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No	PART NO.	DESCRIPTION	SPECIFICATION
	EV121WXM-N12	12.1 Inch MDL	B3 EV121WXM-N12 Product Specification Rev.P0 VISUAL INSPECTION CRITERIA FOR ALL CUSTOMERS (12.1" A Grade)

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HEFEI BOE OPTOELECTRONICS TECHNOLOGY CO.,LTD

B3 EV121WXM-N12 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	EV121WXM-N12-3GP0

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared	张晓磊	2021.4.6
Reviewed	王盛 王贺陶	
Approved	李乘揆 布占场	

REVISION HISTORY

(√)preliminary specification

( )Final specification

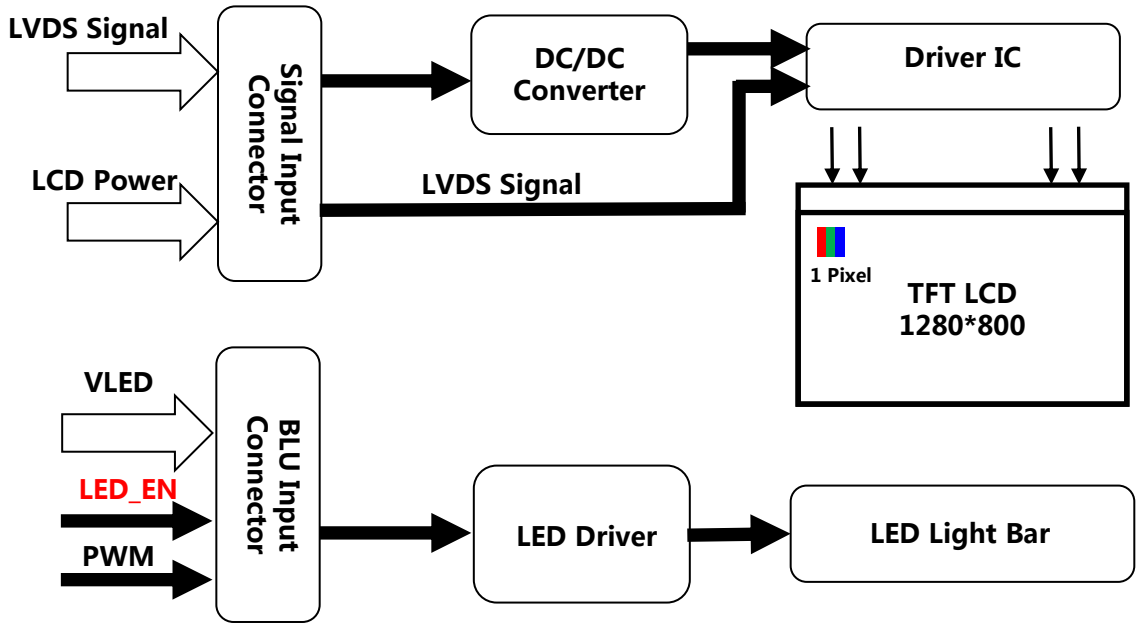
REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2020-11-15	张晓磊
0		完善光学规格	2021-4-6	张晓磊

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

EV121WXM-N12 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 12.1inch diagonally measured active area with WXGA resolutions (1280 horizontal by 800 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.



1.2 Features

- 0.5T Glass (Single)
- Normal Type
- 6/ 8bits LVDS data input selection
- Thin and light weight
- High luminance and contrast ratio, low reflection and wide viewing angle
- RoHS compliant

1.3 Application

- Monitoring

1.4 General Specification

The followings are general specifications at the EV121WXM-N12

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	261.12(H) x 163.20 (V)	mm	
Number Of Pixels	1280(H)×800(V)	pixels	
Pixel Pitch	68*204	mm	
Pixel Arrangement	Transmissive		
Display Mode	Normally Black		
Display Colors	16.7M(6bit +Hi-FRC)	colors	6+FRC
Surface Treatment	AG25		
Contrast Ratio	1200typ/1000min		
Viewing Angle(CR>10)	85°/85°/85°/85°	deg.	U/D/L/R
Response Time	30typ/35max	ms	
Color Gamut	72%typ/68%min		NTSC
Brightness	500	cd/m2	Typ.
Brightness Uniformity	80%		Typ.
Power Consumption	8.11	watt	Max.
Outline Dimension	277.7 (H) x 180.6(V) x 8.7(D)	mm	
Weight	548(Typ.)	gram	±20g
Display Orientation	Landscape Only		

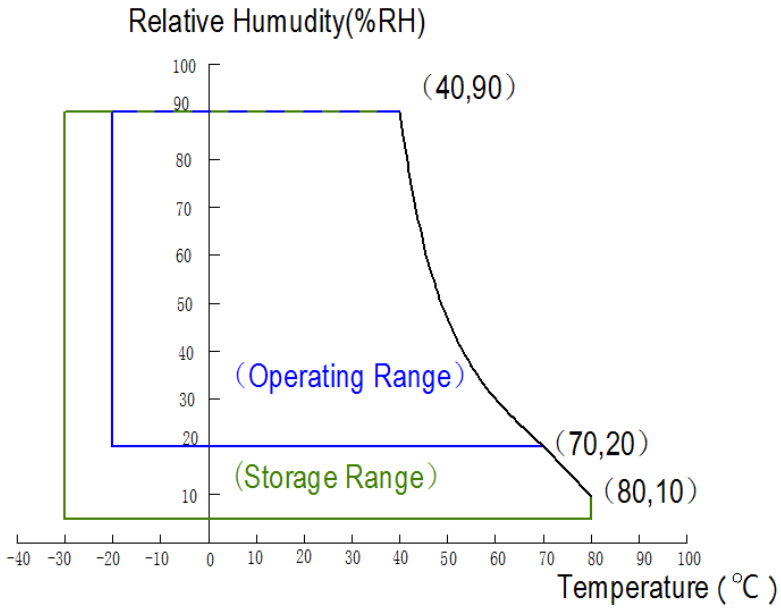
2.0 ABSOLUTE MAXIMUM RATINGS

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>

Parameter		Symbol	Min.	Max.	Unit	Remarks
Power Supply	LCD Module	VDD	0	3.9	V	Ta = 25 ℃
	BLU	V_{BLU}	-	13.2	V	
		I_{BLU}	-	620	mA	
Operating Temperature		T_{OP}	-20	+70	℃	Note 1
Storage Temperature		T_{ST}	-30	+80	℃	

Note : 1) Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ℃ max. and no condensation of water.



3.0 ELECTRICAL SPECIFICATIONS

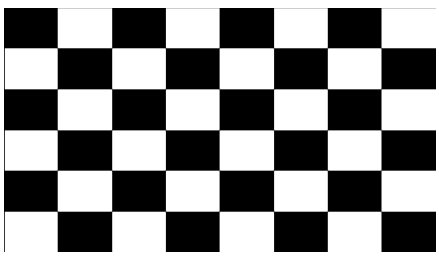
3.1 TFT LCD Electrical specifications

< Table 3. LCD Electrical specifications > [Ta =25±2 ℃]

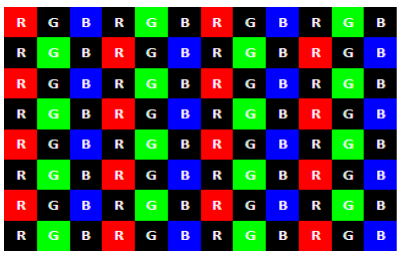
Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Power Supply Voltage	VDD	3.0	3.3	3.6	V	Note 1
Power Supply Current	IDD	150	180	200	mA	
Permissible Input Ripple Voltage	V_{RF}	-	-	100	mV	@ V_{DD}=3.3V
BLU Supply Voltage	V_{BLU}	10.8	12	13.2	V	
BLU Supply Current	I_{BLU}	-	-	620	mA	
Power Consumption	P_D	0.495	0.594	0.66	W	Note 2
	P_{BLU}	-	-	7.45	W	
	P_{total}	-	-	8.11	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 VDD=3.3V, Frame rate f_V=60Hz and Clock frequency = 72.4MHz. Test Pattern of power supply current

a) Typ : Mosaic 8 x 6 Pattern(L0/L255)



b) Max : skip subPixel(L255)



2. Calculated value for reference (V_{LED} × I_{LED}) , With 85% driving efficiency.

3.2 Backlight Unit

< Table 4. LED Driving Guideline Specifications >

[Ta =25±2 ℃]

Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max.		
LED Forward Voltage		V_F	-	-	3.3	V	
LED Forward Current		I_F	-	40	-	mA	
LED Power Consumption		P_{LED}	-	-	6.336	W	Note 1
EN Control Level	Backlight On		2.5	-	5.0	V	
	Backlight Off		0	-	0.5	V	
PWM Control Level	High Level		2.5	-	5.0	V	
	Low Level		0	-	0.5	V	
PWM Control Frequency		F_{PWM}	200	-	10,000	Hz	
Duty Ratio			1	-	100	%	Note 2
LED Life Time		TLED	50000	-	-	Hrs	Note 3/4

Notes : 1. Calculator value for reference $I_F \times V_F \times 48 = PLED$

2. 1% duty cycle is achievable with a dimming frequency less than 1KHz.

3. The life time of LED, 50,000Hrs, is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.

4. Only under the above operating conditions could the life time of LED be guaranteed.

3.3 INPUT TERMINAL PIN ASSIGNMENT

This LCD employs two interface connections, a 20 pin connector is used for the LCD module electronics interface and a 6 pin connector is used for the backlight unit.

3.3.1 Pin assignment for LCD module

Connector : DF19G-20P-1H (HRS) or equivalent

< Table5. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description	I/O
1	VCC	Power supply	P
2	VCC		P
3	HFRC_EN	6/8bit select	I
4	GND	Ground	-
5	D0-	Pixel data	I
6	D0+		I
7	GND	Ground	-
8	D1-	Pixel data	I
9	D1+		I
10	GND	Ground	-
11	D2-	Pixel data	I
12	D2+		I
13	GND	Ground	-
14	CLK-	Pixel data	I
15	CLK+		I
16	GND	Ground	-
17	SDA	Not connect	-
18	SCL	Not connect	-
19	D3-	Pixel data	I
20	D3+		I

3.3.2 Pin assignment for BLU

Connector : MSA24038P6 (STM) or equivalent

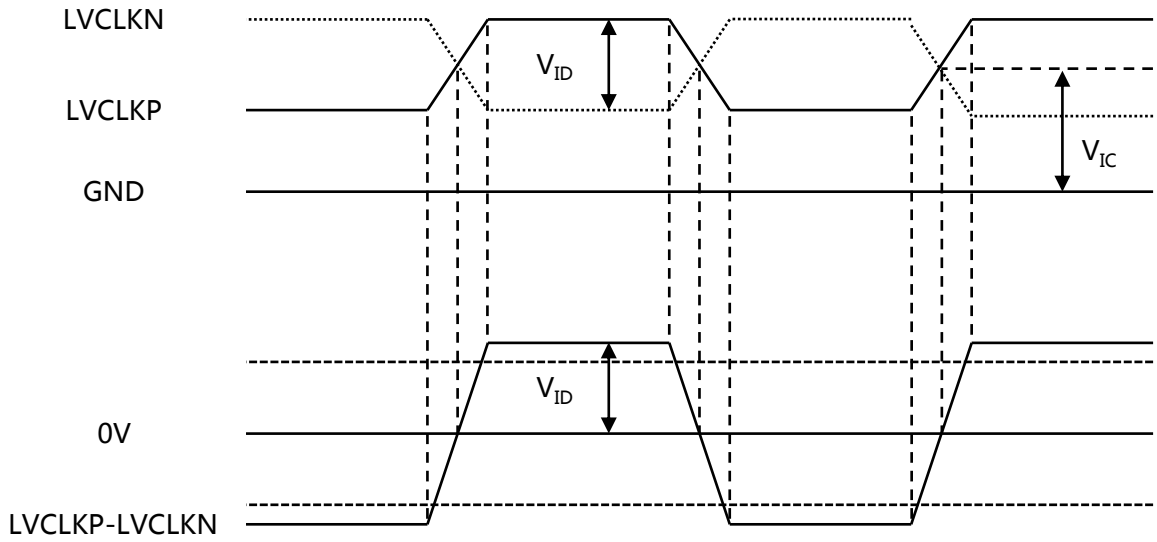
< Table6. Pin assignment for BLU >

Pin No	Symbol	Description	Remarks
1	PWM	Luminance control	
2	BRTC	Backlight ON/OFF control	High or Open : Backlight ON Low : Backlight OFF
3	GND	Ground	
4	GND	Ground	
5	VDD	Power supply	
6	VDD	Power supply	

3.4 DC Specification

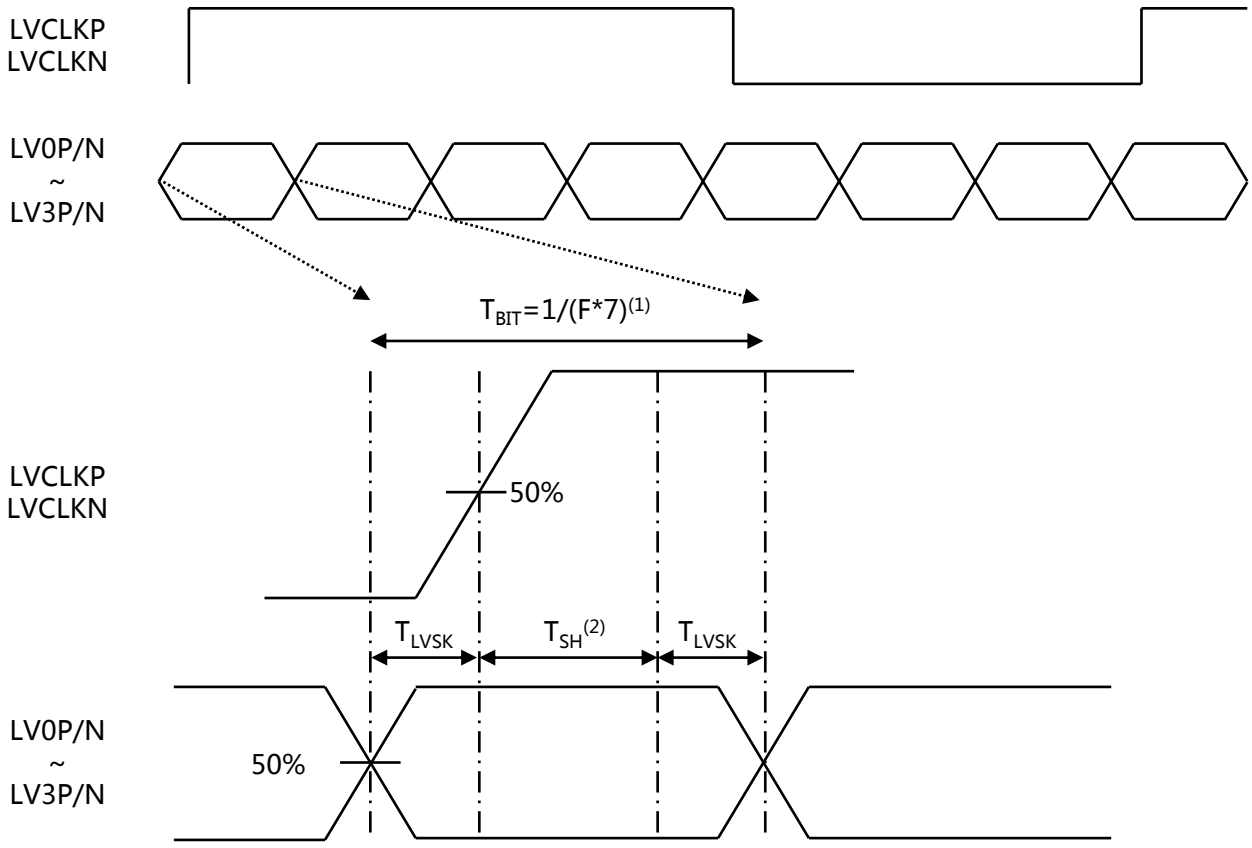
< Table7. DC Specification >

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply current	I_{DD}	150	180	200	mA	
LVDS DC specifications						
Differential input high threshold	V_{TH}	-	-	+100	mV	V_{IC}=1.2V
Differential input low threshold	V_{TL}	-100	-	-	mV	
LVDS common mode voltage	V_{IC}	0.7	-	1.6	V	
LVDS swing voltage	V_{ID}	±100	-	±600	mV	



< LVDS V_{ID} and V_{IC} definition>

3.5 AC Specification



Note:
(1) T_{BIT}: Data period
(2) Internal CLK sampling data window

< LVDS channel to channel skew>

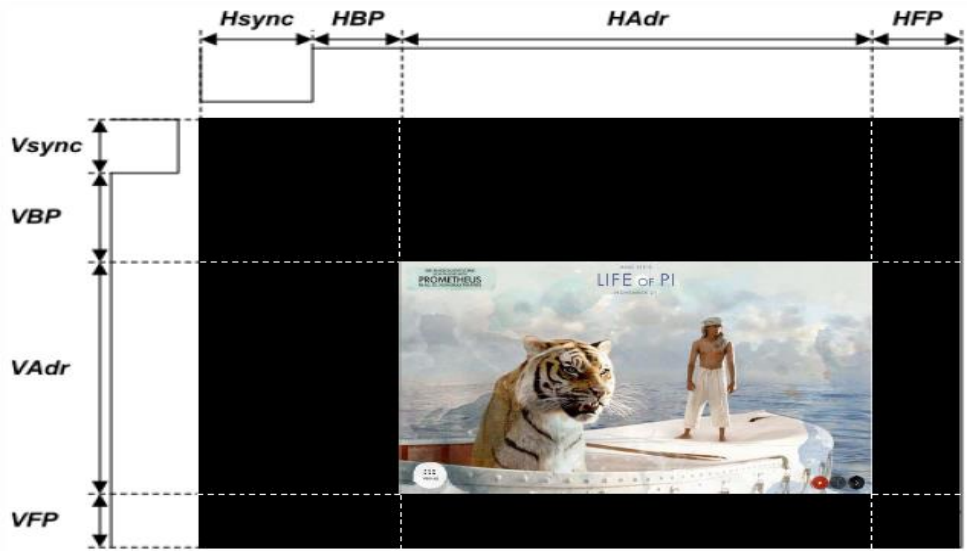
< Table8. AC Specification >

Description	Symbol	Condition	Min	Typ	Max	Unit
LVDS Input frequency	F	-	20	-	85	MHz
LVDS channel to channel skew	T_{LVSK}	F=65MHz V_{IC}=1.2V V_{ID}=±200mV	-600	-	+600	ps

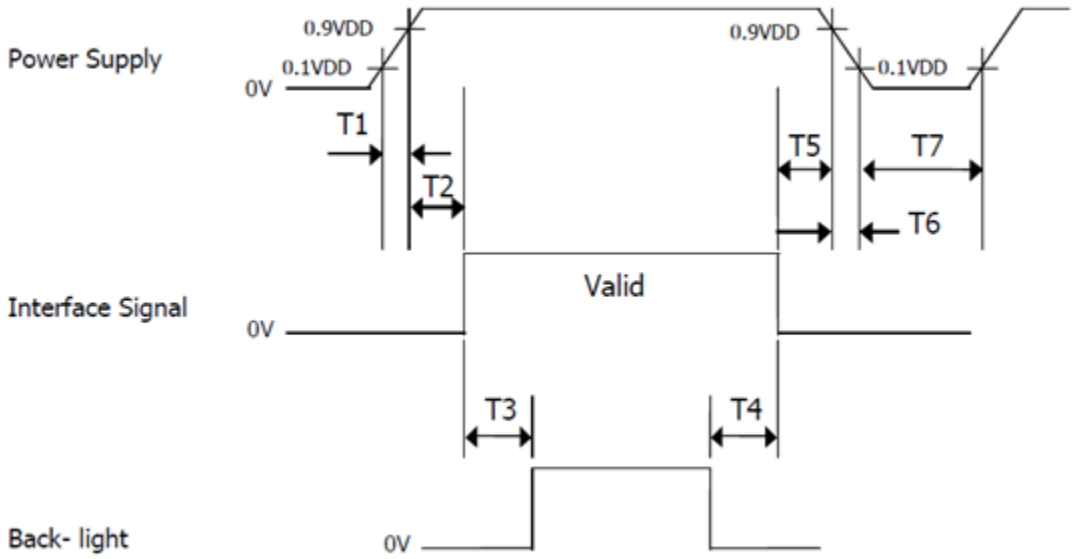
3.6 Interface timing Parameter

< Table9. Timing Parameter >

Item			Symbol	min	typ	max	UNIT
LCD	Frame Rate		-	58	60	62	Hz
	Pixels Rate		-	66.3	72.4	78.9	MHz
Timing	Horizontal	Horizontal total time	tHP	1380	1440	1500	t_{CLK}
		Horizontal Active time	tHadr	800			t_{CLK}
		Horizontal Back Porch	tHBP	-	80	-	t_{CLK}
		Horizontal Front Porch	tHFP	-	80	-	t_{CLK}
	Vertical	Vertical total time	tvp	824	838	872	t_H
		Vertical Active time	tVadr	800			t_H
		Vertical Back Porch	tVBP	-	14	-	t_H
		Vertical Front Porch	tVFP	-	9	-	t_H
Lane				-	1	-	Lane



3.7 Power Sequence



< Table10. Sequence Table >

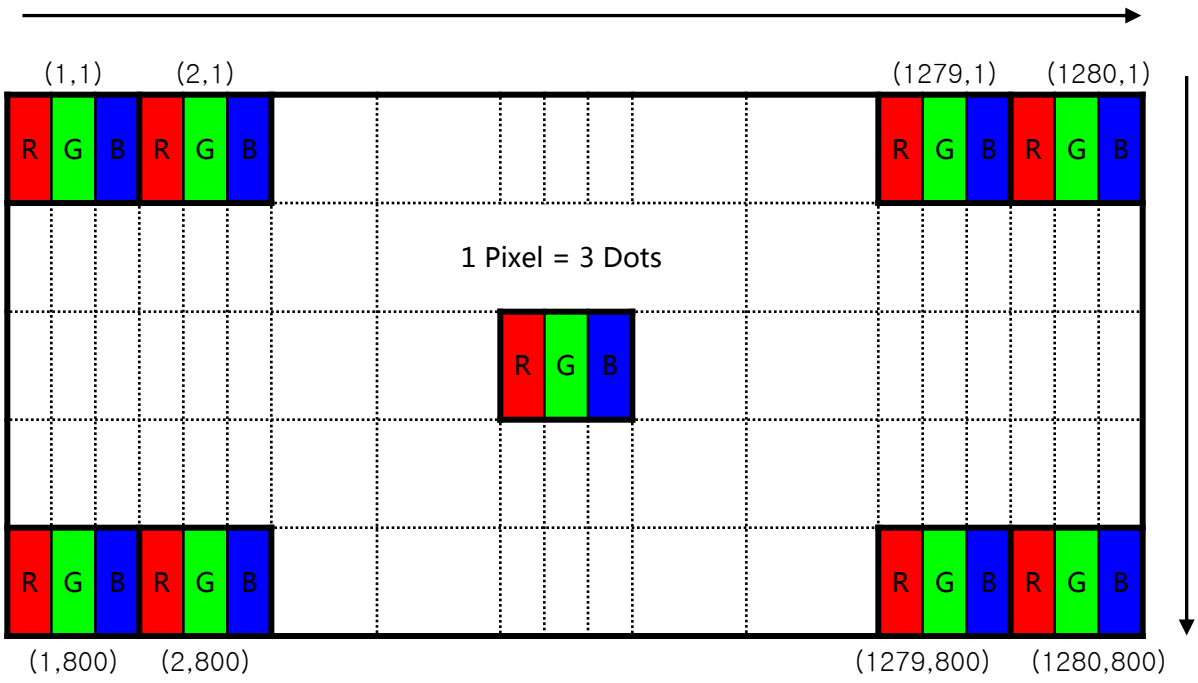
Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0	-	10	(ms)
T2	0	-	50	(ms)
T3	200	-	-	(ms)
T4	200	-	-	(ms)
T5	0	-	50	(ms)
T6	0	-	10	(ms)
T7	500	-	-	(ms)

3.8 Input Color Data Mapping

< Table11. Input Signal and Display Color Table >

Color & Gray Scale		Input Data Signal																							
		Red Data								Green Data								Blue Data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▵	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▵	↑								↑								↑							
	▿	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▿	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▵	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	▵	↑								↑								↑							
	▿	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▿	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▵	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	▵	↑								↑								↑							
	▿	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▿	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of White	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▵	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	▵	↑								↑								↑							
	▿	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▿	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

3.9 Input Color Data Mapping



Display Position of Input Data (V-H)

4.0 OPTICAL SPECIFICATIONS

4.1 Overview

The test of optical specifications shall be measured in a dark room (ambient luminance ≤ 1lux and temperature = 25±2℃) with the equipment of Luminance meter system (Gonio meter system and TOPCON BM-5) 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 θØ =0 (=θ3) as the 3 o' clock direction (the "right"), θØ=90 (= θ12) as the 12 O' clock direction ("upward"), θØ=180 (= θ9) as the 9 O' clock direction ("left") and θØ=270(= θ6) as the 6 O' clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed.

4.2 Optical Specifications

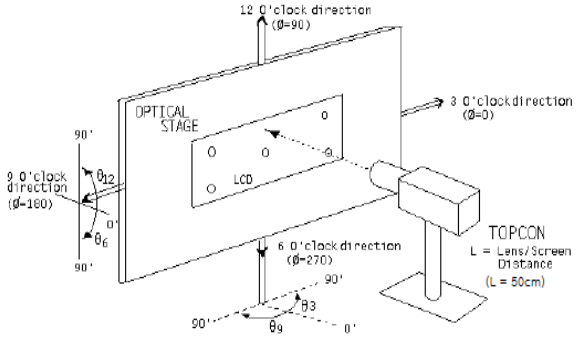
< Table11. Optical Table >

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
luminance	Bp	θ=0°	400	500	--	cd/m2	Note 1
Brightness Uniformity	▵Bp		70	80	--	%	Note 2
Viewing Angle	θL	Cr≥10	80	85	--	deg	Note 3
	θ_R		80	85	--		
	ψ_T		80	85	--		
	ψ_B		80	85	--		
Contrast Ratio	Cr	θ=0° FF=0°	1000	1200	--	-	Note 4
Response Time	Tr+Tf		-	30	35	ms	Note 5
Color Coordinate of CIE1931	Rx	θ=0°	0.618	0.648	0.678	-	Note 6
	Ry		0.300	0.330	0.360		
	Gx		0.267	0.297	0.327		
	Gy		0.600	0.630	0.660		
	Bx		0.121	0.151	0.181		
	By		0.025	0.055	0.085		
	Wx		0.283	0.313	0.343		
	Wy		0.299	0.329	0.359		
NTSC Ratio	NTSC	CIE1931	68	72	--	%	Note 7
Polarization Direction of Front Polarizer	PdF		--	0°	--	deg	Note 8
Polarization Direction of Rear Polarizer	PdR		--	90°	--	Deg	

Note1:Luminance measurement

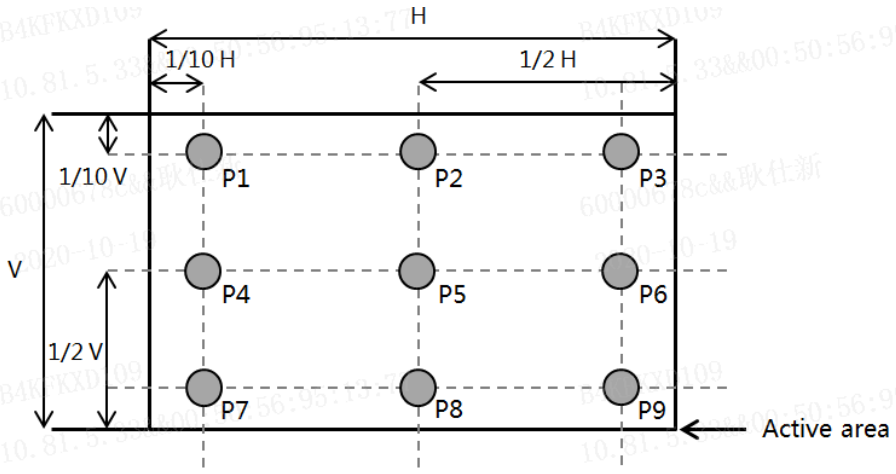
The test condition is at ILED=160mA and measured on the surface of LCD module at 25℃.

- The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the center of the LCD. Measurement equipment CS2000 or similar equipments (Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel must be after more than 5 minutes while backlight turning on.

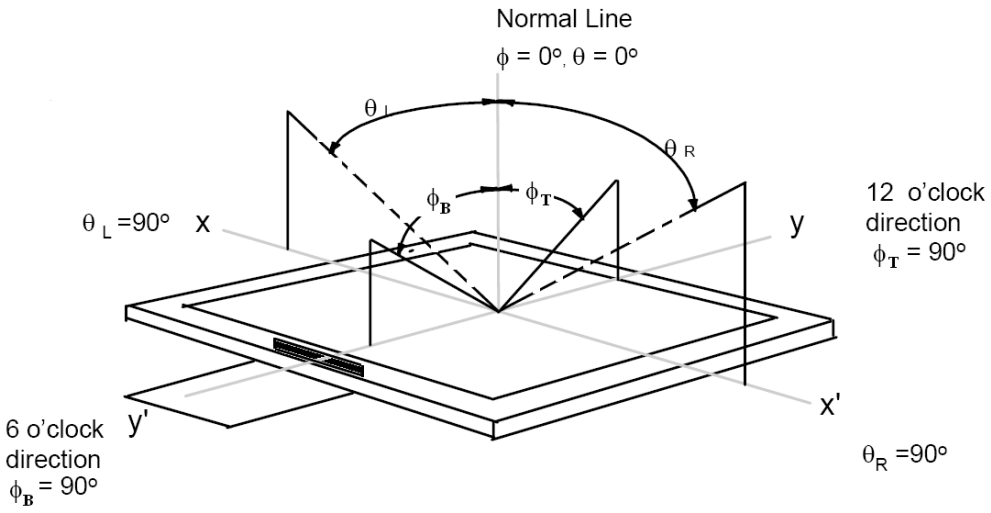


Note2:Uniformity

- The test condition is at ILED=160mA and measured on the surface of LCD module at 25℃.
- Measurement equipment:CS2000 or similar equipments
- The luminance uniformity is calculated by using following formula:
- ▵Bp = Bp (Min.) / Bp (Max.)×100 (%)
- Bp (Max.) = Maximum brightness in 9 measured spots
- Bp (Min.) = Minimum brightness in 9 measured spots.



Note 3:**The definition of Viewing Angle**
Refer to the graph below marked by θ and Φ.

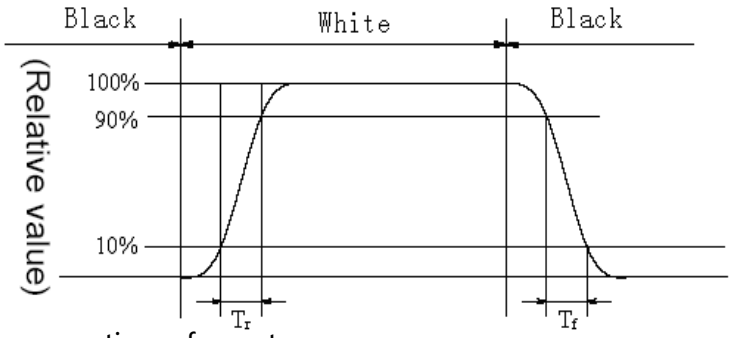


Note4:**ThedefinitionofContrastRatio** (Test LCM using CS2000 or similar equipments):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note5:**DefinitionofResponse time.**(Test LCD using DMS501 or similar equipments):
The output sign also photo detector are measured when the input sign also are changed from "black" to "white" (Voltage falling time)and from "white" to "black" (Voltage rising time), respectively . The response time is defined as the time interval between the 10% and 90% of amplitudes . Refer to figures below.



	L0	L1	L2	L3	L4	L5	L6	L7
L0	■							
L1		■						
L2			■					
L3				■				
L4					■			
L5						■		
L6							■	
L7								■

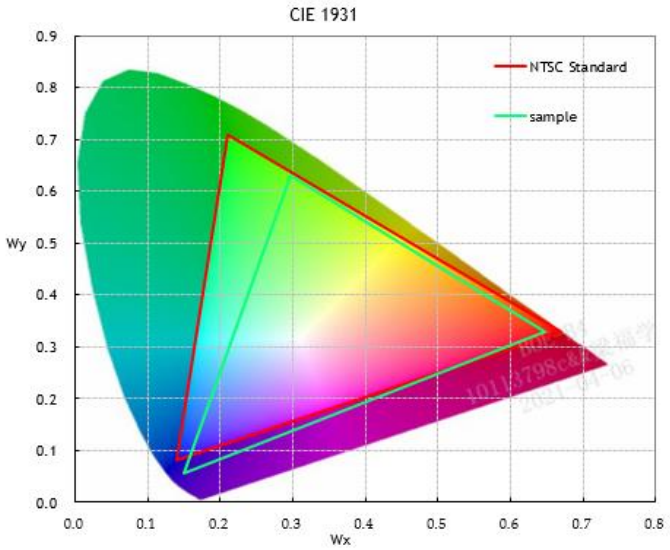
Response time of gray to gray:
Measurement equipment: DMS501 or similar equipments.
Test method: we define 8 grays L0-L7,the grays of L0-L7 were defined as:0,36,73, 109, 146, 182, 219, 255. Theoutputsignalsofphotodetectoraremeasuredwhentheinputsignalsarechanged from "Lx" to "Ly", x, y= [0, 7]. The response time is defined as the time interval between the 10% and 90% of amplitudes. The result of the test can be noted as below:

Note 6: Color Coordinates of CIE 1931

The test condition is at ILED=160mA and measured on the surface of LCD module at 25℃.
Measurement equipment:CS2000 or similar equipments
The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

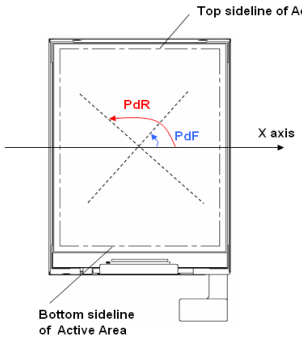
Note 7: Definition of Color of CIE Coordinate and NTSC Ratio.

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$



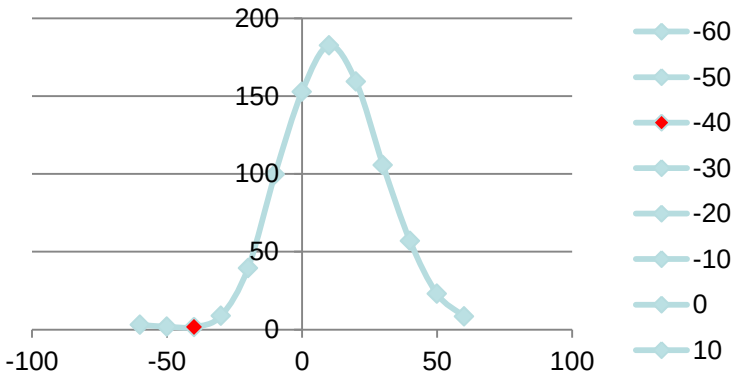
Note 8: Polarization Direction Definition

- Viewing direction is normal user viewing direction which is vertical to the display surface
- The polarizer which is closer to viewer is defined as Front Polarizer
- The polarizer which is on the rear side of viewer is defined as Rear Polarizer
- The X axis is defined as parallel line to top & bottom sidelines of the Active Area
- PdF which is marked in blue arrow is polarization degree of Front polarizer
- PdB which is marked in red arrow is polarization degree of Back polarizer
- The polarization degree parameter must be indicated in range of 0deg to 180deg according to above definition



Note 9: **Definition of gray inversion angle**

- Refer to the graph of note 9.
- Using luminance test method.
- Test pattern : 128 gray
- If the viewing direction is 12 o' clock ,then test the luminance while θ=-60°,θ=-50°, θ=-40°, θ=-30°, θ=-20°, θ=-10°, θ=0°, θ=10°, θ=20°, θ=30°, θ=40°, θ=-50°, θ=60°. The luminance test as figure below:



5.0 RELIABILITY TEST

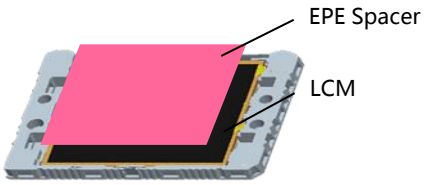
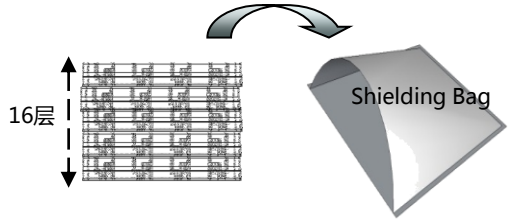
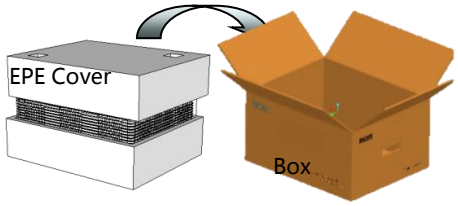
The Reliability test items and its conditions are shown in below.

<Table 12. Reliability Test Parameters >

No	Test Items	Conditions
1	HAST	110℃、85%RH、0.122Mpa，8hr
2	High temperature & high humidity (storage test)	60℃，90%RH，240hr
3	High temperature storage test	80℃，240hr
4	Low temperature storage test	-30℃，240hr
5	High temperature & high humidity (operation test)	60℃，90%RH，240hr
6	Low temperature operation test	-20℃，240hr
7	High temperature operation test	70℃，240hr
8	Thermal Shock Test	-40℃~85℃，1hr/cycle，100cycle
9	PCT	121℃，100%RH，2atm，12hr
10	ESD	150pF，330Ω，±8kV(Contact)，±15kV（Air） Class B：允许可以自动恢复的偶发性息屏或功能异常
11	Packing VIB	1.47G，1-200hz，X，Y，±Z，30min/Axis

6.0 PACKING INFORMATION(产品形态： LCM)

Packing procedure:

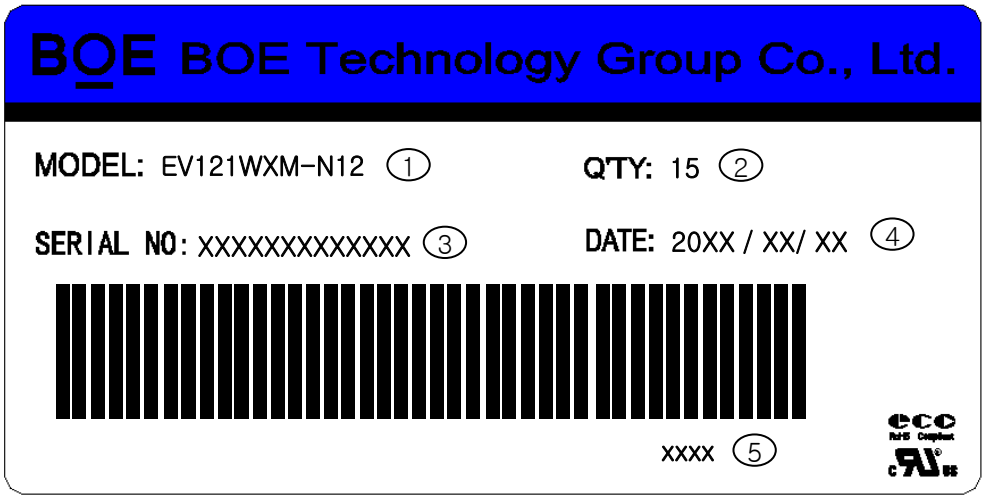
将1pcs LCM放入Tray中（Panel朝上），然后在LCM上放置1pcs EPE Spacer 容量：1pcs EPE Spacer/Tray 1pcs LCM/Tray	堆叠放置15pcs Tray（不旋转堆叠），顶部再放置1pcs 空Tray，然后将16pcs Tray 平放入Shielding Bag并抽真空（注意真空不要过紧，避免Tray变形挤压产品）
 **Step 1**	 **Step 2**
在Inner Box放置1pcs EPE Cover，将堆叠好的16pcs Tray平放入Box，再放置1pcs EPE Cover，对Box进行封箱，并粘贴Box标签 容量：15pcs LCM/Box	每个Pallet上放3层Box，1层8箱，共计24箱，Pallet外进行打包带、缠膜包装 容量：24pcs Box/Pallet 360pcs LCM/Pallet
 **Step 3**	 **Step 4**

6.1 Packing Note(产品形态：LCM)

- Box Dimension: 375mm(W) x 280mm(D) x 290mm(H)
- Package Quantity in one Box: 15pcs

6.2 Box label (产品形态：LCM)

- Label Size :115mm*55mm
- Contents
  Model : First 12 digits of FG-Code: EV121WXM-N12
  Q`ty : 15pcs/Box
  Serial No. : Box Serial No. as shown below.
  Date : Packing Date
  FG Code : Last 4 digits of FG-Code



No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	X	X	S	3	2	0	9	0	0	0	0	0	1
Description	GBN		Grade	B3	Year		Month	Rev	Serial number				

7.0 Product Label

Label Size: 48mmx12mmx0.075mm, 44-9231007

1. FG-CODE: EV121WXM-N12
2. MDL ID
3. MDL ID对应条形码

BOE MDL ID rule

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	X	X	X	3	X	X	X	3	G	P	0	X	X	X	X	X	X
描述	GBN代码		等级	B3	年	月	日	FG Code后四位				序列号					

8.0 Handling & Cautions

Please pay attention to the followings when you use this TFT LCD Module.

8.1 Mounting Precautions

- Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- You must mount a module using specified mounting holes (Details refer to the drawings).
- You should consider the mounting structure so that uneven force (ex. Twisted stress, Concentrated stress)is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- Do not apply mechanical stress or static pressure on module; Abnormal display cause by pressing some parts of module during assembly process , do not belong to product failure, the press should be agreed by two sides.
- Determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Do not apply mechanical stress or static pressure on module , and avoid impact, vibration and falling.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Protection film for polarizer on the module should be slowly peeled off before display.
- Be careful to prevent water & chemicals contact the module surface.
- You should adopt radiation structure to satisfy the temperature specification.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
  Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)

- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane & alcohol is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene , because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- This module has its circuitry PCB' s on the rear side and Driver IC, should be handled carefully in order not to be stressed.
- Avoid impose stress on PCB and Driver IC during assembly process ,Do not drawing, bending, COF package & wire.
- Do not disassemble the module.

8.2 Operating Precautions

- Do not connector or disconnect the cable to/from the Module at the "Power On" Condition.
- When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the module would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.
- Do not allow to adjust the adjustable resistance or switch.
- The electrochemical reaction caused by DC voltage will lead to LCD module degradation, so DC drive should be avoided.
- The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipment to protect against static electricity.
- Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.

- The cables should be as short as possible between System Board and PCB interface.
- Connectors are precision devices to transmit electrical signals, and operators should plug in parallel.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

8.3 Electrostatic Discharge Precautions

- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc.
- Do not close to static electricity to avoid product damage.
- Do not touch interface pin directly.

8.4 Precautions for Strong Light Exposure

- Do not leave the module operation or storage in Strong light . Strong light exposure causes degradation of polarizer and color filter.

8.5 Precautions for Storage

A. Atmosphere Requirement

ITEM	UNIT	MIN	MAX
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	40	75
Storage Life	6 months		
Storage Condition	• The storage room should be equipped with a dark and good ventilation facility. • Prevent products from being exposed to the direct sunlight, moisture and water. • The product need to keep away from organic solvent and corrosive gas. • Be careful for condensation at sudden temperature change. • Storage condition is guaranteed under packing conditions.		

B. Package Requirement

- The product should be placed in a sealed polythene bag.
- Product Should be placed on the pallet, Which is away from the floor, Be cautions not to pile the product up.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.
- As the original protective film, do not use the adhesive protective film to avoid change of Pol color and characteristic.

8.6 Precautions for protection film

- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- People who peeled off the protection film should wear anti-static strap and grounded well.

8.7 Appropriate Condition for Commercial Display

-Generally large-sized LCD modules are designed for consumer applications . Accordingly, long-term display like in Commercial Display application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - Temperature: 20±15℃
   - Operating Ambient Humidity : 55±20%
   - Display pattern: dynamic pattern (Real display)
   - Well-ventilated place is recommended to set up Commercial Display system
2. Special operating condition

   a. Ambient condition

   - Well-ventilated place is recommended to set up Commercial Display system.

   b. Power and screen save

   - Periodical power-off or screen save is needed after long-term display.

   c. As the low temperature, the response time is greatly delayed. As the high temperatures (higher than the operating temperature) the LCD module may turn black screen. The above phenomenon cannot explain the failure of the display. When the temperature returns to the normal operating temperature, the LCD module will return to normal display.

   d. When expose to drastic fluctuation of temperature (hot to cold or cold to hot） ,the LCD module may be affected; Specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD module ‘s surface which may affect the operation of the polarizer and LCD module .

   e. Do not exceed the absolute maximum rating value. (supply voltage variation, input v oltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.

   f. Product reliability and functions are only guaranteed when the product is used under right operation usages. If product will be used in extreme conditions such as high temperature, high humidity, high altitude, special display images, running time, long time operation, outdoor operation, etc. It is strongly recommended to contact BOE for filed application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market and controlling systems.

3. Operating usages to protect against image sticking due to long-term static display.
   a. Suitable operating time: under 20 hours a day.
   b. Static information display recommended to use with moving image.
   - Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
   c. Background and character (image) color change
   - Use different colors for background and character, respectively.
   - Change colors themselves periodically.
   d. Avoid combination of background and character with large different luminance.
   1) Abnormal condition just means conditions except normal condition.
   2) Black image or moving image is strongly recommended as a screen save
4. Lifetime in this spec. is guaranteed only when Commercial Display is used according to operating usages.

8.8 Other Precautions

A. LC Leak

- If the liquid crystal material leaks from the panel, it is recommended to wash the LC with acetone or ethanol and then burn it.
- If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- If LC in mouth, mouth need to be washed, drink plenty of water to induce vomiting and follow medical advice.
- If LC touch eyes, eyes need to be washed with running water at least 15 minutes.

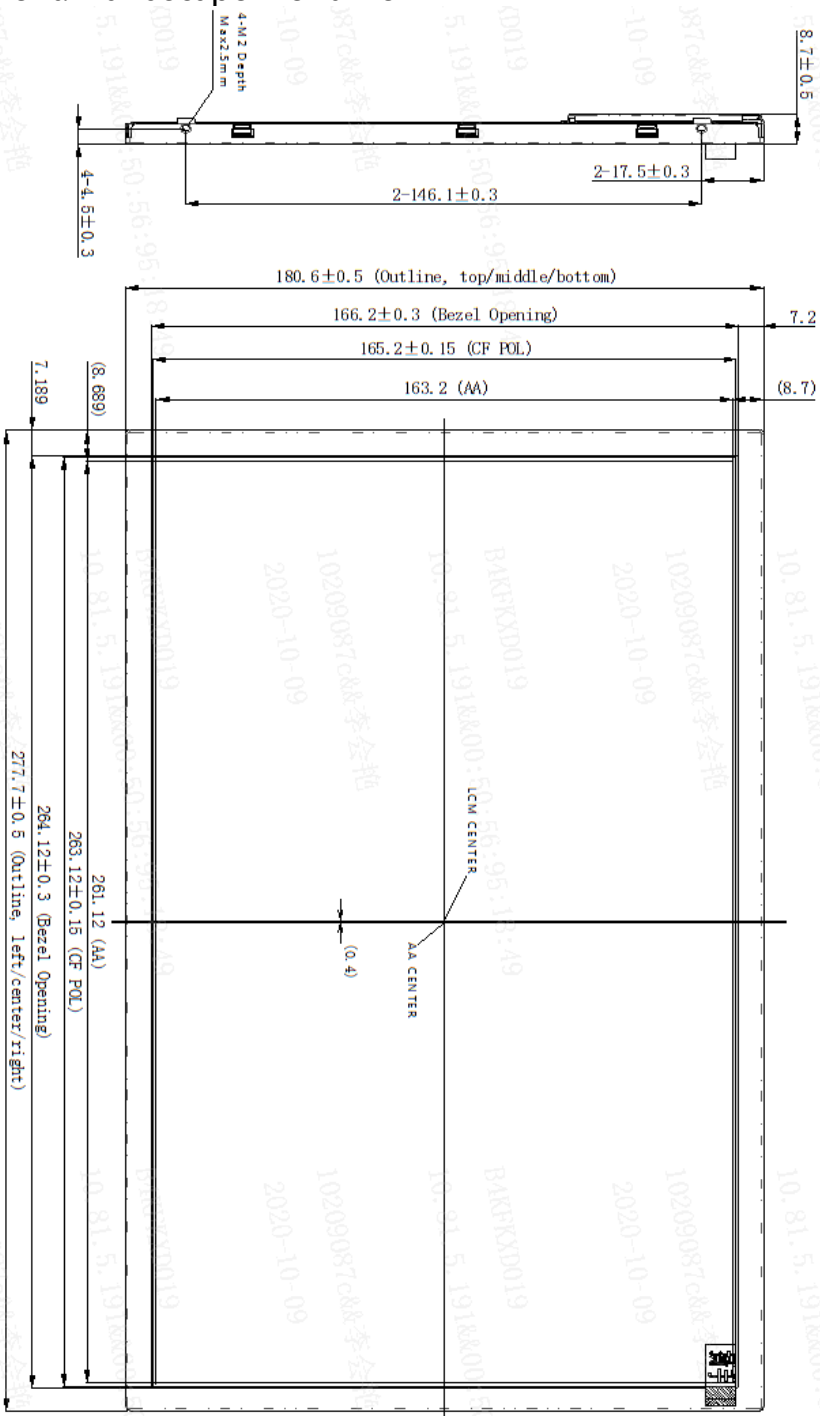
B. Rework

- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

9.0 APPENDIX

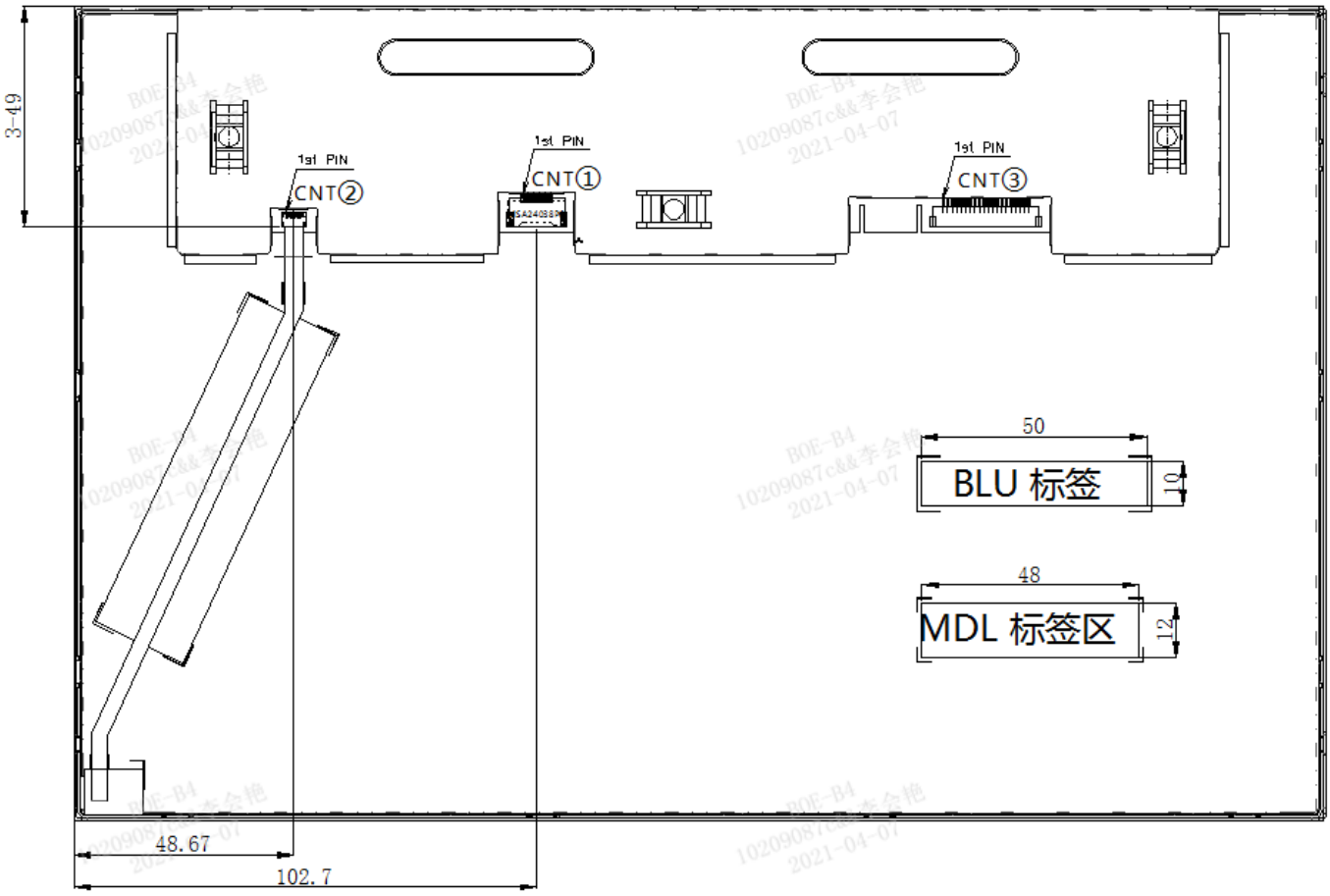
Mechanical Drawing

Drawing Attachment: Landscape Front View



Mechanical Drawing

Drawing Attachment: Landscape Back View



Notes:

CNT①: MSA24038P6

CNT②: PF040-B09B-C09

CNT③: DF19G-20P-1H (54)

Incoming Inspection Spec Approval Sheet

Product Description：_TFT-LCD module_

___ Product Name:_EV121WXM-N12_

Customer :_Rockwell_

Customer Signature	Date	BOE Signature	Date

Record of Revision

Version	Issue Date	Content	Page
2	2018.12.29	Rev.2	ALL

Content

A: Incoming Inspection Specification

1.0 Introduction

1.1. Scope

This incoming Inspection Standard is limited to the TFT-LCD LCD which supplied by BOE Technology Group Co.,Ltd. (hereinafter called the "Supplier") to its Customer.

1.2. Incoming inspection Right

The buyer (customer) shall inspect the LCD within twenty days from receiving as inspection period at its own cost. The results of the inspection, acceptance or rejection shall be notified to Supplier .

The buyer may, under commercially reasonable reject procedures, reject an entire lot within inspection period, define unacceptable LCD number in accordance with incoming inspection standard. Should the buyer fail to notify the result of the inspection to supplier within the inspection period, the buyer's right to reject the LCD shall lapse and whole lot shall be deemed to have been accepted by the buyer.

1.3. Operation Instruction

1.3.1 Mounting Method

- As the panel of LCD which consists of two thin glasses with polarizers was easily get Damaged, please handling LCD cautiously。
- Excessive stress or pressure on the glass of the LCD should be avoided. Please insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- Abnormal display may occur under press setting problem from customer, which does not mean the malfunction of the LCD and should be verified by both party.
- Optimum mounting angle was determined based on specified viewing angle range.
- Please assemble LCD module in accordance with the specification.
- Please mark condition of humiture.

1.3.2 Caution of LCD Handling and Cleaning

- Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration, and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
- The polarizers on the surface of panel are made from organic substances. Be very careful for chemicals that not to touch the polarizers or it may leads the polarizers to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent（recommended below） to clean the LCD's surface with wipe lightly.
  -IPA(Isopropyl Alcohol),Ethyl Alcohol, Trichlorotriflorothane
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizers

and others. Do not use the following solvent.
-Water, Ketone, Aromatics

- It is recommended that the LCD be handled with soft material during assembly, etc. The polarizers on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.
- Do not drop water or any chemicals onto the LCD's surface.
- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.
- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC, Soldering flux, Chlorine, Sulfur, saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.
  LCD should be stored in static-protective & vacuum polythene bag, please assemble it When it expose to the air within 3 days to avoid ITO corrosion
- Please clean the LCD without ultrasonic to avoid line open.
- Temperature of clean and bake should be less than 80℃.

1.3.3 Caution Against Static Charge

- The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, if possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

1.3.4 Caution For operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature(hot to cold or cold to hot），the LCD may be affected; specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at

temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.

- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.
- Static electricity (ESD) will damage the panel,. Please make sure that operators wear static-protective glove effectively and working tables &device are effectively grounded during operation and other ESD protective method
- Please place LCD on the tray provided by BOE while moving it, in order to avoid mechanical damage.
- LCD should be stored in required humidity. Low humidity may add static, while high humidity may corrode the ITO circuit of LCD product.
- Before use the LCD. Please check the Engineering specification.
- Please keep the LCD in the specified, original packing boxes when storage.
- LCD contain a small amount of Liquid Crystal and Mercury. Please follow local ordinances or regulations for disposal.
- DO NOT press the area covered with PET or such materials. These are weak point of LCD since of TCPs (Driver ICs) and PWBs.
- Please DO NOT touch the surface of glass (Polarizer).

2.0 Generals

2.1. Sampling Method

Unless otherwise agreed upon in writing ,the sampling inspection shall be applied to the customer's Incoming inspection.

2.1.1. Lot Size: 1 pallet per same model;

2.1.2. Sampling type: Random sampling;

2.1.3. Inspection level: II

2.1.4. Sampling table: MIL-STD-105E

Major Defect: AQL=0.65

Minor Defect: AQL=1.5

2.2. Inspection Environment

2.2.1.Inspection environment conditions:

a. Room temperature: 23±2 ℃;

b. Humidity: 60 ± 10% RH;

c. Inspection Ambient Illumination : 300~700 Lux (150~250 Lux for function test);

2.2.2. Viewing Distance

The distance between the panel and the inspector's eyes shall be at 30CM~50CM;

2.2.3. Viewing Angle

performing in front of the panel All directions for inspecting the sample should be:

ADS Production： within 45º to perpendicular line.;

TN Production： within 10º to perpendicular line.;

2.2.4. Inspection Area :

Display Area (Active Area)

2.3. Main Defect Definitions

2.3.1 Black / White Spots

Points on display which appear Black/ white at L0/L127/L255 .

2.3.2. Dark / Bright Lines

Lines on display which appear dark/bright at R/G/B. such as vertical, horizontal, or cross lines.

2.3.3. Bright Dot Defects

Dots(sub-pixels) on display which appear bright in the display area at R/G/B.

2.3.4. Dark Dot Defects

Dots(sub-pixels) on display which appear dark in the display area at R,G,B Color Pattern.

2.3.5. Mura

Mura on display which appears darker / brighter against background brightness on parts of display area at L0/L127/L255

2.3.6. Visual Inspection

Inspect PNL in operation

2.3.7. Appearance Inspection

External inspection for Panel in Non Operation

3.0 Inspection Criteria

3.1. Visual Inspection Criteria

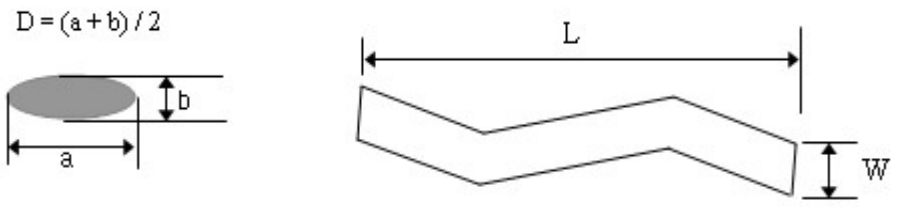
Dimensional unit: mm

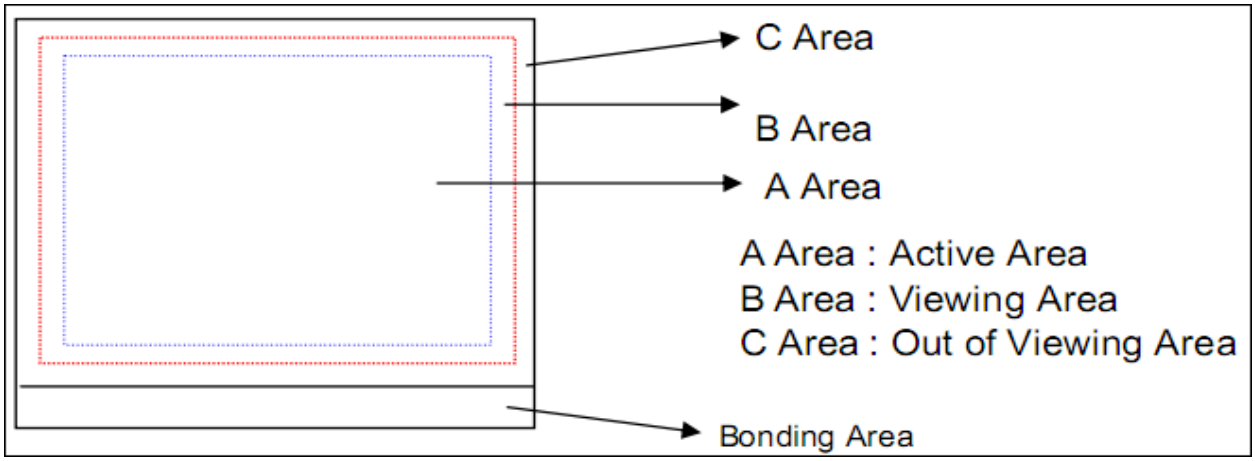
Items		Details	Inspection Criteria		Type
			A Area	B/C Area	
Visual (Function) Inspection	Foreign Material /Dent/ Bubble/ Spots//Extraneous Substances/Dot	Circular Type	0.15<D≤0.5,N≤4	Ignore	Minor
		Linear Type	0.05<W ≤0.10, L ≤3, N≤3		
	Pixel Defects	Bright Dot	N≤2	Ignore	Major
		Dark Dot	N≤3		
		Bright + Dark Dot	N≤5		
		2S(Bright or Dark)	N≤1		
	Line Defects	Bright Line, Dark Line	Not Allowed		
	No Display		Not Allowed		
	Abnormal Display		Not Allowed		
	Cross talk		≤2%		
	Mura		5%ND not visible, or reference limit samples		Minor

Remark: The determination of all defects is based on the panel with Polarizer.

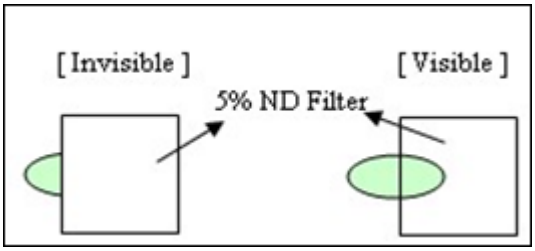
※ Note 1) D = Diameter, L = Length, W = Width, N = Number

※ Note 2) Definition of the Area A Area: Display area B/C Area: No display area



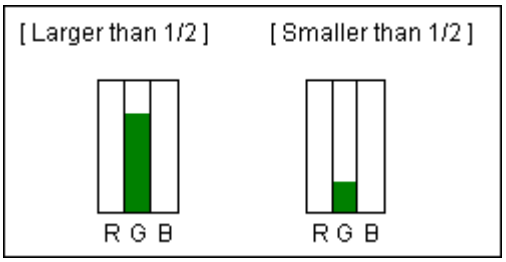


※Note 3) For pixel defect, dot means a sub-pixel. Dot defects should be larger than half size of a sub-pixel. Dot which is invisible through 5% ND filter or smaller than 1/2 of sub-pixel size will not counted as "1 dot" defect.



"No dot defect" (=ignored)

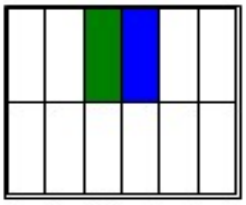
"1 dot defect" (=counted)



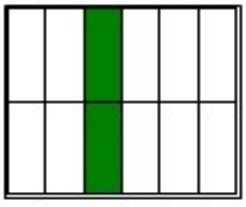
"1 dot defect" (=counted)

"No dot defect" (=ignored)

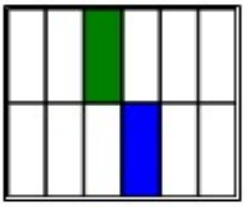
[2 adjacent dots defect]



Type 1

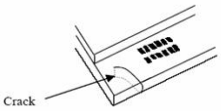
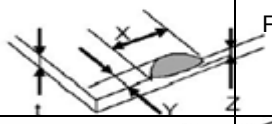
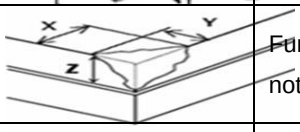
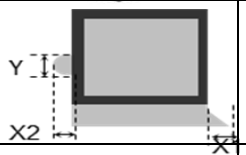
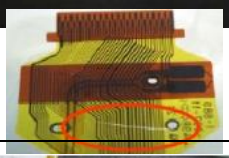
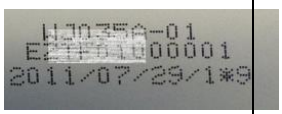


Type 2



Type 3

3.2. Appearance Inspection Criteria

location	Items	Criterion for Defects		Type	scope
All	Stain		Removable stain is OK Slightly indelible，OK	-	All
Be related to PNL	Crack		Not Allowed	Major	Shipment status：Single Cell/FOG /MDL Production
	Side Chipping		Function and assembly are not affected	Minor	
	Corner Chipping		Function and assembly are not affected	Minor	
	Burr		Function and assembly are not affected	Minor	
	Scratch		PNL with POL， based on point/line foreign (scratch) standard to determine,	Minor	
Be related to FPC/PCB	short circuit / open circuit		Not Allowed	Major	Shipment status：FOG/MDL Production
	components and parts		Component missing is not allowed	Minor	
Be related to Backlight	Code-spurting		Key information can be identified is OK	Minor	Shipment status：MDL Production
	Scratch		Function and assembly are not affected	Minor	
	Stain		Function and assembly are not affected	Minor	

Bezel	Inkjet defect	-	Steel seal/Ink marking clearly visible	
	Scratches / dents	-	Function and assembly are not affected,	
Screw	Missing/damaged/sliding wire		not allowed	
Connecter	PIN missing/damaged/ deformation	-	not allowed	
POL	Deviation	-	No access to AA area No access to glass edge	
	Dirty	-	Erasable ok	
	POL Bubble Line	-	Distance from AA area ≥0.65mm	
	Scratch/Dent	-	Followed Circular/Linear spec	

B : BOE Customer Quality Service Process

In order to provide better service to Customer, BOE shall apply the after-sales product quality service process as below:

1.0. According to the P/O from Customer, BOE should deliver required product to the place appointed by Customer.

2.0. Customer will do IQC for the incoming product.

3.0. Inspection standard should be provided by BOE, and it will be valid after confirmed by Customer. Inspection and Defects determination should be carried out according to the standard agreed by both Parties.

4.0. In order to guarantee in-time communication of product quality information and effective service, QA staff on Customer side should send Weekly Quality Report to the appointed CS staff in BOE.

5.0.. BOE should cooperate with Customer for special quality requirement.

6.0. After confirmed by both side, BOE should be responsible for the defect products which caused by its quality problem.

7.0.. Customer should use the LCD product according to the instruction. BOE will not be responsible for the defect product caused by violation of Users' Instruction.

8.0. Both parties should deal with the quality problem with friendly cooperative policy. And both parties should negotiate to deal with the defect products of which the responsibility is not very clear.

9.0. The warranty of the product is 12 months after the delivery date.

The warranty will be avoided in cases of below:

a. When the warranty period is expired.

b. When the LCMs were repaired by 3rd party without Supplier's approval.

c. When the LCMs were treated like disassemble and rework by the Customer and/or customer's representatives without Supplier's approval.