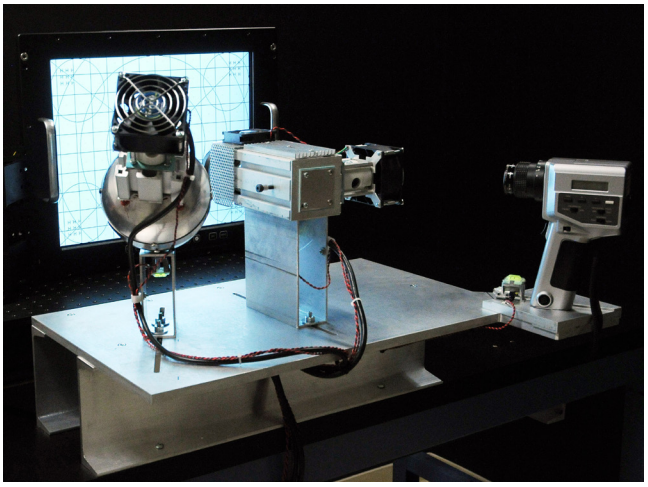
Weber Contrast Class – The True Measure of Sunlight Readable Displays

The demand is high for LCD monitors that are easily readable in high ambient brightness environments. Whether the application is military, avionic, industrial, marine, or commercial, consumers prize clarity—for good reason. In life- or mission-critical applications, display clarity can mean the difference between life and death. Even in benign circumstances, it ensures peak efficiency. Panel suppliers throw around claims of sunlight readability, but by what criteria are they measuring? Do consumers know enough about photometrics to be sure a display will meet their specific requirements?



Photometric Testing Setup

Following are key pieces of information to keep in mind at the beginning of the selection process:

- **There is no standard, agreed-upon definition for LCD sunlight readability.**
- **There is no certifying agency to which suppliers must answer before making claims about sunlight readability, nor is there an oversight committee protecting consumers from false or misleading display performance claims.**
- **LCD OEM and Value-Added Reseller (VAR) data sheets provide metrics such as maximum brightness and contrast, but these aren't a gauge for effectiveness in direct sunlight because they reflect measurements taken in a dark room (there is no direct performance correlation between dark room and direct sunlight performance).**
- **Maximum display brightness is important, but "contrast is king." The better a display's Weber Contrast (contrast while exposed to high ambient lighting), the more legible the display.**

TOP MISTAKES IN SELECTING SUNLIGHT READABLE DISPLAYS

Choosing Based on Brightness Alone

A high contrast ratio (CR) is typically associated with a well-backlit screen, though these figures are generally acquired and reported in the context of a dark room. The greater the difference in luminance between a screen's whitest and blackest points, the sharper the image. But move a display from ideal conditions (dark room) into direct sunlight, and the CR dips dramatically, resulting in a barely legible screen.

Misunderstanding the Impact of Contrast

Black ink on a piece of white paper is easy to see under direct sunlight because of the natural differential in reflected light between the two substances. This differential doesn't exist on an LCD screen, so contrast metrics measured in the absence of ambient light are fundamentally misleading. The only way to attain sunlight readability is to combat reflection itself, and a different metric is needed to assess performance under well-lit conditions.

Making a Decision Without Standardized Metrics Data

The vast majority of suppliers neglect to provide standardized performance data for sunlight readability. Most claims made are entirely subjective or based on irrelevant information. Although the US Military created a reliable standard unit of measure for this explicit purpose, most OEMs and VARs aren't familiar with this standard.

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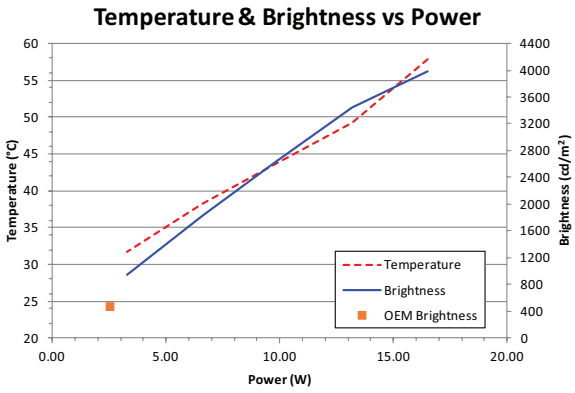
Neglecting to Consider a Display's Operating Temperature

Suggested operating temperatures deserve more consideration than one might expect. Temperature isn't as simple as it may seem. Be aware of differences between OEM and VAR data, and be sure to take the following factors into account:

- **Optimize Backlight Brightness** Try to obtain a brightness-to-temperature performance plot to determine optimal backlight limits under different scenarios.
- **Enclosure** It's important to remember that the internal temperature of sealed enclosures will more readily rise than that of ventilated enclosures. Forced or active cooling is also preferable to convection cooling, allowing for less temperature rise.
- **Backlight Hardware** It's important to pay attention to the PCB material of the LED backlight. FR4 makes for an inexpensive option, but is a poor thermal conductor. Aluminum is a step up, while being predictably more expensive. The best and most expensive thermal conductor is copper.
- **LED Controller** Select an LED controller that uses internal ambient temperature as control feedback to automatically/dynamically adjust brightness in response to temperature. This will optimize performance without damaging critical electronics.



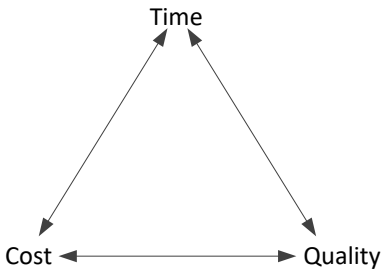
Not Knowing Your Supplier

It's preferable to source displays from the original designer for the ease of making improvements, modifications, and/or repairs. Choose a supplier that has experience in the specific field for your application, whether it's consumer, commercial, industrial, military, marine, aerospace, or medical or otherwise. Ensure from the beginning that they have a system in place for superior customer service and will be able to give you the kind of continued support your applications require.

Not Considering International Costs

While it may be tempting to save up front and go with an overseas VAR, integrators need to consider the less obvious, long-term costs associated with obtaining international service and support:

- **Communication Issues** Not only is it likely that your value-added supplier won't speak your language, their hours of operation are likely not going to fully coincide with your own, making the exchange of information more difficult.
- **Quality Control** It's far more difficult to orchestrate foolproof source inspections or quality audits when the manufacturing party is in a foreign country.
- **Transportation** Shipping a product internationally always takes more time, paperwork and expense, and can involve increased complications for every return or other supporting service the VAR offers.
- **Potential Legal Hassle** In the event of conflict, domestic law, arbitration and collections won't protect you internationally.
- **Order Minimums** Most offshore suppliers will pose a minimum order quantity (MOQ).



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STANDARDIZED SUNLIGHT READABILITY

Weber Contrast

The US Military has already established a standard procedure, MIL-L-85762A, to quantify LCD contrast performance under extreme conditions. Using what's called Weber Contrast, it's possible to consistently gauge and compare any given display's performance in direct sunlight.

The Weber Class Metric

General Digital's Optical Bonding Laboratories saw the need to provide an antidote to the inefficiency of trial and error testing. By making use of the MIL-L-85762A procedure, we have standardized quantification of its value-added display performance. Our LCDs are tested in a well-defined, consistent and controlled lighting environment, which simulates worst-case exposure to sunlight.

Optical measurements are obtained in our specially prepared laboratory to determine Weber Contrast figures, which can then easily be interpreted by customers to guide their decisions using an in-house metric, designed specifically for this purpose:

- Measurements fall into 6 classes: 1 being good in a dark room, 6 being exceptional in direct sunlight.
- Each class details the kind of information that can be practically perceived in worst-case conditions.

Through this objective process of testing and metric reference, consumers can more easily and accurately select a panel that meets their specific needs. They no longer have to base their decisions on blind faith, or take claims on sunlight readability at their unproven word.

Weber Contrast Lookup Chart

Display Class	Contrast Range	Short Description	Ideal Applications
Class 1	0.00 to 1.49	Not sunlight readable	Not suitable for direct sunlight use
Class 2	1.50 to 1.99	Numeric ONLY	Useful for numerics only in direct sunlight
Class 3	2.00 to 2.99	Alphanumeric	Useful for characters and numerical data
Class 4	3.00 to 4.659	Graphic symbols and alphanumerics	Useful for characters, numerical data and static images
Class 5	4.66 to 10.29	Acceptable video performance	Useful for characters, numerical data, static images and low quality video (6 √2 shades of gray with counting off as 1)
Class 6	10.3 and higher	Best case video performance	Useful for characters, numerical data, static images and high quality video (8 or more √2 shades of gray with counting off as 1)

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