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TFT-LCD

Rev.P0

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TITLE : TV097X0M-NS0

Product Specification

Rev. P0

HEFEI BOE OPTOELECTRONICS TECHNOLOGY



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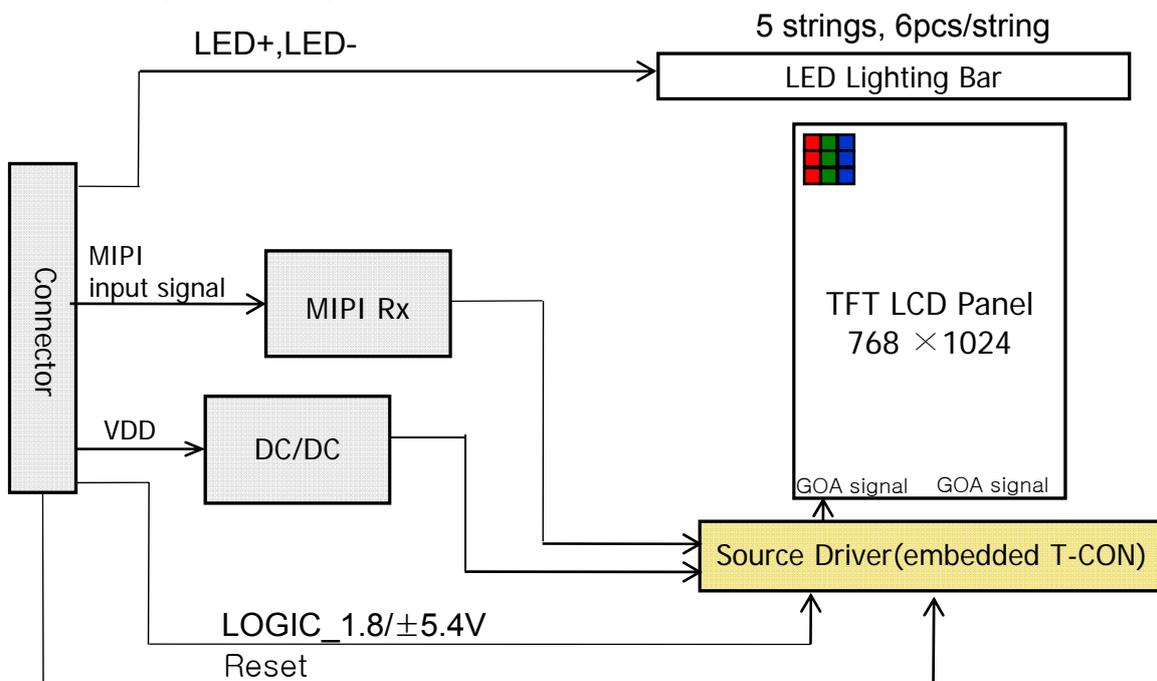
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1.0 GENERAL DESCRIPTION

1.1 Introduction

TV097X0M-NS0 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 9.7inch diagonally measured active area with XGA resolutions (**768** horizontal by **1024** vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors. The TFT-LCD panel used for this module is adapted for a low reflection and higher color type.



1.2 Features

- **4 lanes MIPI Interface**
- Thin and light weight
- Data enable signal mode
- 8-bit color depth, display 16.7M colors
- Low driving voltage and low power consumption
- RoHS Compliant

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1.3 General Specification

The followings are general specifications at the model TV097X0M-NS0. (listed in Table 1.)

< Table 1. General Specifications >

Parameter	Specification	Unit	Remarks
Active area	147.456(W) x 196.608(H)	mm	
Number of pixels	768(H) × 1024(V)	pixels	
Pixel pitch	0.064(H) × 0.192(V)	mm	
Pixel arrangement	Pixels RGB stripe arrangement		
Display colors	16.7M(8bits)	colors	
Display mode	Normally Black		
Outline Dimension	153.716 (H) × 207.838(V) × 1.87(body)	mm	Tolerance: ± 0.2 mm
Weight	105g (typ.)	gram	Tolerance: ± 7g
Power Consumption	P _D : 0.27 (max.)	Watt	Red Pattern
	P _{BL} : 1.935(max.)		
Surface Treatment	HC+LR		



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2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

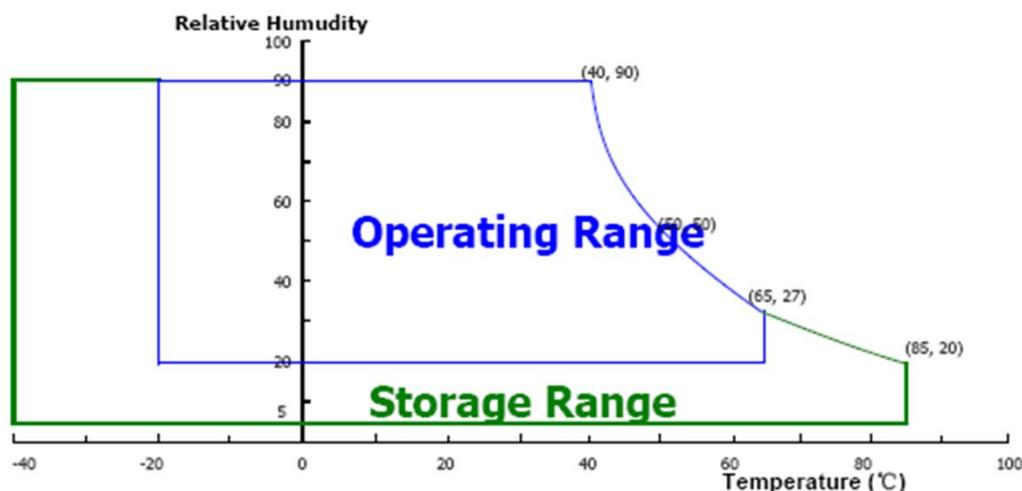
< Table 2. Absolute Maximum Ratings >

Ta=25+/-2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
LCM Power Supply Voltage	VSP	-0.3	6.5	V	Note 1
LCM Power Supply Voltage	VSN	-6.5	-0.3	V	
LCM Logic Supply Voltage	V _{IN}	-0.3	5.0	V	
Operating Temperature	T _{OP}	-20	+60	°C	Note 2
Storage Temperature	T _{ST}	-30	+70	°C	

Notes :

- Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.
- Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (40 OC ≥ Ta)
Maximum wet - bulb temperature at 39 OC or less. (Ta > 40 OC) No condensation.





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3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

< Table 3. Electrical specifications >

[Ta =25±2 °C]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	Vsp	5.1	5.4	5.7	V	Note 1
Power Supply Voltage	Vsn	-5.7	-5.4	-5.1	V	
Logic Power Voltage	VDD3	1.65	1.8	3.3	V	
Input Ripple Voltage	Vripple	-	-	300	mV	
Power Supply Current	Isp	16	21	25	mA	Note 1
Power Supply Current	Isn	13	18	23	mA	
Power Supply Current	Ivdd3	9	12	15	mA	
Power Consumption	P _D	0.19	0.23	0.27	W	Note 1
	P _{BL}	-	-	1.935	W	
	P _{total}	-	-	2.205	W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for ±5.4V and 1.8V input ,Frame rate f_v=60Hz. Test pattern of power supply current is : Typ. and Max. @Red Pattern

2. Considering the worst pattern application, please set the Vsp and Vsn current limit no less than 35mA and VDD3 current limit no less than 20mA.



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3.2 Recommended Driving Condition for Backlight

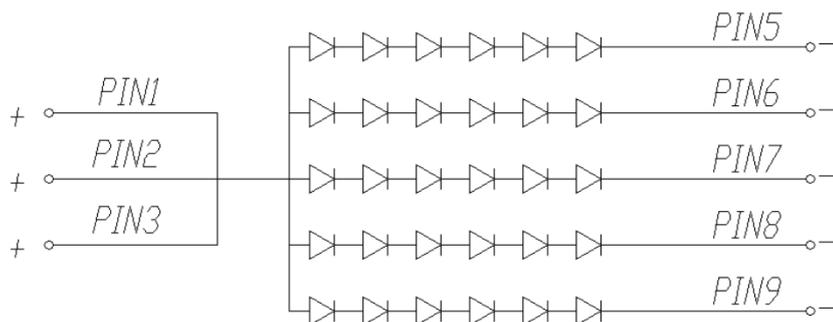
< Table 4. Electrical specifications for Backlight >

Items	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	IF	-	107.5	-	mA	30LEDs (6LED Serial, 5 LED Parallel)
Forward Voltage	VF	16.2	17.4	18	V	
Backlight Power Consumption	-	-	-	1935	mW	
Operating Life Time	-	15000		-	Hrs	IF = 21.5mA Note 3

Note1: The LED driving condition is defined for each LED module (6 LED Serial, 5 LED Parallel). For each LED: IF (1/5) =21.5mA, VF (1/6) =2.9V

Note2: Under LCM operating, the stable forward current should be inputted. And forward voltage is for reference only.

Note3: IF is defined for one channel LED. Optical performance should be evaluated at Ta=25°C only If LED is driven by high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.



3.3 LED Driver

- With LED Driver on Customer System.



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4.0 INTERFACE CONNECTION

4.1 Module Input Signal & Power

- FPC Signal interface : 40 Pin.

< Table 5. LCM Module Input Connector Pin Configuration >

Pin No	Symbol	I/O	Description	Remark
1	GND	P	Ground	
2	GND	P	Ground	
3	NC	-	NC	
4	NC	-	NC	
5	VLED	P	LED Anode	
6	VLED	P	LED Anode	
7	VLED	P	LED Anode	
8	FB1	P	LED Cathode	
9	FB3	P	LED Cathode	
10	FB2	P	LED Cathode	
11	FB4	P	LED Cathode	
12	FB5	P	LED Cathode	
13	VSP	P	5.4V, Power supply for IC	
14	TE	O	Signal for Panel Test	
15	VSP	P	5.4V, Power supply for IC	
16	LOGIC_1V8	P	1.8V logic signal to LCD	
17	BC_C	O	Power IC enable signal	
18	LEDPWM	IO	PWM output	
19	VSN	P	-5.4V, Power supply for IC	
20	RESET	I	Device Reset Signal	
21	VSN	P	-5.4V, Power supply for IC	
22	GND	P	Ground	
23	VPP	P	Power supply for OTP	Internal use only
24	D2P	I	MIPI Input Data Pair	
25	GND	P	Ground	
26	D2N	I	MIPI Input Data Pair	
27	D1P	I	MIPI Input Data Pair	
28	GND	P	Ground	
29	D1N	I	MIPI Input Data Pair	
30	CLKP	I	MIPI Input Data Pair	
31	GND	P	Ground	
32	CLKN	I	MIPI Input Clock Pair	
33	D0P	I	MIPI Input Clock Pair	
34	GND	P	Ground	
35	D0N	I	MIPI Input Data Pair	
36	D3P	I	MIPI Input Data Pair	
37	GND	P	Ground	
38	D3N	I	MIPI Input Data Pair	
39	GND	P	Ground	
40	GND	P	Ground	



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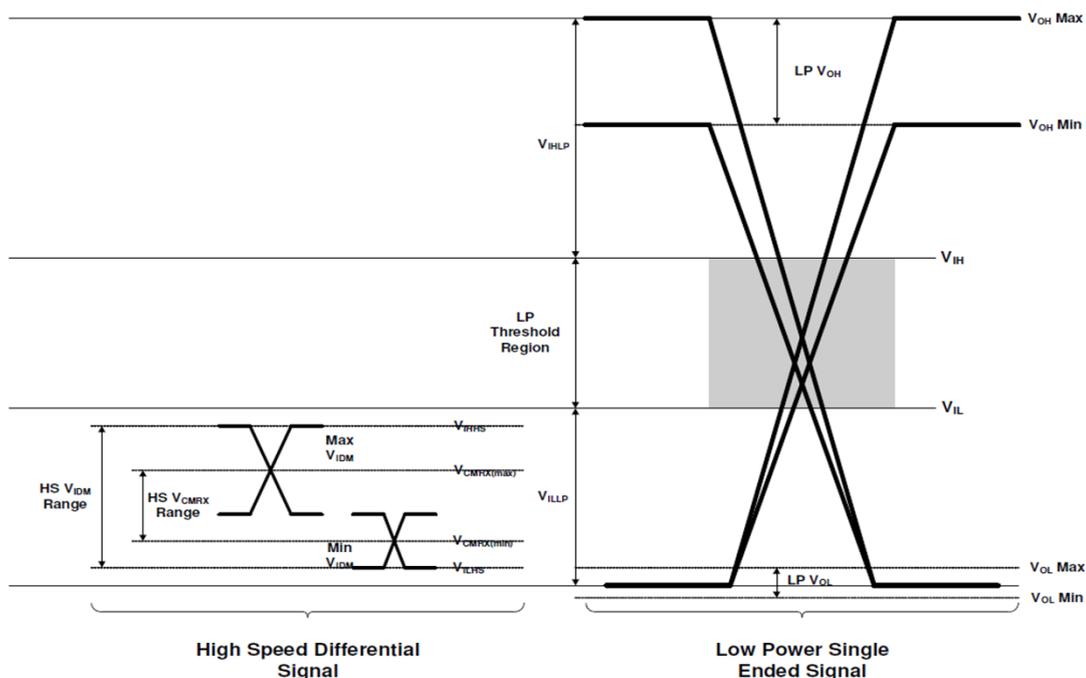
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5. Electrical Specification

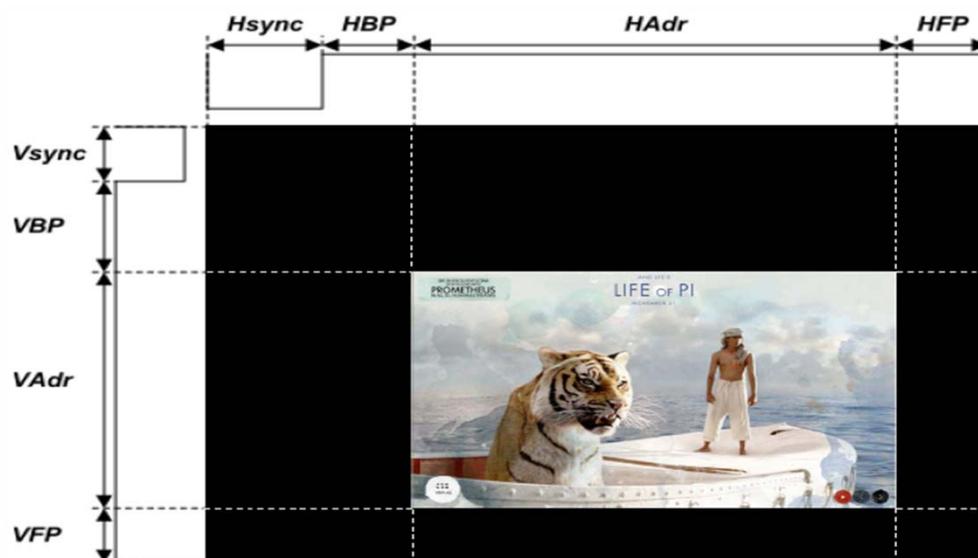
5.1 Timing Parameters

Parameter	Symbol	Min	Typ	Max	Unit	Condition
MIPI digital operation current	I_{VCCIF}	14	15	16	mA	-
MIPI digital stand-by current	$I_{VCCIFST}$	-	200	-	uA	-
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	V_{ILHS}	-40	-	-	mV	
Single-ended input high voltage	V_{IHHS}	-	-	460	mV	
Common-mode voltage	V_{CMRXDC}	155	-	330	mV	
Differential input impedance	Z_{ID}	80	100	125	Ω	
HS transmit differential voltage($V_{OD}=V_{DP}-V_{DN}$)	$ V_{OD} $	85	200	250	mV	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	-50	-	1350	mV	
Ground shift	V_{GNDSH}	-50	-	50	mV	
Output low level	V_{OL}	-150	-	150	mV	
Output high level	V_{OH}	1.1	1.2	1.3	V	

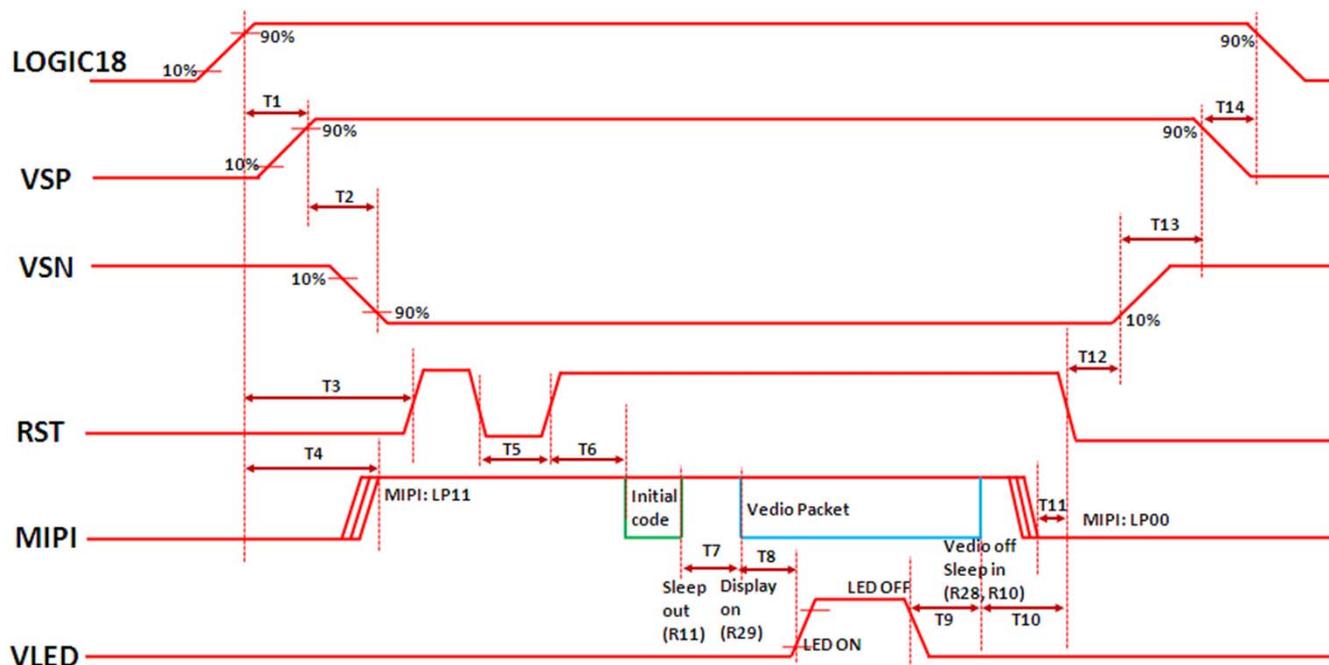


5.2 MIPI Timing Parameter

Item	Symbol	Min	Typ	Max	Unit	Remarks
Pixel CLK	Tpixclk	53.7		75.7	MHz	-
MIPI CLK	Period	4	5	4.8	ns	-
	Frequency	180	200	250	MHz	-
Hsync	Period	16			Tpixclk	-
	Frequency		63.36		KHz	-
Vsync	Period	4			Line	-
	Frequency		60	-	Hz	-
Horizontal Active Display Term rgb vporch 8 4 4 rgb hporch 16 48 16	HAdr		768	-	Tpixclk	-
	HBP	48			Tpixclk	-
	HFP	16			Tpixclk	-
	Total		848		Tpixclk	-
Vertical Active Display Term	Vadr		1024	-	Line	-
	VBP	12			Line	-
	VFP	16			Line	-
	Total		1056		Line	-



5.3. Power Sequence



ITEM	Min.	Typ.	Max.	Unit	Remark
T1	0		5	ms	
T2	1		10	ms	
T3	60		100	ms	
T4	0		T3	ms	
T5	10		1000	us	
T6	200		300	ms	
T7	120		200	ms	
T8	2			Frame	
T9	2			Frame	
T10	100		300	ms	
T11	0				
T12	0				
T13	0				
T14	0				



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6.0 OPTICAL SPECIFICATIONS

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = $25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (CA-310、BM-5A) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0° . We refer to $\theta_{\Phi=0}$ ($=\theta_3$) as the 3 o'clock direction (the "right"), $\theta_{\Phi=90}$ ($=\theta_{12}$) as the 12 o'clock direction ("upward"), $\theta_{\Phi=180}$ ($=\theta_9$) as the 9 o'clock direction ("left") and $\theta_{\Phi=270}$ ($=\theta_6$) as the 6 o'clock direction ("bottom"). While scanning θ and/or Φ , the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be 3.3V +/-10% at 25°C . Optimum viewing angle direction is 6 'clock.

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle	Horizontal	Θ_3	CR > 10	80	89	-	Deg.	Note 1
		Θ_9		80	89	-	Deg.	
	Vertical	Θ_{12}		80	89	-	Deg.	
		Θ_6		80	89	-	Deg.	
Color Gamut				65.8	70.8	75.8	%	-
Contrast ratio		CR		700	900	-		Note 2
Luminance of White		Y_w		360	450	540	cd/m ²	Note 3
White luminance uniformity		$\Delta Y9$		80	85		%	Note 4
White Balance	CCT		$\Theta = 0^\circ$ (Center) Normal Viewing Angle	6450	6950	7650	K	Note 5
	Δuv			-0.005	0.0025	0.010	-	
Reproduction of color	Red	R_x		TYP. - 0.03	0.64	TYP. + 0.03		Note 6
		R_y			0.33			
	Green	G_x			0.30			
		G_y			0.60			
	Blue	B_x			0.15			
		B_y			0.06			
Response Time		T_g		-	30	35	ms	Note 7
Gamma Scale				2.15	2.4	2.65		

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Note :

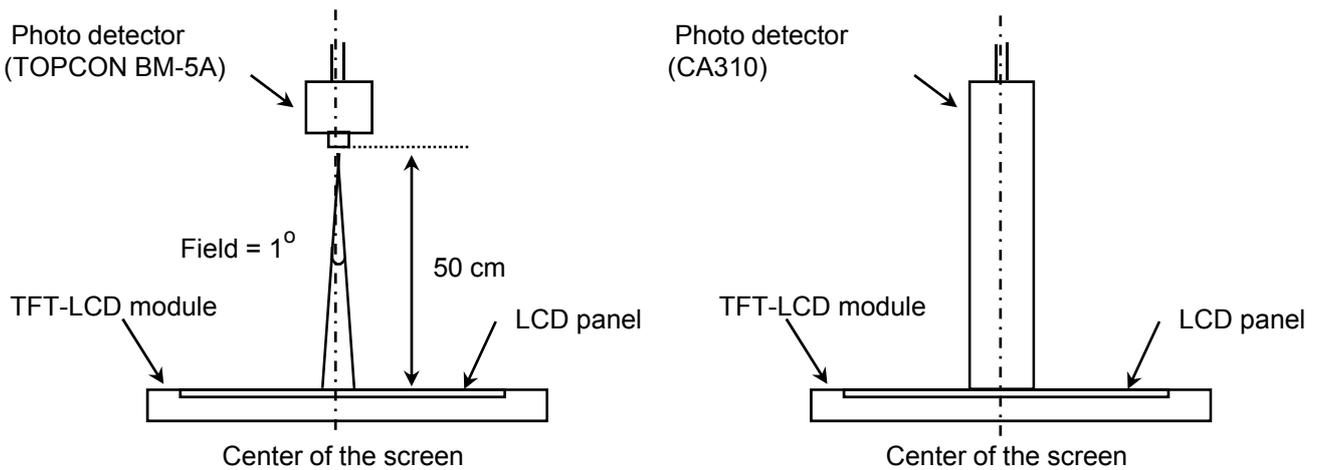
1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see FIGURE 1).
2. Contrast measurements shall be made at viewing angle of $\Theta = 0$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state . (see FIGURE 1) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. Center Luminance of white is defined as luminance values of 1point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display. The luminance is measured by CA310 when the LED current is set at 21.5mA (FIGURE 2) .
4. The White luminance uniformity on LCD surface is then expressed as : $\Delta Y = \text{Minimum Luminance of 9points} / \text{Maximum Luminance of 9points}$ (see FIGURE 3).
5. The color chromaticity coordinates specified in Table 5 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.
6. The color chromaticity coordinates specified in Table 4. shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.
7. The electro-optical response time measurements shall be made as FIGURE 3 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is T_r , and 90% to 10% is T_d (see FIGURE 4) .

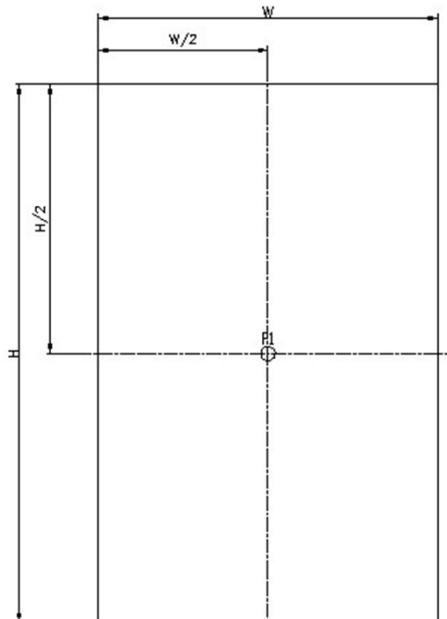
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Figure 1. Measurement Set Up



View angel range measurement setup Luminance , uniformity and color measurement setup

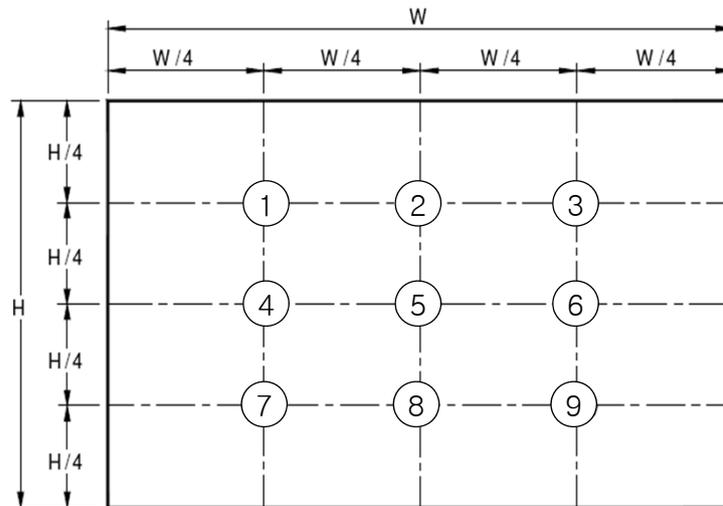
Figure 2. White Luminance and Uniformity Measurement Locations (Center point)



Center Luminance of white is defined as luminance values of center point across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

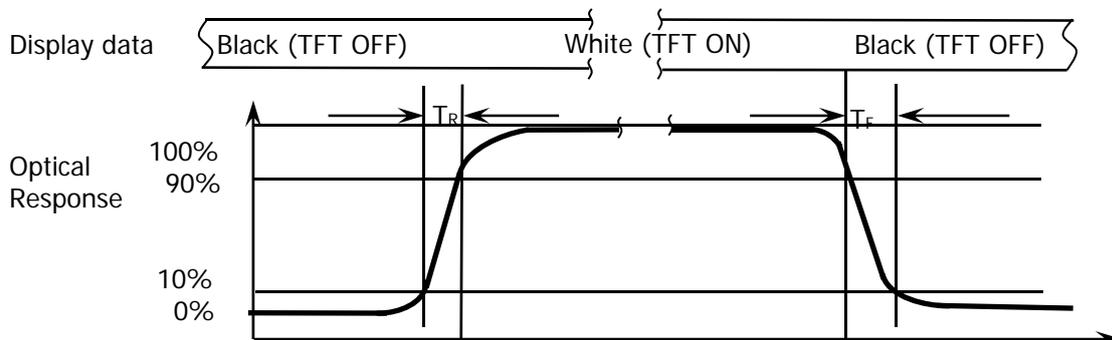
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Figure 3. Uniformity Measurement Locations (9 points)



The White luminance uniformity on LCD surface is then expressed as : $\Delta Y9 = \text{Minimum Luminance of 9 points} / \text{Maximum Luminance of 9 points}$ (see FIGURE 3)

Figure 4. Response Time Testing



The electro-optical response time measurements shall be made as shown in FIGURE 3 by switching the “data” input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is T_r and 90% to 10% is T_d .

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7.0 MECHANICAL CHARACTERISTICS

7.1 Dimensional Requirements

FIGURE 4 (located in Appendix) shows mechanical outlines for the model BA070WS1-200. Other parameters are shown in Table 12.

<Table 12. Dimensional Parameters>

Parameter	Specification	Unit
Dimensional outline	153.716(V) × 207.838(H) × 1.87(body) (typ.)	mm
Weight	105 (typ.)	gram
Active area	147.456(W) x 196.608(H)	mm
Pixel pitch	0.064(H) × 0.192(V)	mm
Number of pixels	768(H) × 1024(V) (1 pixel = R + G + B dots)	pixels
Back-light	3806,30ea	–

7.2 Mounting

See FIGURE 6. (shown in Appendix)

7.3 Surface Treatment of Polarizer.

The surface treatment of the CF POL is 3H HC.



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8.0 RELIABILITY TEST

The Reliability test items and its conditions are shown in below.

<Table 13. Reliability Test Parameters >

No	Test Items	Conditions
1	Temperature Humidity Bias	Ta = 60 °C, 90%RH, 240 h
2	High Temperature Operation	Ta = 60 °C, 240 h
3	Low Temperature Operation	Ta = 0 °C, 240 h
4	High Temperature Storage	Ta = 70 °C, 240 h
5	Low Temperature Storage	Ta = -30 °C, 240 h
6	Thermal Shock Test	Ta = 40 °C ↔ 85°C (2 h), 20cycles
7	ESD	非LDI 侧7points: Air, 150 pF, 330Ω, ±5 KV LDI Center point : Air, 150 pF, 330Ω, ±2 KV



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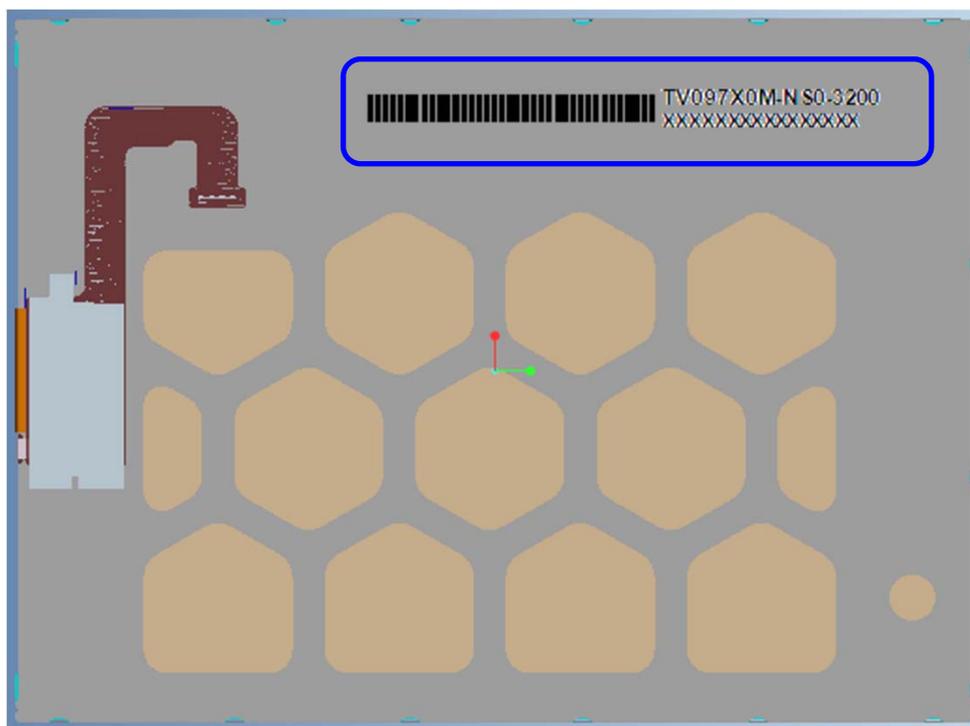
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9.0 Product Serial Number



1. FG-CODE

2. MDL ID

3. MDL ID 条形码

序号号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	X	X	S	3	5	2	7	3	8	0	0	0	0	1	E	E	J
描述	GBN 代码		等级	B3	年	周		FG Code后四位				序列号					



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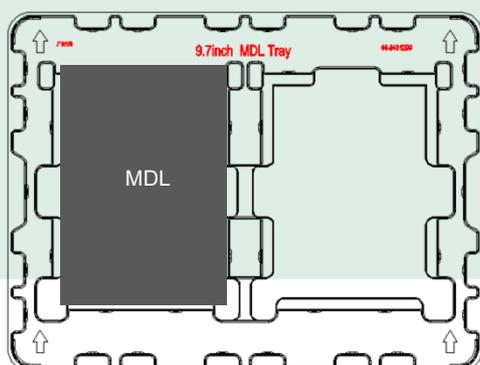
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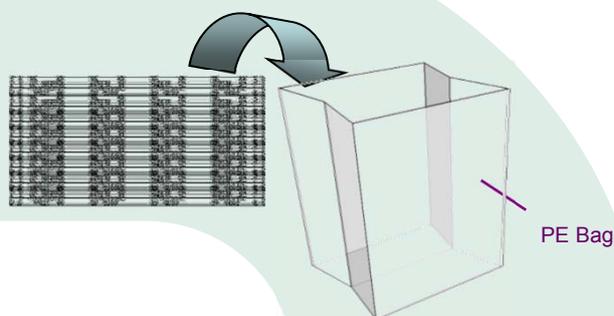
10.0 Packing Form

10.1. Description of packing procedure

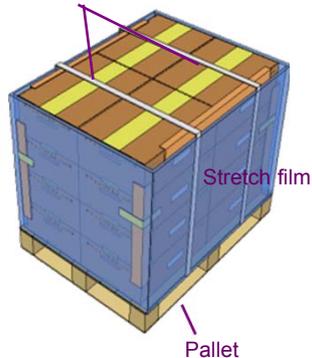
2pcs Panel per Tray



26ea Trays with Cover-Tray



Paper Conner



Stretch film

Pallet



EPE Cover

Inner Box

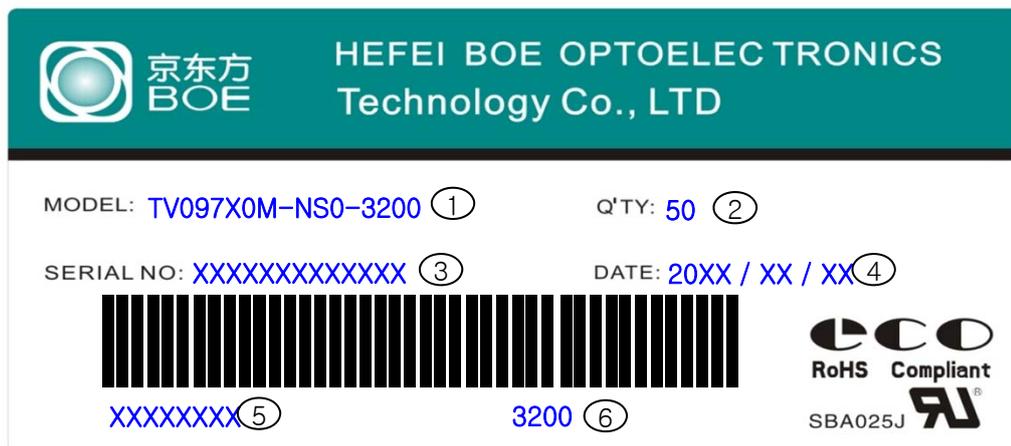
3layers per Pallet, 4 inner boxes per layer
Pallet outer package : Stretch Film & Paper Conner
600pcs Module per Pallet

2EA Cushion -EPE Cover per Inner Box
50pcs Module per Inner Box

step 4

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10.2 Label



蓝色字体为后打印标识, 说明如下:

Label Size: 115mm*55mm

1. **FG-CODE**
2. **Box 产品数量**
3. **Box ID, 编码规则如下**
4. **Box Packing 日期**
5. **客户端产品料号**
6. **FG-CODE 后四位**

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13
代码	4	J	P	3	1	2	7	0	0	0	1	H	D
描述	GBN代码		等级	B3	年份		月	Rev	序列号				

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11.0 HANDLING & CAUTIONS

- (1) Cautions when taking out the module
 - Pick the pouch only, when taking out module from a shipping package.
- (2) Cautions for handling the module
 - As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
 - As the LCD panel and back - light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
 - As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
 - Do not pull the interface connector in or out while the LCD module is operating.
 - Put the module display side down on a flat horizontal plane.
 - Handle connectors and cables with care.
- (3) Cautions for the operation
 - When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the LCD panel would be damaged.
 - Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.
- (4) Cautions for the atmosphere
 - Dew drop atmosphere should be avoided.
 - Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.
- (5) Cautions for the module characteristics
 - Do not apply fixed pattern data signal to the LCD module at product aging.
 - Applying fixed pattern for a long time may cause image sticking.
- (6) Other cautions
 - Do not disassemble and/or re-assemble LCD module.
 - Do not re-adjust variable resistor or switch etc.
 - When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

12.0 Mechanical Drawing

