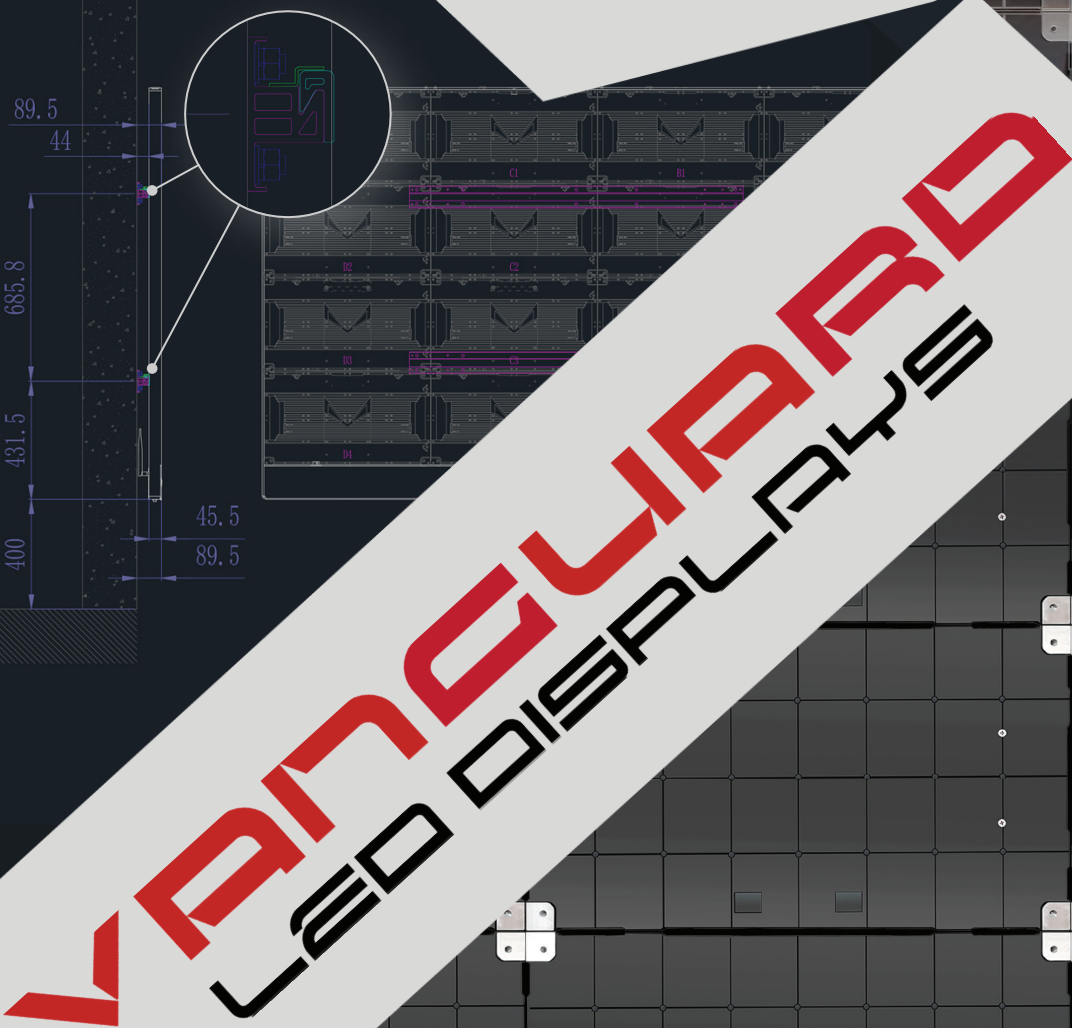




A deep dive into Vanguard's
LED TECHNOLOGY

why Vanguard?

There are significant differences between the companies marketing and selling LED technology. Those differences have a huge impact on how the LED business is conducted.

The first big difference regards the relationship between the manufacturer and factory. There are two primary models into which almost every LED supplier can be categorized, factory-owned and manufacturer OEM factory-partner.

The other guys: Factory-owned

The factory-owned model is probably the most common. The story begins with a factory that is managed by a leadership group. This group is responsible for the facility, staff, quality control, engineering and design of every product the factory produces. The factory will open subsidiary offices in various regions.

Those subsidiaries are typically the only people you ever hear from at these companies, and their only resource is the factory. The subsidiary is managed by the factory and is beholden to sell only what the factory produces. An LED Supplier that is factory-owned will produce as many different models of LED displays as possible. Therefore, consistency of products is tenuous at best and quality control is impossible to achieve

The local subsidiary is little more than a checkout clerk at a store, leaving you dependent on both the subsidiary and the factory. The subsidiary itself is also entirely dependent on the factory.



ACCOUNTABLE TO FACTORY
NO INFLUENCE OVER PRODUCTS
SINGLE-FACTORY PRODUCT LINE





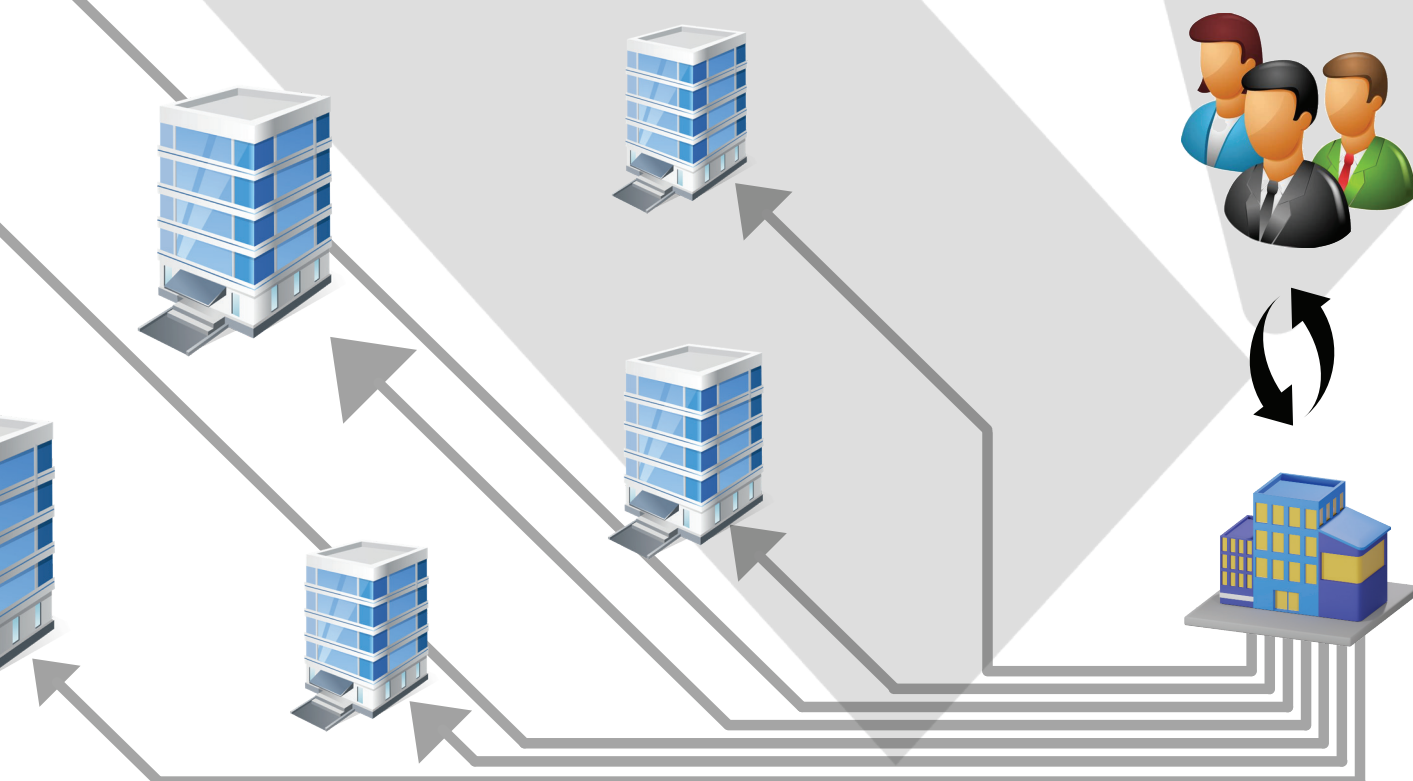
GLOBAL HEADQUARTERS
LAKELAND, FLORIDA, UNITED STATES

Vanguard LED: OEM Factory-partners

Vanguard carefully selects the best OEM factory in every segment of the market. Therefore fine pixel pitches, medium pixel pitches, outdoor displays, curved and custom displays, cylinders, domes, transparent curtains, etc, are each produced in OEM factories which specialize in each specific product.

Vanguard LED is proudly NOT factory-owned. We work directly with our factories as a partnership. With our knowledge of the technology, combined with our understanding of our customer's needs, we can leverage factory capability's in a much more natural and collaborative way. We define the products we sell by sourcing solutions strategically, then negotiating on the specifics.

Vanguard offers special module and panel configurations to suit any customer's display needs. We have classes for exceptionally high-brightness, economy configurations, TAA compliance, and more. We are able to configure displays at the component level, allowing simple modifications for special needs such as epoxy treatments, upgraded receiving cards, alternate pixel technologies, remote AC>DC power conditioning, data and power redundancy, and anything else a customer specifically needs in an LED display.



At Vanguard we are passionate about exactly two things. How amazingly cool LED technology is, and how great your experience is with it.

our story

13

years old

19

global team

>150

customers

>1,400

installations



While striving to offer the lowest pixel pitches, the highest refresh rate, the lowest latency and the latest technology Vanguard never loses its focus on customer satisfaction. This is why Vanguard is such a unique company. Stellar service is the foundation of the company.

Most companies are beholden to sell certain products as they own the factory while Vanguard selects the best OEM factories in each market segment ensuring the best quality and latest technology. We always have your best interests in mind from everything to budget and design through after-sales service.

We measure success through repeat business. Most of our customers have purchased from us several times, and we look forward to working with them as much as they enjoy working with us.

We've come a long way since our inception in 2012, but we've never wavered in providing a unique and high-quality customer experience.

Michael Wiener, our Founder and CEO, sees the opportunities today and into the future with this growing technology. We are excited and proud to be different from the norm. We treasure our partnerships, supporting our customers, and working with the most exciting display technology on the planet today.

**" We can do
this better! "**

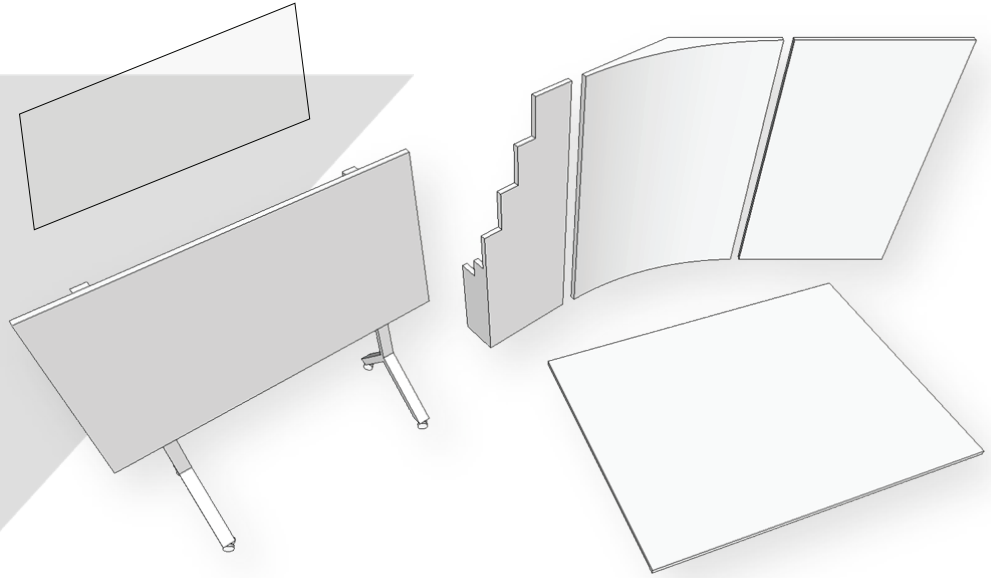


Michael Wiener

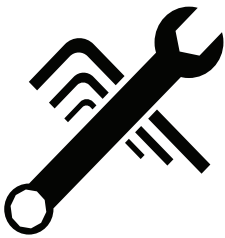
Founder and CEO Vanguard LED Displays

our range

- flat | curved panels
- all-in-one
- 16:9 panels
- creative
- floors
- transparent
- ceiling
- mobile
- rental
- xR Broadcast
- TAA

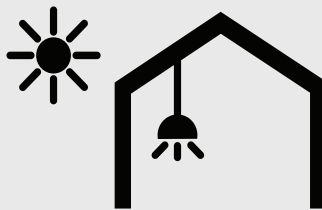


Deployments



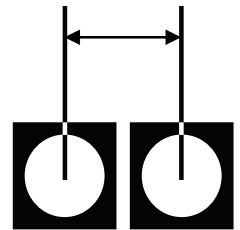
Permanent install
Rental & staging

Environments



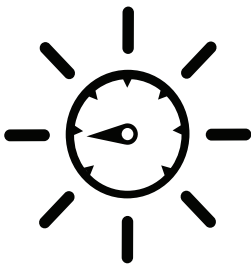
Indoor
Outdoor

Pitch range



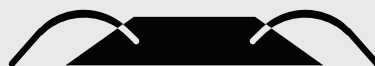
0.6mm - 16.7mm

Max brightness



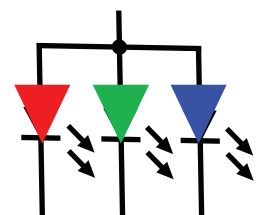
Up to **10,000 nits**

Bonding wire



Flip-chip
Gold
Copper

Power handling



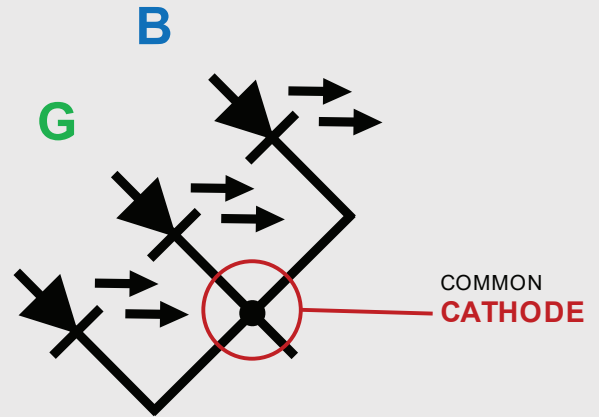
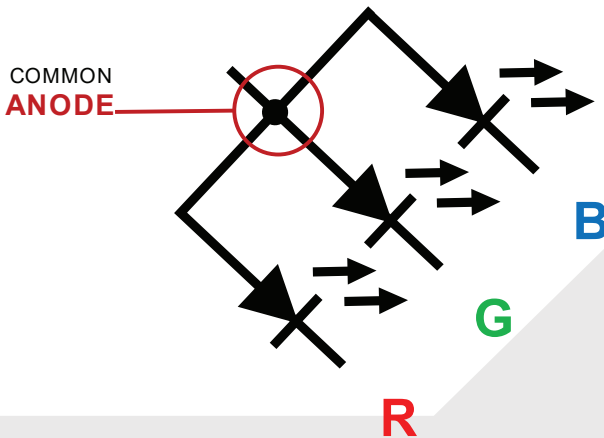
Common Anode
Common Cathode

cathode and anode

COMMON ANODE

Full power into each sub-pixel

- **PRO** - Full range pixel performance
- **CON** - Significant heat and power inefficiency for G and B



COMMON CATHODE

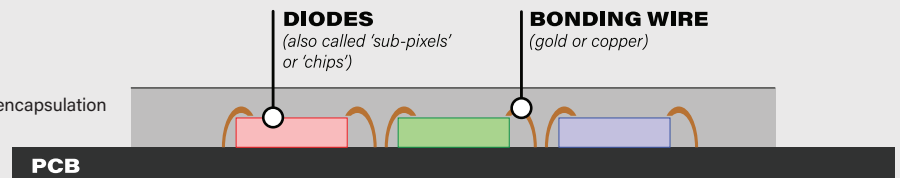
On-demand power into each sub-pixel

- **PRO** - Eliminated inefficiency for G and B resulting in much less heat dissipation from the display
- **CON** - Slight reduction in high-end range

bonding wire

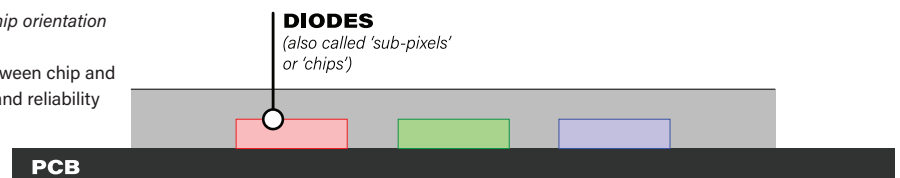
COB | standard configuration

- No pixel-level encapsulation
- Chip mounted directly on PCB
- Gold or copper bonding wire
- Not repairable due to chip size and lack of pixel encapsulation



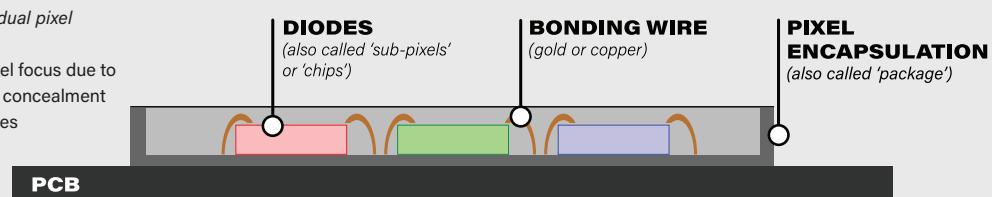
COB | flip-chip

- Similar to standard configuration COB with the chip orientation flipped, removing bonding wire
- **Improves** - heat dissipation through contact between chip and PCB, power handling with reduced resistance, and reliability due to removal of bonding wires



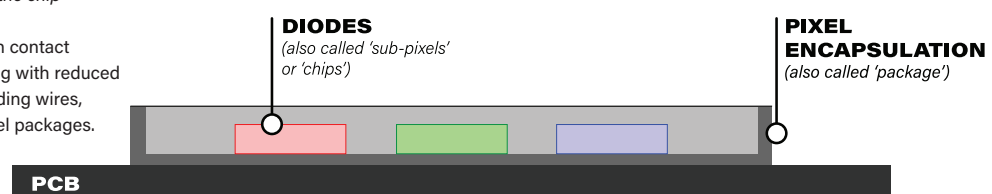
SMD/IMD | standard configuration

- Similar to standard configuration COB with individual pixel packages
- **Improves** - repairability due to pixel housing, pixel focus due to sub-pixel isolation within the housing, and seam concealment due to surface texture of SMD/IMD pixel packages



SMD/IMD/MIP | flip-chip

- Similar to standard configuration SMD/IMD with the chip orientation flipped, removing bonding wire
- **Improves** - repairability, heat dissipation through contact between chip and PCB, improved power handling with reduced resistance, and reliability due to removal of bonding wires, seam concealment due to surface texture of pixel packages.

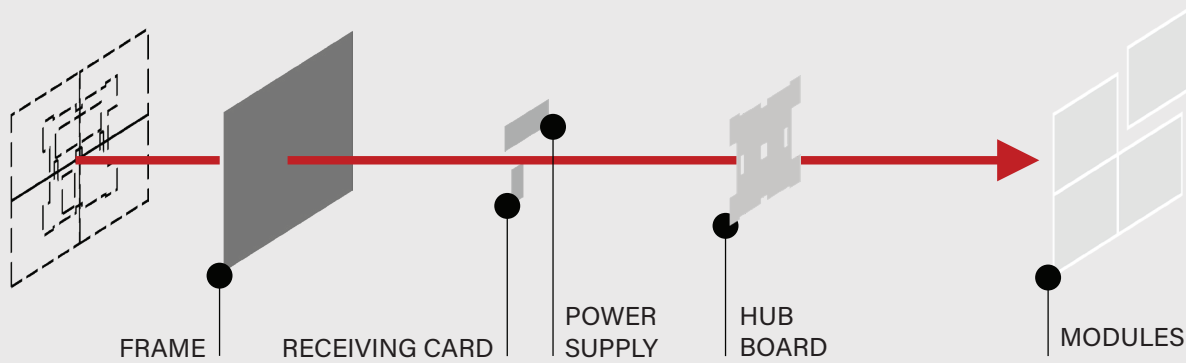


All MIP pixels are common cathode and flip-chip by default

included spare parts

Vanguard LED includes 5% components and spare parts for maintaining the display in operation. Quantities of each part are calculated based on the quantity of that part in the display. Spare parts include modules from the same batch, HUB boards, receiving cards, and power supplies.

Additional spare parts can be added on request.



5% of each field-swappable part *(based on the quantity in the display)*

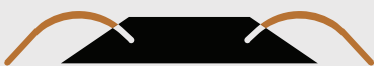
warranty

CONNECTOR GOLD | FLIP-CHIP



default | **5-year**
maximum | **7 years total**

CONNECTOR COPPER



default | **3-year**
maximum | **5 years total**

STARTING



Upon delivery of the display

EXTENSION COST



Percentage of the display cost and additional term

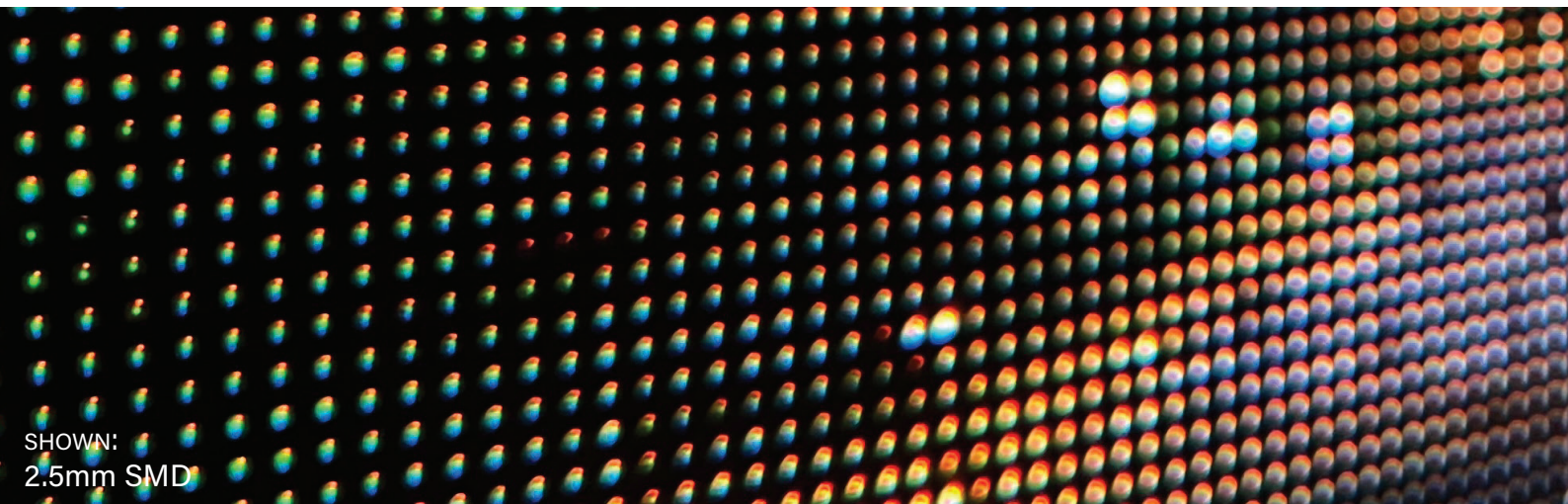
LONGER TERM?



Need a longer warranty?
We can discuss!

VANGUARD
LED DISPLAYS

our pixels



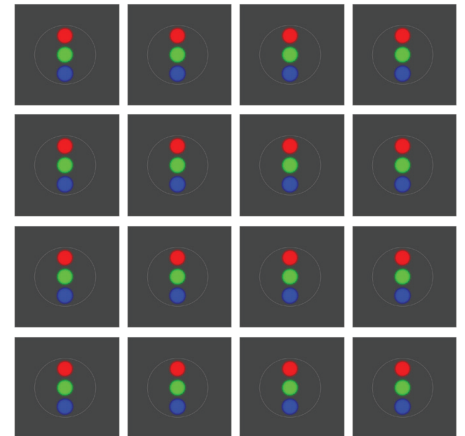
SHOWN:
2.5mm SMD

SMD SURFACE-MOUNT-DIODE



SMD pixels make up >95% of all dvLED today. Sub-pixel LED chips are arranged within a package which is then mounted to the PCB. Pixel packages are highly durable, rarely experiencing an issue within the package itself. Most SMD issues are the result of physical damage between the pixel package and PCB. SMD is available with gold or copper bonding wire, or in a flip-chip configuration.

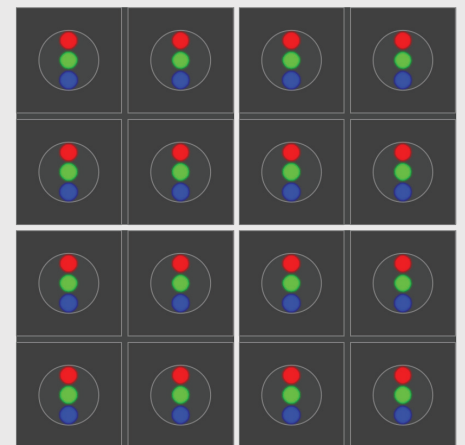
SMD can be fragile at fine pitches, so SMD is an **excellent solution for displays above 1.2mm**. With a protective epoxy treatment, even sub 1mm SMD become durable!



IMD INTEGRATED-MATRIX-DEVICE

IMD pixels have the same physical construct as SMD, combining multiple pixels into a single package. An area where SMD is not ideal is fine pitch applications. As the pixel package gets smaller, so does its connection to the PCB. For fine-pitch, this smaller footprint makes fine-pitch SMD fragile to handling and physical contact.

IMD is an **excellent solution for pitches below 1.5mm** if not using a protective epoxy treatment.





One of the most misunderstood aspects of direct-view LED technology regards the technology within the pixels themselves. dvLED technology has matured significantly in recent years, expanding what was once a single option for the technology of the pixel into several options.

Each technology is best-suited for certain applications and needs. Read more to learn which technology your project needs!

COB CHIP-ON-BOARD

COB pixels remove the enclosure (package/encapsulation) used on every other type of pixel. Individual sub-pixel chips are placed directly on the PCB then the module is coated with a protective epoxy. This coating results in significantly more durable pixels, virtually eliminating the need for pixel repair. COB pixels are by default all flip-chip and without bonding wire, improving power handling and viewing angles.

Due to the size of the LED chips and the protective epoxy, pixels of COB modules typically **cannot be repaired**.

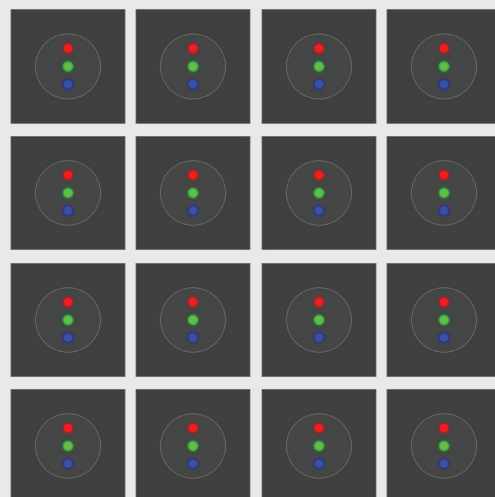


MIP MICRO-IN-PACKAGE - HIGH BRIGHTNESS

MIP is the newest pixel technology. Like SMD, MIP arranges sub-pixel LED chips within a package. Unlike SMD, MIP uses much smaller chips. Using 'micro' chip (smaller than 200µm) adds several benefits.

Depending on the application need, MIP pixels can be configured to provide extreme brightness or extreme contrast.

MIP pixels are an excellent choice for premium displays and displays requiring more contrast or brightness performance than traditional pixel technology can provide.



MIP MICRO-IN-PACKAGE - HIGH CONTRAST

GLUE-ON-BOARD (GOB)

EPOXY RESIN - pixel protection

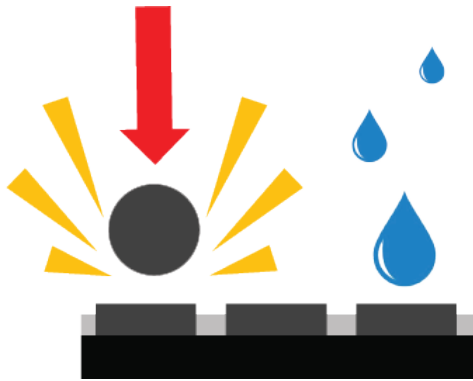
For SMD, IMD, and MIP LED Displays

SHOWN:

1.5mm SMD with Epoxy Mask

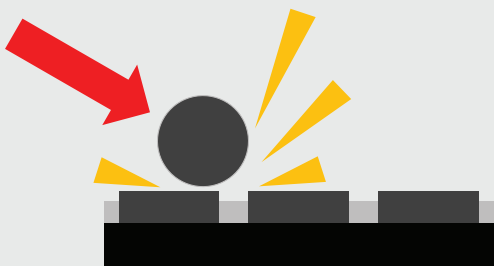
all about epoxy resin...

"GOB", or Glue-On-Board uses an epoxy resin that covers the modules of an LED display cabinet, at the end of the manufacturing process. This produces a strong, smooth finish covering the encapsulated 3-in-1 bulbs. This process has several benefits:



Impact and humidity resistant.

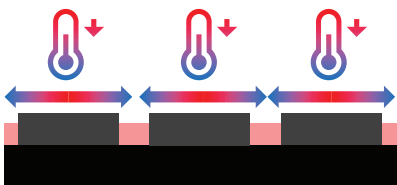
The epoxy resin coating creates a strong, smooth finish over the encapsulated bulbs creating an impact and humidity resistant display, thereby reducing the failure rate of the LED bulbs dramatically.



Restrict lateral movement.

Roughly 75% of dead pixels are the result of physical impact which break the pixels connection to the PCB.

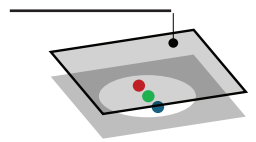
With an epoxy masking between the pixels which is flush to the pixels, versus the slight gap which exists with installed plastic masks, pixels become much more durable. Simply adding this epoxy makes even fine-pitch pixels remarkably durable.



Disperse heat.

Due to the direct contact between the pixel encapsulations and the epoxy, the infill acts as a heat sync drawing heat away from the pixels.

This simple thermal principle reduces the wear on the pixels and extends the life of the display



Fine pitch LED displays are fragile, particularly on the edges of a module, as the pixel encapsulations are tiny. Vanguard has proudly embraced the solution. Epoxy resin coatings!

Post-production epoxy treatments of modules have solved the issue of fragility. Where fine-pitch LED has traditionally meant a very delicate display, adding an epoxy treatment will produce the same durability as COB displays while still being repairable!

the treatments

EPOXY MASK (*em*)

EPOXY MASK (*em*) is also referred to as HOB (*half-on-board*), hGOB (*half glue-on-board*), sGOB (*shrink Glue-on-board*). Similar to the epoxy coating process (*GOB*), epoxy is applied to the module at the end of the manufacturing process.

Where epoxy coating (*GOB*) fills the gaps between pixels and adds a layer on top of the pixel encapsulations, the epoxy masking infills between the bulbs, leaving the top of the pixel encapsulations raised.

With the pixel texture across the face of Epoxy Mask modules, the module seams are made much more discreet than with COB or Epoxy Coated modules.

EPOXY COAT (*ec*)

EPOXY COAT (*ec*) is also referred to as GOB (*glue-on-board*). Unlike epoxy masking, epoxy coating not only completely fills the gaps between pixels but also covers the pixel encapsulations.

Epoxy coating produces a smooth surface, similar to COB. Epoxy coating produces an added layer of protection for the pixel encapsulation. This can be beneficial depending on the environment where the display is installed.



about Vanguard LED

A leader in innovative digital LED display solutions, Vanguard offers an unrivaled range of products, technologies, and support.

Vanguard is an American-owned company, headquartered in Lakeland, Florida. Our mission statement - Complete customer satisfaction, defined by our core values of **expertise, integrity, responsiveness, service, and value.**

Our core values take many practical forms including Industry leading new technology, expert design advice at the outset of a project, timely quotes, the quickest lead times in the industry, helpful CADs and electrical drawings, professional commissioning, proficient on-site training, and stellar after-sales services.



EXPERTISE | INTEGRITY | RESPONSIVENESS | SERVICE | VALUE