



Enabling the Smart Society

OCTOBER 22-25, 2012  
HYATT REGENCY ORANGE COUNTY



# Flat Panel Displays

## Overcoming High-Ambient Light Conditions

Ferdinand Tercenio, Display BU  
Sr. Applications Engineer

**Class ID: 4C04I**

Renesas Electronics America Inc.

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# Ferdinand Tercenio



## ■ Senior Applications Engineer – REA Display Business Unit

- Provide Technical Customer Support on LCD applications in the Americas
  - Advise solutions to common LCD problems
  - Debug and troubleshoot customer's application
  - Work with NLT Technologies in Japan to resolve advanced technical issues
- Examine REA LCD RMA issues requiring further analysis
  - Scrutinize panel failure
  - Investigate for reasons of failure
- Assist of building demonstration computers and display housings for field demo program
  - Manage Inventory
  - Design and Specify custom peripherals
  - Add software support
  - Debug systems
- 12 years engineering experience in the Display BU

# Renesas Technology & Solution Portfolio

DEVCON



# Display Module Solutions

*Sophisticated solutions Sustainable support*

## LED Backlight LCDs

- Low power consumption
- Long life LEDs
- Thin profile and light
- Replaceable LED light

## Wide P

- More data on a single
- 16:9 aspect ratio

## Industrial

- Robust feature sets
- Long-term product support
- Amorphous silicon (A-Si) displays
- Low-temperature polysilicon (LTPS) displays

## Enhanced View TFT (EVT)

### Enhanced View TFT (EVT)

- Suited for a variety of ambient-light environments
- Proprietary transfective LCD technologies
  - Reflective-Enhanced View TFT (R-EVT)
  - Transmissive-Enhanced View TFT (T-EVT)

ient-light

) technologies  
TFT (R-EVT)  
iew TFT (T-EVT)

## T (SFT)

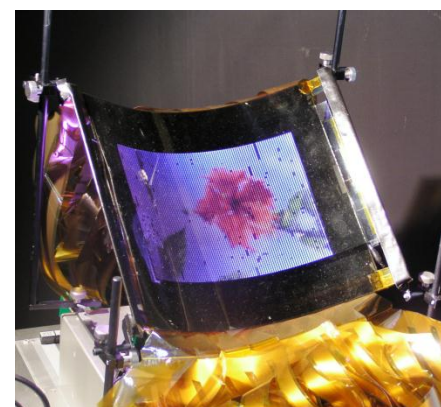
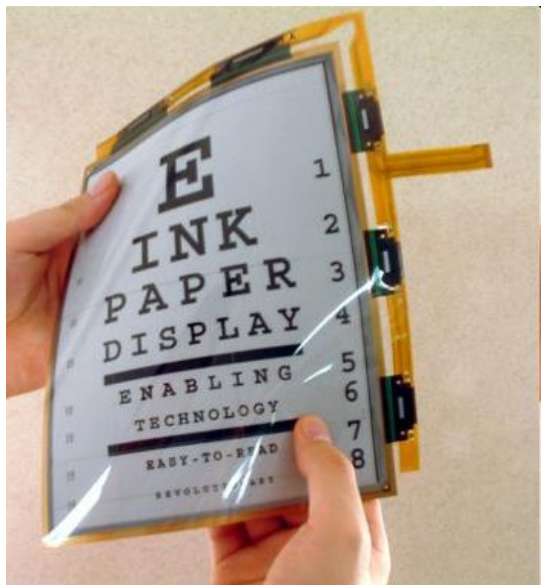
gamut

## Technologies

- 2D/3D displays
- On-cell touch
- PCAP touch



# Innovation



# 'Enabling The Smart Society'

## ■ Challenge:

"In the smart society, obtaining information anywhere one goes will be typical. Usually it is through a display and being able to view these information under the sun via a portable devices or fix stations will require some classes of displays."

## ■ Solution:

*"This class will introduce you to the technologies that are used to overcome high ambient light conditions, understand what light can do to displays and what NLT can do to provide and help solve these problems."*

# Agenda

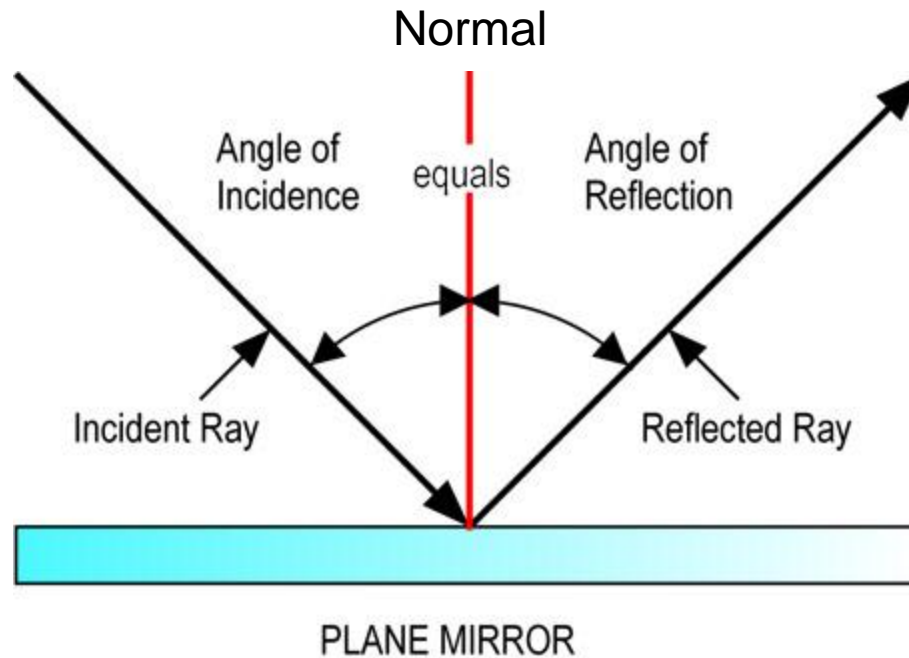
- Properties of Light
- Viewability in High Ambient Light Conditions
- Solutions for High Ambient Light Conditions
- Technology Overview

# Properties of Light



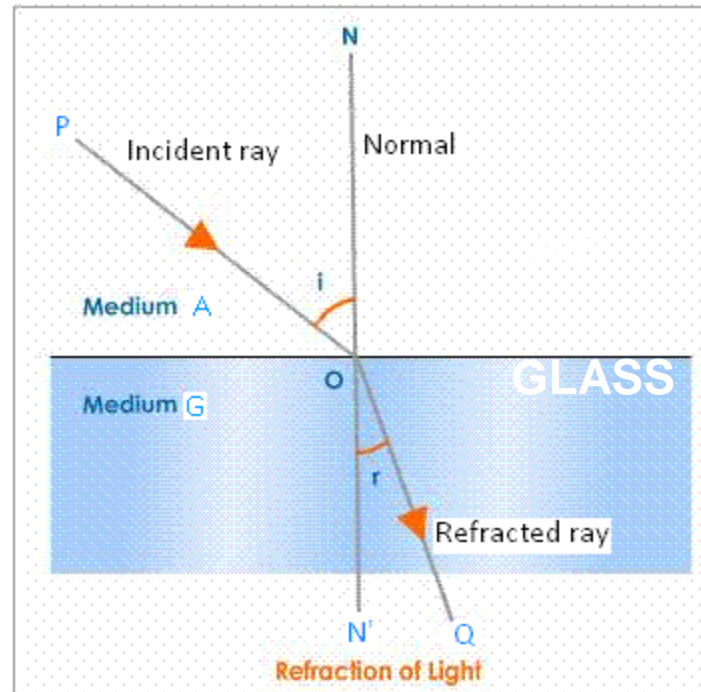
# Properties of Light

- **Specular Reflection** - the mirror-like reflection of light.



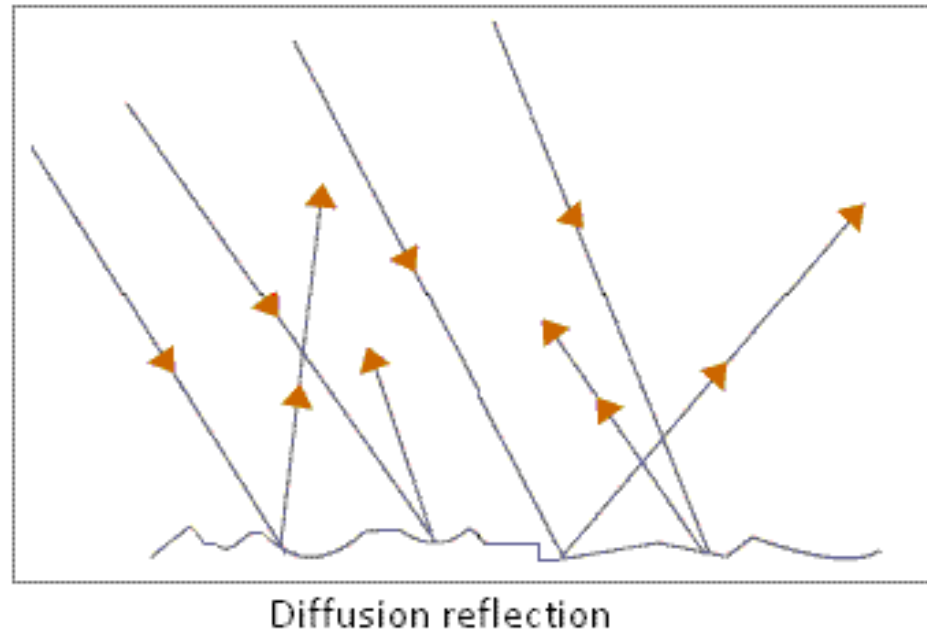
# Properties of Light

- **Refraction** – the change in direction of light when passing through one transparent medium to another.



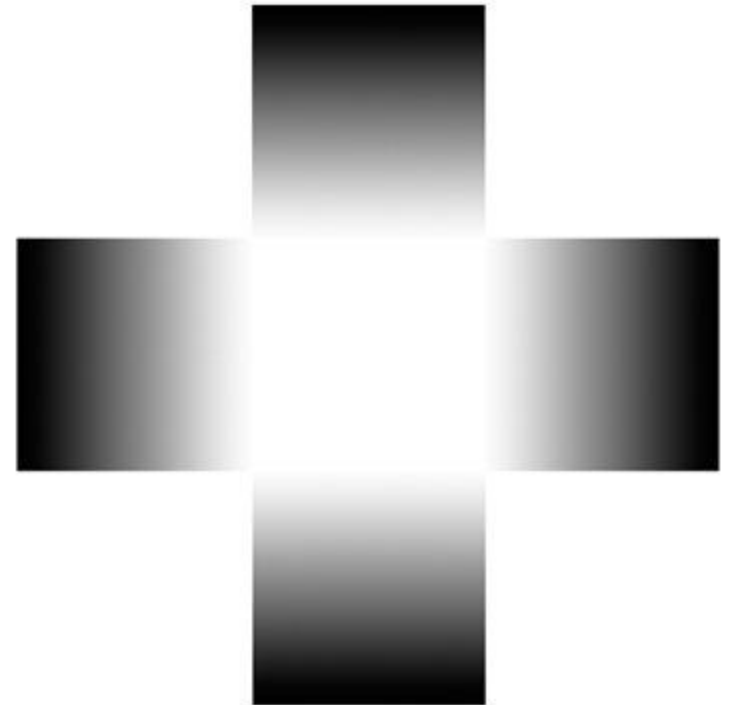
# Properties of Light

- **Diffusion** – incident light is reflected in many directions



# Properties of Light

- **Glare** – Reduction of contrast of the source image due to high incident light reflections.



# Issues Affecting FPD Viewability in High Ambient Light

# Environmental conditions

- Outdoor or direct sunlight





# Reflection & Glare in Strong Sunlight

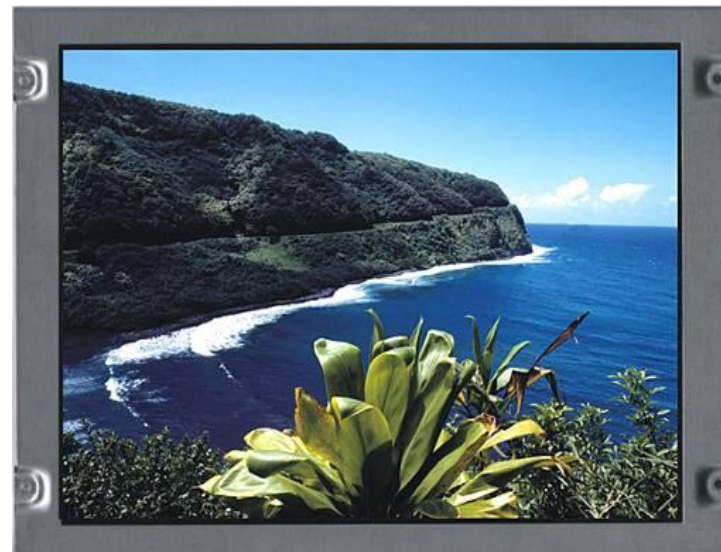
**Standard AG surface**



**Enhanced for sunlight readability**



High reflection  
Low contrast



Low reflection  
Improved contrast

# Attributes That Affect Viewability

- Front of screen peak luminance
- Contrast

**Standard Clear Surface**



**Enhanced Panel  
Clearer but still whitish**

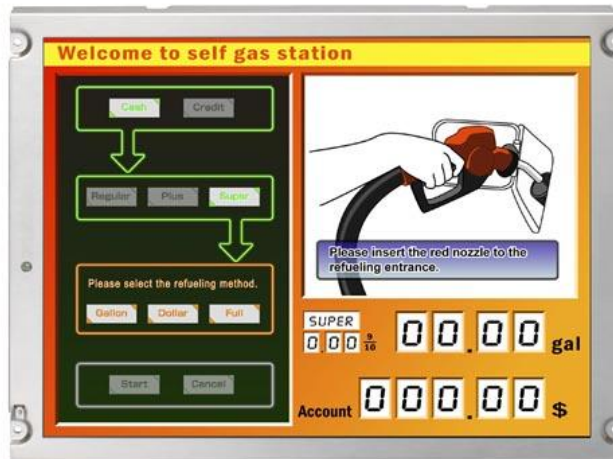


# Solutions for High Ambient Light Conditions

# CCFL Backlight Systems

## ■ High bright CCFL

- Touch panels will reduce a display's luminance and increase surface reflections making it harder to see.
- Extreme brightness of 1100 nits offsets the reduction of luminance and reflection.



## High bright CCFL backlight system

NL8060BC31-36

1100 nits

# LED Backlight Systems

## ■ High bright LED

- To improve backlight life, NLT Technologies, Ltd. optimized the LED alignment and heat dissipation design achieving a high bright LED backlight system comparable to high bright CCFL backlights.



### High bright LED backlight system

NL10276BC24-21F

800 nits @ 50mA/circuit

1000 nits @ 70m/circuit

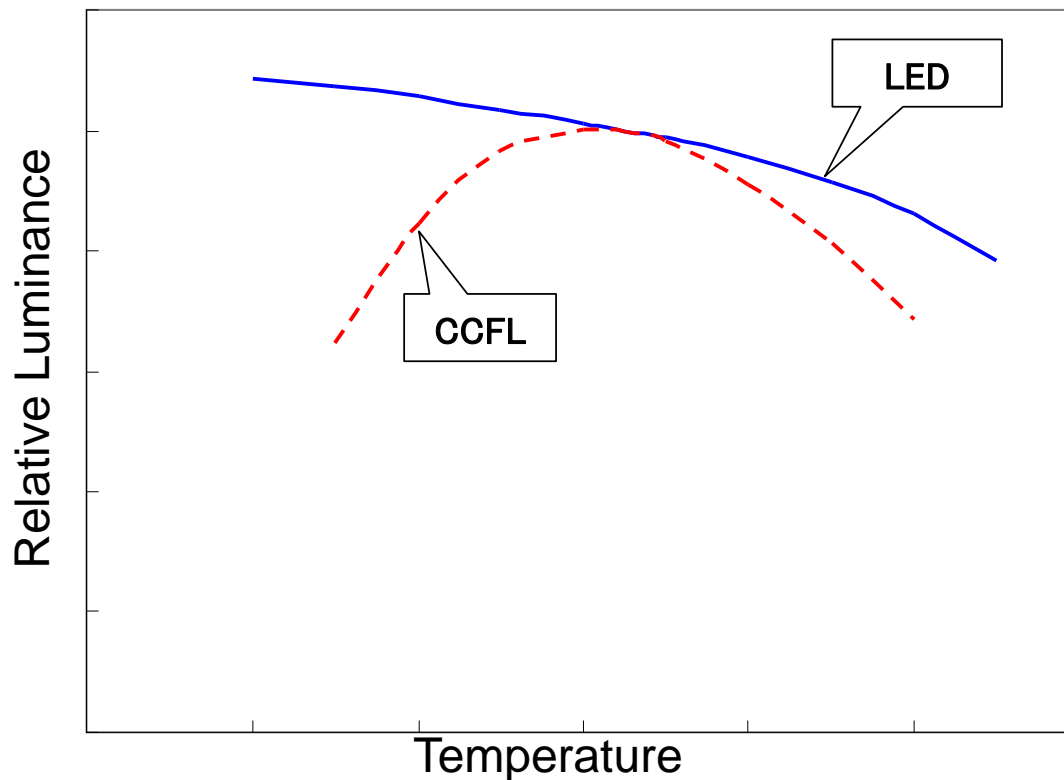
# CCFL vs. LED Backlight Systems

	CCFL	LED
<b>Light source type</b>	Linear type	Spot type
<b>Drive method</b>	AC High voltage INV creates harmonic noise	DC
<b>Dimming range</b>	15 to 100%	0 to 100%
<b>Thermal property</b>	Significant thermal independence	Linear thermal independence
<b>Optical property deviation</b>	Luminance: $\pm 10\%$ Chromaticity: $\pm 0.010$	Luminance: over 10% Chromaticity: $\sim 0.025$
<b>Power consumption</b>	High	40% lower than CCFL
<b>Thermal performance</b>	Low start-ability and shorter life at low temperatures	Exothermic
<b>Environmental</b>	Small amount of Mercury	Mercury free



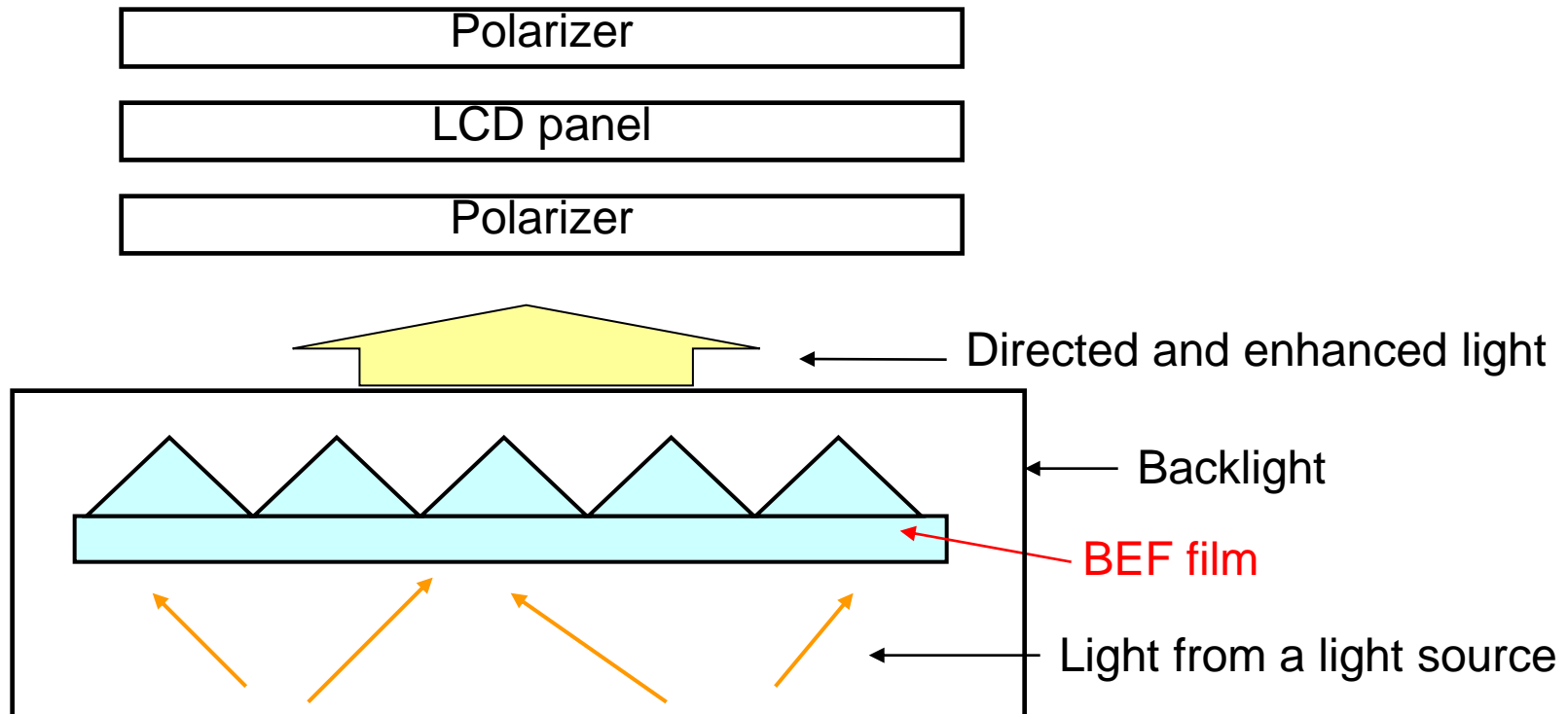
# CCFL vs. LED Backlighting

## ■ Relative luminance vs. temperature



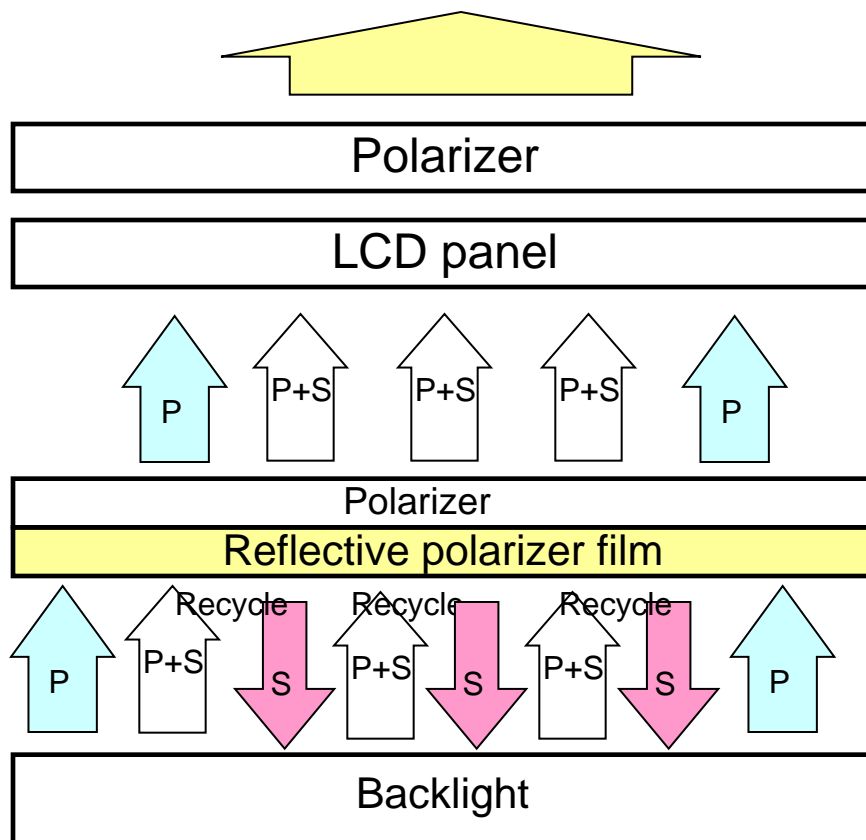
# Brightness Enhancement Film (BEF)

- The film is inserted into a backlight to direct diffusive light from a light source.



# Reflective Polarizer Film (DBEF, APCF and etc...)

- Reflective polarizer made of multi layer plastic film.
- Reflects and transmits light from backlight selectively.

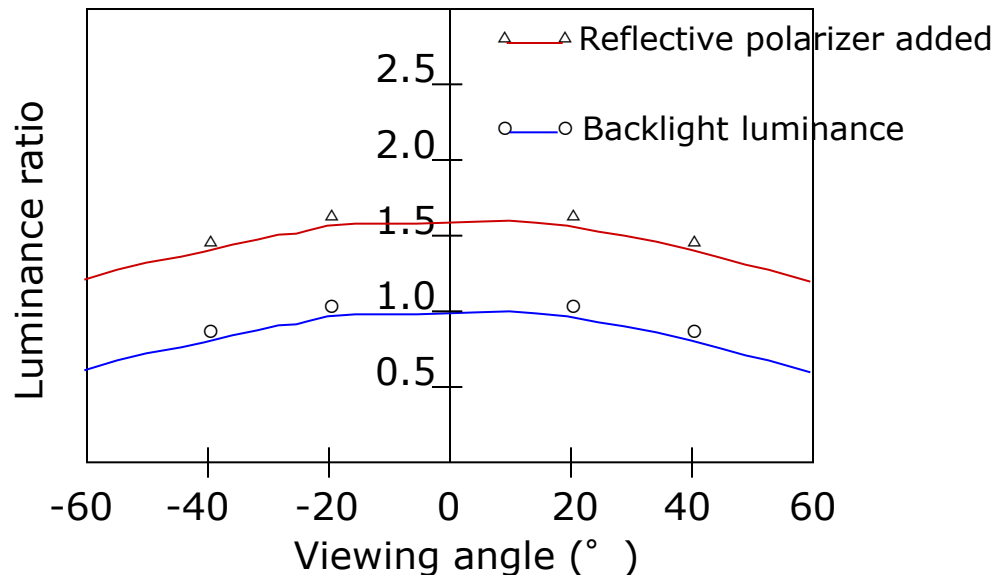


On the film S wave is reflected and goes back into a backlight and recycled.

The recycled light is mixed with S and P wave again.

# Reflective Polarizer Film (DBEF, APCF and etc...)

- By using the Reflective Polarizer Film, the brightness is boosted 1.3 to 1.6 times.
- By adding with another BEF film in a backlight, the brightness can be boosted further more.



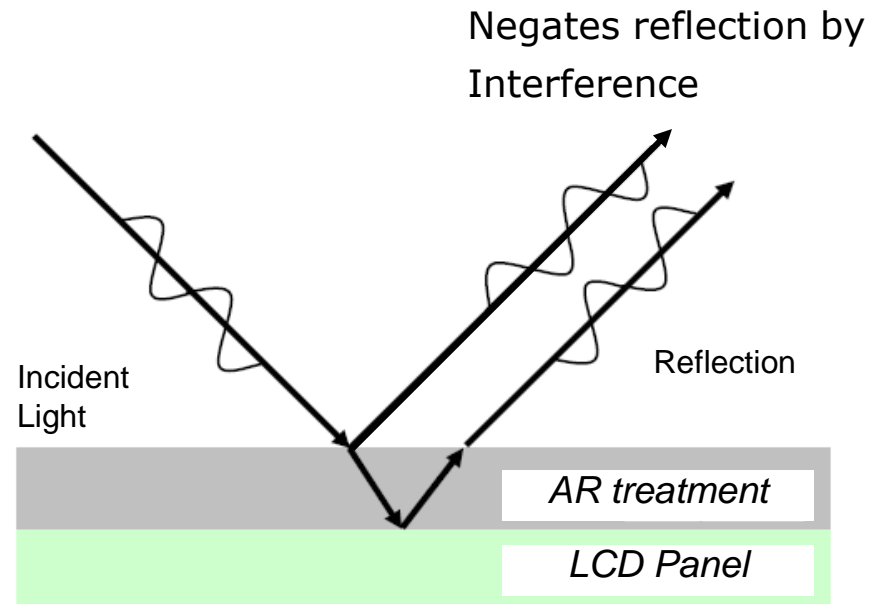
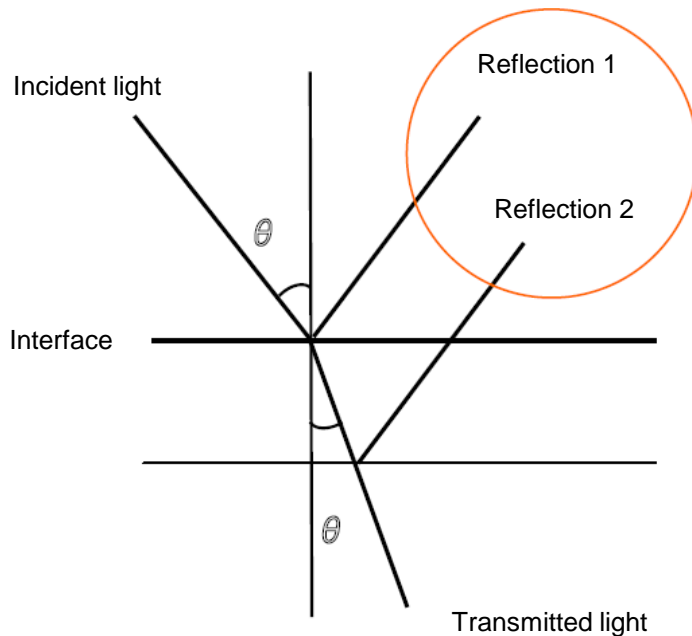
# AG & AR Passive Enhancement Films

- Anti-Glare (AG) - diffuses reflection
- Anti-Reflective (AR) - negates reflection



# Anti-Reflection Film

- The difference in reflection index and path creates a phase difference that negates the effect.





# AR Film Details

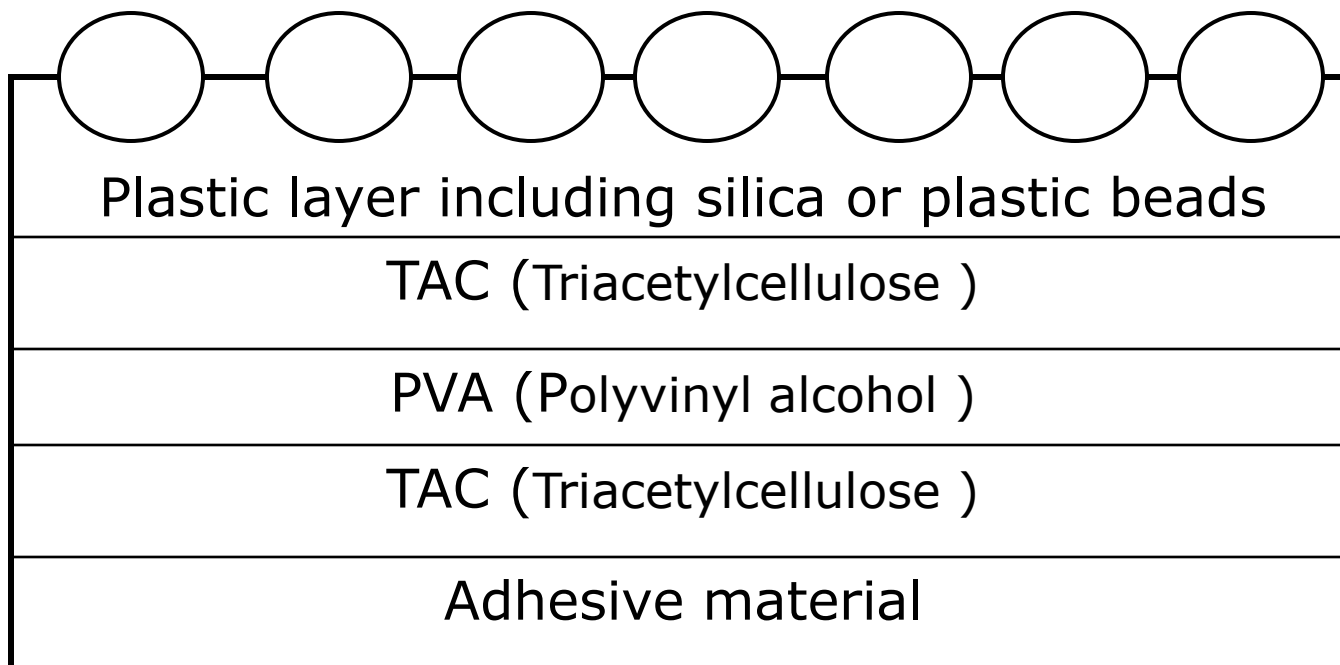
## *Front*

Low index layer (SiO <sub>2</sub> and etc.)
High index layer (TiO <sub>2</sub> , ITO, Nb <sub>2</sub> O <sub>5</sub> and etc.)
SiO <sub>2</sub>
High index layer (TiO <sub>2</sub> )
SiO <sub>2</sub>
Hard coat or Anti-glare layer
Base film (TAC, PET and etc.)
Adhesive material

## *Back*

# AG Film Details

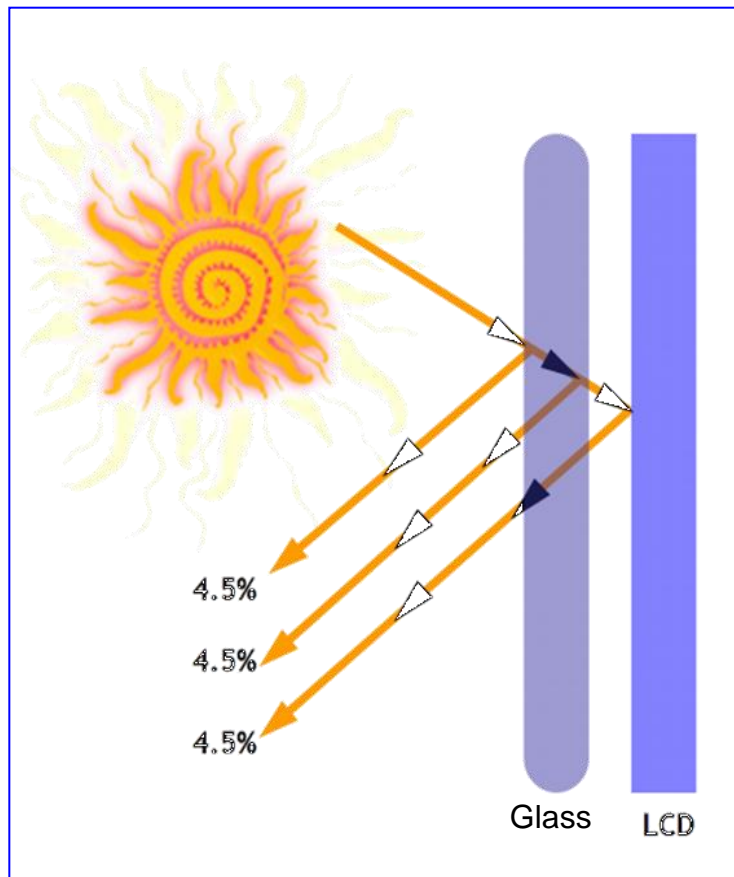
**Front**



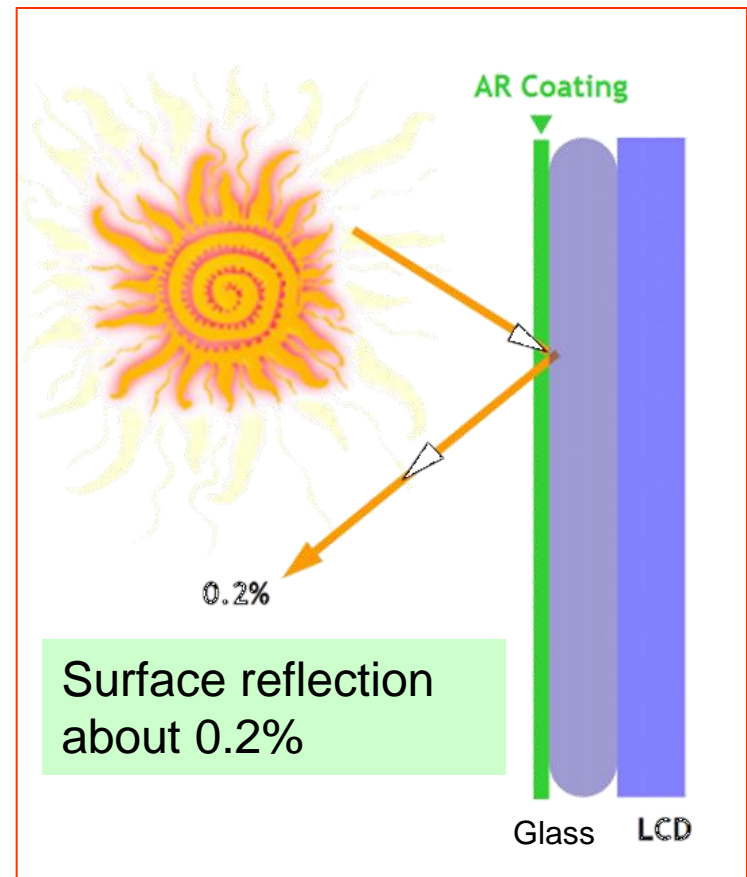
**Back**

# Glass Overlay vs. Direct Bonding

## Glass Overlay



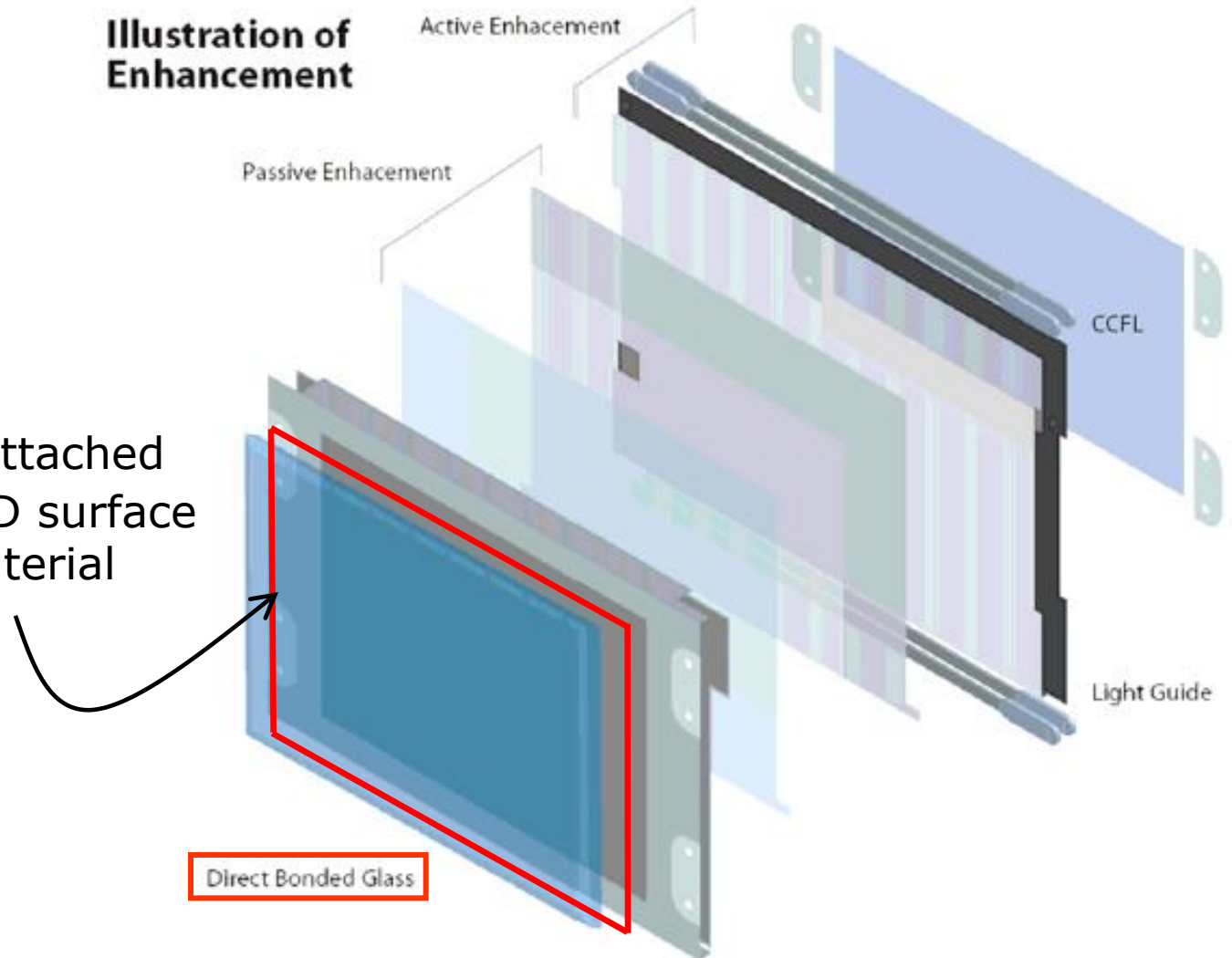
## Direct Bond + AR Coating



# Direct Bonding

## Illustration of Enhancement

AR coated glass attached directly to the LCD surface using bonding material



# Solution Comparisons

	<b>Cost</b>	<b>Weight</b>	<b>Complexity</b>
<b>High bright backlight</b>	High	Middle to heavy	Very complex
<b>AG or AR film</b>	Low	Low	Good
<b>Bonding and Special overlays</b>	Very High	Very heavy	Very complex

# Technology Overview

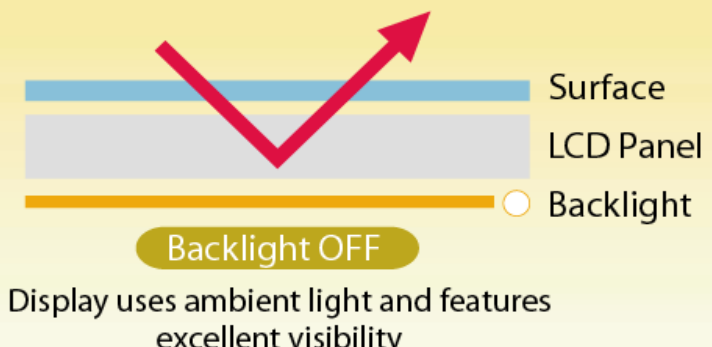
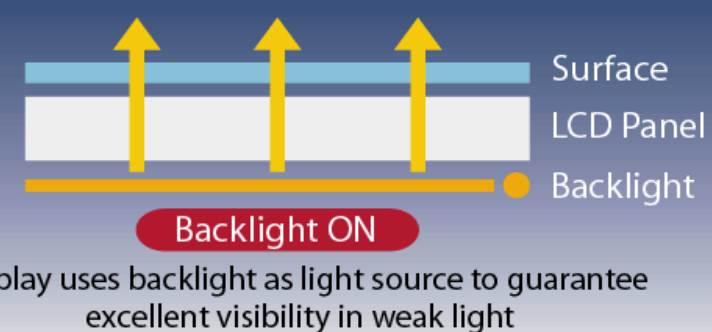


# Enhanced View TFT (EVT)

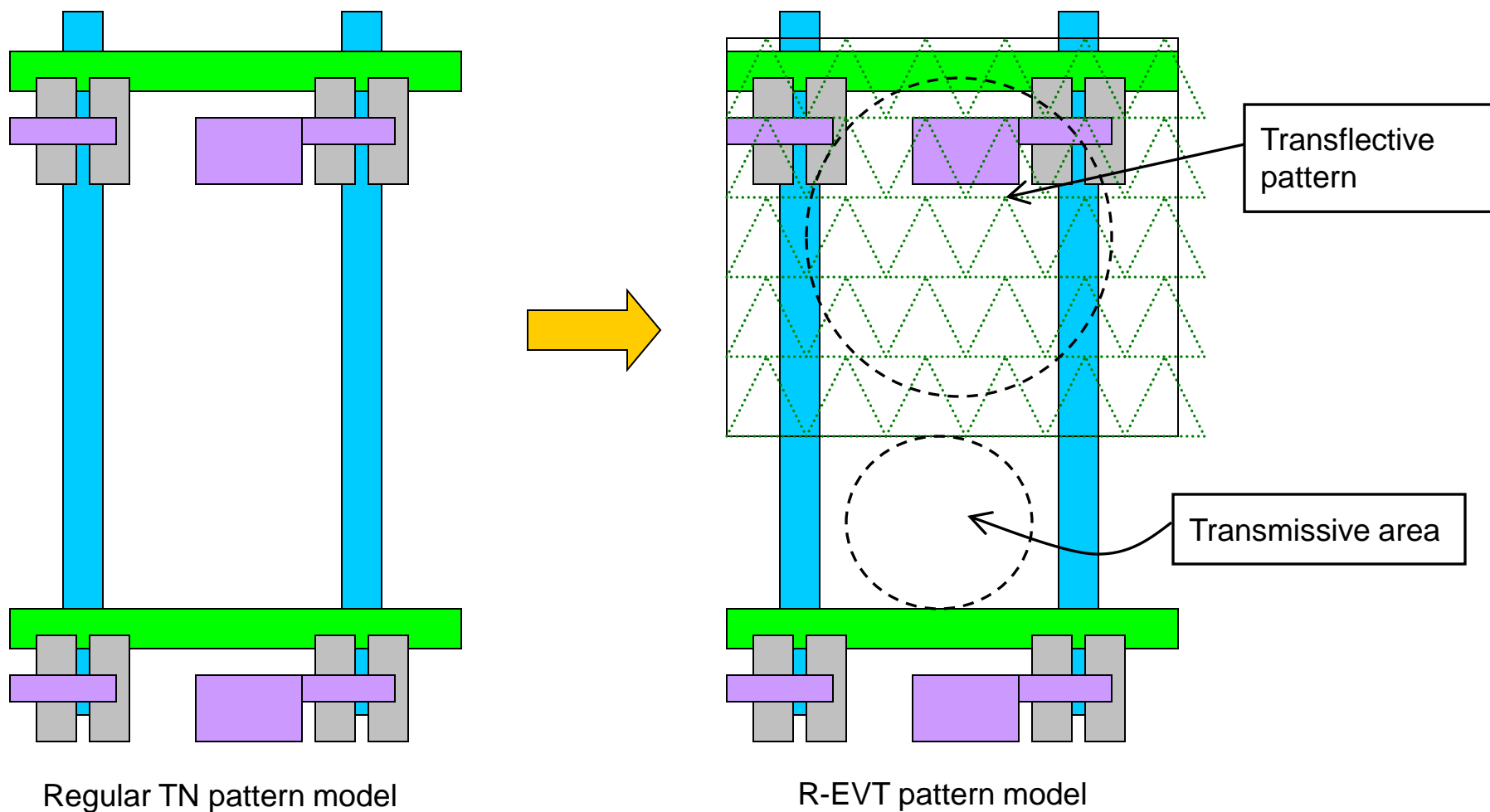
- Proprietary transfective LCD technologies
  - Reflective-Enhanced View TFT (R-EVT)
    - Formerly known as SR-NLT
  - Transmissive-Enhanced View TFT (T-EVT)
    - Formerly known as ST-NLT
- Suited for a variety of ambient-light environments

# R-EVT – Reflective-Enhanced View TFT

Backlight **ON** or **OFF** – Highly reflective surface, great for direct sunlight applications where backlight is normally off for maximum power savings

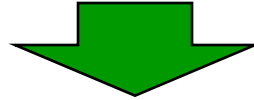
Daytime/Bright Light	Primary Feature
 <p>Surface LCD Panel Backlight</p> <p>Backlight OFF</p> <p>Display uses ambient light and features excellent visibility</p>	Backlight can be switched ON/OFF to minimize energy consumption
 <p>Surface LCD Panel Backlight</p> <p>Backlight ON</p> <p>Display uses backlight as light source to guarantee excellent visibility in weak light</p>	

# R-EVT Mechanism

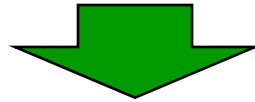


# R-EVT Mechanism

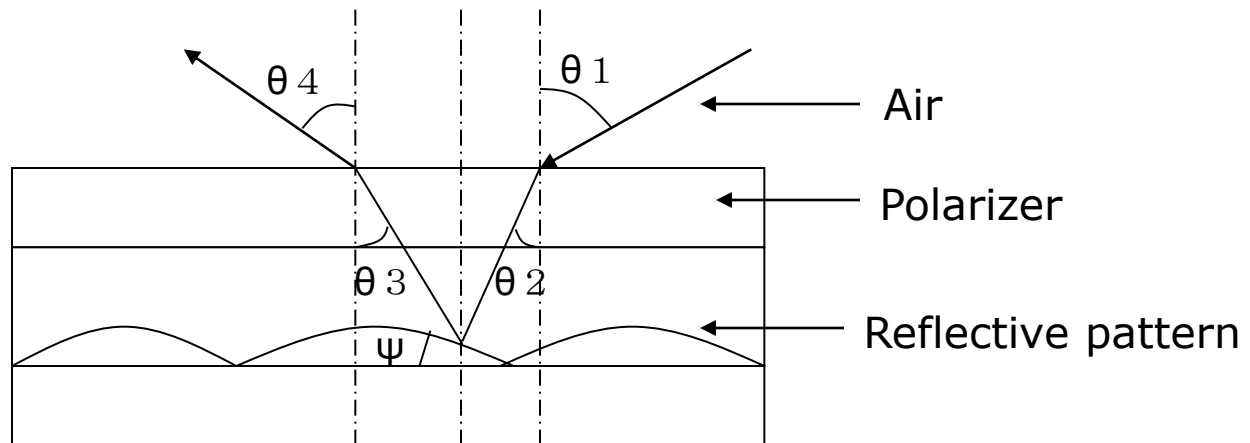
With full flat reflective pattern only frontal reflection can be seen.



Tiny bumpy reflective pattern makes the reflection more diffused.

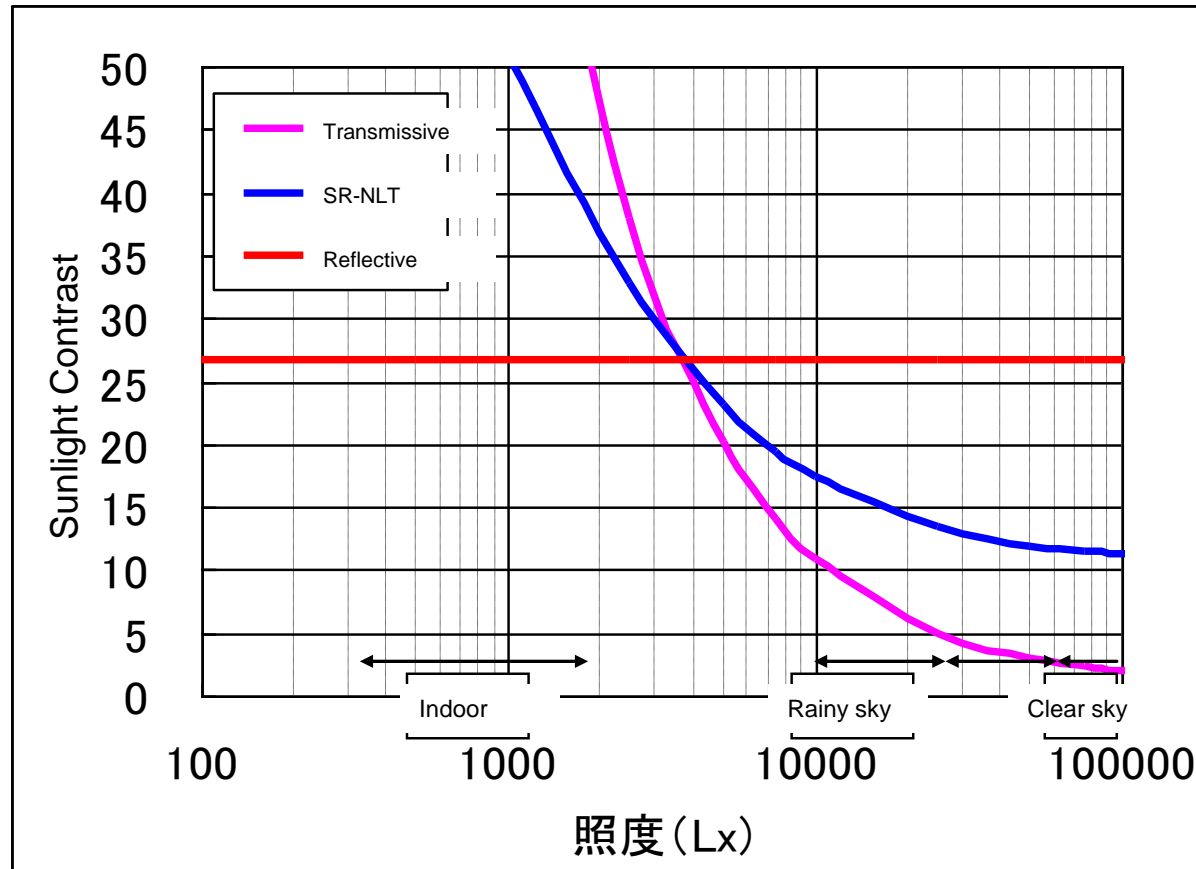


The reflection pattern design is the most crucial. Refraction index from gap between the reflective pattern and air has to be taken into consideration



# R-EVT – Bright Ambient Contrast

Bright ambient contrast



R-EVT has a medium contrast property between complete reflective and transmissive.

# R-EVT Comparison



**Standard TN** with BL Off

Reflection ratio:  $\sim 0\%$

**R-EVT** with BL Off

NEC NL10276BC20-10

Reflection ratio: 35%

# R-EVT Comparison

***NLT NL10276BC20-10***

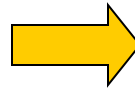


Backlight **ON** @ 175 nits

Reflection ratio: 35%

Contrast ratio: Transmissive: 150:1

Transflective: 15:1



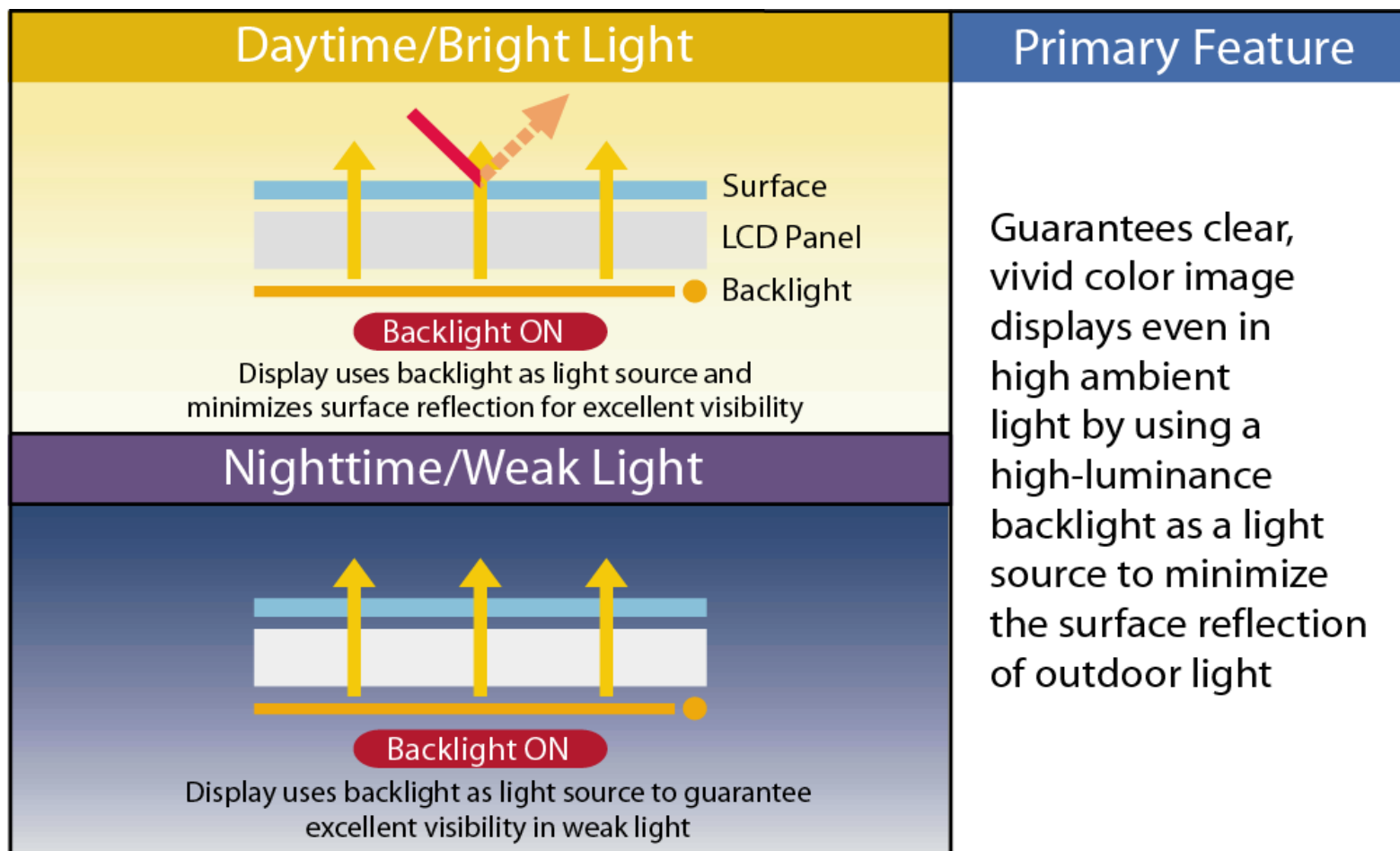
Backlight **OFF** @ 0 nits

To contain reflection, even for R-EVT, AR is recommended as best



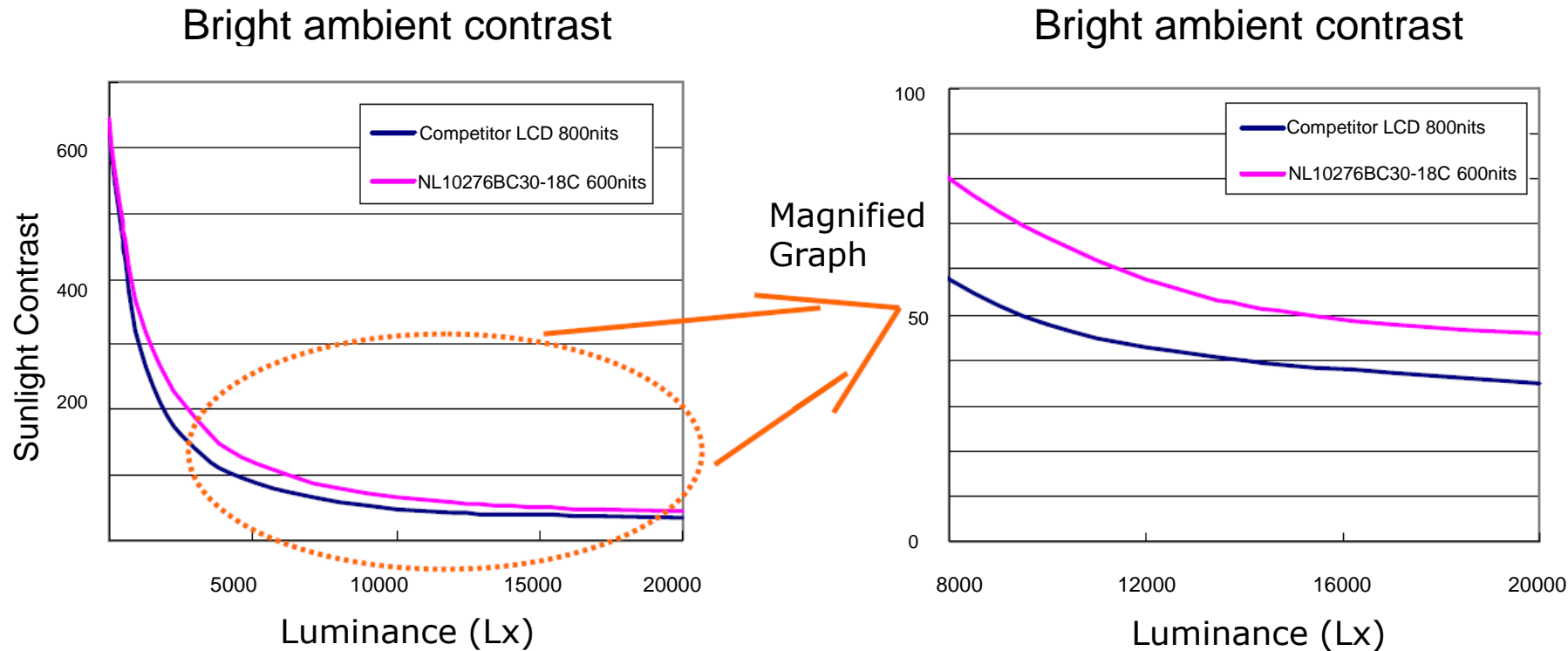
# T-EVT – Transmissive-Enhanced View TFT

Backlight **ON** – High efficient backlight + proprietary AR



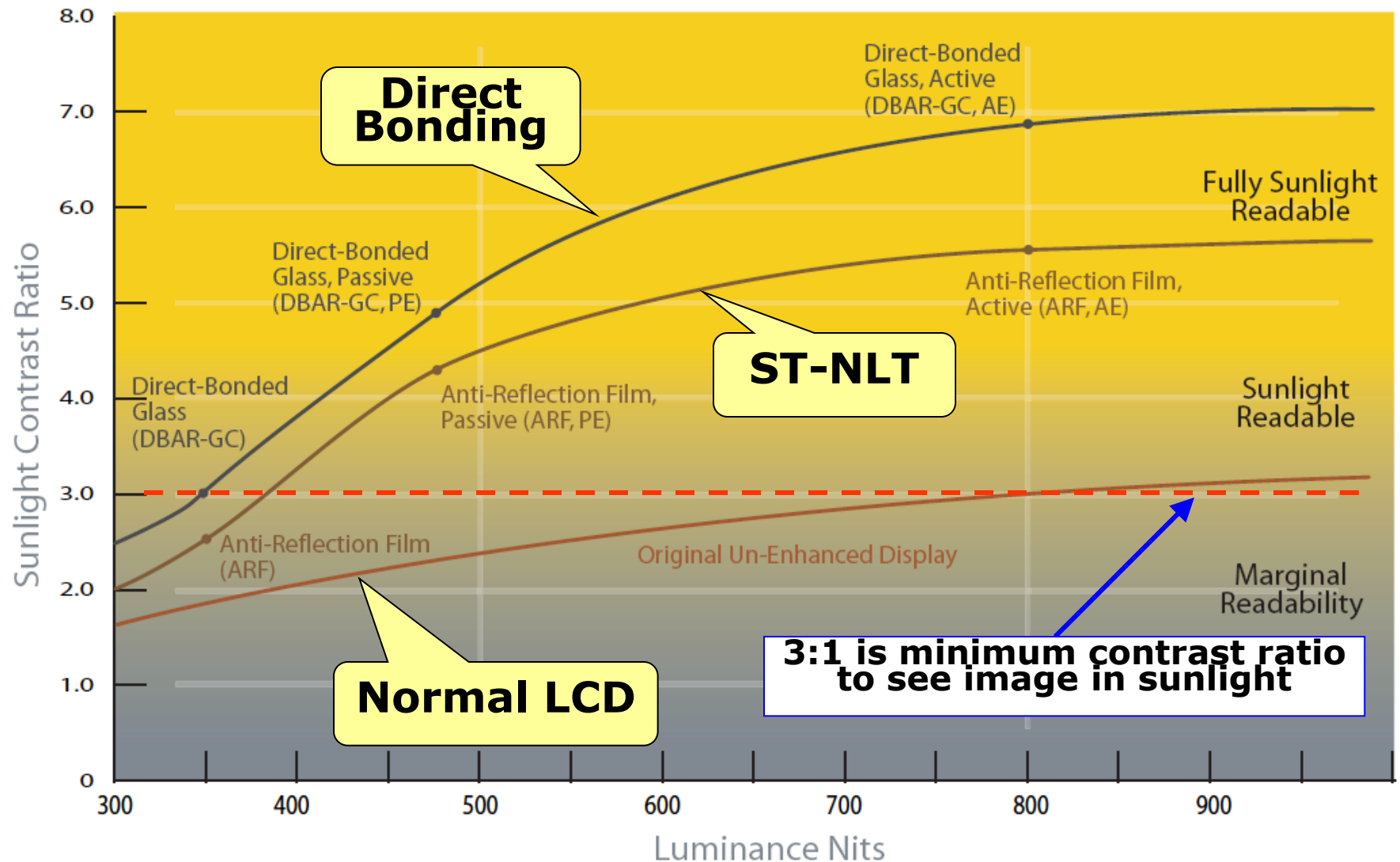


# T-EVT – Transmissive-Enhanced View TFT



■ T-EVT is better in bright ambient

# Contrast Ratio in Sunlight



# Competitive Comparison



Competitor LCD

800 nits



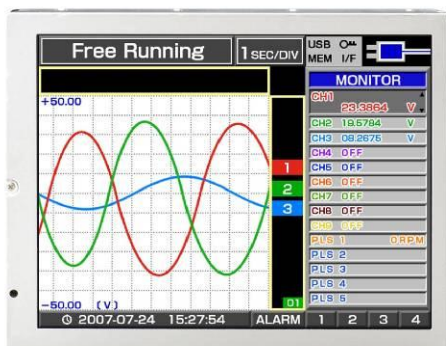
T-EVT

NLT NL10276BC30-18C

600 nits

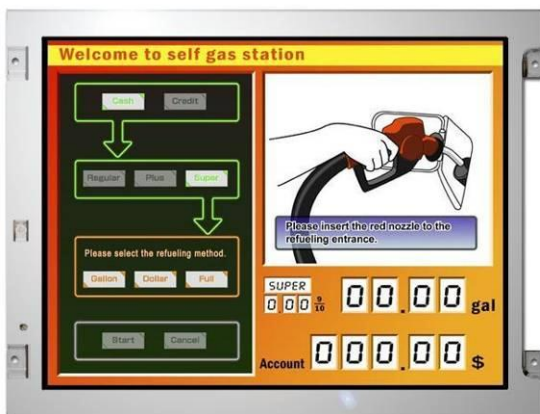
200 nits lower but more viewable

# Examples of High Bright LED Backlight Systems



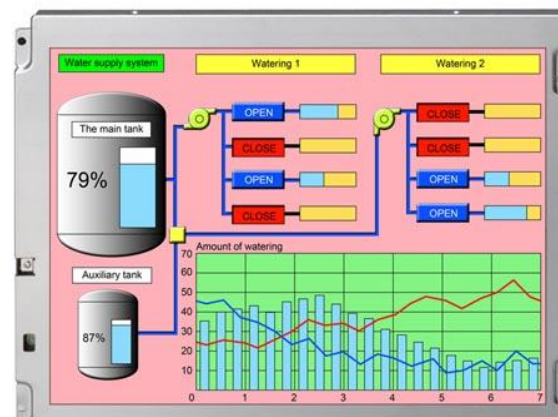
NL6448BC20-30C/30F

900nits



NL8060BC21-11C/11F

800 nits



NL6448BC33-70C/70F

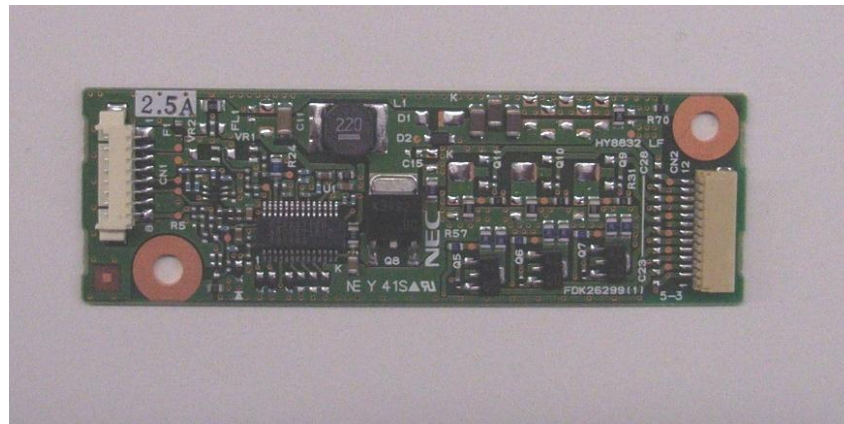
800nits

# Advantages of R-EVT & T-EVT

- R-EVT & T-EVT products carry full manufacturer's warranty.
- NLT uses "passive" enhancements and avoids the reliability pitfalls of high brightening or overdriving lighting components by "brute force". (R-EVT)
- While most customers shop "peak luminance" figures what they should buy is "contrast". (R-EVT & T-EVT )
- An NLT T-EVT panel @ 375 nits equals a standard panel @ 810 nits. Overdriving backlights is not needed.
- In standard TN, increasing the peak (white) luminance, black level also rises making the panel no better in contrast. It may actually cause "wash out". Our T-EVT maintains contrast.

# NLT LED Driver Board

- Same footprint as CCFL boards
- Support up to 6 series LED strings
- Compact size



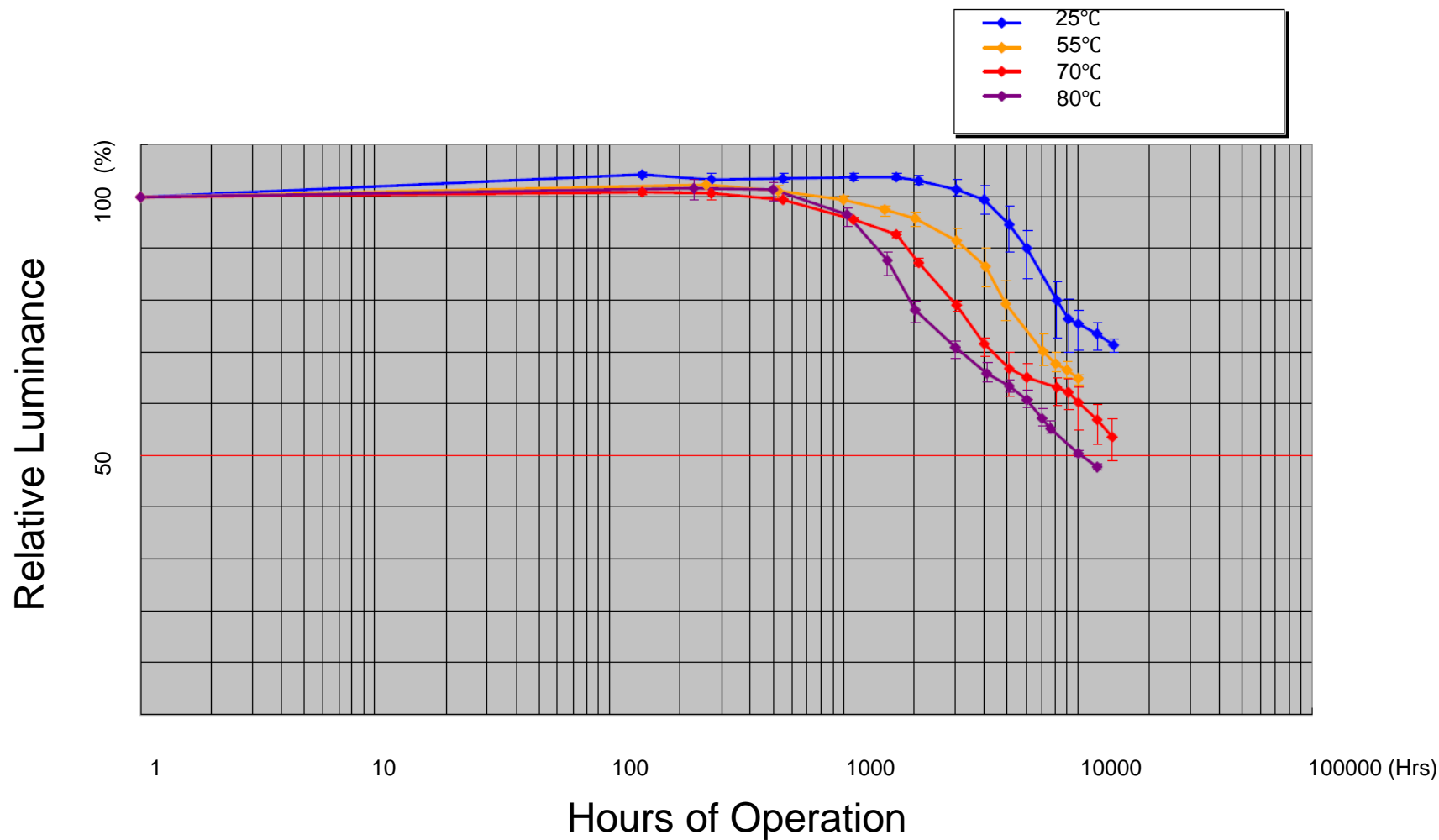


# High Bright LED Backlight Systems

## ■ NLT LED driver line up

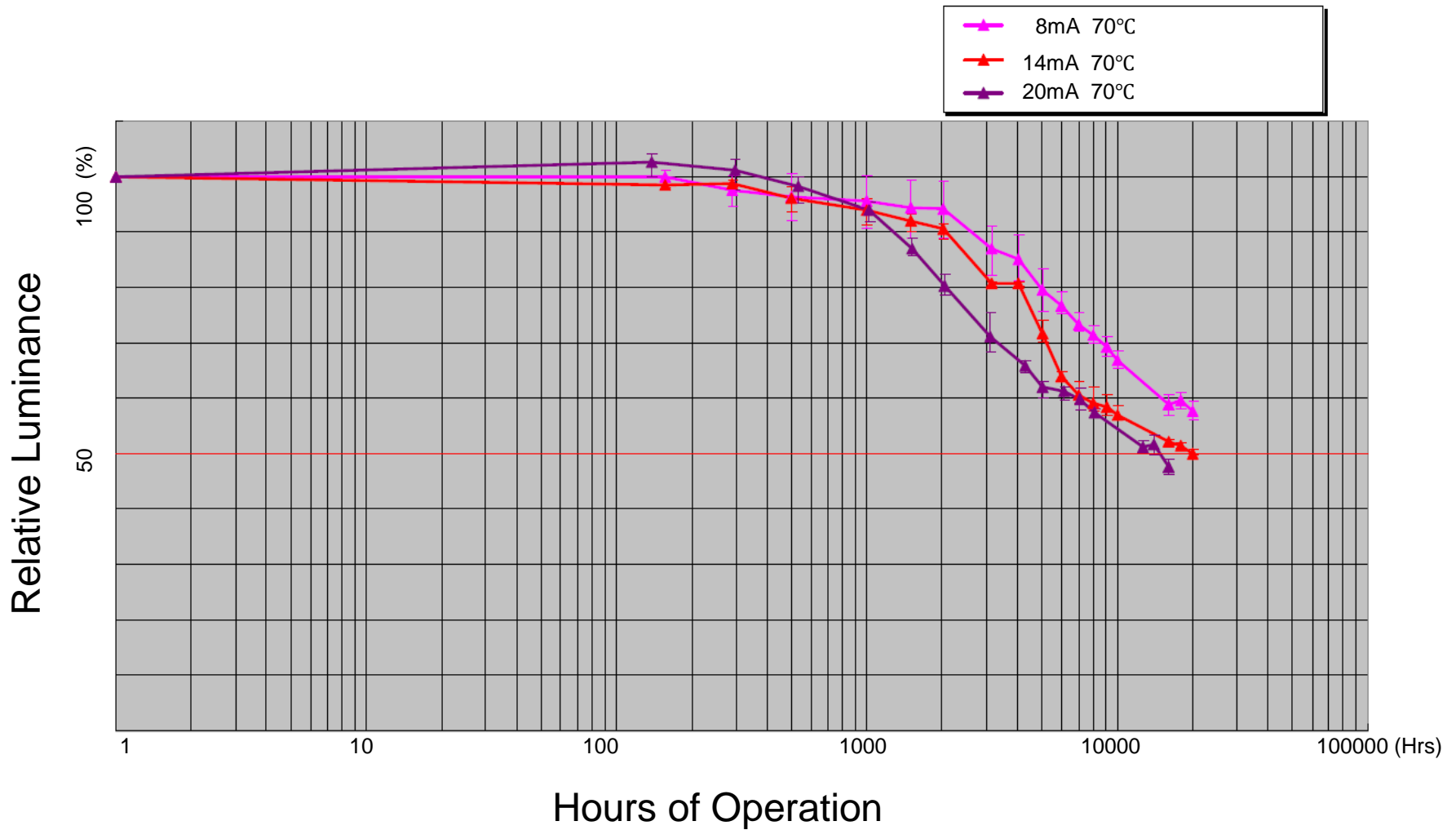
Size	Part No.		LED driver board	Driver board harness
6.5	NL6448BC20-	30/30D	104PW03F	121CBL02
6.5	NL6448BC20-	30C/30F	104PW03F	121CBL02
8.4	NL6448BC26-	26/26D/27/27D	104PW03F	121CBL02
8.4	NL6448BC26-	26C/26F/27C/27F	104PW03F	121CBL02
8.4	NL8060BC21-	10/10D/11/11D	104PW03F	121CBL02
8.4	NL8060BC21-	10C/10F/11C/11F	104PW03F	121CBL02
9	NL8048BC24-	09/09D	104PW03F	121CBL02
10.4	NL6448BC33-	70/70D/71/71D	104PW03F	121CBL02
10.4	NL6448BC33-	70C/70F/71C/71F	104PW01F	121CBL02
10.4	NL8060BC26-	35/35D/36/36D	104PW03F	121CBL02
10.4	NL8060BC26-	35C/35F/36C/36F	104PW01F	121CBL02
10.4	NL10276BC20-	18/18D	104PW02F	104CBL01
12.1	NL8060BC31-	46/46D/47/47D	121PW02F	121CBL02
12.1	NL8060BC31-	46C/46F/47C/47F	104PW03F	121CBL02
12.1	NL8060BC31-	50C/50F	104PW03F	121CBL03
12.1	NL12880BC20-	05/05D	104PW03F	121CBL03
15	NL10276BC30-	34D	150PW02F	150CBL02

# LED Lifetime @ Temperature





# LED Lifetime vs. Drive Current @ Temperature



# Additional Comments

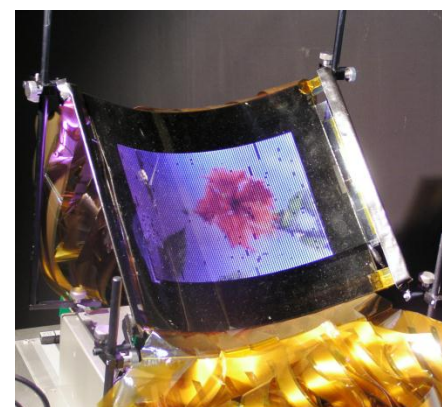
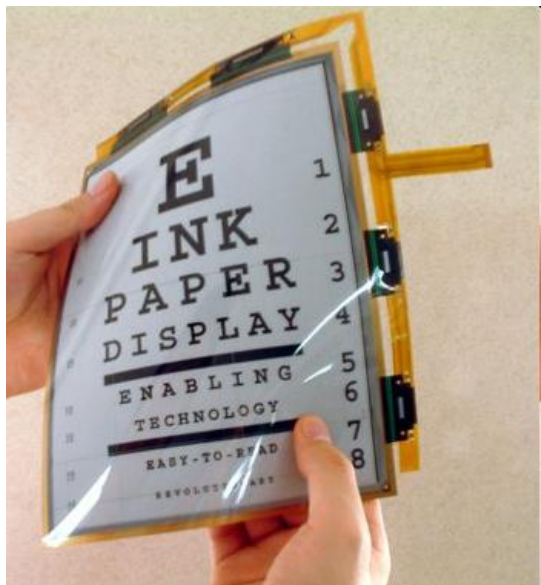
## ■ Power is not free

- Higher power designs are typically more complex, larger & expensive.
- Higher power in the form of heat.
- Higher operating temperatures create opportunities for failure.
- Larger mechanical “footprint” dictates larger product designs.

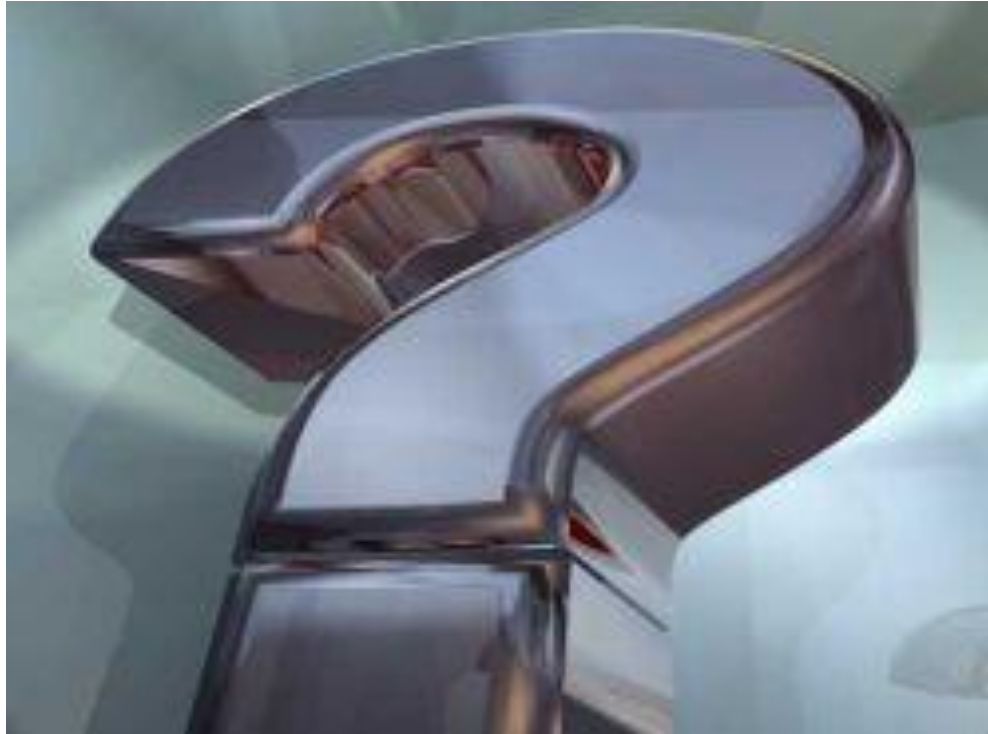
# Summary

- Properties of Light
- Viewability in High Ambient Light Conditions
- Solutions for High Ambient Light Conditions
- Technology Overview

# Innovation



# Questions?



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## ■ Challenge:

"In the smart society, obtaining information anywhere one goes will be typical. Usually it is through a display and being able to view these information under the sun via a portable devices or fix stations will require some classes of displays."

## ■ Solution:

*"This class will introduce you to the technologies that are used to overcome high ambient light conditions, understand what light can do to displays and what NLT can do to provide and help solve these problems."*

## ■ Do you agree that we accomplished the above statement?

# Please Provide Your Feedback...

- Please utilize the 'Guidebook' application to leave feedback



or

- Ask me for the paper feedback form for you to use...

# Thank You!



# DEVCON

Enabling the Smart Society

## RENESAS

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