRIGHTNESS

Who wants a big screen with only 300 nits and a gain 5 screen??

Lasers provide unlimited lumens
   In particular, Novalux lasers are scalable arrays
   … if you need more power, either add more lasers or use a bigger array

   Any screen size can have high brightness and low gain

Major Opportunity: Wider viewing angles with 1000 nits will allow penetration of signage market (airports, train stations, etc.)
Lasers offer substantial weight savings.

- 65” Plasma TV: 175 lbs
- 65” Laser TV: 85 lbs
ELECTRICITY

65” Plasma TV
850W

65” Laser TV
200W

Get your Laser TV for free!! Save $300/year of electricity
CONSUMER COST

65” Plasma TV
$9995*

65” Laser TV
< $2500

Laser TV has lowest cost for big screen & high resolution

* Panasonic 65” 1080p at BestBuy on Mach 12, 2007
Laser TV

THIN

Hang it on a wall

No more bulky rear projection architectures

65” Laser TV < 8” depth
Revolutionary New Performance and Viewing Experience Requires New Branding

Laser TV

Big Screen  Immersive  True High Definition  Thin Modern Look

Unrivaled Picture Quality
STARTING 2008 SEASON

**Laser TV**

- 50” and above (Home Theater)
- 1080p
- xvYCC (>200% NTSC color capable)
- ½ weight of Plasma
- ¼ power consumption of Plasma
- 6” thin

Several Key CE Brands
Roadmap to Market

CES 2006 (Jan 2006)
- Novalux demonstrate 3LCD and DLP Laser TV
- Large Brand Laser Demonstration in Private Suite

CES 2007 (Jan 2007)
- SONY: Laser TV on the Floor (xvColour)
- InFocus: Laser Home Theater on the Floor
- Several brands: TV in Private suites

Christmas 2007
- One TV brand launching Laser TV

Season 2008
- Mass-volume market with top 5 key brands
Laser Adoption in Consumer Display

- **Projection Microdisplay**
  - Laser TV
  - Home/Data FP
  - Pocket
  - D-Cinema
- **Direct Scan**
  - Cell Phones
  - Camcorder
  - PDA's
- **General & Specialty Lighting**
  - LCD Back Lighting
Lasers enable usable pocket projectors

**Pocket Projection**

**Affordable:** smaller and cheaper MD  
**Brighter:** up to 300 lumens
Pocket Projection

Convenient – Versatile – Fun - Affordable - Small

Launch 2008
Through your gadgets …

Project from your PDA …

… or camcorder … or phone

Mobile Projection

On-the-go 2D MEMS scanning projection enables ubiquitous laser products
Mobile Projection

Project Anywhere – Battery Friendly – Share Instantly – All-in-One - Impromptu

Launch - Late 2008 / Early 2009
Head-up Display

Existing solution is backlit LCD panel
  Expensive, hard to see, doesn’t shape to curved windshields, difficult to install

NECSEL currently being tested by major auto companies
  Much brighter (for daylight driving)
  Higher contrast (no ghosting at night)
  Much easier to install (2D MEMS scanner)

HUD is made practical by lasers

Launch - Late 2009 / Early 2010
Lasers can easily be used to backlight LCD panels

**LCD BLU**

Lasers lower cost and improve performance

Samsung 32” LCD TV modified with Necsel laser backlight unit

LCD does not have to miss out on the Laser TV wave!
Lasers highly disruptive

**LCD - BLU**

- Cost decrease > 30%
- Color >200% of NTSC (vs. 80% for CCFL and 110% for LED)

Currently seeding the market – Target launch 2009
Solid state lighting company targeting >$4B market
RGB semiconductor laser technology: **Necsel™** *
Feature a “**True Color Display**” (>90% what the eye can see)

Partnering for mass production of RGB lasers
Seiko Epson, Oerlikon, Young Optics (Coretronics)
Converted several CE companies to use NECSEL in their next generation TVs

Novalux is recognized as the **DISPLAY LIGHTING** high value enabler by the vast majority of display companies worldwide

Several CE brands have introduced their NECSEL Laser TV at CES 2007 and going to market in 2008

* Necsel: Novalux extended cavity surface emitting laser
Lasers enable projection business technically and economically

Lasers offer a unique viewing experience with lifelike colors for the first time

Laser brings consistent color displays through all display forms

Companies are positioning to launch Necsel-based products

www.novalux.com
Lasers are a platform for all types of displays

In your phone...
In the cinema...
In your pocket...
In your home...
In your car...

Thank you for your attention

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