Introduction

The HB-15”-1400 is a 15" high efficiency sunlight readable rugged LCD module. The module uses the AUO.M150XN07 TFT color LCD glass and a New Maxbright very high brightness backlight and also capable of operating under extreme temperature condition.

At the maximum backlight power of 35 Watts, the HB-15”-1400 module delivers a LCD screen brightness of 1400 cd/m^2 (nits). At this brightness level, the display is highly readable under direct sunlight. With a wide dimming range inverter such as New Maxbright MH-N12C, the screen brightness can be adjusted down to about 7 cd/m^2. In coupled with the wide viewing angle and wide color gamut, the HB-15”-1400 LCD module provides a superb image quality at 1024x768 resolution under ambient conditions ranging from full sunlight to total darkness.

Characteristics (Note 1 & 2)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1400	cd/m^2	White (LCD in OFF state)
Luminance Uniformity	20% or better		Note 3
Backlight Power Consumption	35	Watts	Excluding inverter losses
Screen Dimming Ratio	200:1		With BI220A inverter
Typical LCD Contrast Ratio	500		White vs. Black (measured in dark at the normal direction)
Typical Viewing Angles			
3:00 to 9:00 direction	± 60	Degrees	Contrast ratio >5
6:00 to 12:00 direction	± 60	Degrees	Contrast ratio ≥5
3:00 to 9:00 direction	± 55	Degrees	Screen luminance ≥250 Cd/m2
6:00 to 12:00 direction	± 40	Degrees	Screen luminance ≥250 Cd/m2
LCD Screen Chromaticity			
White	x = 0.313, y = 0.329		Note 4
Red	x = 0.617, y = 0.347		Note 4
Green	x = 0.290, y = 0.593		Note 4
Blue	x = 0.148, y = 0.100		Note 4
LCD Module Weight	1400(A/B)	Grams	
LCD Module Dimensions	See P. 6 and P. 7		
Operating Temperature	-20 to 55	Degrees	
Storage Temperature	-25 to 60	Degrees	

Note 1: Please refer to the AUO.M150XN07data sheets for detailed LCD electrical specifications and general precautions.

Note 2: All data is measured at 25^{o}C ± 2^{o}C ambient temperature.

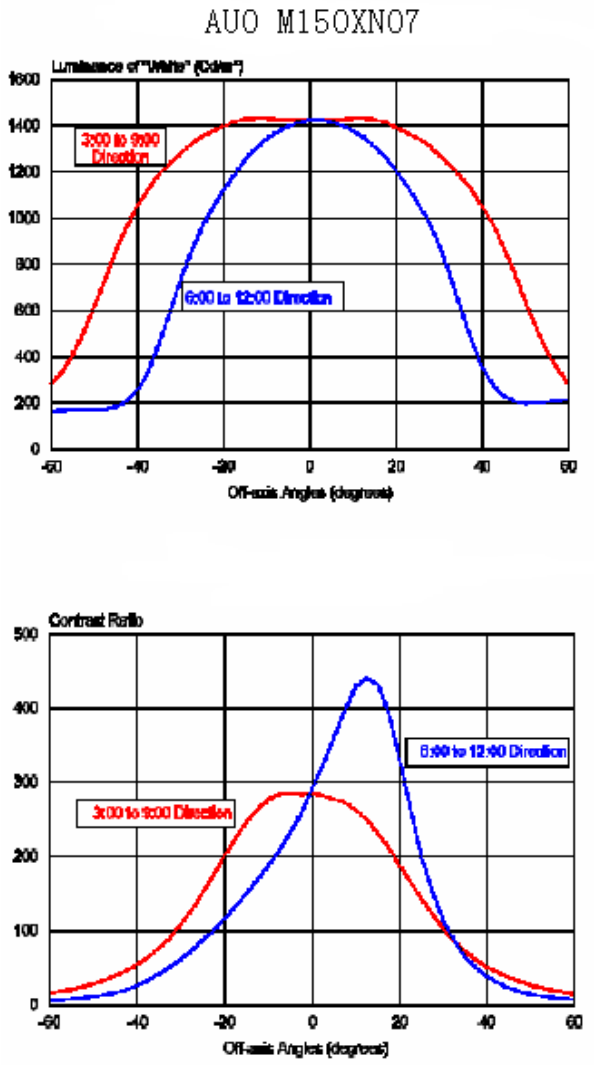
Note 3: Uniformity = (Lmax - Lmin) / (Lmax + Lmin) where Lmax (Lmin) is the maximum (minimum) luminance measured with a

10 mm diameter meter aperture over the LCD active area except the last 10 mm area from the edges.

Note 4: Measured at the direction normal (perpendicular) to the LCD.

LCD Module Optical Performances

The typical screen luminance and contrast ratio for the HB-15”-1400 sunlight readable LCD module are shown in the figures below:

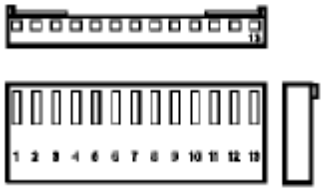


The LCD screen luminance is measured with the LCD in the “Off” state (i.e. the pixels are not energized). This is the “White” state with maximum luminance. Very often, this “Off” state is brighter than the “White” color displayed on the screen when the video signal is on. This difference may be caused by the graphic card and/or the controller card driving the display. When the LCD is properly driven, the difference between the “Off” state and the “White” color displayed on the screen should be less than 10%.

The inherent contrast ratio (CR) of the LCD is the luminance ratio between the “White” and the “Black” states measured in a darkroom. In outdoor environments, the contrast ratio of the display drops significantly due to the reflections and glare caused by ambient illumination at the front surface of the LCD and other layers, such as a touch screen or a protective windo

Backlight Lamp Connections

The very high brightness backlight in HB-15”-1400 module utilizes a total of 12 CCFLs to achieve the required luminance. The lamps are electrically connected in two separate groups.



Connector (Housing): Molex 22-01-3137, Two connectors per backlight

Mating Header: Molex 22-23-2131

Lamp wiring color:

Lamp#1 to Lamp #12	White
Common1 & Common2	Gray

Group 1 Connector		Group 2 Connector	
Pin #	To	Pin #	To
1	Lamp #1	1	Lamp #7
2	NC	2	NC
3	Lamp #2	3	Lamp #8
4	NC	4	NC
5	Lamp #3	5	Lamp #9
6	NC	6	NC
7	Lamp #4	7	Lamp #10
8	NC	8	NC
9	Lamp #5	9	Lamp #11
10	NC	10	NC
11	Lamp #6	11	Lamp #12
12	NC	12	NC
13	COMMON 1	13	COMMON 2

Group 1 contains lamps #1, #2, #3, #4, #5 and #6 and group 2 contains lamps #7, #8, #9, #10, #11, and #12. The lamps are oriented in the horizontal direction with the #1 lamp at the top side of the LCD. The lead wires connecting the lamps are terminated with two Molex connectors. The figure on the left shows the connector pin out assignments.

Backlight Lamp Driving Specifications

It is recommended that an inverter with a 1400 Vrms starting voltage be used to run the very high brightness backlight on the HB-15”-1400 module. The lamp voltage and current at full LCD screen brightness are listed below:

Operating Voltage	515	Vrms
Lamp Current	5.6	mArms

At this driving condition, the backlight delivers a LCD Screen brightness of 1400 cd/m^2 with a power consumption about 35 Watts. Since most inverters have an efficiency between 75 - 80%, the total DC power input to the inverter is about 43.8 to 46.7 Watts. When the backlight is dimmed down, the power consumption decreases.

It is quite difficult to measure the lamp current accurately. As a result, if you intend to run the HB-15”-1400 very high brightness backlight with your own inverter, please measure the

screen brightness instead. Turn on the inverter to operate the backlight without powering up the LCD. Make sure that the room temperature is about 25 °C and run the backlight for at least 30 minutes before measuring the screen brightness. If the measured screen brightness exceeds the specified value by a significant margin, for example more than 15%, the lamps are over-driven. Over-driving the lamps can cause a significant reduction in backlight life.

The New Maxbright MH-N12C are inverters specifically tuned for driving the very high brightness backlight in all 15" sunlight readable LCD modules. The inverter has a PWM (pulse width modulation) dimming circuit that provides a 200:1 dimming ratio (i.e. screen luminance adjustable from 1400 to about 7 nits).

Thermal Management

This high brightness backlight consumes a significant amount of power and as a result, the LCD temperature of a sunlight readable module will be higher than normal. In addition, the front surface of an LCD is a good sunlight absorber. Placing an LCD under strong direct sunlight can cause a significant temperature rise even without the extra heating from the backlight power.

The exact amount of temperature rise due to these two factors depends on how the LCD module is mounted and also depends on the heat dissipation design. For example, if the LCD is mounted vertically, a significant portion of the high brightness backlight heat will be dissipated into the air without heating up the LCD panel, and as a result, the LCD temperature rising will be low. On the other hand, if the LCD module is mounted horizontally, then almost all of the backlight heat rises to warm the LCD panel. However, if a small fan or a heat sink is mounted onto the high brightness backlight, the temperature rise of the LCD panel can be reduced significantly.

With the HB-15”-1400 module operating at its maximum brightness, the LCD temperature rise due to the high brightness backlight is about 15 to 20 ^{o}C. On the other hand, the absorption of direct sunlight, in the extreme cases, can heat up the LCD by more than 40 ^{o}C! As a result, it is recommended that the LCD temperature be measured at full display brightness in your equipment under actual operating environments (for example, on a summer day with full sunshine). The cooling solution should then be designed accordingly. Please refer to the AUO.M150XN07 LCD data sheet for thermal specifications. Make sure that the specified maximum LCD temperature is not exceeded.

If the thermal issue becomes difficult to resolve, New Maxbright recommends a “de-rated

lamp current mode" operation. By limiting the lamp current to, for example, 50% of its full level, the power consumption of the backlight is reduced to about 18 Watts. Consequently, the thermal issue may be relaxed. In the meantime, the LCD screen luminance reduces to 700/400 nits that may be adequate for most applications. Please refer to Technical Note for further details.

Backlight Life

The half brightness life of the very high brightness backlight attached to the HB-15"-1400 sunlight readable LCD module is rated at 30,000 hours. The half brightness life is the number of operating hours before the backlight luminance (so as the LCD luminance) drops down to 50% of its initial value.

For a well made backlight, its life is mainly determined by the lamp life. Lamp life depends strongly on the lamp current. The recommended lamp current for full LCD screen luminance is 5.6 mArms. At this level, the half brightness life of the lamps is rated at 30,000 hours.

In actual applications, a very bright sunlight readable display will most likely be dimmed down during dusk and at night. For example, if the screen brightness of the LCD module is dimmed down to half of its full level, the lamp current decreases to 2.8 mA and the lamp life increases to about 65,000 hours. Therefore, the actual operating lifetime of the very high brightness backlight in an HB-15"-1400 LCD module is expected to exceed 30,000 hours under most practical situations. For more detailed information on backlight life issues and actual test data on New Maxbright backlights, please refer to Technical Note MBT0801.

Mechanical Specifications