BOE

To :	BOE	REQ. Date	2022-1-24
		REF. No.	

APPROVAL

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DATE	

No	PART NO.	DESCRIPTION	SPECIFICATION
	ET121S0M-N14	12.1 Inch MDL	B3 ET121S0M-N14 Product Specification Rev.P0 VISUAL INSPECTION CRITERIA FOR ALL CUSTOMERS (12.1" A Grade)

PLEASE KINDLY FIND AND APPROVE THE SPECIFICATIONS INSERTED HEREIN AND RETURN ONE COPY HERE OF WITH YOUR SIGNATURE OF APPROVAL.

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HEFEI BOE OPTOELECTRONICS TECHNOLOGY CO.,LTD

B3 ET121S0M-N14 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	ET121S0M-N14-DHP0/ET121S0M-N14-3HP0

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

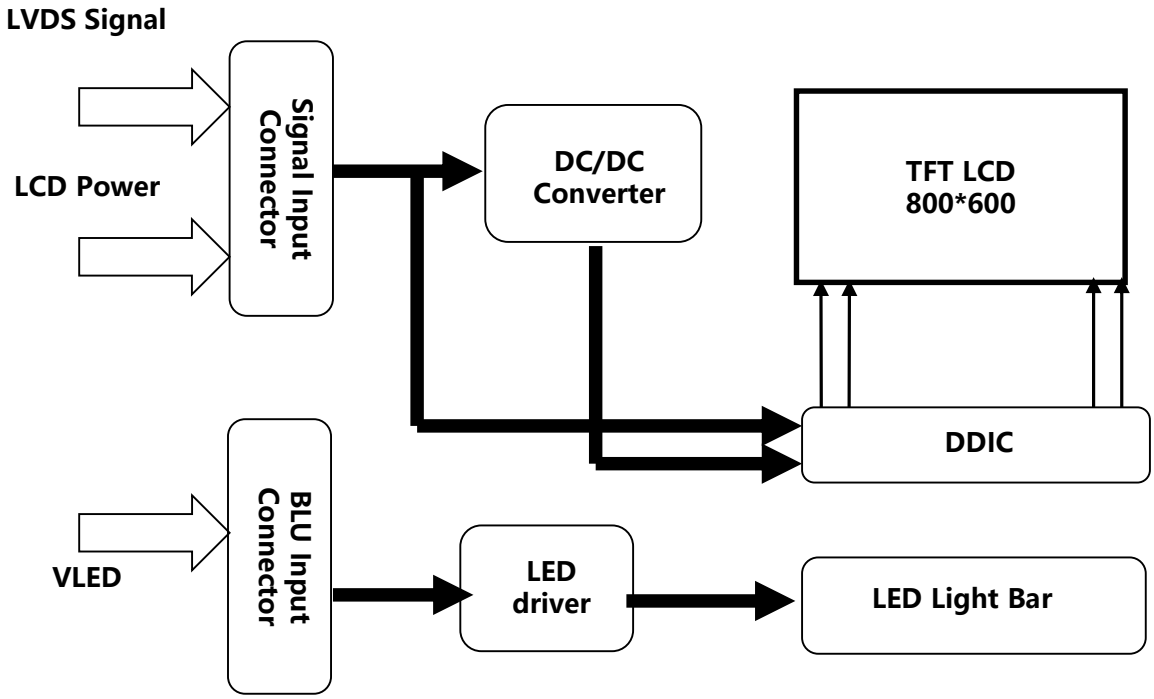
REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2021-12-07	ALL
P1		P19 update CIE	2021-1-20	Liang fuxue

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

ET121S0M-N14 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 12.1 inch diagonally measured active area with SVGA resolutions (800 horizontal by 600 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) ;
- Module Design
- 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

- Medical Monitor

1.4 General Specification

The followings are general specifications

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	246(H)*184.5(V)	mm	
Number Of Pixels	800(H)×600(V)	pixels	
Pixel Pitch	0.3075(H)×RGB×0.3075(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally White		
Display Colors	262K/16.7M	colors	
Display Mode	Transmissive mode		
Surface Treatment	AG25（CF），Clear（TFT）		
Contrast Ratio	800:1(typ.)		
Viewing Angle(CR>10)	80/80/65/75(typ.)	deg.	
Response Time	30(typ.)	ms	
Color Gamut	55%		
Brightness	320(min)/400(typ)	cd/m2	
Brightness Uniformity	9 point: min 75% 9 point: typ 80%		
Power Consumption	5.3 W(Max.)	watt	
Outline Dimension	279(H)*209(V)*9.0(typ)	mm	
Weight	630（MAX)	gram	

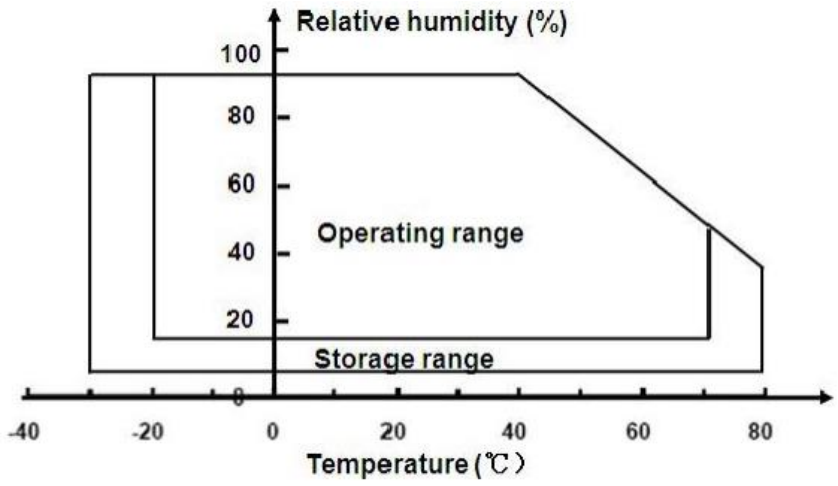
2.0 ABSOLUTE MAXIMUM RATINGS

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 3. Absolute Maximum Ratings>

Parameter		Symbol	Min.	Max.	Unit	Remarks
Power Supply	LCD Module	VCC	VSS-0.3	3.9	V	Ta = 25 ℃
	BLU	VLED	VSS-0.3	24	V	
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

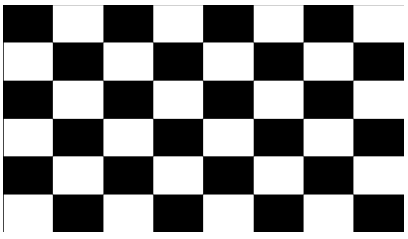
3.1 TFT LCD Module

< Table 4. LCD Module Electrical specifications > [Ta =25±2 ℃]

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
Power Supply Voltage	VDD	3.0	3.3	3.6	V	
Power Supply Current	IDD	90.63	122.4	153.4	mA	
Power Consumption	PLCD	0.299	0.403	0.506	W	TBD

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 = 33MHz. Test Pattern of power supply current

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



b) Max : black

2. The duration of rush current is about 2ms and rising time of Power Input is 1ms(min)

3.2 Back-Light Unit

Table 4. LED Dirver Electrical Specifications > [Ta =25±2 ℃]

Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max.		
BLU Supply Voltage		VDD	11.5	12	12.5	V	
BLU Forward Current		I_{VDD}	352.4	367	383	mA	
Power Consumption		P_{LED}	-	4.4	4.8	W	Note 1
BLU BRTC Level		BLU ON	3.0	3.3	3.6	V	
		BLU OFF	0		0.5	V	
PWMIN	Level	High Level	1.9	-	-	V	
		Low Level	0	-	0.8	V	
	Frequency	F_{PWM}	200	-	20K	Hz	
	Duty Ratio	D_{PWM}	1	-	100	%	
LED Life Time		TLED	30000	-	-	Hrs	Note 2/3

Notes:

1. PLED = VDD ×I_{VDD} (Within LED converter transfer efficiency)
2. The life time of LED, 30,000Hrs, 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.
3. Only under the above operating conditions could the life time of LED be guaranteed.

3.4 INPUT TERMINAL PIN ASSIGNMENT

This LCD employs two interface connections, a 20 pin ZIF connector is used for the LCD module electronics interface and a 5 pin ZIF connector is used for the internal backlight system.

3.4.1 Pin assignment for LCD module

Connector : MSB240420HEA or equivalent

< Table7. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description	I/O
1	VCC	Power supply	P
2	VCC	Power supply	P
3	GND	Ground	-
4	SEL	VCC:8Bits; GND/NC:6Bits	I
5	RIN0-	LVDS signal input	I
6	RIN0+	LVDS signal input	I
7	GND	Ground	-
8	RIN1-	LVDS signal input	I
9	RIN1+	LVDS signal input	I
10	GND	Ground	-
11	RIN2-	LVDS signal input	I
12	RIN2+	LVDS signal input	I
13	GND	Ground	-
14	CLKIN-	LVDS clock input	I
15	CLKIN+	LVDS clock input	I
16	GND	Ground	-
17	RIN3-	LVDS signal input	I
18	RIN3+	LVDS signal input	I
19	NC	SDA,For BOE Use	-
20	NC	SCL, For BOE Use	-

3.4.2 Pin assignment for LED Bar

Connector : MSB24038P5 (STM) or equivalent

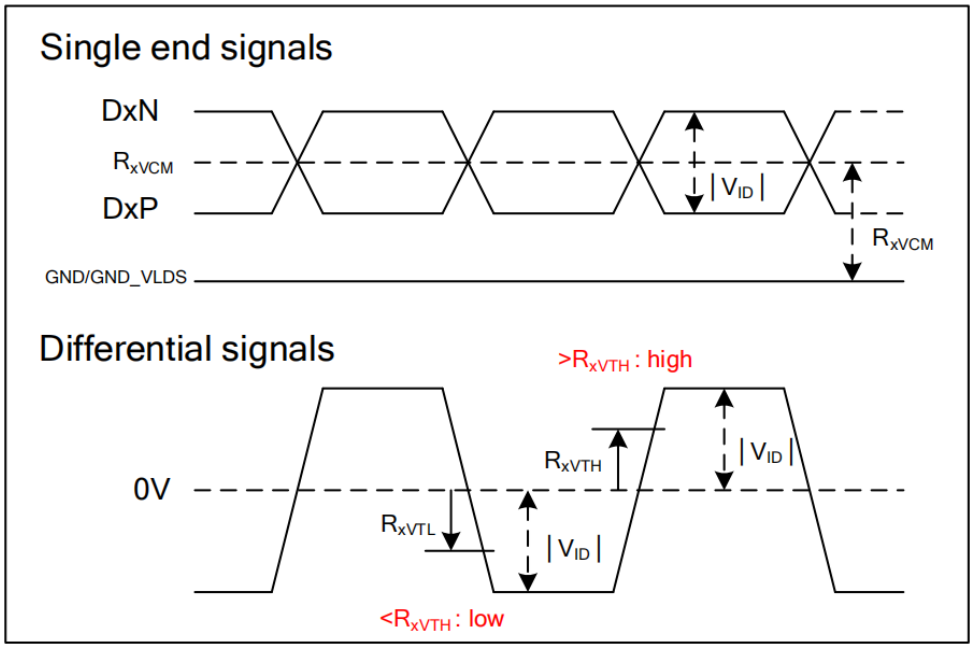
< Table8. Pin assignment for LED Bar >

Pin No	Symbol	Description	Remarks
1	NC	STBYB, For BOE Use	
2	PWM	Luminance control	
3	EN	3.3V-on / 0V-off	
4	GND	Ground	
5	VLED	Power supply	12V

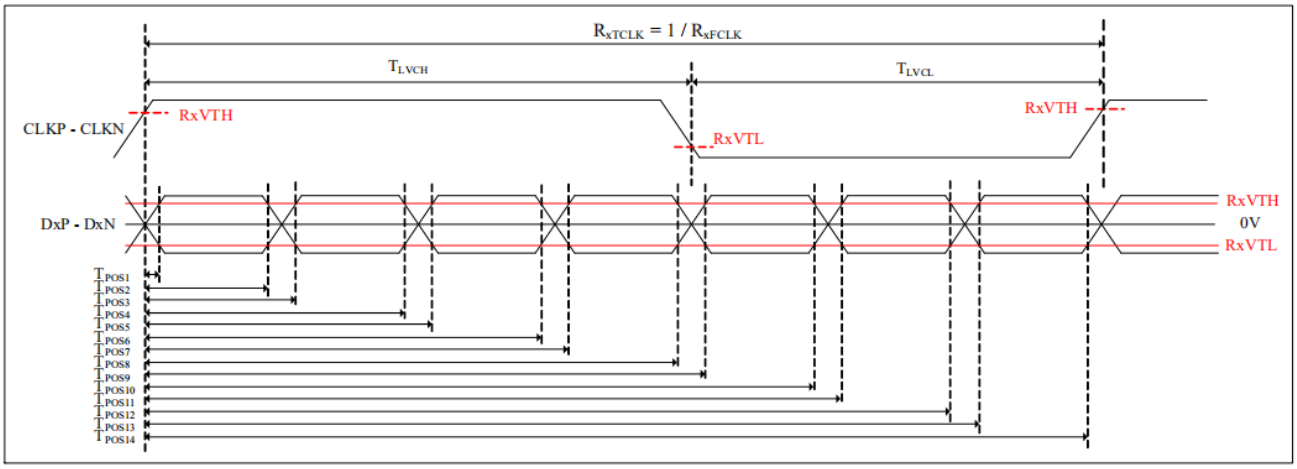
3.5.2 DC Specification

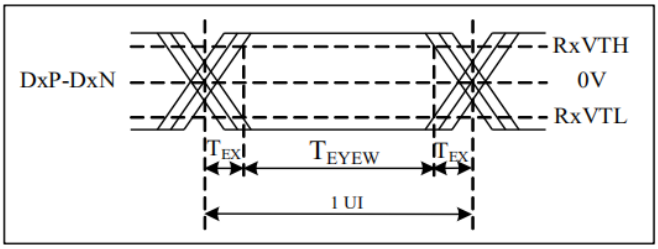
< Table11. DC Specification >

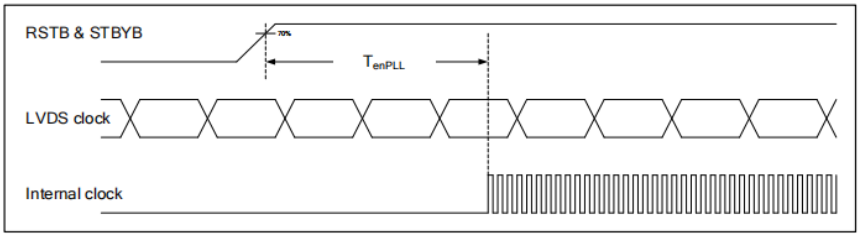
Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions
Differential input high threshold voltage	R_{xVTH}			0.1	V	RxVCM = 1.2V
Differential input low threshold voltage	R_{xVTL}	-0.1			V	
Input voltage range (singled-end)	R_{xVIN}	0		VDD-1.2	V	
Differential input common mode voltage	R_{xVCM}	0.8	1.2	1.4	V	
Differential input voltage	$\|V_{ID}\|$	0.2	0.4	0.6	V	
Differential input leakage current	RV_{xliz}	-10		10	uA	
Digital Operating Current	I_{VDD}		(TBD)		mA	FCLK=80 MHz , V15D_RX=1.5V, Data pattern=FF/H
Digital Stand-by Current	I_{STBD}		800		uA	RSTB=0 or STBYB=0, Clock & all functions are stopped.



3.5.3 AC Specification







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

< LVDS channel to channel skew>

3.5.3 AC Specification

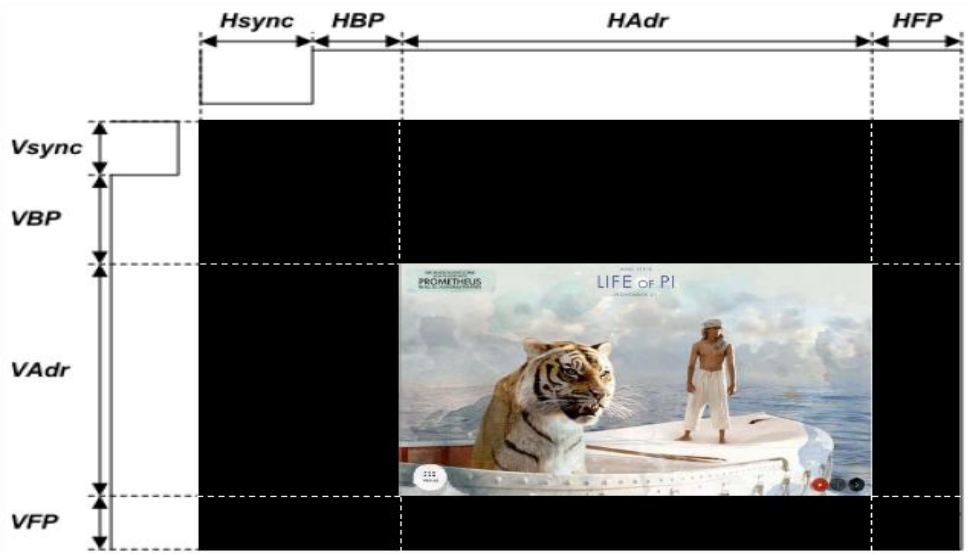
< Table12. AC Specification >

Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions
Clock Frequency	R_{xFCLK}	20		105 85	MHz	Max. 105MHz for single port LVDS with one SC5015 panel. Max. 85MHz for dual port LVDS, L&R two port LVDS, single port multi-drop LVDS panel.
Clock Period	R_{xTCLK}	9.5 11.8		50	ns	Min. 9.5ns for single port LVDS with one SC5015 panel. Min. 11.8ns for dual port LVDS, L&R two port LVDS, single port multi-drop LVDS panel.
1 data bit time	UI	-	1/7	-	R_{xTCLK}	
Clock high time	T_{LVCH}		4		UI	
Clock low time	T_{LVCL}		3		UI	
Position 1	T_{POS1}	-0.25	0	0.25	UI	
Position 2	T_{POS2}	0.75	-	1.25	UI	
Position 3	T_{POS3}	0.75	1	1.25	UI	
Position 4	T_{POS4}	1.75	-	2.25	UI	
Position 5	T_{POS5}	1.75	2	2.25	UI	
Position 6	T_{POS6}	2.75	-	3.25	UI	
Position 7	T_{POS7}	2.75	3	3.25	UI	
Position 8	T_{POS8}	3.75	-	4.25	UI	
Position 9	T_{POS9}	3.75	4	4.25	UI	
Position 10	T_{POS10}	4.75	-	5.25	UI	
Position 11	T_{POS11}	4.75	5	5.25	UI	
Position 12	T_{POS12}	5.75	-	6.25	UI	
Position 13	T_{POS13}	5.75	6	6.25	UI	
Position 14	T_{POS14}	6.75	-	7.25	UI	
Input eye width	T_{EYEW}	0.5	-	-	UI	
Input eye border	T_{EX}	-	-	0.25	UI	
PLL wake-up time	TenPLL			150	us	

3.6 Interface timing Parameter

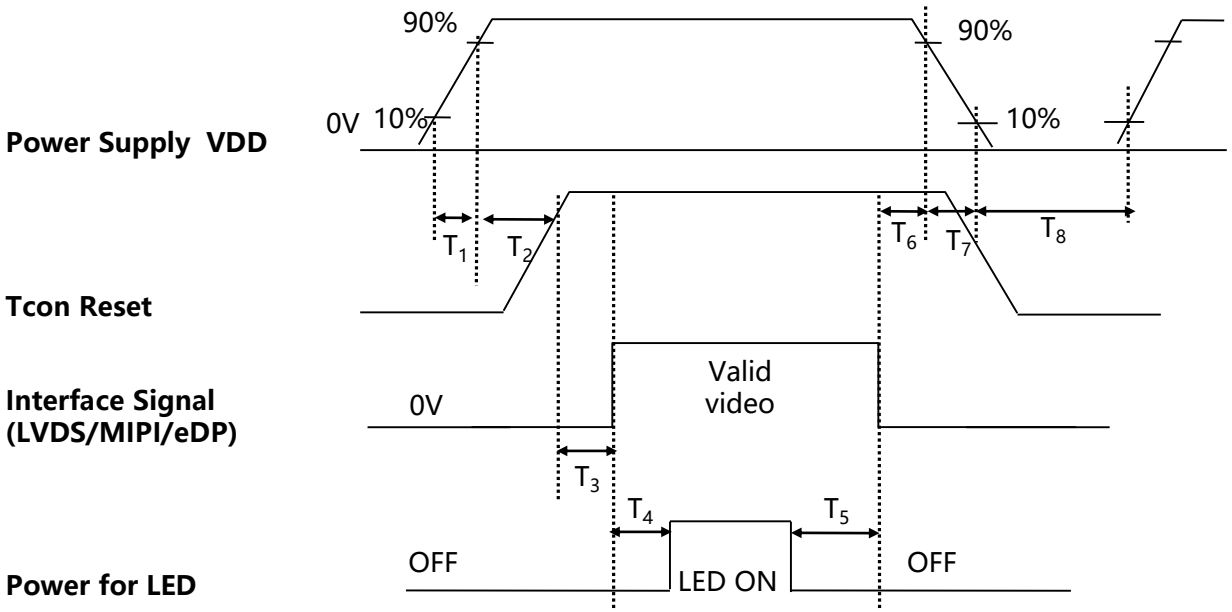
< Table13. Timing Parameter >

Item			Symbol	min	typ	max	UNIT
LCD	Frame Rate		-	50	60	65	Hz
	Pixels Rate		-	-	33.0	68.1	MHz
Timing	Horizontal	Horizontal total time	tHP	860	860	1300	t_{CLK}
		Horizontal Active time	tHadr	800			t_{CLK}
		Horizontal Back Porch	tHBP	30	30	255	t_{CLK}
		Horizontal Front Porch	tHFP	30	30	245	t_{CLK}
	Vertical	Vertical total time	tvp	620	640	806	t_H
		Vertical Active time	tVadr	600			t_H
		Vertical Back Porch	tVBP	10	20	100	t_H
		Vertical Front Porch	tVFP	10	20	106	t_H
Lane				-	1	-	Port



3.7 Power Sequence

[Ta =25±2 ℃]



< Table15. Sequence Table >

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.1	-	5	(ms)
T2	1	-	30	(ms)
T3	5	-	100	(ms)
T4	200	-	-	(ms)
T5	200	-	-	(ms)
T6	0	-	50	(ms)
T7	0	-	10	(ms)
T8	500	-	-	(ms)

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

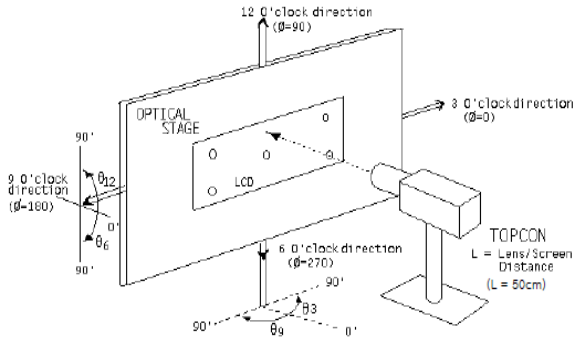
< Table16. Optical Table >

Item	Symbol	Condition	Min	Typ.	Max	Unit	Note
luminance	Bp	θ=0°	320	400	--	cd/m2	Note 1
Brightness Uniformity	△Bp		75	80	--	%	Note 2
Viewing Angle	θL	Cr≥10	70	80	--	deg	Note 3
	θ_R		70	80	--		
	ψ_T		55	65	--		
	ψ_B		65	75	--		
Contrast Ratio	Cr	θ=0° FF=0°	600	800		-	Note 4
Response Time	Tr+Tf		-	30	35	ms	Note 5
Color Coordinate of CIE1931	Rx	θ=0°	0.583	0.613	0.643	-	Note 6
	Ry		0.316	0.346	0.376		
	Gx		0.291	0.321	0.351		
	Gy		0.550	0.580	0.610		
	Bx		0.123	0.153	0.183		
	By		0.071	0.101	0.131		
	Wx		0.263	0.313	0.363		
	Wy		0.279	0.329	0.379		
NTSC Ratio	NTSC	CIE1931	50	55	--	%	Note 7
Polarization Direction of Front Polarizer	PdF			45°		deg	Note 8
Polarization Direction of Rear Polarizer	PdR			45°		Deg	
Gray inversion angle				6点钟			Note 9

Note1:Luminance measurement

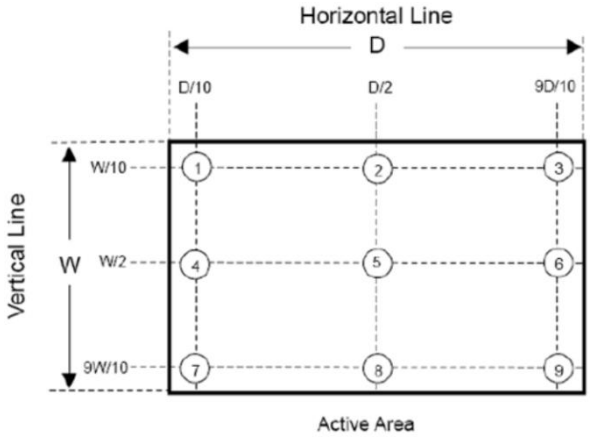
The test condition is at ILED=150mA and measured on the surface of LCD module at 25℃.

- 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.

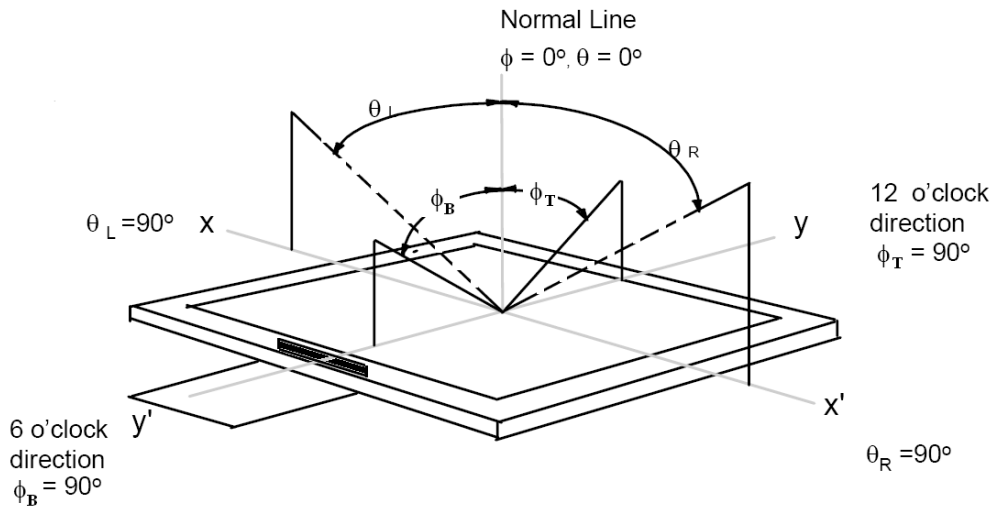


Note2:Uniformity

- The test condition is at ILED=150mA 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.

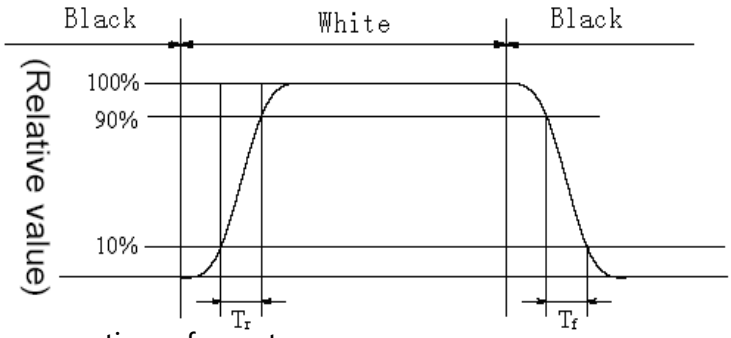


Note4:**ThedefinitionofContrastRatio** (Test LCM using CS2000 or similar equipments):

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

(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 fi gures below.



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

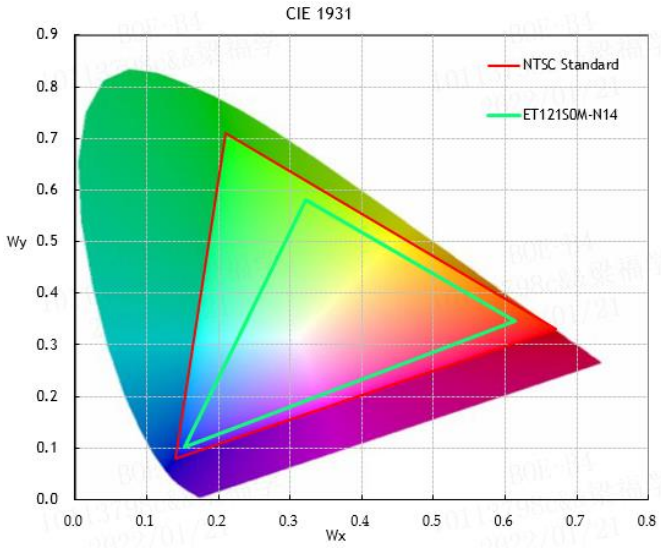
Response time of gray to gray:
Measurement equipment: DMS501 or similar equipments.
Test method: we define 8 grays L0-L7,the grays of L0-L7 were defined as:0,36,73, 109, 146, 182, 219, 25 5. Theoutputsignalsofphotodetectoraremeasuredwhentheinputsignalsarechanged from "Lx" to "Ly" , x, y= [0, 7]. The 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=150mA 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.

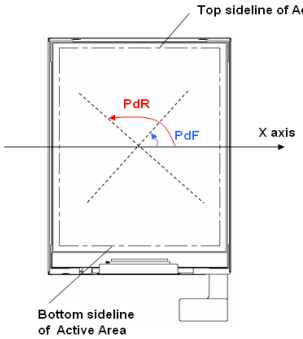
Note 7: Definition of Color of CIE Coordinate and NTSC Ratio.

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



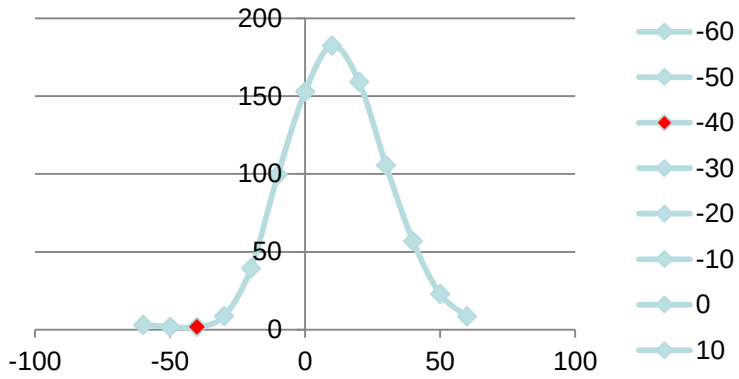
Note 8: Polarization Direction Definition

- 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 RELIABLITY TEST

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

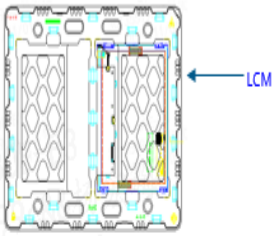
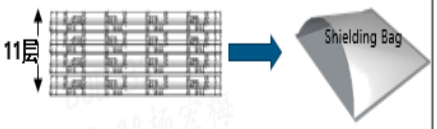
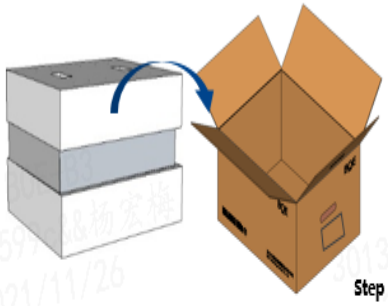
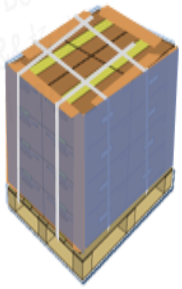
<Table 17. Reliability Test Parameters >

No	Test Items	Conditions
1	High temperature storage test	80℃，240hr
2	Low temperature storage test	-30℃，240hr
3	High temperature & high humidity (operation test)	60℃，90%RH，240hr
4	Low temperature operation test	-20℃，240hr
5	High temperature operation test	70℃，240hr
6	Thermal Shock Test	-40℃~85℃，1hr/cycle，100cycle
7	ALT	-10℃~65℃，0%~93%，24hr/cycle，10 cycle
8	PCT	121℃，100%RH，2atm，12hr
9	ESD	150pF，330Ω，±6kV(Contact)，±8kV (Air)
10	Packing VIB	1.47G，1-200hz，X，Y，±Z，30min/Axis

Remark : Vertical line appear when the temperature is below 10℃

6.0 PACKING INFORMATION(产品形态：LCM)

Packing procedure:

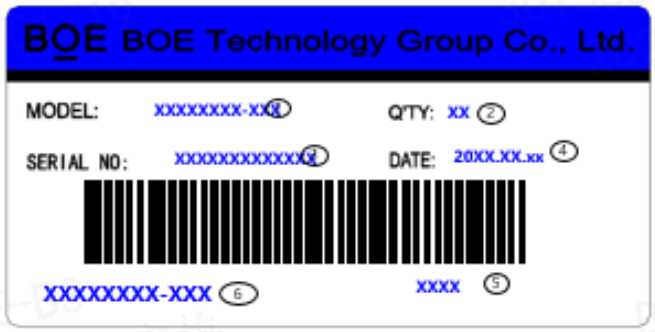
将2pcs LCM 平放入Tray，panel向上放置 产品上放置1pcs EPE PAD 2 LCM/2 EPE PAD/Tray	将盛装LCM的Tray叠码10层，然后在整摞上面放1个空Tray，然后放入屏蔽袋中抽真空； 20 LCM/20 EPE PAD/11 Tray;	将1包产品上下各扣一个EPE Cover，然后放入Inner Box; 20 LCM/2 EPE Cover/Inner Box;
 Step 1	 Step 2	 Step 3
采用“一”字形封箱方式，对Inner Box进行封箱，并在Box的Mark处粘贴相应标签； 20 LCM/Inner Box;	Box四层码拍，每层4箱（2*2放置），Box标签统一朝向外侧以便扫码，捆绑带“井”字型打包，pallet外进行缠绕膜包装； 320 LCM /16 Inner Box/Pallet;	厢车装载方式：一横一竖双层码放 厢车装载量_12m：12800pcs（40托）
 Step 4	 Step 5	 Step 6

6.1 Packing Note(产品形态：LCM)

- Box Dimension: 607mm(W) x 507mm(D) x 240mm(H)
- Package Quantity in one Box: 20pcs

6.2 Box label (产品形态：)

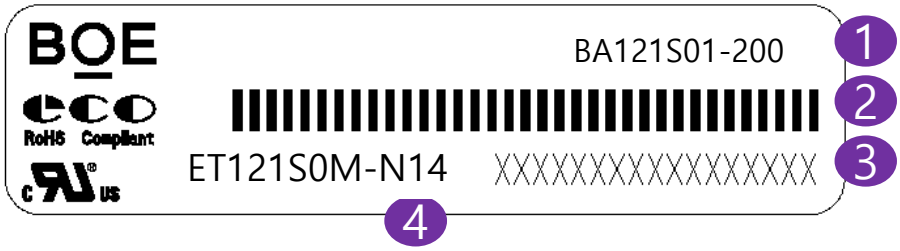
- Label Size :110mm*55mm
- Contents
  Model : LCM
  Q`ty : 20pcs/Box
  Serial No. : Box Serial No. as shown below.
  Date : Packing Date
  FG Code : FG Code of Product

<table>
<tr><th>Item</th><th>Box Label</th></tr>
<tr><td>Picture</td><td>


</td></tr>
<tr><td>代号
说明</td><td>序列号标注部分需打印, 说明如下:
1. FG-CODE(前12位) ： ET121S0M-N14
2. 产品数量: 20
3. Box ID
4. 包装日期
5. FG-Code后四位:3HP0
6. 客户料号: BA121S01-200

Total Size:110×55mm</td></tr>
<tr><td>编码
规则</td><td>
<table>
<tr><td>Digit</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td></tr>
<tr><td>Code</td><td>S</td><td>L</td><td>S</td><td>S</td><td>1</td><td>2</td><td>3</td><td>D</td><td>0</td><td>0</td><td>0</td><td>6</td><td>8</td></tr>
<tr><td>Description</td><td colspan="2">Products/GBN</td><td>Grade</td><td>Line</td><td colspan="2">Year</td><td>Month</td><td>Revision Code</td><td colspan="4">Serial Number</td></tr>
</table>
</td></tr>
</table>

7.0 Product Label



Label Size: 80mmx25mmx0.08mm,
1. Customer Code
2. MDL ID bar code
3. MDL ID
4. FG-CODE First 12 digits

BOE MDL ID rule

No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	X	X	S	3	8	3	2	D	8	5	0	0	0	0	0	2	1
	GBN		Grade	B3	Year	Month	Day	FG Code last four digits				Serial number					

8.0 Handling & Cautions

8.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizers which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

8.2 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 not to touch the polarizers or it 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 gloves 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.

8.3 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.

8.4 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.

8.5 Packaging

- Modules use LCD element, and must be treated as such.
  -Avoid intense shock and falls from a height.
  -To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

8.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCD’ s surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizers.
- Do not store the LCD near organic solvents or corrosive gasses.
- Keep the LCD safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
  -Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
  -Store in a dark place where neither exposure to direct sunlight nor light is.
  -Keep temperature in the specified storage temperature range.
  -Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

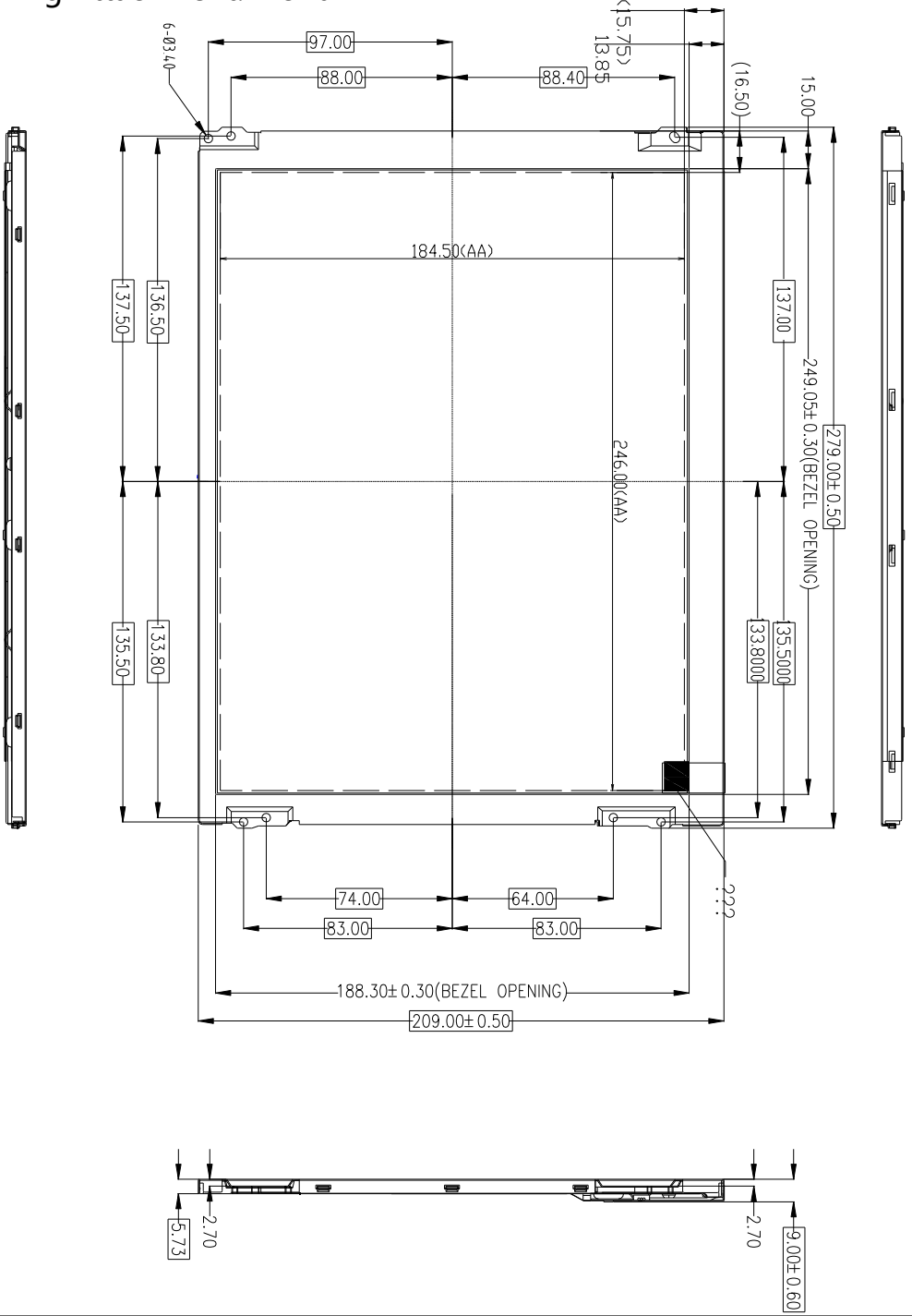
8.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.
- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.
- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.
- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

9.0 APPENDIX

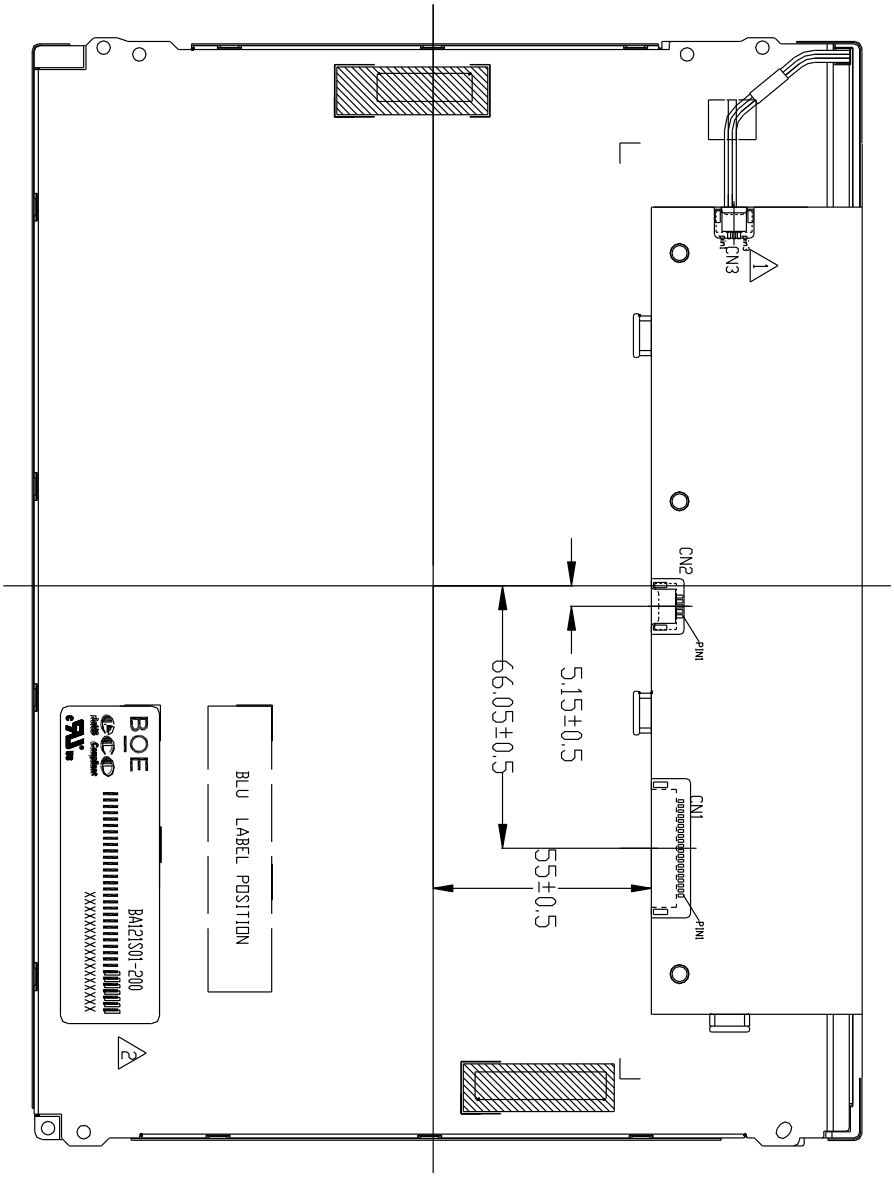
Mechanical Drawing

Drawing Attachment: Front



Mechanical Drawing

Drawing Attachment: Back



1.Connector 1: MSB240420HEA

2.Connector 2: MSB24038P5

3.OPERATING TEMP: -20°C TO 70°C

4.STORAGE TEMP: -30°C TO 80°C

Incoming Inspection Spec Approval Sheet

Product Description： TFT-LCD MDL			
Product Name:			
Customer :			
Customer Signature	**Date**	**BOE Signature**	**Date**

Record of Revision

Version	Issue Date	Content	Page
0	2020.11.16	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: 25±5 ℃ ;

b. Humidity: 65 ± 5% 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

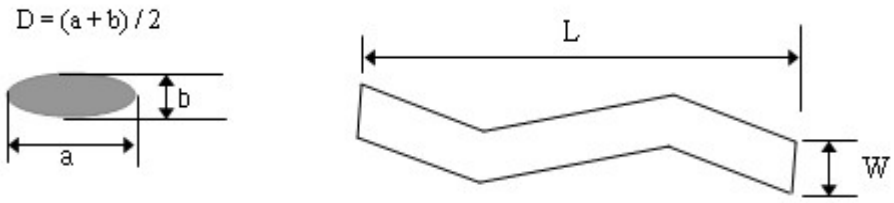
Dimensional unit: mm

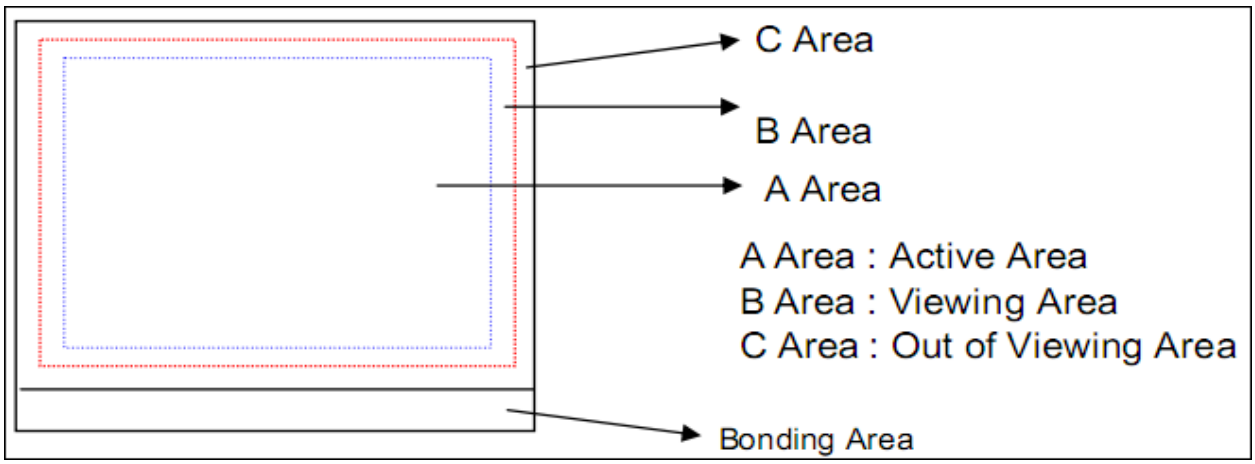
Items		Details	Inspection Criteria			Type
			A Area	B/C Area	DS	
Visual (Function) Inspection	Foreign Material /Dent/ Bubble/ Spots//Extraneous Substances/Dot	Circular Type	0.1＜D≤0.3,N≤4	Ignore	⩾ 15mm	Minor
		Linear Type	W≤0.05 & L≤2 N≤4			
	Pixel Defects	Bright Dot	N≤2	Ignore		Minor
		Dark Dot	N≤3			
		Bright + Dark Dot	N≤3			
		2S	0		-	
	Line Defects	Bright Line, Dark Line	Not Allowed		-	Major
	No Display		Not Allowed		-	
	Abnormal Display		Not Allowed		-	
	L0 Light leakage &Mura		5%ND not visible, or reference limit samples		-	Minor
	Zara		10mm X 10mm area ≤15		-	
	Cross talk		2%		-	

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

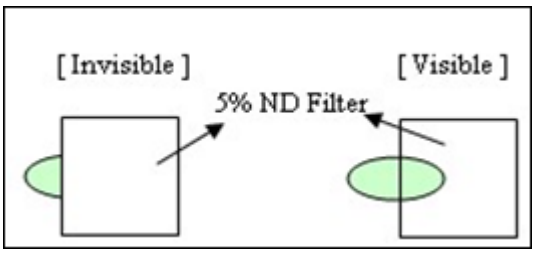
※ Note 1) D = Diameter, L = Length, W = Width, N = Number

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



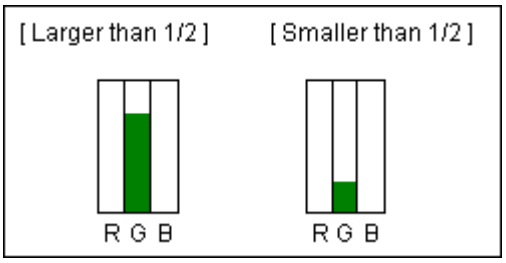


※Note 3) For pixel defect, dot means a sub-pixel. Dot defects should be larger than half size of a sub-pixel. Dot which is invisible through 5% ND filter or smaller than 1/2 of sub-pixel size will not counted as "1 dot" defect.



"No dot defect"
(=ignored)

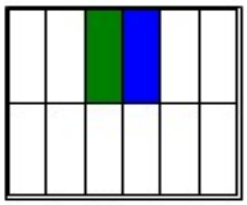
"1 dot defect"
(=counted)



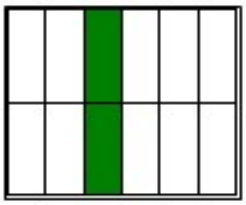
"1 dot defect"
(=counted)

"No dot defect"
(=ignored)

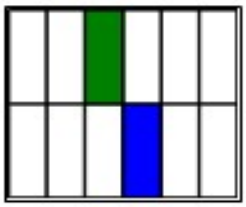
[2 adjacent dots defect]



Type 1

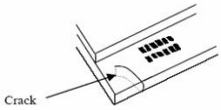
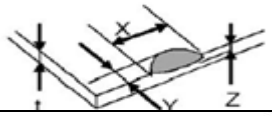
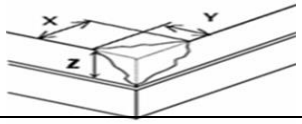
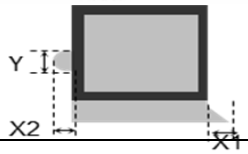
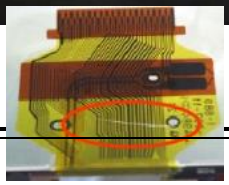


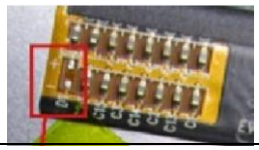
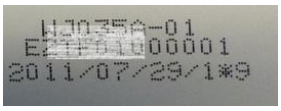
Type 2



Type 3

3.2. Appearance Inspection Criteria

location	Items	Criterion for Defects		Type	scope
All	Stain		Slightly not Wipeable ignored	-	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

	components and parts		Component missing is not allowed	Minor	Production
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		Slightly not Wipeable ignored	Minor	
Bezel	Inkjet defect	-	Steel seal/Ink marking clearly visible	Minor	
	Scratches / dents	-	Function and assembly are not affected,		
Screw	Missing/damaged/sliding wire		not allowed		
Tape	Missing, damaged	-	damaged :2*2mm, not affected lighting,ignored Missing ,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.