

#### Introduction

The LMG227-104X01 is a 10.4" Sunlight Readable XGA (1,024 x 768) LCD module. The module consists of a Hydis HV104X01-100 TFT color LCD panel and a VHB (very high brightness) LED backlight in a side mount package of less than 10 mm maximum thickness.

At the maximum backlight power of 9.2 Watts, the LMG227-104X01 delivers a very high screen brightness of 1,350 Cd/m<sup>2</sup> (nits). At this level, the display can maintain a good contrast ratio under high ambient lighting. In addition, the LMG227-104X01 is a normally black, wide viewing angle LCD. Thus, it can be used in portrait mode as well as landscape mode. There is no color shift when viewing the display from large off-axis angles.

#### Characteristics (Note 1, 2)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1,350	Cd/m <sup>2</sup>	LCD displays the brightest white
Luminance Variation	± 15% or better		Note 3
Backlight Power Consumption	9.2	Watts	Excluding LED driving board losses
Screen Dimming Ratio	20:1		With LD200A LED driving board
Typical LCD Contrast Ratio	600:1		White vs. Black (measured in the dark at the normal direction)
Typical Viewing Angles			
3:00 to 9:00 direction	± 89	Degrees	Contrast ratio ≥ 10
6:00 to 12:00 direction	± 89	Degrees	Contrast ratio ≥ 10
3:00 to 9:00 direction	± 89	Degrees	Screen brightness ≥ 200 Cd/m <sup>2</sup>
6:00 to 12:00 direction	± 89	Degrees	Screen brightness ≥ 200 Cd/m <sup>2</sup>
LCD Screen Chromaticity (x, y)			
White	(0.264, 0.293)		Measured at the normal direction
Red	(0.501, 0.349)		Measured at the normal direction
Green	(0.309, 0.545)		Measured at the normal direction
Blue	(0.146, 0.104)		Measured at the normal direction
LCD Module Weight	500	Grams	
Display Resolution	1,024 x 768		
Operating Temperature Range	-20 to 70	°C	

Note 1: Please refer to the Hydis HV104X01-100 data sheet for detailed LCD electrical specifications and general precautions.

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

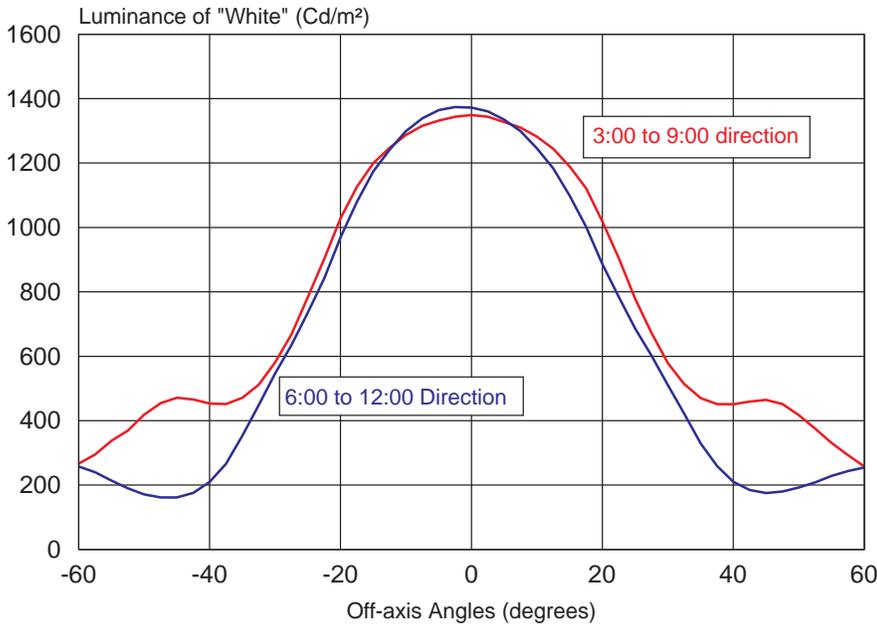
Note 3: Screen luminance is measured at 5 points as shown in the Hydis HV104X01-100 LCD data sheet. The luminance variation is the percent deviation of the maximum and minimum values measured versus the average value of the 5 points.

## LCD Module Optical Performances

### Luminance & Contrast Ratio

The typical LMG227-104X01 LCD module screen luminance and contrast ratio are shown in the figures below: Since the Hydis HV104X01-100 is a wide viewing angle, normally black LCD, the screen luminance is measured with the LCD displaying the white color. The LCD controller is carefully adjusted to provide the best image quality on the

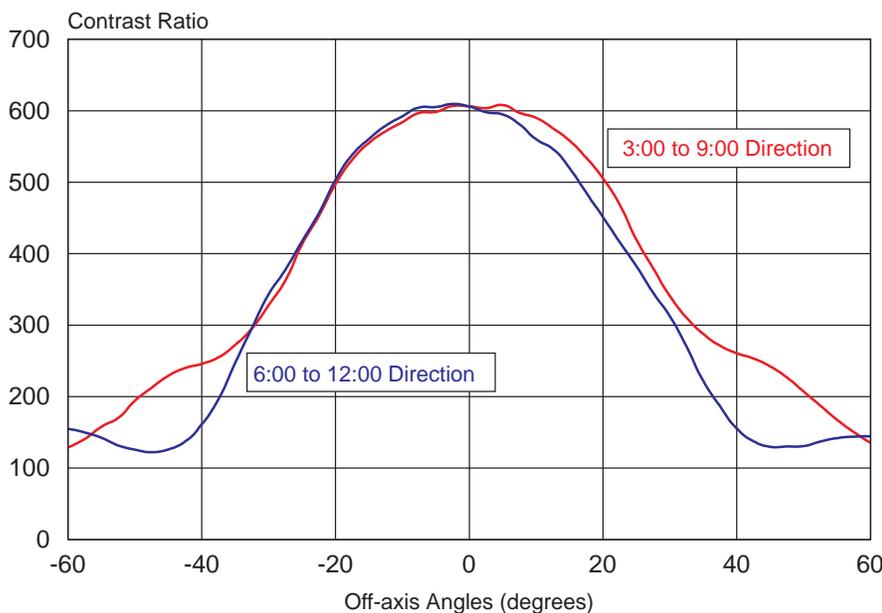
LMG227-104X01 LCD Screen Luminance  
Angular Distribution



screen yet maintains a bright white color. If this is not done properly, then the luminance of the “white” color displayed on the screen may be significantly lower than 1.350 nits. Re-adjusting the LCD controller and/or the graphics card will bring the screen luminance to within 5% of the specified value.

The LMG227 LCD module has a contrast ratio (CR) about 600:1 along the normal direction. For all practical viewing angles, the CR value is well above 100:1. 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, particularly in bright outdoor environment, the CR drops significantly due to reflection and glare at the front surface of the LCD.

LMG227-104X01 LCD Contrast Ratio  
Angular Distribution

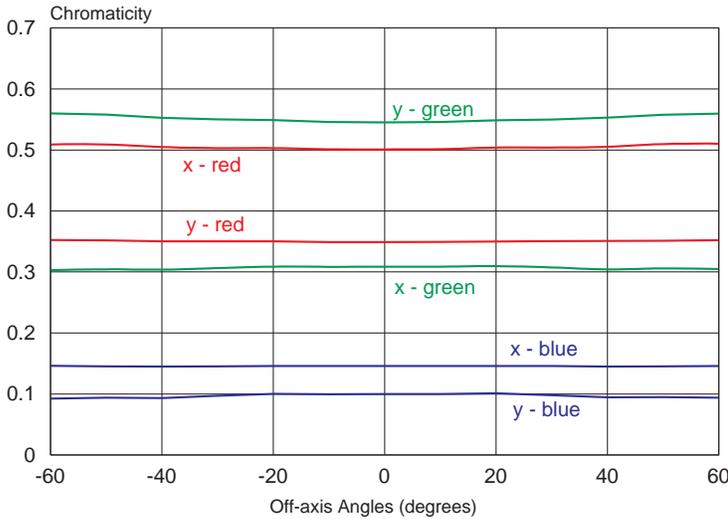


### Chromaticity

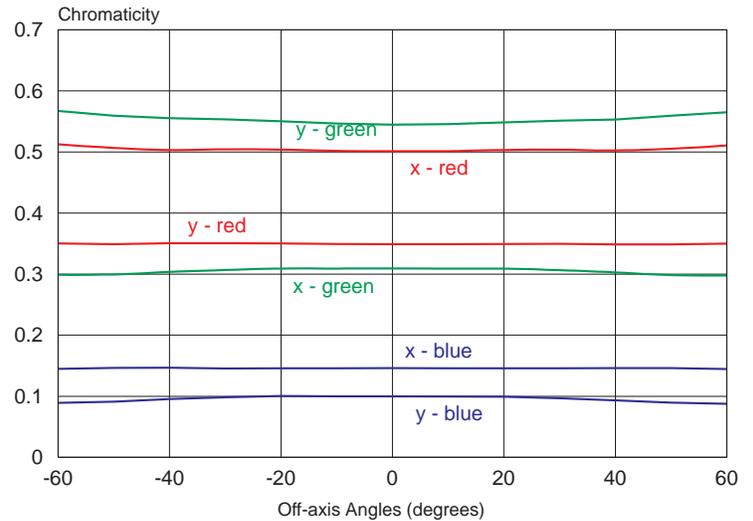
Since the Hydis HV104X01-100 is a normally black wide viewing angle LCD, there is almost no color shift when viewing the LCD at off-axis angles.

The figures on the next page show the chromaticity (x, y) values of the R, G, B primary colors as a function of the viewing angles along the 3:00 to 9:00 direction and along the 6:00 to 12:00 directions. There are virtually no changes in chromaticity values.

LMG227-104X01 Color Shift along the 3:00 - 9:00 Directions  
(Positive Angles are along the 3:00 Direction)



LMG227-104X01 Color Shift along the 6:00 - 12:00 Directions  
(Positive Angles are along the 6:00 Direction)



### LED Backlight Driving Specifications

The LMG227 LCD module has a VHB backlight with one LED lamp strip. The LED strip has 27 white LEDs that are electrically connected into 3 strings in parallel. Each string has 9 LEDs connected in series.

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

At the maximum screen brightness setting of 1,350 nits,

the driving conditions of each LED strip (with 6 strings) are,

LED strip driving voltage	28	Vdc (typ)
LED strip driving current	330	mA

Thus, the LED strip in the backlight consume about 9.2 Watts. With Landmark’s LD200A LED driving board (tuned for the LMG227), the total power drain from the 12V supply is 10.7 Watts.

### Thermal Management

The backlight power consumption of the LMG227-104X01 LCD module is 9.2 Watts at full screen brightness. This is only 2.7 Watts more than the power of the original backlight in Hydis LCD at 350 nits. So the LCD temperature increase due to this additional backlight power is not significant.

For outdoor display applications where the LCD may be subject to direct sunlight exposure, the LCD screen can absorb a large amount of solar heat. In the worst conditions, the heating power generated from sunlight exposure can reach 35 Watts, which is nearly 4 times the LED backlight power. As a result, the LCD temperature can rise beyond 70°C°. Also, both LED efficiency in Lumens per Watt and LED life span decrease when the ambient temperature rises beyond a certain level. Thus, please remember to implement cooling measures to maintain the LCD temperature well below 70 °C to ensure good display performances and long LED backlight life span.

For outdoor applications in cold winter weather, the ambient temperature may drop to below -20°C. Therefore, the

## Thermal Management (continued)

thermal management (cooling and heating) system should be designed according to the worst case conditions anticipated for the LCD to ensure that the LMG227 LCD with its LED backlight will operate properly.

### Backlight Life

The half brightness life of the VHB backlight in the LMG227-104X01 sunlight readable 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 chip 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.

### Caution:

The LMG227-104X01 is a side mount LCD module. The locations of the mounting holes and the screw size are specified in the Mechanical Dimensions Drawing on the next page. Please use four M2 screws to mount the LMG227 LCD onto the display case.

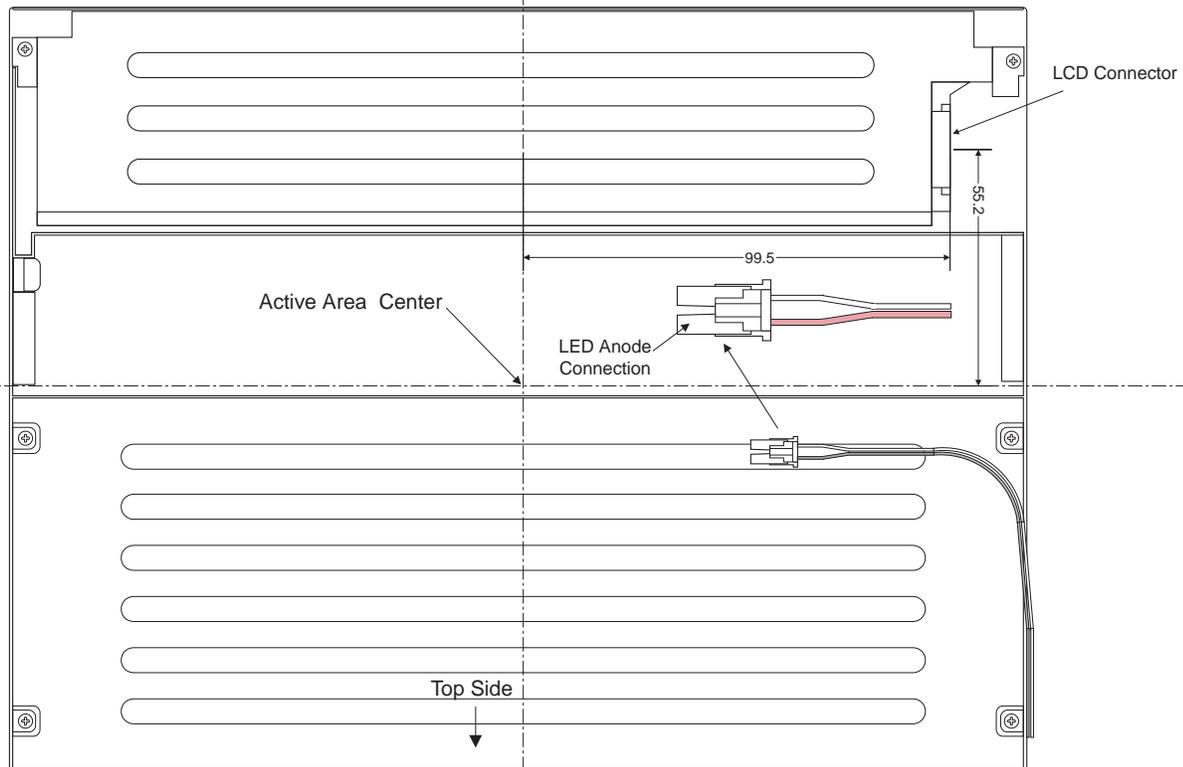
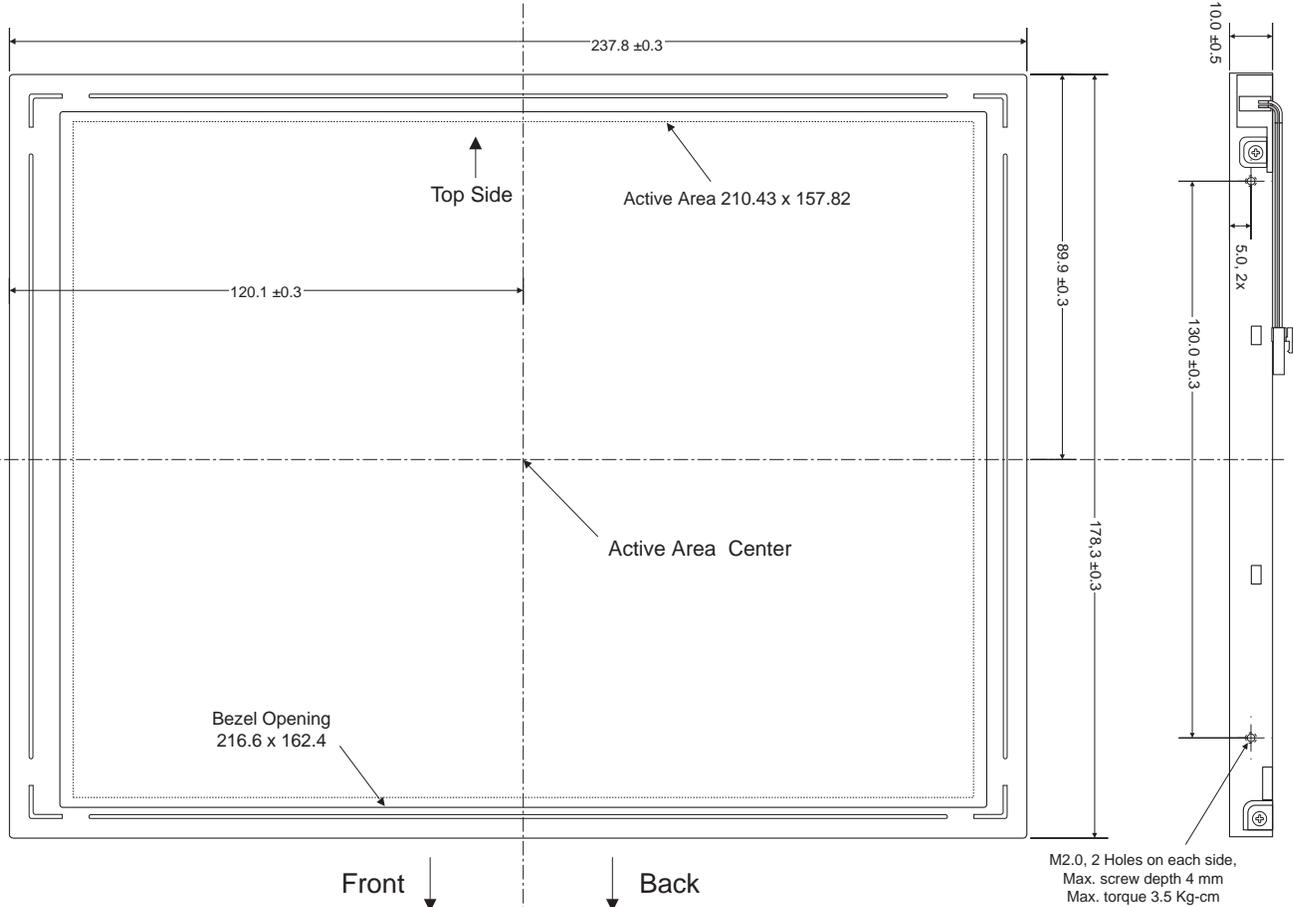
The maximum depth of the screws penetrating inside the LCD module is 4 mm. The maximum torque used to tighten the screws is 3.5 Kg-cm (3 lb-in). Excessive torque and longer screws can cause severe damage to the LCD module.

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LMG227-104X01 Mechanical Dimensions



All dimensions are in mm