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Project Size.	2.1 inch		
Model No.	P021B002-IPS		
Samples No.			
Product type.	480xRGBx480 RGB mode		
Signature by customer:			
Prepared	Checked	Approved	

Shenzhen Polcd Technology Co.,Limited

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1.0 GENERAL DESCRIPTION

Item	Specification	Unit
Screen Size	2.1 inch	Diagonal
Number of Pixel	480RGB(H)x480(V)	Pixels
Display area	53.28(H)x53.28(V)	mm
Pixel pitch	111(H)x111(V)	um
Outline Dimension	56.18x59.71x2.20	mm
Pixel arrangement	RGB Vertical Stripe	— —
Display mode	Normally Black	— —
Viewing Direction(eye)	ALL	— —
Gray inversion direction	--	
Display Color	262K	— —
Luminance(cd/m²)	300	nit
Contrast Ratio	1000:1	— —
Surface treatment	— —	— —
Interface	3Line_SPI_18Bit_RGB	
Back-light	LED Side-light type	— —
Drive IC	ST7701S	
Operation Temperature	-20~70	℃
Storage Temperature	-30~80	℃
Weight	— —	g

1.1 Features

- n 3Line_SPI_18Bit_RGB interface.

1.2 Applications

- n MPOS Device.
- n Personal Navigation Device.
- n Other devices which require high quality displays.

FPC connector is used for electronics interface

[illegible]

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3.0 OPTICAL CHARACTERISTICS

3.1 Optical specification

Item		Symbol	Condition	Min	Type	Max	Unit	Note
White luminance (Center)		Lv	Θ=0 Normal Viewing Angle I _{BL} =20mA	--	300	--	cd/m ²	(4)(5)(7)
Response time		Tr+Tf		--	30	35	ms	(1)(3)
Contrast ratio		CR		800	1000	--	--	(1)(2)
Color Chromaticity (CIE1931)	white	Wx		0.285	0.300	0.315		(1)(4)
		Wy		0.311	0.326	0.341		
Viewing Angle	Hor	ΘL	CR≥10	80	85	--		(1) (4) Measuring with Polarizer, Reference Only
		ΘR		80	85	--		
	Ver	ΘU		80	85	--		
		ΘD		80	85	--		
Brightness uniformity		Avg	Θ=0	80	90	--	%	(5)
Color Gamut		NTSC	Θ=0	64	69	--	%	C-light
Optima View Direction		ALL						(5)

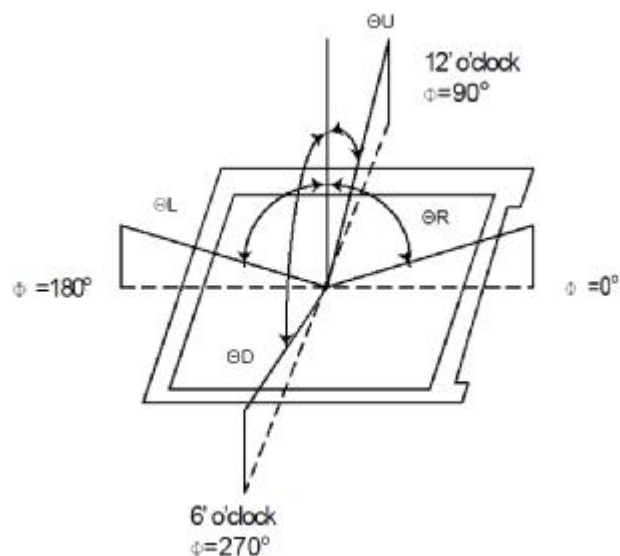
3.2 Measuring Condition

- n Measuring surrounding: dark room
- n LED current IL:20mA
- n Ambient temperature: $25\pm 2^{\circ}C$
- n 15min. warm-up time

3.3 Measuring Equipment

- n FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-7 for other optical characteristics.
- n Measuring spot size: 20 ~ 21 mm

Note (1) Definition of Viewing Angle

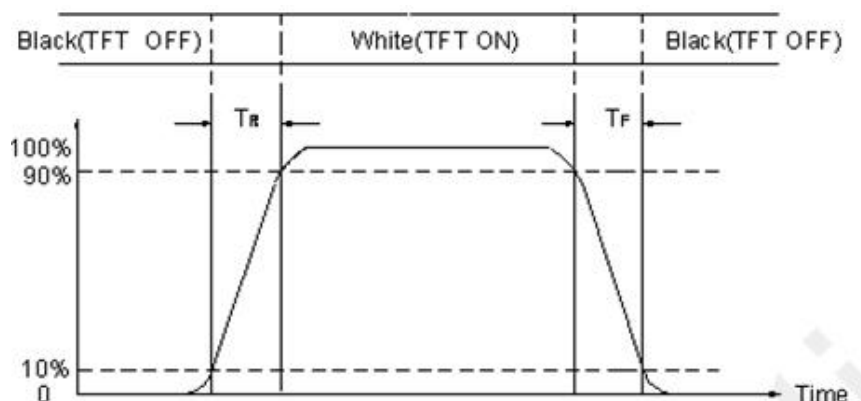


Note (2) Definition of Contrast Ratio(CR):

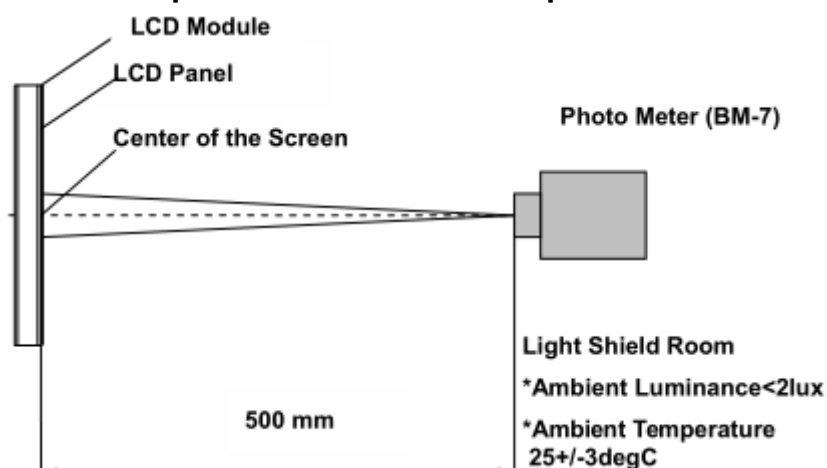
Measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

Note (3) Definition of Response Time: Sum of TR and TF



Note (4) Definition of optical measurement setup



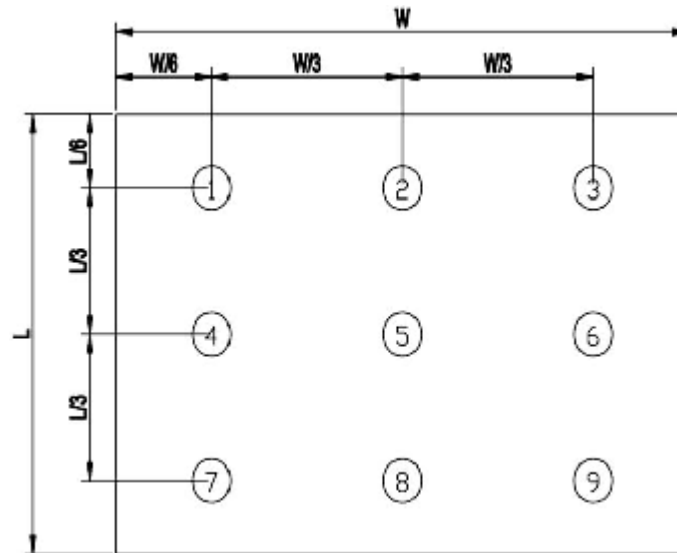
Note (5) Definition of brightness uniformity

The luminance uniformity is calculated by using following formula.

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

$B_p (\text{Max.})$ = Maximum brightness in 9 measured spots

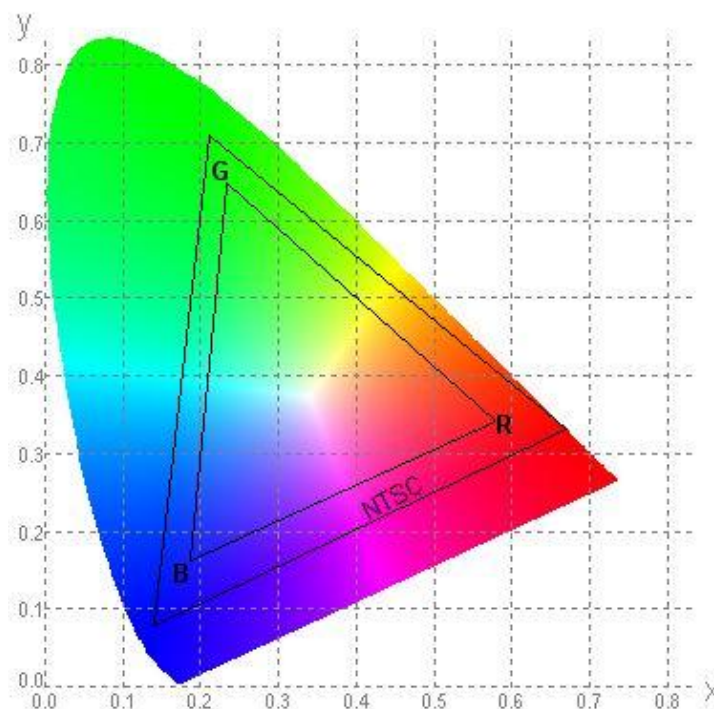
$B_p (\text{Min.})$ = Minimum brightness in 9 measured spots .



Note (6) Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

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



Note (7) Measured the luminance of white state at center point.

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4.0 ELECTRICAL CHARACTERISTICS

4.1 TFT LCD Module

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Analog supply voltage	VCC	2.4	2.8	3.3	V	
Digital supply voltage	IOVCC	1.65	1.8	3.3		
Input signal Voltage	VIH	0.7VDDI	-	VDDI	V	
	VIL	GND	-	0.3VDDI	V	

6.2 Back-Light Unit

The backlight system is an edge-lighting type with 4 LED in strand

The characteristics of the LED are shown in the following tables.

Item	Symbol	Min	Typ	Max	Unit	Note
LED current	IL	-	15	20	mA	(2)
LED voltage	VL	-	11.2	12.8	V	
Operating LED life time	Hr	-	20000	15000	Hour	(1)(2)

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: $T_a=25\pm3\text{ }^{\circ}\text{C}$, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$ and $IL=10\text{mA}$.

5.0 Parallel Interface Timing Characteristics

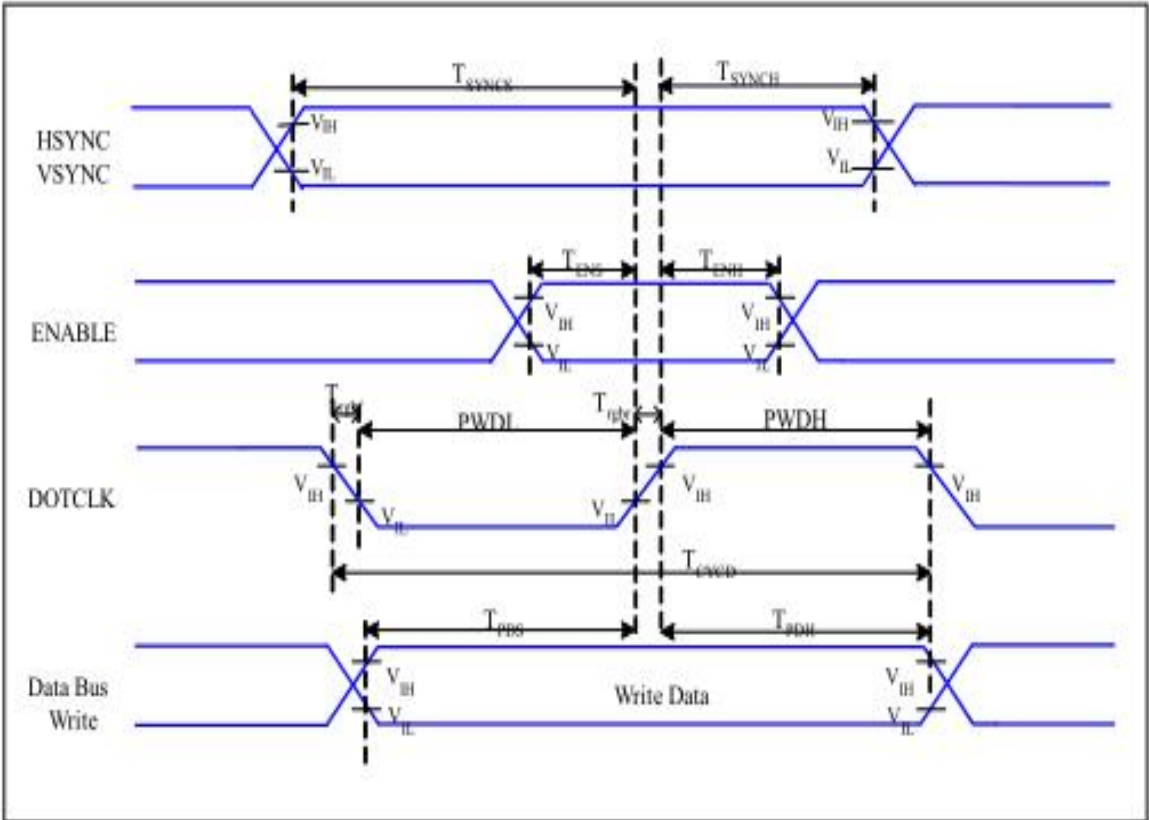


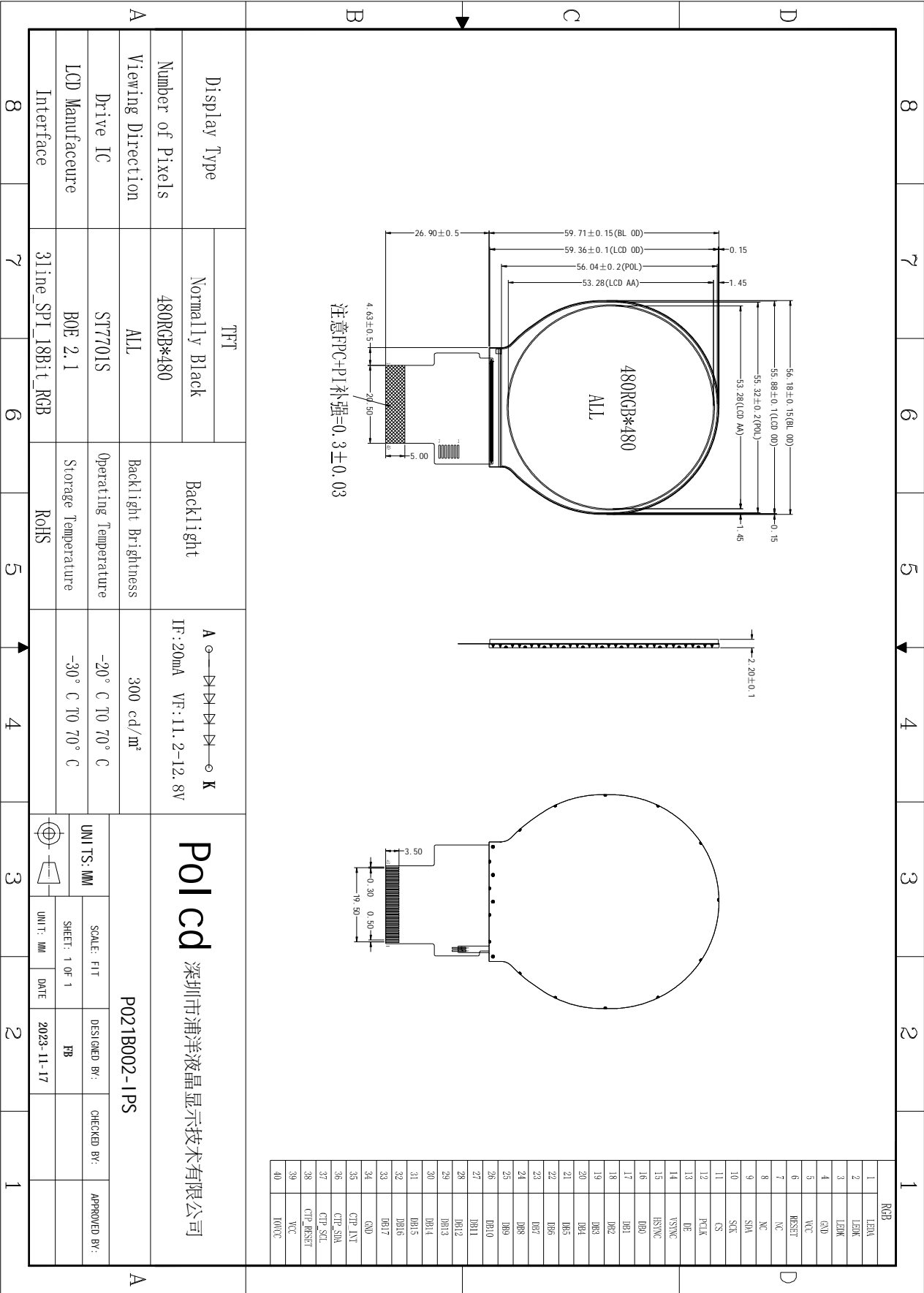
Figure 3 RGB Interface Timing Characteristics

$V_{DD1}=1.8, V_{DD}=2.8, AGND=DGND=0V, T_a=25\text{ }^{\circ}\text{C}$

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
HSYNC, VSYNC	T_{SYNC}	VSYNC, HSYNC Setup Time	5	-	ns	
ENABLE	T_{ENS}	Enable Setup Time	5	-	ns	
	T_{ENH}	Enable Hold Time	5	-	ns	
DOTCLK	PWDH	DOTCLK High-level Pulse Width	15	-	ns	
	PWDL	DOTCLK Low-level Pulse Width	15	-	ns	
	T_{CYCD}	DOTCLK Cycle Time	33	-	ns	
	Trghr, Trghf	DOTCLK Rise/Fall time	-	15	ns	
DB	T_{PDS}	PD Data Setup Time	5	-	ns	
	T_{PDH}	PD Data Hold Time	5	-	ns	

Table 6 18/16 Bits RGB Interface Timing Characteristics

6.0 OUTINE DIMENSION

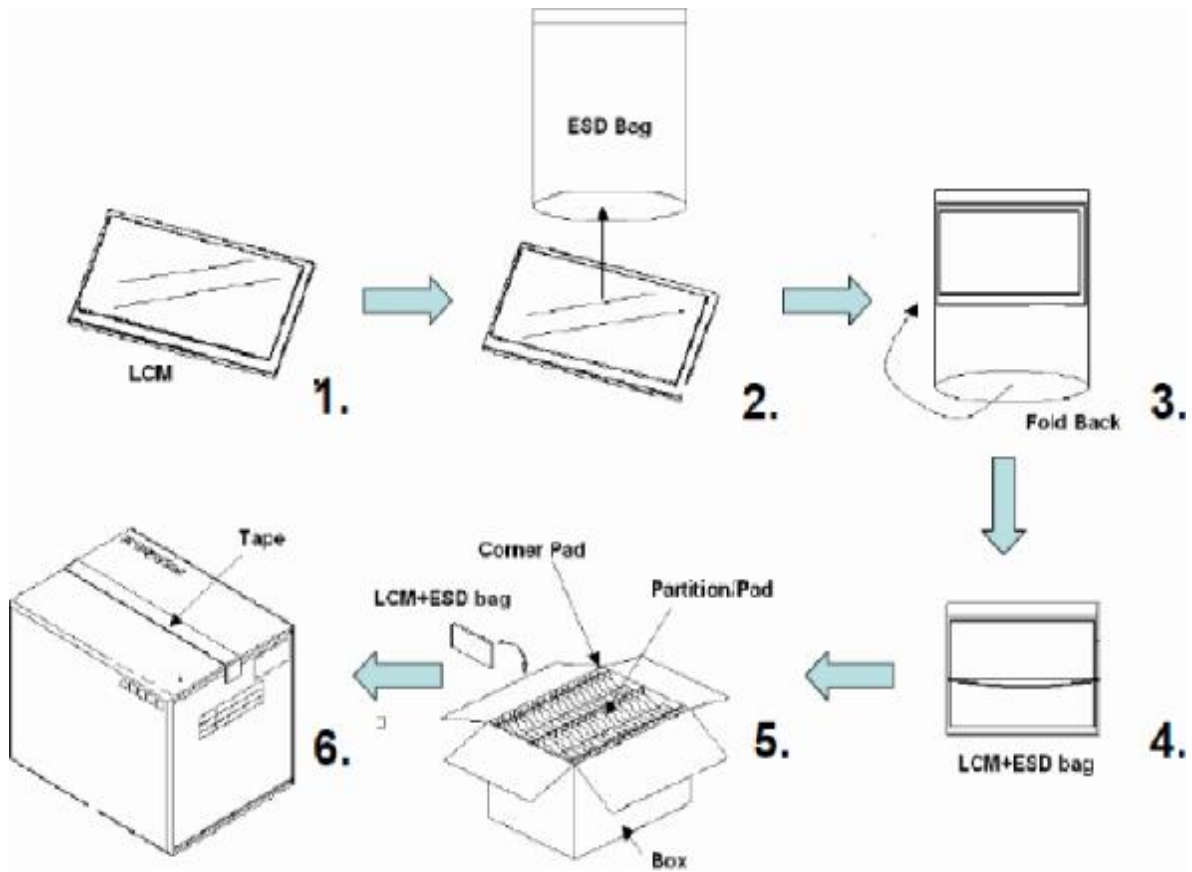


7.0 PACKAGE SPECIFICATION

7.1 Packing form

LCM Model	LCM Qty. in the box	Inner Box Size (mm)	Notice
	TDB	TDB	

7.2 Packing assembly drawings



Items	Material	Notice
Box	Corrugated Paper Board	AB Flute
Partition/Pad	Corrugated Paper Board	A/B Flute
Corner Pad	Corrugated Paper Board	AB Flute
ESD bag	PE	

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8.0 Items and Criteria:

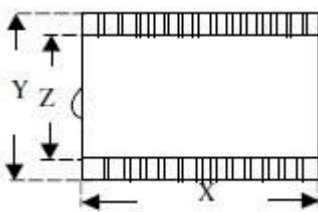
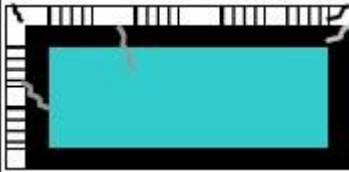
8.1 Guarantee

APEX warrants the quality of our products for **1 year** (from the date of delivery). If there are functional defects found during the period of warranty, the defective products would be replaced on a one-to-one basis. Apex would not be responsible for any direct /indirect liabilities consequential to any parties.

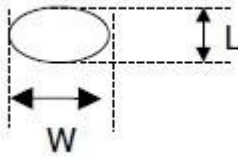
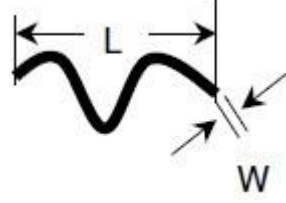
All the products should be stored or used as specified conditions described in these sheets. If module productions are not stored or used as specified conditions, herein, it will be void the **1 year** warranty(guarantee).

8.2 Visual inspection criterion in cosmetic

(1) Glass defect

Glass defect			
NO	Defect	Criteria	Remark
1	Dimension(Minor)	By engineering diagram	
2	Cracks(Major)	Extensive crack 【Reject】	

(2) LCM appearance defect

NO	Defect	Criteria		Remark
1	Round type(Minor)	Spec	Permissible Qty	1. $\psi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 
		$\psi \leq 0.10\text{mm}$	Disregard	
		$0.10\text{mm} < \psi \leq 0.20\text{mm}$	3	
		$0.20\text{mm} < \psi$	0	
2	Line type(Minor)	Spec	Permissible Qty	1. L: Length, W: Width 2. Disregard if out of A.A. 
		$W \leq 0.03\text{mm}$	Disregard	
		$L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$	2	
		$L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.10\text{mm}$	1	
		$W > 0.10\text{mm}$ or $L > 3.0\text{mm}$	0	
3	Polarizer dent(Minor)	Spec.	Permissible Qty	1. $\psi = (L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A.
		$\psi \leq 0.20\text{mm}$	Disregard	
		$0.20\text{mm} < \psi \leq 0.30\text{mm}$	2	
		$0.30\text{mm} < \psi \leq 0.50\text{mm}$	1	

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(3) FPC

NO	Defect	Criteria	Remark
1	Copper peeling(Minor)	Copper peeling 【Reject】	
2	Golden finger	FPC golden finger broken, dead fold, indentation makes FPC surface broken 【Reject】 Tin plating layer(or gold plating) scratch, but not hurt circuit 【Accept】 Except circuit, other position scratch but not expose metal wire 【Accept】	
3	Pin	FPC PI layer delamination 【Reject】 Material and color are inconsistent with sample, FPC burrs 【Reject】 FPC Pin deformation but not affect function. 【Accept】 FPC Pin area is dirty 【Reject】 Other than FPC Pin area is dirty but not affect function 【Accept】	
4	Golden finger	Golden finger edge has burrs,foreign material 【Reject】 Golden finger oxidation (dark), uneven electroplating, pinhole, foreign material 【Reject】 Golden finger soldering pad crack exceeds 1/3 length of soldering pad, and soldering pad crack exceed 2 Pins 【Reject】 Golden finger tin plating(or gold plating)scratch, but not hurt circuit 【Accept】 Other than golden finger area scratch but not expose metal circuit 【Accept】	
5	FPC Silk printing	Ghosting, incomplete silk printing, wrong printing 【Reject】	
6	FPC Circuit line width	Line width deviation exceed 1/3 line width 【Reject】	

(4) Black tape


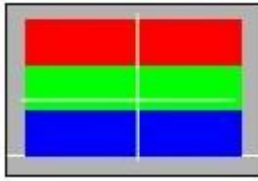

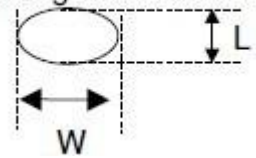
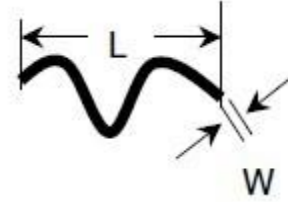
NO	Defect	Criteria	Remark
1	Shift(Minor)	IC exposed 【Reject】	
2	No black tape(Minor)	No black tape 【Reject】	

(5) Silicon

NO	Defect	Criteria	Remark
1	Amount of silicon (Minor)	ITO exposed 【Reject】	

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8.3 Visual inspection criterion in electrical display

NO	Defect	Criteria		Remark
1	No display (Major)	Not allowed		
2	Missing line (Major)	Not allowed		
3	Darker or lighter Line (Major)	Not allowed		
4	Weak line(Major)	By limited sample		
5	Bright / Dark point (Minor)	Spec.	Permissible Qty	1:1sub-pixel: 1R or 1G or1B 2:Point defect area $\geq 1/2$ sub pixel.
		Bright point	1	
		Dark point	2	
6	Round type (Minor)	Spec	Permissible Qty	1. $\psi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 
		$\psi \leq 0.10\text{mm}$	Disregard	
		$0.10\text{mm} < \psi \leq 0.20\text{mm}$	3	
		$0.20\text{mm} < \psi$	0	
7	Line type (Minor)	Spec.	Permissible Qty	1. L: Length, W: Width 2. Disregard if out of A.A. 
		$W \leq 0.03\text{mm}$	Disregard	
		$L \leq 3.0\text{mm}$ and $0.03\text{mm} < W \leq 0.05\text{mm}$	2	
		$L \leq 3.0\text{mm}$ and $0.05\text{mm} < W \leq 0.10\text{mm}$	1	
		$W > 0.10\text{mm}$ or $L > 3.0\text{mm}$	0	
8	Mura (Minor)	By 5% ND filter invisible		