

Sunlight Readable NVIS-Compatible Displays

How LED Backlights Improve LCD Performance & Longevity



When discussing display technology that has the capacity to be sunlight readable or night vision goggle compatible—or both—LED backlights invariably enter the picture. Here, we outline the finer points of these technologies and how this trinity works together, allowing General Digital to bring you LCD monitors with superior performance.

LED BACKLIGHT ADVANTAGES

Today, LCDs are normally produced with LED backlights, rather than with the traditional/legacy cold cathode fluorescent lamps (CCFL). This decision is motivated by the many advantages that LED backlights provide, such as:

- » Greater efficiency (brightness vs. power)
- » Lower cost
- » More durable solid-state design
- » Extended operating and storage temperatures
- » No mercury content
- » Faster startup times



WHY ARE GENERAL DIGITAL LCD BACKLIGHTS NECESSARY?

Since manufacturers are already building their LCD displays with LED backlights, you may wonder why General Digital Display Systems (GD-DS) produces its own value-add LED backlights. Most LCD manufacturers target large-volume markets for their designs, where they can maximize their return on investment. Since competitive pressures from other suppliers exist in these markets, their products are designed to meet the bare essential requirements at a minimum cost in an attempt to achieve product acceptance and market competitiveness.

Traditionally, Original Equipment Manufacturers (OEMs) of liquid crystal displays have underserved niche markets (e.g., military, avionics, marine, outdoor usage) that require very specialized display performance, such as extended operating temperatures, sunlight readability, night vision capability and long product life cycle. GD-DS prides itself on solving industry problems and providing product solutions to these underserved and specialty markets. Customers find our LED backlights to be necessary to meet one or more of the following application requirements:

- » To provide superior brightness performance for use in high ambient lighting conditions or direct sunlight.
- » To convert a legacy LCD design (that meets a specific need) from a CCFL backlight to a comparable design using less power, with increased durability and efficiency.

- » To provide an LED backlight with greater reliability than the OEM design. Many OEM backlights have a mean time between failure (MTBF) between 30,000 and 70,000 hours. Typically, General Digital uses LEDs that have a brightness rating in excess of 110,000 hours.
- » To provide a more efficient LED backlight design than the OEM LED backlight that provides customer-required performance at lower power consumption / heat dissipation. This requirement is especially important for display solutions that are housed in fanless or fully sealed enclosures.
- » To provide night vision goggle compatibility.
- » To provide, in combination with our LED controllers, a wider dimming range than the OEM LED backlight/controller, as well as additional programmable functionality.



WHAT MAKES A DISPLAY SUNLIGHT READABLE?

There are many display performance attributes that must be considered when selecting a display to be used in high ambient lighting conditions or in direct sunlight, such as:

- » Brightness
- » Contrast
- » Dimming range
- » Viewing angle
- » Operating life
- » Power consumption
- » Heat dissipation
- » Reflectivity
- » Response time
- » Operating/storage temperature

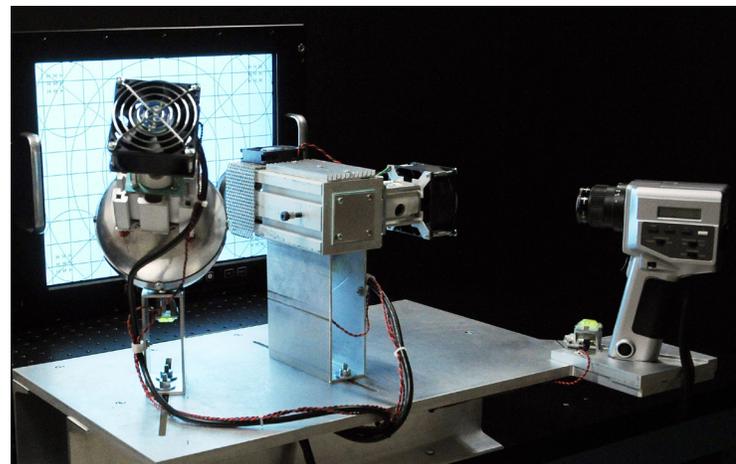
Often, users prequalify panels by how bright they are, employing the “if it is brighter, it must be better” mentality. While brightness may indeed be an important performance consideration for many applications, GD-DS holds that the display’s contrast is even more important. Ultimately, it is the user’s ability to discern a difference between colors (contrast) that enables them to properly view information under varying lighting conditions—from total darkness to direct sunlight.

OEMs provide the contrast performance of their LCDs in dark room conditions within their display specifications. While this information is an important indicator for consideration if the LCD is to be used indoors, it provides an inconclusive indication of how well the LCD will perform when exposed to high ambient lighting conditions. For this reason, we quantify the performance of our LED enhanced LCDs in our Photometric Laboratory following the guidelines of MIL-STD-3009 (formerly MIL-L-85762-A).

Following these guidelines, we provide our customers with a host of performance metrics, most notably its Weber Contrast, its contrast under 10,000 foot candles of direct light and a Display Class. These metrics allow customers to compare our performance to the military’s standard of approval for display usefulness in direct sunlight, as well as the type of information that can be read under these conditions, ranging from numeric-only to live video. This data also will allow customers to compare our products to competitive alternatives on a level playing field.

GENERAL DIGITAL’S PHOTOMETRIC LABORATORY

General Digital’s Optical Laboratory was created to provide quantification of the optical performance of an LCD under a variety of extreme ambient conditions along with raw intrinsic system characteristics. The data provided by the laboratory tests allows for numerical performance descriptions of each LCD display system. This enables the customer to compare displays across the entire GD-DS display catalog and provide the ability to choose the correct product for the target environment while removing guesswork. To ensure accuracy and cross correlation, sunlight and NVIS measurements adhere to procedures and regulations outlined in MIL-L-85762A, and its successor, MIL-STD-3009.



HOW NIGHT VISION GOGGLES WORK

Night vision goggles (NVG) take low level (undetectable by the human eye) incoming light in the visible spectrum (photons) and amplify it to a human viewable level. They also take non-visible light in the infrared (IR) spectrum and convert it to the visible spectrum.

These processes occur simultaneously and are converted into electrical energy called electrons. The electrons pass through a thin disk that's about the size of a quarter and contains more than 10 million channels. As the electrons go through the channels, they strike the channel walls and thousands more electrons are released. These multiplied electrons then bounce off of a phosphor screen which converts the electrons back into photons and lets you see an impressive nighttime view, even in pitch black surroundings.

WHY STANDARD MONITORS DON'T WORK WITH NVGs

Standard monitors (CCFL-backlit LCDs and CRTs) emit high levels of IR radiation, specifically the kind that's amplified by night vision goggles. This interrupts the view of a person equipped with NVG by causing blooming (washed out view) and oversaturation, which renders the user effectively blind. This is true even if the monitor is in the proximity of the user but not in their direct field of view.

MAKING AN LCD MONITOR NVIS COMPATIBLE

To make a display NVIS (Night Vision Imaging System) compatible, GD-DS expertly re-engineers the existing display hardware to virtually eliminate the emission of high levels of IR radiation. In some instances, we install entirely new back-lighting systems, whether CCFL or LED. Both approaches are fully compliant with the military specification, MIL-STD-3009.

By configuring an LCD monitor to be night vision compatible, an NVG user is easily able to view information on a display screen, as well as view their surroundings, while using night vision goggles.



ASPECTS OF NIGHT VISION TECHNOLOGY

Light-colored objects with a dull surface may appear darker through a night vision unit. Conversely, dark-colored objects with a highly reflective surface may appear lighter. For example, a shiny dark-colored jacket may appear brighter than a light-colored jacket with a dull surface.

Depth Perception

The monacle-type night vision goggles do not display normal (unaided eye) depth perception.

Fog and Rain

Night vision goggles are very sensitive to reflective ambient light; therefore, light reflecting off of fog or heavy rain amplifies the light in the night vision unit and may degrade its performance.

Honeycomb

This faint hexagonal pattern is the result of the manufacturing process.

Spots

A few black spots throughout the image area are inherent characteristics of night vision technology. These spots will remain constant and should not increase in size or quantity.

Sparkle or Snow

Some light shimmering spots can arise from high-energy solar particles striking the detector and being converted into visible light.

LED BACKLIGHT CONTROLLERS

GD-DS also designs and integrates our own line of intelligent LED backlight controllers to provide command, control and status of our LED-equipped NVIS-enhanced and NVIS/Sunlight Readable-enhanced displays and backlights. These ruggedized products can be purchased from our stock or integrated by our expert technicians.

Additionally, our software engineering staff can tailor our controller firmware to provide the precise performance necessary to meet a customer's operational requirements. Typical requests include, but are not limited to, the following:

- » Minimum and maximum brightness levels for NVIS luminance.
- » Minimum and maximum brightness levels for standard/sunlight readable luminance.
- » Brightness resolution (number of brightness steps between minimum and maximum set points).
- » Automatic brightness control algorithm adjustment based on ambient lighting conditions.

MANY DISPLAY SIZES AVAILABLE

GD-DS has engineered a multitude of sunlight readable and/or NVIS-compatible LCD display solutions that feature OEM LCD displays and our custom-designed LED backlights (edge-lit and direct-lit), light optimization films and overlay enhancements. Our standard LCD display solutions range in size from 6.5 inch to 24.0 inch and larger. We design new LCD monitors regularly, and can engineer one specific to your needs upon request.

Call an Applications Engineer today to discuss how General Digital may best serve your application requirements.



An SBA Small Business Concern

60 Prestige Park Road

East Hartford, Connecticut 06108

Phone 860.282.2900 Toll-Free 800.952.2535

E-mail gdc_info@generaldigital.com

Web www.gdoptilabs.com



999-0907-001r1

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