

Introduction

LMG210B-064DG01 is a 6.4" sunlight readable LCD module with an LED backlight. The module consists of a Sharp LQ064V3DG01 TFT LCD panel and a Landmark VHB (very high brightness) LED backlight.

At a maximum backlight power of about 4.3 Watts, the screen luminance reaches 1,900 Cd/m². At this brightness level, the display is highly readable under direct outdoor sunlight. With the Landmark LD200A LED driving board, the screen luminance can be adjusted down to about 90 Cd/m². For night display viewing that may require very low LCD brightness, a PWM dimming LED driving board should be used.

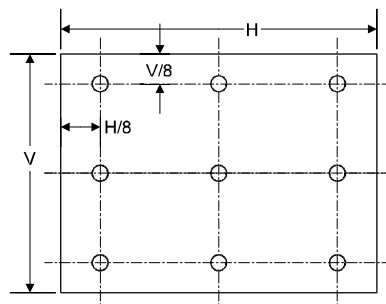
Characteristics (Note 1, 2)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1,900	Cd/m ²	LCD in OFF state (normally White)
Luminance Variation	±15% or better		(Note 3)
Backlight Power Consumption	4.3	Watts	Excluding LED driver board losses
LCD Contrast Ratio	~ 560:1		At the optimum viewing direction
	~ 500:1		At the viewing direction ⊥ to LCD
Typical Viewing Angles			
3:00 to 9:00 directions	± 60	Degrees	Contrast ratio ≥ 5
6:00 direction	60	Degrees	Contrast ratio ≥ 5
12:00 direction	40	Degrees	Contrast ratio ≥ 5
LCD Screen Chromaticity (x, y)			Measured at the normal direction
White	(0.303, 0.346)		
Red	(0.578, 0.351)		
Green	(0.318, 0.609)		
Blue	(0.142, 0.116)		
LCD Module Weight	270	Grams	

Note 1: Please refer to Sharp LQ064V3DG01 LCD data sheets for detailed LCD electrical specifications and general precautions.

Note 2: All data is measured at 25° C ± 2° C ambient temperature.

Note 3: Screen luminance is measured at 9 points at the locations shown in the drawing on the right. The luminance variation is the percent deviation of the maximum and the minimum values measured versus the average value of the 9 point.

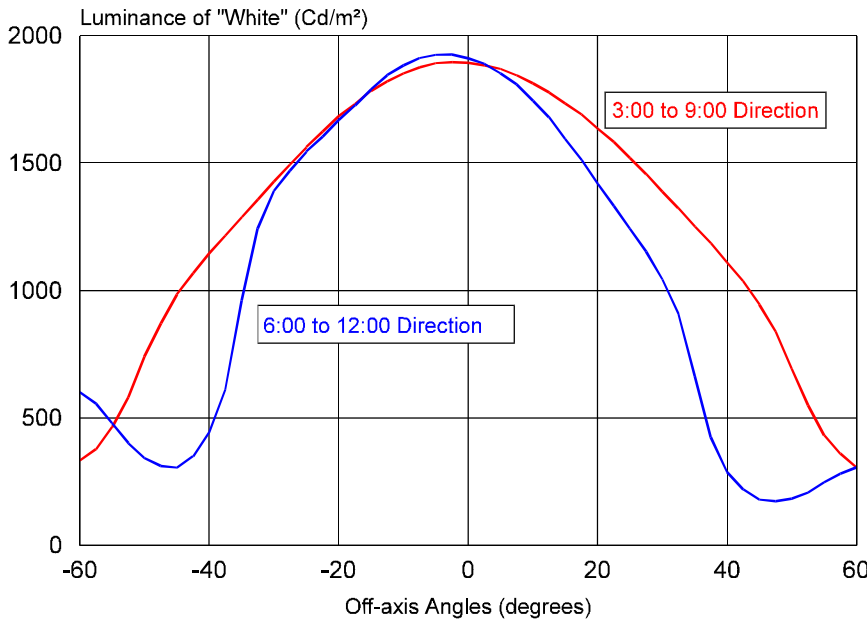


LCD Module Optical Performances

Luminance & Contrast Ratio

The typical LMG210B-064DG01 LCD module screen luminance and contrast ratio are shown in the figures below. Since this is a normally white LCD module, the screen luminance is measured with the LCD in the “Off” state (i.e. the pixels are not energized). This is the “white” state with the maximum possible luminance. The “white” color displayed on the screen when the video signal is applied may have a slightly lower luminance. The difference can be caused by 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.

LMG210B-064DG01 LCD Screen Luminance
Angular Distribution

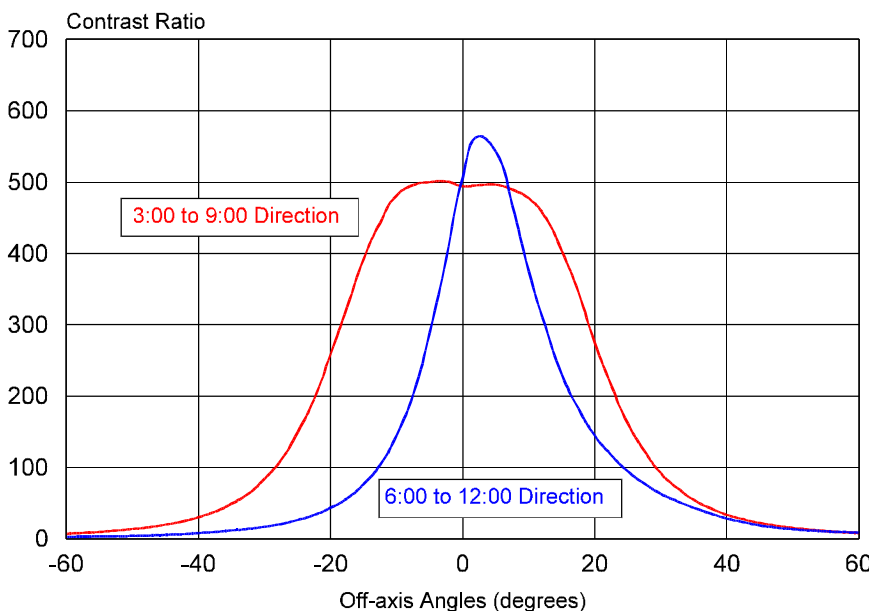


At the optimal viewing direction, the LMG210B-064DG01 LCD module has a high contrast ratio (CR) of about 500:1. This is the inherent CR which is the luminance ratio between the “White” state and the “Black” state measured in a totally dark room. Under ambient lighting, particularly in bright outdoor environments, the CR value of the display drops significantly due to the reflection and glare caused by the ambient illumination.

Chromaticity

The 1931 CIE chromaticity coordinates of the R, G, B primary colors measured at the normal direction are presented in the table on page 1.

LMG210B-064DG01 LCD Contrast Ratio
Angular Distribution



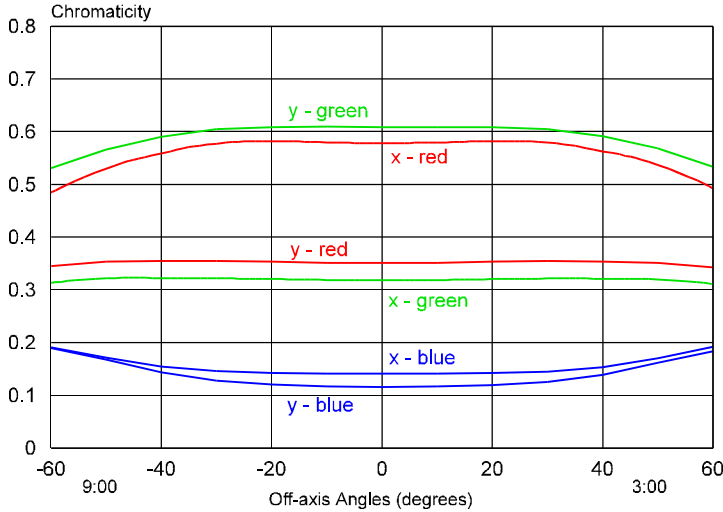
The LMG210B-064DG01 LCD module has some color shifts at the large off-axis viewing angles. The figures on the next page present the chromaticity (x, y) data of the R, G, B primary colors as a function of the viewing angles

Along the 3:00 to 9:00 directions, the chromaticity values of the red and green primary colors have relatively small changes, up to about 50 degrees off axis viewing angles.

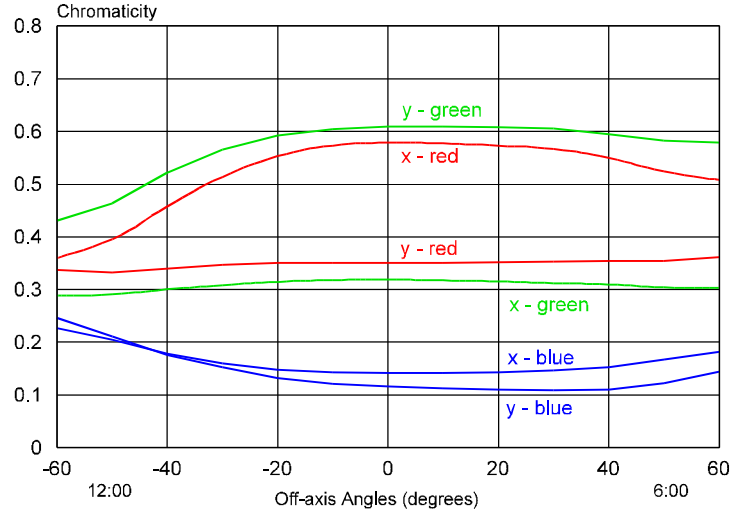
Along the 6:00 direction, the color shifts are quite small also. However, along the 12:00

direction, there are significant color shifts toward white for viewing angles beyond 30 degrees. In addition, the screen brightness drops off very rapidly along the 12:00 direction. Therefore, as the viewing direction moves toward the 12:00 directions, the display appears dark, in particular under bright ambient lighting.

LMG210B-064DG01 Color Shift along the 3:00 - 9:00 Directions
(Positive Angles are along the 3:00 Direction)



LMG210B-064DG01 Color Shift along the 6:00 - 12:00 Directions
(Positive Angles are along the 6:00 Direction)



Backlight and the LED Strip Connections

The backlight has one LED strip (lightbar) with a wedge shaped light guide. The LED strip has 24 LEDs organized in 3 strings with each string having 8 LEDs connected in series. The 3 LED strings are connected in parallel and are terminated with a JST 2-pin connector. The details of the connector, wiring, and the mating connector are listed on the right side.

LED strip connector:

JST BHSR-02VS-1 or equivalent

Mating connector:

JST SM02(4.0)B-BHS-1-TB or equivalent

LED strip wiring color:

LED Anode	Pink
LED Common	White

Backlight Driving Conditions

The driving conditions of the LED strip at the maximum screen brightness of 1,900 nits are listed below:

LED Current (each string)	60	mA
LED strip total Current	180	mA

At this driving conditions, the power consumption of the backlight is about 4.3 Watts.

The LCD screen brightness can be adjusted down by reducing the LED strip current. This can be done by either reducing the DC current going through the LEDs or by

pulse width modulating (PWM) the LED current from 180 mA to 0 mA. For PWM, the screen brightness is proportional to the average LED strip current.

Landmark's LD200A is a driving board that provides a DC LED strip current. As the screen brightness is adjusted down, the DC current going through the LED strip reduces. It has a conversion efficiency of about 85%. Thus, the 12V DC power input to the LD200A is about 5 Watts. For detailed information, please refer to the LD200A driving board data sheets.

Thermal Management

The VHB backlight in the LMG210B-064DG01 LCD module consumes only 4.3 Watts at full LCD screen brightness of 1900 nits. Thus, its effect to the LCD screen temperature is quite small.

When the LMG210B-064DG01 LCD module is placed in outdoor environments with strong direct sunlight exposure, the black front surface of the LCD is a good sunlight absorber and can absorb more than 12 Watts of solar power. Thus, some thermal management considerations should be implemented to keep the LCD within the specified operating temperature range. For more information on LCD sunlight heating issues, please refer to Landmark Technical note TK1199.

Backlight Life

The half brightness life of the VHB backlight in the LMG210B-064DG1 LCD module is rated at 50,000 hours. The half brightness life is the number of operating hours before the backlight luminance (seen as the LCD screen brightness) drops down to 50% of its initial value.

The lifetime of an LED backlight is mainly determined by the luminous decay of the LEDs. As the temperature of the LED chips rises, the LED luminance decay accelerates. This temperature effect on the LED life is relatively small if the LCD case temperature is maintained below 50 °C.

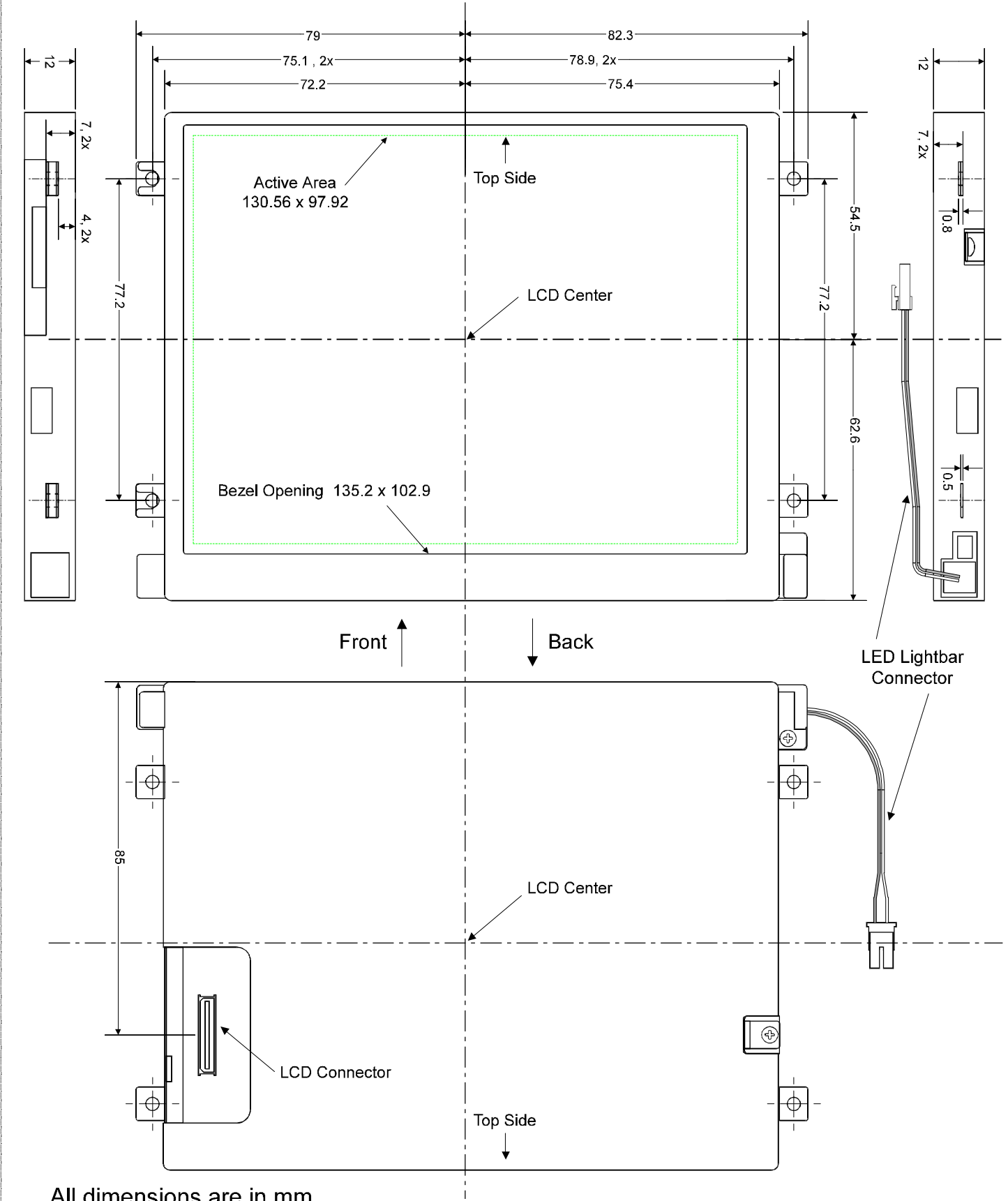
In practical applications, the LCD screen brightness is usually adjusted down as the ambient illumination reduces. This reduces the LED current, which increases its half brightness life. Therefore, the practical operating lifetime of the backlight in the LMG210B-064DG01 LCD module can be expected to reach 50,000 hours or more. .

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LMG210B-064DG01 Mechanical Dimensions



All dimensions are in mm