LED EXPERTS GROUP

PROJECT AND DESIGNS CONSIDERATIONS FOR DVLED DISPLAYS

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WHITEPAPER

Learn about the three part journey for dvLED designs. Let the LED Experts Group help find the “perfect fit”.

When technology, application, and price converge, opportunities are created… so it has become with dvLED displays. The technology has evolved, and applications are coming to the forefront, as the price of dvLED display is moderating. As dvLED display opportunities become more pervasive, the commercial AV and digital signage design/build firms will be required to learn about dvLED, and the variables in both the technology and the design parameters (as they once did for projection and LCD flat panel displays). Only then can they confidently add these solutions to their group of offerings.

A dvLED display project involves a three-part journey of discovery. One is to understand dvLED displays, how they differ from other display technologies, as well as the challenges we are confronted with. The second is to research and select a reliable vendor to work with as a partner on the project, and the third is to consider the project design parameters.

Step 1 - Know dvLED and the Challenges

The benefits of dvLED displays are front and center (literally) for all to see. They are seamless, nearly limitless in size and shape, and dvLED produces colorful, high contrast images with brightness levels to fit low to high ambient light environments.

With decades of expertise in mainstream displays (i.e., projection and LCD flat panels), we are comfortable in what we know. Admittedly oversimplified, projection is all about screen size, lumen light output, and overcoming ambient light. For LCD flat panels it is about fixed image size, ambient light status, and duty cycle. The decision-making variables are well known, and we are used to working with them. As dvLED displays comes into increasing prominence, we need to realize that they are fundamentally different in several aspects.

First, the technology and the manufacturing processes are different than LCD or imaging chips for projection. An LED (light emitting diode) is a semiconductor device that emits light when a voltage is applied to it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons (aka. light). Properly defined this is electroluminescence, in which the LED material emits light in response to an electric current. Discrete or individual LEDs are “placed” on a circuit board in groups of 3 or 4 red, green, and blue subpixels to create the full color spectrum and images we see in dvLED displays.

Unlike LCD flat panels there are significant differences among LED display manufacturers and their processes relative to how a display is built. Think R&D and quality control. Regarding quality, there are significant differences here as well. Many think an LED is an LED… but that is only partly true. The core concept of how they work (electroluminescence) is common to all, but the individual LEDs come from a few suppliers (4 to 6 are most well-known) and in a variety of quality levels. Think of good, better, and best from a given supplier. The common differences in LED “grades” are in brightness, color accuracy, and lifetime. The LED is not the only quality difference. The way the circuit boards are manufactured, and the ancillary components vary in quality with gold wire designs at the top followed by copper, etc. The nuances are not “black versus white” in concept rather a grayscale, with value versus performance as the driving factor.

It is in the variables of how dvLED displays work and are manufactured that requires research and

due diligence up front. This will ultimately lead to selecting and working with a manufacturer that you will have come to know and trust. Caveat: No matter who is selected as an dvLED display vendor, it is not if but when issues arise, and how they are addressed by you (and your dvLED display partner) that will determine the outcome of a project.

Step 2 - Select a Reliable Vendor

In projection and LCD flat panels, major manufacturers (and their products) have been clearly defined for us over many years. The variables are few. Much of the manufacturing is standardized across brands. The products are reliable, and the industries are mature. In dvLED displays we do not have that history and depth of experience that we do elsewhere. File this under the need to know more than you may currently about this relatively new display medium.

There are currently around 2,000 companies (!) who claim to be manufacturers of dvLED displays. Research shows that most of these are assemblers, who buy components from others and then integrate them into a finished product. Putting those aside for a moment, that still leaves a huge number of true manufacturers of dvLED displays. Currently there are over 100 such companies that are attempting to do business in the USA. Suffice it to say, this has injected a high level of confusion as to whom to buy from, and more importantly, in whom to place your trust. Some of the major participants in video projection and LCD flat panels have entered the dvLED display market under their own brand names… and if they have earned your trust, this is certainly a place to start. Keep in mind though, that there is a lot of OEM business out there. Companies (mainly out of China) are manufacturing for known brands selling in the USA. Some known brands buy their LED displays OEM from more than one supplier.

Beyond the confusion among manufacturers, who does what, and who to buy from, there is more to consider. As noted, LED displays are different… and how they are different falls under a set of parameters that you do “need to know”. The best advice is to get acquainted by looking beyond the obvious and see what lurks beneath the surface.

In the white paper Quality is Job One for Customer Satisfaction (Available on LEDexpertsgroup.com as a download) we discuss the concept and significance (or necessity) of quality and what it really means along the journey of product design, development, and manufacturing. It is incumbent on resellers to conduct due diligence on their own and align themselves with quality dvLED display manufacturers. Suffice it to say that it is not as easy as looking at a screen at a tradeshow, perusing a website, or listening to a sales pitch. Hard work to be sure, but well worth the efforts!

The search and research required should not be construed as onerous, but rather something that will take shape and an outcome of its own. If done properly, that outcome can be positive. Be aware and get to know (and verify) those manufacturers who adopt quality control, testing, and continuous measurable improvement as their key principles. This is the litmus test of who to work with and helps ensure that there will be a happier ending.

The following is a place to start… a dvLED display manufacturer should adopt, adhere to, and adapt their processes to the following. By the way, just because it says so on a web site does not mean it is true!

- In North America verifiably meeting FCC, UL, along with NOM in Mexico. (dvLED Displays and North American Certifications and Standards: Let the Buyer Beware! (Available on LEDexpertsgroup.com as a download)
- Proven adherence to and adoption of total quality management (TQM) as a management tool.
- Meeting certified ISO 9001 R&D, Design, and Engineering standards
- Proof of quality tested components (circuit boards, LED chips, IC, power supplies, processors, cabinets, etc.)
- Testing for performance and mean time between failure (MTBF) and mean time to repair (MTTR)
- Manufacturing and quality control certified to ISO 9001 standard

Step 3 - Project Design Parameters
The basic systems design elements that go into a dvLED display project are familiar to the design build community… but more varied than with other display technologies. The basics to be considered:

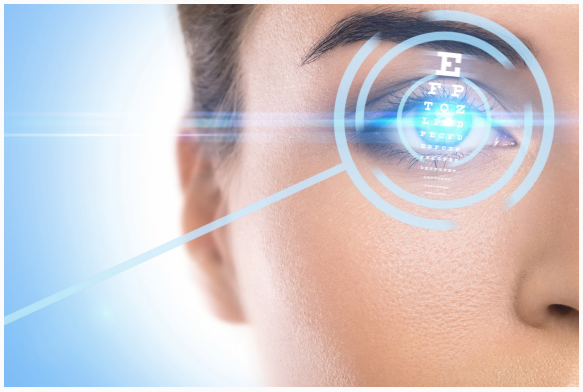
- **Indoor or outdoor**
  - Beyond the obvious of where the dvLED display will be located, there are local codes that must be considered. For indoor use the local codes will typically follow similar rules to installing a flat panel or a projector. There may be electrical codes dealing with power and plenum rating or requiring cables in conduit. There may be structural engineering codes in mounting the display due to the increased weight and depending upon the location there may be ADA compliance to consider.
  - For outdoor applications it is more complex. Mounting may require certified structural engineering sign-off and power distribution may have codes specific to those areas, but the two biggest issues will be who installs the sign and the location of the sign. From an installation perspective many municipalities require a certified sign company to install the sign. Regarding location, many municipalities have limitations on where these displays can be, relative to roads, and may have rules about static content versus motion graphics or video. This relates to driver distraction. They may also have rules about light emission due to environmental concerns or comfort of those living nearby.

- **Size and aspect ratio (16:9 or irregular)**
  - As noted, the size of a dvLED display is almost limitless. LCD flat panels are fixed in size and limited in how large they can be; projection will be more flexible, but will typically follow similar configurations.
  - The de facto aspect ratio in AV and digital signage has become 16:9, or the ubiquitous widescreen we are all used to seeing. Since LED can be configured in nearly any shape, aspect ratio comes into play. Even for 16:9 design applications, the varying sizes of an dvLED cabinet my mean that a precise 16:9 may not be possible.
  - There are applications such as dvLED tickers, dvLED floors, curved dvLED, transparent dvLED, and irregular shapes and sizes that may be part or all the LED project.
  - The admonition is that with irregular sizes and aspect ratios the content must be created and configured to fit.

- **Viewing distance and visual acuity**
  - One of the biggest design considerations in dvLED is based on the audience's viewing distance. That is the choice of pixel pitch, or the distance between pixels. Depending on the pitch between discrete LEDs you may be able see the individual pixels when viewing the

display. Unlike fixed resolution in projection and LCD flat panels there are a wide variety of choices in dvLED. Pixel pitches range from (approximately) .6mm to over o20mm. Whether a viewer sees pixels or not is dependent upon the viewing distance… if they stand far enough back, based on visual acuity, they will not be able to discern the space between LEDs. From a budgetary perspective the smaller the pixel pitch, the higher the price. For most of us the "sweet spot" is that middle ground where the pixel pitch is coarse enough to conserve cost, but where the viewer does not see pixels from where they are expected to be.

- Visual Acuity Distance is a formulated calculation of the distance a person with 20/20 vision must move away from a dvLED video display to no longer distinguish individual pixels. An example is a 2.5mm pixel pitch x 3438 (the scientifically derived scale factor of 1 arc minute for 20/20 vision) equals 28.2 feet converted from mm to feet. Examples of visual acuity formula distances:



  - 10mm = 112 ft. 10 inches
  - 8mm = 90 ft. 3 inches
  - 4mm = 45 ft. 1 inch
  - 2mm = 22 ft. 7 inches
  - 1.5mm = 16 ft. 11 inches
  - 1mm = 11 ft. 3 inches

- For those who are math averse a safe rule of thumb is to use 10X multiplier of pixel pitch (i.e., 2.50mm x 10 = approx. 25 feet).
- There are those who claim that this is too extreme. Some claim that you can get closer to the screen than 10x… and in some cases they are right. This boils down to subjectivity, and what kind of content is being viewed. The science cannot be argued, but some will say that they are fine in viewing at a closer distance or watching content (like full motion video) where visible pixels are less of an issue. File this under subjectivity, and not science… and apply where appropriate in a design. The key factor here is that viewing distances are rarely fixed. They span a range of nearest to farthest viewer. Best practices say to design for the typical viewing distance and err on the side of working from the nearest rather than the farthest.

- The environment (location, temperature, humidity, dust, ambient light)
  - The evaluation of the environment where the LED display will reside begins with an ambient light measurement that will affect the performance of the images on screen. The light output of the displays must overcome the ambient light in the space.
  - If the dvLED display is outdoors, the consideration will be competing with direct sunlight (all or part of a day) versus a dvLED display located in a shaded area.
  - If the dvLED display is indoors, the ambient light must also still be measured. Is the ambient light static and consistent, or does it increase or decrease over the time period the LED display is operational? You will need to plan to ensure the display is bright enough to overcome this.
  - The light output requirement of the dvLED display can range from 600 nits to over 10,000 nits and is derived from this analysis and measurement.
  - As in all display technologies there are specifications listing operational ranges for both temperature and moisture:
- **Heat**

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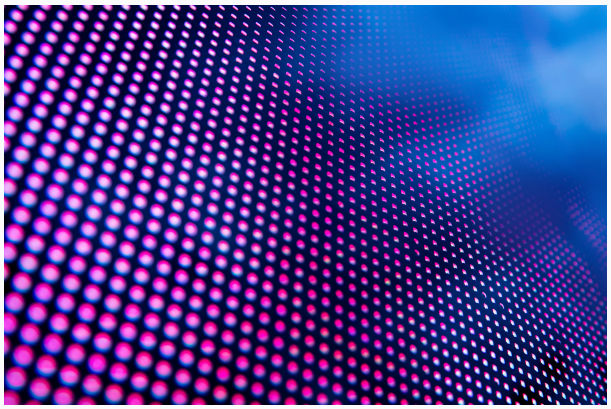
- Heat
  - Temperature ranges will vary slightly by manufacturers and model but on average the ambient temperature range for an indoor LED display
  - ≤0-40C. For outdoor displays the typical temperature range is ≤-20-60°C. Both in-door and outdoor applications should keep ventilation in mind as noted below.
  - Some amount of heat is generated by the normal operation of any electronic device. Combine this with the heat from sunlight exposure, internal power supplies shedding heat as part of their switching processes, and other any number of other heat sources, and the internal temperatures of a dvLED display could climb into an uncomfortable range. Ideally, the internal temperature of your display should remain under 120℉. Obviously, outdoor displays are typically subject to a wider range of temperatures throughout seasonal changes than are indoor displays. In cold environments, dvLED displays usually generate enough heat on their own to keep running. The challenge is in the warmer summer months when an outdoor display is exposed to much higher ambient temperatures. Unchecked, temperatures exceeding 122℉ (50℃) and even 158℉ (70℃) aren't unheard of. Temperatures like this can have several negative and dramatic impacts such as a degradation in overall image quality and imbalanced color particularly in the red LED component.



- Moisture and Humidity
  - The critical dvLED display components, such as lamps and ICs, are susceptible to moisture and high humidity, resulting in short-circuiting and electronic failure. Best practices are when the relative humidity of the environment exceeds a continuous 65 to 70 percent relative humidity, the dvLED screen should employ some type of dehumidifier. There are also "nano coatings" that can be applied to the surface to reduce the negative effects of moisture and high humidity.
  - Manufacturers of outdoor dvLED screens offer weatherproof cabinets and are Ingress Protection or IP rated (ideally you want IP65 or better!). This is protection against moisture and dust for outdoor and even some indoor applications.

- Site factors (power availability, wall structure, mounting, site accessibility, etc.)
  - dvLED display projects are somewhat different than what we may be used to, but one common denominator is the availability of power relative to the location where the display will be installed, and the increased amperage requirements of this type of display. Keep in mind this will be different, and greater, than a single flat panel or a projector.
  - There will typically be a larger number of components required to assemble the dvLED display. Most times, there will be cabinets that are physically connected and then the LED modules magnetically or physically latched to the cabinets. There may also be differences in wiring. Some displays are simply daisy chained between the cabinets and panels, and others feature a cable free direct connect design.
  - The mounting system will be considerably different than the VESA mount for flat panels or the projector ceiling mounts that we are used to. Each dvLED display manufacturer uses a proprietary mount system. Many times, the mounts are provided by a third party rather than coming from the dvLED display manufacturer.

    - As the dvLED display is assembled onto its mounting system, the total weight of the finished display and mount combined will exceed a single flat panel and be more in line with an LCD videowall. Safety is critical, and both the total weight (display and mount) and the shear factor for wall mounted displays relative to structure must be calculated.
    - The manner in which the display is serviced is also different. Depending upon the installation type and location, service may come from the front of the display, or the back (or in some cases, both). It is a matter of accessibility.
- Processor location
    - There are distance limitations unique to the dvLED display processor that is specified. Look at specs on communication and control and follow appropriately. It may not be as easy as simply adding a longer cable!
- Surface durability
    - dvLED displays have the individual LEDs mounted on the surface of the display. The LEDs are susceptible to damage. Glue on Board or GOB module encapsulation technology address the need for dvLED surface protection driven by the demand for more robust dvLED systems especially with rental screens and fine pitch led displays which require natural protection for the dvLED to ensure longer life.
    - GOB is essentially a transparent epoxy glue that is applied to the surface of the LED module PCB that has already been assembled, soldered with thousands of SMD LED lamps creating a physical shield on its surface.
    - Once the GOB is applied, dvLED display units are rendered as capable of withstanding minor collisions, shocks, and moderate rough handling. They become dust and water resistant, insulated, and anti-UV without compromising the quality and performance of the display.
- Spares and warranty (tool requirements)
    - Spare parts are specific to a manufacturer, and to that specific model. This means that one challenge in dealing with spares is that as models evolve, the spares that fit a current model may not fit an older model from the same manufacturer. It is recommended that a project include 10% whole (populated) spare cabinets, to ensure enough spares for all components.
    - dvLED displays require specialized tools to remove a module from a cabinet. In some cases, the tool is a twist lock release driver inserted at the corner of a module. In other cases, the module is removed via a magnetic pickup device on the surface of the module and reinserted the same way. Another common type uses a powered suction device, like a vacuum cleaner, to remove and insert modules.
    - Warranties are unlike commercial LCD flat panels with their standard 3 to 5 years parts and labor on site. Typically, dvLED displays include two years parts warranty against defects in manufacturing. Some companies extend this warranty for an additional fee. The end user or reseller sends the part back to the factory for replacement. There are a few companies that offer onsite services and maintenance contracts but that is at an additional fee as well.
- FCC and UL compliance (TAA compliance for government)
    - FCC is a national mandate with severe penalties for non-compliance. UL compliance is for all intents and purposes universal in North America. For this section we refer you to dvLED Displays and North American Certifications and Standards: Let the Buyer Beware! (Available on LEDexpertsgroup.com as a download)

Review
Suffice it to say that a dvLED display project differs from one with an LCD or a projector. Images are created on a screen but how they produce those images is different, and there are certainly additional considerations with dvLED displays… and this is especially true for those who manufacture them. The performance of dvLED displays can vary widely among manufacturers. This is driven by the quality of the core LEDs, the electronic components used, the manufacturing process, and their quality control. The differences we see on the surface of the display are in brightness, contrast, color saturation, and uniformity but underneath is where the tale is told.

As you can imagine with so many dvLED manufacturers and so many differences, the performance, lifetime, prices, and frankly the risks are different. Knowing the differences in what we know and what we do not know in each display technology type is key to our level of risk. In dvLED displays, separating the good from the bad is job one. The biggest concerns should be quality, performance, and serviceability but price must be taken into consideration. The price challenge: Spend no more than you need to and no less than you should. This is where your research into dvLED displays, and their manufacturers pays off. The overall “sweet spot” is where you and your customers want to be. Our advice… do your homework. Educate yourself, and if you do not know dvLED displays work with someone who does.

Let's collaborate!

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