Introduction

HB-20.1”-800 is a 20.1", VHB (Very High Brightness) rugged LCD module. The module consists of a AU.A201SNO2 TFT color LCD glass panel and a rugged VHB backlight。At the maximum backlight power of 65 Watts, the HB-20.1”-800 module delivers 1400 Cd/ m^2 (nits) of LCD screen brightness. At this brightness level, the display is highly readable under direct sunlight. In addition, the color tone of the “White” displayed on the LCD screen closely matches the color of normal sunlight. With a wide dimming range inverter, the screen brightness can be adjusted down to less than 5 Cd/m^2.

The HB-20.1”-800 LCD module displays a superb color image at 800 x 600 resolution with greater than 600:1 contrast ratio and wide viewing angles in all directions, making it suitable for applications that demand unsurpassed image quality under normal and extra bright ambient illuminations.

Characteristics

Parameters	Typical Value	Units	Conditions
LCD Screen Luminance	1,400	Cd/m^2	LCD displays the brightest white
Luminance Uniformity	20% or better		Note 3
Backlight Power Consumption	65	Watts	Excluding inverter losses
Screen Dimming Ratio	200:1		With LMT BI330A inverter
Typical LCD Contrast Ratio	700:1		White vs. Black (measured in the dark at the normal direction)
Typical Viewing Angles			
3:00 to 9:00 direction	> ± 70	Degrees	Contrast ratio 10
6:00 to 12:00 direction	> ± 70	Degrees	Contrast ratio 10
3:00 to 9:00 direction	> ± 60	Degrees	Screen brightness 200 Cd/m2
6:00 to 12:00 direction	> ± 60	Degrees	Screen brightness 200 Cd/m2
LCD Screen Chromaticity			
White	x = 0.350, y = 0.371		Measured at the normal direction
Red	x = 0.642, y = 0.350		Measured at the normal direction
Green	x = 0.297, y = 0.599		Measured at the normal direction
Blue	x = 0.142, y = 0.106		Measured at the normal direction
LCD Module Weight	3,000	Grams	
LCD Module Dimensions	See P. 1		
Operating Temperature	-20 to 55	Degrees	
Storage Temperature	-20 to 60	Degrees	

Note 1: Please refer to the AU.M201UNO2 data sheet for detailed LCD electrical specifications and general precautions.

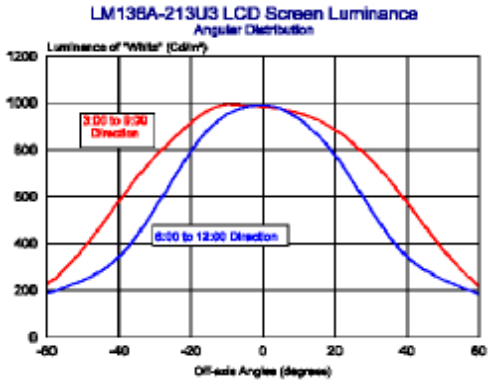
Note 2: All data are measured at 25o C ± 2oC ambient temperature.

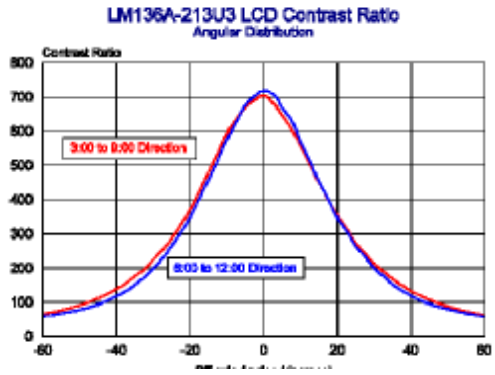
Note 3: Uniformity = (Lmax - Lmin) / (Lmax + Lmin) where Lmax (Lmin) is the maximum (minimum) luminance measured with a 10mm diameter meter aperture over the LCD active area except for the last 10 mm area from

the edges.

LCD Module Optical Performances

The typical HB-20.1"-800 LCD module screen luminance and contrast ratio are shown in the figures below: The screen luminance at the normal viewing direction (at 0^o off-axis angle) is about 1400 Cd/m^2. AU M201UN02 is a normally "black" LCD, 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 the OSD settings. When the LCD is properly driven, the measured luminance of the brightest "White" should be within 10% from the specified value.

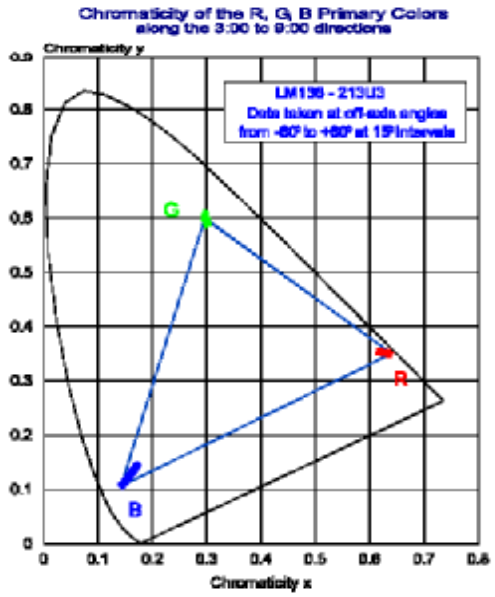


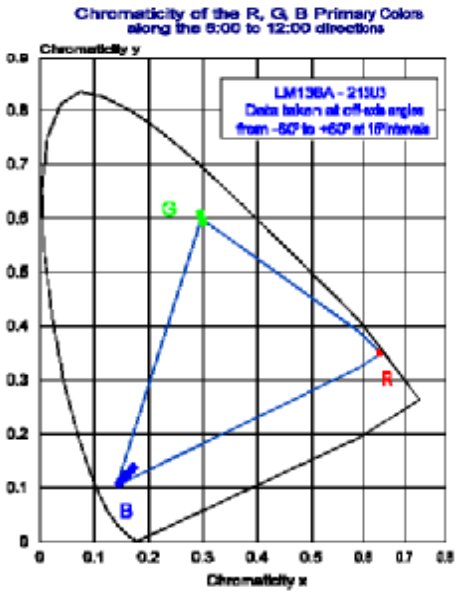


The HB-20.1"-800 LCD module has an exceptionally high contrast ratio (700:1). This is the inherent contrast ratio (CR) of the LCD, which is the luminance ratio between the "White" state and the "Black" state measured in a totally dark room. Under ambient lighting, particularly in bright outdoor environments, the contrast ratio of the display drops significantly due to the reflection and glare caused by the ambient illumination at the front surface of the LCD and other layers such as a touch screen or a protective window placed in the front of the LCD.

The HB-20.1"-800 provides a very wide viewing angle with minimal color shifts. The figures on the next page present the chromaticity (x, y) data of the R, G, B primary colors displayed on the screen, over the viewing angles from -60o to +60o along the 3:00 to 9:00 and the 6:00 to 12:00 directions respectively.

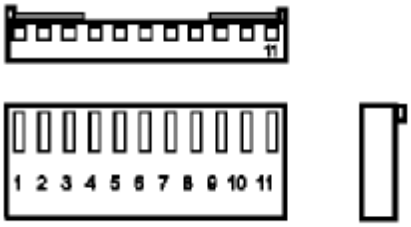
The triangle in each figure is the color gamut of the display measured at the normal direction. The chromaticity data were measured at off-axis angles from -60o to +60o at steps of every 15o. It is obvious that the chromaticity data points for each primary color, in particular those for the red and the green, are very closely located on the chromaticity plane, indicating a very little color shift over the entire viewing angle range.





Backlight Lamp Connections

HB-20.1"-800 VHB LCD module uses a total of 16 cold cathode fluorescent lamps to achieve the required screen luminance. The lamps are oriented in the horizontal direction and are electrically connected into 4 groups through four 11-pin Molex connectors. The figure below shows the connector pin out assignments for the group #1 and group #2. The groups #3 and #4 have a similar pin assignment



Connector: (Housing) Molex 22-01-3117 Two connectors per backlight

Mating Header: Molex 22-23-2111

Group 1 Connector		Group 2 Connector	
Pin	To	Pin	To
1	NC	1	NC
2	NC	2	NC
3	Lamp #1	3	Lamp #5
4	NC	4	NC
5	Lamp #2	5	Lamp #6
6	NC	6	NC
7	Lamp #3	7	Lamp #7
8	NC	8	NC
9	Lamp #4	9	Lamp #8
10	NC	10	NC
11	COMMON 1	11	COMMON 2

Backlight Lamp Driving Specifications

It is recommended to use an inverter with a starting voltage at 1700 Vrms 。In order to have a wide screen luminance adjustment range, please use an inverter with the PWM (pulse width modulation) or the “burst mode” dimming capability.

The lamp voltage and current at full LCD screen brightness are listed below:

Operating Voltage	700	Vrms
Lamp Current	5.8	mArms

At this driving condition, the backlight delivers about 1,000 Cd/m2 of LCD screen brightness with a power consumption of about 65 Watts. Since most inverters have an efficiency between 75 - 80%, the total DC power input to the inverter is about 81 to 87 Watts. When the backlight is dimmed down, the power consumption decreases.

It is quite difficult to measure the lamp current accurately. Therefore, if the lamp current measured with the inverter differs significantly from the above figure, please measure the screen brightness to determine the correct lamp driving condition. To accomplish this, turn on the inverter and set the brightness of the white on the LCD screen to the maximum. Make sure that the room temperature is about 25 °C and run the backlight for at least 30 minutes before measuring the screen brightness. If the measured screen brightness differs from the specified value by a significant margin, for example more than ±15%, the lamps are either under-driven or over-driven. Significantly over-driving the lamps can cause a reduction in backlight life.

Thermal Management

he backlight power consumption of the HB-20.1”-800 LCD module is approximately 65 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 Samsung’s temperature specifications for the LTM213U3-L07 LCD.

The exact degree of screen temperature rise depends on the installation of the LCD module in your equipment. For example, with the HB-20.1”-800 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 oC 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.

If the thermal issue becomes difficult to resolve, it is possible to run the HB-20.1”-800 module at a lower brightness to reduce the backlight power. For example, if the backlight is dimmed down to about 60%, the LCD screen brightness is about 600 nits and the backlight power will be reduced by about 40%. As a result, the thermal related issues are reduced proportionally.

Backlight Life

The half brightness life of the VHB backlight in the HB-20.1”-800 sunlight readable module is rated at 40,000 hours. The half brightness life is the number of operating hours before the backlight luminance (so as the LCD luminance) drops down to 50% of its initial value.For a well made backlight, its life is mainly determined by the lamp life. Lamp life depends strongly on the lamp current. The HB-20.1”-800 module uses the latest long life CCFLs. Therefore, at the recommended lamp current for full screen brightness (5.8 mA), the half brightness life of the backlight is rated at 40,000 hours.

In actual applications, a VHB display is likely adjusted down under dim ambient lighting conditions. In general, operating a backlight at a lower brightness increases its life. As a result, the actual operating lifetime of the VHB backlight in the HB-20.1”-800 module is expected to exceed 40,000 hours under most practical situations. For more detailed descriptions on backlight life issues and actual test data on Landmark Technology backlights, please refer to Technical Notes TK801

Mechanical Specifications