Whitepaper

\Orchestrating a brighter world NEC

NEC Display Solutions

How display brightness affects successful implementation of Digital Signage applications

Stunning visibility in a bright world

Summary

Today's society is characterised by a growing need for a constant information flow, accessible anytime and anywhere. This is underlined by the phenomenal global uptake of personal display technology such as smartphones and tablets. The need for constantly updated communication – be it information, entertainment or advertising - is also impacting the way businesses are communicating with customers and how they can make information visible to their audiences. People are constantly on the move and businesses want to catch and focus their attention to maximize mind-space for their product or brand or to help people find their way quickly and efficiently.

This white paper offers you an overview about the importance of Brightness requirements in display technology and how High Brightness screen technology can improve the interaction with your audience specifically under difficult lighting conditions and in different environments, whether inside a shopping mall, an airport, a corporate reception or outside at a QSR restaurant, train station or bus stop. This paper is also intended to be a reference guide to assist you in making the most appropriate choice of a display that will meet your or your customers' requirements.

Introduction

Today, digital signage displays are omnipresent showing various types of information ranging from simple static to interactive or moving content, from information to advertising topics. Of course, digital displays are more dynamic, up-to-date and flexible compared to static signage like posters. If cost is the main denominator for the choice of hardware, customers may be tempted to use consumer-grade products instead of professional equipment which offer dedicated hardware and software designed to support commercial applications.

As TV-grade displays don't fulfil the technical requirements to withstand long-term operation or to provide clearly visible contents under bright environments, a purchase that was intended to be a low cost option quickly turns out to be a false economy.

High Brightness technology will make your message shine

Most end users are experienced in selecting the right screen size for the desired application, but making the right choice regarding seemingly secondary characteristics like brightness and anti-reflectance in order to get the content presented correctly is absolutely crucial.

What are brightness and contrast?

There are two essential terms describing light and brightness properly: luminance and illuminance.

- **Luminance** is the light we see: reflected or radiating from objects, measured in candela per square meter (cd/m²) or 'nit'.
- **Illuminance** is light we can't see directly, so-called ambient light; light passing through air which is actually invisible until it reflects off an object (which we then see as luminance). It's measured in lux (lx or lm/m².

In order to provide ergonomic viewing, an image must have adequate levels of brightness and contrast for easy viewing. Brightness refers to the maximum luminance within the image.

Contrast is defined as the ratio of the brightest and the darkest area of the image. Increasing the contrast can be achieved by raising the difference between the bright and dark areas of the image, making shadows darker and highlights brighter. Adding contrast usually adds “pop” and makes an image look more vibrant while decreasing contrast can make an image look duller. For example, a white rabbit running across a snowy field has poor contrast, while a black dog against the same white background has good contrast ratio.

High vs. low contrast ratio

High Contrast Ratio

Low Contrast Ratio

What is visibility?

There are two defining factors for visibility, the minimum brightness of a display - mostly denominated as black level – and the maximum brightness – called white level. To maintain a certain minimum visible contrast and hence visibility, the maximum brightness is crucial. The importance of maximum display brightness can be witnessed especially in bright ambient light scenarios such as airports or shopping malls where TV-grade displays are unable to cope with the ambient conditions and the image is too dim to deliver satisfactory performance. With low brightness comes low contrast and thus texts and information get harder and harder to read.

Brightness, as a main contributor for visibility is required for presentation contents that enable the human eye to clearly perceive information. And the clearer the image quality, the quicker the information transfer from the displays to the viewer.

However, the best image quality can get negatively influenced by glare that disturbs the viewing process. Glare effects typically appear when ambient light gets reflected by highly glossy surfaces.

What is the viewing angle?

In display technology parlance, viewing angle is the maximum angle at which a display can be viewed with acceptable visual performance. The viewing angle is measured against the perpendicular line at the centre of the display’s plane in horizontal and vertical direction, giving a maximum of ±90° for each direction. The maximum viewing angle is the threshold value where the contrast ratio falls below a given value. Mostly the threshold value for viewing angle measurements is 10:1. A wide viewing angle prevents colour drift and supports perfect readability even for viewers that are watching from the side.

This is important for areas such as Retail, Digital out of Home or Leisure where people are walking by and experiencing a constantly changing viewing angle.

What is glare?

Glare is defined as parts of an image with extremely high luminance, resulting from either the image content itself or by reflections of ambient light at the surface of a screen. Ergonomic viewing is defined by parameters like brightness, contrast, viewing angle and the clarity of the content itself. Both glare and reflections can negatively influence all of those image parameters, which lead to unpleasant and inconvenient imaging. Reflections appear on the complete screen independent of the image content shown, but especially the darker areas of a display can get outshined by glare. This results in a loss of visual information and reduction of visual contrast. If the darkest areas of a screen are affected by glare, the “useful” black level of the screen will be raised onto a level that the human eye can perceive without disturbance. A higher black level results in a lower visual contrast and thus in lower readability.

Highly glossy surfaces have the undesirable characteristic to reflect more with increasing viewing angle onto the surface. This means that glossy displays have a much lower “useful” viewing angle than displays with antiglare coating.

What is the haze level?

The display’s surface is the visual connection between the screen and the viewer. Modern display technology allows for different surface treatments resulting in different levels of glossiness. Unlike the CRT-monitors of the past, the modern display is not restricted by a hard and highly reflective glass surface. The nature of the screen surface is much more flexible and takes many forms – with varying degrees of anti-reflection or glossy properties. A matte display surface comprises an outer ‘polarising layer’ that has been coarsened using mechanical or chemical processing.

As a result, a matte finish to the screen surface helps to diffuse ambient light rather than reflecting it directly back to the viewer. This is mainly required in bright ambient light environments as the reflections on glossy and low-brightness surfaces outshine the contents of the display

making contents unreadable. As a highly matte surface is however also slightly reducing the light output and colour vibrancy from the displays, it is important to consider enough luminance of the screen in order to compensate that loss.

High vs. low haze level

High Haze Level

Low Haze Level

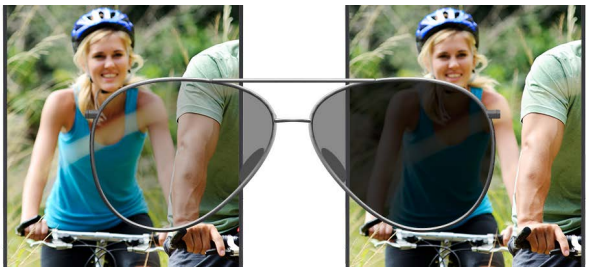
When sending a ray of light onto a display's surface, the haze level is defined as the ratio of scattered light versus the directly reflected light. The higher the haze level, the rougher surface, the more the level of scattering resulting in less reflection. Currently the highest hazel level to be achieved is 44%. Higher haze levels improve the visibility of an image in areas of strong direct or ambient light. In addition it reduces the potential for eyestrain in such circumstances as you don't have to focus 'through' intense reflections or glare to see the image.

Dust, grease and dirt also become less visible. Highly reflective screen surfaces are not suited for installations in bright spaces as the surface will mirror the ambient light and the screen content will become barely visible.

What else supports perfect visibility under harsh environments?

NEC is using a Quarter Lambda Filter, which is an optical filter to overcome polarization of light emitted by the display. This guarantees full readability even when viewers are wearing polarized sunglasses. Without such a filter, people wearing sunglasses would be unable to see the content, the display would appear black. This is why this functionality is beneficial for all semi-outdoor installations such as kiosks or info totems.

Quarter Lambda Filter



Quarter Lambda Filter

Without Quarter Lambda Filter

Display technology operating under bright, (sun)lit conditions has to withstand more heat and higher temperatures inside the display. Tni is the temperature at which the pure liquid crystal system undergoes the isotropic-nematic transition. Below this point, the liquid crystals are working perfectly as light blockers and create a fine and crisp image. If the temperature rises above this transition point the crystals will melt and lose their ability to guide light.

The screen will create black spots in the affected areas at least as long as the temperature level is above the critical point. In order to prevent this failure, the NEC HB display series is using specific liquid crystals with higher melting points, or a higher Tni.

The Tni of 110°C will guarantee perfect visibility even under situations where sunlight is hitting and heating the panel surface, compared to standard screens using panels with a Tni of 60°- 80°C where black spots will become visible on the surface. Even if the display temperature is far below the panel temperature indicated above, effective heat management is required to ensure reliability and durability.

Different applications and their adequate levels of brightness

The following table gives an overview of different use case scenarios. It lists typical ambient brightness levels and the recommended display brightness in order to ensure that information is properly displayed even under difficult lighting conditions. Please note that these values present references only with a wide span.

Display brightness levels can be adjusted based on your specific environments and ambient lighting situations.

Brightness Table

Industry	Workspace	Typical ambient brightness	NEC recommended display brightness	NEC recommended product series
Aviation and Transportation	Airport departure hall	350 - 5,000 lux	700 - 2,700 cd/m²	P Series, HB Series, UN Series, LED
	Departure gates	350 - 2,500 lux	700 - 2,700 cd/m²	P Series, HB Series, LED
	Check-in area	300 - 2,000 lux	600 - 2,700 cd/m²	P Series, HB Series, UN Series, LED
Corporate Office	Corridors	50 - 250 lux	350 - 500 cd/m²	E Series, C Series, V Series
	Meeting room	150 - 500 lux	350 - 800 cd/m²	E Series, C Series, V Series, InfinityBoard
	Board room	200 - 700 lux	400 - 1,000 cd/m²	C Series, V Series, UHD Series, P Series, LED, InfinityBoard
	Reception area	250 - 1,000 lux	500 - 1,600 cd/m²	V Series, P Series, HB Series, UN Series, LED
	Office desk area	200 - 500 lux	350 - 800 cd/m²	E Series, C Series, V Series
	Atrium	400 - 5,000 lux	700 - 2,700 cd/m²	P Series, UN Series, HB Series, LED
Digital Cinema	Cinema lobby and ticket office	200 - 2,000 lux	400 - 2,700 cd/m²	V Series, P Series, HB Series, LED
	Cinema window frontage / glazed facade	1,000 - 10,000 lux	1,700 - 2,700 cd/m²	HB Series, LED
DooH	Roofed area	2,000 - 10,000 lux	2,000 - 5,000 cd/m²	HB Series, UN Series, LED
	Outdoor area	5,000 - 50,000 lux	2,000 - 6,000 cd/m²	HB Series, LED
Education	Corridor	100 - 300 lux	350 - 600 cd/m²	E Series, C Series, V Series
	Classroom	150 - 500 lux	350 - 800 cd/m²	E Series, C Series, V Series, InfinityBoard
	Auditorium	200 - 1,000 lux	400 - 1,600 cd/m²	V Series, P Series, LED
Healthcare	Reception area	250 - 1,000 lux	500 - 1,600 cd/m²	V Series, P Series, HB Series, LED
	MDT room	150 - 350 lux	350 - 650 cd/m²	V Series, P Series, InfinityBoard
	Waiting room	150 - 500 lux	350 - 800 cd/m²	E Series, C Series, V Series
Entertainment, Leisure and Hospitality	Entrance area	300 - 2,000 lux	700 - 2,500 cd/m²	P Series, HB Series, UN Series, LED
	Reception	250 - 1,000 lux	500 - 1,600 cd/m²	V Series, P Series, HB Series, LED
	Corridors / staircases	100 - 250 lux	350 - 500 cd/m²	E Series, C Series, V Series
	Sports and event arena	200 - 1,000 lux	400 - 1,600 cd/m²	V Series, P Series, HB Series, LED
	Museum	200 - 1,000 lux	400 - 1,600 cd/m²	V Series, P Series, HB Series, LED
Food and Beverage	Restaurant window frontage / glazed facade	1,000 - 10,000 lux	1,700 - 2,700 cd/m²	HB Series, LED
	Menu board	250 - 500 lux	500 - 800 cd/m²	C Series, V Series, P Series
	Self-ordering kiosks	250 - 600 lux	500 - 900 cd/m²	V Series, P Series
	Drive-thru menu board (Housing)	5,000 - 50,000 lux	2,000 - 5,000 cd/m²	HB Series, LED
Rental and Staging	Outdoor area	5,000-50,000 lux	2,000 - 6,000 cd/m²	HB Series, LED
	Tradeshow stand	250 - 2,500 lux	500 - 2,700 cd/m²	V Series, P Series, HB Series, UN Series
	Sports and event arena	250 - 1,000 lux	500 - 1,600 cd/m²	P Series, HB Series, UN Series, LED
Retail	Store frontage / glazed facade	1,000 - 10,000 lux	1,700 - 2,700 cd/m²	HB Series, LED
	Entrance area	300 - 1,000 lux	600 - 1,600 cd/m²	P Series, HB Series, UN Series, LED
	Pharmacy interior	200 - 700 lux	400 - 1,000 cd/m²	C Series, V Series, P Series, LED
	Retail store interior	200 - 700 lux	400 - 1,000 cd/m²	C Series, V Series, P Series, UN Series, LED
	Grocery store/ supermarket interior	200 - 600 lux	400 - 900 cd/m²	C Series, V Series, P Series, UN Series
	Product showroom	350 - 1,500 lux	600 - 2,700 cd/m²	P Series, HB Series, UN Series, LED

Examples for typical deployment environments

1) Aviation and Transportation

a. Departure hall

Entrance and departure halls are one of the most challenging applications for any sort of display. Usually these premises are built using glass to make efficient use of the daylight. Different types of information displays will be present, be it the typical Flight Information Display, general information displays or airline information at check-in counters. Most of the displays require 24/7 operation which any sort of consumer grade TV is not able to deliver. Depending on the type of installation and direction of direct daylight, displays can get impacted massively and might be unreadable if the display brightness is just not sufficient. Light-flooded departure halls and waiting areas can experience high brightness levels of up to 5,000 lux resulting in a required display brightness of at least 700 cd/m² or even higher. Scenarios with small text font sizes for flight information require a high contrast for optimum readability.

b. Check-in and waiting area

Most check-in or waiting areas on airports will have brightness scenarios that may vary between 300-around 600 lux and result in a required display brightness of 700 cd/m². These displays are highly important since they show critical flight information and updates. A minimum contrast and therefore brightness is required in order to guarantee good readability. Since this is also usually a 24/7 operation scenario, it is key to have commercial grade displays that offer maximum reliability and long term consistency.

c. Train stations and bus stops

The majority of displays used in public transportation such as bus shelters or train stations are located in outdoor installations where visibility is directly related to weather conditions. Displays are not only used for time schedules but also to provide general advertising or infotainment. Due to changing ambient parameters like temperature and illumination by sunlight, commercial grade equipment is required to provide sufficient and constant visual quality and readability. High brightness displays with brightness levels of 1,500 cd/ m² and above are recommended.

2) Quick service restaurants - Drive-thru menu boards

Customers of quick service restaurants expect fast service and easy to understand menu information. Research has shown that digital signs can reduce customers' perception of wait times by as much as 40 percent, presumably increasing their satisfaction. Due to changing sunlight conditions during day and night it is paramount to have a display that can automatically adjust its brightness in order to provide constant readability. Besides that, strict governmental laws regulate the maximum brightness of public displays at certain times of the day and at night. Another important point is that these types of screens are usually placed in protective cabinets which can also impact the brightness and certainly has to be taken into consideration when choosing the right display type. High brightness displays with at least 2,000 cd/ m² are recommended.

3) Retail and signage

a. Shopping malls

In day lit shopping malls, the weather can be critical and impact greatly on the effectiveness of advertising displays, information screens and wayfinding. Similar to airport environments, brightness levels can easily reach up to 5,000 lux and require displays with brightness levels of 2,000 cd/m² or above. In addition, screens are typically placed in protection cabinets which can impact brightness. Average indoor retail stores will have an ambient brightness of 250-1.000 lux which leads to an ideal maximum display brightness of 350-1,600 cd/m². Most retail displays will use big font sizes and picture or video content, so that medium contrast ratio levels are sufficient for ergonomic viewing.

b. Store frontage / glazed facade

The frontage of a store is the area where the shop owners try to engage customers entering the sales floor and therefore is key for generating revenue. Displays used in this critical area must be convincing which is a huge challenge under commonly difficult light situations where several thousands lux of ambient light are normal. The highest class of brightness output of 2,000 cd/m² or more and durability is required here.

4) Leisure & Museums - Sports and event arenas

Public venues for sports and concerts can be highly challenging. Bright spot lights, light fixtures with different brightness levels and colours and laser beams highly impact the performance and visibility of displays. Outdoor venues like sports arenas usually utilize open architecture to allow sunlight to fill the space which naturally greatly influences the visibility of scoreboards and advertising screens. Most sports stadiums and indoor arenas use high intensity discharge (HID) lamps for almost all of their overhead lighting. Depending on the individual ambient brightness levels on-site, the ideal display brightness typically lies between 500 and 1,500 cd/m²

5) Corporate Office - meeting rooms

Meeting room applications demand good visual contrast ratios in order to guarantee readability throughout long meeting sessions without eye-fatigue. The ambient brightness levels in meeting rooms vary between 150-500 lux which requires a display brightness of between 350-700 cd/m² depending on the individual light situation. Lower brightness levels may result in bad contrast, levels that are too high create unnecessary glare which puts additional stress on the visual system, especially if small text fonts combined with white content background is used.

Conclusion

Improved display functionality and low operational cost are the key drivers in the digitalization of paper information. Whilst image quality of many consumer products is good under living room conditions, most professional applications in public places demand for dramatically higher levels of quality and endurance. Checking the first pages of user manuals of consumer-grade products tells us that hardware manufacturers mostly

design their products based on a maximum of 8 operating hours per day, which is clearly not meeting the demands for most business scenarios. As a summary, sufficient levels of brightness and low reflectance of a display are the most beneficial factors in the delivery of image presentation. Application scenarios with bright ambient conditions are extremely demanding and require highly professional displays with high quality visual parameters. Dim LCD panels that neither attract the viewer nor deliver sufficient contrast ratios to support the human visual system are not the right choice for mission critical installations.

Quality and longevity should be the key decision factors

NEC is offering a wide range of displays designed to meet the needs of professional installations, especially when it comes to stable and consistent operation throughout long operating hours. Whether for standard or more demanding applications, the majority of NEC commercial grade large format displays guarantee flawless 24/7 operation in order to provide a reliable canvas for business-critical applications.

At NEC, there are typically 4 different display brightness levels to choose from. NEC large format displays are available in all the mentioned categories of brightness, supporting a wide range of applications from standard indoor retail signage to mission critical flight information systems. The E Series displays are providing a brightness level of 350 cd/m² and are recommended for controllable light situations. Its brightness performance is slightly surpassed by the C Series which delivers 400 cd/m².

Models like the NEC V Series, the UNV Series as well as the interactive NEC InfinityBoards feature 500 cd/m² delivering excellent readability in standard ambient light conditions. Screens like NEC's P and UN/UNS Series provide 700 cd/m² brightness and serve the majority of applications where ambient light is high but without direct sunlight impacting on the screen surfaces. Displays specifically designed for true high brightness environments are represented in the NEC XHB Series.

These screens typically deliver 2000 cd/m² and above and are created to withstand the demands of challenging environments. In addition, NEC's new portfolio of fine pitch and outdoor LED solutions greatly widens the options available for large screen sizes and high brightness environments.

One brand fits all

NEC's portfolio of Large Format Displays has been carefully developed to fulfil the requirements of sufficient brightness levels and low reflectance in order to guarantee state-of-the-art image performance with investment and future-proof security. NEC is uniquely positioned in the market, able to supply LCD monitors, Direct View LED modules and Projection solutions allowing it to take a consultative approach, remaining technology-agnostic in its recommendation for the best technology to suit the application. In order to find a display solution that perfectly fits your application, we recommend that you contact your local NEC sales team or NEC partner to guide you in achieving the perfect visual solution.

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