

Specification of LCD Module

EARHLCD-3.1-720720

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2 GENERAL DESCRIPTION

The EarthLCD -3.1-720720 is a Color TFT LCD supplied by EarthLCD. This main module has a 3.1 inch diagonally measured active display area with 720 X RGB X 720 resolution. Each pixel is divided into Red, Green and Blue sub-pixels and dots that are arranged in vertical stripes. LCD color is determined with Dithering 65K Color signal for each pixel. The EarthLCD-3.1-720720 has been designed to apply the interface method that enables low power, high speed, and high contrast.

3 FEATURES

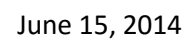
Display Mode	Normally Black Transmissive Type
Screen Size	3.1 inch
Display Format	Graphic 720 X RGB X 720 Stripe type
Color	16.8M color
Interface	RGB IF(24 bit)
Viewing Direction	12, 3, 6, and 9 o'clock
Weight	

4 MECHANICAL SPECIFICATION

Item	Specification	Unit
Dimensional outline	59.78(W) × 65.67(H)*×1.6(D)	mm
Resolution	720×(R, G, B)×720	dot
Active Area	55.62(W) × 55.62(H)	mm
Pixel pitch	0.077(W) × 0.077(H)	mm
Polarizer	Anti-Glare	

*Without FPC

5 MECHANICAL DIMENSION



6 MAXIMUM RATINGS

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

Item	Symbol	Values		Unit	Condition
		Min	Max		
Operating Temperature	T _{op}	0	50	°C	
Storage Temperature	T _{stg}	-10	60	°C	
Humidity	H _{stg}	-	90	%RH	*

*T_A≤40°C without dewing

7 ELECTRICAL CHARACTERISTIC

7.1 TFT LCD CHARACTERISTIC

Item		Symbol	Min.	Typ.	Max.	Unit
Power supply for LCD	Voltage	VCC	3.5	5.0	6.5	V
	Current	I _{dd}	-	-	50	mA
Driver input signal voltage	H	V _{IH}	0.75*VDD	-	VDD	V
	L	V _{IL}	0	-	0.3*VDD	V

7.2 BACKLIGHT CHARACTERISTIC

Item		Symbol	Values			Unit
			Min.	Typ.	Max.	
Power Consumption		P _{LED}	-	-	-	mW
Power supply for LED	Voltage	V _{LED}	-	-	-	V
	Current	I _{LED}	-	13	25	mA
Luminous color		White				

- Test Instrument: BM-7 (Distance =500mm; Field = 1)
- Light Source: White LED * 6
- Uniformity = (Min. Brightness / Max. Brightness)*100%
- Uniformity ≥ 85%
- Estimated backlight lifetime: 20,000 hours. "LED decay lifetime" is defined as the brightness decrease to 50% original brightness that the ambient temperature is 25°C and LED dice current=20mA.

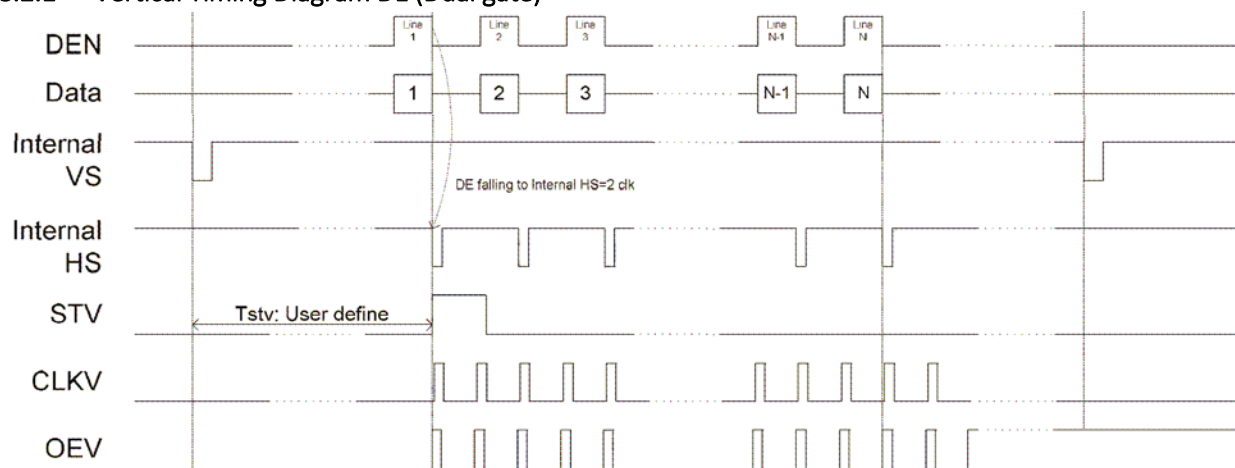
8 MODULE FUNCTION

8.1 PIN DESCRIPTION

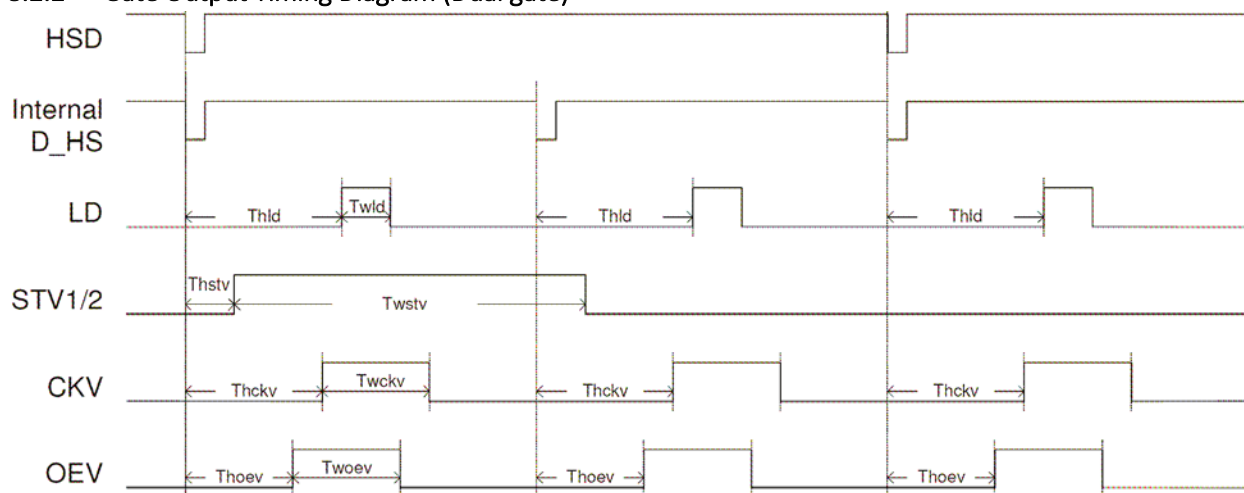
No.	PIN Name	Pin Description	Host Connection MIPI DSI Interface	No.	PIN Name	Pin Description	Host Connection MIPI DSI Interface
30	GND	Ground	GND	29	GND	Ground	GND
28	ANODE 6	LCD Backlight LED Anode	LED_A6	27	CATHODE 2	LCD Backlight LED Cathode	LED_C2
26	ANODE 5	LCD Backlight LED Anode	LED_A5	25	CATHODE 1	LCD Backlight LED Cathode	LED_C1
24	ANODE 4	LCD Backlight LED Anode	LED_A4	23	GND	Ground	GND
22	ANODE 3	LCD Backlight LED Anode	LED_A3	21	D0_P	MIPI Data differential line	LCD_D0_F_P
20	ANODE 2	LCD Backlight LED Anode	LED_A2	19	D0_N	MIPI Data differential line	LCD_D0_F_N
18	ANODE 1	LCD Backlight LED Anode	LED_A1	17	GND	Ground	GND
16	VSP	LCD_SOURCE_+5V_POS	LCD_5V_POS_F	15	D1_P	MIPI Data differential line	LCD_D1_F_P
14	GND	Ground	GND	13	D1_N	MIPI Data differential line	LCD_D1_F_N
12	VSN	LCD_SOURCE_-5V_NEG	LCD_5V_NEG_F	11	GND	Ground	GND
10	GND	Ground	GND	9	CLK_P	MIPI Strobe differential signal line	LCD_CLK_F_P
8	PWM	PWM output for CBABC backlight control	LCD_CBABC_PWM	7	CLK_N	MIPI Strobe differential signal line	LCD_CLK_F_N
6	GND	Ground	GND	5	GND	Ground	GND
4	RST	LCD_RESET_N	LCD_RST_N	3	VCC	VOLTAGE_INPUT (System) 2.85V +/-3%	DISP_2V85
2	GND	Ground	GND	1	VIO	VOLTAGE_INPUT (Interface) 1.8V +/-3%	DISP_1V8

8.2 TIMING CHARACTERISTICS

8.2.1 Vertical Timing Diagram DE (Dual gate)

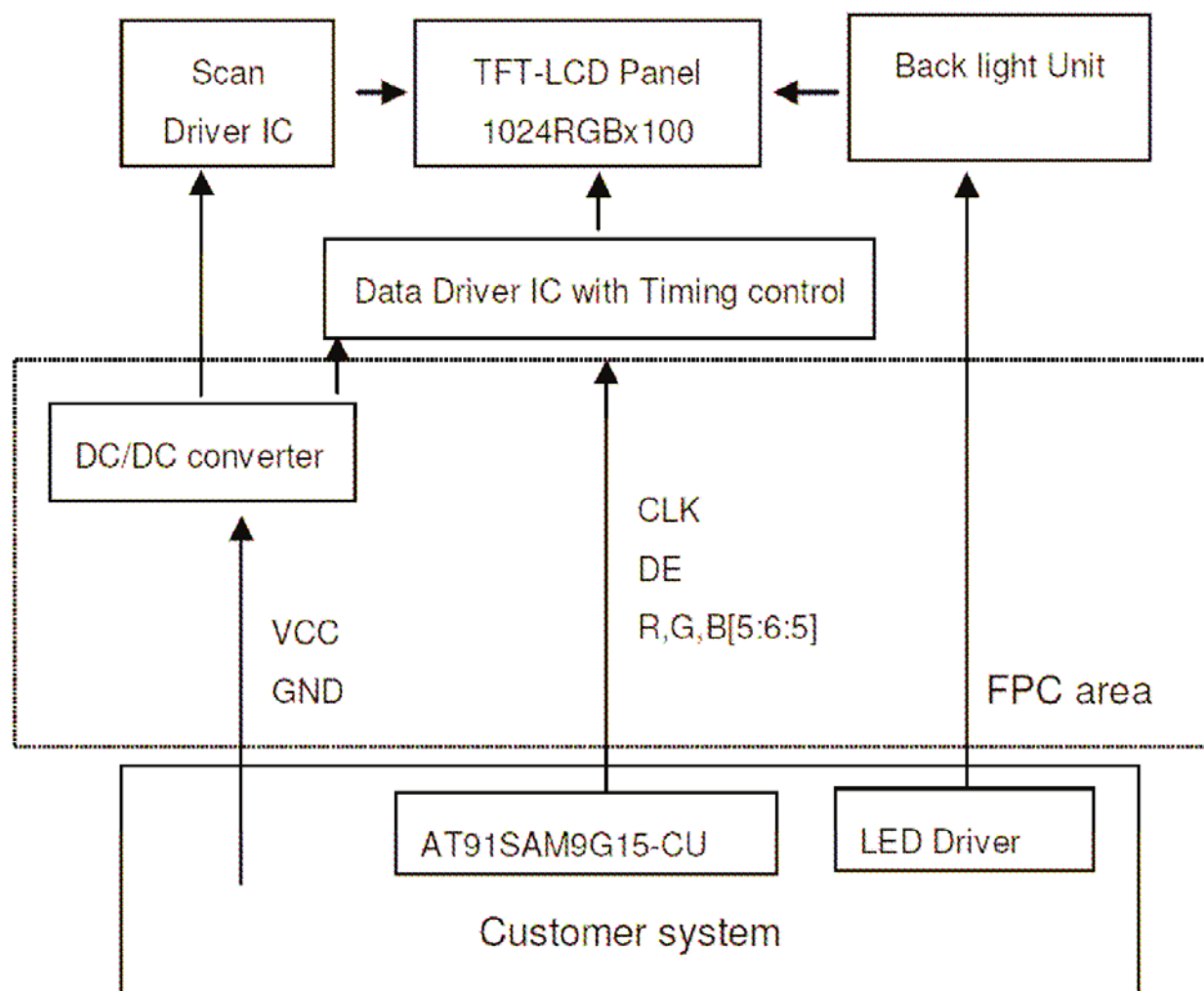


8.2.2 Gate Output Timing Diagram (Dual gate)



Parameter	Symbol	1024*RGB*130			Unit
		Spec.			
		Min.	Typ.	Max.	
DCLK Frequency	fclk		25		MHz
Horizontal Display Area	thd	1024			D CLK
HSD Period	th		1344		D CLK
HSD Blanking	thb+thfp		320		D CLK
Vertical Display Area	tvd	130			T _H
VSD Period	tv		310		T _H
VSD Blanking	tvbp+tvfp		180		T _H

8.3 BLOCK DIAGRAM



9 ELECTRO-OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in dark room or equivalent state with the methods shown in Note 1 below

9.1 OPTICAL CHARACTERISTIC

LED backlight transmissive module:

Item	Symbol	Temp.	Min.	Typ.	Max.	Unit	Conditions
Response Time	T_R+T_F	25°C	-	25	50	ms	$\theta=0^\circ$, $\phi=0^\circ$ (Note 2)
Contrast Ration	CR	25°C	200	300	-	-	$\theta=0^\circ$, $\phi=0^\circ$ LED: ON, LIGHT: OFF (Note 3)
Brightness	L		200	250	-	cd/m ²	
Viewing Angle	Degree		60/50/60/60				CR≥10

12"/6"/9"/3"					(Note 4)
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9.2 CIE(x, y) CHROMATICITY

Parameter		Symbol	Min.	Typ.	Max.	Units	Note
CIE color Coordinates	White	Wx	0.287	0.337	0.387	-	BM5; 2° angle (Note 5)
		Wy	0.298	0.348	0.398		
	Red	Rx	0.528	0.578	0.628		
		Ry	0.283	0.333	0.383		
	Green	Gx	0.343	0.393	0.443		
		Gy	0.493	0.543	0.593		
	Blue	Bx	0.108	0.158	0.208		
		By	0.092	0.142	0.192		
NTSC	39				%		

9.3 NOTES

Note 1

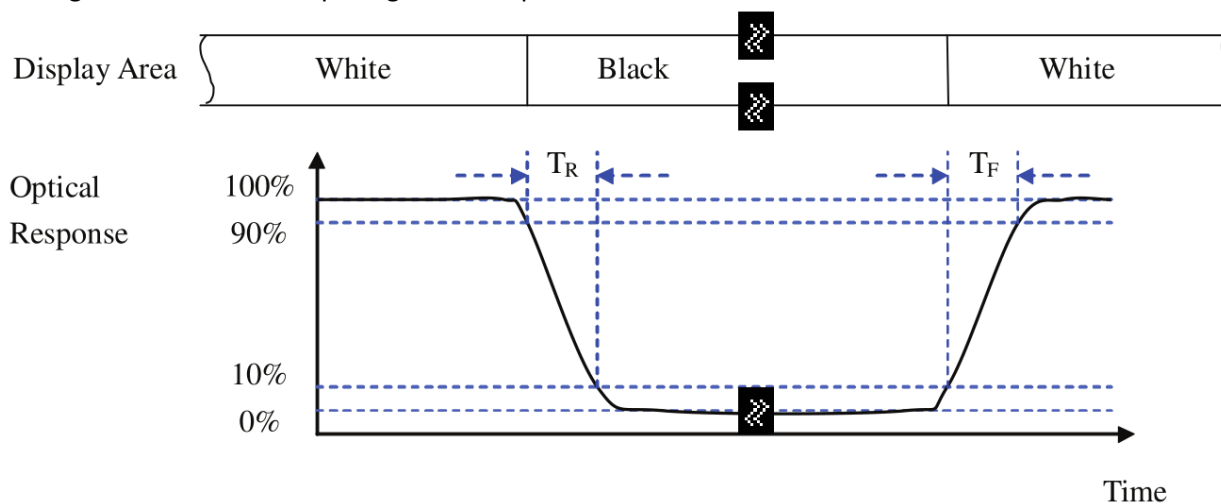
Test equipment setup

After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-5A with a viewing angle of 1° at a distance of 50cm and normal direction.

Note 2

Definition of response time: T_R and T_F

The figure below is the output signal of the photo detector.



Note 3

Definition of contrast ratio:

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

White $V_i = V_{i50\%} \pm 1.5V$

Black $V_i = V_{i50\%} \pm 2.0V$

"±" means that the analog input signal swings in phase with VCOM signal.

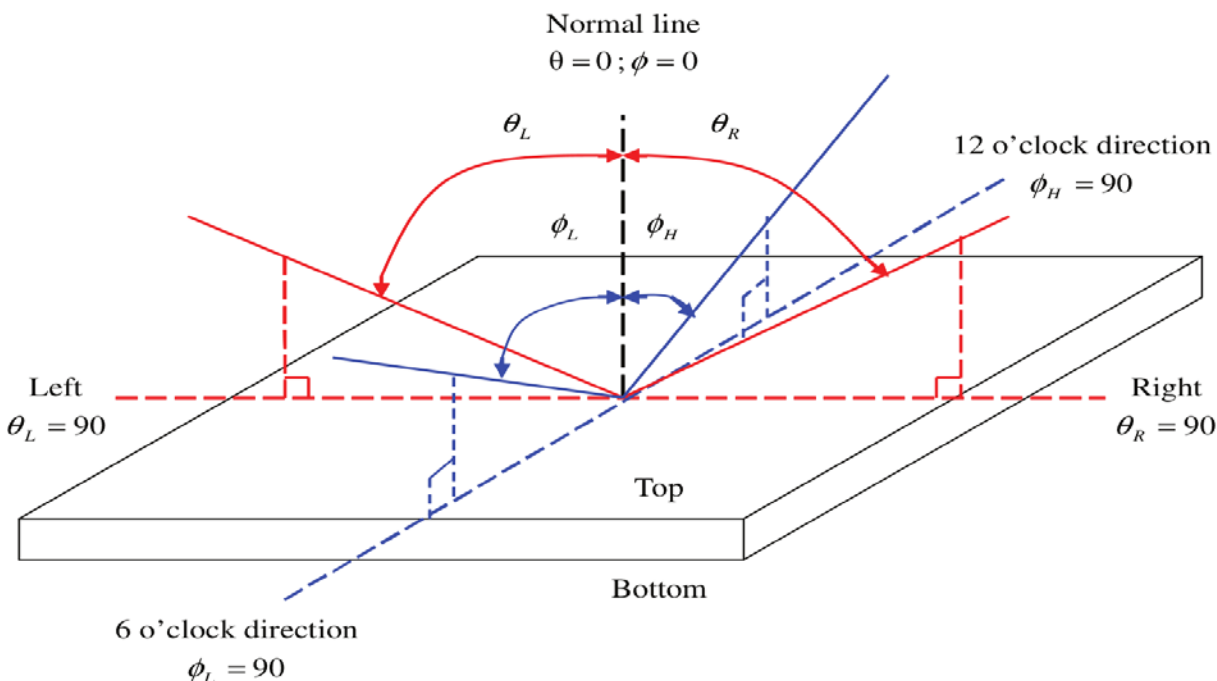
"μ" means that the analog input signal swings out of phase with VCOM signal.

$V_{i50\%}$: The analog input voltage when transmission is 50%.

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 4

Definition of viewing angle:



Note 5

Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

10 RELIABILITY

10.1 MTTF

The LCD module shall be designed to meet a minimum MTTF value of 50,000 hours with normal condition. (25° C in the room without sunlight; not include life time of backlight)

10.2 TESTS

No	Item	Condition	Criterion
1	High Temperature Operating		No defect of operational function in room temperature are allowable (23±5°C).
2	Low Temperature Operating		
3	High Temperature Non-Operating		

4	Low Temperature Non-Operating		Leakage current should be below double of initial value.
5	High Temperature/Humidity Non-Operating	50°C : 90%RH : 240hrs	
6	Temperature Shock Non-Operating	-20°C $\longleftrightarrow$ 70°C (60min) (5min) (60min) 10 Cycles	
7	Electro-static Discharge (IEC 61000-4-2)	HBM: ± 2 kv	

Testing Notes:

- Test after 24 hours in room temperature.
- The sampling above is individually for each reliability testing condition.
- The color fading of polarizing filter should not care.
- All of the reliability testing chamber above, is using D.I. water.(Min value:1.0 MΩcm)
- In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

10.3 COLOR PERFORMANCE

Number	Item	Criterion (initial)
1	Luminance	>50%
2	NTSC	>70%
3	Contrast Ratio	>50%

11 INSPECTION CRITERIA

11.1 INSPECTION CONDITIONS

11.1.1 Environmental conditions

The environmental conditions for inspection shall be as follows:

Room temperature: 23 $\pm$ 5° C

Humidity: 50 $\pm$ 20%RH

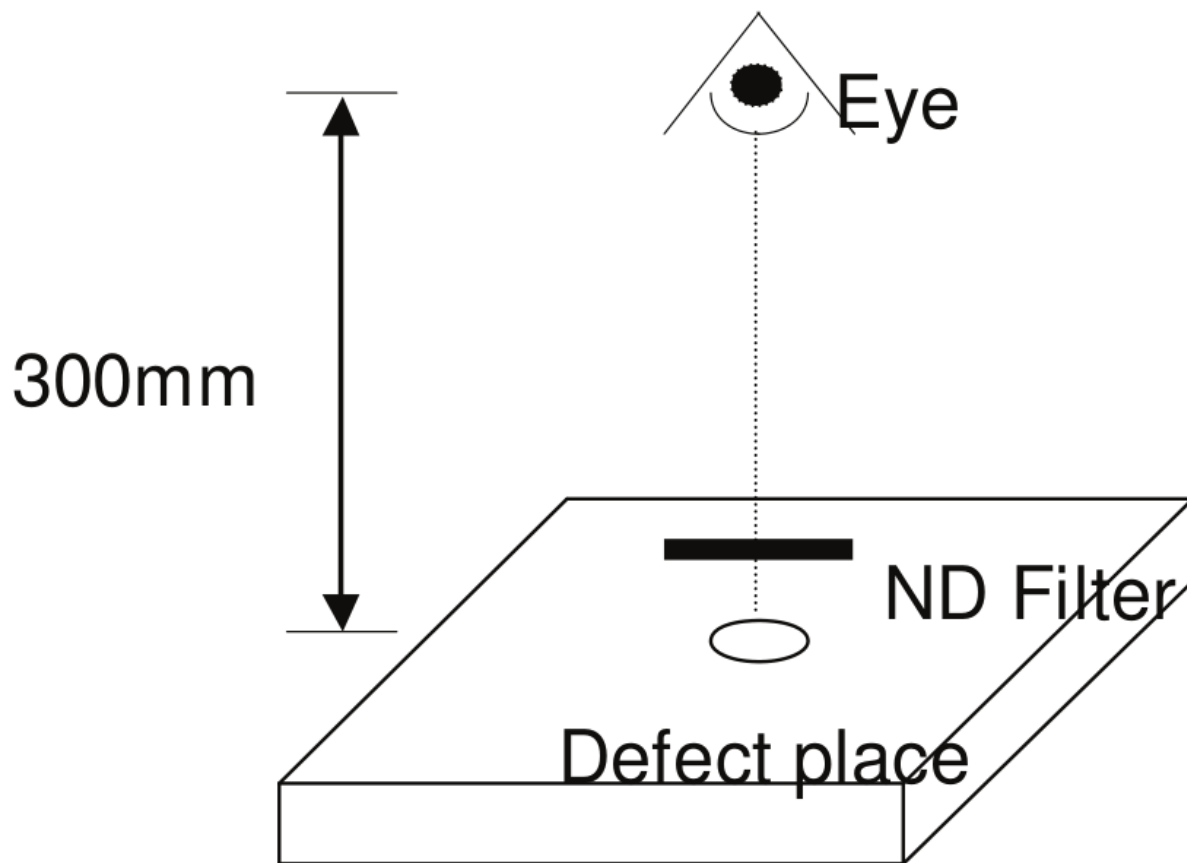
11.1.2 The external visual inspection

With a single 1000 $\pm$ 200lux fluorescent lamp as the light source, the inspection was in the distance of 30cm or more from the LCD to the inspector's eyes

11.2 LIGHT METHOD

Environment lamp under 1000 $\pm$ 200 lux, Viewing direction for inspection over 30cm.

The distance from eye to defect around 300mm, the distance from ND Filter to defect around 25~30mm.



11.3 CLASSIFICATION OF DEFECTS

11.3.1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

11.3.2 Minor defect

A minor defect refers to a defect which is not considered to be able substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

Note: if the LCD/LCM's cosmetic and display performance do not specify in "inspection criterion," it should be based on these delivered samples.

11.4 SAMPLING & ACCEPTABLE QUALITY LEVEL

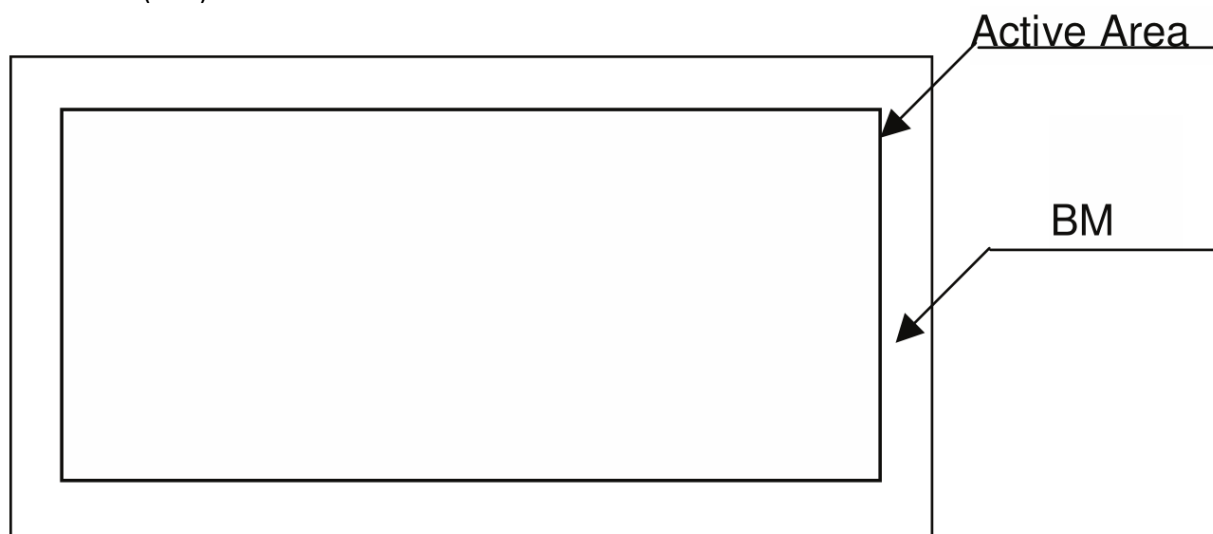
Level II, MIL-STD-105E

	Major	Minor
Cosmetic	1.0%	1.5%

Electrical-display	0.4%	0.65%
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11.5 DEFINITION OF INSPECTION AREA

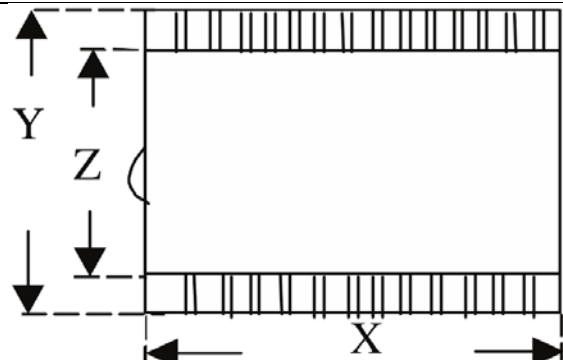
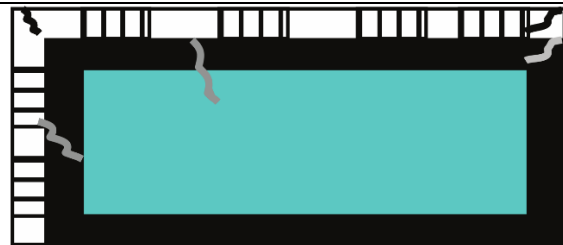
Active Area (A.A.)



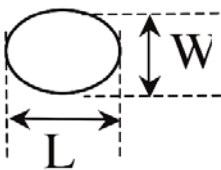
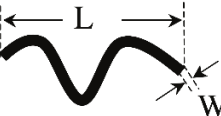
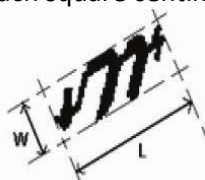
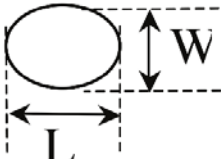
11.6 ITEM AND CRITERIA

11.6.1 Visual inspection criterion in cosmetic

Glass defect

No.	Defect	Criteria	Remark
1	Dimension (Major)	By engineering diagram	 The diagram shows a rectangular area with dimensions X, Y, and Z indicated by arrows. X is the width, Y is the height, and Z is a smaller vertical dimension within the height.
2	Cracks (Major)	Extensive crack [Reject]	 The diagram shows a rectangular LCD panel with a large, irregular crack running across the center. The panel is colored light blue, and the crack is shown in black.

LCM appearance defect

No.	Defect	Criteria		Remark
1	Round type (Minor)	Spec.	Permissible Q'ty	1. $\phi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 3. Distance between two points >5mm 
		$\phi < 0.20\text{mm}$	Disregard	
		$0.20\text{mm} \leq \phi \leq 0.6\text{mm}$	4	
		$0.6\text{mm} < \phi$	0	
2	Scratch (Minor)	Spec.	Permissible Q'ty	1. L: Length, W: Width 2. Disregard if out of A.A. 3. No more than two lines in each square centimeter (cm^2) 
		$W \leq 0.02\text{mm}$ and $L \leq 15\text{mm}$	Disregard	
		$0.02\text{mm} < W \leq 0.1\text{mm}$ and $L \leq 15\text{mm}$	5	
		$W > 0.1\text{mm}$ or $L > 15\text{mm}$	0	
3	Fiber (Minor)	Spec.	Permissible Q'ty	1. L: Length, W: Width 2. Disregard if out of A.A. 3. No more than two lines in each square centimeter (cm^2) 
		$W \leq 1.5\text{mm}$ and $L \leq 2.0\text{mm}$	5	
		$W > 1.5\text{mm}$ or $L > 2.0\text{mm}$	0	
4	Polarizer Bubble/Dent (Minor)	Spec.	Permissible Q'ty	1. $\phi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 3. Distance between two points >5mm 4. No more than two lines in each square centimeter (cm^2) 
		$\phi < 0.30\text{mm}$	Disregard	
		$0.30\text{mm} \leq \phi \leq 0.6\text{mm}$	4	
		$0.6\text{mm} < \phi$	0	

FPC

No.	Defect	Criteria	Remark
1	Copper peeling (Minor)	Copper peeling [Reject]	

Black tape

No.	Defect	Criteria	Remark
1	Shift (Minor)	IC exposed [Reject]	
2	No black tape (Minor)	No black tape [Reject]	

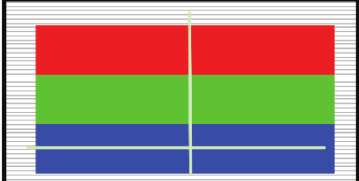
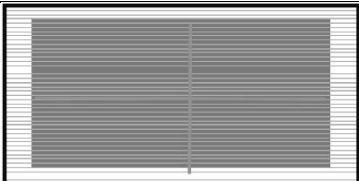
Silicon

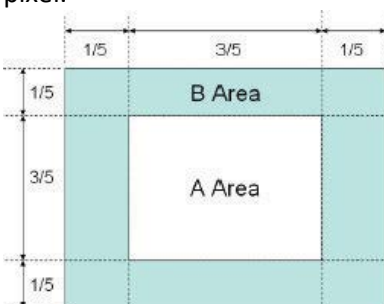
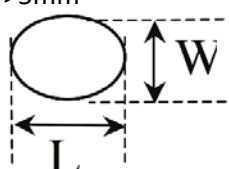
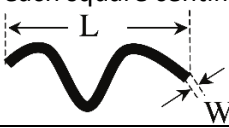
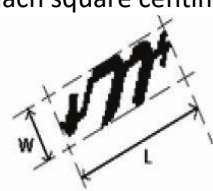
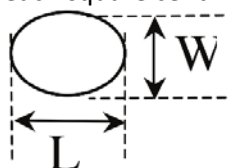
No.	Defect	Criteria	Remark
1	Amount of silicon (Minor)	ITO exposed [Reject]	

Bezel

No.	Defect	Criteria	Remark
1	Oxidized spot (Minor)	Oxidized sport, rust [Reject]	
2	Outline deformations (Minor)	By engineering diagram	
3	Greasiness (Minor)	Greasiness [Reject]	
4	Spots, round Type (Minor)	H≤By engineering diagram [Disregard]	H=Total height (thickness)
5	Plating (Minor)	Bubble, peeling [Reject]	

11.6.2 LCM electrical criterion

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	Bright/Dark point (Minor)		A Area	B Area	Total	1. 1 sub-pixel 2. Point defect area≥½ sub-
		Bright point	1	2	3	

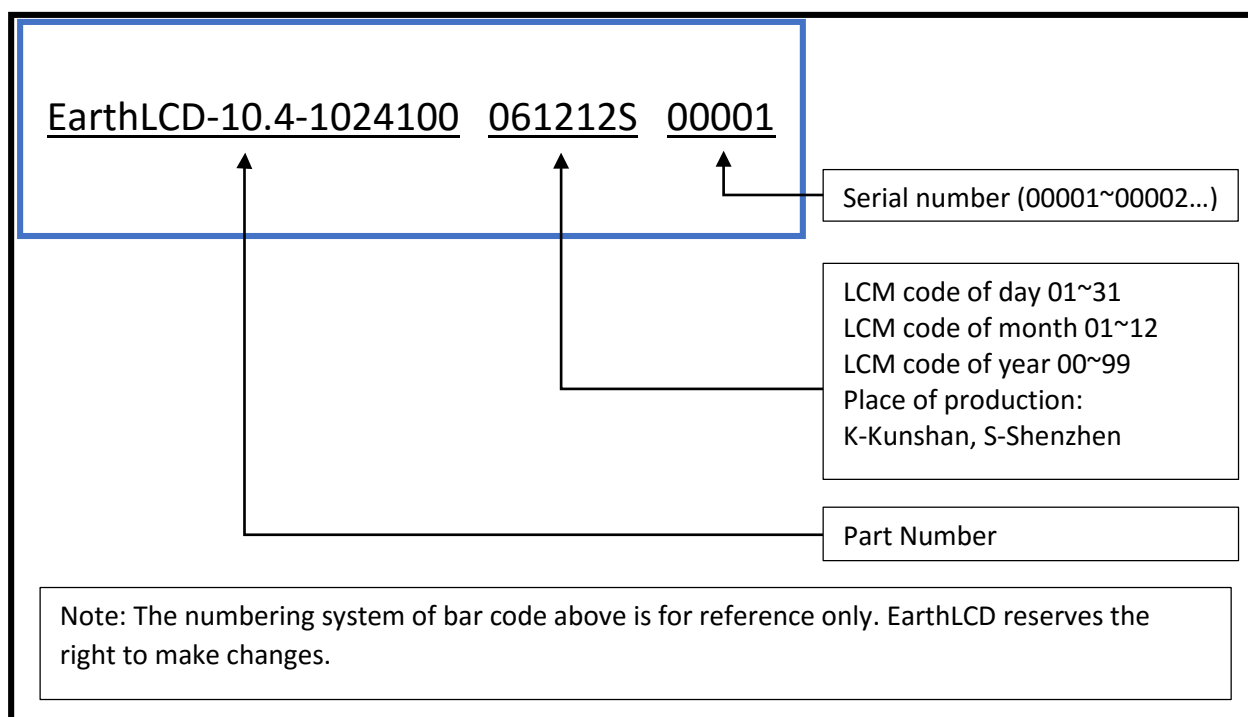
		Dark dot point	2	3	4	pixel. 
		Bright + Dark point	3	4	5	
1	Round type (Minor)	Spec.	Permissible Q'ty		1. $\phi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 3. Distance between two points >5mm 	
		$\phi<0.20\text{mm}$	Disregard			
		$0.20\text{mm}\leq\phi\leq0.6\text{mm}$	4			
		$0.6\text{mm}<\phi$	0			
2	Scratch (Minor)	Spec.	Permissible Q'ty		1. L: Length, W: Width 2. Disregard if out of A.A. 3. No more than two lines in each square centimeter (cm^2) 	
		$W\leq0.02\text{mm}$ and $L\leq15\text{mm}$	Disregard			
		$0.02\text{mm}<W\leq0.1\text{mm}$ and $L\leq15\text{mm}$	5			
		$W>0.1\text{mm}$ or $L>15\text{mm}$	0			
3	Fiber (Minor)	Spec.	Permissible Q'ty		1. L: Length, W: Width 2. Disregard if out of A.A. 3. No more than two lines in each square centimeter (cm^2) 	
		$W\leq1.5\text{mm}$ and $L\leq2.0\text{mm}$	5			
		$W>1.5\text{mm}$ or $L>2.0\text{mm}$	0			
4	Polarizer Bubble/Dent (Minor)	$\phi<0.30\text{mm}$	Disregard		1. $\phi=(L+W)/2$, L: Length, W: Width 2. Disregard if out of A.A. 3. Distance between two points >5mm 4. No more than two lines in each square centimeter (cm^2) 	
		$0.30\text{mm}\leq\phi\leq0.6\text{mm}$	4			
		$0.6\text{mm}<\phi$	0			

5	Mura (Minor)	By 2% ND filter invisible	
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11.6.3 Others

1. Issues that are not defined in this document shall be discussed and agreed with both parties. (Customer and supplier)
2. Unless otherwise agreed upon in writing, the criteria shall be applied to both parties. (Customer and supplier)
3. Polarizer, more than 0.5mm in size reduction rejected.

12 ILLUSTRATION OF LCD BARCODE



13 PACKAGE DRAWING

Package Order
(1)~(10)

(1) TRAY No. : PLOM1307A01

②
180° REVERS



Normal ①



TRAY

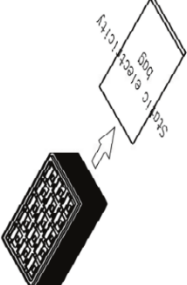
(2) Order



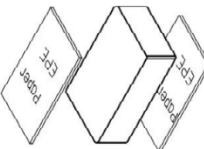
(3) Static electricity bag



(4) Static electricity bag



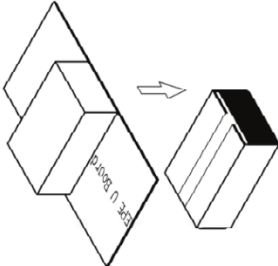
(5) EPE U-Bord



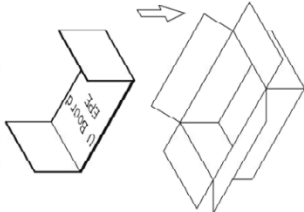
(6) EPE U-Bord



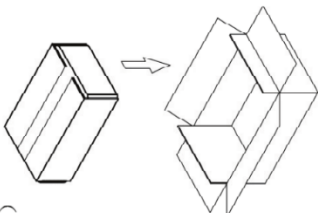
(7) EPE U-Bord



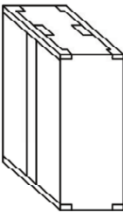
(8) EPE U-Bord



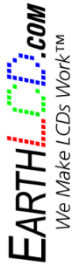
(9) Package finished



(10) Package finished



SCALE		TOLERANCE		ORG DATE	
UNIT	mm				
MATERIAL		DRAWN BY	05.29.12		
FINISH		CHECKED BY	wen		
		CONCURRED BY			
		APPROVED BY			



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NOTE:

1. Tape on the carton
2. Stored up the by 12 trays then put it in to the static electricity bag and seal it aswell

14 ROHS COMPLIANT WARRANTY

RoHs Hazardous substances including:

- Cd < 100 ppm
- Pb < 1000 ppm
- Hg < 1000 ppm
- Cr+6 < 1000 ppm
- PBDE < 1000 ppm
- PBB < 1000 ppm

15 PRECAUTIONS FOR USE

15.1 SAFETY

- (1) Do not swallow any liquid crystal, even if there is no proof that liquid crystal is poisonous.
- (2) If the LCD panel breaks, be careful not to get liquid crystal to touch your skin.
- (3) If skin is exposed to liquid crystal, wash the area thoroughly with alcohol or soap.

15.2 STORAGE CONDITIONS

- (1) Store the panel or module in a dark place where the temperature is $23\pm5^{\circ}\text{C}$ and the humidity is below $50\pm20\%\text{RH}$.
- (2) Store in anti-static electricity container.
- (3) Store in clean environment, free from dust, active gas, and solvent.
- (4) Do not place the module near organics solvents or corrosive gases.
- (5) Do not crush, shake, or jolt the module.
- (6) Do not exposed to direct sun light of fluorescent lamps.

15.3 INSTALLING LCD MODULE

Attend to the following items when installing the LCM:

- (1) Cover the surface with a transparent protective plate or touch panel to protect the polarizer and LC cell.
- (2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be $\pm 0.1\text{mm}$.

15.4 PRECAUTIONS FOR OPERATION

- (1) Viewing angle varies with the change of liquid crystal driving voltage (V_o). Adjust V_o to show the best contrast.
- (2) Driving the LCD in the voltage above the limit will shorten its lifetime.

- (3) Response time is greatly delayed at temperature below the operating temperature range.
However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.
- (4) When turning the power on, input each signal after the positive/negative voltage becomes stable.
- (5) Do not apply water or any liquid on product which composed of T/P.

15.5 HANDLING PRECAUTIONS

- (1) Avoid static electricity which can damage the CMOS LSI; please wear the wrist strap when handling.
- (2) The polarizing plate of the display is very fragile. Please handle it very carefully.
- (3) Do not give external shock.
- (4) Do not apply excessive force on the surface; it may cause display abnormal.
- (5) Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- (6) Do not use ketonics solvent & Aromatic solvent, use with a soft cloth soaked with a cleaning naphtha solvent.
- (7) Do not operate it above the absolute maximum rating.
- (8) Do not remove the panel or frame from the module.
- (9) Do not apply water or any liquid on product, which composed of T/P.

15.6 WARRANTY

- (1) The period is within 12 months since the date of shipping out under normal using and storage conditions.
- (2) The warranty will be voided in case of defect induced by customer.

16 REVISION HISTORY

Version	Remark	Date
A	Initial version	June 11, 2014