Landmark Technology

LMG215-084BC21 - 8.4"

VHB LCD Module with LED Backlight

Introduction

The LMG215-084BC21 is an 8.4" sunlight readable LCD module. The module consists of an NEC NL8060BC21-03 TFT color LCD panel and a VHB (very high brightness) LED backlight. At the full brightness setting, the LCD screen lumiannce can reach about 1,300 Cd/m^2 (nits). At this level, the total backlight power consumption is only 4.9 Watts including the LED driver board losses. In addition, it has an anti-reflective front surface.

The LMG215 has an AR coated front polarizer. At 1,300 nits screen brightness, the display is highly readable under bright ambient lighting, including direct outdoor sunlight. In addition, the NEC NL8060BC21-03 has a wide operating temperature range, from -10 to +70^oC, making this LCD module specifically suitable for demanding outdoor applications.

Characteristics (Note 1, 2)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1,300	Cd/m^2	LCD in OFF state (normally White)
Luminance Uniformity	20% or better		Note 3
Backlight Power Consumption	4.9	Watts	Total power to the LED driver board
Screen Luminance Dimming Ratio	20:1		With LD200 LED driver board
Typical LCD Contrast Ratio	600:1		White vs. Black (measured in the dark along the normal direction)
Typical Viewing Angles			
3:00 direction	80	Degrees	Contrast ratio ≥ 10
9:00 direction	80	Degrees	Contrast ratio ≥ 10
6:00 direction	80	Degrees	Contrast ratio ≥ 10
12:00 direction	60	Degrees	Contrast ratio ≥ 10
LCD Screen Chromaticity (x, y)			
White	(0.301, 0.348)		Measured at the normal direction
Red	(0.549, 0.368)		Measured at the normal direction
Green	(0.339, 0.557)		Measured at the normal direction
Blue	(0.152, 0.141)		Measured at the normal direction
Response Speed			
Rise time	6	msec	White to Black, 10% - 90% transition
Fall time	19	msec	Black to White, 10% - 90% transition
LCD Module Weight	350	Grams	

Note 1: Please refer to NEC NL8060BC21-03 LCD Specification for detailed electrical specifications and general precautions.

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

Note 3: Uniformity = (L_{max} - L_{min}) / (L_{max} + L_{min}) where L_{max} (L_{min}) is the maximum (minimum) luminance measured using a 10 mm diameter meter aperture over the LCD active area, except the last 10 mm area from the edges.

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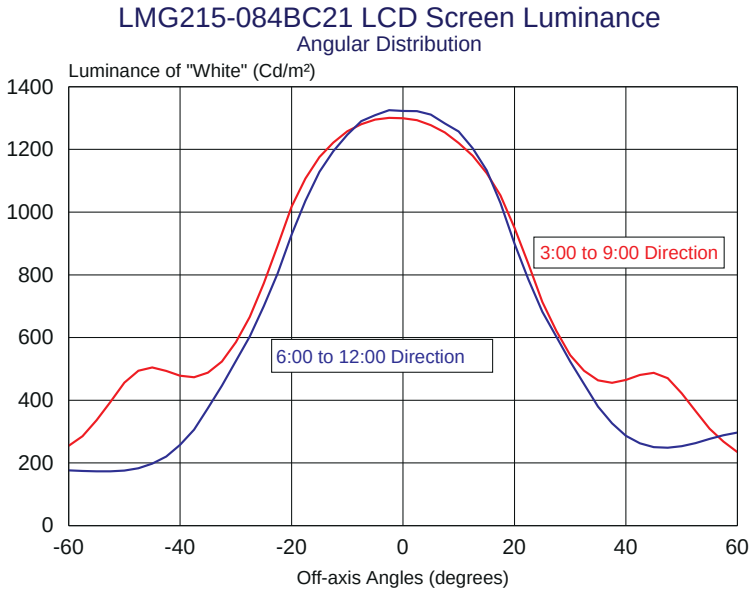
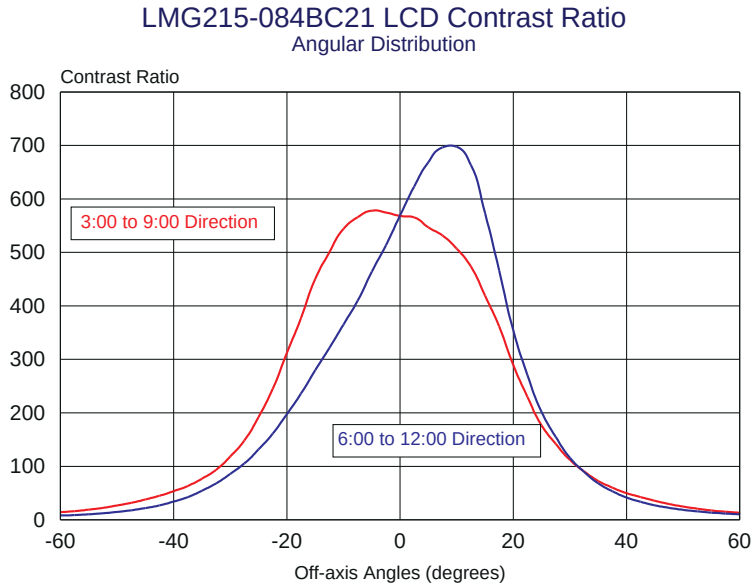
LCD Module Optical Performances

Luminance & Contrast Ratio

The typical LMG215-084BC21 LCD module screen luminance and contrast ratio are shown in the figures below.

At the best viewing direction, this module delivers a very high screen luminance of about 1,300 Cd/m^2. Since this module is a normally white LCD, the screen luminance is measured with the LCD in the "Off" state (i.e. the pixels are not energized). This is the "white" state that provides the maximum possible luminance. The "white" color displayed on the screen when the video signal is applied may have a lower luminance which can be caused by the improper settings of the graphics card and/or the LCD controller. When the LCD is properly driven, the measured luminance of the "white" color displayed on the screen should be within 10% of the specified value.





The LMG215-084BC21 LCD module also has a high contrast ratio (CR) of about 600:1 measured on axis. For all the practical viewing angles, the CR value exceeds 50:1. These values are the inherent CR, which is the luminance ratio between the "White" and the "Black" states measured in a dark room. Under ambient lighting, the CR value of the display drops due to reflection and glare. Since this LCD has an AR front surface, it can maintain a good CR value even under strong ambient illumination.

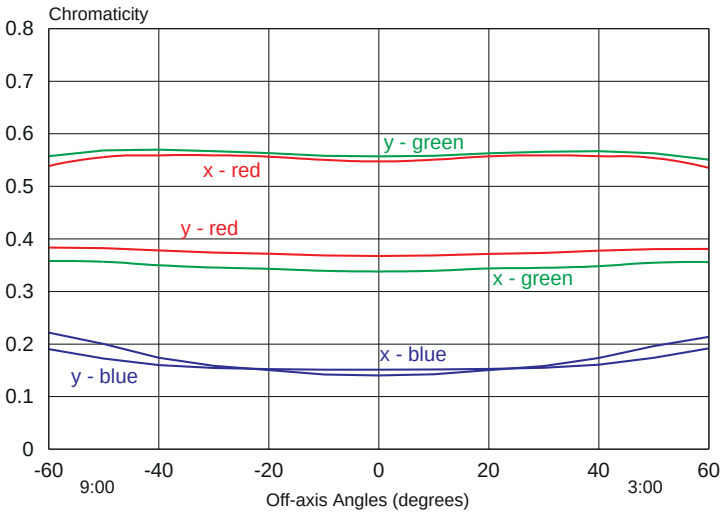
Chromaticity

The figures on the next page present the chromaticity (x, y) data of the R, G, B primary colors displayed on the screen.

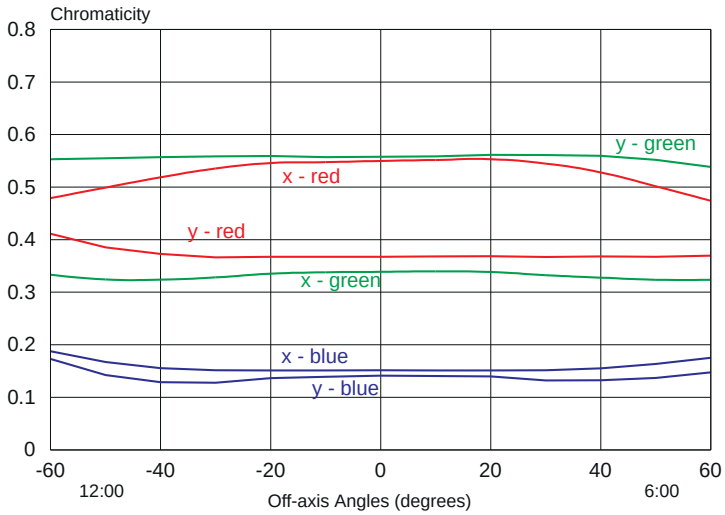
Along the 3:00 to 9:00 (horizontal) directions, the chromaticity values of the Red and Green primary colors virtually have no change. Only the Blue primary color shows a very slight color shift at very large off-axis angles.

Along the 6:00 to 12:00 (vertical) directions, the chromaticity value changes are also very small. At very large off-axis viewing angles, the Red and Blue primary colors show some color shifts toward the white. Therefore, the image displayed on the screen has only small color shifts for all the practical off-axis viewing angles along all directions.

LMG215-084BC21 Color Shift along the 3:00 - 9:00 Directions
(Positive Angles are along the 3:00 Direction)



LMG215-084BC21 Color Shift along the 6:00 - 12:00 Directions
(Positive Angles are along the 6:00 Direction)



LED Backlight Driving Specifications

The LMG215 LCD module has a VHB backlight with an LED lamp strip having 64 white LEDs that are electrically connected into 8 branches in parallel. Each branch has 8 LEDs connected in series.

The LED lamp strip is terminated with a JST 2-pin connector, BHRS-02VS-1. The JST mating connector part number is SM02-BHSS-1-TB.

The driving voltage and current for each LED branch in the LED lamp are listed below:

LED driving voltage	19.2	Vdc
LED driving current	22	mA

At this driving condition, the backlight delivers 1,300 Cd/m^2 of LCD screen luminance. With a high efficiency LED driver board, the total power consumption (with the driver board losses) at this brightness level is about 4.9 Watts.

Thermal Management

The maximum backlight power consumption of the LMG215 LCD module is only 4.9 Watts. At this level, the backlight does not create any thermal management issue. However, the efficiency of an LED in Lumens per Watt decreases as temperature increases. In order to keep the efficiency up and maintain the LCD screen brightness, it is necessary to keep the LED lamps cool. Therefore, as the LCD temperature increases, it is necessary to implement cooling measures to maintain the optimal operating condition.

For outdoor display applications where the LCD may be subject to direct sunlight exposure, the major source of heat usually comes from sunlight. For example, if strong sunlight shines on the display at a perpendicular direction, the LMG215 LCD module can absorb up to 25 Watts of solar power. This is more than five times the power consumption of the LED backlight including the driver board losses. As a result, the LCD temperature can rise very quickly which reduces the LCD screen brighness significantly. In extreme cases, the temperature may approach or even exceed the maximum operating temperature of the LCD. For a detailed description of the thermal impact caused by direct sunlight exposure, please refer to Technote 1199 on Landmark's web site.

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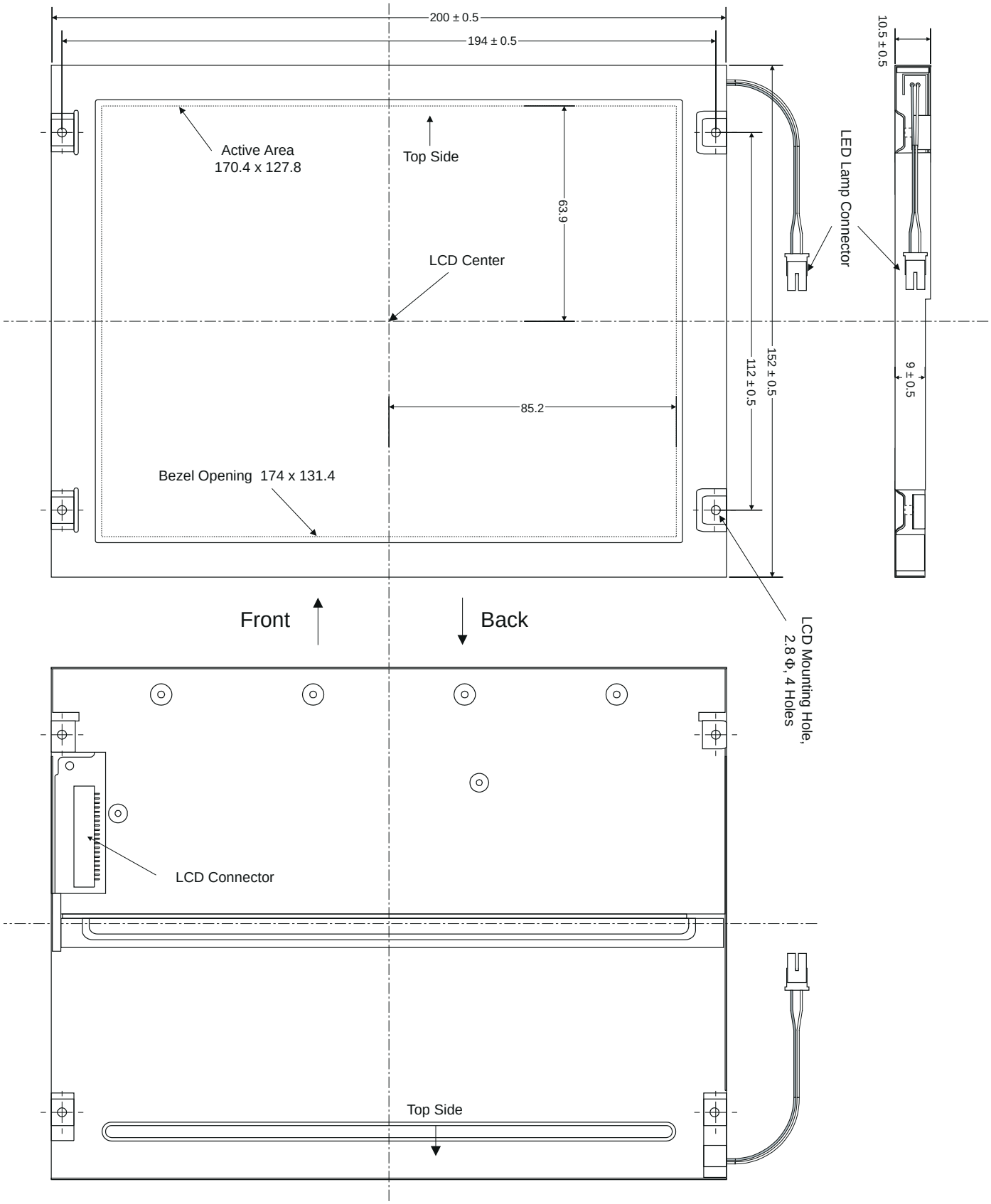
LMG215-084BC21 Mechanical Dimensions



All dimensions are in mm