



26" Sunlight Readable Open Frame LCD Kit

Model: LOPH2600-kit

LOPH2600-KIT is a 26" sunlight readable open frame LCD kit that includes the Landmark LM181A-190EG02 LCD module with a BI330 inverter and an industrial grade LCD controller MG22, mounted behind the LCD module. At the full brightness setting, the display screen luminance is 1450 Cd/m² (nits). At this level, the display is highly readable under bright ambient lighting including direct outdoor sunlight. In addition, the LCD controller MG22 has a wide range brightness control that can adjust the screen brightness all the way down to 7 nits for night viewing.

The LOPH2600-KIT has 1,280 x 1,024 native resolution. It can accept various video inputs including VGA, Composite video, S-video. It also has stereo audio input and output which makes the LOPH2600-KIT a multi-media sunlight readable display.

General Features

Outline dimensions (mm)	404.2 (W) x 330.2 (H) x 48 (D)	Screen Brightness	1500 nits
Active area dimensions	376.32 x 301 mm	LCD Contrast Ratio	LCD Contrast Ratio
Diagonal	19.26" (487.48 mm)	Color	16.2M (RGB 6 bits + FRC data)
Resolution	1366 x 768 (WXGA)	Operating mode	TN, normally white
Screen aspect ratio	16:9	Surface treatment	AG
Total Weight	1,950 gm		

Optical Characteristics (notes 1)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1450	Cd/m ²	LCD in ON state (normally Black)
Luminance Uniformity	15% or better		Note 2
Screen Brightness Control Rang	1450 - 7	Cd/m ²	Using OSD brightness control
Typical LCD Contrast Ratio	800:1		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	> 80 Degrees		Contrast ratio >= 10
LCD Screen Chromaticity (x, y)			
White	(0.345, 0.362)		Measured at the normal direction
Red	(0.647, 0.345)		Measured at the normal direction
Green	(0.277, 0.614)		Measured at the normal direction
Blue	(0.142, 0.075)		Measured at the normal direction
Response Speed			
Rise time	3.6 msec		White to Black, 10% - 90% transition
Fall time	1.4 msec		Black to White, 10% - 90% transition

Note 1: All data are measured at 25oC ± 2oC ambient temperature.

Note 2: See Luminance Uniformity in LCD Module Optical Performances for details.



Display Optical Performances

Screen Luminance (Brightness)

When the backlight is adjusted to the full brightness, the screen luminance (brightness) of the LOPH2600-KIT is 1450 nits. As the backlight brightness is adjusted down, the LCD screen brightness decreases accordingly. Since LOPH2600-KIT is a normally black display, the specified 1450 nits is measured with the LCD in the ON state (that is, the pixels are energized). This is the "white" state that provides the maximum possible brightness. The "white" color displayed on the screen when the video signal is applied may have a slightly lower brightness if the settings of the LCD controller and/or the graphics card in the PC are not optimized. When the LCD is properly driven, the measured brightness of this brightest "White" should be within 5 - 10% of the specified 1450 nits value.

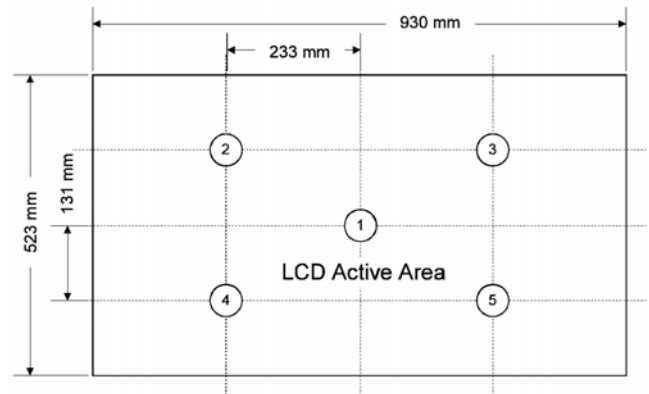
Luminance Uniformity

The luminance uniformity is measured with the brightest "White" at 5 points on the screen as shown in the figure

If Y_{max} and Y_{min} are the highest and the lowest brightness readings among these five points, then the luminance uniformity is defined as:

$$\text{Luminance Uniformity} = \frac{Y_{max} - Y_{min}}{Y_{max} + Y_{min}}$$

The specified uniformity is 15% or less. At 15%, from the above equation, $Y_{max} = 1.35 Y_{min}$. Thus, the brightest point is 35% brighter than the darkest point.



Contrast Ratio

Contrast ratio (CR) is defined as:

$$\text{CR} = \frac{\text{Screen luminance of the brightest White}}{\text{Screen luminance of the darkest Black}}$$

The specified CR value in an LCD data sheet is usually measured at the center point along a perpendicular (on-axis) direction with the display in a dark room. Again, the OSD has to be adjusted to its optimal settings.

The specified CR value is called the inherent contrast ratio. For LOPH2600-KIT, the inherent CR is about 600:1. With ambient lighting, particularly in bright environments, the CR value observed by the viewer drops significantly due to the reflection and glare of the ambient illumination at the front surface of the display. For detailed description of this subject, please refer to Technote TK0101 "LCD Sunlight Readability" on Landmark website under Support/Tech Note.

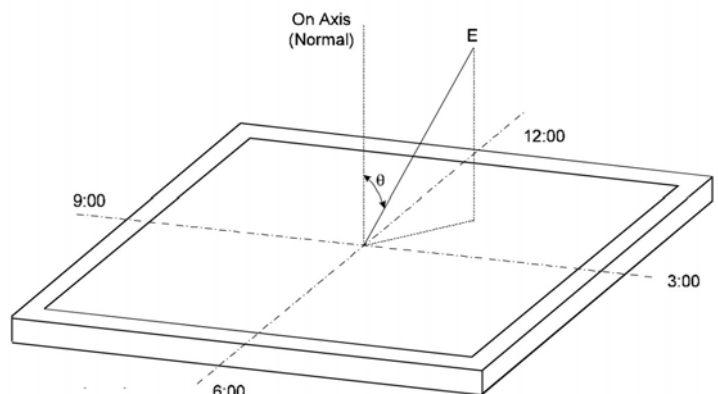
As the viewing direction moving toward off-axis angles, the CR drops, particularly at large angles. For LOPH2600-KIT, even at 50 degrees off axis viewing angles, the CR (inherent) is still higher than 25:1

Viewing Angles

Viewing angles are defined as the angles where the CR is greater than 10. The angles are specified along the horizontal (3:00 to 9:00) directions and along the vertical (6:00 to 12:00) directions as shown in figure on the right. The specified viewing angles of LOPH2600-KIT are 80 degrees along all four directions.

Chromaticity & Color Shifts

As the viewing direction moving to off-axis angles, the chromaticity values of the Red, Green, and Blue primary colors changes. This results color shifts when viewing the screen image from large off-axis angles. For LOPH2600-KIT, among the R,G, B primary colors, only the blue (B) primary color has some color shifts toward the white at large off-axis viewing angles. The red (R) and green (G) primary colors have minimal color shifts, in particular along the horizontal directions. For more detailed information of this topic please refer to Landmark's LM181-190EG02 data sheets.



LCD and Controller

The LCD power is supplied by the on-board MG22 LCD controller. The input voltage and the current requirements to the MG22 card are listed in the following table:

Parameters	Min	Typ	Max	Units	Notes
Input Voltage (from Power Supply)	11.4	12.0	12.6	Vdc	
Input Current (at 12 V)		0.66		A	1
Power Consumption		7.9		Watts	1

For details on the MG22 controller, please refer to MG22 User's Guild .

Backlight and Inverters

LOPH2600-KIT uses BI330C inverter to operate the VHB backlight. The input voltage and the current requirements to the inverters are listed in the following table:

Parameters	Min	Typ	Max	Units	Notes
Input Voltage (from Power Supply)	11.5	12.0	12.5	Vdc	
Input Current (at 12 V)		5.8		A	2
Power Consumption		80		Watts	

Note 1: The input current is measured at the power input connector of the MG22 controller, at 12.0 V and $25 \pm 20^{\circ}\text{C}$ ambient temperature. The LCD is set to display the black color. So, the specified values are the combined current and power consumption of the LCD and the controller.

Note 2: The typical inverter current and power consumption are measured at 12.0 V, $25^{\circ}\text{C} \pm 20^{\circ}\text{C}$ ambient temperature, and the backlight is set at full brightness after 40 minutes of warming up.

Backlight Life

The LOPH2600-KIT backlight uses CCFLs with 50,000 hours of rated half brightness life. The half brightness life is the number of operating hours before the CCFL surface luminance drops down to 50% of its initial value. At the rated LCD screen luminance of 1450 nits, the CCFLs in the LOPH2600-KIT are driven at a lamp current about 5.5 mA. At this current level, the half brightness life of the lamp should be 50,000 hours. If the LCD screen luminance is adjusted (or dimmed) down during night time, the CCFLs are driven at a lower current and their lifetime increases. For detailed descriptions on backlight life issues and actual test data on Landmark Technology backlights, please refer to Technical Note TK801 on Landmark website under Support / Tech Note.

Since most inverters have an efficiency level between 75-80%, the DC power input to the inverter is about 57 to 71 Watts. When the LCD luminance is adjusted down, the power consumption decreases. Landmark BI330C inverter is designed to drive the 15 CCFL backlight in the LM181A-190EG02 module. The inverter has a PWM (pulse width modulation) circuit that provides a 200:1 screen luminance adjustment (i.e. from 1450 to 7 Cd/m²). For detailed information, please refer to the BI330C data sheet.

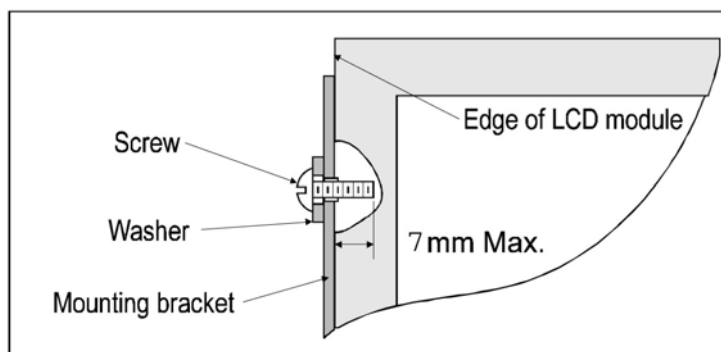
Backlight Life

When the lamps in the LOPH2600-KIT-190EG02 backlight are operating at the recommended current for full LCD screen luminance, they are rated at 50,000 hours of half brightness life. The half brightness life is the number of operating hours before the CCFL surface luminance drops down to 50% of its initial value. In general, the luminance of a backlight decays slightly faster than that of a CCFL. This is due to the aging the backlight. However, in actual applications, the luminance of a VHB display will likely be adjusted down in dimly lit environments. Since the half brightness life increases rapidly when lamps are operated at reduced current levels for lower LCD screen luminance, the actual operating lifetime of the backlight in this LCD module can be expected to reach beyond 50,000 hours. For detailed descriptions on backlight life issues and actual test data on Landmark Technology backlights, please refer to Technical Note TK801.

Thermal Management

The backlight power consumption of the LOPH2600-KIT Open Frame LCD kit is approximately 80 Watts at full brightness. As a result, the LCD screen temperature will be higher than normal. It is necessary to dissipate the backlight heat such that the LCD temperature stays within the temperature specifications of the LM181-190EG02. The exact increase in screen temperature depends on the installation of the LCD module in the equipment. For example, with the LOPH2600-KIT operating at full brightness in open air with no air flow (still air) the average temperature of the LCD front surface is about 15 to 20 Co above the ambient air temperature. The highest temperature rise usually occurs if the LCD is placed horizontally. If the LCD is placed vertically, a portion of the heat may rise and dissipate into the air without heating up the LCD. When the LCD is mounted on a heat conducting bezel or a cooling fan is used, the screen temperature rise can be significantly reduced. It is recommended that the LCD screen temperature be measured at full brightness in the equipment under actual operating environments. The cooling measure should then be designed accordingly. Please make sure that the specified maximum LCD temperature is not exceeded.

Caution:
LOPH2600-KIT is a side mount LCD module. Please use screws of proper size and length for LCD mounting. Excessively long screws can cause severe damage to the LCD module. Please follow the drawing on the right as a guideline for the proper screw length.



Mechanical Drawing

