

Introduction

LM179-190EG01 is a 19" sunlight readable LCD module. The module consists of an AUO M190EG01 TFT color LCD panel and a Landmark VHB (very high brightness) backlight. The module has the same foot print and uses the same mounting holes as the Landmark LM160-190EN02 sunlight readable LCD module.

At the maximum backlight power of 53 Watts, the LM179-190EG01 module delivers 850 Cd/m² (nits) of LCD screen luminance. At this brightness level, the display is highly readable under bright ambient lighting including direct outdoor sunlight. It is recommended that the Landmark BI330C inverter be used to operate the backlight in this LCD module. With this inverter, the LCD screen luminance can be adjusted down to 4 Cd/m² for night viewing.

Characteristics (Note 1, 2)

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	850	Cd/m ²	LCD displays the brightest White
Luminance Uniformity	20% or better		Note 3
Backlight Power Consumption	53	Watts	Excluding inverter losses
Screen Luminance Dimming Ratio	200:1		With LMT BI330C inverter
Typical LCD Contrast Ratio	900:1		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	(0.327, 0.355)		Measured at the normal direction
Red	(0.645, 0.345)		Measured at the normal direction
Green	(0.284, 0.602)		Measured at the normal direction
Blue	(0.142, 0.065)		Measured at the normal direction
Response Speed			
Rise time	15	msec	Black to White, 10% - 90% transition
Fall time	5	msec	White to Black, 90% - 10% transition
LCD Module Weight	1,700	Grams	

Note 1: Please refer to AUO M190EG01 LCD Specification for detailed electrical specifications and general precautions.

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

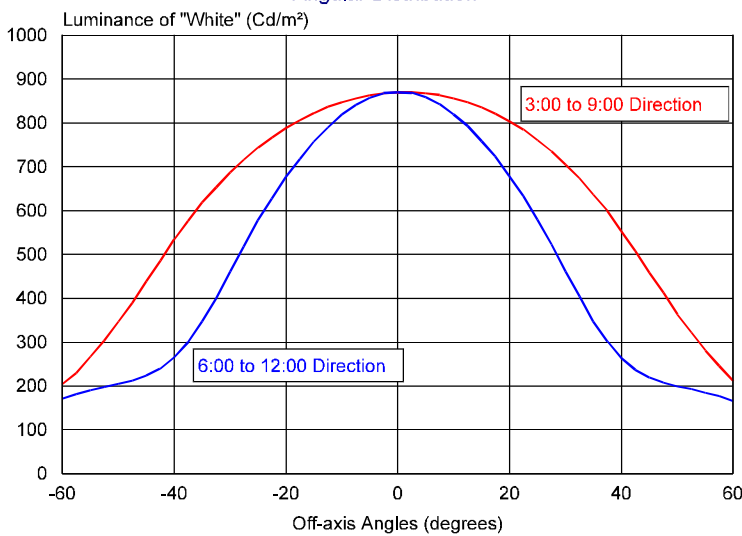
Note 3: Uniformity = (L_{max} - L_{min}) / (L_{max} + L_{min}) where L_{max} (L_{min}) is the maximum (minimum) luminance measured using a 10 mm diameter meter aperture over the LCD active area, except the last 10 mm area from the edges.

LCD Module Optical Performances

Luminance & Contrast Ratio

The typical LM179-190EG01 LCD module screen luminance and contrast ratio are shown in the figures below. Since this module is a wide viewing angle, normally “black” display, the screen luminance is measured with the LCD driven to the brightest “White” color. Therefore, the measured screen luminance may depend on the graphics card, the LCD controller and its OSD settings. When the LCD is properly driven, the measured luminance of the brightest “White” should be within 10% from the specified value.

LM179-190EG01LCD Screen Luminance
Angular Distribution



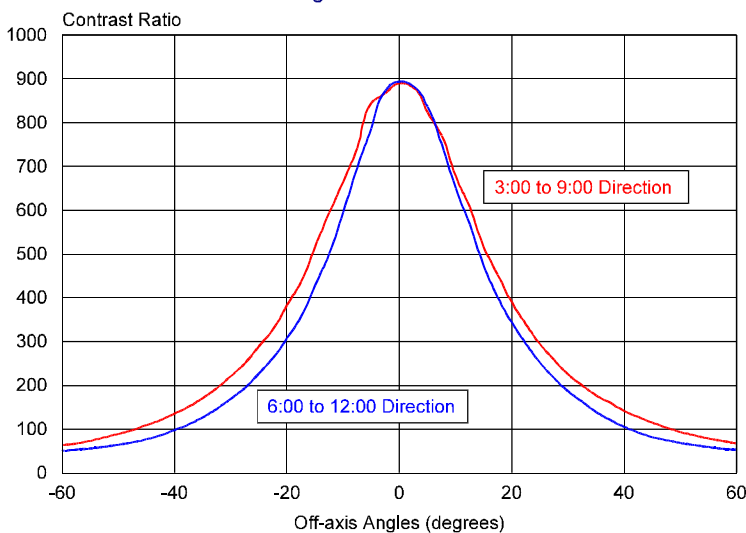
At the optimal viewing directions, the LM179-190EG01 LCD module has an extremely high contrast ratio (CR), about 900:1. This is the inherent CR, which is the luminance ratio between the “White” and the “Black” states measured in a dark room. Under ambient lighting, particularly in bright outdoor environments, the CR value of the display drops significantly due to the reflection and glare caused by the strong ambient illumination.

Chromaticity

LM179-190EG01 is an LCD module that has a very wide viewing angle with virtually no color shift.

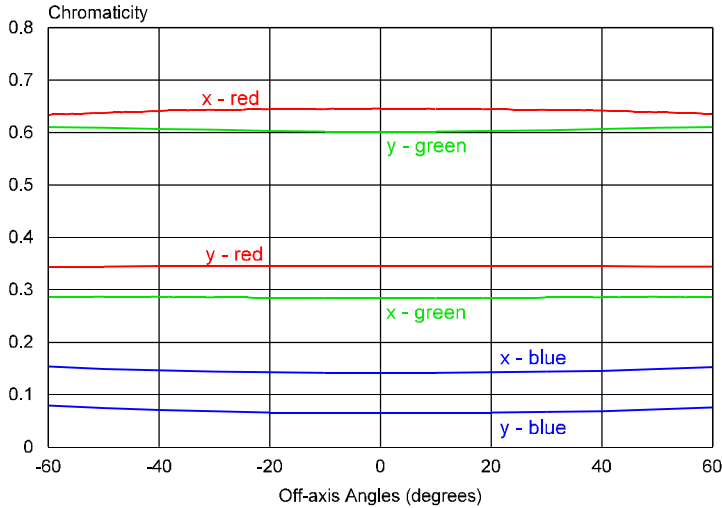
The figures on the next page present the chromaticity (x, y) data of the R, G, B primary colors displayed on the screen.

LM179-190EG01LCD Contrast Ratio
Angular Distribution

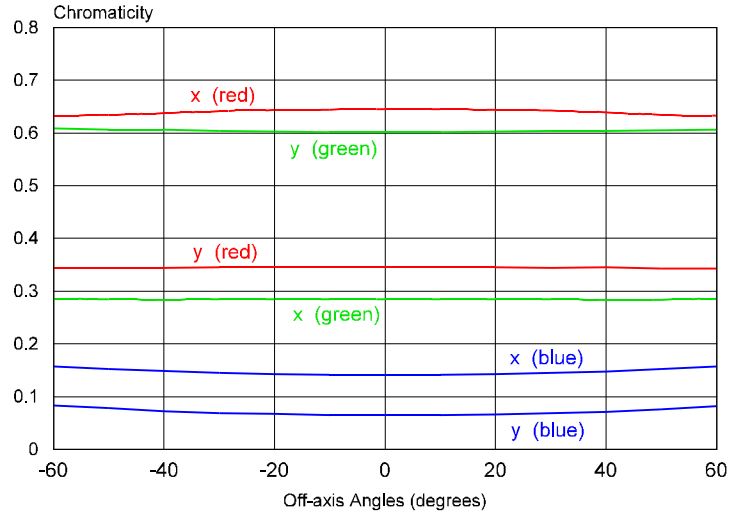


The amount of color shifts are about the same along the 3:00 to 9:00 (horizontal) and along the 6:00 to 12:00 (vertical) directions. Among the R, G, B primary colors, the green (G) color has no color shift when the viewing angle moves toward large off-axis directions. The red (R) and blue (B) have very little color shifts at very large off-axis viewing angles.

LM179-190EG01 Color Shift along the 3:00 - 9:00 Directions
(Positive Angles are along the 3:00 Direction)



LM179-190EG01 Color Shift along the 6:00 - 12:00 Directions
(Positive Angles are along the 6:00 Direction)



Backlight Lamp Driving Specifications

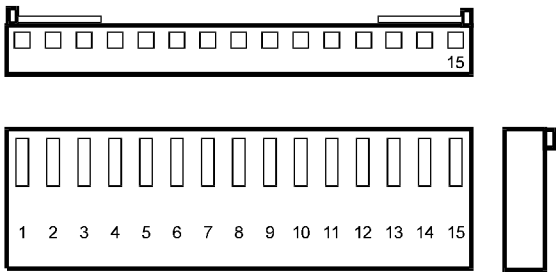
LM179-190EG01 VHB LCD has a VHB backlight with 15 cold cathode fluorescent lamps (CCFLs). The lamps are electrically connected into three groups through three 15-pin Molex connectors. The figure below shows the connector pin out assignments.

voltage and current at full LCD screen luminance are listed below:

Lamp Voltage	680	V_{rms}
Lamp Current	5.2	mA_{rms}

It is recommended that an inverter with a minimum of 1700 V_{rms} starting voltage be used to run the VHB backlight on the LM179-190EG01 module. The lamp

At this driving condition, the backlight delivers 850 Cd/m^2 of LCD screen luminance with a power consumption of about 53 Watts.



Connector #1		Connector #2		Connector #3	
Pin #	To	Pin #	To	Pin #	To
1	Lamp #1	1	Lamp #6	1	Lamp #11
2	NC	2	NC	2	NC
3	Lamp #2	3	Lamp #7	3	Lamp #12
4	NC	4	NC	4	NC
5	Lamp #3	5	Lamp #8	5	Lamp #13
6	NC	6	NC	6	NC
7	Lamp #4	7	Lamp #9	7	Lamp #14
8	NC	8	NC	8	NC
9	Lamp #5	9	Lamp #10	9	Lamp #15
10	NC	10	NC	10	NC
11	NC	11	NC	11	NC
12	NC	12	NC	12	NC
13	NC	13	NC	13	NC
14	NC	14	NC	14	NC
15	Common 1	15	Common 2	15	Common 3

Connector (Housing) Molex 22-01-3157
Three connectors per LCD Module

Mating Header: Molex 22-05-3151

Lamp wiring color:

Lamp#1 to Lamp #15 White
Commons 1, 2, 3 Gray

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 LM179-190EG01 module. The inverter has a PWM (pulse width modulation) circuit that provides a 200:1 screen luminance adjustment (i.e. from 850 to 4 Cd/m²). For detailed information, please refer to the BI330C data sheet.

Backlight Life

When the lamps in the LM179-190EG01 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 of other materials in 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

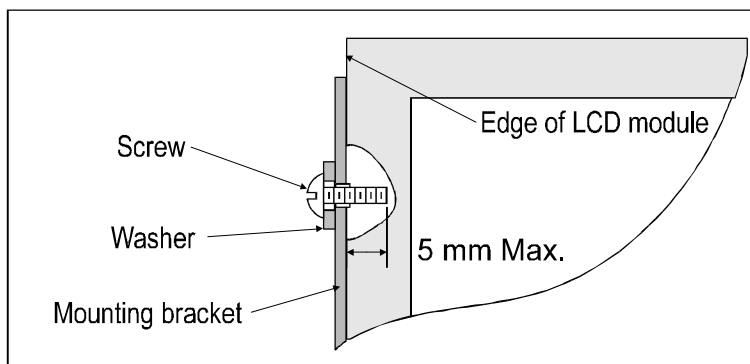
The backlight power consumption of the LM179-190EG01 LCD module is approximately 53 Watts at full brightness. As a result, the LCD screen temperature will be higher than normal. It is necessary to dissipate the backlight heat such that the LCD temperature stays within the temperature specifications of the AUO M190EG01 LCD.

The exact increase in screen temperature depends on the installation of the LCD module in the equipment. For example, with the LM179-190EG01 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 °C 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:

LM179-190EG01 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.



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LCD Module Mechanical Dimensions

