Why IPS
Commercial Display

LG Display
1. Panel Technology (IPS vs. VA)
2. Why IPS Commercial Display (IPS Commercial Display vs. TV)
Display technology is defined by Liquid Crystal alignment and IPS is completely different from conventional.

**IPS**
- Horizontal alignment
- Completely different from TN matrix

**TN**
- Vertical alignment
- Modified to solve the main limitations of the TN matrix

**VA**
- Vertical alignment

**LCD**: A flat panel that uses the light modulating properties of liquid crystals.
**IPS**: In-plane switching.
**VA**: Vertical Alignment.
When $\Delta u'v'=0.02$ or above, color shift is noticeable with human eyes.

IPS has viewing angle 120° or above while VA has only 100°

Comparison in Color Coordinates (viewing angle 60°)

<table>
<thead>
<tr>
<th></th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>VA</td>
<td>0.108</td>
<td>0.029</td>
<td>0.122</td>
</tr>
<tr>
<td><strong>IPS</strong></td>
<td>0.011</td>
<td>0.004</td>
<td>0.004</td>
</tr>
</tbody>
</table>

No Color Wash from any angle!
### 1. PANEL TECHNOLOGY

#### 1) Wide Viewing Angle

<table>
<thead>
<tr>
<th>Lux</th>
<th>LGD (IPS)</th>
<th>Viewing Angle</th>
<th>Direction</th>
<th>Viewing Angle</th>
<th>Competitors (VA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 lx</td>
<td></td>
<td>114°</td>
<td>Horizontal</td>
<td>91°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>117°</td>
<td>Vertical</td>
<td>83°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>109°</td>
<td>Diagonal</td>
<td>90°</td>
<td></td>
</tr>
<tr>
<td>3,000 lx</td>
<td></td>
<td>97°</td>
<td>Horizontal</td>
<td>88°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>100°</td>
<td>Vertical</td>
<td>81°</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>99°</td>
<td>Diagonal</td>
<td>87°</td>
<td></td>
</tr>
</tbody>
</table>

**Color Shift**

- **Lux:** 0 lx, 3,000 lx
- **LGD (IPS):** Full color accuracy across wide viewing angles
- **Viewing Angle:**
  - Horizontal: 114°, 97°, 99°
  - Vertical: 117°, 100°
  - Diagonal: 109°, 100°
- **Competitors (VA):**
  - Horizontal: 91°, 88°
  - Vertical: 83°, 81°
  - Diagonal: 90°, 87°
# 1. PANEL TECHNOLOGY

## 1) Wide Viewing Angle

<table>
<thead>
<tr>
<th>Direction</th>
<th>0 lx</th>
<th>3,000 lx</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LGD</strong></td>
<td><img src="image1" alt="Graph" /></td>
<td><img src="image2" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Competitors</strong></td>
<td><img src="image3" alt="Graph" /></td>
<td><img src="image4" alt="Graph" /></td>
</tr>
<tr>
<td><strong>LGD</strong></td>
<td><img src="image5" alt="Graph" /></td>
<td><img src="image6" alt="Graph" /></td>
</tr>
<tr>
<td><strong>Competitors</strong></td>
<td><img src="image7" alt="Graph" /></td>
<td><img src="image8" alt="Graph" /></td>
</tr>
</tbody>
</table>

- **Gamma Shift**

- **Horizontally:**
  - LGD: 0°, 15°, 30°, 45°, 60°
  - Competitors: 0°, 15°, 30°, 45°, 60°

- **Vertically:**
  - LGD: 0°, 15°, 30°, 45°, 60°
  - Competitors: 0°, 15°, 30°, 45°, 60°

- **Diagonally:**
  - LGD: 45°, 90°, 135°, 180°, 225°
  - Competitors: 45°, 90°, 135°, 180°, 225°
LG Display 84” UHD IPS Panel showed better performance than 85” UHD VA Panel in terms of color shift, the viewability and the directional Gamma Distortion Ratio.

# Certification on Wide Viewing Angle

84” UHD received a certificate from intertek

LG Display 84” UHD IPS Panel showed better performance than 85” UHD VA Panel in terms of color shift, the viewability and the directional Gamma Distortion Ratio.

84” UHD received Test Report from CIEA

IPS Panel had better viewability compared to VA Panel.

<table>
<thead>
<tr>
<th>Item</th>
<th>VA</th>
<th>IPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Shift</td>
<td>0.0298</td>
<td>0.0170</td>
</tr>
<tr>
<td>Viewability</td>
<td>23.6%</td>
<td>40.9%</td>
</tr>
<tr>
<td>Gamma Distortion</td>
<td>41.9%</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>VA</th>
<th>IPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Shift</td>
<td>0.031</td>
<td>0.016</td>
</tr>
<tr>
<td>Viewability</td>
<td>32%</td>
<td>51%</td>
</tr>
<tr>
<td>Gamma Distortion</td>
<td>47.28%</td>
<td>2.21%</td>
</tr>
</tbody>
</table>
Videowall

Importance of Viewing Angle in Video Wall

Video Wall consists of multiple displays tiled together. Video Wall has larger screen sizes and more influenced by viewing angle.

(Color wash is detected in VA with viewing angle 60˚)

If you move just one more step away from the edge, you will experience color shift with VA Videowall.

Viewing Distance\(^*\) (D) = \text{height} \times 3 = 2.1 \text{m}
When Teachers or presenters explain, they stand very closely at the corner to the panel.
1. PANEL TECHNOLOGY

1) Wide Viewing Angle

Casino

Face Up Touch Display

Menu board
1. PANEL TECHNOLOGY

2) Color Accuracy

“COLOR ACCURACY”

Because IPS projects the color close to real objects, it is widely used in broadcasting, medical and professional designing. (Testing with Mcbeth24color chart, IPS shows the accurate color between input and output color signal)

<table>
<thead>
<tr>
<th></th>
<th>Broadcasting MNT</th>
<th>VA</th>
<th>IPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>0.0017</td>
<td>0.0290</td>
<td>0.0030</td>
</tr>
<tr>
<td>Green</td>
<td>0.0023</td>
<td>0.0203</td>
<td>0.0029</td>
</tr>
<tr>
<td>Blue</td>
<td>0.0037</td>
<td>0.0217</td>
<td>0.0054</td>
</tr>
<tr>
<td>Average</td>
<td>0.0029</td>
<td>0.0102</td>
<td>0.0025</td>
</tr>
</tbody>
</table>

“It’s got a gorgeous IPS display”

“Super high quality display using IPS technology”

“IPS provides much more accurate color”

- Steve Jobs quote
1. PANEL TECHNOLOGY

2) Color Accuracy

For IPS, Actual color and the color on the screen are the same.
IPS has a fast Liquid Crystal recovery property. Therefore, no flash occurs when touching the screen. However, VA panels have a slower Liquid Crystal recovery property which causes flash upon touch of screen.
How to **Distinguish** between **IPS** and **VA**??

Well, **IT’S VERY SIMPLE!!**

“**Just Knock**” and **YOU WILL SEE.**
1. PANEL TECHNOLOGY

3) Stable Panel
2. Why IPS COMMERCIAL DISPLAY vs. TV

Commercial display needs exclusive developments due to various usage conditions.

<table>
<thead>
<tr>
<th></th>
<th>TV</th>
<th>COMMERCIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luminance</td>
<td>300~450 nit</td>
<td>300~2,500 nit</td>
</tr>
<tr>
<td>Operating hour</td>
<td>8~10 Hr/ a day</td>
<td>16~24 Hr/ a day</td>
</tr>
<tr>
<td>Moving Picture</td>
<td>Landscape</td>
<td>Static Image</td>
</tr>
<tr>
<td>Contents</td>
<td>Main</td>
<td>Portrait &amp; Landscape</td>
</tr>
<tr>
<td>Landscape</td>
<td>Mode</td>
<td></td>
</tr>
<tr>
<td>Warranty</td>
<td>12 ~ 24M</td>
<td>24 ~ 36M</td>
</tr>
</tbody>
</table>

Exclusive developments for Commercial display:
- Liquid Crystal
- Mechanism
- Design
- Optics Design
- Circuit Design
2. Why IPS COMMERCIAL DISPLAY

1) Yogore Free

Yogore defects, When a static picture is displayed for a long time, the Yogore Defect may happen. The exclusive liquid crystal applied to all LGD’s CD panels improves the defect.

- Yogore Mura: Permanent image sticking including indeterminate stain

LGD’s Commercial Panel
-18hr/7days usage

TV Panels
-8hr/7days usage

* Yogore Mura: Permanent image sticking including indeterminate stain
Control Room MNT (Signal On)

Control Room MNT (Signal-Off)
Blackening defects, causes when liquid crystal loses its own characteristics over the critical point of temperature. LGD improves it by increasing the critical point up to 110 degree.

Over 85°C (167°F), blackening defect is visible. By 110°C (230°F), blackening defect is still not visible.
Blackening Field Issue

* Outside Temp : -1 ℃
* Inside Temp : 20 ℃

Direct Sunlight → Blackening
Recovering If there is no direct sunlight

If there is no direct sunlight
Outdoor Video Wall @ New York in Winter
LGD improves gravity defect by optimizing volume of liquid crystal and increasing cohesive power.

Gravity Defect Free

**LGD’s Commercial Panels**

- Liquid crystal does not flow down.

**Convention TV Panels**

- Flow-downed liquid crystal makes a picture yellowish.
Gravity Issue

In Portrait Mode

In Landscape Mode

After 4 Hours
2. Why IPS COMMERCIAL DISPLAY

4) QWP Technology

- **With QWP application, Display is still visible even with wearing polarized sunglasses.**
  (Over 50% of drivers put on sunglasses and about 10% among them uses polarized sunglasses in US)

- **Note:** QWP: Quarter Wave Plate (1/\(4\lambda\))
New Technology

M+ Panel

M+ Structure

RGB

M+

Transmittance

65%

Transmittance

18%

High Brightness

350 Nit

50% Up
(White)

560 Nit

Power Consumption

RGB

M+

Max 35%

- Save Energy
- Save Environment

LG Display
Take away

1. **IPS is the only Technology** for Commercial Display
   - Wide Viewing Angle
   - Color Accuracy
   - Stable Panel (Touch)

2. Commercial use of a display **must use the Commercial Dedicated Display with Different Liquid Crystal** / Mechanical Design etc.
   Use of Consumer TV may cause critical Quality Issue.
   - Yogore / Image sticking / Blackening
   - Portrait Mode
   - QWP Technology
THANK YOU