LED Screen Selection Guide

What to Consider Before Investing in an LED Screen

ONE WORLD LED
LED DESIGN, MANUFACTURE & WHOLESALE

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Table of Contents

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Key Selection Factors for Digital Commerce/LED Screens

This document outlines the key considerations in selecting the LED screens for advertising, signage, sports scoreboards, automated contents management and transaction processing such as V-commerce.

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Intellectual Property (IP)

This is the most critical aspect of LED screens' Total Cost of Ownership (TCO). A brief description and example of this aspect of technology due diligence is provided below.

Intellectual Property Rights

A list of patents protecting the IP rights covering the supplied products provides the safety and security for the end user's investment in LED Screens products and technologies. One World LED fully protects users' investments from any infringement claims by the technology owners and suppliers in this industry sector.

The following links are provided as examples and more details on One World LED IP that covers its supplied products:

LED Systems and Methods Inventions - A Patent Primer
Digital Signage, V-Commerce CMS Inventions – CMD Patent Primer

Briefly, there are two significant family of inventions that have pioneered the development of the large LED screens globally. These include: Daktronics inventions protected by few patents issued in the United States in the 90's and, One World Technology, protected by dozens of patents globally. The details of these two technologies are explored in the One World LED Architecture Primer.

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Installation Methodology

Installation options dictate the type and specification of the hardware. These options include:

- Indoor
  - Permanent, wall-mounted other structures
  - Temporary or Rental
  - Transparent
- Outdoor
  - Fixed
    - Pylons/poles or other structures
    - Buildings or other structures
  - Temporary/Rental
  - Transparent & Other Architectural Requirements
    - Cubes, Flexible/Curves, Spheres, etc.

Depending on the type of installation, the screen requirements can drastically vary and require significantly more complex equipment and installation work detail. For example, wall-mounted screen may require scaffolding or more complex lift equipment for installation and for ongoing maintenance and service. For more details refer to following documents:

- One World LED OEM Basics
- One World LED Service Primer

Other factors to consider:

- Power/data specifications.
- Project specific.
- Equipment Requirement and Availability for Installation or Service.
- Ongoing Access.
-

The indoor structure and frames usually costs less than the outdoor screens. However, the suppliers' in house engineering talent and experience can make a significant difference in cost versus outsourced projects by retailers who manage purchase and installation rather than performing them.

Requesting detailed project guides for similar or larger projects is a prudent method and helps ensure the success of the project.

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Hardware

The following is a summary of information provided within a sample incomplete tender documentation. Pixel pitch, is the measured distance between the site of one pixel to the next (in both horizontal and vertical directions). For all standard digital screen applications, this pixel pitch is square (horizontal and vertical distances are equal). The only exception to this rule applies to custom, transparent displays.

Screen	Dimension (width x height)	Resolution	Pitch (Horizontal)	Pitch (Vertical)	Aspect Ratio:
Type 1	3500x2000	1150x640	3.043478260869565	3.125	7:4
Type 2	7500x3500	1920x1080	3.90625	3.240740740740741	15:7

Table 1: Proposed Specification per documentation

One World LED Hardware Structure Guide offers certain key considerations for successful LED hardware installations.

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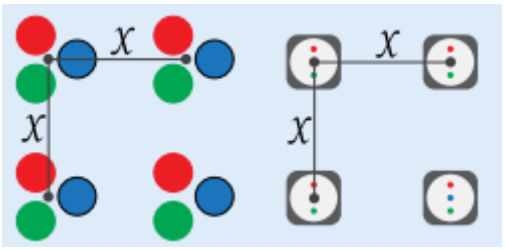
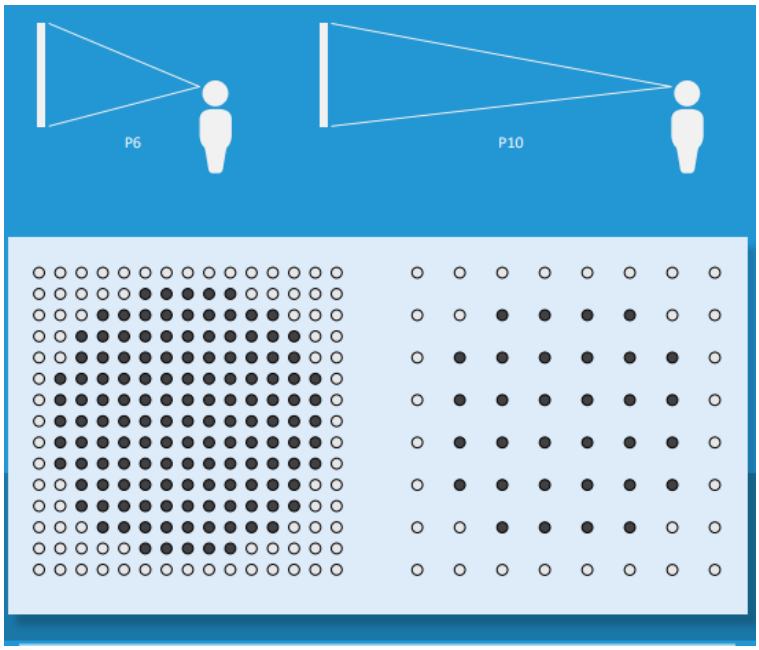
Pixel pitch

To calculate pixel pitch, the number of pixels (resolution width or height) can be divided by the physical dimension. For example, on a screen 1000mm wide if the pixel pitch is 4mm, the number of pixels will equal 1000 / 4 = 250. If the screen was also 1000mm high with a pixel pitch of 4mm, the resolution would be 250 x 250, totally 62,500 pixels.





Is pixel pitch specified in documentation and do calculations provide correct information regarding the screen resolution?

Pixel pitch should be equidistant horizontally and vertically. To ensure consistency in tender responses and specification, a pixel pitch (or options of) should be specified. For transparent the fidelity of the rendered contents is a critical factor.

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Aspect Ratio

Aspect ratio is the ratio of width to height of a display screen. For example, all standard screens in the home (TV's, computer screens etc) are 16:9. This is so that content (television, movies, videos, computer web pages etc) are prepared to a standard size.

Has aspect ratio been specified for Intended Application?

One World LED recommends specifying an aspect ratio that is consistent between the proposed screens (they can be different sizes, but should retain the ratio) for the purpose of content preparation and management.

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Brightness

Has brightness[1] been specified within the requirements for the screens?

One World LED recommends further consultation with experts for correct specification of this parameter[2].

Brightness is a critical consideration not only to ensure it performs to an acceptable standard given application specific factors, but also to counteract screen brightness reduction over time.

All LED screens lose brightness over time (the effect is less for higher quality screens), but having headroom to increase brightness settings counteracts the physical degradation.

To make a professional recommendation as to what brightness the screens should be, information about the ambient lighting is required:

- Is all lighting artificial or a combination of ambient and artificial lighting?
- How bright is the ambient lighting at its brightest (sun-facing period)?
- Is the screen exposed to any direct hitting sunlight?
- What is the colour temperature and luminance of artificial lighting?

Brightness for indoor can range from >1000 to 4000 and for outdoor from >6000 to 10000 Nits are typical ranges for major applications.

[1] This factor should be reconciled against other key related factors.
[2] This parameter may be dependent on or impact other desired factors such as scan rate, contrast and or refresh rate.

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Contrast

Has contrast been specified within current specifications of the screen(s)?

To ensure consistency in tender responses and fair evaluation between offerings, One World LED recommends further consultation to specify this parameter.

A key factor in LED production cost is the diode component (SMD over 40%) type and packing. The black SMDs are more expensive than while SMD because they produce much higher contrast but at the same time their luminance is much more limited.

A Contrast of 4000:1 for indoor and >2000:1 for outdoor is typical.

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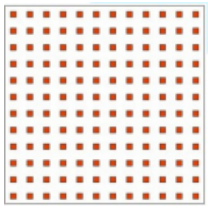
Scan Rate

The scanning rate of LED display should not be confused with the refresh rate of the display which refers to number of images per second that can be displayed on the screen. Following section details the Scan Rate explanation. Means LED is driven by IC and, means LED is off for this explanation.

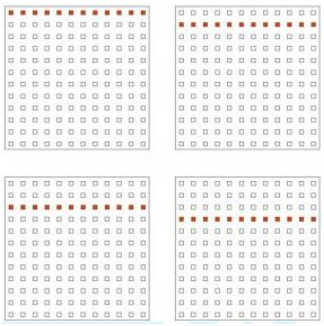
In this example, each driver IC chip has 16 pins, and can drive up to 16 LED components at the same time (this can vary based on specification). Static drive mode means all the LEDs on the LED module are driven by IC at a given time, as shown in the following image:



1/12 scan mode, means 1/12th of LEDs on the module of this example are driven by the IC chips at a time, and next cycle the next 1/12th of LEDs are driven as shown in cycles below.

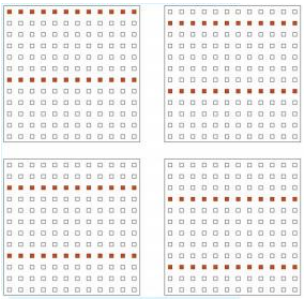
1/6 scan mode, means 1/6th of LEDs on the module are driven by the IC at a given time, and next 1/6th LED are driven next. Below pictures four cycles of driving the screen at 1/6th scan rate

Note: Please refer to One World LED Comprehensive LED Handbook V4.0 for additional information by clicking on the above link.



The example of 1/6th scan rate (below) is twice as bright as the 1/12th scan rate (above) but will require twice the number of IC driver chips and consume twice as much power. Another way of looking at this is that the 1/12th scan

rate the lights are off twice as much as 1/6th scan rate. For more details please refer to One World LED Design Primer document.



Note: Because the scan rate change scan lines faster than can be noticed visually, one feels like the LEDs light are on all the time. In fact, the scan rate has LEDs off at the complemented rate. Thus, the effective brightness is a function of LEDs Scan Rate. Not all components off-the-shelf provide sufficient quality and brightness for lower scan rates and may require constant drive (always on) to be active.

Consequently, the lower scan rate can save LED driver IC counts, energy and costs and increase life expectancy and reliability. The trade-off is the brightness and visibility.

The following companies specialise in manufacture of IC driver chips and have different tiers of products depending on the application and project budget:

- Macroblock (One World LED preferred)
- Texas Instruments
- JXI
- ICN

Has scan rate[3] been specified within current documentation for the screen(s)?

'Optimum scan rates' may be stated, which does not specify what is the optimum for the desired application. One World LED recommends further consultation to specify this parameter.

[3] Refer to previous footnotes.

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Diode Component Size

In addition to pixel pitch, diode size is another critical consideration.

Surface mounted diodes (SMD or GOB) are the current industry standard for indoor and outdoor screens. The packed RGB diode components are mounted to the surface of the printed circuit board (PCB) as implied by the name. The alternative to this technology is dual in-line package (DIP), which should not be considered for this application so will not be further discussed.

SMD diodes contain filaments that produce the colours (red, green and blue), which constitutes one pixel. A matrix of pixels then forms the display surface area, which the target audience visually receive as information (logos, pictures, score, videos, colours etc).

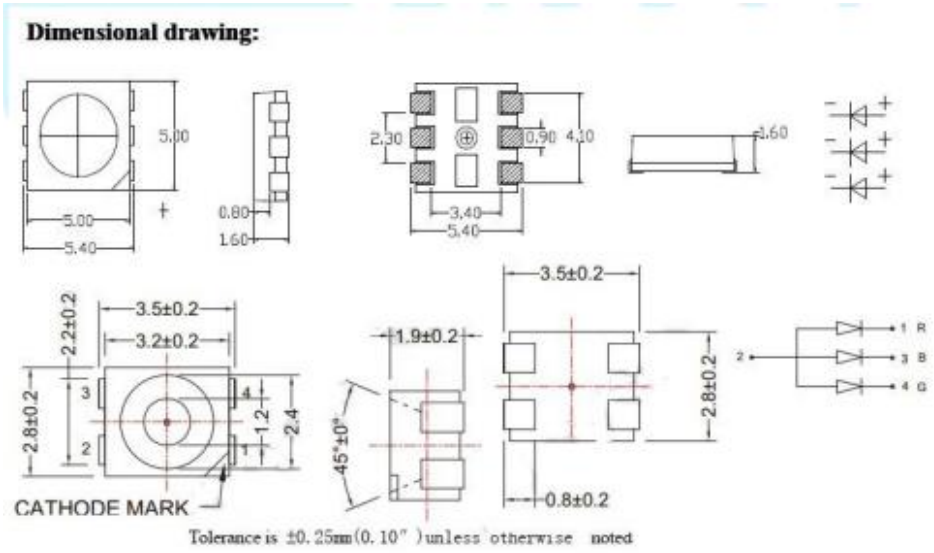

Figure 1:Typical SMD3535 Top versus SMD3528 LED Components Specifications

In the above, two different sized pixel components are compared. One shares a common anode between all three colours (one anode three cathodes) and one has independent anodes for each colour. This can have large implications on how the image is produced, how bright, efficiency, heat production and diode lifetime.

Has diode size been specified in the tender documentation for the screen(s)?

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To ensure consistency in tender responses and fair evaluation between offerings, One World LED recommends further consultation to specify this parameter.

This specification impacts the performance, pricing, reliability and longevity (life-expectancy) of LED screens at various duty-cycles.

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Diode Manufacturer, Encapsulation and Packing House

The type of material, methods and equipment used during the encapsulation process is a major consideration, as higher quality substrate and material result in less heat, higher efficiency, higher brightness and prolonged diode life with lower brightness reduction over time.

Tin, copper and gold are the three main types of substrate used. Tin is inefficient, resistive to current thus produces more heat and means the diode must be driven harder, lowering its lifetime.

Copper is most commonly used again because of its cost-effectiveness. It is better than tin and accepted as a reliable and good middle of the road solution.

Gold is the highest performing, most efficient and least heat producing substrate available. It increases costs relatively substantially and for indoor screens is not generally required as indoor applications do not require the brightness and do not expose the screen to the same heat extremes and fluctuations.

The following companies specialise in diode 'chip' manufacturing and have different tiers of products depending on the application and project budget:

- Silan (One World LED preferred)
- Epistar
- Nichia
- Cree
- AXT
- Taiwan-Opto
- Others - tier-3 parts

The following companies specialise in encapsulation and have different tiers of products depending on the application and project budget (ordered list):

- Nationstar (One World LED preferred)
- Kingbright
- Reestar (NS)
- Xinda
- Mulinsn
- Multicolour
- Harvatek (below 1mm pixel pitch)
- Kinglight
- Hongsheng
- Shenzhen Huayi
- Hao Xiang

- Huayi
- Others - tier-3 parts

Note that each LED supplier provides a subset of standardized packaging such as 3528, 3535, 2727, etc. and for each standard package may offer multiple options including Copper, Gold or other type of part internal wiring. This means there are hundreds of products to choose from. Selecting the wrong product may mean discontinuation or part obsolescence may render user's investment worthless or severely degraded. The supplier track record may be the best reference for users.

Has diode manufacturer, encapsulation (packing) or substrate has been specified within current documentation for either of the screens. Diode substrate has large implications on cost and ongoing quality of the screen. To ensure consistency in tender responses and fair evaluation between offerings, One World LED recommends further consultation to specify this parameter.

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Control System

Has control system manufacturer been specified within documentation for the screen(s)?

One World LED partners with and uses Colorlight who owns and controls key IP for most innovative and advanced control systems that are used for major global projects (including all world class custom projects). Efficiencies in design, simplification of control system and elimination of redundant hardware is an attribute of Colorlight control solution, which reduces cost and points of failure.

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Rating Considerations

Power rating/efficiency

Have power rating or efficiency values been specified within requirements for the screen(s)?

IP rating:

Has IPxx (Ingress Protection) been specified within documentation for the screen(s)?

It is assumed as they are indoor thus they will require no water/dust ingress protection. An IP68 rating is usually not necessary and inhibits the flow of air, thus reduces passive cooling and can have adverse effects for most application. Typical indoor specification is IP45 and outdoor is IP65.

IK rating:

Has IK rating been specified within the documentation for the screen(s)?

The screens are to be installed within an environment where balls may hit it. One World LED recommends consultation to determine frequency and approximate impact rating of balls to determine whether an IK rating should be specified for the hardware.

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Software

Has integrated solution with single-sourced hardware-software been specified?

Software is absolutely the most important factor for proper and optimum utilization of automated Advertising and transaction processing and V-commerce deployment. As an example, One World's Adverpost has been recognized as significant innovation and received over a dozen patents in China and Australia.

The most significant test of seamless integration between the hardware, firmware and software is the number of parties involved in completing the solution for the application.

Typically multiple software packages are patched together to offer a tier-2 solution. Tier-1 solutions usually comprise of single supplier that has designed, developed, the integrated solution and provides support services with >99.9% uptime.

One example of all-in-one solution is the One World LED Adverpost which operates on most reliable, most secure and most fault tolerant ShowScreen Server Linux/Intel platforms. One World LED solution requires no sender and no video processor as the only single supplier fully integrated solution.

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Content Management Systems

Software is of paramount importance, as once the hardware specification has been elected, installed and commissioned – it is only software that provides the screen operators with benefit and ongoing capabilities (or lack thereof, if the choice is software is misinformed or made without due consideration).

Software mentioned in documentation is FUSION Cloud Signage Software (android based). No specifics have been provided pertaining to software capabilities for screen functionality other than that the screen is 'intended to display sponsor logos and media relating to current sporting events'.

One World LED software technologies offer two distinct packages that have extensive capabilities in their respective fields:

- Adverpost: An integrated multi-party platform that allows remote (cloud based) management of content. It excels in its ability to sell screen time to third parties, which would allow Mt Gambier to sell space on the screen to sponsors, retailers and sporting bodies associated with the venue. Please visit www.adverpost.com for more information.
- Sportal: A multi-sport scoring platform that allows flexibility across multiple sports and fully programmable screen real estate. Custom options are available to ensure the presentation of scores suits the venue and its specific requirements. The platform eliminates archaic, proprietary technology (item code ASB01 for example) Please visit www.sportal.gg for more information.
- V-Commerce: Using patented innovations that combines the most advanced innovations of artificial intelligence, automated contents management systems with Ambient Responsive Visual Commerce, Adverpost/IPAM with E2V allows SMEs to utilize the most cost effective solutions to compete with multi-national conglomerates and actually deliver a better, cheaper product and service faster to the consumers.

Has integrated reliable contents management system, scoreboard or automated transaction processing solution been requested or specified within the documentation for the screen(s)?

Further consultation for software consideration is recommended to ensure screen capabilities and the opportunity for return on investment are maximised.

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Remote Integrated Support/Service System

Has Remote Control System/Automatic Updates been specified within current documentation for the screen(s)?

One World LED partners with and uses Colorlight for the majority of its projects. Efficiencies in design, simplification of control system and elimination of redundant hardware is possible, which reduces cost and points of failure.

This parameter impacts the overall development capability as well as the support/serviceability of the products during its life-cycle. One World LED has full access to the source code of the control systems and often provides tailored configuration and custom software to maximize the efficiency and utilization of the supplied screens. Refer to OWL Transparent, Stock Ticker and Sport screens products for more examples. Also see One World Led Design Primer for more information.

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Service Methodology

In most cases, the screen's owner is responsible for providing clean power, reliable data and access for installation and support services.

A fixed, wall-mounted or tall pylon screens may require lifts, scaffolding or other facilities for access for ongoing maintenance. These are usually the owner responsibility.

One World LED OEM Basics: https://oneworldled.com/wp-content/uploads/2017/11/OEM-Basics.pdf

Serviceability: Please consult One World LED Service Primer for more information.

Other factors to consider:

- Power/data distribution specifications
- Project dependent.
- Equipment Requirement and Availability for Installation or Service.
- Ongoing Access.

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Compliances

Our products are compliant with the following certifications:

- UL
- FCC
- AS
- ISO
- C-Tick
- Others

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Final Note from One World LED

Dear Friends,

We hope this document has been helpful to you and you would consider partnering with us for Integrated Digital Out Of Home (IDOOH) advertising and commerce solutions.

Major corporations in Australia, China and United States have chosen to partner with One World LED and or license our technology. We consider this as the most valuable vote of confidence in our technology, product and services.

We are proud to share how one of our partners has summed up their reasons for selecting One World Led below:

i. One World LED is the #1 Australian manufacturer and innovator of digital signage, electronic billboards, and virtual commerce
ii. OWLED holds X patents within Australia, Y patents within China, and Z patents within the United states, among other IP/trademarks/protections globally
iii. OWLED vigorously defends its IP from infringements from distributors of fake/unlicensed technology
iv. OWLED fulfils projects other companies literally couldn't do (UniSA rotating animated multi-zone real-time ticker, Botanic Cube, GP Transparent, etc.)
v. OWLED has the greatest ability to customise hardware/software to suit digital billboards in Australia
vi. Other companies simply purchase from manufacturers or marketing companies within China, add their logo on it, and mark it up -- usually with zero technical depth to support this hardware and no control over the quality or genuine parts.

We are proud of our world class projects such as Transparent GP in Bondi, UniSA's 40-meters/indoor/outdoor multi-zoned stepped real-time ASX Ticker, Botanic Seamless Cube, and the largest high resolution multimedia outdoor Salisbury Civic Hub with complementary indoor corner screen, and many CarSwap's ShowScreen Virtual Commerce portable screens to list a few.

We look forward to learning about your projects and contributing to advancement of technology in your organization.